Place and Space - Architectural Daylight Design in Traditional Housing in Northern and Southern Regions of Europe

Mathiasen, Nanet

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Place and Space – Architectural Daylight Design in Traditional Housing in Northern and Southern Regions of Europe

Nanet MATHIASEN
Architect, PhD student, The Royal Danish Academy of Fine Arts, School of Architecture, Institute 2,
Philip de Langes Allé 10, 1435 Copenhagen K, Denmark
E-mail: nanet.mathiasen@karch.dk

ABSTRACT
Every place on earth has its own particular kind of daylight – this is a familiar truth to which people have often referred. But what kind of daylight does each place have, and how has daylight influenced the architectural planning of daylight apertures?
This paper will discuss these issues in two sections: *place* and *space*. The section entitled "place" discusses the characteristics of daylight and the variation between northern and southern latitudes; and the section entitled "space" provides examples of the way in which architecture has responded to daylight conditions in various periods of the history of architecture.

1. INTRODUCTION

Light varies first and foremost because of the altitude of the Sun at the latitude in question, and this might be the main reason why many people have emphasised the specific light that each place on earth has. [1 + 2]

This paper contains some initial reflections regarding the PhD project *Nordic Light - and its impact on the design of apertures in Nordic architecture* (started in September 2009). The project is an attempt to specify and exemplify what Nordic light is, and how the design of apertures relates to specific light conditions. To underline the characteristics of Nordic light, it is contrasted with southern light. Nordic light will be regarded as the light of Scandinavia with the main emphasis on Denmark, located at latitude 56°N; and southern light will be regarded as the light of Italy, more specifically around the latitude of Rome at 42°N.
The architectural examples discussed in this paper are studied on site and subject to the given conditions (obstructing neighbouring buildings, trees with leaves etc.). The daylight measurements have been taken in overcast weather (0.85 m above the floor) and subsequently converted into daylight factors and then finished in a plan drawing. [3] The illustrations should be regarded with some degree of uncertainty, since the days on which access to the buildings concerned was permitted were not always days with a perfect overcast sky.
Furthermore, it is important to note that a daylight factor illustrates how much of the light from the total sky at a certain latitude enters a room. [4] But as the luminance of the sky varies from latitude to latitude, the actual lux level (intensity of the light) is not the same even though the daylight factor is the same at a northern and southern latitude.

2. PLACE

The characteristics of light are closely linked to the climate of the place in question. Denmark has a temperate coastal climate which is characterised by its changeable weather, moderate temperature, humidity and frequent precipitation. The summers are cool and short, and the winters are mild.
Italy has a Mediterranean climate characterised by being mild with little variation between night and day. The summers are long and warm, and the winters are short, cool and humid. [5]

Sunlight, skylight or reflected light can be the predominant type of light depending on the climate concerned. As the sky often changes in Denmark, and as it often changes into clouds and rain, the predominant sky is the overcast sky. By way of contrast to this, the sun often shines in Italy and the predominant light is sunshine. Reflected light is present in both types of light, but the higher intensity of light the more reflected light whereas it is more within the sunlight. All three types of light can be characterised on the basis of the three parameters *colour*, *intensity* and *distribution*. [6] They are all variable in relation to each other, and they are all dependent on the condition of the sky.

2.1 The colour of light

The colour of light ranges from warm over neutral to cold depending on its spectral composition. The visible light spectrum has a wavelength of between approximately 380 nm and 780 nm. Light that contains the same amount of energy within all wavelengths in the visible area will be perceived as white.
In Copenhagen the sun shines during the daytime approximately 1/3 (36%) of the time on average throughout the year, which means that 2/3 of the time the sky is cloudy and appears white, grey or pale blue in colour. By contrast, Rome has sunshine and a clear blue sky approximately ½ (54%) of the time. This means that the warm colours dominate more often in Italy than in Denmark. [7]

2.2 The intensity of light

The intensity of light increases as the altitude of the Sun increases, although if there is thick cloud cover the light intensity will be lower and if the cloud cover is thin the sky will appear white and be brighter than a dark blue sky. As the altitude of the Sun is higher in Italy than in Denmark, the light intensity is also higher. Rome will have the highest light level in connection with sunshine, but that is different in Denmark. Meteorological computer simulations of the sky throughout the year show that during wintertime, when there is sunshine and the altitude of the Sun is at its lowest, it is in fact the diffuse pale blue sky that provides the most intensity in the light. [8]

2.3 The distribution of light

The distribution of light varies from direct to diffuse. The Sun provides direct light with parallel rays, whereas diffuse light comes from all sides of the luminous firmament. In between direct sunlight and the diffuse light of the sky, there are countless variations, depending on how big the dominant light source is. [9]
The distribution of light is particularly important with regard to the shadow pattern. Direct sunlight gives a shadow with an exact delimitation; the light from the sky is diffuse and gives a dim, soft shadow or no shadow at all.

