

Barbara Stec

Sunlight,
Atmosphere
and
Architecture

Translated by
Krzysztof Barnaś

Kraków 2020

To my Parents



Publikacja sfinansowana w ramach realizacji projektu „KA 2.0 - program rozwoju Krakowskiej Akademii im. Andrzeja Frycza Modrzewskiego”,
współfinansowanego ze środków Unii Europejskiej w ramach Europejskiego Funduszu Społecznego,
Program Operacyjny Wiedza Edukacja Rozwój 2014-2020, Oś Priorytetowa III. Szkolnictwo wyższe dla gospodarki i rozwoju, Działanie 3.5
Kompleksowe programy szkół wyższych. Projekt realizowany w ramach konkursu Narodowego Centrum Badań i Rozwoju: POWR.03.05.00-IP.08-00-PZ1/17.

Publishing Board of the Andrzej Frycz Modrzewski Krakow University:
Klemens Budzowski, Maria Kapiszewska, Zbigniew Maciąg, Jacek M. Majchrowski

Reviewer: Tomasz Wagner

Photographs and drawings: Barbara Stec

Schemes, drawings and photographs edited by: Rafał Pasternak

DTP: *Grafpol* Agnieszka Blicharz-Krupińska
21 Żmudzka Street, 51-354 Wrocław, tel. 507-096-545, e-mail: argrafpol@argrafpol.pl

Cover design: Barbara Stec, **implementation:** Grafpol

Editor: Krzysztof Barnaś

This monograph was published as a part of the project 'KA 2.0 – the development programme of Andrzej Frycz Modrzewski Krakow University' realized as a part of Operational Programme Knowledge Education Development 2014-2020, Axis III Higher Education for economy and development; Measure 3.5. Comprehensive university programmes. The project is co-financed by the European Union within the European Social Fund.

ISBN 978-83-66007-46-8

Copyright by Krakowska Akademia im. Andrzeja Frycza Modrzewskiego

Copyright by Barbara Stec

No part of this publication may be copied or stored in a manner that allows its reuse or circulation in any form using electronic, mechanical, copying, recording and other means without the prior written consent of the copyright holder.



Commissioned by:
The Andrzej Frycz Modrzewski Krakow University, www.ka.edu.pl

Publisher: AFM Publishing House, Kraków 2020

Print: *Grafpol* Agnieszka Blicharz-Krupińska

130 copies printed

Free copy

Table of Contents

Preface	9
Acknowledgements	10

INTRODUCTION:

ATMOSPHERE IN THE INTERIOR AS A RESULT OF THE RELATIONSHIP BETWEEN SUNLIGHT AND ARCHITECTURE	11
---	-----------

I

ASSUMPTIONS AND STATE OF RESEARCH	15
--	-----------

I. 1. Object of Study	16
I. 2. Scope of the Study	18
I. 3. Aspect of the Study	21
I. 4. Method	23
I. 5. Objective	25
I. 6. State of Research	26

II

RELATIONSHIP BETWEEN SUNLIGHT AND ARCHITECTURE: DETERMINANTS	47
---	-----------

II. 1. Physical Determinants	48
II. 2. Human Physiological Determinants	54
II. 3. Psychological Determinants	66
II. 4. Cultural Determinants	80

III

RELATIONSHIP BETWEEN SUNLIGHT AND ARCHITECTURE: ATMOSPHERE	91
---	-----------

III. 1. Mutual Exposure of Architecture and Sunlight in the Interior	92
III. 1.1. Impressiveness of Exposure	97
III. 1.2. Ambience of Exposure	98
III. 1.3. Projection Capacity of Exposure	98
III. 1.4. The Criterion of Evaluating the Relationship Between Sunlight and Architecture in the Aspect of Atmosphere	98

III. 2. Referencing the Study to the Theory of Atmosphere	100
III. 2.1. Defining Atmosphere	101
III. 2.2. Atmosphere and the Materiality of the Interior	108
III. 2.3. Perception of Atmosphere	109
III. 2.4. Describing Atmosphere	113
III. 2.5. Building Atmosphere with Light	121

IV

ARCHITECTURAL OPERATION WITH SUNLIGHT AND THE ATMOSPHERE OF ARCHITECTURE

IV. 1. Elementary Architectural Methods of Operating with Sunlight: a Typology	128
IV. 1.1. Activity of Architecture	129
IV. 1.2. Organisation of Illumination	135
IV. 1.3. Architectural Tools	138
IV. 2. Taxonomy of Elementary Methods of Operating with Light in the Interior	146
IV. 3. Mutual Exposure of Architecture and Sunlight in the Interior	147
IV. 4. Valuating the Atmosphere of Architecture as a Result of the Mutual Exposure of Architecture and Sunlight	150
IV. 4.1. Atmosphere of Architecture as Viewed by Le Corbusier and John Pawson	151
IV. 4.2. Atmosphere of Architecture as Viewed by Steen Eiler Rasmussen, Mieczysław Twarowski, Peter Zumthor and Henry Plummer	152
IV. 4.3. Dependence of the Atmosphere of Architecture on Exposing the Interior as a Result of Operating with Sunlight Within It	157

V

ARCHITECTURAL OPERATION WITH SUNLIGHT ACCORDING TO THE ACTIVITIES OF ARCHITECTURE AND IN THE ASPECT OF THE ATMOSPHERE—CASE STUDIES

V. 1. Direct Admittance	165
V. 1.1. Complete Penetration	165
V. 1.2. Carving	168
V. 1.3. Forcing through	177
V. 1.4. Isolation	180
V. 2. Reflection	181
V. 2.1. Mirror-like Reflection	181
V. 2.2. Scattering and Breaking	194
V. 2.3. Scattering and Bending	198
V. 2.4. Scattering and Slipping	201
V. 2.5. Scattering and Channelling	206

V. 3. Filtering	212
V. 3.1. Sifting	212
V. 3.2. Refraction	229
V. 3.3. Absorption	230
V. 4. Activities of Architecture in the Aspect of the Atmosphere of the Interior	239
V. 5. Complex Method of Operating with Light, Compiling Methods of Operating with Light	241

VI

ATMOSPHERE AS A RESULT OF EXPOSING ARCHITECTURE AND SUNLIGHT—CASE STUDIES

ATMOSPHERE AS A RESULT OF EXPOSING ARCHITECTURE AND SUNLIGHT—CASE STUDIES	253
VI. 1. Exposing the Materiality of Architecture—Tempered Darkness, Intimacy, Focus	254
VI. 2. Exposing the Shape of the Interior—Gradation of Light and Shadow, Tempered Brightness, Clarity, Coherence, Calmness	262
VI. 3. Exposing the Filter Structure—Contrasts of Light and Shadow or the Blurring of Light, Ornament, Illusion, Fleetingness	269
VI. 4. Exposing the Space of the Interior—Density of Space, Unclarity, the Forest	275
VI. 5. Exposing the Blending of the Interior with the Exterior—Openness, Spaciousness, Lightness	285
VI. 6. Exposing the Physical Properties of Sunlight	289
VI. 6.1. Orchestration	292
VI. 6.2. Choreography	298
VI. 6.3. Orchestration and Choreography	307
SUMMARY OF FINDINGS, CONCLUSIONS	310
LITERATURE	314
INDEX OF NAMES	322
LIST OF WORKS OF ARCHITECTURE DISCUSSED IN THE WORK	327
TABLE OF ILLUSTRATIONS AND TABLES	329
ABSTRACT	333

Preface

This book is an English-language extension of the study published in 2017 in the Polish-language monograph by the author, entitled *O świetle we wnętrzu. Relacja między światłem słonecznym a architekturą w aspekcie atmosfery architektury*. The new framing of this subject arose from continuing my studies over the period of three years that separated the publishing of these books. The subject that was developed the most was that of atmosphere as related to the dynamic development of the theory of atmosphere as an interdisciplinary branch of science. This has been reflected in the State of Research, which has been supplemented in relation to the previous monograph to include newer works on atmosphere and—to a lesser degree—sunlight in architecture. Due to this update concerning research in this work, the subject of atmosphere is a separate chapter. This affected a change in the perspective, layout and editing of the content featured in the monograph entitled *O świetle...* The typology and taxonomy of operating with light in an interior, which was developed previously, has been incorporated into this work as a universal tool for the analysis of sunlight in architecture that can serve as a basis for further study.

The atmosphere of architecture is not a new phenomenon, but rather a new name for a matter that has existed within architecture since its inception. Contemporary experience tells us that the atmosphere experienced by users in historical architecture is rated higher than the atmosphere of new interiors and the atmosphere of historical fragments of cities is set as an example for new urban spaces. This can indicate that building an intended sensory, emotional and reflective reception of architecture has always been a goal of builders, one that used to be successfully achieved in the past, and is currently often distorted or neglected. This makes positive examples from among the architecture of recent decades that have been listed in the Case Study section all the more valuable. It is possible that this distortion further exacerbates the yearning for atmospheric places and affects the current development of the theory of atmosphere, both in the aspect of studying and building it. This increases the necessity for new studies which, in light of contemporary knowledge, point to the role of atmosphere in human life and the manners of building it in architectural and urban interiors.

In the English-language literature, the subject of the relationship between light and architecture as referred to the interior and its atmosphere has been discussed in numerous works, yet most of them refer to the latest electrical, artificial lighting technology. Referring this relationship to sunlight is much less frequently discussed in books, and those that do so are valuable. However, much has undoubtedly changed ever since Juhani Pallasmaa argued that ‘this issue has hardly entered the theoretical discourse of architecture’.¹ Works on atmosphere from the last several years motivated the author to continue her earlier research. It provides new arguments, presents new methods of describing atmosphere based on interdisciplinary experiences in the fields of architecture and neuroscience, architecture and ethnography, in addition to casting a new light on traditional methodologies. They for a background that grants this study a place in the field of architectural criticism, education and design, wherein attempts at least partially objectivising matters of atmosphere are constantly made so that they can be applied in practice. This is also aided by the focus of the author on a single component of atmosphere: sunlight, and studying it on the basis of the properties of interiors.

¹ J. Pallasmaa, *Oczy skóry. Architektura i zmysły*, transl. M. Choptiany, Kraków 2012, p. 19. Also: *The Eyes of the Skin: Architecture and the Senses*, Chichester 2007.

Acknowledgements

This book could not have been written without inspiration, advice and suggestions from numerous people. It is not possible to list all of the friends of this endeavour, yet at least some should be acknowledged. I would like to particularly thank the reviewers of the monograph *O świetle...*: Lucyna Nyka and Krzysztof Lenartowicz, as well as the reviewers of the author's post-doctoral application: Justyna Martyniuk-Pęczek, Anna Franta and Tomasz Wagner. I would also like to direct a heartfelt acknowledgement to Zbigniew Zuziak, who noted the research potential of the first monograph and inspired the further trajectory of studies. The author would like to thank the late Wojciech Kosiński, an enthusiast of science, a bibliophile and a wonderful colleague from my university.

The author would also like to separately thank all architects who use light and shadow to create distinct atmospheres.

I look at the glancing light, which is such a meaningful light on the side of the mountain bringing every tiny detail to the eye and teaches about the material and choice in making a building. [...] The most wonderful aspects of the indoors are the moods that light gives to space.

Louis I. Kahn, *Silence and Light*

We create architecture, we identify, understand, feel and remember it primarily as a composition of three-dimensional forms—created by light and colour.

J. Rabiej, *Światło i kolor - uniwersalne walory architektury sakralnej*

Introduction:

Atmosphere in the Interior as a Result of the Relationship Between Sunlight and Architecture

When we try to recreate a house in a garden or a fragment of the city in our memory, our imagination displays to us their images. They typically focus not on specific massings, but the impression of their luminosity or darkness, a specific play of light and shadow. Some writers could even state via literary hyperbole, that ‘One remembers only light. Always the light. And the smell. A bright aroma of brilliance’.² In memory, a veranda in a lace of light and shadow emerges, the refreshing interior of a studio, a street with its sun-bathed surface. The projection of an image is created in the human mind thanks to the light one remembers, and which had originally entered into an actual relationship with architecture and gained a new form while doing so.³ This form—defined, physical, perceivable by humans, is exposed by the memory because it is an image: spots of light and shadow on the wall, but also—the moment, the exceptional capacity of a place, which we can call it its expression, ecstasy, atmosphere. The form of a place and its atmosphere merge into a single experience and differentiate memories. ‘There are cities that remain mere distant visual images when remembered, and cities that are remembered in all their vivacity. The memory’—wrote Pallasmaa—‘re-evokes the delightful city with all its sounds and smells and variations of light and shade. I can even choose whether to walk on the sunny side or the shaded side of the street in the pleasurable city of my remembrance’.

Sunlight and the atmosphere of architecture, in the broadest sense, are the subject of this work. The relationship between architecture and sunlight affects the atmosphere of architecture in an already built interior, where it can be studied, and the other way around—the creation of a specific atmosphere, treated as a goal that an architect pursues, can affect the shaping of the relationship between architecture and sunlight in the interior under design. The second case can be illustrated by two examples, presented below.

Peter Zumthor, in a description of the Kunsthhaus Bregenz building, stated ‘the art museum stands in the light of Lake Constance. [...] The spatial constellation of the slabs varies the orientation of the light, generates shadows and reflections. It tempers the mood of the light and gives depth to the room. The constantly fluctuating light creates the impression that the building is breathing. Everything seems permeable, permeable to light, wind and weather, as if the building could manage, up here, without an airtight skin’.⁴ The architect made this light the source of the design idea and introduced it to the main interiors so as to expose its mutability depending on the cardinal direction, time and weather. The atmosphere of these interiors is the result of the relationship between architecture and sunlight that is perceptible to humans. They do not feature any actual hazy glow from the side of the lake, but there is a hazy glow—tempered, scattered, which moves within the interior along with the time of day, the year and the weather, which exposes fragments of walls, the spatiality of interiors and the enclosing of people within them.

Kengo Kuma, in a description of the Hiroshige Andō Museum in Bato, stated that sources of the design idea behind the museum was Andō’s woodcut entitled *Sudden Shower Over Shin-Ohashi Bridge and Atake*, a part of the series of the *One hundred Famous Views of Edo*: ‘Western researchers are drawn to the way lines are used to depict rain [...] Using lines to depict rain is rooted in a uniquely Japanese sensibility, to which Hiroshige gave expression. [...] In Hiroshige’s work, man and nature are not opposed to each other. Rather overlap and blend together. I hoped to express this layering in Hiroshige’s work by using wooden lattices in the Museum’.⁵ The layering of lines to present the rain was particularly inspiring. Within the museum’s interior there are no water streams, but there are countless overlapping strips of shadow and light, which

² A.D. Liskowacki, *Aneks. Pejzaż wieczorny z lodziami*, [in:] *idem, Cukiernica pani Kirsch*, Kraków 1998, p. 171.

³ J. Pallasmaa, *Oczy skóry...*, *op. cit.*, p. 81.

⁴ P. Zumthor, *Kunsthhaus Bregenz*, Ostfildern-Ruit 1999, p. 13, 14.

⁵ K. Kuma, *Architecture Making Maximum Use of the Character of the Land will be the Norm in the Twenty-first Century*, [in:] M. Poprawska, M.A. Urbańska (ed.), *Kierunki. Nowa architektura w Japonii i Polsce / Directions. New Architecture in Japan and Poland*, Kraków 2005, p. 164.

blur its actual boundaries and create an illusion of a heavy *rain of shadow and light*. As a result of this peculiar operation with sunlight, the museum has an atmosphere of boundlessness and intimacy, of unclarity and dynamic variability.

The cases described here can be used as an argument that architects search for a specific atmosphere to be present in the interiors they design and they apply it by, among others, a precisely built relationship between architecture and sunlight. Light in an interior is therefore the building block of atmosphere that is appreciated by architects as it can be shaped by them.

The notion of light appears in the discussion on the atmosphere of architecture that is increasingly often discussed by architects and philosophers, although it used to be the domain of poets and writers. Atmosphere built by light was indirectly discussed over half a century ago by Steen Eiler Rasmussen and Mieczysław Twarowski, and later by Józef Krzysztof Lenartowicz, Konrad Kucza-Kuczyński, Juhani Pallasmaa, Peter Zumthor, Henry Plummer, Gernot Böhme, Federico De Matteis, Mikkel Bille, Tonino Griffero, Andrea Jelić, Klaske Havik and many other scholars. From among the components of architecture's atmosphere, such as: the musicality of an interior, the air temperature inside it and that of its materials, the smells and tastes in an interior, they also point towards light. Humans who reside in an interior can perceive each of these components, including light, in accordance with the state of their senses and minds, which leads to the unavoidable subjectivity of this perception. Meanwhile, the atmosphere of architecture itself, which is comprised of these components, can be, with some degree of simplification rooted in the practical objectives of the study, treated as a capacity of the interior. This is the meaning of atmosphere that has been adopted in this work. The discussion on atmosphere points to a consensus as to it being essential to the full experience of architecture by humans and that its reception, despite its subjectivity, is similar enough in many people, that is can form a basis for its design and building in architecture.

When discussing atmosphere, many authors highlight the role of the senses and direct contact with matter, including matter that is invisible, in the building of multi-sensory experience of architecture. The negation of the regime of the eye does not depreciate the sense of sight. On the contrary, it demonstrates an even greater scope of its capacity than the one used to view flat images, for instance its ability to penetrate the depth and expansiveness of space in the peripheral field of view or its ability to cooperate with other senses. From the point of view of design practice, it is the visibility of light that provides an opportunity to at least partially perceive the atmosphere that it comprises, and thus—its design. In the study of the dependencies between light and the atmosphere of architecture, it is both light which, apart from traditional utilitarian functions, takes on the function of a building block of atmosphere, and the atmosphere itself which, thanks to the visibility of light, can be relatively easily described and designed using drawing-related, photographic and imaging methods, that gain significance.

The evaluation of the atmosphere of architecture based on visual stimuli does not rule out experiencing it in a multi-sensory manner. The full, corporeal engagement of man in the reception of atmosphere is expressed in the situation of a *person immersing oneself* in an architectural, urban or landscape interior that has an atmosphere. For this reason, the notion of the interior, which implies the notions of volume and content, became key to the study.

The metaphorisation of language is a natural consequence of describing atmosphere, the effects of light that build it and their reception by humans. The study uses metaphors, as they concisely and intelligibly convey the essence of the phenomena in question, which is very subtle and whose essence can easily be distorted by literal phrasing. If these metaphors are widely used, as in the case of the immersion of a person in an interior, they have not been highlighted in the text, but if they are rarely encountered, they have been marked in italics. However, if the metaphors are repeated frequently, after being written in italics initially, they shall no longer be written using this script.

Due to the specificity of the study, graphical schemes and photographs are an essential part of it. The schemes are intended to explain the physical mechanisms of operating using light in

an interior, while photographs—are to present the application of individual methods of operating with light in selected interiors, as well as expose the characteristics of the interior due to a specific relationship between light and architecture, which affects, as demonstrated in the study, the atmosphere of the interior. Descriptions and photographs can be considered phenomenographies used in the study. The layout of the book was planned as the following sequence: from a section that is solely comprised of text (Chapters I, II, III), through parts of text with graphical schemes (Chapter IV), parts of text with small photographs that illustrate distinct cases of operating with light (Chapter V) to parts of text with larger photographs that illustrate highly distinct examples of obtaining an interior atmosphere using the relationship between architecture and light (Chapter VI).⁶

The study was confined to sunlight due to the scope of how it operates on Earth, its natural character; the uncontrolled, yet predictable changes resulting from the seasons of the year, time of day, climate or weather; and thus, due to its exceptionally strong impact on the atmosphere of an interior. Over the yearly cycle, sunlight covers the entire planet. It always enters interiors from the outside, constantly changing the angle of incidence of its rays and the quality of radiation. Humans must adapt to it: by both protecting themselves from its excess and using its beneficial effects. All of this causes sunlight to illuminate the ground at one's feet both figuratively and literally,⁷ which places it in a relationship with architecture, the solar system and the cosmos. Defining the dependencies between architecture and sunlight as a relationship highlights its exceptionally important, unavoidable and strictly rule-dependent role for the human being at its centre—the receiver of the light and atmosphere in architecture.

⁶ Each chapter is accompanied by a quote that reflects the matter it discusses. They are fully referenced in the literature section.

⁷ Cf. The title *The Luminous Ground*—of one of the four volumes of Christopher Alexander's *The Nature of Order*, from: J.K. Lenartowicz, *Do polskiego czytelnika*, [in:] Ch. Alexander (et al.: S. Ishikawa, M. Silverstein, M. Jacobson, I. Fiksdahl-King, S. Angel), *Język wzorców. Miasta, budynki, konstrukcja* (1977), transl. A. Kaczanowska, K. Maliszewska, M. Trzebiatowska, Gdańsk 2008. Also: *A Pattern Language: Towns, Buildings, Construction*, New York 1977.

From the first rays of the sun that struck the golden capstone of the pyramid and set it on fire dawn after dawn to the bouquet of light and color animating the interior of the chapel at Ronchamp, light has not only provided illumination and perception—it has placed us in a particular relationship with the sun and has contributed an essential element to architectural meaning.

A.M. Borys, *Lume di Lume. A Theory of Light and Its Effects*

The use of light effects in architecture defines the impression of order and harmony, it allows one to highlight the spatiality of a massing or leave it without clearly defined shapes.

M. Popczyk, *Światło i obrazy*

|

Assumptions and State of Research

This chapter presents the object of the study, its scope and perspective. It also features the adopted definitions of the terms: light, sunlight, interior, architecture, and atmosphere of architecture. It also presents the method used in the study and its objective, as well as an overview of the state of research.

I. 1. Object of Study

The primary object of this study is, in its broadest sense, light, similarly as in the monograph entitled *O świetle...* Other matters under analysis refer to this object. This work assumes a definition of light, according to which it is electromagnetic radiation and a stream of photons at the same time.⁸ Light includes: ultraviolet light, visible light and infrared light. Light, which has a dual, wave-particle nature, enters into relationships with matter at numerous levels which are studied by different branches of physics,⁹ particularly geometrical optics, physical optics (wave and quantum optics) and spectroscopy.¹⁰ Furthermore, light is the object of study of numerous other sciences, especially astronomy, climatology and meteorology, biology, medicine, the psychology of vision, lighting engineering and stage engineering. Architects draw useful knowledge from these sciences, which aids them in the design of architecture. Light is the sine qua non condition, and sometimes even the subject matter of paintings and sculptures. An architectural approach to light combines its scientific and artistic elements.

In geometrical optics, the essential term (although it is conventional), that allows one to express and describe the relationships between light and matter is the ray of light, which means an infinitely narrow beam of light (an equivalent to a line in geometry). It is assumed that rays of light are completely independent from one another¹¹ and travel within a given optical medium following a straight line (with a speed of 3×10^8 m/s in perfect vacuum). Shadow is considered to be proof of light travelling along a straight line. Light phenomena that are described using geometry include: the travel of light following a straight line, the reflection of light, which can either be perfectly mirrored or scattered, and refraction. In geometrical optics, the reflection of light is a physical phenomenon, based on light rays changing direction at the border of two different media in a manner that causes the ray to remain in the medium which it travels in.¹² In geometrical optics, refraction is a physical phenomenon based on light rays changing their direction after passing into a different material medium.¹³

⁸ The overview of physical terms was based on: R.P. Feynman, R.B. Leighton, M. Sands, *Feynmana wykłady z fizyki*, vol. 1.2: *Optyka, termodynamika, fale*, 6 ed., revised and supplemented, transl. A. Jurewicz, M. Grynberg, M. Kozłowski, T. Butler, Warszawa 2007 and: A. S. Gajewski, *Wybrane zagadnienia z fizyki*, Kraków 2003.

⁹ See: R.L. Gregory, *Oko i mózg. Psychologia widzenia*, transl. S. Bogusławski, Warszawa 1971. Gregory was of the opinion that the conflict concerning the nature of light is one of the most interesting in the history of science. He referenced the views of Sir Isaac Newton, who argued that light is comprised of corpuscles, i.e. light particles emitted by bodies and who to some degree foresaw the contemporary theory in which light has dual properties: those of particles and waves *Ibidem*, p. 16–19.

¹⁰ Gajewski also lists: electron optics, instrumental optics, physiological optics and non-linear optics. A.S. Gajewski, *Wybrane zagadnienia...*, *op. cit.*, p. 235.

¹¹ The author omitted the interference of light, which is associated with the wave-like nature of light and denotes a phenomenon of the superposition of waves, causing a strengthening of waves at some points of space and the weakening of waves at others, appropriate to the phase relationship between the waves.

¹² From: A.S. Gajewski, *Wybrane zagadnienia...*, *op. cit.*, p. 239.

¹³ From: *Ibidem*, p. 240.

Wave optics studies the nature of light as an electromagnetic wave. It is the basis of and defines constraints for geometrical optics (it explains its laws at the level of electromagnetic phenomena). The laws of geometrical optics are true only for distances that are much longer than its wavelength. Wave optics also uses the notion of the ray of light, which denotes the direction of the travel of energy that is carried by light.¹⁴ Basic light phenomena described by wave optics include: interference, diffraction, refraction, polarisation¹⁵ and dispersion.¹⁶ However, diffraction is a physical phenomenon wherein the direction of the travel of a light wave changes along the edges of and near barriers. Diffraction is clearly observable for obstacles with sizes comparable to the wavelength of light and it is for this reason why it is not studied by geometrical optics. The light wave at the border with a different material medium, for instance between air and water, is refracted, diffracted or becomes polarised. Refraction, which is described by geometrical optics as the refraction of light after passing into a different medium, is translated in wave optics as a change in the velocity of light when it passes into a different optical medium. The change in the speed of a light wave in this phenomenon is associated with a change in wavelength, and thus with a change in the colour of light as perceived by the human eye. Refraction, diffraction and interference are accompanied by dispersion, which results in light being dispersed into a colourful spectrum. White light is a mixture of the colours of the light spectrum. Every colour of the spectrum is light with a different wavelength and frequency.¹⁷

Quantum optics studies the nature of light as a stream of photons.¹⁸ Many light phenomena, such as thermal radiation, photoelectric radiation, Compton scattering, photochemical processes or the absorption of light, are explained using light's quantum properties. The absorption of light is a physical phenomenon based on a reduction of the energy of a light wave during its travel through a medium as a result of a conversion of the energy of the wave into said medium's internal energy or the energy of secondary radiation with a different spectrum and a different direction of travel (photoluminescence). The smallest wavelengths correspond to the highest wave energies, therefore the greatest energy within visible light is carried by light that the human eye sees as violet in colour, and the lowest—by that which is perceived as red.

¹⁴ Isotropic media (which display identical physical properties across all directions) it is perpendicular to the wavefront.

¹⁵ Polarisation is the emission of linearly polarised light (light whose electric and magnetic vectors vibrate in two mutually perpendicular directions) from natural light or partially polarised light. A.S. Gajewski, *Wybrane zagadnienia...*, *op. cit.*, p. 289, 290.

¹⁶ Dispersion is the dependency between the speed of light and its length within an optical medium.

¹⁷ See: R.L. Gregory, *Oko i mózg...*, *op. cit.* And O. Müller, *Goethe i zasady świata barw*, transl. S. Trzaska, "Autoportret" 2008/2009, no. 4 (25) / 1 (26), Kraków 2009. Gregory reported that experiments on refracting white light had been performed by, among others, Sir Isaac Newton and Jan Wolfgang Goethe. Newton distinguished 7 colours of the spectrum: red, orange, yellow, green, blue, indigo and violet. Gregory argued that Newton liked the number 7 and added the colours indigo and orange to create this magical number. R.L. Gregory, *Oko i mózg...*, *op. cit.* p. 22. Olaf Müller noted that Goethe, in his work *Farbenlehre* (1810) argued with Newton and had performed an experiment on refracting sunlight using a prism. In the watercolour that he painted at the age of eighty (called the *Eight-part colour wheel* by archivists in Weimar), he displayed the gradual shifting of one colour into another and thus presented an uncountable number of colours. Müller observed that Goethe had primarily concentrated on the passing, unstable colours that are registered by vision: sky blue, sunsets, colourful shadows, the rainbow and colourful phenomena that can be conjured using a glass and water prism. O. Müller, *Goethe i zasady świata barw...*, *op. cit.*, p. 5.

¹⁸ As seen by quantum optics, light is a stream of photons—elementary particles that are individual discrete portions of electromagnetic radiation and electromagnetic waves at the same time.

I. 2. Scope of the Study

This chapter defines the type of light under analysis and when and where it was operated with.

—The study of light was confined to sunlight. The notion of sunlight as adopted in this work denotes light whose source is the Sun and which operates on Earth; during the day it is the direct light produced by the Sun's radiation and is reflected from the celestial sphere and the from the surface of the earth, while at night—it is the light produced by the Sun's radiation as reflected from the Moon and that reaches Earth. The celestial sphere is the optical illusion of the internal surface of a sphere with an infinitely large radius and a centre at the point of the observer's location; (the model of the celestial sphere is used in astronomy and geography to determine the location of celestial bodies relative to a given place on Earth without accounting for their actual distances).¹⁹ To define the direct, directed solar radiation that is emitted by the Sun and that reaches Earth and is an essential source of not only light, but also heat, the author also used the term insolation (which means that insolation is a specific case of sunlight and, as a result, these terms have different meanings). The author elected not to use the term daylight,²⁰ as it would exclude moonlight, which is significant in the study of atmosphere.

Sunlight is also described in this work through the term 'light' (unless indicated otherwise, it denotes sunlight in the study, in its previously explained meaning).

—The study was confined to light that is visible to the human eye.²¹ Matters associated with ultraviolet and infrared light appeared in the section on the impact of human physiology on the perception and design of light within interiors. Among physical laws that govern the phenomenon of light, the study focused on those laws that are perceptible to humans using the sense of sight in a natural manner: the law of the travel of rays of light along a straight line, the law of the reflection of light rays (mirror-like and scattered), the law of light refraction and the law of light absorption.

—The study of light was confined to architectural, urban and landscape interiors. The author also referenced the definition of the interior, as formulated by the Krakow school of landscape architecture (Zygmunt Jan Novák, Janusz Bogdanowski, Aleksander Böhm, Wojciech Kosiński, Piotr Patoczka), which places this term as the primary conventional unit of spatial division.²² This

¹⁹ From: J. Mietelski, *Astronomia w geografii*, 4 ed. corrected, Warszawa 2013, p. 24–27.

²⁰ In the literature on architecture one can encounter various uses of the term sunlight. It typically denotes any type of light that operates during the day and is emitted by the Sun: direct or indirect, reflected by the earth and the celestial sphere. It is rarely referred to solely as light from the celestial sphere. There is a distinction between the notion of daylight and insolation, which denotes direct sunlight. Cf. M. Twarowski, *Słońce w architekturze*, Warszawa 1962; E. Neufert, *Podręcznik projektowania architektoniczno-budowlanego* (1973), transl. S. Janicki, R. Łucki, R. Tauszyński, A. Zawadzki, Warszawa 1980. Twarowski uses the term insolation to describe the effect of direct solar rays. Neufert, in the chapter Illumination–insolation, uses the notion of daylight in the analysis of interior daylighting, which is sourced from outside of a building during the day (without specifying whether this is direct or indirect light), while the term insolation—is used solely to refer to direct solar radiation which enters an interior. E. Neufert, *Podręcznik projektowania...*, *op. cit.*, p. 105–124.

²¹ Visible light is electromagnetic radiation with wavelengths in a vacuum varying between 380 nm do 770 nm, which causes visual sensations directly in the human eye. The scope of the wavelengths of visible light forms the visible light spectrum, which includes colours ranging from violet (the shortest visible light wavelength), through blue, green, yellow, orange to red.

²² Patoczka wrote: 'Half a century ago, the founder of the Krakow landscape architecture school, Professor Janusz Bogdanowski, defined the notion of the "interior" by giving this ordinary word a specialist meaning. [...] Four parts of this conventional unit were defined, distinguishing the following in each interior: walls and gates, a floor, a ceiling and freestanding masses. [...] An architectural or landscape interior, or a complex of similar interiors, are a designation of the notion described as the physiognomy of the surroundings P. Patoczka, *Monitoring ochrony i kształtowania krajobrazu w Bieszczadzkim Parku Narodowym i jego otulinie*, "Roczniki Bieszczadzkie" 2010, 18, p. 390, <https://www.bdpn.pl/dokumenty/roczniki/tom18/31.pdf> [accessed: May 2017].

definition states that the interior is ‘a part of the surroundings that is more or less specifically enclosed by walls and accessible through gates’, that humans can enter.²³ The notion of the interior as a ‘portion—a form of the surroundings’ of humans corresponds to the notion of human surroundings as used by Gernot Böhme,²⁴ and is thus referenced in contemporary philosophical and aesthetic discourse. The interior has/can have its own light: that which can be lit or turned on inside it (natural light—such as that provided by fire, artificial light—like that of a lamp) and that which enters it from the outside (sunlight during the day, and sunlight reflected from the moon, starlight, the glow of streetlights, car headlights, etc. during the night). As per this assumption, the study only focused on sunlight that operates within an interior. The source of this light is always located outside of it.

Due to the specificity of the study, it was assumed that every interior has elements in the form of its space and its boundary. The boundary of an interior is comprised of: its walls, floor, ceiling and masses.²⁵ Treating these elements as a sort of apparatus that is used to introduce sunlight into the interior and to modify it, the author defined the meaning of the mass that belongs to the boundary of the interior as a three-dimensional form that can have its own interior in a positive sense (e.g. in the form of a light cannon) or in a negative sense (e.g. in the form of ducts hidden in the structure of a building between a structural deck and a suspended ceiling). The interior’s simple three-dimensional form is comprised of mass angles (described by Twarowski as convex angles of an interior’s elements, e.g. mass corners).²⁶ According to the above, the following elements were distinguished within the area of boundary: partitions (perceived as non-three-dimensional) and masses (perceived as three-dimensional), with masses not being necessary elements of an interior.

The notion of architecture, as assumed in the study, denotes ‘the art and skill of shaping and organising space in physical forms that are intended to satisfy the material and spiritual needs of man’.²⁷ Physical forms, which the definition mentions, create architectural urban or landscape interiors, which is why the terms architecture and interiors are used interchangeably within the work (the interior is created as a result of the ‘art and skill of organising space within physical forms’).

Limiting the object of study to the interior led to the following specific conditions:

- 1) Sunlight can be introduced into an interior and modified by its elements (space, boundary: partitions, masses). These elements, in specific cases, can be poorly perceivable in the interior or even unperceivable to humans. These are typically cases concerning a mass within the boundary of an interior that is a part of the building to which the interior belongs. Therefore, the scope of the boundary of an interior was extended to include:
 - **positive masses:** various three-dimensional formations of the boundary of the interior (such as those that are visible within the building to which the interior belongs), perceived as masses typically outside of the interior and used to introduce light into the

²³ There is a possible interpretation concerning the interior which states that ‘[...] the walls close at eye-level, the ceiling covers from above, and under our feet is the floor, while the observer becomes “a freestanding mass” within the interior’. P. Patoczka, *Monitoring ochrony i kształtowania krajobrazu...*, *op. cit.*, p. 391.

²⁴ See: G. Böhme, *Filozofia i estetyka przyrody w dobie kryzysu środowiska naturalnego*, transl. J. Marecki, Warszawa 2002. Böhme notes that ‘placement within the surroundings’ as referred to people, can become one of the key problems of contemporary aesthetics.

²⁵ Gates as openings in walls were treated as elements of an interior’s boundary.

²⁶ M. Twarowski, *Słońce w architekturze...*, *op. cit.*, p. 133–136.

²⁷ J.K. Lenartowicz, *Słownik psychologii architektury dla studiujących architekturę*, Kraków 1997, p. 10. In a longer version of the definition, Lenartowicz wrote: ‘Depending on the scale and variety of social and individual needs, architecture must continually adapt to complex form of human life, to technical progress, to the social and economic development of mankind and the psychological tendencies distinct for a given community’.

interior and to modify said light, such as spatial skylights (including Le Corbusier's light cannons);

- **negative masses:** adjoining (separate) interiors within the structure of the boundary of the interior under study, which enter modified light, such as spatial ducts, shafts, *light pipes*;
- **delineating partitions:** walls, eaves, sun screens (including Le Corbusier's brise-soleils), as well as protective barriers, shadow projectors, screens on the external side of the boundary of the interior under study.

In the first and second case, achieving the intended quality of light in a specific interior can considerably impact the idea that defines the form of the entire massing of the building to which the interior belongs.

- 2) The illumination of an interior, particularly within a building, can be changed relatively easily using temporary arrangements: louvres, shutters, curtains, parasols, or plants. These arrangements were taken into consideration in the study, provided they could be considered architectural i.e.,—according to the adopted definition of architecture—as 'shaped and organised by man'. The lightness or organic origin of the material from which they are made does not eliminate their architectural character as architecture is/can be built by elements of nature organised by humans. For this reason, plants planted by humans or adapted from nature as a boundary of an interior are within the scope of interior elements under study (e.g. a fence from living bamboos in a Japanese garden or pine trees inside a house in Lège-Cap-Ferret, designed by Lacaton Vassal Architects).
- 3) The constraining of the object of the study to the interior required a reference to the definition of architecture as formulated by Le Corbusier. It was assumed that his limitation does not exclude Le Corbusier's traditional view of the relationship between architecture and the solar world. Since the time when Le Corbusier formulated his thought that 'architecture is the learned game, correct and magnificent, of forms assembled in the light',²⁸ the custom of equating forms with the building (or buildings) in an urban or landscape interior in which light operates (which is observable in architectural criticism and design) has firmly asserted itself. However, Le Corbusier himself never indicated where the observer who perceives this game of forms in the light is to stand, so there is no possibility of ruling out that the observer stands inside a building and perceives the game of forms (boundary of the interior) in the light. Under such conditions, Le Corbusier's definition of architecture can apply to any interior. This possibility was accepted as true in this study and it was assumed that the 'learned game, correct and magnificent, of forms assembled in the light' can also take place inside an architectural, urban and landscape interior, into which the sun pours its rays, instilling in it an 'ineffable space'.²⁹

This interpretation of Le Corbusier's definition of architecture is supported by the analyses of sunlight featured in his works. For instance, in the monastery in La Tourette (Le Corbusier, Éveux-sur-l'Arbresle, 1953–1960) light cannons fulfil a unique role in introducing specific sunlight into the interior of the church's chapel and it is difficult to believe the

²⁸ Le Corbusier, *W strongę architektury*, transl. T. Swoboda, Warszawa 2012, p. 80.

²⁹ Le Corbusier used the term *l'espace indicible* during a visit to the La Tourette monastery during the final phase of its construction, when he gave a tour of it to its future users—Dominican friars. Le Corbusier's statements, recorded on tape at the time, were written down and published in a book by F. Biot, F. Perrot (et al.), *Le Corbusier et l'architecture sacrée. Sainte-Marie-de-La-Tourette – Éveux*, Lyon 1985. The term being quoted is from the following statement by Le Corbusier: 'Je suis inventeur de l'expression: "l'espace indicible" qui est une réalité que j'ai découverte en cours de route. Lorsqu'une oeuvre est à son maximum d'intensité, de proportion, de qualité d'exécution, de perfection, il se produit un phénomène d'espace indicible: les lieux se mettent à rayonner, physiquement, ils rauonnent. Ils déterminent ce que j'appelle "l'espace indicible", c'est-à-dire un choc qui ne dépend pas des dimensions mais de la qualité de perfection. C'est du domaine de l'ineffable'. *Ibidem*, p. 96.

architect had designed them solely for the game of light and shadow that plays out on their masses as seen from the exterior, from the chapel's roof. On the contrary, it is the effects of light in this interior that manifest the deliberateness and effectiveness of the application of skylights. The proposed interpretation of the 'game of forms assembled in the light' is also allowed by critics of Le Corbusier's architecture, such as Francesco Venezia and Henry Plummer. Venezia expressed this in his book *La Torre d'Ombre* wherein he paired a photograph of a corridor of the La Tourette monastery with the following text: 'Le ombre creano in un edificio sequenze, ritmi, melodie, che intessono tra loro un gioco complesso'.³⁰ Likewise, Plummer's photographs in his book on Le Corbusier's religious architecture³¹ demonstrate that the author referred the famous definition of architecture both to the massing of the building in its landscape or urban interior and to the architectural interior.

—A territorial and temporal scope was assumed for a part of the study. In Chapters I, II and III no territorial or temporal restrictions were employed. In Chapter IV, a territorial restriction was put in place, encompassing geographical zones with the exception of the equatorial zone, for which the organisation of illumination should be specified differently. In Chapters V and VI, which include case studies, territorial restrictions were put in place, confining the study to European and Japanese interiors, which the author had the ability to visit in person. A temporal restriction, confining the study to the years 1965–2015 was also introduced. The restrictions in Chapters V and VI allowed the study to be more firmly tied with the multi-sensory, personal experience of architecture in a specific cultural and historical context. This experience was assumed as a basis for formulating arguments. All figures featured in the work, including photographs and drawings, are fully original and were made by the author.

I. 3. Aspect of the Study

Sunlight in the interior was studied in the aspect of:

- the relationship with architecture,
- the determinants of this relationship,
- the atmosphere of architecture.

—Sunlight in the interior was studied as an interrelation with architecture. This relation, though ephemeral (dependent on weather and changing elements of the air, such as water vapour, mineral and organic suspensions), is physical and regular enough that it can be described and studied in terms of many types of determinants.

—The relation between architecture and sunlight in the interior was studied with a focus on the following determinants: physical, those related to human physiology and psychology, and cultural determinants.

—Sunlight in the interior was studied in terms of the atmosphere of architecture. It is the third aspect of the study, as it was written on the basis of the previous aspects. For this reason, sunlight in the interior was studied with a focus on atmosphere as a relationship between sunlight and architecture, on the basis of said determinants.

³⁰ F. Venezia, *La torre d'ombre o l'architettura delle apparenze reali / La Tour d'Ombres ou l'architecture des apparences réelles*, transl. into French: M. F. Buonaiuto, Venezia 1988, p. 18.

³¹ The book in question is H. Plummer, *Cosmos of Light. The Sacred Architecture of Le Corbusier*, Bloomington 2013.

It was assumed that the atmosphere of architecture is the capacity of architecture to elicit specific sensory experiences and states of mind within people.³² This study also uses a working definition of the atmosphere of architecture, which arises from translating the notion of capacity as an attribute of ability, which can further be understood as a property that is essential to the existence of a given ability.³³ The author referenced the definition of human capacity and applied it to the capacity of an interior. From this standpoint, atmosphere can be studied using the analysis of a property of an interior as perceived by humans, which is comprised of its individual physical properties (visible and invisible light, temperature, humidity, smell, partition directions, etc.). In the literal sense, atmosphere (Greek *atmós*—vapour, smoke; *sphaira*—globe) is the gaseous envelope of a planet or the external layer of a star.³⁴ Of course, the atmosphere of architecture, in its meaning assumed in the study, is not atmosphere as understood in physics, where it is the gaseous envelope that surrounds a celestial body due to gravity, yet it pertains to the physical property of an interior. Its significance is close to the metaphorical meanings of the notions of ambience, mood and aura,³⁵ while the terms mood and ambience imply a situation in which the interior is filled and humans are immersed in them, while the aura implies an emanation from an object and the person acting as the observer of a phenomenon.

The etymology of this term references the combination of two Greek words that denote a ‘ball of vapour’. Over time, this term was adopted into other languages: Flemish as *dampcloot* and Latin as *atmosphæra*.³⁶ The Latin term, in its original meaning, spread into European languages through cosmological and meteorological essays. ‘With the Romantic age, the word atmosphere assumed new cultural inflections, becoming a semantic medium capable of describing intersubjective relations of varied nature (social, psychological, sentimental, and ethical), not only between two or more individuals, but also between an individual and their physical surroundings’.³⁷

The impact of architecture on humans elicits sensory experiences in them. They are typically associated with the fastest, intuitive feeling and practical use of an interior, e.g. for reading, sleeping, eating, performing physical exercise or hygiene. Due to this, the notion of the impressiveness of architecture as its capacity to elicit sensory experiences in humans was introduced.³⁸

The impact of architecture on humans affects their mood. Because of this, the author introduced the notion of the ambience of architecture,³⁹ which denotes architecture’s capacity to

³² B. Stec, *O światle Wenecji*, “Zeszyty Naukowo-Artystyczne. Wydział Malarstwa Akademii Sztuk Pięknych w Krakowie” 2005, b. 6, p. 163–178.

³³ W. Szewczuk, term: abilities, [in:] *idem* (ed.), *Encyklopedia Psychologii*, Warszawa 1998, p. 1106.

³⁴ W. Kopaliński, *Słownik wyrazów obcych i zwrotów obcojęzycznych*, Warszawa 1983, term: atmosphere, p. 42. Atmospheres surround celestial bodies with a mass sufficient to maintain a layer of gasses as a result of gravitation. The atmosphere that envelops Earth is a mixture of gasses without smell, taste or colour (air), water vapour and suspended particulate matter. There are numerous layers with specific properties that are distinguished in the atmosphere, and which differ in terms of e.g. temperature or the composition of air.

³⁵ Understood colloquially, atmosphere denotes: mood, the psychological ambience within a given environment, place or aura, the tone of a given environment or place From: W. Kopaliński, *Słownik wyrazów obcych...*, *op. cit.*, p. 42.

³⁶ This took place in 1608, when the term was used by Dutch astronomer Willebrord Snellius in the translation of Simon Stevin’s cosmological treatises (E. Canepa, V. Scelsi, A. Fassio, L. Avanzino, G. Lagravinese and C. Chiorri, *Atmospheres: Feeling architecture by emotions*, “Ambiances. International Journal of Sensory Environment, Architecture and Urban Space” 2019 [online] <https://journals.openedition.org/ambiances/2907> [accessed: March 2020], par. 7).

³⁷ E. Canepa, V. Scelsi, A. Fassio, L. Avanzino, G. Lagravinese and C. Chiorri, *Atmospheres: Feeling architecture by emotions*, *op. cit.*, par. 7.

³⁸ Cf. B. Stec, *O światle...*, *op. cit.*, which introduced the term: sensory experiences, which refer directly to the reception of interiors by humans. In this study, this term was replaced by ‘impressiveness of architecture’ as a capacity of architecture.

³⁹ Cf. B. Stec, *Aspekty scenografii w architekturze współczesnej. Wzmocnienie oddziaływania formalnego architektury przez wprowadzenie elementów scenograficznych*, unpublished doctoral dissertation, Kraków 2000, p. 81–83 and B. Stec, *O światle...*, *op. cit.*

induce a specific mood in humans. The impact of architecture on humans is not solely confined to stimulating mood, but also imagination. Due to this, the author introduced the notion of the projection capacity of architecture,⁴⁰ which denotes its ability to produce specific illusions or associations in the human mind. The ambience of architecture affects atmosphere, it acts like a fixative on memories (an atmosphere can have its ambience), similarly as projection capacity affects atmosphere by enhancing its reception (we can speak of an atmosphere of a hazy radiance near a lake). Therefore, the ambience of architecture is a term that evaluates atmosphere in terms of human mood,⁴¹ similarly as architecture's projection capacity is a term that evaluates atmosphere in terms of illusions and associations produced in the human mind. The atmosphere itself is a term that evaluates an interior in the aspect of its ability to affect humans: their senses and state of mind.

The meaning of the term atmosphere used throughout this study is not to be confused with the notion of the *character* of architecture that is applied to architecture in psychology and which shows properties that are bestowed upon architecture by humans.⁴² The notion of the atmosphere, applied to architecture from physics, points to the physical properties of architecture, which are not conferred upon it by humans, but stimulate the human reception of architecture, and are defined, described and evaluated by humans.

The atmosphere of architecture is also used in a shortened form in this work, as atmosphere (unless specified otherwise, hereinafter this term shall refer to architecture).

I. 4. Method

The method used in this study is based on: 1) an analysis of the determinants of the relationship of sunlight within an interior based on the literature (Chapter II); 2) an analysis of the current significance and method of studying the atmosphere of architecture against the background of contemporary atmosphere theory with highlighting the criterion of valuating sunlight within the interior in terms of atmosphere and the specific criteria of valuating atmosphere (Chapter III); 3) proposing a typology of elementary architectural methods of operating with sunlight in an interior and their taxonomy as tools that can be used to describe light in an interior (Chapter IV); 4) determine the results of elementary architectural methods of operating with sunlight in an interior associated with the mutual exposure of the properties of architecture and light (Chapter IV); 5) valuation of the mutual exposure of the physical properties of the interior and

⁴⁰ Cf. *ibidem*. Both terms: ambience and projection capacity of architecture were defined by the author in her doctoral dissertation, assuming them to be 'scenographic functions of architecture'. In the monograph from 2017 the author opted not to use references to scenography so as not to suggest the placement of man outside of the interior as an observer, which would come into conflict with the essential placement of man inside the interior. However, the user of an interior can be equated to an actor on a stage, as mentioned by Böhme (interview with T. Ajder, Warszawa 2013, *The art of the stage set as a paradigm for an aesthetics of atmospheres...*).

⁴¹ One of the results of perceiving atmosphere by humans is their mood, which affects the perception and remembering of atmosphere, acting as, for instance, a fixative for memory.

⁴² Cf. W. Szewczuk, term: character [in:] *idem* (ed.), *Encyklopedia psychologii, op. cit.*, p. 44. Term: in the first sense, character refers to the characteristic of a person. Szewczuk stated that 'psychologists are becoming increasingly aware, following everyday experience, that it is about the properties in which interpersonal relationships are expressed. Essential components of a character's structure are methods of achieving goals, referring to other people and referring to oneself and one's own actions'. In a similar sense, when pertaining to architecture, its character is a result of humans referring to architecture. Also cf.: Ch. Norberg-Schulz, *Znaczenie w architekturze Zachodu*, transl. B. Gadomska, Warszawa 1999, Chapter *Przestrzeń, charakter i architektura*, p. 223–226.

light in terms of the atmosphere of the interior according to criteria determined earlier and those listed by Rasmussen, Twarowski, Zumthor and Plummer (Chapter IV); 6) a presentation of the atmosphere of architecture in table form as a result of exposing the characteristics of architecture and light (Chapter IV); 7) an analysis of the application of each method of operating with light in selected interiors (Chapter V); 8) the analysis of the atmosphere of selected interiors, obtained via a specific relationship between architecture and sunlight (Chapter VI); 9) formulating conclusions as to the usefulness of the study in architectural education, criticism and practice. During stages 4)–8), the author made direct use of the research published in the monograph *O świetle...* (2017).

Due to its specificity, the study is based on descriptions of the physical properties of interior elements and descriptions of these properties by people across all stages. This leads to the necessity of using adjectives and metaphors which often describe a distinct quality or matter in the simplest manner. Adjectives that grade emotional reception are highly significant in the exploration of the relationship under study, as illustrated by Le Corbusier's definition of architecture: if it had been stripped of the terms 'learned, correct and magnificent', the definition of the architecture as 'the game of forms assembled in the light' would have made no sense.

Below is a detailed description of the eight stages of the study's method.

- 1) Analysis of the determinants of the relationship between sunlight and architecture in the interior was conducted on the basis of the state of the research and the personal experience of the author. To illustrate the physical and psychological impacts in question, the author used the example of the relationship between sunlight and the architecture of Venice as a spectacular case, discussed in the literature and known to the author from personal experience.
- 2) The analysis of determinants became a basis for the definition of the significance of the atmosphere of architecture assumed in the study and presenting it against the background of the contemporary theory of atmosphere. The mutual exposure of the physical properties of architecture and the nature of light in the interior was assumed to be a criterion of the evaluation of light in the interior in the aspect of the atmosphere of architecture. Detailed criteria of valuating atmosphere were formulated. By referring to authority figures and scholars of atmosphere, the partial findings of the study were confronted with contemporary thought concerning the definition of atmosphere, its reception, description and construction. The framing of the author's research against the background of the theory of atmosphere was assumed to be a context and reference to further stages of the study.
- 3) When building a tool for the study, namely the typology of elementary architectural methods of operating with sunlight in an interior, the following three factors were accounted for: from where does sunlight enter the interior, how is it modified (what happens to it) and what elements of the interior introduce and modify it. These three factors condition every manner of operating with light in an interior. Because they are characterised by interdependencies, the taxonomy has the form of a three-dimensional cube (instead of a table). This taxonomy is a tool used to describe the manners of operating with light in an interior and not of their evaluation. It also allows one to identify the scope of the possibility of using elements of the interior (their physical properties) in a specific case of operating with light in an interior and therefore is a basis for the further stage of the study: defining the results of operating with light in an interior in the aspect of atmosphere.

Operating with light in an interior was analysed based on visual perception. This also became the basis of the typology featured in the study. It was assumed that perception that is typical of most people with an average degree of healthy vision allows one to explicitly and legibly describe operating with light in an interior. This does not mean that light is not perceived through experiences that are other than visual (e.g. based on the temperature of the interior) and in intellectual and spiritual experiences, yet the design of the tool of the study was based on perceiving the interior by humans as a starting point or symptomatic for other components of perception.

When formulating the typology, the author accounted for sunlight across the entirety of its nature, as this is the form in which it enters the interior and falls onto humans. Although the dimensions described by geometrical optics are the closest to the human scale used in the design of architecture,⁴³ they are not always sufficient to explain the phenomena that comprise operating with light in an interior as only wave optics can explain reflection, refraction or dispersion, while quantum optics—can explain the absorption of light.

- 4) The next step in the study was the formulation of the results of elementary architectural methods of operating with light. Due to the aspect of the study, the author distinguished results based on the mutual exposure of the physical properties of the interior and the light.
- 5) The following stage was the evaluation of the exposure of the physical properties of the interior and the light in the aspect of atmosphere. It was performed based on the criteria formulated earlier (in Chapter II) and based on the criteria formulated by Rasmussen, Twarowski, Zumthor and Plummer.
- 6) As a result of the study, a table of dependencies between the atmosphere of architecture and the mutual exposure of the physical properties of the interior and light was constructed. This exposure is an element of the atmosphere of the interior. The taxonomy that presents the methods of operating with light that achieved a specific exposure of the interior allowed the presentation of how atmosphere depends on the physical structure of the interior.
- 7) The application of each method of operating with light in selected interiors, which the author was able to personally experience, was presented both in writing and using photographs (case studies).
- 8) Selected interiors in which a specific, vivid atmosphere was obtained through the appropriate design of the relationship between sunlight and architecture was presented in writing and through photographs (case studies).

To present the case studies, the author sought examples of interiors that had been designed with the intent to obtain a specific atmosphere as a result of sunlight in architecture (the written intentions of the designers were particularly valuable to the study). The personal experience of interiors analysed by the author was acknowledged as the basis for the assessment of how the atmosphere of the interior was co-created by light. The territorial scope of the study enabled the underscoring of the significant role of cultural determinants in the reception and design of light in the interior and demonstrate the universality of the research tool that was presented. The temporal scope assumed in the work enabled the author to highlight the impact of historical circumstances on the design of the interiors under analysis.

I. 5. Objective

The primary objective of this study was to demonstrate the humanising role of the analysis of the atmosphere of architecture produced by sunlight in architectural criticism, education and design. The secondary objective was to present and characterise the dependencies between the relationship of light and architecture and the atmosphere of the interior. In order to achieve this objective, the author formulated a method of describing and valuating this relationship in the aspect of the atmosphere of architecture: a taxonomy of elementary architectural methods of operating with light was formulated, along with the results of operating with light, which were assessed

⁴³ J.K. Lenartowicz, *Słownik psychologii architektury...*, *op. cit.*, p. 128.

according to the criterion of atmosphere. The objective of the work was the application of the final and partial findings of the study in architectural criticism and education and in design practice. Examples of this application have been listed in the final two chapters.

I. 6. State of Research

The state of research concerning the subject of this work includes the literature that is cited and used throughout it. It was presented in chronological order. Older writings are dominated by the subject of the relationship of sunlight and architecture, while the atmosphere of architecture emerged as a separate and well-defined issue towards the end of the twentieth century. However, this subject was mentioned in the oldest architectural treatises, but was presented indirectly in descriptions of various aspects of the impact of light on the users of architectural interiors.

The matter of the relationship between sunlight and architecture is discussed in the oldest treatises: in Vitruvius' *De architectura*,⁴⁴ written in the first century AD; in Leone Battista Alberti's *De re aedificatoria*;⁴⁵ in Sebastiano Serlio's *L'Architettura*;⁴⁶ in Andrea Palladio's *I Quattro Libri dell'Architettura*⁴⁷ and in Vincenzo Scamozzi's *L'Idea dell'Architettura Universale*.⁴⁸

Marcus Vitruvius Pollio, generally known as Vitruvius, did not devote a separate book to light, as he did to water,⁴⁹ but did discuss it in various places of his treatise while describing the climate-related determinants of architecture. Vitruvius associated sunlight with daylighting (the direct light of the sun), i.e. not only with brightness, but also the warmth that light introduces into the interior. Thus, he recommended a specific cardinal direction for each room.⁵⁰ And so, in the Sixth Book on domestic buildings, in chapter four, entitled *The proper exposures of the different rooms*,⁵¹ Vitruvius discusses which interiors should face which cardinal direction to obtain favourable use conditions for each. He advised that winter triclinia and baths should face the south-west and be illuminated with sunlight towards the evening as this was the time of day they were used the most often, as well as 'because the setting sun, facing them in all its splendour but with abated heat, lends a gentler warmth to that quarter in the evening'.⁵² He recommended that bedrooms and libraries are to be oriented towards the east, 'because their purposes require the morning light, and also because books in such libraries will not decay', while summer triclinia should face northwards, 'because that quarter is not, like the others, burning with heat during the solstice, for the reason that it is unexposed to the sun's course, and hence it always keeps cool, and makes the use of the rooms both healthy and agreeable. Similarly with picture galleries, embroiderers' work rooms, and painters' studios, in order that the fixed light may permit the colours used in their work to last with qualities unchanged'.⁵³ For the study, it is essential that Vitruvius

⁴⁴ Marcus Vitruvius Pollio, *O Architekturyze ksiąg dziesięć* (first century BCE), transl. K. Kumaniecki, Warszawa 1956. Also: *The Ten Books on Architecture*, transl. M. Hicky Morgan, Cambridge, 1914.

⁴⁵ L.B. Alberti, *Ksiąg dziesięć o sztuce budowania* (1450), (ed.) I. Dziewoński, transl. I. Biegańska, Warszawa 1960.

⁴⁶ S. Serlio, *L'Architettura*, Venezia 1537.

⁴⁷ A. Palladio, *I Quattro Libri dell'Architettura*, Venezia 1570.

⁴⁸ V. Scamozzi, *L'Idea dell'Architettura Universale*, Venezia 1615.

⁴⁹ Marcus Vitruvius Pollio, *O Architekturyze ksiąg dziesięć...*, *op. cit.* The Eighth Book of the treatise is entitled *On Water* and is devoted to the properties and study of different types of water and means of supplying it to various buildings.

⁵⁰ *Ibidem*, p. 73.

⁵¹ *Ibidem*, p. 108.

⁵² *Ibidem*.

⁵³ *Ibidem*.

mentioned three types of illuminating interiors with sunlight: direct light with side rays, wherein the interior receives ‘sun shining straight’, and indirect lighting with scattered sunlight, when the interior that faces away from the sun is evenly lit. Associating insolation with warmth, and specific cardinal directions with winds that they typically brought (for the territory of the Roman Empire in the second decade BC, when Vitruvius wrote his treatise). In this chapter, which only features a few sentences, Vitruvius initiated a series of elements of the relationship under study in its aspect related to the climate, health (human physiology), and the psychophysical aspect, which connects with the aspect of the atmosphere of architecture. He touched matters of indirectly illuminating architecture with sunlight, when writing on the planning of buildings, fluting, the width of the intercolumnia, optical corrections as to the proportions of architectural elements, on interior decoration and pigments. However, he never distinguished light as something that exposes the shape of a building in his writings. The entire Ninth Book, on clocks and clock making, particularly its seventh chapter, entitled *The analemma and its applications*,⁵⁴ concerns the analysis of sunlight in the astronomical sense, which characterises Vitruvius’ approach to sunlight as a means with which to discern the movement and properties of celestial bodies and that conditions human life. It is clear that Vitruvius wrote about the relationship between sunlight and architecture in its many aspects, and also indirectly, in the aspect of the atmosphere of architecture.

The Middle Ages were a time of a specific relationship between architecture and sunlight, which was associated with the practice and organisation of life (in monasteries, for example) on the one hand, while on the other—with spiritual life and mysticism. Tomasz Wagner⁵⁵ directed the author towards an excellent example of early medieval literature—*Corpus Dionysiacum*, a collection of theological texts written by Dionysius the Areopagite, also called Pseudo-Dionysius the Areopagite. Although the author of the work presented himself as a Greek who had converted to Christianity after listening to the speech of Saint Paul the Apostle at the Areopagum, the modern consensus is that he was a student of the Neoplatonic philosopher Proclus and lived around the turn of the sixth century and wrote in the spirit of Neoplatonic metaphysics. Since the sixth century, the writings of Dionysius attracted increasing respect, in addition to expanding their influence in the West of Europe, which they reached first in 758, ‘when the pope offered a manuscript to Peppin the Short, a student of Saint-Denis’, and later in 807, when ‘the emperor of Constantinople, Michael the Stammerer, sent a second copy to the emperor of the West, Louis the Pious’.⁵⁶ Dionysius’ writings reached the monastery of Saint-Denis, where their author was associated with St Denis of Paris who had been buried there and had been the first bishop of Paris, executed in the third century and a martyr.⁵⁷ Saint-Denis was where Dionysius’ writings were translated into Latin: the first translation, performed by Abbot Hilduin and the second (with commentary, believed to be better by Duby), written by John Scotus Eriugena during the times of Charles the Bald. This study references contemporary works that refer to Dionysius’ writings: Georges Duby’s *The Age of the Cathedrals: Art and Society, 980–1420*,⁵⁸ the presentation *A Symbolic Turn of Mind. Lech Kalinowski and the Giants of Iconography*⁵⁹ by Paul Crossley and the aforementioned review by Wagner.⁶⁰ The Areopagite’s writings are essential to this work, as they are a theological basis for the symbolism and mysticism of

⁵⁴ *Ibidem*, p. 147.

⁵⁵ T. Wagner, *Ocena przedstawionego osiągnięcia habilitacyjnego i dorobku naukowego dr inż. arch. Barbary Stec*, 04.06.2019, p. 7.

⁵⁶ G. Duby, *Czasy katedr. Sztuka i społeczeństwo 980–1420*, transl. K. Dolatowska, Warszawa 1986, p. 120. Also: *The Age of the Cathedrals: Art. And Society, 980–1420*, transl. E. Leveux, B. Thompson, Chicago 1981.

⁵⁷ Up to the sixteenth century, Dionysius the Areopagite was mistaken for Saint Denis, the patron saint of France.

⁵⁸ G. Duby, *Czasy katedr. Sztuka i społeczeństwo 980–1420*, *op. cit.*

⁵⁹ P. Crossley, *A Symbolic Turn of Mind. Lech Kalinowski and the Giants of Iconography*, unpublished presentation delivered at a jubilee of Professor Lech Kalinowski in 2000.

⁶⁰ T. Wagner, *Ocena przedstawionego osiągnięcia habilitacyjnego i dorobku naukowego...*, *op. cit.*

the light of Christian religious architecture, including medieval architecture. Wagner highlighted that Dionysius' collection was 'a major work that affected the symbolism and role of light in medieval temples'.⁶¹ In the first half of the twelfth century, the Areopagite's work was well-known to abbot Suger and profoundly affected the remodelling of the Saint-Denis church. The thought that God is the light was critical to the symbolism and mysticism of light. Crossley, based on *The divine Names* and his *Prooemion*, explained that Dionysius 'distinguishes between intelligible light (*intelligibile lumen*) and light perceived by the senses (*sensibilis luminis*). Intelligible light is a divine "Name" because it belongs to God's objective, ontological and transcendent nature; it is "the source of light and actually transcends light";... 'it reaches from the highest and most perfect forms of being to the very lowest. And yet it remains above and beyond them all, superior to the highest and yet stretching out to the lowliest'.⁶² To Dionysius 'the lower forms of light begin their life in the Word of sensible things, and are attributed to God only metaphorically'. It is on the basis of the distinction between *sensibilis luminis* and *intelligibile lumen* that one could find the link between them and point to one as a metaphor for the other. The Areopagite's thought laid the theological foundations for the symbolism and mysticism of light, and the interior of the church, bound with light, was made into a new model of religious space. Due to this, the *Corpus Dionysiacum*, read together with medieval religious architecture, explains the role of sunlight in building the atmosphere of architecture. It is obtained with light that is used to symbolically read and see the metaphysical in a single experience

The writings of Witelo, an outstanding natural philosopher, mathematician and psychologist of the Middle Ages, who was active in, among other places, Silesia, are dated to the thirteenth century. This scholar gained the title of *magister atrium* in Paris, but also studied in Padua, where he familiarised himself with a treatise on optics, written by the Arab scholar Alhazen. While residing at the papal court in Viterbo, Witelo wrote *Perspectiva* (1270–72). The fragments of this work where he explains his revolutionary views on the psychology of vision are particularly valuable to this work. He rejected the Greek extramissive doctrine, which argued that 'sight is based on grasping objects by rays emitted from the eyes',⁶³ instead opting for Alhazen's intramissive doctrine, according to which vision is based on the eyes detecting luminous and illuminated objects. Due to this, Witelo conditioned sight on specific determinants, which included: 'light, distance from the eye, placement opposite the eye, the angular size of the object, the transparency of the air, the duration of observation and visual health'.⁶⁴ The condition of healthy vision lies on the side of man, but the condition of light, the angular size of the object and the transparency of air—on the side of the environment. Meanwhile, the three remaining conditions: the time of observation, distance from the eye, and placement opposite the eye of the observer, describe the relationship between the person and the object. Thus, Witelo accurately defined the conditions of perceiving the properties of the surroundings and thus—of their atmosphere built using light. Witelo's presentation of light phenomena is close to their presentation from the point of view of atmosphere adopted in this work, as it links discussing physical phenomena: the propagation of light along a straight path, reflection, scattering or refraction, with meteorological phenomena associated with light and phenomena belonging to the psychology of perception. Witelo's work can thus be considered precursory in the study of atmosphere created by light. Another matter important to the study that Witelo analysed was perspective and optical illusions. Witelo explained them as a process of the 'erroneous identification of objects due to the erroneous application of the knowledge of forms, which is stored in the human soul, i.e. in the darkness one

⁶¹ *Ibidem*.

⁶² P. Crossley, *A Symbolic Turn of Mind. Lech Kalinowski and the Giants of Iconography*, *op. cit.*, p. 4, 5.

⁶³ J.K. Lenartowicz, *Słownik psychologii architektury...*, *op. cit.*, p. 146; the entire fragment on Witelo was based on: *ibidem*, p. 146, 147.

⁶⁴ *Ibidem*, p. 146.

can mistake a horse for a donkey'.⁶⁵ In the aspect of this study, Witelo demonstrated that human visual perception is considerably impacted by seeing the surroundings through perspective and the creation of optical illusions in the human mind. Stage designs that have utilised perspective and illusion as means of creating reality since the beginning of their history, the Middle Ages included, are proof of this. Witelo studied the essential components of building atmosphere through illuminated objects. This deserves recognition concerning the contemporary psychology of vision, according to which the study of optical illusions is to promise key discoveries intended to develop knowledge of visual perception overall.

Other publications concerning medieval architecture that were used in the work were mentioned in the review of the later literature.

Leon Battista Alberti (who was a scholar) discussed the subject of sunlight in architecture in his treatise *De re aedificatoria*. He treated openings as the sixth element of architecture and subjected their placement and proportions of the overall composition, structure and order of architecture. He used the term sunlight as insolation, similarly as Vitruvius had. Alberti did consider direct sunlight as desirable in interiors, but it can sometimes be inconvenient, which is why he recommended to limit it. This approach to direct sunlight is probably tied to the heat of the Mediterranean climate. Alberti linked light with beauty, when he wrote in his discussion on the ornament that it is 'a form of auxiliary light and complement to beauty'.⁶⁶ However, in Alberti's view and in accordance with the Renaissance idea of beauty, light should be clear, stable, uniform, and thus it would be best if it were scattered, faithfully highlighting the interior's architectural forms in their entirety and which, due to such exposure, should have carefully designed proportions.

Sebastiano Serlio, in an architectural treatise featured in seven books (and an eighth, unfinished one) focused primarily on geometry and perspective as the basis for the architectural art. However, he also accurately studied the matter of designing wall openings, which is why his writings are of critical significance to this study, particularly in terms of the structure of architectural tools used to *carve* light. Serlio produced numerous designs of windows and portals, including that of the *serliana*, an arcade or window with three openings, the central of which is wider than the others and topped with an arch (the *serliana* is also known as the Venetian or Palladian window, as it was often used by Palladio and became one of the distinct features of architecture described as Palladian).

Andrea Palladio continued Vitruvius' discussion on sunlight in architecture. In his treatise, he postulates the application of sunlight in buildings according to its practical utility within an interior. This can be seen in his discussion on the dimensions of doors and windows, which should be adapted to the needs of appropriate (i.e. practical for use) interior light. In the Second Book of his treatise, which focuses on the architecture of houses, he advised on the orientation of the building relative to the cardinal directions and the use and different conditions of insolation. Palladio's innovation in the means of using sunlight in interiors, which can be seen in his projects, can be a result of purely practical rules that he was able to masterfully apply.⁶⁷

Vincenzo Scamozzi's Renaissance treatise entitled *L'Idea dell'Architettura Universale* was an essential contribution to this study. Through this work, Scamozzi became the first person in history to isolate light *per se* as a means of building architectural form. In his discussion, he presented himself as an architect who pursued a more complex and varied light than the uniform,

⁶⁵ *Ibidem*.

⁶⁶ A.M. Borys, *Lume di Lume. A Theory of Light and Its Effects*, "Journal of Architectural Education" 2004, p. 4.

⁶⁷ Cf. *ibidem*. Borys quoted James Ackerman, who had called Palladio 'a magician of light and color' and noted that Palladio's extraordinary ability to use sunlight in architecture did not correspond with the theory as written in the treatise. However, when comparing the treatise and Palladio's buildings, we can conclude that Palladio's mastery lies in his application of simple and practical rules.

relatively stable light preferred during the Renaissance. At the same time, he was not interested in the dramatic effects of light nor in its capacity to elicit extreme emotions in people, particularly ecstatic emotions, as Baroque architects pointed out. He noted the different physical form of light in the interior depending on the manner of admitting it into said interior through properly formed elements of architecture. In the thirteenth chapter of the Second Book of the treatise he mentioned six different categories of daylight in the interior and illustrated his theoretical discussion on the plan and cross-section of Villa Bardellini (which was never finished and was ultimately dismantled) with graphs of places that he envisioned in the design as covered in various shades and lit with different forms of light. In this manner, Scamozzi became a pioneer of the geometric method of designing specific light in interiors. He mentioned six categories of interior light (here with commentary by Ann Marie Borys): *lume amplissimo, o celeste* – ‘intense from direct sun on a clear day’, 2) *lume vivo perpendicolare* – ‘lively and perpendicular, as received in courtyards and through domes’, 3) *lume vivo orizzontale* – ‘horizontal free is received frontally or diagonally as in rooms and porticos’, 4) *lume terminato* – ‘limited light obstructed by a place’s narrowness like a street’, 5) *lume di lume* – ‘also called secondary light, it comes from an adjacent directly lit space’, 6) *lume minimo* – ‘minimal light is reflected light’.⁶⁸ On the plan and cross-section of Villa Barellini, different forms of light reaching the interior were marked by Scamozzi with letters and properly annotated. For instance, he used the letter D to mark a single type of light in the corner of a room, and the letter R—‘the light of the light of small interiors with secret stairs’.⁶⁹

Never before had architectural interior light been so precisely distinguished and named depending on its physical form as a result of specific architectural manners of operating with sunlight in the interior. The fact that Scamozzi drew the scopes of light of different size and from each side of his oriented villa was also exceptional: on the charts, the lines that define the scope of entering light do not denote direct rays (as it is typically shown in architecture insolation charts), but—the rays of sunlight that exist outside of the building, also as rays of sunlight that are reflected from the celestial sphere (daytime and night-time with the light of the moon and stars). This understanding of the notion of sunlight demonstrates Scamozzi’s originality when compared with Vitruvius and Palladio.

In light of the above, Scamozzi’s notes on light and architecture can be considered to be the first taxonomy of architectural methods of operating with light in an interior in the aspect of their impact on humans. Scamozzi presented the idea of light that was not as much ‘dramatic’ as ‘symbolic’ and capable of inducing ecstasy in humans, light that was more sensual, intimate, associated with everyday practical human experience. Although Scamozzi did not write about the atmosphere of the interior directly, his manner of naming and analysing light in the interior demonstrates that he noted this atmosphere and linked achieving it with the physical form of the relationship between sunlight and architecture in specific interiors. Thus, Scamozzi was the first to demonstrate that atmosphere can be designed, at least in the part in which it is built by the relationship between sunlight and architecture.

In the five oldest treatises on architecture one can note that the subject of the relationship between sunlight and architecture pertains to the interior similarly as in the assumptions of this work (architecture is treated as a tool to achieve proper sunlight in an interior).

The subject of the relationship between architecture and sunlight became a part of many cross-sectional, multi-threaded works on architecture, written according to criteria other than its relationship with light, for instance according to the criteria of structure, styles, geographical conditions, health-related determinants, significance in architecture or criteria concerning the

⁶⁸ A.M. Borys, *Lume di Lume...*, *op cit.*, p. 8.

⁶⁹ *Ibidem.*

methodology of architectural design.⁷⁰ As one of many subjects, this problem also appears in more modest and detailed works concerning various aspects of architecture. It is both a part of the history of architecture concerning the individual characteristics of various periods and architectural styles, ranging from ancient architecture to Modernism, including the Byzantine period, the Romanesque style, the Gothic style, the Renaissance, Mannerism, the Baroque, the nineteenth century of iron and glass, the Secession, or Expressionism. It turns out that the stylistic characteristics of architecture are closely tied to sunlight. This study referenced this literature, both Polish: Tadeusz Broniewski's *Historia architektury dla wszystkich*,⁷¹ Stefan Sienicki's *Historia wnętrz mieszkalnych*⁷² and English: Nicolas Pevsner's *An Outline of European Architecture*⁷³ and Christian Norberg-Schulz's *Meaning in Western Architecture*.⁷⁴ The author also used cross-sectional works concerning the history of contemporary architecture that featured the problem under study in its different aspects: from technological to metaphorical ones, such as the now-classic work by Kenneth Frampton *Modern Architecture. A critical history*.⁷⁵ In the field of arts history, the analysed literature includes E. Panofsky's *Studies in Iconology*, as treated by Jan Białostocki.⁷⁶ Chapters that discuss the role of sunlight in building the atmosphere of medieval religious interiors are valuable to this work. Panofsky explained its significant role in the remodelling of St Denis by abbot Suger and describes the relationships between architecture and scholastics as well as medieval iconography. The analysis of the role of light in medieval architecture was also drawn from the French publication *Pierre, lumière, couleur. Etudes d'histoire de l'art du Moyen-Âge en l'honneur d'Anne Prache*.⁷⁷

History's first direct linking of the formal essence of architecture with sunlight was performed by Le Corbusier and his definition and idea of architecture,⁷⁸ as presented in the texts that make up *Towards an Architecture*.⁷⁹ Le Corbusier practically derived his definition of architecture directly from architecture's relationship with light in the aspect of architecture's atmosphere, as he based it on the 'game of forms assembled in the light', but not just any game—'a learned, correct and magnificent' game (as assessed by the person who sees it). If this definition were to be applied to the interior, 'the game of forms assembled in the light' is the physical property of an illuminated interior to which these forms belong, which is essential to eliciting sensory and mental experiences in the person inside this interior that would allow it to be assessed as 'learned, correct and magnificent'. Le Corbusier's descriptions are thus of considerable significance in this work, as they combine the characteristic of the interior with light and human reception, which refer directly to atmosphere, obtained via an appropriate relationship between sunlight and

⁷⁰ The relationship between sunlight and architecture lies at the source and in the results of structural inventions, it builds the meanings and symbolism of architecture, translates the adaptation of architecture to local geographical conditions, stimulates human physiology and health in the environment of human life, and is a component or foundation of methodologies of architectural and urban design. Thus far, no general history of architecture in the aspect of its relationship with sunlight has been written down similarly to how its aspects of architectural styles or structure have been (e.g. W. Borusiewicz, *Konstrukcje budowlane dla architektów*, Warszawa 1973) or in the sense of meaning in architecture. This state was confirmed by Werner Oeschlin in 1988 'The history of light in architecture has yet to be written', who was quoted by Borys (Daidalos, 1988). In: A.M. Borys, *Lume di Lume...*, *op. cit.*, p. 3.

⁷¹ T. Broniewski, *Historia architektury dla wszystkich*, Wrocław–Warszawa–Kraków 1964.

⁷² S. Sienicki, *Historia wnętrz mieszkalnych*, Warszawa 1954.

⁷³ N. Pevsner, *Historia architektury europejskiej* (1943), transl. A. Morawińska, H. Pawlikowska, Warszawa 1976.

⁷⁴ Ch. Norberg-Schulz, *Znaczenie w architekturze Zachodu...*, *op. cit.*

⁷⁵ K. Frampton, *Modern Architecture. A critical history*, London 1980.

⁷⁶ E. Panofsky, *Studia z historii sztuki*, anthology edited by Jan Białostocki, Warszawa 1971.

⁷⁷ *Pierre, lumière, couleur. Etudes d'histoire de l'art du Moyen-Âge en l'honneur d'Anne Prache*, F. Joubert et D. Sandron, (eds.), Paris 1999.

⁷⁸ Le Corbusier did not make it specifically clear which light he had meant, but we can infer from the context that he was referring to sunlight.

⁷⁹ Le Corbusier, *W stronę architektury...*, *op. cit.*

architecture. Le Corbusier's presentation of architecture began a series of studies on the relationship between architecture and light in the aspect of the shape and composition of light and shadow.

Among studies of this type we can mention the group work entitled *Das Geheimnis des Schattens. Licht und Schatten in der Architektur. The secret of the shadow. Light and shadow in architecture*,⁸⁰ which deals with numerous visual aspects of the relationship between architecture and light. Werner Oeschlin presented in it the period between the seventeenth and the start of the twentieth century in the context of its dominant architectural ideas concerning the meaning of darkness, shadow, dusk, and the modelling of light.⁸¹ In this book, historical examples were compared with the now increasingly common disappearance of the protection and significance of shadow (and its subtle half-tones) and darkness in architecture. Examples of the work (photographs, drawings, texts) of fifty contemporary architects who use shadow and half-shadow as the material of their architecture (among them being Sverre Fehn, Peter Zumthor, Zaha Hadid, Kazuyo Sejima and Ryue Nishizawa, Daniel Liebeskind) are a part of this book. The atmosphere of architecture does not appear in it as a separate issue, but is linked with matters of perception and meaning of light in the interior.

The study of the relationship between architecture and light in Modernist architecture is presented by Paul Overy's *Light, air & openness. Modern architecture between the wars*.⁸² It presents an overview of the idea of 1920s and 30s Modernism based on the criterion of 'opening' architecture to daylight and discusses it against the background of the cultural context of the period on examples of analysed buildings. The third part of the book entitled *Sun*, which includes the chapters *Mountains & the sea, Built into the Sun* and *The outdoor room* (p. 98–153) discusses the genesis and architectural consequences of the Modernist phenomenon of humans opening themselves to solar radiation. This work was valuable particularly in light of the analysis of the impact of human physiological and psychological conditions on the shape and reception of the relationship under study.

Since the period of Modernism, an in-depth reflection on light in the interior has resulted both from its visual and health-related aspect. The impact of sunlight, particularly insolation, on the proper development of humans, became the subject of dedicated works already in the first half of the twentieth century. Some of them, like the books of physicians, the brothers Elio and Hugo Biancani entitled *Les Rayons ultraviolets*⁸³ and *Lumière et rayons infrarouges*⁸⁴ and the book by André Dognon, Hugo and Elio Biancani *Ultra-sons et biologie*⁸⁵ were published already before the Second World War, yet most were published after it had concluded. This work also makes use of the contemporary literature concerning methods of medicinal treatment with sunlight that was conducted in the first half of the twentieth century by physician Jean Saidman. The source of this literature is the research by Thierry Lefebvre and Cécile Raynal, published in the book *Les Solariums tournants du Dr Jean Saidman. Aix-les-Bains, Jamnagar, Vallauris*.⁸⁶

⁸⁰ *Das Geheimnis des Schattens. Licht und Schatten in der Architektur. The secret of the shadow. Light and shadow in architecture*, exhibition catalogue in DAM, Tübingen–Berlin 2002.

⁸¹ W. Oeschlin, „Je fais la lumière”: *Wie der Architekt aus dem Schatten des Malers tritt. How the architect emerged from the shadows of the painter*, [in:] *Das Geheimnis des Schattens...*, op. cit. p. 78–95.

⁸² P. Overy, *Light, air & openness. Modern architecture between the wars*, London 2007.

⁸³ E. et H. Biancani, *Les Rayons ultraviolets*, Paris 1928.

⁸⁴ E. et H. Biancani, *Lumière et rayons infrarouges*, Paris 1929.

⁸⁵ A. Dognon, H. Biancani, *Ultra-sons et biologie*, Paris 1937.

⁸⁶ T. Lefebvre, C. Raynal, *Les Solariums tournants du Dr Jean Saidman. Aix-les-Bains, Jamnagar, Vallauris*, Paris 2010. Also see: C. Raynal, T. Lefebvre, *Médicaments ayurvédiques en France. La tentative des laboratoires Polythérapie*, “Revue d'histoire de la pharmacie” 2010, vol. 97, no. 368, p. 413–430, http://www.persee.fr/doc/pharm_0035-2349_2010_num_97_368_22237 [accessed: 30.10.2017]; E. Belle, Ph. Gras, *Etablissement médical, dit station héliothérapique orientable ou Solarium tournant*, la Région Auvergne-Rhône-Alpes,

A more personal and painterly presentation of light in architecture has been brought by Steen Eiler Rasmussen's book *Experiencing Architecture*,⁸⁷ particularly its chapters *Daylight in architecture* (p. 205–237) and *Color in architecture* (p. 238–249). In this book, Rasmussen made an in-depth analysis of every analysed case of the relationship between architecture and sunlight in the interior and the impact of this relationship on human experiences in this interior—these experiences typically being his own. Rasmussen's analyses provided valuable source material for this study, which the author used to develop the psychological determinants of light in the interior and, most importantly, evaluate manners of operating with sunlight in the interior in the aspect of atmosphere.

In Poland, the subject matter of light and architecture, in terms of its architectural application, was developed by Mieczysław Twarowski, in his internationally pioneering book *Słońce w architekturze*,⁸⁸ (it was published only three years after the first edition of *Experiencing Architecture*). Its author primarily analyses the determinants and results of insolation in architecture, and thus focuses on the dependencies between the composition of light and shadow (in interiors and on masses) from the changing angle of incidence of sunlight. This work features an analysis of insolation in terms of its numerous benefits to humans, including health benefits resulting from access to sunlight in interiors (urban, architectural and garden interiors), as well as aesthetic ones, associated with a proper 'solar expressivity' (Twarowski's original term) of architectural massings, interiors, the landscape and the garden and visual composition (helioexpressivity, in Twarowski's terminology). Twarowski proposed an accurate method of architectural and urban design based on the application of the 'solar ruler'. Accounting for the massing in its surrounding, the building in its surroundings, interiors (in buildings) of varying shape (simple rectangular, with a slanted ceiling, with unevenly oriented walls, with three-dimensional forms), as well as landscapes and gardens, Twarowski analysed a similar scope of interiors to the one in this study, which is why the author makes numerous references to *Słońce w architekturze*. The author used the analysis of interior elements in terms of their function, the introduction of light into the interior and modifying it, e.g. the highlighting of mass angles as elements of the interior that considerably impact how one operates with light in them. Twarowski also indirectly discussed the atmosphere of architecture. This is visible in the passages where he discussed the physical properties of interiors obtained due to specific insolation, particularly direct insolation, and how these properties act on human health and mood.

Twarowski's work denotes a moment in the literature when architectural and urban design handbooks became popular (although early historical architectural treatises can be considered as such), which featured an analysis of its relationship with light as a component of the design. Among such works, the still-popular and topical *Architect's Data* by Ernst Neufert is a seminal work,⁸⁹ in which matters concerning sunlight are discussed in the chapters *Daylight* and *Lighting*. In them, Neufert listed essential information about the design of interiors with insolation that is beneficial to user health (typically following German architectural standards), while accounting for the intensity of vertical and horizontal sunlight. He proposed mathematical methods of calculating an interior's and massing's illumination parameters, based on proper coefficients and angular data for the position of the sun in various places along a latitude of 51.5 degrees north. For building interiors, he defined the principles of the size, shape and distribution of windows, the evenness of illumination, average horizontal illumination, shading, light

Dossier IA73002334, 2014, <http://www.patrimoine-aixlesbains.fr/?page=fiches&p=IA73002334> [accessed: 4.11.2017].

⁸⁷ S.E. Rasmussen, *Odczuwanie architektury* (1959), transl. B. Gadomska, Kraków 2015. Also: *Experiencing Architecture*, Cambridge 1959.

⁸⁸ M. Twarowski, *Słońce w architekturze...*, *op. cit.*

⁸⁹ E. Neufert, *Podręcznik projektowania...*, *op. cit.*

intensity; while for the massing: insolation intensity and time. Of note is Neufert's patent, which is based on using 'ceilings that are stepped downwards' and windows that are placed high, thanks to which sunlight can penetrate a building up to a depth of 60 m.⁹⁰ In this study, Neufert's patent became a significant argument in favour of the statement that the desire to achieve a specific light in an interior can significantly affect the design of the entire massing of a building (and not only the number and size of its windows), to which said interior belongs. This argument was reflected in the typology of methods of operating with sunlight in the interior.

The literature on perception frames the relationship under study differently, although they still do so in the context of the human body and psychology. Examples include Richard Langton Gregory's *Eye and Brain: The Psychology of Seeing*⁹¹ and *Sensation and Perception*⁹²—a group work edited by Richard Langton Gregory and Andrew Michael Colman. The author used them to obtain knowledge of the physiological mechanisms of human perception, particularly visual perception, and its relationship with psychological processes. Another work that cannot be omitted in this part of the literature is Johann Wolfgang Goethe's *Die Schriften zur Naturwissenschaft*.⁹³

A Pattern Language: Towns, Buildings, Construction by Christopher Alexander and other authors was an expression of increased interest in the psychophysical aspects of the relationship under study in the 1960s and 70s.⁹⁴ In this book, Alexander made multiple indications of the need to build a specific relationship between architecture and sunlight to obtain psychophysical states that are beneficial to humans. He presented how to adapt different interiors and specific places in those interiors to various human needs associated both with light overall and sunlight. Nine out of the 253 patterns listed by Alexander directly refer to designing sunlight in architectural and urban interiors: 107. *Wings of Light*, 128. *Indoor Sunlight*, 135. *Tapestry of Light and Dark*, 138. *Sleeping to the East*, 159. *Light on Two Sides of Every Room*, 199. *Sunny Counter*, 236. *Windows which Open Wide*, 237. *Solid Doors with Glass*, 238. *Filtered Light*. Pattern 252. *Pools of Light* can also be included in sunlight-related patterns, as it includes recommendations as to the proper operation with artificial light in an interior for meetings. The proposed pools of light can be used relatively easily and independently of the local time using artificial light, but they can also be used by appropriately applying sunlight accounting for the season of the year, time of day and weather.⁹⁵

The relationship between sunlight and architecture was incorporated into the design of religious architecture as formulated by Sister CR Maria Ewa Rosier-Siedlecka in her academic handbook *Posoborowa architektura sakralna. Aktualne problemy projektowania architektury kościelnej*.⁹⁶ The subject of light, which connects with matters of structure, function and expressivity of a church, is referenced throughout the entire work and was subjected to a detailed analysis in the chapter *Światło jako czynnik formowania architektury kościoła*.⁹⁷ Its author dis-

⁹⁰ *Ibidem*, p. 121.

⁹¹ R.L. Gregory, *Oko i mózg. Psychologia widzenia*, *op. cit.* Also: *Eye and Brain: The Psychology of Seeing*, New York–Toronto 1966.

⁹² R.L. Gregory, A.M. Colman (ed.), *Czucie i percepcja* (1995), transl. M. Siemiński, Poznań 2002. Also: *Sensation and Perception*, London–New York 1995.

⁹³ J.W. Goethe, *Die Schriften zur Naturwissenschaft*, Weimar 1947.

⁹⁴ Ch. Alexander (et al.), *Język wzorców...*, *op. cit.*

⁹⁵ The solar light rays obtained in this manner can be considered an expressive example of the impact of the relationship between sunlight and architecture on atmosphere, particularly as their weather- and time-dependent variability would make the atmosphere of the interior closer to human nature, which is fully subjected to transience.

⁹⁶ M.E. Rosier-Siedlecka, *Posoborowa architektura sakralna. Aktualne problemy projektowania architektury kościelnej*, Lublin 1980.

⁹⁷ *Ibidem*, p. 179–197.

tinguished nine of the most common ‘systems of operating with light in religious spaces’.⁹⁸ The first system is based on light that ‘enters directly through an opening or gap in the wall or ceiling, or indirect light, wherein the rays that enter are reflected’,⁹⁹ the other systems include: light differentiated by the surface (structure) of the walls through which it enters, light that enters a space fully or is excluded from it, light directed at the altar, light that enters the interior from all sides by semi-transparent walls, light with a specific direction, i.e. side light, light from the top and side or zenith light, light directed towards the altar by slips in the wall, light differentiated through the thickness of the window wall and the flaring of a window, light ‘smoothened’ by brise-soleil-like screens. Systems of operating with sunlight, as distinguished by Rosier-Siedlecka for religious interiors, can be generally referred to all interiors where one expects an atmosphere that corresponds to human spiritual needs. Rosier-Siedlecka’s study constitutes valuable analytical material for this work.

This study’s methodology, object scope, structure and the section on psychological conditions of the relationships under study were heavily influenced by Józef Krzysztof Lenartowicz’s book *O psychologii architektury. Próba inwentaryzacji badań, zakres przedmiotowy i wpływ na architekturę*,¹⁰⁰ particularly its eighth chapter, *Analiza cech środowiska budowlanego* (analysis of the characteristics of the built environment). In it, Lenartowicz analysed the objective and subjective properties of works of architecture and their impact on humans and their behaviour. He also presented and discussed mechanisms of the perception of works of architecture, which affected the definition of terms key to this work: the atmosphere of architecture, ambience and projection capacity.

The author also used architectural design handbooks that present the relationship of light and architecture in the aspect of its design methodology aimed at health, economic and visual benefits for users. Such handbooks appeared particularly often towards the end of the twentieth and at the start of the twenty-first century. Here we can list Norbert Lechner’s *Heating, cooling, lighting. Sustainable design methods for architects*,¹⁰¹ whose first edition was published in 1991. It is a source of definitions, analytical drawings and data displayed as measurement results. On their basis, Lechner discussed several strategies of illuminating interiors with sunlight, particularly by following the light intensity specific to the proper use of interiors. He used the term sunlight to describe the direct light of the sun, while using the term sky light to describe the light of the sun as reflected from the celestial sphere.

The handbooks *Sun, Wind & Light. Architectural design strategies* by G.Z. Brown and M. DeKay¹⁰² as well as *Daylighting. Natural Light in Architecture* by Derek Phillips¹⁰³ also influenced this work. In the latter, its author documented the relationship between sunlight and architecture in the aspect of 1) historical determinants; 2) environmental determinants along with an overview of the benefits to humans: how it changes and varies, the modelling of the interior, the orientation and insolation of the interior, the exposure of interior colours, the view from inside the interior and health; 3) the shape, structure and symbolic significance of windows; 4) energy; 5) light intensity calculations. Phillips also noted the currently observable increase in interest in the use of daylight in interiors. He also discussed various methods of operating with daylight in the interior so as to obtain functionally optimal indoor illumination, the view from an interior towards the outside, insolation, light and shadow effects and shading the interior using architectural tools in the interior and exterior, as well as the use of various

⁹⁸ *Ibidem*.

⁹⁹ *Ibidem*, p. 186.

¹⁰⁰ J.K. Lenartowicz, *O psychologii architektury. Próba inwentaryzacji badań, zakres przedmiotowy i wpływ na architekturę*, Kraków 1992.

¹⁰¹ N. Lechner, *Heating, cooling, lighting. Sustainable design methods for architects*, 4th ed., Hoboken 2014.

¹⁰² G.Z. Brown, M. DeKay, *Sun, Wind & Light. Architectural design strategies*, Hoboken 2001.

¹⁰³ D. Phillips, *Daylighting. Natural Light in Architecture*, preface by C. Gardner, Oxford 2004.

types of glass. The aspect of the atmosphere of architecture was not discussed by him per se, but it did appear in the section on the health-related aspect of light in the interior.

The study also references the book *Lumière et ambiance*,¹⁰⁴ by Roger Narboni, in which he focused on the dependence between light and the psychological and physical condition of man. Documenting this dependence and a lexicon of associated terms places this book high on the list of valuable knowledge sources, although it largely focuses on the design of illumination that is independent of the sun, using various types of lamps. As an active lamp-based illumination designer focusing on urban spaces, Narboni presented his designs and projects, which is why this book can be treated as a collection of case studies.

Lou Michel's *Light: The Shape of Space: Designing with Space and Light*¹⁰⁵ is a valuable book concerning the aspect of atmosphere, as it presents complementing arguments from the world of art and science, supplying analyses and practical advice on the design of spaces using light, the illumination of spaces and materials, colours, mutual interactions of illuminated spaces. The specific shape that space gains thanks to light was studied here in terms of the impressions that it produces in users on the basis of the reaction of the sense of sight to colour, brightness, texture and pattern. In the presented study, the aspect of atmosphere corresponds with the subject matter of the book by Anthony Tischhauser, Marc Major and Jonathan Speirs entitled *Made of Light. The Art of Light and Architecture*,¹⁰⁶ which focuses on the visual sensations and emotional reactions of man towards architecture and designing it with light. The authors discussed the subject matter of the control of light and shadow and interaction with the material and form of buildings. José Maria Cabeza Lainez's *Fundamentos de transferencia radiante luminosa o La verdadera naturaleza del factor de forma y sus modelos de cálculo*¹⁰⁷ is a handbook on light in the interior. In it, Cabeza presented his original mathematical and empirical method of measuring light intensity in various areas of interiors (using an interpretation of data readings from a measurement device he had developed). Cabeza's method can be applied in the design of the relationship between sunlight and the architecture of a specific interior (enabling the calculation of light parameters in a newly-designed interior based on its floor plans and cross-sections) and in the analysis of light intensity and distribution in an existing interior (enabling its valuation in terms of illumination).

The aspect of the relationship under study, as developed by the Biancani brothers during the interwar period and by Twarowski in the 1960s, was continued by Philippe Rahm, who presented his idea of meteorological architecture to the Polish reader in his essay *Architektura bezpośrednia* (featured in the second volume of the book *Co to jest architektura?*)¹⁰⁸ Rahm's designs and experiments, described and illustrated through drawings on the Philippe Rahm architectes studio website (www.philipperahm.com) were discussed in terms of the impact of human physiology on the relationship under study.

The physiological determinants of the perception of light, separately for sunlight and electrical light, are the subject of studies in contemporary medicine, as well as scientific literature. This work references the paper *Light in the Built Environment: Potential role of Circadian Disruption in Endocrine Disruption and Breast Cancer* by Richard Stevens and M.S. Rea,¹⁰⁹

¹⁰⁴ R. Narboni, *Lumière et ambiances*, Paris 2006.

¹⁰⁵ L. Michel, *Light: The Shape of Space: Designing with Space and Light*, New York 1995.

¹⁰⁶ A. Tischhauser, M. Major, J. Speirs, *Made of Light. The Art of Light and Architecture*, Basel 2005. The author would like to thank Professor Justyna Martyniuk-Pęczek who has been engaging in the study of light and architecture for a long time, for her suggestions concerning the literature.

¹⁰⁷ J.M. Cabeza Lainez, *Fundamentos de transferencia radiante luminosa o La verdadera naturaleza del factor de forma y sus modelos de cálculo*, Oleiros 2009.

¹⁰⁸ Ph. Rahm, *Architektura bezpośrednia*, transl. A.M. Urbańska, [in:] A. Budak (ed.), *Co to jest architektura? / What is Architecture?*, vol. 2, Kraków 2008, p. 541–565.

¹⁰⁹ Stevens R., Rea M.S., *Light in the Built Environment: Potential role of Circadian Disruption in Endocrine Disruption and Breast Cancer*, "Cancer Causes & Control" 2001, no. 12, p. 279–287.

which focuses on the model of sunlight as the main signal of human daily activity. The scientists accentuated the significance of the circadian rhythm in maintaining health, particularly endocrine functions. This work confirms the necessity of studying the application of a solar model of illuminating indoor spaces.

The literature concerning the design of architectural illumination using lamps also includes a discussion of general issues associated with light, as well as compositional ones. The book by Sage Russell, entitled *The Architecture of Light*,¹¹⁰ was highly significant to the study in this regard.

Sunlight in the interior was also analysed in the context of the work of outstanding architects who innovatively or exceedingly attractively designed the relationship between sunlight and architecture in their projects. In the more distant past, such architects included Andrea Palladio, Vincenzo Scamozzi, Étienne-Louis Boullée, Henri Labroust, or Antoni Gaudí, while more recent ones include: Le Corbusier, Alvar Aalto, Louis Isador Kahn, Carlo Scarpa,¹¹¹ Steven Holl, Jean Nouvel, or Peter Zumthor. This study referenced original writings in which the architects themselves explained their design ideas and projects (these include the treatises by Palladio and Scamozzi), as well as works by other authors.

Apart from Le Corbusier's texts, the classics of this type of literature from the twentieth century include the written statements by Louis I. Kahn. This work was based on the French translation of Kahn's texts from English in the book *L.I. Kahn: Silence et lumière, choin de conférences et d'entretiens 1955-1974*.¹¹² It also references Urs Büttiker's *Louis I. Kahn: Light and Space*¹¹³ and later selections of Kahn's texts: *Between Silence and Light*¹¹⁴ and *Light is the Theme: Louis I. Kahn and the Kimbell Art Museum*.¹¹⁵ Christian Deviller's paper *La lumière selon Kahn*¹¹⁶ also contributed essential content to the study. The titles of these publications clearly indicate the dependency between light and the atmosphere of architecture, which Kahn typically worded as the poetry of architecture. They are a source of essential arguments in this work.

Particular value was provided by texts that discuss technical matters concerning the relationship between light and architecture in the aspect of the atmosphere of architecture, particularly the writings of Peter Zumthor featured in the books: *Architektur Denken*,¹¹⁷ *Kunsthhaus Bregenz*,¹¹⁸ *Therme Vals*,¹¹⁹ and the five-volume work *Peter Zumthor. Réalisations et projets*.¹²⁰ Zumthor's reflections on the subject of light, as featured in *Architektur Denken*, in the chapter on light in the landscape, refer strictly to the aspect of the atmosphere of architecture. Zumthor devoted a separate book to atmosphere: *Atmospheres: Architectural Environments – Surrounding Objects*.¹²¹ In it, based on a personal experience of the interior, Zumthor identified the components of atmosphere and presented their specific forms. Zumthor's reflections, particularly his books on atmospheres, were referenced multiple times in this study, making them the essential criterion of evaluating light in the interior in the aspect of the atmosphere of architecture.

¹¹⁰ S. Russell, *The Architecture of Light*, La Jolla 2012.

¹¹¹ E.g. S. Los, *Carlo Scarpa 1906–1978. Architetto Poeta*, Köln 2009.

¹¹² L.I. Kahn, *Silence et Lumière*, Paris 1996.

¹¹³ U. Büttiker, *Louis I. Kahn: Light and Space*, New York 1994.

¹¹⁴ L.I. Kahn, J. Lobell, *Between Silence and Light*, Boston 2008.

¹¹⁵ L.I. Kahn, N.E. Johnson (ed.), *Light is the Theme: Louis I. Kahn and Kimbel Art Museum*, Yale 2012.

¹¹⁶ C. Devillers, *La lumière selon Kahn*, "L'architecture d'aujourd'hui" April 1991, no. 274, p. 150–152.

¹¹⁷ P. Zumthor, *Myślenie architektury*, transl. A. Kożuch, Kraków 2010. Also: *Thinking Architecture*, Basel–Boston–Berlin 1988.

¹¹⁸ P. Zumthor, *Kunsthhaus Bregenz*, *op. cit.*

¹¹⁹ P. Zumthor, *Therme Vals*, Gollion 2007.

¹²⁰ P. Zumthor, T. Durisch (ed.), *Peter Zumthor. Réalisations et projets*, vol. 1–5, Zurich 2014.

¹²¹ P. Zumthor, *Atmospheres: Architectural Environments – Surrounding Objects*, Basel–Boston–Berlin 2006.

Likewise valuable to this work are Juhani Pallasmaa's discussions on architecture, particularly his book *The Eyes of the Skin: Architecture and the Senses*,¹²² in which he described and analysed the significant role of the perception of the atmosphere of architecture in experiencing reality. Criticising oculo-centric culture, he demonstrated the complexity and cognitive potential of the process of seeing, which is much greater than the one used in mass image culture. Pallasmaa explained what focused and peripheral vision are based on and their consequences concerning the experience of an interior. He cited arguments about the role of peripheral vision and the coordination between various senses in experiencing the atmosphere of architecture.

A separate section of the literature, in which the relationship under study appeared as an essential subject or as core content, is formed by publications that focus on singular works of architecture. Francesco Venezia's *La Torre d'ombra o l'architettura delle apparenze reali*¹²³ is of particular importance here. It was devoted to the detailed analysis of sunlight in Le Corbusier's Tower of Shadows designed for the Capitol in Chandigarh, and built in the 1980s by the Le Corbusier Foundation. In Venezia's presentation, light in architecture has a poetic, musical and mathematical dimension, extracted from the expressivity of Le Corbusier's architecture. When using the definition of architecture of the Tower of Shadows' designer, Venezia contributed arguments for evaluating the relationship under study in the aspect of the atmosphere of architecture.

Among books about singular works, the work *Santuario dell'Amore Misericordioso Collevaenza*¹²⁴ is also highly significant. It is a guide to the architecture of its titular sanctuary. The analysis of the design and construction of the Sanctuary of Merciful Love in Italy, along with the drawings and explanations provided by the architect—Julio Lafuente, provided a basis for acknowledging the interior of the church of Collevaenza as a suggestive case of the relationship between light and architecture, design so as to obtain a specific atmosphere of the interior.

The study also relied on the excellent album by Lucien Hervé *Architecture of Truth*¹²⁵ which features black and white photographs of the monastery in Le Thoronet, a preface by Le Corbusier and an epilogue by John Pawson. Hervé's photographs are a testimony to the existence of an intense atmosphere of architecture in the interiors of this monastery, and Le Corbusier's and Pawson's commentary directly concern the relationship between light and architecture in the aspect of atmosphere. Another album that was valuable to this study was *Venezia* with a text by Carlo Della Corte and photographs by Elio Ciol.¹²⁶

Manuela Incerti's *Il disegno della luce nell'architettura cistercense*¹²⁷ is an exceptional item on this study's literature list, as it combines the beauty of precise drawings and astronomical calculations with an in-depth scientific analysis concerning the role of solar geometry in the organisation of the liturgical calendar and plant cultivation in Cistercian monasteries. This study pertains to the architecture of times when the hour was not the one-twenty-fourth part of the day and night, nor was it the twelfth part of the day. She analyses white and rational light, which is different to Brother Suger's *lux continua*, while also describing Cistercian architecture as a system in which light for seeing corresponded to light applied to the circadian rhythm, while those enabled metaphysical illumination. The conditions of life without electric lighting, without mechanical clocks, with the organisation of life around the daily and yearly solar cycle, cannot be feasibly restored today. Nevertheless, the atmosphere of architecture constructed as a solar instrument brings them back after a fashion.

¹²² J. Pallasmaa, *Oczy skóry...*, *op. cit.*

¹²³ F. Venezia, *La torre d'ombra o l'architettura...*, *op. cit.*

¹²⁴ *Collevaenza. Santuario dell'Amore Misericordioso*, guidebook, Peruggia 2000.

¹²⁵ L. Hervé, *Architecture of Truth*, London 2001.

¹²⁶ *Venezia*, tex: C. Della Corte, photographs: E. Ciol, Milano 1995.

¹²⁷ M. Incerti, *Il disegno Della luce nell'architettura cistercense. Allineamenti astronomici nelle abbazie di Chiaravalle della Colomba, Fontevivo e San Martino de' Bocci*, Firenze 1999.

The author also used the album edition of *L'Architecture lumineuse au XXe siècle, Luminous architecture in the 20th century*.¹²⁸

The author also employed the discussion of German philosopher Gernot Böhme, whose reflection oscillated on the border of philosophy, the history of science, the philosophy of nature, aesthetics and philosophical anthropology. Böhme, who dealt with atmospheres as quasi-objective experiential qualities of the human environment, also focused on the atmosphere of architecture, which was expressed in the Polish translation of the book *Filozofia i estetyka przyrody w dobie kryzysu środowiska naturalnego*,¹²⁹ the German *Atmosphäre: Essays zur neuen Ästhetik*¹³⁰ and *Architektur und Atmosphäre*,¹³¹ and the English-language *Atmospheric Architectures: The Aesthetics of Felt Spaces*,¹³² and in papers, especially in *The art of the stage set as a paradigm for an aesthetics of atmospheres*.¹³³

Böhme's philosophical reflection on atmosphere had had a considerable impact on the selection of the subject of this work and on acknowledging the atmosphere of architecture as the subject of academic research. The last of the books listed, *Atmospheric Architectures...*, which is an original selection of earlier texts by Böhme on the dependency between atmosphere and architecture, confirms the grounded presence of the issue of atmosphere in contemporary aesthetics and its section concerns light and space, refers directly to the relationships between light, atmosphere and space.

Here one should also list the key significance of Krystyna Wilkoszewska's study *Uwagi na marginesie książki Gernota Böhme'go „Filozofia i estetyka przyrody”*,¹³⁴ in which Wilkoszewska commented on Böhme's concepts of atmospheres and framed them in contemporary philosophical discourse. This study also references texts concerning aesthetics featured in the work edited by Wilkoszewska entitled *Estetyka czterech żywiołów: ziemia, woda, ogień, powietrze*.¹³⁵ The study also referenced the works of one of the creators of the theory of atmosphere, Tonino Griffero. These were, among others, the books *Quasi-things*¹³⁶ and *Places, affordances, atmospheres: A pathic aesthetics*¹³⁷ and papers, particularly *Something more. Atmospheres and pathic aesthetics*.¹³⁸

Contemporary group works were also significant to the study of atmosphere as an aspect of the relationship between sunlight and architecture. These included *Architecture and Atmosphere* (texts: Gernot Böhme, Juhani Pallasmaa, Tonino Griffero, Jean-Paula Thibaud),¹³⁹ *Architectural Atmospheres. On the Experience and Politics of Architecture* (ed. Christian Borch, texts: Gernot Böhme, Christian Borch, Olafur Eliasson, Juhani Pallasmaa).¹⁴⁰ Their authors highlighted the

¹²⁸ É. Monin, N. Simonnot (eds.), *L'Architecture lumineuse au XXe siècle, Luminous architecture in the 20th century*, Gand 2012.

¹²⁹ G. Böhme, *Filozofia i estetyka przyrody w dobie kryzysu...*, op. cit.

¹³⁰ G. Böhme, *Atmosphäre: Essays zur neuen Ästhetik*, Frankfurt/Main 1995.

¹³¹ G. Böhme, *Architektur und Atmosphäre*, Paderborn 2013.

¹³² G. Böhme, *Atmospheric Architectures. The Aesthetics of Felt Spaces*, ed. and transl. A.-Ch. Engels-Schwarzpaul, Bloomsbury 2017.

¹³³ G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres*, "Ambiances. International Journal of Sensory Environment, Architecture and Urban Space" 2013 [online] <https://journals.openedition.org/ambiances/315> [accessed: March 2020].

¹³⁴ K. Wilkoszewska, *Uwagi na marginesie...*, op. cit.

¹³⁵ K. Wilkoszewska (ed.), *Estetyka czterech żywiołów...*, op. cit.

¹³⁶ T. Griffero, *Quasi-things*, Albany 2017.

¹³⁷ T. Griffero, *Places, affordances, atmospheres: A pathic aesthetics*, London-New York 2019.

¹³⁸ T. Griffero, *Something more. Atmospheres and pathic aesthetics*, [in:] T. Griffero & G. Moretti (eds.), *Atmosphere/Atmospheres: Testing a new paradigm*, Milan 2018, p. 75–89.

¹³⁹ Ph. Tidwell (ed.), *Architecture and atmosphere*, Helsinki 2014.

¹⁴⁰ Ch. Borch (ed.), *Architectural Atmospheres. On the Experience and Politics of Architecture* (texts: G. Böhme, Ch. Borch, O. Eliasson, J. Pallasmaa), Besel 2014.

significance of atmosphere in the human experience of space and architecture, pointing to atmosphere as an essential objective of the cooperation of architects and developers and a subject of the education of architecture students. The contribution of light to creating atmosphere was treated by them rather superficially, without delving into specific dependencies.

Descriptions and evaluations of how humans experience their surroundings were critical to the study. They are placed between phenomenology and the psychology of perception, constituting a basis for the valuation of architectural and urban interiors in terms of their atmosphere. The starting point for this portion of the literature is the paper by the creator of the term phenomenography, Ference Marton: *Phenomenography – Describing conceptions of the world around us*.¹⁴¹ The description of the relationship between light and architecture proposed in the study draws on arguments from phenomenographic practices, which assume the use of individual phenomenological experience. Here, the study made use of contemporary works, especially the paper *Phenomenographies: describing the plurality of atmospheric worlds* by Federico De Matteis (an architect), Mikkel Bille (an anthropologist and sociologist), Tonino Griffero (a philosopher and scholar of aesthetics, one of the creators of the theory of atmosphere) and Andrea Jelić (an architect)¹⁴² This subject matter was developed in De Matteis' book *Vita nello spazio: Sull'esperienza affettiva dell'architettura*.¹⁴³ In this group of the literature, one should also mention published research on the description and valuation of the experience of atmosphere, particularly valuable research combining neuroscience and architecture. In this regard, this study was significantly influenced by *Atmospheres: Feeling architecture by emotions*¹⁴⁴ by Elisabetha Canepa and her team. A different phenomenography was described by Sumartojo and Pink in their book *Atmospheres and the experiential world: Theory and methods*¹⁴⁵ and in the multi-author paper *Atmospheres in Urban Light*.¹⁴⁶ Significant references were made to the work of Klaske Havik, which documented the suitability of literary phenomenographies in describing the atmosphere of architecture.¹⁴⁷

The relationship under study is featured numerous times in publications on the history of art and literature. The greatest impact on this study was made by works whose content, language and poetics had attractively and suggestively depicted the relationship under study in the aspect of the atmosphere of architecture: Ewa Bieńkowska's *Co mówią kamienie Wenecji*,¹⁴⁸ Joseph Brodsky's *Watermark*¹⁴⁹ and Jun'ichirō Tanizaki's *In'rei Raisan*, translated into Polish as *Pochwała cienia* (and English as *In Praise of Shadows*).¹⁵⁰ These works present subjects that

¹⁴¹ F. Marton, *Phenomenography – Describing conceptions of the world around us*, "Instructional Science" 1981, vol. 10, p. 177–200.

