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Colours, light & well-being : Characterisation of chromatic phenomena in collective housing.

Caumon Lorrain^{1,2,3,*}, Georges Zissis¹, Céline Caumon², Élodie Bécheras², Estelle Guerry^{1,2} and Christelle Infantes³

¹ LAPLACE, UMR5213 (CNRS, INPT, UT3), Toulouse University, France; firstname.lastname@laplace.univ-tlse.fr

² LARA SEPIA, EA 4154 (UT2J), Toulouse University, France ; firstname.lastname@univ-tlse2.fr

³ SOBRIM Company - HARANAM concept, Bayonne, France; contact@sobrim.fr

* Corresponding author: lorrain.caumon@laplace.univ-tlse.fr

Abstract

The objective of the study presented is to demonstrate the value of a chromatic and luminous analysis of a place in the pre-design phase. This analysis protocol is part of a designer's ethic which is to anticipate and respond to the conscious and unconscious needs of users, thus participating in the construction of a quality approach. Using the case study of the "Bonamour" project (Capbreton, France), we question the value and interest of promoting a protocol that favours a benevolent and differentiated design approach. This will allow us to evaluate the relevance of the devices applied. Ultimately, the data collected and the recommendations applied to the project will enable property developers to gradually turn towards a more inclusive and sensitive design of lighting and colour applied in the residential sector.

Keywords: *Light design, Color design, Visual comfort, Protocol, Accompaniment.*

INTRODUCTION

1.1 Health and housing threats

The actual pandemic is the sixth one that has hit humanity since the Spanish flu of 1918. According to a ONU report, the frequency and severity of these global epidemics could accelerate in the coming years, due to our lifestyles and the incredible adaptive capacities of viruses, IPBES (2020). In this exceptional health context, we have seen that housing conditions have more than ever impacted our daily lives. As a result, we have become aware that the problems related to the quality and sharing of collective living spaces during a pandemic will be major issues in the future and must require the full attention of real estate professionals.

All the more so as for many reasons, keeping people at home can be accompanied by multiple and varied disabilities, thus affecting the quality of life, Eideliman and Gojard (2008, 89-111), Piccoli et al (2020), ONU (2020). In France, approximately 12 million people are affected by a disability, including 1.5 million with a visual impairment and 850,000 with reduced mobility, INSEE (1999-2001). Also, age is a factor to be taken into consideration, because in 2050, metropolitan France will have approximately 70 million inhabitants, more than a third of whom will be 60 years old, INSEE (2002). For all these people, the positive and secure perception of the daily environment must become an important issue. Therefore, it becomes necessary to adapt the environment of collective housing to people with different pathologies and their potential consequences on their habits.

1.2 Chromatic effects and methods of approach.

With this study, we want to provide reflections on design issues such as designing built, sensitive and inclusive spaces. To do this, we have focused on what inclusiveness means in the creation of the atmosphere of a place through its colour and light factors. For this purpose, we defined that an inclusive atmosphere translates into situations of sensitive and accessible interactions understood as

the plural and singular experience that one has of a given place at a given time, influencing our sensations and quality of life. For many years, designers and authorities have been placing people and their plurality at the heart of architectural projects, but if we stick to strict compliance with standards, as people do not respond to any average, many gaps remain.

For example, in the French standards (EN 12464-1 completed by NF X35-103), the only indications are that the age of people must be taken into account to define the lighting levels on work surfaces. In collective dwellings, article 10 of the order of 24 December 2015 imposes minimum characteristics to ensure average horizontal illuminance values measured on the floor along a usual circulation route, taking into account transition zones. It goes without saying then that strict compliance with these standards does not allow us to guarantee the success of an architectural project in the perception of these users, Mudri (2002).

1.3 Color-Light: a factor of identity and orientation.

In the literature of cognitive sciences and psychology, there is little research on the role of colour in its relationship to space and in particular in the spatial orientation of people. However, we know that a visual environment adapted, Damelincourt (2010), to the pathologies of people suffering from disabilities has positive effects, but must respect a certain number of criteria such as a quantity of light, contrasts and an appropriate spatial distribution. We therefore hypothesised that colour in the architectural environment of collective dwellings could support spatial location and orientation, particularly for people with disorientation, who are less receptive to conventional signage systems, Bay et al (2021, pp97-103).

In doing so, this empirical approach will hopefully instil thoughts around colour in communal housing environments. Inherited from hygienic and standardised norms, we note, even today, that few works integrating colour are the object of a voluntary approach. The selection of colours and materials often depends on the tastes of the project manager and the customary validation of the client, but what appears to be a secondary issue is in reality a key point in the assessment of the success of an architectural project. The results of this study will enable the implementation of a creative protocol that will assist property developers in designing visual environments adapted to the needs of all its inhabitants. The main results expected from this study are :

- Improve the analysis and interpretation protocol to define comfortable visual environments.
- Develop tools for simulating lighting ambience in the programme design phase.
- Facilitate the integration of the results of this study by professionals.

