

# Colour Composition and Visual Tectonics in Facades; Adapting Colour Teaching to Current Architectural Practice

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## ABSTRACT

In Norway, this last decade has seen a steadily increasing demand for knowledge of how to use colour in an architectural context, and this paper will focus on the application of colour theory in building façade design. In architecture, colour theory is a body of practical guidance to the visual effects of a specific colour combination creating a logical structure for colour, how we can organize them, and how colours can be used to enhance architectonic intent. Current architectural education largely focusses on the *tectonic*, as in relating to building and construction, and on the formal aspects of the *visual tectonic*, but until very recently, the teaching has devoted little focus to the visual tectonics of colour. As most research estimates that approximately eighty percent of our perception, learning, cognition, and activities are mediated through vision, with form and colour being a key feature, it could be argued that we should put more emphasis on the visual qualities of colour of architecture, i.e., inherent or applied. This paper will discuss how developing an understanding of colour theory and implementation relevant to architectural education and practice in Norway is changing both students and professional practitioners' attitudes towards the use of colour in architectural projects, giving examples from the recent years colour teaching at NTNU and professional implementation by the authors.

**KEYWORDS** colour in architecture, colour theory, façade design, visual tectonics, advancing and receding colours.

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## 1. Introduction

The authors observe that the general paucity of colour understanding in architectural education and the profession leads to serious deficiencies in the built environment. The lack of knowledge of colours' actual qualities and functions across all architectural scales leads, at best, to an appeal to aesthetics without the necessary structural argument to convince developers or clients, and to "best guess" intuition late in a project without confidence in the outcome and with unpredicted and unfortunate effect. Often the colour knowledge gap means that colour is dismissed as merely a secondary phenomenon of little cultural or design importance resulting in an indiscriminate following of whatever trend is dominant. The authors along with other colleagues have worked to develop an educational structure that addresses these deficiencies.

*"... to take an aesthetic interest in a building is to attend to it in all its completeness, to see it, not in terms of narrow or predetermined functions, but in terms of every visual significance that it will bear" (Scruton, 1979)*

The following course descriptions outline how colour teaching is integrated in the curriculum at NTNU. This

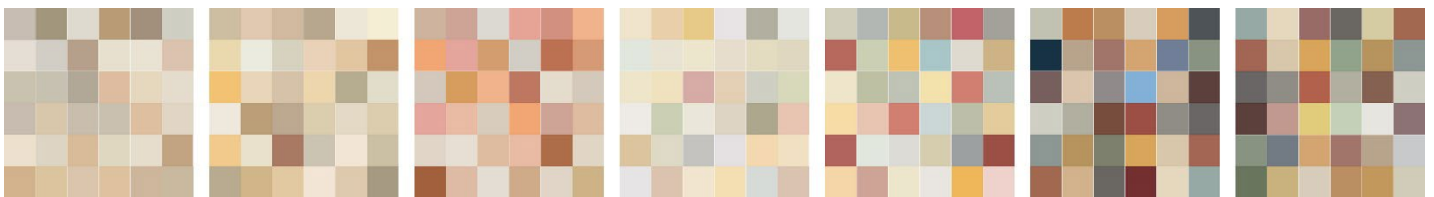


Fig. 1. Examples of colour spaces of different European cities; Paris, Florence, Rome, Vienna, Graz, Copenhagen, and Trondheim.

## 3. Architecture 3: Housing

The third semester focuses on architectural design for urban housing, the basic typologies, and organisational principles, dimensioning of architectural elements and space, light, construction, and form in relation to the urban fabric, outdoor spaces, and facades. This course runs parallel to the *Form and Colour, module 1*.

Form and Colour, module 1 start with an introduction to perception, light and colour and how colour can be used to enhance or conceal form. As all building materials have colours, inherent or applied, students are given examples of how colours affect the formal aspect of existing buildings, discussing how architects can use colour as an aid in the visual tectonic appearance (Ostwald, 1969).

Colour theory cannons, such as Goethe and Itten, and relevant colour reference systems used in the architectural profession (NCS and RAL) are addressed

shows how the teaching of colour in architecture is extended from a theoretical component to crossing the implementation gap by emphasising colour as a material quality that engages in, and contributes to, the formal, structural, and aesthetic discourse in architectural and urban practice. The first colour teaching starts in the second semester (Architecture 2) and progresses with varying levels of interaction and into the master's level.