3. SPACE

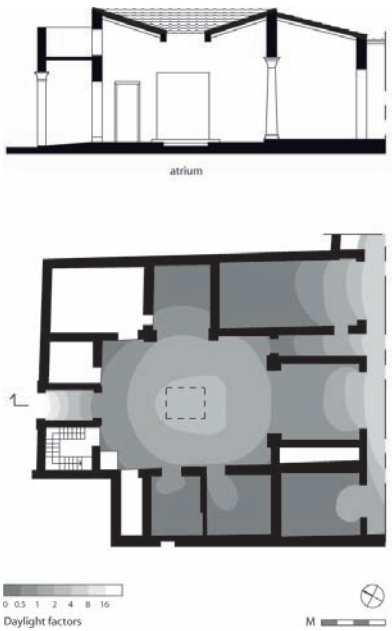
A building structure, its boundaries and surfaces have the important role of interacting with the light and thereby creating a distinctive light setting. The following case studies from two different latitudes illustrate different ways of planning daylight in domestic houses at various points in history.

3.1 Classical Antiquity and the Medieval period

- House of Menander (Casa del Menandro), 3rd cent. BC, Pompeii, Italy
- Farmhouse from Halland (Hallandsgården) in Skåne, a southern province in Sweden, 17th century, now situated at the Open-Air Museum, Copenhagen, Denmark

The layout of *Casa del Menandro* in Pompeii follows the typical plan of a town house in Classical Antiquity, with the rooms being arranged around the atrium. Figure 1 shows how well lit the atrium is; because of the size of the skylight, the light from the sky will produce a relatively high light level and even distribution. The mild climate is probably the reason why it was possible to create such a large opening towards the open air. In the atrium the colours of light are represented by the cooler light coming from the blue sky and the warm, direct sunshine. The intensity of light is high without creating uncomfortable glare, and the distribution of the light from the sky is even and efficient as the skylight is big.

Skylights were the main source of light in early Scandinavian settlements, too. The *Farmhouse from Halland* was



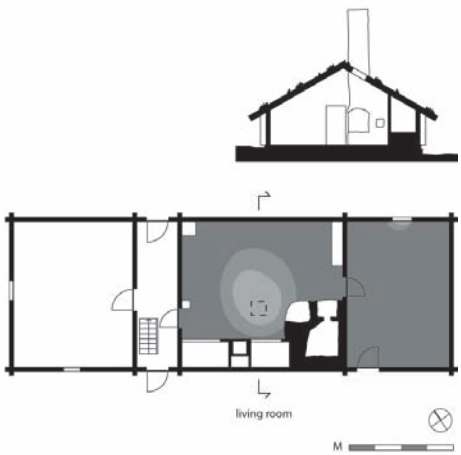
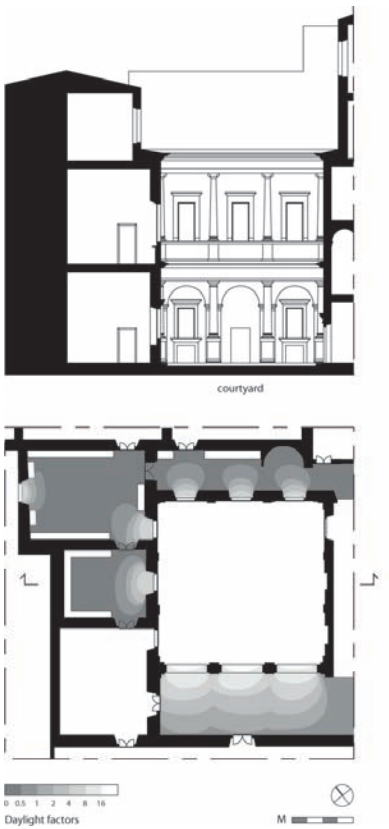


Fig. 1 (left)
Casa del Menandro, section and plan with daylight factor distribution
Fig. 2 (right)
Farmhouse from Halland, section and plan with daylight factor distribution

built in the 17th century following the traditional layout, which can be traced far back. Unfortunately we are not so fortune to have well preserved houses from ancient time but remaining from the Viking Age and the Medieval period indicates a typically scheme for the settlements which the farmhouse from Halland follows. The fireplace was situated in the centre, and above it there was a small opening in the roof, which apart from ventilation also gave light to the room. During the 18th century the farmhouse was rebuilt, a chimney was added, and the fireplace was moved to the corner. The small opening (45 x 55 cm) in the roof was kept as a window. Figure 2 shows how low the light level is, but considering the size of the window it is astonishing how much light it offers. But the low light level, in contrast to the luminance of the sky, creates a high contrast in the interior. Furthermore, the light mainly comes from the sky, providing a cold light.

