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## On the influence of narrative in the perception of raw earth construction

### Preface

Among human activities, the construction sector is one of the biggest energy consumers; it depletes over 40% of the annual global energy supply<sup>1-2-3</sup>. It is also a major consumer of resources - it consumes 40% of the world's production of natural aggregates, a quarter of the world's virgin forests and 16% of the water annually<sup>2-4</sup>. The European Commission estimates that the sector is responsible for 50% of extracted raw materials in Europe<sup>5</sup>. Likewise, it is a major generator of waste<sup>6</sup>.

Raw earth as a resource possesses reversible characteristics as well as being a local and natural material<sup>7</sup>. In addition, it has low embodied energy<sup>2</sup>. Moreover, about 75% of the waste from the building sector is made up of mineral soil, the raw material used in raw earth construction<sup>8</sup>. Due to all the above reasons, raw earth stands out as an important building material in addressing the climate crisis.

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<sup>1</sup> Manish K. Dixit “Life cycle recurrent embodied energy calculation of buildings: A review”. *Journal of Cleaner Production* n° 209. 2019. p. 731–754.

<sup>2</sup> Keefe, L. (2012) *Earth Building, Methods and materials, repair and conservation*. Taylor & Francis Group, Abingdon (UK), 2005

<sup>3</sup> Grace K C DING. (2004) *The development of a multi-criteria approach for the measurement of sustainable performance for built projects and facilities*. PhD, University of Technology, Sydney, 2004.

<sup>4</sup> Manish K. Dixit et al. “Identification of parameters for embodied energy measurement: A literature review”. *Energy and Buildings*, n°42. 2010. p. 1238–1247.

<sup>5</sup> *Roadmap to a Resource Efficient Europe*. Brussels : European Commission, 2011.

<sup>6</sup> Dahlbo, H. et al. ”Construction and demolition waste management - A holistic evaluation of environmental performance”. *Journal of Cleaner Production*, n°107. 2015. p. 333–341.

<sup>7</sup> Hamard, E. Cazacliu B, Razakamanantsoa A, Morel J-C. “Cob, a vernacular earth construction process in the context of modern sustainable building”. *Build Environ*, n°106. 2016. p103–19.

<sup>8</sup> Cabello Eras, J. J. et al. “Improving the environmental performance of an earthwork project using cleaner production strategies”. *Journal of Cleaner Production*, n°47. 2013. p. 368–376.

Moreover, raw earth as a material has numerous technical advantages, which can contribute to the quality of life of people living in and using raw earth buildings. To date, its hygrothermal advantages are probably those which have been most widely investigated<sup>9</sup>. However, raw earth has other strong points which can also contribute to quality of life in a building, but which are less well known and less researched, such as acoustic performance. However, raw earth's contribution is not purely technical. Its performance in the sensory domain deserves more attention. Earth buildings are often reported to bring great benefits in terms of comfort and quality of life for their inhabitants. 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<sup>10</sup>. In order to treat the issues connected with both technical and sense-related factors, this study will take an approach based on architectural ambiances<sup>11</sup>.

## Introduction

### *The return of raw earth*

In many countries of higher income, the emergence of industrial materials in the early 20th century led to the abandoning of traditional ones, including raw earth<sup>12-13</sup>. However, these past decades, raw earth has garnered renewed interest, particularly as a material with a low carbon footprint. This can be observed from the increased number of projects and studies around raw earth<sup>14</sup>.

Interest in raw earth is also present within institutions, with an increasing number of sustainable and clean public buildings<sup>15</sup>. This research has identified a total of 16 newly-built school buildings in France, built between 2009 and 2019, with raw earth in some parts of the interior and/or exterior walls. (Fig.01). The demand for such buildings continues to grow, with new projects in, for example, Guérande (44, France), Guenrouët (44, France) and Villepreux (78, France).

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<sup>9</sup>McGregor, F. and al. "A review on the buffering capacity of earth building materials". *ICE Publishing*, University of Bath, 2016.

<sup>10</sup>Audas, N. "Le rôle de l'affect dans l'ambiance ressentie". *1st International Congress on Ambiances*. Grenoble, France 2008. p. 213–219.

<sup>11</sup>Dubois, D. "Dénommer, définir, identifier, décrire une ambiance - A semantic analysis of the word "soundscape"". *Ambiances in action / Ambiances en acte(s) - International Congress on Ambiances*. Montreal, Canada 2012. p. 683–688.

<sup>12</sup>Erica, A., Guillaud, H. and Mary, H. *Terra Literature Review: An Overview of Earthen Architecture Conservation*. The Getty Conservation Institute, Los Angeles (USA), 2008.

<sup>13</sup>Villain, V. *Sociologie du champ de la construction en terre crue en France (1970-2020)*. PhD, Université de Lyon, 2020.

