Course syllabus

Dagsljus och belysning i byggnader Daylighting and Lighting of Buildings

AEBN25, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED V
Date of Decision: 2023-03-21

General Information

Main field: Energy-efficient and Environmental Buildings.
Compulsory for: MEMB1
Language of instruction: The course will be given in English

Aim

This course aims at introducing key concepts about human vision, visual perception, non-visual effects of light, photometry, lighting calculations, measurements, physical light modelling and simulation tools. The course provides an overview of key design principles and strategies for successful daylight utilisation and integration in building design and with the electric lighting system. The course will also explain components of daylight systems as well as electric lighting installations and principles of energy efficient architectural lighting design.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- Show literacy about important concepts in lighting such as e.g. the non-visual effects of light, visual comfort, vision, electric light sources, control systems, energy efficient lighting, etc.;
- Describe and discuss the physical parameters that influence light quality and quantity in a space;
- Describe key material properties (e.g. diffusivity vs. specularity) in relation to lighting and daylighting in a space;

- Distinguish precisely the difference between basic lighting terms e.g. illuminance, luminance, contrast, daylight factor, discomfort and disability glare, daylight autonomy, etc;
- Describe lighting and daylighting sources and discuss the relation between the sources' characteristics and their effects e.g. difference between sunlight and sky light, overcast and clear sky, etc.

Competences and skills
For a passing grade the student must

- Influence design decisions related to lighting and daylighting based on the use of tools (hand calculations, graphic tools, physical modelling and simulations);
- Identify, qualify and integrate various electric lighting systems and schemes in a daylit building concept;
- Carry out appropriate light measuremens (with a lux and luminance meter) in a full-scale space and use this information in a meaningful way for analysis and transformation of the space;
- Carry out basic lighting hand calculations as well as more advanced annual daylight analyses;
- Use graphic tools and physical scale modelling in a productive way in analysis, design and transformation of architectural spaces;
- Verify compliance of a building to known certification systems (e.g. LEED, BREEAM, Miljöbyggnad, etc.);
- Communicate verbally and graphically an architectural daylighting and lighting concept using the appropriate vocabulary.

Judgement and approach
For a passing grade the student must

- Describe and critically discuss the qualities of a lighting and daylighting installation, including daylighting systems (glazing + shading systems) and technology, electric light and daylight integration strategies and technologies;
- Name and critically discuss the work of some light masters (architects) who have integrated daylight in a meaningful and effective way in the design of a building;
- Formulate relevant research and/or consulting questions and tasks in relation to lighting and daylighting of buildings;
- Discuss relevant research trends and challenges in the field of architectural lighting and daylighting.

Contents

Daylighting a building describes the conscious effort to admit natural light into a building. The objectives for doing so are manifold, ranging from a desire to create healthful and stimulating spaces to efforts to reduce energy use for electric lighting and cooling. Integrated with electric lighting, daylighting is an essential component of a good and healthy indoor environment.

The history of architecture has shown that light is a determining element of architectural creation. However, the development of electric lighting and cooling systems in the 1930s transformed the fundamental role that natural light traditionally played in the design of architectural spaces. This development allowed designers to isolate the built form from natural light considerations. Today, it is possible to build spaces without any transparency (or without any opacity!). These technological transformations have also modified the role of the architect as the Master of the luminous character of architectural space. Today, numerous architects rediscover the formal possibilities of natural light as a key aspect to integrate in sustainable, healthy building design.

The interaction of daylight and building form is also an important contributor to the aesthetic experience of a space and daylighting holds today an established position within architectural practice and education. Also, it is important to understand that design decisions regarding openings (size, orientation and properties) not only affect daylight quality and quantity in a space and the resulting electric lighting consumption: they also have a definite impact on heating and cooling loads, thermal comfort and the natural ventilation potential in a space. A versatile lighting and shading solution is essential to ensure a good balance between indoor thermal comfort and natural illumination.

This course will address predominantly topics related to daylighting buildings. However, key issues related to the planning and calculations of electric lighting installations including daylight-electric light integration will also be covered in depth.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Active participation and attendance at lectures, tutorials, group meetings, presentations etc is compulsory. The final grade is to 70% based on the written examination and to 30% on the performance related to the exercises and lectures.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts
Code: 0123. **Name:** Exercise.
Credits: 3. **Grading scale:** UG. **Assessment:** Examination based on written report according to given criteria. **Contents:** Assignment: Analysis by calculation and simulation of daylighting conditions and lighting needs and solution in architectural space.
Code: 0223. **Name:** Written Examination.
Credits: 4,5. **Grading scale:** TH. **Assessment:** Examination based on the written exam. **Contents:** Written examination of the whole course.

Admission

The number of participants is limited to: No
The course overlaps following course/s: AEBF15

Reading list

- Dubois, MC, Gentile, N, Laike, T, Bournas, I, Malin, A: Daylighting and lighting under a Nordic sky. Studentlitteratur, 2019, ISBN: 978-91-44-12577-0.
- Course literature will be available through an electronic course library via the course website.

Contact and other information

Course coordinator: Marie-Claude Dubois, marie-claude.dubois@ebd.lth.se
Teacher: Thorbjörn Laike, thorbjorn.laike@mpe.lth.se
Course coordinator: Niko Gentile, niko.gentile@ebd.lth.se
Teacher: Rafael Campamà Pizzaro, rafael.campama_pizarro@ebd.lth.se
Course administrator: Linnéa Ekman, linnea.ekman@ebd.lth.se
Course homepage: http://www.ebd.lth.se/master