3.2 Renaissance and Baroque

● Town house Baldassini, (Palazzo Baldassini), 1519, Rome, Italy
Architect: Antonio da Sangallo the Younger



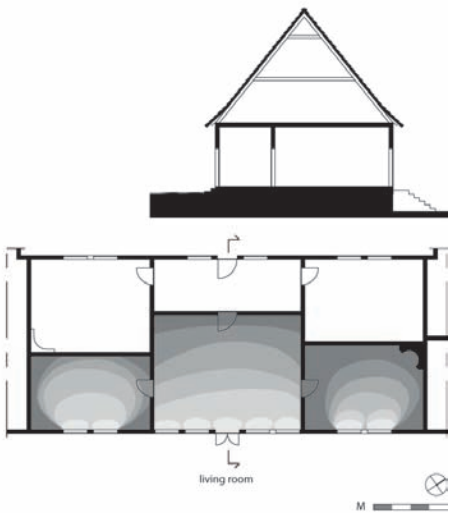


Fig. 3 (left)
Palazzo Baldassini, section and plan with daylight factor distribution
Fig. 4 (right)
Tersloese Manor, section and plan with daylight factor distribution

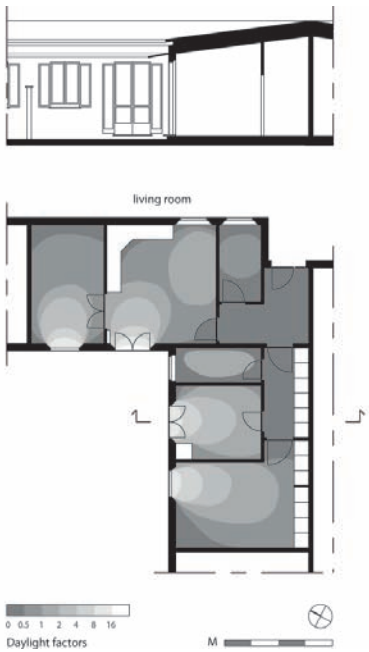
● Tersloese Manor (Tersløsegaard), 1737, Sorø, Denmark

Palazzo Baldassini is situated in the historical centre of Rome, and was built and designed in the early Renaissance by the architect Antonio da Sangallo the Younger. The rooms have high ceilings and tall windows towards the courtyard, but there is a limited influx of light because of the obstruction from the building structure, as illustrated in figure 3. The walls are thick and the shutters are placed inside on the wall of the deep window recess, so the dark shutters absorb a lot of the light instead of reflecting it. As a result, the light conditions in the rooms vary a good deal, and this is characteristic of the rooms.

Tersloese Manor was built in 1737 as a half-timber construction designed in Baroque style. The central living room has windows in the whole length of the façade towards the south, where the garden is situated. This allows a lot of light to enter and creates a bright room with an even distribution of the light, as illustrated in figure 4. In contrast with the Italian palazzo, where it was important to create shade, it is essential here to let in as much light as possible in order to create a well lit space.

3.3 Modernism

● Courtyard houses (Unità di abitazione orizzontale, Tuscolano III), 1954, Rome, Italy



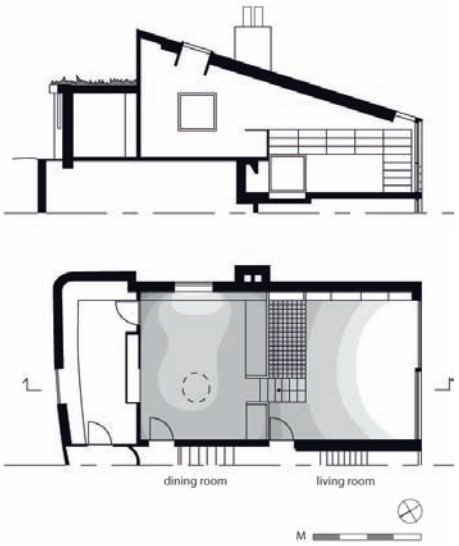


Fig. 5 (left)
Unità di abitazione orizzontale, section and plan with daylight factor distribution
Fig. 6 (right)
Private residence, section and plan with daylight factor distribution

