Architectural Atmosphere in Learning Environments
 – Daylight in Practice

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Theme: Learning environments; how can daylight drive changes in the way schools are built or renovated; supporting learning capabilities, social interaction, health and wellbeing?

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Daylight and learning environments

The design of learning environments is a challenging, yet highly interesting field for many architects due to the inherent social dimension and the complexity of factors, which affect the creative process. Learning spaces are not merely an accommodating framework for students and teachers; the physical environment, if designed with consideration, can be an influential factor for successful learning (Løtveit 2015).

A number of factors influence our spatial perception, and as such, form part of the architectural process; e.g. spatial organisation, materials and indoor climate. In order to achieve inspiring spaces of high quality for students and teachers, the architect must therefore be able to materialise the latest pedagogical and didactical theories in relation to the specific academic program for the school – uniting spatial considerations with external factors such as cost constraints, building technology and the conditions of the building site.

Especially daylight plays an important role in our spatial perception, and the impact of daylight on the health, social interaction and learning achievements of students in indoor spaces has been the subject of extensive research over the years. Already in 1874 Robson stressed the importance of daylighting in classrooms in the book ‘School architecture: practical remarks on the planning, designing, building, and furnishing of school houses’ (Robson 1874) and the Danish school ‘Skolen ved Sundet’ from 1938 stands as an early manifestation of the belief that daylight supports the process of learning.

In recent years this idea has been supported by several academic studies, e.g. a statistical analysis by Lisa Hesong et al., presented in the paper ‘Daylighting Impacts on Human Performance in Schools’ from 2002 (Hesong et al 2002, pp. 101-114). To further unfold existing and ongoing studies into the positive effects of daylight in learnings environments lies beyond the scope of this paper. Rather, the intention of this paper is to discuss the actual implementation of daylight in architectural practice in a Norwegian context.

In Norway, similar studies to that of Hesong et al. have been carried out. However, according to Leif Daniel Houck today’s focus on energy efficient buildings challenges the daylight conditions in new school buildings (Houck 2013 pp. 16-31). In his paper "Skolelys i mørke skoler" (school light in dark schools) he calls for a more holistic approach to sustainability and an increased awareness of the impact of daylight in learning environments amongst design professionals handling school competitions. So far, the debate has not been translated into radical legislative changes in Norway. However, the authors of this paper see a positive tendency towards an increased demand for documented daylight performance, often specified as a required minimum daylight factor in e.g. The Breeam-Nor standards (Norwegian Green Building Council 2012 p. 84) and the individual specifications for school competitions.

But how do we as practitioners transform the specified minimum requirements into inspiring spaces, which support the envisioned pedagogical and didactical principles in the best possible way? The paper discusses this issue routed in an understanding of architectural atmosphere.

Architectural atmosphere

Specification of the required daylight level serves as a valuable outset in a design process. However, it is the hypothesis of this paper that the discussion should include both quantitative and qualitative aspects and, as such, calls for an increased understanding of the relationship between daylight design and the overall architectural atmosphere in learning environments - viewing daylight not as an isolated factor, but as part of a holistic design approach.

The public school, Vestmyra Skole (Vestmyra School), in Northern Norway, serves as a brief case study. The school is under construction and is scheduled to open in August 2016. In the competition phase, the client, Fauske Municipality, set up specifications for a minimum daylight factor of 5 % in primary learning spaces, serving as a more ambitious guideline for the development phase than the legislative requirement of 2 % average daylight factor (web 1: Direktoratet for Byggkvalitet: tek10, § 13-12. Lys). However, there are different ways to achieve a certain ratio of illuminance, depending e.g. on geometry and materiality of surfaces, and one way may be preferred to another when taking into consideration the desired use of the space at a certain time by a certain constellation of students and/or teachers.

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In our endeavor to reach beyond the ‘measurable’ and discuss also the more ‘intangible’ or qualitative characteristics of a daylit learning space, we use the term architectural atmosphere. “Atmosphere” is a rather trendy notion in contemporary architectural discussions and the meaning can be somewhat ambiguous. In this paper we lean on philosopher Gernot Böhme, who explains the term “atmosphere” as “a certain tone or feeling (that) ‘seems to fill the space’” (Böhme 1993 p. 114). He further states that “…An experience of atmosphere consist of more than the separate parts and is an experience of totality” (Böhme 2012). As such, the atmosphere of a space is always the total of impressions and is always dependent on the experiencing subject, who senses the given space through a bodily encounter.

This represents some limitations when trying to evaluate atmosphere from a mere objective standpoint, let alone trying to unscramble the aspects, which contribute to a given atmosphere. Daylight is an integral part of a space and as such, the evaluation of daylight performance in e.g. a learning environment should reflect a holistic approach to the atmosphere of the given space. This calls for a vocabulary for discussing daylight and “atmosphere” in practice – for in-house discussions as well as dialogue with client and contractors, e.g. in the case of the turnkey contract process in Vestmyra School.

