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*Published in:*  
Color Research and Application

*DOI:*  
[10.1002/col.22284](https://doi.org/10.1002/col.22284)

Published: 01/01/2018

*Document Version*  
Peer-reviewed accepted author manuscript, also known as Final accepted manuscript or Post-print

*Please cite the original version:*  
Arnkil, H., & Pyykkö, S. (2018). Color–light–space: An interdisciplinary course for graduate and postgraduate students. *Color Research and Application*, 43(6), 857-864. <https://doi.org/10.1002/col.22284>

*This is the peer reviewed version of the following article: Color-light-space: An interdisciplinary course for graduate and postgraduate students, which has been published in final form at <https://onlinelibrary.wiley.com/journal/15206378> (DOI: 10.1002/col.22284). This article may be used for non-commercial purposes in accordance with Wiley Terms and Conditions for Use of Self-Archived Versions.*

## Colour – Light – Space: an interdisciplinary course for graduate and postgraduate students

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### Abstract

The course Väri – valo – tila/Colour – Light – Space at the Aalto University School of Arts, Design and Architecture, aims at disseminating an in-depth understanding of the possibilities and role of colour and lighting in the built environment. Central pedagogical methods are learning-by-doing, real-life cases and collaborative learning. The course is based on integrating theory with practice. The main assignment of the course is a real, on-going architectural project on which the students can test and develop their skills in colour design. Other assignments involve visual and multisensory analyses of existing spaces, their atmosphere and sense of place. The practical and on-site assignments are complemented with lectures given by professional experts on the theory and technology of colour and light and with excursions to companies and relevant urban environments.

**Keywords:** Architecture, Education, Colour, Light, Space

### Introduction

Colour and lighting are multidisciplinary subjects that transcend traditional disciplinary borders, and are therefore often left without a home in the educational structures of university programs and curricula. Finnish education in architecture and spatial design is no exception; courses in colour or lighting tend to be ad-hoc and subject to individual teachers' interests in these areas. Therefore, education in colour and lighting often lack continuity and a solid grounding in research. The course Väri – valo – tila/Colour – Light – Space (hereafter CLS) addresses this need and aims at disseminating an in-depth understanding of the possibilities and role of colour and lighting in the built environment. The course is taught by two teachers, up to five visiting lecturers with excursions to indoor and outdoor spaces of interest from the perspective of colour and lighting.

CLS is a free choice-course for students of Aalto University School of Arts, Design and Architecture (Aalto ARTS). The course is open for all Finnish-speaking graduate and postgraduate students, but it is aimed specifically for the needs of master's degree students in architecture, interior architecture and landscape architecture. The course has been planned in collaboration with

professors of the interior architecture and architecture programs of Aalto ARTS. Although the course is new, it is based on long experience. The authors have taught similar courses in Aalto ARTS since 1996, but the present course is the first one to involve not only interior architecture but also architecture and landscape architecture students, in addition to students from several other major programs.