<sup>14</sup>Morel, J. C. and Charef, R. "What are the barriers affecting the use of earth as a modern construction material in the context of circular economy?". *IOP Conference Series: Earth and Environmental Science* 225. Brussels 2019.

<sup>15</sup>22 retours d'expériences pour des bâtiments publics durables et sains. BRUDED Bretagne rurale et urbaine pour un développement durable. 2019.



Fig. 01. 1: Kindergarten - Les Roches-de-Condrieu © Studio Erick SAILLET | 2: Miribel School – Drôme © NAMA Architecture | 3: Public school – Treffieux © M.Miranda | 4: Elementary school – Saint Germé © CAUE du Gers | 5: Kiethon, day centre of autistic individuals, Médréac © Art Mur | 6: Félix Leclerc School - Bouvron © Jean François Mollière | 7: « l'Écol'eau » kindergarten - La Chevallerais © Journal La Mée Châteaubriant | 8: Primary school – Veyrins-Thuellin © Design & Architecture | 9: Hauts-du-Moulin school - Villepreux © 78actu.fr | 10: School and health facilities - Salies-de-béarn © Luc Claverie | 11: Public primary school – Baulon © M.Miranda | 12: La Madeleine kindergarten – Fégréac © M.Miranda | 13: Public school - Mouais © M.Miranda | 14: Miriam-Makeba School group – Nanterre © Architecture TerreBois.

Despite the increasing relevance of raw earth, both in research and new buildings, technical guidelines on raw earth's qualities are yet to be developed. The raw material sector faces serious challenges in becoming integrated into modern standards and productivity models, which are tailored to industrial materials. The vast majority of existing standards focus on structural engineering of materials with limited attention to the nature of materials and the role of water in materials such as raw earth. On the other hand, experiences from finished projects evidence high appreciation of the usage of raw earth<sup>16</sup>. As such, the main subject of this work is to explore the relationships between narratives around the use of raw earth in buildings, and perceptions of these buildings by their users. It will also examine the way these narratives and perceptions may reinforce each other.

#### *Narrative as a boundary object*

With the exception of self-built constructions, buildings are designed and built in three main phases: the determination of a programme, design, and finally construction. These three phases are connected to one another but require different skills. The programme will take care not to suggest architectural forms but will define articulations between spaces and their proportions. The design phase will provide the set of graphic documents that establish volumes and guide the construction. During the construction phase, the graphic documents are followed and adapted if need be. The project clients are involved in the whole process.

<sup>16</sup> Pélissier C. "Matériaux naturels et expériences sensible : Les matériaux de construction biosourcés et géo sourcés participent-ils à répondre au besoin de nature ?" *École Nationale Supérieure de Paysage – AgroParis Tech*, 2020.

However, in most cases, the final user will know and use the building only after its construction. This is even more frequent for public buildings.

The appropriation of the building by the final user is thus subject to the perception of the finished object, often without knowing the design team's intentions. However, there exist projects in which such intentions are clearly exposed and will be part of the users' appropriations. This is the case, for example, in Rezé, in the Nantes area, with the "Les Jardins de la Piroterie" operation (2005), which gained significant media coverage and gave the inhabitants the impression of living in an innovative and exceptional place. A similar mechanism is found in Patrick Bouchain's projects and in the recent Pritzker Prize winners, Anne Lacaton and Philippe Laval for their Grand Val operation in Bordeaux.

In this way, narrative can be developed within the design teams. It then spreads through different media and infuses future users of the space, who grasp the building and its conceptual "instruction manual". This type of process is even further developed in self-build projects, in which the appropriation of the project by its users implies their direct participation in the design phase and, most importantly, in the construction phase. In this case, the narrative of the project is written collectively and is shared by all parties involved. It will continue to be shared and will build the set of values of the community that inhabits it.

This process, aiming to put in common the values of a project to make its design and construction more efficient, is well described in the world of innovation for applications beyond architecture. Therefore, reflections are carried out to understand how to realise projects subject to multiple constraints, especially when they are carried by different actors, each with their own precise reference framework that is not always compatible with all the stakeholders. The concept of boundary-crossing was developed by John Seely Brown and Paul Duguid<sup>17</sup>, who proposed to overcome the outline of their attributions in order to put their skills at the service of the common interest. The concept of the boundary object, proposed for the first time in 1989 by Suzan Leigh Star and James Griesemer<sup>18</sup> proposed a method to reconcile scattered interests. The boundary object goes beyond the object on which everyone must work to give it values that can be shared.