## 2. Architecture 2: Tectonic

In the second semester, students are introduced to the most important basic building materials and gain a basic understanding of architecture's most important design principles as well as experience of how architecture affects place and how a place influences the architecture. Colour is introduced as one of the key aspects of identity of place (Angelo, K. and Booker, A., 2018) on their first excursion abroad, i.e., Vienna and Graz. Students are given an assignment of studying the nominal and perceived colours (Fridell Anter, 2000) of buildings, when learning how to measure specific building facades.

on the basis of their strengths and weaknesses, with the goal of extracting viable, practical advice. The aim is to introduce basic concepts of colour and relevant terminology to create a common platform for comparative experimentation and discussion.

The colour education is structured to have relevant transfer and implementation value to architectural practice across all building scales and locations. At first emphasis is placed on the key aspects of human colour vision; light, object/surface, and perception. Students are given an introductory assignment of exploring the elementary colours through painting and arranging colour samples according to their main visual character of whiteness, blackness, yellowness, redness, blueness, and greenness. This is the core of the natural colour system (NCS)

*Concepts addressed: colour reference systems in practice, colour properties and characteristics, lightness, darkness, chromaticity.*

### 3.1. Assignment A) Colour and form

Students focus on composition with colour and are given a specific 2D composition with the task of making three visually balanced compositions, working with achromatic colours, equiluminant colours and complementary colours to explore the optical quality and its impact on the formal composition.

*Concepts addressed: simultaneous contrast, advancing and receding colours, quality, quantity, proportion, balance, orientation, gestalt principles of colour.*

### 3.2. Assignment B) Colour and light

Students are given one colour with the task of designing a composition with nine variations of surface structure with the aim of generating a variance of perceived colour that is as wide as possible through use of texture, relief, and light reflectance properties.

*Concepts addressed: structure, texture, relief, the spectral properties of daylight and artificial light, light temperature, light reflection, light dispersion, light, and shadow.*

### 3.3. Assignment C) Colour and space

Students are given a specific 3D scale model with the task of making a spatial composition that is visually balanced when seen in all directions. The starting point is the colour palette from one of the 2D-compositions from assignment A, by experimenting in smaller sketch models before painting the final proposal.

*Concepts addressed: simultaneous and successive contrast, spatial aspects of colour, advancing and receding colours, colour perspective, aerial perspective, visual boundaries, zoning, overall gestalt.*

### 3.4. Impact on Architecture 3

Students begin to have a deeper appreciation of colour and material as an architectural design tool and are starting to understand colour's capacity in proportional and spatial articulation. Through a more methodological application in projects, they are starting to evolve more sophisticated arguments for material and colour choices in dialogue with context and the production of urban identity.

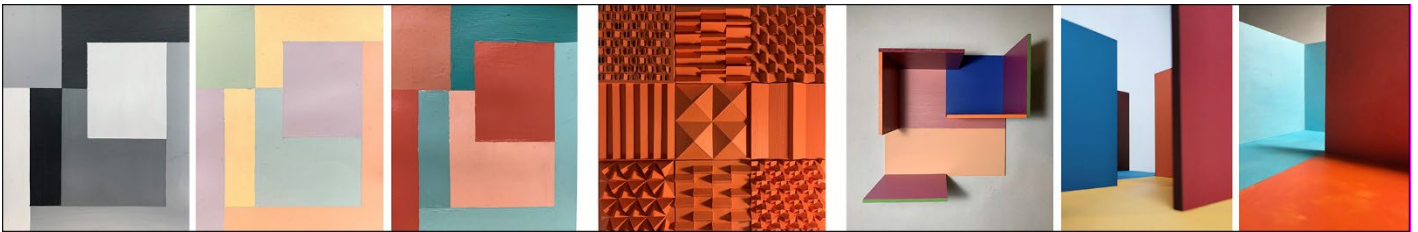


Figure 2: Example from Form and Colour, module 1, assignment A, B and C.

## 4. Architecture 4: Transformation

The examination and analysis of existing buildings through hands-on investigation. Developing projects on the basis of field investigation in conservation, reuse, and transformative adaptation with relevant choices of change based on careful attention to resource use and sustainability. This course runs parallel with Form and Colour module 2 which focuses on working within a specific colour palette of a place and pattern formation from 2d to 3d.

Form and Colour module 2 further develop the understanding of how to implement colour in architectural practice through exploring the development of colour, material, gestalt, and the understanding of pattern structure in facade design; facades are composed of elements that result in an overall gestalt.

### 4.1. Assignment D) The Trondheim Palette

Students make their own "Trondheim palette" by mixing colours, selecting colour samples to represent the wider

range within the colour space of the city. For this assignment, they have access to NCS tools (Indexes, atlases and colour pins) as colour reference for comparison. Their selection should represent the width and depth of the colours hues and nuances of the city.

