Experiences from Design-Build-Test (DBT) projects in Lighting Design

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ABSTRACT

There is a very rapid change and development in lighting in terms of the development of new lighting sources. The lighting industry is in dire need of surveys, measurements and documentation of how different light sources affect our experience of the illuminated reality.

The projects described here are part of the education of Lighting Designers at Jönköping University, School of Engineering, Department of Building and Lighting Design. In several of the courses in the Lighting Design program students work in Design-Build-Test (DBT) projects. The reality as a field for studies.

In the course Exterior Lighting Design students work in groups regarding planning, testing and evaluating outdoor lighting design at some selected locations in the city of Jönköping. Students work with design ideas and technical solutions and present, discuss and evaluate each other's proposals. Students are trying out different solutions at the current location and present a proposal finally agreed. Students evaluate, measure and document their proposals and visit their student-colleagues projects. Back at the school, students write a self-reflection and an evaluation of their own and their student-colleagues projects in a report. The choice of design idea and technical solutions are documented and discussed.

In the course Interior Lighting Design students work in a Lighting laboratory in scale1:1. They test different light sources, brightness, color temperature, distance, and so on, and compare it to rooms and interiors built up in the lab. In the Light lab, it is possible to lower or raise the ceiling for different room heights. Students evaluate, measure and document their proposals and discuss their colleagues' projects. Students write a self-reflection and evaluation of their own and their colleagues' projects in a report.

In the course, Light source and Luminaire Proficiency students work with so-called Light boxes to test different light sources and their color temperature in terms of impact on their surroundings. Students work with ideas of behavior and then test and draw conclusions from their tests.

KEYWORDS

Design Build Test projects, Lighting Design, Field test, Group work.

INTRODUCTION

University Diploma – LIGHTING DESIGN 120 ECTS.

The program provides knowledge in lighting planning from idea to a fulfilled lighting system design. The program also gives knowledge in how to design for lighting in different environment and how to take in consideration of the room, the daylight and the human being.

Program Description

Background

Light is vital for human well-being. Daylight is superior, but in parts of the day and in the seasons, we need the support of the artificial light. New insights into the influence of light on the human being makes it important to control the artificial lighting, identify the needs of natural light and reduce light pollution. A major challenge for a sustainable society is to optimize energy use and use of natural light to create a good indoor environment with respect to both the visual comfort of the thermal indoor climate, and considering reasonable investments and lifecycle costs. There is also a technology change where old light bulbs are phased out and replaced with new technology. It is important to study and analyze the impact of this shift.

Our visual perception of the environment requires not only that we have a light that supports a high visibility. The light should also create a stimulating environment . One step is to educate lighting designers and planners who have an understanding of these issues and who can work in the construction process. Through an increased competence in procurement and planning of the lighting features of environments, buildings and plants, electricity consumption and environmental load decrease significantly, while favorable environment is created. Lighting expertise need to formulate requirements, plan and give feed-back to lighting functions with the increasing demands placed on them.

Purpose

The program aims to develop basic professional skills and meet society's need for skilled labor in lighting design and planning. Close collaboration with industry, aims to give students a holistic understanding of the industry's various professional roles. Theoretical knowledge is interspersed with practical applications and projects aimed at fostering a creative, independent and reflective practices in program area.

JTH education concept

All two-year graduate programs at the School of Engineering is made in accordance with the school's overall educational concept.

The basis of the concept is based on a holistic approach, where theoretical and practical knowledge in education subject area are integrated to develop both the skills as a relevant scientific approach.
The courses have extensive relationships with industry through sponsor activities and multiple-job projects. This is a central part of the training concept and the means for example that the student individually or in groups carrying out development projects, or in cooperation with a company. In these projects, students will get good insight into how theory and practice interact and to reflect on the theoretical content of the training with a holistic approach and its scientific basis.

Learning outcomes for degree programs at the School of Engineering Jönköping University (JTH)

Knowledge and understanding

The student should:

1) have a scientific attitude and ability to seek, gather and critically interpret information and to communicate both orally and in writing in order to formulate answers to relevant questions in the main field of study.
2) be able to independently apply the acquired knowledge in practical work and have an insight into their future profession and have a basic knowledge of business conditions and business in the relevant training activities.
3) demonstrate an ability to discuss and explain issues in the field of knowledge and act for the project teams and have knowledge of project methodology.
4) reflect on issues concerning ethics, gender and sustainable development relevant to the program.

