

EARTH WALL - A CHANGE OF MATERIALITY TO AWAKE SENSES

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Abstract

Earth buildings are often reported to bring great benefits in terms of comfort and quality of life for their inhabitants. However, raw earth's contribution is not purely technical. Investigating the sensory domain in the design of inhabited space is essential, as it takes into account the experiences and responses of people who will build and use the buildings. In order to treat the issues connected with both technical and sense-related factors, this study will take an approach based on architectural ambiances. This paper will question the specificities of atmospheres designed and built with raw earth to get answers to see if the presence of raw earth could change the ambiance perception of a place. If a change can happen, how is it highlighted? Which factors are involved? How important are perceptual factors with respect to physical values? Could people's perception be affected by getting involved and participating in the construction process? To get answers to these questions, two experiments were conducted. The first one took place in Barcelona, where the composition of a wall inside a university's office was modified. More specifically, an earth plaster was applied to one of the four walls of the office. The second experiment was carried out in Grenoble, where one of the walls of a break-room was covered with earth bricks. The results of both experiments showed that the sensorial attributes of raw earth seem to reinforce the creation of more pleasant and soothing atmospheres by raw-earth spaces.

1. INTRODUCTION

1.1. AN ARCHITECTURE THAT HAS BECOME BLAND

Since the ancient era in Western mindsets, eyesight has prevailed over other senses. However, this prevalence was less present in people's daily lives where oral culture was predominant. Since the modern era and with the advent of inventions such as print or later in the twentieth century technological discoveries, the hegemony of the eye has been reinforced and mainstreamed in all fields of study including Architecture [1][2][3][4]. Buildings are primarily designed to be seen, whereas we experience them daily as our second skin. As per Erwine's words in the book *Creating Sensory Spaces*, "modernist design at large has housed the intellect and the eye, but it has left the body and the other senses, as well as our memories, imagination and dreams, homeless" [5].

The passage of our western society through the Industrial Revolution would explain the current move towards sensory uniformity within built environments. The harsh living and housing conditions of the time lead to a desire to guarantee minimum standard levels of comfort for the whole population. The result will be the introduction of standards that determine our built spaces according to acceptable ranges of temperature, light, smell, sound, texture and colour [5].

These standards, by democratizing comfort, leave out the enchantment, the inspiration, the delight, the emotion of feeling a deep connection to a place. Comfort is thus confused with the absence of sensation [6].

1.2. FOR A MULTI-SENSORY ARCHITECTURE

« It is evident that 'life-enhancing' architecture has to address all the senses simultaneously, and help to fuse our image of self with the experience of the world » (Pallasmaa, 2012, p.12) [1].

This "sensory mediocrity" [6] cannot be streamlined to the entire architecture of the last century. During the first decades of the 20th century, expressionist architecture favoured haptic plasticity with the distortion of forms but also with the valorisation of the potential of craftsmanship. Later on, the works of Frank Lloyd Wright and Alvar Aalto show a particular attention to the human condition with details designed for the pleasure of the body. Today, many architects are trying to "re-sensualise" architecture by reinforcing hapticity through their textures, temperatures, weights, and play of light and shadow. Glenn Murcutt, Steven Holl, Peter Zumthor, Herzog Meuron are interested in the notion of ambiance [1].

The apprehension of an atmosphere is the result of a complex fusion of countless factors [1]. Immediately, as soon as we enter a place, we have a multi-sensory experience that is complemented by the affective, cultural and subconscious information belonging to each individual [1][7][8][9]. As such, lived experiences generate along with them a notion of time: it will have a determined duration and will be attached to a precise temporal context where perception, memory and imagination are intertwined [1].

Although we consider the separation of the senses to be artificial as a result of modern dualism, in this research we emphasize the study of space perception through touch and hearing. Sound often provides the temporal continuum in which visual impressions are integrated [1]. While the eye is directional and implies exteriority, sound is omni-directional and creates an experience of interiority [1]. Touch is expressed, among other things, through the materiality of built spaces. This sense connects us with time and tradition [1] (these notions will be explored in more detail in the next section). In conclusion, these two senses stimulate our imagination and allow us to conceive and apprehend space in a different way than with vision.

