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Earthen Temples

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Abstract. Religion and faith have accompanied man since the dawn of history. Over time, these two factors gave rise to the need to establish permanent places of worship, which could provide both shelter from the elements during increasingly elaborate rituals and express the important status of said rituals to the community that erected such edifices. Almost every religion has produced distinct forms of temples, each tailored to their specific liturgy and symbolism. The often imposing size of these structures meant that they required significant feats of structural engineering and architectural design to be built, often prompting the development of construction technologies. These technologies made use of locally available materials – one of them being earth, used in one form or another as a part of the different construction technologies which incorporate it. In addition to being a construction material, earth has held great significance in practically every religion and culture as a symbol of fertility, the material from which man has been shaped, the medium through which the gifts of a deity may be bestowed through a bountiful harvest and finally, as a resting place of the dead, be it through the burial of their remains or the scattering of their ashes. It is no wonder that temples are still being built out of this symbolic material, although in the majority of cases it is a matter of local building traditions rather than acting on the aforementioned spiritual connotations. The article describes both historical and contemporary temples constructed using various building technologies employing earth, focusing on how the material has affected their architecture, structure and visual expression.

1. Introduction

Earth is and has always been the most fundamental and basic construction material. The first supposed human dwelling - the cave - can also be said to have been made of it, for what is stone if not an extension of earth as a philosophical element? Over time, humanity developed new and increasingly complex methods of using earth for various purposes. From the simplest of mud huts, through adobe to clay bricks and rammed earth, all sorts of construction technologies were devised, utilising this most basic of materials. Earth, in its various forms provided, either directly or indirectly, nearly everything that man needed to form his civilisation: buildings, tools and the possibility of taking up agriculture. It is no wonder then, that almost every civilisation on the planet had a period during which earth-related materials were used as the dominant construction component in its architecture.

There is also another common element to practically every civilisation: places of worship. Religion has played an immense role in the development of culture, at times becoming nearly synonymous with it. With religion came temples - buildings devoted to performing the rituals and services of organised religion, one that left behind the holy forests, mountains and hills in favour of structures that would, over time, take on strictly defined characteristics - a canon, distinct for each and every religion. Due to



the development of technology and the pursuit of environmentally friendly solutions in order to make our societies more sustainable, we are currently revisiting certain construction technologies that had been all but abandoned long ago and were being considered primitive until only recently. Decision-makers, developers, designers and engineers are rediscovering technologies long thought to be obsolete or outright too primitive to use, reinventing them in ingenious ways and adapting them to current needs, creating environmentally friendly and often cost-effective alternatives to materials that are currently thought of to be the standard.

2. Mud-brick - Aqaba Church

While mud-brick is not the oldest technology when compared to others that have been mentioned further in the article, the church that will be discussed below undeniably is. The Aqaba Church, located in Aqaba, Jordan, is considered by some to be the first purpose-built church - the first structure to be built from the ground up by Christians for the express purpose of being their temple [1]. Indeed, it is thought that all structures that fulfilled the role of churches before this one had been either repurposed and adapted public buildings, temples of other religions or private homes.

The structure in question bore all the marks of a Roman-style Christian church: it had the form of a basilica with a narthex, and was orientated eastwards, with several Christian artefacts such as crosses being discovered inside. Indeed, the use of mud-bricks in this church has no particular significance, apart from the fact that it was and still is a very commonly used material in the region of its construction and other construction technologies were simply unfeasible or difficult to employ.

3. Adobe

One of the most prolific and still used earth construction technology is adobe, which involves mixing earth with various organic materials and either directly forming walls out of it, using it to make bricks or using it in a similar manner to concrete - pouring a specially prepared semi-liquid adobe mixture into a formwork with some type of reinforcement in place. The word has been around for at least 4000 years [2], while the technology most probably for much, much longer.

