GEOMETRY, SHAPE AND COLOUR IN DESIGN
Research notes from historic colour theory

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ABSTRACT
Colour is considered a non-essential element, referred to phenomena, versus building elements as matter, shape and geometry, which are meant as concepts with proper archetypes.
Classic culture defines colour as appearance, underlining physiologic and perceptive topics with subjective components. This is evident in architecture treatise, where colour is neglected, also in the debate about building honesty.
But it is just its belonging to appearance that gets it important to visual perception: it dominates objects identification and thus becomes the being of painting. The last describes perceived reality with coloured pictures in contradiction with drawing, that means concept through signs.
Industrial design, born from applied arts brought colour in chosen variation, without strong design tools. New research of our unit in INDACO Departement intends to deepen the colour role in design, starting from historic theory and his contemporary applications to develop new design references.

Keywords: colour design, colour model, colour theory

1. INTRODUCTION – THE RESEARCH
This text aims to set the main references of the cultural debate around the theme of colour in projects, aiming to indicate and define the practical issues in order to give research some direction and to help the work group to head towards concrete results taking in consideration both the representational academic requirements and those of the industrial design. Far from trying to be the conclusive result of the research, this text is more like an introduction, since the hugeness of the topic requires narrowing down the area of interest. Therefore we're going to try and focus on the living space, especially on the interior and urban architecture, on the elements and objects that characterise it. Afterwards we shall be able to also focus on the representations and materials that are peculiar to the image.

2. THE STATE OF THE ART – THEORY AND APPLICATIONS
The starting point is the state of the art, characterised by an extensive biography [1] in which it's possible to find different points of view caused by opposite academic backgrounds not only in the area of exact science. They mostly refer to the physical and chemical nature of colour, reminding us of the possible ways for it to present itself: light and pigmentation. Colour is a fundamental element in the nature recognising process, it express itself through
coloured phenomena and shapes [2]. This particular aspect of colour makes it an issue related to knowledge, involving a philosophical debate starting from its fundamentals, especially with regards to the opposition between subjectivity and objectivity [3].

This is why perception becomes of interest; the sociological approach is subject to the confrontation of the physiological and psychological aspects resulting in an anthropological phenomenon [4].

The variety and esthetical fascination of this phenomenon have contributed to develop its relation to the arts, in which the interest towards colour finds its utmost expression in painting, which is essentially the art of colour, however, architecture and all the other practical arts needed to confront themselves with this complex ensemble of factors.

Still, colour, which has always been subject to great attention in thought, has never been considered a concrete element in architecture projects, remaining a secondary factor - no matter its continuous presence in buildings - for a long time. Usually it wasn't listed in technical documents, both graphical and descriptive. The main cause may be due to difficult definition and reproduction of colours hues in project drawings. For this reason colour is now a delicate issue in restoration procedures, which mostly underline the role of representation in the colour debate. The role that colour was assigned by those movements that promoted the renewal of architecture in the decades of the last century seems contradictory when the artistic avant-gardes have promoted its formal properties; however, the affirmation of the Modern Movement seems to have created its own “law of the grout”, announced by Le Corbusier in 1925.

It is the relation between the representation and the design that leads to the interest in architecture and in applied arts, for which the colour plays a decisive role. Actually it is only apparently non-planned.

3. COLOUR AND DESIGN - THE TOOLS OF REPRESENTATION

"Des goûts e des coleurs... (on ne disputes pas)". This is how Le Corbusier starts “Polychromie architecturale” [5] without needing to put an end to the sentence, assuming it wouldn't be necessary to finish such a common saying no matter its contradictory terms. The biography meant to describe the more technical aspects of colour is in fact, rich in all knowledge fields and there are numerous indirect references in many other documents. Since the ancient Greek times western thinking has been trying to figure out a way to explain the colour phenomenon in relation to the knowledge of the physics world. These attempts have recently developed into an independent interest in human studies, often referred to Goethe’s work and Schopenauer’s development [6]. However painters interest, there's a lack of references to colour in architectural documents, underlining its concept as only an accessory, which can be neglected during the planning process because of its secondary role in relation to shape, the true essence of architecture.

There are other texts dedicated to other disciplines help find a deeply rooted reason in the long tradition of western thinking in which shape has the value of concept and colour has the value of phenomenon, binding the first to substance and the second to appearance. Architecture, artificial model of the world, is shape and substance; colour is a consequence of the material or finishing touch that belongs to the realm of ornaments and decorations, implicitly related to appearance. Colour is left to the arts and crafts of the decorator –even when he or she is a renowned artist. It is perceived the same way that great paintings and frescos were perceived in the renaissance and the colour of historical architecture finds its utmost expression in interiors, which are meant to be covered in wall paintings and tapestry.

The wall won't be naked as colour will be its clothing. Exterior colour, decoration of the urban space, is subject to
trends and limitations due to objective needs, such as the outlay of the material or the pigmentations available in the making of great surfaces on plaster and lime. The exteriors final outcome also depends on the cultural legacy; Le Corbusier believed that architectural surfaces owned mostly a formal, constructive, quality preventing the colour as being perceived as a factory element but more as a secondary component only valuable for painting.

Frescos and painted in tempera tapestries are confined to the interior walls. Serlio condemned the use of gothic facades with characters or animal paintings, but forgave the fake architectural compositions: the colour/ornament is a simulating tool for richer elements and materials but never a quality itself. Colour belongs to the minor arts and it is given a decorating role neglected by the architectural project.

The triumph of colour in ornamentation finds its place in the new style currents at the beginning of the XX century and it’s the result of the coeval attempt to unite the diverse arts – including architecture and painting - in one piece of work, together with the research of applied arts school, which will also give birth to design itself.

