

Recognition of a heritage in danger: rammed-earth architecture in Lyon city, France

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Abstract. Historically, man has built with what he had underfoot: if the earthen construction is a tradition of 11 000 years old, the technique of the rammed earth (earth rammed in a formwork) is relatively new since it appeared for the first time in Tunisia in 814 BC. Exported in France, rammed earth is established mainly in Rhône-Alpes Region which has an ideal soil, rich in gravel, sand, silt and clay. Traditionally associated with the rural world, rammed earth heritage is also present in urban centers. The city of Lyon is one of the rare European cities to concentrate a large proportion of rammed earth buildings: the inventories made show that they are present in almost all the districts as well as in the suburban areas. This high density could be explained by the phenomenon of rural exodus experienced by Lyon during the nineteenth century. The agricultural populations, attracted by the prosperity of the city, then settled at the doors of this city, bringing their know-how by building with the cheaper and easier material available: earth. Rammed earth buildings are therefore located on boulder areas between the countryside and the city. They are thus found on lands that were once outside the city walls. With the advent of the industrial era at the end of the 19th century and the appearance of concrete, rammed earth constructions gradually disappeared. The constructions that we see today are therefore prior to 1900. Varied, ranging from detached houses to the 6-storey buildings, they stand as a testimony to a know-how that finds a particular resonance today, while the environmental and economic concerns are at the forefront. Little known, they constitute a heritage in danger that should be rediscovered.

1. Introduction

Earth is the simplest building material, the most natural and thereby the oldest. Earthen constructions are indeed part of our built heritage, they are present worldwide, on all continents (see [Figure 1](#) below), and in various forms. There are indeed different earth building techniques: rammed earth, mud, bung, adobe and CEB (Compressed Earth Block). Nowadays one estimates that 50% of the world's population lives in a mud construction, and it is even more interesting to note that 15% of the architectural works on the UNESCO World Heritage List are built in earth. Among these are, for example, the Great Wall of China or the Alhambra of Granada.

In France, the architecture of raw earth constitutes 15% of the architectural heritage, and all the techniques of construction can be found. Traditionally, earthen constructions are associated with the



rural world. However, this is not the case in France, since it is found in bourgeois homes as well as large urban centers.

On the scale of the architectural heritage built in raw earth in France, the Rhône-Alpes region is an important and rich center of many rammed earth buildings. As the main area of study of the Grenoble laboratory CraTerre, this region has already been the subject of inventories, yet none has been made recently on the city of Lyon. In 1981-1983, Dominique Bertin and Anne-Sophie Cléménçon, with the collaboration of Domar Idrissi, wrote a report for the Ministry of Urban Planning and Housing [1]. Thirty years later, part of the inventory has been destroyed, or deeply transformed. The work of the author was first to restrict the studied area to geographical areas where rammed buildings are numerous (see chapter 2); then, in this area, the buildings inventoried in 1983 were updated and then completed by the author's own inventory between 2011 and 2012.