¹⁴² F. De Matteis, M. Bille, T. Griffero and A. Jelić, *Phenomenographies: describing the plurality of atmospheric worlds*, "Ambiances. International Journal of Sensory Environment, Architecture and Urban Space" 2019 [online] <http://journals.openedition.org/ambiances/2526> DOI: <https://doi.org/10.4000/ambiances.2526> [accessed: March 2020].

¹⁴³ F. De Matteis, *Vita nello spazio: Sull'esperienza affettiva dell'architettura*. Milan 2019.

¹⁴⁴ E. Canepa, V. Scelsi, A. Fassio, L. Avanzino, G. Lagravinese and C. Chiorri, *Atmospheres: Feeling architecture by emotions*, *op. cit.*

¹⁴⁵ Sh. Sumartojo & S. Pink, *Atmospheres and the experiential world: Theory and methods*, London–New York 2019.

¹⁴⁶ Sh. Sumartojo, T. Edensor & S. Pink, *Atmospheres in Urban Light*, "Ambiances. International Journal of Sensory Environment, Architecture and Urban Space" 2019 [online] <https://journals.openedition.org/ambiances/2586> [accessed: April 2020].

¹⁴⁷ K. Havik, *TerriStories. Literary Tools for Capturing Atmosphere in Architectural Pedagogy*, "Ambiances. International Journal of Sensory Environment, Architecture and Urban Space" 2019 [online] <https://journals.openedition.org/ambiances/2787> [accessed: March 2020].

¹⁴⁸ E. Bieńkowska, *Co mówią kamienie Wenecji*, Gdańsk 2000.

¹⁴⁹ J. Brodsky, *Znak wodny*, transl. S. Barańczak, Kraków 1993. Also: *Watermark*, New York 1992.

¹⁵⁰ J. Tanizaki, *Pochwała cienia* (1933), transl. H. Lipszyc [in:] K. Wilkoszewska (ed.), *Estetyka japońska. Estetyka życia i piękno umierania*, anthology, vol. III, Kraków 2005. The book, which was first published in Japan

display the relationship between architecture and sunlight in atmospheric, literary descriptions. They are valuable to the study as they contribute considerable technical information on the physical structure of the relationship under study and, most importantly, the atmosphere of architecture (which is a common theme of literary and poetic works and requires masterful command of language). Of particular significance to the work is Tanizaki's *In Praise of Shadows*, as it is an in-depth study of light in a traditional Japanese interior, analysed in the aspect of atmosphere. Setting the West's tradition of bright interiors against the dark interiors of Asia, Tanizaki pointed to the role of tradition as a factor that considerably affects the preferences as to sunlight in the interior. It is for this reason that Tanizaki's writings were used in the study of cultural determinants of the relationship under study. Tanizaki masterfully described the skilfulness of composing shadows that delicately differ in intensity and temperature and thus create a unique atmosphere in Japanese interiors.

This section of the literature also includes Paulina Tendera's monograph *Od filozofii światła do sztuki światła*¹⁵¹ which is a strictly academic work. It presents the subject matter of light in philosophy and art in a holistic manner, i.e. 'It is an attempt at a philosophical and artistic description of the phenomenon of light from the perspective of the Hegelian philosophy of history with a particular emphasis on their Platonic roots (claritas)'.¹⁵² This frame of the subject allowed Tendera to point to numerous dependencies between specific philosophies and trends in art or specific works of art, and perform an analysis of selected artistic phenomena among which were the mosaic and stained glass. This work was used in the study primarily to formulate the cultural conditions of the relationship under study.

A poetic approach to the dependency between light, architecture and atmosphere was proposed by the authors of *Traité de la lumière*: Libero Zuppiroli, Marie-Noëlle Bussac, Christiane Grimm,¹⁵³ and Zuppiroli and Bussac in their book *Traité du couleurs*.¹⁵⁴ This work references the book by Mikkel Bille *Homely atmospheres and Lighting Technologies in Denmark: Living with Light*¹⁵⁵ which concerns the atmosphere built with light in architectural and urban interiors of Denmark. This publication, although it refers to light which is typically described as artificial, discusses atmosphere from the perspective of the latest studies and provides important arguments for this work.

Anna Franta's academic report on the impact of sunlight on the directing of public spaces in the book *Reżyseria przestrzeni: o doskonaleniu przestrzeni publicznej miasta*¹⁵⁶ was also valuable to this study. The problem of atmosphere in the context of the identity and culture of the city, as described in the paper *Kultura miasta / The Culture of the City*¹⁵⁷ also contributed important arguments as to the conditions of creating and perceiving the relationship under study.

Studies on light in architectural and urban design conducted by Justyna Martyniuk-Pęczek were highly significant to this study. Here, the author referenced *Światła miasta*¹⁵⁸ which concerns electrical light in urban interiors, but also in the context of atmosphere, as well as advice and suggestions the author was given in her post-doctoral review.

in 1933, was translated into numerous languages: French (*Éloge de l'ombre*, 1977), English (*In Praise of Shadows*, 1977), Thai (1985), German (1987), Arabic (1988), Greek (1992), Spanish (1994), Finnish (1997), Polish (2005), Chinese (2007).

¹⁵¹ P. Tendera, *Od filozofii światła do sztuki światła*, Monografie, vol. 3, Kraków 2014.

¹⁵² *Ibidem*, p. 200.

¹⁵³ L. Zuppiroli, M.-N. Bussac, *Traité de la lumière*, Lausanne 2009.

¹⁵⁴ L. Zuppiroli, M.-N. Bussac, *Traité du couleurs*, Lausanne 2011.

¹⁵⁵ M. Bille, *Homely atmospheres and Lighting Technologies in Denmark: Living with Light*, Bloomsbury 2019.

¹⁵⁶ A. Franta, *Reżyseria przestrzeni: o doskonaleniu przestrzeni publicznej miasta*, Kraków 2004.

¹⁵⁷ A. Franta, *Kultura miasta / The Culture of the City*, "Czasopismo Techniczne" 2008, p. 167–176.

¹⁵⁸ J. Martyniuk-Pęczek, *Światła miasta*, Wrocław 2014.

The state of research was supplemented by doctoral dissertations concerning architecture and light. Of particular significance here is the dissertation by Katarzyna Jucha entitled *Architektura światła i cienia*,¹⁵⁹ defended at the Faculty of Architecture of the Cracow University of Technology, in and whose author attempted to structure various methods of conducting the game of light and shadow on architectural massings. This work proposed connecting categories formulated on the basis of visual effects on architectural massings with the symbolism and cultural significance of light. The matters of building the relationship between the interior and sunlight in the aspect of the atmosphere of architecture, which were not within the scope of this dissertation, were featured in it only sporadically. Of greater significance to this study was Jucha's original take on the matter of light and shadow in architecture as a formal game, with an analysis of its principles and an overview of examples of its occurrence.

The subject of the relationship between sunlight and architecture was also discussed by Paweł Żuk in his doctoral dissertation entitled *Rola oświetlenia naturalnego w kształtowaniu formy architektonicznej współczesnych muzeów*,¹⁶⁰ defended at the Faculty of Architecture of the Cracow University of Technology. The analysis of forty museum buildings, in which the author identified architectural elements used to illuminate exhibition spaces with natural light and that also affected the architectural forms of these buildings, was especially significant.

This study also references the doctoral dissertation of Hubert Schneider, entitled *Minimalizm jako metoda twórcza w architekturze współczesnej na wybranych przykładach z lat 1990–2005*.¹⁶¹

A journalist take on the relationship between architecture and light was presented in the group work *Qu'est-ce que la Lumière pour les architectes?*¹⁶² edited by Alice Dubet, which features short essays by 51 architects. In these essays, their authors answer the question: what is architecture to them/what should light be like? Here we can find short descriptions of specific architectural projects with light in their interiors and their significance to atmosphere, which is why this work also provided arguments for use in this study. In terms of the role of light in creating the atmosphere of the interior, the author also referenced Chris van Uffelen's *Lumière & architecture*.¹⁶³

Journals and papers entirely devoted to the relationship and its aspect under study were also important. The previously mentioned paper by Ann Marie Borys *Lume di Lume. A Theory of Light and Its Effects* played an immense role here, as it was devoted to a detailed analysis of Renaissance ideas of light in architecture as included in famous Renaissance treatises and texts, and which also appeared in architectural practice. Borys' analysis of light in Vincenzo Scamozzi's treatise and work was particularly valuable.

Scientific papers detailing achievements in physics and the perception of daylight published by the community of the University of Lausanne and focused around Marilyne Andersen formed a key contribution to the previous study. Among these several articles there was *Daylight patterns as a means to influence the spatial ambience: a preliminary study*.¹⁶⁴ The description and valuation of perceptual experience associated with a specific tool of introducing and modifying light in the interior became an argument for the study of atmosphere produced by light.

¹⁵⁹ K. Jucha, *Architektura światła i cienia*, doctoral dissertation, Kraków 2004.

¹⁶⁰ P. Żuk, *Rola oświetlenia naturalnego w kształtowaniu formy architektonicznej współczesnych muzeów*, doctoral dissertation, Kraków 2010.

¹⁶¹ H. Schneider, *Minimalizm jako metoda twórcza w architekturze współczesnej na wybranych przykładach z lat 1990–2005*, doctoral dissertation, Gdańsk 2009.

¹⁶² A. Dubet (ed.), *Qu'est-ce que la lumière pour les architectes?*, Paris 2013.

¹⁶³ Ch. van Uffelen, *Lumière & architecture*, Paris 2012.

¹⁶⁴ K. Chamilothoni, J. Wienold, M. Andersen, *Daylight patterns as a means to influence the spatial ambience: a preliminary study*, [in:] N. Rémy, N. Tixier (eds.), *Ambiances, tomorrow. Proceedings of the 3rd International Congress on Ambiances*, September 2016, Volos 2016, p. 117–122.

In the field of light perception, Peter Robert Boyce's *Human Factors in Lighting*¹⁶⁵ had a considerably influence on this study. It discusses the ways in which humans interact with lighting, including the capacity to perceive and perform associated tasks, as well as experience comfort and safety. Although the study was aimed at the use of electrical lighting in interiors that is proper to humans, the issues of perception remain universal.

Out of Polish-language journals, the issue of *Autoportret* (a quarterly published by the Lesser Poland Institute of Culture) entitled *Przestrzenie światła, światło w przestrzeni*¹⁶⁶ and which was entirely devoted to light, was valuable to this study. This issue featured fifteen essays on light, which focused on 'its selected spectra: symbolism, the relationship with dark and shadow, identity with intellect and rationality, identification with truth, with the Godhead',¹⁶⁷ as described by Dorota Leśniak-Rychlak, the lead editor of *Autoportret*, in the introduction to the issue. It directly referenced Olaf Müller's essay *Goethe i zasady świata barw*¹⁶⁸ and the author's own essay entitled *Węzeł krajobrazu*¹⁶⁹ which pertained to two perspectives of light in Vincenzo Scamozzi's La Rocca Pisana villa in Vicenza. The issue of *Autoportret* entitled *Zmysły/percepcja*,¹⁷⁰ from which the author referenced, among others, J. Pallasmaa's *Krajobrazy zmysłów, dotykane świata przez architekturę*,¹⁷¹ which was likewise of great importance. Among the numerous essays and papers on the chosen aspect of the relationship under study, Piotr Winskowski's works, including *Światło północy, światło południa. Light of the North, light of the South*,¹⁷² were a considerable influence. Konrad Kucza-Kuczyński's papers on the dependency between beauty and architecture and the characteristics of the architecture of the sacred, e.g. *Piękna architektura – czy piękno architektury, czyli: czytając Stróżewskiego*,¹⁷³ were also of considerable significance to the subject matter of the atmosphere of architecture. The author also referenced Małgorzata Rogińska-Niesłuchowska's paper *Architektura i światło*,¹⁷⁴ which discusses various forms of treating sunlight in selected architectural projects and styles. Jan Rabiej's paper *Światło i kolor – uniwersalne walory architektury sakralnej*¹⁷⁵ not only enriched the source material of the work, but also attested to the contemporary renaissance of interest in sunlight as an actual material of an architectural interior, with a specific ambience and symbolism. This reflection points to sunlight as an element of the atmosphere of religious interiors, which is not devalued in a time of stylistic change and whose role is currently increasing, as it is often the sole vehicle of religious symbolism and content. Mateusz Gyurkovich, in his paper *Rola światła w architekturze na przykładzie ikonicznych obiektów kultury. Wybrane przykłady*,¹⁷⁶ presented the role of sunlight in creating unique and distinct cultural buildings.

¹⁶⁵ P.R. Boyce, *Human Factors in Lighting*, Boca Raton 2014.

¹⁶⁶ "Autoportret" 2008/2009, no. 4 (25) /1 (26).

¹⁶⁷ D. Leśniak-Rychlak, "Autoportret" 2008/2009, no. 4 (25) /1 (26), p. 2.

¹⁶⁸ O. Müller, *Goethe i zasady świata barw...*, *op. cit.*, p. 5–14.

¹⁶⁹ B. Stec, *Węzeł krajobrazu*, "Autoportret" 2008/2009, no. 4 (25) /1 (26), p. 55–59.

¹⁷⁰ "Autoportret" 2011, no. 3 (35).

¹⁷¹ J. Pallasmaa, *Krajobrazy zmysłów. Dotykane świata przez architekturę*, transl. M. Choptiany, "Autoportret" 2011, no. 3 (35), p. 4–11.

¹⁷² P. Winskowski, *Światło północy, światło południa. Light of the North, light of the South*, "grafia" 2002, no. 2 (2), p. 18.

¹⁷³ K. Kucza-Kuczyński, *Piękna architektura – czy piękno architektury, czyli: czytając Stróżewskiego*, "Czasopismo Techniczne" 2007, p. 83–86.

¹⁷⁴ M. Rogińska-Niesłuchowska, *Architektura i światło*, "Czasopismo Techniczne" 2010, p. 323–327, b. 7-A/2, <http://yadda.icm.edu.pl/baztech/element/bwmeta1.element.baztecharticleBGPK-3576-3578> [accessed: November 2017].

¹⁷⁵ J. Rabiej, *Światło i kolor – uniwersalne walory architektury sakralnej*, "Studia Teologiczno-Historyczne Śląska Opolskiego" 2015, no. 35, p. 423–432, <http://www.rtso.uni.opole.pl/index.php/artykuly/item/swiatlo-i-kolor-uniwersalne-walory-architektury-sakralnej> [accessed: May–November 2017].

¹⁷⁶ M. Gyurkovich, *Rola światła w architekturze na przykładzie ikonicznych obiektów kultury. Wybrane przykłady*, "Środowisko Mieszaniowe. Housing Environment" 2017, no. 18, p. 95–105, [http://www.ejournals.eu/housingenvironment/2017/18\(2017\)/art/9185](http://www.ejournals.eu/housingenvironment/2017/18(2017)/art/9185) [accessed: November 2017].

These papers provided a solid foundation for the conviction that motivated this study: that light and shadow are used as an ornament that enriches the form and the interior that surround man in contemporary architecture now more than ever before. The author also referenced her own essay *O świetle Wenecji*,¹⁷⁷ which was published in one of the academic and artistic bulletins of the Faculty of Painting of the AFA in Krakow.

The works of Henry Plummer, an American architect, writer and photographer, and an architecture professor at the universities of Illinois and Urbana-Champaign, were of particular significance to this work. The relationship between sunlight and architecture was a subject of many years of academic study by Plummer, as well as the subject of his work as a photographer, as expressed in the books *Light in Japanese Architecture*,¹⁷⁸ *The Architecture of Natural Light*,¹⁷⁹ *Nordic Light: Modern Scandinavian Architecture*,¹⁸⁰ *Cosmos of Light. The Sacred Architecture of Le Corbusier*.¹⁸¹ These works introduce the reader to the subject matter of light and architecture through unique photographs and poetic descriptions which bring to mind attractive albums, yet also contain in-depth studies of operating with sunlight in interiors, formulated in the aspect of their visual, painterly and spatial outcomes. These results largely pertain to the atmosphere of architecture and became one of the fundamental references for this work. Various forms of the relationship between architecture and sunlight were structured by Plummer according to his own categories. In *The Architecture of Natural Light*, he distinguished seven categories of relations between sunlight and architecture, which, to him, constructed 'metaphysical space: 1. Evanescence. Orchestration of light to mutate throughout time; 2. Procession. Choreography of light for the moving eye; 3. Veils of glass. Refraction of light in a diaphanous film; 4. Atomization. Sifting of light through a porous screen; 5. Canalization. Channelling of the light through a hollow mass; 6. Atmospheric silence. Suffusion of light with a unified mood; 7. Luminescence. Materialization of light in physical matter'.¹⁸² In *Nordic Light: Modern Scandinavian Architecture*, he distinguished nine categories of relationships between architecture and natural light: 1. Whiteness, 2. Rhythm, 3. Journey, 4. Carving, 5. Forest, 6. Transiency, 7. Tranquillity, 8. Diffusion, 9. Darkness. Plummer's categories were referenced in the formulation of architectural methods in operating sunlight in the interior and their outcomes, which were evaluated in the aspect of atmosphere. Plummer also analysed atmosphere in his paper *Light and the Soul of Architecture*,¹⁸³ presenting a study of the impact strength of the relationship between architecture and light on human psychological and spiritual states. When discussing the traditional buildings of small towns of the Mediterranean region (built by local craftsmen), the interiors of the Le Thoronet monastery, the cathedral in Chartres and several buildings designed by Le Corbusier, Louis Kahn and Alvar Aalto, Plummer tried to prove that sunlight is in fact the 'soul of architecture'.

This work also references studies by Mohamed Boubekeri (conducted at the Illinois School of Architecture), concerning daylighting design and published in his book *Daylighting Design. Planning Strategies and Best Practice Solutions*.¹⁸⁴ Boubekri framed the subject of the relationship between architecture and sunlight in the aspect of economic performance and the health-related consequences of various strategies and systems of introducing light into the

¹⁷⁷ B. Stec, *O świetle Wenecji*, "Zeszyty Naukowo-Artystyczne. Wydział Malarstwa Akademii Sztuk Pięknych w Krakowie" 2005, z. 6, p. 163–178.

¹⁷⁸ H. Plummer, *Light in Japanese Architecture*, Architecture and Urbanism, Extra Edition June, Tokyo 1995.

¹⁷⁹ H. Plummer, *The Architecture of Natural Light*, London 2012.

¹⁸⁰ H. Plummer, *Nordic Light, Modern Scandinavian Architecture*, London 2014.

¹⁸¹ H. Plummer, *Cosmos of Light...*, *op. cit.*

¹⁸² Section names, H. Plummer, *The Architecture of Natural Light...*, *op. cit.*

¹⁸³ H. Plummer, *Light and the Soul of Architecture*, "Oz Journal of the College of Architecture, Planning & Design Kansas State University" 1992, vol. 14.

¹⁸⁴ M. Boubekri, *Daylighting Design. Planning Strategies and Best Practice Solutions*, Basel 2014.

interior. He divided the manners of introducing light into the interiors into two types of systems: sidelighting systems, through which the interior receives dynamic light, and toplighting systems, through which the interior receives static light. Boubekri discussed these systems in detail primarily in terms of obtaining optimal light intensities for specific interior functions. The matters concerning the human perception of light and its role as an object of contemplation were discussed very briefly (in the introduction). This study primarily references the categorisation of daylighting systems, i.e. the division of sunlight into side, dynamic light and top, static light.

Similarly, Fuller Moore's book *Concepts and Practice of Architectural Daylighting*¹⁸⁵ presents contemporary strategies of daylighting in buildings based on proper solar energy management to heat, cool or illuminate interiors. The subject of sunlight was presented here not only in the aspect of energy efficiency, but also user health and comfort.

This study also makes multiple references to Stanisława Wehle-Strzelecka's *Energia słońca w kształtowaniu środowiska mieszkaniowego – ewolucja koncepcji na przestrzeni wieków*,¹⁸⁶ in which the author presented the findings of her research on the use of solar radiation in architecture and urban planning from ancient times to the present in European and American culture. Although this book is oriented towards energy performance and methods of accumulating heat or cooling various interior spaces, it also discusses their associated issues of sunlight in the interior, particularly direct sunlight, its dependence on local climate and the purpose of the interior. Wehle-Strzelecka's analysis of historical solutions was highly valuable here. Specifically, the author referenced it in discussing the dependencies between light and human physiology and the resultant assessment of the atmosphere of the interior (solar energy is a significant factor in creating interior atmosphere and is linked with the well-being of the user).

The work also makes heavy use of *Słownik psychologii architektury dla studiujących architekturę* by J. K. Lenartowicz.¹⁸⁷ The definition of architecture and a series of other definitions which are key to this work were sourced from this dictionary.

Piotr Patoczka's *Monitoring ochrony i kształtowania krajobrazu w Bieszczadzkim Parku Narodowym i jego otulinie*,¹⁸⁸ was also of great significance in determining the notion of the interior, which describes the concept of the interior as used in the Krakow landscape school.

The scientific works *Wybrane zagadnienia z fizyki* by A.S. Gajewski¹⁸⁹ and *Feynmana wykłady z fizyki. Optyka, termodynamika, fale* (volume 1.2) by R.P. Feynman, R.B. Leighton and M. Sands¹⁹⁰ were critical in referencing physical terms associated with sunlight. The analysis of astronomical determinants of sunlight on Earth was also based on the academic handbook *Astronomia w geografii* by Jan Mietelski, which was written already in the 1970s and received multiple revised re-editions.¹⁹¹

The state of research indicates that the subject matter under study has been discussed in the literature since ancient times, both in the oldest (Vitruvius) and the latest works (Boubekri, Böhme). In recent years, authors have been developing technical aspects of the subject, concerning new technological potential, the economics of design and sustainable development on the one hand, while on the other—subjects that pertain to psychosomatic and spiritual human needs. This work is aligned with the latter. The state of research also indicates a renaissance of interest in the subject matter of the dependency between sunlight and architecture among the Polish academic

¹⁸⁵ F. Moore, *Concepts and Practice of Architectural Daylighting*, Hoboken 1991.

¹⁸⁶ S. Wehle-Strzelecka, *Energia słońca w kształtowaniu środowiska mieszkaniowego – ewolucja koncepcji na przestrzeni wieków*, Kraków 2014.

¹⁸⁷ J.K. Lenartowicz, *Słownik psychologii architektury...*, *op. cit.*

¹⁸⁸ P. Patoczka, *Monitoring ochrony i kształtowania krajobrazu...*, *op. cit.*

¹⁸⁹ A.S. Gajewski, *Wybrane zagadnienia z fizyki...*, *op. cit.*

¹⁹⁰ R.P. Feynman, R.B. Leighton, M. Sands, *Feynmana wykłady z fizyki...*, *op. cit.*

¹⁹¹ J. Mietelski, *Astronomia w geografii...*, *op. cit.*

community. Polish literature laid the groundwork for motivating the author to take up this study and formed a broad field of reference for it.

The presented state of research was used to the greatest extent in the analysis of determinants of the relationship between sunlight and architecture and the atmosphere of architecture. Concerning the formulation of the typology of methods of operating with sunlight in the interior, the works which characterised various types of sunlight depending on the direction of its introduction into the interior were critical [Vitruvius (1956), Scamozzi (1615), Twarowski (1962), Rasmussen (1955, 2015), Plummer (2012, 2014), Phillips (2004), Borys (2002), Boubekri (2014)] and those which listed architectural tools used to introduce and modify light in the interior [Scamozzi (1615), Twarowski (1962), Rasmussen (1955, 2015), Plummer (1999, 2006, 2012, 2014), Phillips (2004), Boubekri (2014)]. The works of Rasmussen (1955, 2015), Twarowski (1962), Lenartowicz (1992), Zumthor (2006), Plummer (2012, 2014) and Winskowski (2002) were of particularly important in the evaluation of the outcomes of operating with sunlight in the interior in the aspect of exposing the physical properties of the interior and the characteristics of sunlight. The definition of criteria for evaluating the atmosphere of architecture was based primarily on the works by Böhme, Twarowski (1962), Lenartowicz (1992), Stec (2000), Zumthor (2006) and Plummer (1995, 2012, 2014). The literature that affected the study in its aspects concerning the psychological conditions of perception, ambience and projection capacity were the works of Lenartowicz (1992), Pallasmaa (1996, 2012), Zumthor (2006) and Plummer (2012, 2014).

Focused vision confronts us with the world
whereas peripheral vision envelops us
in the flesh of the world.

J. Pallasmaa, *The Eyes of the Skin. Architecture and the Senses*

Carefully planned illuminated and dark areas, regardless of use,
simultaneously play an artistic, aesthetic and semantic role.

M. Popczyk, *Światło i obrazy...*

II Relationship Between Sunlight and Architecture: Determinants

This chapter shall discuss the impact of physical, psychological and cultural determinants and human physiology that affect the building and perception of the relationship between sunlight and architecture.

Some determinants can be attributed to more than one category, particularly in light of contemporary knowledge. Gregory wrote: 'Indeed, it is often quite difficult to establish whether a visual effect should be regarded as belonging to psychology, physiology or physics. They get pretty well mixed up'.¹⁹² For instance, the significance attributed by man to perceived light is the outcome of psychological and cultural determinants of light in an interior. Likewise, sensory experiences induced in humans by the perception of light in architecture are the result of both physiology and psychology. The evolutionary adaptation of humans to sunlight prevalent in areas where they have resided for generations (either using it or avoiding it) likewise belong to determinants associated with human physiology and traditional, i.e. cultural ones, which affect the form of a given relationship. The division into each determinant type is therefore rather artificial, yet it structures the matter under study. While formulating this distinction, the author took the following criteria into account: 1) the impact of physical determinants encompasses astronomical and geographical properties of sunlight and the physical properties of architecture; 2) the impact of human physiology includes electrical and biochemical reactions of the body to light (the action of the organism that takes place regardless of its consciousness, i.e. in the mechanism of perception), which 'can be studied through physiological data [...] and by an analysis of data that verbally describe the content of a given individual's experiences',¹⁹³ and therefore human biological needs; 3) the impact of psychological determinants covers perception 'in the scope in which essential somatic activity condition activities of a higher order of organisation',¹⁹⁴ and include the perception of sensory experiences caused by light and the emotional evaluation of these experiences based on human psychological needs; 4) the impact of cultural determinants concerns the significance and meaning of the relationship between architecture and sunlight assumed by humans due to their membership in a specific culture (cultural community).

II. 1. Physical Determinants

The physical determinants of the relationship under study arise from the physical properties of sunlight and the physical form of architecture. The properties of sunlight in a given place on Earth depend on astronomical and geographic conditions that are distinct for this location. In essence, before sunlight makes contact with Earth, it is independent of humans, although human activity does have an impact on the composition of the atmosphere due to civilisational processes. Sunlight in a given place will also be dependent on current weather conditions and, indirectly—on the physical structure of the site.

The author discussed the positions of the Sun over a given location at a given moment as the essential astronomical determinant of sunlight for said location. This position is typically defined on the celestial sphere in a horizontal layout based on knowing the solar zenith angle (i.e. the height of the Sun's position above the line of the horizon, measured in degrees) and the solar azimuth angle (the angle between the half-plane of the initial meridian and the half-plane

¹⁹² R.L. Gregory, *Oko i mózg...*, *op. cit.*, p. 25.

¹⁹³ J.K. Lenartowicz, *O psychologii architektury...*, *op. cit.* p. 152.

¹⁹⁴ *Ibidem.*

of the vertical angle that intersects with the Sun).¹⁹⁵ The outcome of the yearly travel of the Sun along the ecliptic are the seasons of the year and the outcome of the rotation of Earth around its axis—are day and night. Sunlight is therefore the basis for the human measurement of time, as proven by solar clocks that have been known since ancient times,¹⁹⁶ and liturgical calendars in medieval monasteries.¹⁹⁷ Due to the distance between the Sun and Earth, sunlight reaches Earth after approximately 8 minutes and 19 seconds.

Sunlight, when it passes through Earth's atmosphere, is refracted, absorbed and scattered. Jan Mietejski compared Earth's atmosphere to a 'complicated optical filter', as 'for some wavelengths of the electromagnetic spectrum it is completely opaque, while others are let through by so-called atmospheric windows, but to a varying degree'. Thanks to the atmosphere translucency coefficient and knowledge of the height of the Sun, we can check how many times each of sunlight's colours have been weakened. The red colour of the setting sun is associated with the fact that red is weakened the least when the Sun's height is the lowest, as solar rays pass 'as if through three atmospheres'.¹⁹⁸ The absorption of light by atmospheric gasses causes the disappearance of specific intervals of its spectrum. In turn, the scattering of light by the particles of Earth's atmosphere, water drops, ice crystals and particulate matter suspended in the air, causes the effect of the luminance of the celestial sphere. Its blue colour, typical for the clear sky, is the result of the scattering of only the waves with the shortest wavelengths, i.e. violet and blue ones, by the solid elements of the atmosphere, which, due to the low intensity of violet in the spectrum, results in the colour blue (hence the name Blue Planet).¹⁹⁹ The gradual and smooth passage of day into night and night into day, i.e. the existence of dusk and dawn, are associated with the scattering of sunlight in Earth's atmosphere. Traditionally, as a consequence of adopting three different moments of the end of dusk, we distinguish three types of dusks: civilian, marine or navigational, and astronomical dusk. The differences between these types of dusk are as follows: 'During a civilian dusk, one can easily read fine print, provided that the sky is clear and we are outside of an enclosed space. Towards the end of a civilian dusk, we begin to feel the need for positional lighting in vehicular traffic. However, we do not feel a need for road illumination'; the final phase of a marine dusk, which is longer than civilian dusk, is 'colloquially called nightfall', while astronomical dusk, which still lasts after a marine dusk has ended, ends when the atmosphere's scattering of 'the Sun hidden behind the horizon is weaker than the light of the stars and comparable to the light of an aurora borealis, from the so-called luminance of the night sky, zodiac light and the so-called gegenschein'.²⁰⁰ In addition, sunlight is reflected by almost every object located in the atmosphere and on the surface of Earth, which brightens the light of the celestial sphere when observed by humans on the surface.

Based on astronomical determinants, sunlight reaches the Moon and reflects off of its surface, which is generally built of rather dark rocks, at a share of around 7% on average, which from a position on Earth's surface is perceived as the light of the Moon. The luminosity of the Earth's surface during a full moon on a clear night is around 0.2 lx (for comparison, nighttime street lights have a luminosity of around 0.5 lx). The perceived brightness of the Moon is

¹⁹⁵ The overview of astronomical determinants that condition sunlight was primarily based on: J. Mietejski, *Astronomia w geografii...*, *op. cit.*

¹⁹⁶ Cf. Marcus Vitruvius Pollio, *op. cit.*, chapter seven: *Sundials and Water Clocks* in Book Nine p. 147.

¹⁹⁷ Cf. M. Incerti, *Il disegno Della luce nell'architettura cistercense. Allineamenti astronomici nelle abbazie...*, *op. cit.*

¹⁹⁸ J. Mietejski, *Astronomia w geografii...*, *op. cit.*, p. 297.

¹⁹⁹ Celestial bodies that lack atmosphere, such as the Moon, have a black sky above an insolated surface. If a planet possesses an atmosphere, then (primarily) depending on their pressure and composition, it takes on a specific colour, e.g. a 'pale watery' colour in the case of Uranus and Neptune due to a high methane content. From: J. Mietejski, *Astronomia w geografii...*, *op. cit.*, p. 346.

²⁰⁰ *Ibidem*, p. 102.

primarily dependent on its phase and weather.²⁰¹ The moon also reflects sunlight that has been previously reflected from Earth. ‘Grey light, seen on the Moon close to its new moon phase, is sunlight that, after having been reflected from Earth and once again reflected by the Moon’s soil, returns to our eye’.²⁰²

The differences in the insolation of specific areas of Earth across multi-year periods enabled the distinction of climate zones. Mietelski noted five zones of the planet that are traditionally known as climate zones are five areas that were established ‘using criteria that define the characteristics of the insolation of these areas. We distinguish [...] a hot zone, two temperate zones and two polar zones’.²⁰³ This is confirmed by placing the border tropics between each zone (the Tropics of Cancer and Capricorn, the polar circles) on the basis of a specific declination of the Sun and the latitude from where it is observed.

Sunlight at a given location is impacted the most by the astronomical conditions of the Sun that are distinct for said location, i.e. that are associated with its geographical location on Earth, which determines the intensity of its insolation, the length of day and night and, indirectly—temperature distribution and the character of soils and plants. For this reason, the insolation intensity of the surface of a given place on Earth is calculated for a given latitude. The longest day in the southern edges of Europe lasts around 14 hours and 30 minutes, while the polar day (along with the periods of civilian dusk and dawn)—several months. The difference in the length of day and night affects not only air temperatures, but also the evaporation of water and the vegetation of the organic world, which indirectly affects the quality of sunlight in a given location, similarly as the hydrography of the terrain and its vertical shape. This is also associated with the classification of the climate on Earth used in geography and that includes six zones: the hot and humid climate, the dry climate, the warm temperate climate, the cool temperate climate, the polar climate and the highland climate. These zones are divided into regions, e.g. the warm temperate climate zone is divided into: the Mediterranean climate region with hot and dry summers, the subtropical climate region with hot and humid summers, marine climates (Central and Western Europe) with a cool climate. Climate impacts associated with the physical makeup of a given location were defined in this study as geographical determinants.

Twarowski studied insolation conditions and drafted ‘solar ruler’ charts for a latitude of 52.2 degrees North, while Neufert in his architectural handbook listed insolation data for a latitude of 51.5 degrees North. Neufert distinguished the insolation of a vertical surface (he defines it as ‘side illumination’) from insolation on a horizontal surface (analogously defined as ‘overhead insolation’). Vertical illuminance is typically half of the value of horizontal illuminance. For a latitude of 51.5 degrees North, the average value of illuminance on a horizontal surface is 70,000 lx, while during a sunny day this value can reach up to 100,000 lx, and on a December morning (at 9.15 AM) it can be as little as 3,000 lx.²⁰⁴

Sunlight at a given location is highly dependent on weather conditions: clouds, fog, precipitation, or air temperature. These factors can alter illuminance by a factor of several hundred percent. Account for climate and weather differences, the International Commission on Illumination distinguishes fifteen types of sky luminance distributions.²⁰⁵ They include sky brightness

²⁰¹ From: *ibidem*, p. 246.

²⁰² *Ibidem*, p. 212.

²⁰³ *Ibidem*, p. 94.

²⁰⁴ From: E. Neufert, *Podręcznik projektowania...*, *op. cit.*, p. 118.

²⁰⁵ ISO 15469: 2004/CIE S 011/E: 2003. Spatial Distribution of Daylight _ CIE Standard general SKY. ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies. The work of preparing International Standards is normally carried out through ISO technical committees. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardisation. ISO 15469 was prepared as Standard CIE S 011/E by the International Commission on Illumination, which has been recognized by the ISO Council as an international standardizing body. It was adopted

in three cloudiness groups: complete, moderate and clear sky. Every type of sky is described via a geometrical model of the spatial distribution of luminance. The figure presents the sky dome (one half of the celestial sphere), the solar point and any point in the sky for which an absolute and relative luminance point is calculated. R. Kittler and S. Darula²⁰⁶ proposed an amendment to the definition of sky types by accounting for vertical illumination. The sky types described in the standard differ depending on geographical location and season of the year. Oleg Sergeychuk found²⁰⁷ that numerous studies of the gradation of luminance for various locations were performed after the standard's introduction and differences were observed. He proposed the adoption of a calculation model for the entire year as divided by months. Luminance studies are primarily intended to rationally apply sunlight and artificial light, as well as the energy performance of interiors. They are also a basis for studying the impact of luminance on interior users. Changes in the brightness of the sky considerably affected the illuminance of daylight and the human perception of light at a given location: brightness, colour, glare and thermal comfort.²⁰⁸

Due to astronomical reasons, sunlight as observed by humans on Earth is characterised by two properties that are critical to the study. First, its source is always outside of the interior and constantly moves from east to west along the arch of the ecliptic above the horizon; second, it causes the radiance of the celestial sphere (during the day and on a clear moonlit night via light reflected from the Moon), which results in the effect of the sky dome above interiors that are completely open from the top. These characteristics apply only to sunlight and are independent of humans: humans must adapt to them.

The physical form of architecture understood as an interior is the effect of the physical properties of the elements of the interior and the characteristics of its site, i.e. the place where it has been/will be built.

The physical characteristics of a given place are the result of its geographical location (the scope of physical geography that studies physical processes that take place on the surface of the Earth and in its atmosphere, as well as the relationships between them attests to the numerous aspects of geographical location; it includes: geomorphology, hydrography, meteorology and climatology as well as biogeography, which concerns the distribution of plants and animals). It conditions the most important characteristics of a place: elevation above sea level, geological layers and form, water body distribution, climate, the presence of variable components of air within space (water droplets, ice crystals, mineral and organic suspensions and particulate matter). Geological conditions, water body distribution, and elevation above sea level characterise the boundaries of a given landscape interior, perceived by humans as the physiognomy of the Earth (a term used in the Krakow landscape school). Atmospheric (climate) and weather conditions directly affect the physical quality of an interior's space.

The physical characteristics of an interior concern its elements: its boundary (partitions and masses) and spaces (Chapter I.2.). According to the specificity of the study, the author accounted for those properties of interior elements that are essential to the admittance of light from outside

by ISO under a special procedure which requires approval by at least 75% of the member bodies casting a vote, and is published as a joint ISO/CIE edition. The International Commission on Illumination (abbreviated as CIE from its French title) is an organization devoted to international cooperation and exchange of information among its member countries on all matters relating to the science and art of lighting. <https://www.iso.org/obp/ui/#iso:std:iso:15469:ed-2:v1:en>.

²⁰⁶ S. Darula, R. Kittler, L. Komar, *Sky type determination using vertical illuminance*, "Przegląd Elektrotechniczny" 2013, vol. 6, p. 315–319.

²⁰⁷ D. Radomtsev, O. Sergeychuk, *Employment Features of CIE S 011/E2003 (ISO 15469:2004) "CIE Standard General Sky" under Designing Systems of Room Daylighting*, [in:] *Proceedings. The 9th International Conference on Future Generation Communication and Networking (FGCN)*, Jeju 2015, p. 49–54.

²⁰⁸ See: J. Martyniuk-Pęczek, *Recenzja osiągnięć naukowych i aktywności naukowej dr inż. arch. Barbary Stec*, dated 08.06.2019, p. 9, 10.

into the interior and its modification. Four types of such properties were distinguished: —openings (e.g. windows and oriels within an interior's boundary), —structure (e.g. meshes, perforated walls, channels, ducts, light cannons within an interior's boundary), —material (e.g. materials with rough textures, translucent materials, materials that absorb light within the boundary of the interior, water vapour suspended within the space of the interior), —shape (e.g. proportions, flatness, convexity, concavity of the of an interior's boundary, a cloud within the space of the interior, the visible range of the celestial sphere).

When comparing the physical determinants of light with the physical determinants of architecture, it is easy to observe that the geographical location of the site in which a specific relationship between light and architecture occurs is repeated in both. Geographical location gives rise to other important influences, such as climate and the presence of variable air components. Geographical location can thus be considered an essential physical determinant of the relationship between sunlight and architecture. Its analysis is typically included when studying the conditions of a site in which a given interior is to be built.

The close relationship between the physical form of urban and architectural interiors with the physical determinants of their location can be observed in the original development of historic cities. It is a testament to the deliberate choosing of places that are particularly beneficial to humans in terms of residence due to their insolation.²⁰⁹ Within the tissue of old cities one can observe how the local form of sunlight affected the planning of streets, squares, the selection of sites for temples, theatres, houses or baths, as discussed by Vitruvius. In addition, conversely, we can observe how a growing city affected the form of the light that operates within it, particularly after a long time has passed. In almost every old city, the local sunlight, used in a manner that is distinct for each city, becomes an essential component of its unique atmosphere. There are also exceptional cities whose builders made light an irrationally important element of architectural order—the soul of their interiors. One such city is Venice.²¹⁰ Its geographical coordinates (45°26' North and 12°27' East) are what encodes the phenomenon of its exceptional sunlight.

Impact of a Given Location's Physical Determinants and the Physical Properties of Architecture on Light in Architectural and Urban Interiors: the Case of Venice

In Venice, the relationship between sunlight and architecture can be analysed on different scales: from the intimate interior of a room, through the interior of a church, campo, a canal, Piazza San Marco and Bacino San Marco, to the interior of the lagoon with its compact archipelago of islets on both sides of the Grand Canal. On each of these scales we encounter interiors whose sunlight and architecture mutually expose themselves as if on a theatrical stage.²¹¹

When we adopt the scale of the lagoon, sunlight illuminates the compact archipelago of old Venice from all sides as if it were a freestanding mass within an interior. Because of this, Venice within its historical borders is perceived as a single island, crossed by the Grand Canal, and whose waterfronts are highly diverse due following the cardinal directions: illuminated from the south (from Bacino San Marco) and shaded from the north. People can experience this phenomenon by walking along the *fondamenta*—shoreside streets which encircle almost the entire city (contrary to islands that are tightly encircled by walls). The island location and the opening of the city towards the lagoon allows light to penetrate the deep interiors of narrow canals and small streets.

The reflection of sunlight by the water surface gives the city practically two sources of sunlight: from overhead and from below. The water of the lagoon is a peculiar mirror: it is either

²⁰⁹ See: S. Wehle-Strzelecka, *Energia słońca w kształtowaniu środowiska mieszkaniowego...*, *op. cit.*

²¹⁰ See: B. Stec, *O świetle Wenecji...*, *op. cit.*

²¹¹ A. Franta, *Reżyseria przestrzeni. O doskonałości przestrzeni publicznej miasta...* *op. cit.*

rippled or smooth depending on wind and precipitation; either clear or muddy depending on the solutions within the water. The typical blue-and-green and yellow-and-green shades of the lagoon's waters are the consequence of their considerable salinity, small algae, microorganisms, sand and pollution. The colours of the water mix with the reflection of the colours of the sky and elements of architecture. The surface of the lagoon's water is unique as one can see the depth of the water layer, i.e. the mass of semi-opaque liquid that partially absorbs light, through the surface. Thus, the water not only reflects, but also stores light, becoming a peculiar residence for it. The lagoon's waters typically produce vapour, so light absorption and reflection are accompanied by scattering on the particles of water vapour and water droplets within the air. Due to this, the image of architecture in most urban interiors exists in a suspension of humidity, illuminated from above and below. Della Corte began his text entitled *Dall'acqua al cielo: due Venezie a confronto* by quoting Federico Fellini's words on Venice: 'Costruita sull'acqua, dipinta nell'area'. This poetic expression expresses the essence of the intense relationship between architecture and light in this city, which arises primarily from its geographical determinants.

This relationship was accounted for on Venice's map—*Pianta prospettica* from 1500 by Jacopo de' Barbari. This map, drawn in black and white, depicts Venice in a perspective projection and in three dimensions, with the height of houses, palaces and walls around courtyards, while accounting for insolated places from the south and east and shaded fones rom the west and north. Insolation was also presented by the coloured map painted by Odoard Fialetti from the beginning of the seventeenth century and that also used perspective projection. In relation to de' Barbari's map, it is less precise (although it depicts Venice from a closer distance), yet it presents the city as an archipelago of islets bathed in the golden rays of the setting sun, which deeply penetrates the narrow canals oriented along the north-south direction, insulating their western shores and walls. The inclusion of insolation on historical maps of Venice is proof of its essential role in the everyday lives of its residents and in creating the identity of Venetians.²¹² These maps present the relationship between the city and sunlight across three levels: as a free-standing mass in the lagoon's interior, as an urban interior and as a complex of architectural interiors.

The multiplication of sunlight through its reflection in the lagoon's waters has affected the properties of Venice's architecture: its orientation, openings, structure, material and shape. This is confirmed by, among other things, the application of colourful marble in Venice, and various forms of glass and gilding. The colourful marble stone of the San Zaccaria Church and the Santa Maria dei Miracoli or the Basilica of San Marco shimmer with mineral shades of their veins similarly as the spots of light and shadow vibrate on the water surface on the undersides of bridges.

Ewa Bieńkowska identified the peculiar light of Venice as the primary source of the uniqueness of Venetian paintings. When writing about Bellini, Titian or Tintoretto, Bieńkowska stated:

Venice, with its exceptional light, which is caused from the presence of water and the scattering of the glow across the lagoon, was to them more of a lesson on universal light, a quintessence of painterly light, that a master can achieve by understanding the laws of painting and technical mastery. Today, by marvelling on the unequalled reds, blues and yellows, think about the privilege they were given: to work in a city where everything that the eye can see achieves unparalleled intensity.²¹³

Light and colour are inseparable in their physical phenomena as 'it is impossible to discuss light in grayscale or merely one, arbitrarily selected colour'.²¹⁴ Rabiej, in his analysis of light and

²¹² See: A. Franta, *Kultura miasta / The Culture of the City...*, *op. cit.*

²¹³ E. Bieńkowska, *Co mówią kamienie Wenecji...*, *op. cit.*, p. 11.

²¹⁴ D. Leśniak-Rychlak, "Autoportret", *op. cit.*, p. 2. For this reason, the quoted issue of "Autoportret", devoted to light, was in colour, which is an exception as it had previously been printed in black-and-white.

colour, notes that ‘in his work *Polichromie Architekturne*, Le Corbusier formulated an accurate poetic paraphrase of interdependencies between light and colour in architecture by calling “colour the daughter of light”²¹⁵ (Rabiej also noted the Modernist treatment of colour as a material that builds/constructs architecture).²¹⁶

However, the openings, structure and shapes of Venetian architecture can be seen the most clearly on its black-and-white photographs. Instead of the painterly character of the city, they present the geometry and shape of its interiors: the expanse and depths of spaces, the three-dimensional character of the relief in the window and door frames, the spatiality of the loggias, statues, the convexity of church apses or the depth of the campos. It was Ciol who depicted Venice on black-and-white photograms in the previously mentioned album. Lucien Hervé’s photographs of the Le Thoronet monastery in *La Plus Grande Aventure du Monde* (Paris 1956) and its subsequent editions, e.g. *Architecture of Truth* (London 2001) and the majority of photographs of the interiors of Cistercian monasteries in Manuela Incerty’s *Il disegno Della luce nell’architettura cistercense...* are also black and white.

After dark, artificial lights appear rarely and out of necessity in Venice, without creating impressive arrangements. The towers of churches blacken in their actual and reflected view: the first being matte and unmoving, while the second is watery and vibrant. In the nightly spectacles, one of the world’s most theatrical cities uses primarily the light of the Moon, doubled by the water surface.



Mini. 1

II. 2. Human Physiological Determinants

Human physiological processes, i.e. the vital signs and activities of the human organism, have a significant impact on the reception and shaping of the relationship between sunlight and architecture. These processes take place within the body regardless of its consciousness and will (as a result of electrical and biochemical reactions). Physiology defines the rules of the proper functioning of the body (health) and allows the formulation of methods with which to restore this state of functioning during pathological states. It refers to human biological needs.

It is generally known that sunlight conditions numerous human biological processes, as well as in most organisms that live on Earth, yet it can be surprising that Włodzimierz Szewczuk, among the dozen or so biological needs (including those of humans) lists the need for light or its lack as the second, after the need for oxygen, and before the need for warmth (third) and the need for location within space (fourth). The study references the definition of needs, formulated by Włodzimierz Szewczuk. It states that, in general, a need (in reference to any organism) is a ‘state

²¹⁵ J. Rabiej, *Światło i kolor...*, op. cit., p. 423.

²¹⁶ *Ibidem*, p. 423, 424.

that emerges as a result of disturbing a given organism's existential optimum, which initiates its activity directed at achieving something that can more or less restore this optimum. [...] no need stems directly from the "nature" of a given organism, but is instead shaped through a process in its structure as an equivalent of the elements of the surrounding world in which it emerged and in which it lives'. This leads to 'the internalisation of the surrounding world in various ways and based on various mechanisms'.²¹⁷ Therefore, the need for light is classified as immeasurably important, right after the need to breathe and before the need for warmth. Furthermore, the energy of solar radiation, which is inseparable from sunlight, is also linked with satisfying the next two biological needs: for warmth and location within space. Scientific studies confirm the condition of proper biological functioning of the human body by appropriate doses and quality of sunlight. It can be observed that during evolutionary development, humans, as a species, have adapted to various local insolation conditions of the areas they have inhabited across generations.

Sunlight initiates and stimulates primarily the sense of sight and the sense of touch (the skin), leading to specific sensory experiences. Visual experiences are the most critical to perceiving the relationship between architecture and light, producing its image on the basis of visible radiation. However, although the sense of sight is the most specialised recipient of light, it is not sight but human skin that is the largest organ of the human body that experiences sunlight as the energy of visible, ultraviolet and infrared radiation. Therefore, humans can, through visual and tactile experiences, see and feel the relationship between light and architecture, while their own organisms are stimulated (enabled to live) by light; it is light that provides hormonal balance, nourishes and secures it. It is the skin that chiefly takes part in these processes. Sensory experiences and the biological reaction of the organism as a result of light in the interior are directly linked with the atmosphere of the interior and its physical properties—they are both its outcome and indicator.

Using the sense of sight in an interior, humans receive the major part of stimuli arising from the physical form of the relationship of sunlight and architecture (it is estimated that the sense of sight registers around 80% of all external information in humans).²¹⁸ Gregory stated that '[...]less than half the quanta reach the receptors, the rest being lost by absorption and scattering within the eye'.²¹⁹ The process of seeing engages not only the eyes, but also numerous areas of the brain. Gregory wrote that the function of the eyes is to relay to the brain information encoded in the operation of nerve tissue in the form of sequences of electrical impulses.²²⁰ The sense of sight encompasses the first-tier visual system, i.e. the eyes and specific areas of the brain and the nerve pathways that reach them. Complicated mechanisms of sight can be described as follows:

In the case of vision, specialized neurons in the retina of the eye receive light, and cause neural signals to be generated and transmitted through the various pathways [...] to the posterior portion of the brain. Notice that there are various relay stations on the way to the brain cortex, at which information is sorted and refined. Of particular importance are the retina, that light-sensitive area at the back of the eye on to which light is focused by the optical lens at the front of the eye and the lateral geniculate bodies of the midbrain, where signals from the two eyes are first 'mixed'.²²¹

The retina is described as an 'outgrowth of the brain'—its specialised section that is sensitive to light.²²² Brain cells located between light receptors and the ocular nerve modify the

²¹⁷ W. Szewczuk, term: needs [in:] *idem* (ed.), *Encyklopedia psychologii...*, *op. cit.*, p. 434, 435.

²¹⁸ From: P.C. Dodwell, *Podstawowe mechanizmy widzenia*, [in:] R.L. Gregory, A.M. Colman, *Czucie i percepcja...*, *op. cit.*, p. 13.

²¹⁹ R.L. Gregory, *Oko i mózg...*, *op. cit.*, p. 24.

²²⁰ *Ibidem*, p. 8.

²²¹ P.C. Dodwell, *Podstawowe mechanizmy widzenia...*, *op. cit.*, p. 15, 16.

²²² R.L. Gregory, *Oko i mózg...*, *op. cit.*, p. 56, 57.

operation of the receptors themselves: rods and cones, distributed unevenly across the retina. The peripheral areas of the retina feature both rods and cones, while the central section, the fovea, features a denser array of cones. Cones operate in daylight and enable photopic vision (which distinguishes colours), while rods operate in light that is weaker than daylight and enable scotopic vision—in shades of grey.²²³ In mesopic vision, there is a partial loss of colour in the perceived image.

In recent years, scientists have discovered a third class of light-sensitive neurons in the mammal retina. They are Intrinsically Photosensitive Retinal Ganglion Cells—ipRGC. The presence of ipRGC was first noted in 1923 in experiments on mice, where it was found that cones and rods were not the only photoreceptors in the retina. However, it was only in the 1980s that studies of these cells began and which resulted in new discoveries at the start of the twenty-first century. Contrary to other retinal cells, the newly-discovered neurons are intrinsically photosensitive due to the presence of melanopsin, a protein that is sensitive to light, which is why they may be critical in studying visual disorders and blindness.

Light, which is a ‘proper stimulus’ as stated by Dodwell,²²⁴ is converted in the eye into physiological signals that are then sent to the occipital lobe. Contemporary researchers who focus on the physiology of sight highlight the interaction between congenital factors and those gained through individual experience. It is only through this interaction that a mature vision system can emerge.²²⁵

In the human process of seeing, images from both eyes are combined into a single visual experience. This phenomenon is associated with the perception of an interior’s depth, which can be assessed almost immediately. The human sense of sight can, based on light waves scattered by objects, determine the shape of the interior, its size, depth, colours and materials. However

The different sensory qualities of contour, movement, colour and depth have all been found to be processed in anatomically distinct “channels” which even have separate “maps” in different parts of the brain cortex [...] Certain “higher order” neurons that are sensitive to more complicated aspects of the visual field than simple oriented line segments have been identified, even some that respond to hands, moving human bodies, and faces [...].²²⁶

The result of perception is therefore a sensory observation, a type of ‘direct cognition, based on sensing some singular element as being extant and independent of the perceiving consciousness, that currently exists’.²²⁷ Perception is primarily conditioned by the effectiveness and sensitivity of human senses, but also the work of the brain. According to Lenartowicz, perception is observation, i.e. ‘an activity that results in sensory observation, based on learning external facts via senses by the observing entity. The system of notions and the language of the observing entity plays a significant role in this process’. In this same definition, Lenartowicz also calls perception ‘a process of the direct reflection of phenomena due to the operation of analysers based on an

²²³ Pallasmaa wrote: ‘With its 800,000 fibres and 18 times more nerve endings than in the cochlear nerve of the ear, the optic nerve is able to transmit an incredible amount of information to the brain, at a rate which far exceeds that of all the other sense organs. Each eye contains 120 million rods which take in information on roughly five hundred levels of lightness and darkness, whereas more than seven million cones make it possible for us to distinguish among more than one million combinations of colour’. J. Pallasmaa, *Oczy skóry...*, *op. cit.*, endnote 73 to part two, p. 126.

²²⁴ P.C. Dodwell, *Podstawowe mechanizmy widzenia...*, *op. cit.*, p. 15.

²²⁵ *Ibidem*, p. 18.

²²⁶ *Ibidem*, p. 18, 19.

²²⁷ J.K. Lenartowicz, *Słownik psychologii architektury...*, *op. cit.*, p. 130.

individual's previous experience'.²²⁸ Dodwell similarly notes the role of individual experience in perception, as it corrects purely physiological stimuli.

Dodwell highlights that the nature of perception arising from physiological and neural processes of the brain cannot be boiled down to an analysis of the optical and physical properties of the observed environment. This can be seen in unconscious inference, i.e. perceptual continuity (concerning sizes, shapes, colour and brightness) which is performed without the active engagement and knowledge of the observer and which is a fundamental element of seeing the world in perspective.²²⁹ Perceptual continuity is associated with the 'superdetermination' of images and enhancing visual information with stimuli from other senses. As a result, the image of reality can be falsified via an optical illusion. Dodwell believed that studies of illusions are key to enhancing knowledge about visual perception.

Study of the illusions is important, but the fact is they seem to raise almost as many questions as they answer. No one theory of the illusions has gained universal acceptance; perhaps their main challenge is reminding us of the many different factors that can enter into perceptual processing, and alerting us to the need to be flexible in thinking how we come to know the world through seeing.²³⁰

The objective intensity of light in the interior, which can be measured using photometers, is crucial to seeing the world. It should not be mistaken with brightness, which is a human sensation—a subjective reception of illuminance. Gregory highlighted the weight of this distinction in the analysis of perception, just as he accentuated the difference between colour as a sensation and colour as an electromagnetic wavelength. 'Strictly speaking light itself is not coloured: it gives rise to sensations of brightness and colour, but only in conjunction with a suitable eye and nervous system'.²³¹ Light with a given intensity produces brightness in the eye of the observer that is dependent on numerous factors, e.g. the degree to which the eye has adapted to light or darkness or complex determinants that define the contrast of objects or spots of light and shadow. Brightness is also a function of colour. Anna Franta confirmed in her studies that the sense of sight is more sensitive to the brightness of an image than it is to its colour.²³² Different colours of light with the same intensity are perceived by the human eye as light with different brightness: colours from the centre of the spectrum that produce the impression of a yellowish green colour, are perceived as brighter, as 'the centre of the field of vision and the greatest sensitivity of the eye are around 555 nm'.²³³ A decrease in brightness, which can take place at dusk, results in the loss of coloured vision and the observation of interiors in a scotopic manner. The sense of sight perceives the edge of the field of vision in a similar manner (stimuli from these areas are processed solely by the retina's peripheral areas dominated by rods).

The adaptation of the eye to darkness, i.e. an increase in the photosensitivity of the eye, is associated with the different rate at which rods and cones adapt to darkness. Gregory reported that 'cone adaptation is completed in about seven minutes, while rod adaptation continues for

²²⁸ J.K. Lenartowicz, *Słownik psychologii architektury...*, *op. cit.*, p. 130. Cf. A. Grabowska, term: perception [in:] W. Szewczuk (ed.), *Encyklopedia psychologii...*, *op. cit.*, p. 385. Grabowska wrote: 'Perception is the process of receiving and analysing sensory information and interpreting according to one's knowledge. [...] Humans are not a passive receiver of information that reaches them, but process, select and interpret it in light of the knowledge about the world recorded in memory'.

²²⁹ P.C. Dodwell, *Podstawowe mechanizmy widzenia...*, *op. cit.*, p. 19, 20.

²³⁰ *Ibidem*, p. 22.

²³¹ R.L. Gregory, *Oko i mózg...*, *op. cit.*, p. 87.

²³² A. Franta, *Otoczenie przestrzenne a psychika człowieka – systematyka uwarunkowań oddziaływania*, doctoral dissertation, Kraków 1990.

²³³ A.S. Gajewski, *Wybrane zagadnienia...*, *op. cit.*, p. 236.

an hour or even more'.²³⁴ This is a phenomenon associated with the regeneration of the visual pigment, which is bleached by the eye.

[...] bleaching in some unknown way stimulating the receptors to transmit electrical signals to the optic nerve.[...] It would also seem that brightness must be related to the amount of photochemical present to be bleached.²³⁵

However, Gregory cautioned against simplifying the mechanisms of colour perception, as they depend not only on light stimuli with specific wavelengths and light intensity, but also the processes that take place in the brain. In the phenomenon of the adaptation of vision to light or dark, the sensitivity to individual wavelengths of the light spectrum changes. Photopic, mesopic and scotopic vision defines the different capacities of the sense of sight that allow for *f o c u s e d* and *p e r i p h e r a l* *v i s i o n*. Photopic vision provides the eye with the greatest sensitivity to the colour of an object at the centre of the field of vision on which it is focused due to the engagement of cones located in the fovea. In scotopic vision, the eye is far more sensitive to even the slightest brightness of objects in the peripheral field of vision, and is better able to perceive its entire spectrum, including depth.

The human eye is constantly active, which arises from stimulation with 'spontaneous noise in the system'.²³⁶ Even in the total absence of light, the retina and optical nerve display some degree of activity. Because of this, it is up to the brain to qualify the signals it receives. Ultimately, noise in the nervous system affects the ability to perceive, i.e. visual acuity.

We now think of any stimulus as having an effect on the nervous system, but only being accepted as a signal of an event when the neural activity is unlikely to be merely a chance increase in the noise level.²³⁷

For this reason, the difference in intensities perceivable to the eye depends not only on the sensitivity of the retina's receptors, but also the possibility to detect it as a signal against chance noise. This is due to the fact that extreme intensities raise the noise threshold and weaken visual acuity (just as extremely loud sounds weaken hearing). A high visual noise threshold weakens the sensitivity of the sense of sight. Therefore, it can be concluded that interiors with moderate light intensities are the most beneficial to visual hygiene.²³⁸

Visual hygiene is currently mentioned in the context of the overexposure of interiors. Light intensity on a sunny summer day (a value of 100,000 lx) should not be a universal model for indoor lighting for humans. On the contrary, it is a model to be followed in exceptional situations that considerably exceeds optimal values for a range of everyday human activities. We only need 20 lx to distinguish facial features, and 50 lx to perform simple tasks, for office work and using a computer—50 lx, while for high-precision tasks—1,000 lx.²³⁹

A specialised sense of sight provides humans with good vision in different lighting conditions. The capacity of the human eye to discern shades of light is so great that it can distinguish objects both in moonlight during the night and in sunlight, which is over two hundred and fifty

²³⁴ R.L. Gregory, *Oko i mózg...*, *op. cit.*, p. 88.

²³⁵ *Ibidem*, p. 88, 89. Gregory referenced the experiments and findings of the British physiologist W.A.H. Rushton, who isolated the photochemical compound rhodopsin from the eye of a frog and investigated its behaviour under the influence of light. He detected pigments sensitive to different colours. Gregory noted that the dependence between the energy of the stimulus and the amount of bleached substance had a logarithmic ratio. *Ibidem*.

²³⁶ *Ibidem*, p. 98, 99.

²³⁷ *Ibidem*, p. 102.

²³⁸ Cf. J. Pallasmaa, *Krajobrazy zmysłów...*, *op. cit.*, p. 4–11.

²³⁹ From: E. Neufert, *Podręcznik projektowania...*, *op. cit.*, p. 105–108.

times brighter than the light of the Moon.²⁴⁰ We should also remember that humans always see an image of the world as it was in the past, due to the slight delay in how information travels along nervous pathways.²⁴¹

The relatively new trend in research on non-image forming effects of light focuses on the impact of light parameters on the human circadian rhythm, including tiredness, sleepiness, alertness and performance, and pertains to the impact of light on the human eye. These studies primarily deal with artificial lighting design for office workspaces, but their findings are universal. For instance, the authors of *Non-Image Forming Effects of Light on Brainwaves, Autonomic Nervous Activity, Fatigue, and Performance*²⁴² observed that a lower subjective sleepiness and lower subjective tiredness is observed in light below 3730K and during pre-noon sessions. This paper also lists a contemporary method of the physiology of melatonin suppression by light.

Sight is undoubtedly the most specialised of the human senses that receive sunlight—every type of sunlight, be it direct or reflected. Humans use skin, i.e. the sense of touch, to receive direct solar radiation, namely insolation as a carrier of energy. Contemporary aesthetics and architecture criticism highlight the significance of the sense of touch, believing it to be the sense of direct human contact with the surroundings, which is primal relative to the sense of sight. Pallasmaa, based on contemporary knowledge, even went as far as to state that ‘skin is actually capable of distinguishing a number of colours’.²⁴³

Both senses associated with sunlight: the sense of sight and the sense of touch, are of fundamental significance to the physiological processes of the human body. These sensory apparatuses enable us to benefit from the riches of Earth’s environment and also adapt to various living conditions and to optimise these conditions in accordance with the body’s vital needs. Over the course of the adaptation of humans as a species to specific insolation and day length prevalent in the area occupied for extended periods of time, humans have produced different skin colours and different shapes and sizes of eyes. White, yellow and black skin colours are the effect of different pigment content in the skin, which is intended to protect us from solar radiation. Yellow skin displays a remarkably poor resistance to insolation, which is explained by the emergence of yellow-skinned peoples’ characteristics in a cold climate that forced the covering of the body due to low temperatures and resulted in a loss of the skin’s resistance to radiation. For instance, in the case of the Japanese, their high sensitivity to sunlight results in prolonged exposure to solar radiation producing eczema on the skin that is difficult to heal (they usually protect their skin from the sun using umbrellas and proper clothing). This physiological characteristic of the Japanese people gave rise to cultural tradition expressed as a preference for both white skin and shaded interiors, which shall be discussed in section II.3.

Apart from the different properties of the skin, the different eye shapes and colours are likewise a result of the human species’ adaptation to insolation: dark eyes are more resistance to radiation than bright eyes and a narrow palpebral fissure better protects the eye from intense glare not only from above, but also from below as a result of the reflection of light off of snow.

The time of exposure of the human body (skin) to the sun that is necessary for well-being is dependent on the incidence angle of solar rays (time of day, season of the year and latitude) on the one hand, and the individual characteristics of each person (particularly skin colour and the colour and shape of eyes) on the other. Twarowski reported that the time of exposure to the sun that is beneficial to humans ranges between thirty minutes to two hours per day. All solar

²⁴⁰ From: S.E. Rasmussen, *Odczuwanie architektury*, *op. cit.*

²⁴¹ R.L. Gregory, *Oko i mózg...*, *op. cit.*, p. 19.

²⁴² T. Askaripoor, W. Motamedzade, R. Golmohammadi, M. Farhadian, M. Babamiri, M. Samavati, *Non-Image Forming Effects of Light on Brainwaves, Autonomic Nervous Activity, Fatigue, and Performance*, “Journal of Circadian Rhythms” 2018, no. 16 (1) [online] <https://www.jcircadianrhythms.com/articles/10.5334/jcr.167/> [accessed: March 2020].

²⁴³ J. Pallasmaa, *Oczy skóry...*, *op. cit.*, p. 15.

radiation, including infrared and ultraviolet radiation that is invisible to the eye, enters the human body. However, ultraviolet radiation penetrates it to a lesser degree, while infrared enters deeper.²⁴⁴

The beneficial influence of solar radiation on health was used by humans already during prehistory and was evident in the earliest settlements. Wehle-Strzelecka observed that in prehistoric times humans resided in caves that had a large opening from the direction from which the sun could heat their interiors, e.g. the caves in Les Baux de Provence from over 6,000 BC, which had south-facing entrances. ‘Observation of the incidence angle of the solar rays during summer allowed its residents to obtain shade in the rocky interiors during this time’.²⁴⁵ In the first human civilisations that appeared on different continents and in different climate conditions, considerable significance was placed on orienting residential and urban interiors.²⁴⁶ In ancient times, it was ‘obvious to include such factors like the orientation of the building relative to the sun, its shading, the use of the thermal mass of construction materials and natural ventilation’.²⁴⁷ Solar radiation was used as a source of heat and intense light, optimal for specific room uses. Wehle-Strzelecka noted that the ability to draw energy benefits from the sun in construction were much greater in ancient times than in the present,²⁴⁸ although contemporary knowledge in this field surpasses that of the ancients. For instance, ancient Greek cities from the fourth and third century BC are still seen as models of ‘ideal solar cities’. Wehle-Strzelecka wrote: ‘Development based on open units composed of houses with courtyards opening to the south created a beneficial microclimate for residents and also acted like a row of solar collectors placed side-by-side’.²⁴⁹ One example of the archetype of a solar house was the so-called house of Socrates. It had a portico that was open to the south, through which the low rays of the winter sun could penetrate the interior and in the summer the rays arriving at a high angle were blocked, producing shadow in the interior. Wehle-Strzelecka also notes that in this period Greeks were already ‘[...] aware of the hygienic significance of introducing solar architecture. [...] This is attested to by, among others, the opinions of Oribasius, who was an authority on medicine’.²⁵⁰ The Romans, ever a practical people, developed and even legislated the principles of drawing benefits directly from sunlight, as evidenced by Vitruvius’ comments in his treatise, as well as legal regulations. In the Roman Empire: ‘In the second century AD, a lawyer named Ulpian introduced a provision that benefitted the owners of houses and that concerned access to sunlight. [...] In the fourth century, “solar rooms” in residential buildings and public buildings were so popular that solar law, which guaranteed access to sunlight, was included in the Code of Justinian (528–534)’.²⁵¹ In ancient Egypt, sunlight had not only religious, but also practical and health-related significance. Sunlight therapies offered in Helum near Cairo are known.²⁵²

The health-related aspects of sunlight remained unappreciated for a considerable amount of time after the fall of the Roman Empire—between the Middle Ages and the middle of the nineteenth century²⁵³—and no specific attempts were made to protect oneself from it (insolation caused the rapid aging of the body, the alleged multiplication of disease-causing bacteria, while

²⁴⁴ From: M. Twarowski, *Słońce w architekturze...*, *op. cit.*

²⁴⁵ S. Wehle-Strzelecka, *Energia słońca w kształtowaniu środowiska mieszkaniowego...*, *op. cit.*, p. 12.

²⁴⁶ See: Marcus Vitruvius Pollio, *O architekturze ksiąg dziesięć...*, *op. cit.*; S. Wehle-Strzelecka, *Energia słońca...*, *op. cit.*

²⁴⁷ S. Wehle-Strzelecka, *Energia słońca...*, *op. cit.*, p. 12.

²⁴⁸ *Ibidem.*

²⁴⁹ *Ibidem*, p. 15.

²⁵⁰ S. Wehle-Strzelecka, *Energia słońca...*, *op. cit.*, p. 16. The author of the referenced work quoted: K. Butti, J. Perlin, *Golden Thread. 2500 years of solar architecture and technology*, New York 1980, p. 3–13.

²⁵¹ *Ibidem*, p. 24.

²⁵² From: M. Twarowski, *Słońce w architekturze...*, *op. cit.*

²⁵³ ‘[...] along with the fall of the Roman Empire, the roman tradition of erecting transparent and glazed southern walls and orangeries disappeared in Europe, only to reappear after a thousand years’. S. Wehle-Strzelecka, *Energia słońca w kształtowaniu środowiska mieszkaniowego...*, *op. cit.*, p. 24, 25.

in truth it caused the drying and reddening of the skin and eye conditions). However, the appreciation of light as a source of specific visual stimuli did increase. Sunlight, no longer as a vehicle of warmth, but as that of a specific atmosphere and aesthetic experiences, was admitted into interiors in a carefully planned and often innovative manner. Meanwhile, humans developed and cultivated the need for proper light for different actions, and psychological and spiritual states. Wehle-Strzelecka noted:

Many cases of medieval architecture and that from later periods referred to the sun solely by introducing its light into interiors so as to obtain an ambience and a friendly atmosphere and lighting effects. This concerned primarily Gothic and Renaissance religious buildings. However, it was in Baroque churches and cathedrals that an unparalleled mastery was achieved in this field.²⁵⁴

However, the warmth of solar radiation remained in use in vernacular architecture and in the structures of various buildings used to cultivate plants, in a manner that went against fashion, yet was aligned with building economics.²⁵⁵ During the Middle Ages, winter gardens used to cultivate exotic plants, utilising glass in windows and sunlight, were already known but appeared highly sporadically. Since the Renaissance they have been built much more often, with orangeries appearing particularly in countries of Northern Europe, which was associated with glass entering greater use in construction. Wehle-Strzelecka observed that over time, the practical function of winter gardens and orangeries, meant to protect plants, transformed into a formal and recreational function (even when their ‘main inhabitants’ were still plants).²⁵⁶ In the seventeenth and the eighteenth centuries, known as the age of greenhouses,²⁵⁷ orangeries became a staple of Baroque layouts, demonstrating both the needs of those who commissioned them and the new technological possibilities that enabled the production of increasingly large panes of translucent glass. This enabled the improvement of the structures of greenhouses and make the following century a true age of glass.²⁵⁸ Apart from the large greenhouses and formal structures intended for expositions, such as Joseph Paxton’s famous Crystal Palace, winter gardens integrated with the spaces of houses and intended for recreation began to appear increasingly often. However, these interiors, either in a house or palace-like scale, filled to the brim with sunlight, were primarily of economic, formal and aesthetic significance, instead of a hygienic and health-related one.

This situation slowly started to change after the middle of the nineteenth century. Louis Pasteur, who published his works on microbiology and virology, argued for the beneficial and bactericidal effect of solar rays. At the same time, Arnold Rikli, an enthusiast of the Alps from Switzerland, popularised his model of ‘hygienic’ attire for mountain hikes: a shirt with short sleeves, a deep and broad neckline and knee-length trousers. At the time, this was an extravagant demonstration of exposing skin to sunlight. In 1855, Rikli established the first sanatorium in Veldes (present-day Bled in Slovenia), which recommended natural therapy with proper air—Lichtluftbad,²⁵⁹ which can be described as a sunny air bath, or—immersion in an interior with a sunny atmosphere. Discoveries in the field of light-based treatment made by the Danish physician Niels Ryberg Finsen and awarded the Nobel Prize in 1903 laid the groundwork for a cultural breakthrough in the approach to sunlight. In the same year, Swiss national August Rollier established a sanatorium in Leysin in the Swiss Alps which slowly became famous. It employed heliotherapy in the treatment of tuberculosis and skin conditions.²⁶⁰ This radical shift in

²⁵⁴ *Ibidem*, p. 25.

²⁵⁵ *Ibidem*.

²⁵⁶ *Ibidem*, p. 27–35.

²⁵⁷ *Ibidem*, p. 35.

²⁵⁸ See: M. Wigginton, *Glass in architecture*, Phaidon 2004.

²⁵⁹ From: P. Overy, *Light, aire & openness...*, *op. cit.*, p. 98, 99.

²⁶⁰ See: A. Rollier, *Heliotherapy*, Oxford 1927.

the approach to light in medicine had a profound effect on the period's architecture, particularly on the siting, orientation and massings of health resorts, which had to have proper south-facing expositions, large terraces and tall arcades and balconies. These architectural measures were also introduced to housing. Sanatoriums, previously established chiefly in the mountains and mountain valleys, started to be built near the sea. They became one of the symbols of modern hygiene during the start of the twentieth century.

During the period of Modernism, when knowledge concerning the beneficial effects of insolation was already common and pasteurisation and the refrigerator protected foodstuffs from spoiling, sunbathing and outdoor sports became increasingly common. The umbrella and gloves were replaced by a bathing suit and tennis racket as the attributes of a fashionable woman, and the tan replaced the snow-white complexion. Contemporary architectural and urban interiors had to be properly exposed to direct sunlight and enable the new lifestyle. We know of physicians from the period of Modernism who continued study of heliotherapy from the turn of century. In 1920s France they were conducted by Jean Saidman, who collaborated with physician Rémus Krainik and pharmacist René-Henri Monceaux,²⁶¹ while the brothers Hugo and Elio Biancani developed treatment methods incorporating ultraviolet and infrared.²⁶²

Saidman argued for the rational use of sunlight in the treatment of tuberculosis and rheumatoid arthritis in hospitals, where he recommended the construction of special solar rooms. His idea of the rotating solarium ('Solarium tournant' or 'la station héliothérapique orientable'), a rotating station for heliotherapy which included a pavilion that was rotated by a special mechanism to follow the direction of sunlight and thus maintained solar radiation in its interior, became an important element of architectural history. Saidman wanted to build this solarium in Aix-les-Bain, a then-famous thermal baths facility. In 1929, he commissioned architect André Farde to prepare a design and the Solarium was built a year later thanks to cooperation by Saidman's supporters and the local community of physicians.²⁶³ It became the first of three of such structures to be designed and built around the world.²⁶⁴ The erection of such an extraordinary structure aligned with the spirit of the time. The fact that in 1929 engineer Angelo Invernizzi designed the Villa Girasole near Verona, which was to follow the sun according to a principle similar to that of the Solarium, is proof of this. This villa, much larger than the Solarium, was completed in 1935. The interior, which followed direct solar rays, is an example of the radical subjection of the relation between light and architecture to human hygiene.

²⁶¹ C. Raynal, T. Lefebvre, *Médicaments ayurvédiques en France...*, *op. cit.*, p. 413–430.

²⁶² See: E. et H. Biancani, *Les Rayons ultraviolets*, *op. cit.*; E. et H. Biancani, *Lumière et rayons infrarouges*, *op. cit.*

²⁶³ From: C. Raynal, T. Lefebvre, *Médicaments ayurvédiques en France...*, *op. cit.* and from: E. Belle, Ph. Gras, *Etablissement médical, dit station héliothérapique orientable ou Solarium tournant*, *op. cit.* Raynal and Lefebvre wrote: '[...] on the 26th of April 1930, a strange rotary Solarium, "half-house, half-aeroplane" was opened on the hills of Aix-les-Bain, under the sun's rays'. C. Raynal, T. Lefebvre, *Médicaments ayurvédiques en France...*, *op. cit.*, p. 415, 416. The article is illustrated with a watercolour by Cécile Raynal, made on the basis of a postcard depicting Saidman's Solarium: a rotary, cuboid structure with an elongated pavilion located on the roof (in the form of an eight-sided, cut pyramid), which covers a single-storey octagonal building. In *Etablissement médical* it was reported that the structure was built with the cooperation of over forty construction companies near the Roche-du-Roi castle. During the Second World War, the Germans took over the Solarium and placed in it their wounded soldiers there. A year after Saidman's death in 1949, the Solarium was closed and began to fall into ruin until its demolition in 1967. In 1931 the Solarium was photographed by Hungarian photographer André Kertész who was preparing a report on the Savoie region at the time. *Etablissement médical...*, *op. cit.*

²⁶⁴ The remaining two were built in Vallauris dans les Alpes-Maritimes and in Jamnagar, India. From: *Etablissement médical, dit station héliothérapique orientable...*, *op. cit.* See: T. Lefebvre, C. Raynal, *Les Solariums tournants du Dr Jean Saidman. Aix-les-Bains, Jamnagar, Vallauris*, *op. cit.*

Along with the popularisation of hygiene as based on solar therapy, there spread a fashion for an aesthetic of bright residential²⁶⁵ and public interiors filled with direct sunlight. Interiors with a sunny space and atmosphere became popular in the housing environment: rooftop terraces and balconies on which people could sunbathe (programmatic elements of Le Corbusier's villas and housing units, visible in the Villa Savoye in Poissy and the Unité d'habitation in Marseilles). White wall surfaces that reflected all of the light that touched them (to be more precise—waves with all wavelengths) were not without significance in obtaining bright, sunny interiors. The whiteness of Modernist architecture is directly linked with the culture of man opening up to sunlight.

At present, awareness of the beneficial and detrimental effects of insolation is increasing. It is now widely known that ultraviolet radiation increases the iodine content in the thyroid, iron content in the blood, as well as red and white blood cell counts and haemoglobin,²⁶⁶ and that 'blue light, with a peak at 460–480 nm, regulates the biological clock, concentration and metabolic processes'.²⁶⁷ Red and infrared radiation, that penetrates deeper into the body, 'speeds up the healing of wounds and aids in relieving inflammation'.²⁶⁸ Proper insolation is used to support treatment of tuberculosis and bone disorders. It has particular significance in the production of vitamin D in the body, which contributes to increased calcium and phosphorus deposits in bone (particularly in children) and is important to the proper functioning of the human brain. According to modern medicine, vitamin D deficiencies in seniors can contribute to the development of dementia. However, excessive insolation is harmful to the body, causing skin lesions and eye disorders. There are states of the body or disorders that are accompanied by light aversion (for instance in meningitis or sinusitis), as well as some in which avoiding solar radiation is recommended (for instance in treatments using vitamin A and some pharmaceuticals). Bactericidal and fungicidal properties of direct sunlight exposure are beneficial to man. Contemporary studies of the physiology of seeing highlight the significance of the circadian rhythm to the body's wellbeing.

Residents of cool and cold climate zones, such as Scandinavia, must confront deficiencies in insolation. Their residential architecture commonly features various means of increasing the amount of sunlight, direct sunlight that is admitted indoors in particular. By analogy, residents of areas in warm climate zones, such as Mediterranean countries, must measure against excessive insolation. In these areas, it is common to limit the penetration of direct sunlight indoors. In the historical architecture of Greece and Rome one can find examples of all kinds of architectural devices used to limit the amount of sunlight admitted into interiors, such as arcades and porticos or types of interiors that emerged as result of such reduction, such as the peristyle and stoa.

It is easier to limit the admittance of sunlight into the interior than to increase or cause it when it is minuscule or not present at all for astronomical reasons, which is why humans believe insolation to be beneficial regardless of geographic area.

The impact of solar radiation on human physiology directly translates into the appropriate shaping of the relationship between architecture and light in the interior. Every interior that

²⁶⁵ See: P. Overy, *Light, aire & openness...*, *op. cit.*, p. 98–153.

²⁶⁶ M. Twarowski, *Słońce w architekturze...*, *op. cit.*

²⁶⁷ See: Federacja CELMA-ELC, *Bezpieczeństwo optyczne oświetlenia LED – POL Lighting*, 2011, <https://www.pollighting.pl/optical-safety-polv31052011> [accessed: 4.08.2016]. This document presents an analysis of the impact of optical radiation on human eyes and skin and defines standards for the application of artificial light indoors. Apart from indicating the harmful effects of blue light on human eyes and skin, it also notes the biological significance of this light on the human organism: 'People spend most of their time indoors (offices, etc.) and often do not receive a sufficient dose of blue light. Sources of blue and cool white light can be used to create illumination conditions that provide the daily dose of blue light that can adapt physiological processes to the natural circadian rhythm'. *Ibidem*, p. 4.

²⁶⁸ M. Twarowski, *Słońce w architekturze...*, *op. cit.*, p. 7.

humans are present in—from an intimate room to an urban interior—has its microclimate, largely conditioned by sunlight. Familiarity with the dependencies between the microclimate of interiors of different architectural and urban scales and the local climate is the basis for the design of the relationship between light and architecture that can be beneficial to the health of their residents or that respects their physiological needs. Twarowski noted these dependencies already in the 1960s, writing on ‘the indirect impact of sunlight on humans’, who live ‘in a microclimate of interiors’ (in reference to building interiors), in a ‘local climate’ and ‘polis-climate’.²⁶⁹ Twarowski proposed to look at the layout of these interiors as if they were one complex of intertwining microclimates conditioned primarily by insolation, which defined temperature distribution, humidity, bactericidal and fungicidal action and air movements. Thus, Twarowski formulated an original, innovative and practical rule for the design of interiors of varying scale as one ‘climate composition’, comprised of, among other things: the form and colour of the building, the distances between buildings, the shape of the building, the form and layout of individual window openings in a specific interior and the layout of greenery.

In the overview of the impact of human physiology on the design and reception of light in the interior, it should be mentioned that although visible light stimulates primarily visual experiences and direct sunlight also stimulates tactile experiences, it also engages other senses. For instance, it stimulates the sense of orientation and balance (in the dark humans lose orientation and often also balance; a high contrast between light and shadow on the floor can disrupt one’s sense of balance). We also cannot completely rule out the indirect impact of sunlight on other sensory experiences. Although it is difficult to discuss the smell, taste or sound of light that is perceived through human senses, we can discuss the smell, taste and sound of materials (including gasses within space) that comprise an interior and that when subjected to light, and thus, indirectly—discuss the smell, taste or sound of the relationship between light and architecture or simply—light in an interior. The warmth of direct sunlight that is admitted into an interior can alter the physical properties of materials and the air and thus—cause them to emit or change their smell, taste, hardness, roughness or physical state. When a material changes from solid to liquid form, the warmth of light can initiate the musicality of the interior (for instance as a consequence of ice melting in an igloo).

Impact of Human Physiology on the Reception and Design of Light in an Interior: Examples of Physiological and Meteorological Architecture

Jean-Gilles Décosterd and Phillippe Rahm’s artistic experiments and architectural designs demonstrate a strict dependency between the microclimate of interiors and human physiology. They are creators of so-called physiological architecture²⁷⁰ and Rahm himself performs experiments with meteorological architecture.²⁷¹ The impact of light on physiology was illustrated by the *Hormonorium* installation, built at the Swiss pavilion in the Giardini, Venice.²⁷² In a tightly

²⁶⁹ *Ibidem*.

²⁷⁰ In the years 1995–2004, J.-G. Décosterd and Ph. Rahm jointly operated *Décosterd & Rahm, associés* in Lausanne. They jointly published: Décosterd & Rahm *Physiological Architecture. Architecture physiologique*, Basel 2002.

²⁷¹ See: B. Stec, *Architektura meteorologiczna Philippe’a Rahma*, “Autoportret” 2011, no. 3 (35), p. 38–44; *eadem*, *Philippe Rahm. The Meteorological Architecture*, “CyberEmpathy: Visual Communication and New Media in Art, Science, Humanities, Design and Technology” (Augmented Reality, Visual & Media Studies). ISSUE 5/2013, Visual Poodle. ISSN 2299-906X. Kokazone. Mode of acces: Internet via World Wide Web., peer-reviewed online publication, 2013; *eadem*, *Wykorzystanie fizycznych praw środowiska w eksperymentach architektonicznych Philippe’a Rahma*, “Państwo i Społeczeństwo” 2017, no. 1, p. 65–78.

²⁷² J.-G. Décosterd, Ph. Rahm, *Hormonorium*, artistic installation, 8th Venice Architectural Biennale, 2002. An overview of the interior was provided on the basis of: www.philipperahm.com/ and the author’s personal experience.

enclosed interior, an intensive glare was generated, typical for snowy mountain glaciers at an elevation of 3,000 metres above sea level.²⁷³ This glare was stimulated by 528 fluorescent lamps which, placed in the floor under plexiglas tiles, emitted light with UVA and UVB radiation at an intensity of between 5,000 and 10,000 lx. The floor-based light source caused visitors to reflexively avert their eyes. The high doses of UVA radiation caused an observable yet delicate increase in satisfaction, while high doses of UVB radiation caused higher rates of vitamin D synthesis in the skin (the temperature in the interior was not simulated and allowed the visitors to remain in summer clothing). The increase in illuminance caused the bodies of the people in the interior to stop producing melatonin, which resulted in similar physiological reactions: a reduction in any sleepiness, tiredness and a stabilisation of mood. In the *Hormonorium*, the human eye could not detect the edge of the interior, only a bright whiteness. Through the directness of its impact on the human body, the installation did not have semantic and aesthetic references, instead reinforcing the physiological actions of the human organism: breathing, the reactions of the sense of sight, hormonal activity and initial sensory reactions. As a result, the interior stimulated human experiences and behaviours that are typical for hammam and temples, i.e. not only physiological reactions, but also their closely related psychological reactions.

Of the climate determinants of light, the one that has the strongest impact on human physiology is day length, dependent on the season of the year and latitude. The project called *The Second Summer Temporal Distortion Eybesfeld's Island*²⁷⁴ assumed the establishment of a climate island with a persistent summer on an area of 200 square metres in the locality of Eybesfeld and that would exist outside of the local climate.²⁷⁵ The climate of an 'endless summer' would also be simulated using light that would imitate sunlight (via illuminance and duration) on the day of the summer solstice on the 21st of June. In the Eybesfeld meadow, the day was to be of equal length throughout the entire year and last exactly 15 hours and 53 minutes from sunrise at 5.03 to sunset at 23.51, regardless of the local time of day or night.

The project of a private house for Fabrice Hybert in southern France²⁷⁶ was to ensure its owner 'shifted climate parameters' from those typical of the house's location to those typical of Tahiti, a volcanic island located on the Pacific Ocean (17 degrees and 31 minutes south and 149 degrees and 34 minutes north). Due to this 'shift', an optimal time of day and light brightness typical of Tahiti were determined (with a humidity of 50% and a temperature of 20 degrees Celsius), and a layer of soil with a chemical and biological makeup and temperature corresponding to those of Tahiti was prepared as well. This soil, under simulated lighting, is to be used to cultivate exotic plants that can condition the appearance of an organic and mineral airborne suspension typical of Tahiti.

Designs of climate islands make us aware of just how humans associate their well-being with the climate in which they live in, particularly the time of day and insolation.

The impact of individual spectra of light (visible to humans as colours of light) on physiology, particularly the production of melatonin, became the basis for the *Ghost Flat* installation.²⁷⁷ It was based on building the interior of an apartment consisting of a living room, bedroom and

²⁷³ The artificial climate in the *Hormonorium* was also achieved via a reduction of oxygen content in its interior, from 21% (a content typical of the standard composition of air in the troposphere up to 100 metres) to 14.5% (an amount typical for an elevation of 3000 metres above sea level).

²⁷⁴ Ph. Rahm, *The Second Summer Temporal Distortion Eybesfeld's Island*, climate installation design, Eybesfeld, Austria 2005.

²⁷⁵ The artificial summer would be generated by warm earth, maintained at a stable temperature of 8–12 degrees Celsius year-round. This warmth would be supplied to the soil via its own interior using a water and soil pump, fitted with a geothermal probe at a depth of 160 metres, attached to a water circuit at a level of 25 centimetres below the surface. Due to the probe, water at a temperature of 35 degrees Celsius would heat up the soil to the desired temperature.

²⁷⁶ Ph. Rahm, *Jardin D'Hybert*, climate installation design in a private house, Vendée 2002.

²⁷⁷ Ph. Rahm, *Ghost Flat*, artistic installation, Kitakyushu Centre for Contemporary Art, Japan 2004.

bathroom, in the same space solely by light waves with different wavelengths. The perception of the apartment's observer/user was to be shifted from typical dimensions of registering the interior into dimensions of the light spectrum, counted in nanometres and registered by the sense of sight not as a dimension, but as light with a specific colour. The bedroom, living room and bathroom thus occupied the same space when measured in centimetres, but changed their sizes in dimensions of light waves: the bedroom appeared in the electromagnetic field between 400 and 500 nanometres, the living room between wavelengths of 6000 to 800 nanometres and the bathroom—between 350 and 400 nanometres.

The impact that radiation of a specific colour has on human physiology was also illustrated by the project *Split Time Café*.²⁷⁸ Three interiors were designed in the cuboid, glazed mass of a café: one lit with yellow light that simulated 'endless night', a second one lit with blue light, that simulates 'endless day' and a third, that received local light from the surroundings of the café. At the *Split Time Café*, people could experience three different times simultaneously: one that was natural and two that were simulated. The yellow room simulated constant night due to waves with a length in excess of 570 nm (the human body starts to produce melatonin at this wavelength), and blue—constant day, as blue light stops the production of melatonin.

Although Rahm's extravagant idea of 'climate islands' and the practical idea of Twarowski's 'climate compositions', presented earlier, are in conflict with one another, both convincingly demonstrated the fundamental role that sunlight plays in human physiological processes and conversely, the precision of the human body's attunement to the perception of light. The physiology of this perception is the basis for the emotional and intellectual valuation of light in the interior as performed in the human mind in accordance with its knowledge of the world. In the light of contemporary science, it is the unconscious processes that comprise the mechanism of perception and the initial sensory experiences that are an essential tool for experiencing reality. These impressions are particularly important to the study, as they considerably contribute to the experiencing of the atmosphere of architecture by man and, being biologically conditioned, have a similar course in most humans.

II. 3. Psychological Determinants

Architecture is designed and valued by humans according to their psychological needs, being essentially linked with psychology. The development of the psychology of architecture is proof of this.²⁷⁹ Lenartowicz wrote:

Since the dawn of humanity, architecture has been focusing on shaping spaces that satisfy the needs of human behaviours. It thus naturally enters the field of psychology, which is a science about humans and their behaviour. Long before psychology came about as a notion and then as a science, architecture had to solve psychological problems inseparably tied with the process of creating and using the physical environment of human life.²⁸⁰

²⁷⁸ Ph. Rahm, *Split Time Cafe*, cafe design, Graz 2007.

²⁷⁹ See: J.K. Lenartowicz, *O psychologii architektury...*, *op. cit.*; J.K. Lenartowicz, term: psychology of architecture, [in:] W. Szewczuk (ed.), *Encyklopedia psychologii...*, *op. cit.*, p. 520–526.

²⁸⁰ J.K. Lenartowicz, term: psychology of architecture, [in:] W. Szewczuk (ed.), *Encyklopedia psychologii...*, *op. cit.*, p. 520.

The psychological determinants of the reception and building of the relationship between light and architecture encompass the psychological needs of individuals that concern the intensity and quality of sunlight in the interior. Sunlight defines the primary references to time, the manner of housing and valuation of reality in human life. Therefore, in alignment with Lenartowicz's statements on the 'psychological tendencies distinct for a given community',²⁸¹ we can also discuss communal preferences as to a specific form of sunlight in interiors (as they are a basis for creating tradition, they were included in the cultural determinants of the relationship under study and shall be discussed in the following section).

The psychological needs of the users of interiors are thus key to defining the psychological determinants of light in the interior. In the most essential distinction, Szewczuk divides individual needs into biological and acquired needs, which emerge over the course of an individual's life and are shaped depending on its conditions. In the case of humans, the biological needs listed previously as the impact of human physiology on the relationship between light and architecture undergo, as noted by Szewczuk, varying degrees of specification due to an individual's social relationships. Acquired needs fully refer to psychology, as they are 'socially conditioned and individually shaped. Contrary to biological needs, they are typically **human social needs**'.²⁸² Among them is the need for meaning, creation, learning, beauty, play, love, happiness, aid and sense of life. In particular, the need for: **m e a n i n g , b e a u t y , c r e a t i o n , l e a r n i n g a n d p l a y** are satisfied with considerable contribution from a specific form of light in the interior.

Psychological needs significantly affect the reception of the realised relationship between light and architecture and human expectations and motivations as to the interior under design. These needs are constantly revised over the course of one's life due to the collection of perceptual experiences (the 'internalisation of the world' according to Szewczuk). Similar experiences shape communities with similar psychological preferences.

The reception of the relationship between light and architecture is comprised of perception and sensory valuation: both emotional and intellectual (reflective), defined as evaluative perception.²⁸³ The matter of perception was discussed in the overview of the physiological perception of light (Chapter II.2.). It defined perception as sensory perception, which included physiological mechanisms along with their initial (uncontrolled) intellectual analysis, performed as a result of remembered experiences.

The role of congenital and acquired characteristics of perception is the object of research in psychology.

Of the major perception theories in psychology, we can list gestalt psychology and the theory by James Jerome Gibson,²⁸⁴ who studied matters of perception together with his wife, psychologist Eleanor Jack Gibson. The nativist theory of gestalt psychology, which bases perception on organisational rules within the field of view, as studied by the brain, is currently seen as highly questionable,²⁸⁵ yet some admit that it provided 'a brilliant set of demonstrations of organisational phenomena in perception that are still valid, and pose a challenge to modern theories of perception'.²⁸⁶ It is these organisational phenomena described by Guillaume's gestalt psychology that Juliusz Żórawski based his theory of the structure of architectural form on.²⁸⁷ According to this theory, prior to an observation's evaluation (e.g. following Żórawski's theory, in categories of compact and loose formations and strong and weak formations), there must be a time to experi-

²⁸¹ *Ibidem*.

²⁸² W. Szewczuk, term: needs, [in:] *idem* (ed.), *Encyklopedia psychologii...*, *op. cit.*, p. 436. Szewczuk's words in bold.

²⁸³ J.K. Lenartowicz, *O psychologii architektury...*, *op. cit.*

²⁸⁴ See: J.J. Gibson, *The Perception of the Visual World*, Boston 1950.

²⁸⁵ From: P.C. Dodwell, *Podstawowe mechanizmy widzenia...*, *op. cit.*

²⁸⁶ *Ibidem*, p. 24.

²⁸⁷ J. Żórawski, *O budowie formy architektonicznej* (1962), Warszawa 1973.

ence the observation of shape, distance and depth, size, the surroundings, the place and colours that are dependent on individual brain capacity.²⁸⁸

Gibson's theory argues that visual stimulation of the image is coherent due to an 'optic array', the physical structure of light that reaches the observer's eye. This coherence is therefore not the result of the organisational function of the brain, as argued by gestalt theory, but acquired sensory experience. According to Gibson, it is learned by individuals and not an innate function of the brain that leads to specific perceptual capacities. Learning is based on 'coming to differentiate and discriminate among the features of the environment, represented in the optic array'.²⁸⁹

At present, the coexistence of two different types of perceptual learning are highlighted: synthetic learning, responsible for an infant's ability to coordinate images and sounds important to creating notions of 'object permanency'²⁹⁰ and analytical, responsible for, for instance, an infant differentiating the faces of two different people from their surroundings. Synthetic perception leads to learning about objects in terms of their functional attributes, while analytical—in the aspect of perceived characteristics²⁹¹. The second type is key in the perception of light in the interior as it allows us to tell apart shades of colour, spots of shadow and light, the gradation of shadows on elements of an interior's boundary and within its space.

The differentiated elements of the perception of light in an interior: perception and evaluative perception, while almost simultaneous, mutually affect each other and ultimately combine into one experience of reality that is essential to the perception of the atmosphere of architecture. It includes both physical perception: sensory, susceptible and utilitarian (directly associated with biological needs), such as emotional and intellectual perception of light in the interior. It is therefore conditioned both by the ability and sensitivity of the senses of a specific individual, as well as their personality, personal experience, and general education. Lenartowicz also noted that personality is not a permanently defined quality, but 'undergoes low-amplitude fluctuations along with a person's mood and behaviour', and is linearly variable between the poles of introversion and extraversion as time goes on, reinforcing human genetic tendencies.²⁹²

The analysis of perception presented below was incorporated into the psychological determinants of the relationship under study, as it fits the scope of—as framed by Lenartowicz—'fundamental somatic activities that determine activities organised higher'. This scope includes the field of perception in which the sensory recordation of light in the interior and its unconscious intellectual perception lead to the emergence of specific sensory experiences, and that is important in the study.

The multi-sensory perception of the relationship between architecture and light, as mentioned in the overview of the impact of human physiology, is also caused by the coordination of sensations from different senses, i.e. 'sensory polyphony'.²⁹³ Philosophers and architects who criticise the oculo-centrism of contemporary architecture (Maurice Merleau-Ponty, Juhani Pallasmaa), also highlight the essential role of visual experiences in concert with other senses. The coordination of sensory experiences can have an atypical course, as in synaesthesia (Greek *synaisthesis*—union of the senses), which causes experiences of the sense of sight to also produce experiences distinct of other senses: for instance, saying or imagining a letter or number causes an association with colour that has a specific brightness that is always identical for a given number or letter (the author can confirm this type of synaesthesia from personal perceptive

²⁸⁸ From: J.K. Lenartowicz, *O psychologii architektury...*, *op. cit.*

²⁸⁹ P.C. Dodwell, *Podstawowe mechanizmy widzenia...*, *op. cit.*, p. 32.

²⁹⁰ *Ibidem.*

²⁹¹ *Ibidem.*

²⁹² See: J.K. Lenartowicz, *O psychologii architektury...*, *op. cit.*, p. 110.

²⁹³ See: G. Bachelard, *Poetyka marzenia*, transl. L. Brogowski, Gdańsk 1998, p. 14.

experiences). As underscored by Gregory and Colman, the full, bodily experience of the world is essential, because it is real:

The eyes have imperfect images; the skin has depressions from objects in contact; the ears receive vibrations of the air; the nose analyses particles chemically. But what we experience is far more than pictures and touches and vibrations and dust.²⁹⁴

That which is more complex and yet is singular—is atmosphere. Contemporary psychology not only differentiates the senses, but also organises them. For instance, Gibson grouped them into five sensory systems: the visual system, the auditory system, the taste-smell system, the basic-orienting system and the haptic system.²⁹⁵ Meanwhile, in anthropology and psychology as based on Rudolf Steiner's studies, there are twelve senses: touch, life sense, self-movement sense, balance, smell, taste, vision, temperature sense, hearing, language sense, conceptual sense and ego sense.²⁹⁶ The sense of sight cooperates with the other senses, particularly with the sense of touch. Pallasmaa even believed that 'all the senses, including vision, can be regarded as extensions of the sense of touch—as specialisations of the skin',²⁹⁷ which is why he states that the sense of touch can be considered the 'subconscious of sight'.²⁹⁸ This is due to the fact that the eye touches, implying unconscious touch while also using the body's haptic memory ('vision reveals what the touch already knows').²⁹⁹ This is essential to the perception of atmosphere as it applies to the visual 'apprehension of materiality, distance and spatial depth' that 'would not be possible at all without the cooperation of the haptic memory'.³⁰⁰ Pallasmaa references George Berkeley and states that 'vision needs the help of touch, which provides sensations of "solidity, resistance, and protrusion", sight detached from touch could not "have any idea of distance, outness, or profundity, nor consequently of space or body"'.³⁰¹ Apprehending the interaction of different senses (or leaving it unmutated) that cooperate with vision is essential to the 'first contact with the world, unmediated by the mind',³⁰² that is also called the 'non-reflective contact with the world'.³⁰³ First impressions, which are tied with the physiology of the body and the first, unconscious action of the brain the strongest, allow humans to reach the living tissue of the world's carnality³⁰⁴ and immerse themselves in it.

The carnal experience of architecture as an environment of life was discussed at length by Kengo Kuma.³⁰⁵ The direct relationship between the human body and architecture allows him to use the term *body of architecture* without its metaphorical meaning, but to highlight that architecture, by having its materiality—physical properties—constantly adapts and revises its structure to the environment similarly to the human body. The relationship between the human body and the matter of

²⁹⁴ R.L. Gregory, A.M. Colman, *Czucie i percepcja...*, *op. cit.*, p. 7.

²⁹⁵ From: J. Pallasmaa, *Oczy skóry...*, *op. cit.*, p. 51.

²⁹⁶ *Ibidem*, endnote 84.

²⁹⁷ *Ibidem*, p. 51, 52.

²⁹⁸ *Ibidem*, p. 53.

²⁹⁹ *Ibidem*.

³⁰⁰ *Ibidem*.

³⁰¹ *Ibidem*. Pallasmaa quoted [from:] S. Houlgate, *Vision, Reflection and Openness: The "Hegemony of Vision" from a Hegelian Point of View*, [in:] D.M. Levin (ed.), *Modernity and the Hegemony of Vision*, Berkeley–Los Angeles–London 1993, p. 100.

³⁰² K. Wilkoszewska, *Od Redakcji*, [in:] *idem* (ed.), *Estetyka czterech żywiołów...*, *op. cit.*, p. 7.

³⁰³ Cf. A. Berleant, *Wrażliwość i zmysły. Estetyczna przemiana świata człowieka*, transl. S. Stankiewicz, Kraków 2011.

³⁰⁴ A. Berleant, *Wrażliwość i zmysły...*, *op. cit.*, p. 112.

³⁰⁵ See: K. Kuma, *Anti-Object* (2000), London 2008; *idem*, *Defeated Architecture*, Tokyo 2004; *idem*, *Materials, Structures, Details*, Basel–Berlin–Boston 2004.

architecture manifests itself in the ‘replaceable act of experiencing/building/experiencing the matter of architecture’.³⁰⁶ Kuma wrote:

We are composed of matter
and live in the midst of matter.
Our objective should not be to renounce
matter, but to search for a new form of matter
other than objects.
What that form is called
—architecture, gardens, technology—
is not important.³⁰⁷

Matter, as an element that is shared by the body, the environment and architecture, is a territory of mutual flows and impacts.³⁰⁸ The bodily sensation of architecture, in practice, means to experience its materiality in one’s own body. In this situation, the material of architecture, by resonating within the human body, becomes as if equivalent to the experience of an interior/environment/surroundings and allows one to experience harmony: ‘we are composed of matter and we live in the midst of matter’. In Kuma’s view, architecture is not an object placed on a site and detached from it, but is a part of the environment’s structure.³⁰⁹ Filled with this idea, Kuma treated his own body as an instrument of identifying the physical characteristics of interiors. The sensual body collects over its lifetime a trove of experiences, ones that are typically not immediately known, but become such only after some time. For instance, Kuma explained his aversion to concrete interiors and his affirmation of wooden ones with openwork walls by the reactions of his body and his childhood experiences.

Even then, I kept a distance from the excited crowd because the “too-close” style of the exposed concrete box did not harmonize well with my physical senses. I could not breathe, my muscles became strained, and my body temperature dropped when I entered such boxes. I do not know what brought about such reactions. It may have had something to do with the fact I was born and raised in a pre-war Japanese wood frame residence. This house was originally constructed by my grandfather, who was a doctor in Ohi, Tokyo, as a weekend farming residence. It was simple, with plenty of ventilation. Moreover, both my grandfather and father abhorred the inhuman texture of the aluminium window frames so much that when the house was added onto or renovated, only wooden window frames allowing draughts to flow in were permitted. Exposed of concrete was of course visually pleasing enough, but on the other hand, my physical senses, trained by the perhaps too open house I grew up in, could not completely become adapted to the idea of the exposed concrete box.³¹⁰

Kuma admitted that allowing his body to speak as an instrument of identifying the environment marked a turning point in his career.

Peripheral vision, which is not focused on anything, and is immediate and unconscious, plays a significant part in creating initial sensory experiences. Pallasmaa compared it to the experience of humans finding themselves instinctually in long-inhabited spaces, while Zumthor called them simply the first, unconscious reaction of the senses:

³⁰⁶ B. Stec, *Materialność jako relacja...*, *op. cit.*, p. 36–44.

³⁰⁷ K. Frampton, K. Kuma, *Kengo Kuma: Complete Works*, London 2013, cover on the back of the book.

³⁰⁸ T. Ingold, *Splatać otwarty świat*, transl. E. Klekot (ed.), Kraków 2018.

³⁰⁹ See: K. Kuma, *Anti-Object...*, *op. cit.*

³¹⁰ K. Kuma, *Materials, Structures, Details...*, *op. cit.*, p. 6.

The world of emotions is highly complex and distributed over time. However, prior to the conscious reaction there are the sensory, unconscious reflexes, which all but attack us. Then comes intelligence and later, the intellect. [...] I think that it is the first, slightly naive impression that is important in design.³¹¹

Peripheral and focused vision are mutual opposites. Pallasmaa noted that focused vision ‘confronts us with the world’, while peripheral vision ‘envelops us in the flesh of the world’.³¹² The suggestive terms used by Pallasmaa prove that peripheral vision is essential to the experience of the atmosphere of the interior.

A remarkable factor in the experience of enveloping spatiality, interiority and hapticity is the deliberate suppression of sharp, focused vision. This issue has hardly entered the theoretical discourse of architecture as architectural theorising continues to be interested in focused vision, conscious intentionality and perspectival representation. The very essence of the lived experience is moulded by hapticity and peripheral unfocused vision.³¹³

Peripheral vision is not only quicker from conscious vision, as observed by Zumthor, but is also broader, capable of perceiving complex environments and atmosphere.³¹⁴ Zumthor and Pallasmaa concordantly note primacy of experiencing the holistic atmosphere of the environment relative to the conscious observation of details.

The preconscious perceptual realm, which is experienced outside the sphere of focused vision, seems to be just as important existentially as the focused image. In fact, there is medical evidence that peripheral vision has a higher priority in our perceptual and mental system.³¹⁵

In peripheral vision, sight apprehends primarily light—it senses its brightness within a certain range. This light can alter the actual dimensions of an interior, its smells, its colours, it can expose a given material or shape while blurring another, according to the strength of their first unconscious effect on the person. The initial sensual perception of light in the interior is therefore essential not only because it informs us more or less sufficiently of the objective characteristics of the interior prior to submitting the information to ‘the judgement of the intellect’,³¹⁶ but also because it allows the body to immerse in the space of the interior, give pause to this judgement and initiate a multi-sensory, uncontrolled and natural resonance of the body.

Perception of light in the interior, which defines its sensual and utilitarian perception, is less subjective than its intellectual evaluation. Optimal interior lighting allowing us to orient within it, to read, sleep or look at sculptures, is similar for most people. Lenartowicz lists the following chain of dependencies: the physical properties of the surroundings affect the objective properties of these surroundings, while these—affect the subjective properties as perceived by the observer.³¹⁷ In reference to the relationship under study, we can present these dependencies on the following example: an oculus in a cylindrical interior affects the relationship between light and architecture and conditions the uniform illumination of its boundary by cool and stable light, which affects the subjective perception of this interior by humans. Observing the interior’s clear shape occurs in most people, while the interpretation

³¹¹ P. Zumthor in an interview: B. Stec, *Trzy rozmowy z Peterem Zumthorem*, “Architektura & Biznes” 2003, no. 2 (127), p. 21.

³¹² J. Pallasmaa, *Oczy skóry...*, *op. cit.*

³¹³ *Ibidem*, p. 17, 18.

³¹⁴ *Ibidem*, p. 19.

³¹⁵ *Ibidem*.

³¹⁶ *Ibidem*, p. 53.

³¹⁷ J.K. Lenartowicz, *O psychologii architektury...*, *op. cit.*

of this observation can vary: some will enjoy the shape of architecture or the regularity of the cylinder and dome, while others will be bored with the excessive obviousness of geometry; it will incline some to analyse the laws of optics, while others—to mystical experiences.

While remaining within the field of the subjective properties of perception, the relationship under study can tune experiences (emotions) or enrich them.

In the first case, light in the interior tunes experiences (emotions) in a manner that is more or less pleasant relative to the degree to which it corresponds to a given person's expectations and motivations (this is the functional and aesthetic impact on human experiences when it pertains to the 'connotative aspect of meaning', which refers to questions such as 'how much do I like these surroundings?').³¹⁸

In the second case, light in an interior (in a surrounding space) enhances experiences (emotions) 'via multi-lateral denotative associations [...] i.e. the linking between two or more phenomena of consciousness, as a result of the occurrence of one of these elements causes the occurrence of the second element or the remaining elements'.³¹⁹ In this case, the denotative aspect of the meaning of light in the interior (surrounding space) 'refers to answers to questions such as "what is this?", "what does this represent?". Denotation covers clearly defined elements of the experience, associated with one's knowledge, and which corresponds to the objective content of the vehicle of meaning'.³²⁰

The first case can be referred to the ambience of the relationship under study, while the second—to its projection capacity (Chapter I. 1.3.). Both cases, although they belong to the subjective properties of perception, fundamentally affect the design of the relationship under study and its valuation., due to similar perceptual experiences in numerous people which enable understanding between the interior's designer and user.

For instance, it can be stated that darkness objectively decreases human ability to visually perceive the interior, which is why it produces similar subjective reactions in most people: uncertainty, anxiety or fear, while enhancing senses other than sight. Not seeing objects allows us to imagine them, which is why darkness objectively enhances introversion and the activity of the imagination. Because it is easy to hide something embarrassing or evil in darkness (also ugliness or an unacceptable act), we colloquially refer to dark acts or shady persons. A brightly illuminated interior, conversely, leads most people to feel safe (we can assess danger) and enhances extraversion (drawing our vision to the surroundings, exploring them). Insofar as similar perceptual experiences lead to a similar emotional reception of darkness as suspect, dangerous, sad and brightness as trustworthy, safe and joyful, the degree of an interior's brightness or darkness that is considered optimal cannot be so easily defined by similar values among different people (proof of this includes the difference in treating shadow and light in interiors in the cultures of the West and the Far East, that shall be discussed in the following section).

Most people similarly perceive differences between dark and bright spots in an interior. Contrasts are overbearing to visual experiences, they disrupt the uniform image of the interior into fragments, obscuring the vision of its actual shape (either remembered or sensed by touch), which is why they cause most people to be stimulated in the range of: from tension, to refreshment, to interest or exasperation, to dramatism. Slight differences, i.e. a gradation of shadow and light, conversely, highlight the clarity of the actual shape of the interior, its rational perception, good orientation within it. Thus, it induces calmness, docility and a sense of safety. However, if the differences between the shaded and illuminated places of the interior are almost indistinguishable, people can feel a loss of orientation in them (different places at different distances from the observer look similar), disorientation, melancholy, boredom or tiredness.

³¹⁸ *Ibidem*, p. 153, 154.

³¹⁹ *Ibidem*, p. 154.

³²⁰ *Ibidem*.

The similarity of perceptual experiences allows us to shape light in religious interiors in ways so that they attune the human psyche and emotions to prayer and metaphysical experiences.³²¹ This can be seen in temples and religious urban or landscape interiors of many religions, ranging from the dawn of history to the present.³²² Le Corbusier explicitly stated that emotion comes from that which is seen with the eyes—light or its absence.³²³ Rosier-Siedlecka, when analysing religious interiors from the 1950s, 60s and 70s, referred to Le Corbusier's thought and highlighted the psychological role of light that defines the emotional expression of the entire temple. She wrote:

It is primarily the game of light that gives an interior a religious character and intimate ambience. It is the game of light that is this magic that creates an 'ineffable space', the poetics of the interior, an atmosphere that is conducive to focus and prayer, that psychologically dematerialises the building.³²⁴

The similarity of perceptual experiences in humans is widely used in theatrical stage design, as stages are to inspire similar, intense experiences in the audience.³²⁵ Based on this similarity, art transcends cultural boundaries.

