

THERMAL AND ECOLOGICAL BENEFITS IN EARTH CONSTRUCTION

¹M.Abdul Malik, ²S.Santhosh, ³Z.Shabeer Hussain, ⁴Ar . S K E .Nathar Sha

B.Arch final year students, Assistant Professor.

Department of Architecture

Periyar Maniammai Institute of Science & Technology, Vallam, Thanjavur.

Abstract : The use of earth as a construction material is a very old and well-known practice. Every year, new ways of earthen construction are invented. With the big influence from new and more modern technologies, these techniques became a bit forgotten. However, there is still people trying to go back living in harmony with nature and environment, making a lot researches to improve the quality of the earth and People may be materialised, educated, and guided towards a greater level of living.

Keywords : *Earth Materials , Earth Building, Bricks, Rammed earth*

I. INTRODUCTION

Traditional building materials are affordable, easily accessible, and require little preparation before use. Additionally, to further reduce labour costs, the labour used in the construction process is sourced locally, frequently from members of the household, extended family, or the neighbourhood. For more than 9,000 years, people have used earth, also known as mud, as a building material. According to estimates, one-third of all people on the planet still reside in homes that are at least partially made of earth. This number is thought to be significantly higher in developing nations. In comparison to homes made of concrete or fired clay bricks, earthen homes are thought to be more affordable and environmentally friendly for a variety of reasons. For instance, earthen homes are known to improve thermal comfort and indoor air quality. They also use less energy during the production of their materials, which lowers transportation costs. The rising cost of construction materials in recent years has led to a worldwide revival of interest in earthen construction, raising a crucial question.

TOWARDS THE FUTURE

Earthen construction has a rich history and a bright future, particularly in Auroville. It is unquestionably a useful, economical, energy- and cost-efficient, and environmentally friendly technology that can support a sustainable future. Obviously, mastering the materials and techniques is necessary to achieve the best chances for a harmonious, long-lasting, comfortable, and effective architecture. These are some benefits of using earth for construction.

- The earth is a local substance that contributes to long-term development; and
- the technology is easily adaptable and transferrable.

Thermal comfort and space quality are often superior to traditional materials.

One must also understand the material's drawbacks, which are typically changes in soil quality, and therefore block quality and on-site block manufacture. These reductive aspects can be underlined:

- Mechanical qualities are less regular.
- Sensible building details are required.

Related Ecological Issues

Ecology is the study of the relationship between the environment and living things. The study of life and how creatures interact with their environment is known as ecology. Humanity's top concern has always been ecological issues. According to Buzzle (2011), a clean and healthy environment is necessary for leading a healthy life because it plays a crucial role in how we live. Here is a list of the various ecological concerns that we need to be aware of when using building materials. The use of materials for construction can lead to problems such as soil, water, and air pollution, species extinction and habitat destruction, disease, and other problems.

Earth Construction

Earth construction as the discipline of building using unfired, untreated, raw dirt. Since it has been used successfully for more than 11,000 years, earthen structures are thought to be used by about half of the world's population today to live and work.

Earth Materials

Naturally, the kind of materials that are readily available locally will change depending on the surroundings of the construction site. Native stone from the area, including limestone, marble, granite, and sandstone, is widely available. Ideally, stone from the construction site can be used; depending on the type of stone, it can be used for crushed stone, pavers, facing blocks, and structural blocks. The majority of brick factories are situated close to the clay deposit where brick is made. Clay blocks are moulded and baked to create bricks. Brick products come in a variety of shapes and sizes, including paving brick, face brick, roof tile, structural tile,

and floor tile. Mined from regions with calcium-carbonate soils and limestone bedrock, caliche is a soft limestone material. Although it is most commonly used as a road bed material, it may also be transformed into an unfired building block and stabilised with a product like cement. Other earth materials include soil blocks, which are typically made using forms or compression and stabilised with a cement additive. Rammed earth walls are constructed from stabilised or moist, sandy soil that has been tamped into form work. Walls are at least 12 inches thick. Ideally, soils would have 70% sand and 30% clay.

Types of Earth Building

Culture, climate, and resource considerations influence the techniques and methods used in earth construction, but within the sustainable building movement they can be divided into the following categories: cob, rammed earth, wattle-and-daub, light straw, earth bags, earth bricks, earth floors, and earth plasters and finishes.

