Light & Colour Group

Established in 2011 at NTNU, Faculty of architecture and fine art.
Department of Architectural Design, Form and Colour.
https://www.ntnu.edu/bff/lightandcolour

LIGHT & COLOUR GROUP

NTNU
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Core members of Light and Colour Group

Barbara Szybinska Matusiak (BM); Leader of the group. Professor at the Department of Architectural Design, Form and Colour Studies. Trained as an architect and has 6 years practice from arch. officies, PhD from NTH "Daylighting in Atrium Buildings" (1998) and 15 years of experience as teacher and scientist at the Faculty of architecture, NTNU.
Competence: Architectural Design, Daylight and Electrical light, Colour *Excellence:* Daylighting - all aspects

Alex Booker (AB); Professor at the Department of Architectural Design, Form and Colour Studies. Trained as a fine artist and has over 35 years of experience with colour as aesthetic and communication in the visual arts, public art in architecture, product design and visual communication.
Competence: Fine Art, Colour, Technical Design, Photography, Philosophy; *Excellence:* Fine Art

Arne Valberg (AV); Professor Emeritus, originally from the Department of Physics, NTNU.
Competence: Visual perception; *Excellence:* Colour vision/theory

Kine Angelo (KA); Assistant professor at the Department of Architectural Design, Form and Colour Studies. Interior Architect.
Competence: Interior Design and Colour Design; *Excellence:* Colour design

Claudia Moscoso (CM); Postdoctoral Fellow at the Department of Architectural Design, Form and Colour Studies. Architect.
Competence: Architectural Design; *Excellence*: Perception of daylight and architectural quality

Veronika Zaikina (VZ); Researcher at the Department of Architectural Design, Form and Colour Studies. Architect.
Competence: Architectural Design; *Excellence*: Daylighting

Shabnam Arbab (SA); PhD candidate at the Department of Architectural Design, Form and Colour Studies. Architect.
Competence: Architectural Design; *Excellence*: colour/theory

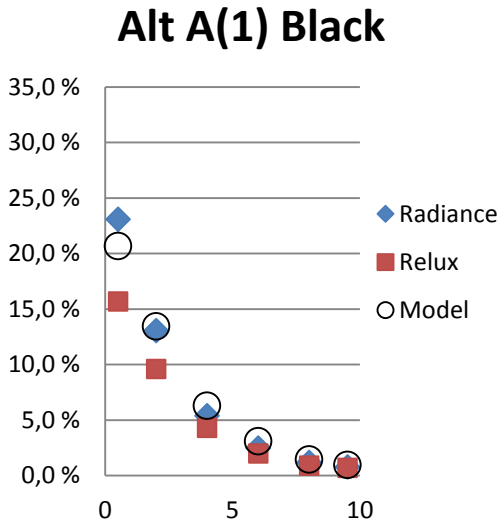
Michael Gruner, researcher, Department of Architectural Design, Form and Colour Studies (40%) and SINTEF (60%)
Competence: Sustainable Architectural Design; *Excellence*: Daylighting

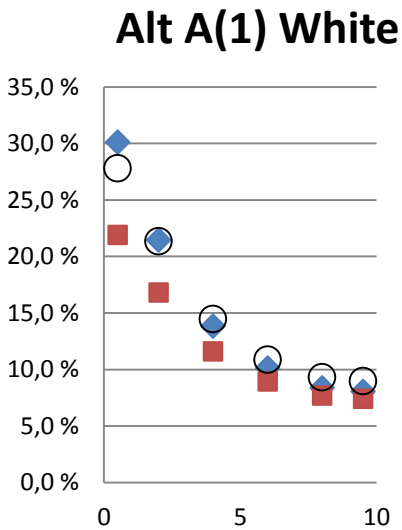
Karin Fridell Anter. PhD, Docent in Architecture with special focus at colour. Leader of the SYN-TES research group previously at University College of Arts, Crafts and Design (Konstfack) Stockholm.
Competence: Colour and light in architecture; *Excellence:* Colour/theory

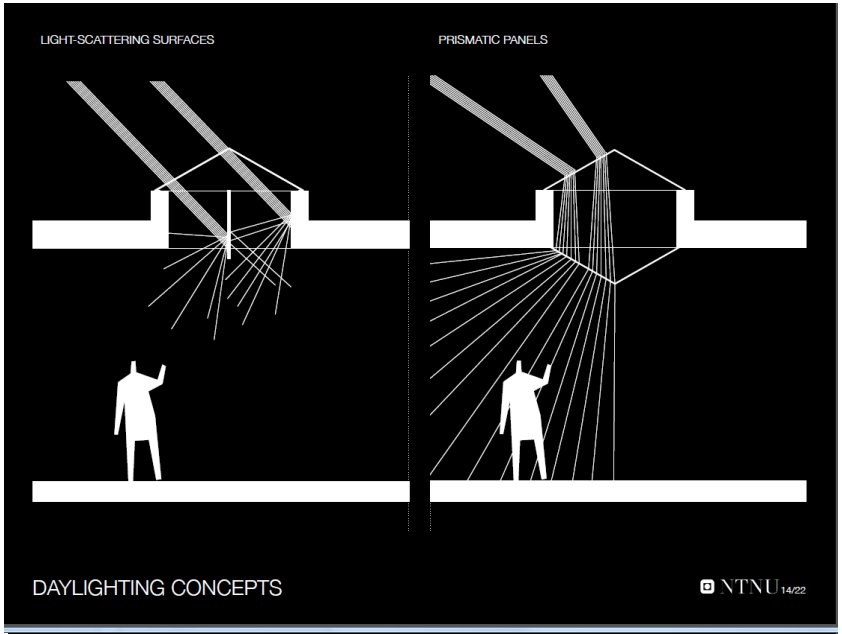
Anna Sochocka (AS); PhD candidate at the Department of Architectural Design, Form and Colour Studies in cooperation with WUT. Architect.
Competence: Architectural Design; *Excellence*: Daylighting.