3.1. Great Mosque of Djenné, Djenné, Mali

One of the largest temples made out of adobe is the Great Mosque in Djenné, Mali. The building, built out of sun-baked earth bricks called *feréy*, bound with a mortar consisting of a mixture of sand and earth and covered with plaster, is a very distinct example of the Sudano-Sahelian architectural style. One of the mosque's unique features is perhaps not the form itself, but the fact that it was redeveloped and remodeled numerous times after it had reportedly been built around the year 1200. The building has a very distinct, "molded" appearance, with its soft, clay-like edges. Its facades are dotted with bundles of *rodier* palm sticks, which act both as a decoration, as well as playing a practical role. They are used as scaffolding in order to perform the building's yearly repairs.

The manner of their placement on the facade appears to resemble that of the *vigas* used in the American variant of adobe. Indeed, the amount of the bundles differed in each "version" of the mosque, with some iconographic materials dated to the year 1910 showing them used quite sparingly, mostly in the uppermost part of the outer walls, which makes the comparison to the aesthetic effect of the *vigas* all the more appropriate.

The building is unique in the fact that it is tended to by the entire local community. The palm sticks form a permanent scaffolding for the facade so that it can be repaired as a part of a local yearly festival, which, apart from construction work, also involves celebrations with music and food. As the repairs are performed every year - otherwise the facade would be severely damaged if not maintained at such regular intervals - it would simply be impractical to erect and dismantle the scaffolding every time it is required. This feature can also be seen in other mosques built in the same style in Mali, owing to the distinct climate of the southern part of the country, with its dry and wet seasons. Such drastic changes in humidity throughout the year are understandably quite damaging to adobe structures.

3.2. *Cristo Rey Church, Santa Fe, New Mexico, United States of America*

Adobe has been very popular, among other places, in the Americas, and is seen as a signature element of the so-called Pueblo style, featuring distinct smooth walls and flat roofs, as well as decorative elements placed on the timber fragments of the structure, as this material is used for horizontal structural elements in this style, such as beams and floors. The first half of the twentieth century was period of the birth of modernism, which spread quickly all over the world and started to dominate its architecture, going as far as to be named the International style by some. However, as every major movement in the arts, modernism was not without its detractors and opponents. Some saw the need to remain with the more traditional approach to architecture, one that did not break away with the continuity of what became known as historicism, opting to continue using forms rooted in the cultural legacy of the areas in which they were designing. Among the many movements which either originated in this manner or, having had been established earlier, persisted through its heyday, was Pueblo Revival. This style was based on the aforementioned Pueblo style, but took it a step further, adapting it to contemporary needs and forms of use. In a sense, it did borrow some elements of modernism, especially early modernism and its transformation of historicist architecture by stripping away its ornamentation. In many of its manifestations, the Pueblo Revival style took early modernist forms and gave them an expression transformed by adobe technology, as was the case with Hodgin Hall, a building located on the grounds of the campus of the University of New Mexico.

However, other buildings built in this style opted for a different approach, closer to its origin, embracing more of the traditional ornamentation associated with the areas of New Mexico, Arizona and Colorado. One such building was the Cristo Rey Church in Santa Fe, New Mexico, designed by architect John Gaw Meem and built in 1940. It is considered to be one of the largest adobe buildings in the United States of America. The massing of this building is typical of the style, featuring simple cuboid forms that slightly taper upwards, with distinctly smooth edges. The only ornamentation applied to the building can be found in its timber elements: the balcony overlooking the entrance portal and a portico along its side. The relatively small and sparse windows highlight the stocky expression of the building - particularly the shapes that flank its entrance, the taller of which is the church's belfry. The only elements that disturb this smoothness are the aforementioned timber elements, as well as the *vigas* that protrude only from the form of the church's main body.

4. **Rammed Earth - Reconciliation Chapel in Berlin, Gemeindezentrum in Karlsruhe, Church of the Holy Cross in Stateburg, South Carolina**

Rammed earth is currently perhaps one of the most sought-after material when one requires both environmentally-friendly construction technology, a concrete-like aesthetic, and a construction material that can perform well in temperate climates, in which humidity is much higher than in the desert regions where earth-based construction technologies are still commonly used. Due to its aesthetic expression and the smoothness of its surfaces, it is often seen as an architectural replacement for concrete, albeit only in the case of walls, as this material cannot be used to construct elements like beams. In addition, the thickness of the elements made out of this material causes it to be perfect for interiors that are to foster an atmosphere of calm and quiet.