1.3. RAW MATTER TO TAKE ROOTS IN HISTORY

"The detachment of construction from the realities of matter and craft further turns architecture into stage sets for the eye, into a scenography devoid of the authenticity of matter and construction. These products of instrumentalised technology conceal their processes of construction, appearing as ghostlike apparitions." (Pallasmaa, 2012 p.34) [1]

This flatness of current constructions is reinforced by a "weakened sense of materiality" [1]. Machine-made materials of today (e.g. synthetic plastics, enamelled metals) aim to maintain the appearance of a timeless perfection or novelty [1]. The resistance to the recording of stories leads us to atemporal, banal spaces that neither follow the cycles of human beings and surrounding environments.

If we look at vernacular architecture, buildings were constructed with raw and local materials. By taking resources that are located nearby, architecture reflects the surrounding landscape: its forms, textures and colours. This contextualisation endows spaces with a characteristic emotion that makes us feel that a building is in harmony with a place.

On the other hand, if raw materials have the power to place us in an environment, they can also place us in time [1]. On one hand, these materials are impregnated by the history of their origins and along human usage [1]. Traces of their construction enrich their inner essence. On the other hand, as materials age, they allow themselves to be transformed with the process of erosion. They transmit their age. Thus, materials witness time and their way of expressing it is authentic.

Stone, earth, wood, hemp, straw, bamboo, and reed, among others, have unique textures. Their surface patterns never repeat themselves exactly, allowing our gaze to plunge into an infinite depth that "resonates with that of our own flesh" [10]. We are in touch with the veracity of the material [1].

To conclude, raw materials could bring the lost roots of our built spaces, weaving the link to our environment and our history in order to face the "hors-sol" architectures that Berque refers to.

1.4. THE INVOLVEMENT OF USERS

In contrast to conventional building sites that use conventional materials, earth-building sites can offer greater participation for future users, non-professionals, and the general public. In the cases presented in this article, we organised a raw earth bricks production workshop in Grenoble and an earth plaster workshop with students in Barcelona. These sessions allowed us to create a synergy of exchange and a diffusion of knowledge. Interviews to participants also inquired about how their involvement in the building phase could have changed their perception of a place.

Firstly, these types of experiences allow participants to be in contact with a raw material, a connection which is nowadays increasingly rare as materials and objects reaching our hands have undergone multiple transformations. Furthermore, their involvement enabled them to learn an earthen construction technique. Finally, this hands-on engagement could leave traces in the form of a body memory and might change the perception of a space, which is the base assumption this article questions.

2. METHODOLOGY

2.1. ASSUMPTIONS AND RESEARCH QUESTIONS

Our initial assumption relates to the hypothesis that architectural spaces when designed using raw materials have the capacity to guide (i) specific ambiances and (ii) processes of apprehension, design and construction directly involving the body and therefore the whole of our sensorium. This is why, through the experiment presented in the following pages, we question:

- Firstly, how the use of raw earth could help us to become grounded by strengthening the connection between the body and its environment.
- Secondly, how could changing the materiality of a place change the perception of itself?
- Finally, does the fact of participating in the transformation of the material have an impact on the perception of the transformed space?

2.2. CONTEXT

The experiment was carried out in two different contexts: the first in a working-class housing estate in the Abbaye district of Grenoble (France) and the second in an office of the materials department at the Higher Polytechnic School of Construction of Barcelona (Spain) (Figure 1). For each experiment, a different raw earth implementation was carried out: a raw earth brick wall (adobe) in Grenoble, and an earth plaster in Barcelona.



Figure 1. Case studies: Grenoble (left) and Barcelona (right).

2.3. SETTING UP THE EXPERIMENT PROTOCOL

The survey conducted is based on an isolation protocol lasting a total of 10 minutes in the area to be studied (Figure 2). The isolation time is preceded by a reception where instructions and explanations are given. Afterwards, the semi-structured interview and the questionnaire were conducted. More specifically, the isolation in the room was divided into two stages:

- A first period of discovery where the interviewee is invited to apprehend the place based on his/her reading of reality.
- A second period of habituation where the interviewee is invited to appropriate the space by developing an action. This is an action that could have been done in the room outside the framework of the experiment, such as reading, drinking tea or coffee or listening to music (these are the three actions that were proposed).