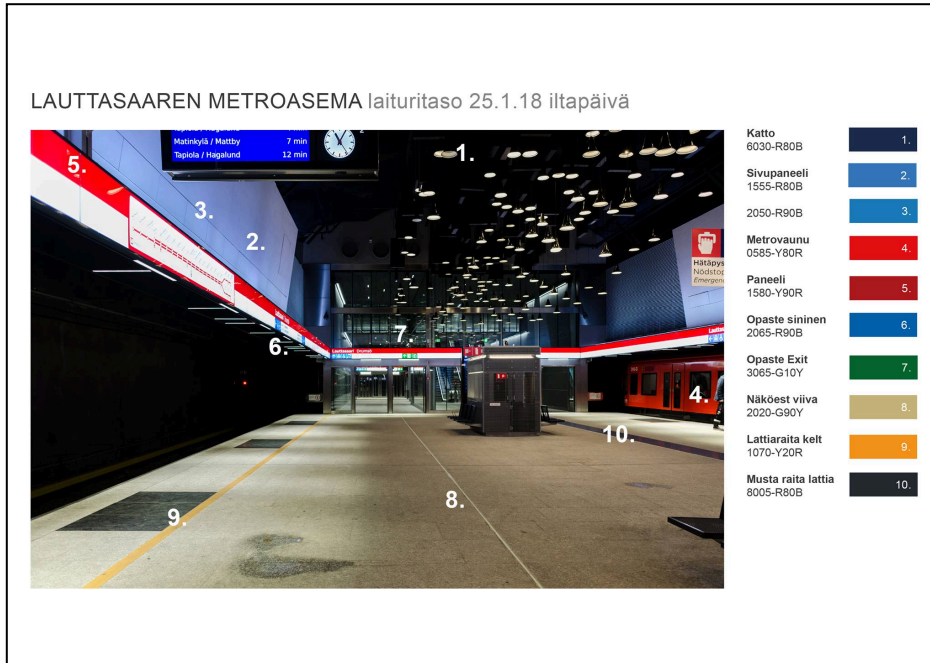


Figure 1. Assignment 2 (2018), Anna Akins, bachelor student of interior architecture, Lotta Harjula, bachelor student of architecture and Juhana Havas, bachelor student in landscape architecture. Colour and atmosphere analysis of the Laattasaari metro station, Helsinki (Architects: Helin & Co).

## Background

The most important art-related colour theories and pedagogical methods in use today were developed by artists (painters) during the first decades of the 20<sup>th</sup> century. The Vkhutemas and INKhUK in Moscow and the Bauhaus in Germany included several faculty members (Wassily Kandinsky, Johannes Itten, Paul Klee, Josef Albers), who taught colour as a dedicated subject both in the aforementioned schools and institutes and later other schools. All of them have written on the subject of colour books and texts which are still in print and have impacted colour pedagogy worldwide. Their methods and ideas were developed mostly *within* and *for* two-dimensional applications, such as painting, printmaking, textile and graphic design, and their approach stems largely from a modernist aesthetic of abstract, constructivist and minimalist art. Two of the most influential pedagogical books on colour ever written are Johannes Itten's *Kunst der Farbe/The Art of Color* (1961)<sup>1</sup> and Josef Albers's *Interaction of Color* (1963)<sup>2</sup>. These two books, more than any other, have shaped the way colour has been taught to art and design students for the past 60 years. Useful in their own right, these books and pedagogies completely omit the subject of colour and light as *spatial* phenomena.

Until very recently (and to a larger extent even today) colour courses aimed specifically for architects and spatial designers have had to rely on either colour theories derived from the modernist fine art pedagogics or gather disconnected scraps of information from sources representing quite disparate disciplines and fields of knowledge. These fields of knowledge tend to have their very own sets of concepts and terminology, which do not always converse or translate across disciplines (See Arnkil 2015)<sup>3</sup>. Furthermore, spatial contexts of colour require a spatial approach, which integrates knowledge of colour, light, space, materials and human perception and experience.

In the late 1990s Åsa Dahlin conducted in her licentiate thesis a survey of colour pedagogy for architects in 14 architecture-related programs, six in Sweden and eight outside of Sweden.<sup>4</sup> She found three main approaches to teaching colour in these. *The material-based approach* dealt with practical knowledge of colour as material and included figurative painting, practical studies in colour mixing, training in pictorial representation of the perception of environmental light- and colour, practical studies of building materials, pigments and painting techniques and studies of material surfaces' structures and patterns. *The system-based approach* was based on theoretical starting points such as colour theories, colour systems, colour naming and coding and colour research. *The space-based approach* included methods in which the starting point was the architectural treatment of space; a combination of hands-on and theoretical training in the experience of colour in architectural space. The teaching included architectural colouring exercises, analysis of existing spaces, the relationship between buildings' exteriors and interiors, knowledge of the historical, cultural and geographical significances of colours for architecture, and computer simulation of colours in space. Dahlin found that "The three approaches were linked with the different pedagogical goals, whereas they did not show a direct connection to the practical work of architecture." In her thesis Dahlin highlights the need for an experience-based approach:

"It takes time to understand the complexity of architectural concepts, and architectural training should form a basis on which to build for a lifetime. This grounding means the development of an understanding based on direct experience and a feeling for spatial layout as well as an ability to interpret spatial interrelatedness."<sup>5</sup>

Dahlin's survey was conducted almost twenty years ago and much has happened since in both architectural and space-related colour and light research and theory. We find two developments particularly important for the theoretical and pedagogical starting points of our course. First, the phenomenologically oriented discourse around the concept of atmosphere in architecture, which focuses on the multisensory experience of architectural space. Second, the perception and practice - based research carried out within SYN-TES, the Nordic interdisciplinary research project on colour and light, which had as its aim to improve communication across disciplines about knowledge and concepts of colour and light.<sup>6</sup> In CLS, we have aimed to integrate the philosophical approach of the first with the pragmatic approach of the second.

The theory and methods of CLS have been selected to apply to a spatial – and more specifically – to an architectural context. The course aims at an experience-based and holistic approach to the built environment. Central pedagogical methods are learning-by-doing, real-life cases and collaborative

learning. The students study the multisensory impact of existing architectural spaces first-hand, compare their experiences and later use the collective experiential knowledge in their designs on a real-life case. The practice-based generation of knowledge is supported by theoretical knowledge. The students gain access to this knowledge by attending a series of lectures based on past and ongoing research and scientific literature on the subjects of perception and experience of colour and light in space (Arnkil 2007, Arnkil 2015, Billger 1999, Böhme 2017, Fridell Anter 1999, Fridell Anter & Klarén 2017, Hårleman 2007, Klarén 2013, Pallasmaa 2016, Porter & Mikellides 2009).

## Atmosphere of architecture

Atmosphere is a central aesthetic and theoretical theme of the course. Atmosphere is a multisensory and holistic concept which encompasses the experiences of colour, light, space, tactility, acoustics and olfactory and other sensations. Juhani Pallasmaa, Peter Zumthor and Gernot Böhme have written about atmosphere in architecture.<sup>7</sup> In the early years the discourse centred on defining architectural atmosphere and its constituent elements. Böhme wrote in his article “Atmosphere as a fundamental concept of new aesthetics” about the designer’s active role, the *making of atmosphere*: “Atmosphere is the common reality of the perceived and the perceiver. It is the reality of the perceived as the sphere of its presence and the reality of the perceiver, in so far as in sensing the atmosphere s/he is bodily present in a certain way.”<sup>8</sup>

Pallasmaa further defines atmosphere as follows: “The quality of space or place is not merely a visual perceptual quality as is usually assumed. The judgement of environmental character is a complex multi-sensory fusion of countless factors, which are immediately and synthetically grasped as an overall atmosphere, feeling, mood or ambience.”<sup>9</sup>

Essential, then, in colour education for architects is that the student begins to understand through her own experience how colour, light, space, materials, textures, lighting and the observer are interlinked. By utilizing this understanding, she will not only be able to recognize and analyse atmospheres of space, but also to *create* and *build* specific atmospheres in her future design work. We postulate that an architectural space always consists in atmosphere and that colour and lighting are inseparable components of atmospheres.

## Tools for charting colour, light and atmospheres of spaces

One of the main aims of SYN-TES, the Nordic interdisciplinary research project on colour and light was “to contribute to the elimination of barriers between different thematic, scientific and professional approaches and thus forward the development of a coherent field of knowledge, dealing with both colour and light from a multitude of starting points.”<sup>10</sup> PERCIFAL (Perceptual Spatial Analysis of Colour and Light) was a sub-project of SYN-TES, which aimed at creating “...better and more accurate methods of recording and analysing the visual experience of architectural space...” and “...developing a method of analysis that can capture coherent spatial experiences of colour and light.”<sup>11</sup> The PERCIFAL method is based on direct visual observations and the recording of these observations by verbal-semantic descriptions using a questionnaire. These can be complemented with photography, photometric measurement and colour sample

matching for later comparison with the visual observations. “The questionnaire is divided into the following eight main topics: 1) General impression of the space, 2) Overall level of light, 3) Light distribution in the space, 4) Shadows and flecks of light, 5) Reflections and glare, 6) Colour of light, 7) Surface colours, 8) Interaction of space, objects and people.”<sup>12</sup> The students used the PERCIFAL questionnaire as well as complementary verbal descriptions, photography and colour-sample matching to record and convey their total impressions of the visual quality and atmosphere of the spaces in assignment 2.