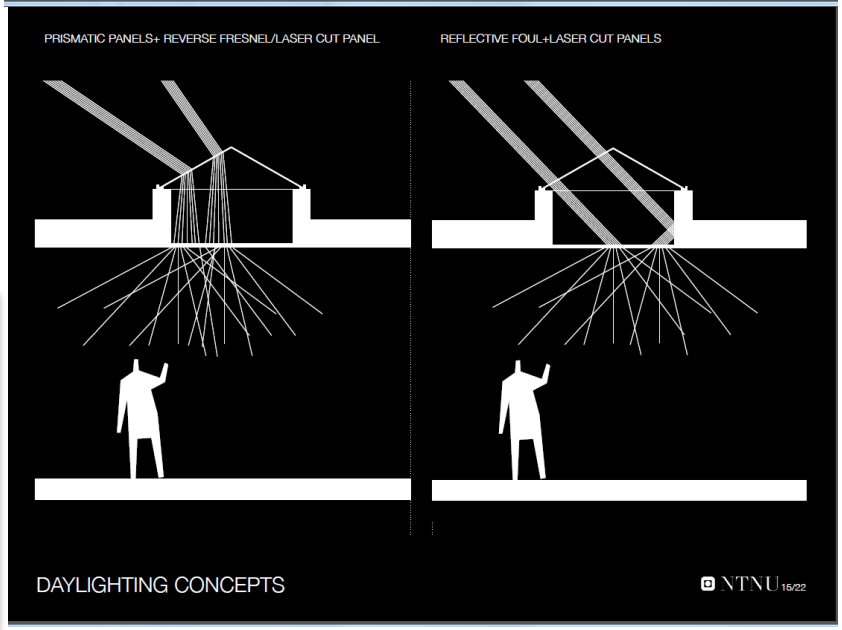
DayLighting, NRF project

1. Comparison of lighting calculations with scale-model measurements









2. Development of new versions of skylight design

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Forskningsrådet

NTNU – Trondheim
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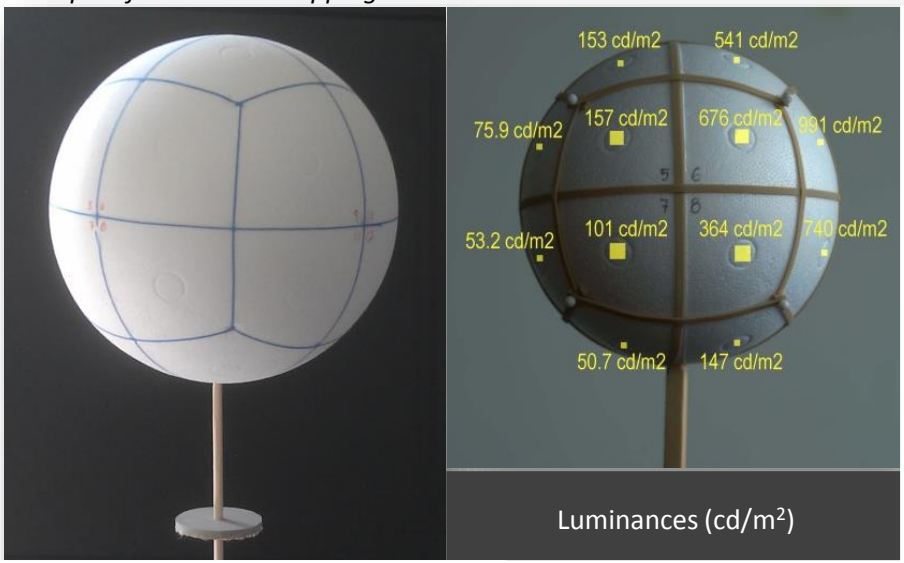
IEA-SHC Task 50: Advanced Lighting Solutions for Retrofitting Buildings.

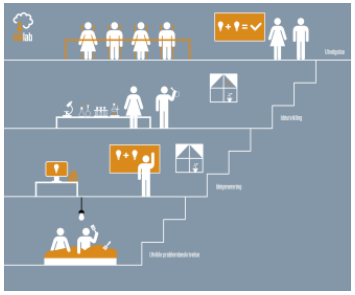
The monitoring procedure for retrofitting of lighting systems is one of the tasks;
a new procedure for estimation of the directivity of light has been developed by the Norwegian group. It is based on the usage of a white ball; the luminance mapping on its surface enables estimation of directivity.
Luminances (cd/m^2)
Daylight with distinguish directivity, the white ball and an example of luminance mapping.

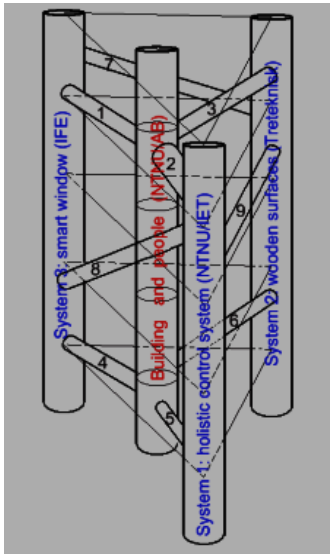
From left to right: Daylight with distinguish directivity, the white ball and an example of luminance mapping.



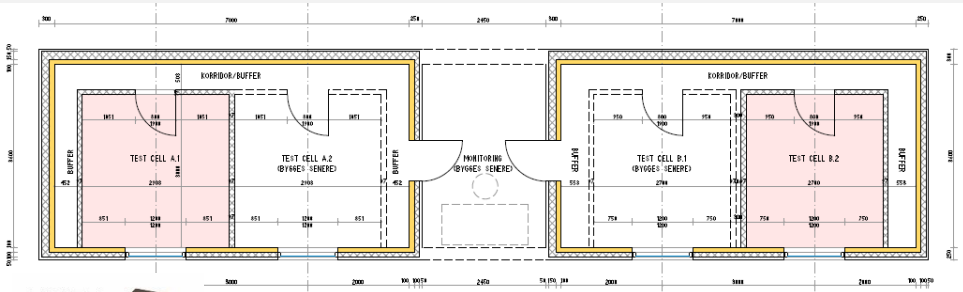
Idélab → HOME, holistic monitoring of indoor environment