Architect: Adalberto Libera
● Private residence (villa Sølystvej 11), 1938, Klampenborg, Denmark
Architect: Mogens Lassen

Unità di abitazione orizzontale at Tuscolano, situated 6 km from the centre of Rome, was designed by Adalberto Libera. The courtyard houses are in groups of four carefully arranged to fit into the site. The rooms have large glazed doors or windows towards the courtyard and smaller windows towards the street, so the main light comes from the courtyard, see figure 5. The houses are only one floor high, so there is little obstruction from the surrounding houses. To control the light the doors and windows have exterior shutters. The windows are not huge, but compared to the size of the rooms they do have a fairly large size, so the rooms are well lit.

The *private residence* in Klampenborg north of Copenhagen was designed by Mogens Lassen in 1938. The dining room is lit by a north-facing sidelight high up, an east-facing sidelight and a roof light. The high sidelight distributes light from the cool northern sky evenly into the dining room, whilst the east-facing window gathers the warm light around the dining table and feels like the room's main light source. The living room is lit by a large window orientated towards the south-facing garden. The light intake continues approximately 1 m across the roof, which means that light is drawn further into the living room, illustrated in figure 6. There are a lot of large windows, resulting in a diffuse light and bright interior.

4. RESULTS AND DISCUSSION

The six examples illustrate how rooms at two different latitudes have been lit by daylight. Generally speaking, one can say that at the southern latitude the apertures have changed little in size over time. They are fairly large, but not too large. The well-developed shutter design has become a typical characteristic of Mediterranean architectural design – shutters have been successful in controlling the light, thereby preventing rooms from becoming overheated.
The size of the windows at the northern latitude has increased over time. There has never been any doubt about the fact that the main function of the early settlements of Scandinavia was to provide shelter from the severe weather conditions. Creating a beautiful light setting has been a minor issue. Not until the technologies were developed was it possible to improve the window design and make apertures that were capable of letting in as much daylight as possible. This means that the well lit and light-filled rooms which we traditionally associate with Nordic interiors were not designed until the technology made them possible.

5. CONCLUSIONS

When place and space correspond, the design of the aperture is taking the specific local daylight situation in consideration, resulting in functional and beautiful interior light settings.
Therefore it is useful to gather more specific information about the local light situation and categorise the light conditions in relation to the three characteristics of light: colour, intensity and distribution. It is also important to gather more empirical data as a basis for the further study of aperture design.

The subject of this paper is daylight planning, and as mentioned above the light situation depends a very great deal on the technologies available. But factors such as culture, financial capability and social structure will also influence the way in which building structures are designed, thereby influencing the light conditions as well. These aspects will also be of importance for further studies, always hoping that academic knowledge will not take away the poetry of light but instead give rise to more qualified design to suit local daylight conditions.

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REFERENCES

1. Norberg-Schultz, Christian: *Genius Loci, Towards a Phenomenology of Architecture*, Rizzoli International Publication, INC. New York, 1980, pp. 23-42.
2. Frampton, Kenneth: "Ten Points on an Architecture of Regionalism: A Provisional Polemic", Vincent B. Canizaro (ed) *Architectural regionalism: collected writings on place, identity, modernity, and tradition*, Princeton Architectural Press, New York, 2007, pp. 375-385.
3. Fontoynont, Mark (ed): *Daylight Performance of Buildings*, James & James, 1999, pp. 12-20.
4. Hopkinson, R.G.; Petherbridge, P.; Longmore, J.: *Daylighting*, University College, London, Building Research Station, Garston, Watford, England, William Heinemann Ltd. London, 1966, pp. 68-70.
5. Dahl, Torben: *Climate and Architecture*, Routledge, Taylor & Francis Group, 2010, pp. 16-21.
6. Mathiasen, Nanet; Voltelen, Nina "Light and Shadow", Dahl, Torben: *Climate and Architecture*, Routledge, Taylor & Francis Group, 2010, pp. 115-129.
7. CIE proceedings, 22nd session, Melbourne 1991, CIE publication No. 91, Bureau of the CIE, Vienna, 1992.
8. According to animated meteorological computer simulations of the sky conditions throughout the year, produced by Kristian Pagh Nielsen, Dr. Scient., Danish Meteorological Institute, spring 2010. Not yet published.
9. Frandsen, Sophus: *The Scale of Light*, International Lighting Review, 1987/3 pp. 108-112.