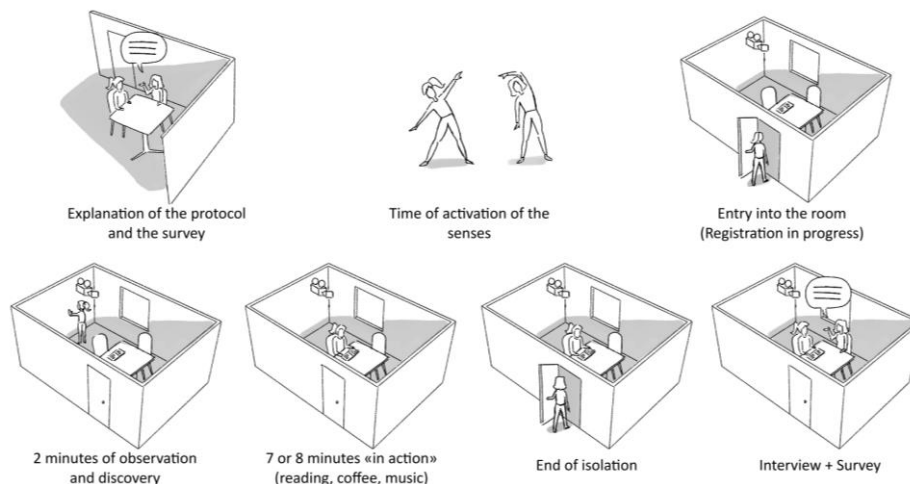


Figure 2. Experiment protocol.

In order to be able to analyse people's movements in the space, video cameras (GoPro 7 and GoPro 5) were installed in the room. The interviewees were informed of the existence of these devices. However, the exact location is not given to allow natural movements and avoid potential influence in their behaviour.

The data collected and subsequently analysed were obtained through the implementation of questionnaires, individual semi-directive interviews within the context [11][12], analysis through the observation of the participants' movements and physical measurements, mainly, on the sound conditions of the rooms. The use of a mixed method research aims to obtain a more complete view of the phenomenon to be studied [13].

All experiments had a total duration of 30-35 minutes. In Grenoble 33 people participated (17 in the initial state and 16 in the final state) and in Barcelona 30 people (15 in the initial state and 15 in the final state).

3. FINDINGS AND DISCUSSION

In order to make a complete analysis of the feedback from both cases, we analyse the physical measurements and data collected (quantitative and qualitative) separately. The data as well as the case studies are also compared.

3.1. PHYSICAL MEASUREMENTS

The physical measurements focused on (i) acoustic values (reverberation time and Speech Transmission Index measurements, STI), and (ii) temperature and humidity elements during the experiment.

Acoustically, the presence of raw earth in both cases revealed a tendency towards a decrease in high frequencies with the reverberation time measurements and, just in Grenoble, a decrease in two STI points. In the case of Grenoble, this decrease in reverberation is more marked (between 5% and 14% decrease) than in Barcelona (between 3% and 7%) (Figure 3). This variation is partly due to the fact that Barcelona's case room had more physical objects and furniture than in Grenoble. The presence of the raw earth could mitigate to some extent the phenomenon of comb filtering due to its micro-roughness and bring less metallic-sound feelings to the room. In both cases, when exposed to raw earth several participants noticed a reduction in the room's reverberation and even a less metallic side, which shows consistency with the values obtained in the quantitative measurement. In the case of Grenoble, several participants also noted a stronger and peculiar resonance in the room, which could be explained by values obtained above one second, hence not in compliance with the values established for small rooms (62.5m³), as in the experiment's meeting room. As such, we could observe certain coherence between measurements and participants' feelings, who also expressed a greater acoustic comfort than the values obtained quantitatively.