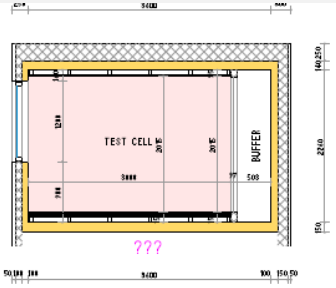
This project was developed in the Idélab organized by RCN for the first time in Norway, January 2014;
its topic was: “Toward zero emission society!” The main objective of the Idélab was to cultivate radically new ideas and solutions to existing and future societal challenges. 25 handpicked participants from different disciplines met in an intensive working session; the projects have been developed in discussion with appointed mentors. The HOME project is one of the 4 winning projects. It is established at the Faculty of Architecture and Fine Art, NTNU in cooperation with IFE, Treteknisk and IET/NTNU. It started in November 2014 and will last for three years; the total budget is NOK 10 mill. Our main research question is: How can the energy use (and thereby the emissions) for maintaining full comfort in interiors be radically reduced by introducing rapidly responsive materials (wood?) and technologies, (smart window?) and by using a holistic control system?





FULL SCALE EXPERIMENT IN NMBU IN ÅS, NORWAY





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Thermo-modernization of two chosen public buildings according to nZEB standards

NTNU and WUT

Aim of the project to develop a methodology of modernisation of public buildings to the standard of nZEB. The expertise of worldwide known Research Centre ZEB in Trondheim give an exceptional opportunity to transfer both Norwegian know-how and technologies to Poland. Such a transfer will need to be tailored to Polish conditions with a support of scientific approach. The applicability of the developed universal methodology will be checked on two case studies.

Partners

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Norwegian University of Science and Technology

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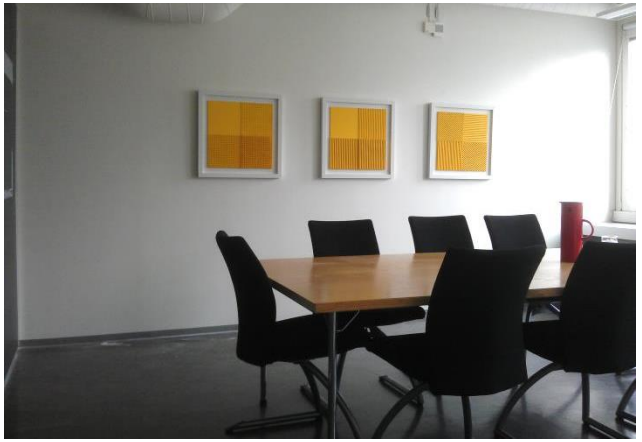
ZEB

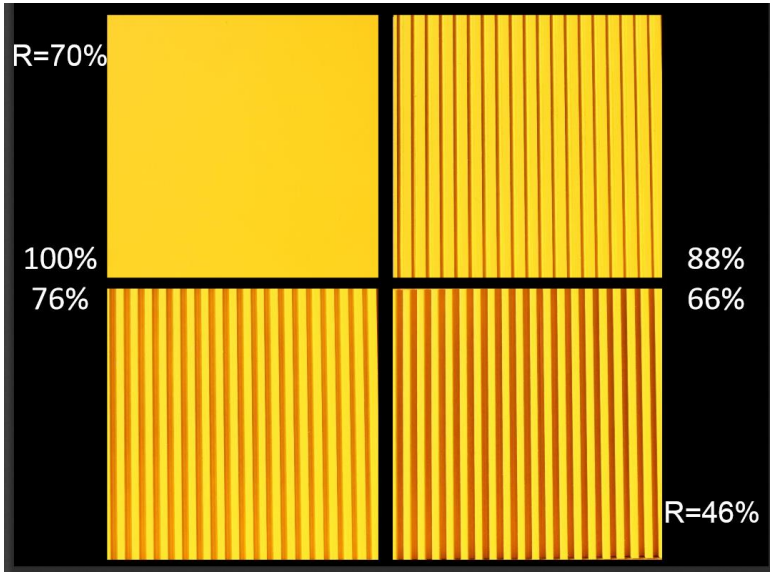
POLITECHNIKA WARSZAWSKA

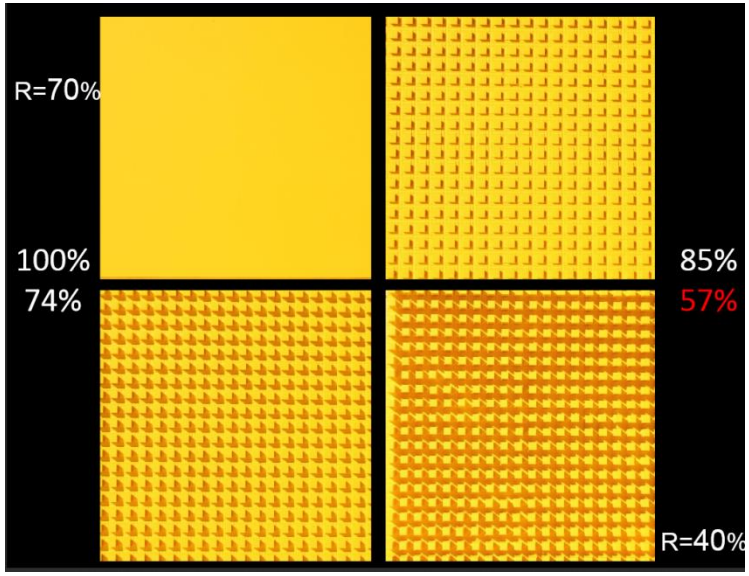
SINTEF

Relief, interaction between colour and light

This project focuses at the perception of lightness and colours of surfaces in different lighting conditions.
Subjective observations are compared to the exact measurements with the PR-655 SpectraScan.