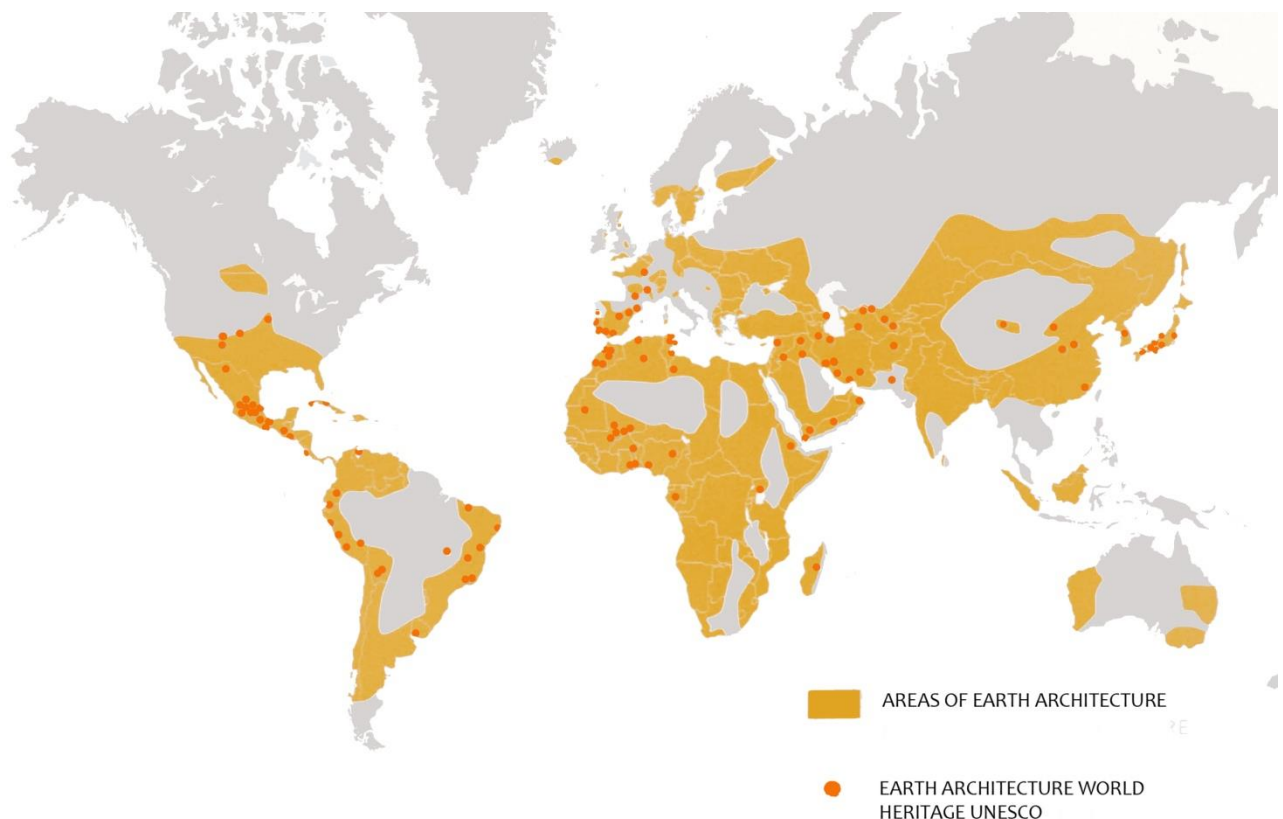


Figure 1. Half of Humanity lives in Earth construction [2]

2. Origins of earthen architectures in Lyon

2.1. Geological factors

The emergence of earth building is linked to a particular context based on the availability of a suitable material on the one hand, and converging human factors on the other. The special nature of the soil and subsoil of Lyon allows us to understand why rammed earth buildings were built, as well as their geographical distribution. Lyon stands at the crossroads of major geological regions, between the Massif Central in the west and the Alps in the east. In the Quaternary, the great glaciers of the Alps came to butter on the Crystalline Massif Central. This explains why it is on the heights of Lyon, towards the Fourvière hill, at the end of western Lyon and on the Croix-Rousse hill - promontory of the Dombes in the Northeast - that many houses realized in rammed earth coming from moraines were

built. The silts lying on the alluvial basins of the left bank of the Rhone, in other words in the lowland areas east of Lyon, produce lower-quality buildings because these silts are composed of finer grains and are therefore poor in pebbles and coarse grains which usually ensure the cohesion of the masonry.

2.2. History of rammed earth constructions in Lyon

In the Gallo-Roman era, on the Fourvière plateau, the Romans already used the earth as building material. In one of the streets in the 5th District multiple testimonies of this type of construction [3] have been found. The excavations have made it possible to understand the different methods used. Molded raw earth brick (adobe) was commonly used for homes. Subsequently, at the end of the first and second century AD, adobe constructions were gradually replaced by half-timbered dwellings using mud as a filling. The specific technique of rammed earth is not attested at this time.