MATERIALS AND METHODS

2.1 Color-matter, color-light

The protocol presented is based on a combination of chromatic expertise (colour matching) concerning the choice of materials, textures and finishes, favouring colour for its plastic character; and lighting (light characterisation) concerning the quantity and colourful character of the light, giving particular importance to the different colour temperatures. This study focuses mainly on the common spaces and the interior horizontal circulations. This is because the visual ambience of these areas should create a sense of welcome, visual comfort and safety for all users, at all ages, during the day and at night. Therefore, the method used will serve to create coherence and harmony between the exterior landscape treatments and the interior chromatic and lighting treatments in order to create an intuitive and inclusive chain of movement. The method was divided into two stages:

2.2 Step 1: Captures

The surveys presented were carried out on 26 June 2019 in Capbreton (Landes, France) over a period of 8 consecutive hours at the site of the future "Bonamour" residence built by the property developer SOBRIM (Basque Country, France).

The first phase consisted of collecting photographs of the site, as the survey of the existing site is an essential phase before any project. Equipped with cameras, this preliminary chromatic analysis was accompanied by a walk around the site. Photographs cannot be used to faithfully reproduce colours on a palette. However, they are indispensable graphic documents for memorising, visualising and disseminating information, Lenclos et al, (1982, 65). Most chromatic studies employ photographic investigations to support the colour surveys. In our case, photography was used in two approaches, one aimed at establishing an inventory of the surrounding urban colours and forms, and the other at colour and light diagnosis in order to judge the appearance of the site under cyclical conditions. This stage was a means of transcribing and analysing the experience of a space.

The second phase consisted of referencing the colours of the site with the help of countertypes. In our study, the colour survey consisted of observing the colours that made up the environment and the architectural elements surrounding the project in order to compare them to reference colour samples. Here, we used the colours of the NCS colour chart. The Natural Color System, is a universal system used for standardised colour communication, based on an intuitive codification designed on human vision. This reference system allows us to communicate about colours in a universal way in various fields of application. This representation also allowed us to retranscribe these chromatic readings in values thanks to the L. a. b system from the CIE XYZ, taking into account the logarithmic response of the eye, but also by the specific characteristics of the coloured surfaces with their luminance index.

The third phase was to carry out a series of measurements to characterise the lighting environment of the site. The evaluation was carried out at three different times of the day (morning at 10:00, early afternoon at 14:00, late afternoon at 17:30) to measure the light amplitude. Also, in order to analyse the light distribution of the space, it was divided into several areas of the site. This series of measurements was carried out with the IRC CL-70F chromaticity meter, allowing us to collect all the values of the light. A video-luminance meter was also used to identify areas that may be sensitive to glare and shadows caused by the future buildings.

2.3 Step 2: Creations

The first phase consisted of a study of the existing light, environment, chromatic and architectural identity of the site (see Figure 1).



Figure 1 : Environment Study

Each environment has a unique identity, of which colour and light are part. The mission of the colour designer must necessarily include a diagnosis of the existing environment. This stage defines how we will approach the existing environment and certain elements in relation to the project, but also to the promoter's wishes in terms of the expected aesthetic and functional ambitions. In this phase, we took into account the so-called "permanent" and "cyclical" colours. The "permanent" colours are the basis of any chromatic study. They constitute the stable elements of the place, having a durable character, such as the building materials. They are opposed to "cyclic" colours, which are unstable and subject to innumerable temporal, meteorological and luminous variations, such as the colour of patinas, plants and the sky (etc.).

The second phase consisted of recommending atmospheres adapted to the place, using chromatic ranges, materials and lighting systems that would favour the safety and visual comfort of all the inhabitants. This method consisted of experimentally constructing chromatic ranges by means of the view, proceeding by variation and multiplication of optical combinations until a visual impression was obtained that conformed to the aesthetic expectations of the project. In order to conceive these chromatic ranges, we used the NCS colours previously surveyed on the site, which we then matched with the colour charts of the paint and plaster manufacturers used for this project. Thus, an atmospheric work was conceived around the spirit of the place, the chosen shades are sublimated by the contribution of contrast around several soft and affirmed tonalities inspired by nature and harmonizing perfectly with the vegetal contribution present on the site. These prescriptions led to the creation of three chromatic palettes specific to each building in the project (see figure 2)