People are mostly phototropic and move towards and orient themselves towards light. This is why they prefer to be present in places which expose this direction—between shadow and light, for instance on verandas, in openwork gazebos, seated near windows or in the thickness of walls,³²⁶ on low windowsills.

Emotional perception also includes human aesthetic tastes which, despite their subjectivity, do display a range of similarities. The human mind has an innate propensity to favour certain patterns, regardless of their role in everyday experience,³²⁷ such as the harmony of form or its relatively low complexity. When referred to the relationship between light and architecture, harmony can be understood as a balance between spots of shadow and light in the interior or the equivalence between actual and exposed physical properties of the interior. Another favoured pattern is an optimal degree of complexity, i.e. the desired balance between complexity and 'stimulant brightness'.³²⁸ Lenartowicz even stated that it is possible to psychologically measure the 'optimal distribution of simulation between the poles of 'too simple' and 'too complex'.³²⁹

The specific exchange that takes place between the person that perceives a work of art and the work itself was noted by Pallasmaa:

When experiencing a work of art., a curious exchange takes place; the work projects its aura, and we project our own emotions and percepts on the work. The melancholy in Michelangelo's architecture is fundamentally the viewer's sense of his/her own melancholy enticed by the authority of the work.³³⁰

Pallasmaa noted the existence of a work's 'aura' that allows a peculiar exchange between the matter of the work and human emotion and judgement of the work.³³¹ From the context of

³²¹ See: J. Rabiej, *Światło i kolor...*, *op. cit.*

³²² Due to the close relationship between religion and culture, a broader overview of light in religious spaces was included in Chapter II.4. Cultural Determinants.

³²³ Cf. F. Biot, F. Perrot (et al.), *Le Corbusier et l'architecture sacrée...*, *op. cit.*, p. 74.

³²⁴ M.E. Rosier-Siedlecka, *Posoborowa architektura sakralna...*, *op. cit.*

³²⁵ See: A. Franta, *O reżyserii przestrzeni...*, *op. cit.* and B. Stec, *Aspekty scenografii w architekturze...*, *op. cit.*

³²⁶ Ch. Alexander (et al.), *Język wzorców...*, *op. cit.*

³²⁷ Cf. J.K. Lenartowicz, *O psychologii architektury...*, *op. cit.*, p. 101–107.

³²⁸ A term from: J.K. Lenartowicz, *O psychologii architektury...*, *op. cit.*, p. 103.

³²⁹ *Ibidem.*

³³⁰ J. Pallasmaa, *Oczy skóry...*, *op. cit.*, p. 79.

³³¹ From: *ibidem*, p. 790.

this statement, we can infer that what Pallasmaa understands as the aura of the work of art is that which is the atmosphere of architecture.

Experiences stimulated by perceiving light in the interior were analysed by Rasmussen.³³² In his descriptions, he typically went no further than to carefully record the physical properties of the relationship between light and architecture and its use and experience, only sometimes going as far as to explore intellectual meaning and cultural interpretation. In his view of sunlight in the interior we can clearly observe the aspect of atmosphere.

The valuation of light in the interior as described by Rasmussen was tied to his personal expectations and his vision as to the optimal light for specific interiors, yet they can be summarised as rather typical. Rasmussen did not refer to specialist knowledge or extraordinary cognitive devices. On the contrary, he pointed to simple emotional reactions that form in the human mind under the influence of the careful observation of the environment. To most people, just like to Rasmussen, light that does not expose geometries, i.e. shape, that is excessively bright, is 'characterless'.³³³ Likewise, the impressions of an interior being either closed or open, as obtained through light and described by Rasmussen, are sensations that are typical for most people.

Experiences elicited by perceiving reality are the basis of the method of designing and building architecture by Zumthor. In his book *Atmospheres*, he presented an in-depth analysis of interior elements that comprise his subjective perception of the atmosphere of architecture. Zumthor pointed to the inseparability of sensual perception from the emotional experience of an interior, which is why his statements about architecture are deeply personal. However, to Zumthor, the basis for subjective experience is the careful and long observation of the interior as it is in a given place and time and in a given light.

Perception, based on enhancing the experience of humans—the observer of the relationship between light and architecture, is linked with its intellectual interpretation. Lenartowicz, by referencing to, among others, the thoughts of Roman Ingarden on the work of architecture³³⁴ and the interpretation of works of architecture by Bonta (a category that applies to individual determinants of the reception of works of architecture), pointed to the complexity of intellectual perception. It is tied to, among others, changes in this interpretation over time. Lenartowicz noted that the categories of a work of architecture's interpretation as given by Bonta are as follows: 1) blindness, complete obliviousness, 2) precanonical reaction, 3), official interpretation, 4) canonical interpretation, 5) categorisation, assignation to a type, 6) propagation, 7) grammatical analysis and gradual fading into obscurity, 8) metalinguistic analysis, 9) reinterpretation.³³⁵

In this analysis, one can only suggest the impact of the psychological factor on the preferences of traditional, contextual and domestic form light in the interior as seen by the observer, which shall be discussed in detail in the following section.

Light takes part in preparing the interior to act as a 'meeting space', which is associated with the 'theory of meeting'.³³⁶ According to this theory, humans adapt a given place to meet (another person, a book, a computer, an architecture). This adaptation is based on, among others, three procedures associated with light:—ensuring sufficient illumination for the meeting, —an illumination that can 'further enhance it, act in an inspiring manner or create a proper atmosphere (e.g. provide devices that can facilitate ambient illumination)'³³⁷—proper direction of light. If a person

³³² S.E. Rasmussen, *Odczuwanie architektury...*, *op. cit.*

³³³ A term used by Rasmussen in: *ibidem*.

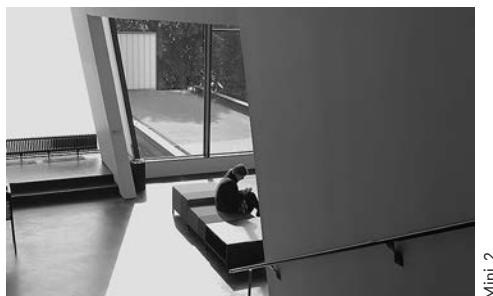
³³⁴ See: R. Ingarden, *O dziele architektury*, [in:] *idem, Studia z Estetyki*, vol. 2, Warszawa 1966.

³³⁵ J.K. Lenartowicz, *O psychologii architektury...*, *op. cit.*, p. 86.

³³⁶ From: J.K. Lenartowicz, *O psychologii architektury...*, *op. cit.*

³³⁷ *Ibidem*.

adapts a place to a meeting with architecture and sunlight, they practically lead to the exposure of specific physical properties of architecture and the nature of sunlight itself.



Mini. 2

The interior of a house is a ‘meeting place’. Pallasmaa suggestively framed it by writing:

Our domicile is the refuge of our body, memory and identity. We are in constant dialogue and interaction with the environment, to the degree that it is impossible to detach the image of the Self from its spatial and situational existence. “I am my body”, Gabriel Marcel claims, but “I am the space, where I am”, establishes the poet Noël Arnaud.³³⁸

The relationship between light and architecture in the home adapts its interiors for the resident to meet those closest to them and themselves. ‘The fact is that very few things have so much effect on the feeling inside a room as the sun shining into it’.³³⁹ To Alexander, a bright house is a pleasant house, and a dark house is a gloomy house. For a house to be pleasant, one should first properly expose its interiors southwards. Of course, specific planning must be conditioned by the individual needs of residents, but it is typically easy to identify residential functions that require the application of specific types of sunlight. For a long house, it is optimal to orient it along the east-west axis so that it will have a longer southern exposure. However, this layout requires the possibility of building a garden from the south, as bushes and trees can properly filter southern light and obtain its proper form before it enters the interior. Alexander listed examples of interiors that can be prepared as ‘meeting spaces’ thanks to specific types of light (pattern 128):

1) a porch that gets the evening sun late in the day; 2) a breakfast nook that looks directly into a garden which is sunny in the morning; 3) a bathing room arranged to get full morning sun; 4) a workshop that gets full southern exposure during the middle of the day; 5) an edge of a living room where the sun falls on an outside wall and warms a flowering plant.³⁴⁰

Interiors where people are often present because of use-related circumstances should be attuned to south-eastern and south-western light, while pantries, storage spaces and garages—to shaded areas from the north. People take pleasure in waking up because of the sun (pattern 138), which is why bedrooms should be placed from the east. Alexander linked specific relationships between light and architecture with pleasure experienced by people. And so, people find it pleasant to prepare meals on a counter illuminated by light (pattern 199), light from two sides in a room (pattern 159), having a ‘sunny place’ in a house (pattern 161), the ability to ‘open a window

³³⁸ J. Pallasmaa, *Oczy skóry...*, *op. cit.*, p. 77. Pallasmaa gives two quotes here: 1) a statement by G. Marcel from: H.L. Dreyfus, P. Allen Dreyfus, *Translators’ Introduction*, [in:] M. Merleau-Ponty, *Sense and Non-Sense*, Evanston 1964, p. XII, 2) a statement by N. Arnaud from: G. Bachelard, *The Poetics...*, p. 137.

³³⁹ Ch. Alexander (et al.), *Język wzorców...*, *op. cit.*

³⁴⁰ *Ibidem*, p. 625.

wide' (pattern 236). Human phototropy makes it pleasant for people to reside in a 'scenery of events' formed by the 'tapestry of light and dark'—a mixture of brighter and darker interiors or places and, something that can very often be seen in everyday practice in our homes, to sit on the border between brighter and darker interiors (or brighter and darker places in a single interior), for instance near windows. Alexander's psychological analyses bring to mind Vitruvius' advice that pertained to practical and health-related effects of the proper planning of the interior of the home (according to the lifestyle of ancient Romans in Vitruvius' times), which allowed one to satisfy psychological needs.

Impact of Psychological Determinants on the Shaping and Perception of Light in the Interior: the Case of Venice

The impact of psychological conditions on the shaping and perception of the relationship between light and architecture can be illustrated, similarly to physical determinants, on the example of Venice. Ewa Bieńkowska noted that Venice taught one to look:

Each of its times of day and seasons of the year or the whims of its weather was a lesson on how the theatre of visibility plays out, how planes and depths emerge. How objects stand before us and how they escape us. How they inhabit their surfaces and how they can leave them. What happens to colours when the variable shine of the lagoon falls upon them, how the shapes organise when they line the serpentine trail of a canal or the crescent-shaped coastline. What is twice-reflected light, from the water and from stone; how it allows to penetrate into the hidden substance of things and how it keeps us as at a distance, in an illusion.³⁴¹

Bieńkowska and Brodsky³⁴² wrote of the 'autonomy' of the human eye that looks at Venice. In this city, people become 'additions' to their eyes or their 'vehicles'. The relationship between light and architecture that is experienced here every day has fundamentally affected the capacity for vision in the people who shaped this city. In Venice, where plants are typically hidden in 'secret gardens',³⁴³ the seasons of the year are to this day identified by the quality of light, its intensity and warmth, the place of the setting sun in the panorama of Marghera and the place of the rising sun in the panorama of Lido, by the hour when light fully embraces the marble facade of San Giorgio Maggiore, entirely bright by the nature of its material, by the colour or intensity of the light and the depth of the shadow at a specific campo. The sunny summer day exposes warm light that melts the image of architecture, while the humid autumn day—the light of the mist, the sunny winter day—the crystalline purity of the interior space that makes the image of its boundary surreally vivid.

The light of the sun, doubled by reflection in the water, causes the impression of brightness to dominate within the perception of the city and sharpens its image at the cost of the sense of depth of its interiors and the possibility of abstract thinking. Bieńkowska noted this, writing of a certain 'superficiality' of the world's sensual perception that Venice attunes people to.

It can be said that Venice is an anti-theoretical place, entirely formed by practice, as if its successive builders turned risk into their course of action: to try and see what will become of it. However, it is also a place of constant bewilderment, of asking questions. From the most detailed: how was something like this materially possible? —to less specific ones: what happens with the vision that learns and matures in this environment?³⁴⁴

³⁴¹ E. Bieńkowska, *Co mówią kamienie Wenecji...*, *op. cit.*, p. 238.

³⁴² J. Brodsky, *Znak wodny...*, *op. cit.*

³⁴³ Cf. C. Moldi-Ravenna, T. Sammartini, photographs: G. Berengo Gardin, *Giardini Segreti a Venezia*, Verona 1997.

³⁴⁴ E. Bieńkowska, *Co mówią kamienie Wenecji...*, *op. cit.*, p. 236.

Light in Venice's interiors considerably affects the customs and habits of its residents, which remain closely tied to the daily and yearly solar rhythm: it guides those who go on walks and adapts specific squares and arcades to a given function. The need for light or shadow for specific activities or behaviours is associated with the pursuit and creation of places wherein residents either capture light or flee from it. One example is Venice's famous *ombra*, which gave rise to the custom of drinking an aperitif in the shade of Piazza San Marco in the afternoon, when the shadow of the tower is expansive enough that a group of friends can hide in it. One can then delight in both the drink itself and the view of the city while in a cool shade.

The ability to perceive various forms of light in interiors that a person who walks across Venice can find themselves in is associated with experiencing joy. For instance, the centre of Venice—Piazza San Marco with the Piazzetta and Bacino San Marco—are bathed in the sun for the major part of sunny days. The Piazzetta and Bacino in particular are exposed to the southern light and admit it deep into the area in front of the Basilica of San Marco. It is the most expansive and open fragment of the city within its dense and shaded tissue. The decision to place the city's formal square on the southern coast of the island began a chain of dependencies that contributes to the exceptional mutual exposure of architecture and light. On the square, on a sunny day, the side light from the side of the Piazzetta and the opening of the lagoon exposes the sculpted marble texture of the basilica.

Brodsky's *Watermark* includes suggestive descriptions of the author's experiences and feelings caused by the Venice variation of the relationship between sunlight and architecture. He typically visited his favourite city in winter, when people who go on walks cling to sunny places and expose their faces to the sun, although its low rays blind the eyes at this time of year. Brodsky delighted in the winter light in the Piazzetta's interior:

The sky is brisk blue; the sun, escaping its golden likeness beneath the foot of San Giorgio, sashays over the countless fish scales of the laguna's lapping ripples; behind you, under the colonnades of the Palazzo Ducale, a bunch of stocky fellows in fur coats are revving up Eine Kleine Nachtmusik, just for you, slumped in your white chair and squinting at the pigeons' maddening gambits on the chessboard of a vast campo. The espresso at your cup's bottom is the one black dot in, you feel, a miles-long radius.³⁴⁵

At the same time, the author of *Watermark* investigated (from a poet's point of view), what this extraordinary and observable role and activity of the eye in Venice is based on and how the eye cooperates with the brain and the human psyche:

In the morning this light [...] having pried your eye open like a shell, runs ahead of you, strumming its lengthy rays [...] "Depict! Depict!" it cries to you, either mistaking you for some Canaletto or Carpaccio or Guardi, or because it doesn't trust your retina's ability to retain what it makes available, not to mention your brain's capacity to absorb it. Perhaps the latter explains the former. Perhaps they are synonymous. Perhaps art is simply an organism's reaction against its retentive limitations. At any rate, you obey the command and grab your camera, supplementing both your brain cells and your pupil.³⁴⁶

In winter, the warmth of sunny places holds people, and chases them away from shaded ones. The Piazza and Piazzetta in front of the Bacino San Marco also hold the passerby because light extracts this area's theatricality. The passerby easily becomes an observer, caught at the edge of the Bacino by the charm of the perspective of the island and the San Giorgio Maggiore and the panorama of La Giudecca laid out before their eyes. They are also caught by the watery mirror underneath their feet, onto which they cannot step on, but which lights their way via an additional

³⁴⁵ J. Brodsky, *Znak wodny...*, *op. cit.*, p. 61, 63.

³⁴⁶ *Ibidem*.

light from underneath. The surface of the water in perspective creates and maintains a distance between people on opposite shores, on its two sides. In this urban theatre, light plays a fundamental role—without it there would be no exposure, no enticement, no joy, no transformation of utilitarian architecture into theatrical decoration. During specific times of day and the year light exposes other urban interiors. For instance, Zattere, the southern fondamenta of Venice, typically become more populated in the afternoon, when the sun diagonally lets in the low, golden and orange rays of the sunset directly onto the facade of San Giorgio Maggiore, falling on the white Istrian marble in the Palladian composition as if on the screen of a theatrical prospect. Another spectacle is provided by the north-eastern Fondamenta Nuove, which are covered in shadow for most of the day and open towards the lagoon with an illuminated panorama of the San Michele cemetery.

From the brightly illuminated campi³⁴⁷ and Piazza, one can enter an urban labyrinth formed by narrow pedestrian streets and passages: rive, rughe, saliziade, calli, small bridges and waterways: canali and rio. The narrow streets and canals are often shaded, and if any direct sunlight falls into them, then it does so for only few minutes, perhaps a dozen or so. The intertwining of canals with pedestrian paths makes it easy to perceive the difference between the shaded matter of water and that of the stone floors. One gets the impression of shadow's materiality. Shadow is derived from the object that casts it and takes from it only its shape, for it owes the matter of its infinitely thin layer entirely to the substance on which it falls. The intersections of calle and rio, where the shining and dynamic shadow on the water meets the matte and static shadow on the stone, one can actually notice the materiality of shadow: the wet and soft and the dry and hard. By analogy, matter imparts itself onto the light that falls on it as well, creating soft and hard, and fluid and dry reflections.

Underneath bridges, where one can expect the greatest amount of shade, the reflections off of the water's surface produce vibrating veins. This phenomenon was used by Carlo Scarpa and artist Mario di Luigi in *Arcosolio* (a small symbolic bridge), located in the Brion Family mausoleum in San Vito di Altivole. Mario di Luigi clad the underside of this bridge, which was suspended above the graves of the Brion family, with a golden mosaic, which reflects rays previously reflected from the earth. This phenomenon produces associations with the reflection of light from the water as seen on the underside of Venetian bridges (underneath which golden veins are produced not by a golden mosaic, but by the reflection of sunlight off of the water) and thus—of the suggestion that underneath the *Arcosolio* there flows the directly unobservable *water of life*.

The placement of Venice's cemetery on the island of San Michele is likewise spectacular. The island, which can be seen from the northern, shaded shore of the city, appears to shine brightly, bathed in sunlight. Thus, people go on their last voyage from the dark into the light.

Walking along the narrow streets of Venice strengthens the pedestrian's experience of the matter that creates the boundary of local interiors. Perceiving walls, fences and floor surfaces from up close can be immediately verified via touch and, conversely, involuntarily brushing against the material of interiors makes the perception grounded in haptic contact and more fully records the properties of materials: roughness, smoothness, granularity, hardness and softness, even weight and lightness. Close cooperation between the eye and touch is common in this city.

Binding customs with the solar rhythm, as intensively as in Venice, is the source of its painterliness and ambience. In Bieńkowska's opinion, the primary thread of Venetian painting

³⁴⁷ See: S. Bettini, *Venezia nascita di una città*, Milano 1978. Campo denotes a field and not a square, as there had been only a single square (piazza) in Venice for a very long time: Piazza San Marco together with the Piazzetta. In the nineteenth century, a second square was built: Piazza Le Roma. The names campo and campiello are derived from the fact that these areas were often used to grow vegetables, to graze animals and as water sources (the wells provided clean water via stormwater filtration).

[...] is built on observations of solar phases and variations, spun from attention to the everyday operation of the sun, that we learn as soon as we have settled here—either for many years or for but a week. All the four times: the white mornings, the silvery noons (the moment of the shortest shadow), dark gold afternoons on the coast or the shadowed campi, sunsets of fire and cooling heat, give us their replicas in Venetian paintings. Not necessarily in landscapes[...].³⁴⁸

Bieńkowska noted that the light of Venice can be recognised on images of everything that has been painted here even before the emergence of Venetian vedutism. It can be seen on religious, mythological scenes and those of everyday life, in the spaces of interiors and on portraits.³⁴⁹ Eighteenth-century vedute painting can be treated as proof of the ability of this city to intensify visual experiences. It is also proof of the ambience of Venice's sunlit interiors—likewise in their capacity to affect the mood of painters that portrayed it. As mood depends on personality and a person's feelings, Venice, as depicted by different painters, is presented variably. All we have to do to see this is to compare the paintings by Canaletto, Carlevarijs and Guardi. All three painted Venice more or less during the same period, but did so differently, which probably resulted from their different personalities. Each of these painters even chose different types of weather for their views so as to even more attune them to their personal perception. Canaletto's paintings are a 'festival of "clear" observation'.³⁵⁰ The artist recorded the finest details on them. The crystal-clear light of the painting and the hard lines of the contours of architecture, the gondolas and figures appear to record the actual atmosphere of the Venetian landscape with a mathematical and cold objectivity, almost 'corresponding to the tension of the eye that absorbs, that records, that removes chance noise, reaches objects placed in this island space and under this sky'.³⁵¹ Luca Carlevarijs sharpened Venice's crystal atmosphere even more than Canaletto. In his precise views, as if drawn by pencil instead of paint, he was able to suggestively present the ambience of Venice, fleeting and delicate. On Guardi's paintings, the relationship between sunlight and architecture is different—it is blurry, dramatic, vibrant, as if it were capricious. The light on these paintings partially absorbs the view of architecture, making it unclear and clouded for the viewer.

When describing Venice as the 'most painterly place in the world', Bieńkowska noted that this was due to both 'the combination of natural elements, colours and forms that were unequalled in Western civilisation',³⁵² and 'accurately reaching for sensual sensitivity, in which there lives the spontaneous myth of harmony and complementation with a missing whole'.³⁵³ The mutual adaptation of the city's construction and the sensual sensitivity of its builders affected the atmosphere of Venice, affirmed by some and believed to be excessively superficial to others.

Venice provides numerous arguments for the mutual dependence between sunlight, architecture and human behaviours and experiences. The impact of the properties of interiors, exposed by sunlight, on the psyche and customs of people is the easiest to observe, but one can also see here

³⁴⁸ E. Bieńkowska, *Co mówią kamienie Wenecji...*, *op. cit.*, p. 239.

³⁴⁹ *Ibidem*. Bieńkowska wrote: '[...] on the depicted items: cups with drink, the furs of notables, the complexion of women's bodies, which can also be morning, noon or weaved from an early evening twilight (all we have to do is compare the female figures by Tiepolo and Titian's Pastoral Concert!). Everywhere we can see the Venetian sun, its phases along its daily route, which are marked ostentatiously here, as if they had been created for painting and its personification intentionally'. Further on, Bieńkowska continues this train of thought: 'Their gaze affixed on Venice, it drove them (painters)—in tribute to the City—towards velvetiness in their paintings, sunny sprinklings, to the space behind the heads of figures that was filled with a glimmering air. This is a joy of experiencing the world to which the key is the fact of a double existence, in the ever-present reflection in water' (*ibidem*, p. 243).

³⁵⁰ *Ibidem*, p. 253.

³⁵¹ *Ibidem*.

³⁵² *Ibidem*, p. 10.

³⁵³ *Ibidem*.

an opposite impact: of expectations and motivations shaped by long-term perceptual experience of Venice—on the design of architecture and urban layouts.³⁵⁴

The psychological determinants of the relationship under study are fundamental to this work, as they directly pertain to the impact of the interior's physical properties on the sensory and mental experiences of man, and thus are linked with the ability of architecture that conditions its atmosphere.

II. 4. Cultural Determinants

The shaping and perception of the relationship between architecture and sunlight is different depending on its setting in a specific culture. Cultural determinants affect this relationship in an often greater manner than a person's practical, economic and health-related determinants. They are closely related with the evolutionary adaptation of people to specific insolation in an area that has been inhabited by them over a longer period of time (this adaptation is based on physiological processes and the results—in cultural processes).

This work references specific definitions of culture.³⁵⁵ Following Heinrich Rickert, it was assumed that the notion of culture includes all objects (both natural and man-made) that are significant and important to a given group. Fleischer wrote:

Some objects attract our interest due to their specific uniqueness, or conversely—unique specificity, and it is those objects that form culture. [...] Objects of culture are objects like any other, yet have a specific significance to the participants of the culture, and in this manner, and only in this manner, become cultural objects.³⁵⁶

According to this concept, sunlight, even though it is an element of nature, is an object of culture, as it has cultural importance and significance. Following Ernst Cassirer, the work assumes an ethnographic and semiotic concept of culture, that assumes that culture is a *symbolic system*, that mediates between a 'system of receptors' and a 'system of effectors' (systems of receptors and effectors are present in all animal species and the symbolic system that divides them characterises the human perception of reality).³⁵⁷ It was also assumed that 'the essential core of culture is comprised of *traditional* (i.e. historically obtained and selected) ideas, and the values ascribed to them in particular'.³⁵⁸ The subject of symbolic culture was developed by, among others Polish culture philosopher Jerzy Kmita.³⁵⁹ Symbolic culture, which includes art,

³⁵⁴ This influence could be easily seen in projects prepared as a part of a workshop at the IUAV university in Venice in 2016, which the author had the pleasure of viewing thanks to an invitation by Professor Armando Dal Fabbro. The projects focused on revitalising the post-industrial areas of Porto Marghera—Venice's port.

³⁵⁵ The overview of the definition and concept of culture was prepared primarily on the basis of: M. Fleischer, *Teoria kultury i komunikacji*, Wrocław 2002. Fleischer reviewed various views on culture, and the many academic disciplines that existed throughout history, ranging from the nineteenth century to the present. This work demonstrates the multitude and diversity of these views, both in science and among laymen. Fleischer listed an example: in the book devoted to the notion of culture, *Pattern Theory of Culture* from 1952, its authors, Alfred L. Kroeber and Clyde Kluckhohn 'collected over 150 different definitions of culture...'. *Ibidem*, p. 31.

³⁵⁶ *Ibidem*, p. 21.

³⁵⁷ *Ibidem*.

³⁵⁸ *Ibidem*, p. 31.

³⁵⁹ Cf. J. Kmita, term: culture [in:] W. Szewczuk (ed.), *Encyklopedia psychologii...*, *op. cit.*, p. 185, 186. According to Kmita, culture is a 'complex of forms of social awareness (with a broad understanding of the term social

architecture, customs, literature, entertainment (and play), and science is characterised by its own specific symbolism of sunlight in the interior.

In reference to the relationship under study, culture provides a basis for the formation of a cultural community linked with a heritage of meanings and forms of evaluating phenomena of light in the interior and behaviours associated with them. Inheriting is based on a process of being brought up in a given culture. Culture as a system of valuating phenomena and behaviours primarily refers to the cultural community, but also, indirectly, to a given place that has shaped a given tradition. Equivalent meanings and interpretations of the relationship of sunlight in the interior emerge within a culture, as well as certain tastes as to its sensory perception. Rickert's 'significance' and 'importance' refer to the cultural valuation of the relationship between light and architecture. It can be based on tradition (according to the concept of Kroeber and Kuckhohn) or on the symbolic significance of this relationship.

The cultural determinants of the relationship between light and architecture thus emerge from its significance and importance to the members of a given culture. By significance we understand 'a portion of information about something that a given symbol refers to as its vehicle. "it is something that the one who uses the symbol understands by it" (Barthes) [...]. Of essence is the necessity to differentiate between the meaning that is given and the meaning that is read'.³⁶⁰ Conferring meaning to objects is their interpretation, including symbolic interpretation.³⁶¹ Cultural communities exist because, among other things, the meanings given by some of its members are read by its other members, they are identical. The significance of the relationship between light and architecture in the interior is therefore conditioned primarily by its valuation based on the culture acquired by a given person.

The interdependencies between perception and significance in the perception of light in the interior allow us to distinguish symbolic significance and traditional significance.

This distinction was introduced on the basis of the concept of culture outlined in the beginning of this overview. To Cassirer, tradition is the gene of culture and as such, acts without regard to the degree of awareness and education of a given person, while the symbol requires one to be aware and to learn its meaning, thereby it works by 'familiarity and respect for normative and directive beliefs', as discussed by Kmita, and which require the engagement of the consciousness. They can accompany each other, but do not necessarily have to. The distinction between symbolic and traditional significance allows one to see that the cultural determinants of the relationship under study are not a result of the symbolism of light alone, but also from the sensory practicing of experience associated with light and given by culture.

Symbolic significance is based on knowledge of symbolism adopted by the members of a cultural community: individuals adopted a given meaning by intellectual cognition. In this meaning, light represents a different object or concept than itself.³⁶² The conveyance of meaning is typically associated with human emotional reactions caused by the contrast between the relative simplicity of light phenomena and the complexity of their meaning. If the conveyance of meaning is not linked with emotion, then we have a pure symbol of light.

awareness, whose correlates are all human behaviours, or communal awareness on a large societal scale, and thus intersubjective'), while symbolic culture is 'a part of global culture, participation in which requires a familiarity with and respect for normative and directive beliefs that govern human behaviours, without which one cannot participate in producing, receiving and consuming the values of this culture'. See: J. Kmita, *Kultura i poznanie*, Warszawa 1985.

³⁶⁰ J.K. Lenartowicz, *Słownik psychologii architektury...*, op. cit., p. 156, 157.

³⁶¹ *Ibidem*, p. 49.

³⁶² Cf. the term: symbol [in:] J.K. Lenartowicz, *Słownik psychologii architektury...*, op. cit., p. 133.

The symbolic significance of light is linked with human spiritual needs and enters the field of metaphysics. Light becomes the ‘vehicle of ideas’;³⁶³ it is ‘where we locate magic in architecture’³⁶⁴ and co-creates the meaning of architecture. The symbol for light adopted by the individual shows their understanding of the world. Paulina Tendera synthetically phrased this by, writing that:

In Platonism it is linked with the idea of Good and Beauty, in medieval theology it denotes the Christian God, while in Romantic art, as understood by Georg Wilhelm Friedrich Hegel, a self-reconciled internal subjectivity.³⁶⁵

The symbol of light as the element of perfection and divinity is common to many cultures from different ages. For instance, in ancient Egypt, in the temple of Amon in Karnak, the ray of the rising sun, as a symbol of the god, entered the interior thought to be the most sacred and within this interior pointed to the location of the greatest sanctity. In Christianity, Jesus Christ is the Light of the World, hence light has profound symbolic significance, defining the programme of the interior unchangingly since the Byzantine era, the Middle Ages, the Renaissance, the Baroque, Classicism up to the present. Rabiej believes that:

The gradual illumination of the “House of God”—from old Christian basilicas, through Romanesque collegiate churches, to Gothic cathedrals—depicts the direction of the pursuit of the temple’s architectural ideal. [...] The mysterious shadow of Romanesque temples foreshadows the moment of the perfect dematerialisation of Gothic cathedrals. It is in their illumination that we find the symbol of the full immersion of matter in the light of spiritual reality.³⁶⁶

The symbolism of light in Christianity, as outlined in the writings of Dionysius the Areopagite, was the foundation for the remodelling of the church of Saint-Denis and afterwards—the erection of Gothic cathedrals. Abbot Suger was familiar with the writings of Dionysius: ‘The Corpus of his writings rested in the library of St Denis,[...]; and he was read to the monks in the refectory on the eve of his feast Day. And he may well have understood Dionysius’ notion of anagogy, of using the material to understand the immaterial, and thus to move upwards, in devotional stages, from the lower to the higher states of divine consciousness’.³⁶⁷ Following Dionysius’ thought, *sensibilis luminis*, the light observed by the senses, could be treated as a metaphor for the sensory inaccessible Light of God—*intelligible lumen*. Sunlight had unique theological symbolism, as did the space of the church illuminated by the ‘ever-lighting sun’. Crossley, quoting the Areopagite, wrote: ‘God is “like the sun” – *ostendi quomodo nomen luminiis solaris metaphorice Deo attribuitur* – yet “the great shining, is only the apparent image of the divine goodness, a distant echo of the God”’³⁶⁸. Crossley noted the poetic potential of the Areopagite’s thought: ‘on the bridges between the two sets of predicates [...]. God’s “sensible” signs are broadly speaking fourfold: cosmological, ethical, epistemological, and aesthetic. God’s intelligible light, as it becomes sensible, orders time and measures the earth: “Light is the measure and illuminator of the hours”...’³⁶⁹ Crossley’s commentary allows us to assume that sunlight was to the Areopagite

³⁶³ P. Winkowski, *Światło północy, światło południa...*, *op. cit.*, p. 18.

³⁶⁴ A.M. Borys, *Lume di Lume...*, *op. cit.*, p. 3.

³⁶⁵ P. Tendera, *Od filozofii światła do sztuki światła*, *op. cit.*, p. 9.

³⁶⁶ J. Rabiej, *Światło i kolor...*, *op. cit.*, p. 425.

³⁶⁷ P. Crossley, *A Symbolic Turn of Mind. Lech Kalinowski and the Giants of Iconography*, *op. cit.* p. 3, 4.

³⁶⁸ *Ibidem*, p. 5.

³⁶⁹ *Ibidem*.

the basis of metaphorical sense and mystical experience. Crossley saw in the Areopagite's thinking 'the distinction between metaphorical and metaphysical speech'.³⁷⁰

Thanks to sensual light, humans can contemplate the Light of God: 'Metaphor here has brought us to the threshold of a natural theology, for the Pseudo-Dionysius adds that "the invisible reality of God can be understood through reason, by contemplating the creation and what was created"'. Thus, the metaphor of light expands its meanings. Light is the symbol of God's Benevolence. Symbolically, sunlight is also an echo of the light of Truth: 'And with light comes, almost inevitably, intellectual illumination and right perception. "The Good is described as the light of the mind because it illuminates the mind of every supra-celestial being with the light of the mind, and because it drives from souls the ignorance and the error squatting there"'. Light was also equated with Beauty. Wagner wrote that 'In the Middle Ages, light—lumen, radiance—claritas and harmony—consonantia, were understood as equivalent notions, and light, as the absolute beauty, was an immaterial phenomenon, was the negation of sensory beauty, of matter'.³⁷¹ Light, although perceived with the senses, was an immaterial phenomenon, and therefore—pure—it was beauty itself, and not a beautiful object. Wagner quoted a passage by the Areopagite: "'If material beauty is rooted in the mutual proportions of the parts and of good colour, then can this notion of beauty not apply to light, which is something simple and uniform? Can it not have it because the proportionality of light is present not between parts, but in relation to sight...?'. Light is therefore always a whole, simple and uniform, it lacks nothing. An ornament from light, from radiance and harmony was in the eyes of the faithful a metaphor for purity, innocence, benevolence and the absolute. The metaphor of light also includes the symbol of the unification of the community: 'It gives them all a share of sacred light'. And this sharing becomes an act of community. God's sensible light gathers and unites all those receiving illumination. "It returns them to the truly real" It is "the light of the mind", the "beam and spring", the "overflowing radiance"'.³⁷² Enveloping and unifying light is the symbol of the One True God, who creates the unity of the universe in *lumen intelligibile*. Light that emanates from God gives everything that is created its place, but also unifies everything. The closer to God is a visible object, the better it reflects His light. Following this pattern, sunlight should unify the space of a religious interior.

Abbot Suger, familiar with the Areopagite's writings, realised the mysticism of light in the Church of Saint-Denis. Thanks to its remodelling 'from the choir to the door, outpouring light must spread throughout all the inner volume of the church without not one obstacle in its way, so as to make the entire edifice a symbol of the mystical creation'.³⁷³ The symbolism and mysticism of sunlight also demanded that the wreath of chapels around the altar be remodelled as well, as so as to insolate them and to enable the flow of light in-between, and through this: to merge their light during a single liturgical celebration (this is why partition walls were replaced by columns).

The metaphorical understanding of light as described by Dionysius the Areopagite took on a specific form in Gothic cathedrals, but also transcended the boundaries of the Middle Ages, becoming a more universal symbolism of light. It is associated with the symbolism of illuminating places of the greatest religious significance, such as the tabernacle and the presbytery, and the principle of orienting the church, linked with the symbolism of the rising sun. The role of sunlight in creating the symbolism of a Catholic church's interior can be seen by churches designed by Dominikus Böhm, as shown by Wagner's in-depth analysis.³⁷⁴ Telling examples include: the Church of St Joseph in Zabrze and the Church of St Camillus. In their designs, sunlight was an

³⁷⁰ P. Crossley, *A Symbolic Turn of Mind. Lech Kalinowski and the Giants of Iconography*, op. cit. p. 7.

³⁷¹ T. Wagner, *Ocena przedstawionego osiągnięcia habilitacyjnego i dorobku naukowego...*, op. cit.

³⁷² *Ibidem*, p. 6.

³⁷³ G. Duby, *Czasy katedr. Sztuka i społeczeństwo 980–1420*, op. cit. p. 123.

³⁷⁴ T. Wagner, *Zabrze. Nieznane oblicza śląskiej architektury*, op. cit., T. Wagner, *Architektura sakralna Dominika Böhma na Górnym Śląsku i jej znaczenie w kontekście rozwoju architektury oraz krajobrazu kulturowego Górnego Śląska*, op. cit.

essential conveyor of Christian symbolism and a component of the atmosphere of the sacred. Wagner acknowledges this characteristic as distinct for Böhm, seeing it in his early designs, when the German architect was fascinated with Baroque light effects, as well as in the designs from his mature phase, from the turn of the 1930s, when he designed the ‘jewel of Zabrze’s architecture’—the Church of St Joseph. The illumination of Zabrze’s churches by natural light was devised to inspire the mysticism of religious architecture, similar to the one that had been achieved in the Middle Ages: that dosed light sparingly and precisely to create darkness and symbolism. This architecture is moving ‘not by scale or grandeur, but by that, which cannot be touched nor measured—“programmatically” mysteriousness and dignity’.³⁷⁵ The case of the Church of St Joseph in Zabrze gives us an occasion to perform an analysis of the symbolic role of light in building the atmosphere of the sacred of the Christian temple. Wagner described the symbolism of the altar³⁷⁶ as the source of this luminance:

The symbolism of the altar as the source of luminance appeared in almost all of Dominik Böhm’s significant projects. The only difference lied in the direction of light. One solution that appeared often was the glazing of the altar wall (St Engelbert in Essen, Mönchen-Gladbach). However, it is hidden light that appeared in Böhm’s churches the most often, [...]. The Church of St Joseph is a classical design of a Bohemian interior wherein the columns of the nave are illuminated by seven invisible windows. Their bright light is further scattered by stained-glass windows with a brightness that increases the closer it gets to the altar. Each was to be an allegory of the seven sacraments, of which only a part were built. The brightest light falls onto the altar via the windows of the presbytery that are hidden between the columns. The contrast between the right and left side of the church is distinct for the Church of St Joseph. The illumination of the nave is provided by small, circular windows of the eastern wall (to the left of the altar), placed high, just below the ceiling, and thin, Gothic-like windows in the western wall (to the right of the altar). The difference in the intensity of the light finds its analogy in medieval architecture, where the right—southern—church wall was reserved for New Testament representations, while the left—northern—side for Old Testament representations. The right nave symbolises the New Testament—Christ.³⁷⁷

New Testament representations are better illuminated, as they refer directly to Christ—the Light of the World—and the altar was illuminated the strongest—‘the altar, as “mystical Christ” and the culmination of the church’.³⁷⁸

Although in the Gothic church illumination light achieved its peak symbolic value, as argued by Rabiej, ‘it remained the chief “creator” of the semantic dimension of the modern temple. It turns out that the manifold symbolic attributes of churches change the power of their expression, but the symbol of “light” remains a metaphysical element’.³⁷⁹ It is as just such an element: primal and substantially linked with human life on Earth, that it speaks in an archetypal language, understandable to people with different levels of education and of different religions. Rabiej developed this thought as follows:

³⁷⁵ T. Wagner, *Zabrze. Nieznane oblicza śląskiej architektury*, op. cit., p. 46.

³⁷⁶ Wagner added that the symbolism of the ‘path to salvation’ in the architecture of the Church of St Joseph is accentuated by Professor Ewa Chojecka in the book she edited, entitled. *Sztuka Górnego Śląska na przecięciu dróg europejskich i regionalnych*, Katowice 1999. T. Wagner, *ibidem*, note 192, p. 106.

³⁷⁷ *Ibidem*, p. 58, 59.

³⁷⁸ *Ibidem*, p. 59.

³⁷⁹ J. Rabiej, *Światło i kolor...*, op. cit., p. 426.

Light and colours remain universal symbols also in contemporary temples. Their legibility today speaks volumes of the cultural phenomenon of the church. In it we find a source of inspiration that inclines us to build temples open to the various manifestations of the contemporary individual's metaphysical sensitivity. Light and colours are media that create an aura of the religiosity of places of worship, regardless of their denomination. Their symbolic expression is a part of a general archetype of the temple, which resists all forms of simplifications of canons or doctrines.³⁸⁰

Light as a symbol resists simplified interpretations: it maintains the innocence and purity of the phenomenon and is therefore an inexhaustible symbol of perfection.

The traditional significance of light is based on the practicing of sensory experience: an individual adopts a given meaning not by intellectual cognition, but by practicing a sensory experience that one is tasked with repeating in a given culture that has assumed this experience to be important. The importance of the sensory experience practiced generation after generation impacts the formation and persistence of specific traditions—'the gene of culture'.³⁸¹ Because of this, the attentive experiencing of architecture and light in the interior can be given to an individual by the tradition in which they are brought up. Tradition affects the reception and shaping of the relationship between sunlight and architecture in interiors assigned for contemplation, meditation and prayer. Light in these interiors is to produce specific sensory impressions, moods, illusions and associations that comprise a multi-sensory and emotional experience (it is not conditioned by familiarity with the symbolism of light, although it can affect it and change it).

The importance of the sensory experience is visible in the adaptation of the Christian temple to dominant aesthetic styles and ideas of spirituality. They have produced, in a general sense, two methods of affecting human sensuality: centripetal and centrifugal. The first, visible in Romanesque monasteries or churches, focuses human thoughts on a small (on the human scale), closed and austere interior, while the second, visible in the Baroque church, apprehends human senses and imagination into a contemplation of suggestive illusions, dynamic sculptures, spiral columns and axes that all but pulsate within the physical confines of the interior.³⁸² In every case, light in the interior affects human sensuality independently of one's understanding of symbolism, 'it is the fundamental factor that produces an atmosphere of prayer'.³⁸³ Rosier-Siedlecka noted that the space of a religious interior 'gains emotional values primarily thanks to the game of light and can be perceived poetically'.³⁸⁴

In temples, the symbolic and traditional significance of light typically coexist with one another. Typically, sensory experiences reinforce the symbolism of light, they embody it after a fashion. The expositional role of light in architecture is therefore based on tradition and symbolism.³⁸⁵ Light that exposes architecture produces the desired mood, illusions and associations within people. The game of light and shadow, dramatic contrasts and the indicative role of the ray of light at a specific time and place are model examples of exposing architecture through light with the intent to build ambience and illusion. This can be seen in the Egyptian temple, the Greek Acropolis, medieval cathedrals in Chartres or Amiens, or in the Vierzehnheiligen Baroque church.³⁸⁶ In the previously mentioned churches by Dominikus Böhm, light plays an important role both in building the visual effect of the interior and its symbolism. These two layers combine into a single attribute of the interior that inspires the experience of mysticism.

³⁸⁰ J. Rabiej, *Światło i kolor...*, *op. cit.*, p. 427.

³⁸¹ Cf. M. Fleischer, *Teoria kultury...*, *op. cit.*

³⁸² See: B. Stec, *Architektura duchowości...*, "Architektura & Biznes" 2014, no. 07/08 (265), p. 38–51.

³⁸³ M.E. Rosier-Siedlecka, *Posoborowa architektura sakralna...*, *op. cit.*, p. 184.

³⁸⁴ *Ibidem*, p. 180.

³⁸⁵ Cf. B. Stec, *Aspekty scenografii...*, *op. cit.*

³⁸⁶ *Ibidem*.

The expositional role of sunlight can also be seen in the tradition of orienting churches, which attests to a deep religious, astronomical and psychological knowledge of their builders. When comparing the orientation of medieval churches, standing at close proximity, for instance St Mary's Basilica and the Church of St Adalbert on the Main Market Square in Krakow, one can observe that their axes, directed towards the east, do not overlap: the axis of St Mary's Basilica is aimed at the astronomic east on the day of the Assumption of Mary, which is observed on the 15th of August, while the axis of the Church of St Adalbert—on the day of St Adalbert, i.e. the 23rd of April. The orientation of churches thus applied to the astronomical east of a specific day—the observance of the patron of the temple, which allowed the physical exposure of the interior on a given day before the eyes of worshippers. On the celebration day of the patron of the church, on a sunny day, the temple became filled with exceptionally attractive light with a vivid symbolism. It was observable particularly well when the presbytery rose above the buildings near the church.

The coexistence of the symbolic and sensory perception of light and architecture in the church remodelled by Suger was noted by Crossley. When commenting on the distinction between metaphorical and metaphysical speech in the writings of the Areopagite, Crossley observed that:

Suger these mutual interactions formed one large nexus of delight and transcendence. The contemplation of the light-filled objects of his church, or the clarity of his sculpture on the west front of his new basilica brought about a trance where the vibrant adjectives and nouns of splendor, lux and clarus fill out his enthusiastic descriptions like rhetorical hyperbole. This is not the lyrical cosmology of the Divine Names but rapture at the sensible. Yet no one could say that the Pseudo-Dionysius did not stand in the path of that rapture, and give it a theological system. As theology it was not a blueprint for artistic form, but it existed as its intellectual backdrop: a music that caught Suger's ear, on occasion, like a memory.³⁸⁷

The thought about asymbolism constitutes an intellectual background for inspiring 'rapture of the sensible'.

The power of tradition causes the rational, practical and economic aspect of the relationship between architecture and light to give way to a less rational and not always comfortable ambience or projection capacity. The repetition of specific sensory experiences that forms the gene of a given culture is the basis for the persistence of specific aesthetic tastes. Tradition distinguishes these tastes in people with similar levels of education and social status. This happens despite the innate propensity of the human mind to favour certain aesthetic patterns, such as harmonious formation.³⁸⁸ Examples of this include the difference in preference as to brightness and shadow in interiors in Japanese and Western tradition, presented with 'sensual sensitivity'³⁸⁹ by Jun'ichirō Tanizaki in *In Praise of Shadows*.³⁹⁰

³⁸⁷ P. Crossley, *A Symbolic Turn of Mind. Lech Kalinowski and the Giants of Iconography*, op. cit. p. 7.

³⁸⁸ Cf. J.K. Lenartowicz, *O psychologii architektury...*, op. cit.

³⁸⁹ H. Lipszyc, *Śladem pędzla. Wstęp tłumacza*, [in:] J. Tanizaki, *Pochwała cienia* (1933), transl. H. Lipszyc, Kraków 2016, p. 7. Lipszyc noted that 'parts of the text [...] in which the author discusses his likes, preferences, even his aesthetic creed', are 'fragments that refer to the world and the titular shadows, and those in which he compares, praises or berates various types and intensities of illumination, beautifully, with sensual tenderness, describing lacquer ware and nephrite items, in a true hymn in praise of Japanese paper, delight in the talent and costumes of actors from classical Japanese theatre and finally the beauty of Japanese women and traditional garments'. H. Lipszyc, *Śladem pędzla...*, op. cit., p. 7.

³⁹⁰ In the Polish edition, quotes from Tanizaki were taken from: J. Tanizaki, *Pochwała cienia* (1933), transl. H. Lipszyc, [in:] K. Wilkoszewska (ed.), *Estetyka japońska...*, op. cit., while in the English edition, they were taken from: J. Tanizaki, *In Praise of Shadows* (1933) transl. T.J. Harper and E.G. Seidensticker, Sedgewick 1977.

Impact of Cultural Determinants on the Perception and Shaping of Light in the Interior: the Case of Japan

Despite insolation conditions similar to those of Europe, Japanese tradition favours shaded and dark interiors, while Western tradition—illuminated and bright interiors. The tradition of the Far East has interiors that are designed so that the user can immerse themselves in the light of the moon, while in the tradition of the West—an interior for sunbathing.

Tanizaki explained the reason behind these differences by pointing to tradition that arose over the long process of the Japanese people adapting to the geographic conditions of their place of residence. He noted that ‘the feeling of beauty grows from real life’, which is why:

Our ancestors, forced to live in dark rooms, presently came to discover beauty in shadows, ultimately to guide shadows towards beauty’s ends. And so it has come to be that the beauty of the Japanese room depends on a variation of shadows, heavy shadows against light shadows—it has nothing else.³⁹¹

Tanizaki was also of the opinion that a preference for darkness and shadow was the result of the Japanese innate acceptance of reality as is, while the people of the West:

The progressive Westerner is determined to always better his lot. From candle to oil lamp, oil lamp to gaslight, gaslight to electric light—his quest for a brighter light never ceases, he spares no pains to eradicate even the minutest shadow.³⁹²

It is clear that Tanizaki referred his comparisons to the Modernist architecture of the 1930s (when *In Praise of Shadows* was written), which praised and introduced large glazing and openings for sunlight. In these years, as noted by Lipszyc, ‘The object of his concern [...] was the insufferable excess of electrical lighting that accompanied the rapid modernisation of the country. He decried it, for it was a clear contradiction with a preference for twilight inherited from past generations’.³⁹³

Using the first person plural, Tanizaki stressed that he was voicing the views of the majority of the Japanese (he viewed himself as a representative of a cultural community):

It is precisely this indirect light that makes for us the charm of a room. [...] We delight in the mere sight of the delicate glow of fading rays clinging to the surface of a dusky wall, there to live out what life remains to them. We never tire of the sight, for to us this pale glow and these dim shadows far surpass any ornament.³⁹⁴

The propensity of the Japanese for dusky interiors and tasting their appearance and delighting in their ambience attest that the gene of culture is based on sensory experience. And this experience directly refers to the atmosphere of the interior. This is why a particular atmosphere of interiors, achievable primarily by proper admittance and modification of light, became a tradition in Japan. Tanizaki described his struggles with obtaining a traditional atmosphere in the house he was building, one that would result from a light with a round softness provided by genuine

³⁹¹ Tanizaki wrote: ‘Westerners are amazed at the simplicity of Japanese rooms, perceiving in them no more than ashen walls bereft of ornament. Their reaction is understandable, but it betrays a failure to comprehend the mystery of shadows. Out beyond the sitting room, which the rays of the sun can at best but barely reach, we extend the eaves or build on a veranda, putting the sunlight at still greater a remove’. J. Tanizaki, *Pochwała cienia...*, *op. cit.*, p. 90.

³⁹² *Ibidem*.

³⁹³ H. Lipszyc, *Śladem pędzla...*, *op. cit.*, p. 7, 8.

³⁹⁴ *Ibidem*.

paper *shōji*.³⁹⁵ He criticised the combination of traditional wood, traditional yet unpractical, with tiles in the bathroom as he took issue with their brilliance.³⁹⁶ He even noted the differences in the operation with chiaroscuro and colour in the cinematography of different nations and in the art of photography,³⁹⁷ he deliberated on the beauty of Japanese dishes in a traditionally illuminated interior ('Our cooking depends upon shadows and is inseparable from darkness'),³⁹⁸ he wrote of the 'soft, fragile beauty of the feeble light', which also called 'sad', 'fleeting', 'pale' and when 'the light from the garden steals in but dimly through paper-paneled doors'. The light that enters is called 'dim', for 'no matter the season, on fair days or cloudy, morning, midday or evening, the pale white glow scarcely varies'. Tanizaki observed that in the temple, the dim light, 'powerless to dispel the heavy darkness of the alcove, is instead repelled by the darkness, creating a world of confusion where dark and light are indistinguishable'.³⁹⁹

Over time, light in the interior of the home lost its initial, practical function, but remained in building tradition as it enhanced the ambience of the interior (which has become its either new or basic function). For instance, the case of the office window in a tokonoma, which had been used for reading, 'over the years it came to be regarded as no more than a source of light for the alcove', creating a unique tokonoma light, which exposes the scroll or other decoration placed in the alcove.⁴⁰⁰

In his book, Tanizaki testified not only of the Japanese tradition of a preference for dusky interiors, but also the Japanese manner of the sensory experience of architecture. The Japanese tradition instils in its members an attentive perception of the properties of interiors, to sharpen their senses and to inquisitively and deliberately perceive shapes that emerge from the twilight, to free their imagination to distinguish the projection of illusions through the confusion formed by flickering shadows. In the Japanese tradition, experiencing atmosphere is deeply aesthetic.⁴⁰¹ The relationship between the interior and light co-creates this experience in an essential way, which is why it is carefully labelled and praised by the Japanese. It is the basis of the aesthetisation of life in Japan, visible in many works of contemporary Japanese architecture.

Wilkoszewska described the Japanese tradition of interpreting the reflections of light in mirrors. It is based on the definition 'shadowy depth', used to describe the apparent depth of the mirror. Wilkoszewska explained that, in Japanese tradition, the mirror adds more shadow to an interior than light, for it 'entraps' light and hides it deep inside.⁴⁰²

The relationship between Japanese tradition and light in architecture was analysed by Plummer in *Light in Japanese Architecture*.⁴⁰³ He proposed twelve categories of the relationship between Japanese architecture with light, chiefly natural light, but not exclusively, as in Japanese tradition natural light is customarily linked with artificial light:⁴⁰⁴ 'Moonlite Gray, Autumn Gold, Vermilion Red, Painted Shadows, Cloudy Translucence, Woven Air, Watery Luster, Floating on the Wind, Captured Alive, Chrysalis, Incantation, Streams of Sun'.⁴⁰⁵ These categories frame

³⁹⁵ J. Tanizaki, *Pochwala cienia...*, *op. cit.*, p. 78.

³⁹⁶ *Ibidem*, p. 79.

³⁹⁷ *Ibidem*, p. 83.

³⁹⁸ *Ibidem*, p. 90.

³⁹⁹ *Ibidem*, p. 92.

⁴⁰⁰ Tanizaki wrote: 'Whenever I see the alcove of a tastefully built Japanese room, I marvel at our comprehension of the secrets of shadows, our sensitive use of shadow and light. [...] Ultimately, it is the magic of shadows. Were the shadows to be banished from its corners, the alcove would in that instant revert to mere void'. (*Ibidem*, p. 91).

⁴⁰¹ Cf. K. Wilkoszewska (ed.), *Estetyka japońska...*, *op. cit.*

⁴⁰² K. Wilkoszewska (ed.), *Estetyka japońska...*, *op. cit.*

⁴⁰³ H. Plummer, *Light in Japanese Architecture...*, *op. cit.*

⁴⁰⁴ Cf. K. Kuma, *Kengo Kuma and Associates*, [in:] A. Dubet (ed.), *Qu'est-ce que la lumière pour les architectes?*, *op. cit.*, p. 119. Kuma mentioned the practice of combining sunlight with artificial light as typical for Japanese tradition.

⁴⁰⁵ H. Plummer, *Light in Japanese Architecture...*, *op. cit.*

the relationship between light and architecture in the aspect of the physical properties of the interior which have the capacity to elicit impressions, emotions and projections in humans. They accentuate the strong ambience and high projection capacity of Japanese architecture, not only its historical version, typically built from wood, but the contemporary one from concrete, steel and glass as well. The atmosphere of Japanese interiors, closely connected with the aesthetic of their use, remains one of the major properties of architecture in Japanese culture, and is pursued even at the cost of comfort and practicality in radically shaded or excessively illuminated interiors.

The review of the determinants of the relationship between sunlight and architecture in the interior allows us to observe the manifold utility and significance of this relationship to humans. It is the foundation of human perception and numerous physiological processes that condition the meeting of biological needs, enable the use of interiors for various activities, stimulate emotions, intellectual and metaphysical satisfaction, induce aesthetic experiences, enable meetings with other people, exploring the world and is an element of tradition and symbolism of a given culture. This review already includes numerous references to the atmosphere of architecture understood as per the assumptions of this work, and created using the relationship between light and architecture.

The matter looks different if approached from the side of production aesthetics, which makes it possible to gain rational access to this “intangible” entity. It is the art of the stage set which rids atmospheres of the odour of the irrational: here, it is a question of *producing* atmospheres. This whole undertaking would be meaningless if atmospheres were something purely subjective. For the stage set artist must relate them to a wider audience, which can experience the atmosphere generated on the stage in, by and large, the same way. It is, after all, the purpose of the stage set to provide the atmospheric background to the action, to attune the spectators to the theatrical performance and to provide the actors with a sounding board for what they present. The art of the stage set therefore demonstrates from the side of praxis that atmospheres are something quasi-objective. What does that mean?

G. Böhme, G., *The art of the stage set as a paradigm for an aesthetics of atmospheres...*

This kind of reaction to light might be ascribed to the fact that its power of emotional excitability is so strong that it can influence the perceiving abilities of the subject, regardless of their empathic disposition to emotional resonance. Thus, the consequences of lighting design activity might transcend the personal domain of emotional predisposition and, eliciting a perceptual saturation, manage substantial reactions from the point of view of arousal and valence.

E. Canepa (et al.), *Atmospheres: Feeling architecture by emotions...*

|||

Relationship Between Sunlight and Architecture: Atmosphere

This chapter discusses matters of the atmosphere of architecture, developed on the basis of an analysis of determinants and references to the contemporary theory of atmosphere. The review of the determinants of the relationship between architecture and sunlight allowed the observation that its impact on humans is directly associated with a critical property of this relationship that is the mutual exposure of the physical properties of architecture and/or the nature of sunlight in the interior. This exposure was acknowledged as a criterion of evaluating the relationship between sunlight and architecture in the aspect of atmosphere. Detailed assessment criteria for evaluating this relationship were formulated as criteria of the assessment of the atmosphere of the interior built by light. Afterwards, they were confronted with the current state of research on atmosphere, pertaining to its definition, reception, description and building.

III. 1. Mutual Exposure of Architecture and Sunlight in the Interior

To a person in the interior, light becomes a specific guide to this interior and vice versa—architecture becomes the guide when it reveals before us the nature of light. The physical properties of architecture and the properties of light in this mutual relationship are either modified, enhanced or weakened. Therefore, this relationship considerably impacts the specific exposure of the interior, which is its new capacity, its new attribute. It is new insofar as it belongs to time in this relationship, which is enhanced by the exceptional nature of sunlight and its ceaseless variance. Thanks to sunlight, this new attribute of the interior is inseparably associated with the current state of the sky, dependent on the weather and other factors (Chapter II.1.). The analysis of the determinants of the relationship between light in architecture presented earlier demonstrated that this attribute is expressed in the property that is experienced, described, evaluated, memorised, liked or disliked by people, which means that it significantly causes specific sensory experiences and states of mind in humans. On this basis, in accordance with the adopted definition of atmosphere (Chapter I.3.) the mutual exposure of the physical properties of architecture and/or nature of sunlight in the interior were assumed to be a criterion of the evaluation of the relationship between light and architecture in terms of the atmosphere of the interior.

This exposure is perceived by people both in focused and peripheral vision (Chapter II.2., II.3.). It stimulates initial sensory experiences in humans and affects the evaluation of these experiences, constituting the ambience and projection capacity of architecture.

The exposure of architecture through light of any type is quite obvious: light extracts the interior from shadow, and thus explicitly and metaphorically explains it, allowing humans to see and evaluate said interior. However, only sunlight moves in the interior following its apparent journey across the celestial sphere in regular daily and yearly cycles. Only sunlight, due to its physical determinants, cannot be reproduced in two different places on Earth. Constantly changing its incidence angle, intensity, and brightness, light exposes various physical properties and fragments in the interior. The interior can be looked at as the structure of places that admit (capture), reflect, filter or exclude (flee from it) to a different degree during specific times of day and the year. This light exposes the interior in a different way each time and exposes its place and orientation on the globe, astronomical time and weather on a given continent. As a result of this exposure, sunlight creates a unique atmosphere of a specific interior.

Exposing architecture through sunlight and conversely light by elements of architecture was noted and analysed by Twarowski in his work on helioexpressivity, the solar expressivity of the massing and the solar expressivity of the interior. The author of *Słońce w architekturze* explored the exposure of masses and or interiors particularly via direct rays of sunlight. This exposure

is associated with effects that can be seen by the observer: the enhancement of the shape of the interior or masses, 'elevating the value of the composition', the 'highlighting' of an element of architecture, such as a mass form, 'impressive underscoring' of the interior or its element in the journey of rays of sunlight, namely the creation 'phases of visual expressions'. Twarowski wrote:

Visiting even the most beautiful edifices is typically done without paying attention to the conditions of illumination [...]. It is no wonder then, that visitors often lose the ability to fully experience beauty under these conditions. When I studied the layouts of shadows and light in the garden compositions in Tivoli and Ravello, I observed the characteristic reaction of observers several dozen times. The compositions that were ignored in periods of poor illumination attracted large groups of tourists who expressed their joy when impressive shadow layouts were formed on them. Of course none of those tourists analysed the causes of this elevation of the composition's value, nor did they try to determine the duration of each phase of visual expression.⁴⁰⁶

Twarowski also noted the possibility of obtaining a 'solar beam'⁴⁰⁷ in the interior. It is the result of admitting directed light into a shaded interior so that it is exposed: increase the contrast of the shaded space and the light of the beam, extend its path and place in it a compositionally attractive or significant element. In the helioexpressivity of sculptural compositions, Twarowski recommends that designers note three types of shadows: 1) those in the composition itself, 2) those cast by visual elements on the background, 3) those produced by shadow projectors.⁴⁰⁸ He thus proposes the exposure of architecture by insolation with the use of properly sculpted compositions placed on southern, eastern and western facades, resulting in an impressive and constantly changing game of light and shadow. He also noted the exposure of interiors by adapting their structure to local insolation conditions. He lists two different examples of the exposure of architecture through local light: of the Egyptian and Greek temple. In the Egyptian temple, this exposure is based on the gradation of light and shadow in the compositional layout of a sequence of interiors, ranging from a sun-drenched courtyard, via a dusky hall, to the darkest, most sacred and smallest interior with the statue of the godhead, illuminated solely and at times by a narrow beam of sunlight from overhead. In the Greek temple, this exposure is based on the masterful play of chiaroscuro, penumbras that create 'impressive visual expression' on entire facades and their sculpted details.

The mutual exposure of architecture and light corresponds with the expressiveness of stage reality, as discussed by Anna Franta.⁴⁰⁹ This expressivity is the overarching attribute of every interior that is directed as a stage. Franta even wrote that it is the space that serves expressiveness and not the other way around—'so that it can be "meaningful" and understandable. To achieve this, one must be able to use and combine all possibilities provided by the line, the surface, the mass, space, colour, light and shadow'.⁴¹⁰ In this description, Franta precisely described all of the elements of the interior: the walls, the mass, its space, that enter into a relationship with light to produce the expressiveness of the interior, capable of intensely affecting humans. Although the direction of a theatrical stage suggests the role of lamp light, Franta noted that in the theatre of everyday life, natural light that she calls 'fire-derived', plays a fundamental role. 'Operating with the element of fire as light stresses the building of the dynamism and dramaturgy of space'.⁴¹¹ Due to this, the users of the stage—both the actors and the audience—can become involved in the atmosphere of the interior, 'understand the significance of each frame and scene of reality'.⁴¹²

⁴⁰⁶ M. Twarowski, *Słońce w architekturze...*, *op. cit.*, p. 93.

⁴⁰⁷ *Ibidem*, p. 136, 157.

⁴⁰⁸ *Ibidem*, p. 94.

⁴⁰⁹ A. Franta, *Reżyseria przestrzeni. O doskonałości przestrzeni publicznej miasta*, *cit.*, p. 83.

⁴¹⁰ *Ibidem*, p. 83.

⁴¹¹ *Ibidem*, p. 128.

⁴¹² *Ibidem*, p. 127.

Due to the transcendental character of sunlight and the strength of sensory experiences and symbolic meanings, light exposes the religious interior, and the religious interior—exposes sunlight almost by definition. This was noted in Chapter II.4. The expository role of sunlight is present in temples of different religions, building the space of the sacred both in a universal and individual sense in the symbolic references of a specific religion. In Christianity, in which Christ is the Light of the World, the symbolism of light pertains to the illumination of specific interior elements in a specific time, the symbolism of the ‘path of salvation’, the gradation of light in the sequence of interiors. Furthermore, in different cultures of the same Christian religion, the symbolism of light takes on different forms, highlighting radiance and glare to some, and in others it is the scattered, hidden and mystical light of the Middle Ages. The dependencies between specific methods of operating with light and optical experiences combine the effects of impressiveness with significance and symbolism, constituting a valuable argument concerning the building of an atmosphere of the sacred using precise design calculations. As an example of twentieth-century architecture that employs this exposure at a level comparable to the mysticism of medieval churches is the Church of St Joseph in Zabrze, subjected to an in-depth analysis by Wagner.

The expositional role of light, including sunlight, in museum interiors was analysed by Mateusz Gyrkovich.⁴¹³ The matter of the mutual exposure of architecture and sunlight was discussed by Piotr Winkowski, who wrote of the benefits of illuminating museum interiors with sunlight:

[...] this light plays a significant visual role in these interiors [...]. It also affects the experiencing of proper exhibits by the experience of the place in which they are viewed and thus makes them a local experience and thus a unique one: even if they were from the most distant places, even if the represented “global” or “cosmopolitan” art., in “our” museum we view them in “our” light. [Sunlight—B. Stec] makes the perception of visual works richer than when they are viewed in artificial light: it is also richer in video installations or in art experienced via a computer screen, plugged into a uniform voltage of 220 V.⁴¹⁴

Because of sunlight, a museum can also exhibit its place on the planet and local time and weather. On the example of exhibition spaces we can clearly see that sunlight, by exposing a work, itself becomes ‘an eternal, natural exhibit’.⁴¹⁵

Sunlight creates special conditions for exposing art in exhibition interiors, for instance at the Venice Biennale.⁴¹⁶ Its stage-related value was acknowledged by the curators of the ‘Freespace’ 16th Venice Biennale of Architecture (2018): Yvonne Farrell and Shelley McNamara, who decided to adapt the two main exhibitions at the Padiglione Centrale and Cordie to the specific sunlight that operated in the space of these buildings. They identified differences in displaying the exhibition in the ‘melancholic’ interior of the Corderie and the ‘zenithal’ light of the Padiglione

⁴¹³ See: M. Gyrkovich, *Rola światła w architekturze...*, *op. cit.*

⁴¹⁴ P. Winkowski, *Światło północy, światło południa...*, *op. cit.*, p. 19.

⁴¹⁵ *Ibidem*, p. 18, a term by Winkowski. Winkowski wrote: ‘Sunlight, with all its “natural” parameters, does not surrender so easily to manipulation as artificial light, as it requires further arrangements, the dedication of a true and not apparent space to travel, scatter or be directed at some point in (e.g. an exhibit). [...] Museum buildings are even more interesting, as in them sunlight has been engaged not to illuminate this or that exhibit, but to demarcate architecture itself—the mass in space—to become a reference point. This peculiar context is not defined relative to nearby buildings, the material from which they were made, the roof pitch or window proportions, but to the nature of the greatest of scales that are possible to experience: the cosmic scale. The global context of architecture—in the sense that it refers to the placement of the building on the planet—becomes more legible when architecture divides the path of light that penetrates the interior into stages, when it frames it somehow, when light encounters numerous phenomena that it participates in, many different spaces that it illuminates in different ways’.

⁴¹⁶ See: B. Stec, *Sunlight in art exhibition spaces on the example of Venice Biennale pavilions*, “Kwartalnik Naukowy Uczelni Vistula. Vistula Scientific Quarterly”, no. 1 (59)/2019, p. 60–70.

Centrale.⁴¹⁷ The expositional role of sunlight can be appreciated particularly significantly in the pavilions of the Giardini, which are used solely to exhibit art from spring to autumn. Most of them are designed with using sunlight in their interiors in mind and for the creation of unique exhibition conditions. This can be seen in the Netherlands Pavilion (arch. Thomas Gerrit Rietveld, 1953),⁴¹⁸ the Finland Pavilion (arch. Alvar Aalto, 1954) and the Nordic Pavilion (arch. Sverre Fehn, 1962).

Light effects often constitute an element of an exhibit or an inspiration for the artist or curator. During the 16th Biennale of architecture, sunlight built the installation in the Austria Pavilion (arch. Josef Hoffmann and Robert Kramreiter, 1934), particularly in the section exhibited in the courtyard, which was enclosed by wall arch by Hoffmann and added to the pavilion twenty years later. The installation ‘Sphere 1:50.000’ (curator: Verena Konrad, exhibit: LAAC, 2016) referenced the geometry of this arch, as well as geometry on a larger scale: the dome of the sky and the Earth. This found its expression in the curvature of the courtyard’s floor surface using the same radius as that of the courtyard arch: 128 metres, which is 1:50.000 of the radius of the Earth. The curvilinear space of the floor was mirror-like. The noted uncommon geometrical coincidence of the radii of the arch and the Earth was exposed by sunlight not only in the sense of light effects, but also in the sense of referencing the cosmic scale of the Solar System: the view of the apparent space in the reflection could bring to mind the curvature of the Earth.

Philippe Rahm used the expositional role of sunlight in a different way in his project ‘Géologie blanche’ (Grand Palais, Paris, 2009). Based on light that enters the interior of the Grand Palais from overhead by a glazed roof, Rahm developed a method of designing an exhibition on modelling the starting shape of a white cuboid in accordance with optimal spatial and lighting conditions for each exhibit. Thus, every sculpture, painting, installation or projection found its individual and optimal place and natural lighting. Sunlight in ‘Géologie blanche’ turned out to be sufficient for exhibitions, as the white surfaces reflected as much as 80% of it.⁴¹⁹

To humans inside interiors, the nature of sunlight in and of itself can constitute a source of fascination. For instance when a person notices that, thanks to the properties of the interior, light travels across cosmic distances measured in millions of light years and at the same time does so on the interior’s wall, that without shape, it allows itself to be shape in the interior, that while it cannot be grasped by hand, it can be felt via warmth on the skin, that it changes constantly but returns every day in its regular rhythm, that even at night it can highlight the shape of the interior and one’s facial features via rays reflected from the Moon. The exposure of the nature of sunlight with architecture also pertains to exposing various illuminations of the sky or current weather, which stimulates human mood to such great extent, but also affects the work of the imagination and sensory experiences. A properly shaped interior can expose light effects associated with atmospheric phenomena, for instance the effects of sunlight falling on rain (in its various forms) or on snow, as in Peter Zumthor’s architectural projects.

Sometimes we encounter more spectacular cases, where the interior—which is still but spatial and continues to exist over time, exposes the apparent journey of sunlight with the precision of a light instrument: it demonstrates the change in temperature and colour tone of eastern and western light, the law of reflection and refraction of light rays or the associated physical phenomena. For instance, elements of the interior that have the form of prisms illustrate that white light is a mixture of colourful light, and that colourful interiors expose the properties of individual waves from the visible light spectrum and their impact on humans, for instance the sleep-inducing effect of red light or the stimulating effect of blue light.

⁴¹⁷ Curator description: Y. Farrell and S. McNamara, press materials of the 16th Venice Architecture Biennale 2018, pages without numbers.

⁴¹⁸ The pavilion designed by Rietveld replaced an earlier building designed in 1912 by Ferdinand Boberg.

⁴¹⁹ See: <http://www.philipperahm.com/data/projects/whitegeology/index.html>, [accessed: May 2020].

Going back to the case of Venice: in its views painted by masters of Venetian vedutism, we can trace how the exposure of the physical properties of the interior is linked with its light and also—how heavily this exposure forms a specific atmosphere that spills over to the observer of the painting. Bieńkowska noted that Canaletto’s paintings feature crystalline light ‘that reaches objects placed in t h i s island space and under t h i s sky [highlights—B. Stec]⁴²⁰ and exposes the physical properties of the Grand Canal’s interior.

Canaletto was interested and absorbed [...] by this p l a c e [highlight by Bieńkowska], which sent its rays to the *camera ottica* of the eye and, conveyed onto paper, the canvas, with the cold passion of someone who does not want to protect even the smallest window frame, shaded niche nor any small circle used to anchor the gondolas.⁴²¹

Meanwhile, Brodsky, in his praise of the winter light of Venice, described how the architecture of his beloved city became a cicerone, guiding him along the nature of this light:

The winter light in this city! [...] In the morning, this light [...] runs ahead of you, strumming its lengthy rays—like a hot-footed schoolboy running his stick along the iron grate of a park or garden—along arcades, colonnades, red-brick chimneys, saints and lions. [...] “Depict it,” whispers the winter light, stopped flat by the brick wall of a hospital or arriving home at the paradise of San Zaccaria’s frontone after its long passage through the cosmos. And you sense this light’s fatigue as it rests in Zaccaria’s marble shells for another hour or so, while the earth is turning its other cheek to the luminary. This is the winter light at its purest. It carries no warmth or energy, having shed them and left them behind somewhere in the universe, or in the nearby cumulus. Its particles’ only ambition is to reach an object and make it, big or small, visible. It’s a private light, the light of Giorgione or Bellini, not the light of Tiepolo or Tintoretto. And the city lingers in it, savoring its touch, the caress of the infinity whence it came.⁴²²

The referenced texts convey the mutuality of the exposure of the physical properties of light and architecture in their relationship: both on the vedute of Venice and in Brodsky’s description there is no separating them. Typically, man in the interior is guided along architecture and the nature of light simultaneously, but perceives this exposure as one experience, according to the predisposition of his body, personality, education and culture, as discussed in Chapter II. For instance, in the interior of a church, man can immerse themselves in a warm light that falls from the side of the red panes of the stained-glass window, to pray, but also to take a nap, cuddling against the twilight or be seduced by the ambience of shapes and materials exposed by a beam of light that enters the presbytery by a high-placed window. They can study the time of day following the path of light and shadow or observe the absorption of light by the colourful stained-glass window, checking the difference in temperature between red and blue light on the skin. In each of these situations, the architecture of the interior and light expose each other, and this exposure elicits sensory experiences in man, stimulates the use and evaluation of the interior, and thus essentially co-creates the atmosphere of architecture.

⁴²⁰ E. Bieńkowska, *Co mówią kamienie Wenecji...*, *op. cit.*, p. 253.

⁴²¹ *Ibidem*, p. 253.

⁴²² J. Brodsky, *Znak wodny...*, *op. cit.*, p. 61–65.

III. 1.1. Impressiveness of Exposure

Based on an analysis of determinants of the relationship between light and architecture, particularly physiological and psychological ones, it was assumed that the specific exposure of architecture and light in the interior elicits sensory experience in man—‘the first contact with light, unmediated by the mind’.⁴²³ This exposure strengthens the physical experience of the physicality of the interior. If light gives the interior the capacity to affect the person immersed in it, then it creates in this interior an impressive or sensual atmosphere (following the definition of the atmosphere of architecture assumed in the study, Chapter I.3.).

The role of first impressions in the experience of the interior, and even in constructing the aesthetic experience, was ennobled at the start of the twenty-first century by both philosophers (Böhme, Griffero, Wilkoszewska, Berleant and others) and architects (Pallasmaa, Zumthor, Plummer and others). Experiencing light with architecture should first be discussed at the level of first impressions and bodily perception,⁴²⁴ to which peripheral vision is significant (Chapter II.2, II. 3.). At the same time, Pallasmaa suggested that peripheral vision plays the deciding role in the perception of the atmosphere of the interior, as it causes individuals to experience their immersion in the interior as a spatial environment.

In the reflection on first sensory impressions, a certain difficulty of contemporary humans in grasping and holding them in their pure form is highlighted.⁴²⁵ Wilkoszewska noted:

[...] Post-modernism highlights weariness with symbolic culture and the confusion of contemporaries in the excess of meanings. [...] the effect of the excess of symbols is the disappearance of their simple reference to the world of real things, symbols form an increasingly autonomous realm, referencing other symbols, which means that there are no longer any innocent words, that the notion of nature is a product of culture and that we do not even have direct access to our body, only to its cultural icons. [...] The shift from representation and the replacement of interpretation with direct experience is not only an essential problem in the sphere of the elements and their aesthetic, but also one of the more important problems of our contemporary culture.⁴²⁶

Sensory experiences, as the first to contact man with the interior, enable him to perceive the exposure of interior in light, which is the most faithful towards their objective form as found in a given moment. It is also for this reason that first impressions allow us to grasp the atmosphere of the interior as built by light. The capacity to induce sensual experiences, specified in the assumptions of the study as the impressiveness of architecture and assumed to be a term that evaluates the atmosphere of architecture, can be referenced to the study and applied as a term that evaluates the relationship between light and architecture in the aspect of atmosphere.

⁴²³ The quoted phrase by Wilkoszewska accurately reflects the character of the sensory experience that, as we know from physiology, is also construed by the brain, yet in an unconscious manner. K. Wilkoszewska, *Od redakcji...*, [in:] *idem* (ed.), *Estetyka czterech żywiołów...*, *op. cit.*, p. 7, 8.

⁴²⁴ A. Berleant, *Wrażliwość i zmysły. Estetyczna przemiana świata człowieka*, transl. S. Stankiewicz, Kraków 2011, p. 101, 110, 112.

⁴²⁵ K. Wilkoszewska, *Od redakcji...*, *op. cit.*, p. 7.

⁴²⁶ Cf. J. Pallasmaa, *Oczy skóry...*, *op. cit.*

III. 1.2. Ambience of Exposure

Based on an analysis of the determinants of the relationship between light and architecture, it was observed that the result of exposing the interior can come in the form of its ambience. It was thus assumed in the study that ambience is the result of a specific exposure of the interior in the relationship between architecture and light. It considerably affects the mood of people in this interior (it has the power to change the initial mood of a person that enters the interior). One can formulate the thesis that: if exposure confers a capacity to affect the mood of the person inside the interior upon said interior, then it creates an *ambient atmosphere* in the interior. The ambience of architecture, noted in the study's assumptions as a term that evaluates the atmosphere of architecture, can be referenced in the study and applied as a term that evaluates the relationship between light and architecture in the aspect of atmosphere.

III. 1.3. Projection Capacity of Exposure

Based on an analysis of the determinants of the relationship between light and architecture it was observed that the mutual exposure of architecture and light can produce illusions and associations (projections) in the human mind, and thus lead to the projection capacity of the interior. In the study, projection capacity was assumed to be the result of a specific exposure of the interior in the relationship between light and architecture. We can formulate a thesis that: if light produces or strengthens the projection capacity of architecture, it produces in it an atmosphere of projection. A pattern from spots of shadow and light in an interior can produce an illusion of the shattering of the interior, an illusion of falling snow or rain, a starry sky, or create a symbolism of a holiness of love. And thus, as presented in the study of psychological and cultural determinants, projection capacity is the result of subjective and enhancing human evaluation. The projection capacity of architecture, listed in the assumptions of the work as a term that evaluates the atmosphere of architecture, can be referred to the study and apply as a term that evaluates the relationship between light and architecture in the aspect of atmosphere.

III. 1.4. The Criterion of Evaluating the Relationship Between Sunlight and Architecture in the Aspect of Atmosphere

The mutual exposure of architecture and light in the interior was assumed to be a criterion of evaluating the relationship between light and architecture in the aspect of atmosphere. This exposure affects people in the interior, producing sensory experiences, mood, illusions and associations. Three criteria of evaluating the mutual exposure of the interior/its atmosphere were proposed: — *i m p r e s s i v e n e s s*, — *a m b i e n c e*, — *p r o j e c t i o n c a p a c i t y*.⁴²⁷

⁴²⁷ See: B. Stec, *O świetle we wnętrzu...*, p. 87.

These three specific abilities of the interior are essentially the result of how the relationship between architecture and light is shaped in it. They comprise the singular ability of architecture to affect the senses and minds of humans. This is why they were assumed to be the specific criteria of evaluating the atmosphere of architecture produced by light in the interior.

The assumed criteria of evaluating atmosphere are dependent on the observer of the atmosphere. By these criteria, man measures atmosphere via his body and mind, he determines the capacity of the interior on the basis of their own, individual experience and the exposure of the relationship between architecture and light. The difficulty in the evaluation of atmosphere that appears is tied not as much with the application of the adopted criteria but with the generalisation of the results of this evaluation by different people.

The criterion of impressiveness is relatively the most objective, as indicated by the analysis of determinants, as it can be based on physiological processes.

In the assessment of the ambience of an interior, it is the emotional sensitivity of a specific individual, as studied by psychology, psychiatry and neurophysiology, that plays an important role. The ambience of the interior is therefore more difficult to clearly define, as its impact on an individual's mood has the characteristics of subjectivity and objectivity (we can find similarities in groups of people with similar psychological preferences and cultural communities). Apart from this, people differ in their ability to express/name the mood they experience.

Man's imagination, knowledge and education play an important role in evaluating an interior's projection capacity. This criterion is relatively easy to verify, but we can expect that the results of its application will differ the most.

Every result of the evaluation of atmosphere in the category of impressiveness, ambience and projection capacity will be significant to the study. This means that every property of the interior, defined via the application of evaluation criteria, is important, as it denotes the ability of the interior in the sense of its potential to produce the effects in question that are outlined by the definition of atmosphere. The object of the study is not to unify these results, on the contrary, every result can point to some new specific attribute of the interior. Likewise, a result confirmed by a single experience is significant to describing atmosphere. For instance, to others it can have a value that enhances and sharpens perception. Due to the delicate nature of atmosphere, every single suggestion is valuable. Documenting the results with the intent to design architecture so as to produce a specific atmosphere requires one to select them so that they can pertain to a group of potential architecture users. Typically, this selection emerges during conversations and the process of familiarisation between the architect and the client/future user. Experience teaches us that communication between people concerning the perception of atmosphere does exist, which is why the object of the study is not associated with the objectivisation and uniformisation of phenomena that are subjective and complex by nature.

The applied criteria of studying atmosphere do not apply to the mechanisms that produce sensory experience, shape human moods, or the work of the imagination and the formation of associations and illusions in the human mind. These subjects, typically fascinating to any architect, are the object of study of other scientific disciplines. The architect can account the findings of these studies in their designs. The criteria presented refer to phenomena that are easily recognisable in our everyday perception of the world and typically serve the architect to assess the atmosphere in the experience of their own body. They can make a conversation about atmosphere between an interior's future user and its architect easier. The difficulties listed apply to methods of describing and building atmosphere and not to adopting the proposed evaluation criteria.

III. 2. Referencing the Study to the Theory of Atmosphere

The partial results of the study, conditioned by the meaning of atmosphere assumed in the work, and its subsequent evaluation in the relationship between sunlight and architecture, are framed in the context of the theory of atmosphere that is currently a dynamically developing and interdisciplinary field of science.

The term atmosphere does not denote a new phenomenon, but is a new term, which now has academic significance, for a matter that has existed in architecture since its very beginning. Building a specific sensory, emotional and reflective perception of architecture was often the goal of builders in the past and that was successfully achieved, as evidenced by the perception of historical structures by contemporary users. Böhme informed us that the scientific presentation of the metaphorical sense of atmosphere is relatively new:

It began in the field of psychiatry, specifically in Hubert Tellenbach's book *Geschmack und Atmosphäre* [Taste and atmosphere] (Tellenbach, 1968). Here, atmosphere refers to something bordering on the olfactory—such as the climate of the homeland or the smell of the nest, that is, a sphere of familiarity which is perceptible in a bodily-sensuous way. Since then, atmospheres have been researched in detail by phenomenology.⁴²⁸

However, at the turn of the twenty-first century, the notion of the atmosphere crossed the borders of phenomenology and aesthetics. First, it entered disciplines that focus on describing human activity and that of human surroundings: urban geography, planning and geopolitics, studies of ethnography, memory and heritage, prodromal studies aimed at the design of space and mobility studies. At present, the notion of the atmosphere is developed as a part of numerous branches of science, including anthropology, neuroscience, musicology, art criticism and, increasingly dynamically—architecture and urban planning.⁴²⁹ Each of these disciplines provides a distinct methodological and descriptive apparatus in its own outlook on the notion of atmosphere, which affects the interdisciplinarity of the studies and causes an observable breakthrough and gives them a new development trajectory: 'We believe that the simple indication of some tensions can contribute to the growing interdisciplinary debate triggered by the so-called "atmospheric turn"'.⁴³⁰

In architecture and urban planning, the atmospheric turn denotes a new treatment of this notion. It has ceased to apply to a non-descript and non-verifiable category of sentimental evaluation through its subjectivity, but has become a starting point for serious reflection that places the human perception of reality at the centre of human attention. In this sense, the study of atmosphere has become the basis of academic reports concerning both finished works and those under design. The study of atmosphere in architecture is directed by the practical matter of building it, which sets all fields of artistic creation apart against the background of the theory of atmosphere. This applies not only to architecture and urban planning, but also: literature, the visual arts, music, design-related arts: stage design, cinematography, photography and even the culinary arts. While generally similar, there are observable differences in which atmosphere is built in the narrative of

⁴²⁸ G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres...*, *op. cit.*, par. 3.

⁴²⁹ F. De Matteis, M. Bille, T. Griffero and A. Jelić, *Phenomenographies: describing the plurality of atmospheric worlds...*, *op. cit.*, par. 4.

⁴³⁰ *Ibidem*.

a film, the space of flavours and fragrances, literature, painting, architecture, urban planning and other arts. It is for this reason, in the aspect of design practice, that it is beneficial to reference to a broad range of studies and conclusions formulated on their basis to then refer to the specificity of one's own discipline. The academic and interdisciplinary outlook on atmosphere should not redirect the architect outside of their own technical ability and the possibilities of architecture. The developing theory of atmosphere can even encourage architects to explore a specifically architectural methodology of research based on the properties of architecture. They could then contribute an original argument to the universal debate. In this spirit, the proposed study assumes the physical properties of architecture and the human experience of the relationship between light and architecture as a basis, which means that it does not go beyond the autonomous borders of the discipline. The precision of academic analysis maintained within these borders is expressed in the definition of the subject of the study as the atmosphere of architecture that is a part of the broader theory of atmosphere.

The academic outlook on atmosphere assumes the subjectivity of experiencing atmosphere also in the case of the scholar who analyses it. The authors of *Phenomenographies: describing the plurality of atmospheric worlds* wrote:

Both the occasional onlooker and the informed researcher—who reports the scene by implementing a set of methodologically fine-tuned skills—‘resonate’ with the affectively charged space. Thus, the description becomes tinged: by being embedded in a situation, we are not altogether free to take that backward analytical position that could grant us the objective stance of the external observer.⁴³¹

Every study of atmosphere is burdened with subjectivity, but when confronted in a broader group of researchers, designers and users of architecture, it gains cognitive significance and builds a language of mutual communication in the discipline of architecture and thus aids in defining the degree of subjectivity and objectivity of one's own experiences and the ability to apply them in practice.

III. 2.1. Defining Atmosphere

Studies of atmosphere indicate that defining the notion that is key to them is not treated as an overarching issue. Instead, scholars distance themselves from crisp definitions by proposing that a certain blurriness of atmosphere be maintained. It can be observed that a slight blurriness conditions the attitude of the scholar who studies atmosphere, heightens their alertness and keeps them in a constant state of experiencing. Böhme likewise distances himself from the crisp constraining of the definition of atmosphere, as seen in his reflection on what he believed atmosphere was not. ‘Atmospheres, to be sure, are not things. They do not exist as entities which remain identical over time; nevertheless, even after a temporal interruption they can be recognised as the same, through their character’.⁴³² He also displays astonishment that atmosphere has become an object of strictly scientific works in the last decade.

⁴³¹ *Ibidem*, par. 2.

⁴³² G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres... op. cit.*, par. 8.

Now, this matter-of-fact way in which atmospheres are talked about and manipulated is extremely surprising, since the phenomenon of atmosphere is itself something extremely vague, indeterminate, intangible. The reason is primarily that atmospheres are totalities: atmospheres imbue everything, they tinge the whole of the world or a view, they bathe everything in a certain light, unify a diversity of impressions in a single emotive state. And yet one cannot actually speak of “the whole”, still less of the whole of the world; speech is analytical and must confine itself to particulars.⁴³³

Mark Wigley’s thought, written down towards the end of the twentieth century, which stated that ‘Atmosphere escapes the discourse about it. By definition, it lacks definition. It is precisely that which escapes analysis. Any specific proposal for constructing atmosphere, no matter how changeable or indeterminate, is no longer atmospheric⁴³⁴ remains topical. Particularly so that the discussion of the phenomenon that it defines can be found in works from many centuries ago (State of Research). In light of this, the theory of atmosphere is in a distinct state of multi-definition of its essential term. This state is a background for discussion even when a single orientation is taken. The academic outlook on atmosphere denotes the formulation of precise names and studying cognitive paths associated with adopting a specific meaning of atmosphere as a hypothesis. The notion of the hypothesis is exceptionally useful in the academic approach to atmosphere. Canepa and her team qualified the assumptions adopted for studies of neuroscience and architecture, described as an experiment, as a hypothesis.⁴³⁵ However, these scholars also highlighted the need for the scientific study of atmosphere: ‘However, the difficulty, if not even the impossibility, of resolving the atmospheric issue is equal to the urgency of finding a clear and—if possible, scientifically grounded—understanding’.⁴³⁶

It can be assumed that definitions of atmosphere, even when adopted as working definitions, are hypotheses that play an essential role in research: they allow scholars to direct them at research goals, select the methodology of the description and evaluation of atmosphere. But the reverse can also be observed: these hypotheses are the result of the direction of the study, associated with a given academic discipline and specific goals. The adoption of a specific meaning of atmosphere is the result of a study’s specificity and research goals. In this work, this goal is the humanisation of architecture via the application of atmosphere to architectural criticism, education and design. The practical goal is the most important to them.

Against the background of the notion of atmosphere, two essential methods of treating it emerge: as an attribute of space or as a relationship between space and the individual who perceives it. The first outlook is earlier, and exists already in the initial meaning of atmosphere as a ‘ball of vapour’ (Chapter I), while the second is later, and is linked with the metaphorical and romantic use of the term.

Canepa and her team found eleven meanings of the term atmosphere in architecture, which they listed as follows:

1) atmosphere as *an environmental-control condition* (that is an artificial microclimatic bubble, able to influence the psychophysical comfort of individuals through the manipulation of thermic, hygrometric, and physical-chemical factors in the composition of indoor air);

⁴³³ G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres...*, *op. cit.*, par. 4.

⁴³⁴ M. Wigley, 1998 cited in: E. Canepa, V. Scelsi, A. Fassio, L. Avanzino, G. Lagravinese and C. Chiorri, *Atmospheres: Feeling architecture by emotions*, *op. cit.*, par. 3.

⁴³⁵ E. Canepa, V. Scelsi, A. Fassio, L. Avanzino, G. Lagravinese and C. Chiorri, *Atmospheres: Feeling architecture by emotions*, *op. cit.*

⁴³⁶ *Ibidem*, par. 3.

- 2) atmosphere as *a meteorological staging* (that is a scenic design procedure, working together with the light and the phenomena proper of the Earth's atmosphere, such as clouds, hazes, air flows, or lightning);
- 3) atmosphere as *an aesthetical-decorative quality* (found in the external covering of the architectural object or, more appropriately, in its decorative apparatus, independent from surrounding environmental conditions);
- 4) atmosphere as *the innate and distinctive identity of the place* (that is the *genius loci*, commonly interpreted as the 'spirit of the place');
- 5) atmosphere as *the collective imaginary* (the outcome of the *Zeitgeist*, the 'spirit of the age', that rises as the vehicle of values typical of a community: social, ideological, political, and holy values);
- 6) atmosphere as *a metaphor* (linked to the integrative power of words and imagination, capable of evoking a missing physical presence or of delineating particular qualities that transcend the domain of concrete and material);
- 7) atmosphere as *the constitutive character* (that is an expressly designed identity, able to confer an explicit and unequivocal appearance to a specific space, drawing an emotional, sentimental, social, ideological, moral, or spiritual connotation);
- 8) atmosphere as *the aura* (that is the inherent trait of authenticity and uniqueness emerging from the architectonic work);
- 9) atmosphere as *a collector of memories* (linked to the personal past, a synthesis of intimate experiences lived and subconscious associations);
- 10) atmosphere as *a perceptive experience* (that is the perceptive tension among the architectural features of a place and the subjective sensitivity of the individual immersed in that spatial domain);
- 11) atmosphere as *a mood* (that is the emotional tonality radiated by the surroundings and attuned to the temporary state of mind or feeling of whoever stays in that space).⁴³⁷

Defining atmosphere, in a sense, depends on the language one uses. The French word *ambiance* is relatively easier to use as a category of relationship. Narboni, in the book *Lumière et ambiances*, introduced the term *Ambiance lumineuse*, 'atmosphere of luminance', which he explains as 'Résultat d'une interaction entre un ou des lumières, un individu, un espace et un usage. L'ambiance lumineuse provient d'un éclairage naturel ou artificiel et influence momentanément ou durablement la perception du lieu éclairé'.⁴³⁸ He thus frames the category of relationship as an interaction, but introduces more participants into it: light or lights, the individual, space and use. This is of essential significance to this work: it corresponds with the adopted notion of the relationship between sunlight and architecture, which is perceived and evaluated by the individual. The evaluation of atmosphere is a result of this relationship. Narboni's *Ambiance lumineuse* was also an inspiration for the author's further research.

The meaning of the atmosphere of architecture as adopted in the work—as the interior's attribute of proficiency that is essential to the impact on the senses and minds of humans, is slightly different from the version proposed in *O światle...*, where atmosphere was more explicitly

⁴³⁷ *Ibidem*, par. 10.

⁴³⁸ R. Narboni, *Lumière et ambiances*, *op. cit.*, p. 234.

associated with a physical property of the interior. The delicateness of the difference in meanings expresses the style of discourse on atmosphere in its theory. This difference pertains to the ontological level and slightly affects the practical presentation of the subject of atmosphere in studying the relationship between architecture and light.

To refer the adopted meaning of the key term to a broader range of studies on atmosphere, it is fitting to quote Böhme, who derived his understanding of atmosphere against the background of the natural evolution of the notion from a meteorological to a metaphorical term.

The term *atmosphere* has its origin in the meteorological field and refers to the earth's envelope of air which carries the weather. It is only since the 18th century that it has been used metaphorically, for moods which are "in the air", for the emotional tinge of a space. Today this expression is commonly used in all European languages; no longer it seems artificial and is hardly even regarded as a metaphor. One speaks of the atmosphere of a conversation, a landscape, a house, the atmosphere of a festival, an evening, a season. The way in which we speak of atmospheres in these cases is highly differentiated—even in everyday speech. An atmosphere is tense, light-hearted or serious, oppressive or uplifting, cold or warm. We also speak of the atmosphere of the "petite bourgeoisie", the atmosphere of the Twenties, the atmosphere of poverty. To introduce some order into these examples, atmospheres can be divided into moods, phenomena of synaesthesia, suggestions for motions, communicative and social-conventional atmospheres. What matters is that, in speaking of atmospheres, we refer to their *character*. With this term *character* we already bring our understanding of atmospheres close to the sphere of physiognomy and theatre. The character of an atmosphere is the way in which it communicates a feeling to us as participating subjects. A solemn atmosphere has the tendency to make my mood serious, a cold atmosphere causes me to shudder.⁴³⁹

Böhme gave himself considerable freedom in defining atmosphere. He equated it with the 'mood' of a given space, which is imparted to the person that is present in said space. Similarly, Böhme's atmospheres were defined by Wilkoszewska as 'moods found on the side of things'.⁴⁴⁰ As understood in this study, the mood of a space is its ambience—its capacity to affect a person's mood. The proposed approach thus directly corresponds to Böhme's thought, although it attempts to use more precise terms, that are used in such fields like psychology. But Böhme also defined atmosphere as a 'marked space'⁴⁴¹—and as such a space with specific properties. However, he immediately noted that the property of an object does not constitute the atmosphere itself, but the condition for its creation, or rather its generator. Afterwards, he described atmosphere as follows: 'I speak of ekstases—that is, ways of stepping-outside-oneself'.⁴⁴² Therefore, the difference between properties and ekstases are explained by Böhme as an example of the antithesis between convexity and concavity: 'a surface which, in relation to the body it encloses, is convex, is concave in relation to the surrounding space'.⁴⁴³ In the term of ekstases, Böhme draws close to understanding atmosphere as the ability of an object, as used in this work. The closeness of these meanings is illustrated by Böhme's comment, in which he remarks that 'atmospheres are

⁴³⁹ G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres... op. cit.*, par. 2.

⁴⁴⁰ K. Wilkoszewska, *Uwagi na marginesie...*, *op. cit.*, p. 22. Wilkoszewska wrote: 'The thought to ascribe moods to an object entity appeared either naive—provoking arguments of a return to animism, or obscurantist—provoking suspicions of giving in to New Age esoteric practices. Nevertheless, here or there in philosophy one could find attempts at placing emotional qualities on the side of objects. Böhme, using his favourite and poorly known philosopher Schmitz as a basis, spoke explicitly on this subject, particularly in his *Philosophical Anthropology*'. *Ibidem*, p. 22.

⁴⁴¹ G. Böhme in an interview with Teodor Ajder in Warsaw on the 22nd of June 2013. The conversation was held as a part of the "Zielony Jazdów ekologia / ciało / taniec" project, <https://alchetron.com/Gernot-Böhme-2636578-W>.

⁴⁴² G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres... op. cit.*, par. 15.

⁴⁴³ *Ibidem*, par. 14.

something like the aesthetic quality of a scene or a view, the “something more” that Adorno refers to in somewhat oracular terms in order to distinguish a work of art from a mere “piece of work”; or they are “the Open” which, since Heidegger, has given us access to the space in which something appears. Seen in this way, atmospheres have something irrational about them, in a literal sense: something inexpressible.⁴⁴⁴

The authors of *Phenomenographies: describing the plurality of atmospheric worlds* maintain a scholarly distance from crisp definitions. They noted both the relational and spatial nature and atmosphere:

The phenomenology of atmospheres has come of age by underpinning a wide variety of explorations of reality. The world ‘out there’, in its inextricable unity, shows many aspects and can be described from a variety of perspectives; but no matter what our analytical intent may be, we agree on its fundamentally spatial nature, and on the corporeal and affective engagement it exhorts from all those present, either in an unreflective or more focused fashion.⁴⁴⁵

The definition adopted in the work sets atmosphere in the category of space. However, in light of contemporary studies, we can also refer it to the category of relationships understood as ‘pre-dualistic background of that relation, as an original, holistic “in-betweenness” in the sense of the result of a subject–object relationship.⁴⁴⁶ ‘Original, holistic in-betweenness’ and the ‘background of relation’ correspond with the meaning of an interior’s ability. Treating atmosphere as a result of the subject–object relationship requires us to dismiss the existence of atmosphere in an interior without a person in it. This is difficult to determine. The subject can be interesting in a phenomenological and ontological aspect, but in the aspect of architecture exploring it is rather fruitless. Perhaps, as Böhme put it with his peculiar ability, ‘without the sentient subject, they are nothing’.⁴⁴⁷ Böhme sets his understanding of atmosphere as a category of relations, by writing that ‘But atmosphere itself is not a thing; it is rather a floating in-between, something between things and the perceiving subjects’.⁴⁴⁸

Contemporary studies, even if they set atmosphere in the category of a relation, do not dismiss the possibility of understanding it as an ability/attribute of space, and even suggest it by some phrases. For instance, Canepa and her team, in the quoted paper indicate the metaphorical understanding of atmosphere as “‘ineffable” expressions’, which deliberately refers to Le Corbusier’s ‘ineffable space’⁴⁴⁹ and Böhme’s marked spaces and ekstases.

Böhme also wrote of ‘tone and emanation’, which in his terminology denote ‘atmosphere radiated by things’.⁴⁵⁰ Radiation is thus a manner in which things emanate in their surroundings, and also, how they are perceived by individuals who are present in those surroundings. The notion of radiance corresponds directly with the notion of exposure, distinguished in this work as a criterion of defining atmosphere. Böhme developed this further, by writing: ‘For this

⁴⁴⁴ *Ibidem*, par. 4.

⁴⁴⁵ F. De Matteis, M. Bille, T. Griffero and A. Jelić, *Phenomenographies: describing the plurality of atmospheric worlds...*, *op. cit.*, par. 2.

⁴⁴⁶ *Ibidem*, *op. cit.*, par. 50.

⁴⁴⁷ G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres...* *op. cit.*, par. 4. Böhme wrote: ‘Finally, atmospheres are something entirely subjective: in order to say what they are or, better, to define their character, one must expose oneself to them, one must experience them in terms of one’s own emotional state. Without the sentient subject, they are nothing’.

⁴⁴⁸ *Ibidem*, par. 10.

⁴⁴⁹ E. Canepa, V. Scelsi, A. Fassio, L. Avanzino, G. Lagravinese and C. Chiorri, *Atmospheres: Feeling architecture by emotions*, *op. cit.*, par. 6.

⁴⁵⁰ *Ibidem*, par. 16.

the ancients had the beautiful expression *parousia*. Thus, for Aristotle, light is the *parousia* of fire [...].⁴⁵¹

Different meanings of atmosphere are a result of their different placement along the spectrum between the subject and the object: once closer to the subject and once closer to the object. Böhme wrote:

And yet: the subject experiences them as something “out there”, something which can come over us, into which we are drawn, which takes possession of us like an alien power. So, are atmospheres something objective after all? The truth is that atmospheres are a typical intermediate phenomenon, something between subject and object. That makes them, as such, intangible, and means that—at least in the European cultural area—they have no secure ontological status. But for that very reason it is rewarding to approach them from two sides, from the side of subjects and from the side of objects, from the side of reception aesthetics and from the side of production aesthetics.⁴⁵²

This study, oriented towards education and design, is an outlook on atmosphere from the side of the object, i.e. ‘from the side of production’. The capacity of an interior, just as the expression or ‘ekstasy’ of space, refers to the broadly understood potential of architecture that resides in its physical properties. With there being ontological differences between treating atmosphere from the side of the subject or object in different definitions, methods of describing and building atmosphere are similar, although they either constitute the essence of atmosphere, or its condition or generator. Böhme highlighted that in his notion, ‘The making of atmospheres is therefore confined to setting the conditions in which the atmosphere appears’,⁴⁵³ namely its generators.

As a capacity of the interior, the atmosphere of architecture is generated by many of its physical properties, visible and invisible to the naked eye, which affect humans. Architects refer to them as components of atmosphere. These include: visible and invisible light, smell, musicality, temperature, humidity, coarseness, smoothness, looseness, hardness, softness of materials, the shapes of the boundary of the interior, etc. Experience teaches us that intangible properties, which remain in the sphere of the users’ thoughts and emotions and that arise from the relations between people, their number in the interior, do affect the atmosphere of the interior, yet they impact the atmosphere of its architecture only when they have a reason to or when they find an expression as a physical trace within the interior. The architect can affect the number of users in the architecture they design, as well as their density and placement in the interior, as well as mutual spatial relations by the physical properties of architecture and thus shapes the atmosphere of architecture by using the physical elements of the interior. The architect can direct the sphere of their thoughts and emotions, yet does so using physical properties of the interior. For this reason, the assumptions carried over from *O światle...* were retained and a study of atmosphere was proposed that would use the properties of the interior that have a physical expression.

The essence of the subject–object relationship gives rise to the quasi-objectivity of atmospheres. It is a property of atmospheres that is widely adopted by other scholars in their studies. In Wilkoszewska’s commentary, Böhme’s atmospheres are quasi-objective, as ‘their ultimate definition [...] comes about as the reaction of the subject’.⁴⁵⁴ Similarly, in this work it was assumed that atmosphere as an ability/attribute of the interior is quasi-objective, for it is the individual who defines it in their sensory experiences, mood and states of mind, and these are subjective.

⁴⁵¹ *Ibidem*, par. 16.

⁴⁵² G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres...* *op. cit.*, par. 5.

⁴⁵³ *Ibidem*, par. 10.

⁴⁵⁴ G. Böhme, *Filozofia i estetyka przyrody...*, *op. cit.*, cited by K. Wilkoszewska, *op. cit.*, *Uwagi na marginesie...*, *op. cit.*, p. 23.

The property of quasi-objectiveness of atmosphere enables, according to Böhme, to discuss it using language that links the participants of a cultural or social community. Insofar as architects and architecture users form a cultural or social community, this thought refers to architecture and urban planning.

The property of the quasi-objectiveness of atmospheres is essential in the field of architectural theory and practice, as it allows one to assume the perceptive experiences as a material of the atmosphere of a design, and on the other—to refer perceptual experiences directly to architecture, such as those of its materials, scale and shape. In this outlook, the properties of architecture are not conferred upon it during perception, but are instead perceived. For instance, labelling a material as hard or soft is measured in haptic experience, which does not mean that the individual affects the encountered state of matter and alters it with their perception. This is referred by the situation of touching water: when a person goes into it slowly, they feel its softness, while when they jump into it from a great height, they feel its hardness. Meanwhile, water in the sense of the physical, objective property of the element of the interior, remains the same. However, it is the perceived property that is of the greatest significance to experiencing atmosphere. This is why the architect, when designing a given element of architecture, operates quasi-objectively, which means trying to come as close to the objective properties of the material to use them well, but also, by designing the use of architecture, tries to identify the properties of the material in its specific perception, in a specific use-related situation. It is for this reason that distinguishing and incorporating use as the ‘participant’ of atmosphere (interaction), as proposed by Narboni in his definition of *Ambiance lumineuse*, is accurate.

Atmosphere can be treated as an independent entity. This is distinct for artists and designers, but is also accessible to a philosopher’s thoughts. To remind the reader of this, Pallasmaa, when writing about the aura, quoted Sartre:

“Tintoretto did not choose that yellow rift in the sky above Golgotha to signify anguish or to provoke it. It is anguish and yellow sky at the same time. Not sky of anguish or anguished sky; it is an anguish become thing, anguish which has turned into yellow-rift of sky”.⁴⁵⁵

Scholars who study atmosphere (Böhme, Griffiero, De Matteis, Sumartojo) highlight the holistic nature of the phenomenon of atmosphere, which they identify as the as difficulty of its academic definition and reaching its essence. They suggest that ‘atmospheres cannot be comprehensively generated, only the conditions for their possible appearance, thus depending on other, unpredictable events’.⁴⁵⁶ Böhme, by proposing an approach to atmosphere from the side of stage design practice (apart from the academically traditional approach—from the side of the aesthetics of perception) advised a focus on the specific tool of generating atmosphere—light. Thus, this study focuses on one of the components of atmosphere: sunlight and its appropriate description methods.

The interior, critical to the definition of atmosphere assumed in the work, can be referenced to every form of human surroundings as understood by Böhme,⁴⁵⁷ or Zumthor. Böhme references atmosphere not only to interiors or architecture, but to the open space of parks (particularly English parks), gardens, natural formations, such as valleys or all kinds of interiors: their space, as defined by boundaries.

⁴⁵⁵ J. Pallasmaa, *Oczy skóry...*, *op. cit.*, p. 790.

⁴⁵⁶ F. De Matteis, M. Bille, T. Griffiero and A. Jelić, *Phenomenographies: describing the plurality of atmospheric worlds...*, *op. cit.*, par. 45. This is a reference to: G. Böhme, *The Art of the stage...*, *op. cit.*

⁴⁵⁷ G. Böhme, *Filozofia i estetyka przyrody...*, *op. cit.*

III. 2.2. Atmosphere and the Materiality of the Interior

The meaning of atmosphere as adopted in the work aligns itself with the contemporary current of accentuating the material and the materiality of architecture. Not only in its subjects in which atmosphere, unnamed directly, can be clearly felt. In this outlook, discussions on atmosphere can easily be found in the idea of architecture as an environment, as presented by Kengo Kuma. According to this idea, building architecture is to adapt the environment to the human body in a long-term process of experiencing and negotiating the materiality of architecture (Kuma describes this process as: *showing/erasing, entering/leaving, breaking/connecting*).⁴⁵⁸ The environment and the body exist as linked components of a single, yet complex matter. Kuma references the idea of the fold, as laid out by Gilles Deleuz in the book *Le Pli. Leibniz et le Baroque* (Paris 1988). According to the idea of the fold, matter is continuous, fluid and flexible, and is thus folded. The lack of gaps in matter denotes its ‘dilution, densification, delamination, layering, expansion, collapse, stretching, focusing, adapting and affiliating’.⁴⁵⁹ Matter as seen by Kuma strongly resembles the Deleuzian fold: it is constantly folded and extended from different layers by the principle of continuity.⁴⁶⁰ The properties of the material define its materiality, visible in continuous and variable processes to which it is subjected, e.g. in processing or aging. Thanks to its capacity to enter into a relationship with humans, matter is a mediator between the human body and architecture. Matter is subjected to external and internal stimuli (as resulting from its properties) and this changes, oscillating between density and dilution, hardness and softness. Kuma, having found these subjects in the philosophy of the author of *Le Pli*, wrote that we perceive the solid and fluid form of a body as opposition, but water becomes ‘hard’ for someone who touches it when falling from a great height. He wrote that, apparently, the transition from a solid to a fluid form was relative and ambiguous, and that those were the points of Deleuze’s and Guattari’s theory.⁴⁶¹ Kuma used the example of water and its perception, which the author also used to demonstrate the difference between the objective material and the subjective perception of its properties. This outlook on the material and materiality strongly corresponds with the meaning of the atmosphere of architecture as adopted in this work and demonstrates that the ideas of Kuma participate in the debate on the atmosphere of architecture.

In the same vein, Tim Ingold noted the lack of equivalence between materiality, which attracts the focus of scholars today, and the material, the essence of the matter. In his anthropological outlook on history as measured across billions of years, materials from which the environment is comprised—

do not exist—like the objects of the material world – but occur. Thus the properties of materials, regarded as constituents of an environment, cannot be identified as fixed, essential attributes of things, but are rather processual and relational. They are neither objectively determined nor subjectively imagined but practically experienced. In that sense, every property is a condensed story. To describe the properties of materials is to tell the stories of what happens to them as they flow, mix and mutate.⁴⁶²

⁴⁵⁸ K. Kuma & Associates, *Studies in Organic*, op. cit., p. 058–060.

⁴⁵⁹ B. Stec, *Materialność jako relacja*, “Autoportret” 2015, no. 1 (48), p. 36–44.

⁴⁶⁰ See: K. Kuma, *Organisms as Relationships*, [in:] K. Kuma & Associates, *Studies in Organic...*, op. cit., p. 056–060. See: B. Stec, *Materialność jako relacja*, op. cit.

⁴⁶¹ K. Kuma & Associates, *Studies in Organic...*, op. cit., p. 046.

⁴⁶² T. Ingold, *Splatać otwarty świat*, op. cit., p. 31.

The study uses the notion of materiality as an atmospheric, variable effect of human experience, associated with the exposure of the material. It corresponds with Ingold's outlook on materiality. In one of his essays, Ingold proposes the reader to experience the stone on the desk in reference to Christopher Tilley's reflection on materiality.⁴⁶³ Experience teaches us, that the essence of the 'stoniness' of stone, 'is not constant but endlessly variable in relation to light or shade, wetness or dryness, and the position, posture or movement of the observer'.⁴⁶⁴ This is a repetition of the non-equivalence of material and materiality. It can be referred to the quasi-objectiveness of atmospheres, and particularly to the quasi-objective properties of objects, defined as their materiality. However, Ingold considerably expanded the perspective of time and existence of material across time, perceiving buildings as a the constantly changing environment of man. The scale of Ingold's perspective is presented or can be exposed in the relationship between architecture and sunlight: it requires us to perceive every experience of the surroundings/interior as a short-term exposure of materials and the dome of the sky, with its display of the Solar System and the universe.