## The assignments

The students are given two main assignments at the beginning on which they work throughout the 12-week span of the course. Assignment 1 is a real-life architectural project; Assignment 2 consists of analysis and charting of an existing architectural space’s colours, lighting and atmosphere. During this time, the course meets once a week for a full afternoon of lectures, excursions, critiques or discussions. In between the classes the students work individually or in pairs and small groups, depending on the task at hand. The scope of the course is 4 ECTS (European Credit Transfer System).

These main assignments are supported by a series of smaller tasks and exercises, which are designed to give tools for tackling the main assignments. The whole course is underpinned by a series of lectures by the authors and visiting colour and lighting experts, covering such subjects as 1) The holistic and multisensory experience of space, 2) The quantitative and qualitative measurement and assessment of spaces, 3) Colour systems and colour tools for designers, 4) Lighting and colour: atmosphere, colour temperature and the Colour Rendering Index, 5) Architectural lighting and its latest technologies, 6) Principles and practicalities of colour design of residential areas, 7) Building conservation and historical colours of cities and buildings, 8) Indoor and outdoor paints, their technical properties, tinting systems and logic of colour charts. The students are given handouts and a list of relevant literature for future in-depth study (see ‘Literature’ at the end of this article). Some reference material is distributed through the course’s website.

## Theory and practice combined – Experience-based learning

The students gain experience on the CLS course by developing their skills on a real-life architectural case study. While the cases are real building projects, the students have the liberty to experiment, make mistakes and surprising discoveries without the pressures of a real planning project. While they are provided with information about the limits and criteria of real-life building, the students are encouraged to make proposals that are even “fantastic” or “imaginary”. They work with the knowledge that their designs will receive reality-based feedback from the architects, designers and contractors of the projects, but they also know that they are free to offer novel and surprising proposals.

With the highly detailed task of the atmosphere exercise of Assignment 2, the students develop their understanding of the factors which affect changes in the visual appearance and experience of a given space. Since the students had to not only record their perceptions of the studied space, but

also communicate their experience of its atmosphere, they evaluated which are the appropriate tools: NCS, photography, sketches, verbal descriptions or the PERCIFAL questionnaire. In the real-life Assignment 1, they were able to apply to it the knowledge gained during Assignment 2 about how the atmosphere of a space is transformed by changes in weather, illumination and seasons.



Figure 2. Colour design for Assignment 1 (2017) by bachelor student of landscape architecture Elka Lupunen. The north facades of the six-story residential houses in Oulunkylä, Helsinki, face the main outbound railway line.

#### Assignment 1: Architectural colour design

Assignment 1 is based on an on-going architectural project in which the students can test and develop their skills in colour design. This assignment is chosen and specified in collaboration with a company and architects who provide the drawings and necessary details for colour planning. The students first acquainted themselves with the plans, elevations and perspectives of the project. They then visited the site, recording its essential features and atmosphere as described above. As the work progressed, the students received feedback on their initial sketches and ideas from the teachers and each other in a mid-course critique. The final presentation was given at the very end of the course. Although this course was evaluated as Pass/Fail, the students received feedback for their work on the grounds of aesthetic merit, originality and the student's ability utilize and express what they had learned during the course.