Rammed earth is perhaps the oldest construction material, with documented use going as far as the fifth millennium BCE [3], and structures of this type can be found all over the world. It is very easy to build elements out of this material, the knowledge of its use being almost instinctive to man, as all it requires is suitable earth, simple tools - or none at all - and a lot of persistence. Indeed, most buildings composed of rammed earth elements can be considered elaborate and sophisticated mud huts - as most of the changes to the use of this material boil down to appropriately treating the material during and after construction, as well as the tools employed in the compression process.

The authors would like to present two religious buildings from Germany in this chapter: the Reconciliation Chapel in Berlin and the Gemeindezentrum in Karlsruhe. Both buildings make use of a rammed earth structure, with the texture of the material featuring prominently in their interiors. This is one aspect of rammed earth structures that allows a person to immediately tell it apart from concrete,

as the textures of the two materials appear identical at a glance. However, when we look closely at a surface of a wall built out of the former, we can clearly see the successive layers of earth that were being compressed during an element's construction. Depending on the colour of the earth used to build the element in question, these layers will most likely be in that colour. Seeing as the material is most often obtained on-site, this provides a somewhat symbolic connection between the site and the building. For how much more site-specific can a structure be, if it is actually built from the very material of the site [4]?

4.1. Reconciliation Chapel, Berlin, Germany

The Reconciliation Chapel in Berlin, designed by Rudolf Reitermann and Peter Sassenroth, is a relatively small religious structure. When looking at its floor plan we can see that it is composed of two main interiors: an outer circular hallway and an internal prayer room, with the former completely encircling the other. The outer space is separated from the outside by a screen of thin wooden planks, which work somewhat similarly to artificial louvres. They let the light from outside into the hallway, illuminating it in a soft, indirect manner, while the outer earthen wall of the prayer room, without any openings, creates a simple, warmly coloured surface. The fact that both the internal and external walls do not have any right angles has a calming effect on the interior.

When inside the prayer room we are greeted by an interior that is simple and austere, with nothing but the colours of the earth's layers visible on the wall's surface for decoration. Surprisingly, this appears to be enough. The interior does not feel cold and intimidating like in pristine white interiors of some minimalist churches. The natural rhythm of the earthen layers and the changes in texture, combined with the soft light entering the room from above creates a unique atmosphere of peace and focus inside, aiding in the mystic side of prayer.

4.2. Gemeindezentrum, Karlsruhe, Germany

The Gemeindezentrum and Church in Karlsruhe, designed by the Löffler_Schmeling design practice, although using relatively similar structural solutions - it employs rammed earth walls - it does so in a completely different fashion. The Gemeindezentrum, although it does contain a church, also features offices and meeting spaces. Its form is also different. Whereas the Reconciliation Chapel makes use of elliptical, smooth shapes, the Gemeindezentrum has a practical, cuboid massing, its interior being neatly arranged on two sides of a large hallway. The earthen walls in this building have been used much less expressively - they have a smoother finish and are more uniform in terms of colour.

However, they also provide the interiors with a similar warmth and homeliness, and the spaces, although austere, do not feel threatening or alienating, as is often the case with purely minimalist spaces, which feel detached from life, from emotion. The wall structure of the building was specifically developed by the designers in such a manner as to be particularly resistant to earthquakes, as rammed earth is seen as a material that, without additional structural elements, is very prone to damage caused by this natural phenomenon.

4.3. Church of the Holy Cross, Stateburg, South Carolina, United States of America

Rammed earth is usually associated with massive, stocky buildings, as well as a minimalist style when contemporary architecture is concerned. However, this is not always the case, as the material has been proven to be very flexible in terms of its use across an entire variety of architectural styles. One of these styles is Gothic Revival, which borrows heavily from the traditional Gothic style, which is widely known for its verticality and slenderness - seemingly an antithesis of the popular image of structures that utilise rammed earth. However, the Church of the Holy Cross in Stateburg, South Carolina in the United States of America, has proven that the two can be successfully merged, resulting in a building that, while not of immense height, does highlight the vertical in both its massing and interiors.