III. 2.3. Perception of Atmosphere

With a certain dose of simplification, scholars maintain that the perception of atmosphere is comprised of the coexistence of the affective and reflective *embodiment* of a space by the observer. Although contemporary aesthetics accentuates the value of unmediated perception of space, made prior to interpretation, the experience of atmosphere is also comprised of knowledge and cultural socialisation, as noted by psychologist Ference Marton and which was confirmed by contemporary scholars.

In this sense, Marton opposes the central phenomenological feature of the *epoché*—bracketing off one's pre-understanding—and rather accepts that the way people sense and make sense of the world is deeply embedded in cultural and social domains. Marton's version of phenomenography, originating in a Scandinavian context, has inspired much further research, particularly in the educational field (Marton 1986; Entwistle, 1997; Bowden & Walsh, 2000; Larsson & Holmström 2007; Feldon & Tofel-Grehl, 2018).⁴⁶⁵

Culturology describes the process of the internalisation of cultural patterns, particularly tradition, based on upbringing and conditioning towards certain sensory practices (e.g. the 'practicing' of contemplation). As highlighted by scholars of atmosphere, the tension between the affective and reflective component of experiencing is the most fascinating in the academic sense.

The perception of atmosphere is an essential matter to this study, as it allows one to describe and evaluate a specific capacity of an interior. The criteria of evaluating atmosphere adopted in this work pertain directly to its experience by humans. They are within the scope of affective-reflective embodiment as indicated by scholars. It is proposed to separate sensory experiences as a group of physiological experiences, which are the closest to 'unmediated' contact with an objectively existing interior (inaccessible to human experience, as suggested by Ingold). Affective perception is a component of the perception of interior in its mood. It depends on an individual's emotionality, which was outlined in psychological determinants. Reflective perception

⁴⁶³ Ch. Tilley, *The materiality of stone: Explorations in Landscape Phenomenology*, Oxford 2004.

⁴⁶⁴ T. Ingold, *Splatać otwarty świat*, *op. cit.*, p. 32.

⁴⁶⁵ F. De Matteis, M. Bille, T. Griffero and A. Jelić, *Phenomenographies: describing the plurality of atmospheric worlds...*, *op. cit.*, par. 19.

pertains to ambience and, most importantly, the projection capacity of architecture, which is the deciphering of meanings, creating illusions and associations, reading symbols and comparisons. The framing of the three criteria as three types of perceiving the interior was dictated by analytical order, which enables the description of the experience of architecture. As indicated earlier, the mechanisms of their creation are not the subject of this work. The author agrees that it is their *coexistence* that is critical, as it comprises the experience of atmosphere and is academically the most interesting.

This work is not intended to demonstrate the equivalent impact of interiors on people nor to indicate groups that are more or less susceptible to the impact of atmosphere. The author wanted to discuss a number of cases of the experience of architecture, as described by architects: designers and critics. In the aspect of the educational and design-focused goal of the study, they can contribute the greatest amount of original arguments. The atmospheric strength of numerous projects, including historical architecture, convinces us that the architect uses their own intuition and emotionality as a tool to design atmosphere. The experience of the surroundings by an architect is the basis on which they build the atmosphere of new interiors. This atmosphere is typically experienced and identified by users with a similar psychological and cultural predisposition. This circle becomes even narrower the more the architect follows their own emotionality and can build an atmosphere that is particularly intense and unique through their ability to embody affective experiences. In this situations, it happens that an atmosphere intentionally created by the architect to be pleasant is contested by certain people, who do experience it, but as unpleasant. This was one of the reasons why the study featured an attempt to determine the ambience of architecture in direct reference to physical sensory experiences, without rating them on the scale of pleasantness.

Böhme noted that although atmospheres ‘are always perceived only in subjective experience—as a taste or a smell, for example, to return to Tellenbach—it is possible to communicate about them intersubjectively’.⁴⁶⁶ He expanded on this thought as follows:

We can discuss with one another what kind of atmosphere prevails in a room. This teaches us that there is an intersubjectivity which is not grounded in an identical object. We are accustomed, through the predominant scientific mode of thinking, to assume that intersubjectivity is grounded in objectivity, that detection of the presence and determinateness of something is independent of subjective perception and can be delegated to an apparatus. Contrary to this, however, the quasi-objectivity of atmospheres is demonstrated by the fact that we can communicate about them in language. Of course, this communication has its preconditions: an audience which is to experience a stage set in roughly the same way must have a certain homogeneity, that is to say, a certain mode of perception must have been instilled in it through cultural socialisation.⁴⁶⁷

The reception of atmosphere continues to be the subject of study and experiments, particularly in psychology and neurophysiology. The numerous questions they bring concern the role of human engagement in experiencing atmosphere. Everyday experiences point to the possibility of being susceptible to a given atmosphere unknowingly, without identifying it and being consciously engaged in its experience, while on the other, they show that the opposite is possible: that one can identify the atmosphere in the interior without being affected by it, or without engagement in it.

⁴⁶⁶ G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres... op. cit.*, par. 8.

⁴⁶⁷ *Ibidem.*

On these occasions—think of the experience of mere contemplation—an observer would be capable of clearly recognizing an atmosphere outside of felt-body involvement. This condition could grant the observer a deep ‘understanding’ of the situation’s ‘objective’ roots, and the ability to flawlessly convey its character to a third party, leveraging on shared situations and the constancy of affective responses to recurring conditions. Literature and poetry, for example, but also the notion of phenomenography as illustrated here, point in this direction.⁴⁶⁸

The incoherence or incompatibility between perception and affective engagement can be a basis for further study concerning the perception of atmosphere by psychology and neurophysiology. The architect can affect engagement in perception through their design: Zumthor discussed this matter:

When we look at objects or buildings which seem to be at peace within themselves, our perception becomes calm and dulled. The objects we perceive have no message for us, they are simply there. Our perceptive faculties grow quiet, unprejudiced and unacquisitive. They reach beyond signs and symbols, they are open, empty. It is as if we could see something on which we cannot focus our consciousness. Here, in this perceptual vacuum, a memory may surface, a memory which seems to issue from the depths of time.⁴⁶⁹

Zumthor’s original approach to engagement contributes a valuable voice to the discussion: a quiet, unacquisitive and calm perception is best for experiencing atmosphere, that can be said to be indifferent. Through it we see not the object that is at the periphery of our vision, but the emanation of this object, one that lives and moves.

The aspect of engagement was not subjected to a separate analysis in the methodology of this study. It is directly linked with the study, as human attention is engaged in changing effects of sunlight, which changes as well. These effects reinforce the feeling of the temporariness of experience.

The non-coincidence between perception and affective involvement proves, *inter alia*, the weakness of any projectivist thesis, also surfacing in some of the articles: the idea that an externally perceived atmospheric feeling can be accounted for as the mere projection on the surrounding world of a purely subjective feeling. Nonetheless, this occasional misalignment between perception and corporeal engagement could imply the need of admitting the presence of a minimal affective ingredient in every cognitive account—and vice versa.⁴⁷⁰

Scholars also ask questions, which leads to the different experience of a given atmosphere by different people. De Matteis et al. wrote of this commenting on the experiments of the authors of *Ambiances* from 2019.

In describing certain atmospheres, some of the articles do not exclude the possibility that these could generate distinct moods in different receptors. In other words, the pre-reflective recognition of their presence does not necessarily lead to an agreement between various subjects on their ‘definition’—an aspect of informed appraisal. The question arises: are these varying effects the result of distinct atmospheres, or rather diverging filtrations of the same phenomenon? After all, opposing affective responses, such as attraction and repulsion, could share the same atmospheric origin.⁴⁷¹

⁴⁶⁸ *Ibidem*, par. 40.

⁴⁶⁹ P. Zumthor, *Myślenie architektury*, *op. cit.*..., p. 17.

⁴⁷⁰ F. De Matteis, M. Bille, T. Griffiero and A. Jelić, *Phenomenographies: describing the plurality of atmospheric worlds*..., *op. cit.*, par. 41.

⁴⁷¹ *Ibidem*, par. 42.

When describing their experiments, scholars adopt different standpoints on these differences: they point to different thresholds of atmosphere tolerance in different people (Sumartojo et al.), they discuss different assessment of atmospheres presented by different people to objectively record existing differences (Canepa), highlight the subjectivity of atmospheric experiences (Mackrodt,⁴⁷² who assumes an analogy to differentiating assessments in the situation in which blind people who touch different parts of an elephant disagree as to what they perceive).

Questions also concern how we are taught to experience atmosphere by culture, socialisation, as well as how we are becoming accustomed to it by training. Scholars point to the danger of the instrumentalisation of atmosphere and using it to manipulate people: whether politically or for marketing purposes. Böhme wrote that atmosphere has been used increasingly often to manipulate in recent years:

If we review these examples, it emerges that the attention which is now paid to atmospheres in aesthetic theory has its material background in the fact that staging has become a basic feature of our society: the staging of politics, of sporting events, of cities, of commodities, of personalities, of ourselves. The choice of the paradigm of the *stage set* for the art of generating atmospheres therefore mirrors the real theatricalisation of our life.⁴⁷³

Open matters concerning the experience of atmosphere also include questions about contemplation, which is a traditionally acknowledged method of reaching and experiencing atmosphere. In her commentary on the quasi-objectiveness of Böhme's atmospheres, Wilkoszewska expressed her disappointment that their definitiveness is defined by the reaction of the subject understood 'in the spirit of contemplative perception',⁴⁷⁴ which is a traditional approach. However, contemporary studies list contemplation as a method of grasping atmosphere and that still deserves recognition.

Among the articles, Morselli and Sumartojo, Edensor and Pink privilege a perception that is not detached, rather deambulatory and articulated over time. This is in line with a beneficial pragmatic-ecological turn in the humanities: nevertheless, as Mackrodt discusses, the need still remains to integrate a more traditional, contemplation-oriented paradigm, which may focus on the detached observation of individual objects—panoramas, photos, works of art, etc.⁴⁷⁵

Apart from qualitative and quantitative analyses, there still remains the intuitive factor of the reception of atmosphere.

Atmospheric phenomenographies may aim at combining qualitative and quantitative elements. Despite the difficulties intrinsic to this goal, it is the path taken by various articles, all seriously engaged in trying not to reduce—despite the ineluctably enigmatic character of atmospheres—the qualitative to pure and incontrollable ineffable intuitions, or the quantitative to exquisitely extra-emotional formulas. Canepa et al.'s contribution, in this sense, provides a possible starting point for further investigations.⁴⁷⁶

⁴⁷² U. Mackrodt, *How atmospheres inform urban planning practice – insights from the Tempelhof airfield in Berlin*, "Ambiances. International Journal of Sensory Environment, Architecture and Urban Space" 2019 [online] <https://journals.openedition.org/ambiances/2739> [accessed: May 2020].

⁴⁷³ G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres... op. cit.*, par. 18.

⁴⁷⁴ G. Böhme, *Filozofia i estetyka przyrody w dobie kryzysu środowiska naturalnego, op. cit.*, cited in K. Wilkoszewska, *Uwagi na marginesie książki Gernota Böhme'ego..., op. cit.*, p. 23.

⁴⁷⁵ F. De Matteis, M. Bille, T. Griffero and A. Jelić, *Phenomenographies: describing the plurality of atmospheric worlds..., op. cit.*, par. 46.

⁴⁷⁶ *Ibidem*, par. 47.

The reception of atmosphere affects human behaviour. Sumartojo wrote that atmospheres ‘weave together the representational, the immaterial and the affective, as they signal activities and appropriate ways to behave. As such, they can prompt us to action, a point that Jean-Paul Thibaud (2015, p. 40) makes when he asks, “what does an ambiance make it possible to be, to experience, to do, to perceive and to share?”⁴⁷⁷ Bille⁴⁷⁸ argued that in studies of atmosphere we can distinguish two currents: one refers to what atmospheres are and what they do: to collective aspects of engagement, direction and transformation of atmosphere.

The role of light in the human perception of atmosphere is critical to the study. These matters have been partially discussed in Chapter II. Ingold highlighted that light is a ‘phenomenon of experience’ and ‘engagement in the world’, which determines the distinction of man as a subject, and its surroundings as an object. Light is, in a sense, the source of the matter about the quasi-objectivity of the subject-object relationship. This relationship is more or less objective or subjective due to the brightness of the light or thanks to light. Sumartojo concluded that ‘Light is integral to the perception and experience of our surroundings and our sense of ourselves as spatially and socially located’.⁴⁷⁹

III. 2.4. Describing Atmosphere

The ability to describe atmosphere lies in stating its quasi-objectivity. In one of his arguments, Böhme frames the matter in reverse: the ability to describe atmospheres, confirmed with experience, allows one to speak of its quasi-objective character. He wrote ‘[...], however, the quasi-objectivity of atmospheres is demonstrated by the fact that we can communicate about them in language’⁴⁸⁰.

The subject of methodology was placed at the centre of research on atmosphere by De Matteis, Bille, Griffiero and Jelić, who asked: ‘how can what is experienced, or even intended to be experienced, be described?’ research, educational and design objectives force the necessity to describe atmosphere.

More broadly, representing atmospheres becomes necessary whenever we strive to convey to a third party a situation in absentia of the actual space and time where it unfolds—either because it is physically unavailable, or because it is envisioning something that does not yet exist. Many art forms—painting, poetry, music—are capable of producing atmospheric effects: but can the same be achieved through descriptions relying on the more technical avenues of formalized methods?⁴⁸¹

Methods of describing perceptual experiences called phenomenographies are used to describe atmosphere. The term was created by psychologist Ference Marton, who used in the 1970s to describe ‘research aimed at description, analysis and understanding of experiences’.⁴⁸² The name suggests that phenomenography is derived from phenomenology and its research methods, but is in itself not phenomenology. Phenomenography focuses on the essence of

⁴⁷⁷ Sh. Sumartojo, T. Edensor & S. Pink, *Atmospheres in Urban Light...*, *op. cit.*, par. 1.

⁴⁷⁸ M. Bille, *Homely atmospheres and Lighting Technologies in Denmark: Living with Light*, *op. cit.*

⁴⁷⁹ Sh. Sumartojo, T. Edensor & S. Pink, *Atmospheres in Urban Light...*, *op. cit.*, par. 7.

⁴⁸⁰ G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres...* *op. cit.*, par. 8.

⁴⁸¹ Sh. Sumartojo, T. Edensor & S. Pink, *Atmospheres in Urban Light...*, *op. cit.*, par. 1.

⁴⁸² Quoted from: F. Marton, *Phenomenography – Describing conceptions of the world aroundus*, “Instructional Science” 1981, p. 180, cited in: F. De Matteis, M. Bille, T. Griffiero and A. Jelić, *Phenomenographies: describing the plurality of atmospheric worlds...*, *op. cit.*, par. 18.

experiences and later perception of a phenomenon, while phenomenography focuses on the essence of the phenomenon. Phenomenographers assume an empirical orientation and study the experiences of others.

Phenomenographies pertain to both the empirical and conceptual layer of experiencing, that, which is ‘lived’, and how culture teaches us to experience reality and how everyone individually develops ‘ways of relating ourselves to the world around us’.⁴⁸³

De Matteis et al. noted that phenomenographies strive to create a transition between lived experience and the new, differentiated object of perception that is associated with it,⁴⁸⁴ and thus investigate the nature of the connection between affective and reflective perception.

Affective perception and the reflective approach—if we at least momentarily admit such divarication—meet and clash in representations, becoming connected. In a way, phenomenographies investigate the nature of this connection, exploiting it to create a passage between lived experience and a new, distinct object of perception related to it: they articulate the tension, making it productive.⁴⁸⁵

The scale of the incompatibility between evocation and representation of experience becomes a problem: ‘Strathern’s opposition of ‘evocation’ to ‘representation’ further underscores the tension running through the describer, the recipient, the phenomenography, and the lived space they all somehow relate to’.⁴⁸⁶

Phenomenography also includes photographs and images of interiors, when they communicate with the viewer using the language of emotion and expose the atmospheric properties of the interior. They show fragments of interiors, such as dwellings, and create images of realities in which, using technical means, one can highlight atmospheric properties. Scholars do not negate photo-editing techniques such as cropping, changing an image’s proportions or its scale (in the quoted fragment, they refer to Antonioni’s film *Blow-up*):

A photograph can be adjusted in tone and color to solicit a felt-body resonance through multi-sensorial effects, pointing to a certain Stimmung. Even simple procedures such as framing and cropping—well highlighted in *Blow-up*—can lead to remarkable differences in the resulting effect [...].⁴⁸⁷

De Matteis, Bille, Griffero and Jelić, following Böhme, highlight that on a photograph, the object of representation and its depictions can produce the same effect. They also state that the image can evoke a portion of our experience of reality if it is capable of focusing in it spatial properties/content that could remain hidden without them.⁴⁸⁸

In this study, the author used original photographs of interiors as phenomenographies. They are comprised of the description of the atmosphere of architecture.

The *autoethnographic* method, in which atmosphere is described in situ and not from an analytical perspective of time and space, was used to study cities by Shanti Sumartojo, Tim Edensor and Sarah Pink.⁴⁸⁹ To obtain space-time unity of the experience and its description, they conducted a dialogue during a night-time walk across downtown Melbourne, Australia. Sumartojo stated that:

⁴⁸³ *Ibidem*.

⁴⁸⁴ F. De Matteis, M. Bille, T. Griffero and A. Jelić, *Phenomenographies: describing the plurality of atmospheric worlds...*, *op. cit.*, par. *op. cit.*, par. 24.

⁴⁸⁵ *Ibidem* par. 24.

⁴⁸⁶ *Ibidem* par. 26.

⁴⁸⁷ *Ibidem*.

⁴⁸⁸ *Ibidem*.

⁴⁸⁹ Sh. Sumartojo, T. Edensor & S. Pink, *Atmospheres in Urban Light...*, *op. cit.* This was discussed by F. De Matteis et al., *Phenomenographies: describing the plurality of atmospheric worlds...*, *op. cit.*, par. 30.

atmosphere can best be understood by way of what configures into our experiential worlds; we must therefore attend to memory, temporality, movement, sensation, material and immaterial surroundings (Sumartojo & Pink, 2018). It follows that attempts to describe and thereby understand atmospheres are most productive when we are immersed within them rather than regarding them from a distanced or outside location.⁴⁹⁰

Three scholars went on a walk—two women and one man, between their late forties and early sixties. None of them had grown up in Melbourne. They primarily noted the light of the city and the various moods, feelings and impressions it made on them. The choice of light was not coincidental, as its role as the primary component of night-time urban atmosphere was noted in the literature numerous times and continues to be studied. Sumartojo and her team referenced such authority figures as: Ebbensgaard (2015), Shaw (2014), Slater, Sloane and Entwistle (2015), Edensor (2012, 2015), Cochrane (2004). In the Polish literature, this subject was academically analysed by Justyna Martyniuk-Pęczek in her book *Światła miasta*. In the assumptions of Sumartojo's study, light was significant enough that her team called it the 'light walk'. One of the scholars wore a camera that recorded some of the view, the conversation, gestures, movements and pace of the walk, which lasted one and a half hours. Sumartojo and her team (2017, 2018) had made similar experiments in urban space earlier (for instance, they recorded the automation of experiencing commuting by people who repeated this activity every day for an extended period). In the 'light walk' experiment, the scholars noted that they found it significant that they focused their attention on the relationship between the place and the light within it as a single phenomenon in a night-time city. This corresponds with its study of light and architecture in their mutual coexistence, i.e. relation or relationship. During the 'light walk', the scholars' experiences oscillated between 'bright conviviality to shadowy menace, from rippling mystery to blazing consumerism'.⁴⁹¹

As written by the authors of the experiment, they chose a dialogical autoethnographic method, so that the description/commenting on the atmosphere could be attuned to its exploration in the constant flow of the surrounding reality. During the 'light walk', they tried to grasp the flow and change of not only impressions and feelings, but also imaginations and meanings that comprise the experience of the relationship between urban elements and light. They observed that the recording allowed them to describe 'the ways in which our experiences mixed the sensory, imagined and representational elements of urban public place'.⁴⁹² The experiment allowed them to experience and describe the dependencies between atmosphere and the light of lamps in the city and thus draw conclusions concerning the design of night-time illumination in urban space.

The experiment by Sumartojo et al. contributes essential arguments to this work concerning the exceptional role of light in building atmosphere. Although they refer to so-called artificial city illumination, they are universal, as they cover: 'texture, accent, spatial transition, visual cues, security and perception of security, moods, cerebral temperature and drama', radiating diverse qualities of sparkle, glow, glare, highlighting and diffusion. These diverse lighting effects guide understandings about how to act and manoeuvre within distinctive spatial and social settings'.⁴⁹³

Methods of describing atmosphere based on neurophysiological measurement and reporting of the effects of perceptual experience, particularly in architectural interior simulators, inspire hope in many architects. These methods assume the physiological origin of spatial

⁴⁹⁰ *Ibidem*, par. 13.

⁴⁹¹ *Ibidem*, par. 4.

⁴⁹² *Ibidem*, par. 13.

⁴⁹³ *Ibidem*, par. 6.

interactions, which makes it easier to measure them using neurophysiological and neuroimaging techniques. This group of studies on the perception and evaluation of atmosphere includes the experiment by Elisabetta Canepa and her team. They wrote that the combination of neuroscience with design methods can ‘foster an evolution of the study of how people perceive, imagine, and interpret textures, colours, distances, proportions, that is to say the totality of physical, sensorial, and material properties that define a room or an urban landscape’.⁴⁹⁴ The authors of the experiment argue that experimental and phenomenographic methods complement each other and can be of considerable significance in design practice.

Starting with these assumptions, Canepa and her team performed an experiment on a group of students, which had them perceive a hallway in its variants that differed in terms of: floor plan, cross-section, vertical finishes, horizontal finishes and lighting. The experiment was purposefully limited to the properties of the surroundings that were visible to the participants, although the researchers were aware of the multi-sensory and synaesthetic properties of the reception of architecture.

This work also assumed the properties of the interior that are visible to man as a basis of its methodology. To select architectural valuables to the corridor’s architecture, the researchers analysed forty virtual architectural layouts. However, they decided to limit their number to twenty, so as not to dull the attention of participants.

The authors of the experiment wrote: ‘our work intended to explore the atmospheric issue from an independent, architectural perspective, by studying the topic throughout the sensory-emotional filter of the perceiving subject located in the built environment’.⁴⁹⁵ The study enabled the verification of an original architectural hypothesis that was assumed at the start of the experiment: ‘the personal definition of the atmospheric phenomenon, with which we have tried to match limited numbers of specifically chosen neuroscientific models’. In the experiment, they did not use neurophysiological measures, but found a research basis ‘in evaluating the existence of a neurobiological basis of atmospheric perception that would underscore the importance of the physiological origin of spatial interactions, conscious of the need of moderating the neuroscientific initiative and relying on exploratory studies’.⁴⁹⁶ They stated in the conclusions:

The significance and worth of the experiment performed does not wholly lie in the single and partial results obtained, but rather in its entire process and approach. It suggests that there is a genuine opportunity for and benefit to studying atmospheric perception (as an expression of architectural experience *tout court*) using scientific methodology. The attempt to adopt a rigorous experimental approach, even if it is not strictly of a neuroscientific nature (as hypothesised in the theoretical objectives) because supported by self-report analyses on emotions, partially integrates the atmospheric condition in its linguistic vulnerability. There is, in fact, an apparently insurmountable discrepancy between the possibility of living an atmospheric experience and the ability to communicate and describe it. In the future, to further develop the conclusions of this prototypical study, we – architects and neuroscientists alike – should contemplate validating gathered experimental results by neurophysiology and/or functional neuroimaging techniques.⁴⁹⁷

⁴⁹⁴ E. Canepa, V. Scelsi, A. Fassio, L. Avanzino, G. Lagravinese and C. Chiorri, *Atmospheres: Feeling architecture by emotions, op. cit.*, par. 13.

⁴⁹⁵ *Ibidem*, par. 4.

⁴⁹⁶ *Ibidem*.

⁴⁹⁷ *Ibidem*, par. 35.

As observed by the authors of the experiment, atmosphere turned out to be not only the goal, but the basic tool of studying the manner of experiencing architecture in human impressions and emotions. The objective was to learn the sense of experiencing the space of architecture.

The conclusions concerning variants of manipulating light and shadow in the hallway were of particular significance to this study. The experiment demonstrated that the variant with strong light and shadow was rated as the most stimulating and pleasant to the respondents out of the entire investigated library of variants. These conclusions indicate that light affected the perception of the interior in a particularly strong manner among the categories used.

Completely different is the case of category V5, namely that which worked with the manipulation of light and shade: it was, unequivocally, the most arousing and pleasant set of arrangements on the level of the emotive effect, exactly as we expected. However, V5 corridors did not report a statistically significant correlation with the measure of dispositional empathy. This kind of reaction to light might be ascribed to the fact that its power of emotional excitability is so strong that it can influence the perceiving abilities of the subject, regardless of their empathic disposition to emotional resonance. Thus, the consequences of lighting design activity might transcend the personal domain of emotional predisposition and, eliciting a perceptual saturation, manage substantial reactions from the point of view of arousal and valence.⁴⁹⁸

The experiment by Canepa and her team contributed an essential argument to this work, as it allows one to assume that light stimuli are so strong to humans that they affect their ability to perceive regardless of their personal emotional predispositions. This objectivises the study of the perception of light in architecture and thus the study of the relationship between sunlight and architecture in the aspect of atmosphere. It also casts light as an exceptionally important strong component of the atmosphere of architecture, which defines its impact on man.

The study of atmosphere on the basis of neurophysiological methods takes on the character of experiments and requires an interdisciplinary team of specialists, laboratory conditions and the statistical processing of findings. These findings are accepted as highly reliable and as proofs. The situational character of the impact of atmosphere on man leads to a rise in the popularity of performative surveys in architectural space simulators. However, De Matteis, Bille, Griffero and Jelić note the valuable artificially created spatial simulators also falsify the experience of atmosphere in relation to the original pattern of architecture. Regardless of the ontogenesis of atmosphere (assuming a similarity between atmosphere produced in a simulator to the one that exists in actual architecture), the affective perception of the interior 'is not prone to interpretation. The quasi-objective character of atmospheres implies that different subjects encountering them may respond in varying ways: depending on their corporeal disposition and personal biography.⁴⁹⁹ [...] The question arises: are these varying effects the result of distinct atmospheres, or rather diverging filtrations of the same phenomenon?'⁵⁰⁰

In this situation, distancing themselves from hasty assessments, the researchers noted the greater usefulness of written descriptions in describing atmosphere due to the lesser subjectivity of this perception. They believe that literary texts, as phenomenographies, are advantageous as they filter not only the atmosphere, but the group that perceives it, it can 'call into play a range of individual skills that increases with the distance from the object that is being observed: even the most minute textual description of a spatial condition, for example, requires the reader to know the language in which it is written, and to have at least a basic previous experience of the

⁴⁹⁸ *Ibidem*, par. 33.

⁴⁹⁹ F. De Matteis, M. Bille, T. Griffero and A. Jelić, *Phenomenographies: describing the plurality of atmospheric worlds...*, *op. cit.*, par. 9. The quasi-objective character of atmosphere suggests that different people who interact with them can react in different ways: depending on their bodily propensities and personal biographies.

⁵⁰⁰ *Ibidem*, par. 42.

illustrated situation or of an analogous one. This filter causes the faithfulness of the representation to its object is all but guaranteed'.⁵⁰¹ Therefore, due to the use of a denser 'literary' filter for the receivers of quasi-objective atmospheres, the selected experiment participants have similar psychological and cultural predispositions.

It also turned out that the literary describing of atmosphere is 'more "empathetic" to places: through the [...] use of a multi-sensorial description of places, their social use and the foreshadowing of something that does not yet exist could actually come to life'.⁵⁰²

An analysis of the suitability of literary language in the methodology of studying atmosphere was performed and experimentally confirmed by Klaske Havik. In a pedagogical experiment named *TerriStories*, which concerned preparing a design for a Moomin museum at a selected site in Finland, combined the study of the spatial characteristics of a given territory with the study of history and social characteristics of the local community. Havik mentioned her first experiment of this type, performed together with Veldhuisen during a summer school at the Faculty of Architecture in Skopje in 2009, performed in a monastery in the mountains of Macedonia. The idea of *TerriStories*—the design of the Moomin museum—accounted for numerous factors that would comprise its future atmosphere: light, water, trees, the soil, man, as well as the fictitious Moomin characters. The design method chosen was storytelling, which created a different biography of the place for every student. Each biography was built by a mutual relationship between the participants of the story: the characters of the narrative, both real and fictitious, the terrain and the environment. The design tools used were poetic descriptions, short texts, sketches that were to 'evoke the atmospheric qualities of the designed spaces, expressing how materials meet, how color, light and shadow would work together. In detailed models and drawings, these insights were then further elaborated'.⁵⁰³ Havik noted that incorporating the Moomins into the phase of design analyses considerably affected the results: the attitude of students, their relationship with the site, the content of the design and the manner of its presentation. As a result, the students employed their own mindfulness of the atmosphere of a given site with the 'power of literary imagination'. The narrative method replaced the conventional analysis of a map of the plot with a different, unconventional map, developed on the basis of the perception of the site and literary stories.

This starting point created a mind-set for the entire course: the experiential aspects of design were foregrounded throughout the semester. In the second phase, that of "placing characters" the position of empathy was taken further, from the characters of the fictional text to the future users of the museum, taking into account spatial practices of different types of users, and investigating the spatial requirements for these practices beyond mere square meters surface: rather, thinking of the dimensions, viewing axes, color palettes and characters of the spaces as being for instance cold or warm, open or closed, dark or light, welcoming or distant. From the attentiveness to atmospheric qualities of the site towards the way atmospheres could be evoked by the building, the last two phases of the project used methods of narration and of poetic description.⁵⁰⁴

The literary reference to the story of the Moomins was both a source of inspiration and the content of the design. Havik concluded that had there been no inspiration with the Moomin

⁵⁰¹ *Ibidem*, par. 9 they list a series of individual skills that improve along with the distance from the object being observed: even the smallest written description of spatial conditions requires that the reader be familiar with the language written and have at least a basic prior experience with the situation or its analogy. The number of turning points becomes exponential and the faithfulness of the presentation of the object almost guaranteed.

⁵⁰² *Ibidem*, par. 43.

⁵⁰³ K. Havik, *TerriStories. Literary Tools for Capturing Atmosphere in Architectural Pedagogy*, *op. cit.*, par. 8.

⁵⁰⁴ *Ibidem*, par. 20.

characters, the design outcomes would have been ‘less playful and imaginative’.⁵⁰⁵ Her remarks concerning the universality of the employed method, which can also be referred to designs that are not programmatically linked with literary characters, in this case the Moomins. Havik concluded that looking at a site by associating it with a fictitious character stimulated empathy towards it and opened one to its impact, developing an awareness of atmosphere in the architecture that is designed at multiple levels: ‘in relation to site-specificity, in relation to the experience of future users, and in relation to material and detail’. According to Havik, *TerriStories*: combined the actual and imagined territory of Finland, actual landscapes referenced in descriptions of Moomin novels and those imagined by the students. Havik wrote:

By seeing the design evolve through the eyes of different characters, and by imagining time and time again how spaces could be used and experienced, and how they can accommodate different moods and events, the students moved beyond the conventional “problem-solving” approach, towards more engaged, empathic and attentive ways of designing.⁵⁰⁶

In this experiment, Havik investigated the potential of literary language in understanding how people experience the urban areas they inhabit and how literary narratives can be used as a tool of spatial analysis and design in architectural education. Literary descriptions were observed to be an excellent medium that enriches empirical and embodied engagement of students with the environment which facilitated the expression and description of the perception of the surroundings and that also enabled the prognostication of spaces in the design. Havik observed that the key benefit of using such tools in the process of design was based on giving a voice to the silent forms of empirical and embodied knowledge. This practice confirmed the link between language and spatial, bodily and affective experiences in describing atmosphere. Displaying this relationship is a universal achievement of Havik’s study, which touches on the nature of language in the aspect of its abilities rooted in direct bodily, emotional, social and cultural experiences of the world. Havik referenced others who studied this matter, such as Lakoff and Johnson (1980), Borghi et al. (2016), Buccino et al. (2016). Havik proposed narrative methods of investigating site-specific atmosphere to architects, assuming that literary language offers the ability to conceptualise atmosphere and its qualitative properties. Referencing the thought of Griffero, Mallgrave and Bachelard, Havik wrote:

Taking seriously this suggestion of *reading* and *describing* atmospheres, the question emerges whether literary language may provide potential for pedagogical explorations into the topic of atmosphere. In literary descriptions of architecture in novels, stories and poems, atmosphere is often eloquently brought to the fore. In poetic descriptions, we find detailed account of how materials meet, and how texture, shadow or color may render emotional responses. As Gaston Bachelard observed, “poets are born phenomenologists, noting that things ‘speak’ to them”.⁵⁰⁷

In the discussion on her experiment, Havik mentioned architectural projects built as a result of similar inspirations with literature: the Knut Hamsun museum in Norway, designed by Steven Holl and the Museum of Innocence in Istanbul, inspired by Orhan Parnuk’s eponymous novel. In De Matteis’ commentary, Havik’s didactic exercise corresponds with an idea that is important in the theory of atmosphere, and that the language of architecture corresponds with embodied and affective human experiences.

⁵⁰⁵ *Ibidem*, par. 21.

⁵⁰⁶ *Ibidem*, par. 22.

⁵⁰⁷ *Ibidem*, par. 3.

The narrative method of design, based on literary inspiration, corresponds with scenographic urban narratives, which the author of this work proposes to students as her programme during the *Stage design in architecture* module at the Chair of Stage Design of the AFA in Krakow.⁵⁰⁸ Student assignments are prepared on the basis of a literary text for specifically selected places in a city, typically Krakow. As a part of yearly exercises, the narrative of interventions in the space of the city arises from their direct link with the plot, be it historical or fictitious, the stage-like character—due to their intense impact on passersby and the temporariness of the installation, the urbanity—from the physical link between architecture, its materials, shape, openings to sunlight. The goal of designing scenographic urban narratives is to open students to experiencing a given location, note and expose, primarily using sunlight, its extant atmosphere of architecture, and evoke a new atmosphere in relation with the literary narrative. The proposed urban narratives are not spectacles in the traditional sense of the word and do not feature actors, but are scenographic via their narrative means.

One example of a historical narrative was the scenographic exposure of places linked with Stanisław Wyspiański's life in Krakow on the anniversary of his death in 2017. The basis for the designs was a trail of 48 places in and around Krakow that Wyspiański was tied to in some way and that the author compiled. The biography of the artist and the architectural fabric, in a relationship with sunlight, created a new biography for these places.

During the 2015/2016 academic year, the narratives took on the form of *A Walk with...* Some students prepared *A Walk with Brodsky* while others—*A Walk with Ortega y Gasset*, in specific places around Krakow. *A Walk with Brodsky* was designed in four places in Krakow, based on fragments of Joseph Brodsky's *Watermark* (1993). The poet's reflections allowed students to expand their own perception of Krakow with that of Brodsky, which had been full of love for his cherished Venice, as well as an uncommon poetic sensitivity and erudition. The main material for each of the four installations was sunlight and shadow in a relationship with the architecture of the selected sites. *A Walk with Ortega y Gasset* was an installation in the space of Krakow's centre, inspired by Ortega y Gasset's *Estudios sobre el amor*. They were prepared by two Spanish students, who used the original Spanish text and its Polish translation. Their engagement went beyond the scope of the project. The students organised a series of events in the space of the main building of the AFA in Krakow and on its façade, in the space of the square and performed interviews with AFA students.

The value of descriptive practices in describing atmosphere was noted by De Matteis, Bille, Griffero and Jelić, who cited a fragment of Walter Benjamin's childhood journal. On this example, they indicated the key to descriptive practices:

the potential discrepancy between a recollected atmosphere and its representation through an image. Benjamin's memory of his childhood winter strolls does not match the image until he manipulates it, holding it up against the light and associating the postcard's label to his own prior knowledge of the area around Hallesches Tor. It is a conceptual operation, grounded in the intersection between an intuition and an interpretation. Phenomenographic practices often rely on the collaboration between different expressive channels and sensory domains that become synesthetically intertwined, and are in turn related to the object of representation: the question on the floor thus regards the nature of the relationship between these various spheres, and how they affect us—both as isolated objects and in their intersection.⁵⁰⁹

⁵⁰⁸ B. Stec, *Scenograficzne narracje miejskie. Spacer z... / Scenographic city narratives. Walking with...*, [in:] I. Kozina (ed.), *Narracje miejskie. Miasto jako obszar interwencji polityków, architektów i artystów / City Narratives. City as a space of intervention between politicians, architects and artists*, Akademia Sztuk Pięknych w Katowicach, Katowice 2019, vol. 2., p. 243–250 (Polish), p. 69–77 (English), illustrations p. 127–132.

⁵⁰⁹ F. De Matteis, M. Bille, T. Griffero and A. Jelić, *Phenomenographies: describing the plurality of atmospheric worlds...*, *op. cit.*, par. 23.

The matters of describing atmosphere under discussion have been present in stage design and scenography for a long time, which is why they also appear in methods of designing public space as stage.⁵¹⁰ Böhme reminded that in the past, gardens were designed on the basis of the atmosphere that they were to produce. Designers followed the mood that it was to evoke in users. The data required for this was collected from observing human behaviours, descriptions of feelings, and dramaturgy. As a result, in the garden-stage, the user-actor took on a role imposed on them by the stage design of the interior.

Böhme also noted the possibility of communication between designers and the audience of a spectacle in the art of stage design ‘Of course, this communication has its preconditions: an audience which is to experience a stage set in roughly the same way must have a certain homogeneity, that is to say, a certain mode of perception must have been instilled in it through cultural socialization’.⁵¹¹ Therefore, stage design art, as a phenomenography, ‘filters’ the audience of the atmosphere of a stage similarly as literary texts filter the observers of their atmosphere. The art of theatre and scenographies can therefore be acknowledged as one of the more important phenomenographies.

Due to the multi-sensory nature of the perception of atmosphere, its description uses a combination of different phenomenographies, which also highlights the intuitive layer of experiencing the environment. In light of these arguments, the application of descriptive phenomenographies based on texts and the ability of language, photographic phenomenographies and a combination thereof, in this work is justified.

III. 2.5. Building Atmosphere with Light

The matter that makes the theory of atmosphere the most dynamic pertains to the possibility and manner of evoking it. They affect the character of methodologies, the selection of assumptions and hypotheses, and direct the course of pursuits within various academic disciplines and design arts. The practice of evoking atmosphere is linked with the objective of humanising design methods, and thereby improving quality of life within architectural and urban interiors. Because of this, the practical side of atmosphere causes a great deal of emotions and hopes not only among architects, urban planners and designers, but also among architecture critics and users.

Suggestions associated with evoking atmospheres are formulated on the basis of its experience and evaluation and are therefore linked with the matters that have been discussed already in the book. Böhme, when writing about atmosphere in stage design, asked ‘All the same, can one really make atmospheres?’. And added: ‘The term *making* refers to the manipulating of material conditions, of things, apparatus, sound and light’.⁵¹²

Similarly, De Matteis and other scholars observed that tensions in the theory of atmosphere are produced not by arguments about definitions, but the methods of evoking atmospheres. ‘Can an atmosphere be intentionally produced and controlled, or is it rather groundlessly floating in lived space, entirely independent from human action?’⁵¹³

In response to the question that he himself had formulated, Böhme answered that there is a limited possibility of generating atmosphere: ‘The making of atmospheres is therefore confined

⁵¹⁰ See: A. Franta, *Reżyseria przestrzeni...*, *op. cit.*; G. Böhme, *The art of the stage...*, *op. cit.*

⁵¹¹ G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres...* *op. cit.*, par. 8.

⁵¹² *Ibidem*, par. 10.

⁵¹³ F. De Matteis, M. Bille, T. Griffero and A. Jelić, *Phenomenographies: describing the plurality of atmospheric worlds...*, *op. cit.*, par. 45.

to setting the conditions in which the atmosphere appears. We refer to these conditions as *generators*'.⁵¹⁴ He developed this matter by reminding us of the notion of *phantastike techne* as discussed by Plato, which denotes art that accounts for the point of view of its observer.

This art of *phantastike* is perhaps not yet quite what we mean by the art of making atmospheres, but it already contains the decisive feature: that the artist does not see his actual goal in the production of an object or work of art, but in the imaginative idea the observer receives through the object. That is why this art is called *phantastike techne*. It relates to the subject's power of representation, to the imagination or *imaginatio*. We come close to what concerns us through the *skenographia* developed by the Greeks as early as the fourth century BC.⁵¹⁵

Phantastike techne was thus clearly intended to generate specific projections in the imagination of its viewers, 'It does not want to shape objects, but rather to create phenomena. The manipulation of objects serves only to establish conditions in which these phenomena can emerge'.⁵¹⁶ The art of stage design is therefore aimed at generating specific themes and images in the imagination of the audience. For this reason, it is necessary for the audience to actively participate in generating atmosphere: 'But that is not achieved without the active contribution of the subject, the onlooker. It is interesting when Umberto Eco claims precisely this for all pictorial representation'.⁵¹⁷ Böhme noted that contemporary stage design has gone beyond scenography (referring to tradition), and saw the breakthrough in Wagner's operas and their impact on not only the audience's imagination, but also its emotionality.

Due to its impact on the audience, scenography uses perspective projections of representations of the surroundings of humans, typical for human perception. Ancient Greeks used optical correction in their formal buildings for similar reasons.

Specific means of operating with light and optical correction were used by Dominikus Böhm in his Church of St Joseph in Zabrze, 'to seemingly deepen the nave and heighten the walls and columns'.⁵¹⁸ They are an essential building block of the atmosphere of this interior's sacredness, as pointed out by Wagner, who subjected them to a detailed analysis.

The distance between the columns of successive chapels from the side of the narthex was 5.6 m and decreased proportionally towards the altar to 4 m. The distance between opposing columns near the narthex is 16 m and lowers proportionally to 14 m at the edge of the presbytery. The result of the corrections is an apparent deepening of the nave and the perspective of the chapel wreath in the passages between them. The four levels of windows have the following heights: 7.2 m, 6.4 m, 5.8 m and 5 m, respectively. This creates an illusion of a greater foreshortening, and thus an appearance that the church is in fact taller than it actually is. This is aided by the fact that there was no way to look at the walls from a large distance both inside and around the main body.⁵¹⁹

Pointing to optical corrections makes sense only in light, as it allows them to create illusions concerning scale, depth and proportions of architecture and thus generate a new property of the interior, producing the desired sensory experiences in worshippers.

⁵¹⁴ G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres... op. cit.*, par. 10.

⁵¹⁵ *Ibidem*, par. 12.

⁵¹⁶ *Ibidem*.

⁵¹⁷ *Ibidem*, par. 12.

⁵¹⁸ T. Wagner, *Zabrze. Nieznane oblicza śląskiej architektury, op. cit.*, p. 44.

⁵¹⁹ *Ibidem*, p. 45. Wagner further wrote: 'The interior also featured a repetitiveness of various numerical systems. This quality, highly distinct of Böhm's work, repeated itself in most religious buildings he had designed, constituting a reference to the medieval symbolism of architecture'. *Ibidem*.

In the practice of designing the atmosphere of architecture, light is given an exceptionally important role. De Matteis and his team, when commenting on Sumartojo's 'light walk' experiment, asked 'does it escape comprehensive design control, relying on unpredictable accessory factors, such as in the case of the ephemeral lighting effects reported by Sumartojo, Edensor and Pink?' However, ephemeral light effects turn out to be fundamental to atmosphere and the most common as the material for making it.

In his reflection on making the atmosphere of the stage, Böhme focuses a greater amount of attention on this component of atmosphere. Although the reference to the stage suggests electrical illumination, then Böhme's thought is a clear argument that demonstrates the expository value of light in the interior built as a stage and thus the exceptional role of light in building atmosphere. Böhme also mentioned sound, smell and temperature, yet in the field of design arts, which include architecture and urban planning, he points to the overarching role of light as the tool of design at the architect's disposal.

Böhme noted the ambience and projection capacity as elements of scenography and tied the manner of building them with operating with light. He thus indicated that scenographic functions and methods of building them, analysed by the author in her doctoral dissertation (2000) and then used to study the relationship between light, architecture and atmosphere (2017). The attributes of the interior: ambience and projection capacity, are the abilities of the interior that define its scenographic functions. They are scenographic as they play a primary role in scenography and are fundamental to it, and even necessary, while in architecture they play a secondary role and are neither fundamental nor necessary. We can formulate a conclusion that by building the ambience and projection capacity of architecture, we confer scenographic functions upon it. The scenographic function reinforces that atmospheric character of architectural and urban interiors, adapting them into a stage of actor-users and audience-users, which was confirmed in Franta's study (2004). The study of the role of the scenographic aspects of architecture in building its atmosphere gains a new value in light of Böhme's thought.

Böhme referred to contemporary scenographies, which surround the viewer more spatially than how it was possible in a traditional box theatre. This understanding of scenography directs our thoughts to eighteenth-century gardens and parks, whose types were determined in the past on the basis of their atmosphere, as reminded by Böhme. In a similar sense, he pointed to experiences from contemporary arts of the stage. He proposes to adopt them as a model for building the atmosphere of architecture. He wrote: the art of the stage set turns out to be a paradigm for what are the main concepts of the theory of 'atmosphere: types of atmospheres (characters), their quasi-objectivity, means to produce atmospheres, emotional content'.⁵²⁰

Böhme restored the value of the intuitive and empirical element in building atmosphere. One cannot formulate recipes and even if such had been formulated, the essence is based on practical skill. The model is the historical method of teaching the profession of the stage designer, just as one would teach a craft in the process of a student's work for their master by cooperation and imitation. Böhme wrote that the 'guiding practical knowledge is tacit knowledge'. Practical guidelines are the closest to this tacit knowledge. This is why, towards the end of his reflection on making atmosphere, he quoted Robert Kümmerlen, and to be specific, his statement on the role of light in creating the ambience of the stage from the book *Zur Aesthetik bühnenräumlicher Prinzipien* (Kümmerlen, 1929). 'Kümmerlen writes about the use of light on the stage. He argues, we should note, that an *atmosphere* is created on the stage with light'. He analysed light in terms of its practical use, i.e. 'more precisely by saying that a *characteristic mood* is imparted by it to the performance'.⁵²¹ Atmosphere arises from precision and practicality, similarly as in the work of Zumthor and other architects who are artistically involved in the design and

⁵²⁰ G. Böhme, *The art of the stage set as a paradigm for an aesthetics of atmospheres... op. cit.*, abstract.

⁵²¹ *Ibidem*, par. 18.

construction of their work. Böhme expressed his respect for Kümmerlen's concise description from the 1920s. He demonstrated that if the goal of reflection concerning atmosphere is to make it, then the description of said atmosphere should be precise, based on the physical properties of objects and be supported by examples. Kümmerlen does use examples. Böhme wrote: 'he mentions *somber* and *charming* moods—that is, moods with a synaesthetic and a communicative character. Finally, he also recognises the status of the “in-between existence” typical of atmospheres: “The lighting on its own generates a fluid between the individual structures of the performance”'.⁵²² Kümmerlen's remarks are a valuable argument for this work, which is why they shall be referenced, as quoted by Böhme:

‘The space to be contemplated is given its brightness by the lighting; stage performances are only made visible by light. The first function of lighting, the simple provision of light, creates, with the brightness, what might be called the atmosphere in which the space exists. The light-atmosphere, achieved in the most diverse ways, varies the space; through the lighting the performances take on a characteristic mood. The space creates an effect in its totality; the lights of the special representation produce a self-contained impression; the space stands in a unifying light. With the illumination of the whole scene a “unified character” is produced. A uniform mood emanates from the space; for example, the representation of space is subjected to a “muted” light. We find that three-dimensional objects “gleam” in a regular light; the space appears, for example, as “charming” or “somber”. The lighting on its own generates a fluid between the individual structures of the performance. A specific mood is contained in the space represented through the ethereal effect of brightness (Kümmerlen, 1929, p. 36)’.⁵²³

Kümmerlen framed this phenomenon quite originally: it is the space that exists in atmosphere and not the other way around. This allowed him to write about the ‘atmosphere of light’, which alters space. Light has an exceptional role of connecting, of creating a whole. Light is, in a sense, superior to space in the exposure of the stage. The unifying role of light is fundamental for building the atmosphere of the stage. Thanks to it, space ‘stands’ in light.

Light is the binding element, that unifies space. But it does so in various ways: by focusing the space or breaking it apart through diffusion. However, different means serve the same function of unifying space, but do so by different principles. The light of the stage gives an appearance of independence as its ambience and projection capacity are its overarching function. The practical side of light on the stage is secondary. Therefore, the greater the expositional and scenographic role of light, the more said light is independent, it creates the atmosphere of the light in which space exists.

The subject of atmosphere formulated in this manner pertains to exposing the relationship between architecture and light, framed differently than in this study, i.e. not in terms of architecture (practice, teaching), but in terms of light. Although atmosphere evoked by light gains properties perceived by individuals due to the matter of the surroundings, this outlook on the relationship between light and architecture is closer to light. In this study, many interiors generate the atmosphere of light thanks to their architecture, but the outlook on the subject from the side of design practice required the adoption of the perspective of architecture, and as a consequence of the study: the atmosphere of architecture.

Although Kümmerlen wrote of building scenography, he developed his thought: ‘A uniform mood emanates from the space; for example, the representation of space is subjected to a “muted” light’. The final role of light, the most essential in reference to the sunlight studied in this work, was noted and precisely formulated as follows: ‘the lighting on its own generates a fluid between the individual structures of the performance’. The ‘ethereal effect of brightness’ that changes

⁵²² *Ibidem*, par. 18.

⁵²³ *Ibidem*, par. 19.

from dawn to successive dusks and dark creates a fluidity between interiors perceived during the day. The night sky, even during a clear sky and a full moon, is incapable of generating fluidity between perceived interiors: they emerge as fragments and do not constitute a unity, and the distances between them do not form a network of connections. In a wider perspective, sunlight generates fluidity between individual days as frames of human activity and everyday life. Man perceives the fluidity of his existence thanks to the atmosphere of light. It is in it that architectural and urban interiors achieve their fluidity.

Böhme's paper and his reference to Kümmerlen contributed new outlooks on the author's previous research. As a result, it became necessary to prepare its third part, focusing solely on the *Atmosphere of Sunlight*.

Böhme's discussion and the detailed observation of stage design master Kümmerlen derive from practice and it is for this reason why it is easy to adapt them to it. Although laconic, they are of particularly essential significance to this work, which is oriented towards architectural design. Böhme wrote of the art of stage design as a model. The significance of light and sound in stage design, urban planning, interior architecture and even advertisement alters the objective of design in his opinion. 'But for our purpose it is important to modify the traditional understanding of design, according to which design amounted merely to *shaping* or *configuring*'.⁵²⁴ Likewise, Sumartojo and her team, in the overview of their experiment, highlighted the key role of light in building atmosphere, quoting Ingold and Böhme in his spirit of commentary on Kümmerlen. Referring to Böhme, she wrote that he 'goes further' in his understanding of light when he writes that because 'all of what is seen takes on a tint that turns the diversity of what is seen into a unified whole'. Here light draws together the visual world into a way of feeling and understanding our surroundings'.⁵²⁵ She took out arguments about the atmosphere of light from his thoughts, which were discussed in reference to Böhme's commentary on Kümmerlen.

Sumartojo references Bille and Sørensen's studies (2016), who analysed 'how less tangible phenomena such as light, sound and air, are part of the sensuous experience of buildings, and how manipulations of architectural form through the use of lighting technologies, heating and so forth influence the experience of built space'. In their experiment, Sumartojo et al. tried to remain close to design practice and demonstrate the limitations in building and difficulty in controlling atmosphere.

The theory of atmosphere introduces a new outlook on design practices. According to Böhme, the value of the atmospheric revolution in architecture is based on changing the objective of design. The art of stage design can be a model to determine it. 'One might speak of a practical, or better: a poetic phenomenology, because we are dealing here with the art of bringing something to appearance'.⁵²⁶ This corresponds with the thought expressed in Mallgrave's books:⁵²⁷ the objectification of architecture and treating design as creating objects should once again be directed to those whom the design is to serve, its users, who inhabit the built environment. This forms the foundation of the humanising role of the atmospheric revolution in architecture.

⁵²⁴ *Ibidem*, par. 17.

⁵²⁵ Sh. Sumartojo, T. Edensor & S. Pink, *Atmospheres in Urban Light...*, *op. cit.*, par. 7.

⁵²⁶ *Ibidem*, par. 17.

⁵²⁷ H.F. Mallgrave, *Architecture and Embodiment: The Implications of the New Sciences and Humanities for Design*, *op. cit.*

Architecture, by operating with three-dimensional spatial layouts,
organises the penetration of light inside the building
by the openwork of windows, openings, skylights or colonnades.

M. Popczyk, *Światło i obrazy*

The structures is a design in light. The vault, the dome, the arch, the column are structures related to the character
of light. Natural light gives mood to space by the nuances of light in the time of the day and the seasons of the year,
as it enters and modifies the space.

Louis Kahn, za U. Büttiker, *Louis I. Kahn, Light and Space*

IV

Architectural Operation With Sunlight and the Atmosphere of Architecture

This chapter explores the principles of the functioning of the relationship between sunlight and architecture, the methods of operating with light in the interior. To this end, a research tool was developed: a typology and classification of elementary architectural methods of operating with sunlight in the interior. Afterwards, the results of operating with light in the interior were evaluated in the aspect of atmosphere, which is the mutual exposure of the physical properties of architecture and light, using previously defined criteria (Chapter III).

In this chapter, a distinction and definition of factors that condition operating with light in the interior was proposed into: the activity of architecture, the organisation of illumination and architectural tools.

IV. 1. Elementary Architectural Methods of Operating with Sunlight: a Typology

The starting point of the analysis of determinants of operating with light in the interior is to state a constant physical circumstance that characterises each relationship between architecture and sunlight, namely: the source of sunlight is always outside of the interior and it can be admitted into it using architectural means, including with the use of the apparent vault of the sky over an interior that is completely open from above.

It was observed that every method of operating with light in the interior is the result of three factors: 1) the activity of architecture (it answers the question about what architecture does with sunlight), 2) the organisation of illumination (it answers the question from where does light come from and from where is it admitted into the interior relative to its sides), 3) architectural tools (they answer the question as to which elements of the interior perform the activity of architecture). The architectural methods of operating with light in the interior listed here are elementary, and thus fundamental for each and every case of operating with light.

The three factors of operating with light in the interior are mutually dependent and are always present simultaneously, which is why it is not possible to discuss one without using the other. Their definition was discussed in sequence: first the activity of architecture, followed by the organisation of illumination and the tools at the end.

According to the study's assumptions, it is the physical relationship between architecture and light that is studied, perceivable due to natural capacities of the human sense of sight. It is for this reason that factors that comprise the operation with sunlight in the interior must have this scale, namely an actual, objective, absolute dimension,⁵²⁸ that can allow a functioning human sense of sight to perceive them. The sets of architecture's activity, the organisation of illumination and architectural tools were created on the basis of the properties of the interior and the effects of light phenomena, whose actual dimensions are distinguished by human sight and qualified on the basis of its own dimensions.

⁵²⁸ Cf. J.K. Lenartowicz, term: scale, [in:] W. Szewczuk (ed.), *Słownik psychologii architektury...*, *op. cit.*, p. 127, 128.

IV. 1.1. Activity of Architecture

The activity of architecture is linked with the admittance of sunlight from outside into the interior and modifying it using architectural tools. It is not based on the movement of architecture over time, but on the operation of the laws of physics that govern light in architecture (they were discussed in Chapter I. 1.). Due to the human perception of these phenomena, the law of the travel of light rays along a straight path, the law of the reflection of light (both mirror-like and scattering), the law of the refraction of light and the law of the absorption of light. Most optical phenomena associated with sunlight and visible light in the interior are a result of the overlapping and addition of phenomena that arise from the operation of these four laws. In reality, it is light (not architecture) that acts and operates in the interior, namely it travels, reflects, breaks, changes its wavelength, but this operation is enabled and caused by architectural tools, which is why it was decided that statements that architecture admits, reflects, breaks and absorbs light are also true.

The typology of the activity of architecture was formulated not only on the basis of optical phenomena governed by the laws of physics, but also on the basis of the different visual results of these phenomena in the interior. The phenomena based on the same law can return different visual results in human vision. Therefore, in determining the relationship between architecture and light, it was necessary to distinguish reflections not only due to the laws of optics (in such conditions there are two: mirror-like reflections and scattering), but also due to the distinguishing of different visual effects of these phenomena by the human eye. Concerning the physical form of light in the interior, it is significant whether this light is admitted directly from outside, or after a prior reflection from elements of architecture or using a filter in the boundary of the interior. Therefore, overall, the typology includes: 1) **the admittance of sunlight into the interior directly from outside** (associated with the travel of rays along a straight line), 2) **ray reflection** (associated with the law of the reflection of rays), 3) **ray filtering** (associated with refraction and absorption, as a different material medium that acts as a filter takes part in both phenomena).

When admitting rays directly from outside, the scope of the limitation of the penetration of light rays by the elements of the interior—from full penetration to isolation—is important to the physical form of said interior. When reflecting light rays, it is important what this reflection is like and what is its course. When filtering light, a specific filter structure produces a specific physical phenomenon that light is subjected to. In light of the above, a clarification of general activities was proposed via their division into elementary ones, to be divided by the obtained level of brightness and the visual effects of light in the interior.

The set of activities of architecture is therefore as follows:

Tab. 1. Activity of architecture

ACTIVITY OF ARCHITECTURE		
Direct ray admittance	Reflection	Filtering
1) full penetration 2) carving 3) forcing through 4) isolation	5) mirror-like reflection 6) scattering and breaking 7) scattering and bending 8) scattering and slipping 9) scattering and channelling	10) sifting 11) refracting 12) absorption

The proposed names, which have a metaphorical character, are intended to highlight the *operativeness* of architecture, achieved in its elements and which is used to admit sunlight into the interior and modify it.

Overview of the activity of architecture:

- **Admitting rays directly from outside into an interior is an activity of architecture that enables the penetration of light rays coming directly from the Sun or from the celestial sphere inside the interior without altering their direction and without a filter, in the spectrum ranging from full penetration to isolation;**

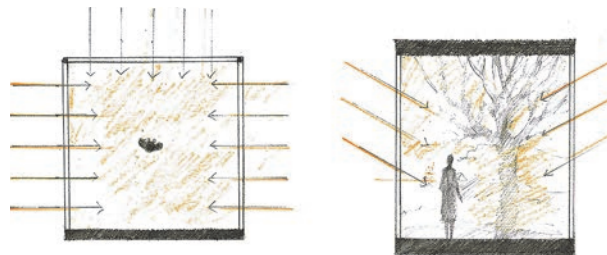


Fig. 1

- 1) **full penetration** is the admittance of rays directly from outside into the interior without constraints from at least three sides of the interior or from above (Fig. 1);

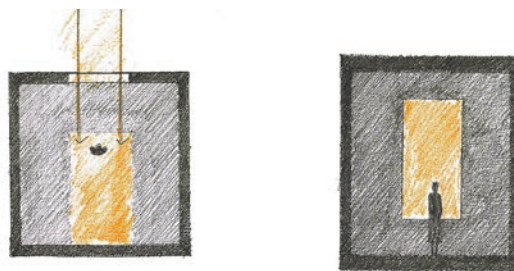


Fig. 2

- 2) **carving** is limited via the dimensions of the opening that admits rays directly from outside into the interior, yet the dimensions of the opening enable a person to lean outside (Fig. 2);

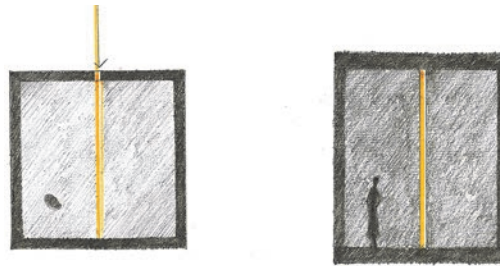


Fig. 3

- 3) **f o r c i n g t h r o u g h** is a heavily limited admittance of rays directly from outside into the interior via an opening that is narrow enough that it prevents the person inside from leaning outwards through it (Fig. 3);

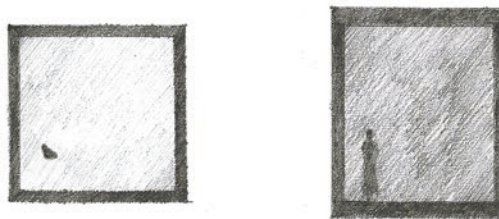


Fig. 4

- 4) **i s o l a t i o n** is the complete blocking off of the interior to the admittance of rays directly from outside; in practice, it means the complete enclosure of the interior to rays that come from outside (this makes it impossible for humans to see the celestial sphere, i.e. the sky, even in the slightest) (Fig. 4);

- **R e f l e c t i o n** is an activity of architecture based on intercepting direct rays from outside before they enter the interior or ones that are already inside it and changing their direction using architectural tools so that they can enter the interior (remain in it); the reflection can be mirror-like or scattered, also called scattering; rays of light reflect according to the law of reflection, which states that the angle of reflection is equal to the angle of incidence, and the incoming ray and the reflected ray are a normal⁵²⁹ relative to the surface at the point of the ray's incidence are on the same surface;



Fig. 5

- 5) **m i r r o r - l i k e r e f l e c t i o n** is a form of reflecting rays from a perfectly smooth surface in one direction so that they can enter the interior; the mirror-like reflection preserves the properties of the light wave and the image of its source (Fig. 5);

⁵²⁹ In geometry, the normal of a surface is a line that is perpendicular to the surface given.

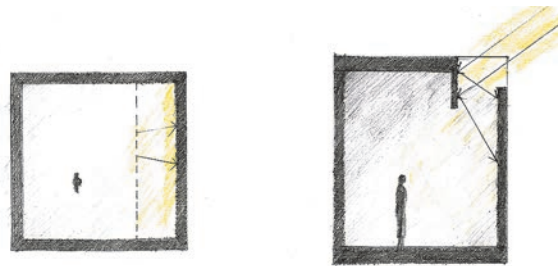


Fig. 6

- 6) **scattering and breaking** is a one-time reflection of rays from a coarse surface in different directions so that they can enter the interior (remain in it); breaking can be described as the simplest scattering reflection; from the perspective of waves, the reflection only alters the direction of its propagation and not its wavelength; the phenomenon of scattering is dependent on the ratio of a surface's coarseness⁵³⁰ to the wavelength (Fig. 6);

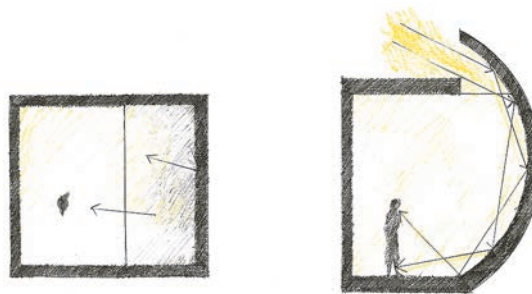


Fig. 7

- 7) **scattering and bending**⁵³¹ is a sequence of scattering and breaking reflections that take place in an interior with a coarse, concave or convex surface (Fig. 7);

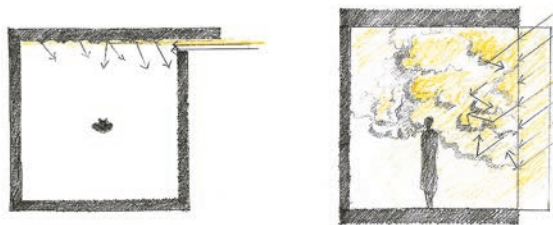


Fig. 8

- 8) **scattering and slipping** is a sequence of scattering and breaking reflections in an interior that take place on a coarse surface, that is perpendicular to the surface of the opening through which the light is admitted from outside (Fig. 8);

⁵³⁰ In the study it was assumed that coarseness is the property of a solid body that defines the ration of distances between differences in height to their depth. Coarseness depends on the type of material and its processing (such as polishing, cutting, sanding, honing, or smoothing). Coarseness is a property of the material, which means it belongs to the properties of the physical tools of operating with light. In metrology and materials science, there are standards and classifications for measuring coarseness. The Polish Standard (PN-58/M-04252) distinguishes 14 classes of coarseness. Coarseness is measured using measuring tools called profilometres. From: S. Adamczak, *Pomiary geometryczne powierzchni. Zarysy kształtu: chropowatość, falistość*, Warszawa 2008.

⁵³¹ The term 'bending light' was proposed due to its common use in describing light phenomena in architecture. It is associated with the effect of reflecting light that is visible to humans and is not in any way related to the bending of light waves, which is diffraction (Chapter I.1.). Diffraction occurs independently of the size of the obstacle, but is also clearly observed with barriers of a size comparable to the length of the light wave, which excludes it from this typology category.

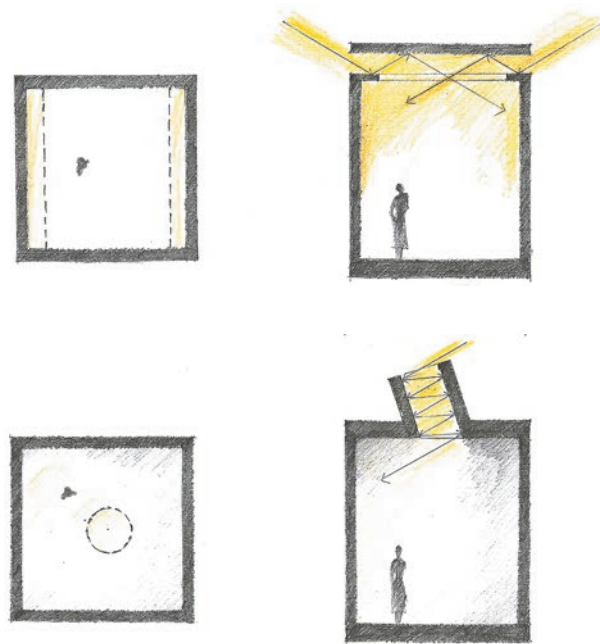


Fig. 9

- 9) **scattering and channelling** is a sequence of scattering and breaking reflections that take place in a negative or positive mass (i.e. a separate interior that abuts the interior under study: a channel, duct, case or light cannon) so that they can enter the interior under study (Fig. 9);
- **Filtering** is the activity of architecture based on intercepting rays from outside by an architectural filter, which is an architectural tool that lets through only a portion of the rays that fall on it or only a part of the light spectrum, while the remaining rays or elements of the spectrum are reflected outside or stored in the filter as its own energy (absorption);

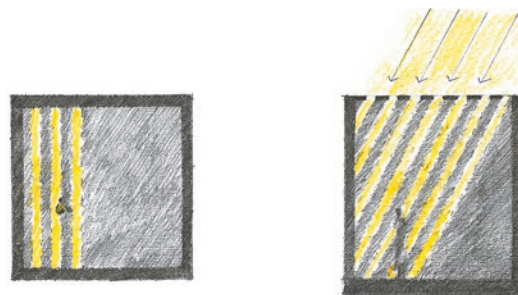


Fig. 10

- 10) **sifting** is the filtering of light based on letting rays through an architectural filter that acts like a sieve, by reducing the amount of rays that enter the interior via reflecting those that fall on the filter's material and letting through those that fall through the opening in the filter; the distinction between carving and sifting is based on the size and number of openings relative to the dimensions of the human body and the size of the interior; the distinction between sifting and reflection is based on the fact that in filtering the rays that enter the interior are not reflected from the architectural tool, while in reflecting—they are (Fig. 10);

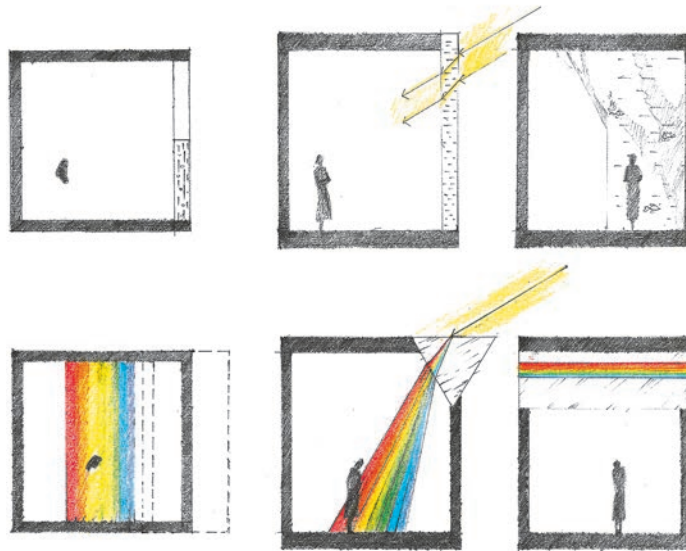


Fig. 11

- 11) **r e f r a c t i o n** is filtering based on letting rays through a layer comprised of a different optical medium (which causes their refraction) so that they can enter the interior upon filtration; refracted rays return to their original trajectory after being shifted by a certain distance; in wave optics, the phenomenon of refraction is the basis of splitting white light into a colourful light spectrum using a prism; individual waves refract in the prism and exit it at different angles, shifted relative to one another (Fig. 11);

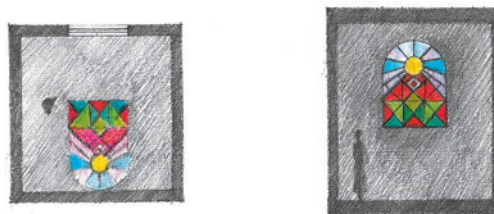
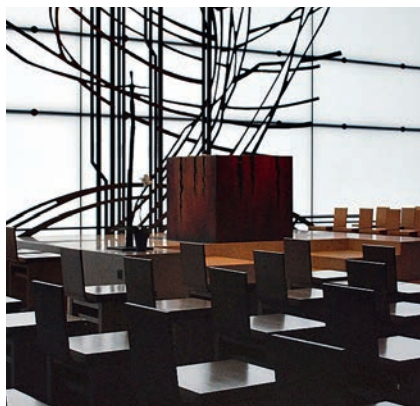


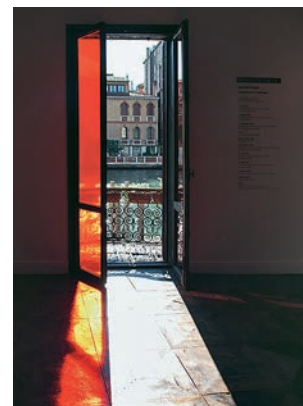
Fig. 12

- 12) **a b s o r p t i o n** is filtering based on intercepting and storing specific waves of sunlight by the absorbing substance of the architectural filter; the absorbing substance of the architectural filter can be a matte or coloured pane of glass or smoke; light intercepted by the substance of the filter causes an increase of its internal energy (contrary to refraction, which does not cause such an increase); absorption of rays from white light causes photons with a specific frequency to be removed from it (Fig. 12).

Differences between the listed types of activity of architecture are subtle in a number of cases. In interiors we typically encounter complex ways of operating with sunlight or a combination of several elementary methods of operating with sunlight into one.



Mini. 3



Mini. 4

IV. 1.2. Organisation of Illumination

As sunlight enters the interior always from outside, we can treat elements of the interior (its boundary and space) as a specific apparatus that is used to admit sunlight into it and modify it. Due to the possibility of the spatial complexity of these elements, particularly boundary in the form of masses or tools in the form of space, two characteristics defining the direction of sunlight in the interior were distinguished and labelled as the organisation of illumination. The first—denotes the trajectory of sunlight that falls from outside onto an element of the interior, which is an architectural tool of operating with light (tools shall be discussed in the following part of this subsection) and includes three categories (stemming from the astronomical determinants of sunlight): side light, light from the top and top light from the side. The names intentionally distinguish this light from a different type of light, top light from the side, which denotes side light introduced into the interior from an opening located high on a vertical wall of the interior. This light was not distinguished in the organisation of illumination as a separate category.

The second—defines the direction of light that enters the interior using an architectural tool and is defined relative to the sides of the interior, its bottom and top (See: Fig I–XII). The sides of the interior were determined relative to the vertical as the direction of gravity and the direction that is of particular significance to man and the physical form of the interior.⁵³² The direction of light was treated in accordance with the assumption adopted in the study (the definition of sunlight) and similarly as presented by Scamozzi in his treatise⁵³³ as the direction of direct sunlight and the light reflected off the celestial sphere, which is the brightness of the celestial sphere.

The category of side light from the top was introduced to account for specific cases wherein the distinction into light from the top and light from the side is not sufficient to precisely reflect the specificity of the organisation of light and the associated structure of the interior. Twarowski, following a similar principle, distinguished for his research purposes the category of the light from the front and side.⁵³⁴ It also pertains to those interiors which are equipped with a tool on which light from the top and light from the side fall simultaneously, for instance in the upper corner of the interior or on the surface of a vault. Such light has both the properties of light from the side and light from the top, which essentially impacts the physical properties of the architecture it enters into a relationship with. The category of light from the top and side should be treated as another level of detail to the scope of the organisation of illumination, whose application is justified in constructing the tool of operating with light in the interior (the direction or directions of its opening). Without such a justification, one would remain with the categories of light from the side or light from the top. Light from the side and top, together with light from the side, were classified as directed light. Therefore, in the organisation of light, two main distinctions of sunlight were made: directed light (light from the side and light from the side and top) and scattered (from the top).⁵³⁵

The two proposed characteristics allow us to include in the set of the organisation cases in which there is a distinction between the direction of light as perceived by humans in the interior, and the direction of light from which it falls onto the architectural device, which often remains outside of the field of view of the person inside the interior. Although these cases are not common, they are not a rarity and are particularly valuable to the study, as they pertain to interiors with carefully designed means of operating with light and tools designed for this

⁵³² Cf. J. Żórawski, *O budowie formy architektonicznej*, Warszawa 1962.

⁵³³ V. Scamozzi, *L'Idea dell'Architettura Universale...*, *op. cit.* thirteenth chapter of the second book of the treatise.

⁵³⁴ See: M. Twarowski, *Słońce w architekturze...*, *op. cit.*, p. 110.

⁵³⁵ According to the study's assumption, the equatorial zone was excluded.

purpose. They perform a change of the direction of light that allows specific properties of sunlight to be obtained in the interior. The most typical of these tools are masses (in the negative or positive sense) as well as those to which light enters using a nearby interior (the case described by Scamozzi as *lume di lume*).⁵³⁶ The final case concerns the situation in which one interior fluidly enters another, as is often the case in urban and landscape interiors (boundaries of each interior are not clearly defined). The proposed distinction is therefore important in grasping the qualities of the interior's structure, which is closely tied with achieving a specific modification of sunlight within it.

To provide a stronger justification for the research significance of the proposed organisation of illumination, a hypothetical example has been presented below: the comparison of two interiors in the shape of a cylinder topped with a concrete lid. In both cases, sunlight enters the interior using an oval opening located near the side edge of the cylinder with the concrete lid, yet placed differently in each case. In the first interior, the opening has been cut out from the lid (the effect of too small a lid), and in the other—a cut section of the side surface of the cylinder (the effect of a raised lid). In both cases we are dealing with the same activity—the slipping of light, obtained using a seemingly similar tool—an opening in the form of a ring near the upper edge of the cylinder, yet the organisation of light is clearly different: in the first case, it is top light from overhead that enters the interior, while in the second—side light from all sides. The results of both manners of operating with sunlight in the interior are perceptibly different. In the first case, the rays of light slip along the surface of the cylinder equally from all sides, highlighting its texture and illuminating the oval, regular interior along with its floor, while the underside of the lid is in a deep shadow surrounded by the clear, luminous circle of the opening. Thus, the interior is perceived by man as less closed and wider than it actually is. During the day, this illumination will slightly change in direction. In the second case, side light always enters with greater intensity from one side of the cylinder and slips along the underside of the lid, exposing its shape, material and texture. The walls of the cylinder are divided into light zones: shaded at the bottom and illuminated at the top with strong direct rays and those reflected from the lid. As a result—the exposed lid appears to levitate above the interior, which gains spatiality because of this. It is reinforced by rays that diagonally cut the space from top to bottom. During the day, this light is dynamic, it constantly changes: its intensity, colour, direction and along with light—so does the appearance of the interior: at one time it is its space that is exposed, while at another, the underside of the lid or different fragments of the walls.

The scope of the proposed typology of the organisation of interior illumination was to cover as large a set of cases as possible, including those that are rarely used. The properties of directed light (light from the side and light from the side and top) and light from the top are different due to the physical determinants of sunlight, particularly astronomical ones, and fundamentally differentiate the perceivable form of the illuminated interior. Light from the side, light from the side and top, and light from the top can be introduced into the interior from either one or several sides, from all sides, from overhead and even from below. The organisation of illumination does not feature a specific cardinal direction or latitude. They are fully individual for every interior. When referring the organisation of illumination to a specific interior, this data should be detailed further.

The set of the types of the organisation of illumination via sunlight in the interior is as follows:

⁵³⁶ See: State of Research, Chapter. I. 6.

Tab. 2. Organisation of illumination

ORGANISATION OF ILLUMINATION		
From the side	From the top	From the side and top
I side light from either one or several sides (Fig. I)	V top light from overhead (Fig. V)	IX side and top light from one or several sides (Fig. IX)
II side light from all sides (Fig. II)	VI top light from either one or several sides (Fig. VI)	X side and top light from all sides (Fig. X)
III side light from overhead (Fig. III)	VII top light from all sides (Fig. VII)	XI side and top light from overhead (Fig. XI)
IV side light from below (Fig. IV)	VIII top light from below (Fig. VIII)	XII side and top light from below (Fig. XII)

ORGANISATION OF ILLUMINATION – FROM THE SIDE

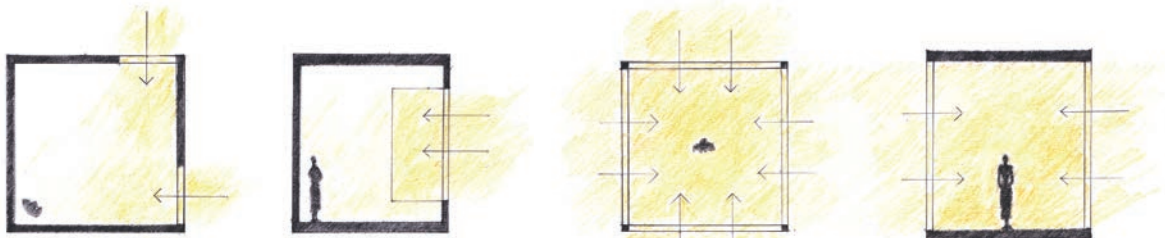


Fig. I

Fig. II

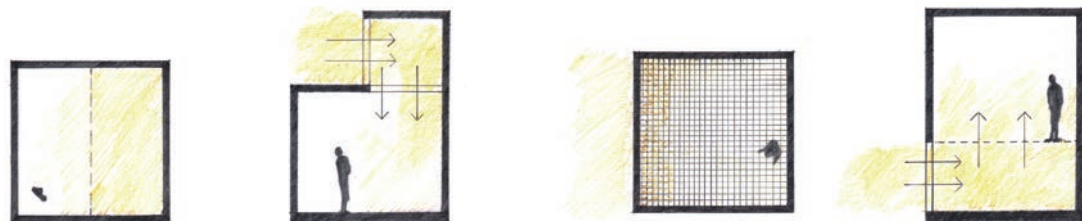


Fig. III

Fig. IV

ORGANISATION OF ILLUMINATION – FROM THE TOP



Fig. V

Fig. VI

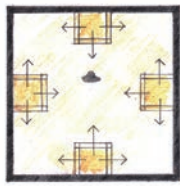


Fig. VII

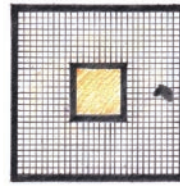


Fig. VIII



ORGANISATION OF ILLUMINATION – FROM THE SIDE AND TOP

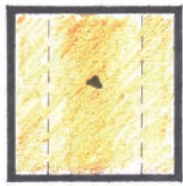


Fig. IX

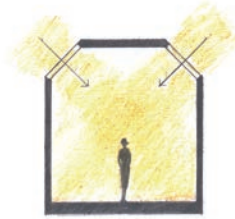


Fig. X

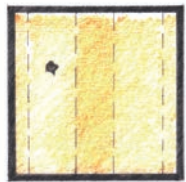
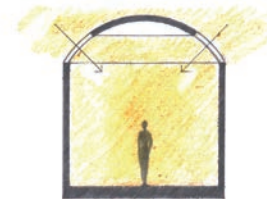


Fig. XI

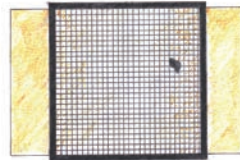
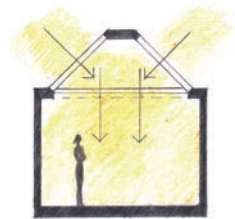
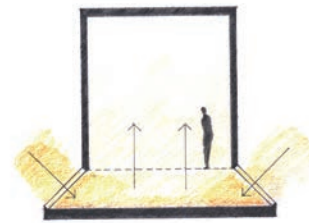


Fig. XII



Rasmussen noted and described the impact of the organisation of light on the atmosphere of the architecture of the interior.⁵³⁷ He distinguished three types of interiors depending on their illumination: 1) ‘the bright open hall’, 2) ‘the room with a skylight’, 3) ‘the room with light entering from the side’. These types can be definitively described using the proposed typology of the organisation of illumination.

IV. 1.3. Architectural Tools

Architectural tools are the factor of operating with light in the interior. Through them, architecture carries out its activities—the admittance of sunlight into the interior and modifying the light inside it. The set of these tools was formed on the basis of elements of the interior distinguished in the assumptions of the study: the space of the interior and its boundaries, which in turn include partitions and masses. These elements, analysed as architectural tools that introduce light into the interior and modify it, were laid out in the following sequence: BOUNDARIES: A. PARTITION

⁵³⁷ S.E. Rasmussen, *Odczuwanie architektury...*, *op. cit.*, p. 207 and later.

(non-mass boundaries comprised of walls, the ceiling and floor) B. MASS (mass boundaries) and C. SPACE. Architectural elements of the interior, as explained in the study's assumptions, were taken into account. This made it possible to further specify and differentiate them according to their physical properties, which were listed in the discussion of the physical determinants of the relationship under study. These properties are as follows: opening, structure, material, shape.⁵³⁸ The mutual dependencies between the elements of the interior and physical properties resulted in twelve groups of tools. They comprise a broad range of architectural tools that can be used by various activities of architecture in specific organisations of illumination, to admit light into the interior and modify it. The typology of architectural tools therefore focuses on the structure of the interior and defines its materiality (as understood by Kuma, Chapter III.2.2.), which conditions the existence and quality of sunlight in the interior. Below is a table listing of elementary architectural tools.

Tab. 3. Elementary architectural tools of operating with sunlight

Physical properties	Interior elements		
	A PARTITION (walls, ceiling, floor)	B MASS	C SPACE
a) opening	aA1) window openings in the partitions aA2) slits in the partition aA3) flat skylights in the partition aA4) rings in the partition	Positive masses: aB1) oriels aB2) spatial skylights aB3) light catchers, light cannons aB4) slits between masses	aC1) rift in the fog
b) structure	bA1) openwork, regular pattern, bA2) openwork, freeform pattern, bA3) combined openwork elements (weaved, glued, welded) regular pattern bA4) combined openwork, freeform pattern bA5) perforated openwork, regular pattern bA6) perforated openwork, freeform pattern bA7) expanded metal mesh, bA8) horizontal sun barriers, bA9) vertical sun barriers, bA10) sun barriers perpendicular to the partition, bA11) sun barriers parallel to the partition	Negative masses: bB1) light catchers in the structure of a mass (walls, channels, ducts, slits between elements of the mass) bB2) <i>light pipes</i>	bC1) air density bC2) space structure

⁵³⁸ Zbigniew Zuziak distinguished and analysed similar elements of the 'architectonics' of urban space: form, urban matter and spatial structure. Z. Zuziak, *O tożsamości urbanistyki*, Kraków 2008.

Physical properties	Interior elements		
	A PARTITION (walls, ceiling, floor)	B MASS	C SPACE
c) material	cA1) coarse materials cA2) smooth materials cA3) perfectly smooth materials, with mirror-like surfaces (mirrors) cA4) translucent materials cA5) semi-translucent materials cA6) fully opaque materials	cB1) coarse materials cB2) smooth materials cB3) perfectly smooth materials, with mirror-like surfaces (mirrors) cB4) translucent materials cB5) semi-translucent materials cB6) fully opaque materials, materials that scatter light, prisms	cC1) air composition (constant and variable components, water vapour, mineral suspensions, organic suspensions)
d) shape	dA1) rectilinear partitions dA2) curvilinear partitions dA3) vaults dA4) cylinders dA5) domes dA6) niches dA7) spheres	dB1) concavities of the mass dB2) convexities of the mass, mass angles (convex) dB3) pyramids dB4) cylinders dB5) vaults dB6) domes dB7) spheres	dC1) interior volume

Overview of elementary architectural tools:

A. PARTITION (walls, ceilings, floors) (Fig. A.)

a) opening (entirely visible in the interior)

- aA1) windows—flat openings in the partition, used to illuminate and cross-ventilate interiors with proportions that allow looking outside;
- aA2) slit—singular gaps that are long and narrow relative to the entire partition or cuts in the partition;
- aA3) flat skylights—non-mass structures on the vault of the interior, for instance in a ceiling, which illuminate interiors from above;
- aA4) rings—openings along the periphery of the interior with an oval;

b) structure (an external layout of the partition arising from combining its individual sections into a whole and the interdependency between these parts with the whole;⁵³⁹)

⁵³⁹ The term 'structure; has wide use in architecture and denotes the composition, structural system, spatial layout, organisation, interdependence of a part relative to the entirety or a set. In morphology, this term refers to, e.g. the layout of crystals, in phonology—to tectonics. Cf. Kopaliński: 'Latin *structura* "composition; structure" from *struere* "to lay (on top of another); erect; build". W. Kopaliński, term: structure, [in:] *Słownik wyrazów obcych...*, *op. cit.*, p. 401.

partitions that limit the penetration of the interior by sunlight, also on the outer side of the interior under study)

- bA1) openwork laid into a regular pattern
- bA2) openwork laid into a freeform pattern
- bA3) combined openwork (weaved, laid, glued, welded, etc.), regular pattern
- bA4) combined openwork (weaved, laid, glued, welded, etc.), freeform pattern
- bA5) openwork with regular, perforated patterns
- bA6) openwork with a freeform perforated pattern
- bA7) expanded metal meshes
- bA8) horizontal sun barriers (also horizontal shadow projectors)⁵⁴⁰
- bA9) vertical sun barriers (also vertical shadow projectors)
- bA10) sun barriers perpendicular to the partition
- bA11) sun barriers parallel to the partition
- ba12) diagonal sun barriers (also diagonal shadow projectors)

c) material

- cA1) coarse materials⁵⁴¹
- cA2) smooth materials (glossy)
- cA3) perfectly smooth materials, which produce mirror-like reflections (mirrors)
- cA4) translucent materials
- cA5) semi-translucent materials (partially absorbent)
- cA6) fully opaque and absorbent materials

d) shape

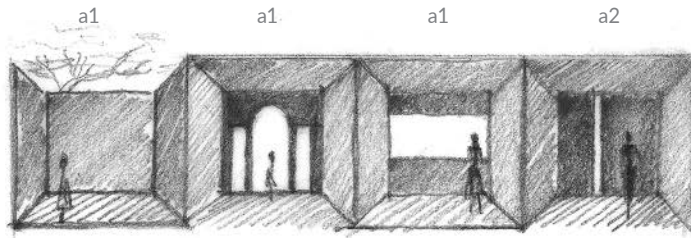
- dA1) rectilinear partitions
- dA2) curvilinear partitions
- dA3) vaults
- dA4) cylinder interiors
- dA5) dome interiors
- dA6) niche interiors
- dA7) sphere interiors

⁵⁴⁰ Cf. M. Twarowski, *Słońce w architekturze...*, *op. cit.*

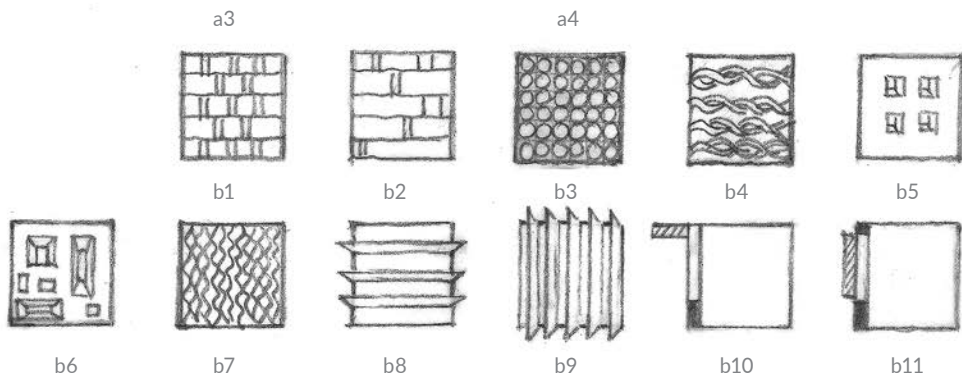
⁵⁴¹ Coarseness as the property of the material that acts as a tool of operating with light is evaluated depending on the type of activity of architecture and not as in metrology and materials science—measured and classified in a standard way. S. Adamczak, *Pomiary geometryczne powierzchni...*, *op. cit.*

Fig. A
PARTITION

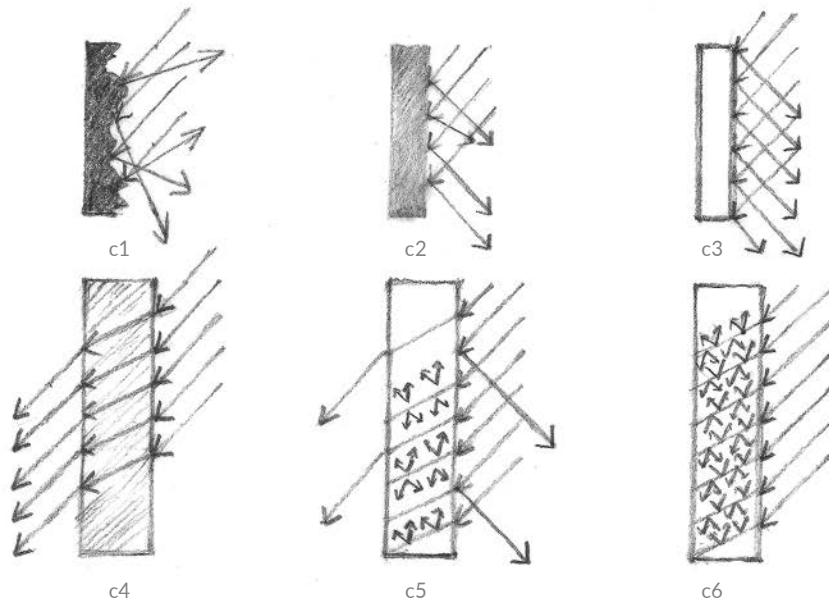
a) OPENING



b) STRUCTURE



c) MATERIAL



d) SHAPE

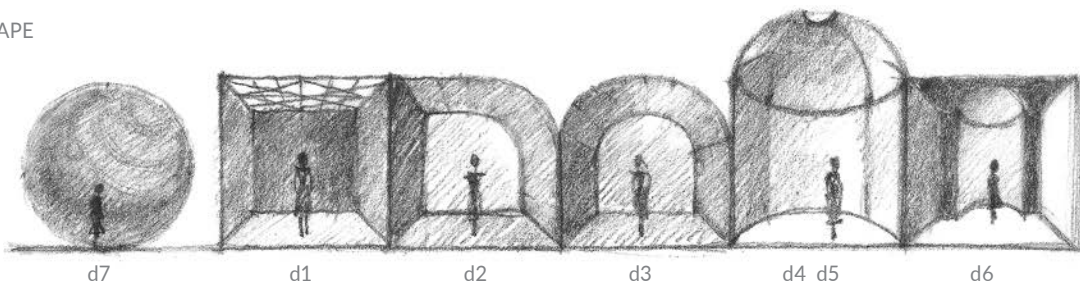
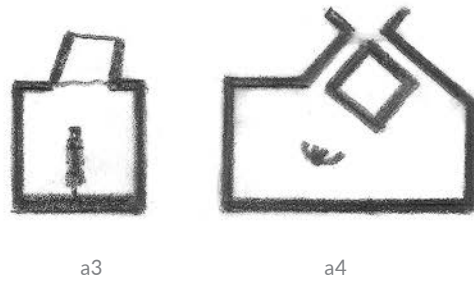
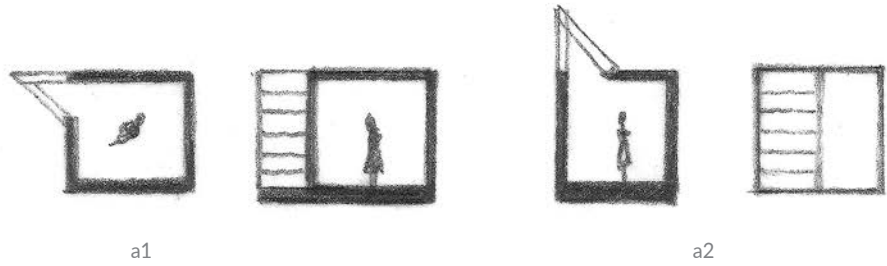
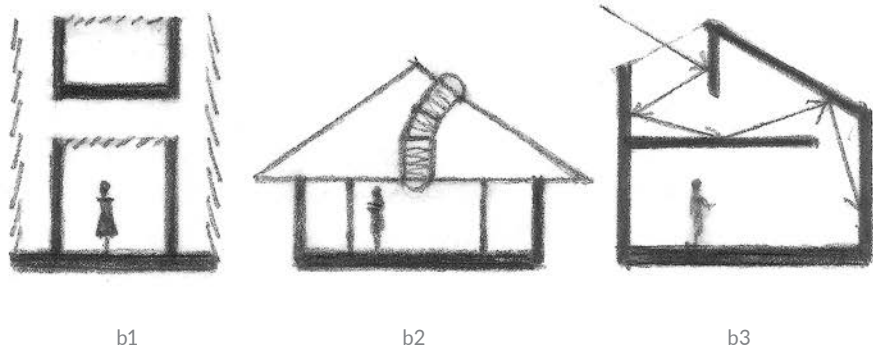


Fig. B.
MASS

a) OPENING

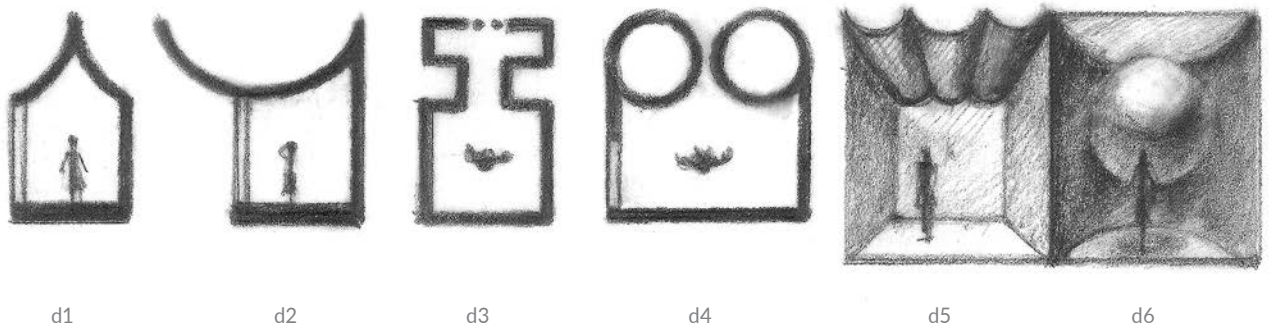


b) STRUCTURE



c) MATERIAL (Fig. A. C.)

d) SHAPE



B. MASS (Fig. B.)**a) opening**

- **positive masses:** masses that have their own interior in a positive sense relative to the boundaries of the interior, i.e. various types of three-dimensional formations of the boundaries of the interior (also the building to which the interior belongs), perceived masses open to light, either inside the interior or outside it)
 - aB1) oriels
 - aB2) spatial skylights
 - aB3) light catchers: light cannons
- **others**
 - aB4) gaps between masses

b) structure

- **negative masses:** mass that possess their own interiors in a negative sense relative to the boundaries of the interior, i.e. hidden, neighbouring (separate) interiors in the structure of the boundaries of the interior under study, that admit modified light
 - bB1) light catchers in the structure of a mass (walls, channels, ducts, gaps between elements of the mass, ducts in the structure of the building between a structural deck and a suspended ceiling)
 - bB2) *light pipes*

c) material

- cB1) coarse materials
- cB2) smooth materials (glossy)
- cB3) perfectly smooth materials that produce mirror-like reflections (mirrors)
- cB4) translucent materials
- cB5) semi-translucent materials
- cB6) fully opaque and absorbent materials

d) shape

- dB1) mass concavities
- dB2) convexities (mass angles, mass forms)⁵⁴²
- dB3) pyramids
- dB4) cylinders
- dB5) masses composed of intersecting cylinders
- dB6) masses with round shapes

C. SPACE (Fig. C.)**a) opening**

- aC1) rift in a fog, suspension or spatial structure

b) structure

- bC1) air density
- bC2) the structure of space (e.g. pouring rain, falling snowflakes, condensing water vapour, suspensions drifting in the air, other, heavier structures in the space of the interior, including masses, which due to their density and number within space define it to a significant extent, forming a 'wall space', as described by Twarowski (Twarowski

⁵⁴² Cf. M. Twarowski, *Słońce w architekturze...*, *op. cit.*, p. 133–136.

named spaces in which columns or pillars that obscure the actual size of the space as ‘wall spaces’⁵⁴³ and that is comparable to a forest; mass elements that populate an interior can also be treated separately as individual tools—masses—but in light of their density within space, it is much better to treat them as a structure within space; the term ‘forest’ was introduced to describe a group of masses that can be treated as a structure of space due to their density and proportions within the interior

c) material (air composition, material of the structure that fills the space)

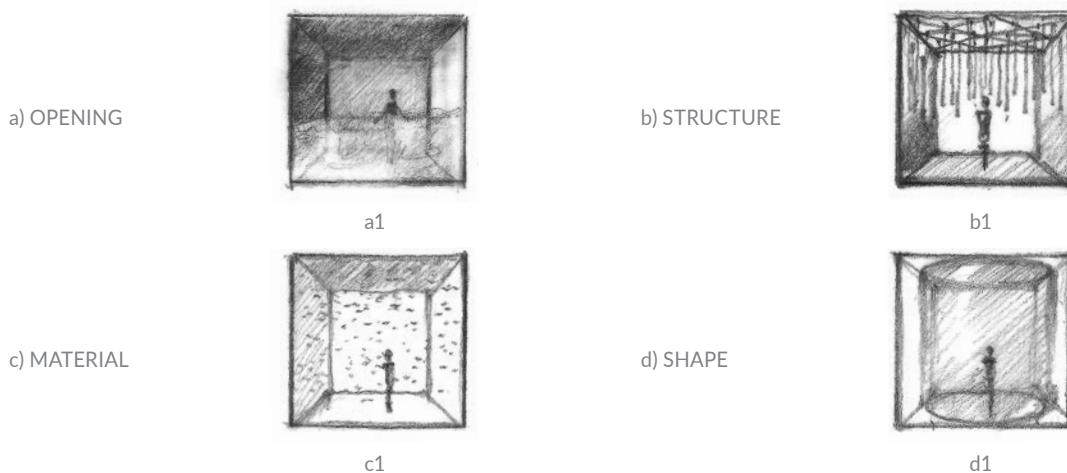
cC1) air composition—primary constant components of air: nitrogen (78.084%), oxygen (20.946%), argon (0.934%), carbon dioxide (0.0360%), neon, helium, methane, krypton, hydrogen, xenon; variable components: water vapour, dinitrogen oxide, sulphur dioxide, mineral solutions like particulate matter and soot, organic suspensions such as microorganisms, plant spores; water vapour content in the air changes along with insolation and temperature, which is linked with the relationship under study; atmospheric water vapour can condensate in the form of fog or fogginess. Fog is comprised of minute water droplets mixed with particulate matter and soot.

d) shape

dC1) the interior’s volume, the visible scope of the space of the celestial sphere in interiors open from above, the visible scope of spaces that abut the space under study.

The space of the interior typically modifies the sunlight that has entered it using a different tool. The air composition inside the interior or the structures that fill the interior can cause the scattering or filtering of light (sifting, refraction, absorption). The Swiss pavilion called *Blur (The Cloud)* presented in Yverdon-les-Bains in Switzerland as a part of EXPO 2002, designed by Diller + Scofidio, is an excellent example of an interior built from water droplets suspended in the air.⁵⁴⁴ Space as a tool of introducing light into the interior occurs in interiors that are completely open from above to the radiance of the celestial sphere. The so-called sky vault is only apparently the internal side of a sphere, while it is actually a space. Space also fulfils the role of a tool that filters light when it enters the interior under study from a nearby interior. This is a case of derivative light (*lume di lume*) as described by Scamozzi.

Fig. C
SPACE



⁵⁴³ M. Twarowski, *Słońce w architekturze...*, op. cit., p. 137, 138.

⁵⁴⁴ Cf. L. Nyka, *Od architektury cyrkulacji do urbanistycznych krajobrazów*, Gdańsk 2006, p. 88, 89.

In practice, it sometimes happens that a complex tool is used for a single activity of architecture. For instance, an openable window in the wall of a room fitted with a translucent pane of glass is a complex tool: **PARTITION opening, material (Aac) for: carving (2)**, as carving is active due to the opening in the wall and (when the window is closed) due to the material of the partition, which is translucent glass. The curtain that can be used to cover the window removes neither the permanent tool which is the opening in the wall and the translucent glass, nor the possible activity of architecture. Should the window be also equipped with openwork shutters, the interior would gain a new tool in the form of a filter for sifting light: **PARTITION structure (Ab) for: sifting (10)**. Although the shutter can be placed on the translucent glass of the closed window, it is not the glass that sifts the light but the shutter, which is why we follow the principle of listing only the tool used to perform the activity in question.

The close and mutual dependency between the organisation of illumination and the tool and activity is important for the study. This dependency enables obtaining a different result of illumination of the interior by merely changing one factor of operating with light. Rasmussen noted this, as he pointed to differences in the illumination of interiors despite using light with the same organisation of illumination and the same tools. The cause of the differences was the different activity of architecture. The example listed by Rasmussen concerns two different results of illuminating a room with light from the side at a distance from a side wall, in the other—close to the side walls. The difference stemmed from the different activity of architecture: in the first case it was carving, while in the second—the slipping of light. In the typology assumed in the study, this difference is therefore noted and characterised via the factor of operating with light that caused it. The difference methods of placing openings in partitions are essential to the study as they affect elements of operating with light in the interior. This also pertains to other characteristics of the interior's structure. Therefore, every dependency between each factor of operating with light clearly characterises an elementary case of such operation, detailing its mechanisms. The proposed typology allows accounting for those physical properties of the interior that essentially affect the light that operates in it.

IV. 2. Taxonomy of Elementary Methods of Operating with Light in the Interior

As discussed above, the factors of methods of operating with sunlight in the interior that include the activity of architecture, the organisation of illumination and architectural tools feature interdependencies. Their three-dimensional layout defines an exhaustive set of elementary methods of introducing sunlight into the interior and modifying it. Thanks to the typology of operating with light presented here, this set is a taxonomy of elementary methods of operating with sunlight in the interior. It enables the identification of potential links between each factor that conditions the relationship between architecture and light in the interior, both built and under design. This makes analysing the light in a given interior quicker and easier. The three-dimensional layout of dependencies can be presented using a cube with 1728 cubic segments ($12 \times 12 \times 12$).

In an axonometric projection of the cube in three dimensions, the author placed each factor of elementary architectural methods of operating with light: activity, organisation of light and tools. Every factor includes twelve cases, whose markings refer to proper tables: Table 1 with an overview of activities, Table 2 with an overview of the organisation of illumination and Table 3 with an overview of tools. The unintended regularity of the cube/taxonomy can make it easier to apply it in practice despite the high number of cases it covers.

The taxonomy is equipped with descriptions of each factor of operating with light and is an easy-to-use library of possible means of operating with light in the interior (due to its regularity and logic).

The elementary means of operating with light can be combined in complex methods. For instance, scattering and channelling can be combined with filtering into one complex means of operating with light using a duct (in the structure of the interior's boundary) with a wall of matte glass, which filters previously channelled light, modifies it and admits it into the interior. Thanks to combining scattering and channelling with filtering into one tool—in this case, a duct—a complex method of operating with light was created.

Another case is the combination of two or more methods of operating with sunlight that appear independently in the interior.

The presented taxonomy is a tool of describing the operation of light in the interior and not its evaluation. As a tool of study, it primarily allows identifying the potential for using the structure of the interior to apply specific operations with light inside it.

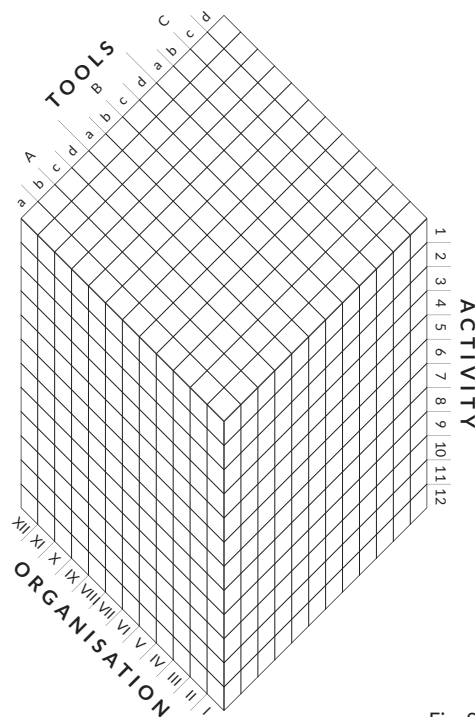


Fig. 5.

IV. 3. Mutual Exposure of Architecture and Sunlight in the Interior

Every method of operating with sunlight in the interior produces results in the form of a specific relationship between architecture and sunlight. The study accounts for these results of operating with light which comprise the mutual exposure of the physical properties of the interior assumed to be a criterion of atmosphere of the relationship between architecture and light (Chapter III.1). Listed in Chapter III:—the exposure of the physical properties of architecture and exposing the physical properties of sunlight (its nature) was subjected to a detailed analysis. As architecture exposes the nature of sunlight, including its astronomical properties, the documentation of results of operating with light in the interior accounts for the temporary nature of sunlight due to the apparent movement of the sun along the ecliptic (contrary to the taxonomy, which does not account for it).

Exposing the physical properties of architecture

The physical properties of architecture have already been defined in the study (Chapters: II.1., IV.1.3) as the four properties of interior elements that specify three elements of the interior: partitions, masses and space. These properties are as follows: OPENINGS, STRUCTURE, MATERIAL and SHAPE. At this point in the study, they have been presented in sequence from exposure at the closest distance between man and the element of the interior, to the exposure at the greatest distance from the element:

- exposing MATERIAL—the materiality of architecture
- exposing SHAPE—the shape of architecture
- exposing the FILTER STRUCTURE—the structure of partitions
- exposing the STRUCTURE OF SPACE—the space of the interior (a spatial structure)
- exposing OPENINGS—the blending of the interior with the exterior

The exposure of these properties of architecture applies to man in the interior. Therefore, as a result of this exposure, sunlight is to man a guide of architecture.

Exposing the physical properties of sunlight

Two essential types of light were distinguished in the organisation of illumination: a) light from the side and light from the side and top as directed light and b) light from the top. These types include 12 detailed types of the organisation of light in the interior. In the study, the distinction into two types of light was assumed to essentially impact the exposure of the physical properties of the interior (Vitruvius, Palladio, Scamozzi, Twarowski, Boubekri).

Due to the direction of light, the study distinguishes the exposure of the physical properties of directed sunlight (from the side and from the side and top) and sunlight from above. Therefore, this exposure includes:

- a) light from the side and light from the side and top (directed)—diverse, variable, warm, direct, producing beams of light,
- b) light from the top—uniform, stable, cool, scattered,

Light from the side was described following Boubekri as dynamic light, while light from the top—as static light. Light from the side, which is dynamic, is characterised by variable intensity, direction and colour tone, affecting the physical form of the interior and its use (Twarowski analysed it in detail). Dynamic light is typically easy to model by the user of the interior⁵⁴⁵ (regulating covers, window shutters, etc.). While light from the top was described as static, as changes in its intensity, the direction from which it enters the interior and colour tone are relatively minor on the scale of human perception and because this light is not easy to modulate by the user for technical reasons.⁵⁴⁶

Due to the exposure of the luminance of the celestial sphere in the interior (Chapter II.1.), the following was also distinguished:

- c) the orchestration of light

Due to the exposure of the movement of sunlight (and light reflected off the Moon during the night), the following was distinguished:

- d) the choreography of light.

The terms orchestration and choreography were taken from Plummer,⁵⁴⁷ but they were given a slightly different meaning. To Plummer, orchestration is the variability of the illumination of the interior over time, perceived by unmoving human eyes, while choreography is the variability

⁵⁴⁵ M. Boubekri, *Daylighting Design. Planning Strategies and Best Practice Solutions...*, *op. cit.*

⁵⁴⁶ *Ibidem.*

⁵⁴⁷ H. Plummer, *The Architecture of Natural Light...*, *op. cit.*

of the interior's illumination over time that is detectable by eyes in motion. This study retains the reference to time, but introduced a reference to the position of light (with an equivalent, stable position of the observer in the interior). Therefore, it was assumed that: orchestration is the result of different means of operating with light in the interior at the same time, while choreography—the result of one method of operating with light in the interior over time (assuming the possibility that this method can be complex). Choreography is exposed primarily by directed light and orchestration is associated with the luminance of the entire celestial sphere—via directed light. Choreography depends on different types of the sky's illuminance to a greater extent than orchestration.

As a result of exposing the physical properties of sunlight, architecture guides the person in the interior along the nature of this peculiar light. Thanks to orchestration and choreography in particular, man can perceive the interior as a specific instrument of light that allows him to read the properties of the interior as a function of time, place and weather.

The term beam of light was borrowed from Twarowski to define the physical property of directed light in the interior (Chapter III.1.).

The exposure of individual physical properties of architecture was investigated depending on the type of light (its direction). Orchestration and choreography are special cases of exposing light and the interior as an instrument of said light, which is why they were placed into a separate category of exposing the interior overall. In the table, it was added to the exposure of the properties of architecture as both orchestration and choreography require a specific complex structure of the interior's boundary.

The table includes 12 different types of results of the mutual exposure of the properties of the architecture of the interior and sunlight. Each result forms a new, specific physical property of the interior, perceived by man as the atmosphere of architecture.