In spring 2017 the task was a residential project in northern Helsinki by Ark-House Architects, consisting of five connected six-story condominiums. The residential six-story condominiums are situated right beside and nearly parallel with the railway. The buildings appeared very different when viewed from southwest than from a passing train or a nearby footbridge crossing the railway. The students produced a wide variety of designs: sketches for mural paintings and patterns, short animations or 'flipbooks', studies of building materials, graphic concrete artworks, double facades covered in creepers or illuminated facades glowing with colour. The main focus was on the experience of the facades when passing by at different speeds. The students were keen to pick up this aspect, how the facades of the houses would be seen (for a few seconds only) from a passing



train. The main entrances and balconies look onto a quiet road and secluded courtyard, providing a very different situation.

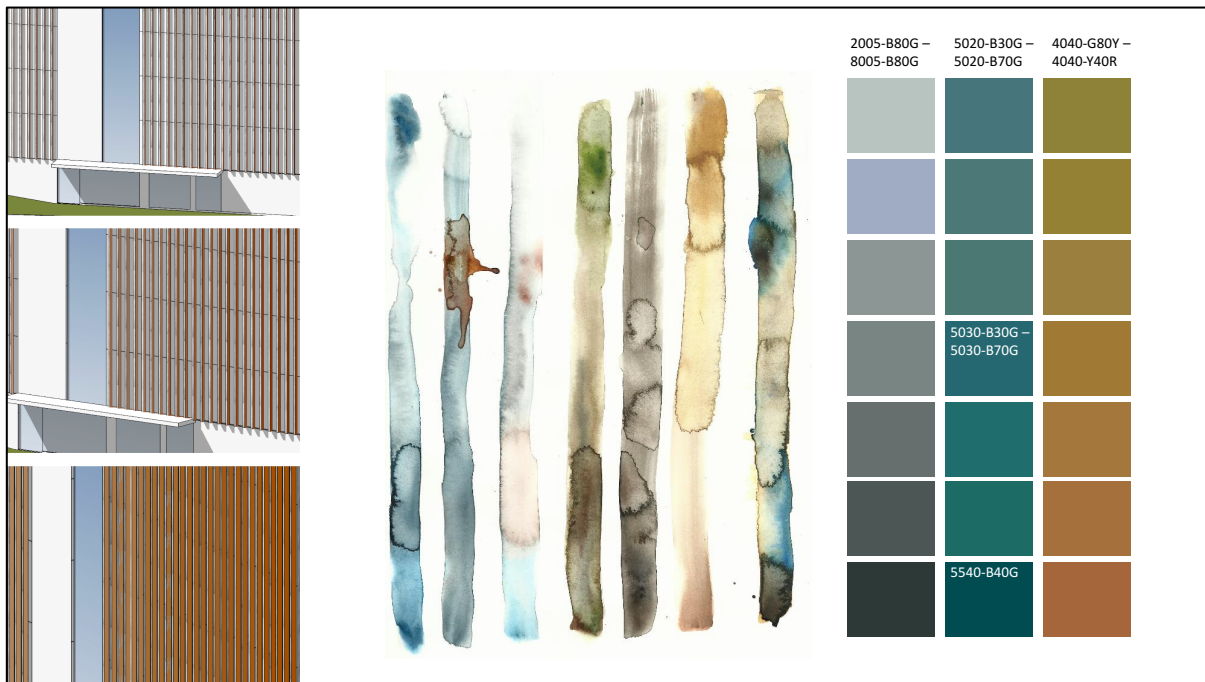


Figure 3. Assignment 1 (2017). The Oulunkylä residential buildings. Sketches for facade colours, material and structures. Piia Jalkanen and Liisa Vuorenpää, bachelor students of interior architecture.

In 2018 the students worked on a project by SARC Architects and SRV building contractors: four new skyscrapers which are to be built in the Keilaniemi area in Espoo. The site is large and quite complex. It offered multiple possibilities for colour design exercises ranging from apartment interiors and street-level views of entrances to the high-rise buildings' visual appearance. The students concentrated on the colouration and illumination of the skyscrapers' facades, the parking garage, entrance lobbies and the shared facilities in the upper stories. The towers will be built in an area near the seashore, which now contains only office buildings. It was crucial to understand how the skyscrapers alter the skyline and landscape, how they look in different seasons, weathers and lighting conditions, and what it is like to live surrounded by office blocks. (See Figures 9, 10 and 11).



