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THE LIGHTING OF SACRAL BUILDINGS

Dóra EDELMANN

Department of Building Construction
Budapest University of Technology and Economics
H–1521 Budapest, POB. 91. Hungary

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Abstract

Some essential thoughts of illumination of the sacral buildings, being emphasized the performance method justifying planning dimension theory.

Keywords: illumination, sacral building, dimension-theory, light, in-streaming light, artificial light, natural light.

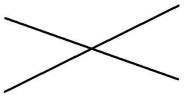
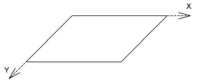
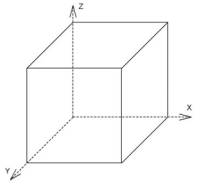
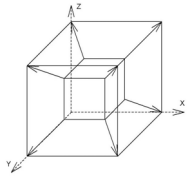
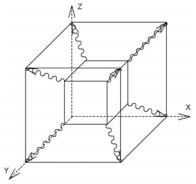
1. The Dimension Theory of Design, Introduction

Prior to the discussion of the characteristics of the lighting of sacral buildings it is necessary to provide a detailed introduction of the analogy drawn between design and dimension as it justifies the main points, the basic steps of the analysis.

The process of designing – be it architectural, structural, or that of lighting – may be vividly described in terms of its analogy with the definition of dimensions in mathematics and in physics. Its basic element is the proper functioning of the sense organs which corresponds to the zero dimension, i.e. *the point*, which is the basic constituent of all further, higher dimensions. The acquisition of the skills of reading, writing and drawing, which stand for the first dimension, in other words *the line*, presupposes the presence of the zero dimension. An infinite number of well-defined lines constitute *the plane* that represents the knowledge of the characteristics of applied materials, the load-bearing behaviour of structures, building technologies, economic issues, etc. The possession of all that expertise is a necessary but not a sufficient condition of understanding and of application, in other words the birth of the third dimension or *space*. This level of the analogy may be termed the level of actual identification, namely with the given space, task, function, demand and possibilities, the borders of lower dimensions.

In our present world, as we know it, the determination of the location of a point and its characterisation requires the introduction of a fourth dimension, i.e. *time*. If time is considered to pass with a constant velocity the third dimension may be said to be present in the smallest unit of the forth dimension (and this reasoning may be extended to all other dimensions). Similarly, the cube expanding with constant velocity regarded at any specific moment in time is a cube of a constant size. Both the design rendered on a sheet and the material form of the building are undoubtedly projections at a single moment of time, not the results, merely stages of a process,

Table 1. The process of designing

					
$0D$	$1D$	$2D$	$3D$	$4D$	$5D$
point	line	plane	space	space changing with constant speed	space changing with varying speed
point	section	square	cube	cube expanding with constant speed	cube expanding with varying speed
$x = 0$ $y = 0$ $z = 0$ $t = 0$ $a_t = 0$	$x = a$ $y = 0$ $z = 0$ $t = 0$ $a_t = 0$	$x = a$ $y = a$ $z = 0$ $t = 0$ $a_t = 0$	$x = a$ $y = a$ $z = a$ $t = 0$ $a_t = 0$	$x = a$ $y = a$ $z = a$ $t = a$ $a_t = 0$	$x = a$ $y = a$ $z = a$ $t = a$ $a_t = a$
the functioning of sense organs (seeing, hearing, feeling, smelling, tasting)	the acquisition of the skills of reading, writing, drawing (basic learned processes)	knowledge of materials, structures, building technologies, etc. (learned skills)	understanding, application, identification	further thoughts	emotions

which may be seen as the infinite continuation of thinking, the indispensable basis of all of art, design and scientific work. In addition to its primary denotation of drawing or putting thought to paper the term ‘planning’ (designing) in Hungarian has an elusive secondary meaning, hard to define precisely as in the not quite eloquent but colloquial phrase ‘What have you planned for Sunday?’, which bears reference to future activity. That question, despite the past form of the verb, explicitly defines the time of the event to take place in the future, nobody is misled to believe that happenings of the previous Sunday are being mentioned. Therefore the term ‘planning’ (design) must contain reference to a process in time, in the future.