Tab. 4. General dependencies between exposing the physical properties of the architecture of the interior and the properties of sunlight arising from its direction

exposure	a) directed light (light from the side and light from the side and top)	b) scattered light (light from the top)
1) exposure of the materiality of architecture	Dynamic, diverse, variable, with different colours and temperatures, momentarily warm, direct, producing beams of sunlight, exposes the physical properties of the interior's materials	Static, uniform, stable, cool, scattered, exposes the physical properties of the interior's materials
2) exposure of the shape of architecture	Dynamic, diverse, variable, with different colours and temperatures, momentarily warm, direct, producing beams of sunlight, exposes the shape of the interior	Static, uniform, stable, cool, scattered, exposes the shape of the interior
3) exposure of the filter structure	Dynamic, diverse, variable, with different colours and temperatures, momentarily warm, direct, producing beams of sunlight, exposes the spatial structure of the filter in the interior, an ornament of light and shadow	Static, uniform, stable, cool, scattered, exposes the spatial structure of the filter in the interior, an ornament of light and shadow

exposure	a) directed light (light from the side and light from the side and top)	b) scattered light (light from the top)
4) exposure of the space of the interior	Dynamic, diverse, variable, with different colours and temperatures, momentarily warm, direct, producing beams of sunlight, exposes the spatial structure in the interior, the volume of the interior, boundlessness	Static, uniform, stable, cool, scattered, exposes the spatial structure in the interior, the volume of the interior, boundlessness
5) exposure of the blending of the interior with the exterior	Dynamic, diverse, variable, with different colours and temperatures, momentarily warm, direct, producing beams of sunlight, exposes the blending of the interior with the exterior	Static, uniform, stable, cool, scattered, exposes the blending of the interior with the exterior
6) exposure of the interior as an instrument of light	Dynamic, diverse, variable, with different colours and temperatures, momentarily warm, direct, producing beams of sunlight, exposes the cardinal directions and time; high choreography, possible orchestration	Static, uniform, stable, cool, scattered, exposes persistence; low choreography, possible orchestration

IV. 4. Valuating the Atmosphere of Architecture as a Result of the Mutual Exposure of Architecture and Sunlight

The mutual exposure of sunlight and architecture in the interior leads to the emergence of a new, specific property of the interior—its atmosphere. Depending on its capacity to affect man, atmosphere can be valued in terms of sensory impressiveness, ambience and projection capacity. To perform this evaluation, the author used the experience of selected architects, written in the literature on architecture and the author's own experiences concerning the perception of interiors.

IV. 4.1. Atmosphere of Architecture as Viewed by Le Corbusier and John Pawson

In the literature on architecture one can find numerous records of experiencing the atmosphere of architecture, whose emergence is to be associated with the relationship between architecture and sunlight. This is proven by works mentioned in the state of the research and mentioned in Chapter III. Atmosphere was discussed by architects (F. Venezia, Rasmussen, Zumthor, Plummer), writers (Tanizaki), arts historians (Bieńkowska) and poets (Brodsky). Fragments of their writings have already been quoted in the discussion of the determinants of the relationship between architecture and light and in the overview of atmosphere as an aspect in studying the relationship between architecture and light. In this view, they are a phenomenography, which is useful to this study.

Two suggestive testimonies of experiencing atmosphere should be added to the previously mentioned literary texts: those of Le Corbusier and John Pawson⁵⁴⁸ concerning Le Thoronet monastery. Both testimonies were written as a commentary to the black-and-white photographs of the monastery made by Lucien Hervé: Le Corbusier wrote the introduction to the first (French) edition of the album with Hervé's photographs: *La plus Grande aventure du monde – l'architecture mystique de Citeaux* (Paris 1965), while Pawson wrote the epilogue to a reprint of the English edition of the album, entitled *Architecture of Truth*. The title of the English-language edition references Le Corbusier's sentence from the introduction to the French edition, in which he described the photographs featured in the album as 'witnesses to truth' and called Le Thoronet monastery 'an architecture of truth, calmness and strength'.⁵⁴⁹ As both architects wrote of a monastery they knew and that was displayed on the photograph, they focused on what these photographs depicted: the relationship between the monastery and sunlight, occurring on the fragmentation of monastic interiors depicted on the photographs and the interior of the Argens Valley, in which its massing stands.

In his introduction, Le Corbusier focused on the materiality and shape of the monastery in sunlight: light makes materials expressive, and interiors and masses—vivid, persistent in time. He described how stone strips, arches, vaults, floor tiles, pillars, columns with plinths and capitals enter into a close relationship with light and through this relationship 'speak'. Le Corbusier called light and shadow the 'words' of this architecture.

In the English edition (with an introduction by Le Corbusier and an epilogue by Pawson), photographs are laid out according to prayer hours stipulated by the rule of the Order of St Bernard. The layout depicts the choreography of the relationship between architecture and sunlight in the interior of the monastery as the source of their atmosphere. Pawson described his delight caused by the placement of the massing of the monastery in a forested valley surrounded by the hills of Provence, where light exposes the harmony of the massing and its interior, its shape, materials, the grey of the local stone, the ochre of the roof tiles. He described how light in relationship with architecture highlights the 'internal' beauty of materials, 'sculpts' the interior, spills puddles on the floor and how light exposes itself as a 'solid matter', from which shadow 'cuts' arches as if carving a form in metal.⁵⁵⁰ Light exposes even the small traces of carving on the surface of the stone. In the relationship between architecture and light, Pawson observed a strength that stimulated his sensory experiences and state of mind: a focus of sight on the 'forms'

⁵⁴⁸ See: B. Stec, *Architektura duchowości...*, *op. cit.*

⁵⁴⁹ Le Corbusier, *Introduction*, [in:] L. Hervé, *Architecture of Truth*, London 2001, p. 7.

⁵⁵⁰ J. Pawson, *Afterword*, [in:] L. Hervé, *Architecture of Truth*, London 2001, p. 151–153.

of shadow and light, a focus of vision on the intimate scale of the stone surface, leading attention, evoking associations with the symbolism of light (for instance in the church nave, where light guided his vision towards the apse and altar). The expressive shape and materiality of architecture, the ambience of dramatism, contemplation, intimacy and the stimulation of the mind to metaphysical states are in Le Thoronet a result of the atmosphere of the architecture of its interior, created as a result of the relationship between this architecture with sunlight.

IV. 4.2. Atmosphere of Architecture as Viewed by Steen Eiler Rasmussen, Mieczysław Twarowski, Peter Zumthor and Henry Plummer

Operating with sunlight in the aspect of atmosphere was the basis of evaluating light in the interior by Rasmussen, Twarowski, Zumthor and Plummer. It was discussed in texts that are a valuable phenomenography for this work. The evaluation was based on the personal perception of each author, based on attentive and extended observation of the physical properties of interiors and their interpretation, yet without going too far beyond the autonomous field of architecture.

Steen Eiler Rasmussen

When describing his experiences and feelings, Rasmussen often analysed the factors of operating with light, indicating the effects they have on the manner of exposing the shape of the interior. His descriptions can be treated as a study of the relationship between architecture and light in the aspect of atmosphere. They are relatively objective, as they concern sensory experiences typical of most people. Rasmussen noted that, essentially, the perception of an interior illuminated with side light differed from that of an interior illuminated with top light from above.

Using examples of built interiors, Rasmussen investigated which methods of operating with light in the interior are the best to highlight the shape of the interior, which is associated with an atmosphere of clarity and calmness. Atmosphere as a result and goal of the relationship between architecture and sunlight can be 'dramatic' due to the contrast between light and dark, for instance in the pairing of a small and poorly lit museum space with a stone sculpture at its centre and a very bright room nearby. The perception of the ambience of the interior in sunlight was linked by Rasmussen with the practical use of this interior (using it for various activities) as visible in old Dutch houses depicted on seventeenth-century paintings, particularly by Jan Vermeer and Pieter de Hooch. In their paintings we can almost feel the atmosphere of architecture in the interiors they depict. The atmosphere created by light, particularly by the scattering of side light using splayed windows that fluidly merge with walls. Rasmussen also described the impression of an interior being closed or open as a result of specific operations with sunlight in the interior.

He performed a detailed analysis of various effects of exposing the interior using the different placement of two windows in one wall. This case was already mentioned in the section of the typology of operating with light, yet it is worth noting the atmosphere that these two methods of operating with light create in the interior. The placement of two windows in the centre of a room's wall results in the frontal illumination of the interior: the light highlights its space, but does not highlight its geometry (boundaries are poorly visible). However, placing two windows in the room's corners (as in the tradition of the Venetian palace) causes light to slip along the surface of the side walls, perpendicular to the surface of the windows and exposes the texture of these walls

and the shape of the interior. Light that reinforces the effect of the interior's shape (or that of the fragments of its boundaries) is called 'good' by Rasmussen, who distinguished it from 'bright' light, which is often wrongly considered good, while it is typically not optimal for perceiving the interior, as it does not highlight its geometry (increased intensity of light flattens the shape of the interior). Rasmussen perceived an interior illuminated from overhead as lit beneficially in every place. He listed the Pantheon in Rome as an example, in which 'it is the great architecturally enclosed space round us which makes the deepest impression':

[...] Coming into the Pantheon from the tangled network of streets outside, we experience it as the perfect expression of peace and harmony. The ordinary scale of the houses just passed makes the peristyle, in comparison, seem overwhelmingly high with its gigantic columns disappearing into the twilight under the roof. As you enter the rotunda you are immediately aware of a mild light coming from a source high above you, three times as high as the ceiling of the peristyle. The dome does not seem to limit the space but rather to expand and raise it.⁵⁵¹

Rasmussen compared the impressions elicited in him by the relationship between architecture and light in the Pantheon with the impression of this relationship in the Classical Revival cathedral in Copenhagen, where the long nave is covered with three barrel vaults pierced by three rectangular skylights. Although both interiors are illuminated from overhead, Rasmussen concluded that the interior of the cathedral was 'excessively light and lacking in character'. He explained that the differences in impressions produced by these two interiors, both illuminated from above, are rooted in the different formation of their vaults and skylights.

Mieczysław Twarowski

Twarowski discussed the concept of the atmosphere of architecture indirectly, yet essentially, by focusing on exposing massings and the interior using appropriate illumination. By using his tool to study and design the scope of insolation in the interior, the 'solar ruler', he developed a series of guidelines for designing compositions that, thanks to directed sunlight, take on a compositional value, understood as making architecture more visual, increasing its 'visual expression'. The evaluation of the relationship between light and the interior was based by Twarowski primarily on the criterion of perceiving and experiencing the beauty of architectural composition, but also on the criterion of first impressions (stimulated by health-related determinants, which he analysed as essential in the first chapters of the book) and the criterion of meaning. This analysis profile resulted in Twarowski formulating a detailed series of architectural tools of admitting sunlight into the interior and modifying it. He specifically focused on openings: windows, glazed walls, roof windows, as well as various screens, which were characterised (side vertical, solid horizontal, with varying forms, either perpendicular or parallel to the facade surface, louvres), but also materials: matte, glossy, colourful; and shapes of the interior: simple rectangular, with an uneven ceiling, with non-parallel walls, with concave and convex mass forms. In his overview of screens he noted that apart from the utilitarian purpose of limiting the penetration of direct light rays into the interior, they were used to evoke specific sensory experiences, moods and projections in persons present in interiors. Using so-called shadow projectors, one can obtain carefully designed shadow projections on the surfaces of the interior's boundaries. They typically enhance the interior through ornamental motifs, and sometimes—by symbolic forms that carry a given meaning. Shadow projections observed at different time intervals can display sequences that comprise stories as if in a theatre of shadows. One impressive example of the use of vertical shadow projectors is the presentation of a comic about a student and a wolf: the direct rays of the morning sunlight present the student chasing

⁵⁵¹ S.E. Rasmussen, *Odczuwanie architektury...*, *op. cit.*, p. 213, 214.

the wolf, at noon, when the rays are increasingly shorter—the student almost catches the wolf, and in the afternoon, via rays from the west—the wolf chases the student.⁵⁵²

Focusing on insolation, Twarowski analysed the admittance of rays directly (and direct rays themselves) in the interior, as well as the slipping and filtering of rays. When studying the cut-outs and movement of sunlight spots in interiors and the game of shadow and light on masses, he noted the ability to highlight the texture and pattern of the walls via slipping side sunlight rays across their surface.

Twarowski introduced the factor of time into the analysis—of the persistence and variability of composition, its impressive highlighting in specific periods or in the ‘movement of the solar ray’. He thus accentuated the impact of directed, namely variable light, on the exposure of the interior. He stated that ‘with scattered light, the outlines of shadow on matte forms are typically minuscule’,⁵⁵³ and distinguishing a form through light, i.e. the good expressivity of the form, can only take place with considerable differences in the illumination of this form, so it is best when it is illuminated from one side via direct rays. Twarowski admitted there were two opposing positions in helioexpressivity: one states that the best visual effect is given by scattered light, while the other states the same is true for directed light. He thus stated that one should avoid extreme positions and that light should be adapted to individual forms of visual composition and requirements. However, he constantly argued that illuminating masses with direct light had immense potential for attracting human attention and to attractively highlight composition elements.

Twarowski made direct references to the atmosphere of architecture when it came to creating the appearance of depth (the apparent enlargement of the interior) and beams of light. Twarowski wrote of different methods of creating an impression of depth in the interior and blurring its actual boundaries. One of these was to scatter light on glossy surfaces that shine brightly even in scattered light, for instance via a cloud.

Glossy surfaces react exceptionally intensely to any changes in light intensity. For instance, the passage of a slightly translucent cloud that obscures the sun for a brief moment causes a very strong weakening and even the disappearance of light effects that once again appear after the cloud passes.⁵⁵⁴

Other methods of obtaining the impression of apparent depth include: weakening the illumination of the interior’s boundaries (they vanish in darkness) or the introduction of a so-called ‘wall space’, similar to a forest wall. Humans perceive the space of the forest as boundless, which is why an interior with a ‘wall space’ appears larger than it actually is. Twarowski wrote:

The forest creates and suggests the size of the space, but does not display its size [...] Columns and pillars play a similar role, as by obscuring a part of the interior and shading it they can produce the impression of the existence of space behind them, a space whose size we cannot tell [...] The impression of the ‘depth of the interior’ can generally be intensified by displaying fragments of nearby interiors in a number of directions [...] Every form located in the depth of the ‘wall space’, clearly shown, weakens the impression of depth.⁵⁵⁵

Creating a beam of light in an interior frames and highlights its fragment, properly exposing the physical properties of architecture and/or light itself. The beam of light that pierces the interior from on high and diagonally, far from its boundaries, exposes the space of the interior.

⁵⁵² From: M. Twarowski, *Słońce w architekturze...*, *op. cit.* Phot. 12, p. 104.

⁵⁵³ *Ibidem*, p. 136.

⁵⁵⁴ *Ibidem*, p. 109.

⁵⁵⁵ *Ibidem*, p. 137, 138.

Peter Zumthor

In his book *Atmospheres...*, Zumthor analysed elements of the interior that comprised his subjective perception of the atmosphere of architecture. He pointed to the inseparability of the sensory perception and emotional reception of the interior, which is why his statements about architecture are deeply personal. However, to Zumthor, the basis of subjective feeling is the attentive and long-term observation of the interior as is, in a given place and time. The physical properties of the interior are ‘in’ its elements and he perceives these properties. For instance, Zumthor wrote that temperature has a physical sense (it is objective, measurable) and a psychological sense: ‘It’s in what I see, what I feel, what I touch, even with my feet’.⁵⁵⁶ The matter is similar with the atmosphere of architecture: it is ‘in what’ he sees, what he feels, what he touches—it belongs to the world of things. To Zumthor, atmosphere is not what he sees, but ‘in’ what he sees. This subtle difference allows us to assume that atmosphere is a property of the interior that must be reached, grasped, held. However, in Zumthor’s view, atmosphere is not a human mood—it is in things.

Zumthor listed specific properties of architecture as conditions for atmosphere to exist in an interior:⁵⁵⁷ the sound of a space, the temperature of a space and its materials, the presence of surrounding objects, which can be more or less intense, tension between the elements of the interior (balancing between composure and seduction), tension between the interior and exterior, levels of intimacy, the light on things, and coherence.⁵⁵⁸ While conversing on architecture, Zumthor often asked a student: ‘Do you feel the tension? Do you feel the atmosphere?’ He argued that atmosphere can be similarly felt by different people and that a person can be taught to be sensitive to it. He noted that feeling architecture, when given a powerful enough voice, unsilenced by intellectual evaluation, becomes increasingly similar in different people:

[...] I think that individually, highly internal experiences are also very, very common. [...] The more subjective they are, the more objective they are. The deeper we immerse in individuality, the more common, deep and typically human a feeling becomes. Things that are deep inside are shared.⁵⁵⁹

One of the student assignments given at Zumthor’s Atelier at the Mendrisio Academy of architecture (in the 2002/2003 academic year), had the title ‘Make it typical, then it becomes special!’. Zumthor explained that a design is special when it is the result of ‘felt experience’—a long-term process of designing typical (appropriate, also traditional) architecture in its confrontation with a specific place and the personal, sensory experience of material, shapes, openings and structure by the designer. The assignment stressed that students become aware that pursuing the exceptionality of architecture should not be the goal of design, as it often leads to formalism, while exceptionality appears by itself in studying the architecture that is designed by its sensory experience. He encouraged students to learn to be sensitive to the physical properties of the interior as based on experiences, models, comparisons, as these properties are not easy to imagine.

Zumthor liked to use the word to temper in its meaning ‘to attune’ in describing the regulation of the mood of light and the regulation of the atmosphere of architecture, as he saw the similarity between tuning an instrument and tuning the atmosphere/ambience of architecture.

⁵⁵⁶ P. Zumthor, *Atmospheres...*, *op. cit.*, p. 17.

⁵⁵⁷ *Ibidem*, p. 48.

⁵⁵⁸ *Ibidem*.

⁵⁵⁹ P. Zumthor during an interview with: B. Stec, *Trzy rozmowy...*, *op. cit.*, p. 21.

Among the determinants of the atmosphere of architecture in the interior listed by Zumthor, several pertain to the effects of operating with light in the interior: the surrounding objects, the tension between the elements of the interior (composure and seduction), the tension between interior and exterior, levels of intimacy, the light on things, and the coherence of the interior.⁵⁶⁰ In the description of the atmosphere of Kunsthau Bregenz, Zumthor used the word to temper in the sense of tuning and to ‘regulate the mood of light’, highlighting the architectural apparatus used for this regulation. The sound of a space and the temperature of a space (and its materials), that Zumthor lists as the essential conditions of atmosphere, are not sufficiently exposed by the relationship between architecture and sunlight to be included as a separate category, yet they are included in the categories listed via the cooperation of different human senses in creating the experience of architecture.

Henry Plummer

A listing of the methods of operating with light in the interior that is the closest to the proposed typology can be found in Plummer’s work.⁵⁶¹ He does not list the activities of architecture, tools or the results of operating with sunlight as separate types, but he does use them, and they can be identified in his many terms concerning light. In *The Architecture of Natural Light*, five out of the seven proposed categories of light in the interior were created on the basis of activities and tools (listed together): ‘Veils of glass. Refraction of light in a diaphanous film’ (third in Plummer’s sequence), 2) ‘Atomization. Sifting of light through a porous screen’ (fourth in Plummer’s sequence), 3) ‘Canalization. Channelling of the light through a hollow mass’ (fifth in sequence), 4) ‘Suffusion of light with a unified mood’ (sixth in sequence), 5) ‘Materialization of light in physical matter’ (seventh in Plummer’s sequence). Two categories are formed based on the results of operating with sunlight in the interior:⁵⁶² ‘Orchestration of light to mutate through time’ (first in Plummer’s sequence) and the ‘Choreography of light for the moving eye’ (second in the sequence). In *Nordic Light: Modern Scandinavian Architecture*, Plummer created two categories based on activities: ‘Diffusion’ (eighth in Plummer’s sequence) and ‘Carving’ (fourth in sequence), as well as one based on a tool: ‘Whiteness’ (first in Plummer’s sequence). The remaining categories outlined in *Nordic Light...* are created on the basis of results of operating with light in the interior: ‘Rhythm’ (second in Plummer’s sequence), ‘Journey’ (third in Plummer’s sequence), ‘Forest’ (fifth in sequence), ‘Transiency’ (sixth), ‘Tranquillity’ (seventh) and ‘Darkness’ (ninth).⁵⁶³ ‘Evanescence’, mentioned in *The Architecture of Natural Light* (first in sequence) cannot be qualified as a result of the operation of light in an interior.

In *The Architecture of Natural Light*, Plummer conditioned the constructing of ‘metaphysical space’ in the interior from the results of operating with sunlight. Thus, Plummer’s categories feature pairings of different factors of methods of operating with sunlight in an interior and their results and the atmosphere of the space, which means that the dependency between them become even clearer. Plummer also combined different outcomes of operating with light in the interior with the atmosphere of architecture: evanescence with the ‘orchestration of light to mutate through time’, journey—with the choreography of light for the moving eye, ambient silence—with the suffusion of light with a unified mood’, luminance—with the ‘materialization of light in physical matter’.⁵⁶⁴ Of the terms mentioned by Plummer that pertain to atmosphere, such as transiency, journey, ambient silence, luminosity, only silence is not a visual experience.

⁵⁶⁰ P. Zumthor, *Atmospheres...*, *op. cit.*

⁵⁶¹ H. Plummer, *The Architecture of Natural Light...*, *op. cit.*; *idem*, *Nordic Light...*, *op. cit.*

⁵⁶² *Idem*, *The Architecture of Natural Light...*, *op. cit.*, 1. Evanescence.

⁵⁶³ *Idem*, *Nordic Light: Modern Scandinavian Architecture...*, *op. cit.*

⁵⁶⁴ *Idem*, *The Architecture of Natural Light...*, *op. cit.*

However, due to the mutual coordination of sensory experiences, the experience of silence is strongly correlated with the impression of calmness, which has a metaphorical sense in defining the physical properties of the interior: emptiness, austerity of expression, stasis, balance, symmetry, unification, and to denote ambience: calmness, uniformity, clarity, obliviousness, loosening, rest, balance between being open and closed, safety.

IV. 4.3. Dependence of the Atmosphere of Architecture on Exposing the Interior as a Result of Operating with Sunlight Within It

Using the discussion on the atmosphere of architecture presented above and the author's own experience, a set of dependencies between the atmosphere of architecture and the mutual exposure of the physical properties of the interior (architecture and sunlight) have been determined. To do this, the author first evaluated the results of operating with sunlight in the interior in the aspect of the atmosphere of architecture following previously defined criteria: 1) impressiveness, 2) ambience and 3) the projection capacity of architecture. Some values accounted for references to authors of given terms or architects who focused on them in a particular manner.

- 1) **exposing the MATERIALITY of the interior's architecture**—impressiveness: vividness of material surface, diluted or condensed darkness (Zumthor), darkness with a bright spot, vividness of fragments of the interior's boundaries, vividness of the beam of light (Twarowski); ambience: intimacy (Zumthor, Plummer), materiality (Zumthor), focus, tension (Zumthor), mysteriousness (Plummer), dramatism, enclosure, inaccessibility; projection capacity: shadowy depth (Tanizaki, Twarowski, Wilkoszewska),⁵⁶⁵—theatricality (view–frame–scene);
- 2) **exposing the SHAPE of the interior's architecture**—impressiveness: vividness of the shape of the interior, tempered brightness (Zumthor), suffusion with light in a uniform tone (Plummer); ambience: clarity (Rasmussen, Zumthor, Plummer), stasis, suffusion with light in a uniform mood, peace, quiet (Plummer, Zumthor); projection capacity: 'I see what is, it is what I see';
- 3) **exposing the FILTER STRUCTURE**—impressiveness: vividness of the filter structure (Twarowski), blurring of the appearance of actual materials and shapes of the interior, variability, journey of shadows (Twarowski); ambience: unclarity, ambiguity, intangibility, separation, feeling of evanescence; projection capacity: numerous illusions and associations; in addition, depending on filter type: a) sensory experiences: vivid contrasts between shadow and light; ambience: confusion, diversity; projection capacity: diffusion, atomisation (Plummer) or b) sensory experiences: darkening of the interior, dimming light, tempering brightness (Zumthor); ambience: mysteriousness; projection capacity: dimming, fogginess of the interior;

⁵⁶⁵ This term was borrowed from Wilkoszewska (Chapter II.4.) and expanded to include every apparent depth (also the appearance of an increase of actual depth) using shadow present in the interior. K. Wilkoszewska (ed.), *Estetyka japońska...*, op. cit.

- 4) **exposing the SPACE of the interior**—impressiveness: vivid volume of the interior (either partially or in its entirety), blurring the borders of the interior, densification of space using elements; ambience: density, balance between being open and closed; projection capacity: forest (Twarowski, Plummer);
- 5) **exposing the BLENDING of the interior with the exterior**—impressiveness: blurring visibility of the boundaries of the interior, vividness of the outside surroundings, ambience: openness, spaciousness, luminosity, lightness (Rasmussen, Zumthor, Plummer), projection capacity: theatricality (view–scene), freedom;
- 6) **exposing the interior as an INSTRUMENT OF LIGHT**—orchestration—impressiveness: diversity, complexity (Lenartowicz); ambience: variability, motion, intensity, possibly a beam of light (Twarowski), tension, musicality in the *vivace* tempo; projection capacity: pulsating brightness of the celestial sphere, starry sky;—choreography—sensory experiences: the slow movement of sunlight, also at night as light reflected off the Moon (Twarowski, Plummer), slow changes in intensity, temperature, colour of light, uniformity of light; ambience: experience of transience, evanescence, the uniformity of the interior, musicality in the *moderato* tempo; projection capacity: choreography of light, the journey of the Sun/Moon across the celestial sphere (Twarowski), transience.

Exposing the properties of light:

- a) **exposing light from the side and light from the side and the top:** impressiveness: direct light, light that is dynamic, variable, diverse, momentarily intense and warm, colourful, with different temperatures, directed, focused, producing a beam of light (Twarowski); ambience: intimacy, closeness, directness, warmth, momentary intensity; projection capacity: choreography (Twarowski, Plummer), illusions, numerous associations, shadow compositions (Twarowski);
- b) **exposing light from the top:** impressiveness: scattered light, light that is static, stable, uniform, cool; ambience: refreshment, clarity, explicitness, distance, restraint; projection capacity: 'I see what is, it is what I see' (Zumthor), metaphysics, the cosmos (Plummer).

The dependencies between the exposure of the difference physical properties of the interior and the exposure of the physical properties of sunlight produce a scope of the possibilities for generating a specific atmosphere of architecture in the interior. It has been presented in the form of a table. Each type of atmosphere has been characterised in the aspect of sensory experiences, ambience and projection capacity, which can be evoked within a person. The qualities of atmosphere that are intensified as a result of the mutual exposure of architecture and light were marked in bold. References to authors were not given during their description.

Tab. 5. Dependence of the atmosphere of architecture on the mutual exposure of the physical properties of the interior and the properties of sunlight

exposure	a) directed light (light from the side and light from the side and the top)	b) scattered light (light from the top)
1) exposure of the materiality of architecture	<p>impressiveness: light that is direct, dynamic, variable, diverse, momentarily intense and warm, colourful, with different temperatures, directed, producing a beam of light; focused, vividness of the surface of the material, diluted or condensed darkness, darkness with light spots, vividness of the boundaries of the interior</p> <p>ambience: intimacy, closeness, warmth, directness, slow transience (evanescence), focus, enclosure, mysteriousness, dramatism, tension between light and shadow, inaccessibility, balance between openness and enclosure, momentary intensity</p> <p>projection capacity: shadowy depth, theatricality (view–frame–scene); choreography</p>	<p>impressiveness: light that is scattered, static, stable, uniform, cool; vividness of the material's surface, diluted or condensed darkness, darkness with bright spots, vividness of the boundaries of the interior</p> <p>ambience: refreshment, clarity, explicitness, distance, mysteriousness, dramatism, enclosure, inaccessibility, balance between openness and enclosure</p> <p>projection capacity: shadowy depth, theatricality (view–frame–scene); framing of the sky, metaphysics, the cosmos</p>
2) exposure of the shape of the interior	<p>impressiveness: light that is direct, dynamic, variable, diversity, momentarily intense and warm, colourful, with different temperatures, directed, producing a beam of light; focused, tempered brightness, journeying light</p> <p>ambience: intimacy, closeness, directness, slow transience (evanescence), warmth, momentary intensity, journeying brightness, transience;</p> <p>projection capacity: choreography, foggy radiance near the lake</p>	<p>impressiveness: light that is scattered, static, stable, uniform, cool; vividness of the shape of the interior, tempered brightness</p> <p>ambience: refreshment, explicitness, distance, restraint, clarity, stasis, peace, ambient silence, suffusion with light in a uniform mood</p> <p>projection capacity: 'I see what is, It is what I see', metaphysics, the cosmos</p>

exposure	a) directed light (light from the side and light from the side and the top)	b) scattered light (light from the top)
3) exposure of the filter structure, the ornament of light and shadow	<p>i m p r e s s i v e n e s s : light that is direct, dynamic, variable, diverse, momentarily intense and warm, colourful, with different temperatures, directed, producing a beam of sunlight, focused; vivid filter structure, blurring of the appearance of actual materials and shapes of the interior depending on filter type: a) vividity of contrast between light and shadow, b) weakening of light intensity and interior vividity, blurriness of shapes.</p> <p>a m b i e n c e : unclarity, ambiguousness, variability, intangibility, separation, intimacy, closeness, directness, warmth, momentary intensity, depending on filter type: a) dispersion, or b) darkening, dimming of light, vividness of the flow of time, tempered brightness, mysteriousness, uncertainty, dramatism</p> <p>p r o j e c t i o n c a p a c i t y : choreography, numerous illusions, allusions a) breaking up of the interior, diversity, atomisation, magic, b) darkening, fogginess</p>	<p>i m p r e s s i v e n e s s : light that is scattered, static, stable, uniform, cool; vivid filter structure, blurring of the appearance of actual materials and shapes of the interior, depending on filter type: a) vividity of contrast between light and shadow, b) darkening of light intensity and weakening of the vividity of the interior, blurriness of shapes</p> <p>a m b i e n c e : refreshment, restraint, intangibility, separation, depending on filter type: a) breaking up, or b) darkening, dimming of light, tempered brightness, mysteriousness, dramatism</p> <p>p r o j e c t i o n c a p a c i t y : metaphysics, choreography, numerous illusions, allusions, a) breaking up of the interior, diversity, atomisation, the cosmos, magic, b) blurriness, fogginess</p>
4) exposure of the structure of the interior's space	<p>i m p r e s s i v e n e s s : direct light, dynamic, variable, diverse, momentarily intense and warm, colourful, with different temperatures, directed, producing a beam of sunlight, focused; vividity of the volume of the interior (either a part of it or its entirety), blurring of the boundaries of the interior, population of space with elements</p> <p>a m b i e n c e : intimacy, warmth, directness, slow transience, momentary intensity, density, boundlessness, balance between openness and enclosure</p> <p>p r o j e c t i o n c a p a c i t y : choreography, forest</p>	<p>i m p r e s s i v e n e s s : light that is scattered, static, stable, uniform, cool; vividity of the volume of the space (either a part of it or its entirety), blurring of the boundaries of the interior, population of space with elements</p> <p>a m b i e n c e : weakened refreshment, density, boundlessness, balance between openness and enclosure</p> <p>p r o j e c t i o n c a p a c i t y : metaphysics, forest</p>

exposure	a) directed light (light from the side and light from the side and the top)	b) scattered light (light from the top)
5) exposure of the blending of the interior with the exterior	<p>impressiveness: direct light, dynamic, variable, diverse, momentarily intense and warm, colourful, with different temperatures, directed, producing a beam of sunlight, focused; blurriness of the boundaries of the interior, vividity of the view of the surrounding exterior</p> <p>ambience: intimacy, closeness, directness, slow transience, warmth, momentary intensity, openness of the interior, boundlessness, freedom</p> <p>projection capacity: choreography, theatricality (view–frame–scene), freedom</p>	<p>impressiveness: light that is scattered, static, uniform, cool; blurring of the overhead boundaries of the interior, vividity of the view of the sky and boundless space</p> <p>ambience: refreshment, clarity, explicitness, distance, restraint, opening of the interior towards the sky, freedom</p> <p>projection capacity: metaphysics, the cosmos</p>
6) exposure of the interior as an instrument of light	<p>impressiveness: light that is direct, dynamic, momentarily intense and warm, colourful, with different temperatures, directed, producing a beam of light, focused; diversity, complexity, transience, mobility</p> <p>ambience: variability, mobility, directness, dynamism, intensity, tension, musicality in either <i>vivace</i> or <i>moderato</i> tempo</p> <p>projection capacity: choreography, journey of the Sun/Moon across the celestial sphere, evanescence, possible orchestration, pulsating brightness of the celestial sphere, starry sky, the music of the spheres</p>	<p>impressiveness: light that is scattered, static, stable, uniform, cool, diversity, complexity</p> <p>ambience: refreshment, clarity, distance, variability, musicality, tension, musicality in the moderato tempo</p> <p>projection capacity: possible orchestration in the moderato tempo, pulsating brightness of the celestial sphere, starry sky, metaphysics, the music of the spheres, the cosmos</p>

The listing of the results of the mutual exposure of the properties of the architecture of the interior and sunlight in the aspect of the atmosphere of architecture allows us to assess which exposure of light causes the exposure of specific properties of the interior, which eases them and which eliminates them. Two or more types of the exposure of the properties of architecture and light can take place within an interior. In such cases, the specific exposure is either weakened or intensified, generating gradients of properties listed in the table. These gradients strengthen the uniqueness of the atmosphere. One can use this to avoid mutually opposing exposures that could lead to a bland atmosphere (if they expose mutual opposites such as intimacy and distance—the resultant exposure shall be weakened). In such cases, the proposed listing can make it easier to predict the atmosphere that will be generated in the interior by pairing its different types.

This listing also allows one to easily detect cases when overlapping exposed properties of the interior neither reinforce nor eliminate each other, but result in evoking a new property of atmosphere. For instance, the exposure of the shape of architecture in light from the side weakens it a little, yet in exchange provides ambience of journeying brightness, which can create an illusion of a foggy radiance near a lake (Zumthor), or: orchestration in side light results in a *vivace* mood, and in light from the top—in *moderato*.

In summary: based on this listing, one can specify what to expose or what light should be selected to generate a specific atmosphere of architecture, for instance an atmosphere with an intimate ambience, as discussed by Zumthor, or of distanced clarity, praised by Rasmussen, of openness or enclosure, an atmosphere of illusion or metaphysics that Plummer wrote about, or of boundlessness and evanescence, as analysed by Twarowski. For this reason, this listing can be useful in the design of the relationship between architecture and sunlight with the intent to generate a desired atmosphere.

The evaluation of the atmosphere of architecture in the aspect of sensory experiences, ambience and projection capacity was intentionally maximally objectivised (for instance, the author used the term *dense*, instead of *claustrophobic* or *suffocating*), so as to distance it from valuations such as: pleasant, unpleasant. This valuation is the object of study in psychology and neurophysiology.

The most subtle elements of architecture
that are inseparably tied with a work of high value
are the finesse of form, the game of light and shadow
and the expressivity of colour and texture.

M. Twarowski, *Słońce w architekturze...*

Without the view and warmth of the sun, we die—our spirit cools and our body withers.

J. Rabiej, *Światło i kolor...*

∨

Architectural Operation with Sunlight according to the Activities of Architecture and in the Aspect of the Atmosphere—Case Studies

This chapter features a detailed analysis of the operation with sunlight in selected interiors that was based on the earlier results of the study. It incorporates the evaluation of the operation with sunlight in terms of atmosphere that it produces in the interior. To maintain order, the analysis was performed in sequence, divided by the activities of architecture. Every case was presented graphically in the three-dimensional field of the classification, displayed in an axonometric projection as a cube. Segments that correspond to each elementary architectural method of operating with sunlight in the interior were highlighted upon it. If a given interior was used in two or more activity cases, the axonometric cube that illustrates a given case shall also feature those cases.

Fig. AA.

1	Complete penetration
2	Carving
3	Forcing through
4	Isolation
5	Mirror-like reflection
6	Scattering and breaking
7	Scattering and bending
8	Scattering and slipping
9	Scattering and channelling
10	Sifting
11	Refraction
12	Absorption

V. 1. Direct Admittance

[1) complete penetration, 2) carving, 3) forcing through, 4) isolation]

Admitting rays directly from outside into the interior was described in the study as an activity of architecture that allows rays of light emitted directly by the Sun or from the celestial sphere to enter the interior without altering their direction and without a filter, ranging from complete penetration to isolation. It is the most common activity, as it results in admitting not only sunlight, but also solar radiation into the interior. It typically (although not always) allows people present in the interior to look outside. As shown by the psychological determinants of the relationship between architecture and sunlight, this form of operating with sunlight can meet many human needs, including those related with the desired atmosphere of architecture in the interior.

V. 1.1. Complete Penetration (1)⁵⁶⁶

In the study, complete penetration denotes the admittance of rays directly from outside without boundaries from at least three sides or without an overhead boundary. It was observed that a borderless opening of the interior from three successive sides is sufficient to obtain the effect of complete openness in human perception (an unmoving person perceives openness from the front, left and right side, and thus within the scope of the interior's visibility). Minimising any divisions in openings, the structures of windows or glazed walls or the minimising of the visibility of existing divisions is crucial for complete penetration. These divisions determine whether a given activity of architecture is complete penetration or carving (in cases where the dividing elements are of significant width relative to the opening, as in an ancient colonnade, where the effect is carving) or sifting (when divisions are dense enough to form a filter, as in the timber structure of a glazed wall, which sifts light).

Complete penetration takes place in courtyards open from above, examples of which can be found across European architecture from all periods. The admittance of rays directly from outside from three successive sides was possible only through new industrial technologies that have allowed the obtainment of increasingly thin structural elements and greater panes of glass—from the end of the eighteenth century onwards. The history of spacious glazed interiors is associated with the nineteenth century, called the age of iron and glass. Greenhouses, glass pavilions and courtyards with glazed ceilings became popular already in its first half, particularly in Paris (les serres) and London. At the time, Pierre Francois Louis Fontaine⁵⁶⁷ designed the Gallery of Orleans at the Royal Palace (1829–1831),⁵⁶⁸ while Joseph Paxton erected a greenhouse for the Victoria Regia giant water lilies in Chatsworth (1837). In 1851 in London, Paxton built the famous Crystal Palace, glazed from all sides and from overhead. The structure became a

⁵⁶⁶ The number in parentheses denotes the number of the given activity in the typology, displayed in axonometric projection as a cube.

⁵⁶⁷ Pierre Francois Louis Fontaine was the first architect of emperor Napoleon. He became famous as the architect of the Louvre, Tuileries and Versailles. Together with Charles Percier he contributed to the revival of the tradition of classical building in Paris, as expressed by the Arc de Triomphe du Carrousel in Paris.

⁵⁶⁸ In its present state the Gallery is an open courtyard, as the glazing was removed in 1935.

model for modern European architecture of the second half of the nineteenth century for many years. Around a dozen years or so later, Giuseppe Mengoni designed the Gallery of Vittorio Emanuele II in Milan (1865–1867).

During the first half of the twentieth century, interior translucency and the blending of the interior with the exterior were proclaimed as indicators of modernity, as proven by the open form of the German pavilion designed by Mies van der Rohe for the exposition in Barcelona in 1929. However, in modern and considerably glazed buildings, such as in the Cité de Refuge in Paris (Le Corbusier 1930–1931) one could not always find an interior with three successively glazed sides. Maison de Verre (1928–1931) designed by Pierre Chareau and Bernard Bijvoët in Paris has walls erected from glass bricks which do not result in complete penetration, but filter sunlight. Complete penetration was offered by the Glass House designed by Philip Johnson in New Canaan (1949) as well as by Farnsworth House in Plano, designed by Mies van der Rohe (1951). After the Second World War, there appeared a much greater number of projects with interiors that were radically transparent, for instance: Cité des sciences et de l'industrie in Parc de la Villette in Paris (Adrian Fainsilber, Peter Rice, 1983–1986) or the Louvre Pyramid (Ieoh Ming Pei, 1983–1988).

In the present day, we can observe cases of complete penetration in many projects by SANAA (Kazuyo Sejima and Ryue Nishizawa), as well as Jun'ya Ishigami. For instance: the interior of the Ibaraki café pavilion (SANAA, Tokyo prefecture, Japan, 1997–1998), which is an elongated cuboid whose side walls are all made from translucent glass, can be entered by sunlight directly from all sides, giving a strong impression of the interior blending with the pavilion's surroundings. The interior is articulated with the floor and roof, supported by four wide columns and narrow posts (in the interior's proportions), while the walls of the interior disappear via an optical impression. The load-bearing columns are clad in polished stainless steel, which produces mirror-like images of the light that enters from all sides. Tables and chairs were also made from reflective materials, which adds additional reflections and luminance to the interior.

Complete penetration is also a feature of the interior of the Onishi Community Centre complex (SANAA, Kazuyo Sejima and Ryue Nishizawa, Gunma, Japan, 2003–2005). Side light enters the interior from all sides (via walls from translucent glass) and top light from overhead (via openings that wave from the interior's top). The architectural complex includes three intertwining interiors that are enclosed by translucent walls from glass and non-roofed spaces between them. The space and spaciousness of the interior are exposed, as is its blending with the exterior. Complete penetration from all sides can also be observed in the interior of the KAIT university pavilion (Kanagawa Institute of Technology) in Kanagawa, designed by Ishigami (2012).

Complete penetration most profoundly exposes the blending of the interior with the exterior and creates the sensory impression of the blurring of the boundaries of the interior, of the vividness of the view of the surroundings, and an ambience of openness, spaciousness, luminosity, lightness, and has a projection capacity that is based on theatricality (view–scene). The exposure of the interior's materiality and shape is also present regardless of architectural tools. Complete penetration exposes the structure of the interior's space, the vividness of its volume and the blurring of its boundaries. If there are freestanding masses in the interior, complete penetration reinforces the population of the space, the ambience of density, of a balance between openness and enclosure and projects associations with the forest.

1/ V/ Cd

complete penetration / top light from overhead /
SPACE shape

Museum of Stone, interior of an architectural complex
Kengo Kuma, Nasu, Japan 2000

The interior of the architectural complex is penetrated by solid top light from overhead. It exposes the impression of the blending of the interior of the exterior (from overhead), the vividness of the surroundings (from overhead), the materiality of the interior, the properties of *Ashino* stone, the shape of the interior and the structure of the walls. The interior gains the ambience of moderate openness, stasis, spaciousness, luminosity and lightness, as well as a projection capacity based on theatricality (view–frame–scene).

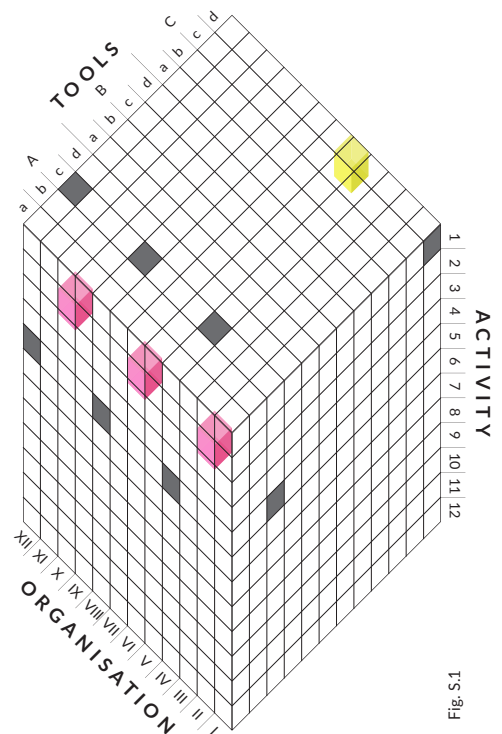


Fig. 1



Phot. 1

V. 1.2. Carving (2)

Carving is limited by the dimensions of the opening that admits light directly from outside into the interior, with the dimensions of the opening enabling a person to lean outside. Carving can introduce direct sunlight into the interior in a scope that can be regulated, which is why it is the most common type used in interiors intended for human habitation. From an aesthetic standpoint, it frames the view of the surroundings into an image that enhances the interior and creates a unique atmosphere inside it. In this sense, carving has been the basis for designing a specific form of light in the interior for a long time and can be described as a traditional activity of architecture. Designing openings in walls has remained a matter of not only structure and function, but also the style of architecture and the aesthetics and prestige of the interior's user. The great popularity of the pattern book of wall openings prepared by Serlio (published in his treatise in 1537) during the period of the Renaissance and Mannerism can be seen as proof of this. The design of the *serliana* became a favourite motif in Venetian, French and Polish Mannerist architecture as an architectural tool used in the creation of a favoured aesthetic of the interior and its atmosphere.

In nineteenth-century architecture, one could observe masterful light carving in two Paris projects by Henri Labrouste: in the Nouvelle Bibliothèque Sainte-Genève (1838–1850) and the La Bibliothèque 'impériale, puis national' (1854–1875). In the first case, the interior of the reading room has a wreath of windows enclosed with a full arch, placed high in the side walls along the periphery of the interior. Side light is first carved and then partially scattered in the thickness of the window opening. It delicately illuminates bookstands under the wall on the opposite side and flows down unto the reading stations, creating an atmosphere of subtle balance of slightly shaded and slightly illuminated places. Light from the side, variable by nature, loses its dynamism due to being scattered on the walls and in the space of the interior. The reading space of the National Library is equipped with nine domes with skylights at their centres: a larger, central one and eight smaller ones to the sides. Thanks to round skylights, top light, static and uniform, is precisely carved into circular forms and due to the spherical shapes of the domes—it is delicately scattered. It flows into the interior from the top, losing its intensity, but lays itself out uniformly on the reading tables and slips across the books placed on shelves. In the atmosphere of these reading spaces one can see a similarity to the aura emanated by the unbuilt designs of Étienne Louis Boullée, particularly his perspective drawing depicting a design of the reconstruction of the royal library (1785). This atmosphere is built by, among other things, the carving of light from the regular frame of the celestial sphere and thus—exposing the spatiality, spaciousness, shape, stasis, clarity, distance and restraint.

In the twentieth century, Modernist architecture manifested its programmatic departure from historicism by, among other things, propagating its own shape of the horizontal window (strip window), which intentionally contrasted with the tall historical window (Le Corbusier introduced the horizontal window into his pattern catalogue of modern architecture).

In the La Tourette monastery, the interior of the hallways around the courtyard are entered by side sunlight via horizontal slits cut out of the concrete walls at human eye level. Thanks to these slits, light enters the interior and enriches it via horizontally framed views of monastic buildings. The shape of the light's carving exposes the direction of the journey.

Carving exposes the materiality of an interior's architecture to the greatest extent, it generates an impressiveness of the vividness of material surfaces, of diluted or condensed darkness, of darkness with a bright spot, of the vividness of the boundary of the interior. It exposes the ambience of intimacy, of tension between light and shadow, of focus, mysteriousness, dramatism, inaccessibility; of balance between openness and enclosure and a projection capacity based on the impression of a shadowy depth and theatricality (view–frame–scene).

2/ I/ Ac

carving / side from one or several sides /
PARTITION material

Sanctuary of Merciful Love in Collevaleza, hallway
Julio Lafuente, Collevaleza (Peruggia), Italy 1963–1967

In the interior of the hallway leading from the church to the monastic buildings one does not require artificial lighting during the day as it is bright enough to use due to side light that enters directly from outside through semicircular and square-shaped windows. The windows carve light and frame views of the Umbrian landscape. As a result of exposing singular views of the surroundings, the darkness is diluted and the balance between openness and enclosure is reached, as is an ambience of tension and dynamism, and a projection capacity based on theatricality (view–image–frame–scene).

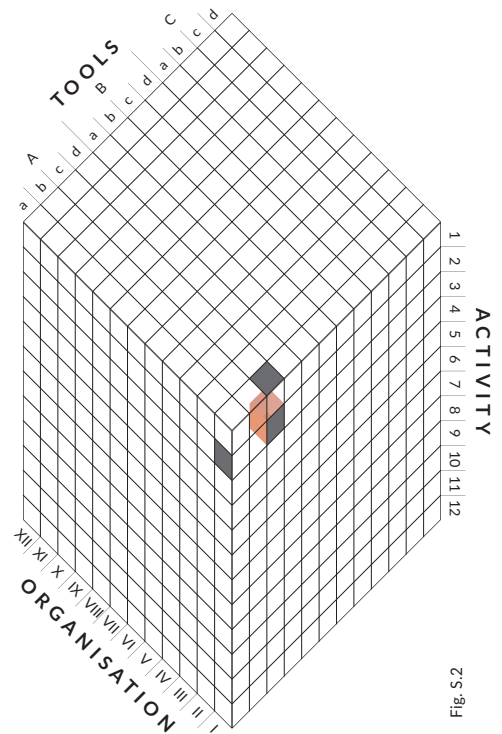


Fig. S.2



Phot. 2

2 /X/ Ac

Tempelaukio, church interior

Timo and Tuomo Suomalainen, Helsinki, Finland 1968–1969

The interior of the church is entered by light from the side and top by a ring-shaped skylight located at the base of a shallow dome that covers the interior. From underneath, the dome (inlaid with a spirally coiled copper cord) is shaded despite glints of copper being visible in some places. The rocky walls of the circular interiors carve a sport of light in the shape of a ring that surrounds the interior. The location of the skylight allows people inside the interior to see the tallest points of the church's surroundings and the sky. The exposure includes: the materiality of the interior (rocks, copper), the carving of light, balance between the dynamism and stasis of the interior, the impression of diluted or condensed darkness, an ambience of intimacy, dramatism, a stabilising balance between the openness and enclosure and a projection capacity based on theatricality (view–frame–scene).

carving / side-top from all sides /
PARTITION material

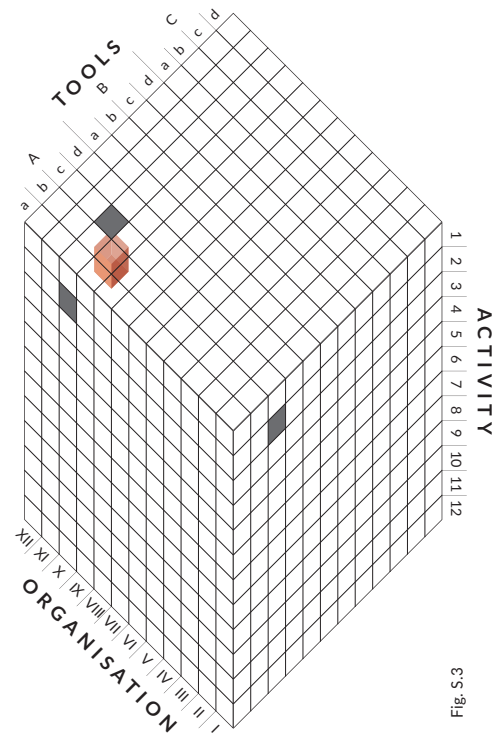


Fig. 3



Phot. 3

2 / I / Ac

The Ark of the Lord, main nave

Wojciech Pietrzyk, Bińczyce, Nowa Huta, Poland 1966–1977

Light from the side enters the interior of the church through a slit in the upper part of a curved wall. The height of the slit and the translucent glass that fills it allow people inside to look at the ceiling that extends beyond the wall into the eave of the roof and fluidly transforms into the roof itself. The exposure includes the carving of light by the slit, the blending of the interior with the exterior, an impression of tempered darkness, an ambience of intimacy and balance between enclosure and openness, dramatism and a projection capacity based on theatricality (view–frame–scene).

carving / side light from one or several sides /
PARTITION material

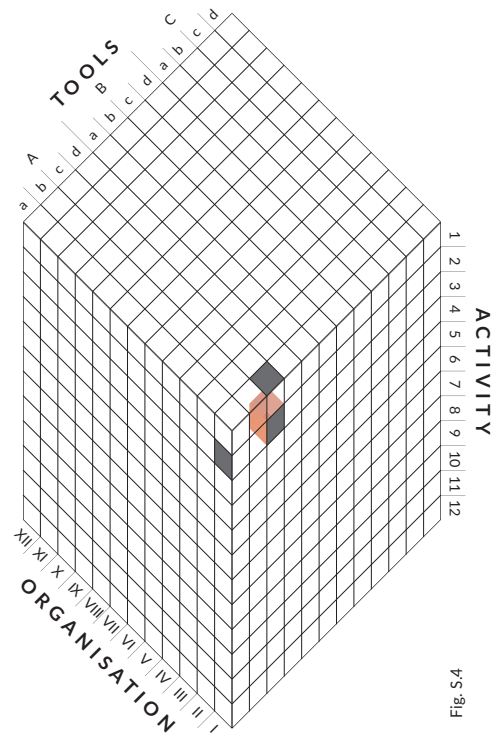
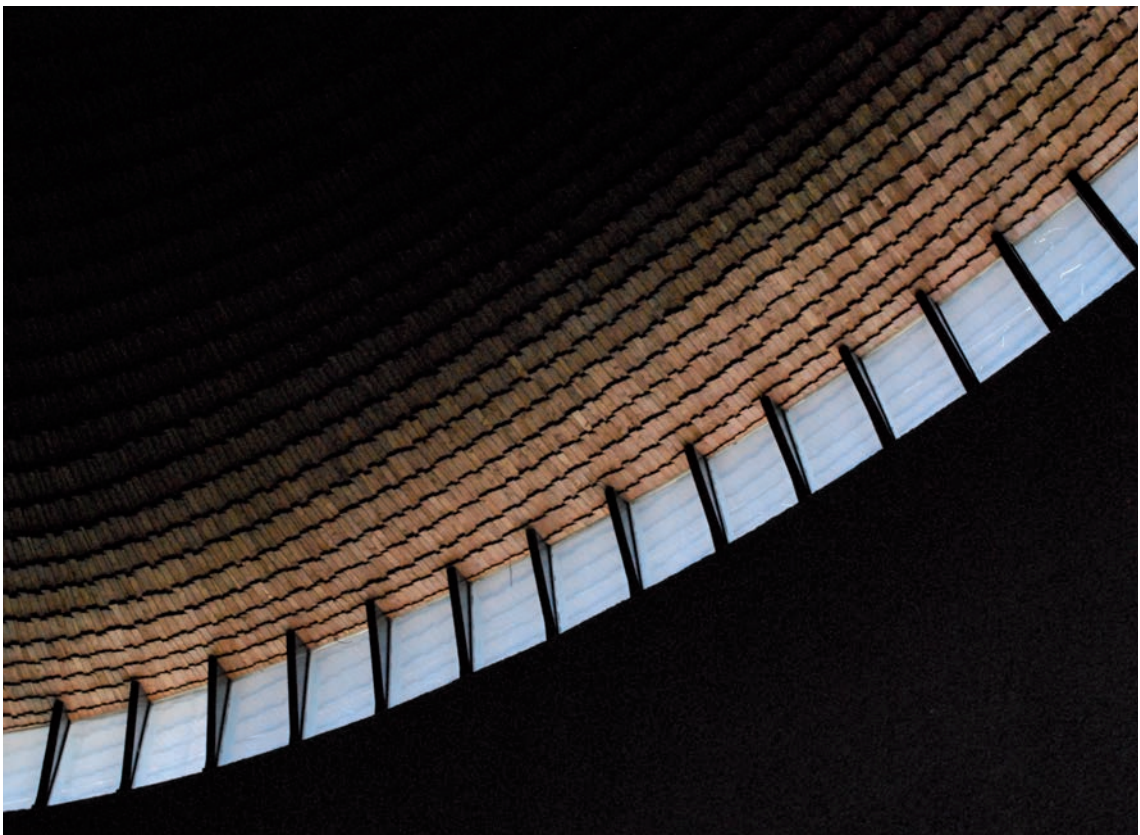


Fig. 5.4



Phot. 4

2/ I/ Ac

Church of Light

Tadao Andō, Ibaraki, Osaka, Japan 1989

The single-nave space of the church, which has a floor area of only slightly more than a hundred square metres, with concrete walls and a black-painted wooden floor, has a cross cut out from sunlight in its altar wall. It is created by intersecting slits with a width of 20 cm that cut the wall from the edge with the floor, ceiling and the side boundaries of the interior. The strong contrast of light and shadow causes the expression of the carved form of the cross to become more vivid. The exposure of the contrast of light and shadow on the wall enhances the duskiess of the interior wherein the impression of diluted or condensed darkness and delicate dynamism are stabilised, in addition to an ambience of intimacy, a tension between openness and enclosure and dramatism, a slow transience (evanescence). The projection capacity of the light in this interior is based on theatricality (view–frame–scene) and shadowy depth. It creates symbolic meanings associated with Christian culture and the mysticism of light.

carving / side light from one or several sides /
PARTITION material

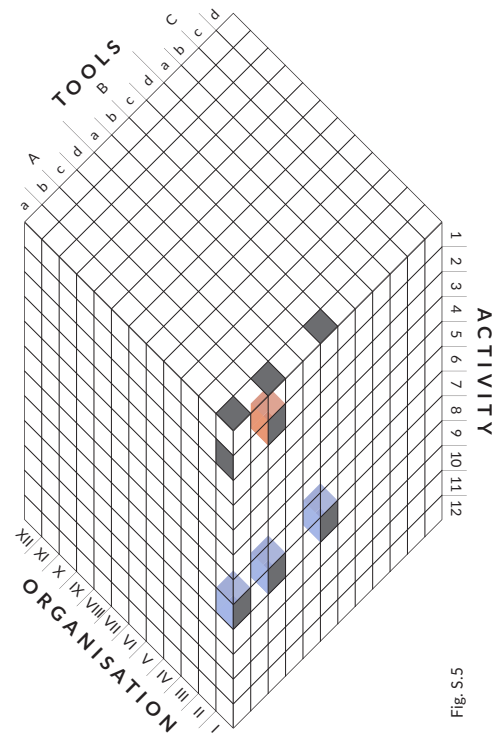


Fig. 5



Phot. 5

2/ I/ Ac

Vallila Library, reading room

Juha Leiviskä, Helsinki, Finland, 1991

The interior of the reading room is entered by light from the side from all sides, directly, via tall windows from the floor to the ceiling and strip windows in the upper section of the walls right underneath the ceiling. The windows are fitted with translucent glass. The structure and surfaces of the walls, floor and ceiling, made of wood, form a uniform background for the rectangular cut-outs of windows, which carve light and the view of the surroundings. The uniform material of the partitions of the interior and dynamic side light (including light from the top and side) which operates from all sides reinforce the shape of the interior and the impressiveness of the softness of wood. Exposed elements include the materiality of the interior (wood), its shape, space and spatiality, the impression of diluted or condensed darkness, of the partial blending of the interior and the exterior, an ambience of harmony, balance between enclosure and openness and a projection capacity based on theatricality (view–frame–scene) and associations with a forest.

carving, side light from one or several sides /
PARTITION material

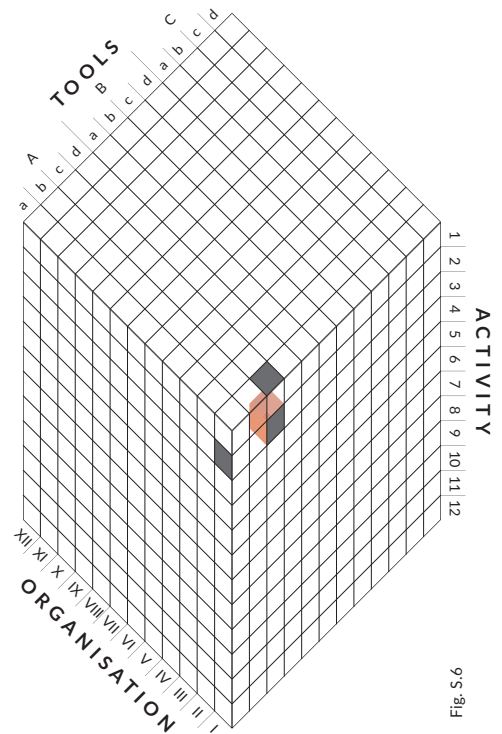


Fig. 5



Phot. 6

2 / V / Aa

Brother Klaus Chapel

Peter Zumthor, Wachendorf, Germany 2007

The interior is entered by top light from overhead via an irregularly shaped oculus. The shaded walls form a background in which there is cut-out with a view of the celestial sphere. The exposure includes the materiality of the interior, its shape, the impressiveness of a partial blending of the interior with the exterior, of diluted or condensed darkness. The interior gains an ambience of being static, of a strong separation from all sides and an opening towards the sky and a projection based on the theatricality of exposure (view–frame–scene), producing illusions and associations concerning the tradition of sensory experience, the symbolism and metaphysics of light and the cosmos.

carving / top light from overhead /
PARTITION opening

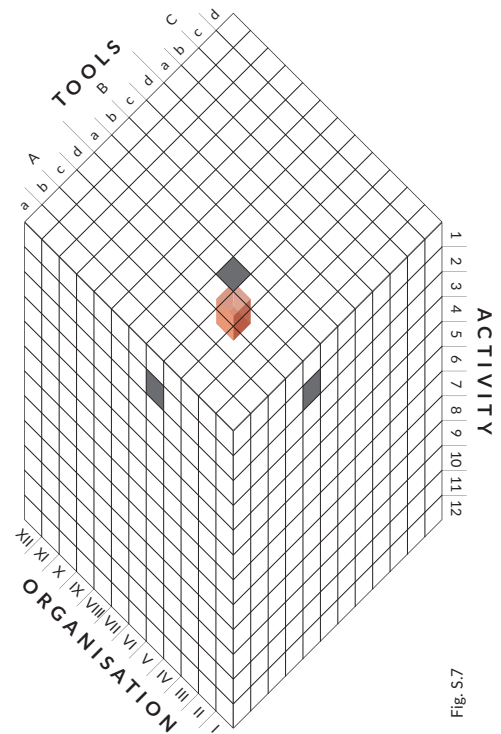


Fig. 5



Phot. 7

2/ I/ Ac

Nezu Museum of Art

Kengo Kuma, Tokyo, Japan 2009

The interior of the museum's hall is entered by sunlight from two opposing sides: from the garden and the entrance zone, via fully glazed walls. The exposure includes the view of the outside in an architectural frame, the partial openness of the interior and the partial blending of the interior with the exterior; an impressiveness of diluted or condensed darkness is created, as well as an ambience of intimacy, balance between enclosure and openness, and harmony, while projection capacity is based on theatricality (view–frame–scene) of exposure.

carving / side light from one or several sides /
PARTITION material

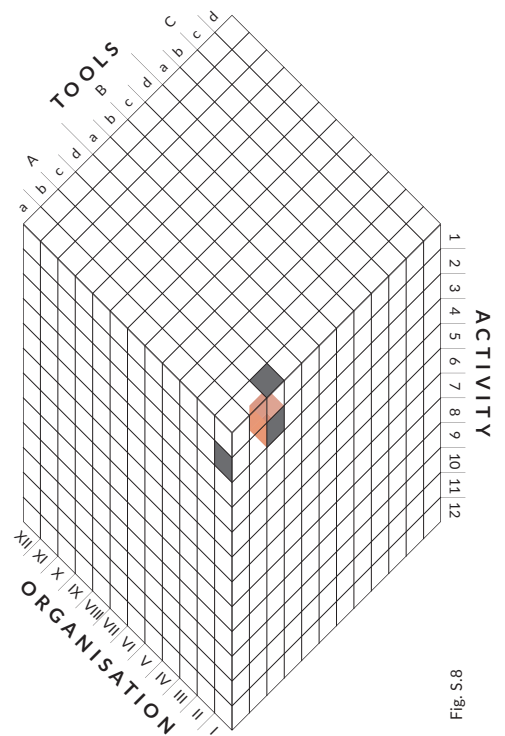


Fig. 8



Phot. 8

2/ I/ Ac

Capitol Hotel Tokyu, foyer
Kengo Kuma, Tokyo, Japan 2010

The stairs-equipped interior housing the foyer is entered by light from the side of the courtyard through a wall from translucent glass (fitted with delicate screens in its upper part). There are several masses in the interior, including structural columns, the walls of the stairwell and the stair run. The shaded stair run and walls (from dark materials) carve light and the view, creating in the interior a composition with a rectilinear geometry. In another area of the foyer, a column frames the view through the translucent wall. The exposure includes the view of the exterior in an architectural frame, the partial openness of the interior, the partial blending of the interior with the exterior; there is an impression of diluted or condensed darkness, an ambience of intimacy, slow transience (evanescence), balance between enclosure and openness, of harmony; the interior has a projection capacity based on theatricality (view–frame–scene).

carving / side light from one or several sides /
PARTITION material

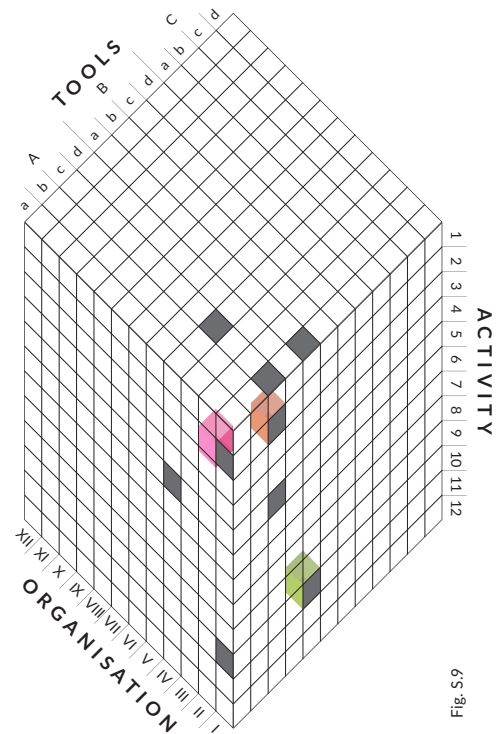


Fig. 5



Phot. 9

V. 1.3. Forcing through (3)

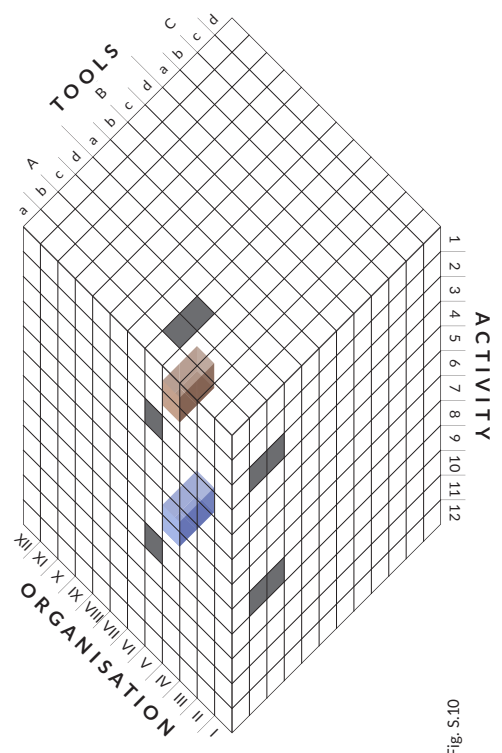
Forcing through is a highly limited form of introducing light directly from outside into the interior via an opening that is narrow enough that it prevents people inside from leaning outside. The activity of forcing through is accompanied in most cases by a varying degree of light scattering in the thickness of the slit through which it is forced through. In essence, forcing through considerably limits the penetration of light into the interior and exposes condensed or slightly diluted darkness inside it. The inability to look outside causes the light to expose an impression of the enclosure of the interior, its materiality, an ambience of intimacy, mysteriousness, unclarity, dramatism and a projection derived from illusions and associations produced by the legible shape of the slit.

3/ V/ Abc

Vals Thermal Baths, roofed interior with a large pool
Peter Zumthor, Vals, Switzerland 1996

Light enters the interior from the top through slits in the ceiling which are eight centimetres wide (between deck slabs). The slits have different widths caused by the thickness of the green roof; they have a width of eight centimetres within the thickness of the reinforced concrete layer, and they are slightly wider towards the top. In the scale of the thermal baths building they are narrow slits. The covering of the slits with screens from translucent glass slightly weakens the light. The massiveness of the concrete slab of the green roof causes the slits to have enough of a thickness to direct the rays downwards. The forcing through in its pure form takes place in the slits, which do not abut the side walls. The exposure includes the boundary of the interior, the shape of the slits, the depth of space and the materials on the interior's floor (water, the floor), condensed or slightly diluted darkness, a feeling of fogginess, an ambience of mysteriousness, stasis, tension and projection capacity based on producing associations with a cave, and a shadowy depth.

forcing through / top light from overhead /
PARTITION structure, material



01.S-Fig. 1

3/ V/ Abc

Sanctuary of Merciful Love in Collevalenza, main nave
Julio Lafuente, Collevalenza (Peruggia), Italy 1963-1967

Sunlight from the top is forced through to the interior of the main nave of the church by slits in the reinforced concrete ceiling, creating the shape of the cross on the entire surface of the deck. The slits were produced in the structure of the ceiling at the point of contact of four independently operating reinforced concrete slabs supported by side columns with cylindrical shapes. They are covered with translucent light from the top. They do not allow a view of the sky, but due to the brightness of the celestial sphere they form a clear shape of the cross. The light exposes the shape of the slit, slightly diluted or condensed darkness, an ambience of dramatism, tension, stasis, mysteriousness and a strong projection capacity via theatricality, symbolic meanings and metaphysical references.

forcing through / top light from overhead /
 PARTITION structure, material

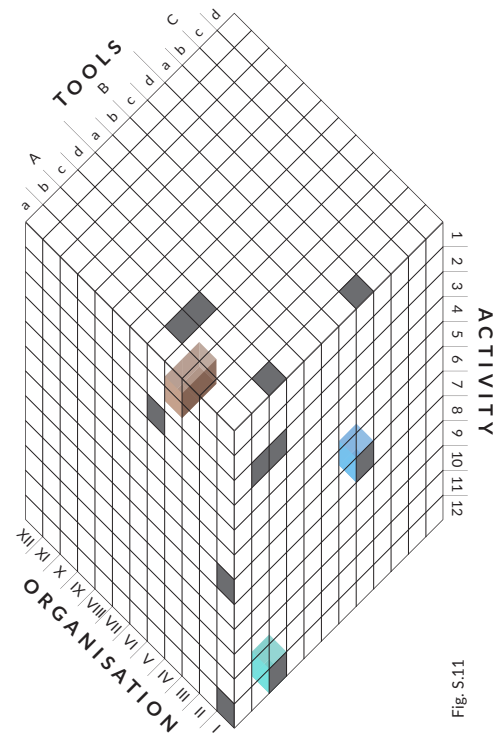


Fig. S.11



Phot. 10

3/ I/ Ab

Louvre Lens Museum, foyer
 SANAA, Lens, France 2009–2012

forcing through / side light from one or several sides / PARTITION structure

Side light enters the interior directly from outside by being forced through the slits between louvres fitted in front of a translucent pane of glass (and which are a boundary layer of the interior). The exposure includes the shape of the slit, darkness that is condensed or slightly diluted, the ambience of tension, transience (the flow of time), mysteriousness and a projection capacity based on theatricality (view–frame–scene).

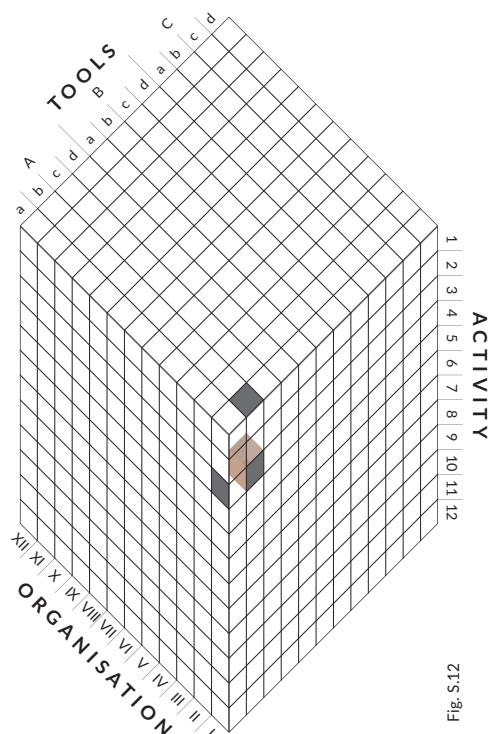


Fig. 5.12



Phot. 11

V. 1.4. Isolation (4)

Isolation denotes the complete exclusion of the interior in terms of introducing light directly from outside. In practice, this means that the interior is blocked off from direct sunlight and light reflected off of the celestial sphere, making it impossible for people inside to see the sky. Therefore, this activity is the most effective at exposing the enclosure and shading of the interior, in which only scattered light can appear. Isolation reinforces the scattering of light and is often a necessary condition for its perceptibility and vividness in human perception. In this sense, isolation is an activity of architecture that doses light carefully and with precision to expose delicate gradients of shadow, rich spectra of duskiness and brightness, associated with the materiality and shape of the interior's boundaries, as well as to cut the interior off from sudden changes and extreme intensities of external sunlight. The atmosphere of architecture creates the impressiveness of darkness that is condensed or diluted and of tempered brightness (depending on other activities of architecture that accompany isolation), the weakening of the perception of colour and an enhancement of monochromatic vision in shades of gray and peripheral vision. The high ambience of atmosphere results from exposing enclosure, introversion, mysteriousness, the monochromatic nature of the interior, a feeling of both its intimacy and immensity. The high projection capacity of the atmosphere is based on intensively stimulating the human imagination in the interior to create illusions and associations, produced by the gradation of darkness and brightness.

4/ III, V/ Bbc

Kunsthaus Bregenz, exhibition space on the first floor
 Peter Zumthor, Bregenz, Austria 1990–1997

The exhibition space on the first floor is completely isolated from direct sunlight (it is illuminated only by scattered and filtered light). This exposes the enclosure and duskiness of the interior, its materiality, tempered brightness. It creates an ambience of intimacy, mysteriousness, dramatism and tension and a projection capacity of associations with enclosure in a confined space between clouds, underneath a fog from a lake, etc. and complete detachment from the surroundings.

isolation / side light from overhead, top light from overhead / MASS, structure, material

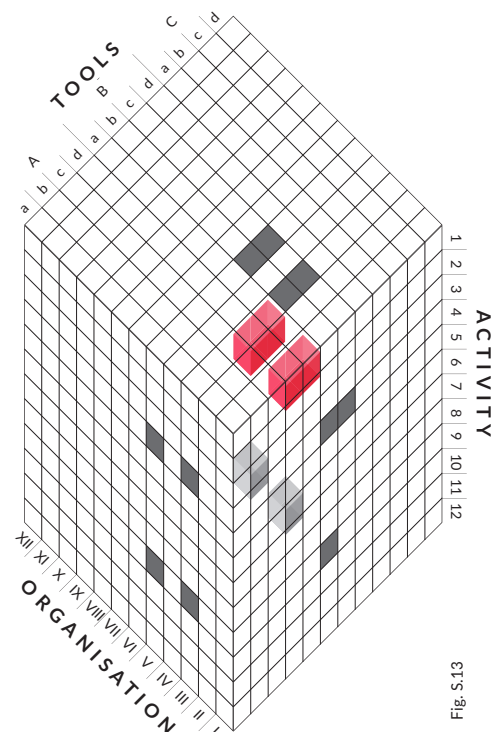


Fig. S.13

V. 2. Reflection

[5) mirror-like reflection, 6) scattering reflection and breaking,
7) scattering reflection and bending,
8) scattering reflection and slipping, 9) scattering reflection and channelling]

Reflection has been described in the study as an activity of architecture based on intercepting direct light from outside and changing its direction using architectural tools so that they can enter the interior; the reflection can be mirror-like or scattered. Therefore, as a result of reflection, reflected rays with a direction that is altered relative to the rays outside operate in the interior. Every reflection breaks the ray, and thus reflection and breaking was assumed to be the essential form of reflection. However, mirror-like reflection has been presented first, as a special type of reflection in which the image of the source of sunlight is retained.

V. 2.1. Mirror-like Reflection (5)

Due to the activity of mirror-like reflection, rays of light that are reflected from a perfectly smooth surface in one direction operate with the interior following the law of reflection. In a mirror-like reflection, the properties of the light wave and the image of its source are retained, which leads to possible impressions of the source of light being inside the interior. Mirror-like reflections are typically obtained using mirrors and smooth water surfaces, typically on the interior's floor. This reflection considerably increases the brightness of the interior and thus exposes its illuminance and the reflection of the source of sunlight. It creates an impression of the fragmentary boundlessness of the interior (a hole in the boundary), an ambience of spaciousness or of a tear in the boundary, of distancing (a person can stop at the edge of the mirror and cannot come closer to the object perceived in it), unclarity, mysteriousness and a projection capacity based on an illusion of the enlargement of the space, of the existence of a source of sunlight (apparent) within the interior and of a shadowy depth or luminous depth.



Phot. 12

5/ IV, VIII, XII/ Ac

Tapiola Cultural Centre, interior of an architectural complex
 Arto Sipinen, Tapiola, Finland 1989

Light from the top and light from the side and the top enters the interior of the architectural complex, whose floor is largely composed of water that fills an expansive pool. Due to the extensiveness of the interior and the specificity of the tool—a horizontal water surface, the following rays were accounted for: side, top, and side and top, which reflect off of the smooth water surface. Due to intense reflections, numerous fragments of the views of the interior and its surroundings are exposed, as well as apparent light of the sun in the water and a general illumination of the interior. The interior gains an ambience of spaciousness, calmness, slow transience (evanescence), distancing, quiet, mysteriousness. The high projection capacity of the atmosphere is based on an illusion of enlarging the interior, a shadowy depth, softness, a source of sunlight in the interior.

mirror-like reflection / side light from below, top
 light from below, light from the side and the top
 from below / PARTITION material

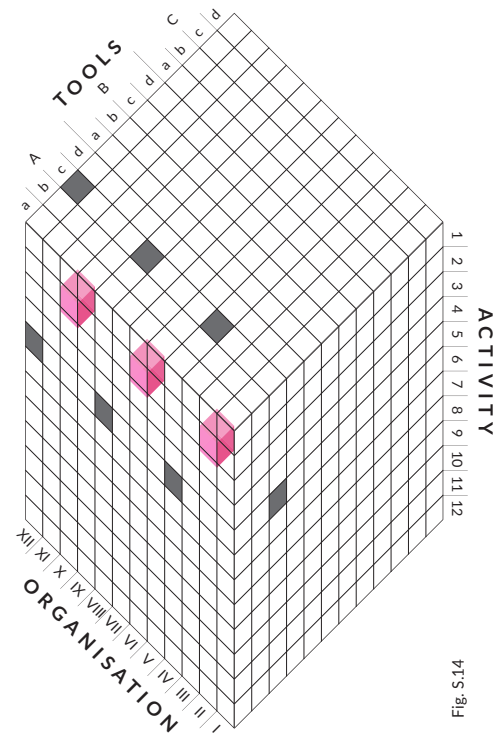


Fig. S.14



Phot. 13

5/ IV, VIII, XII/ Ac

Kiasma Museum, interior of an architectural complex
 Steven Holl, Helsinki, Finland 1993–1998

The interior of the entrance complex features a pool of water. Due to being open on two sides and from the top, top light, side light and light from the side and top falls on the smooth water surface and is reflected, illuminating the interior from below. This exposes the intense illumination of the interior, the reflection of sunlight in water, an ambience of calmness, of slow transience (evanescence), distancing, an ambient silence, mysteriousness. The high projection capacity is based on an illusion of the enlargement and spaciousness of the interior, of a source of sunlight in the interior, a shadowy depth.

mirror-like reflection / side light from below,
 top light from below, side and top from below /
 PARTITION material

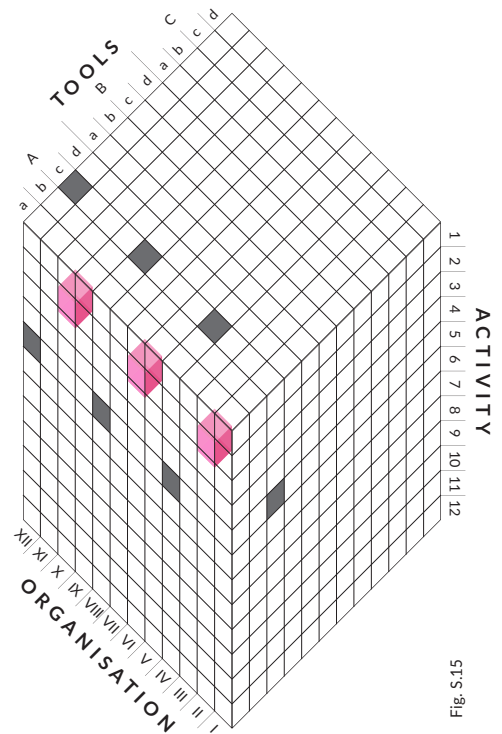


Fig. 5.15



Phot. 14

5/ IV, VIII, XII/ Ac

Museum of Stone, architectural complex

Kengo Kuma, Nasu, Japan 2000

Pools with water form a part of the floor of the architectural complex. The interior is open from above and from one side. If the water surface is undisturbed, it forms a mirror that reflects light from the top, light from the side and light from the side and top, as well as views of the sky and stone structures. It also reflects the source of sunlight. The exposure focuses on the spaciousness of the interior, its illumination, an ambience of mysteriousness, distancing, a slow transience (evanescence), calmness. The projection of the atmosphere is based on an illusion of numerous lights and fragments of stone structures, as well as of an apparent source of sunlight in the interior, a shadowy depth, and the theatricality of exposure (view–image–frame–scene).

mirror-like reflection / side light from below,
top; light from below, side and top from below /
PARTITION material

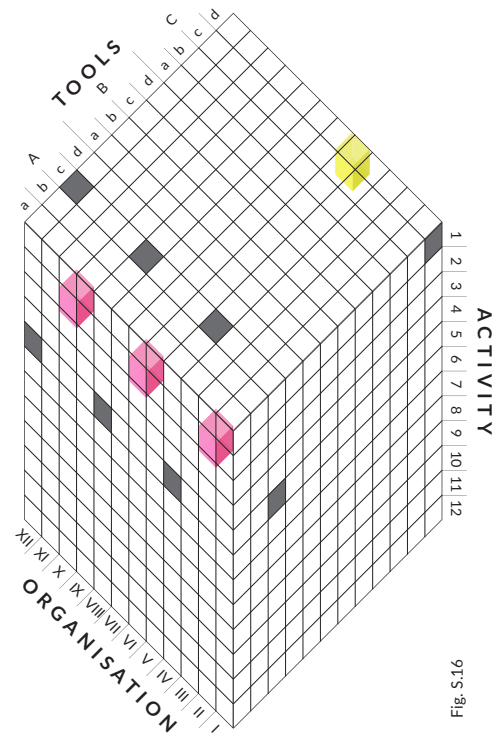
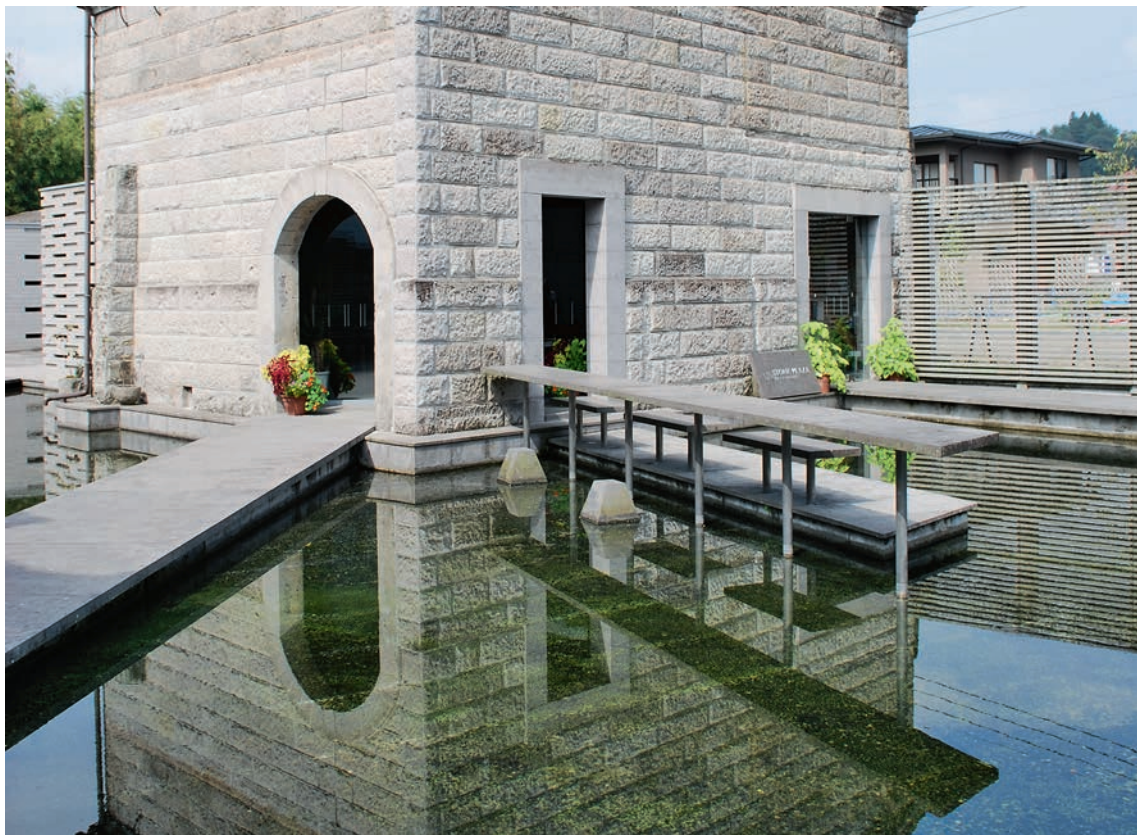


Fig. S.15



Phot. 15

5/ IV/ Ac

mirror-like reflection / side light from below /
PARTITION / material

Museum of Stone, interior of the 'Stone-Water' gallery
Kengo Kuma, Nasu, Japan 2000

In the interior of the 'Stone-Water' gallery, a pool of standing water is a part of the floor. If nothing disturbs the water, it becomes a mirror for solar rays that enter the interior directly from outside through slits between stone blocks on the walls (which are not obscured by anything). The mirror-like reflection makes the interior delicately illuminated from below, and produces an impression of an undefined depth from below, an ambience of mysteriousness, slow transience (evanescence), unclarity. The high projection capacity of the interior is based on an illusion of unbound depth, filled with shadow and lights that escape downwards.

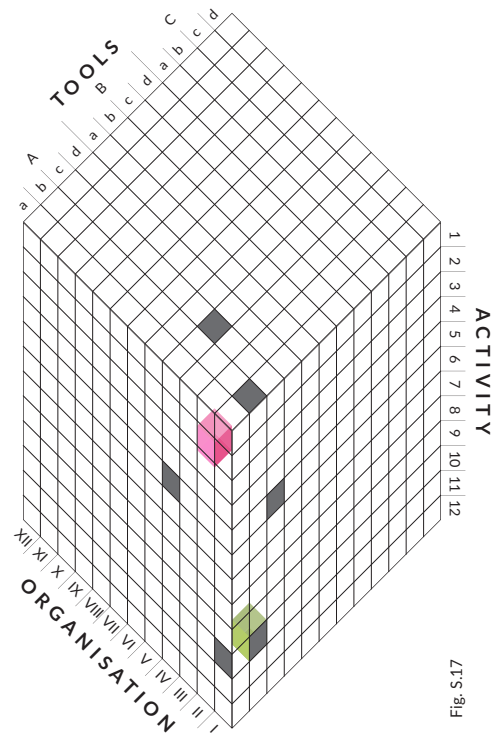


Fig. 5.17



Phot. 16

5/ I / Ac

Nasu Historical Museum, landscape interior
Kengo Kuma, Nasu, Japan 2000

The landscape interior is bound by the face of the mountain and the wall of the museum. Side light from one or several sides is reflected in a mirror-like fashion from the smooth surface of translucent glass (with a south-eastern and south-western exposition). The exposure focuses on spaciousness and the illumination of the interior, an ambience of mysteriousness, distancing and calmness. The high projection capacity of the atmosphere is based on theatricality (view–image–frame–scene), the evoking of numerous illusions, for instance of apparent sunlight in the interior and also of a shadowy depth.

mirror-like reflection / side light from one or several sides / PARTITION / material

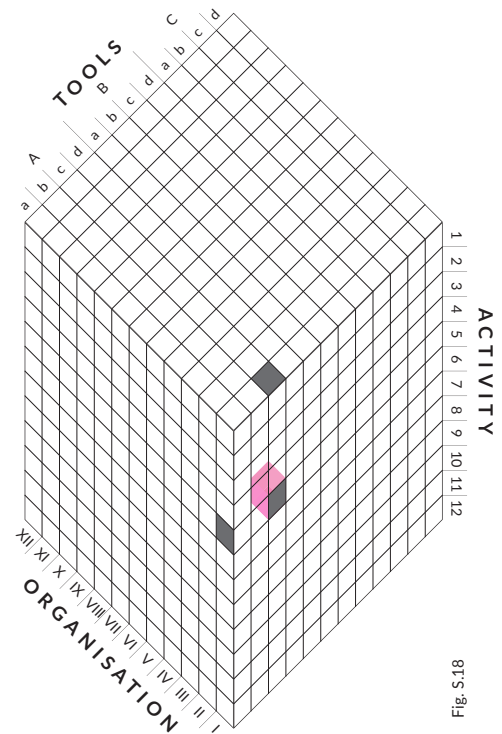


Fig. S.18



Phot. 17

5/ IV, VIII/ Ac

Centennial Hall National Museum, entrance complex interior
 Yoshio Taniguchi, Kyoto, Japan 2006

The interior of the new entrance complex to the museum features a pool with water. It is placed in a gate that exposes the frame of the museum deep into the courtyard (an abutting interior). The water does not allow people to cross the gate, which vividly exposes the view of the museum, while also reflecting its image on its surface. Due to the partial covering of the pool, the water surface reflects side and side-top rays (the upper corner of the interior has no boundaries for light). In this way, the interior of the entrance complex gains side light from below. The exposure focuses on the illumination of the interior, the illusion of depth in the gate, views of the surroundings, an ambience of distancing, spaciousness, unclarity, mysteriousness, slow transience (evanescence), a projection capacity of theatricality (view–image–frame–scene).

mirror-like reflection / side light from below,
 light from the side and top from below /
 PARTITION material

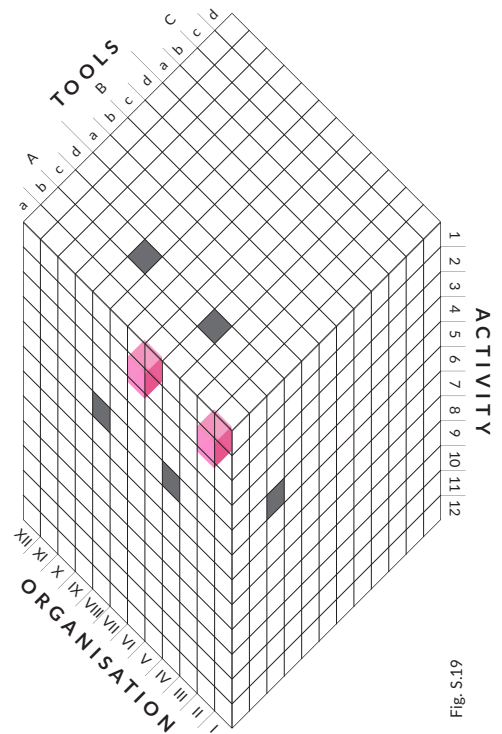
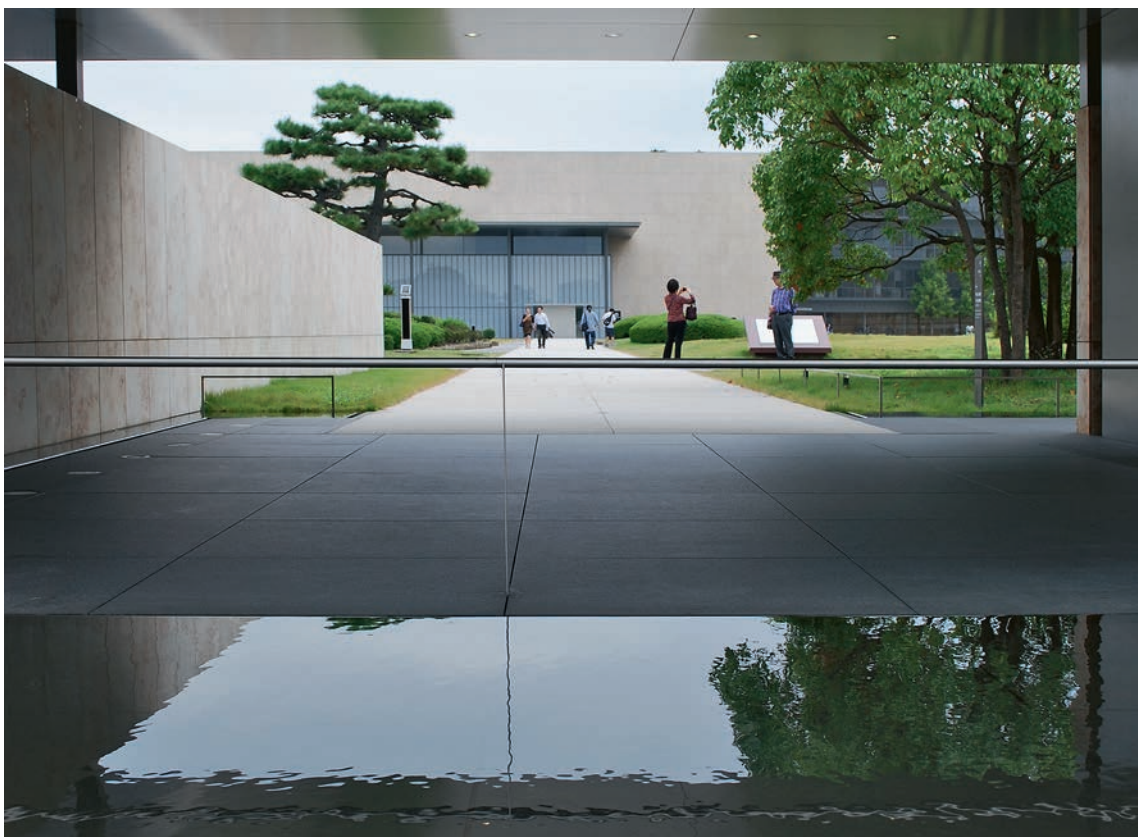


Fig. 5.19



Phot. 18

5/ IV/ Ac

Kolumba Museum, exhibition space on the first floor
 Peter Zumthor, Cologne, Germany 2007

In the exhibition space on the first floor, side light that enters from outside through a window is reflected in the mirror of a smooth floor. The matter of polished concrete and clay forms a surface that is so smooth that it reflects the rays like a mirror. The reflected rays illuminate the interior from below. The exposure focuses on the illumination of the interior, the vividity of materials, the ambience of spaciousness, calmness, slow transience (evanescence), ambient silence, unclarity and restraint. The projection capacity of the atmosphere is based on an illusion of unique luminous depth and the illusion of views of the interior in the bright, watery and slightly wavy matter.

mirror-like reflection / side light from below /
 PARTITION material

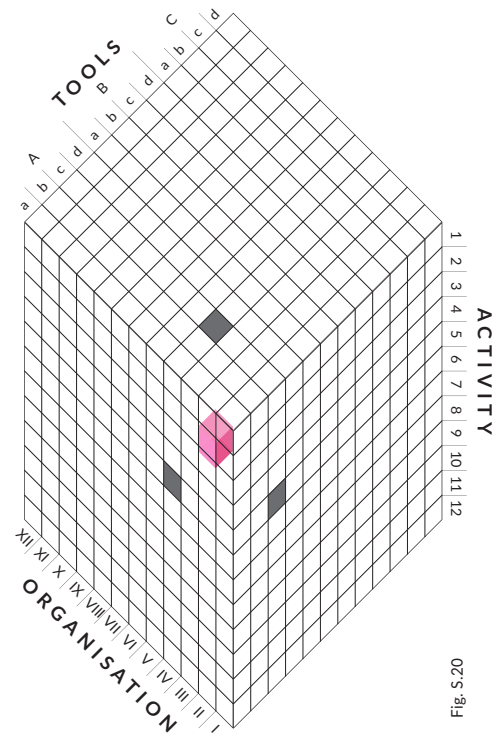
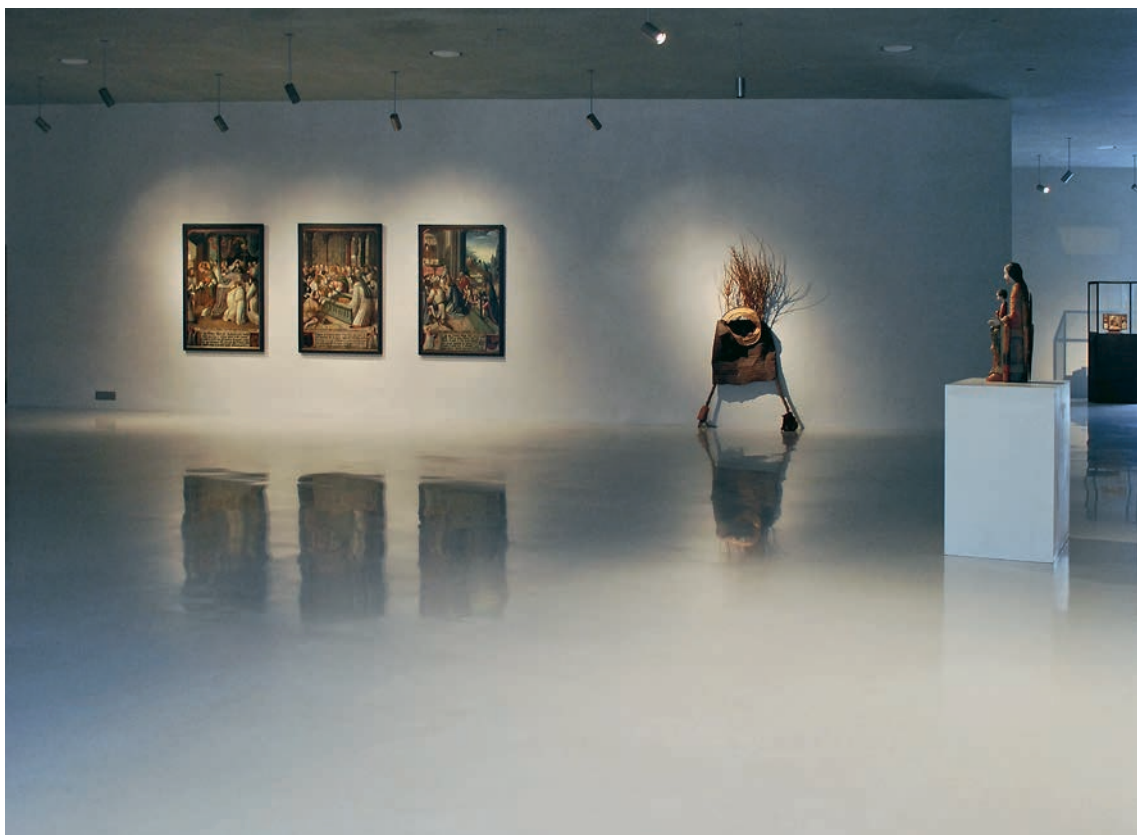


Fig. S.20



Phot. 19

5/ IV, VIII, XII/ Ac

Capitol Hotel Tokyu, interior of the architectural complex
 Kengo Kuma, Tokyo, Japan 2010

In the interior of the architectural complex formed by the hotel foyer, a corridor leading to the restaurant building, the wall of the restaurant and the water pool, side and top light is reflected as if in a mirror from the water surface and the vertical glass pane of the corridor. The exposure focuses on spaciousness and illumination of the interior, an ambience of mysteriousness, distancing, calmness, the projection of countless apparent views and lights in the interior, as well as of a source of sunlight, the illusion of a shadowy depth and the theatricality of exposure (view–image–frame–scene).

mirror-like reflection / side light from below, top light from below, side and top light from below / PARTITION material

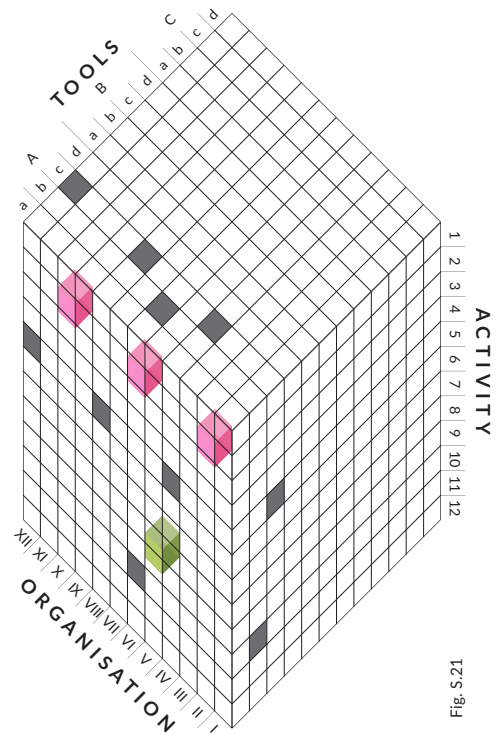
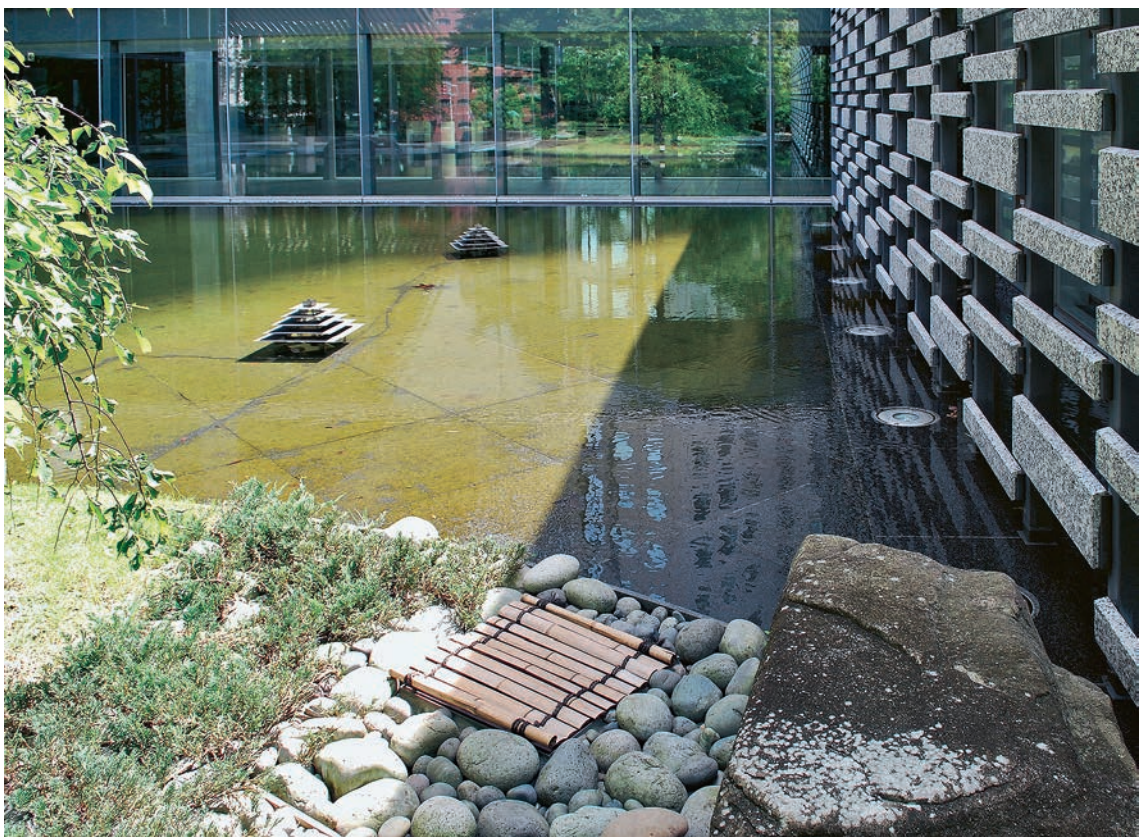


Fig. S.21



Phot. 20

5/ IV/ Ac

Capitol Hotel Tokyu, foyer
Kengo Kuma, Tokyo, Japan 2010

The interior of the foyer includes a pool of water, used as a plinth for ikebana. The material of the pool is black and the water surface—perfectly smooth. It reflects side light that, upon being reflected, illuminates the interior from below. The exposure focuses on the spaciousness of the interior, the softness of the water, the illumination of the interior, an ambience of slow transience (evanescence), mysteriousness, distancing, calmness, the projection of a shadowy fog, the theatricality of exposure (view–image–frame–scene).

mirror-like reflection / side from below /
PARTITION material

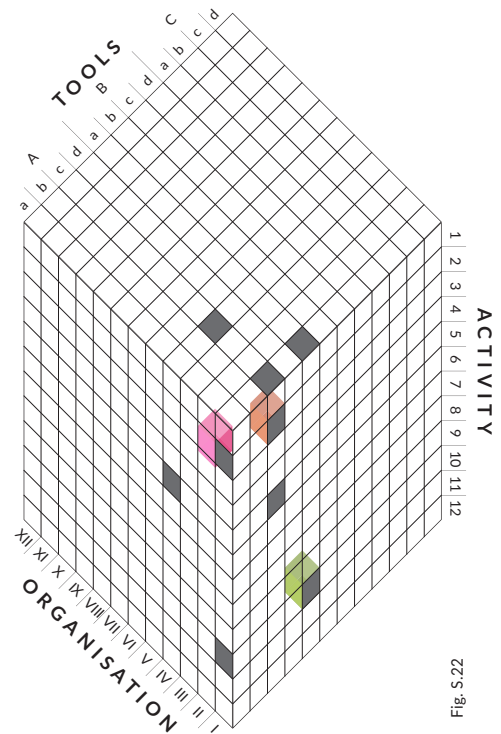


Fig. S.22



Phot. 21

5/ I, IX/ Ac

Louvre Lens Museum, interior of an architectural complex
 SANAA, Lens, France 2009–2012

Due to the extensiveness of the interior, vertical walls receive not only side light, but also side and top light. It is reflected in a mirror-like fashion from the perfectly smooth surface of the museum wall. This exposes the spaciousness and illumination of the interior, an ambience of uncertainty, distancing, playfulness, the projection capacity of numerous illusions formed by reflections and apparent source of sunlight in the interior and the theatricality of exposure (view–image–frame–scene).

mirror-like reflection / side light from one or several sides, side and top light from one or several sides / PARTITION material

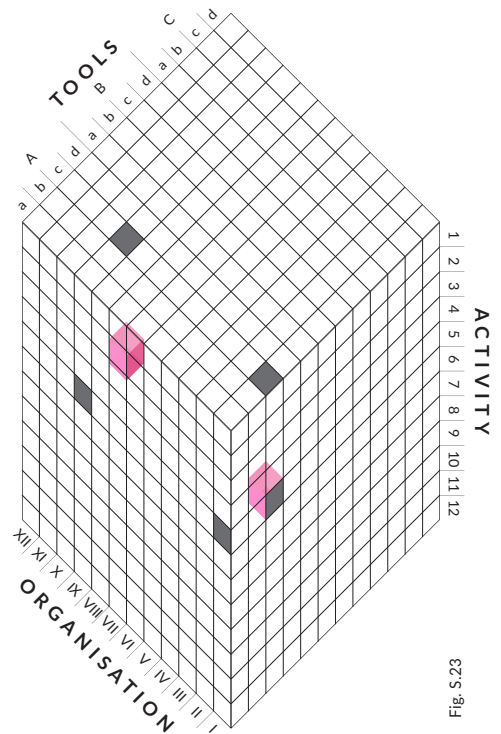


Fig. S.23



Phot. 22

5/ IV, VIII, XII/ Ac

Fondation Luis Vuitton, interior with water
 Frank Gehry, Paris, France 2014

In the museum, on the level below the street, there is an interior delimited by the structures of the building and partially filled with water (its surface is a part of the interior's floor). If the water does not move, it reflects sunlight from the top, from the side and the top and from the side and directs them downwards into the interior. The exposure focuses on the spaciousness and illumination of the interior, an ambience of mysteriousness, distancing, calmness, and a projection of numerous illusions produced by reflections and the theatricality of exposure (view–image–frame–scene).

mirror-like reflection / side light from below, top light from below, side and top light from below / PARTITION material

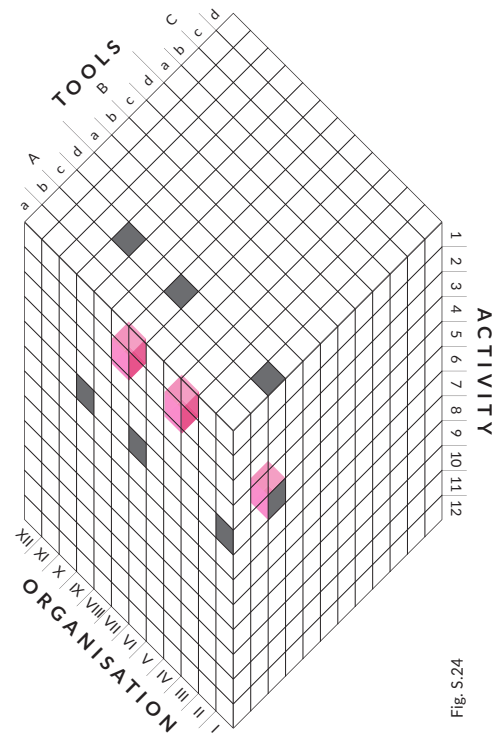
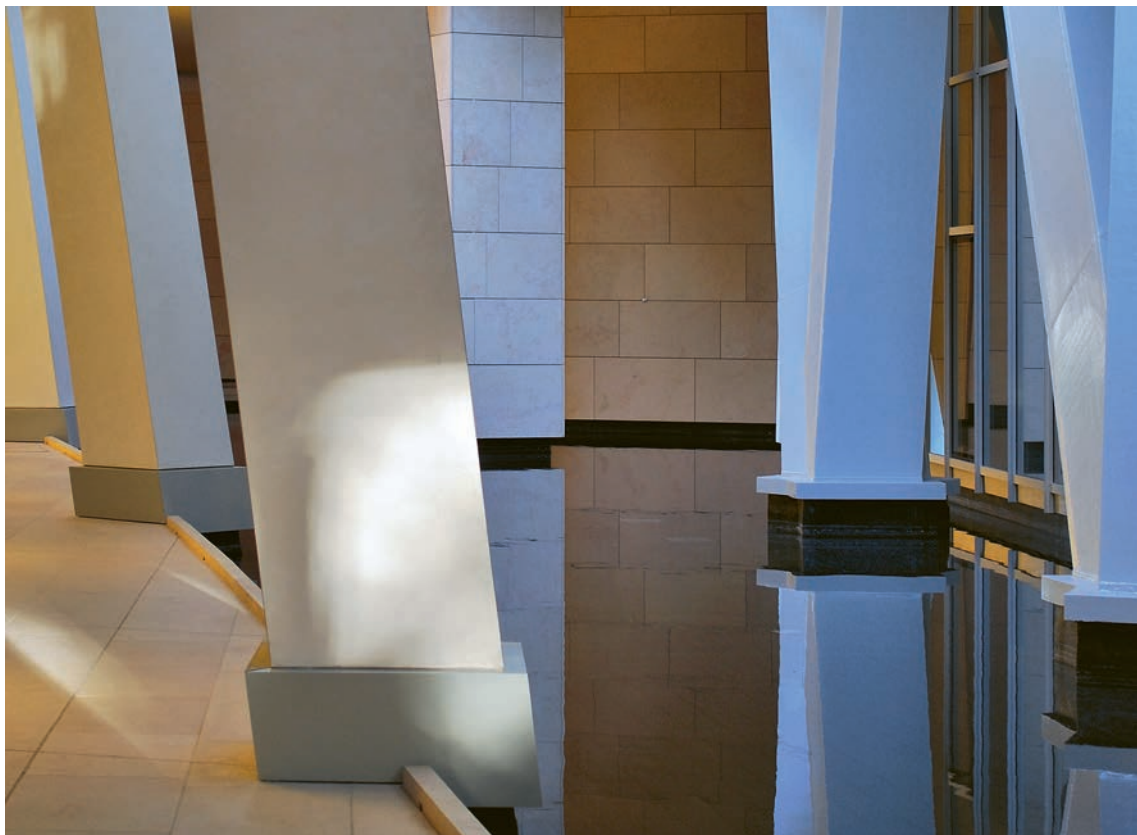


Fig. S.24



Phot. 23

5/ I, VI, IX/ Ac

Fondation Luis Vuitton, interior with mirrors and water

Frank Gehry, Paris, France 2014

The interior, with a water, features pyramidal columns covered in mirrors. Side light, top light and light from the side and top is reflected off of the mirrors and enters the interior from several sides. The exposure focuses on countless reflections of sunlight, as well as its sources, spaciousness and illumination of the interior. The interior gains an ambience of high unclarity, it becomes non-descript, broken up, mysterious, dramatic. The projection capacity of the atmosphere is based on the illusion of being broken up and the diffusion of the interior in countless fragments of views of its boundaries and the surrounding and the source of light in the interior, the theatricality of exposure (view–image–frame–scene).

mirror-like reflection / side light from one or several sides, top light from one or several sides, light from the side and top from one or several sides / PARTITION material

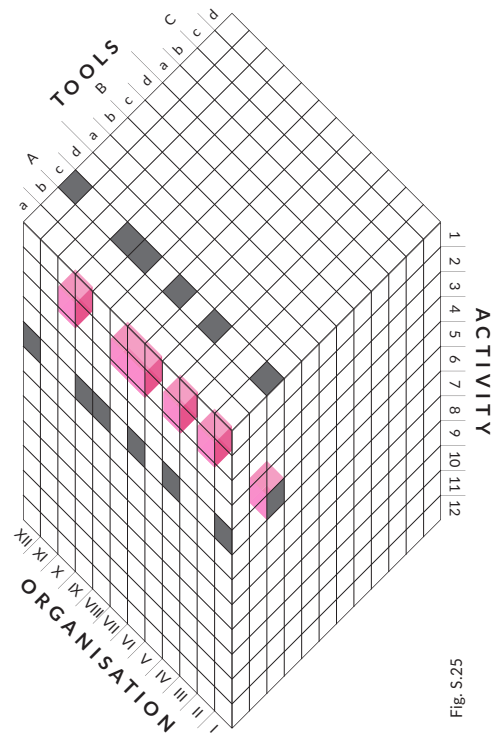


Fig.S.25



Phot. 24

V. 2.2. Scattering and Breaking (6)

Scattering and breaking was defined in the work as a single instance of reflecting rays from a coarse surface in different directions so that they can enter the interior (or remain in it). It was assumed in the study to be the simplest form of scattering light. In terms of the wave form of light, the intensity of scattering is dependent on the coarseness of the reflecting surface and the length of the light wave. Almost every object illuminated by light reflects its rays in different directions, causing a brightening of the area near the object or the interior in which the object is located.