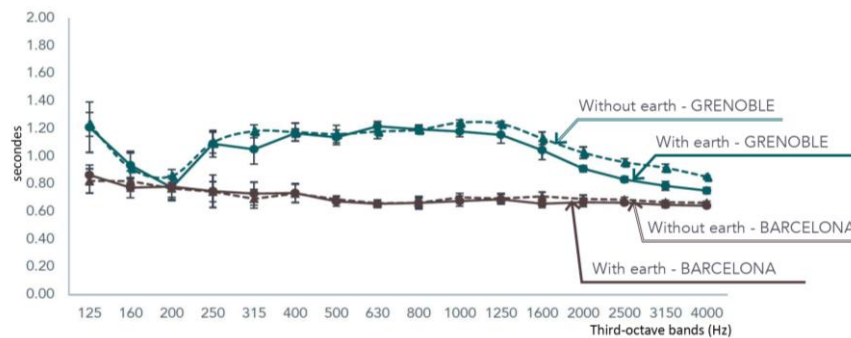


Figure 3. Average of reverberation time.

Correlation is also found at temperature measurements in Barcelona as many participants felt a more comfortable temperature with raw earth. This also relates to the values that show an overall increase in temperature and a decrease in humidity. This trend aligns to the participant's feedback, who repeatedly assessed a better thermal comfort with the raw earth plaster. However, in the case of Grenoble, most data points are situated outside the comfort zone as registered temperatures were below 19°C [14]. On the other side, humidity values are within the comfort zone with a greater humidity comfort observed in the raw earth scenario. Furthermore, participants' answers also confirm a warmer feeling when inside an earth-wall room.

3.2. QUANTITATIVE DATA – QUESTIONNAIRE RESULTS

Questionnaire results in both locations reflect a more pleasant ambiance sensation with the presence of the raw earth. Notably in the case of Grenoble, participants' feedback indicates that, although ambiance is more pleasant with the raw earth, natural light felt less pleasant. It is important to note that most interviews for the without-raw-earth scenario took place during sunny weather conditions, whereas most days in which participants shared their opinions on raw earth were mostly cloudy and rainy. Accordingly, interviews conducted during sunny weather conditions show less natural light discomfort. Compared to Barcelona, it seems that the raw earth positively modifies the perception towards the room's ambiance, particularly in visual factors including shape, colour, and architecture (Figure 4).

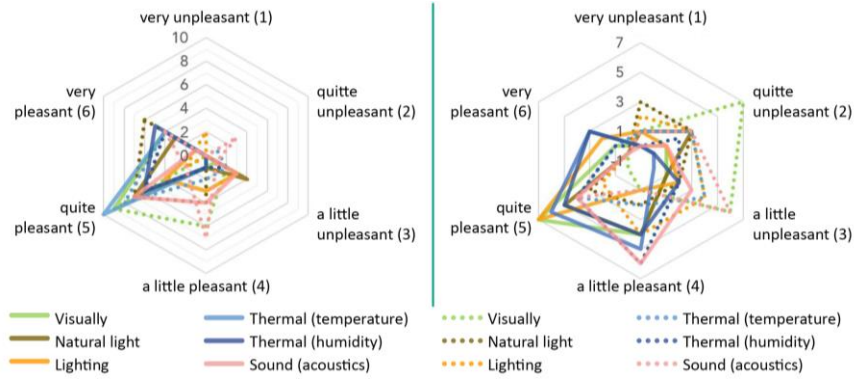


Figure 4. Answers of questionnaires (Grenoble right – Barcelona left). Full line with earth and dotted line without wall earth.

3.3. QUALITATIVE DATA

In the two case studies (Grenoble and Barcelona), it was observed that the relationship with space can be expressed in many ways, including personal judgment "I find it very pleasant". The participants also often appeal to their bodily feelings, with expressions such as for example "It's overwhelming". On several occasions, they also highlighted the importance of the body's self-perceptions in the feeling experience, and the challenge of focusing on a single sense. It was also noted that there is a certain level of complexity in putting the relationship with space and, more concretely, the atmosphere of a place into words. In this regard, and perhaps in order to better illustrate their perceptions, they use metaphors and rely on their own memories and experiences. For instance, "It reminds me a bit of a hospital, not abandoned, but a certain sloppiness".