Application Principles

The program comprises 120 credits, most of which consists of courses with theoretical content and practical applications. In the final part of the training makes the student a workplace-based projects for 15 credits and a thesis of 7.5 credits. These two courses are using, and deepens the student their previously acquired knowledge and skills.

Project work applied in most of the courses to promote both independent and responsible approach that the ability to cooperate and increase employability.

Large and small projects are, therefore throughout the training and some projects are interdisciplinary. Projects followed

Always a project report with reflections, analysis and discussion of lessons learned in the project.

The training is conducted in close collaboration with industry and the early implementation of joint projects with various industry companies. In these projects, students make important contacts for their future professional careers and share expertise with industry stakeholders.

Several of the teachers in training are directly related to the practice, which further contributes to a business-related training.

Learning outcomes for Lighting Design

The student should be in addition to the common objectives:

1) able to account for lighting scientifically based theory
2) ability to independently and based on relevant parts of the course conduct planning, design and presentation of daylight facilities in conjunction with artificial light that works well for the user and the location - the room, are user friendly, energy efficient and technologically well-functioning.
3) ability to independently and based on relevant parts of the course conduct planning, design and presentation of lighting systems for indoor environment that works well for the user and the location - the room, are user friendly, energy efficient and technologically well-functioning.
4) ability to independently and based on relevant parts of the course conduct planning, design and presentation of lighting systems for indoor environment that works well for the user and the place - the room, are user friendly, energy efficient and technologically well-functioning.

Lighting Design Program

The program focuses on four different areas:

- Theory and design of daylight.
- Interaction and control, daylight and artificial light.
- Theory and design of indoor lighting with light source and luminaire proficiency knowledge.
- Theory and design of outdoor lighting with light source and luminaire proficiency knowledge.

During year one the basic theoretical and practical knowledge in these four areas are trained. During year two deepened knowledge and skills and the ability to seek and evaluate knowledge with a scientific approach are trained.

The student carries out planning projects both during year one and two. During the second year a final thesis and a workplace-based project are carried out. Both can be implemented either nationally or internationally. These two courses are designed to deepen the knowledge acquired during training. The project train the ability to work both independently and in groups and taking responsibility, giving a preparation for the upcoming work demands and challenges.

DESIGN – BUILD – TEST (DBT) PROJECTS IN LIGHTING DESIGN

In several of the courses in the Lighting Design program students work in Design-Build-Test projects (DBT). The reality as a field for studies. The students work with Design-Build-Test in at least three courses during their education and they do it several times in every course. They work in different groups every time. Sometimes the students form their own groups and sometimes there is a random division. The main purpose is to simulate the process the students will use when they start their profession.

The quality of light in reality is one of the most important experiences our students gain from the DBT-courses. Also how we experience the world and make our interpretations of it. The answers to the tasks have no right or wrong, even no answers at all, just questions. One question leads to another and so on.

There is also a very rapid change and development in lighting in terms of the development of new lighting sources. The lighting industry is in dire need of surveys, measurements and documentation of how different light sources affect our experience of the illuminated reality.

The quality of light is the most important issue to discuss in this rapid change. Quality of light is not just a measure with instruments, it is a visual experience. The students define visual and non-visual criteria for good lighting.

How to perceive the light in a room or a place can be described by seven concepts that characterize observable and describable parts.

- **Light level** - the level of brightness or darkness in the room/at the site
- **Light distribution** - the distribution of brightness and darkness in the room
- **Shadows** - direction and character
- **Reflections** - direction and character
- **Glare** - direction and noticeability
- **Color of objects** - natural/distorted
- **Light color** - how the illuminated color is perceived

The visual is what we perceive; the physical is what we measure.

PROJECT Exterior Lighting Design

In the course Exterior Lighting Design students work in groups regarding planning, testing and evaluating outdoor lighting design at some selected locations in the city of Jönköping.

The planning starts with a site visit in daylight and a concept design. Students work with design ideas and technical solutions and present, discuss and evaluate each other's proposals.