The activity of scattering and breaking is typically used to change the direction of light that falls from outside (astronomically and geographically conditioned) towards other directions that correspond to the needs of the interior's users. This activity causes both the scattering of the entering rays (due to the coarseness of the surface) and their specific redirection. It can also be used to illuminate specific fragments of the interior for purely practical reasons or to expose them in some way, giving them a symbolic sense. For instance, using scattering and breaking it is possible to illuminate the wall with windows, which remains in shadow (which is a result of light travelling along a straight line).

If scattering and breaking is present in the interior as the sole activity of operating with light, then the source of sunlight is easily perceivable (accounting for the most often used fragments of the interior and not its hidden, peripheral elements). Then, the impression of the delicate scattering of light is more pronounced, ambience is more mysterious and projection capacity is richer with illusions and associations. Likewise, the tool that breaks light is typically not exposed, but rather deliberately hidden within the boundaries of the interior from human sight, so as to direct attention towards the place illuminated with the redirected and scattered light. It exposes the shape of a specific fragment of the interior, its depth and materiality. It can also extract the nooks and crannies of the interior from darkness. In this sense, light that is scattered and broken guides man across architecture and, despite its ambient mysteriousness, produces an atmosphere of the clarity of the interior's shape, or at least of a part of it.

In special cases, scattering and breaking can focus the attention of the observer on the architectural tool that, by reflecting the rays from outside and by directing them inside, can be seen as a surface bathed in sunlight. This way we can primarily expose the shape of the tool, its size relative to the interior and partially also its material.

The illusion of sprinkling a surface with light as if it were a material substance is well known. In reality, it is a gradation of light and shadow on the boundaries of the interior that causes the transfer of light into shades, the differentiation of the surface and exposing its shape, its course in the interior and size.

Scattering and breaking most notably exposes the shape of architecture, typically in its fragment, induces the impressiveness of the vividness of the geometry of the interior (its section), of tempered brightness, of suffusing with light with an even tone. The atmosphere is created by an ambience of clarity, stasis of slow transience (evanescence), peace, ambient silence, of suffusion with light in a uniform mood, of mysteriousness. The projection capacity of the atmosphere is based on an impression described as 'I see what is, it is what I see', a slight illusion of the materiality of light, of sprinkling with light, a foggy radiance that rests on the boundary of the interior as if it were a substance.

Scattering and breaking in an interior filled with a structure exposes this structure, the vividness of the content (volume) of the interior, the blurring of its boundaries, the density of space, the ambience of density, boundlessness, a balance between openness and enclosure and the projection of a forest.

6/ I/ Bd

Tapiola Church, nave

Aarno Ruusuvuori, Tapiola, Finland 1965

In the Tapiola Church in Finland, light enters the interior from outside through a very large southern window in the upper part of the wall. Opposite the window, the concrete ceiling as a diagonal cut that reflects the rays of side light and by reflecting them, admits them into the interior and casts them at the base of the wall in which the window is placed. In this way, the wall with the window, typically shaded, is lit with sunlight. The low position of the sun in Helsinki causes a considerable part of the rays that enter through the window to be scattered and broken and returned after a fashion, illuminating the zone underneath the window and its nooks and crannies. It exposes the shape of the interior, the ambience of clarity, uniformity, of slow transience (evanescence) and the projection of 'I see what is, it is what I see' and a slight sprinkling with light.

scattering and breaking / side light from one or several sides / MASS shape

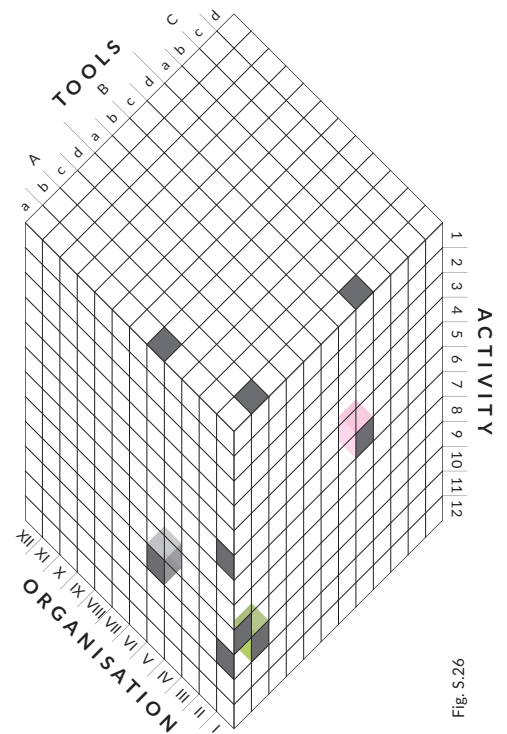
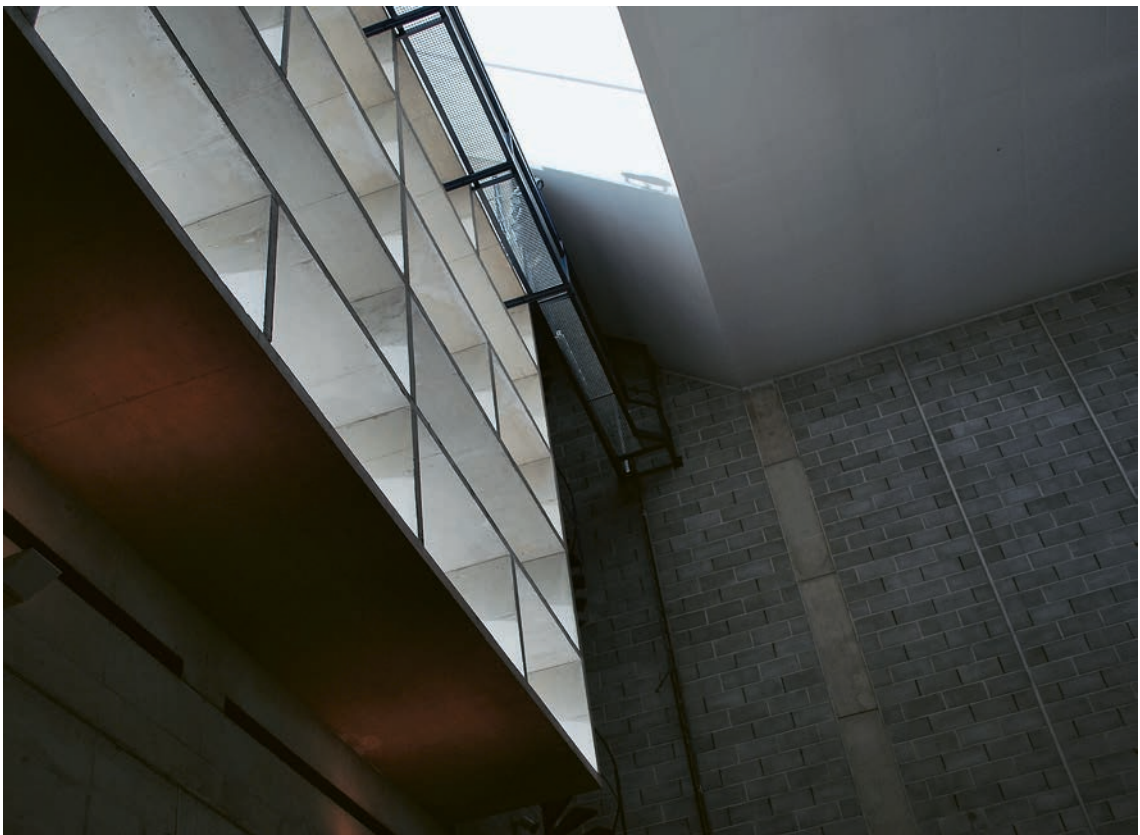


Fig.S.26



Phot. 25

6/ I/ Acd

Laajasalo Church, nave

Kari Järvinen & Merja Nieminen, Helsinki, Finland 2003

Windows from the east have vertical white screens along the edges on their northern sides. These screens intercept side southern light and direct it towards the translucent glass and then further—in the church's interior. The breaking of light enables the direction of a discrete light onto the altar wall and enhancing the entire interior's brightness. This exposes the wood of the altar wall, an ambience of clarity and a projection of 'I see what is, it is what I see' and a delicate sprinkling with light.

scattering and breaking / side light from one or several sides / PARTITION material, shape

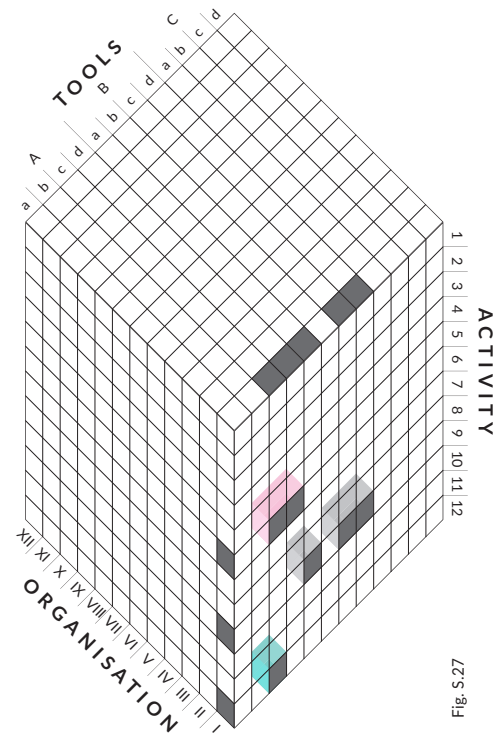


Fig. S.25



Phot. 26

6/ I/ Acd

Laajasalo Church, nave

Kari Järvinen & Merja Nieminen, Helsinki, Finland 2003

scattering and breaking / side light from one or several sides / PARTITION material, shape

Side rays enter the interior through the upper corner of the presbytery, where they are intercepted by the surface of a white reflecting screen. The presbytery is entered by scattered light. The breaking causes the rays to be directed at the altar wall and their even scattering across the space of the presbytery, which exposes the material of the altar wall, an ambience of clarity, a slow transience (evanescence) and a projection of 'I see what is, it is what I see' and of sprinkling with light.

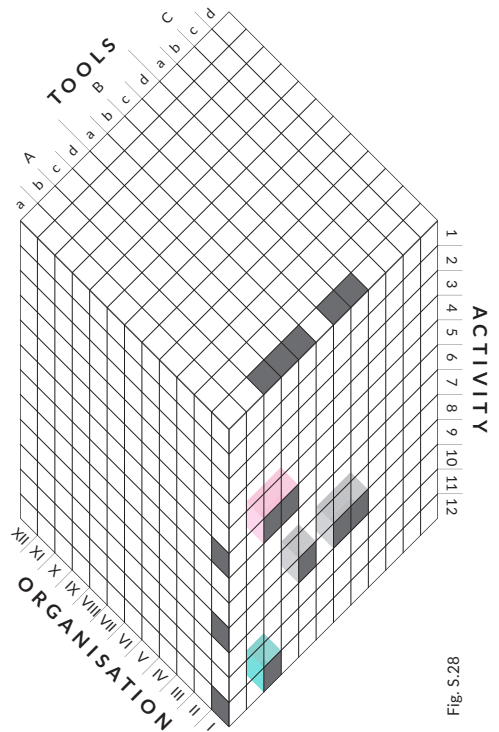
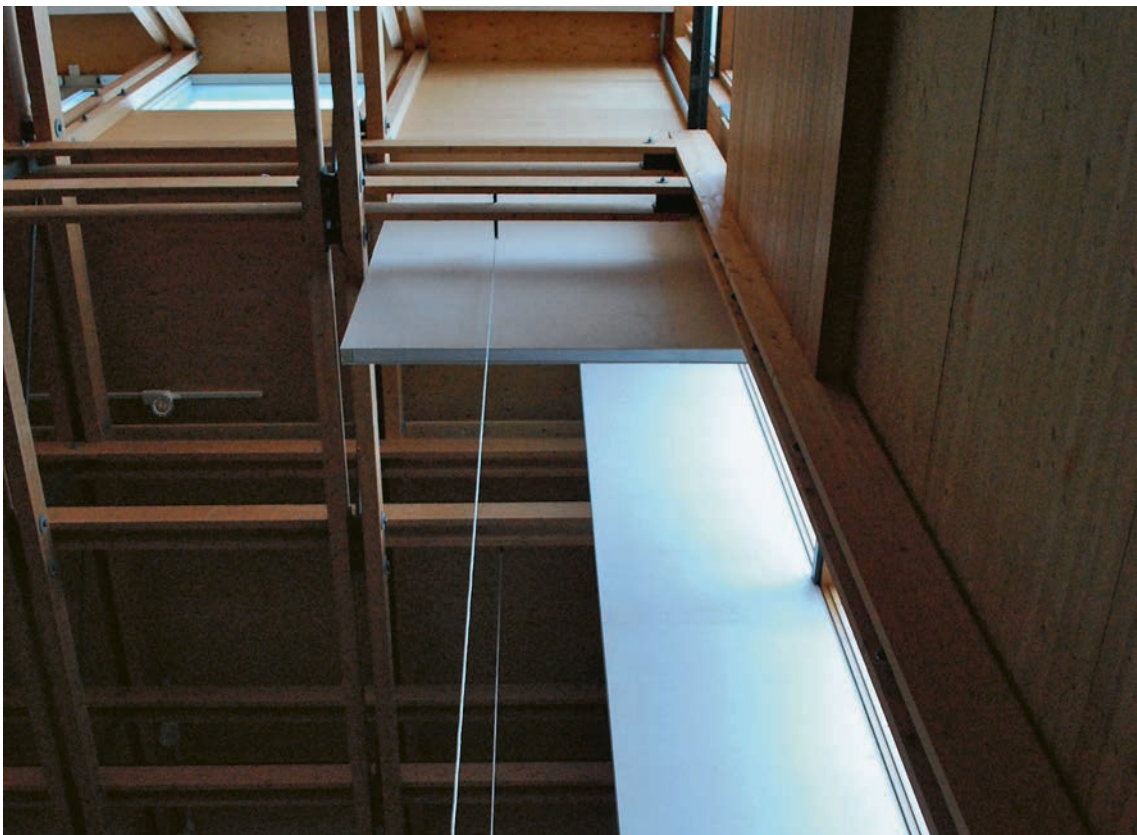


Fig. S.28



Phot. 27

V. 2.3. Scattering and Bending (7)

Due to the activity of scattering and bending, the interior receives light that operates as a result of a sequence of scattering reflections that are performed on a convex or concave surface. This activity takes on a form that is distinct for the interior due to the convexity or concavity of the surface that bends the light. Bending on a concave surface causes the multiple reflection of the same rays and thus increasing the brightness at the centre of the interior. Bending light on convex surfaces causes its rays to be spread in many directions, thus giving them an ability to reach places that are distant from the tool of operating with light.

Thanks to multiple reflections of rays from the surface of boundaries, scattering and bending reinforces the centripetal action of light in the interior in the sense that its rays change their direction and dampens its strength in successive reflections as they become more distant from their source, blurring its human perception in the interior. As a result, they lose their ability to refer the attention of observers to the outside, where the source is located (such as the Sun and the celestial sphere). In exchange, these rays focus human attention on elements of the interior itself, from which they reflect multiple times and which they articulate.

Thus, centripetal light of scattering and bending exposes the geometry and shape of the interior and focuses human attention on them and through this—it enhances ambience and introversion. At the same time, exposing the vividness of the shape, it induces an ambience of clarity (the interior is bright both in a literal and metaphorical sense). The sequence of reflections and their scattering enhances the uniformity of light and thus, in the human perception of the space, enhances the impression of the interior being suffused with light in an even tone, an ambience of balance, peace, calmness, ambient silence. The scattering of rays along the curvature of boundaries brings to mind associations of them being sprinkled with light and the intensification of rays within space produces the effect of the materialisation of light. It creates an illusion of a fog, a veil or some other light substance that silently rests on the boundaries of the interior and levitates in its space.

Scattering and bending light in the interior filled with a structure exposes this structure and produces an impression of a vivid volume of the space (either of its fragment or its entirety), the blurring of its borders, the densification of space, and therefore—an ambience of density, of a balance between openness and enclosure and the projection of a forest.

The bending of light takes place in cylindrical interiors enclosed with a dome with an oculus at its top. The top light that enters such interiors from overhead becomes multiplied in reflections on the concavity of the cylinder and reaches the dome, exposing it delicately. If the dome has ribs, the light exposes their role of enhancing the shape of the interior. In this manner, light enters the central interior of the Villa Capra La Rotonda (Palladio, Scamozzi, 1550–1582) and to the Villa La Rocca Pisana (Scamozzi, 1576). In La Rocca, the effects of scattering and bending are clearly visible as the walls of its central interior have a bright, uniform colour. Light enters it through an oculus in the dome and, directly, from the nearby interiors and the sequences of successive reflections, bends on the concave walls. The scattering hits niches at varying intensities, reaching the dome, and models the entire shape of the interior. In human perception, this centripetal light becomes material and magnifies the brightness of the interior, resulting in an effect of keeping inside the day while outside there is already dusk.

Similarly, the strong effect of scattering bending builds atmosphere in the interiors under the towers of the Notre-Dame du Haut chapel in Ronchamp (Le Corbusier, 1951–1955), especially underneath the tallest southern tower, which introduces side northern light, scattered by nature, and models it in the concavity of its southern wall. This high ambience and projection capacity is attainable in an interior by using the scattering and bending of light.

7/ I/ Bd

Sanctuary of Merciful Love in Collevaleza

Julio Lafuente, Collevaleza (Peruggia), Italy 1963–1967

Side light enters the interior of the church through slits that run from the floor to the ceiling between brick cylinders that form the structure of the interior.⁵⁶⁹ Rays that fall on the convex surface of the cylinders bend by creating an effect of the gradation of light and shadow and scatter light in different directions. This exposes the shape of the interior's architecture, the ambience of calmness, clarity, of slow transience (evanescence), uniformity, a projection of 'I see what is, it is what I see', and of delicate sprinkling with light.

⁵⁶⁹ In the interior of the church there are thirteen cylinders that run along the outline of the nave and are open towards it as side chapels.

scattering and bending / side light from one or several sides / MASS shape

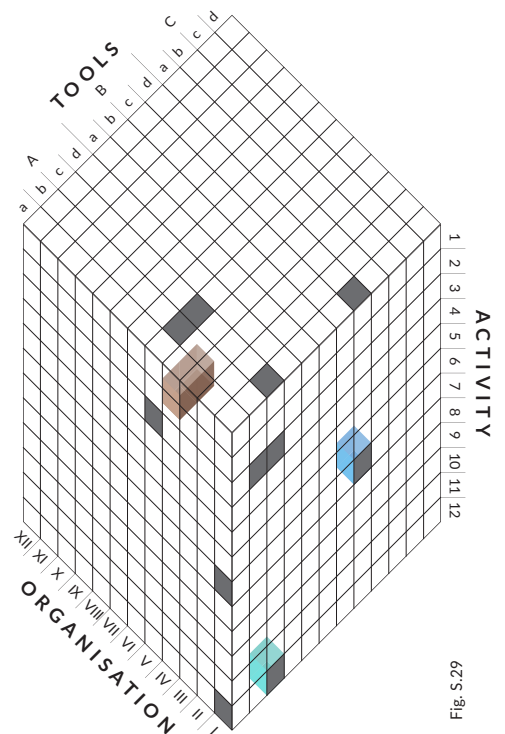
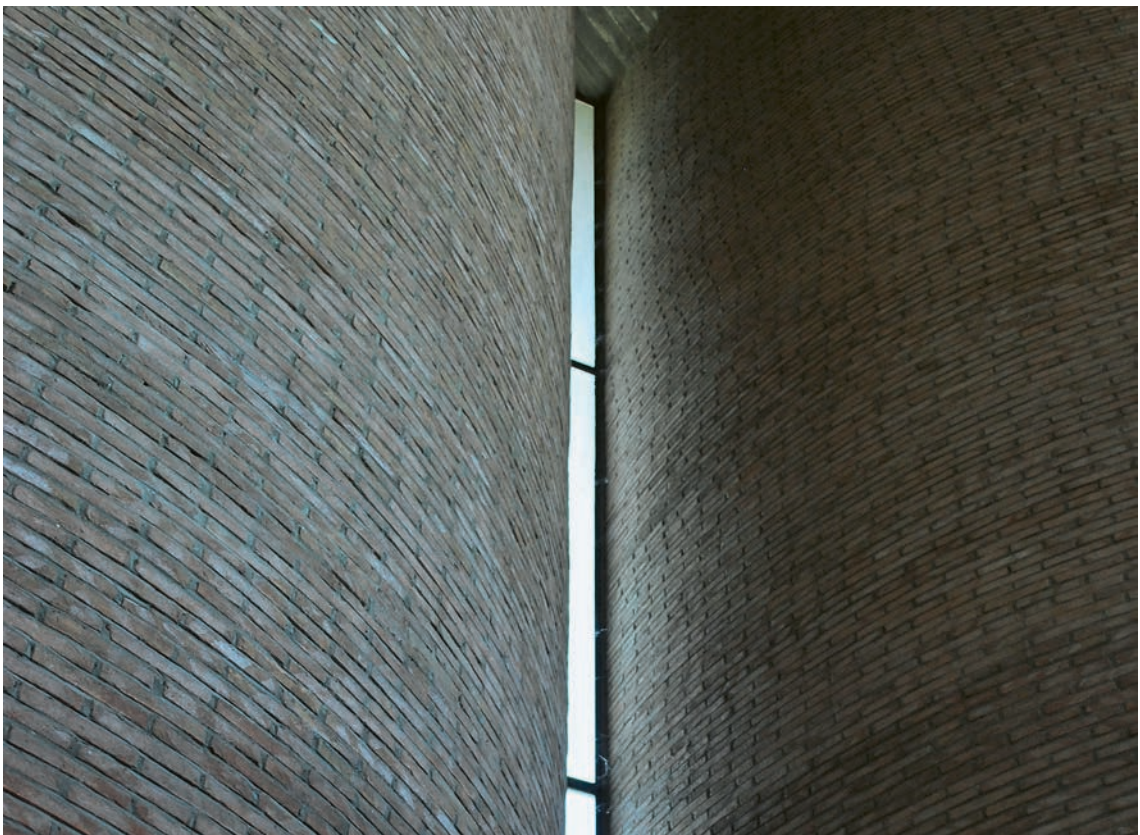


Fig. S.27



Phot. 28

7/ I/ Bad

Kiasma Museum, exhibition space on the first floor
 Steven Holl, Helsinki, Finland 1993–1998

On the uppermost storey of the museum, the sunlight enters the interior in a form scattered by skylights, which intercept side and top light (western) from outside and by scattering and bending admit it into the exhibition space from one side (eastern). The thickness of the roof makes the skylights take on the shape of niches with curved walls that bend light before admitting it into the interior. Reflecting and bending of the rays exposes the shape of architecture and directs rays into the proper side of the interior, creating an ambience of calmness, slow transience (evanescence), clarity, uniformity and a projection of 'I see what is, it is what I see' and of sprinkling with light.

scattering and bending / side light from one or several sides / MASS opening shape

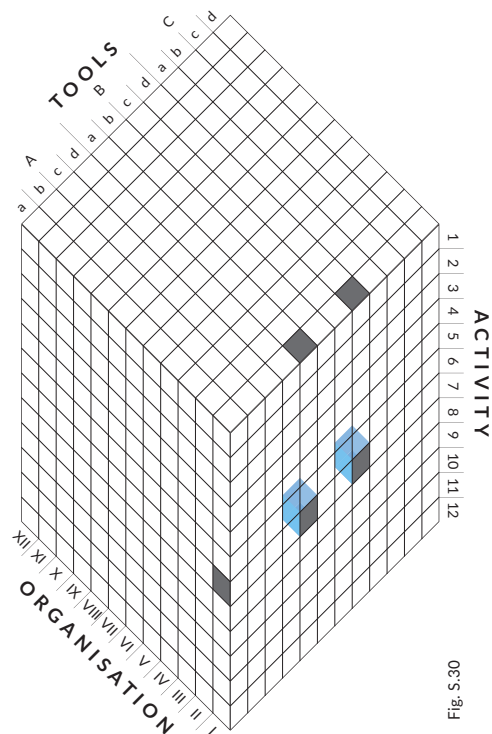


Fig. S.30



Phot. 29

V. 2.4. Scattering and Slipping (8)

In the study, scattering and slipping denotes a sequence of scattering and breaking reflections that occur in an interior with a coarse surface that is perpendicular to the surface of the opening through which the light enters the interior from outside. In the interior, slipping primarily exposes the surfaces along which the light slips—its texture and shape. This can be seen on window lining frames, which are often painted white to enhance the effect of light slipping and thus—of brightening the interior. Placing a window in the corner of a room causes the light to slip along the wall that is perpendicular to it and touches it. This exposes the texture of this wall and any decorations placed on it, insofar as they have a coarse surface (such as a tapestry or relief, as noted multiple times by Rasmussen). Slipping is enhanced by the further direction of the rays onto a coarse surface (for instance via the extension of the wall that is slipped on outside of the interior).

The interior of the Chapel of Silence at the UNESCO building (T. Andō, 1995) is entered by top light from overhead via a ring-shaped slit in the ceiling and slips along the surface of the side walls (the effect of a lid that is too small). This exposes the walls of the cylinder and the texture of the concrete. Along the outline of the interior there forms a curtain of light that contrasts with the shaded lid. The exposure highlights the impression of the interior being closed from above and expanding on the sides.

Scattering and slipping exposes the gradation of light on the surfaces of partitions, the texture of the interior's boundaries, the shape of the interior, condensed or diluted darkness, tempered brightness, the ambience of clarity, peace, mysteriousness, slow transience (evanescence) and the projection of sprinkling with light or a foggy radiance.

8/ V/ Abc

scattering and slipping / top light from overhead /
PARTITION structure, material

Vals Thermal Baths, roofed interior with a large pool

Peter Zumthor, Vals, Switzerland 1996

Some of the slits in the ceiling of the interior are very close to the wall. The top light that enters through them slips along the stone surfaces of the wall. The slits are of considerable thickness so the light is heavily directed. The exposure focuses on the texture of the stone surface, the materiality of the interior, the gradation of light, tempered darkness, the ambience of enclosure, intimacy, dramatism, mysteriousness, tension and the projection capacity of a cave.

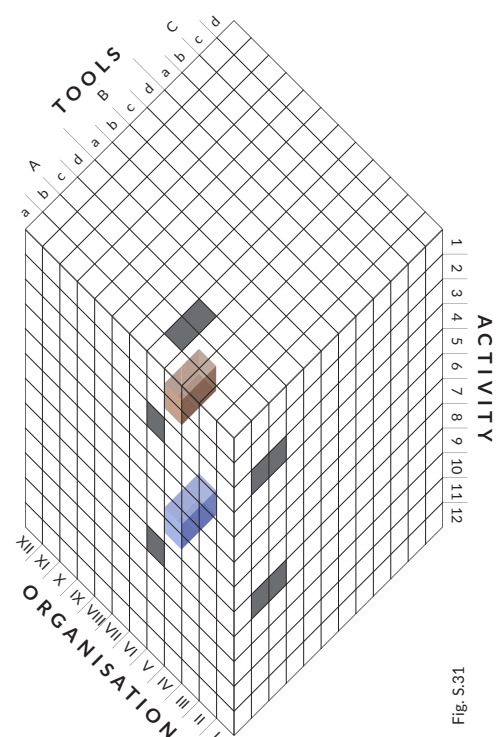


Fig. S.31

8/ I/ Aac, Bb

Church of Light

Tadao Andō, Ibaraki, Osaka, 1989

In the interior of the church, opposite the altar, there is a discrete, glazed vertical slit through which side light enters the interior by slipping on the surface of the concrete wall. This wall extends slightly beyond the interior, intercepting rays and reinforcing the intensity of the slipping. The gradation of light on the surfaces of partitions is exposed, as are the texture of the wall, diluted and condensed darkness, the ambience of mysteriousness, dramatism, slow transience (evanescence) and the projection capacity of sprinkling with light.

scattering and slipping / side light from one or several sides / PARTITION opening, material, MASS structure

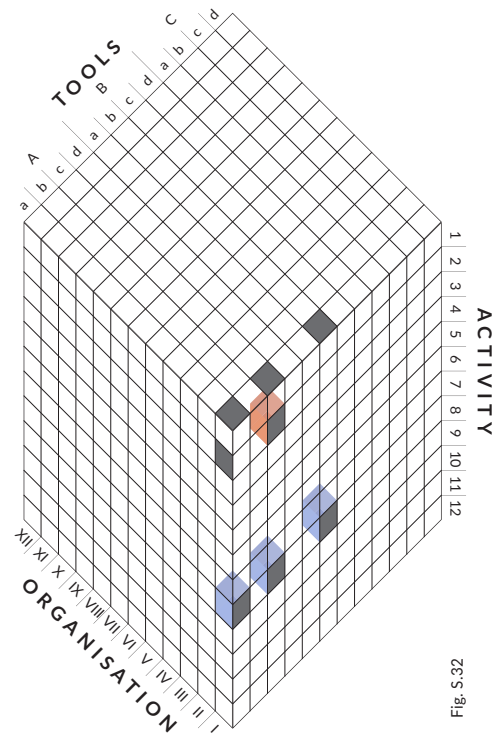
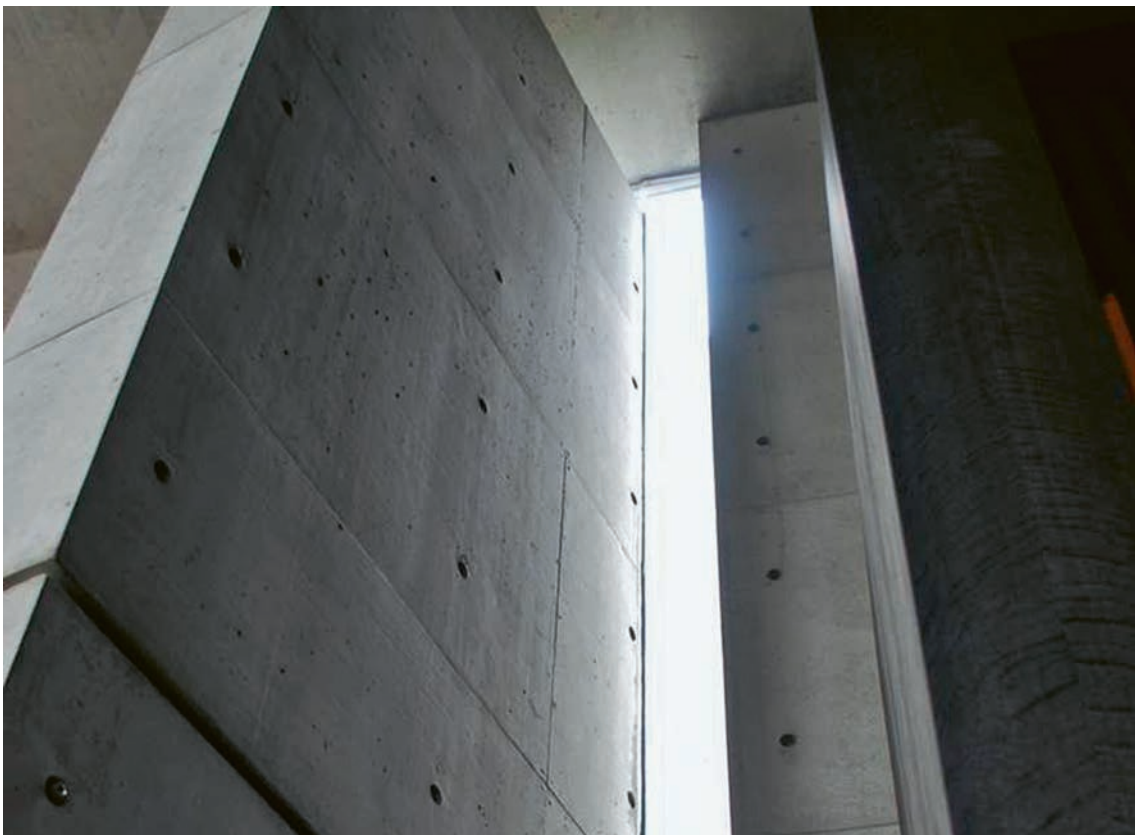


Fig.S.32



Phot. 30

8/ I/ Bacd

Viikki Church, nave
 Samuli Miettinen, JKMM, Viikki, Helsinki 2005

Side light (from the south) enters the interior via a vertical slit in the altar wall (from the west). This slit appears to be a tear in the wall created by cutting it from three sides and bending the cut fragment towards the outside. The slit is poorly visible from inside the church, but the light it admits slips along the central part of the triptych, which presents a vine sculpted on a board and covered with gold polychrome. The slipping light heavily exposes the texture of the ornament. Tempered brightness exposes the gold polychrome, the shape of the triptych and the entire presbytery of the church. The light creates in it an ambience of clarity, tension, harmony, of slow transience (evanescence) and via projection capacity associated with the symbolism of light and metallic states, produced by light with an invisible source entering the interior.

scattering and slipping / side light from one or several sides / MASS opening, shape, material

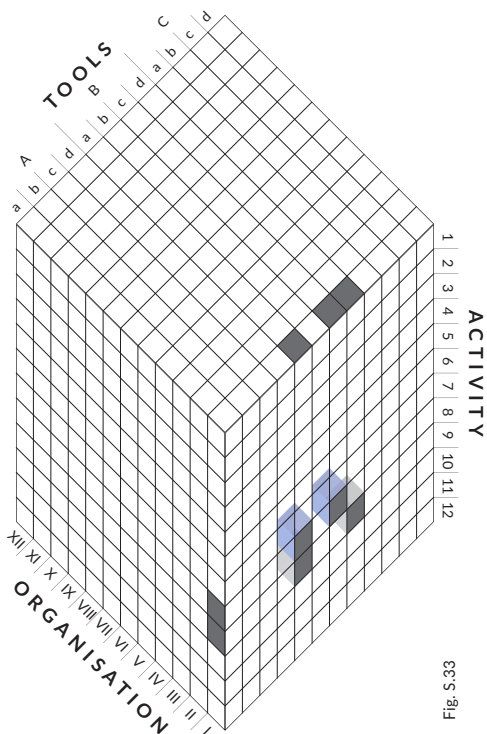
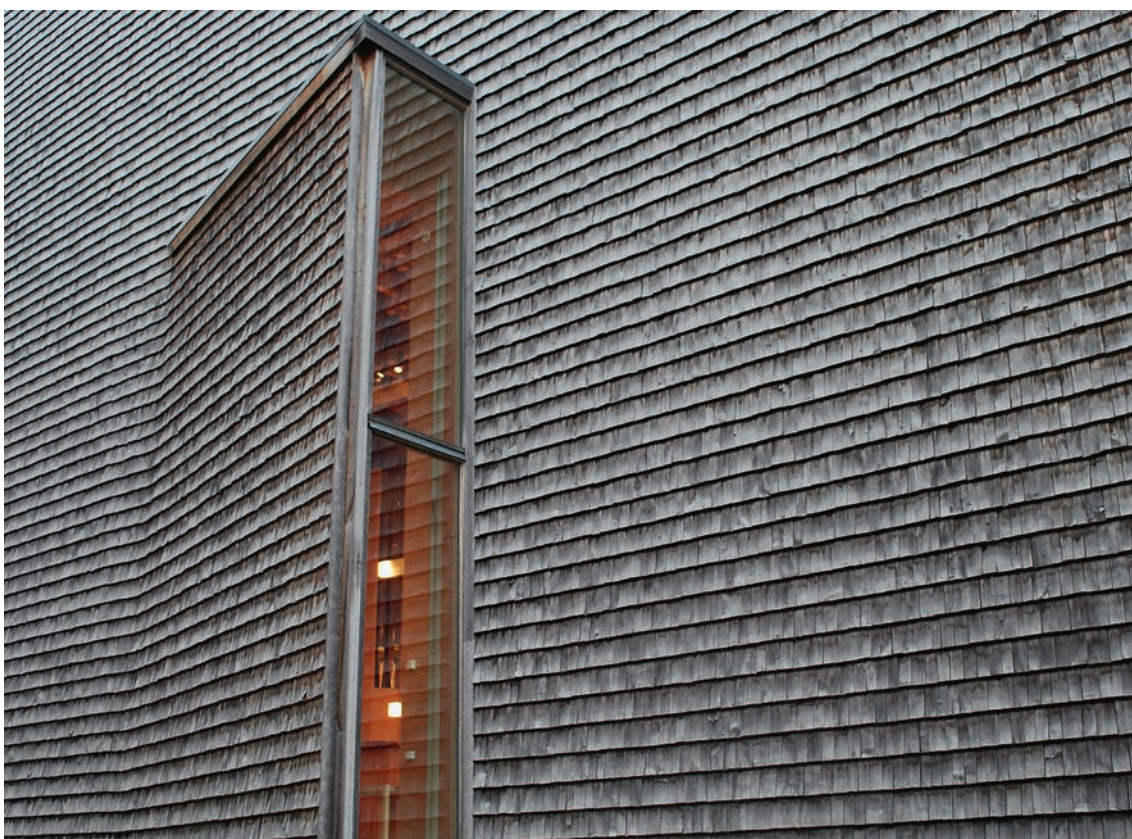


Fig. 5.33



Phot. 31

8 / III / Aac

Capitol Hotel Tokyu, stairwell near the foyer
Kengo Kuma, Tokyo, Japan 2010

The interior of the stairwell, with walls from black stone, is illuminated with side light that enters from overhead and slips along the coarse and wet surface of wet stone. The exposure favours the texture and matter of the wet wall surface, the materiality of the interior, the shimmering matter of the wall, the movement of water, the gradation of light, tempered darkness, the ambience of enclosure, dramatism, mysteriousness, tension, slow transience (evanescence) or projection of the sparkling matter, the illusion of the shivering of water and light, the illusion of a cave.

scattering and slipping / side light from the top /
PARTITION opening, material

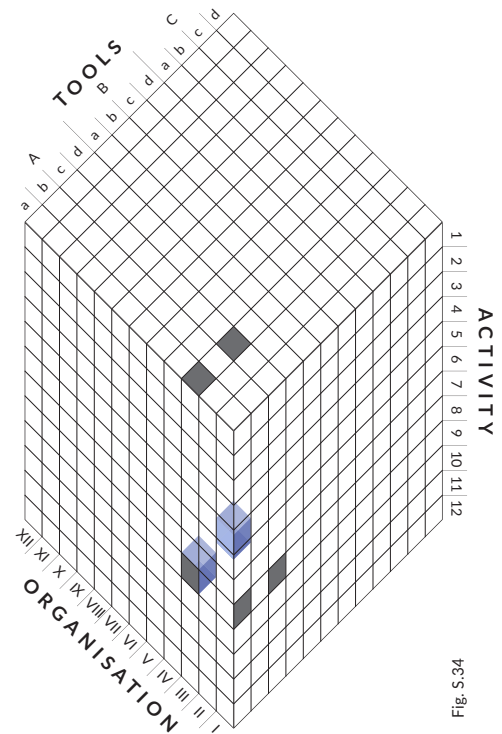
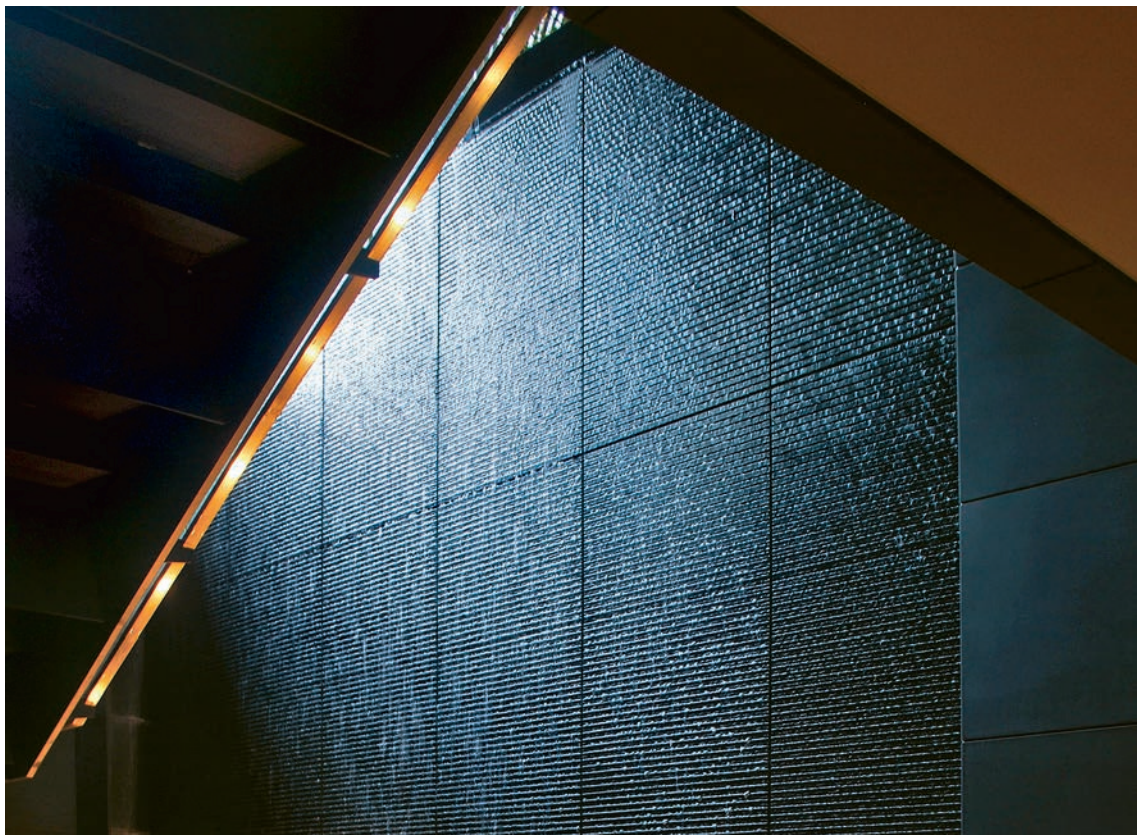


Fig.S.34



Phot. 32

8/ V/ Abc, Bc

scattering and slipping / top light from overhead / PARTITION structure, material MASS, material

Chapel of silence

K2S Architects,⁵⁷⁰ Helsinki 2012

The oval interior of the chapel is entered overhead by top light via a slip between the ceiling of the interior and the side walls (the effect of the lid being too small). The slipping of rays along the wooden surface exposes its texture and the shape of the entire interior, as well as enclosure, the ambience of clarity, stasis, coherence, uniformity, of a hard enclosure and a projection based on the illusion of a delicate widening of the interior and confining it with a curtain of light.

⁵⁷⁰ K2S Architects Ltd., the design team includes: Kimmo Lintula, Niko Sirola, Mikko Summanen, Jukka Makinen, Kristian Forsberg, Abel Groenewolt, Tetsujiro Kyuma, Mikko Naveri, Miguel Pereira, Outi Pirhonen, Teija Tarvo, Elina Tenho, Jarno Vesa.

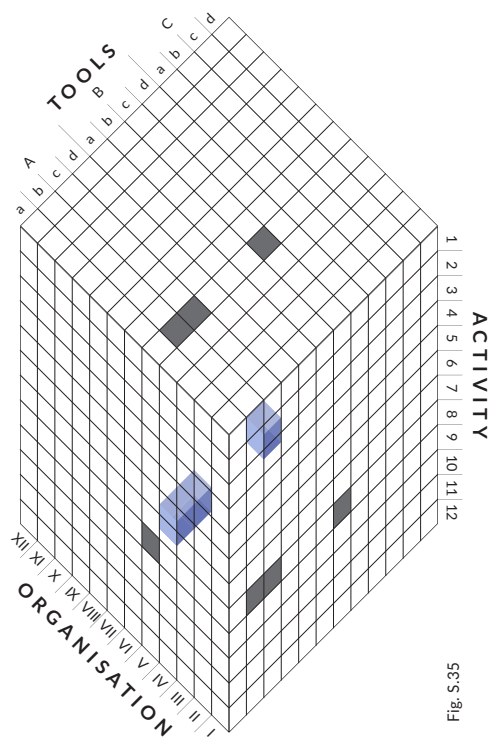
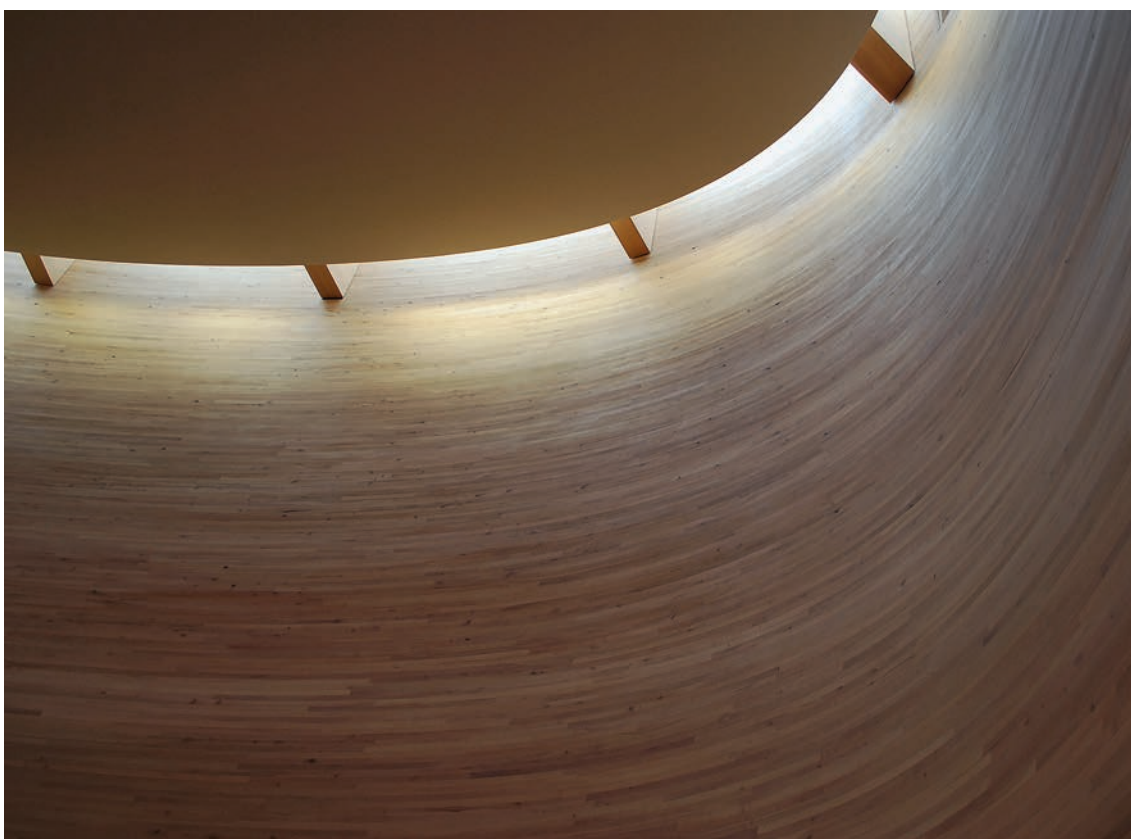


Fig. S.35



Phot. 33

V. 2.5. Scattering and Channelling (9)

In the study, scattering and channelling denotes a sequence of reflections that scatter and break light that occur in a negative or positive mass (a separate interior from the one under study, that abuts it: a channel, duct, container or light cannon) in such a way that the interior under study can be entered by properly directed rays. The channelling of light in architecture leads to the movement of light in the desired direction and scattering it within the channel. This requires the proper design of the boundaries of the interior, particularly in the form of masses (positive and negative) which have their own interiors, which often results in inventive architectural and structural solutions. The tools most often used to scatter and channel light are various masses: light cannons, light containers, ducts, channels in the structure of the interior. Channelling means the same as catching/intercepting light into a trap (an architectural tool), an entrapment of light.⁵⁷¹

Scattering and channelling involves an activity of architecture that leads to the creation of ‘derived light’, which is admitted from a neighbouring interior and that Scamozzi listed in his treatise as a separate category of light in the interior—*lume di lume*. This case occurs when a channel or duct that intercepts light and directs it into an interior is in itself a usable space (it has a size appropriate to human dimensions). *Lume di lume* is of considerable significance in creating the atmosphere of architecture: it strongly exposes the depth of space, the tempering of brightness, the mysteriousness and theatricality of an interior, which can easily be seen on seventeenth-century paintings depicting some interiors via others (for instance on Jan Vermeer’s paintings).

The classical example of this activity of architecture can be seen in the church chapel at the La Tourette monastery, where light from top from outside is channelled using light cannons. The chapel is placed to the left of the entrance to the church, namely from the north, and has several altars, each devoted to a different celebration of Holy Mass. Above the altars in the flat roof there are three light cannons in the form of three cut cones, placed under different angles, so that each could intercept a slightly different light: one intercepts north-eastern light while two others intercept north-western light. These cannons are long enough that they weaken the intensity of sunlight and direct its rays so that in the interior there forms an image of a light spot that sharply cuts off from the shaded ceiling. The scattering and channelling directs appropriate light towards the altars, to be used in liturgy, exposes the ambience of focus, of the interior’s enclosure, of mysteriousness, intimacy and creates a high projection capacity based on the illusion of the view of an enlarged Moon or the proximity of the Moon, of the cosmos, of evoking metaphysical states.

Another expressive example of channelling which does not fit the temporal scope of the case studies can be seen in the Dutch pavilion at the Giardini in Venice, built for the Art Biennale (Gerrit Thomas Rietveld, 1953). Only side light enters the interior, yet its distribution using architectural massing causes the light to enter only from the sides (using traditional glazing in the walls) but also from overhead, improving the conditions of the illumination of exhibits. Side light enters three light containers from three cardinal directions. The containers are masses within the boundaries of the interior (and thus neighbouring interiors relative to the exhibition space). Two containers are cuboid and one is in the shape of the letter L. The openwork grid of matte glass separates the interiors of the containers from the exhibition space, while also filtering and directing rays. This way, light from the side from three different cardinal directions enters the exhibition space from overhead. It is dynamic light, that changes and is variable in terms of intensity and colour tone. It exposes the slow, natural transience of sunlight over time.

⁵⁷¹ Cf. Italian: trappola di luce.

Scattering and channelling most often exposes the shape of the interior, its depth, materiality and the structure of the channelling tool, tempered darkness or tempered brightness, an ambience of intimacy, clarity or mysteriousness, of slow transience (evanescence), of ambient silence, harmony or dramatism and a projection of a foggy radiance, of metaphysicality. It often exposes the choreography of light in the interior.



Phot. 34



Phot. 35

9/ V/ Bad

Sanctuary of Merciful Love in Collevalenza, side chapel

Julio Lafuente, Collevalenza (Peruggia), Italy 1963-1967

The cylindrical interior of the chapel is entered from overhead by light from the top, scattered and channelled via a light cannon placed on the lid of the cylinder. It exposes the shape of the interior, an ambience of intimacy, clarity, focus, stasis, ambient silence, of enclosure. The high projection capacity is obtained via numerous illusions and associations linked with the meaning of light, its symbolism, the stimulation of metaphysical experiences.

scattering and channelling / top light from overhead / MASS opening, shape

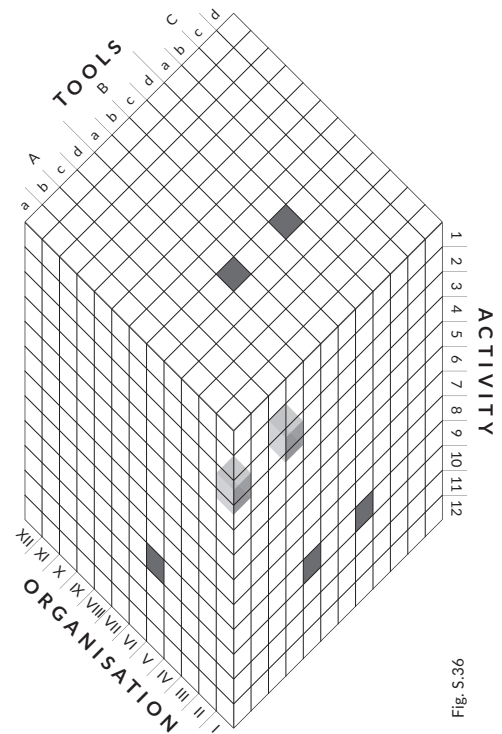
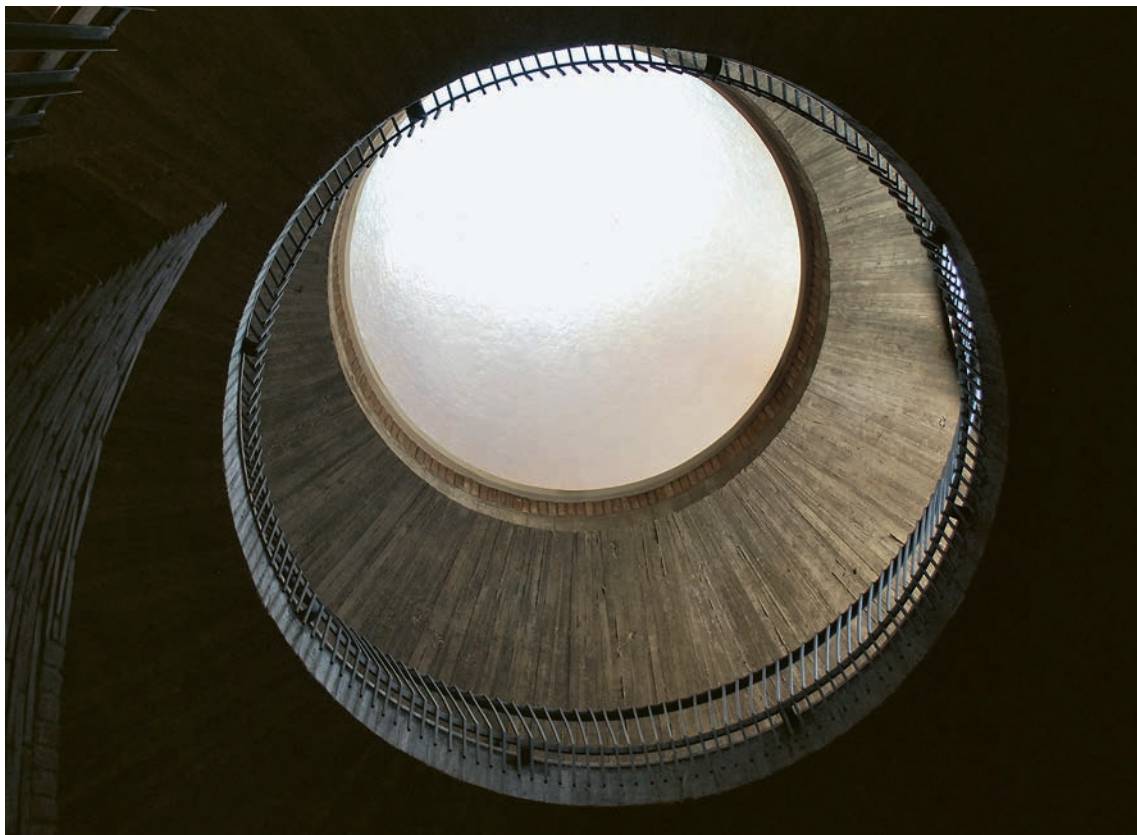


Fig. S.36



Phot. 36

9/ V/ Aa

Tapiola Church, nave
 Aarno Ruusuvuori, Tapiola, Finland 1965

scattering and channelling / top light from overhead / PARTITION, opening

Inside the presbytery, directly above the altar, is a skylight. It is formed by a glazed opening in the ceiling. The skylight intercepts top light, channels it and, having scattered it, directs it at the altar. The exposure focuses on tempered brightness, an ambience of intimacy, focus, stasis, mysteriousness, of ambient silence and a projection of a foggy radiance above the altar and of mysticism.

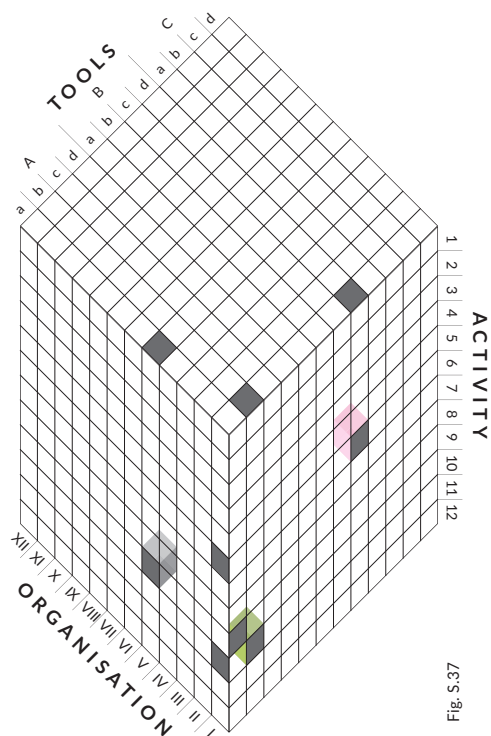


Fig. 5.37



Phot. 37

9/ I / Bacd

Laajasalo Church, nave

Kari Jarvinen & Merja Nieminen, Helsinki, Finland 2003

breaking / side light from one or several sides /
 MASS opening, material, shape

Side light from three sides is intercepted by a skylight in the form of a light container, placed in the corner of the interior as a positive mass, and then directed towards the presbytery. The exposure focuses on the shape of the presbytery, tempered brightness, an ambience of mysteriousness, silence, slow transience (evanescence) and a projection of the sprinkling of the boundaries of the interior with light, of a choreography of light.

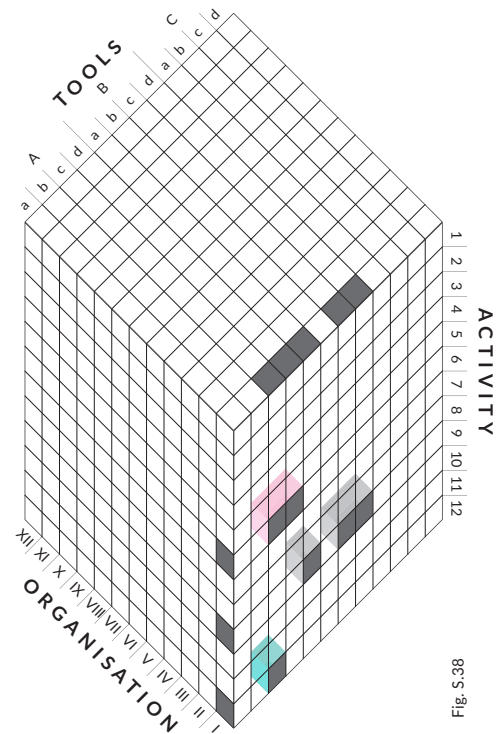


Fig. S.38



Phot. 38

9/ I /Bb

scattering and channelling / side light from one or several sides / MASS, structure

Viikki Church, nave
 Samuli Miettinen, JKMM, Helsinki 2005

Side light is intercepted by the light container hidden in the upper corner of the interior (negative mass), and from there it is directed to the centre of the nave. The exposure focuses on the shape of the presbytery, tempered brightness, the ambience of mysteriousness, silence, slow transience (evanescence) and the projection of a foggy radiance, of the choreography of light.

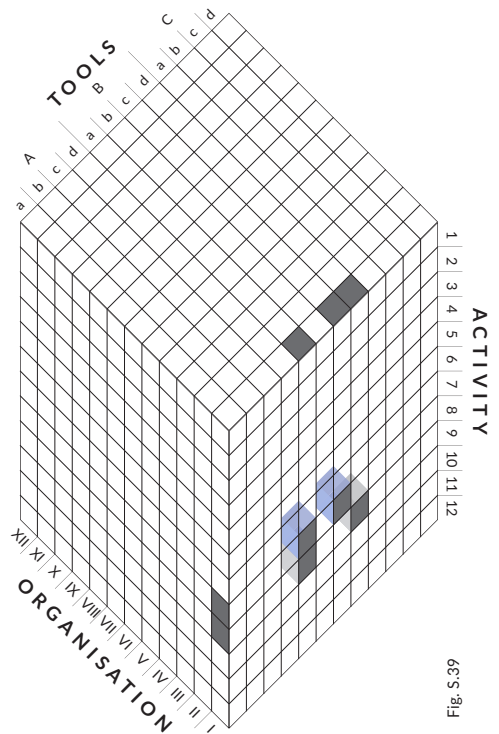


Fig. S.36



Phot. 39

V. 3. Filtering

[10) sifting, 11) refraction, 12) absorption]

Filtering is an activity of architecture based on intercepting light via an architectural filter, an architectural tool that only lets through a portion of the light that falls on it from outside or only a portion of the light spectrum, while either storing the remaining rays or the remaining portion of the light spectrum as its own energy or reflecting it back outside. Filtering is a traditional method of changing the intensity and quality of light that enters the interior. Depending on the type of filter, it is based on sifting, refraction or absorption of some of the rays (in extreme cases it denotes the complete absorption of light). It exposes the structure of the filter, producing such sensory experiences like: the vividity and multiplication of the filter's effect, the blurring of the visibility of actual materials and shapes of the interior, an ambience of unclarity, ambiguousness, immateriality, of isolation, of the variability of the interior. The high projection capacity caused by it is based on producing numerous illusions and associations. Depending on filter type, two types of exposure were distinguished. In the first—the exposure focuses on the contrast between the shadow and light, the ambience of breaking up, a projection based on an illusion of breaking up, diffusion, the atomisation of the interior. In the second, the exposure highlights the darkening of the interior, an ambience of dim light, of tempered brightness, of mysteriousness and projection capacity based on an illusion of smoke, fogginess and cloudiness in the interior.

V. 3.1. Sifting (10)

The distinction between carving and sifting is based on the size and number of openings in relation to the size of the interior and human dimensions. The objective of sifting light is to weaken its intensity, to partially isolate and cover the interior (*mashrabiya*), to create in it a fleeting and time-variable ornament from spots of light and shadow, the dematerialisation of its boundaries. This activity is traditionally used in Mediterranean and oriental architecture. It results in light becoming reduced, and the filter itself is exposed: its structure and material. The following impressiveness is induced: the vividity of the filter structure, the shading of the view of actual materials and shapes of the interior, the vividity of contrasts between light and shadow. The exposure highlights the ambience of a partial separation (but not enclosure), unclarity, of breaking up, ambiguousness, the intangibility of the interior and a projection based on numerous illusions, for instance those of falling rain or snow, of a starry sky, of a kaleidoscopic pattern, of atomisation.

Le Corbusier was a master of filter light using screens and openwork partitions (*brise-soleils*). At the La Tourette monastery, he equipped the monks with loggias secured by balustrades in the form of a concrete grate. The square openings perforated in the concrete have a vertically and horizontally irregular layout, and the light that goes through them exposes the three-dimensionality of the grate, its massiveness and its function as a partition. Meanwhile, in the Notre-Dame du Haut Chapel in Ronchamp, the southern wall (slightly bent to the west) is perforated with rectangular openings of varying size and proportions, with splays directed towards the inside or outside. In this case, the openwork of the sieve has a freeform composition: the windows are not placed along a single line either horizontally or vertically. This sifting of light exposes the impressiveness of the breaking up of the interior, dramatism, organic freedom, variance over time, unclarity and mysteriousness as well as high projection capacity, which induces illusions, associations with the cosmos and the symbolism of light.

10/ I/ Ab

Tapiola Church, nave
 Aarno Ruusuvuori, Tapiola, Finland 1965

Side light enters the interior through a window in the upper part of the southern wall (opposite the altar). The window, with vertical and horizontal divisions, is equipped with a transparent glass pane and a massive concrete grate—the tool that sifts light. This grate repeats the divisions of the window: the horizontal ones are narrower and denser than the vertical ones. The rays that enter the interior are sifted through the grate and reach the opposite altar wall, casting a reflex of regular light spots. This effect is possible due to the low solar orbits in Finland. It exposes the image of the light reflection and the structure of the filter, the contrast between spots of light and shadow, tempered darkness, materiality, an ambience of mysteriousness, dramatism, transience (evanescence). Breaking up, diversity. The high projection capacity obtained via the illusion of a light ornament on the wall, associations with symbolism and the choreography of light.

sifting / side light from one or several sides /
 PARTITION structure

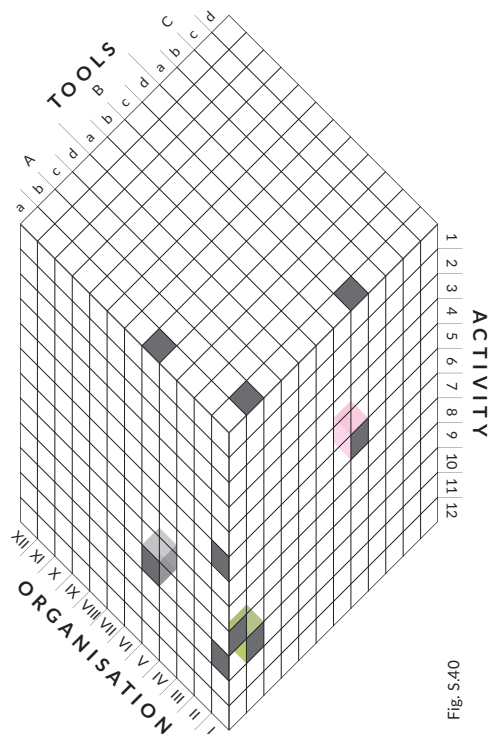


Fig. 5.40



Phot. 40

10/ I, IX/ Aa

Malmi Church, nave

Kristian Gullichsen, Malmi, Helsinki, Finland 1981

The interior of the church is entered by rays of side and top light and side light sifted by the curtain of the wall suspended between the nave and presbytery. The light that enters through it into the interior of the nave appears more intense than it actually is due to the contrast between the brighter presbytery relative to the darker nave. The exposure focuses on the light reflex and the structure of the filter, the contrast between light and shadow, tempered darkness, an ambience of dramatism, mysteriousness and a high projection capacity, based on associations with the glow of a constellation on the night sky, for instance a fragment of *Orion's Belt* (due to the row of openings in the sieve).

sifting / side light from one or several sides,
side and top light from one or several sides /
PARTITION opening

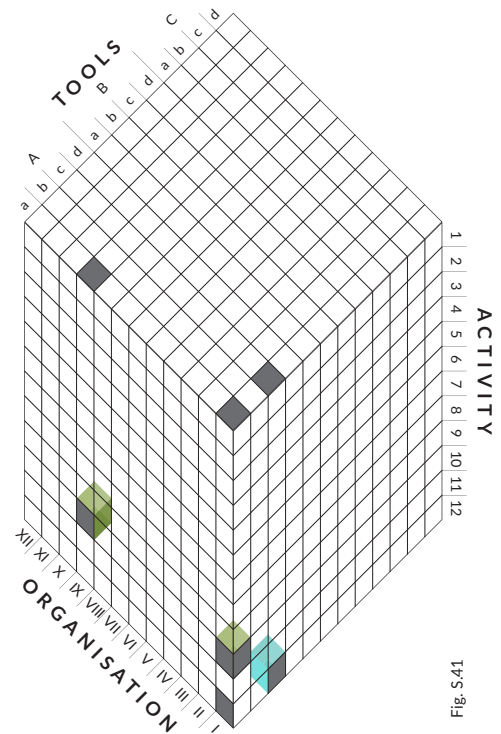
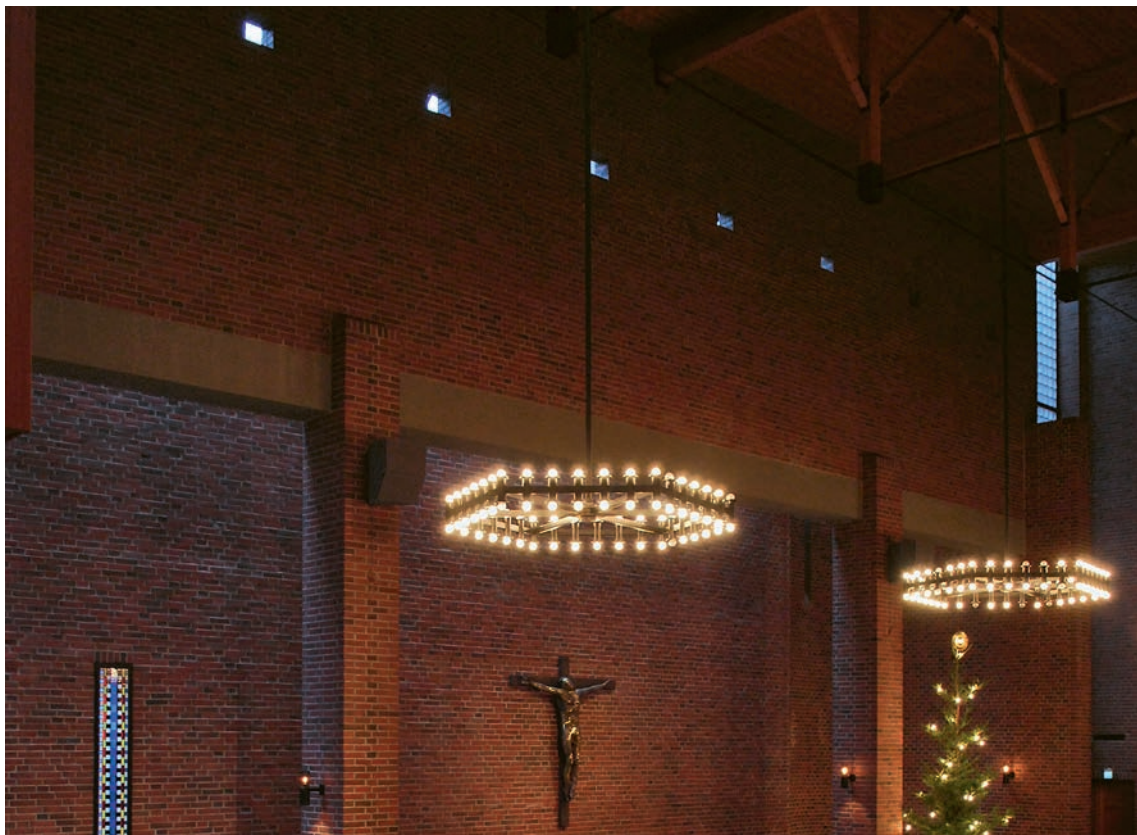


Fig. S45
175



Phot. 41

10/ I/ Ab

Arab World Institute, hallway
Jean Nouvel, Paris, France 1987

Light from the side enters the interior from the south via an openwork wall that is equipped with apparatuses that control the mechanisms of the opening and closing of apertures under the effect of light (similarly as in a photographic camera). The sifted light forms countless patterns of shadow and light reflections on the interior's boundary, forming geometric abstractions of various forms: squares, circles and hexagons. The exposure highlights the image of the reflection of light and the structure of the filter, the contrast of light and shadow spots, the ambience of breaking up, dynamism, variability, of isolation, unclarity, tension, dramatism, ambiguity and fleetingness. The high projection capacity is based on producing an illusion of a changing, travelling ornament of the interior, and associations with the effect of a *mashrabiya*, a starry sky and a kaleidoscope.

sifting / side light from one or several sides /
PARTITION structure

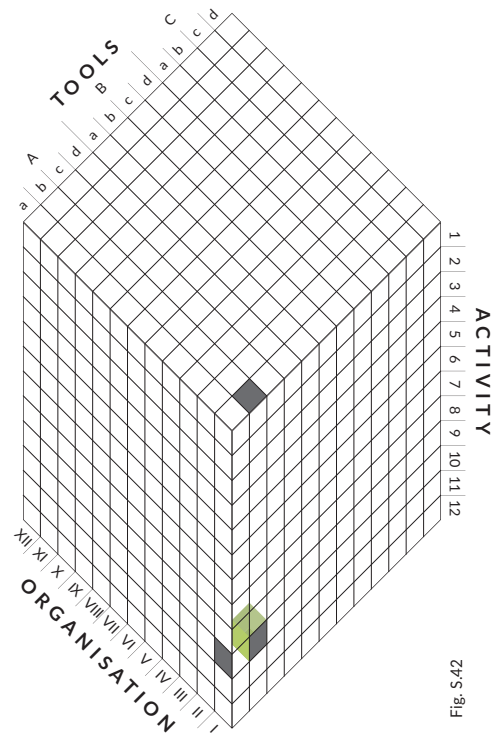
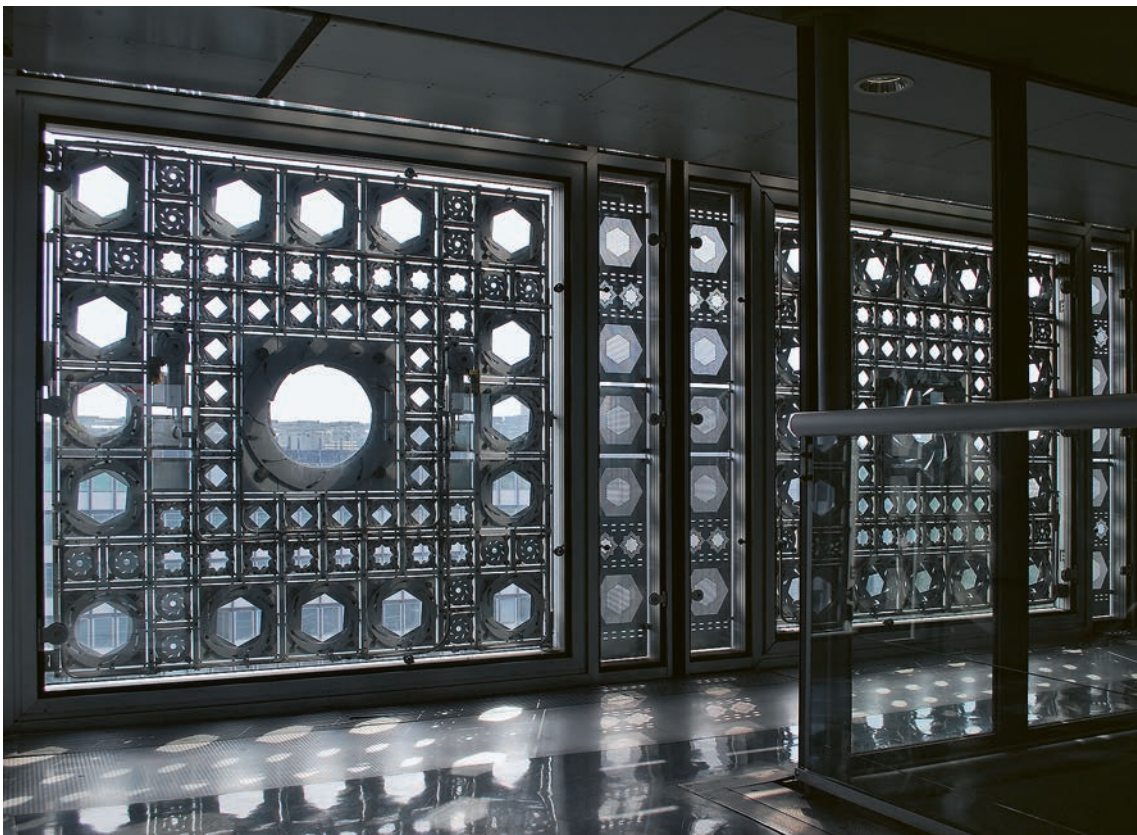


Fig. 5.42



Phot. 42

10/ I/ Ab

Biuro Architekt Kaczmarczyk Studio, first hall on the ground floor

Biuro Architekt Kaczmarczyk, Sucha Beskidzka, Poland 2000–2006

Sunlight enters the interior of the studio from the south, sifted through an openwork wall from wooden laths and translucent glass. As a result, the brightness of the interior is highly tempered and the surfaces of the partitions host a projection of an ornament of light and shadow. The exposure highlights the image of the light's reflections and the filter structure, the contrast of spots of light and shadow, dynamism, transience (evanescence), an ambience of diffusion, separation, materiality, dramatism, ambiguity, fleetingness. The projection capacity is based on producing an illusion of a complex ornament of the interior and associations with a forest.

sifting / side light from one or several sides /
PARTITION structure

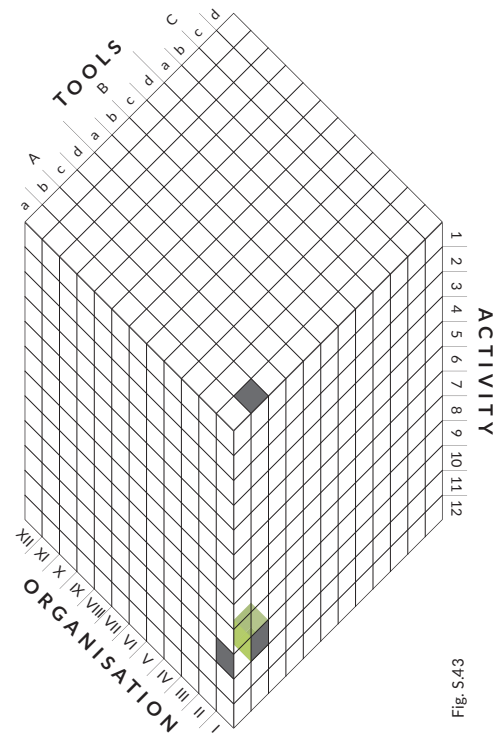


Fig. S43



Phot. 43

10/ I/ Ab

Museum of Stone, 'Stone-Water' gallery
 Kengo Kuma, Nasu, Japan 2000

Light enters the interior of the gallery via a filter in the form of an openwork wall structure made from *Ashino* stone. The openings in the wall have a rhythmical and regular composition, which means that the pattern of light reflections is rhythmical and melodic. The exposure highlights the image of the reflection of light and the filter structure, the contrast of spots of light and shadow, the ambience of isolation, transience (evanescence), unclarity, tension, dramatism, ambiguity, fleet-ingness. The projection capacity is based on evoking an illusion of a complex ornament of the interior and its relevant associations.

sifting / side light from one or several sides /
 PARTITION structure

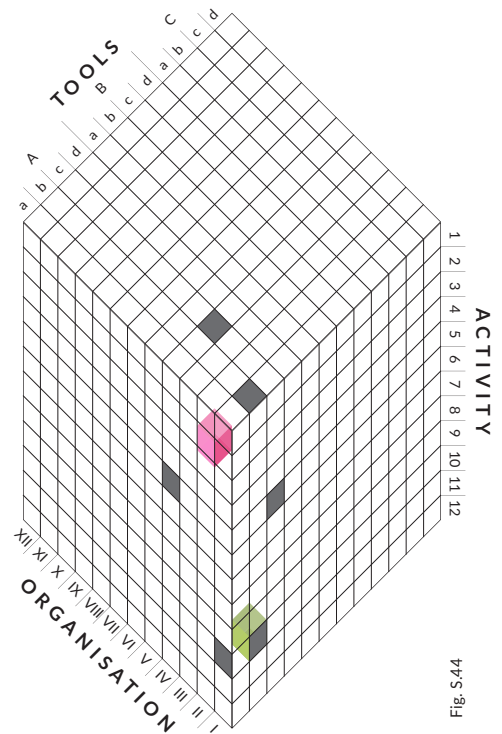


Fig. 5.44



Phot. 44

10/ I, IX / Ab

Hiroshige Andō Museum, foyer
Kengo Kuma, Bato, Japan 2000

The interior is entered by light from the side and light from the side and top sifted through nets made from Japanese redwood laths. They form wall layers from the side of the nearby bamboo garden and a layer of roof surfaces. The interior exposes the pattern of strips of light and shadow that overlap and the elements of the interior, blurring its actual shape. The exposure highlights the structure of the filter, tempered brightness, an ambience of tension, diffusion, dynamism, transience (evanescence), separation, fleetingness, lightness, complexity, ambiguity, mysteriousness. The projection capacity is based primarily on producing a strong impression of heavy rain of light or shadow.

sifting / side light from one or several sides, light from the side and top from one or several sides / PARTITION structure

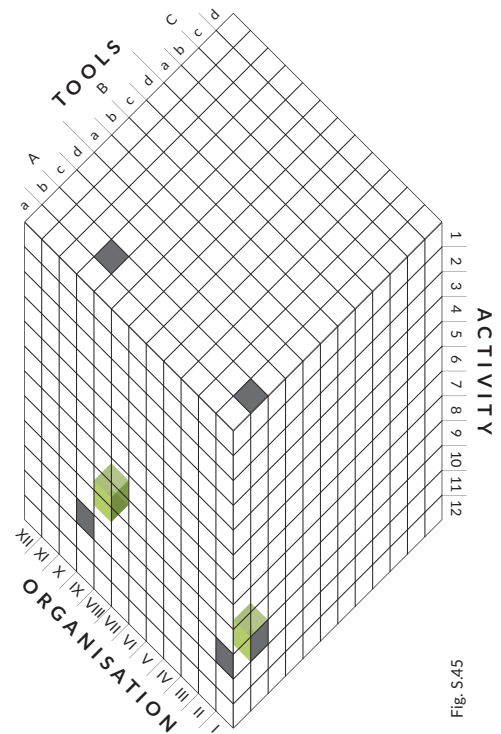


Fig. S45



Phot. 45

10/ IX/ Ab

sifting / light from the side and top from one or several sides / PARTITION structure

Hiroshige Andō Museum, arcade interior
Kengo Kuma, Bato, Japan 2000

Light from the top enters the interior of the arcade from overhead, sifted by an openwork structure of the diagonal eave surface. The exposure highlights the filter structure, tempered brightness, an ambience of breaking up, separation, fleetingness, lightness, ambiguity. The projection capacity of the atmosphere is based on producing illusions of a heavy rain of light or shadow.

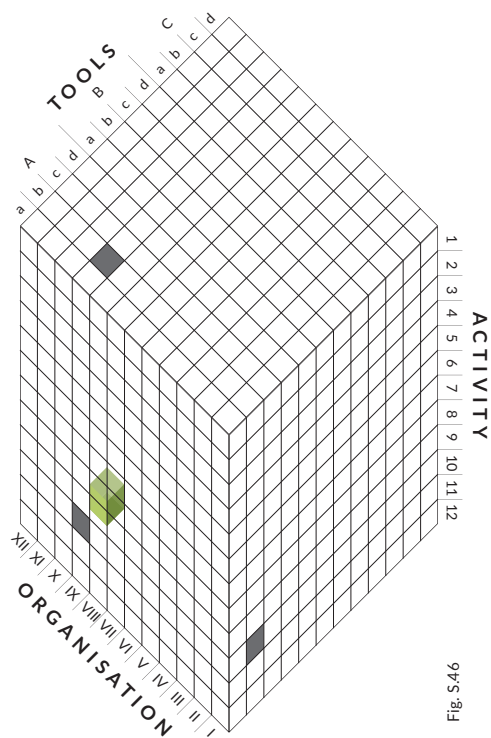


Fig. 5.46



Phot. 46

10/ I, IX / Ab

Nasu Historical Museum, exhibition space

Kengo Kuma, Nasu, Japan 2000

Light from the side and light from the top enters the interior sifted through filters in the form of aluminium mesh panels and straw. The panels are placed inside the interior, in front of walls and on the surfaces of a gabled roof. The meshes have different widths and a ruddy colour. The exposure highlights the structure of the filter, tempered brightness, the softness of the material, materiality (the austerity of the material), an ambience of breaking up, dynamism, transience (evanescence), separation, fleetingness, lightness, complexity, ambiguity. The projection capacity is based on theatricality (framing views), and associations produced by the rusty colour of the interior that changes over time.

sifting / side light from one or several sides, light from the side and top from one or several sides / PARTITION structure

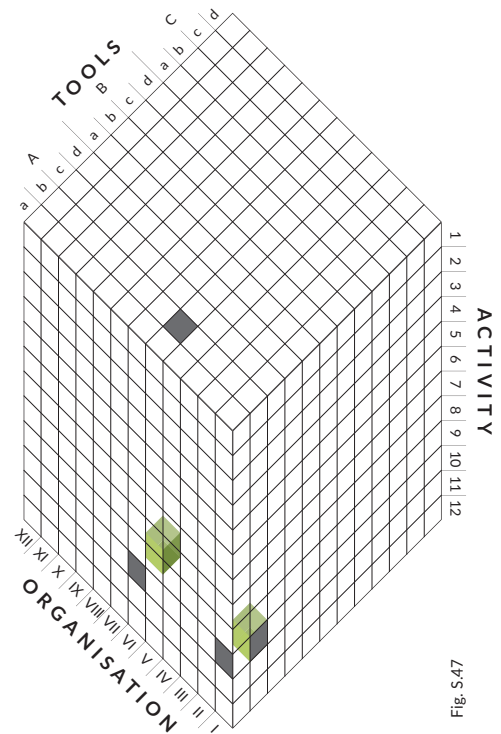


Fig. S.47



Phot. 47

10 / I/ Ab

Chokkura Plaza, pavilion interior
 Kengo Kuma, Takanezawa (Tochigi prefecture) Japan 2006

Side light enters the interior after being filtered by an openwork wall. A steel mesh filled with a structure of *Oya* stone blocks sifts direct rays producing a distinct pattern of shadowy, rhomboid spots. The relationship between the structure of the wall with light exposes the openwork of the wall and the thickness of the stone blocks and thus the three-dimensionality of the wall. The exposure highlights the materiality of the interior, its shape, the porosity of stone, the contrast of light and shadow, the filter structure, tempered brightness, the porosity of the material, an ambience of breaking up, separation, of transience (evanescence), dynamism, fleetingness, complexity, ambiguousness. The projection capacity is based on producing an illusion of diffusion, atomisation and the appearance of the interior's softness.

sifting / side light from one or several sides /
 PARTITION structure

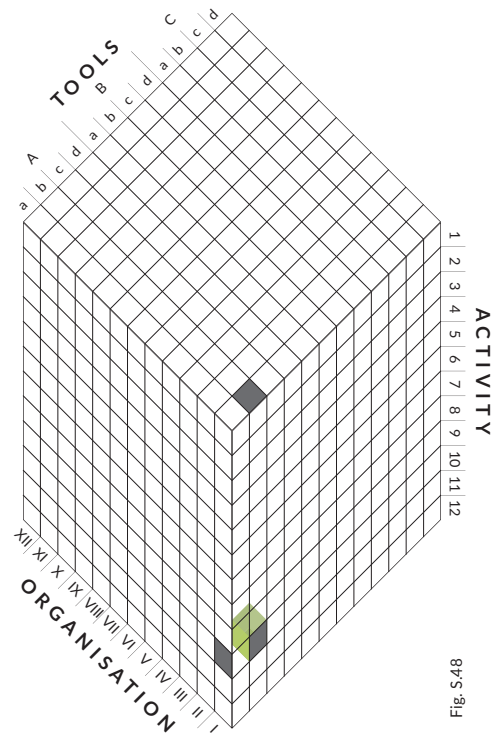


Fig. 5.48



Phot. 48

10/ I/ Ab

Kolumba Museum, interior of the church ruins exhibition

Peter Zumthor, Cologne, Germany 2007

The interior is entered by light from the side sifted through an openwork wall made of brick. The openings between the bricks are present in two layers of wall, separated by a gap. In the view from inside they can overlap either completely, partially or not overlap at all, yet they always open towards the gap inside the wall, which is slightly brightened. Thanks to this, the person in the interior can perceive a change in the configuration of the overlapping wall layers with even the slightest tilt of the head. The most illuminated fragment of the interior is located in its upper, south-eastern corner. The exposure highlights the contrast between light and shadow, the freedom of the formation, the structure of the filter, tempered darkness, materiality, an ambience of mysteriousness, of transience (evanescence), separation, fleetingness, delicateness, freedom, complexity, ambiguity, softness. The projection capacity is based on producing the impression of shimmering stars on a starry sky.

sifting / side light from one or several sides /
PARTITION structure

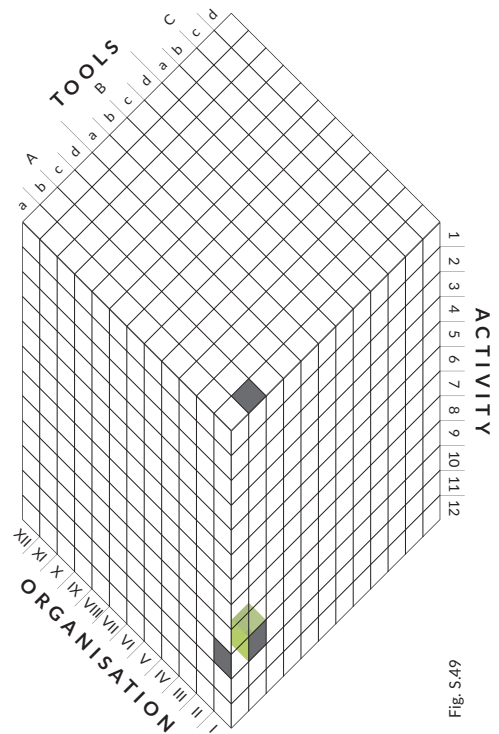


Fig. 549



Phot. 49

10/ VI/ Ab

Capitol Hotel Tokyu, architectural complex
 Kengo Kuma, Tokyo, Japan 2010

The interior of the architectural complex formed by the foyer of the hotel, a corridor that leads to a separate restaurant building and the wall of the restaurant is entered from the side by light from the top, sifted through an openwork structure that is fitted to the restaurant wall. The openwork of the wall resembles a pattern of a stretched checkerboard. The exposure highlights the contrast between light and shadow, the checkerboard pattern of the structure of the filter, tempered brightness, materiality, an ambience of separation, variability over time, dynamism, complexity, ambiguity. Projection capacity is based on producing an impression of the interior being broken up and of atomisation.

sifting / light from the top from one or several sides / PARTITION structure

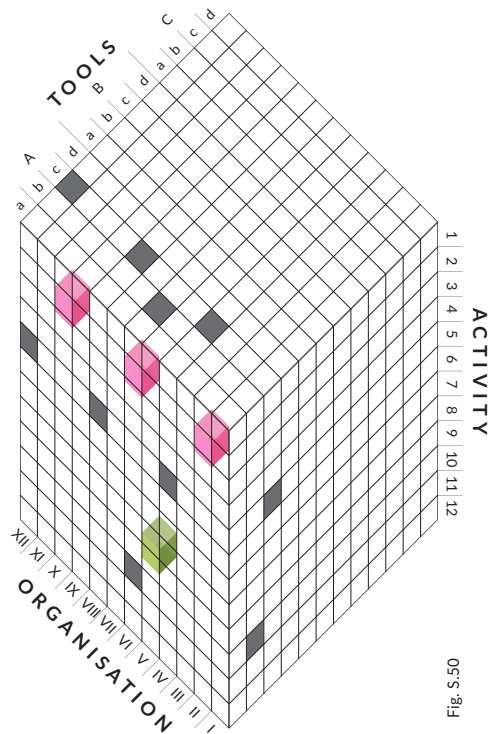


Fig. 5.50



Phot. 50

10/ I/ Ab

Capitol Hotel Tokyu, foyer interior
 Kengo Kuma, Tokyo, Japan 2010

sifting / side light from one or several sides /
 PARTITION structure

In the foyer interior, on its translucent glass wall, there is a permanently affixed mesh that sifts light from the side from the courtyard with the water. The exposure highlights the delicate filter structure, tempered brightness, materiality, an ambience of complexity, of transience (evanescence), dynamism. The projection capacity is based on producing illusions and associations of a pointist image.

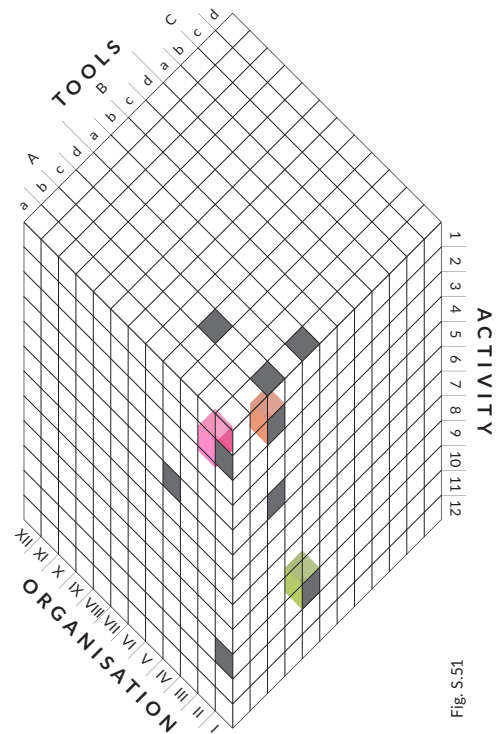
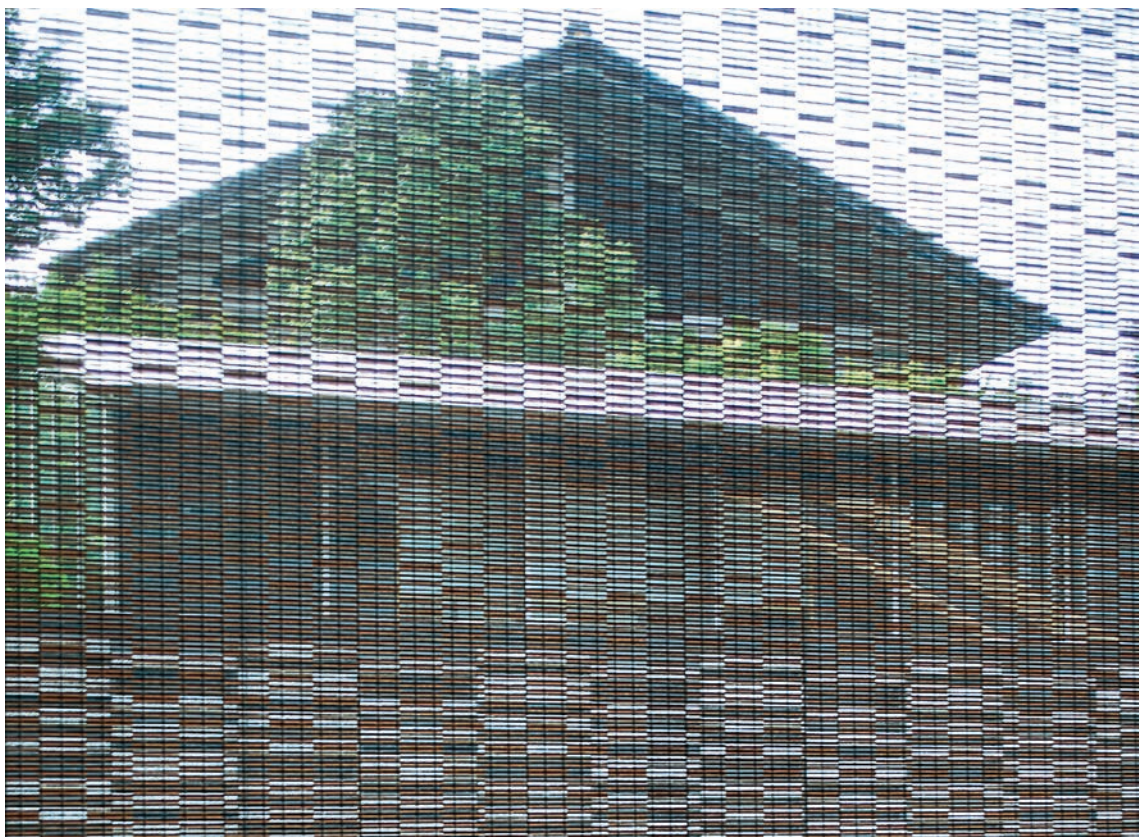


Fig.S.51



Phot. 51

10/ I/ Ab

Wyspiański Information and Exhibition Pavilion 2000,
ground-floor foyer

Ingarden & Ewý Architekci, Krakow, Poland 2007

Light from the side enters the interior of the foyer from several sides sifted by an openwork structure that is a fragment of the wall layer. The structure is made from ceramic blocks suspended on steel rods. The exposure highlights the contrast of light and shadow, the pattern of the filter structure, tempered brightness, materiality, an ambience of separation of transience (evanescence), dynamism, breaking up, complexity, ambiguity. The projection capacity is based on producing illusions of a travelling, fleeting ornament and of atomisation.

sifting / light from the side from one or several
sides / PARTITION structure

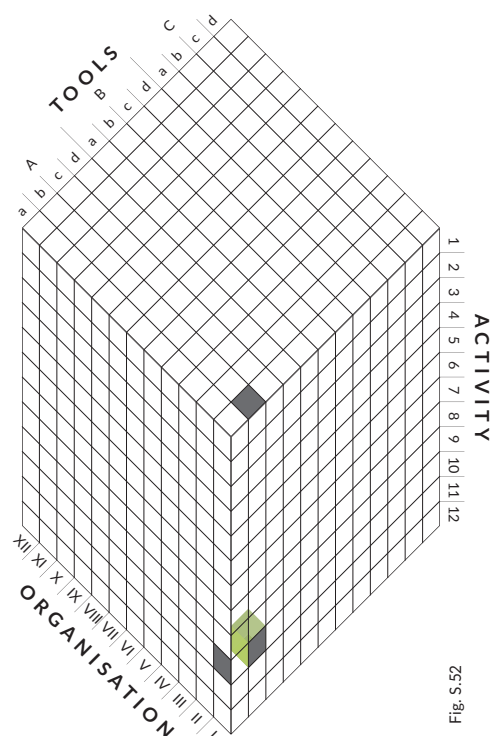


Fig. 5.52



Phot. 52

10/ V/ Ab

Louvre Lens Museum, foyer
 SANAA, Lens, France 2009-2012

The interior is entered by light from the top from overhead, sifted by an openwork structure underneath a skylight. The distance between the elements of the structure and their proportions result in both carving and sifting, which is denoted by the reflection of light on the floor, distinct for this activity of architecture. The exposure highlights the structure of the filter, a delicate ornament of light and shadow, an ambience of separation, complexity, dynamism.

sifting / light from the top from overhead /
 PARTITION structure

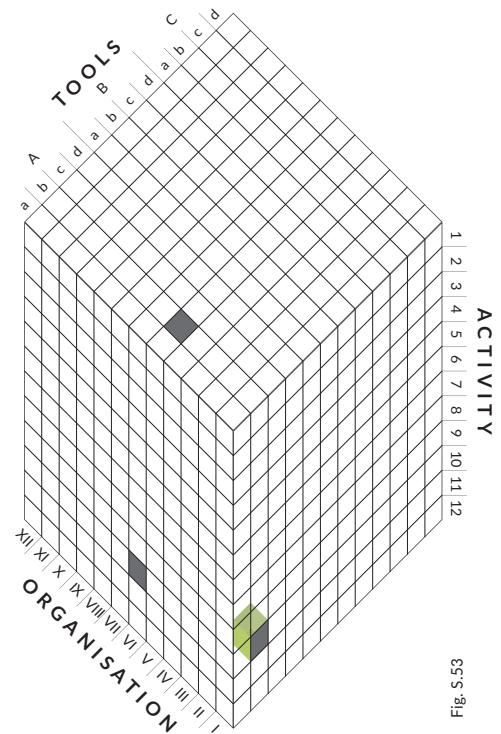


Fig. S.53



Phot. 53

10/ II, V, X/ Ab

Fondation Louis Vuitton, terrace
 Frank Gehry, Paris, France 2014

Light from the side, light from the top and light from the side and top enters from all sides and is sifted by structures in the form of curved wooden, steel and glass sails. The sifting reduces the intensity of light in the interior. The exposure highlights the contrast of light and shadow, the filter structure, the filter material, tempered brightness, an ambience of tension, separation, complexity, ambiguity, unclarity, dynamism and a projection of the atmosphere based on producing the appearance of the breaking up of the interior, its atomisation and the choreography of light.

sifting / side light from all sides, light from the top from overhead, light from the side and top from all sides / PARTITION structure

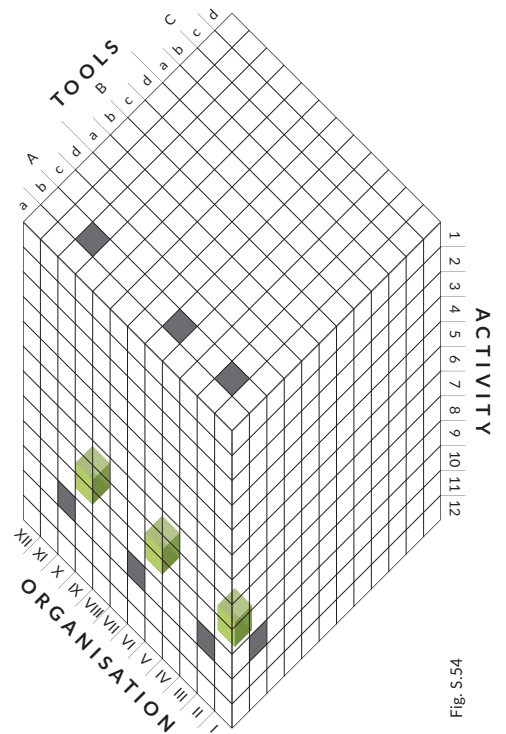


Fig. 5.54



Phot. 54

10/ II, V, X/ Ab

Fondation Luis Vuitton, vertical circulation space
 Frank Gehry, Paris, France 2014

Light from the side, light from the top and light from the side and top enters the space of vertical circulation from all sides and from overhead, sifted by partition structures in the form of curved sails from wood, glass and steel. The sifted rays result in spots of light on the steps of stairs and make the interior dynamic. The exposure highlights the contrast of light and shadow, the filter structure, tempered brightness, an ambience of tension, separation, transience, complexity, movement, ambiguousness, unclarity, dynamism. The projection capacity of the atmosphere is based on producing an appearance of diffusion, of the atomisation of the interior and a vivid choreography of light.

sifting / side light from all sides, light from the top from overhead, light from the side and top from all sides / PARTITION structure

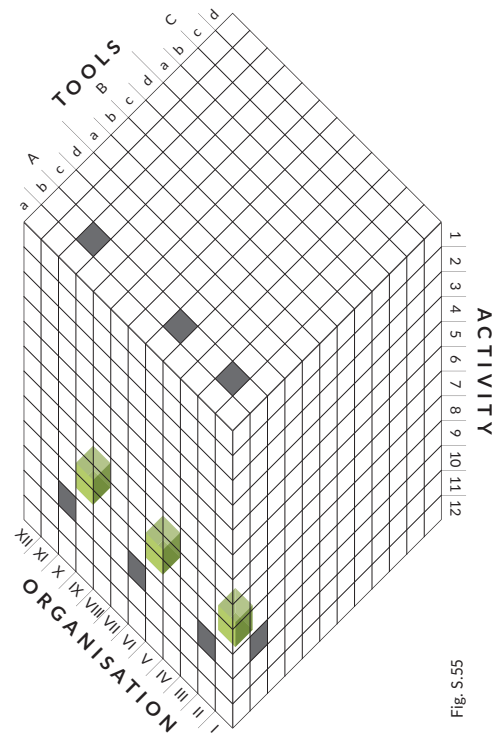


Fig. S.55



Phot. 55

V. 3.2. Refraction (11)

Due to the activity of refraction, the interior is entered by rays of light that travel through a layer comprised of a different optical medium that refracts them, which forms a specific refraction filter—a refraction tool. In such an interior, this filter can be formed by a layer of material that blocks rays, which is located in the boundary or within the space of the interior (it can be a layer of gas). If the refracting filter is not a prism, the rays of light, after passing through it, return to their starting direction after being shifted. If the refraction layer is a prism, the dispersion scatters white light into a colourful spectrum.

For humans to be able to observe refraction, the material that refracts the rays must be translucent (with an absorption index close to zero), as otherwise the view of the refraction of the rays will become blurred by the absorption of rays inside the material. Filters that refract light are typically made of a layer of glass or water that is properly shaped within the boundaries of the interior, but they can also be made of a layer of gas with parameters that distinguish it in a space as a different optical medium, for instance hot gas above tarmac on a hot day. The impressiveness achieved by refraction is: distortions of views from outside, mirages, a vividness of the density of the refracting filter matter, tempered brightness. The atmosphere of the interior builds an ambience of bewilderment, surprise, uncertainty, as well as intimacy and enclosure. Due to the ability to refract light, refraction can enhance the interior with an atmosphere that has a mystical ambience. The high projection capacity of this atmosphere arises from the type of refracting filter—the illusion of being enclosed in a translucent liquid, of the melting of air or immersion in a rainbow.

Refraction was used by Leonardo Erlich in the installation *The Swimming Pool* (2004), displayed at, among others, the Twenty-First Century Art. Museum in Kanazawa, Japan. In this installation, solar rays refract in a thick layer of translucent glass that forms a horizontal partition between an upper and lower level, which is entered without any constraint by rays directly from the celestial sphere. People in both interiors see light refracted in the glass layer and themselves in a distinct distortion. This resembles the effect of the refraction of light by a layer of water, such as a swimming pool. As a result of these appearances and associations, observers on one side of the glass experience the illusion that people and objects on the other side are located in a pool of water.

Architecture features examples of the use of an actual pool or aquarium as an interior boundary (wall, ceiling, floor). There are also projects with pools that have a partially translucent boundary that is linked with the massing of the house. The interior for which a translucent water tank is a ceiling (or deck), sunlight enters after being refracted in the water layer, producing a distinct distortion of the view on the other side of the tank. Examples of such houses include the Jellyfish House (Meduse house) in Spain, designed by Wiel Arets architects (design: 1998–2001, construction: 2013). The pool, with a translucent boundary in the roof of the house, is a refraction filter, that comprises different elements of interior boundaries in each space of the house (a wall, a floor, a ceiling). For the interior of the terrace, it is a ceiling, and it is entered from overhead by refracted light that was originally light from the top and light from the side and top. Refraction exposes the distorted view of the surroundings on the other side of the pool.

V. 3.3. Absorption (12)

Absorption is a form of filtering based on the filter absorbing a specific form of radiation (light waves) from the light that is projected towards it, regardless of the type of filter. One example of this activity is the absorption of a part of the light spectrum by stained-glass windows. A piece of stained glass lets through a light wave only with a specific colour that it is ascribed, while other waves (with their corresponding colours) are absorbed. In this manner, the stained-glass window absorbs a considerable portion of the light spectrum, selecting light and reducing its intensity in the interior.

Light is also absorbed by colourless and semi-transparent materials (such as matte glass), which absorb a portion of the rays and reduce the intensity of light that passes into the interior. Likewise, gas in the space of the interior or the structure of its boundary can absorb a part of the rays, producing an impression of a cloudiness of the interior and weakening the ability or making it impossible to see outside. In extreme cases, filters absorb all of the light and none of its can enter the interior. The capacity to absorb light by absorbent materials is defined by their light absorption coefficient.

Absorption exposes the material of the filter in the interior and blurs the visibility of the exterior depending on filter type it can alter the colour of the interior or its part, its temperature and intensity. It leads to densification of darkness and the tempering of brightness in the interior. It produces an atmosphere with a ambience of ambiguity, unclarity, that is immaterial, enclosed, intimate, darkened, where light is dimmed. A coloured filter enhances the impression of the interior being broken up, diverse, atomised and magical. It creates a high projection capacity of atmosphere as a result of a wealth of all forms of illusions and associations, which stimulate the human imagination through colourful light reflections and the dimming of the interior. Numerous associations pertain to the symbolism of light and the cosmos.

The absorption of light by a stained-glass window is an activity of architecture that is used to produce an atmosphere of the sacred. The effect of the coloration of sunlight in the interior produces an immediate and powerful physical effect that shapes human sensory experiences and affects mood, the imagination and the symbolic reading of architecture. The exposure of a stained-glass window also highlights the proportions and shape of the interior, such as the slenderness of a Gothic cathedral's nave, which can enhance the atmosphere of the sacred. The effect of stained-glass windows is enhanced by the orientation of cathedrals, which allows spectacular radiance of coloured windows: in the apse—by rays of the rising sun and above the entrance—with the warm rays of the setting sun. This is how western light exposes the stained-glass window by Stanisław Wyspiański entitled *God the Father* (completed in 1904) in the interior of the Basilica of the Order of St Francis in Krakow.

Likewise, in contemporary interiors we can see the use of the stained-glass window to build an atmosphere of the sacred. In the Notre-Dame du Haut chapel in Ronchamp the openwork concrete wall and glass form a giant stained-glass window.