On the interview's question of "Write five words that pop into your mind after this moment in the room", the analysis showcases participants' initial impressions in a concise and summary way. In both case studies, the vocabulary used by the participants varies with a reinforcement of the idea of "warm" associated with raw earth. Without raw earth, answers describe the place as "cold" in the case of Barcelona, and "empty" and "bright" in the case of Grenoble. With the presence of the raw earth, in Grenoble participants provide direct references to the wall. However, in the case of Barcelona, the contributions are less straightforward. Participants usually expressed their feelings towards earth in connection to a warm notion. However, their opinions omit concepts around materiality and remain silent about raw earth. Sometimes interviewees named the wall indirectly by talking about a change of focus and colour, among others (Figure 5).

Grenoble: answers with raw earth



Grenoble: answers with raw earth



Barcelona: answers with raw earth



Barcelona: answers with raw earth



Figure 5. Answers to the question "Write five words that pop into your mind after this moment in the room".

On the question "What was the first thing you noticed (that attracted you the most) the first time you entered the room?", most of the participants included in this dual-without-earth experience felt more directly attracted to the earth wall when they came back into the room. This "attraction" to the wall seems less evident among those who had not done the previous without-earth experiment and knew nothing about these types of works and professions. In both cases studies, the analysis of the videos shows this attraction clearly, and in the case of Grenoble, to the extent of participants' choice of placement in the room next to the wall (See Figure 6).

Grenoble: Initial state - Experimental room



Barcelona: Initial state - Experimental room

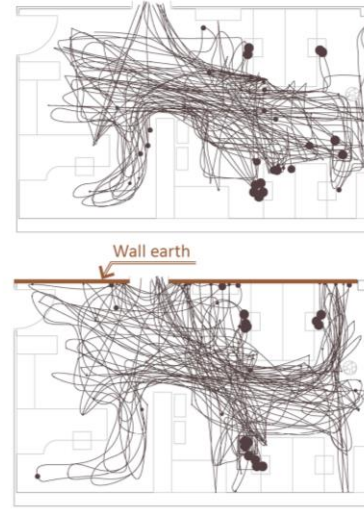


Figure 6. Participants' movements.

Observations out of the various participants' profiles question the potential relevance of prior exposure to and awareness of raw-earth-related narrative in apprehending space and shaping their perceptions.

Concerning the question *"How would you define the general atmosphere/feel of this room? Describe the general ambiances that characterise this room? What does it feel like?"* In the case of Grenoble, without the presence of the raw earth, some participants refer to the room as a rather empty place, not inhabited enough. In Barcelona, without the presence of raw earth, some interviewees find the place cold, inhospitable, crowded and suffocating and also with the feeling that they would not like to spend much time at a place like this. In general, some participants have rather a neutral feeling of the place and describe it as a regular workplace.

As for the ambiance felt with raw earth, participants in both cases share feelings about the presence of earth being the most pleasant sensation in the room, and describe it as a cozy space. Also, on several occasions the room raised feelings of warmth, life, quietness, and welcoming. On the other side in the Barcelona's experiment, where the raw earth intervention is somehow more discreet, the participants who had not done the without-earth experiment before do relate to these notions and most responses remain closer to those obtained without raw earth presence

In response to the question of *"Do you think that the presence of the raw earth contributes to your perception of the general place (from the point of view of your feeling)?"* the difference in the construction techniques used in each case study seems to drive variations among participants' explanations on the perceived atmosphere. In Grenoble, with the earth-brick wall two specific notions appear. The first notion refers to history as participants connect to "antique wall" considerations. They evoke linkages to "vernacular architectures" and to "a garden or the countryside", but also relating to their own past life experiences. Participants emphasize how raw earth presence seems capable of transforming any other insignificant space into a meaningful story. The second recurring impression turns around the human side of this construction material in two distinct manners. One focuses on the texture sensations coming out of the fingerprint traces carved along the raw-earth wall: "it's as if there was a sample of humanity with many different people." The fact that it is handcrafted provokes a sense as if in "something alive" The other relates to the idea of "a reunion of humans, the people's know-how."