The church, built between the years 1850-52, was designed by architect Edward C. Jones. When looking at it from outside, it is practically impossible to tell that the building is indeed made out of

rammed earth. The exterior is covered in stucco, which produces an illusion of the building being carved out of a single, immense piece of stone - indeed, the interior is also painted grey, further intensifying the impression.

5. Earth shelter - Hofskirkja Church, Iceland

Earth-sheltered edifices are an important section of earth-based structures. In Europe these were very common in Scandinavia and Iceland, due to their harsh climates. Iceland in particular still features numerous examples of earth-sheltered buildings, among them being temples. One such example is the Hofskirkja church, whose construction is dated to the year 1884. The church is often styled as a turf church, seeing as homes built using similar structural solutions are called turf houses. The building utilizes a strong timber structure that is used to support turf, which acts as an insulating layer.

In terms of its form, the church is very modest in its appearance. If it were not for the cross symbol mounted on the ridge of its roof, it would look like a typical Icelandic turf house, with an open gable roof covered in grassy turf and a symmetrical frontal facade. The building does not have any architectural features typical of western churches within its massing, such as a belfry, narthex or transept. Indeed, it is more of an expression of the local community's needs and capabilities, rather than following religious canon to the fullest, which does not mean that canon does not play a role here.

6. Results and discussion

The examples of churches built using technologies employing earth as a construction material show that it remains a viable form of building. Indeed, the technology is currently being perfected in order to be able to function on par with other structural systems, and while we may never see rammed earth skyscrapers, efforts are being made to have the material be used on a wider scale as it has undeniable benefits to the environment, making construction more sustainable. Indeed, no single building technology can function well under all conditions. However, buildings from earth do face certain distinct challenges that other construction materials either do not or are significantly less affected by them. These include such phenomena like earthquakes or damage from water. While the latter can be relatively easily addressed as there is a plethora of solutions available to secure rammed earth, adobe or mud-brick structures from water, earthquakes pose a significant problem due to their low resistance to lateral loading.

Thankfully, efforts are under way to develop cost-effective solutions that could aid in increasing the resilience of such structures in the aforementioned conditions. Fully addressing this problem could aid in using this construction material to construct affordable housing across the globe, including in areas where qualified builders are hard to come by. Barring building services and installations, a simple single-storey building can be built out of locally available, natural and sustainable materials, providing a comfortable indoor climate.

However, when temples are concerned, their construction out of earth-related materials does not seem to be related with any particular assumed theological quality of earth itself, numerous mentions of clay in Scripture aside (mostly referred to man rather than an edifice). Indeed, employing this measure by designers appears to be more of a stylistic choice, one that applies either to site-specific conditions, such as the local architectural style or the availability of the material and the fact of it being the dominant building technology in the area.

In the case of historical temples, the material was, in most cases, dictated by local conditions and the skill of the local craftsmen, who - naturally - specialised in techniques involving local materials. Through this, temples became a reflection of the area in which they were built, as well as significant elements within the landscape - just as we are now seeing different types of structures taking on this role [5].

7. Conclusions

Earth-based construction technologies such as mud-brick, adobe and rammed earth, although dating back thousands of years, are a viable, sustainable alternative to currently used industrial high-

embodied-energy structural solutions. While they do not offer the same possibilities in terms of load resistance, they are cheap, fully sustainable and are extremely long-lasting if properly built and maintained, significantly reducing the strain and pressure on the natural environment. Temples built using such technologies express their connection with the culture that had erected them - they are symbols of a community's beliefs and customs, as well as its link with the land that is its home. As such, these temples can be considered a sort of middle ground between a religion's canon - which in the case of organised religions spans a nearly uncountable amount of cultures - with the local customs and traditions of said cultures. Each of these cultures has its own perspective, its own view of the aforementioned canons, interpreting them in their own unique way, subtly adding their own individual context to their religion's fundamentals. It is in these temples that three elements come together: the divine, the human and the earthly [6].

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