Contemporary interiors more typically use the absorption of light by colourless, semi-translucent materials. This can be seen in buildings intended for the exhibition of art, in religious interiors or in sanitary interiors.

Light filtered by absorption produces a different atmosphere in the interior than refracted light. It can momentarily be direct, side and dynamic. Filtering allows increasing the dynamic of the atmosphere of the interior, obtaining a beam of light in it, including a coloured one, and the exposure of transience (evanescence) and the choreography of light.

12/ I/ Ac

absorption / light from the side from one or several sides / PARTITION material

Sanctuary of Merciful Love in Collevaleza, church nave
 Julio Lafuente, Collevaleza (Peruggia), Italy 1963-1967

The church interior is entered by side light, filtered by a coloured stained-glass window. The exposure highlights the decorative character of the filter, tempered darkness inside, the ambience of intimacy, of the interior's illumination, fleetingness, variability. Projection capacity is based on illusions and associations produced by fleeting reflections of coloured lights, which travel along the boundaries of the interior.

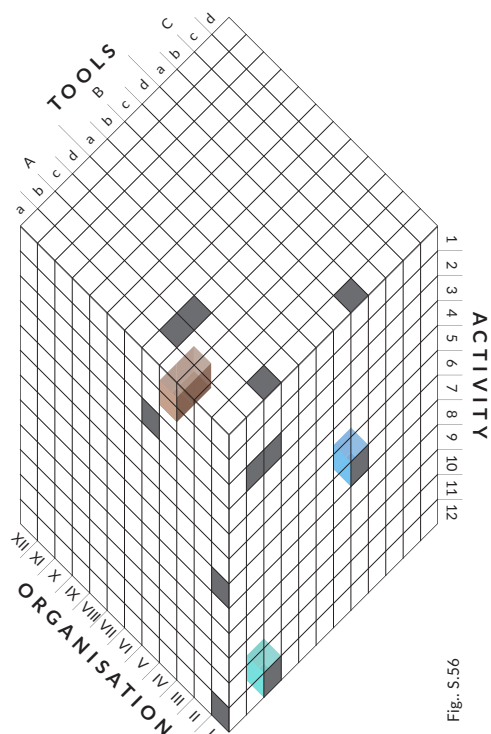
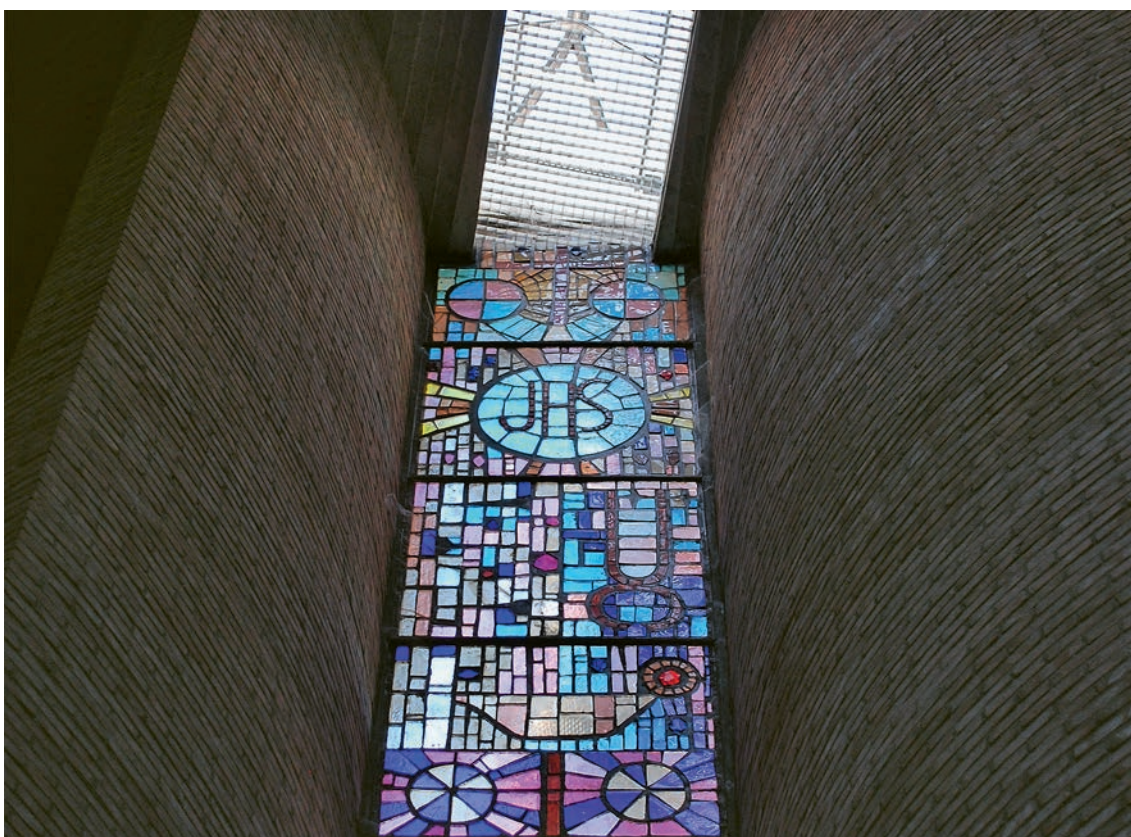


Fig.: S.56



Phot.: 56

12/ I/ Ac

Malmi Church, nave

Kristian Gullichsen, Malmi, Helsinki, Finland 1981

Side light enters the interior via the presbytery through a coloured stained-glass window in the altar wall. The coloured reflections of light form a subtle ornament of a dark interior. The exposure highlights the stained-glass window as an ornament, tempered darkness in the interior, an ambience of intimacy, of the illumination of the interior, of variability over time. The projection capacity is based on illusions and associations, produced by fleeting reflections of coloured lights that move along the boundaries of the interior.

absorption / side light from one or several sides) /
PARTITION material

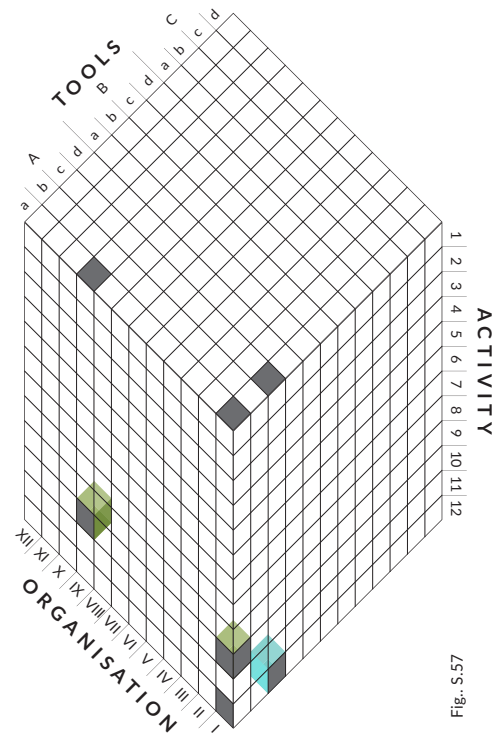


Fig.-S.57



Phot. 57

12/ I/ Ac

Museum of Stone, 'Stone-Light' gallery
Kengo Kuma, Nasu, Japan 2000

Inside the 'Stone-Light' gallery, side rays are absorbed by a layer of Carrara marble that is six millimetres thick, placed in the openings of an openwork wall.⁵⁷² Because of this, the interior is entered by filtered light. The sunlight passes through the structure of the marble and exposes its veins. The marble is exposed as an ornament of the interior, as is tempered darkness in the interior, an ambience of intimacy, calmness, of the illumination of the interior, of slow transience, dynamism, fleetingness. The projection capacity is based on an illusion of the softness of light, its dimness and the blurring of the shapes of interior boundaries and on associations produced by these illusions.

⁵⁷² Filling in window openings with a thin layer of marble was often used in early Christian basilicas.

absorption / light from the side from one or several sides / PARTITION material

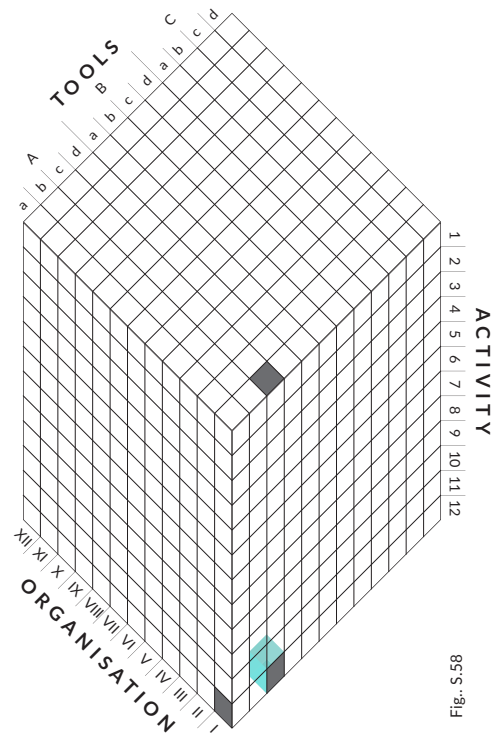


Fig.: S.58



Phot.: 58

12/ I/ Ac

Laajasalo Church, nave

Järvinen & Nieminen, Helsinki, Finland 2003

The interior of the church is entered by side light from the side of the altar wall via a slit where it is filtered by a thick layer of matte and vividly formed glass. The exposure highlights the dimmed light as the ornament of the interior, the tempered brightness of the interior, an ambience of intimacy, calmness, of illumination. The projection capacity is based on illusions and associations produced by the impression of the softness of light, its dimming, haziness, densification and dilution as if it were a liquid.

absorption / side light from one or more sides /
PARTITION material

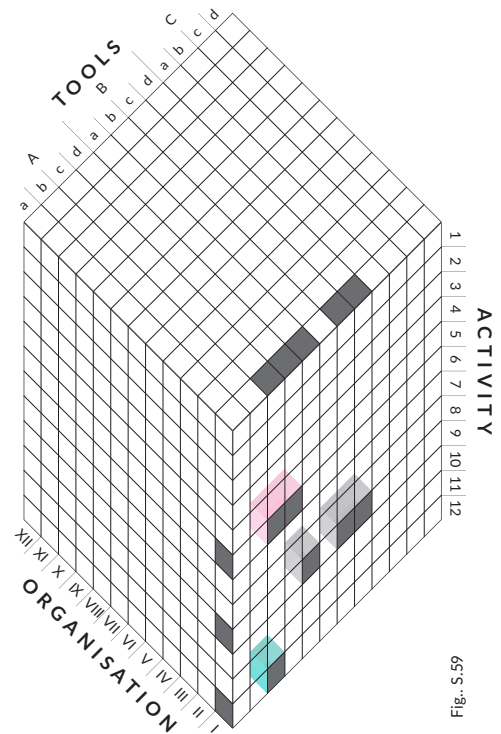


Fig.-S.59



Phot.-59

12/ V, XI/ Ac

LVMH ONE Omotesando, urban interior
 Kengo Kuma, Tokyo, Japan 2004

The roofing of the urban interior in front of a shop window is a container with semi-translucent walls from the top, from one side facing a street with trees and from below. This allows the interior to be entered by light from the top and light from the side and top from above after being filtered by the roof of the interior. The filter that absorbs light is the material of the roof: layers of malachite between two layers of translucent light. The exposure highlights the colourful light as an ornament of the interior, the softness of light, an ambience of astonishment, complexity, intimacy, of breaking up, unclarity, ambiguousness, illumination, a projection capacity based on illusions and associations produced by reflections of light in the colours of green and yellow, matching the greenery of tree leaves in the surroundings of the interior that produce the impression of a forest.

absorption / top light from overhead, light from the side and top from overhead / PARTITION material

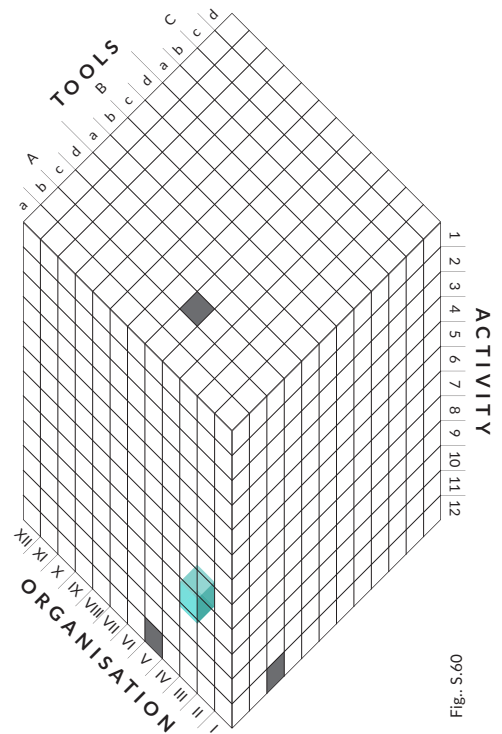


Fig.: 60



Phot.: 60

12/ I/ Ac

LVMH in Shinsaibashi, hallways
Kengo Kuma, Osaka, Japan 2004

The interior of the hallways is entered by side light from the side via two types of filters: one of them is formed by a four-millimetre layer of Pakistani onyx, sandwiched between layers of translucent glass, while the second—a layer of film paper with a print of Pakistani onyx, sandwiched between layers of translucent glass. The filter with the onyx layer absorbs light to a greater degree than the filter with film paper. The exposure highlights coloured light as the ornament of the interior, an ambience of astonishment, intimacy, unclarity, illumination. The projection capacity is based on illusions and associations produced by the appearance of a softness of light, such as blurs and dimming.

absorption / side light from one or several sides /
PARTITION material

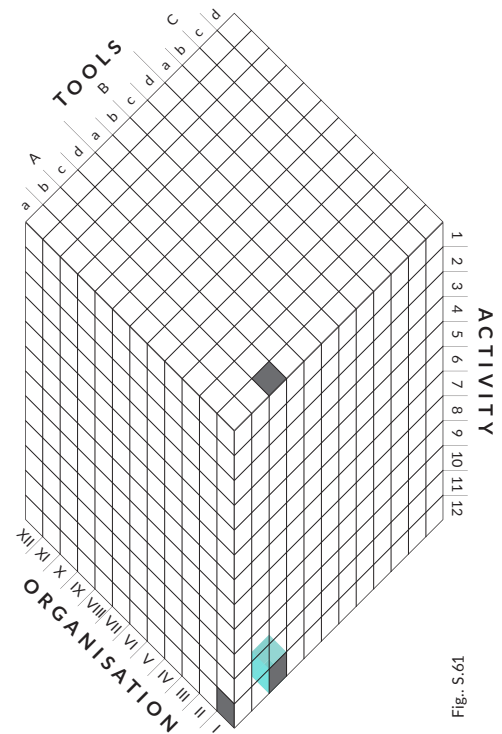


Fig. 19-S



Phot. 61

12/ V/ Ac

absorption / light from the top from overhead / PARTITION material

LVMH in Shinsaibashi, interior of the entrance complex
 Kengo Kuma, Osaka, Japan 2004

The interior of the entrance complex is partially roofed with a slab from a layer of glass and Pakistani onyx. The roof formed this way allows the interior to be entered by top light from overhead that is partially absorbed by a thin layer of stone. The exposure highlights the coloured light as the ornament of the interior, an ambience of astonishment and a projection capacity of illusions and associations produced by the appearance of the softness of light, its dimness, condensation or dilution.

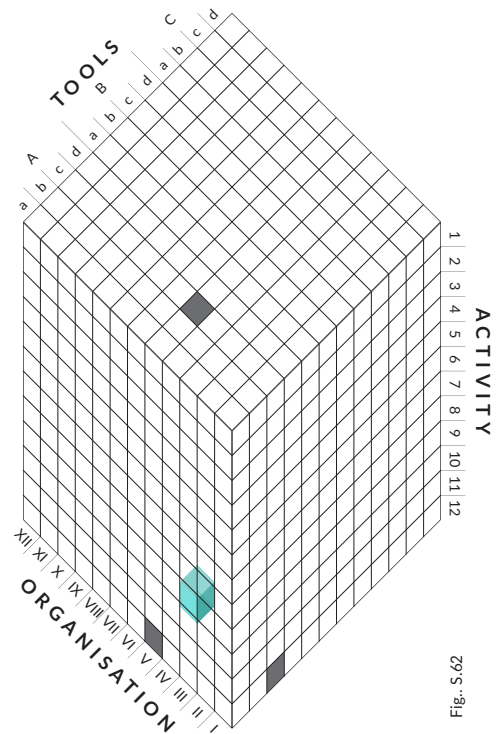


Fig. S.62



Phot. 62

12/ I/ Ac

JR Hoshakuji Station, stairwell

Kengo Kuma, Takanezawa, Tochigi, Japan 2008

absorption / side light from one or several sides /
PARTITION material

The interior is entered by side light filtered from the side by a wall from polycarbonate. The exposure highlights the tempered brightness of the interior, an ambience of intimacy, unclarity, illumination. The projection capacity is based on illusions and associations produced by the appurtenance of the softness of light, its dimness and haziness.

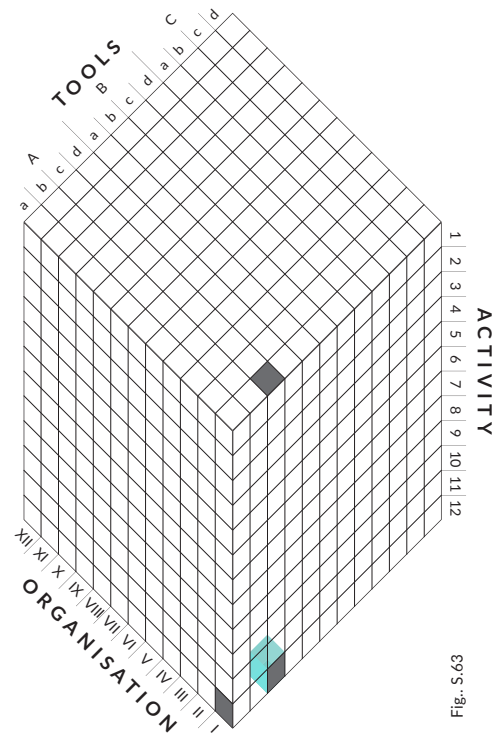
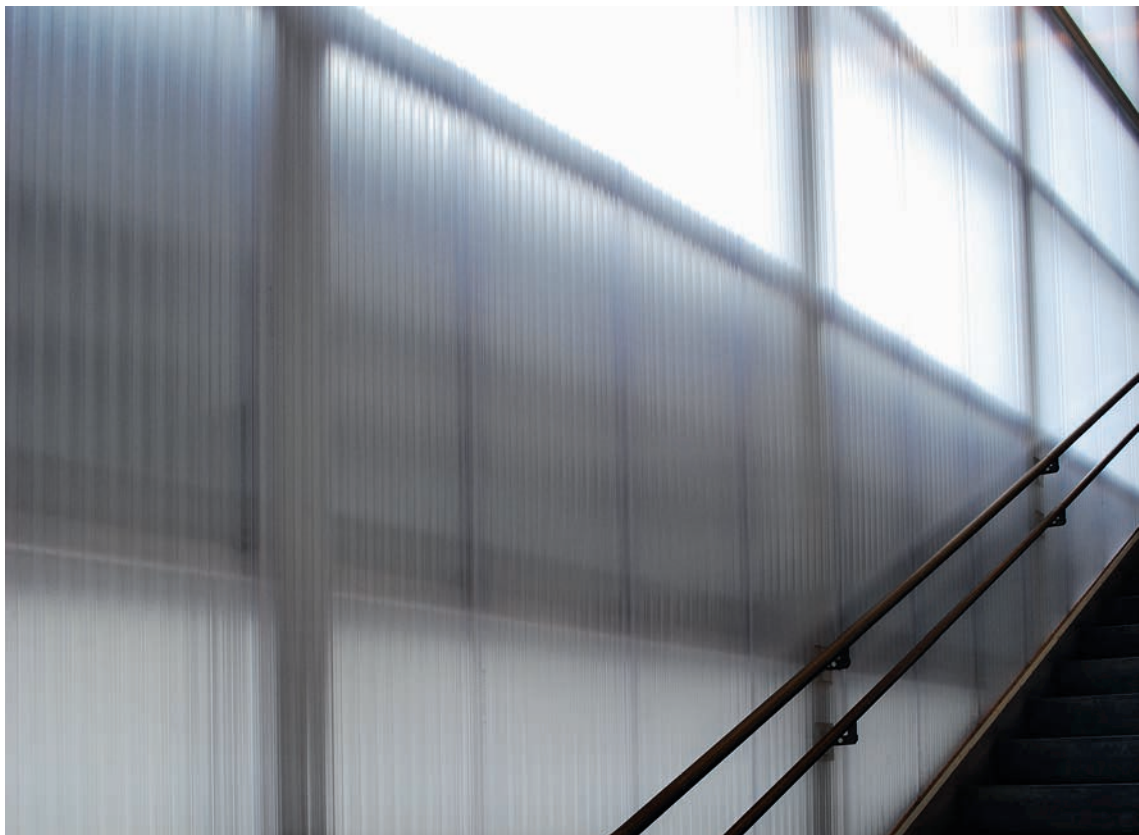


Fig.-63



Phot. 63

V. 4. Activities of Architecture in the Aspect of the Atmosphere of the Interior

As shown by the presented case studies, every activity has its own potential for exposing the physical properties of the interior and thus to produce a specific atmosphere of architecture (Table 4). Dependencies between the exposure of the physical properties of the interior, considered to be a criterion of the atmosphere of the interior, and the various types of activities of architecture were elaborated. This dependency has been presented in the form of a table (Table 6). The x sign was used to mark the presence of a given exposure. A bold script was used when the exposure was reinforced. The o sign was used to denote the inability of producing a specific exposure. The + sign denotes the possibility of orchestration.

Tab. 6. Dependencies between the exposure of physical properties of the interior and the activities of architecture

	Exposure of the materiality of architecture	Exposure of the shape of architecture	Exposure of the filter structure, the ornament from shadow and light	Exposure of the structure of the interior's space	Exposure of the blending of the interior and the exterior	Orchestration
Complete penetration	X	X	O	X	X	
Carving	X				X	+
Forcing through	X		X			
Isolation			X		O	
Mirror-like reflection	X				X	+
Scattering and breaking		X		X		+
Scattering and bending		X				+
Scattering and slipping	X	X		O		+
Scattering and channelling		X		X		+
Sifting		O	X			+
Refraction			X			+
Absorption	X		X			+

The listing presented above has been detailed in the table presenting the dependency between the atmosphere of the interior on individual activities that take part in operating with light in the interior.

Tab. 7. Activity of architecture in the aspect of the atmosphere of the interior

Complete penetration	Exposure of the blending of the interior and the exterior , the structure of the interior's space, the shape of architecture, the materiality of architecture, the blurring of the interior's boundaries, vividity of the view of the outside, the boundlessness of the interior, opening, distance, freedom; choreography
Carving	Exposure of the materiality of architecture , the blending of the interior and the exterior, the vividity of the boundary of the interior, the beam of light, intimacy, closeness, focus, mysteriousness, dramatism, tension, theatricality, choreography; orchestration
Forcing through	Exposure of the filter structure, the ornament of shadow and light , the blurring of the actual shapes of the interior, ambiguity, separation, mysteriousness, high projection capacity , metaphysics, the cosmos
Isolation	Exposure of the shape of architecture , the materiality of architecture, the vividity of the geometry of the interior, clarity, refreshment, explicitness, stasis, peace, ambient silence, suffusion with light in a uniform mood, metaphysics, the cosmos; choreography
Mirror-like reflection	Exposure of the materiality of architecture , of the blending of the interior and exterior, the structure of the interior's space, the blurring of the interior's boundaries, breaking up the interior, mysteriousness, magic, illumination, high projection capacity: illusions, shadowy depth; choreography, orchestration
Scattering and breaking	Exposure of the shape of architecture , the structure of the interior's space, tempered brightness, stasis, clarity, distance, fluidity, refreshment, high projection capacity: foggy radiance, metaphysics; choreography, orchestration
Scattering and bending	Exposure of the shape of architecture , structure of the interior's space, tempered brightness, stasis, clarity, distance, fluidity, refreshment, high projection capacity: foggy radiance, metaphysics; choreography, orchestration
Scattering and slipping	Exposure of the shape of architecture, the materiality of architecture , the vividity of the interior's boundary, tension, intimacy, inaccessibility, closeness, mysteriousness, dramatism, refreshment, high projection capacity: foggy radiance, metaphysics; orchestration
Scattering and channelling	Exposure of the shape of architecture , tempered brightness, the vividity of the geometry of the interior, clarity, stasis, peace, ambient silence, metaphysics; choreography, orchestration
Sifting	Exposure of the filter structure, the ornament of light and shadow, the blurring of the view of actual materials and shapes, weakening of the vividity of the interior, depending on filter type: contrast of light and shadow or blurring of the interior's shapes , breaking up, unclarity, uncertainty, dramatism, high projection capacity: illusions, associations, magic, atomisation or fogginess; choreography, orchestration
Refraction	Exposure of the filter structure, the ornament of light and shadow, the blurring of the appearance of actual materials and shapes, weakening of the vividity of the interior, enhancing the interior with colourful reflections of light , breaking up, mysteriousness, unclarity, uncertainty, dramatism, high projection capacity: illusions, associations, magic; choreography, orchestration
Absorption	Exposure of the filter structure, the ornament of light and shadow, the blurring of the appearance of actual materials and shapes, blurring of the shape of the interior, weakening of the vividity of the interior , mysteriousness, unclarity, uncertainty, dramatism, high projection capacity: illusions, associations, dimming of the interior, foggy radiance; orchestration



Phot. 64

V. 5. Complex Method of Operating with Light, Compiling Methods of Operating with Light

Elementary methods of operating with sunlight are rarely encountered individually as they typically come in combinations, creating a single complex method of operating with light or as a compilation of methods of operating with light. In both cases there is typically an enhancement of the exposure of the physical properties of the interior and thus of its atmosphere.

A complex method of operating with light in the interior can be explained on the example of combining three activities: scattering and bending, scattering and breaking and filtering in the interior of the Nordic Pavilion in the Giardini in Venice (Sverre Fehn, 1962). The tool for all of these activities is the interior's ceiling. Its openwork structure (a grid of reinforced concrete beams), which causes the sifting of top light, is fitted with glass gutters that delicately scatter sunlight on their convexities, and thus cause their scattering and breaking by the side surfaces of the tall beams. As a result, light in the interior is tempered in various ways, while also being evenly scattered in its space. Thus, the shape of the interior is exposed, as is its spatiality, structure and materiality. This exposure induces an ambience of clarity, harmony, tempered uniform and even brightness, stasis, silence and a projection of sprinkling with light and foggy radiance.

The compiling of several methods of operating with sunlight can be explained on the example of the interior of the student chapel in Otaniemi (Kaja and Heikki Sirén, Otaniemi, Finland, 1957). Here, sunlight enters directly from two opposite sides: from the altar, behind which there is a fully glazed wall from floor to ceiling, and from the side of the entrance, through a window placed high on the wall. As the window touches the edge of and a slanting ceiling, the ceiling plays host to slipping of a part of the rays of side light. Side light, which enters directly into the interior, is intercepted by timber posts of the structure of the ceiling, which densely populate the upper part of the chapel's space. Therefore, there is a compilation of four methods of operating with sunlight in this interior (using architectural tools): the carving of side light by the window in the altar wall, the carving of side light by the window in the entrance wall, the slipping of light on the surface of the ceiling and its sifting through the ceiling's posts. People in the interior consider the tools for each activity as separate, which is why there is a compilation of different methods of operating with light instead of a single complex method. In this interior, light, which enters from the side of the entrance, is the upper counter to the light that enters from the side of the altar and, together with light scattered through slipping and filtering by the forest of posts, exposes the shape of the space, the view of the forest around the chapel and the forest of posts in the interior. Thus, the shape of the interior, its materiality and space are exposed, as is an ambience of tempered brightness, clarity, and also dynamism, variability and complexity. A clear projection of the forest is induced.



Phot. 65



Phot. 66



Phot. 67

2, 12, 9/ I/ Aabc, Cd

carving, absorption, scattering and channelling / side light from one or several sides / PARTITION opening, structure, material, SPACE shape

Sanctuary of Merciful Love in Collevaleza, lower church
 Julio Lafuente, Collevaleza (Peruggia), Italy 1963-1967

Side light, filtered through a colourful stained-glass window, enters the interior of the lower church from overhead, from the space of the upper church. The exposure highlights the filter as the interior's decoration, the tempered darkness in the interior, an ambience of intimacy, of discrete illumination of the interior, of fleetingness, transience, dynamism and a projection based on illusions and associations caused by fleeting reflections of coloured light.

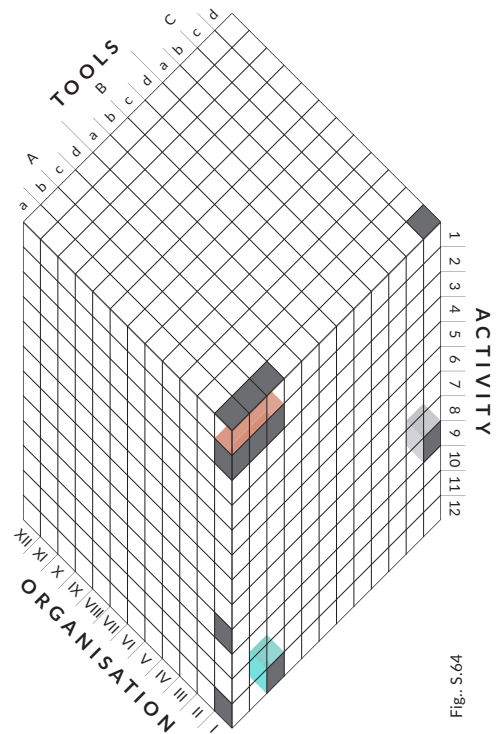
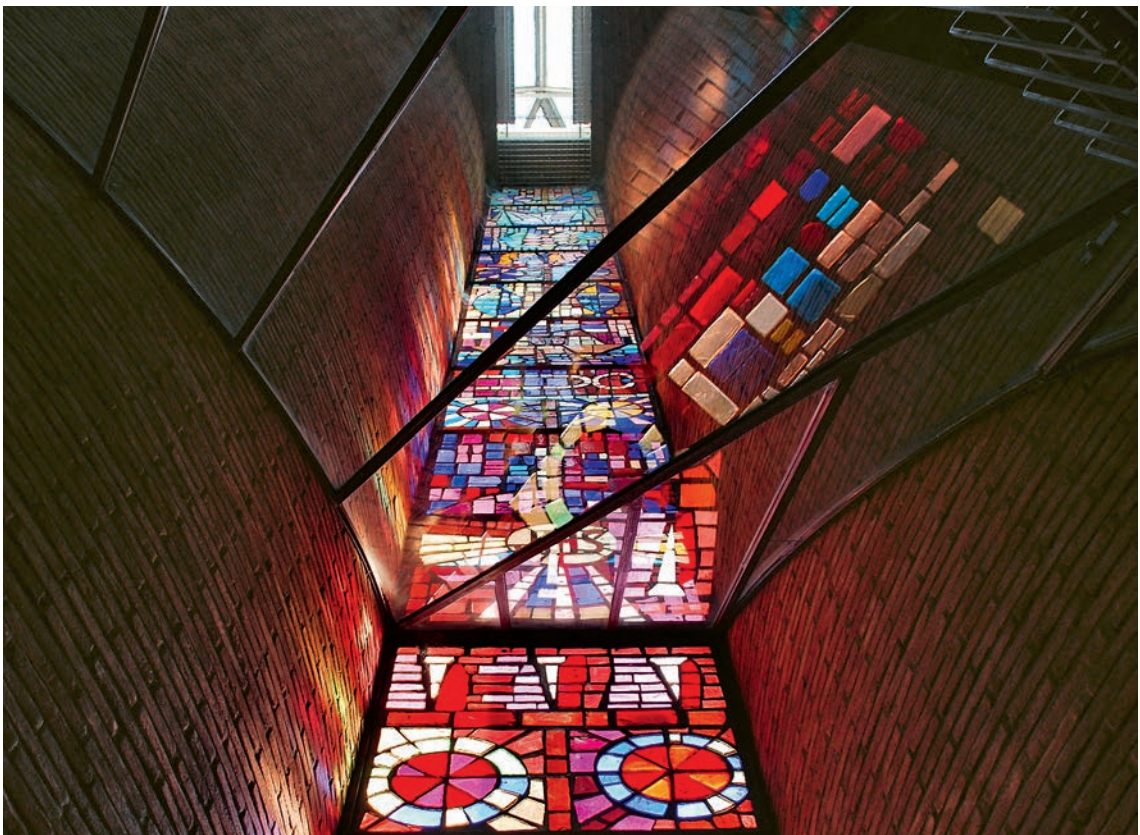


Fig.: S.64

Complex Method of Operating with Light



Phot.: 68

10, 6, 9 /X/ Ab

Tempelaukio

Timo and Tuomo Suomalainen, Helsinki, Finland 1968–1969

Light from the side and top enters from outside of the church interior via a skylight equipped with an openwork structure of densely spaced concrete laths. The shape of the laths and their dense spacing in the structure are the reason for the compilation of three methods of operating with light into one method. Some of the rays enter the interior after being sifted by the structure, others—are broken on the side surface of the laths and enter the interior in scattered form, while others still break on these surfaces several times, which means they are channelled. The exposure highlights the structure of the skylight, the scattering of light, the shape of the interior, its materiality, tempered brightness, ambience, dynamism, rhythm and a projection based on inducing an impression of the forest.

sifting, scattering and breaking and channelling /
light from the side and top from all sides /
PARTITION structure

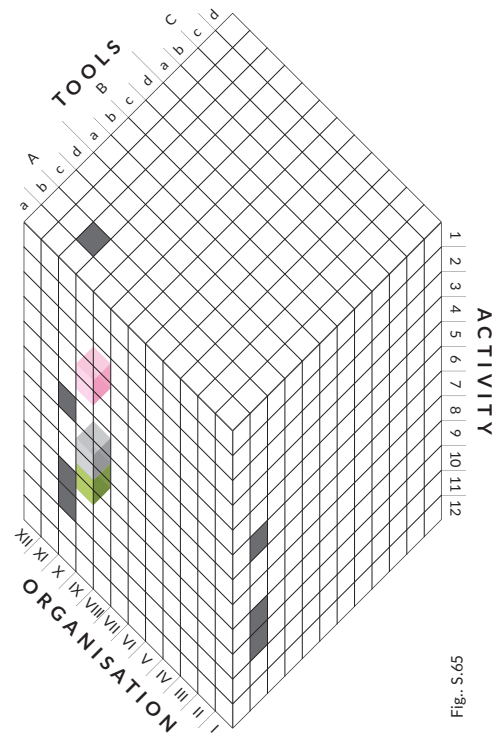


Fig.-S. 69

Complex Method of Operating with Light



Phot. 69

8, 9/ I/ Aa

Church of Light

Tadao Andō, Ibaraki, Osaka, 1989

Side light is intercepted from outside into a light container which is an interior near the church’s nave. This container has the shape of a wedge between two intersecting walls: a concrete wall and a glazed wall. From its space, light enters the nave of the church through a slit under the ceiling. This is derivative light, *lume di lume*. Thus, the nave of the church exposes the gradation of light on the surfaces of partitions, there is tempered darkness, an ambience of mysteriousness, a slow transience (evanescence), dramatism and a projection of a foggy radiance.

scattering and channelling and slipping /
side light from one or several sides /
MASS shape, PARTITION opening

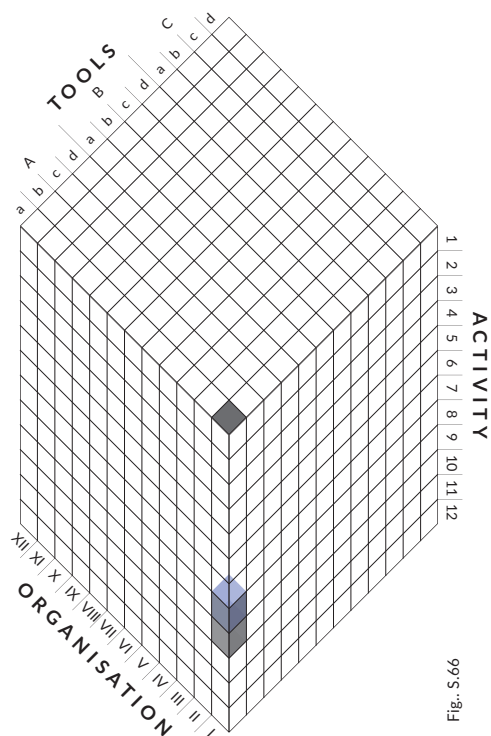
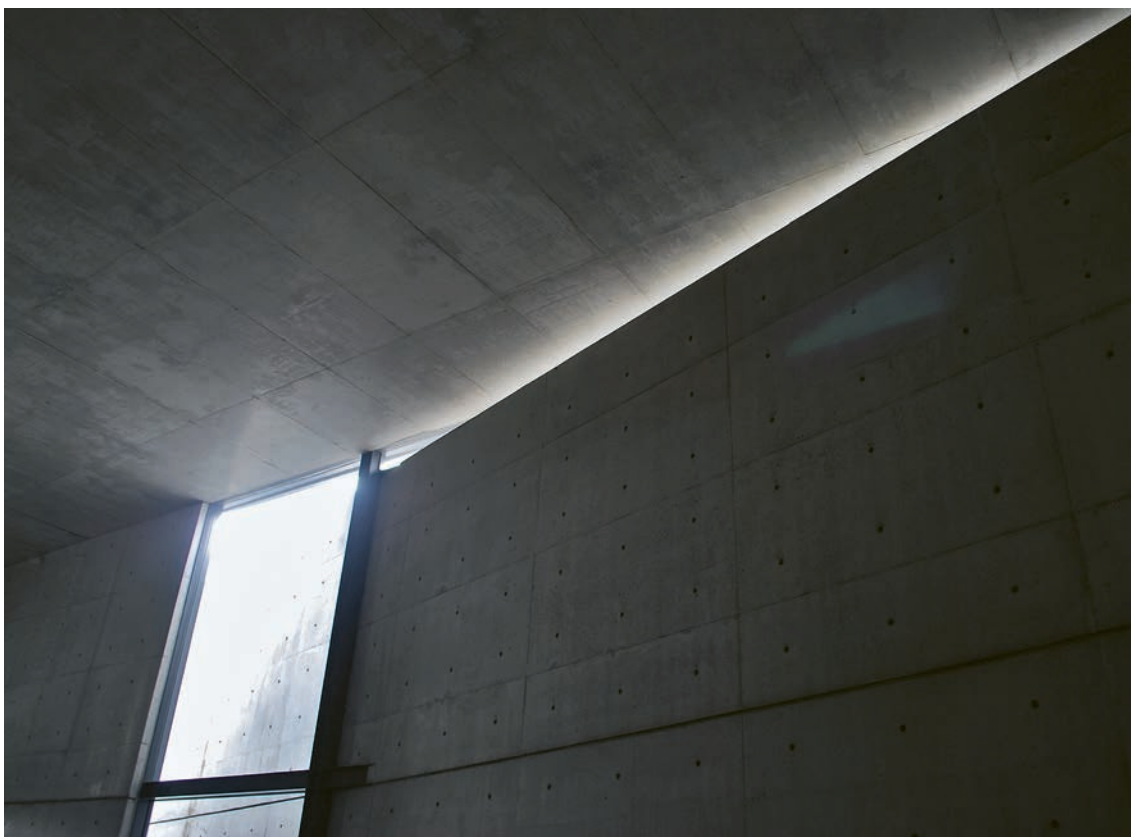


Fig.:S.66

Complex Method of Operating with Light



Phot. 70

9, 2 /III/ Aad, Babd

Higher Seminary of the Congregation of the Resurrection, church

Dariusz Kozłowski, Krakow, Poland 1986–1995

scattering and channeling, carving / side light from overhead / PARTITION opening, shape MASS opening, structure, shape

Side light enters the space of a channel between two roof layers, and from this space—into the church interior, carved by intersecting slits. The exposure highlights the filter structure, the scattering of light, the shape of the interior, the materiality of the interior, stasis, tempered brightness, an ambience of focus and mysteriousness. The high projection capacity is based on the impression of sprinkling with light, evoking associations associated with the symbolism and mysticism of the cross and light.

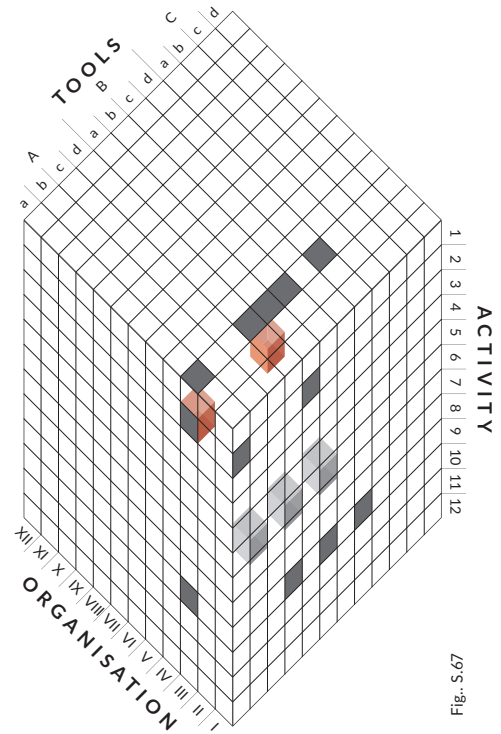


Fig.-S.67

Complex Method of Operating with Light



Phot. 71

6, 9, 12/ V/ Acd, Bb

Kiasma Museum, foyer
 Steven Holl, Helsinki, Finland 1993-1998

scattering and breaking, scattering and channelling, absorption / light from the top from overhead / PARTITION material, shape, MASS structure

The interior of the foyer is entered by light from the top through a skylight in the ceiling and is absorbed and scattered via slipping and breaking. The exposure highlights the softening, scattering and stasis of light, an ambience of intimacy, clarity, illumination and a projection capacity based on illusions and associations produced by an illusion of sprinkling with light and a foggy radiance.

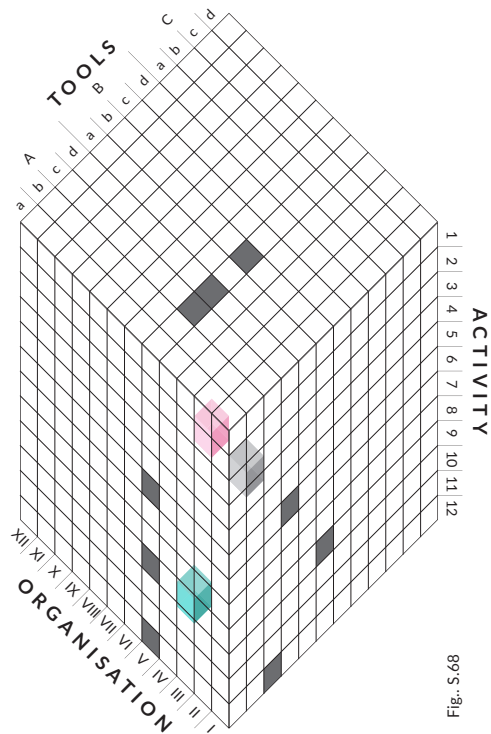


Fig.: S.68

Complex Method of Operating with Light



Phot.: 72

4, 9, 12 /III, V/ Bbc, Abc

Kunsthaus Bregenz, interior with stairs leading from the second to the third floor

Peter Zumthor, Bregenz, Austria 1990–1997

The interior with stairs from the first to the second floor is entered by scattered light from the top through a ceiling made of a matte glass surface, which do not touch, but are spaced apart by the thickness of their fittings (in the middle of each side). Above the ceiling and below the reinforced concrete stair run of the next floor there is a duct/tunnel that channels light within its space: it is side light (that enters it from outside via the matte glass curtain wall of the building) and top light (that enters from outside from overhead into the space between the building's curtain and its internal wall layers, primarily made from concrete; the space is connected with the space of the duct). The duct runs parallel to the stair run, diagonally in the building's cross-section, and is a negative mass in the boundary of the interior (it is a neighbouring interior). The matte structure of glass makes it appear to levitate above the stairs as if it were a backlit layer of mist. Through the slits between the surfaces one can see direct brightness entering from

isolation, scattering and channeling, absorption
/ side light from overhead, top light from
overhead / MASS structure, material,
PARTITION structure, material

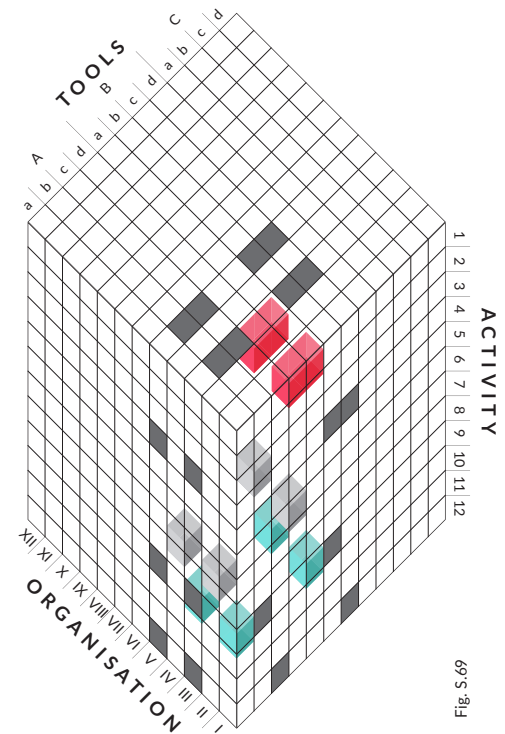
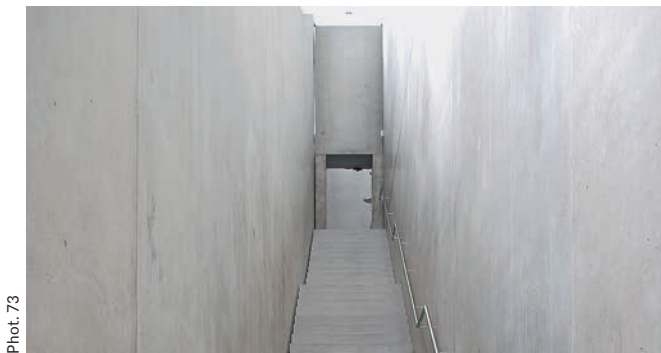


Fig. 69 S



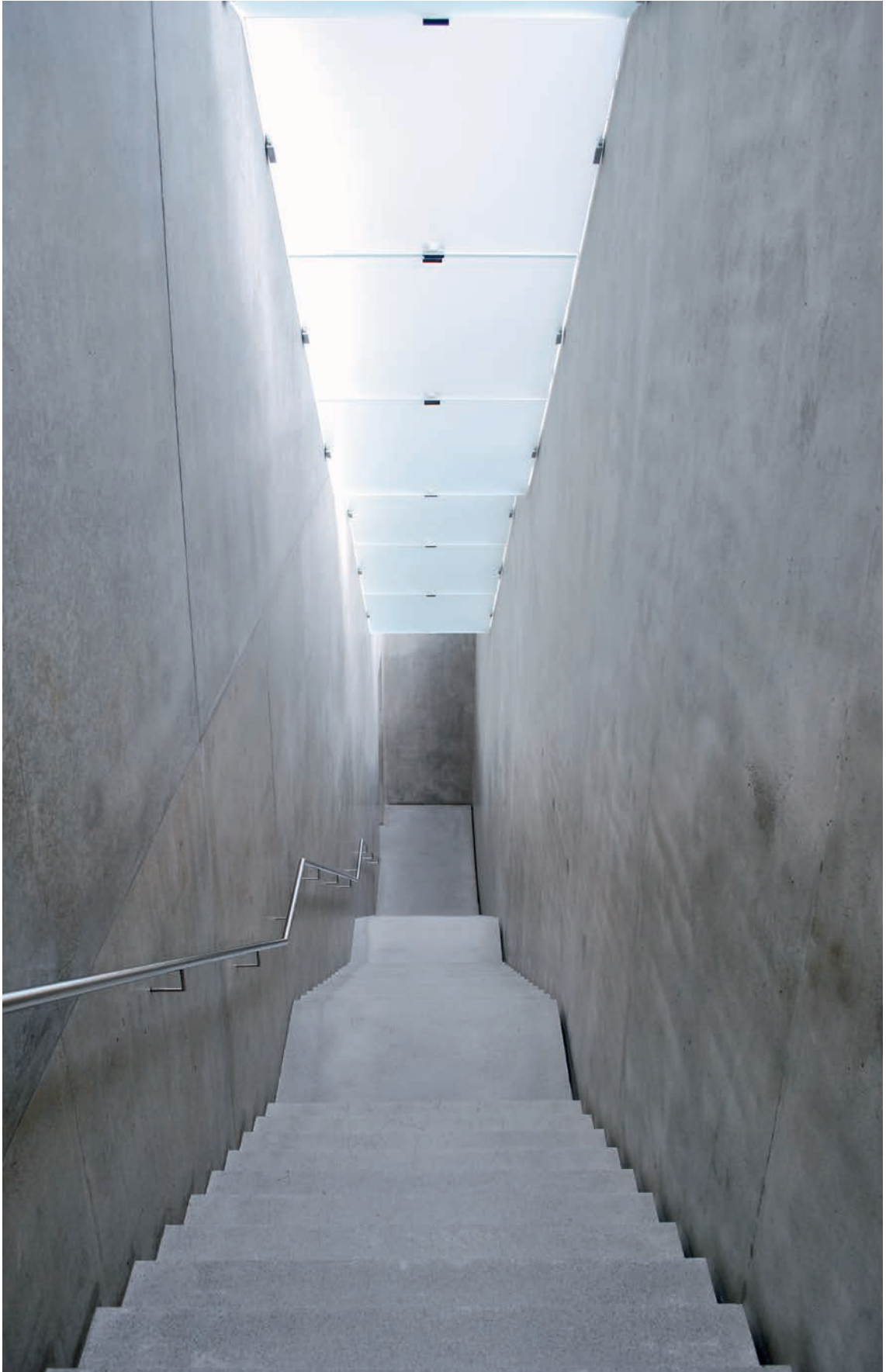
Phot. 73

the duct. The light is directed from overhead (from the south-west) downwards (from the north-east), which causes greater brightness to be able to enter the lower, north-western part of the interior (which is visible when the doors to the stairwell are open). The exposure highlights the shape, enclosure and materiality of the interior, an ambience of intimacy, mysteriousness, uniformity, slow transience (the passage of time), and silence. The high projection capacity is associated with the illusion of the materiality of light, of sprinkling with light, of a foggy radiance suspended in the upper part of the interior, glimmering with flashes of brightness and the choreography of light.



Phot. 74

Complex Method of Operating with Light



Phot. 75

6, 12/ II, X/ Bc

Silesian Museum, architectural complex
 Riegler Riewe Architekten, Katowice, Poland, 2013

scattering and breaking and absorption / side light from all sides, light from the side and top from all sides / MASS material

The interior of the architectural complex features masses made from semi-translucent glass. Side light and light from the side and top from all sides is scattered and broken and partially absorbed by the walls of the masses. In the interior, the exposure highlights light as the interior's decoration, an ambience of intimacy, unclarity, illumination, variability, dynamism and a projection capacity based on an appearance of the softness of light, illusions and associations produced by the illumination of masses in the interior.

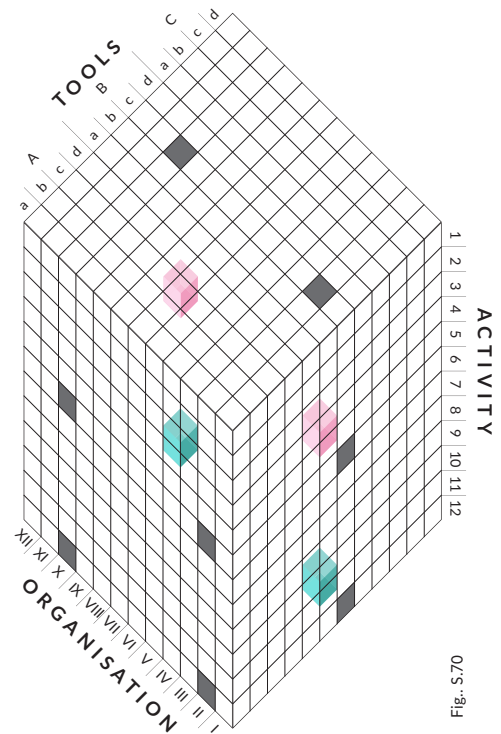


Fig. 70

Complex Method of Operating with Light



Phot. 76

10, 6, 9/ I/ Ab

NOSPR building, foyer
 Mikołaj Konior, Katowice, Poland 2014

sifting, scattering and breaking and scattering
 and channelling / side light one or more sides /
 PARTITION structure

An architectural tool in the form of a wall structure simultaneously sifts, breaks and channels side light and light from the side and top. The exposure highlights the structure of the filter, the scattering of light, the shape of the interior, its materiality, tempered brightness, an ambience of dynamism, rhythm, musicality. The projection capacity is based primarily on producing an illusion of the forest.

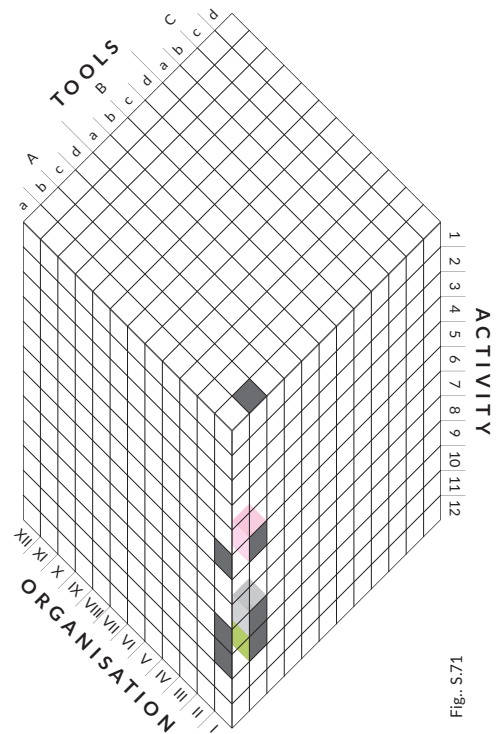


Fig.:S.71

Complex Method of Operating with Light



Phot.: 77

2, 8/ III/ Abc

carving, scattering and slipping /
side light from all sides /
PARTITION structure, material

9 / V/ Bd

scattering and channelling /
light from the top from
overhead / MASS shape

Sanctuary of Merciful Love in Collevaleza, side chapel
Julio Lafuente, Collevaleza (Peruggia), Italy 1963-1967

The side chapel inside the cylinder is entered by light from outside as a result of two different methods of operating with light (with one of them being a complex method): 1) channelling of top light from overhead by a deep spatial skylight covered with a cone of glass and 2) carving of side light from all sides by a glazed slit between the wall of the cylinder and its ceiling and the slipping of light along the ceiling surface. Through this form of operating with light, the exposure highlights the shape of the interior, its materiality, tempered brightness, an ambience of mysteriousness, of being enclosed from the sides and of an openness from overhead, a harmonious balance between the dynamic and the static. The projection capacity is primarily based on an illusion of sprinkling with light and a foggy radiance, as well as the induction of metaphysical states.

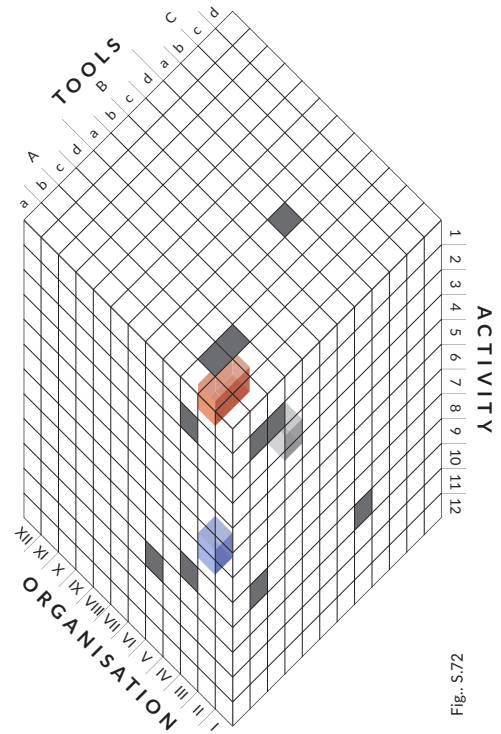


Fig.-S.72

Compiling Methods of Operating with Light



Phot. 78

In the experience of art, a peculiar exchange takes place; I lend my emotions and associations to the space and the space lends me its aura, which entices and emancipates my perceptions and thoughts. An architectural work is not experienced as a series of isolated retinal pictures, but in its fully integrated material, embodied and spiritual essence. It offers pleasurable shapes and surfaces moulded for the touch of the eye and other senses, but it also incorporates and integrates physical and mental structures, giving our existential experience a strengthened coherence and significance.

J. Pallasmaa, *Eyes of the Skin...*

And this is why we search, completely unscientifically, for not only beautiful architecture, but for the beauty of architecture. To do so, we must acknowledge man, noting a dry spatial event with a photograph.

K. Kucza-Kuczyński, *Piękna architektura – czy piękno architektury, czyli: czytając Stróżewskiego*

VI

Atmosphere as a Result of Exposing Architecture and Sunlight—Case Studies

This chapter shall present an analysis of the atmosphere of selected interiors, as achieved as a result of exposing the materiality of the interior, the shape of the interior, the filter structure, the space of the interior, the blending of the interior with the exterior and as a result of orchestration and choreography. The evaluation of the atmosphere of architecture employed the study tool constructed in the work.

VI. 1. Exposing the Materiality of Architecture—Tempered Darkness, Intimacy, Focus

There are interiors in which the relationship between architecture and sunlight significantly exposes their materiality. In these interiors, people focus on materials: their colour, texture, softness or hardness, coarseness or smoothness, looseness or stickiness. It then becomes natural for man to want to touch these materials, to test them, even taste them. The conditions for such a specifically understood intimacy that accompanies man in contact with materials is provided by a specific relationship between the architecture of the interior with sunlight in the interior. This relationship, contrary to what can be expected, is not obvious, as light that is too bright or too static (which dominates in architecture) unifies the appearance of the interior and minimises its materiality among other physical properties. This is why the exposure of materiality is best achieved by those activities of architecture which do not expose the shape of the entire interior, do not create light illusions or patterns of light and shadow, but operate on fragments of the interior's boundary: the architectural activity of carving, slipping and breaking of light rays. Light that is tempered, from the side, dynamic, intense at moments and moves slowly across the interior, is good at exposing materiality. It is supported by framing and squeezing the spot of light on the material, enhancing its shape against a darkened background.

The atmosphere of these interiors is created by tempered darkness, the vividness of the surface of the material, the vividness of a bright spot on a dark background, the vividness of the boundary of the interior, an ambience of intimacy, of tension between light and shadow, of focus, mysteriousness, of balance between openness and enclosure. The projection capacity of these interiors is based on producing an impression of a shadowy depth, of a theatricality (view–frame–scene).

Malmi Church

Kristian Gullichsen, Malmi, Finland 1981

The interior of the church is predominated by tempered darkness—a duskiess from which there emerges an outline of the nave of the church and the brownish shade of brick. The brightest place inside is the presbytery. Light slips along the altar wall with a figure of Christ on the Cross, exposing the wall's unevenness, its protrusions and indentations. The light also slips along the sculpture, formed from the wooden beams of the cross and the figure of Christ, made from metal. The shine of the figure on the axis of the interior focuses human attention and encourages one to come closer to the altar.

Malmi Church



Phot. 79



Phot. 80

The presbytery is entered by side light and light from the side and top through three slits—two which are hidden, and one that is visible to persons inside the nave. The hidden slit is vertical and is located to the left (when looking at the altar), and is filled with glass masonry units and filters side, southern light, while the upper slit is covered with a skylight with a diagonal cover from translucent light and triangular enclosures from matte glass on the sides. The slits make an impression of the altar wall being set back relative to the presbytery. The third slit, located in the altar wall opposite the nave and fitted with a coloured stained-glass window, lets in delicate reflections of coloured light, particularly blue and red.

The atmosphere of the interior's architecture is formed by its tempered darkness, the vividness of the surfaces of brick walls, particularly the uneven surface of the altar wall, the vividness of the bright contrast of the presbytery on the shadowy background of the nave and the complete isolation of the interior from outside. An ambience of intimacy is produced (despite the large size of the interiors), and a tension between the shadow of the nave and the tempered brightness of the presbytery, the mysteriousness, dramatism and a focus of attention on the area with the figure of Christ on the Cross and the figure itself: its shape and material. The projection capacity of the interior is based on theatricality (view–frame–scene).

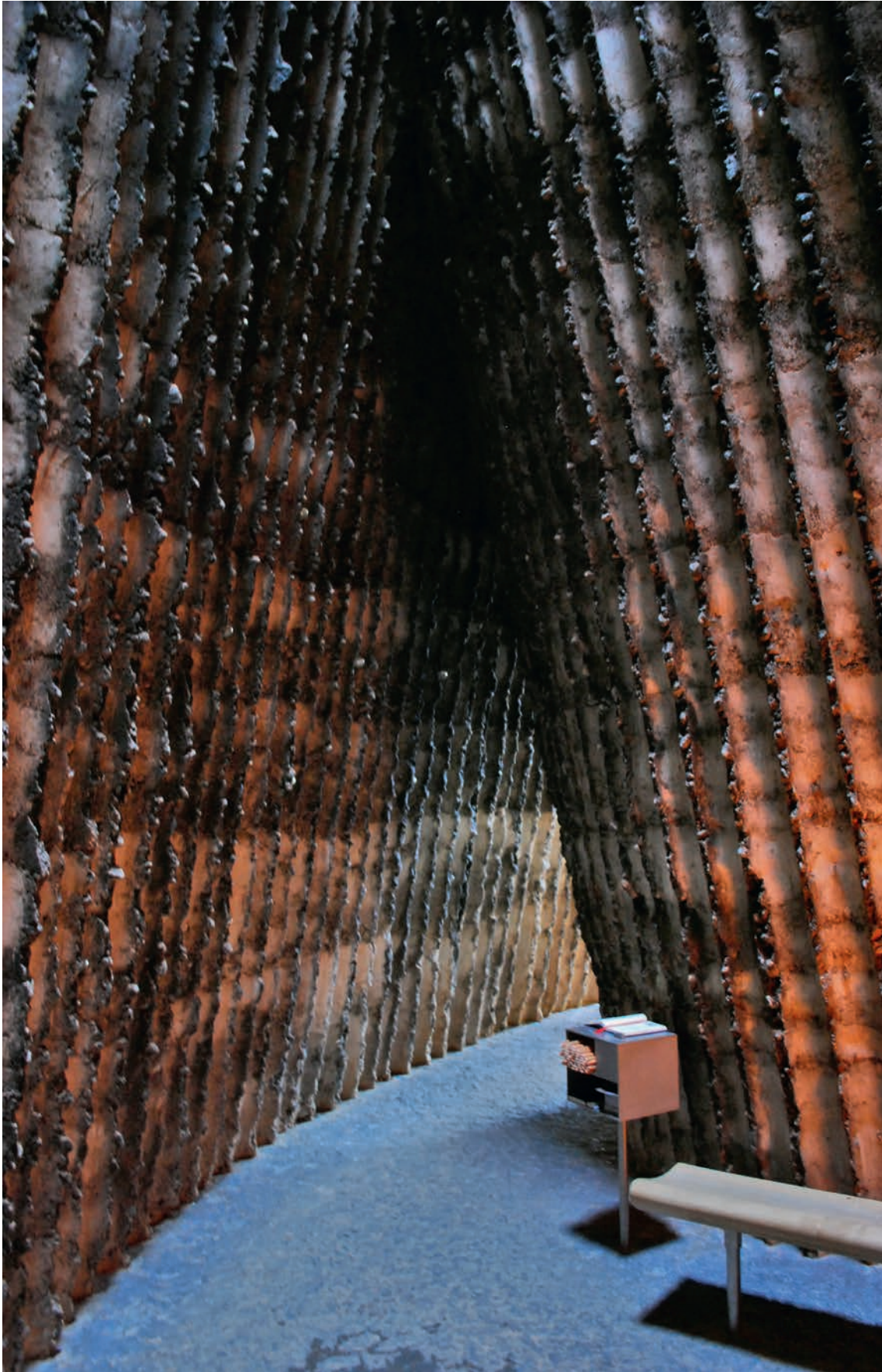


Phot. 81



Phot. 82

Brother Klaus Chapel



Phot. 83



Phot. 84

Brother Klaus Chapel

Peter Zumthor, Wachendorf, Germany 2007

The interior of the chapel is entered by three types of light. The first—is side light, direct and dynamic, that forces through from the side of the entrance by slits between the wing and the door opening, the second—is side light from all sides, filtered by openings filled with glass balls, the third—is light from the top, which is static and enters directly from overhead, carved by an irregularly shaped oculus. The slanted walls are the boundary of the interior from all sides and partially also from the top, leaving only the opening of the oculus unfilled. Thus, the rays of top light slip along the walls, exposing their outline within space, their shape and texture: the carvings, coarse strops of concrete. The rays of top light also fall onto the floor of the interior, which is a layer of lead that is delicately recessed underneath the oculus. If the recess is filled with rainwater, the skylight is reflected in the water's surface. The concavities of the carvings are covered with soot and absorb light rather than reflect it. Side light is filtered by numerous balls of glass sprinkles the dark wall, becoming its ornament that varies depending on the time of day, the season and the weather. The light that forces itself through the slits between the wing and the door opening creates an outline of a slender triangle in the dark interior.

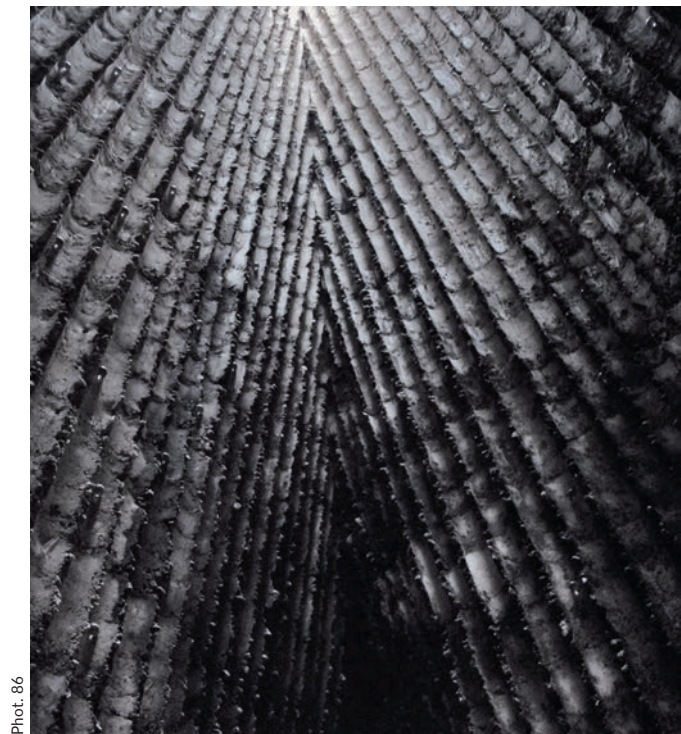
In relation with light, the elements of the interior expose their materiality: the walls of concrete—expose their carvings, the soot, the coarseness; the balls of glass—their smoothness and regularity; the oculus—its shape and the lightness of air; the lead on the floor—its weight; the water—its softness and the smoothness of its surface, which becomes a mirror. The surface made

Phot. 85

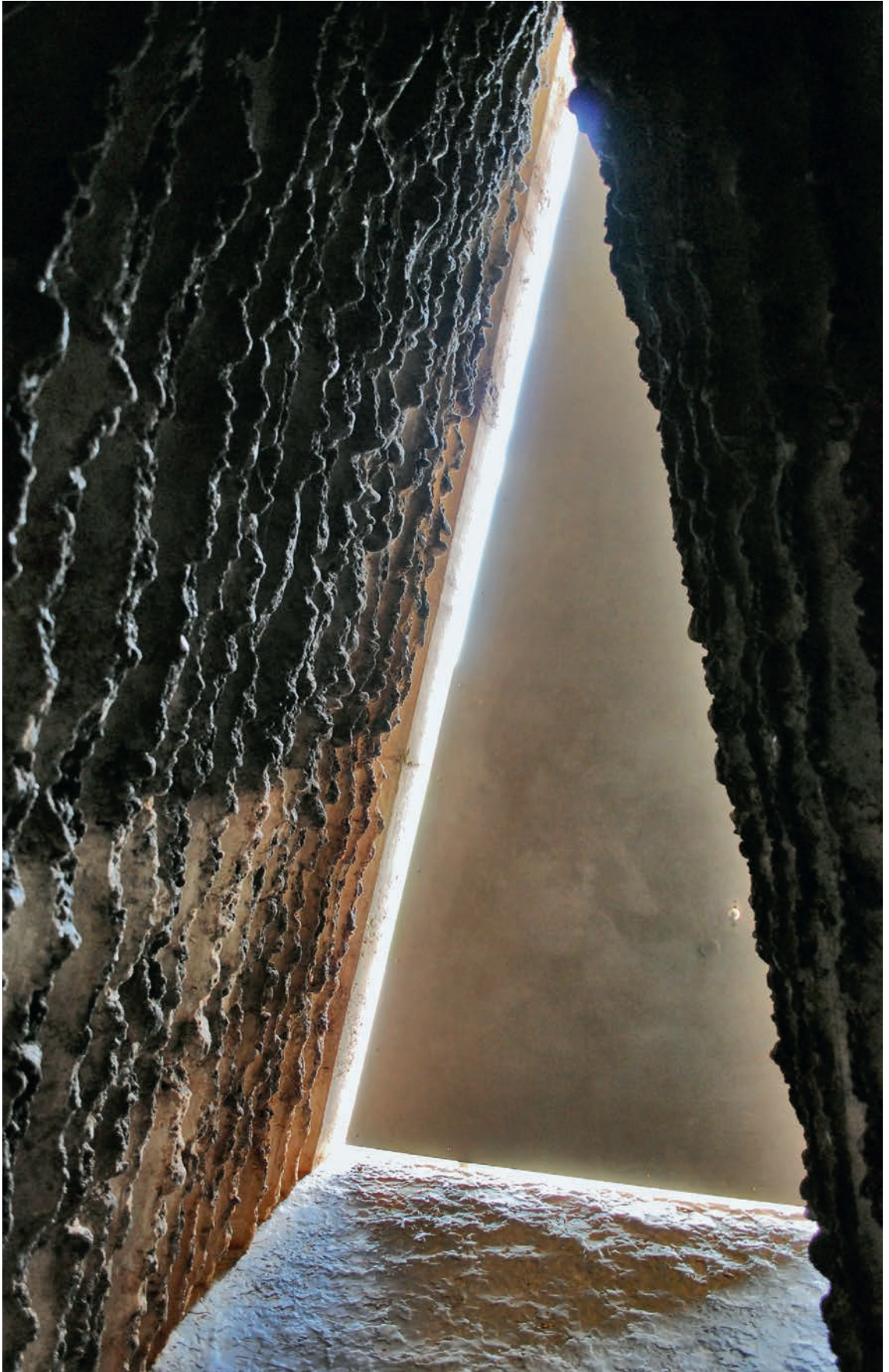


of lead scatters light, while water—reflects the view of the sky and adds an apparent internal source of light in the interior.

The atmosphere of the architecture of the interior is formed by its materiality, which is exposed by tempered darkness, the vividness of the surface of the interior's boundaries from all sides and the opening of the interior at the top. The light and the view of the sky are the most prominent in building the atmosphere. The exposed materiality forms an ambience of intimacy, of tension between light and shadow, mysteriousness, dramatism and focus. The projection capacity of this atmosphere is based on the theatricality of the interior in relation with light and metaphysical references (the framing of the view of the sky in the oculus and from the side—the view of a slender triangle from light that is associated with a ray that points upwards and the ray of the circle of the scheme of the Holy Trinity, suspended in the chapel and associated with the biography of its saintly patron).



Phot. 86



Phot. 87

VI. 2. Exposing the Shape of the Interior— Gradation of Light and Shadow, Tempered Brightness, Clarity, Coherence, Calmness

There are interiors in which sunlight exposes their shape. Humans in these interiors focus their attention on their geometry, volume, convexities, concavities and depth. They clearly see the interior in its entirety, they can ascertain its height, depth. The need to explore the interior, to move about it, becomes natural to man. The conditions for acknowledging the shape of the interior are provided in it by a specific relationship between architecture and light. It is not obvious, as excessively bright illumination flattens the shape of the interior and carved light leaves too many fragments in the dark and excessively exposes the materiality of partitions, while side light, typically present in interiors, is dynamic and variable, and thus produces moving contrasts of light and shadow. This is why, when we want to expose shape, it is best to use those activities of architecture that expose the geometry of the entire interior, that do not form strong contrasts of light and shadow, light illusions or patterns of shadow and reflections of light, but instead sprinkle with a static, scattered light. These activities include the isolation of direct rays and scattering. Light from the top from overhead, which is the static light of the brightness of the celestial sphere, as well as side light introduced from overhead, are good at exposing the shape of architecture. It can also be enhanced by the absorption of light and tempering the brightness of the interior.

Exposing the shape of the interior is often a goal that architects intend to achieve using the proper operation with sunlight. History and contemporaneity provide proof of this. Le Corbusier postulated and applied the exposure of shape, starting with his first private villas and culminating in the urban interior of the Chandigarh Capitol, the Notre-Dame du Haut chapel in Ronchamp and the La Tourette Monastery in Éveux. He developed the classics of operating with sunlight in terms of this exposure.

The atmosphere of the architecture of these interiors is comprised of the vividness of shape, the vividness of volume and spatiality, the delicate illumination of the nooks and crannies of the interior, the gradation of light, tempered brightness, the stasis of light, an ambience of clarity, stasis, coherence, calmness and peace, of suffusion with light in a uniform mood. The projection capacity is primarily based on producing the impression of ‘I see what is, it is what I see’.

Kiasma Museum, entrance hall and ramp

Steven Holl, Helsinki, Finland 1993–1998

The interior of the entrance hall is entered from outside by different types of light: top light from overhead, filtered by the upper, matte-glass skylight, side light directly from outside, carved by a window above the entrance, side light from the neighbouring interior (*lume di lume*), which is the café (which light enters directly through a translucent glass wall), and side and top light from the side of the nearby interior with vertical circulation elements deeper in the hall. Thus, the interior of the hall is entered by light from three sides and from overhead. The interior, which is curved like an arch, is exposed primarily by soft, tempered and static top light from overhead, as the entire, high-placed ceiling acts as a skylight. Light slips on the curved walls and reflects off of white partition surfaces. The light from neighbouring interiors, *lume di lume*, creates a ‘counter’ to the light from overhead. The atmosphere of the architecture of the interior is formed by the vividness of the shape of the interior, the illumination of the nooks and crannies of the interior,

Kiasma Museum



Phot. 88



Phot. 89

a gradation of light, the distribution of various tones of light on elements of the interior, tempered brightness, the stasis of light, an ambience of clarity, dynamism, coherence, complexity and harmony, a projection capacity based on producing the impression of 'I see what is, it is what I see' and the stimulus for moving across the interior.



Phot. 90



Phot. 91

Chapel of Silence



Phot. 92



Chapel of Silence

K2S Architects,⁵⁷³ Helsinki, Finland 2012

The oval interior of the chapel is entered from outside by top light along the outline of the interior through a slit between the ceiling and the side wall (the effect of a lid that is too small). The light slips along the oval, wooden wall, exposing its coarse texture and the shape of the round interior. The light that flows from overhead along the outline of the interior creates the impression of a curtain of light, which apparently extends the interior to the sides. The shadowed leaking ceiling of the chapel forms a contrast with the bright walls. The atmosphere of the interior is created by the vividness of its oval shape, the illumination of the interior in a static manner fully with overhead light that is static and scattered, the gradation of light, a tempered brightness, an ambience of clarity, stasis, coherence, calmness, peace, quiet and suffusion with light with a uniform mood. The projection capacity of atmosphere is based on inducing the impression of ‘I see what is, it is what I see’.

⁵⁷³ See: footnote 570, p. 205.



Phot. 94

VI. 3. Exposing the Filter Structure—Contrasts of Light and Shadow or the Blurring of Light, Ornament, Illusion, Fleetingness

There are interiors in which sunlight exposes the filter structure. In such interiors, humans focus their attention on fleeting reflections of light that contrast with spots of shadow, enriching the interior with a graphical ornament that can be colourful or blurry as if in a watercolour. Such ornaments rest on partitions and blur their actual shapes and materiality. The relationship between architecture and sunlight exposes the theatre of light and shadow in such interiors, which induces various types of illusions in the human eye: the actual interior can appear different: fleeting, blurry, vibrating, variable, immaterial. This exposure can be obtained by those activities of architecture that do not expose its materiality or shape, but instead cast spots of filtered light or blur the view of the interior, which is the activity of filtering: sifting, refraction and absorption. The interior is made the most unreal via the filtering of side, dynamic rays.

The exposure of the filter structure in the interior as its fleeting graphical, colourful or watercolour-like ornament was often used in historical architecture, but is also used in the present. It can be seen in Gothic cathedrals, equipped with colourful stained-glass windows, and in interiors that possess openings fitted with ornamental grates or meshes. The ornament comprised of spots of filtered light is often used to highlight an important place within an interior. Such is the case of the Church of Merciful Love in Collevaleza, wherein stained-glass windows were placed only in three windows (the nave has around a dozen of these in total): on the axis of the nave behind the altar and in the transept. Apart from this, this church's presbytery is entered by side light that is heavily sifted by the altar wall in the form of two convex, openwork cylinder halves (the openwork is produced by spaces between bricks). The light, sifted by openwork semi-cylinders, produces the impression of a starry sky behind the altar. Due to highlighting the filter, the rays of this apparent constellation are scattered centrifugally into the space of the church.

The atmosphere of architecture of these interiors is formed by the vividness of filtered light spots, the blurring of the appearance of actual materials and shapes, and an ambience of unclarity, the diffusion of the interior, of ambiguity, intangibility, separation, dynamism, variability, vibration. The projection capacity of atmosphere inside is based on producing the illusion of a fleeting ornament: one that is graphical, based on the contrast of light and shadow, and painterly, based on the colours of light, or similar to a watercolour, obtained via an impression of light's dimness, blurriness and haziness. These illusions can stimulate the imagination to form various associations, enhancing the projection capacity of atmosphere.

Hiroshige Andō Museum

Kengo Kuma, Bato, Japan 2000

Light enters the interior of the foyer sifted through meshes of laths of Japanese redwood. These meshes are located in two layers of the roof and on the walls, on several sides of the interior. They are either freestanding or abut the walls which are made from translucent glass. They filter side light that enters from the side of a bamboo garden, side light—from the side of the gateway of the entrance and top light. The translucent walls and a floor from polished *Ashino* stone are perfectly smooth surfaces, which produce multiple mirror-like reflections of side and top rays, which are sifted through the meshes. The reflected fragments of the interior and the exterior vibrate along

Hiroshige Andō Museum



Phot. 95



with the rays. The exposure includes both the openness of the interior to light and its openwork isolation. There is a dominant impression of the space being dotted with small points of light and the diffusion of the appearance of the interior (this is the reason why Greg Lynn called Kuma's architecture 'pointist', referencing the paintings by Georges Seurat). Filtering, reflections of light and shadow, and mirror-like reflections produce an impression of the disappearance of the actual shapes of the interior.

The atmosphere of the architecture of the museum's foyer is thus created by the vividness of light spots produced by light sifted through meshes, the blurring of the appearance of the actual shapes of the interior, an ambience of unclarity, ambiguousness, uncertainty, unreality, dynamism, variability, a feeling of transience or enclosure, but not isolation. The projection capacity of the atmosphere is based on producing an illusion of a fleeting, vibrating and travelling graphical ornament, associations with heavy rain, strings of rain and a pointist painting.



Notre-Dame de Pentecôte Church

Franck Hammouténe, Paris, La Defense, France 2001

Side light enters the single-space interior of the church via a glazed altar wall from the north (with a slight turn towards the east). The glass of this wall is matted, whitish, framed by an asymmetrical cross with thick beams and narrow fastenings. In the cuboid interior, this wall carves a milky bright rectangle of brightness that is crossed by an asymmetrical cross. Almost the entirety of the glazed wall is framed by a vague outline of the head of Christ on the cross, drawn by an expressive line from steel rods. The drawing, suspended on a grid of vertical rods, is actually located in front of a window as an independent sculpture, yet when viewed from inside it produces an impression of dividing a single-colour stained-glass window, as the outline is visible because of sunlight that is absorbed and ran through a filter, which creates the background of the drawing. At sunrise, the glass can intercept direct rays and filter them, producing a more intense and warmer brightness from the right side of the window. However, during the day, the glass absorbs and partially passes northern light into the interior. This light is stable, scattered on the celestial sphere, cool and uniform.

The atmosphere of the architecture of the interior is largely built by the light of the altar wall with the sculpture as a stained-glass window. The absorption of light delicately blurs the appearance of actual materials and shapes while also exposing the reflection of the seats, the floor and the interior's metallic elements. The light absorbed in the filter of the glass produces an impression of being condensed and materialises as a boundary, a wall of the interior. Thanks to light, there is an ambience of the separation of the space of the nave from the exterior while

Notre-Dame de Pentecôte Church





Phot. 99

also linking it with the space of the celestial sphere. The strong projection capacity of this atmosphere is based on exposing a watercolour-like dimness, blurriness and haziness of light, as well as an illusion of the materialisation of a layer of light in the altar wall. Its milky brightness produces an illusion of a brightly illuminated cloud and can bring to mind numerous associations linked with metaphysics and religious symbolism.



Phot. 100



Phot. 101

VI. 4. Exposing the Space of the Interior— Density of Space, Unclarity, the Forest

There are interiors in which sunlight exposes their space. In such interiors, humans focus their attention on their space, and sometimes do not notice their boundaries as they disappear in the dark or the complexity of the structure that fills the space and intercepts light. This exposure of space in the interior is conditioned by a specific relationship between architecture and sunlight. It is not rare, as it is almost always present in interiors that are open from the top and filled with the structure of atmospheric precipitation: rain or snow. This precipitation forms a spatial structure, built from moving water droplets or snowflakes. As these elements are perceivable by man in the interior, he can better see the space of the interior as its volume and infill. This is why when exposing the space in the interior it is best to use those activities of architecture that do not expose the boundaries of the interior, do not create its apparent diffusion nor any ornaments from filtered light, but instead operate within the space of the interior: on its various structures (suspended or standing). This is facilitated the most by: complete penetration, carving and breaking. Side, dynamic light that enters the interior from at least two sides, as well as top, static light, are the most suitable for this.

The atmosphere of architecture of these interiors is formed by the vividness of the volume of the interior (either of its fragment or its whole), the blurring of the boundaries of the interior, the population of space with elements, an ambience of density, of the boundlessness of the interior, of tension, enclosure and openness. The projection capacity of atmosphere is primarily based on producing the illusion of the forest.

Kiasma Museum, stairwell

Steven Holl, Helsinki, Finland 1993–1998

Side light enters the stairwell filtered via a semi-translucent wall panels, making it impossible to look outside and exposing the filling of the interior's space. Light from overhead further exposes the structure of the stairs: the jagged profile of its runs, the space between the runs and the railing. The atmosphere of architecture in the interior is produced by the vividness of its volume—the structure of space with the depth of the space between the runs and the weakening of the articulation of its walls, which produces an impression of the blurring of the clear boundaries of the interior and the densification of its space while exposing its depth. The interior gains an ambience of density, of a boundless depth, tension between the structure of its space and the boundary partitions. The projection capacity of the atmosphere is based on optical illusions and associations produced by the spatial layout of dark and bright elements of the interior and the depth of the structure they form.

Kiasma Museum, stairwell



Phot. 102



Phot. 103

General Education School Complex, Pedagogical Library



Fot. 104

Phot. 105



General Education School Complex, Pedagogical Library
Biuro Architekt Kaczmarczyk, Sucha Beskidzka, Poland 2002–2006

Inside the foyer on the upper level of the school there is a visible structure of the interior's space, formed by four black cuboid masses, placed on top of each other with slight shifts. Inside the masses are lecture halls (each with a height of almost five metres and proportions close to cubes). However, they form closed boxes in the space of the foyer, populating its interior. Side light exposes the slits between the masses and exposes their volume. The interior is entered by side light carved from windows in walls from three sides and light from the top from overhead by a skylight. The relationship between architecture and light exposes masses that populate the space of the interior and thus—increase the density of the space of the foyer. The atmosphere of architecture is created here by the vividness of the interior, the exposure of the structure of the space (the slits between the masses and the masses themselves), blurring the boundaries of the interior, populating the space with elements, an ambience of density, tension. The projection capacity of the atmosphere is based on producing associations arising from the space's structure, such as associations of the interior being a gigantic box filled with other, smaller boxes.⁵⁷⁴

⁵⁷⁴ See: B. Stec, *Maniera tenebrosa, czyli o autentyczności w architekturze c.d.*, "Architektura & Biznes" 2014, no. 6 (263), p. 82–87.

Viikki Church



Phot. 106



Phot. 107



Phot. 108



Phot. 109

Viikki Church

JKMM, Helsinki, Finland 2005

The interior of this single-nave church is predominated by tempered brightness that is sufficient to expose the natural colour of wood on the boundaries of the interior and its furnishings. Direct rays enter it through the window, which runs along the entire width of the southern wall and is equipped with translucent glass panes. This window carves light in a rectangular belt that is slightly taller than a person, which is a narrow fragment of the tall wall. Light rays enter the interior also by two windows in the upper corners of the eastern wall (which has an entrance and is located opposite the altar). They illuminate the spatial structure of wooden posts suspended underneath the ceiling in the entire part of the interior's space. The window in the south-eastern corner lets in rays from the side and top, broken in the structure of the opening. The window in the north-eastern corner channels side and top rays and introduces them into the interior in a scattered and directed form. The atmosphere of architecture is created by the vividness of the volume and density of the interior, the blurring of its boundaries, the population of space with wooden posts, an ambience of density and tension. The projection capacity of the atmosphere is based on associations with a forest.⁵⁷⁵

⁵⁷⁵ In Plummer's classification this interior belongs to the 'forest' category, as it 'transforms' sunlight from outside into 'forest light' in the interior. H. Plummer, *Nordic Light...*, *op. cit.*



Phot. 110

Louvre Lens Museum



Phot. 111



Phot. 112



Phot. 113



Phot. 114

Louvre Lens Museum SANAA, Lens, France 2009–2012

The oval interior of the museum's foyer is entered by side light from all sides, and top light—at the site of winding stairs that lead to a neighbouring interior below. Side light enters through walls of translucent glass. Top light is sifted through an openwork mesh in a circular, flat skylight in the ceiling and rests on the stairs, producing a pronounced ornament and incorporating them into the foyer space. Side light and top light is scattered in the interior on the walls of masses that populate the space. These masses have irregular shapes resembling cylinders with various proportions. They are lower than the height of the foyer and are translucent. They thus resemble capsules that highlight individual locations for different functions of the foyer. The atmosphere of architecture is created by the vividness of the volume of the interior, the blurring of the interior's boundaries, the density of the space, the ambience of density, the boundlessness of the interior and tension between its structures. The projection capacity of atmosphere is primarily based on associations produced by glass capsules.⁵⁷⁶

⁵⁷⁶ In Plummer's classification this would belong in the 'veils of glass' category (*ibidem*).

VI. 5. Exposing the Blending of the Interior with the Exterior—Openness, Spaciousness, Lightness

There are interiors in which sunlight exposes their blending with the exterior. In these interiors, humans look outside of their boundaries into the distant exterior outside. This openness can be apparent—only to the sense of sight, or actual, verifiable by touch. The blending of the interior and the exterior is achieved as a result of a specific relationship between the architecture of the interior with sunlight. The exposure of the blending is best served by those activities of architecture that do not expose any element of the interior (neither its boundaries nor its space) and do not result in spots of filtered light, merely accentuating the view of its most distant places or of the surroundings. There are two such activities: complete penetration and the carving of indirect light. Side light, which is dynamic and enters from several sides, is good at exposing the blending of the interior and the exterior as it allows one to look into the most distant places, outside, into neighbouring interiors. In this exposure, the interiors under study are of course extensive and in extreme cases extend towards the horizon, or are only apparently larger or not bound from overhead.

The atmosphere of architecture of these interiors is formed by the vividness of the blurring of their boundaries, the vividness of the view of the most distant places or the surroundings, an ambience of openness, spaciousness, illumination, lightness. The projection capacity of this atmosphere is based on the scenographic framing of the view as a scene, which results in a strong association with freedom.

The blending of the interior and the exterior is associated with the tradition of the glass house—an interior with all of its sides made from translucent glass, which allows a full view of the surroundings from all sides (classic examples include: Phillip Johnson's Glass House and the Farnsworth House by Mies van der Rohe). One contemporary example of such an interior is the glazed veranda of the House of Water and Glass designed by Kengo Kuma on an oceanic cliff in Atami (1995). Thanks to complete penetration, the veranda has a distant view of the Pacific Ocean. The oval shape of the interior is formed by walls of translucent glass and the platform on which the veranda rests is partially filled with water, hence the side light from several sides is reflected multiple times: the water surface produces a mirror-like reflection from below to the sides and upwards in the direction of a ceiling from metal panels that further scatters it.

Hiroshi Senju Museum

Ryue Nishizawa, Karuizawa, Nagano, Japan 2010

The museum hall is entered by sunlight from all sides. Primarily due to courtyards that, although not a part of the museum, are outside the hall as its neighbouring, separate interiors outlined by walls from translucent glass. The external walls of the hall and the museum are matte and fitted with a screen from a bright textile material, which is why they partially absorb side light. From the side of the courtyards, the interior is entered by top light from all sides, which is static and optimal for exhibiting paintings. This light also exposes the blending of the interior of the hall with the nearby interiors and, through them, the hall becomes somewhat open from overhead. This exposure enhances the spatiality of the interior and even makes it appear bigger.

Hiroshi Senju Museum



Phot. 115



Phot. 116



The atmosphere of the interior is created by the vividness of the blurring of the interior's boundaries, the vividness of the view towards neighbouring interiors (their spaces and upward openness), an ambience of openness, spaciousness, illumination and lightness. The projection capacity of the atmosphere is based on scenographic framing of the view as a scene (this impression is also enhanced by the garden in the courtyard, composed as a living ikebana).



VI. 6. Exposing the Physical Properties of Sunlight

There are interiors in which sunlight exposes its nature. In such interiors, people focus their attention on the sunlight itself—its intensity, radiance, direction, colour, position relative to the cardinal directions, its movement through time and space. The conditions for this exposure are created by a specific relationship between the architecture of the interior and sunlight. All activities of architecture and types of light can be used for it: both side, dynamic light, and top, static light. Due to the exposure of the apparent journey of light over time and space and the illumination of the celestial sphere, we distinguish orchestration, which is the result of a single method of operating with light (which can be complex) over time. The atmosphere of such interiors is based on the complexity of choreography and orchestration with the exposure of the physical properties of architecture.

Side light and light from the side and top, which is dynamic light: direct, variable, diverse, warm and directed, exposes an ambience of variability, of the flow of time, of closeness, directness, momentary intensity in the interior. The projection capacity of the atmosphere created by this light in the interior is primarily based on choreography—exposing how light travels over time and in the interior and thus—of astronomical phenomena associated with the apparent journey of the Sun along the ecliptic, the movement of Earth around the Sun and its rotation along its own axis, etc.

Top light, which is static, scattered, stable, uniform and cool, exposes an ambience of refreshment, clarity, explicitness, of distance and restraint. The projection capacity of an atmosphere created by this light in the interior is based on inducing metaphysical states, producing associations with the cosmos and the symbolism of the light of the celestial sphere.

The exposure of orchestration and choreography turns the interior into a specific light instrument. The interior of La Rocca Pisana villa is an excellent example of this. It was designed by Scamozzi and built in 1576 in an open landscape near Vicenza. It continues to stand there today, as a material and mystical node of this landscape.⁵⁷⁷ On the example of La Rocca Pisana we can explain the effect of the light instrument achieved in this interior using a proper relationship between architecture and sunlight.

Historical example: La Rocca Pisana

In the interior of this villa, particularly in its central, cylindrical section, light allows us to treat it as a sun clock on an architectural scale.⁵⁷⁸ The villa, in its proportions, is close to a cube and has in its centre a cylindrical interior covered with a dome and an oculus. From the cylindrical interior of the villa we can see openings facing the four cardinal directions⁵⁷⁹—through

⁵⁷⁷ See: B. Stec, *Węzeł krajobrazu...*, *op. cit.*, p. 55–59.

⁵⁷⁸ Cf. B. Stec, *Powtórne spojrzenie*, interview with Kurt Forster, “Architektura & Biznes” 2005, p. I, no. 5 (154), p. II, no. 6 (155).

⁵⁷⁹ In La Rocca, each of the four facades of the house corresponds with the four cardinal directions, while the frontal facade with the stairs faces south, which is Ostro in the Wind Rose and, respectively: the two side facades to the east and west (Levante and Ponente), and the back facade faced north (Tramontana). As the building has a square-shaped plan, its diagonals outline the precise intermediate directions: northeast (Greco), southeast (Scirocco), southwest (Africo) and northwest (Maestro). This orientation of La Rocca is ‘rotated’ by 45 degrees relative to the placement of Palladio’s La Rotonda. Cf. F. Barbieri, *La Rocca Pisana di Vincenzo Scamozzi*, Vicenza 1985.

barrel-vault-covered vestibules. These vestibules end in *serlianas*⁵⁸⁰ on three sides of the villa, and from the side of the entrance—by a portico. The cylindrical interior is simultaneously entered by top light from overhead via the oculus, side light from four sides (also the cardinal directions), carved, channelled and scattered by the vestibules (*lume di lume*), side light through oval windows from the neighbouring spaces on the first floor, which it enters directly through windows in their walls⁵⁸¹ (*lume di lume*), side light from below through a grate, linking the interior with the nearby cellar, illuminated from its sides (channelled, scattered *lume di lume*). Each light has a different dynamic, colour tone, direction and dynamism.

The composition of several means of operating with sunlight in the interior results in a unique, harmonious and intense orchestration of light. It allows the person in the interior to tell the time of day and year. Dynamic side light that acts in a centrifugal manner and the static top light that acts centripetally stabilise an impression of saturated balance, harmony and order in the interior, producing the unique atmosphere of the interior. Top light, which enters through the oculus, exposes the shape of the interior and lets in the brightness of the celestial sphere at the zenith, which produces an impression of maintaining daytime brightness in the interior. The dome with eight ribs synthesises the relationship between architecture and sunlight.⁵⁸²

In La Rocca we can also see the choreography of light, for instance in the two stairwells, the eastern and western, which are symmetrically placed on the sides of the villa's entrance. The eastern stairwell is entered by side, eastern rays directly, leaving traces in the form of travelling spots of light on the stair treads (an impression of moving keys or strings of a musical instrument). A similar effect of choreography exists in the afternoon in the western stairwell. This choreography also takes place in the interior of the entrance portico, where travelling rays produce the spectacular movement of the strong shadow of the colonnade. The atmosphere of orchestration and choreography aided members of the household in their everyday duties as landed gentry.

⁵⁸⁰ In La Rocca, the balusters of the stone railing have a square-shaped cross-section instead of a circular one as in most of Scamozzi's buildings. This archaism is coherent with the austere, blocky character of the whole. The serliana is located in the face of the facade, and thus makes it unable for people to go beyond the thickness of the villa's wall.

⁵⁸¹ At dawn eastern rays enter directly into the chapel, located to the east on the upper floor, and from it, through an elliptical window (inside the villa) they reach the central interior, which is poorly lit at this time of day by the oculus. The central and cylindrical interior scatters these rays on its curved walls, increasing its brightness. From here, scattered light enters the kitchen spaces below via a stone grate.

⁵⁸² The villa also acts in the landscape interior as its internal mass, oriented and compact (according to Scamozzi it was 'oggetto autonomo'—a complete and autonomous object that is deliberately introvert, and that has a dialectic position relative to the interior). The compact character of the building enhances its isolation in the landscape interior, accentuated by the perspective of a rising road, large entrance stairs and the loggia. Sunlight stabilises the balance between the centrifugal action of the large stairs, laid out in a fan-like manner in front of the entrance and the centripetal action of the loggia, fitted with a column portico (the sharp shadow of the colonnade is always directed inside the villa, the shaded cave of the loggia captures the person from the southern brightness into the deep and refreshing shadow of the interior). The result is a restrained and balance elegance and a coherence of form. See also: F. Barbieri, *La Rocca Pisana di Vincenzo Scamozzi*, *op. cit.*

Sanctuary of Merciful Love in Collevalenza



Phot. 119

VI. 6.1. Orchestration

Orchestration is the result of different means of operating with light in the interior at the same time. The atmosphere of the interior is produced by the vividness of the composition of these methods and the interplay of their results, the vividness of different tools of operating with light (these tools can be compared to musical instruments) and their simultaneous activity (which can be compared to the sounds produced by instruments), an ambience of complexity, harmony, rhythm, musicality and tension. The projection capacity of such an interior is based on producing impressions of musicality in the *vivace* or *moderato* tempo.



Phot. 120

Sanctuary of Merciful Love in Collevalenza

Julio Lafuente, Collevalenza (Peruggia), Italy 1963–1967

Before the eyes of the person in the interior of the main nave there plays out an orchestration of light formed by the composition of various methods of operating with sunlight: the forcing through of top light from overhead by slits that have the shape of a cross, the channelling of top light through a round skylight at the intersection of the slits, the sifting of side light by two convex semi-cylinders with gaps between bricks from the side of the altar, the filtering of side light by colourful stained-glass windows in the presbytery and transept, the carving of side light by windows in the form of slits in the sides of the interior, the slipping of side light on the surfaces of cylinders—the masses of the boundary of the interior, the scattering of top light in the interior of the cylinders, from which it enters into the nave⁵⁸³ (*lume di lume*), the slipping of light admitted by slits near the upper edge of the cylinders of the side chapels along the lids of these cylinders, from where it enters into the interior of the nave, the admittance of top light from below via openings to the nearby interiors of the lower church (illuminated with sunlight from overhead via skylights)⁵⁸⁴ and the sifting and filtering of light via a cylindrical rosette with a stained-glass

⁵⁸³ Thirteen lunettes delicately extend from the mass of the church above its roof. The lunettes are closed with a flat glass lid and directed outwards from the church axis, namely to the east and west.

⁵⁸⁴ Skylights in the form of glazed cones form a wreath above the walkway of the lower church, which is wider than the upper one. Most skylights (seven) are from the western side of the church and only two are from the east,



Phot. 121

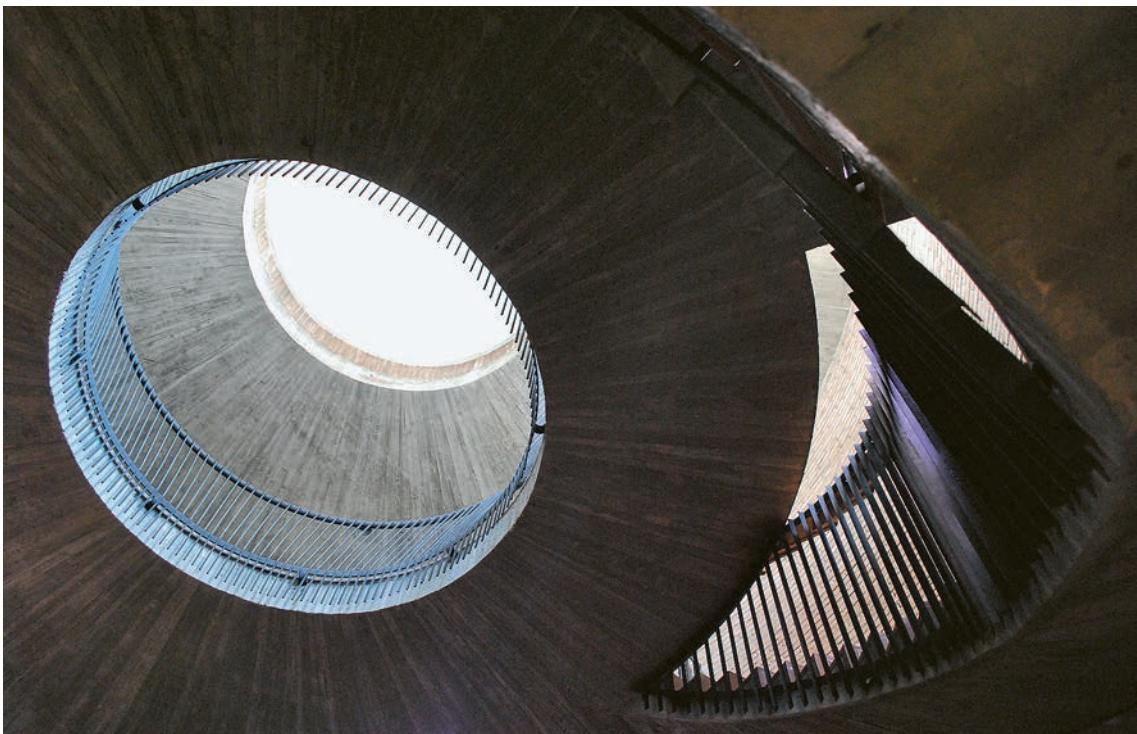
window depicting Christ on the Cross above the entrance to the church. The methods of operating with sunlight in the interior of the nave are only the elementary instruments of the rich orchestration, as they are further enhanced by small accompanying operations in the form of admitting light via small slits and scattering it on surfaces that reflect light. During the day, sunlight in the interior is sufficient for prayer and liturgy. The entrance to the church faces south, while the altar is to the north. The travel of sunlight during the day either enhances or weakens individual methods of operating with light. As a result of this rich orchestration, an extraordinary harmony stabilises in the interior: a tension of the tempered brightness of the nave and tempered darkness of the chapels in cylinders.

The atmosphere of the interior of the nave is the result of compiling numerous methods of operating with light and the interplay of their results in the interior. It is created by the vividness of different tools (instruments) of operating with light and their simultaneous activity (sounds), an ambience of complexity, harmony, rhythm, musicality and tension. The projection capacity of this atmosphere is based on producing an impression of musicality in the *vivace* tempo.

exposing the eastern and western side of the walkway. The skylights are directed centrifugally relative to the axis of the church. The conical glass domes produce mirror-like images and scatter light.



Phot. 122



Phot. 123

Mortensrud



Phot. 124



Phot. 125



Phot. 126

Mortensrud

Skodvin & Jensen, Oslo, Norway 2010

Before the eyes of the person standing in the interior of the main nave of the church there plays out an orchestration of light via a composition of numerous methods of operating with sunlight: the direct penetration of sunlight and its filtering via a coloured stained-glass window in the altar wall, of the admittance of direct light via a wall from translucent glass, the sifting of top and side light via an openwork wall from hewn stone, the scattering and channelling of light from the top and side by a spatial skylight, the scattering and bending of side light on a brick barrel vault and the filtering of light via an illuminated vestibule from the side of the entrance to the church (*lume di lume*). The methods of operating with light also include small accompanying operations in the form of scattering on the metallic surface of a gabled roof. Despite the simple shape of the interior, a rich orchestration of light plays out inside it: bright voids in the openwork walls contrast with darkened stone (dark grey by nature), the colourful light from the stained-glass window behind the altar creates a fleeting, painterly ornament. The travel of sunlight either enhances or weakens the different methods of operating with light. An atmosphere of diversity is created, of modesty and luxury combined, one that is both cheerful and refreshing.

The atmosphere of architecture here results from the compiling of numerous methods of operating with light in the interior and the interplay of their results. It is formed by the vividness of different tools of operating with light (instruments) and their simultaneous activity (sounds), an ambience of complexity, harmony, rhythm and melody. The projection capacity of atmosphere is based on producing impressions of musicality in the *vivace* tempo.



Phot. 127



Phot. 128

VI. 6.2. Choreography

Choreography is the result of one method of operating with sunlight (which can be complex) in the interior over time. The atmosphere of such an interior is created by exposing its different places as time goes by, as a result of either the apparent movement of the Sun along the ecliptic of the celestial sphere and the weather around the interior.

Choreography can be explained easily on the example of two interiors designed to expose it. They are historical interiors and, similarly to La Rocca Pisana, highly distinct for the atmosphere type under discussion and as such have been used to illustrate the matter.

Historical example: Villa Girasole, Angelo Invernizzi 1929–1935

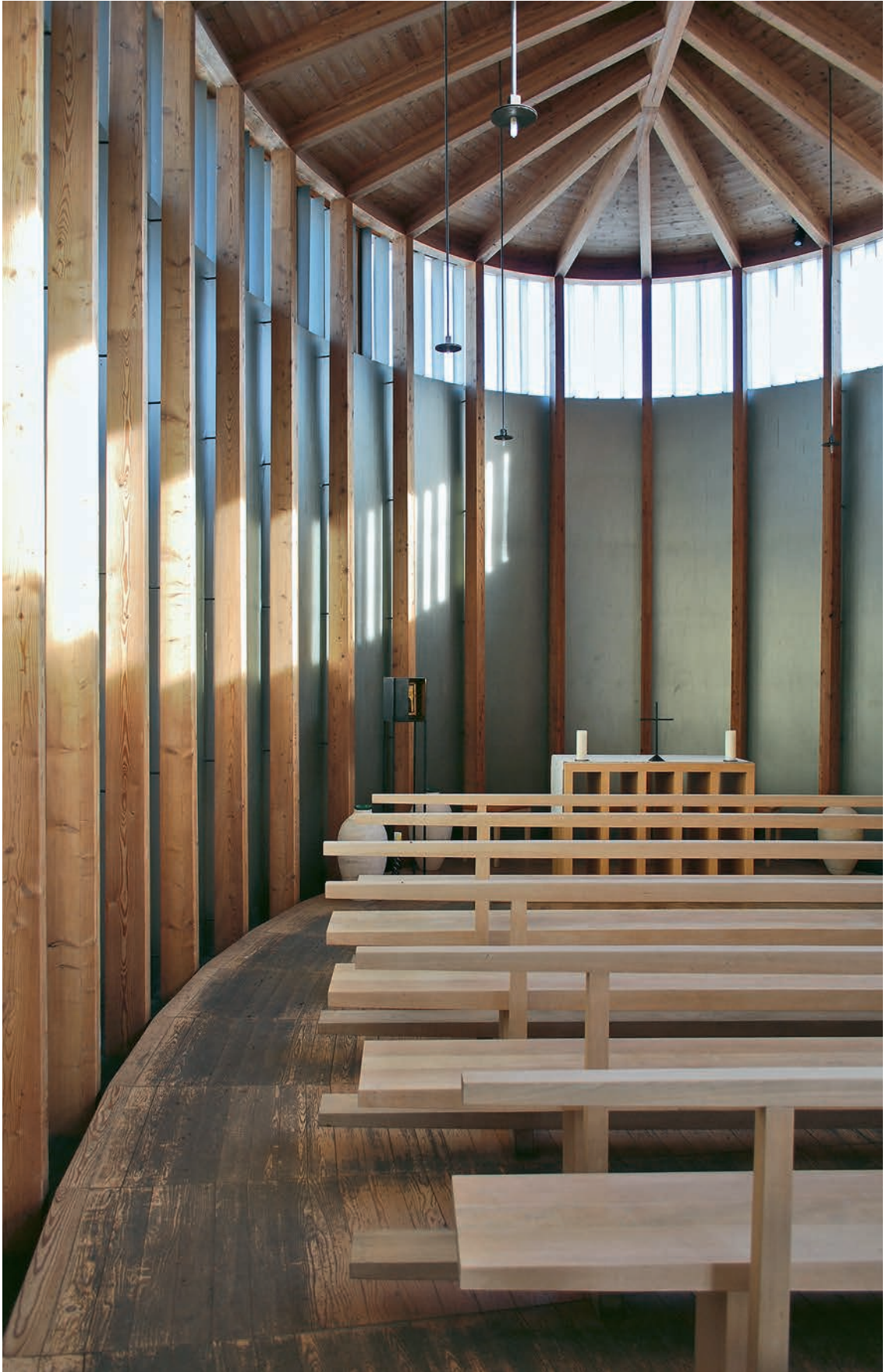
Villa Girasole (Sunflower Villa) was designed by engineer Angelo Invernizzi in Merellise near Verona in 1929. Before the eyes of the person on the villa's terrace there plays out an extraordinarily unnatural choreography of light. Due to complicated machinery, the L-shaped house rotates along its axis as time goes on, with the same speed as the Sun moves along the horizon in its apparent journey. This means that the villa's rotation by 360 degrees takes place over nine hours and twenty minutes, and the villa rotates by four millimetres every second. Due to the villa's rotation, side light enters directly to a specific interior, such as the terrace, is stabilised along the horizontal direction and only moves along the vertical. In this case, the interior is fully subjected to its relationship with sunlight in its idea and construction. The entire mass of the house acts as a peculiar handle of a sun clock in its landscape interior.

Tower of Shadows, Le Corbusier, 1950

The Tower of Shadows, designed by Le Corbusier for the Capitol in Chandigarh and built after his death in the 1980s, presents an exceptionally suggestive choreography of light that can be observed in the interior of the axial layout of Chandigarh's Capitol. The tower is located on the main axis of the Capitol, between the Court of Justice and Parliament buildings. Its two lower storeys are rotated by 45 degrees relative to the Parliament (and relative to the urban grid of the layout), while the uppermost storey is parallel to the Parliament (and thus the walls of the first two storeys face directly towards the north-east, the south-east, south-west and north-east). The Tower of Shadows is a completely openwork structure intended solely to register the game of light and shadow in its structure. The change in the zenith angle and azimuth angle of light causes a ceaseless change in the game of light and shadow as time goes by, particularly on its vertical louvres. To the person in the urban interior of the Capitol it is a building-sized sun clock. The atmosphere of architecture is formed by the projection capacity of choreography, which is based on exposing the sun as the 'master of shadows'.⁵⁸⁵

⁵⁸⁵ P. Valery wrote: 'I was just talking about the sun.... Everything that we see is composed by it, and I consider composition to be the order of visible things and the slow transformation of this order, which is the entire spectacle of the day: the sun, the master of shadows...' (transl. – B.S.) [from:] F. Venezia, *La Torre d'ombre...*, *op. cit.*, p. 101.