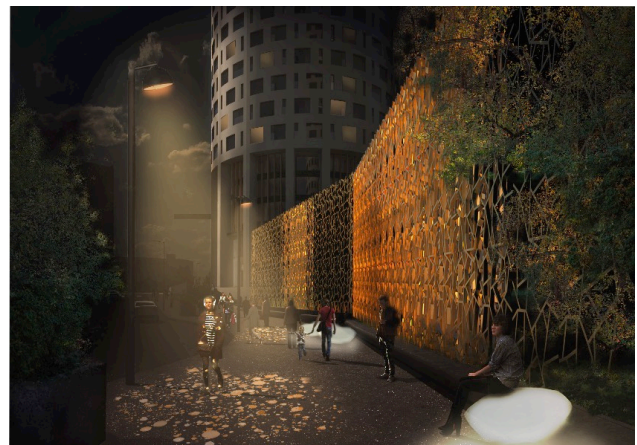


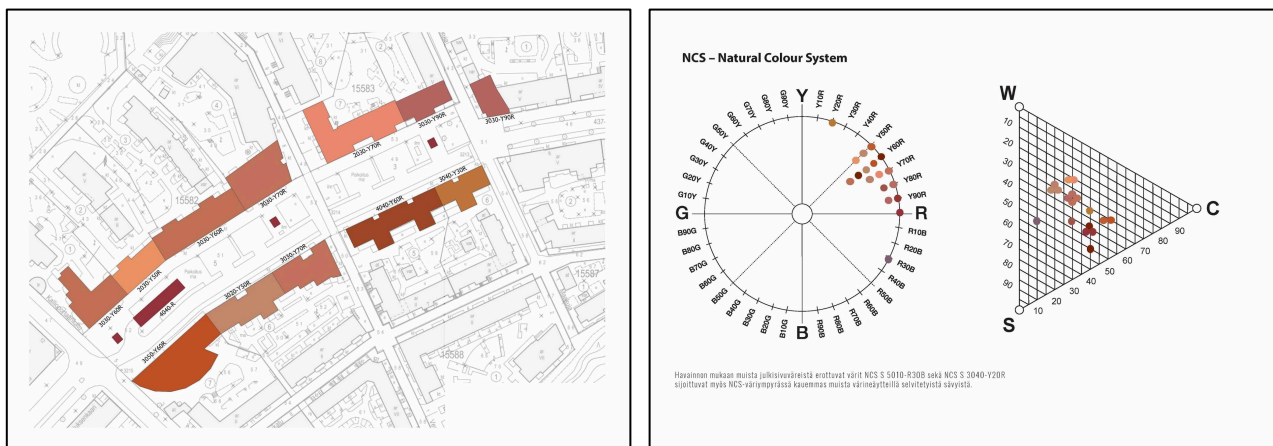
Figure 4 (above). Assignment 1 (2018), Keilaniemi towers, Espoo. Jenny Jolkkonen, bachelor student of architecture, and Johanna Kesälä, bachelor student of interior architecture. Inspirational mood board for colour design. Jenny and Johanna developed the character and atmosphere of their design proposal with a visual and verbal concept analysis of the site. The words translate as reeds, seashore, lichen, autumn, organic and rustling.

Figures 5 and 6 (below). Jenny Jolkkonen and Johanna Kesälä. Night and daytime illustrations for the garage wall design and its adjacent street lighting. A wooden mesh structure gives a feeling of warm tactility and enlivens the long garage wall. In the night, a dappled light pattern from the street lamps repeats the visual idea of the grid structure on the wall.