The Barcelona experience evidences the influence of clay on perceptions connected to colours and surface textures. Participants easily identify earth features with a sense of singularity and highlight its natural side. Further remarks also emphasize how the lack of monotony in raw-earth finishes stimulates mind relaxation, especially if compared to fully uniform and neat finishes with well-established rhythms. In this case, however, the human side stays less promptly noticed and implicitly included within the overall feedback on the surface's appearance.

Despite the full-body sensorium approach applied to facilitate participants to apprehend a place, the opinions on *"most stimulated senses when inside the room"* confirm that visuals still play a predominant role. However, with the presence of raw earth, the tactile sense seems to gain a more important profile in the participants' feelings in both study cases. Challenges in isolating each sense during the perception of a place significantly hinder the capacity of respondents to answer this question. This is particularly evident with the presence of raw earth. Interviewees even spoke directly about synaesthesia, the complexity in structuring feedback on a sense-by-sense basis, and the full-body sensorial experience.

Furthermore, feedback gathered to illustrate the tactile experience confirms the challenge of relating to the experience from the perspective of touch. Prior to the transformation of the space, feedback focused on temperature sensations, descriptions of their movements and elements participants actively touched (e.g. tea cups, chairs, and tables). Yet, the tendency to explain textures and surfaces through the sense of sight also prevails.

In both study cases, the presence of the earth wall generated a greater desire to approach and touch the wall, which most participants did. The earth wall invites users to experience sensations using touch throughout the space apprehension process and to discover it, even when in the search of confirmation of what eyes see [15]. Attention focuses on the wall's surface with detailed descriptions of textures felt through touch. Responses provide a reduced number of references to temperature and objects, which allow room for more references to full-body feelings of the new atmosphere: "it was the feeling of being comfortable, more welcoming", "touching mud walls relaxes me", "it makes me feel more comfortable."

Lastly, in both locations' feedback on the sense of hearing, participants are able to easily attribute words to the overall atmosphere of the room. In order to describe it, participants mention calm, silent, and noisy. Sometimes respondents associate the perceived sound environment with more personal feelings, including loneliness and comfort, and are also able to identify the source of each sound heard (e.g. human voice, and telephone). Few other sound effects are identified beyond resonance and echo, while no insight shared makes use of more sophisticated terms (e.g. delocation). Feedback from both experiment locations show participants' vocabulary on sound effects can be limited [16], not many nuances are observed.

4. MAIN TAKEAWAYS

To finish, we will extract conclusions with reference to the research questions outlined in part 2 of the article. First of all, our first remark refers to the respondents' difficulty in talking about bodily sensations in a space, in other words, expressing the atmosphere. This leads us to a mixture of semantic figures that are sometimes difficult to categorise in a definitive way. We note a lack of vocabulary concerning sound effects and a difficulty in describing the experience of touch.

A 'change of atmosphere' does indeed seem to take place. Initially described as an empty space (Grenoble) and cold (Barcelona), it becomes a warm, cosy, welcoming, lively and reassuring space. The vocabulary used brings us back to an idea of more physical and psychological relaxation. One participant even speaks of energy: "when I came back this time I thought ah, this actually gives me some energy...".

The difference in construction technique in the two case studies seems to bring variations in the description of the atmosphere perceived by the participants. The brick wall in Grenoble transforms an ordinary space into a room with a story. The notion of the human appears clearly in this case study, referring to the "handmade", the fingerprints on the brick surface but also referring to the living. The human side will be less noticed for the clay plaster in Barcelona, and more "implied" in the surface aspects (texture) which give it a singularity but also a more natural side.

There is a general attraction towards the wall which is shown, on the one hand, by the respondents moving around to look at it and touch it, as well as the choice of sitting close to the wall to appropriate the space. On the other hand, the attraction is highlighted by the participants who describe their first glance at the wall, the desire to go and touch it or to sit in the armchairs placed next to it.

We were able to verify, in fact, that sight plays a predominant role in the perception of the atmosphere and is described by the participants as the sense most stimulated by being in the room. When the room was in its initial state, none of the respondents mentioned touch as one of the senses involved. With the change of materiality, the tactile sense takes an important place in the participants' testimonies as well as the appearance of comments referring to the mixing of senses and kinaesthesia.