Figure 1 – Students working with concept design.

Figure 2 – Students preparing for the outdoor assembling of their designs.

In the evening students build up their proposals at the current location. Students are trying out different solutions at the current location and present a proposal finally agreed upon. Students evaluate, measure and document their proposals, visit their student-colleagues projects, and finally mount down the equipment. Back at the school, students write a self-reflection and an evaluation of their own and their student-colleagues projects in a report. The choice of design idea and technical solutions are documented and discussed.

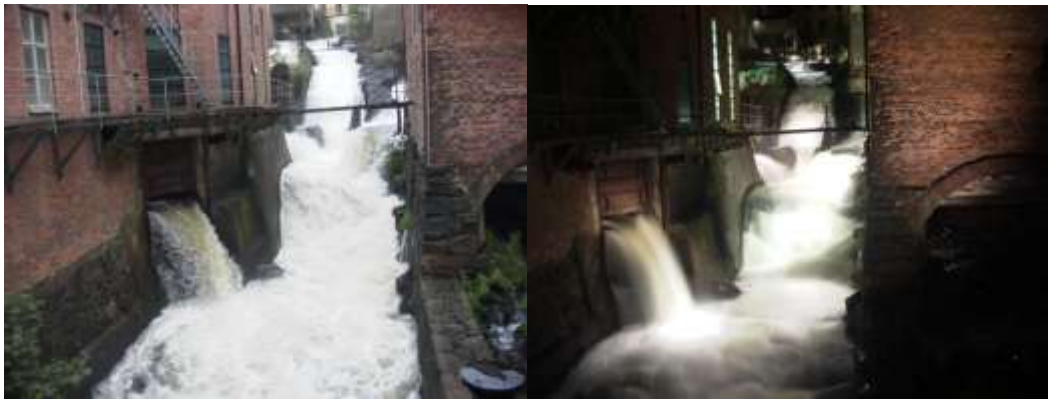

Figure 3 – The project site in daylight and nightlight.

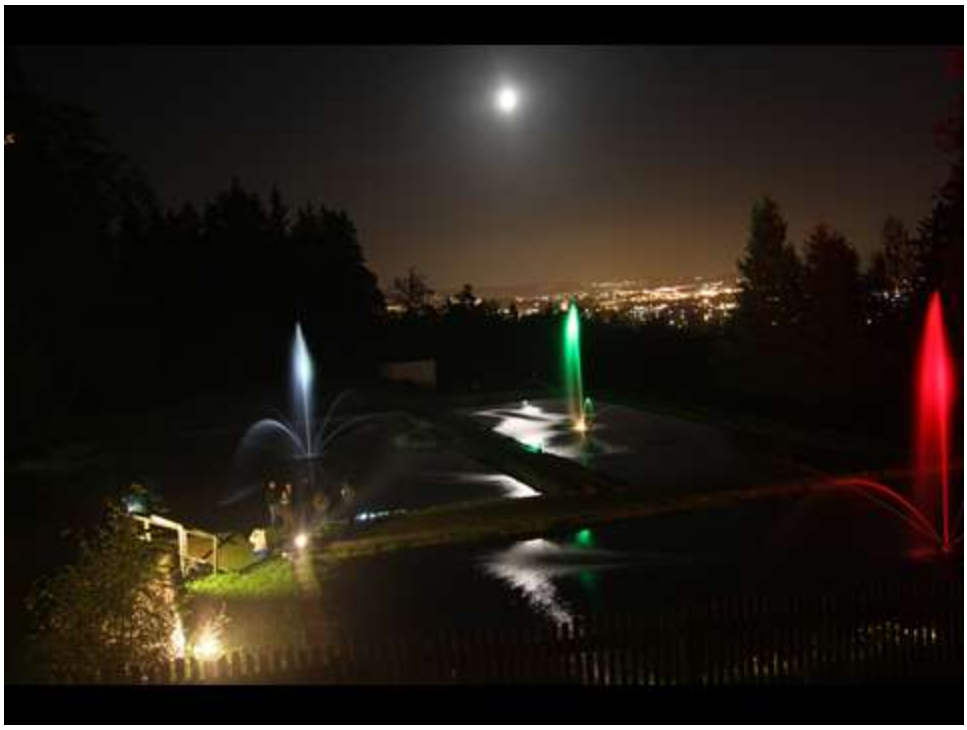

Figure 4 – Students evaluating their project.