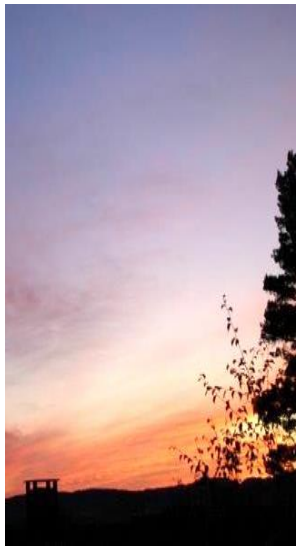


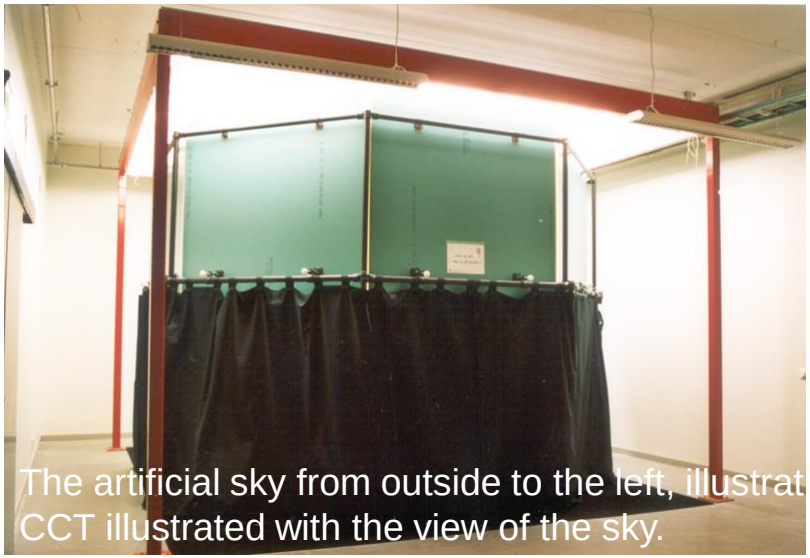




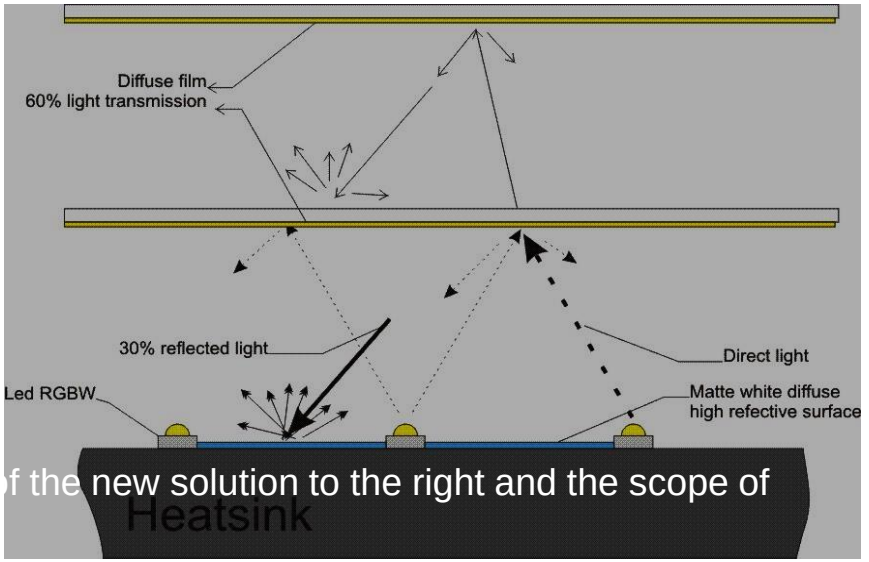
From Daylight lab to Light & Colour Lab

An overcast sky simulator, artificial sky, was developed in the fall of 2000 at the Faculty of Architecture and Fine Art, NTNU. The ceiling was made of evenly distributed fluorescent light tubes and a “perfectly” diffusing canvas stretched beneath. The development in LED-technology gives new possibilities for control of correlated colour temperature (CCT). The present development of the artificial sky consists of the construction of a new ceiling. It have been done by Spectro Color using different types of LED-chips; additionally, a sophisticated solution for diffusion of light from LEDs was developed. The new ceiling enables adjustment of the CCT from 2000K to 18000K in three illuminance levels: 100%, 50% and 25% of the maximum power. Additionally, a special demonstration program will make it possible to choose each of the following alternatives: R, G, B, W-2700K, W-3400K, W-5500, W-6500 and W-8000 separately, in each of the half-parts of the ceiling.





The artificial sky from outside to the left, illustrat f the new solution to the right and the scope of CCT illustrated with the view of the sky.



VIEW: how we evaluate the view out of the window?

NTNU project with the following results:
view distance,
the number of view layers,
the quality of the landscape/elements
the composition of the view.

VIEW descriptors proposed for CEN:	**INSUFFICIENT**	**SUFFICIENT**	**GOOD**	**EXCELLENT**
Width of view window(s)	< 13°	> 13°	> 27°	> 54°
Distance of the view	< 6 m	> 6 m	> 20 m	> 50 m
Number of layers: **- sky** **- landscape (both urban and nature)** **- ground**	only sky or only ground	landscape layer is included	minimum to layers are included	all layers are included
Environmental information: **- location (orientation regarding water, food, heat, sunlight, escape routes, destination)** **- time (environmental conditions which relate to our innate biological clocks)** **- weather (need for clothing, need for shelter, heating/cooling, opportunities for sunbath)** **- nature (the presence of trees, bushes plants, insects, birds and other animals)** **- people (the presence of people and their activities)**	time and weather	time weather and location	time, weather, location and one of: nature and people	all

Subject no. 60: INSUFFICIENT

Subject no. 57: SUFFICIENT

Subject no. 5: GOOD

Subject no. 41: EXCELLENT

FROM WINDOWS TO DAYLIGHTING SYSTEMS:
AESTHETIC PERCEPTION OF DAYLIT INDOOR ENVIRONMENTS

PhD Research Project – Claudia Moscoso

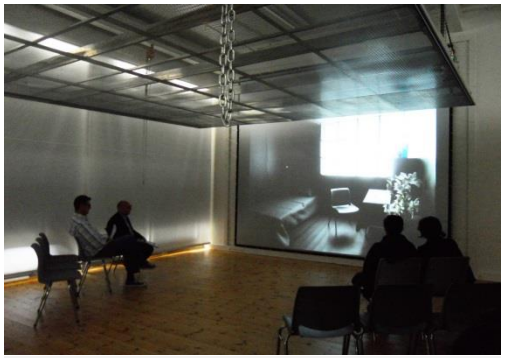
Good lighting quality:

- Provide appropriate viewing conditions to support visual and task performance (photometric studies)
- Contribute to the aesthetic perception of the space (subjective evaluations) < **Not enough research about the relation between daylight and aesthetic qualities.**

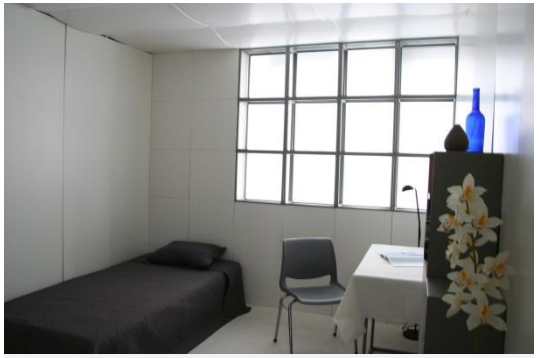
RQ: How does daylighting design affect the aesthetic impression of a built environment?

RQ: Can stereoscopic imaging be considered an accurate exp. method in comparison to real environments in daylighting studies?

Exp. Research



1| Validation of stereoscopic method for daylighting studies



2| Primary daylighting design: Windows

3| Advanced daylighting design: Daylighting systems

Main Findings

Stereoscopic imaging is a valid and accurate method to study aesthetic perception of daylit environments.

For certain attributes, window size is a more important parameter than the room reflectance.

Physical parameters of daylighting systems influenced more the aesthetic judgements than photometric measurements.

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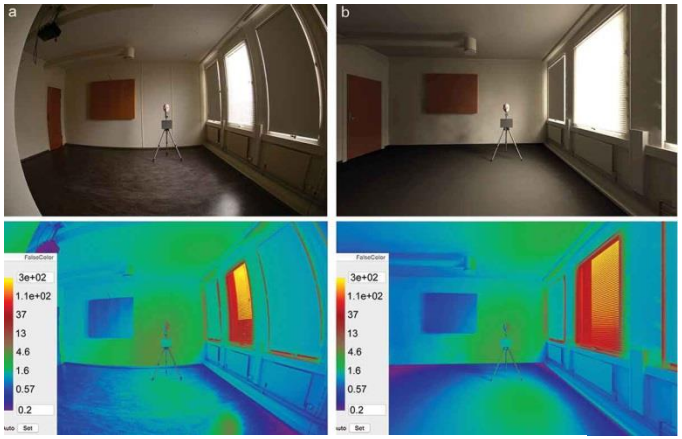
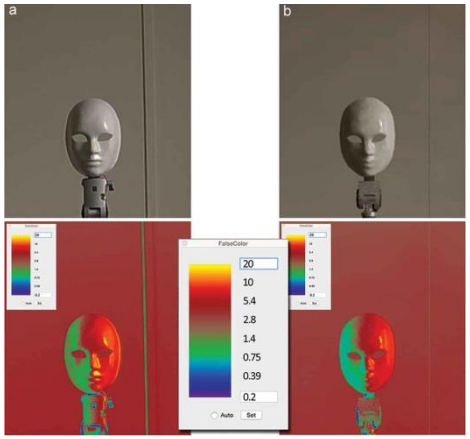
LIGHT MODELLING IN ARCHITECTURAL SPACES. LUMINANCE-BASED METRICS OF CONTOUR, SHAPE AND DETAIL DISTINCTNESS OF DAY-LIT 3D OBJECTS

Veronika Zaikina. PhD research project.

How does colour affect the perception of light level in an architectural space?



What are possible and reliable lum.-based metrics of light modelling for achromatic and chromatic 3D objects in day-lit room?



How effective are the suggested lum.-based metrics compared to the existing illum.-based metrics of light modelling?

The luminance-based metrics of contour distinctness:

1. Contrast metric (Weber formula).
2. Luminance ratio between average luminance of the object and average luminance of the background.
3. Mean point luminance ratio
4. Percentage of the invisible part of the contour.

The luminance-based metrics of shape and detail distinctness:

1. Luminance ratio.
2. Mean luminance of the object.
3. Standard dev. of the luminances of the foreground.
4. Ratio between the max. and the mean luminance of the mask.

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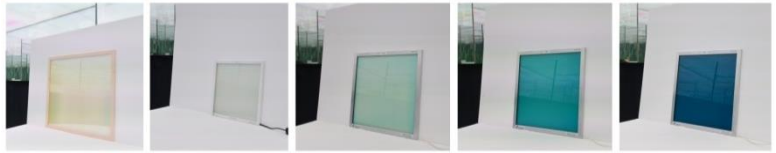
Colours in the architectural context, Advanced glazing

Ongoing PhD project – Shabnam Arbab

For most people, the correct perception of colours of objects and room surfaces is an important part of the quality of life.

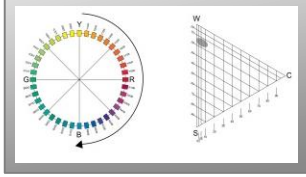
Motivation: need of knowledge about spatial (as opposite to flat) visual perception in colour research and the perception of colour illuminated by light with different spectral.

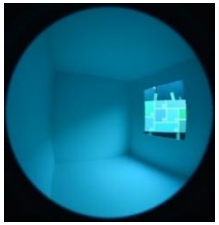


Experimental Design

RQ 1:
How is the perception of colour influenced by the colour temperature (CT) of light?

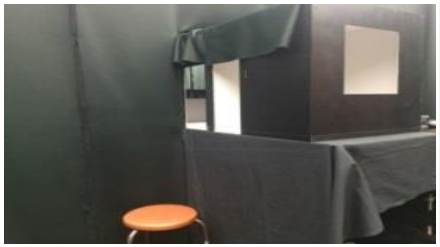
Main findings:
increasing CT of light cause shifts from yellowish to bluish





RQ 2:
How is the perception of colour influenced by glazing types in combination with light of various colour temperatures (CT)?