In the Middle Ages, buildings are in wood or stone. Earth constructions reappear in the mid-16th century with the increase of Lyon urbanization and they will really take off in the 19th century with the phenomenon of rural exodus. As it developed, Lyon attracted agricultural people who settled on arriving at the city's gates, near the main roads. They brought their know-how by building with the material available on site. As a result, rammed earth buildings are located mainly on frontier areas between the countryside and the city.

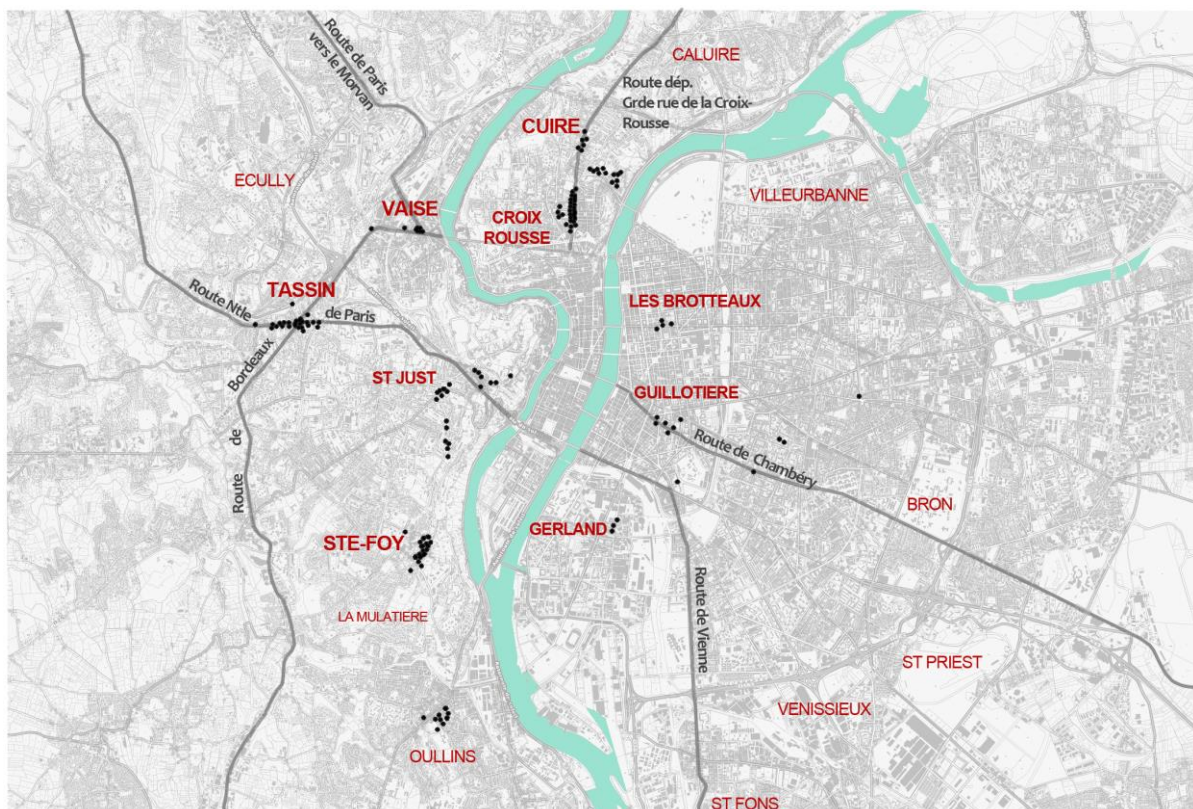


Figure 2. Distribution map of Rammed earth housings in Lyon, according to the inventory made to date [4] ©DA

We could find these constructions: in the North of Lyon, in the districts of Croix-Rousse, Caluire, on the axis of penetration of Dombes; in the West, at Vaise, at the crossroads of the Vienne and the Paris roads; in the fifth arrondissement, south-east of Lyon and Sainte-Foy which were formerly rural territories; finally, in the East, on the left bank of the Rhone, which, by its marshy nature, was only inhabited by a poor and rural population. Anne-Sophie Clemençon traced the history of rammed earth buildings in the context of urbanization in Lyon:

“From the end of the 16th century, began the urbanization of the Croix-Rousse, on the main street of this district, of which a large part is built of rammed earth and where complete sets remain today.[...] The urbanization began around 1550 but it is especially at the end of the 16th century and the beginning of the 17th century that the construction of small low houses of 1 to 2 floors intensified [...]. Then, in the first part of the 19th century, the left bank of the Rhone, between the old town of Guillotière in the South and the new Morand district in the North, was urbanized” [5].

In the Brotteaux district, the land belongs to the *Hospices Civils de Lyon* (HCL) which, while waiting for them to increase in value, rent them at low prices, but with short-term leases (3, 6 or 9 years) to farmers who came to live in Lyon. As the land was to be released in the short term, buildings were often precarious. They were therefore erected quickly, for a short time, using earth as material, which requires no transport and is used directly, i.e. without transformation. Behind the facades of the middle-class housing consisting of high houses made of stone masonry, there are therefore warehouses, factories, workshops and small houses. Their main building material is rammed earth, to which wood, clinker, stone and sometimes brick are often added, as well as salvaged materials for reasons of economy. Rammed earth is considered as a material in itself, considered reliable especially for its fireproof qualities - unlike wood which was forbidden a long time before rammed earth because of the numerous fires which it favoured. Cheaper, economical and therefore “popular”, rammed earth is used by the underprivileged classes, stone being reserved for the housing of the bourgeoisie and the nobility.

On several occasions, the administration tried to regulate buildings in earth. A decree issued in 1840 limits the height of masonry bases to 1.50 meters and buildings to five meters. However, it was only after the terrible flood of the Rhone of 1856 that submerged the left bank and destroyed in a day almost all rammed houses, that drastic measures were taken on June 19 of the same year by the Prefect Vaïsse. He proscribed «*the constructions of fat lime and clinker throughout the agglomeration of Lyon, including the town of Villeurbanne*» [6] and rammed earth walls with a masonry area of less than two meters. In its conclusion, the decree completely excludes rammed earth as masonry: «*Consequently, it will not be in the future, raised throughout the agglomeration of Lyon construction other than good masonry lime and sand* » [7]. The earth constructions, considered dangerous as a result of this flood, could not therefore be repaired and had to be demolished. Being forbidden to build with the only economic material at their disposal, the disadvantaged social classes were then forced to settle further east. They gave way to a middle-class that had become cramped in the peninsula. In 1872, a new decree lifted the ban on the construction of earth while regulating it. This relaxed was justified by the construction of dams and the Rhone development which removed the threat of floods. But the advent of the industrial era, towards the end of the 19th century and the beginning of the 20th century, brought other materials, such as reinforced concrete, which replaced the rammed earth and gave rise to its gradual disappearance.

Today, there are still buildings dating from before 1900 that remain in the urban landscape of Lyon. Although ignored by most writings on the architecture of Lyon, they are still numerous. They testify to a forgotten know-how that it is important to make known to save these historical remains.

3. Recognize rammed-earth

One of the first clues to locate rammed earth dwellings is their height. Built for popular and rural areas, these are often low-rise buildings not exceeding two or three storeys, with a total average height of eight meters. However, in the Croix-Rousse neighborhood, buildings can be up to seven storeys high. Generally a rammed earth building extends in length, forming along the streets bands wider than

high and an average thickness of eight meters. The ratio of full and empty makes it possible to quickly locate a rammed earth construction. The openings are generally few and of low height.

In Lyon, rammed earth houses are usually covered by hollow terracotta tiles (canal). These tiles rest on batten nailed on rafters. The frame, traditionally, is made only of purlins, because there is a significant number of shear walls. These purlins, as well as the main parts of the floors, rest on the walls via wooden or mortar distribution blocks. They must not be removed during the work because they play an indispensable role in maintaining the floor.