The most recent findings in physics clearly refute the constancy of time, which necessitates the introduction of a further dimension, the fifth, which presupposes the existence of lower dimensions but merely as its projections. To our present knowledge, the fact that *time is changing (physically speaking)* is observable only in astrological proportions. Apart from the possibilities in the third and fourth dimensions, that change is evidently present in a subjective way even within the finite duration of human life. Time, which is speeding up as a result of pleasant experiences and vica versa, is the fifth dimension of the process of designing, it refers to the presence of sincere emotions (*Fig. 1*).

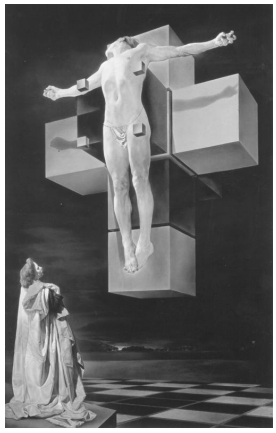


Fig. 1. The simultaneous presence of the fourth and fifth dimensions in Salvador Dali’s Corpus hypercubicus

Fig. 2. Sun-dance in the Kalahari desert

As a consequence of the above reasoning it is evidently impossible to devise a designer’s guide or a ‘user’s manual’ to the lighting of sacral buildings (as well). It is merely the third dimension, i.e., presentation that can be achieved and the creation of the further dimensions of continued thinking and emotions can only be hoped for. The analysis and the interpretation of the lighting of sacral buildings is a seemingly elusive task based on subjective experience. That concept is evident

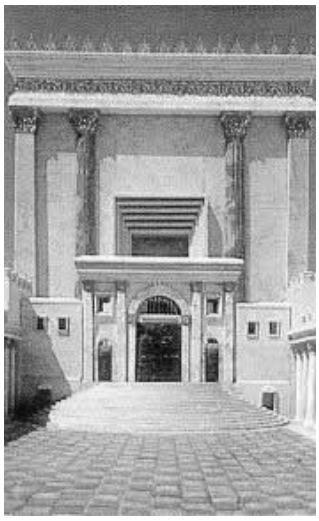


Fig. 3. The hypothetical elevation of Solomon's church

Fig. 4. Concentrated light from the East

in the thoughts of Le Corbusier[1], just like from John Paul II's letter addressed to artists[2] (*Fig. 2*).

Looking at the church buildings of modern times, the need for the detailed analysis of their lighting is evident. The more precise definition of that latter role, the study of its evolution and its various methods, all these were designed to constitute the subject matter of the doctoral thesis written, with respect to the complexity of the task, in the doctoral course of the Faculty of Architecture at the Technical University of Graz, under the supervision of Prof. Dr. Molnár Jenő.

Our present day knowledge concerning the technology of building and lighting provides designers with infinite possibilities. However, the thesis mentioned above, and certain basic notions of which are repeated here, does not aim at making restrictions on the possibilities, at prescribing the correct methods, at imposing a metric system on the concept or at carrying out an analysis based on measurements with no regard to emotions and impressions. The thesis sets out much rather to search for stages in the evolution of the Austrian and Hungarian culture of church building and interpret them from different points of view as well as to present the current tendencies. Thus the handling of both natural and artificial lighting will hopefully become more conscious and more perceptible in the design phase of

[1] 'Lit buildings speak, well-lit buildings sing. Give your buildings a voice!' Le Corbusier

[2] 'The play on light and shadow, the alternation of powerful and graceful forms are evidently accounted for by architectural considerations but they are also part of our experience of God, they have an impression on our encounter with the fearsome yet inviting mystery.' John Paul II, The letter to Artists, 4th, April 1999.

the church buildings of our days and also in the renovation of historic monuments through the introduction of historical as well as modern examples.

2. Lighting Methods of Historical Sacral Buildings

Sacral buildings may be classified into two main categories on the basis of the believers' attitude to God (or gods). One of them is built to serve as 'The House of God' in the sense that profound thoughts should be born in its interior and that the one who enters should feel it to be the sphere of the transcendent on earth. The Christian archetype of that first kind is the sacral building of the age of the Reformation. The other type is not created in order to promote the relationship of God(s) and man or to facilitate the encounter but to express the admiration of humankind for God(s), unapproachable by mortal man, exclusively in praise of (God)s, almost as a kind of sacrifice. The Christian archetype of that is Solomon's Temple (*Fig. 3*).