It’s interesting to witness the relation between colour and the architects who will lay the grounds for the Modern Movement, its denial in the following affirmation and the recent awakening of interest. Bauhaus was important for this process, the role that didactics gave to the arts, especially to painting, involving the teaching by many painters such as Klee, Kandinskij, Schlemmer, and mostly through direct work experiences in Itten [7] and Albers [8] classes and finally in Innerk Scheper’s work with Wallpainting Workshop just as “colour designer” [9]. Itten focused on the study of colour combination even more thoroughly than Bauhaus, bringing back the geometrical models introduced by Goethe and Runge (the circle and the sphere), in order to regulate the mixing and the combination according to general rules [10]. He inscribed simple geometrical shapes in the circle in order to define colour’s regulations and he managed to point out 7 different colour contrasts. The importance of colour emerges from the project drawings that were published, especially in axonometric (Gropius office), but also in perpendicular projections (Kelers’ cradle) or plane developments, in which the representation is supplied with colour. Primary colours are preferred as they were previously the centre of attention of some of the exponents of the avant-gardes studies such as Oud, van Doesburg, Mondriand e Rietveld, but in architecture Bauhaus maisters and their scholars used them carefully, such as did Le Corbusier and Baldessari.

In Germany colour was the object of the attention of Bruno Taut and Alexander Klein, who, in the making of his council estates, uses it to improve the perception of spaces that would otherwise appear to be narrow. Before the war there have been other architects who were involved in the relation between Bauhaus and the German culture, Le Corbusier, Piero Bottoni and Luciano Baledessari are some of those who used colour to characterise their own architectures. Le Corbusier, who started as a painter and then became an architect, finds it necessary to avoid all ornaments – therefore colour too – from the wall (1925) but at the same time he plans coloured interiors and urban spaces (La Roche mansion and cité ouvrière de Pessac). A few years later, attracted by the proposal of the wall paper producer Salubre of Basle, short after a similar commission to Bauhaus in Deutschland [9], he enhanced the role of colour in architecture, confirming the previously affirmed difference between few „tectonic“ colours and the wide range of the others, the first to be used in building and the others to give more importance to the minor elements. In the text supplied with the first sample book, expressing his colour concept in architecture.

Le Corbusier underlines how the use of wall paper as peinture a l’uil en rouleaux guaranteed a colour constancy and
a quality that would otherwise be impossible. At a first examination of the two colour charts it is clear that the attention
shifts from primary colours to a selection of mixed saturated dyes. Figure 1 shows the different keyboards layout. In
1931 the 44 colours of Salubra I were collected in 13 compositions with three hues for floor, ceiling and walls and
fourteen for small elements, without any yellow. In four of them change only the main colours, with a strong prevalen-
ce of warm hues (right side). Some thirty years later, the Salubra II had less colours, sided without any apparent rule
but different contrast. Among the 20 tones of 1959 keyboard, half cold and half warm, three are primary colours, white
black, and the elementary results of their mixture, but violet: green, orange, pink, gray and sky-blue.
In Le Corbusier’s „clavier de coloeurs“ dyes are peculiar in their similarities with those we can view in the numerous
colour attempts by Baldessari for the interior of the Spadacini flat (1932), where colour plays a determining role.
Fig. 2 shows a first study on Baldessari’s colour design, starting from his perspective sketches and colour selection
conserved in CASVA Archive (Milano).
Overall we can say that the use of colour in the last century’s architecture still hasn’t been subject to systematic
studies, but although there have been cultural barriers and prejudice, which might have influenced the process, we
cannot ignore that there are objective problems in this kind of study, all mostly related to the difficulty of representing
the colour, refered to the building of several geometric models.
Actually the principle of order in the rules of geometry, connecting number, shape and measure prompts the use of
regular solids to explain, measure and represent the colours.
In fig. 3 Giampiero Mele illustrates the ancient Plato’s geometric model, based on tetrahedron with black, white, red
and “shining” as main colours in each vertex and composed with others three ones, built on the upper faces of the
first, which go to purple, turquoise and yellow. The italian system “C.M.N -86” uses the same shape to get perceptible
appearance, transformation and disappearance of colours (C): in its own tetrahedron, each colour becomes lighter
or darker getting closer to white (B) or black (N) and it can evolves toward transparence (T) or “reflection” (S). The
model explains both primitive causes, than intention of observer.

4. CONCLUSIONS – REPRESENTATIONS AND GEOMETRICAL MODELS.
The scarce planning documentation of colour is implicit in the difficulties of its representation, which seems to be
the primary cause of this phenomenon. The renewed interest shown from the most recent architectural projects is
a consequence of new planning tools that not only allow and help the representation of colour but also need colour
as an element of viewing the shapes.
Digital representation as a privileged tool of the planning elaboration requests the use of colour as the main element
to view and understand shapes, giving it an explicit planning value.
This new approach underlines the elements of representation in the study of the relation between colour and project,
and it justifies the reference to one of its peculiar working tools – geometry – through the bond with its own relevant
factors: tools, methods, open problems and also in relation to the development of the IT representation that connects
design with the other mathematical branches.
Numerous geometrical models built to explain, measure, define and therefore control colour, are the core element
from which to develop the subsequent deepening of the research.
Fig. 1
Colours selection and combination in Le Corbusier’s Collections for Salubra.
Fig. 2
Colours selection and combinations in Baldessari’s sketches for the Spadacini flat.
REFERENCES

Fig. 3
Geometric colour models according to Plato and Italian system “C.M.N -86” (Giampiero Mele).