School projects incorporating earth walls are halfway between self-build and conventional projects. Raw earth allows for the involvement, however modest, of future users (including children) in the construction process: this could be, for example, by making earth bricks, or by participating in awareness-raising sessions to better understand the benefits of raw earth. This appropriation by realisation represents a story that is shared between parents, teaching teams and

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<sup>17</sup>Brown, John Seely and Duguid, P. "Organizing Knowledge". *California Management Review*, n°40. 1998. p. 90.

<sup>18</sup>Star, S. L. and Griesemer, J. R. "Institutional Ecology, 'Translations' and Boundary Objects : Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39". *Social Studies of Science*, n°19. 1989. p. 387-420.

the director of the school. If we consider the educational stakes as a project in its own right, the **narrative of the construction of the school becomes a boundary object**, in the sense that it federates the parents, the teachers and the school teams.

### **Methodology – The construction of narrative and its dissemination**

If we acknowledge that the narrative of the school construction is a boundary object, we need to ask how it is shared and how it acts, and to identify how it is built and what consequences it can have on the final experience by the users.

The approach implemented in this study aims to go beyond objectivised phenomena, such as thermal, acoustic factors, etc. of a place to focus instead on the non-objectivised ones. With a transversal approach, it aims to understand the qualification of raw earth spaces and to evaluate the permeation force of the narrative in the perception of the school and thus the persistence or not of this boundary object in the life of the school.

The non-objectivised data collected for the analysis of our cases in this research stemmed from different sources: surveys of parents of pupils; surveys of employees of primary schools; one-hour interviews with primary school head-teachers; surveys and 40-minute semi-structured interviews with architects (interviews were correlated with survey answers); surveys of the technical managers of the city council; commented walks with pupils; other documents and public information on the project.

#### ***The origin of the narrative***

Initial surveys identified origins of the narrative and the choice of using raw earth. Firstly, **architects** who create their narrative from lessons learned by experience and knowledge of facts around topics such as energy savings and environmental values, among others. This is particularly true amongst those that showed confidence with and had led raw earth projects. In some projects, such as the Fégréac or Chevallerai schools, the architects also strengthened their story with the presence of raw earth heritage (Fig. 02). The architect Loïc Daubas, from the Belenfant & Daubas studio, explains the thought process in our interview:

“But there’s a story that we’ve been looking for. For Fégréac in particular, it was in the first talks with the city. Are there raw earth constructions on the territory? It participated in the story a little. That is, they showed us, almost like bourrines, animal shelters along the Vilaine. There even was an earthen house that, if I remember, wasn’t so far from the school, and we relied on that too. You can’t invent something you don’t know, we got inspired by a type of construction that was already there in the city, and it helped us because they didn’t feel like they were going down something crazy, an architect’s project, but rather like they were continuing an idea. It was a bit different but relying on similar foundations.”





Fig. 02. Examples of raw earth constructions in the Fégréac and Chevallerais cities ©M. Miranda

Secondly, **project clients** narrative is underpinned by economic reasons and environmental values. They show true interest in using excavated raw soil from the project site mainly due to savings in transportation costs. For example, the City Council representative of Baulon highlighted the low cost of raw earth due to source proximity when asked which was the major factor in their decision to use raw earth.

The interview with the architect in charge of the school of Baulon confirmed that the choice of raw earth came from the City Council. The architect Cédric Smal, from the Faro collective, added: “There was one city council representative that was interested in the question of earth constructions, and he asked for an analysis of the earth”. He also outlined the need for the project leaders to rely on organisations specialised in raw earth, to conquer the reluctance around the use of raw earth by some professions, such as economists or consultants.

#### ***An enabling environment for construction sites***

Another noteworthy fact involved in the creation of narrative is that interviewees often reported that the construction process with raw earth generally went smoothly and with careful attention to implementation from all involved. For example, Bruno Belenfant explains that “what struck me was that the raw earth constructions worked really well every time. There are no problems because everyone is careful with the execution.” Also, earth construction elicits reactions from other companies. Bruno Belenfant recalls: “The raw earth constructions spark the curiosity of other companies”, and Cédric Small adds: “It doesn’t leave anyone indifferent.”

As mentioned previously, in contrast with building sites using conventional materials, earth construction sites can offer greater involvement and participation for future users, non-professionals, and the general public. In countries such as France, it is common to organise workshops or training sessions for professionals or volunteers, supervised by raw earth craftspeople in order to lower the expenses of building and/or to create a synergy of exchange and a diffusion of knowledge. In the cases of the Fégréac or Chevallerais schools, the city councils chose to work with social integration companies in order to develop local employment





Fig. 04. Parents' answers to the question "Write five words that pop into your mind when you think about the school.", with 71 answers and 317 words collected. To facilitate the understanding, words from the same semantic area were summed up in one word. Only words or word groups repeated at least 3 times are shown in Fig. 04.