The internal and external application of light in sacral buildings may have several interpretations. We are speaking of *indirect use* when light (be it natural light filtering in or artificial lighting) serves to highlight an emphatic element of the interior (sculpture, painting, a specific area, etc.): here light is applied in a more or less concentrated and indirect way (*Fig. 4*). The sizing and arrangement of transparent panels with the aim of encouraging meditation and introversion is another instance of the indirect use of lighting.[3] Examples of *direct use* may primarily be found at communities that worship light or the sun. There we find a remarkably wide scale of lighting techniques making use of the annual shift in both the direction and the intensity of daylight as well as the daily cycle of changing lighting conditions from sunrise to sunset. As a result of the further development or the extinction of such cults the latter type of sacral buildings no longer strike their modern viewers with the awe due to the ancient God(s), but often they inspire respect merely for the advanced state of natural science in such ancient communities of our ancestors.

In the *early days* when Christian congregations were housed by unaltered residential buildings, which were later modified through the enlargement of their interior, the size and arrangement of transparent panels (here: windows) was obviously generally the same as for the rest of the residential buildings.

The typically *early Christian* 'catacomb atmosphere' left its mark on sacral buildings for centuries to come. The vaulted, cavelike space, which was dimly lit but in some places brightly illuminated (later an artistic tool of highlighting), had the psychological effect of the cave or a similar building serving to protect our primaeval instincts.

Generally speaking, the *Ravenna school* was the first to handle lighting, the structure of the building, the arrangement of doors and windows and also ornamentation in a perfectly balanced and harmonious manner. Light is streaming in in

[3] See more detailed explanation of this point in: Edelmann, Dóra: Gestaltung der natürlichen und künstlichen Beleuchtung in den Sakralbauten, Untersuchungen und Standpunkte.

portions concentrated in specific directions, thereby creating a dim and vague air nevertheless full of character. The atmosphere of the interior is further enhanced by colours and patterns and it brings to mind the lights of the night. Although the technical and artistic methods applied still resemble the architecture of the age of catacombs (Christ on his throne above the entrance, portrayed as the Good Shepherd and the mosaic on the vaults representing the starry sky display, with respect to the plasticity of the surfaces, the nocturnal version of that age's view of the universe) but the quality and nature of decorative elements signals already at these early buildings the birth of a new school. It was in the golden age of Ravenna – in harmony with early Christian and Roman imagery – that full figures and rings around their heads, as the first appearance of glory, came to be represented. The symbolism of the glory serves well to elucidate the characteristics of the interior of sacral buildings: the originally sharp contrast between light and shadow evolved through time into even lighting virtually devoid of contrast.

The application of a large number of small windows, especially tiny compared to the bulk of the building, was a novelty that was first seen in purely Byzantine architecture. The arrangement of windows was independent of the points of the compass and generally followed a circular pattern or one with at least two axes of symmetry.

The structural knowledge of the late and the ripe Roman period would already have facilitated the instalment of more openings in the walls for the sake of lighting. The fact that it was not the case is mainly attributable to the impossibility of heating huge sacral spaces, the rare application of glazing and the function of church buildings as strongholds.

Gothic architecture introduced an essentially new and homogeneous structural system with the application and development of the pointed arch and the ribbed groined vault. It used a skeleton of graceful supports bearing relatively light vaults to envelope a tidy arrangement of large, soaring spaces and flood them with light. The openings were frequently remarkably big and they were glazed in colour. Though the orientation of the church with regard to the compass, which became more and more strict in Gothic architecture, seemed to impose a limitation on the lighting effects of the interiors, the application of a great variety of structural as well as decorative elements helped to soften this strict system of light direction creating a unique artistic lighting effect for each building.

In the age of the *Renaissance* fine art of religious orientation appeared, at first glance, to be in striking contrast with the rational internal lighting and architectural arrangement of the buildings. On one hand the contrast is evident between the mathematically accurate designing of the incoming light and the pieces of fine art handling their subject and using colours with extraordinary impulsiveness, on the other hand it is perceivable in the rational composition of these paintings, a telltale sign of the artists' attempt at independence in the face of the reigning lighting conditions of the church interior.

Light, which is often the only applied element that allows a relatively easy recognition of almost all forms of mannerist art, was handled in a calculated and conscious way resembling the Renaissance in architecture and it frequently serves

as the only basis for the exact determination of the real dimensions of space among the luxurious spirals and labyrinths of mass and form. Painting was generally monotone, unconventional and often shocking, and among the bold choice of subjects and composition, geometrical forms and the angularity of arrangement, light represented Renaissance softness and bore a slight reference to the characteristic and extremely effective lighting in the Baroque, which was from a single direction and therefore instantly intelligible.