Walls are built with earth drawn directly from the ground, without additional water supply. However, it is not rare to find in Lyon walls composed of a mix of various materials such as rubble, brick, pebbles, etc. The buried parts (foundations) and the basement, of a height above the ground between ninety-five centimetres and two meters, are stone masonry or pebbles. The upper parts are formed by successive layers of about eighty centimetres. A bed of mortar connects these layers together. The wall also has a fairly large fruit [8], which makes it more resistant to forces that could push it outward. Their thickness varies from forty to sixty centimetres, depending on the level. The angles are made of crossed forms reinforced with lime, spaced by twenty centimetres, or a masonry of brick and stones. The houses do not usually have chaining, this being ensured by the floors. This lack of chaining has frequently resulted in the use of tie rods because the angles were opening.

In urban areas, rammed earth buildings have often been coated to protect them from moisture, the roof overhang being generally less severe than in rural areas. These coatings play the role of a second skin, avoiding the penetration of water and therefore the dissolution of the cob wall. It is often easier to locate a rammed earth building when the coating covering it peels off in whole slabs. This coating detachment is the sign of its poor connection to the support and a gradual degradation due to bad weather. It is often caused by the composition used: a coating that is too hard, made of cement mortar with low water permeability [9], will cause swelling of the cob wall, which will crack it and take it off its support.

4. Architectural itinerary: discovering earth construction in Lyon metropolis

The rammed earth houses of Lyon are mainly located in four districts: Saint-Just, Vaise, Tassin and Croix-Rousse. Each of them has the particularity of being on a hill or at least on rocky massifs rich in moraines. So the land is good to build. Since the inventory of 1983, many have disappeared; but in some quarters, they still exist and are in good condition, proof that, despite the untimely use of cement plaster, these houses are resistant to the vagaries of time.

4.1. Saint-Just district

This district, built between the hills of Fourvière and Saint-Irénée, not far from Ste-Foy-lès-Lyon, was formerly mainly rural and largely located outside the ramparts of the 16th century. It constitutes an access to the west Lyon plateau. Its soil is rich in clay and pebbles, which makes it suitable for rammed earth buildings. Unlike the Croix-Rousse plateau, which quickly became part of the urban environment, the Saint-Just Saint-Irénée district has kept its typology of rural houses, with a heterogeneous alignment of low-rise buildings. Remains of Gallo-Roman buildings are still visible. Located high up, like that of Croix-Rousse, this district escaped the damage caused by the floods. François Cointeraux, father of the rammed earth construction in the 18th century, stayed with his family in a house located on Trion street, today disappeared.



Figure 3. < Hostel built by Cointeraux (Hotel des Macchabées), corner rue de Trion and Maccabees.

^ Building in rammed earth (today demolished) at the corner of Fossés de Trion str. and Appian str. ©DA.

4.2. Vaise district

This district, formerly attached to the fifth arrondissement of Lyon, is crossed by major roads that come from one side from the Morvan, and from Bourbonnais from the other. This "Crossroads district" was in the past badly connected to the city of Lyon. In 1840, a flood of the Saone covered all the low parts for several weeks. Place Valmy, the water reached 2.80 meters and stagnated for fourteen days. Nevertheless, rammed houses were not all damaged. This area is important because it has been a real experience ground for Cointeraux [10]. It is in Vaise that he lived and installed his second school of rural architecture, before leaving Lyon definitively to pursue his career in Paris. Today there is still a large group of rammed earth buildings.



Figure 4. House Cointereaux, build in 19th century for Lyon workers, today demolished ©DA.

4.3. Tassin district

Located in the western suburbs of Lyon, not far from the fifth district, Tassin remained until the period of the Revolution a small rural village. Meadows and vineyards stretched along the current Montée de Verdun. The area is crossed by the main roads of Bordeaux and Paris, which intersect at the current Place Pierre Vauboin. In the eighteenth century, it was only occupied in its northern part by a set of houses forming a half-moon, which gave - according to a legend - the name of the new district of “Tassin La Demi-Lune”(Half moon). On this square will be located post offices, hotels, shops and craftsmen's workshops, whose function and typology have little evolved since. All the dwellings presented here are characteristic of rammed earth houses: low height, few holes, corner chaining and lime plaster.