Professor Pentti Kareoja, the chief architect for the building project in case 1, taught during both years a parallel course, *Identity of Space*, for master's degree students. The students of this course worked in both years on the same Assignment 1 cases, but with different objectives and a slightly different timetable. Professor Kareoja took part in the final critiques of CLS on both occasions and in the second year the case study was introduced simultaneously to both groups by teachers and representatives from the architects' and building contractors' companies, who were also presented some of the final results from both courses. This experience was good preparation for future working life.

## Assignment 2: Analysis of atmosphere

Assignment 2 is designed to prepare and give support for doing Assignment 1. Assignment 1 involves the visual and multisensory analysis of existing spaces, their atmosphere and sense of place. In 2017 the atmosphere analysis comprised four outdoor spaces and two interiors.



Figures 7 and 8. Assignment 2 (2017). Analysis of facade colours in Paciuksenkaari street, Helsinki by Elka Lupunen, bachelor student of landscape architecture and Linda Peuraharju, bachelor student of architecture. Paciuksenkaari, “The Red Street”, built at the turn of the millennium, consists of residential buildings with facades of a variety of red-brown hues. The students documented the surfaces, materials and details of the facades with photography and the NCS system.

In both years the groups were mixed, with students from architecture, interior architecture and landscape architecture. This way the students benefited from a co-learning experience involving different viewpoints to spatial design. Photography, written descriptions as well as measurement and documentation of colours, materials and surfaces with NCS and other available means were used in the analyses. The students had to devise their own method of describing and conveying to others the interrelation of colours, lighting, space and materials. A closed Facebook site was set up, where the students could post their observations. This way the observations and measurements were immediately available to the whole group.

In 2017 the sites for Assignment 2 were very different from each other, varying from residential areas from the 1990s and 2010s to Empire-style and Jugend quarters in central Helsinki. The students learned to employ the NCS together with photography and texts on two separate documentation tasks. They were surprised to see how different the colours looked in different

materials such as limewash, plaster, painted concrete and wall cladding. Also, the surprisingly strong effect of illumination at different times of day was noted. The systematic concentration on one site helped the students to understand not only the unstable nature of perceived colour, but also the limits and directions of change and their effect on the atmosphere of a specific place.

In 2018 the locations were five new stations along the newly opened westward extension of the Helsinki metropolitan area metro line. One of the stations is located under and in between the Keilaniemi towers of assignment 1. The students studied the experience of spatial flow in the underground spaces, the escalators and overground station areas. The students' observations of the factors affecting the perception of architectural colour and lighting support the findings of Karin Fridell Anter.<sup>13</sup> The PERCIFAL questionnaire and method (see page 4) were found especially useful for describing the light and shade and reflections in various materials and their orientations in the metro stations.

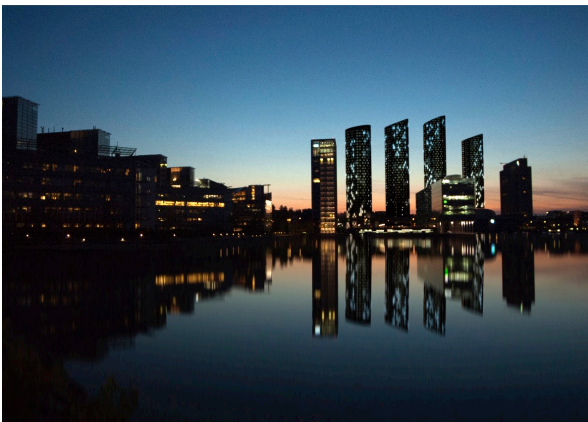
### Student feedback

19 students completed the course in 2017 and 12 in 2018. They were 7 from interior architecture, 4 from landscape architecture, 3 from architecture, 2 from art education, 1 from design and two doctoral students, one from architecture and one from art education. 13 students returned the feedback questionnaire.

The questions were: 1. Name three excursions, lectures or components of the CLS course which you found the most important and which best supported your major and your objects of interest. 2. How well did the following assignments a) the group assignment on atmosphere of space, b) colour analysis of own ongoing or past design project (only in 2017), c) the architectural colour project "Oulunkylän veräjä", further the learning objectives of the course, e.g. increase your understanding of the colours, lighting and spaces of built environments? 3. Was there something of importance that was not included in the course? 4. Was there something that could have been left out? 5. Further remarks.