Cob Building:

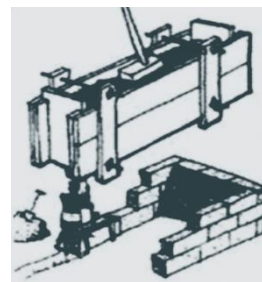
The definition of cob is "lump or rounded mass." Moist subsoil combined with sand and straw is used to create cobs, which are then kneaded into stiff mud loaves and manually rammed together to create a self-designed structure. For self-supporting, load-bearing walls, cob can be used because it dries almost as hard as concrete. Working in layers and waiting for each one to harden completely before adding the next, thick walls (up to 6 feet wide) can be constructed. In wet climates, an overhang or shelter may be required to protect an unfinished wall. The divider is at that point put with clay or lime mortars, or cleared out unfinished. Building with cob is easy, affordable, and only needs your hands and creative imagination. It takes time, but cob has several advantages, including high durability, strength, fire resistance, insulating capabilities, and the simplicity with which it may be beautifully moulded and sculpted.

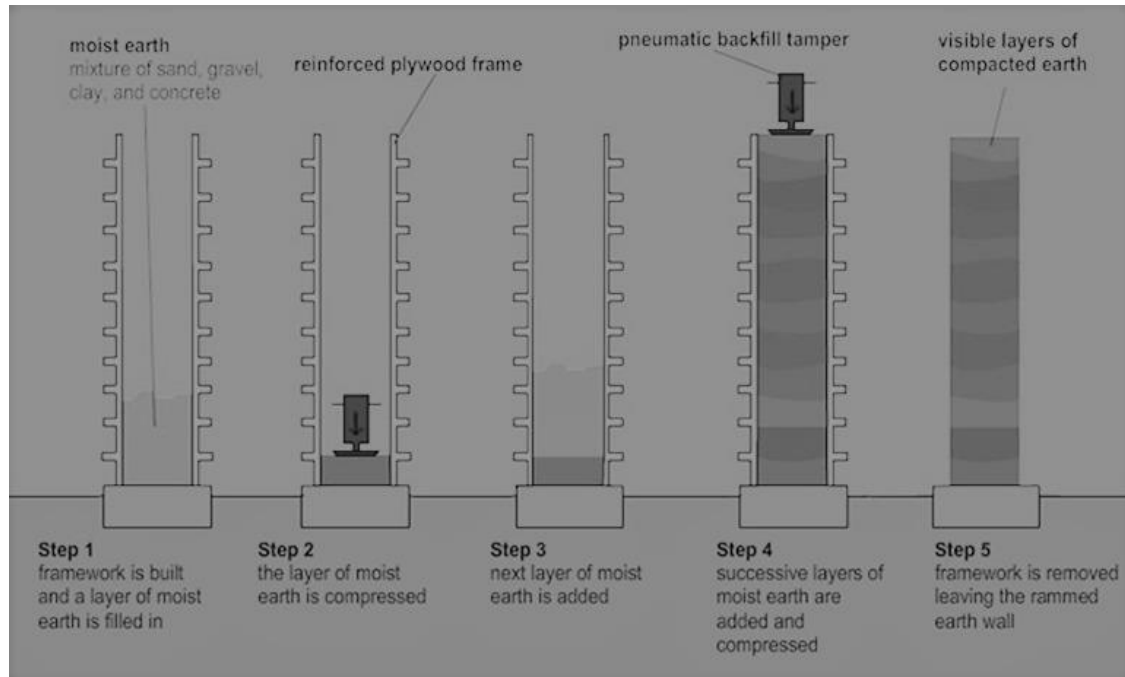


Cob Building

Rammed Earth:

Compaction Shuttering is the process of layering moist subsoil into a temporary formwork before being rammed (tamped) for with either manual or mechanical tools. Without having to wait for each layer to dry out, the layers can be continuously rammed into place until the wall is built. The frame is then taken down, and the walls are allowed to dry naturally. Rammed earth is stronger than cob, although it is more costly because to the shuttering required manual ramming pneumatic ramming.





Method of ramming

Light Earth or Straw Clay:

It involves covering loose straw or other fibrous material with a clay slip that is rammed tightly in layers into a timber frame, similar to cob and rammed earth. It is more insulative and lighter than cob, but because of its weakness, it can only be used as an infill with a timber frame. The final plastering is done after the walls have had time to dry. As insulation for roofs and beneath earthen floors, light earth has also been used between rafters.