*Concepts addressed: colour and context, colour and place, colour guidelines, colour reference systems, colour in practice, Norwegian standard for colour reference (NCS).*

### 4.1. Assignment E) Colour, form and pattern structure – 2D

The students are given a specific "module" and tasked to experiment in creating different patterns by repetition vertically, horizontally, around the axis, by displacement, mirroring, etc. They first start in black and white and then introduce colour to their achromatic designs to explore the theme further and to experience how colour can visually change the perception of form and pattern structure.

#### 4.2. Assignment F) Colour, form and pattern structure – 3D

Students develop a 3D-module out of the 2D-module and use the surfaces of the 3D-element to experiment with colour and how it affects form, and then make compositions based on repetitions of nine of these identically coloured elements/modules. The final task is either to make three different compositions where the

element has the same colours but placed differently or use the same model composition making different compositions through three different colour schemes.

*Concepts addressed: one element/module in repetition, format, rhythm, direction, orientation, size, scale, open, closed, positive, negative, facade design, overall gestalt, visual tectonics of colour.*

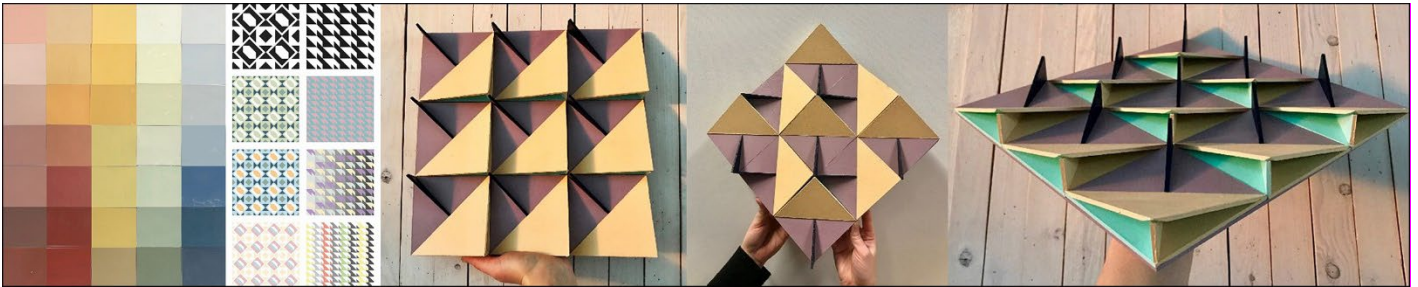


Figure 3: Example from Form and Colour, module 1, assignment D, E and F.

#### 4.3. Impact on Architecture 4 - Traditional Colour Practice in Norway

Students implement the acquired understanding directly in the semester's main project, and there is a sustained discourse on colour and material in heritage identity and adaptation throughout the semester. The Trondheim colour palette is used in all design projects, and plug-in colour assignments are set in the area the students are working in, with the task of experimenting with the effect of colours have on visual tectonics of the façade; advancing and receding colours and how active and passive the

building elements are perceived in the overall gestalt of the façade (Fig. 4). Traditions in previous architectural styles and an understanding of the evolution of material in both heritage and more modern structures are also encountered. This develops increased appreciation for the craft aspect of colour and colours cultural role in heritage and epoch identity.

*Concepts addressed: visual tectonics, formal aspects of colour, advancing and receding colours, perception of gravity in optical weighting.*

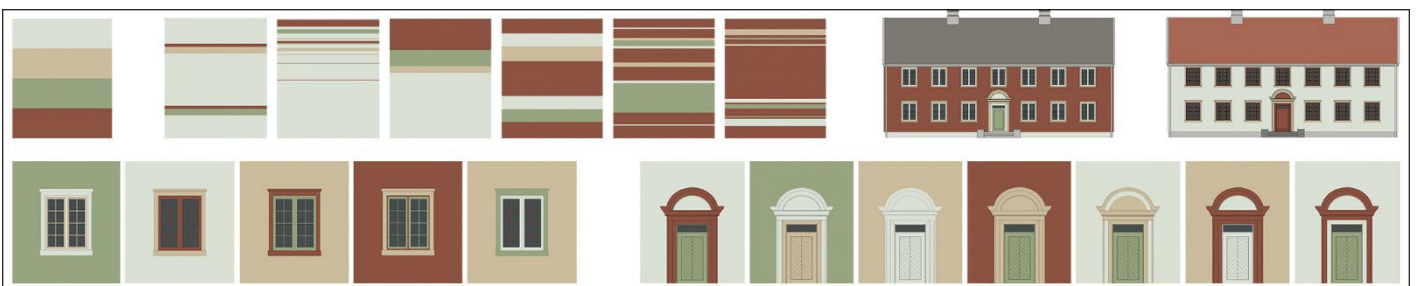


Figure 4: Example of assignment on visual tectonics of colour.