With regard to the sound environment in particular, many participants speak of a reduction in resonance in the room with the presence of the earthen walls. Indeed, the physical data shows a change, albeit a slight one in the case study in Barcelona. This finding suggests that the visual may have an influence on the perception of the other senses.

The small sample of respondents does not allow us to draw any conclusions about whether participation can influence the perception of the change in atmosphere. We note, however, that some participants who were not familiar with us and our work with soil do not talk about the wall or come close to touch it. This underlines the importance of the narrative linked to the perception of the atmosphere.

But, to what extent can the narrative and previously known information influence our apprehension of space? This shows us the need to expand the number of respondents in order to investigate this question further.

The notion of history and the human being as expressed by the participants brings us closer to this idea of being anchored in time and place. What is difficult to say is which mode of awareness works best: does the act of extracting soil from the site in

the Grenoble case study change the relationship to the world or create a particular awareness? We don't know if it is linked to the construction technique, which adds a manipulation stage compared to the plastering stage, or to the fact of extracting the earth from the site, the fact of knowing our sensitivity towards the material... In any case, the respondents who participated in the construction site are aware and have a story.

References

- [1] Pallasmaa, J., 2012. "The eyes of the skin. Architecture and the senses". John Wiley & Sons Ltd.
- [2] Levin, D.M., 1993. "Modernity and the Hegemony of Vision". University of California Press.
- [3] Jay, M., 1994. "Downcast Eyes. The Denigration of Vision in Twentieth-Century French". University of California Press. Berkeley and Los Angeles, California.
- [4] Ong, W. J., 1982. "Orality and Literacy. The technologizing of the Word". Methuen & Co. Ltd., Londres.
- [5] Erwine, B., 2017. "Creating Sensory Spaces". Taylor & Francis. New York.
- [6] Bloomer, K.C.; Moore, C.W., 1977. "Body, Memory and Architecture". New Heaven : Yale University Press. p.105.
- [7] Hégron, G.; Torgue, H., 2010. "Ambiances architecturales et urbaines. De l'environnement urbain à la ville sensible". Coutard, Olivier and Lévy, Jean-Pierre. Ecologies urbaines : État des savoirs et perspectives, Economica - Anthropos, 184-198.
- [8] Dubois, D., 2012. "Dénommer, définir, identifier, décrire une ambiance - A semantic analysis of the word "soundscape"". Ambiances in action / Ambiances en acte(s) - International Congress on Ambiances, Sep 2012, Montreal, Canada. 683-688.
- [9] Flécheux, C., 2010. "Atmosphères : de la sensation à la production". Les Cahiers philosophiques de Strasbourg [En ligne], 46 | 2019, mis en ligne le 12 décembre 2019, consulté le 28 avril 2021.
- [10] Abrahm, D., 2000. "La magia de los sentidos". Kairós. p.303
- [11] Vilatte, J. Ch., 2007. "L'entretien comme outil d'évaluation". Formation « Evaluation » 1-4 décembre 2007 à Lyon.
- [12] Imbert, G., 2010. "L'entretien semi-directif: a la frontière de la santé publique et de l'anthropologie". Association de Recherche en Soins Infirmiers, « Recherche en soins infirmiers » 2010/3 N° 102, 23-34.
- [13] Delgado Santa Gadea K.; Walter Federico Gadea, W.; Vera-Quiñonez, S., 2018. "Rompiendo Barreras en la Investigación". Editorial UTMACH.
- [14] Sulaiman, H. Olsina, F., 2014. "Comfort reliability evaluation of building designs by stochastic hygrothermal simulation". Renewable and Sustainable Energy. Reviews, 40 : 171-184.
- [15] Berenson, B., 1907 [1896]. "The Florentine Painters of the Renaissance". London, UK: C. P. Putnam's Sons, p.4.
- [16] Augoyard, J.F.; Torgue, H., 1995. "À l'écoute de l'environnement : Répertoire des effets sonores". Editions Parentheses.