The talk by lighting designer Roope Siirinen, the "colour walk" with Saara Pyykkö and the excursions to iGuzzini lighting company and Tikkurila paint factory were most often mentioned favourably. In answer to question 2, the assignments were well received throughout and were considered useful for the students' own major studies. Two of the students would have reduced the amount of lecturing on theory, and four students felt that there should have been more information and exercises on lighting. Two students would have liked more discussion on the relationship of colours to materials and textures. All in all, and considering the great variety of student backgrounds, the feedback was very positive and encouraging.





Figures 9, 10 and 11. Assignment 1 (2018). Keilaniemi towers, Espoo. Ahti Launis, bachelor student in landscape architecture. The point of departure was the resident's experience in the buildings' different parts and outside them. The towers' colour and lighting design was based on their visual appearance in different weathers, seasons and lighting conditions. The design includes LED lighting panels which are computer-controlled to react to changes in the lighting and colouration of the sky. Ahti's design is a prime example of a careful analysis of the building's environmental and lighting conditions.

## Results and conclusions

The relative freedom of the design assignment at first caused some orientation problems for the students, but each of them was able to focus on a feature or element that interested them most. Also, the students were able to immediately utilize in their design proposals the knowledge gained in the previous assignments. A thorough analysis of the projected site, its appearance in various

illuminations, seasons and weathers, led to the best design results. The student feedback indicates that there is a demand for colour education that integrates theory and practice with real-life design tasks and in which the teaching is based on both research and artistic sensibility. The fact that in 2018 as many as seven students either did not turn up or dropped out after the first or second class probably indicates that either the main assignments were found too demanding or the content focused too much on architecture for the needs of other than architecture-based students.

The lectures, excursions and assignments broadened the students' understanding of colour, light and space and their interrelation. In the atmosphere assignment, in which the students worked in groups on a single site, they learned through their own observations, the conversations within their groups and from the other groups' observations how the experience of space and its colours and illumination can be altered. They learned to describe to others the atmosphere of a space and how it changes. They learned also that each site is unique and requires the appropriate tools for analysing and communicating the experience of space and that for this more than one method or tool is always required.

'Atmosphere' was found to be an important concept for a holistic understanding of the way various design elements interact and contribute to a total experience of space. The students learned that a design task always involves both quantitative and qualitative methods, and that designing spaces always means also *creating* atmospheres. They also learnt that 'atmosphere' is a multisensory, temporal and dynamic phenomenon.

The perception-based hands-on approach was a good way into the concepts of analysing and making of atmospheres in architecture. However, an in-depth understanding of its full significance requires more time. For this and other reasons it was decided to extend the course in the coming years from 4 to 6 ECTS. This decision was prompted partly by the student feedback. The extra time will allow a more thorough treatment of lighting and surface materials, more exercises with colour systems and reading of relevant literature followed by some writing tasks.

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<sup>12</sup>Ibid:231.

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Harald Arnkil is an artist, colour researcher and educator. After studying art and interior design in the UK, he graduated with a Master's degree in painting from the Finnish Academy of Fine Arts in 1979. Arnkil is currently Senior University Lecturer in Colour Studies at Aalto University School of Arts, Design and Architecture, where he has worked continuously since 1987. He is also a founder and vice president of Suomen väriyhdistys, The Finnish Colour Association. Arnkil is currently working on a doctoral thesis on the subject of Colour in the Artistic Process. His other research interests include the relationship of colour, light and space and the relationships colour and music and the visual arts.

Saara Pyykkö is a colour researcher, colour designer and educator and president of Suomen väriyhdistys, the Finnish Colour Association. She studied at Aalto University, graduating with Master's degrees in art education and landscape architecture. Her on-going doctoral research addresses the question of the architectural colour design process of new neighbourhoods, focusing on the detailed plan and the design guidelines of a new residential areas.