Main findings:
Glazing with different transmittance and colours had significant impact on the visual evaluation, especially EC-coloured tend to give severe colour distortions especially for colour samples with yellow and red hues.



RQ 3:
How much and in which direction the interior colours change their visual appearance due to a given type of glazings?

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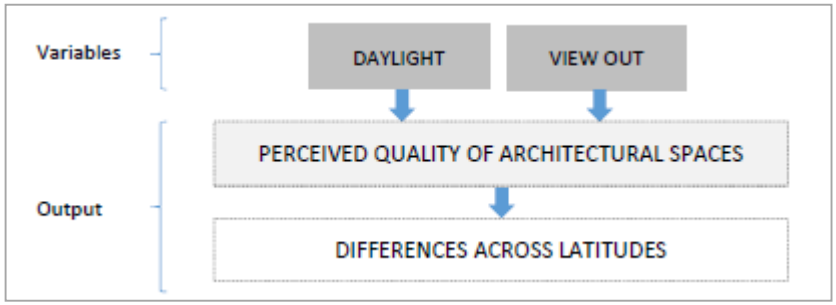
Identifying the impact of regional differences on the perceived quality of daylit architectural spaces

A comparison study across different latitudes

Postdoctoral Project – Funded by VELUX Stiftelse, in cooperation with LIPID Lab, EPFL



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VELUX STIFTUNG

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

LIPID

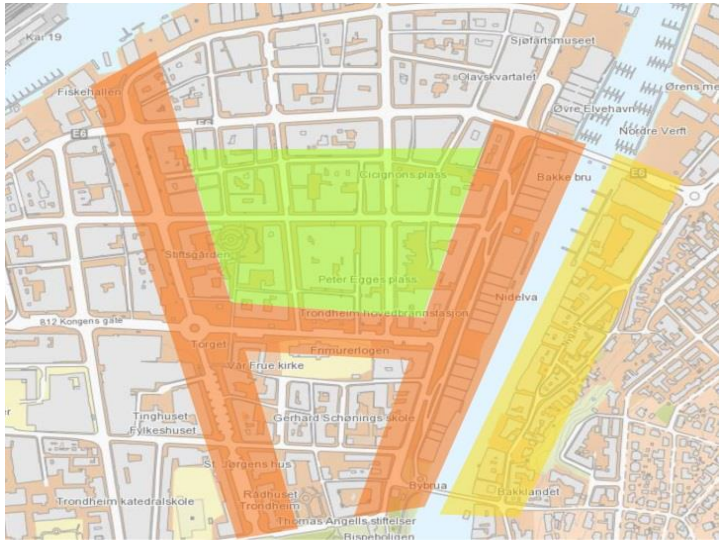
NTNU – Trondheim
Norwegian University of Science and Technology

COLOUR REGISTRATION OF TRONDHEIM 2014/2015

Gårds- og bruksnr. 400/139

Kjøpmannsgata 5

fasade mot vest



FASADEMATERIALER

Stående panel med under- og overliggere, god stand. Endene på panelet som er nærmest bakken er noe preget av slagregn og har slitte ender. Dørene har et synlig fiskebeinsmønster i tre med ca. 2 cm relieff, mens portene etterligner dette mønsteret, men har et lavere relieff. 3 typer vinduer, felles for dem er de smårutede sprossevinduer, med 6 små ruter i hvert. 2-rams vindu med stående rektangulære ruter, to horisontale og en vertikal sprosse, et slikt i 1. etg. 3-rams vindu som ellers er lik førstnevnte, disse er i 1. - 4. etg. I 5. etg er det 3-rams vinduer som er like sistnevnte, med unntak av at disse har kvadratiske ruter. Loftsvinduene er like sistnevnte, men er kun 2-rams. Taket ser nytt ut og består av glaserte, svarte takstein.

FASADEFARGER

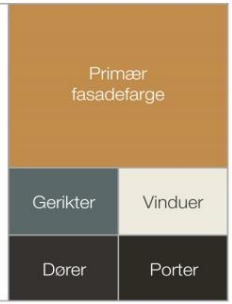
Kledning: NCS S 4030-Y30R

Gerikter: NCS S 3005-B20G

Vinduer: NCS S 0603-G80Y

Dører: NCS S 5502-Y

Porter (bryggene): NCS S 6005-G80Y



NOTATER

Symmetrisk oppbygging av fasade mot Kjøpmannsgata. Skiltene innordner seg fasaden med like størrelser, og plassert mellom vindu i 2. og 3. etasje. Vindskiene fra øverst til nederst er kledningsgul og geriktgrå. Bryggen har gatelykter på høyde med overkant dør i 1. etasje, rytmisk og ryddig. Portene i 2. og 3. etasje har horisontale bord, mulig not og fjær. Portgrinden er i portfarge. Trapper uten gelender. Sør på vestfasaden er det en tre-trinns strekkmetalltrapp. Mot nord er det en rampe pluss et trinn. Et lite takelhus stikker ut og har kledningsfarge, samt geriktfarge på vindskiene.