The new building of the Bouvron school was delivered in 2015. This building takes in children from the first year of kindergarten to the second year of primary school. A large portion of the parents questioned were not present during the construction phases and did not participate in the integrated design project of the school, and we might imagine that they are unaware of the story developed during the project, or the particular involvement of certain users in the processes before the delivery. However, the feedback from the surveys shows the presence of certain key notions running through this school project, such as ecology, the size and distribution of spaces or the use of raw earth. Therefore, it seems obvious that the sharing of the narrative is done mostly by the school head-teacher, who organised a long visit for the parents and recalled that the school was conceived to respect the environment. He clarified that the construction materials came from construction site waste. Instead of disposing of them, they were recycled to build the school. Later, he described the participation of the parents and children in the construction of the bricks and the community project that was built at that moment. While we enter the school, the head-teacher mentions a rite of passage – the silence settles, and the perception becomes almost sacred.

#### *The persistence of a fading narrative*

However, although obvious for the parents, the impregnation of the story of the raw earth school's construction and its ecological notions gradually fades for the school staff. The spatial qualities, the organisational or technical qualities, such as acoustics seem to take over the materiality of the project (use of raw earth) or the realisation of a building with a low carbon footprint. When they are questioned on "What is your general impression of the school? What do you feel? Briefly describe (from your perception)", only one teacher, who arrived at the school in 2019, mentions the earth and the fact that it conveys a peaceful ambiance: "the workplace is pleasant, "peaceful" kindergarten building with its colours, the earthen walls." This lack of reference to the earth is also present in the analysis of the question "What is the first thing you noticed the first time you



entered the school?” Only two out of the eighteen answers collected (employees who arrived at the school in 2018 and 2020) mentioned “earthen walls”. The “space” is the most highlighted element for the employees at the Bouvron school (Fig. 05) even more than amongst parents’ replies. However, in the descriptions of their general impression, the “pleasant” notion is also highlighted: “Very pleasant school, I don’t feel cramped. It is calm and the view is pleasant.”, “This is a pleasant school where we enjoy working” or “a pleasant living place”. Unlike the parents’ feedback to the question “Write five words that pop into your mind when you think about the school.”, the presence of earth or ecology remain limited (Fig. 06).

In line with the design construction, in June 2016 Véronique Girard organised a workshop on experience feedback. The analysis highlighted the space: “We are calm. There is a lot of space, we went from 54m<sup>2</sup> to 80m<sup>2</sup>. We have room, we don’t bump into each other, the circulation is easier”, and the acoustic qualities of the classrooms: “In the classroom, the sound level has lowered. It is like we are in a cocoon, a bubble.” The acoustic aspect was also mentioned in the present study when the employees were questioned on the classroom: “Write five words that pop into your mind when you think about the classroom.” (Fig. 07).



Fig. 05. School employees’ answers to the question “What is the first thing you noticed the first time you entered the school?”. We collected 18 answers (78% of the employees) and 24 words. Words from the same semantic area were summed up in one word.



Fig. 06. School employees’ answers to the question “Write five words that pop into your mind when you think about the school”. 18 answers (78% of the employees) and 82 words were collected. Words from the same semantic area were summed up in one word. Only words repeated at least 2 times are shown in Fig. 06.



Fig. 07 School employees’ answers to the question “Write five words that pop into your mind when you think about the classroom”. 15 answers and 63 words were collected. To facilitate the understanding, words from the same semantic area were summed up in one word. Only words or word groups repeated at least 2 times are shown in Fig. 07.

### ***An absence of predisposition***

In the case of the pupils, the perception of the place is mainly associated with the activities and situations they have been through. After commented walks with the pupils from two mixed last-year of kindergarten classes, one first-year primary school class and one second-year primary school class from the Bouvron school, rare were the cases where raw earth was mentioned. This could strengthen the importance of the story to support the use of raw earth.

### **Main takeaways**

The work carried out has confirmed the existing relationship between the narrative and the perception on sites that have used raw earth. First, a more active engagement to a broader range of stakeholders and their participation from early stages of the project generates a unique conducive narrative for uptake.

Indeed, raw earth narrative seems to drive strong levels of commitment based on perceptions. School employees' relate to building functionality features more prominently, mainly due to their usage time. Conversely parents' perceptions have an emphasized focus on materials since they enter at a school where raw earth is found. Also, raw earth intrinsic characteristics and positive perceptions further reinforce the narrative presented by stakeholders.

This ongoing analysis provides initial insights on the complexity of narratives that raw earth building project stakeholders generate based on a set of experiences. Going forward, the analysis will enlarge the scope of site experiences (i.e. schools with raw earth) and deepen technical findings. For instance, a comparison to non-raw-earth schools is foreseen to better ascertain the role of raw earth in "architectural ambience" and strengthen the distinct aspects shown in narratives.

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