#### 5. Architecture 5: City and Town Planning

Developing sustainable conceptual urban design proposals and urban planning strategies including a general understanding in sustainability and ecology. Methods for analysis and design of urban settings and landscapes space, form/ typologies, and functions. Input on the history and contemporary practice in urban colour plans with particular emphasis on identity, ambience and

wayfinding, extended discussion on the importance of climate, solar angle, geographic position, and locality in colour and material perception.

#### 6. Architecture 6: Large Buildings

The course develops the knowledge for designing large, sustainable buildings. The course focuses on situational

analysis and awareness, application of given context, program, functionality, concept and expression, the structure and elements of buildings, regulations and safety, construction principles, and technical infrastructure. The form and colour component are substantial with extended discussion of gestalt structure in relation to colour and materials in facade and body form and its impact on, and relation to, urban and regional

identities and the objects communication in relation to publicness and everyday aesthetics. Students are encouraged to think with colour and material as a contextual and idea generating tool from the first conceptualisation stage. This is maintained throughout the course by the availability of colour expertise for student project teams. It is expected that students show both colour and material implementation in their final presentation.



Figure 5: Example of project on Architecture 6: Large building, where knowledge from Form and Colour is implemented in façade design.

## 7. Summary of colour teaching at BA level

At the conclusion of their first six semesters (BA level) all students have encountered colour in multiple contexts and through this have developed an understanding of colour's role and relevance in architectural and urban design, at each stage the potentials of implementation have as far as possible been brought from theory into practice. A significant number of students continue to develop their interest at master's level.

*Tectonics in architecture is defined as "the science or art of construction, both in relation to use and artistic design". It refers not just to the "activity of making the materially requisite construction that answers certain needs, but rather to the activity that raises this construction to an art form." (Maulden, 1986)*

## 8. Master Design Course: Architectural Design with Light and Colour.

*Architectural design with Light and Colours* is a design course with a specific focus on the perception and practice of light and colour in an architectural context, and the

course is taken parallel with the theory course *Light and Lighting*. The theory course focuses on daylight in buildings, both quantitatively and qualitatively, and the knowledge is used in the design course when designing the final infill project. The use of daylight in the final assignment on the design course is not discussed in this paper.

The design course has particular focus on application of natural light, building materials and colours in architectural design. The course builds on colour teaching at BA level and aims to further develop practice-related design skills in colour design in public spaces. It focuses on exteriors in the urban realm and universal design in interiors, building up aesthetic argumentation and at the same time complying with building regulations and requirements for public spaces. The specific sites for the design projects change as the course co-operates with municipalities in different towns and cities in Norway, and with various partners in the paint, render and cladding industries (Fig. 6). The aim of the course is to apply learned concepts, methodology and terminology to argue functional and aesthetic aspects of architecture in an urban context.

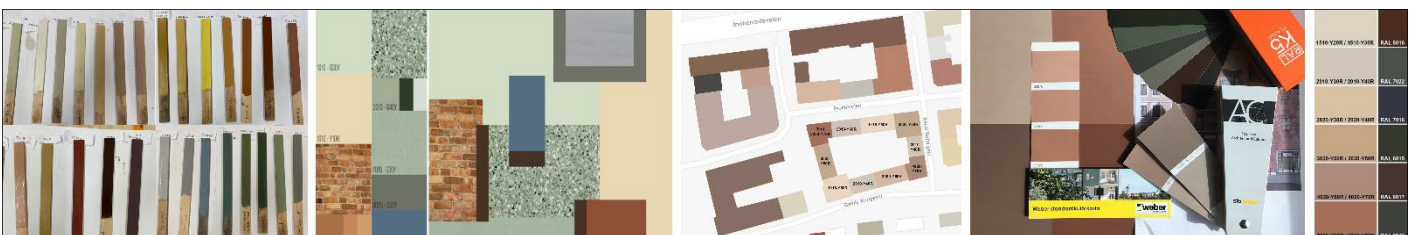


Figure 6: Example of exercises on the master design course with real clients in making new colour selection for linseed oil paint for a company in Oslo, interior palette for client with focus on universal design and LRV, and façade colour palette for new building block in a specific area of Trondheim.