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TRONDHEIM KOMMUNE

NTNU – Trondheim
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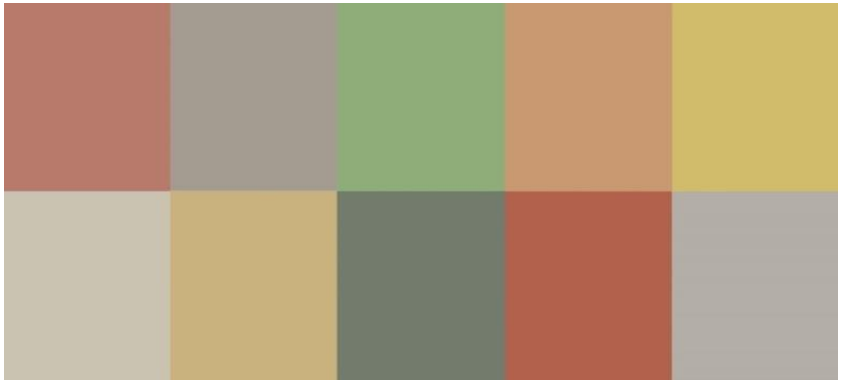
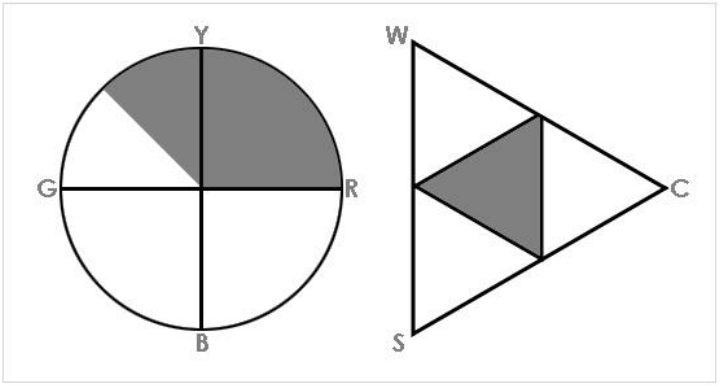
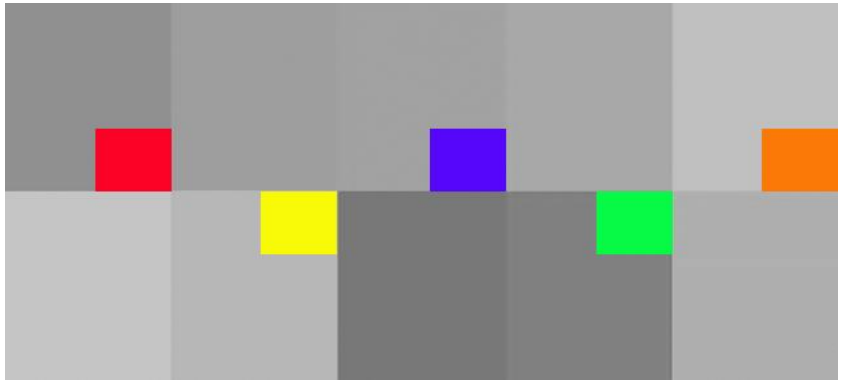
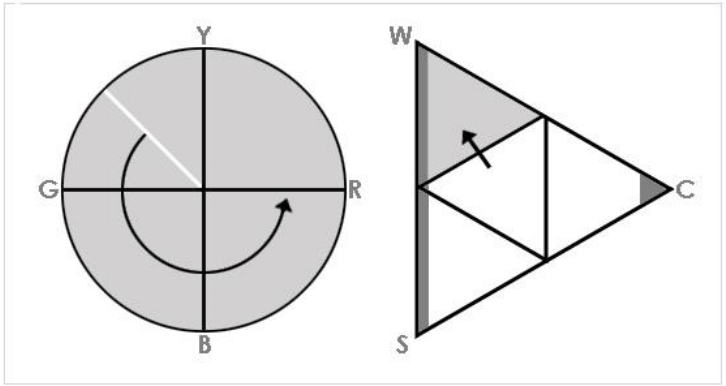
COLOUR REGISTRATION OF TRONDHEIM 2014/2015





Trondheims' traditional colour palette: the chromatic hues are dominated by colours between yellow and red, with a few green colours and achromatic greys. The nuances are mainly the «typically untypical colours – with a characteristic being more or less equally white, black and chromatic.





Modern architecture does not support the traditional colour identity of the city, and is dominated by achromatic hues, often with accents in strongly chromatic colours of all hues. The older chromatic houses are being repainted in colours with a dominant characteristic of whiteness or in the achromatic greyscale.

A GUIDE TO LIGHT AND COLOUR DEMONSTRATIONS

A new book authored by
Arne Valberg

and edited by:

Bjørg Helene Andorsen
Kine Angelo
Barbara Matusiak
and Claudia Moscoso

Printed in October 2015.