Figure 5. Place Vauboin and urban block with cob houses ©DA.

4.4. Croix-Rousse district

Located on the plateau of the hill of the same name, culminating at 250 meters, La Croix-Rousse is known for being the district of "Canuts", craftsmen who weaved silk. These "silkers" were numerous in the nineteenth century and they have deeply marked the urban planning of the district by their five or six storey buildings whose high ceilings allowed to accommodate the famous *Jacquard* loom.

In the eighteenth century, the hill was only occupied by religious congregations, as the Fourvière hill, as well as many traders whose low buildings are still visible today. To discover them, you have to take the Main street of the district, which runs through the fourth arrondissement. It connects the Place de la Croix-Rousse to the place Joannès Ambre and continue to Caluire by rue Coste. The work we did in this neighbourhood consisted of comparing the buildings identified in 1983 by Anne-Sophie Cléménçon and what is now indicated by their location. Unlike other areas previously studied, it appears that the Croix-Rousse has undergone many changes. Indeed, of the fifteen buildings identified in 1983, nine are actually not in rammed earth, but stone. Four had been identified as buildings where the rammed earth was visible - often in the yards of the buildings. Today, these buildings have been renovated, re-coated, and the cob is no longer visible. However, as they present the characteristics of cob dwellings – low height, timber frame and floors, few openings and thick walls, it is unlikely that these constructions were modified in their structure. Finally, of the two remaining buildings, only one is in rammed earth, also visible on the facade, while the other could not be surveyed.



Figure 6. Rammed earth appears under coating in this construction main street of the district ©Craterre

5. Conclusion

This inventory work was not done in vain. It allowed to reveal architecture, and a mode of construction inherited from our forefathers, which we had forgotten. By going through the different Lyon districts where these constructions are present, we were able to give an account of their numerical importance: the first inventory of 1983 reported 88 rammed buildings. In updating this work and in pursuing it, we have raised more than a hundred in total, but it is certain that many constructions are still unknown to this day. On the one hand, this is because, in urban areas, and especially in Lyon, these houses are covered with a coating which makes them difficult to detect. On the other hand it is due to the fact that this material is little or not known by the inhabitants and by the public authorities. It has, however, obvious qualities, like Hubert Guillaud and Sébastien Moriset

remind us in their work [11]; qualities that echo current environmental concerns. Unfortunately, the reality is quite different: because they are of traditional typology, generally of low height, they constitute a brake on urban development that encourages densification. And because they have undergone poor restoration (use of cement in coating in particular), these houses have lost their main qualities, and are now suffering the destruction of time. In fact, in the current state of things, they are doomed to disappear. For these reasons, they deserve all the more our attention.

The work started here in 2012 has been continued in 2015 by an architect and engineer, Emmanuel Mille, specialist of earth heritage: he synthesizes existing inventories and coordinates an inventory participatory [12]. Today sponsored by Aurhalpin Heritage Association, this project aims to change the public's view of the built environment of Lyon metropolis by recognizing the presence of rammed earth as part of its building heritage.

To know and to make know, this is how the value of a building is transmitted, and how the receiving of a heritage is to be born. According to Jean Davallon "*ultimately, heritage is what was saved from destruction, which should have disappeared and was saved from disappearance*" [13].

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- [6] Extract from the decree of prefect Vaïsse, 19th June 1856
- [7] *Ibid*
- [8] The fruit designates in architecture a diminution of the thickness which one gives to a wall, on its external facing, as one raises it, thus advancing its base with respect to the plumb of the top.
- [9] The artificial cement coating can be catastrophic for a rammed earth wall. This one, made up of water, needs to regulate its hygrometry rate with the outside. For this, it must be covered with a coating that allows it to breathe, a natural lime plaster for example.
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