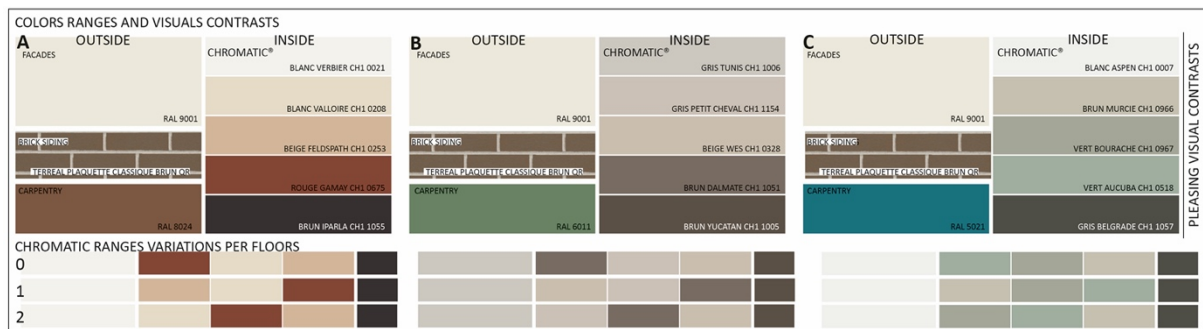


Figure 2 : Chromatic environment creation

Inside, the chromatic combinations are composed of five shades, but established on a dominant trichromatic, Déribéré (1968), varying on each level, thus avoiding all visual disturbances caused by a discordant polychromy, and relieving the space of a certain visual monotony recurrent in this type of place. Particular attention was paid to chromatic contrast and luminance values, as contrast sensitivity generally decreases with age and can be even more disturbed when visual pathology is added. Thus, the luminance indices of each recommended colour are between 0.6 and 0.9 for light colours and between 0.2 and 0.45 for dark colours, and finally, a contrast of 70% has been respected between different important supports so that they can be perceived by a visually impaired person, whose sensitivity to contrasts is still operating. Here, light colours are used for large surfaces and dark colours for smaller surfaces or accessories to allow better discrimination of spatial elements. Some of the contrast values are not equal to 70%, but they have been accepted due to a negligible margin of error. The creation of these differentiated harmonies has therefore allowed us to design circulation spaces with chromatic variations for each level, favouring intuitive orientation as well as efficient and comfortable reading of the chain of movement for all inhabitants.

Finally, these harmonies were also accompanied by a lighting design. This was studied so that the quantity and quality of light would meet the needs of all the inhabitants, because at 55 years of age the quantities of light required are 300% higher than at 25 years of age, and this for an equivalent level of visual performance, AFE (2020). For this reason, we recommended an average of 300 lux at the floor level, homogeneous throughout the buildings, using direct and indirect LED lighting with a colour temperature of 3000 Kelvin. Finally, the choice of materials was studied in order to recommend finishes ranging from matt to satin in the entrance halls according to their natural light contribution in order to adapt to each exposure and thus not generate any glare or darkness.

To conclude, the third phase was the creation of a technical execution file for the project management. This file is based on and complements the documents provided by the project architect and includes normative descriptions as well as graphic documents such as colouring diagrams on plans, lighting system layout diagrams, cross-sections, a book of details and signage, as well as a material library to ensure the proper implementation and monitoring of the project.

RESULTS

The different phases of surveys and analyses contributed to demonstrate in a quantitative and normative way how the place could be perceived by the inhabitants, INSEE 2017. The interpretation of these results allowed us to start prescribing efficient lumino-chromatic atmospheres, taking into account the constraints linked to circadian lighting and the location of the buildings. This creation phase, beyond taking into account the standards in force, called upon an experimental construction method, Pfeiffer (1966), taking into account several factors intrinsic to the project:

- - The analysis of the characterisation of the colour and light on the site.
- - The spirit and visual coherence of the place where the project will be located.
- - An efficient chain of movement.
- - Comfort of use and appreciation of the spaces for all inhabitants.

The outcome of this protocol was the creation of a construction file and a detail booklet, intended for the project owner in order to transcribe the information collected into technical prescriptions, colouring principles and efficient lighting in the future building. We hypothesise that this expertise in chromatic and luminous characterisation within its future circulation spaces will generate more visual reference points and comfort of use thanks to this protocol..

DISCUSSION

The issue of lighting and colour in collective housing is quite complex, as designers' preferences vary greatly according to both objective and quantifiable conditions (economy, standardisation of practices, specific needs related to people with disabilities, etc.) and socio-cultural and subjective conditions (preference for a particular colour scheme, type of luminaire, type of covering, etc.).

As a result, and in the absence of standards directly related to these semi-private spaces, architects tend to use very neutral, even monotonous, colours and materials, and struggle to install lighting that is sufficiently effective, comfortable and aesthetic in common areas. With the help of this study, we are beginning to awaken designers to the challenges of colour and light. Because together, beyond their simple aesthetic contribution, they make it possible to secure and make efficient the circulations while allowing the inhabitants to plunge into singular universes where the atmosphere becomes a factor of wellbeing and cohesion.

CONCLUSION

In the next ten years, a comparative study will complete the research-creation protocol studied in this article. This comparative study will take into account the values obtained in the old residences and those designed from this protocol, this study will be completed by an interview with the inhabitants questioning them on the perception of the place and basing ourselves on a scale of sensations and anhedonia. This study will enable property developers to adjust and design in a systematic and sustainable way visual ambiances better adapted to human physiological needs and to prove the validity of qualitative approaches in terms of light and colour design within new property programmes.

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