PROJECT Interior Lighting Design

In the course Interior Lighting Design students work in a Lighting laboratory in scale1:1. They test different light sources, brightness, color temperature, distance, and so on, and compare it to rooms and interiors built up in the lab. In the Light lab, it is possible to lower or raise the ceiling for different room heights. Here the students creates interiors such as exposures for shops and exhibitions. Students are trying out different solutions and presents proposals. Students evaluate, measure and document their proposals and discuss their colleagues' projects. Students write a self-reflection and evaluation of their own and their colleagues' projects in a report.

DBT project at a scale of 1:1 in the laboratory environment.

Figure 5 – Students assemble and test their designs.

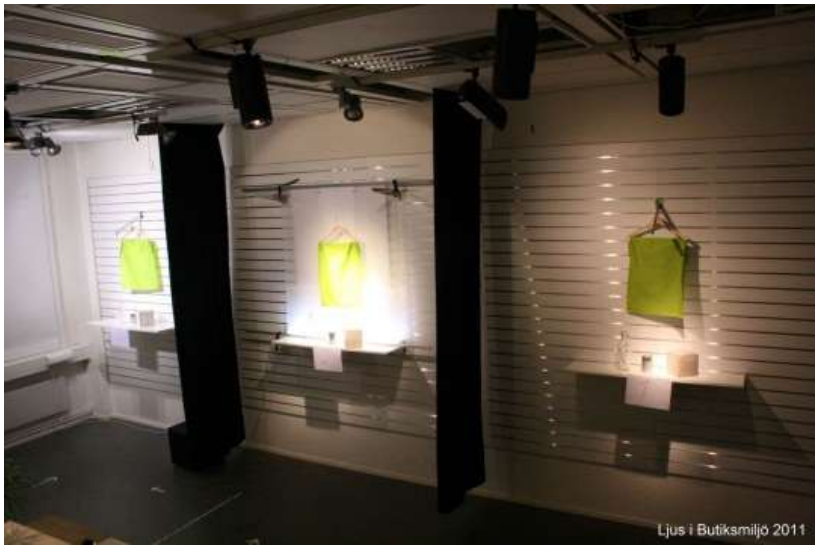

Figure 6 – Different cases for evaluation.

PROJECT Light Source and Luminaire Proficiency

In the course, Light source and Luminaire Proficiency students work with so-called Light boxes to test different light sources and their color temperature in terms of impact on their surroundings. Students work with ideas of behavior and then test and draw conclusions from their tests. They work with a log-book for documentation and measure their various exposures in the Light boxes. Students have also built up a basic facility for demonstrations.

Figure 7 – An exhibition of light boxes, open for the public.

ASSESSMENTS

The School of Engineering in Jönköping has for the last 12 years been evaluating courses with a written course evaluation at the end of all courses. The evaluation paper is always handed out when the students have their mandatory final presentation. The evaluation consists of a number of questions and a part for individual comments. Students rank their answers from very good (5) to very bad (1). The courses always consists of different parts like traditional lectures, study visits and exercises. In the evaluation students are asked to compare the different moments and they always rank the hands on, practical parts very high. The students are very satisfied with DBT-courses and they see the value of the process and the content as a way of thinking Lighting Design and as an approach to the practice.

CONCLUSION

This paper describes examples of the implementation of CDIO as Design – Build – Test courses and how it has been thought at the School of Engineering at Jönköping University in Sweden (JTH). The students are very satisfied working in groups in order to find solutions. In general according to the course evaluation the results show a very high gratification with the DBT-courses and the students like the practical, hands on, approach in the CDIO concept. The students are very committed and the different courses are good alternatives to traditional technical or design courses. Some challenges still remain to be solved. Some students have problems with the process. What is the right answer ? Why do we have to find out so many things ourselves ? Why do we have to do it again ? Why do we have to be outside when it is cold or raining ? We have based on the feedback from the students course evaluations worked hard to improve the courses every year. With good clothing we also try to beat the weather.