St Benedict chapel



Phot. 129



Phot. 130



Phot. 131



Phot. 132

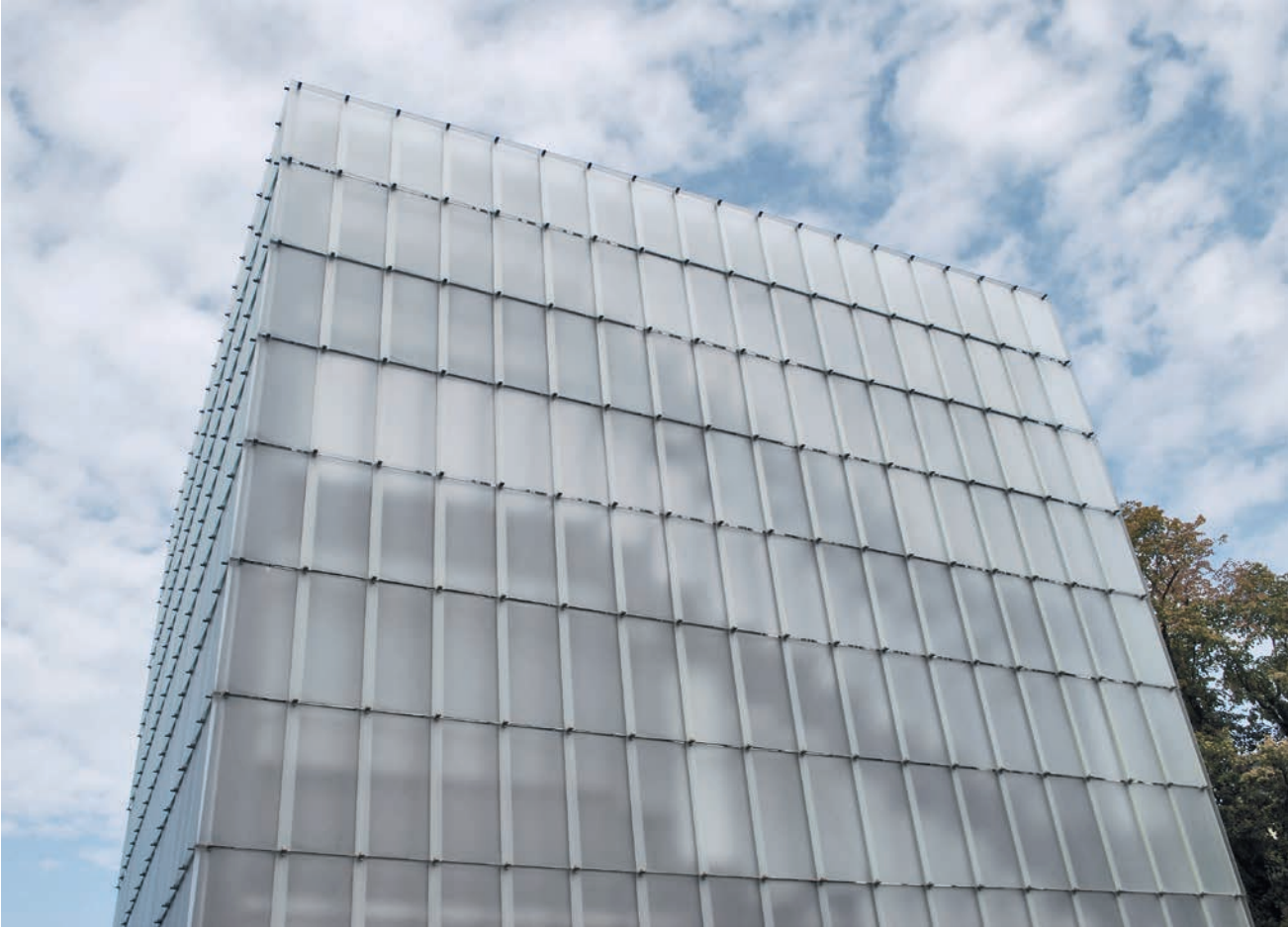
St Benedict chapel

Peter Zumthor, Sumvitg, Switzerland 1988

The choreography of light in the oval interior of the chapel is based on a single complex method of operating with sunlight in the interior: the carving of side light from all sides using a window that stretches in a ring-like fashion along the outline of the interior (on a floor plan resembling one half of a lemniscate) and the sifting of his light using vertical louvres with wooden laths. The ring of the skylight is placed at the very top of the wall, immediately below a ceiling with a wooden truss that resembles a beech leaf in its structure. Side light slips along the surface of the ceiling and exposes its texture and the colour of natural wood. On the wall there rests a carved spot of delicately sifted direct light. It takes on the form of light arches with always upwards-facing tips, which is a result of the oval shape of the interior and the direction of the rays (always from on high). To the person present in the interior for a longer time, during the day or a clear moonlight night, the luminous arch moves along its northern wall from the back towards the altar (on the eastern side) and from the bottom to the top. The light and its reflection depends on weather, the time of year, day and night. The choreography of light co-creates the atmosphere of the interior in an essential way.

Kunsthaus Bregenz

Phot. 133



Phot. 134



Kunsthau Bregenz

Peter Zumthor, Bregenz, Austria 1990–1997

The choreography of light in the exhibition space on the upper level is based on a single complex method of operating with sunlight inside it: scattering and channelling of side light and top light in a duct between the suspended ceiling and deck, the filtering of light entrapped in the duct using matte glass panels (absorption) and the openwork structure of the suspended ceiling (sifting) and filtering (upon admittance) of side light via the glass curtain wall of the building, which houses the interior under study. The complexity of operating with light is a result of the structure of the duct (whose walls are light filters). The duct runs above the entire exhibition space and abuts its walls and partitions. It is entered particularly by side light, which is dynamic, and enters from the south, east and west, as well as top light, which is scattered and weak, reflected from the glass curtain wall. As a result of the complex method of operating with light, the interior is entered by scattered and filtered side and top light from all sides from overhead. It slips along the surface of the walls in place where the ceiling touches the wall and exposes the depth of space. To the person standing in the interior for a longer time, this light will appear to constantly move along with the apparent journey of the Sun along the ecliptic and to change following the weather outside. We can observe the change in its colour on the concrete wall surfaces, which is smooth enough that it delicately scatters light in reflections.⁵⁸⁶ Sunlight is admitted into the exhibition spaces on the second and third floor by the same principle. However, the relationship between architecture and sunlight and thus also the choreography of light takes on a slightly different form on each floor due to the change in the relative elevation of the interior. The atmosphere of the interior is essentially co-created by the choreography of sunlight.

⁵⁸⁶ See: P. Zumthor, *Kunsthau Bregenz...*, *op. cit.*, p. 13.



Brother Klaus Chapel



Phot. 136

Brother Klaus Chapel, landscape interior
Peter Zumthor, Wachendorf, Germany 2007

In the landscape interior of Ranf, the chapel is a tower—the tallest freestanding mass standing on an expansive field. The mass is bright due to the sandy colour of concrete and the bright colour of the metal on the door. On a sunny day, the person in the interior can treat the tower as a light instrument: the length and direction of light in the field point to the time of year and day. When we walk around the tower we can still see a different width, which results from the pentagonal and irregular floor plan of the tower. Thus, every time of day has its own articulation in the form of an illuminated wall and shadow. The choreography of light considerably co-creates the atmosphere of this landscape interior.



Phot. 137



Phot. 138

Church of Christ, Hope of the World



Phot. 139



Phot. 140

VI. 6.3. Orchestration and Choreography

Church of Christ, Hope of the World *Heinz Tesar, Vienna, Austria, 2000*

The single-space interior of the church is entered by: side light from four sides through round openings and two rectangular windows along the edges, light from the side and top from two sides—via two glazed and concave corners of the mass and top light from overhead—via a skylight in the flat ceiling. The side light that enters through round openings large and small, is channelled in the thickness of the wall and thus enters the interior typically in scattered form. The larger round openings are windows that allow a view of the surroundings and the sky, in addition to carving light. The smaller round openings facilitate the forcing through of light and its scattering in the thickness of the walls. The placement and size of the openings, particularly round ones, causes the exposure of the celestial sphere and the current brightness of the sky associated with the time of day, year and the weather—which is the orchestration of light. The ordered geometry of round perforations placed evenly across the entire surface of the walls can be interpreted as the symbolic light of the universe. Special symbolism and metaphysical meaning, exposed by orchestration, is given to the light from the top skylight, which carves light in an S-like pattern of a bent flame. This light, directed towards the southern corner, cuts the ceiling diagonally while framing and unifying the space (the zone of the altar and the circles of pews for worshippers) and makes



Phot. 141



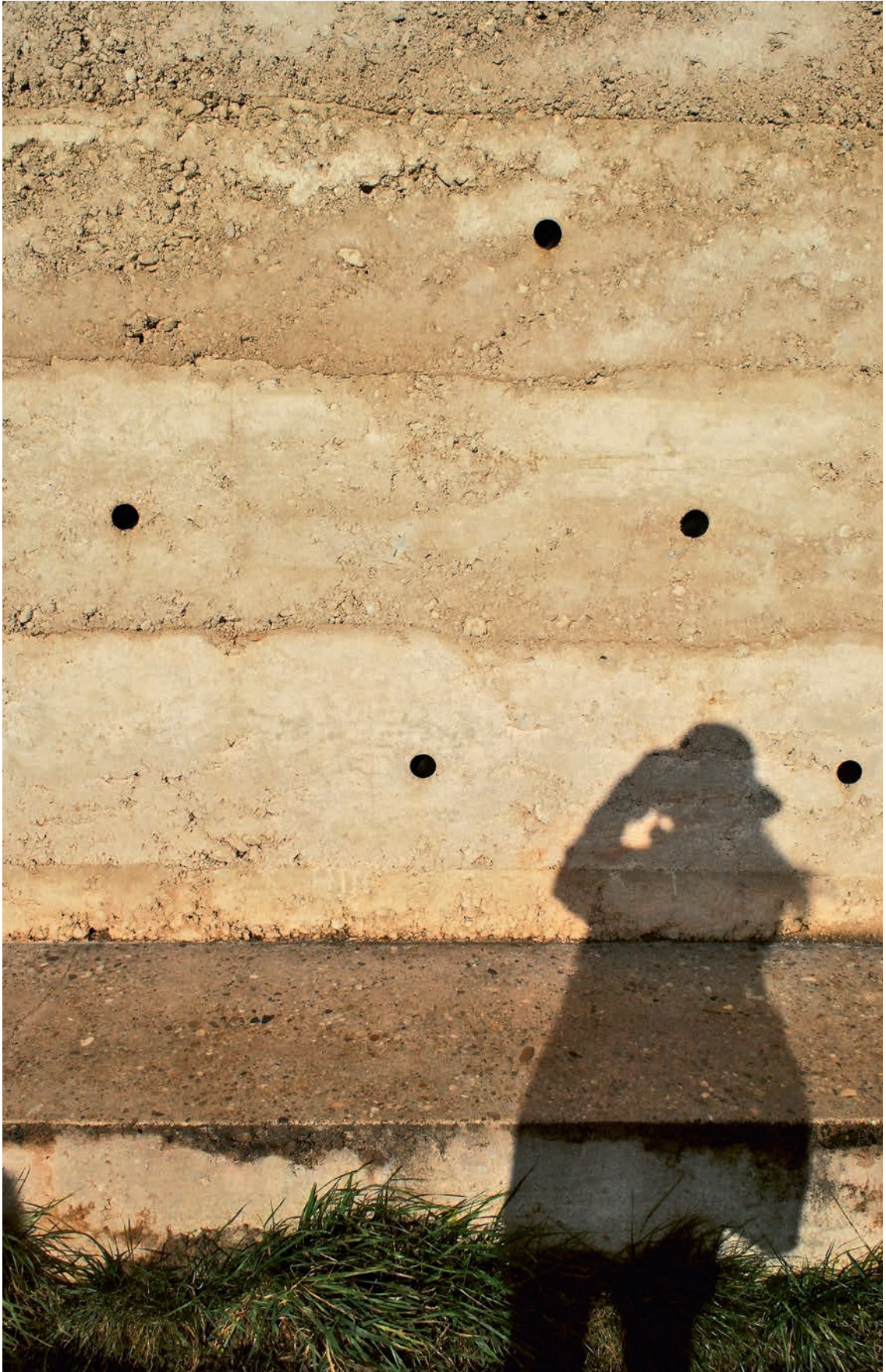
Phot. 142

the interior dynamic. It is the only ornament of the ceiling, which gives it rank that is ascribed to the historical vaults of religious interiors. The orchestration is also aided by light that enters directly from the windows near the entrance and the glazed corners. It exposes particularly the time of day and the weather.

On a sunny day, the choreography of light is exposed in the interior: a travelling, intense brightness that beams from the round openings, but primarily the travelling and directed beam of direct light from the southern glazed corner. The exposure of this beam is even stronger as it is special, as the second glazed corner faces the north (with a slight shift to the east). The placement of the altar near the eastern wall makes the beam flow downwards and from the right side, diagonally, towards the altar, travelling along the altar wall and exposing this place, which is the holiest in any Christian temple.

Thus, the orchestration of light and its choreography significantly co-create the atmosphere of this interior, together with its metaphysical meanings and symbolism.

The case studies presented above confirm the dependence between relationship of sunlight and architecture and the atmosphere of the interior. The taxonomy of elementary architectural methods of operating with sunlight has been confirmed to be a useful tool in describing and analysing the atmosphere of architecture. This means that the taxonomy can be applied in architectural design, facilitating the selection of appropriate methods of operating with sunlight so as to expose specific physical properties of architecture and sunlight, and thus attain a new physical property in the interior—atmosphere—as one intends.



Phot. 143

Summary of Findings, Conclusions

This work presents and characterises the dependence of the relationship between sunlight and architecture and the atmosphere of the interior. It also demonstrated the possibility of using the study's results in architectural criticism. The suitability of the study's use in architectural design has been justified. The following partial results of the study have contributed to achieving the objective of this work.

First, the author defined the objective of the study. It was assumed that it was: sunlight in the interior studied in its relationship with architecture in the aspect of the atmosphere of architecture. The author analysed the meaning of the terms: light, interior, architecture and atmosphere of architecture, in addition to defining temporal and territorial spectrum for cases for analysis. The author discussed the state of research, which included publications that were cited and used in this work (Chapter I).

Further in the work, the author explored how the relationship between architecture and light is conditioned by physical, physiological, psychological and cultural determinants (Chapter II).

Afterwards, the author investigated the notion of the atmosphere as an aspect of studying the relationship between light and architecture (Chapter III). Based on an analysis of determinants, the author identified a specific property of the relationship between architecture and light, which was the mutual exposure of the physical properties of architecture and light. This property was adopted as the criterion of the atmosphere of architecture and appropriately justified. The three detailed criteria of evaluating this relationship have also been listed: impressiveness, ambience and projection capacity. This was a partial result of the study.

From the author's publication entitled *O świetle...*, the author carried over their original method and tool of studying light in the interior: the typology and taxonomy of elementary architectural methods of operating with sunlight in the interior, and the listing of the results of operating with light with the intent to expose the properties of architecture and light. This demonstrated the utility of this typology and taxonomy as a tool of describing the relationship between architecture and light in the interior.

Elementary architectural methods of operating with light in the interior have been listed and their typology has been proposed, pointing to three factors that condition every method of operating with light in the interior: the activity of architecture, the organisation of illumination and architectural tools. The following were distinguished as a part of this typology:

- **twelve activities of architecture:** admitting light directly: 1) via complete penetration; 2) carving; 3) forcing through; 4) isolation; reflection: 5) producing mirror-like reflections; 6) scattering and breaking; 7) scattering and bending; 8) scattering and slipping; 9) scattering and channelling; filtering: 10) sifting; 11) refraction; 12) absorption;
- **twelve categories of the organisation of illumination:** I light from the side from one or several sides; II light from the side from all sides; III light from the side from overhead; IV light from the side from below; V top light from overhead; VI top light from one or several sides; VII top light from all sides; VIII top light from below; IX light from the side and top from all sides; X light from the side and top from one or several sides; XI light from the side and top from overhead; XII light from the side and top from below;
- **twelve categories of architectural tools of operating with sunlight in the interior;** they are comprised of elements of the interior, as defined in the study's assumptions: PARTITION,

MASS and SPACE, which were detailed due to the following physical properties: opening, structure, material and shape; the mutual dependencies between each interior element and their physical properties resulted in a set of architectural tools used by the activity of architecture during a specific organisation of illumination.

To achieve the objective of the work, the author studied the results of operating with sunlight in the interior in terms of the mutual exposure of the physical properties of architecture and light, considered as a criterion of atmosphere in the interior. Afterwards, based on analysing the relationship between architecture and light in the works of Le Corbusier, John Pawson, Steen Eiler Rasmussen, Mieczysław Twarowski, Henry Plummer and Peter Zumthor, the author's own experience of architecture and references to the theory of atmosphere, the author analysed the dependence between results of operating with sunlight in the interior and the atmosphere of architecture. Six types of exposing the interior via the operation of sunlight in the interior were distinguished as a result and linked with atmosphere. It was concluded that specific and mutually different atmospheres of the interior are produced as a result of the different exposure of the physical properties of the interior (its architecture the sunlight that operates inside). Specific dependencies between exposure and atmosphere (studied according to previously defined criteria) were observed. As such, the exposure of:

- 1) THE MATERIALITY of architecture produces an atmosphere (in terms of impressiveness) of the vividness of the surfaces of materials, of diluted or condensed darkness; of darkness with a bright spot, of the vividness of the interior boundary's fragments, of the beam of light that stimulates (in terms of ambience) intimacy, focus, tension, mysteriousness, dramatism, enclosure, inaccessibility and (in terms of projection capacity) associations with shadowy depth and theatricality;
- 2) THE SHAPE of the interior produces an atmosphere (in terms of impressiveness) of the vividness of the geometry of the interior, tempered brightness, stasis, which stimulates (in terms of ambience) clarity, stasis, peace, quite, suffusion with light with a uniform tone and (in terms of projection capacity) associations related to 'I see what is, it is what I see';
- 3) THE FILTER STRUCTURE of architecture produces an atmosphere of (in terms of impressiveness) the vividness of the filter structure, the blurring of the appearance of actual materials and shapes of the interior, which stimulates (in terms of ambience) unclarity, ambiguity, intangibility, separation and (in terms of projection capacity), associations and illusions associated with spots of light and shadow; in terms of its exposure depending on the filter type, the following has been distinguished: a) an atmosphere (in terms of sensory of experience) of the vividness of contrasts between shadow and light, that stimulates (in terms of ambience) confusion and diversity and (in terms of projection capacity) illusions and associations of the interior being diffused and atomised or b) an atmosphere (in terms of sensory of experiences) of the darkening of the interior, the dimming of light, tempered brightness, that stimulates (in terms of ambience) mysteriousness and (in terms of projection capacity) the haziness or fogginess of the interior;
- 4) THE SPACE produces an atmosphere (in terms of impressiveness) of the vivid volume of the interior (either of its fragment or its whole), the blurring of the boundaries of the interior, the population of space with elements, which stimulates (in terms of ambience) density, boundlessness, a balance between openness and enclosure and (in terms of projection capacity) associations with the forest.
- 5) THE BLENDING of the interior with the exterior produces an atmosphere (in terms of impressiveness) of the vividness of distant places in the interior or its surroundings, the blurring of the visibility of the boundaries of the interior, that stimulates (in terms of ambience) openness, spaciousness, illumination, lightness and (in terms of projection capacity) associations of theatricality (view-frame-scene), and freedom
- 6) the INTERIOR AS AN INSTRUMENT OF LIGHT

- through orchestration, it produces an atmosphere (in terms of impressiveness) of diversity, complexity, momentary light beams, stimulating (in terms of ambience) variability, mobility, intensity, tension, musicality in the *vivace* tempo (in terms of projection capacity) associations of the pulsating brightness of the celestial sphere, a starry sky, the music of the spheres;
- through choreography, it produces an atmosphere (in terms of impressiveness) of the slow movement of sunlight (also during the night as light reflected from the Moon), slow changes in intensity, temperature, the colour of light, the uniformity of light; (in terms of ambience) a feeling of the flow of time (transience), uniformity, musicality in the *moderato* tempo; (in terms of projection capacity) associations with the choreography of light, of the journey of the Sun/Moon across the celestial sphere, of evanescence;

However, orchestration is a result of different methods of operating with light in the interior at the same time, while choreography is the result of a single method of operating with light in the interior (including a complex method) over time.

The presented dependencies were explained and illustrated on the basis of characteristic examples of interiors, including historical ones. The utility of the study has been verified via detailed analyses comprised of case studies (Chapters V and VI). In essence, this work retraces the cases featured in *O światle...*, by placing them in the broader context of the theory of atmosphere and by introducing certain changes arising from the adopted criteria of atmosphere evaluation (which were slightly different than in *O światle...*). It was demonstrated that the atmosphere of the architecture of the interior is co-created by specific exposure of the physical properties of the interior through light: materiality, shape, the filter structure, the space of the interior, the blending of the interior with the exterior and exposing the physical properties of light via architecture: orchestration and choreography (Chapter VI).

The work presents a listing and analysis of dependencies between the relationship of sunlight and architecture and the atmosphere. The author proposed to define the atmosphere of architecture produced in the interior via sunlight. The identification of the criterion of evaluating the relationship between light and architecture in the aspect of atmosphere can be considered an original argument in the discussion of atmosphere, and thus, about atmosphere generated by sunlight in the interior. This criterion is the mutual exposure of the physical properties of architecture and sunlight in the interior. Detailed criteria for the assessment of this exposure were defined: 1) the impressiveness of exposure, 2) the ambience of exposure, 3) the projection capacity of exposure. The criteria are characterised by an ease of application in the practice of designing architecture and urban interiors. It was observed that exposing human surroundings using light corresponds with essential phenomena described by the theory of atmosphere. For instance, the use of light in building the atmosphere of stages has been noted. Just like in a traditional theatre, in architectural and urban interiors, sunlight has an exceptionally profound capacity to produce a specific atmosphere. The determinants of sunlight also cause the architecture of these interiors to properly expose the properties of sunlight. The mutuality of the exposure of sunlight and architecture is of particular value in the case of sunlight due to its physical determinants, its significance in human physiology and psychology and in culture, which is why it considerably affects the generation of the interior's atmosphere.

This mutuality is significant to the human perception of the majority of architectural and urban interiors exposed to sunlight in different scopes. The outlook on the relationship between sunlight and architecture as the mutual exposure of their physical properties can be considered this work's original contribution to architectural criticism and the theory of atmosphere.

This study repeats the method and tool of investigating light in the interior as developed in *O światle...* with the intent to confront it with the wider field of the theory of atmosphere and thus assess its academic value and application potential. In its English version, this work first presents the typology and taxonomy of elementary architectural methods of operating with sunlight in the interior and the results of operating with light in order to mutually expose architecture with

sunlight. The expected outcome is their application in architectural education and criticism, as well as the design of architectural and urban interiors in terms of their atmosphere.

The following conclusions have been formulated on the basis of the study:

- 1). The results of the study are aligned with its objective, which was to demonstrate the humanising role of the analysis of the atmosphere of architecture induced by sunlight in architectural criticism, education and design.
- 2). The atmosphere of architecture, as a capacity of the interior to induce specific sensory experiences and states of mind in humans, is perceived and evaluated in the human reception of the interior.
- 3). Atmosphere is generated via specific, physical foundations that can be studied and designed. Light is an essential component of atmosphere, pointed to as the most stimulating in the perception of the surroundings and the strength of this stimulation on the observer is not susceptible to change associated with human emotional predispositions.
- 4). Sunlight, which fulfils utilitarian and aesthetic functions in the interior, is also a significant component of the atmosphere of architecture, as supported by experiences in stage design and the art of the stage.
- 5). The method of studying architecture and sunlight as their mutual relationship in an architectural and urban interior is useful in analysing the atmosphere of the interior. This relationship can be described using a typology and taxonomy based on optical phenomena resulting from the laws of physics and that are perceivable by humans in the interior.
- 6). Physical, physiological, psychological and cultural determinants of the relationship between light and architecture indicate that the mutual exposure of architecture and sunlight can be considered a criterion of the atmosphere of the interior as induced by sunlight.
- 7). Light has the most essential role of uniting the space and generating spatial and temporal fluidity in inducing the atmosphere of architecture.
- 8). Linking the results of operating with light in the interior with the atmosphere of the interior allows one to treat architecture as an apparatus for admitting sunlight and modifying it.
- 9). The proposed criteria of the evaluation of the exposure of the interior with sunlight: impressiveness, ambience and projection capacity, allow us to treat architecture as an apparatus for inducing the intended atmosphere of the interior. The proposed typology and taxonomy are practical tools of designing this apparatus.
- 10). The proposal of the evaluation, design, description and induction of the atmosphere of architecture using sunlight is intended to improve the quality of architecture.
- 11). In the practice of architectural education, criticism and design, it is critical to reinforce trust in methods that employ the literary description of the environment, as based on the link between language and spatial experiences: both bodily and affective.
- 12). The value of the study to design practice is based on highlighting the role of scenographic aspects of architecture in building its atmosphere. Due to the expositional role of light, the interior takes on stage-related functions: the capacity to induce intense sensory experience, ambience and projection capacity, which comprise the atmosphere of architecture.

Literature

- Adamczak S., *Pomiary geometryczne powierzchni. Zarysy kształtu: chropowatość, falistość*, Warszawa 2008.
- Alberowa Z., *O sztuce Japonii*, Warszawa 1983.
- Alberti L.B., *Ksiąg dziesięć o sztuce budowania*, (ed.) K. Dziewoński, transl. I. Biegańska, Warszawa 1960.
- Albertsen N., *Urban atmospheres*, “Ambiances. International Journal of Sensory Environment, Architecture and Urban Space” 2019 [online] <https://journals.openedition.org/ambiances/2433> [accessed: March 2020].
- Alexander Ch., Ishikawa S., Silverstein M., Jacobson M., Fiksdahl-King I., Angel Sh., *Język wzorców. Miasta, budynki, konstrukcja*, transl. A. Kaczanowska, K. Maliszewska, M. Trzebiatowska, Gdańsk 2008.
- Askariipoor T., Motamedzade M., Golmohammadi R., Farhadian M., Babamiri M., Samavati M., *Non-Image Forming Effects of Light on Brainwaves, Autonomic Nervous Activity, Fatigue, and Performance*, “Journal of Circadian Rhythms” 2018, 16 (1) [online] <https://www.jcircularrhythms.com/articles/10.5334/jcr.167/> [accessed: March 2020].
- Arnheim R., *Sztuka i percepcja wzrokowa. Psychologia twórczego oka*, transl. J. Mach, Warszawa 1978.
- Bachelard G., *Poetyka marzenia*, transl. L. Brogowski, Gdańsk 1998.
- Barbieri F., *La Rocca Pisana di Vincenzo Scamozzi*, Vicenza 1985.
- Berleant A., *Wrażliwość i zmysły. Estetyczna przemiana świata człowieka*, transl. S. Stankiewicz, Kraków 2011.
- Bettini S., *Venezia nascita di una città*, Milano 1978.
- Białostocki J., *Sztuka cenniejsza niż złoto. Opowieść o sztuce europejskiej naszej ery*, Warszawa 1969.
- Biancani E. et H., *Les Rayons ultraviolets*, Paris 1928.
- Biancani E. et H., *Lumiere et rayons infrarouges*, Paris 1929.
- Bieńkowska E., *Co mówią kamienie Wenecji*, Gdańsk 2000.
- Bille M., *Homely atmospheres and Lighting Technologies in Denmark: Living with Light*, Bloomsbury 2019.
- Biot F., Perrot F. (et al.), *Le Corbusier et l'architecture sacrée. Saint-Marie-de-La-Tourette – Éveux*, Lyon 1985.
- Bogdanowski J., *Kompozycja i planowanie w architekturze krajobrazu*, Kraków–Warszawa–Wrocław–Gdańsk 1976.
- Bognar B., *Architectural Guide Japan*, Berlin 2013.
- Bonenberg W., *Architektura ostatnich dziesięcioleci XX wieku*, Poznań 2001.
- Boubekri M., *Daylighting Design. Planning Strategies and Best Practice Solutions*, Basel 2014.
- Borch Ch. (ed.), *Architectural Atmospheres. On the Experience and Politics of Architecture* (texts: G. Böhme, Ch. Borch, O. Eliasson, J. Pallasmaa), Basel 2014.
- Borusiewicz W., *Konstrukcje budowlane dla architektów*, Warszawa 1973.
- Borys A.M., *Lume di Lume. A Theory of Light and Its Effects*, “Journal of Architectural Education” 2004, vol. 57, no. 4, p. 3–9.
- Boyce P.R., *Human Factors in Lighting*, Boca Raton 2014.
- Böhm A., *O czynniku kompozycji w planowaniu przestrzeni*, Kraków 2016.
- Böhme G., *Atmosphäre: Essays zur neuen Ästhetik*, Frankfurt/Main 1995.
- Böhme G., *Filozofia i estetyka przyrody w dobie kryzysu środowiska naturalnego*, transl. J. Marecki, Warszawa 2002.
- Böhme G., interview with T. Ajder, Warsaw 22.06.2013, performed as a part of the Zielony Jazdów ekologia / ciało / taniec project, <https://alchetron.com/Gernot-Böhme-2636578-W> [accessed: October 2017].
- Böhme G., *Architektur und Atmosphäre*, Paderborn 2013.
- Böhme G., *The art of the stage set as a paradigm for an aesthetics of atmospheres*, “Ambiances. International Journal of Sensory Environment, Architecture and Urban Space” 2013 [online] <https://journals.openedition.org/ambiances/315> [accessed: March 2020].
- Böhme G., *Atmospheric Architectures. The Aesthetics of Felt Spaces*, ed. and transl. A.-Ch. Engels-Schwarzpaul, Bloomsbury 2017.

- Brodsky J., *Znak wodny*, transl. S. Barańczak, Kraków 1993.
- Broniewski T., *Historia architektury dla wszystkich*, Wrocław–Warszawa–Kraków 1964.
- Brown G.Z., DeKay M., *Sun, Wind & Light. Architectural Design Strategies*, USA 2001.
- Butti K., Perlin J., *Golden Thread. 2500 years of solar architecture and technology*, New York 1980.
- Büttiker U., *Louis I. Kahn: Light and Space*, New York 1994.
- Cabeza Lainez J. M., *Fundamentos de transferencia radiante luminosa o La verdadera naturaleza del factor de forma y sus modelos de cálculo*, Oleiros 2009.
- Canepa E., Scelsi V., Fassio A., Avanzino L., Lagravinese G. and Chiorri C., *Atmospheres: Feeling architecture by emotions*, “Ambiances. International Journal of Sensory Environment, Architecture and Urban Space” 2019 [online] <https://journals.openedition.org/ambiances/2907> [accessed: March 2020].
- Chamilothori K., Wienold J., Andersen M., *Daylight patterns as a means to influence the spatial ambience: a preliminary study*, [in:] N. Rémy, N. Tixier (eds.), *Ambiances, tomorrow. Proceedings of the 3rd International Congress on Ambiances*, September 2016, Volos 2016, p. 117–122.
- Chojacka E., (ed.), *Sztuka Górnego Śląska na przecięciu dróg europejskich i regionalnych*, Katowice 1999.
- Collevalenza. *Santuario dell'Amore Misericordioso*, guidebook, Perugia 2000.
- Crossley P., *A Symbolic Turn of Mind. Lech Kalinowski and the Giants of Iconography*, unpublished presentation delivered at the jubilee of Professor Lech Kalinowski in 2000.
- Dal Fabro A., *Clorindo Testa. L'Architettura animata*, Venezia 2003.
- Darula S., Kittler R., Komar L., *Sky type determination using vertical illuminance*, “Przegląd Elektrotechniczny” 2013, vol. 6, p. 315–319.
- Das Geheimnis des Schattens: Licht und Schatten in der Architektur. The secret of the shadow. Light and shadow in architecture*, Tübingen–Berlin 2002.
- De Matteis F., *When Durga strikes. The affective space of Kolkata's Holy Festival*, “Ambiances. International Journal of Sensory Environment, Architecture and Urban Space” 2018 [online] <https://journals.openedition.org/ambiances/1467> [accessed: March 2020].
- De Matteis F., *Vita nello spazio: Sull'esperienza affettiva dell'architettura*, Milan 2019.
- De Matteis F., Bille M., Griffiero T. and Jelić A., *Phenomenographies: describing the plurality of atmospheric worlds*, “Ambiances. International Journal of Sensory Environment, Architecture and Urban Space” 2019 [online] <http://journals.openedition.org/ambiances/2526> [accessed: March 2020].
- Décosterd & Rahm, *Physiological Architecture. Architecture physiologique*, Basel 2002.
- Deleuze G., *Le Pli*, Paris 1988.
- Devillers C., *La lumière selon Kahn*, “L'architecture d'aujourd'hui” April 1991, no. 274, p. 150–152.
- Dognon A., Biancani H., *Ultra-sons et biologie*, Paris 1937.
- Dubet A. (ed.), *Qu'est-ce que la lumière pour les architectes?*, Paris 2013.
- Duby G., *Czasy katedr. Sztuka i społeczeństwo 980–1420*, transl. K. Dolatowska, Warszawa 1986.
- Feynman R.P., Leighton R.B., Sands M., *Feynmana wykłady z fizyki*, vol. 1.2: *Optyka, termodynamika, fale*, 6th ed, revised and supplemented, transl. A. Jurewicz, M. Grynberg, M. Kozłowski, T. Butler, Warszawa 2007.
- Ferrari S., *Vedutismo*, Firenze 2008.
- Fleischer M., *Teoria kultury i komunikacji*, transl. M. Jaworowski, Wrocław 2002.
- Forstner D., *Świat symboliki chrześcijańskiej*, Kraków 1994.
- Frampton K. Kuma K., *Kengo Kuma: Complete Works*, London 2013.
- Frampton K., *Modern Architecture. A critical history*, London 2016.
- Franta A., *Otoczenie przestrzenne a psychika człowieka – systematyka uwarunkowań oddziaływania*, unpublished doctoral dissertation, Politechnika Krakowska 1990.
- Franta A., *Reżyseria przestrzeni. O doskonałości przestrzeni publicznej miasta*, Kraków 2004.
- Franta A., *Kultura miasta / The Culture of the City*, “Czasopismo Techniczne” 2008, p. 167–176.

- Gage J., *Kolor i kultura. Teorie i znaczenie koloru od antyku do abstrakcji*, transl. J. Holzman, Kraków 2008.
- Gajewski A.S., *Wybrane zagadnienia z fizyki*, Kraków 2003.
- Gibson E.J., *An odyssey in learning and perception*, Cambridge 1991.
- Gibson J.J., *The Perception of the Visual Word*, Boston 1950.
- Gomaliszewski J., *Złudzenia perspektywiczne w architekturze*, Kraków 1966.
- Gregory R.L., *Oko i mózg. Psychologia widzenia*, transl. S. Bogusławski, Warszawa 1971.
- Gregory R.L., Colman A.M. (ed.), *Czucie i percepcja*, transl. M. Siemiński, Poznań 2002.
- Griffero T., *Quasi-things*, Albany 2017.
- Griffero T., *Places, affordances, atmospheres: A pathic aesthetics*, London-New York 2019.
- Griffero T., *Something more. Atmospheres and pathic aesthetics*, [in:] T. Griffero & G. Moretti (eds.), *Atmosphere/Atmospheres: Testing a new paradigm*, Milan 2018, p. 75–89.
- Goethe J.W., *Die Schriften zur Naturwissenschaft*, Weimar 1947.
- Gyurkovich M., *Rola światła w architekturze na przykładzie ikonicznych obiektów kultury. Wybrane przykłady*, “Środowisko Mieszkaniowe. Housing Environment” 2017, no. 18, p. 95–105, [http://www.ejournals.eu/housingenvironment/2017/18\(2017\)/art/9185](http://www.ejournals.eu/housingenvironment/2017/18(2017)/art/9185) [accessed: November 2017].
- Hahn A. (ed.), *Erlebnislandschaft–Erlebnis Landschaft? Atmosphären im architektonischen Entwurf*, Bielefeld 2012.
- Havik K. (ed.), *Building Atmosphere*, Rotterdam 2013.
- Havik K., *TerriStories. Literary Tools for Capturing Atmosphere in Architectural Pedagogy*, “Ambiances. International Journal of Sensory Environment, Architecture and Urban Space” 2019 [online] <https://journals.openedition.org/ambiances/2787> [accessed: March 2020].
- Hasegawa Y., *Kazuyo Sejima + Ryue Nishizawa Sanaa*, series: documenti di architettura, Milano 2005.
- Heikkinen M., Zumthor P., Hornborg M., Toivanen P., *Zumthor – Spirit of Nature Wood Architecture Award 2006*, Tempere 2011.
- Hervé L., *Architecture of Truth*, London 2001.
- Incerti M., *Il disegno Della luce nell'architettura cistercense. Allineamenti astronomici nelle abbazie di Chiaravalle della Colomba, Fontevivo e San Martino de' Bocci*, Firenze 1999.
- Ingarden R., *O dziele architektury*, [in:] *idem, Studia z estetyki*, vol. 2, Warszawa 1966.
- Ingold T., *Splatać otwarty świat*, ed. and transl. E. Klekot, Kraków 2018.
- Jucha K., *Architektura światła i cienia*, unpublished doctoral dissertation, Politechnika Krakowska 2003.
- Kahn L.I., Lobell J. (ed.), *Between Silence and Light*, Boston 2008.
- Kahn L.I., Johnson N.E. (ed.), *Light is the Theme: Louis I. Kahn and Kimbel Art Museum*, Yale University Press 2012.
- Kahn L.I., *Silence et Lumière, choix de conférences et d'entretiens 1955-1974*, Paris 1996.
- Kolumba, “Salve” special issue (Revue for Theology, Spiritual Life, and Culture) 2011, no. 2.
- Keller M., *Fascynujące światło. Oświetlenie w teatrze i na estradzie*, Warszawa 2013.
- Kmita J., *Kultura i poznanie*, Warszawa 1985.
- Krenz J., Brehem M., *A Luz de Lisboa / The Light of Lisbon*, Lisbon 2012.
- Kuczka-Kuczyński K., *Czwarty wymiar architektury miasta*, Warszawa 1982.
- Kuczka-Kuczyński K., *Piękna architektura – czy piękno architektury, czyli: czytając Stróżewskiego*, “Czasopismo Techniczne” 2007, p. 83–86.
- Kuryłowicz S. and E., *Pasja i pragmatyzm: człowiek, architektura, wolność*. Kuryłowicz & Associates, Warszawa 2000.
- Kuma K., *Materials, Structures, Details*, Basel–Berlin–Boston 2004.
- Kuma K., *Architecture Making Maximum Use of the Character of the Land will be the Norm in the Twenty-first Century*, [in:] M. Poprawska, M.A. Urbańska, *Kierunki. Nowa architektura w Japonii i Polsce / Directions. New Architecture in Japan and Poland*, Kraków 2005.
- Kuma K., *Anti-object*, London 2008.

- Kuma K. & Associates, *Studies in Organic*, Tokyo 2009.
- Kümmerlen R., *Zur Aestetik bühnenräumlicher Prinzipien*, Ludwigsburg 1929.
- Labrouste (1801–1875) *Architect. La structure mise en Lumière*, (eds.) C. Belier, B. Bergdol, M. Le Coeur, Paris 2012.
- Le Corbusier, *W stronę architektury*, transl. T. Swoboda, Warszawa 2012.
- Lechner N., *Heating, cooling, lighting. Sustainable design methods for architects*, 4th ed., Hoboken 2014.
- Lefebvre T., Raynal C., *Les Solariums tournants du Dr Jean Saidman. Aix-les-Bains, Jamnagar, Vallauris*, Paris 2010.
- Lenartowicz J.K., *O psychologii architektury. Próba inwentaryzacji badań, zakres przedmiotowy i wpływ na architekturę*, Kraków 1992.
- Lenartowicz J.K., *Słownik psychologii architektury dla studiujących architekturę*, Kraków 1997.
- Lipszyc H., *Śladem pędzla. Wstęp tłumacza*, [in:] J. Tanizaki, *Pochwała cienia*, transl. H. Lipszyc, Kraków 2016.
- Liskowacki A.D., *Aneks. Pejzaż wieczorny z łodziami*, [in:] *idem*, *Cukiernica pani Kirsch*, Szczecin 1998.
- Lisowski B., *Skrócone ujęcie teorii Juliusza Żórawskiego o budowie formy architektonicznej*, Kraków 1982.
- Los S., *Carlo Scarpa 1906–1978. Architetto Poeta*, Köln 2009.
- Mackrodt U., *How atmospheres inform urban planning practice – insights from the Tempelhof airfield in Berlin*, “Ambiances. International Journal of Sensory Environment, Architecture and Urban Space” 2019 [online] <https://journals.openedition.org/ambiances/2739> [accessed: May 2020].
- Mallgrave H.F., *Architecture and Embodiment: The Implications of the New Sciences and Humanities for Design*, Abingdon 2013.
- Mallgrave H.F., *From Object to Experience: The New Culture of Architectural Design*, London 2018.
- Mallgrave H.F., *The Architect's Brain: Neuroscience, Creativity, and Architecture*, Chichester 2010.
- Marton F., *Phenomenography – Describing conceptions of the world aroundus*, “Instructional Science” 1981, vol. 10, p. 177–200.
- Martyniuk-Pęczek J., *Światła miasta*, Wrocław 2014.
- Meisenheimer W., *Das Denken des Leibes und der architektonische Raum*, Cologne 2004.
- Michel L., *Light: The Shape of Space: Designing with Space and Light*, New York 1996.
- Mietelski J., *Astronomia w geografii*, 4th ed., revised, Warszawa 2013.
- Moldi-Ravenna C., Sammartini T., photographs: G. Berengo Gardin, *Giardini Segreti a Venezia*, Verona 1997.
- Monin É., Simonnot N. (eds.), *L'Architecture lumineuse au XXe siècle, Luminous architecture in the 20th century*, Gand 2012.
- Moore F., *Concepts and Practice of Architectural Daylighting*, Hoboken 1991.
- Müller O., *Goethe i zasady świata barw*, transl. S. Trzaska, [in:] *Przestrzeń światła – światło w przestrzeni*, “Autoportret” 2008–2009, no. 25–26, p. 5–14.
- Narboni R., *Lumière et ambiances*, Paris 2006.
- Neufert E., *Podręcznik projektowania architektoniczno-budowlanego*, transl. S. Janicki, R. Łucki, R. Tauszyński, A. Zawadzki, Warszawa 1980.
- Norberg-Schulz Ch., *Znaczenie w architekturze Zachodu*, transl. B. Gadomska, Warszawa 1999.
- Nyka L., *Od architektury cyrkulacji do urbanistycznych krajobrazów*, Gdańsk 2006.
- Overy P., *Light, aire & openness. Modern architecture between the wars*, London 2007.
- Palladio A., *I Quattro Libri dell'Architettura*, Venezia 1570.
- Pallasmaa J., *Krajobrazy zmysłów. Dotykanie świata przez architekturę*, transl. M. Choptiany, “Autoportret” 2011, no. 3 (35), p. 4–11.
- Pallasmaa J., *Oczy skóry. Architektura i zmysły*, transl. M. Choptiany, Kraków 2012.
- Pallasmaa J., *Space, place and atmosphere: Emotion and peripheral perception in architectural experience*, “Lebenswelt. Aesthetics and philosophy of experience”, vol. 4, no. 1 (2014), p. 230–245.

- Panofsky E., *Studia z historii sztuki*, anthology edited by Jan Białostocki, Warszawa 1971.
- Patoczka P., *Monitoring ochrony i kształtowania krajobrazu w Bieszczadzkim Parku Narodowym i jego otulinie*, "Roczniki Bieszczadzkie" 2010, 18, p. 389–402, <https://www.bdnp.pl/dokumenty/roczniki/tom18/31.pdf>, 2010 [accessed: May 2017].
- Pawson J., *Afterword*, [in:] L. Hervé, *Architecture of Truth*, London 2001, p. 151–153.
- Pérez-Gómez A., *Attunement: Architectural meaning after the crisis of modern science*, Cambridge 2016.
- Peter Zumthor *Hortus Conclusus. Serpentine Gallery Pavilion 2011*, London 2011.
- Pevsner N., *Historia architektury europejskiej*, transl. A. Morawińska, H. Pawlikowska, Warszawa 1976.
- Phillips D., *Daylighting*, introduction C. Gardner, Oxford 2004.
- Pierre, lumière, couleur. *Etudes d'histoire de l'art du Moyen-Âge en l'honneur d'Anne Prache*, Joubert F. et Sandron D., (eds.), Paris 1999.
- Plummer H., *Light and the Soul of Architecture*, "Oz Journal of the College of Architecture, Planning & Design Kansas State University" 1992, vol. 14.
- Plummer H., *Light in Japanese Architecture*, "Architecture and Urbanism", Tokyo 1995.
- Plummer H., *Cosmos of Light. The Sacred Architecture of Le Corbusier*, Bloomington 2013.
- Plummer H., *Nordic Light, Modern Scandinavian Architecture*, London 2012.
- Plummer H., *The Architecture of Natural Light*, London 2009.
- Popczyk M., *Światło i obrazy*, [in:] K. Wilkoszewska (ed.), *Estetyka czterech żywiołów...*, Kraków 2002, p. 174–193.
- Pracki P., *Projektowanie oświetlenia wnętrz*, Warszawa 2011.
- Rabiej J., *Architektura: sztuka transfiguracji*, Gliwice 2013.
- Rabiej J., *Światło i kolor – uniwersalne walory architektury sakralnej*, "Studia Teologiczno-Historyczne Śląska Opolskiego" 2015, no. 35, p. 423–432, <http://www.rtso.uni.opole.pl/index.php/artykuly/item/swiatlo-i-kolor-uniwersalne-walory-architektury-sakralnej> [accessed: November 2017].
- Radomtsev D., Sergeychuk O., *Employment Features of CIE S 011/E2003 (ISO 15469:2004) "CIE Standard General Sky" under Designing Systems of Room Daylighting*, [in:] *Proceedings. The 9th International Conference on Future Generation Communication and Networking (FGCN)*, Jeju 2015, p. 49–54.
- Rahm Ph., *Architektura bezpośrednia*, transl. A.M. Urbańska, [in:] A. Budak (ed.), *Co to jest architektura? / What is Architecture?*, vol. 2, Kraków 2008, p. 541–556.
- Rasmussen S.E., *Odczuwanie architektury*, transl. B. Gadomska, Kraków 2015.
- Raynal C., Lefebvre T., *Médicaments ayurvediques en France. La tentative des laboratoires Polythérapie*, "Revue d'histoire de la pharmacie" 2010, vol. 97, no. 368, p. 413–430, http://www.persee.fr/doc/pharm_0035-2349_2010_num_97_368_22237 [accessed: October 2017].
- Rockcastle S., Andersen M., *Visualizing Perceptual Dynamics in Architecture*, "Phoenix, Bauen in Bestand" 2015, no. 1, p. 62–67.
- Rockcastle S., Andersen M., *Human Perception of Daylight Composition in Architecture: A preliminary Study to Compare Quantitative Contrast Measures to Subjective User Assessments in HDR Renderings*, [in:] J. Mathur, V. Garg (eds.), *Proceedings of the 14th International Conference of the International Building Performance Simulation Association*, Hyderabad 2015, p. 1205–1212.
- Rogińska-Niesłuchowska M., *Architektura i światło*, "Czasopismo Techniczne" 2010, b. 7-A/2, p. 323–327, <http://yadda.icm.edu.pl/baztech/element/bwmeta1.element.baztech-article-BGPK-3576-3578> [accessed: November 2017].
- Rollier A., *Heliotherapy*, Oxford 1927.
- Rosier-Siedlecka M.E., *Posoborowa architektura sakralna. Aktualne problemy projektowania architektury kościelnej*, Lublin 1980.
- Russell S., *The Architecture of Light*, La Jolla 2012.
- Scamozzi V., *L'Idée dell'Architettura Universale*, Venezia 1615.
- Schneider H., *Minimalizm jako metoda twórcza w architekturze współczesnej na wybranych przykładach z lat 1990–2005*, Gdańsk 2009.
- Serlio S., *L'Architettura*, Venezia 1537.

- Shusterman R., *Świadomość ciała: dociekania z zakresu somaestetyki*, (ed.) K. Wilkoszewska, transl. W. Małecki, S. Stankiewicz, Kraków 2016.
- Sienicki S., *Historia wnętrz mieszkalnych*, Warszawa 1954.
- Siwek A., *Światło jako czynnik kształtowania architektury współczesnych świątyń chrześcijańskich*, "Zeszyty Naukowe Politechniki Śląskiej. Architektura" 2006, b. 44, p. 205–210, http://delibra.bg.polsl.pl/Content/32740/BCPS_36582_2006_Swiatlo-jako-czynnik.pdf [accessed: November 2017].
- Stec B., *Aspekty scenografii w architekturze współczesnej. Wzmocnienie oddziaływania formalnego architektury przez wprowadzenie elementów scenograficznych*, unpublished doctoral dissertation, Politechnika Krakowska 2000.
- Stec B., *Trzy rozmowy z Peterem Zumthorem*, "Architektura & Biznes" 2003, no. 2 (127), p. 20–38.
- Stec B., *Conversazioni con Peter Zumthor*, "Casabella" 2004, no. 719 (LXVIII), p. 6–13 (transl. *Conversations with Peter Zumthor*, p. 90–95).
- Stec B., *Le Corbusier i inwestorzy w dziele La Tourette*, [in:] S. Hryń (ed.), *Sztuka – społeczeństwo – edukacja*, "Państwo i Społeczeństwo w XXI wieku" 2004, p. 71–84.
- Stec B., *Między wystawą i jej odbiorcą*, "Architektura & Biznes" 2005, no. 1 (150), p. 10–13.
- Stec B., *O świetle Wenecji*, "Zeszyty Naukowo-Artystyczne. Wydział Malarstwa Akademii Sztuk Pięknych w Krakowie" 2005, b. 6, p. 163–178.
- Stec B., *Powtórne spojrzenie*, interview with K. Forster, "Architektura & Biznes" 2005, part I, no. 5 (154), p. 72–75, part II, no. 6 (155), p. 70–73.
- Stec B., *Wczepieni w naturę*, interview with A. Lacaton, "Architektura & Biznes" 2006, no. 2 (163), p. 68–73.
- Stec B., *W stronę lekkości*, "Architektura & Biznes" 2006, no. 5 (166), p. 23.
- Stec B., *Droga, kaplica brata Klausa, Peter Zumthor*, "Architektura & Biznes" 2007, no. 7/8 (180, 181), p. 38–43.
- Stec B., *Żyjąca cząstka przestrzeni*, "Autoportret" 2007, no. 1 (18), p. 24–27.
- Stec B., *Spojrzeń kilka... muzeum „Kolumba”*. *Peter Zumthor Architects*, "Architektura & Biznes" 2008, no. 1 (186), p. 42–49.
- Stec B., *Z ciągłości poruszeń, dom Petera Zumthora*, "Autoportret" 2007, no. 4 (21), p. 43–47.
- Stec B., *Architektura rozwijana w czasie. Peter Zumthor (budynki i projekty 1986–2007)*, "Architektura & Biznes" 2008, no. 3 (188), p. 25.
- Stec B., *Węzeł krajobrazu*, "Autoportret" 2008/2009, no. 4 (25) / no. 1 (26), p. 54–59.
- Stec B., *Architektura meteorologiczna Philipe'a Rahma*, "Autoportret" 2011, no. 3 (35), p. 38–44.
- Stec B., *Świadomość spotkania*, "Architektura & Biznes" 2010, no. 11 (220), p. 38–49.
- Stec B., *Być jak Zumthor*, Archizoom, <http://www.archizoom.pl/articles/byc-jak-zumthor> [accessed: November 2017].
- Stec B., *Fenomen światła. Rozważania na temat roli światła w architekturze*, "Architektura & Biznes" 2013, no. 1 (246), p. 48–59.
- Stec B., *Kiedy forma staje się postawą, czyli o autentyczności w architekturze*, "Architektura & Biznes" 2013, no. 11 (256), p. 80–82.
- Stec B., *Philippe Rahm. The Meteorological Architecture*, "CyberEmpathy: Visual Communication and New Media in Art, Science, Humanities, Design and Technology" 2013, peer-reviewed online publication [accessed: October 2017].
- Stec B., *Piękno skupienia, czyli o autentyczności cd. – miejsca skupienia i rozproszenia*, "Architektura & Biznes" 2014, no. 1 (258), p. 82–85.
- Stec B., *Odpowiednie dać rzeczy słowo, czyli o autentyczności w architekturze cd.*, "Architektura & Biznes" 2014, no. 4 (261), p. 86–89.
- Stec B., *Maniera tenebrosa, czyli o autentyczności w architekturze c.d.*, "Architektura & Biznes" 2014, no. 6 (263), p. 82–87.
- Stec B., *Architektura duchowości*, "Architektura & Biznes" 2014, no. 7/8 (265), p. 38–51.
- Stec B., *Materialność jako relacja*, "Autoportret" 2015, no. 1 (48), p. 36–44.
- Stec B., *Apartament Przyszłości*, "ARCH. Magazyn architektoniczny SARP" 2015, no. 6 (32), p. 91–98.
- Stec B., *Ciężar i lekkość jako problem materii w architekturze*, [in:] B. Pawłowska-Jądrzyk (ed.), *Ciężar i lekkość w kulturze: estetyka, poetyka, style myślenia*, Warszawa 2016, p. 59–82.

- Stec B., *Piękno jako oblicze świętości w Kaplicy Brata Klausa Petera Zumthora. Beauty as a countenance of holiness in Peter Zumthor's Brother Klaus field chapel*, "Architecturae et Artibus" 2017, no. 31 (1), p. 50–62.
- Stec B., *Wykorzystanie fizycznych praw środowiska w eksperymentach architektonicznych Philippe'a Rahma*, [in:] K. Banasik-Petri (ed.), *Architektura eksperymentalna*, "Państwo i Społeczeństwo" 2017, no. 1, p. 65–78.
- Stec B., *O świetle we wnętrzu. Relacja między światłem słonecznym a architekturą w aspekcie atmosfery architektury*, Kraków 2017.
- Stec B., *Światło słoneczne a atmosfera w bazylice Miłości Miłosiernej w Collevalenzy*, "Zeszyty Naukowe Uczelni Vistula. Vistula University Working Papers", no. 61 (4)/2018, p. 49–60.
- Stec B., *Sunlight and Atmosphere in the Lord's Ark Church in Kraków-Bieńczyce*, "Czasopismo Techniczne" 2019, no. 12, p. 63–78.
- Stec B., *Sunlight in art exhibition spaces on the example of Venice Biennale pavilions*, "Kwartalnik Naukowy Uczelni Vistula. Vistula Scientific Quarterly", no. 1 (59)/2019, p. 60–70.
- Stec B., *Scenograficzne narracje miejskie. Spacer z... / Scenographic city narratives. Walking with...*, [in:] I. Kozina (ed.), *Narracje miejskie. Miasto jako obszar interwencji polityków, architektów i artystów / City Narratives. City as a space of intervention between politicians, architects and artists*, Akademia Sztuk Pięknych w Katowicach, Katowice 2019, vol. 2., p. 243–250 (Polish), p. 69–77 (English), illustrations p. 127–132.
- Stróżewski W., *Wokół piękna. Szkice z estetyki*, Kraków 2002.
- Sumartojo Sh., *Commemorative atmospheres: Memorial sites, collective events and the experience of national identity*, "Transactions of the Institute of British Geographers", vol. 41, no. 4 (2016), p. 541–553.
- Sumartojo Sh. & Pink S., *Atmospheres and the experiential world: Theory and methods*, London-New York 2019.
- Sumartojo Sh., Edensor T. & Pink S., *Atmospheres in Urban Light*, "Ambiances. International Journal of Sensory Environment, Architecture and Urban Space" 2019 [online] <https://journals.openedition.org/ambiances/2586> [accessed: April 2020].
- Stevens R., Rea M.S., *Light in the Built Environment: Potential role of Circadian Disruption in Endocrine Disruption and Breast Cancer*, "Cancer Causes & Control" 2001, no. 12, p. 279–287.
- Tanizaki J., *Pochwała cienia*, transl. H. Lipszyc, [in:] K. Wilkoszewska (ed.), *Estetyka japońska. Estetyka życia i piękno umierania*, vol. III, Kraków 2005.
- Tendera P., *Od filozofii światła do sztuki światła*, Kraków 2014.
- Thibaud J-P., *The backstage of urban ambiances: When atmospheres pervade everyday experience*, "Emotion, Space and Society", vol. 15 (2015), p. 39–46.
- Tidwell Ph. (ed.), *Architecture and atmosphere*, Helsinki 2014.
- Tilley Ch., *The materiality of stone: Explorations in Landscape Phenomenology*, Oxford 2004.
- Tischhauser A., Major M., Speirs J., *Made of Light. The Art of Light and Architecture*, Basel 2005.
- Twarowski M., *Słońce w architekturze*, Warszawa 1962.
- Uffelen van Ch., *Lumière & architecture*, Paris 2012.
- Wagner T., *Zabrze. Nieznane oblicza śląskiej architektury*, vol. 1., Zabrze 2003 [online] http://delibra.bg.polsl.pl/Content/29455/BCPS_33097_2003_Zabrze---nieznane-ob.pdf?handler=pdf [accessed: May 2020].
- Wagner T., *Architektura sakralna Dominika Böhma na Górnym Śląsku i jej znaczenie w kontekście rozwoju architektury oraz krajobrazu kulturowego Górnego Śląska*, doctoral dissertation, Politechnika Śląska, Gliwice 2002.
- Wagner T., *Architektura Modernistyczna w Zabrzu*, 2013 [online] https://www.academia.edu/35901927/ARCHITEKTURA_MODERNISTYCZNA_W_ZABRZU_MODERNIST_ARCHITECTURE_OF_INTERWAR_ZABRZE [accessed: May 2020].
- Wagner T., *Architektura – Urbanistyka – Krajobraz – ochrona i interpretacja dziedzictwa kulturowego Górnego Śląska na wybranych przykładach*, Gliwice 2016.
- Wehle-Strzelecka S., *Energia słońca w kształtowaniu środowiska mieszkaniowego – ewolucja koncepcji na przestrzeni wieków*, Kraków 2014.
- Wigginton M., *Glass in architecture*, London 2004.

- Wigley M., *Die Architektur der Atmosphäre / The Architecture of Atmosphere*, "Daidalos – Berlin Architectural Journal", no. 68 (1998) *Konstruktion von Atmosphäre / Constructing Atmospheres*, p. 18–27.
- Wilkożewska K. (ed.), *Estetyka czterech żywiołów: ziemia, woda, ogień, powietrze*, Kraków 2002.
- Wilkożewska K., *Uwagi na marginesie książki Gernota Böhmego „Filozofia i estetyka przyrody”*, "Sztuka i Filozofia" 2004, 24, p. 20–23.
- Wilkożewska K. (ed.), *Estetyka japońska. Estetyka życia i piękno umierania*, vol. III, Kraków 2005.
- Winkowski P., *Kiasma – natura i kultura w centrum Helsinek*, "Archivolta" 1999, no. 3, p. 12–16.
- Winkowski P., *Światło północy, światło południa. Light of the North, light of the South*, "grafia" 2002, no. 2 (2), p. 18–24.
- Winkowski P., *Kiasma. Przenikanie natury i kultury*, "Architekt" 2004, no. 3, p. 30–41.
- Winkowski P., *Świetliki Alvara Aalta*, "Autoportret" 2008/2009, no. 4 (25) /1 (26), p. 46–53.
- Winkowski P., *Ambiwalencja ciężaru i lekkości w architekturze współczesnej*, [in:] B. Pawłowska-Jądrzyk (ed.), *Ciężar i lekkość w kulturze: estetyka, poetyka, style myślenia*, Warszawa 2016, p. 153–183.
- Marcus Vitruvius Pollio, *O architekturze ksiąg dziesięć*, transl. K. Kumaniecki, Warszawa 1956.
- Wlazło-Malinowska K., *Światło jako element budujący wymiar duchowy przestrzeni sakralnych w krajobrazach naturalnych i kulturowych*, [in:] *Sacrum w krajobrazie*, "Prace Komisji Krajobrazu Kulturowego" 2012, no. 17, p. 148–161.
- Wróbel P. (ed.), *Foto-obrazy architektury. Fotografia jako medium referujące i projektujące architekturę*, Kraków 2016.
- Venezia F., *La torre d'ombre o l'architettura delle apparenze reali / La Tour d'Ombres ou l'architecture des apparences réeles*, transl. into French: M. F. Buonaiuto, Venezia 1988.
- Venezia*, text: C. Della Corte, photographs: E. Ciol, Milano 1995.
- Zumthor P., *Kunsthau Bregenz*, Ostfildern-Ruit 1999.
- Zumthor P., *Therme Vals*, Gollion 2007.
- Zumthor P., *Atmospheres: Architectural Environments – Surrounding Objects*, Basel–Boston–Berlin 2006.
- Zumthor P., *Myślenie architektury*, transl. A. Kożuch, Kraków 2010.
- Zumthor P., *Steilneset Memorial for the Victims of the Witch trials in Vardø, Finnmark*, Haldenstein 2011.
- Zumthor P., *Hortus Conclusus*, [in:] *Peter Zumthor. Hortus Conclusus. Serpentine Gallery Pavilion 2011*, London 2011, p. 14–17.
- Zumthor P., Durisch T. (ed.), *Peter Zumthor. Réalisations et projets*, vol. 1–5, Zurich 2014.
- Zupirolli L., Bussac M.-N., *Traité de la lumière*, Lausanne 2009.
- Zupirolli L., Bussac M.-N., *Traité du couleurs*, Lausanne 2011.
- Zuziak Z., *O tożsamości urbanistyki*, Kraków 2008.
- Żórawski J., *O budowie formy architektonicznej*, Warszawa 1973.
- Żuk P., *Rola oświetlenia naturalnego w kształtowaniu formy architektonicznej współczesnych muzeów*, unpublished doctoral dissertation, Politechnika Krakowska 2010.

Index of Names

- Aalto Alvar 37, 44, 95
Ackerman James Sloss 29
Adamczak Stanisław 132, 141, 314
Ajder Teodor 23, 104, 315
Alberowa Zofia 314
Alberti Leon Battista 26, 29, 314
Albertsen Niels 314
Alexander Christopher 14, 34, 73, 75, 314
Andersen Maryline 42, 318
Andō Tadao 172, 201, 202, 245, 333
Angel Shlomo 14, 314
Arets Wiel 229
Arnaud Noël 75
Arnheim Rudolf 314
Askaripoor Taleb 59, 314
Avanzino Laura 22, 40, 102, 106, 116, 315
Babamiri Mohammad 59, 314
Bachelard Gaston 68, 75, 119, 120, 314
Banasik-Petri Katarzyna 319
Barańczak Stanisław 40, 315
Barbari de Jacopo 53
Barbieri Franco 314, 289, 290
Bellini Giovanni 53, 96
Belle Elsa 32, 62
Berengo Gardin Gianni 76, 317
Berkeley George 69
Berleant Arnold 69, 97, 314
Bettini Sergio 78, 314
Białostocki Jan 31, 314
Biancani Elio 32, 36, 62, 314
Biancani Hugo 32, 36, 62, 314
Biegańska Irena 26, 314
Bieńkowska Ewa 40, 53, 76, 78, 79, 96, 151, 314
Bijvoët Bernard 330
Bille Mikkel 13, 40, 41, 100, 105, 107, 109, 111, 112, 113, 114, 117, 120, 121, 125, 314
Biot Francois 20, 73, 314
Boberg Ferdinand 95
Bogdanowski Janusz 18, 314
Bognar Botond 314
Bogusławski Stanisław 316
Böhm Aleksander 18, 314
Böhm Dominikus 83, 84, 85, 122
Böhme Gernot 13, 19, 23, 39, 45, 46, 91, 97, 100, 101, 102, 104, 105, 106, 107, 110, 112, 113, 114, 121, 122, 123, 124, 125, 314
Bonenberg Wojciech 314
Bonta Juan Pablo 74
Borch Christian 39, 314
Borghi Anna M. 119
Borusiewicz Władysław 31, 314
Borys Ann Marie 15, 29, 30, 31, 42, 46, 82, 314
Boubekri Mohamed 44, 45, 46, 148, 314
Boullée Étienne-Louis 37, 168
Boyce Peter Robert 43, 314
Brion Giuseppe 78
Brodsky Joseph 40, 76, 77, 96, 120, 151, 315
Brogowski Leszek 68, 314
Broniewski Tadeusz 31, 315
Brown G.Z. (Philip H. Knight) 35, 254, 315
Buccino Giovanni 119
Buonaiuto Maria Francesca 21, 321
Bussac Marie-Noelle 41, 321
Butler Teresa 16, 315
Butti Ken 60, 315
Büttiker Urs 37, 127, 315
Cabeza Lainez Maria José 36, 315
Canaletto (Belotto Bernardo) 77, 79, 96
Canepa Elisabetta 22, 40, 91, 102, 105, 112, 116, 117, 315
Carlevarijs Luca 79
Carpaccio Vittore 77
Cassirer Ernst 80, 81
Chamilothori Kynthia 42, 315
Chareau Pierre 166
Chiori Carlo 22, 40, 102, 105, 116, 315
Choljecka Ewa 84, 315
Choptiany Michał 9, 43, 317
Ciol Elio 38, 40, 54, 314
Colman Andrew Michael 34, 55, 69, 316
Crossley Paul 27, 28, 82, 83, 86, 315
Dal Fabro Armando 315
Darula Stanislav 51, 315
De Matteis Federico 13, 40, 100, 105, 107, 109, 111, 112, 113, 114, 117, 119, 120, 121, 123, 315
Décosterd Jean-Gilles 64, 315
DeKay Mark 35, 315
Deleuze Gilles 108, 315
Della Corte Carlo 38, 53, 321

- Devillers Christian 37, 315
 Diller Elizabeth 145, 330
 Saint Denis 27
 Dionysius the Areopagite 27, 28, 82, 83, 86
 Dodwell Peter C. 55, 56, 57, 67, 68
 Dognon André 32, 315
 Dolatowska Krystyna 27, 315
 Dreyfus Allen Patrycja 75
 Dreyfus Hubert L. 75
 Dubet Alice 42, 88, 315
 Duby Georges 27, 83, 315
 Durisch Thomas 37, 321
 Ebbensgaard Casper Laing 115
 Edensor Tim 40, 112, 113, 114, 115, 123, 125, 320
 Eliasson Olafur 39, 314
 Engels-Schwarzpaul A.-Ch. 39, 315
 Entwistle Joanne 115
 Ewý Jacek 40, 225
 Fainsilber Adrien 166
 Farde André 62
 Farhadian Maryam 59, 314
 Farrell Yvonne 94, 95
 Fassio Anna 22, 40, 102, 105, 116, 315
 Fehn Sverre 32, 95, 241
 Ferrari Simone 315
 Feynman Richard Phillips 16, 45, 315
 Fialetti Odoardo 53
 Fiksdahl-King Ingrid 14, 314
 Finsen Niels Ryberg 61
 Fleischer Michael 80, 85, 315
 Fontaine Pierre François Louis 165
 Forsberg Kristian 205, 267, 332
 Forster Kurt 289, 319
 Forstner Dorothea 315
 Frampton Kenneth 31, 70, 315
 Franta Anna 10, 41, 52, 53, 57, 73, 93, 121, 123, 315
 Gadowska Barbara 23, 33, 317
 Gage John 316
 Gajewski Andrzej Stanisław 16, 17, 45, 57, 316
 Gardner Carl 35, 318
 Garg Vishal 318
 Gehry Frank Owen 192, 193, 227, 228, 329
 Gibson Eleanor Jack 67, 68, 69, 316
 Gibson James Jerome 67, 68, 69, 316
 Goethe Johann Wolfgang 17, 34, 43, 316, 317
 Golmohammadi Rostam 59, 314
 Gomaliszewski Jerzy 316
 Grabowska Anna 57
 Gras Phillippe 32, 62
 Gregory Richard Langton 16, 17, 34, 48, 55, 57, 58, 59, 69, 316
 Griffero Tonino 13, 39, 40, 97, 100, 105, 107, 109, 111, 112, 113, 114, 117, 119, 120, 121, 315, 316
 Groenewolt Abel 205, 267, 332
 Grynberg Marek 16, 315
 Guardi Francesco 77, 79
 Guattari Félix 108
 Guillaume Paul 67
 Gullichsen Kristian 214, 232, 254, 329
 Gyurkovich Mateusz 43, 94, 316
 Hahn Achim 316
 Hammouténe Franck 272, 329, 332
 Hamsun Knut 119
 Hasegawa Yuko 316
 Harper Thomas 86
 Havik Klaske 13, 40, 118, 119, 316
 Heikkinen Mikka 316
 Hervé Lucien 38, 54, 151, 316
 Hicky Morgan Morris 26
 Hiroshige Andō 12, 218, 219, 269, 270, 330
 Holl Steven 37, 44, 116, 119, 156, 183, 200, 247, 262, 275, 330
 Holzman Joanna 316
 Hornborg Michael 316
 Hooch, de Pieter 152
 Houlgate Stephen 69
 Hryń Stanisław 319
 Hybert Fabrice 65
 Incerti Manuela 38, 49, 316
 Ingarden Krzysztof 225, 330, 333
 Ingarden Roman 74, 316
 Ingold Tim 70, 108, 109, 113, 125, 316
 Invernizzi Angelo 62, 298, 330
 Ishigami Jun'ya 166, 329
 Ishikawa Sara 14, 314
 Jacobson Max 14, 314
 Janicki Stanisław 18, 317
 Järvinen Kari 196, 197, 210, 234, 329, 332, 333
 Jelić Andrea 13, 40, 100, 105, 107, 109, 111, 112, 113, 114, 117, 120, 121, 315
 Jensen Jan Olav 297, 329
 Johnson Mark 119
 Johnson Nell E. 37, 119, 316
 Johnson Philip 166, 285, 330
 Joubert Fabienne 31, 318
 Jucha Katarzyna 42, 316
 Justinian the Great 60
 Kaczanowska Aleksandra 14, 314
 Kaczmarczyk Andrzej 216, 278, 330, 333, 334
 Kahn Louis Isadore 11, 37, 44, 127, 315, 316
 Kalinowski Lech 27, 28, 82, 83, 86, 315
 Keller Max 316

- Kertesz André 62
 Kittler R. 51, 315
 Klekot Ewa 70, 316
 Kluckhohn Clyde 80
 Kmita Jerzy 80, 81, 316
 Komar L. 51, 315
 Konior Tomasz Mikołaj 251, 330, 333
 Kopaliński Władysław 22, 140
 Kosiński Wojciech 10, 18
 Kozina Irma 120, 320
 Kozłowski Dariusz 246, 330
 Kozłowski Mirosław 16, 315
 Kożuch Artur 37, 321
 Krainik Rémus 62
 Krenz Jacek 316
 Kroeber Alfred Louis 80, 81
 Kucza-Kuczyński Konrad 13, 43, 253, 316
 Kuma Kengo 12, 26, 69, 70, 88, 108, 139, 167, 175, 176,
 184, 185, 186, 189, 190, 204, 217, 218, 219, 220, 221,
 223, 224, 233, 235, 236, 237, 238, 269, 271, 285, 316,
 317, 329, 330
 Kuryłowicz Ewa 316
 Kuryłowicz Stefan 316
 Kümmerlen Robert 123, 124, 125, 317
 Kyuma Tetsujiro 205, 267, 332
 Labrouste Henri 168, 317, 329
 Lacaton Anne 20, 319
 Lafuente Julio 38, 169, 178, 199, 208, 231, 243, 252,
 292, 330
 Lagravinese Giovanna 102, 105, 116, 315
 Lakoff George 119
 Le Corbusier (Jeanneret Charles-Édouard) 20, 21, 24,
 31, 32, 37, 38, 44, 54, 63, 73, 105, 151, 166, 168, 198,
 212, 262, 298, 311, 314, 317, 318, 319, 329, 330
 Lechner Norbert 35, 317
 Lefebvre Thierry 32, 62, 318
 Leighton Robert B. 16, 45, 315
 Leiviskä Juha 173, 329
 Lenartowicz Józef Krzysztof 10, 13, 14, 19, 25, 28, 35,
 45, 46, 48, 56, 57, 66, 67, 68, 71, 73, 74, 81, 86, 128,
 158, 317
 Levieux Eleanor 27
 Levin David Michael 69
 Lintula Kimmo 205, 267, 332
 Lipszyc Henryk 40, 86, 87, 317, 320
 Liskowacki Artur Daniel 12, 317
 Lisowski Bohdan 317
 Lobell John 37, 316
 Los Sergio 37, 317
 Lynn Greg 271
 Łucki Roman 18, 317
 Mach Jolanta 314
 Mackrodt Ulrike 112, 317
 Major Marc 36, 320
 Makinen Jukka 205, 267, 332
 Maliszewska Karolina 14, 314
 Mallgrave Harry Francis 119, 125, 317
 Małecki Wojciech 318
 Marecki Jarosław 19, 314
 Marcel Gabriel Honoré 75
 Marton Ferenc 40, 109, 113, 317
 Martyniuk-Pęczek Justyna 10, 36, 41, 51, 115, 317
 Mathur Jyotirmay 318
 McNamara Shelley 94, 95
 Meisenheimer Wolfgang 317
 Mengoni Giuseppe 166, 329
 Merleau-Ponty Maurice 68, 75
 Michelangelo (Michelangelo di Ludovico Buonarrotti
 Simoni) 73
 Michel Lou 36, 317
 Mietelski Jan 18, 45, 49, 50, 317
 Miettinen Samuli 203, 211, 329
 Moldi-Ravenna Cristiana 317
 Monceaux René-Henri 62
 Monin Éric 39, 317
 Moore Fuller 45, 317
 Morawińska Agnieszka 31, 318
 Moretti Giampiero 39, 316
 Motamedzade Majid 59, 314
 Müller Olaf 17, 43, 317
 Narboni Roger 36, 103, 107, 317
 Napoleon 165
 Näveri Mikko 205, 267, 332
 Neufert Ernst 18, 33, 34, 50, 58, 317
 Newton Isaac 16
 Nieminen Merja 196, 197, 210, 234, 329
 Nishizawa Ryue 32, 166, 285, 316, 330
 Norberg-Schulz Christian 23, 31, 317
 Nouvel Jean 37, 168, 215, 329
 Novák Zygmunt Jan 18
 Nyka Lucyna 10, 145, 317
 Oeschlin Werner 31, 32
 Oribasius 60
 Overy Paul 32, 61, 63, 317
 Paavilainen Käpy 329
 Paavilainen Simo 329
 Palladio Andrea 26, 29, 30, 37, 148, 198, 289, 317, 330
 Pallasmaa Juhani 9, 12, 13, 38, 39, 43, 46, 47, 56, 58, 59,
 68, 69, 70, 71, 73, 74, 75, 97, 107, 253, 314, 317
 Panofsky Erwin 31, 318
 Parnuk Orhan 119
 Pasteur Louis 61

- Patoczka Piotr 18, 19, 45, 318
Pawlikowska Hanna 31, 318
Pawłowska-Jądrzyk Brygida 319
Pawson John 38, 151, 311, 318
Paxton Joseph 61, 165, 330
Pei Ieoh Ming 36, 166, 330
Percier Charles 165
Pereira Miguel 205, 267, 332
Pérez-Gómez Alberto 318
Perlin John 60, 315
Perrot Françoise 20, 73, 314
Pevsner Nicolas 31, 318
Phillips Derek 35, 45, 46, 318
Pietrzyk Wojciech 171, 329
Pink Sarah 40, 112, 113, 114, 123, 125, 320
Pirhonen Outi 205, 267, 332
Plummer Henry 13, 21, 24, 44, 46, 88, 97, 148, 151, 152,
156, 157, 158, 162, 281, 284, 311, 318, 326, 336
Popczyk Maria 15, 47, 127, 318
Poprawska Marta 12, 317
Pracki Piotr 318
Rabiej Jan 11, 43, 53, 54, 73, 82, 84, 85, 163, 318
Radomtsev Dmitriy 51, 318
Rahm Philippe 36, 64, 65, 66, 95, 315, 318, 319
Rasmussen Steen Eiler 13, 24, 25, 33, 46, 59, 74, 138,
146, 151, 152, 153, 157, 158, 162, 201, 311, 318, 336
Raynal Cécile 32, 62, 317, 318
Rea Marc S. 36, 37, 39, 64, 320
Rémy Nicolas 42, 315
Rice Peter 166, 329
Rickert Heinrich 80, 81
Riegler Florian 250, 330
Rietveld Gerrit Thomas 95, 206, 330
Riewe Roger 250, 330
Rikli Arnold 61
Rockcastle Siobhan 318
Rogińska-Niesluchowska Małgorzata 43, 318
Rohe, van der Mies 166, 285, 329, 330
Rollier August 61, 318
Rosier-Siedlecka Maria Ewa 34, 35, 73, 85, 318
Rushton William Albert Hugh 58
Russell Sage 37, 318
Ruusuvuori Aarno 195, 209, 213, 329
Saidman Jean 32, 62, 317
Samavati Mehdi 59, 314
Sammartini Teodora 317
Sandron Dany 31, 318
Sands Matthew 16, 45, 315
Scamozzi Vincenzo 26, 29, 30, 37, 43, 46, 135, 136, 145,
148, 198, 206, 289, 290, 314, 318
Scarpa Carlo 37, 78, 317
Scelsi Valter 22, 40, 102, 105, 116, 315
Schmitz Hermann 104
Schneider Hubert 42, 318
Scofidio Ricardo 145, 330
Seidensticker Edward 86
Sejima Kazuyo 32, 166, 316
Sergeychuk Oleg 51, 318
Serlio Sebastiano 26, 29, 168, 318
Seurat Georges 271
Shaw Bonnie 115
Shusterman Richard 319
Siemiński Mariusz 34, 316
Sienicki Stefan 31, 318
Silverstein Murray 14, 314
Simonnot Nathalie 39, 317
Sipinen Arto 182, 329
Sirén Heikki 242, 329
Sirén Kaija 242, 329
Sirola Niko 205, 267, 332
Siwek Anna 319
Skodvin Børre 297, 329
Slater Don 115
Sloane Mona 115
Snellius Willebrord 22
Speirs Jonathan 36, 320
Stankiewicz Sebastian 69, 314, 318
Stevin Simon 22
Stec Barbara 22, 27, 43, 44, 46, 51, 52, 64, 70, 71, 73, 85,
94, 96, 98, 108, 120, 121, 151, 155, 278, 289, 319, 320
Steiner Rudolf 69
Stevens Richard 36, 320
Stróżewski Władysław Antoni 43, 253, 316, 320
Suger 28, 31, 38, 82, 83, 86
Sumartojo Shanti 40, 107, 112, 113, 114, 115, 123,
125, 320
Summanen Mikko 205, 267, 332
Suomalainen Timo 170, 244, 330
Suomalainen Tuomo 170, 244, 330
Swoboda Tomasz 20, 317
Szewczuk Włodzimierz 22, 23, 54, 55, 57, 66, 67, 80, 128
Taniguchi Yoshio 187, 330
Tanizaki Juni'chirō 40, 41, 86, 87, 88, 151, 157, 317, 320
Tarvo Teija 205, 267, 332
Tauszyński Robert 18, 317
Tellenbach Hubert 100, 110
Tendera Paulina 41, 320
Tenho Elina 205, 267, 332
Tesar Heinz 307, 330, 332
Thibaud Jean-Paul 39, 113, 314, 320
Thompson Barbara 27
Tilley Christopher 109, 320

- Tischhauser Anthony 36, 320
Tiepolo Giovanni Battista 79, 96
Tixier Nicolas 42, 315
Toivanen Erkki 316
Trzaska Sylwia 17, 317
Trzebiatowska Małgorzata 14, 314
Twarowski Mieczysław 13, 18, 19, 24, 25, 33, 36, 46, 50,
59, 60, 63, 64, 66, 92, 93, 135, 141, 144, 145, 148,
149, 152, 153, 154, 157, 158, 162, 163, 311, 320, 336
Titian (Tiziano Vecelli) 53, 79
Uffelen, van Chris 42, 320
Ulpian (Gnaeus Domitius Annianus Ulpianus) 60
Urbańska Marta Anna 12, 36, 317, 318
Vassal Philippe 20, 329
Venezia Francesco 21, 38, 151, 298, 321
Vermeer Jan 151, 206
Vesa Jarno 205, 267, 332
Vuitton Louis 192, 193, 227, 228, 329
Wagner Tomasz 10, 27, 28, 83, 84, 944, 122, 320
Wehle-Strzelecka Stanisława 45, 52, 60, 61, 320
Wienold Jan 42, 315
Wigginton Michael 61, 320
Wigley Marc 102, 321
Wilkożewska Krystyna 39, 40, 69, 86, 88, 97, 104, 106,
112, 157, 318, 320, 321
Winskowski Piotr 43, 46, 82, 94, 320, 321
Witelo 28, 29
Marcus Vitruvius Pollio 26, 27, 29, 30, 45, 46, 49, 52, 60,
76, 142, 321
Wlazło-Malinowska Karolina 321
Wróbel Piotr 321
Wyspiański Stanisław 120, 225, 230, 330
Zawadzki Andrzej 18, 317
Zumthor Peter 12, 13, 24, 25, 32, 37, 46, 70, 71, 74, 95, 97,
107, 111, 123, 151, 152, 155, 156, 157, 158, 162, 174,
180, 188, 201, 222, 248, 259, 300, 302, 303, 311,
316, 319, 321, 329, 330
Zupirolli Libero 41, 321
Zuziak Zbigniew 10, 139, 321
Żórawski Juliusz 67, 135, 317, 321
Żuk Paweł 42, 321

List of Works of Architecture Discussed in the Work

Ark of the Lord Church, Bieliczyce, Nowa Huta, Poland, W. Pietrzyk, 1966–1977

Barcelona Pavilion, Spain, Mies van der Rohe, 1929

Biuro Architekt Kaczmarczyk Studio, Biuro Architekt Kaczmarczyk, Sucha Beskidzka, Poland, 2000–2006

Blur (The Cloud), Switzerland, Yverdon-les-Bains, Diller + Scofidio, 2002

Brother Klaus Chapel, Wachendorf, Germany, P. Zumthor, 2007

Cafe pavilion, Ibaraki, Kogo, Tokyo, Japan, SANAA, 1997–1998

Capitol Hotel Tokyu, Tokyo, Japan, K. Kuma, 2010

Centennial Hall, Kyoto, Japan, Y. Taniguchi, 2006

Chapel of St Benedict, Sumvitg, Switzerland, P. Zumthor, 1988

Chapel of St Henry, Turku, Finland, Sanaksenaho Architects, 2005

Chapel of Silence, Helsinki, Finland, K2S Architects, 2012

Chapel, UNESCO, Paris, France, T. Andō, 1995

Chokkura Plaza, Takanezawa, K. Kuma, 2007

Church of Christ, Hope of the World, Vienna, Austria, H. Tesar, 2000

Church of Light, Ibaraki, Japan, T. Andō, 1989

Cité de Refuge, Paris, France, Le Corbusier, 1930–1931

Cité des sciences et de l'industrie, parc de la Villette, Paris, France, A. Fainsilber, eng. P. Rice, 1983–1986

Crystal Palace, London, Great Britain, J. Paxton, 1851

Farnsworth House, Plano, Illinois, USA, Mies van der Rohe, 1951

Fondation Luis Vuitton building, Paris, France, F. Gehry, 2014

Galeria Vittorio Emmanuelle II, G. Mengoni, 1865–1867

General Education School Complex, Pedagogical Library, Biuro Architekt
Kaczmarczyk, Sucha Beskidzka, Poland, 2002–2006

Glass House, Ph. Johnson, New Canaan, USA, 1949

Higher Seminary of the Congregation of the Resurrection, Kraków, D. Kozłowski, 1986–1995

Hiroshi Senju Museum, Karauizawa, Nagano, Japan, R. Nishizawa, 2010

Hiroshige Andō Museum, Bato, Japan, K. Kuma, 2000

House in Lège-Cap-Ferret, Lège-Cap-Ferret, France, Lacaton Vassal Architects, 1998

Imperial Library, later: National Library, Paris, France, H. Labrouste, 1854–1875

Institut du Monde Arabe, Paris, J. Nouvel, 1987

Jellyfish House (Meduse house), Spain, W. Arets Architects (WAA) (project 1998–2001), 2013

JR Hoshakuji Station, Takanezawa, Tochigi, Japan, K. Kuma, 2008

KAIT (Kanagawa Institute of Technology), J. Ishigami, 2010

Kiasma Museum, Helsinki, Finland, S. Holl, 1993–1998

Kolumba Museum, Cologne, Germany, P. Zumthor, 2007

Kunsthau Bregenz, Bregenz, Austria, P. Zumthor, 1990–1997

Laajasalo Church, Helsinki, Finland, K. Järvinen & M. Nieminen, 2003

La Rocca Pisana, Vicenza, Italy, V. Scamozzi, 1576

La Rotonda, Capra, Vicenza, Italy, A. Palladio, V. Scamozzi, 1550–1582

Library of St Genevieve (Nouvelle bibliothèque Sainte-Genève), Paris, France, H. Labrousse, 1838–1850

Louvre Lens, Lens, France, SANAA, 2009–2012

Louvre Pyramid, Paris, France, M. Pei, 1983–1988

LVMH Shinsaibashi, Osaka, Japan, K. Kuma, 2004

LVMH ONE Omotesando Tokyo, Japan, K. Kuma, 2004

Maison de Verre, Paris, France, P. Chareau & B. Bijvoët, 1931

Malmi Church, Helsinki, Finland, K. Gullichsen, 1981

Monastery, La Tourette, Évèux-sur-l'Arbresle, France, Le Corbusier, 1953–1960

Mortensrud Church, Oslo, Norway Skodvin & Jensen, 2010

Museum of Stone, Nasu, Japan, K. Kuma, 2000

Nasu Historical Museum, Nasu, Japan, K. Kuma, 2000

Nezu Art Museum, Tokyo, Japan, K. Kuma, 2009

Nordic Pavilion, Giardini, Venice, Italy, S. Fehn, 1962

NOSPR building, Katowice, Poland, T. M. Konior, 2014

Notre-Dame de Pentecôte Church, Paris, France, F. Hammoutène, 2001

Notre-Dame du Haut chapel, Ronchamp, France, Le Corbusier, 1951–1955

Olari Church, Espoo, Finland, K&S Paavilainen, 1981

Onishi Center, Gunma, Japan, SANAA, 2005

Orlean Gallery, Royal Palace in Paris, P.F.L. Fontaine, 1831

Royal Library, reconstruction, Paris, France, É.-L. Boullée, 1785

Sanctuary of Merciful Love in Collevaenza, Perugia, Italy, J. Lafuente, 1963–1967

Savoie Villa, Poissy, France, Le Corbusier, 1929–1931

Silesian Museum, Katowice, Poland, Riegler Riewe Architekten, 2013

Solarium orientable, Aix-les-Bain, A. Farde, 1929–1930

Student chapel, Otaniemi, Finland, K. and H. Sirén, 1957

Tapiola Church, Finland, A. Ruusuvuori, 1965

Tapiola Culture Center, Tapiola, Finland, A. Sipinen, 1989

Tempelikaution (Church in the Rock), Helsinki, Finland, T. and T. Suomalainen, 1968–1969

The Netherlands Pavilion, Giardini, Venice, Italy, G.T. Rietveld, 1953

Tower of Shadows, Le Corbusier, Chandigarh, India (the design was not completed during the designer's life), 1957

Water and Glass House, K. Kuma, Atami, Japan, 1995

Wyspiański Exhibition and Information Pavilion 2000, Krakow, Poland, Ingarden & Ewý Architekci, 2007

Vallila Library, Helsinki, J. Leiviskä, 1991

Vals Thermal Baths, Vals, Switzerland, P. Zumthor, 1996

Victoria Reggia lily greenhouse, Chatsworth, Great Britain, J. Paxton, 1937

Viiikki Church, Helsinki, Finland, S. Miettinen JKMM, 2005

Villa Girasole, Marcellise near Verona, eng. A. Invernizzi, 1929–1935

Table of Illustrations and Tables

Chapter II (p. 47–89)

- Mini. 1⁵⁸⁷ Venice, Italy
Mini. 2 Foyer of the Kiasma Musuem, Steven Holl, Helsinki, Finland 1993–1998

Chapter IV (p. 127–162)

- Fig. 1–12 Activity of architecture
Fig. I–XII Organisation of illumination
Fig. A. PARTITIONS
Fig. B. MASS
Fig. C. SPACE
Fig. S. Elementary architectural methods of operating with sunlight in the interior—typology in the form of a cube
Tab. 1. Activity of architecture.
Tab. 2. Organisation of illumination.
Tab. 3. Elementary architectural tools of operating with sunlight.
Tab. 4. General dependencies between exposing the physical properties of the architecture of the interior and the properties of sunlight arising from its direction.
Tab. 5. Dependence of the atmosphere of architecture on the mutual exposure of the physical properties of the interior and the properties of sunlight.
Mini. 3 Absorption of light, interior of Notre-Dame de Pentecôte, Franck Hammoutène, Paris, France 2001
Mini. 4 Absorption, entrance of an exhibition pavilion, Venice, Italy

Chapter V (p. 163–252)

- Fig. AA. Activity of architecture marked in colour.
Fig. S.1–S.72 Examples of elementary architectural methods of operating with sunlight in the interior.
Tab. 6. Dependencies between the exposure of physical properties of the interior and the activities of architecture.
Tab. 7. Activity of architecture in the aspect of the atmosphere of the interior.

Direct admittance of rays

Complete penetration

- Phot. 1 Musuem of Stone, architectural complex, Kengo Kuma, Nasu, Japan 2000

Carving

- Phot. 2 Sactuary of Merciful Love in Collevaenza, Julio Lafuente, Collevaenza (Peruggia), Italy 1963–1967
Phot. 3 Tempelaukio, church interior, Timo and Tuomo Suomalainen, Helsinki, Finland 1968–1969
Phot. 4 The Ark of the Lord, main nave, Wojciech Pietrzyk, Bieńczyce, Nowa Huta, Poland 1966–1977
Phot. 5 Church of Light, Tadao Andō, Ibaraki, Osaka, Japan 1989
Phot. 6 Vallila Library, reading room, Juha Leiviskä, Helsinki, Finland, 1991
Phot. 7 Brother Klaus Chapel, Peter Zumthor, Wachendorf, Germany 2007

⁵⁸⁷ Miniature photographs (Mini. 1–Mini. 4) illustrate general subjects and are not a part of the study section, as in the case of photographs (Phot. 1–Phot. 142) in Chapters V and VI.

- Phot. 8 Nezu Art Museum, hall interior, Kengo Kuma, Tokyo, Japan 2009
 Phot. 9 Capitol Hotel Tokyu, foyer, Kengo Kuma, Tokyo, Japan 2010

Forcing through

- Phot. 10 Sanctuary of Merciful Love in Collevalenza, main anve, Julio Lafuente, Collevalenza (Peruggia), Italy 1963–1967
 Phot. 11 Louvre Lens Museum, SANAA, Lens, France 2009–2012

Reflecting

Producing mirror-like reflections

- Phot. 12 Venice. Lustrzane mirror-like reflection on the water surface of a canal
 Phot. 13 Tapiola Culture Centre, interior of the architectural complex, Tapiola, Finland, Arto Sipinen 1989
 Phot. 14 Kiasma Museum, interior of the architectural complex, Steven Holl, Helsinki, Finland 1993–1998
 Phot. 15 Museum of Stone, interior of the architectural complex, Kengo Kuma, Nasu, Japan 2000
 Phot. 16 Museum of Stone, interior of the 'Water and Stone' gallery, Kengo Kuma, Nasu, Japan 2000
 Phot. 17 Nasu Historical Museum, landscape interior, Kengo Kuma, Nasu, Japan 2000
 Phot. 18 Centennial Hall, interior of the architectural complex, Yoshio Taniguchi, Kyoto, Japan 2006
 Phot. 19 Kolumba Museum, upper-floor exhibition space, Peter Zumthor, Kolonia, Germany 2007
 Phot. 20 Capitol Hotel Tokyu, interior of the architectural complex, Kengo Kuma, Tokyo, Japan 2010
 Phot. 21 Capitol Hotel Tokyu foyer, Kengo Kuma, Tokyo, Japan 2010
 Phot. 22 Louvre Lens Museum, interior of the architectural complex, SANAA, Lens, France 2009–2012
 Phot. 23 Fondation Louis Vuitton, interior with water, Frank Owen Gehry, Paris, France 2014
 Phot. 24 Fondation Louis Vuitton, interior with mirrors and water, Frank Owen Gehry, Paris, France 2014

Scattering and breaking

- Phot. 25 Tapiola Church, Aarno Ruusuvuori, Tapiola, Finland 1965
 Phot. 26 Laajasalo Church, Järvinen & Nieminen, Helsinki, Finland 2003
 Phot. 27 Laajasalo Church, Järvinen & Nieminen, Helsinki, Finland 2003

Scattering and bending

- Phot. 28 Sanctuary of Merciful Love in Collevalenza, Julio Lafuente, Collevalenza (Peruggia), Italy 1963–1967
 Phot. 29 Kiasma Museum, upper-floor exhibition space, Steven Holl, Helsinki, Finland 1993–1998

Scattering and slipping

- Phot. 30 Church of Light, Tadao Andō, Ibaraki, Osaka, Japan 1989
 Phot. 31 Viikki church, Samuli Miettinen, JKMM, Viikki, Helsinki, Finland 2005
 Phot. 32 Capitol Hotel Tokyu, foyer, Kengo Kuma, Tokyo, Japan 2010
 Phot. 33 Chapel of Silence, K2S Architects⁵⁸⁸ Helsinki, Finland 2012

Scattering and channelling

- Phot. 34, 35 The Netherlands Pavilion, Gerrit Thomas Rietveld, Giardini, Venice, Italy 1953
 Phot. 36 Sanctuary of Merciful Love in Collevalenza, side chapel, Julio Lafuente, Collevalenza (Peruggia), Italy 1963–1967
 Phot. 37 Tapiola Church, Aarno Ruusuvuori, Tapiola, Finland 1965
 Phot. 38 Laajasalo Church, Järvinen & Nieminen, Helsinki, Finland 2003
 Phot. 39 Viikki Church, Samuli Miettinen, JKMM, Helsinki, Finland 2005

⁵⁸⁸ K2S Architects Ltd.: Kimmo Lintula, Niko Sirola, Mikko Summanen, Jukka Makinen, Kristian Forsberg, Abel Groenewolt, Tetsujiro Kyuma, Mikko Näveri, Miguel Pereira, Outi Pirhonen, Teija Tarvo, Elina Tenho, Jarno Vesa.

Filtering**Sifting**

- Phot. 40 Tapiola Church, nave, Aarno Ruusuvuori, Tapiola, Finland 1965
- Phot. 41 Malmi Church, nave, Kristian Gullichsen, Malmi, Helsinki, Finland 1981
- Phot. 42 Arab World Institute, hallway, Jean Nouvel, Paris, France 1987
- Phot. 43 Biuro Architekt Kaczmarczyk Studio, first-floor hall,
Biuro Architekt Kaczmarczyk, Sucha Beskidzka, Poland 2000–2006
- Phot. 44 Museum of Stone ‘Stone–Water’ gallery, Kengo Kuma, Nasu, Japan 2000
- Phot. 45 Hiroshige Andō Museum, foyer, Kengo Kuma, Bato, Japan 2000
- Phot. 46 Hiroshige Andō Museum, arcade interior, Kengo Kuma, Bato, Japan 2000
- Phot. 47 Nasu Historical Museum, exhibition space, Kengo Kuma, Nasu, Japan 2000
- Phot. 48 Chokkura – Plaza, pavilion interior, Kengo Kuma, Takanezawa (Tochigi prefecture) Japan 2006
- Phot. 49 Kolumba Museum, church ruins exhibition space, Peter Zumthor, Cologne, Germany 2007
- Phot. 50 Capitol Hotel Tokyu, architectural complex, Kengo Kuma, Tokyo, Japan 2010
- Phot. 51 Capitol Hotel Tokyu, foyer, Kengo Kuma, Tokyo, Japan 2010
- Phot. 52 Wyspiański 2000 Information and Exhibition Pavilion, Ingarden & Ewý Architekci, Kraków, Poland 2007
- Phot. 53 Louvre Lens Museum, foyer, SANAA, Lens, France 2009–2012
- Phot. 54 Fondation Louis Vitton building, terrace, Frank Owen Gehry, Paris, France 2014
- Phot. 55 Fondation Louis Vitton building, vertical circulatino space, Frank Owen Gehry, Paris, France 2014

Absorption

- Phot. 56 Sanctuary of Merciful Love in Collevalenza, nave,
Julio Lafuente, Collevalenza (Peruggia), Italy 1963–1967
- Phot. 57 Malmi Church, nave, Kristiana Gullichsen, Malmi, Helsinki, Finland 1981
- Phot. 58 Museum of Stone, Kengo Kuma, Nasu, Japan 2000
- Phot. 59 Laajasalo Church, Järvinen & Nieminen, Helsinki, Finland 2003
- Phot. 60 LVMH ONE Omotesando, urban interior, Kengo Kuma, Tokyo, Japan 2004
- Phot. 61 LVMH in Shinsaibashi, hallway, Kengo Kuma, Osaka, Japan 2004
- Phot. 62 LVMH in Shinsaibashi, entrance hall interior, Kengo Kuma, Osaka, Japan 2004
- Phot. 63 JR Hoshakujji Station, stairwell, Kengo Kuma, Takanezawa, Tochigi, Japan 2008

**Complex form of operating with light. Compliation
of forms of operating with light**

- Phot. 64 Nordic Pavilion, Giardini, Venice, Italy, Sverre Fehn, 1962
- Phot. 65–67 Student chapel, Otaniemi, Finland, Kaja and Heikki Sirén, 1957
- Phot. 68 Sanctuary of Merciful Love in Collevalenza, lower church,
Julio Lafuente, Collevalenza (Peruggia), Italy 1963–1967
- Phot. 69 Tempelaukio, Timo and Tuomo Suomalainen, Helsinki, Finland 1968–1969
- Phot. 70 Church of Light, Tadao Andō, Ibaraki, Osaka, Japan 1989
- Phot. 71 Higher Seminary of the Congregation of the Resurrection, church,
Dariusz Kozłowski, Krakow, Poland 1986–1995
- Phot. 72 Kiasma Museum, foyer, Steven Holl, Helsinki, Finland 1993–1998
- Phot. 73–75 Kunsthaus Bregenz, interior with stairs leading from the second to the
third floor, Peter Zumthor, Bregenz, Austria 1990–1997
- Phot. 76 Silesian Museum, architectural complex, Riegler Riewe Architekten, Katowice, Poland 2013
- Phot. 77 NOSPR building, Katowice, Poland, Tomasz Mikołaj Konior, 2014
- Phot. 78 Sanctuary of Merciful Love in Collevalenza, side chapel,
Julio Lafuente, Collevalenza (Peruggia), Italy 1963–1967

Chapter VI (p. 253–309)**Exposing the materiality of architecture**

- Phot. 79–82 Malmi Church, Kristian Gullichsen, Malmi, Finland 1981
 Phot. 83–87 Brother Klaus Chapel, Peter Zumthor, Wachendorf, Germany 2007

Exposing the shape of architecture

- Phot. 88–91 Kiasma Museum, entrance hall with ramp, Steven Holl, Helsinki, Finland 1993–1998
 Phot. 92–94 Chapel of Silence, K2S Architects, Helsinki, Finland 2012

Exposing the filter structure

- Phot. 95–97 Hiroshige Andō Museum, Kengo Kuma, Bato, Japan 2000
 Phot. 98–101 Notre-Dame de Pentecôte Church, Paris, France, Franck Hammoutène, 2001

Exposing the space of the interior

- Phot. 102, 103 Kiasma Museum, Steven Holl, Helsinki, Finland 1993–1998
 Phot. 104, 105 General Education School Complex. Pedagogical Library,
 Biuro Architekt Kaczmarczyk, Sucha Beskidzka, Poland 2002–2006
 Phot. 102–110 Viikki Church, JKMM, Helsinki, Finland 2005
 Phot. 111–114 Louvre Lens Museum, SANAA, Lens, France 2009–2012

Exposing the blending of the interior with the exterior

- Phot. 111–118 Hiroshi Senju Museum, Ryue Nishizawa, Karuizawa, Nagano, Japan 2010

**Exposing the physical properties of sunlight
Orchestration**

- Phot. 119–123 Sanctuary of Merciful Love in Collevaleza,
 Julio Lafuente, Collevaleza (Peruggia), Italy 1963–1967
 Phot. 124–128 Mortensrud Church, Skodvin & Jensen, Oslo, Norway 2010

Choreography

- Phot. 129–132 Chapel of St Benedict, Peter Zumthor, Sumvitg, Switzerland 1988
 Phot. 133–135 Kunsthaus Bregenz, Peter Zumthor, Bregenz, Austria 1990–1997
 Phot. 136–138 Brother Klaus Chapel, landscape interior, Peter Zumthor, Wachendorf, Germany 2007

Orchestration and choreography

- Phot. 139–142 Church of Christ, Hope of the World, Vienna, Austria, Heinz Tesar, 2000
 Phot. 143 Brother Klaus Chapel, landscape interior, Peter Zumthor, Wachendorf, Germany 2007

Abstract

This work discusses the complex dependencies between the relationship of sunlight and the architecture of the interior and the atmosphere of the interior.

The Introduction features an outline of the content of the work as the dependence between sunlight and architecture of the interior and the atmosphere of architecture. Examples of interiors in which an intended atmosphere was generated via a specific relationship between sunlight and architecture were listed. It was noted that the relationship between sunlight and architecture is an essential component/building block of the atmosphere of architecture, that is appreciated by architects and can be designed within an interior. The author also noted the reflection on the atmosphere of architecture present in architectural criticism and the theory of architecture.

Chapter I includes a detailed outline of the object of the study, its scope and perspective: sunlight in the interior in a relationship with architecture in the aspect of the atmosphere of architecture. No temporal or territorial scope was outlined for Chapters I–IV, while for the case studies presented in Chapters V and VI—the analysis was limited to European and Japanese interiors from the period between 1965 and 2015 that the author could study via direct experience. Key terms were explained: light, sunlight, interior, the atmosphere of architecture, as well as the method of the study, its objective and its novel elements. The chapter also discusses the state of research, comprised of the literature quoted and used in the work.

In Chapter II, the author analysed the impact of physical, physiological, psychological and cultural determinants on the perception and shaping of the relationship between sunlight and architecture. It was studied how these impacts condition the physical properties of the interior: architecture and light that operates within it. Essential dependencies were observed between physical conditions arising from the geographical location of the interior and the human perception and design of light in the interior. Human physiological processes associated with the perception of the interior and the eliciting of sensory experiences, particularly visual ones, were analysed. Methods of the use of solar radiation by humans throughout history were explored, with a particular emphasis on the period of Modernism. An outline of contemporary knowledge on the impact of light on the human body was presented. It was studied how human psychological needs and predispositions affect the reception and shaping of light in the interior and how light affects the state of mind: mood and associations. It was observed that light in the interior is associated with meeting essential human psychological needs. It was studied how culture, with its symbolism and tradition, affects the human reception and shaping of light in the interior. The individual impacts were illustrated with examples of interiors that are distinct for them.

Chapter III discusses the third aspect of the study, associated with the aspect of the relationship under study and its determinants: the atmosphere of architecture. First, based on an analysis of determinants, the chapter lists the criterion of evaluating the relationship between sunlight and architecture in the interior in the aspect of atmosphere: the mutual exposure of architecture and light. As a result of this exposure, the interior generates its new physical property, which is essential in inducing specific sensory experiences and states of mind in humans, namely: the atmosphere of architecture. Three elements of evaluating atmosphere were listed: impressiveness, ambience and projection capacity. The proposed outlook was then referred to the significance of atmosphere in studies developed in the field of the contemporary theory of atmosphere. Four subjects were analysed: defining atmosphere, the reception of atmosphere, describing atmosphere and building atmosphere with light.

In Chapter IV, to study the principles of the mutual exposure of the physical properties of architecture and sunlight and architecture in the interior, the author analysed the functioning

of the relationship between sunlight and architecture. To this end, tools for studying this relationship were developed, namely the *typology and taxonomy of elementary architectural methods of operating with sunlight in the interior*. First, the author defined and discussed three factors that condition the methods of operating with sunlight in the interior: the activity of architecture, the organisation of illumination and architectural tools.

Twelve activities of architecture were distinguished and characterised: ADMITTING RAYS DIRECTLY: 1) complete penetration; 2) carving; 3) forcing through; 4) isolation; REFLECTION 5) producing mirror-like reflections; 6) scattering and breaking; 7) scattering and bending; 8) scattering and slipping; 9) scattering and channelling; FILTERING: 10) sifting; 11) refraction; 12) absorption.

Twelve categories of organisation of illumination were distinguished: I—light from the side from one or several sides; II—light from the side from all sides; III—light from the side from overhead; IV—light from the side from below; V—light from the top from overhead; VI—light from the top from one or more sides; VII—light from the top from all sides; VIII—light from the top from below; IX—light from the side and top from all sides; X—light from the side and top from one or more sides; XI—light from the side and top from above; XII—light from the side and top from below.

Twelve categories of architectural tools of operating with sunlight in the interior were distinguished. They are formed by elements of the interior defined in the study's assumptions: PARTITION, MASS and SPACE, which were detailed depending on the following physical properties: openings, structure, material and shape. The mutual dependencies between individual elements of the interior and their physical properties produced the set of architectural tools utilised by the activity of architecture under a specific organisation of illumination.

Based on the presented typology, the author built a *taxonomy of elementary methods of operating with sunlight in the interior*, that demonstrates the dependencies between individual factors that condition operating with sunlight in the interior. The taxonomy was presented using a three-dimensional cube that includes a (possibly exhaustive) set of 12×12×12 methods of operating with light in the interior.

Further in the study, the author presented the results of operating with sunlight in the interior in terms of the mutual exposure of the physical properties of architecture and light. Afterwards, based on the partial results of the study (concerning the criterion of evaluating the atmosphere of architecture), the discussion on atmosphere and light in the interior in the works of Rasmussen, Twarowski, Plummer and Zumthor and, on the basis of her own experience of perceiving interiors, the work explored the dependency between the results of operating with sunlight in the interior and the atmosphere of architecture. Six types of exposing the physical properties of the interior were distinguished and linked with specific atmospheres. Exposing: 1) the MATERIALITY of an interior induces: an *impressiveness* of the vividness of material surfaces, of diluted or condensed darkness, of darkness with a bright spot, of the vividness of interior boundary fragments, the beam of light; —an *ambience* that stimulates intimacy, focus, tension, mysteriousness, dramatism, enclosure, inaccessibility; —a *projection capacity* of a shadowy depth and theatricality; 2) the SHAPE of an interior induces: —an *impressiveness* of the vividness of the shape of the interior, tempered brightness, of suffusion with light in a uniform tone, stasis; —an *ambience* that stimulates clarity, stasis, peace, quiet; —a *projection capacity* of 'I see what is, it is what I see'; 3) the FILTER STRUCTURE induces: —an *impressiveness* of the vividness of the actual and distorted filter structure, the blurring of the view of the interior's actual materials and shapes; —an *ambience* that stimulates unclarity, ambiguity, intangibility, separation; —a *projection capacity* of numerous illusions and associations associated with spots of light and shadow; in terms of this exposure, depending on the filter type, the following was also distinguished: a) —an *impressiveness* of the vividness and multiplication of contrast

between shadow and light, vividity, multiplication and deformation of posts of shadow and alight arising from the filter structure; —an *a m b i e n c e* that stimulates confusion, nervous stimulation, a diversity of stimuli and —a *p r o j e c t i o n c a p a c i t y* of illusions and associations with the interior's diffusion and atomisation or b)—an *i m p r e s s i v e n e s s* of the darkening of the interior, of the dimming of light and tempered brightness; —an *a m b i e n c e* that stimulates mysteriousness; —a *p r o j e c t i o n c a p a c i t y* of the haziness and fogginess of the interior; 4) of SPACE induces —an *i m p r e s s i v e n e s s* of the vivid volume of the interior (either of its fragment or of its entirety), the blurring of the boundaries of the interior, the population of space with elements; —an *a m b i e n c e* that stimulates density, boundlessness, a balance between enclosure and openness; —a *p r o j e c t i o n c a p a c i t y* of the forest; 5) of the BLENDING of the interior and the exterior induces: —an *i m p r e s s i v e n e s s* of the clarity of the distant areas of the interior or its surroundings, of spaciousness, of blurring the visibility of the interior's boundary; —an *a m b i e n c e* that stimulates openness, luminance, lightness; —a *p r o j e c t i o n c a p a c i t y* of theatricality (view–frame–scene); 6) the interior as an INSTRUMENT OF LIGHT, which in the orchestration of light induces: —an *i m p r e s s i v e n e s s* of diversity, complexity; —an *a m b i e n c e* that stimulates variability, motion, intensity, tension, musicality in the *vivace* tempo; —a *p r o j e c t i o n c a p a c i t y* of the pulsating brightness of the celestial sphere; a starry sky, the music of the spheres; in the choreography of light it induces: —the *i m p r e s s i v e n e s s* of the slow travel of sunlight (also light reflected from the Moon at night), slow changes in intensity, temperature and colour of light, the uniformity of light; —an *a m b i e n c e* of transience (evanescence), uniformity, musicality in the *moderato* tempo; —a *p r o j e c t i o n c a p a c i t y* of the choreography of light, of the journey of the Sun/Moon across the celestial sphere, of transience (it should be noted that orchestration is the result of different methods of operating with sunlight in the interior at the same time, while choreography—the result of a single method of operating with light in the interior—including a complex method—over time).

Further in the study, the author presented the dependency between the atmosphere of architecture on the mutual exposure of the physical properties of the interior and the physical properties of sunlight and did so using a table.

In **Chapter V**, the author analysed light in the aspect of atmosphere in selected interiors sequenced following the activity of architecture. In the chapter's summary, the dependencies between exposing the physical properties of the interior and individual activities of architecture were listed in a table.

In **Chapter VI**, an analysis of the atmosphere of selected interiors as a result of exposing the materiality of architecture, the shape of the interior, filter structure, the space of the interior, the blending of the interior and the exterior and as a result of the orchestration of light and the choreography of light. When evaluating the atmosphere of architecture, the author used the research tool presented in Chapter IV.

The results of the study were then **summarised** and **conclusions** were formulated across 12 points. The author presented the concordance of the study with its intended objective: indicating the humanising role of analysing the atmosphere of architecture induced by sunlight in architectural criticism, education and design. The secondary goal of the work, which was the analysis of the dependencies between the relationship between sunlight and architecture and atmosphere, was achieved. It was observed that the proposed definition of atmosphere with its specification in reference to atmosphere induced in architecture using sunlight can be a significant contribution to the current discussion on atmosphere. The scope of repetitions featured from the author's previous publication, entitled *O światle...* was listed (the typology and taxonomy of elementary architectural methods of operating with sunlight in the interior, the essential part of the documentation of results of operating with light so as to expose the properties of the interior, most examples used in case studies, the essential part

of the evaluation of atmosphere induced by sunlight in architecture). The research value of the criterion of evaluation atmosphere induced by sunlight in the interior was demonstrated: the mutual exposure of the physical properties of architecture and sunlight in the interior. The utility of the detailed criteria of this exposure was demonstrated, for 1) impressiveness, 2) ambience, 3) projection capacity, in the process of evaluating the relationship between sunlight and architecture in the aspect of the atmosphere of the interior. It was observed that exposing architecture using light corresponds with essential phenomena described in the theory of atmosphere. It was stated that, against the background of the theory of atmosphere, the study's novelty includes the demonstration and accentuation of the mutuality of the exposure of architecture and sunlight in the interior. The expositional role of light, used in stage design to build the atmosphere of architecture, was noted. The utility of the analysis presented in architectural criticism and education was demonstrated, as was the ease of applying the study's results to methods of designing architecture with a focus on their atmosphere.

Keywords: sunlight, interior—human surroundings, architecture, the atmosphere of architecture, theory of atmosphere, impressiveness of architecture, ambience of architecture, projection capacity of architecture, stage design.