In the artistic eras before the *Baroque* light surrounding holy figures symbolising God was represented in a way that may be termed general and almost dogmatic. The Baroque brought about a diversion in the representation of the glory: it was illustrated differently across regions and decades by each artist. Beside the explicit and often colourful Byzantine circles, which are also reminiscent of the architecture of Ravenna, and the similarly explicit images of the Renaissance, which were already softer in outline and finer in tone, three representations of Baroque origin and almost exclusively typical of that era came to be dominant. The usually golden glory of irregular contour radiating in all directions is especially typical of sculptures but also present in paintings and it gave an effect of the bright rays of the rising sun around the faces of saints. The glory highlighted with tiny stars in a distinct circle, which reminds us of the starry sky of Ravenna, can also be found both in sculpture and in painting. Finally, the figures without an explicit glory were often emphasised merely by a change in the tone and in the colour of the representation of the sky in the background: rainbows and the glowing colours of the sun-disk were used to catch the eye.

Among countless variations it is almost exclusively the frequent application of natural forms to function as a kind of glory that can be stated to have been general.

Fig. 5. The dynamic use of natural light, an active sense of time: Center of Meditation, Unazuki, Toyama, 1993–94, Enric Miralles

Fig. 6. The dynamic use of natural light, an active sense of time

Fig. 7. The static use of artificial light, the exclusion of natural light, a passive sense of time: Baptist church, Sharpsburg, lighting by The Show Business Sound and Lighting Inc., Georgia

Fig. 8. The static use of artificial light, the exclusion of natural light, a passive sense of time: Kapelle im Erzbischöflichen Collegium Marianum, lighting by Heinz Mack, 1998

The lighting of the *classicist* church shows – in accordance with the characteristics of that style – the basic features of antique public buildings. However, from these times on the design of natural lighting can not be seen to be following uniform principles, as the individual was brought more and more to the foreground in the field of art, the artist firmly demanded personal attention. The great variety in concepts, structural design and the choice of materials no longer permits broad statements concerning the analysis of natural lighting. With respect to the technical standard of the age it necessarily brought about the moment for the introduction of artificial lighting in sacral interiors, even if it may be said to have happened accidentally[4], and this change in turn resulted in an infinite number of varieties.

3. Artificial Light

The necessity for, the justification, the quality and the type of artificial light to be applied all present problems at modern sacral buildings. True, most of them uses natural light as a tool of artistic emphasis or even as a piece of art in itself uniting the proper sphere and visibility, thus the interior does not require artificial light beyond

[4]The body of the Duke of Wellington lay in state in the eternal twilight inside St. Paul's Cathedral. Those occupied with the necessary work of preparation laid down gas pipes for lighting to be able to finish their work in time. This is how the Illustrated London News reported on the unprecedented light effect in its issue of the 6th of November, 1852.: 'When all these gas flames are lit one may barely recognise the interior of St. Paul's for the bright light alters the nature of the building in such a peculiar manner and causes its shadows to sway.'

the merely functional and temporary lighting. On the other hand, another group of modern churches applies artificial light already in the phase of design as part of the art or as a tool of highlighting with respect to the complex set of functions the sacral spaces of our times are expected to serve. The various concerts as well as ecclesiastic, national, communal or family holidays housed by the churches may all require their own design of lighting. There may as yet be few examples of artificial lighting changed strictly in accordance with the stages of the liturgy but some designs of lighting have already been prepared to give the chancel an emphasis distinguished from that on the nave.

Other sacral buildings apply artificial light not so much as a tool of artistic expression but as an indispensable instrument of highlighting architectural form, the lack of which would make internal space insignificant or even frightening.

In another group of artificially lit sacral buildings the arrangement, the colour and the intensity of artificial light are all chosen to highlight architectural design and through that the displayed artistic and ornamental elements at the same time as having a functional role if necessary. Such illuminators are generally arranged in or around the direction in which natural light enters and their design closely follows the atmosphere of the interior of the church. Their arrangement often follows the rhythm of doors and windows and the shape of the beams copies the design of the windows.

Special attention has to be paid to the fact that artificial light has a modifying effect on our sense of time. The cyclical nature of time, the power of regeneration may best be consciously expressed and artistically represented through the proper, *dynamic* use of natural light, while the subjective sense of time slowed down in the sixth dimension may be characterised by the application of *static* artificial lighting (*Figs. 5–8*).