The design projects aim to reflect and respond to contemporary architectural challenges, i.e., identity of place, urban densification, infill projects or building rehabilitation in a specific overall gestalt of a site/street/area/city. The Norwegian Directorate for Cultural Heritage (Riksantikvaren) declared in 2017 a change from the earlier strategy of *contrast* between old and new to emphasis on *dialogue* between the old and new, e.g., dialogue between building materials, overall gestalt of pattern structure, typology and colours. However, the question of *what a good dialogue between existing buildings and new additions is*, is not particularly well exemplified or specified. To achieve this good dialogue the knowledge developed at BA level in colour and form, pattern structure, relief, material colour, building elements and sequential structural order and context are essential.

The final design project starts with on-site registrations, e.g., light, natural context, building materials and typologies, colours, building pattern structures, how the

area is used and what functions are there, to identify the *status quo* of the dialogue. Counter to most current practice of approaching the project from the inside and out by starting with a programme – students instead respond to the site as to what would be a good function of a building in the area and what would be a good aesthetic addition to the context, i.e., from the outside and in. The aim is to establish the functional and aesthetic “frame” of the context at the beginning rather than as an adaptation at the end of a project, and that all choices of building materials, colours and visual tectonics, respond to the overall gestalt of a specific place. Students are encouraged to respond and explore by inclination and ability but are required to professionally argue all of their choices, both for building design and its relation to the context.

*Concepts addressed: context registrations, visual tectonics, pattern structures, dialogue between old and new, identity of place, dogmas of contemporary practice, urban hierarchy.*



Figure 7: Example of registrations of colours, materials and overall gestalt for the final design project.



Figure 8: Example of student projects and studies of brick-and-mortar colours, and of the variation of facade elevation model in 3D of several student projects.

## 9. Diploma level

At the masters (M.A.) and the Diploma (final examination) level we see students who chose to specialise on architectural colour and an increased number of students who address colour as an important design factor and actively seek further consultation on colour issues. Indirectly: an increased number of graduates move into practice as architects or consultants that actively address colour as an important architectural and urban design

factor or have been engaged on the basis of their demonstrated colour competence.

## 10. Conclusions

We conclude from our experience that a meaningful re-weaving of colour into architectural design is dependent on colour teaching that has direct and transferable value in supporting continual semantic development and practical

implementation at every stage in the student's trajectory towards professional practice.

Gestalt, colour and tectonics are treated as descriptive and discursive rather than as exclusively explanatory in nature, the integration of their principles provide part of the semantic vocabulary that allow students to grasp and discuss compositional propositions, it is understood as a form of analysis describing perceivable tendencies in visual organisation, as such it provides the students with a set of tools for analysing, understanding, and manipulating the cumulative qualities of elements and objects in a coherent way in the visual field and in three-dimensional space. The tendencies of colour and tectonics are understood as a set of qualities that interact to variable degrees at any given time, and that they may be manipulated to generate hierarchies of proportion, position and balance, dynamics of rhythm, order, flow, and variation. An understanding of these combined gestalt tendencies equips the students with a set of actions and understandings that enable a deeper structural discourse on the dynamics of composition at a formal level (how elements work together) towards a more complex emergent function in visual, spatial, and structural rhetoric and contextual cultural implications.

Sustaining discourse on colour throughout the study with input that is relevant produces results that are visible both in the quality of the individual work and in understanding of the function and purpose of colour in an aesthetics of structure, furthermore, graduating students have the grammar and experience to confidently explain and argue for their decisions with a rational, formal, architectural and contextual language that goes beyond a purely subjective, expressive feeling and is more firmly anchored in a relational understanding.

### 11. Conflict of interest declaration

The research leading to this paper has been obtained through the authors academic employment at Department of Architecture and Technology, Faculty of Architecture and Design, Norwegian University of Science and Technology (NTNU), as well as through own design practice.

### 12. Funding source declaration

The authors declare no conflict of interest in publishing this paper.

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### 14. Short biography of the authors

**Kine Angelo** - Associate Professor Kine Angelo joined the Faculty of Architecture and Design at NTNU in 2010 where she is currently a full-time lecturer and researcher. Building on previous and ongoing design practice of architectural projects, her research activities are devoted to promoting colour and material gestalt in architecture and urban space through architectural education and public outreach.

**Alex Booker** - Professor Alex Booker trained in the United Kingdom as a fine artist and has exhibited widely in Europe as well as completing a number of major public commissions. In 1995 he joined the Faculty of Architecture and Design where he teaches two and three dimensional form grammar, colour and visual communication for both product design and architecture students.

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