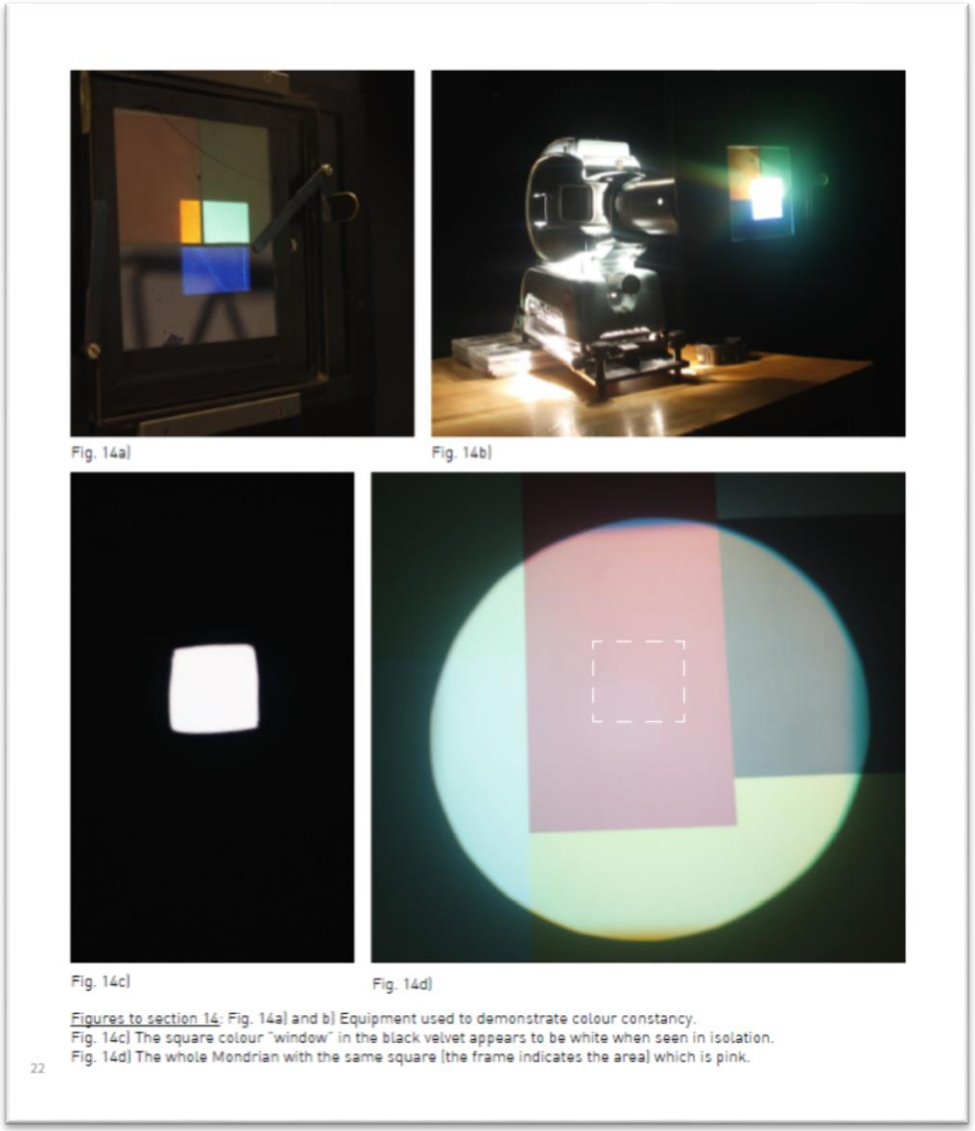


Fig. 14a)

Fig. 14b)

Fig. 14c)

Fig. 14d)

Figures to section 14: Fig. 14a) and b) Equipment used to demonstrate colour constancy.
Fig. 14c) The square colour "window" in the black velvet appears to be white when seen in isolation.
Fig. 14d) The whole Mondrian with the same square (the frame indicates the area) which is pink.

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Science and Technology

RESEARCHERS NIGHT 2016

Stand 22: Perception of light and colour

1100 pupils from 30 schools

Kine Angelo
Andreas Weibye

RESEARCH & DISSEMINATION in organizations:

- **CIE**, International Commission on illumination, tech. committees: TC 3-45, TC 3-53 and TC 3-54
- **NLK**, Norsk Lysteknisk Komitee, the research group in Lyskultur
- **AIC**, the International Colour Accociation
- **Forum Farge**, the interdisciplinary Colour-Network in Norway
- **SYN-TES**: Human Colour and Light Synthesis, the research network in Scandinavia
- **IEA**, International Energy Agency
- **CEN**, TC 169/WG 11 Daylight in buildings

MA AND DIPLOMA STUDENTS PROJECTS

Light Project in cooperation with Trondheim Municipality. 2015

Diploma by Marte Valderaune. 2016

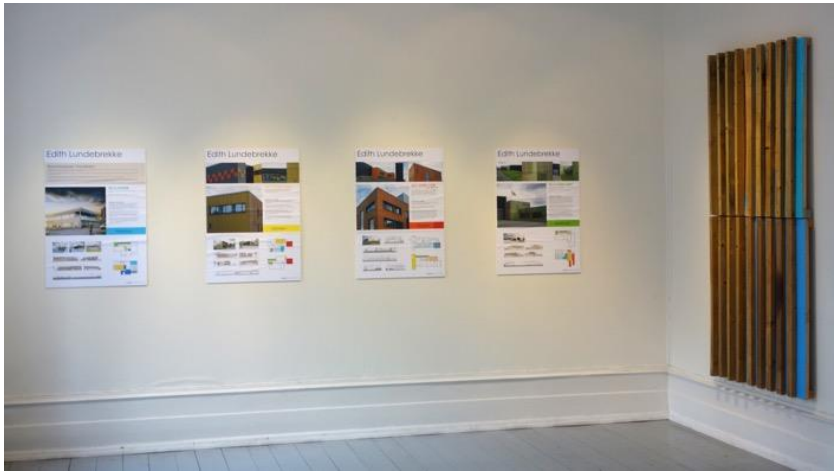
Architectural Design with Light and Colour

Diploma by Bjørg Helene Andorsen. 2016

LIGHT & COLOUR GROUP

NTNU – Trondheim
Norwegian University of Science and Technology

EXHIBITIONS



Colour in the City. Trondhjems Kunstforening and Sumhuset. 2014
Exhibition and conference organised and curated by the light and colour group

Colour in the City. Trondhjems Kunstforening and Sumhuset. 2014

NTNU og kommunen har registrert fargekoderne på en rekke bygninger sentrum. Foto: Jens Petter Sørås

Nå skal byen vår bli mer fargerik igjen

Trondheim skal få mer farge. NTNU og kommunen jobber med en ny fargeveileder som motvekt til den hvite og grå trenden.

6 Uteliv

Ved vannet: Bakene i Kanalen sett fra jernbanestasjonen mot Prinsens gate er ett av mange bynære ved vannet som blir presentert i kommunens utstilling i Trondheims Kunstforening. Foto: ALEX BRANDON

Utforsker byen ved vannet

10

Trondheim

Havna i dag

Ordførerens dag

Husfarge ingen privatsak

Fargene er i ferd med å forsvinne fra bybildet. Stadig flere hus males i hvitt og grått.

Husene i Anton Jensens vei på Ranheim i Trondheim ligger tett i tett – grått mot grått: Mørkegrå vegger og lysegrå verandaer på rekke og rad.

Nabolaget er et klassisk eksempel på hvordan norske nabolag ser ut for tiden.

Publisert i går, kl. 13.10

Kirsti Kringstad
@oppkringstad
Journalist

48 BYGG&BO

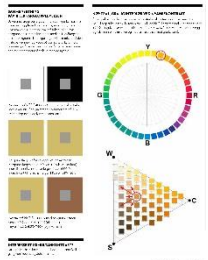
Grå nabolag

Flere maler med sprøyte

Må tåle nabolagets røyk

GRÅ TREND.

"Uniformness combined with low light conditions can get to you," a Norwegian University of Science and Technology researcher tells The Foreigner.



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Will you join us?

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