The model “Light Atmosphere” developed by Lone Stidsen in 2014 (Stidsen et al. 2014 pp. 96-141) is an example of a model, which provides a holistic outset for discussing light and atmosphere. The model was originally developed as part of a research project focusing on daylight and artificial light atmosphere in hospital wards, but is here introduced as a framework for articulating the experienced daylight in a representative classroom in Vestmyra School.

Stidsen includes 4 different aspects of light atmosphere: User, Space, Time and Light (Stidsen 2014 p. 102). A space is often used by more than one user group which may have different characteristics and expectations for the use of light. Further their expectations may vary according to the activity they perform and the time of year/the day they are committed to this activity. The space covers the actual geographical location and orientation of the space as well as the spatial composition and its surfaces and views to the exterior (Stidsen 2014 p. 121). The aspect of light covers not only the level of illumination, but also the characteristics of the source – here daylight; sunlight, reflected light or skylight – and the effect of the light, be that ‘functional’ or of a more ‘aesthetic’ character, for instance with the purpose of creating a “cosy” atmosphere. These aspects form the outset for the following brief review of a representative classroom in Vestmyra School.

**Casestudy: Vestmyra skole**

Vestmyra School is located in Fauske Municipality in Northern Norway surrounded by mountains and fjords. The school project in its entirety consists of a rebuilding of the existing elementary school (1st through 4th grades) and the addition of a new middle school (5th through 10th grade) with corresponding administration, classrooms, special education facilities, and gym. Due to the geographic location of the school, daylight has been a priority to the client and a consistent theme throughout the process. In this text focus will be on a representative classroom on the 1st floor of the building.

The primary users of the classroom are the 7th grade students and their teachers, which all use the space on a daily basis. As this is a preliminary analysis, we lean on the specifications from the competition phase and the envisioned pedagogical principles in order to understand the intended use of the space, the activities. This classroom serves as one of three classrooms available for a year group and is further supplemented by four adjoining group rooms. The key word is ‘differentiated learning spaces’ which can accommodate subdivisions of students into smaller or larger groups in order to support different learning situations. The class room in its own right should also accommodate differentiated learning situations during the school day; a classical teaching situation with the students facing a teacher at a board, subdivision into smaller groups as and/or more informal individual immersion in a book/Ipad. In general the layout of the school should support the use of smartboards and laptops in all learning spaces on equal terms as more traditional tools.

The geometry of the space, as well as location and sizes of window holes, has been the subject of ongoing comparative daylight simulations of a gradually more detailed character. Figure 2 displays selected steps from the process. In order to meet the required daylight factor and generate an evenly daylit space, the geometry of the class room was gradually modified to a narrower layout, 7m x 10m, with windows in two facades and light surfaces. In the rear of the classroom, where the daylight access is rather poor, a “utility core” was placed with a sink, storage and recycling station. The third iteration shows how windows were gradually articulated to include elevated windows, which allow for deep daylight penetration and windows with a low sill height, 450mm. In the Norwegian building regulations the daylight factor is calculated 800mm above floor level (web 2: Sintef Byggforsk 421.626). Hence, the low sill height does not give "value

**Figure 1: Location of Vestmyra School. Fauske. Norway.**
for money” in this regard. However, the low sill height allows for views to the exterior playground and sports facilities and for the students to use the windows as niches for concentrated studies. Utilising the depth of the wall and creating a wooden bench over the radiators, a more secluded zone is established. From a holistic point this is expected to add value for the users of the space, as it allows for a potentially more intimate atmosphere in these areas.

The school is still under construction and, as such, this paper does not include an actual evaluation of the built spaces. The experience of the architectural atmosphere in a space is a construct based on the interaction between the individual and the space he or she occupies (Böhme 1993) and, as such, the way the students and teachers inhabit the spaces may very well differ from the predictions. However, Stidsen’s model of “light atmosphere” serves as an outset for discussions about daylight conditions and a means to unfold and articulate a complex field, which is sometimes reduced to numbers. The brief case study from Vestmyra School serves as a pragmatic example of how the aspects of the model are operationalized. In this process the continuous daylight simulations have served as a tool to translate the numbers into ‘active’ design parameters, which can be processed as an integrated part of the design process in dialogue with the client, contractor and energy- and indoor climate consultants.

**References**

10. Web 2: Sintef Byggforsk 421.626 Beregning av gjennomsnittlig dagslysfactor og glassareal. Published february 2004:

**Figure 2:** Three iterations from the design process (competition phase). Nordic Office of Architecture and AART Architects.