Wattle-and-Daub:

One of the earliest methods for working with the earth involves supporting mud plaster by weaving thin branches together (wattle) (daub). It offers good thermal mass but lacks the super-insulating qualities of straw-bales.



Wattle-and-Daub

Earth bags:

These are sacks of soil that can be used to build domes and walls. Although it is still being researched, this method of natural building appears to offer a quick and simple approach, and it may be especially appropriate for temporary or disaster relief housing. Using a straightforward hand tool, moist soil is compressed after being placed in a burlap bag or plastic bag, stacked against a wall. Cob and straw bale homes are increasingly being built on earth bags as the foundation.



Earth bags

Earthen Floors:

In this case, an earth mixture is poured in one or more layers over a gravel, pumice, or sand substrate. To ensure drainage and low moisture, the site must first be carefully prepared. Occasionally, hardening agents like blood, manure or lime. When the floor is entirely dry, it is sealed with a series of linseed oil and turpentine treatments, and then waxed for protection.

Earth Plasters and Finishes:

These are being produced more frequently and are made from clay slips or lime. They are non-toxic and give walls room to breathe, allowing any moisture that gets trapped inside to escape.



Earth plastering

Earth Bricks:

These are created from an earth and straw mixture similar to cob, which is then formed into moulds to make bricks or blocks and dried in the sun. The most popular type is adobe brick. The usual bricklaying procedures are applied, with an earth or lime mortar. Earth bricks provide load-bearing structural capabilities but offer insufficient insulation.



Earth Bricks

THERMAL PERFORMANCE:

The high thermal mass of rammed earth walls mean they act to naturally regulate the internal temperature of a building, and if a rammed earth wall is designed into the building heating systems significantly reduce the energy required to both heat and cool a building, further reducing a building's carbon emissions. Rammed earth naturally regulates the relative humidity within a building, improving air quality. This is in stark contrast to air conditioning, which dries out the air in buildings and creates harsh working and living conditions.

Earthen houses are known to direct indoor temperature and mugginess, hence giving comfortable indoor climate in all seasons. This was considered by distant the foremost useful perspective of earthen houses. In spite of the fact that, broadly recognized to be cool in summers a few earthen houses were detailed to be colder in winters. A agriculturist in Khunti said that the family favors to remain in rooms developed with soil amid summer and in concrete rooms amid winter. In spite of the fact that, the exact reason was not given indeed after encourage addressing. In numerous cases, conventional soil houses were adjusted over time without full thought and they misplaced the fundamental characteristics such as warm behavior and aesthetics of an earthen development. Building components such as roof was frequently supplanted with present day materials such as metal or asbestos sheets. These materials have a tall warm conductivity and moo warm dormancy coming about into intemperate warm in summers and cold in winters.

Structural Performance:

Rammed earth is ideal as a load-bearing element within a structural system. Dry and unstable rammed earth has a strength of about 1 MPa. The strength and stiffness of materials decrease sharply with increasing moisture content. Therefore, buildings should be properly designed to maximize the structural potential of rammed earth.

Benefits of Rammed Earth as Ecological Stable Material

It has the following ecological advantages: reduced CO₂ emissions, thermal mass, noise reduction, high strength, durability, and low maintenance, fire resistance, pest resistance, cost effective, rapid construction, environmentally friendly, and biodegradable. Rammed Earth walls are essentially maintenance free, have reduced homeowner's insurance, are energy efficient, provide a healthy living environment, and are solar oriented designs that are ecologically friendly and have bespoke interior and external texture.

CONCLUSION

- One of the most prevalent and fundamental building materials is earth. Anyone can build walls, floors, and roofs with complex architectural designs using this straightforward construction technology that only needs a few simple tools to operate. Buildings made of earth are extremely fireproof, non-toxic, and have excellent humidity control and sound insulation. When constructed with thick walls and used in conjunction with passive solar design, they offer excellent thermal mass and insulation. Particularly when the materials are sourced locally, earth buildings have very little embodied energy and little impact on the environment. Earth is the most eco-friendly and easily accessible option for construction materials. Such materials produce a very energy-efficient, user-friendly house that requires little maintenance. In terms of beauty, efficiency, strength, and stability, the resulting house is unmatched by any other product. Rammed Earth construction uses this mixture, along with the pounding, compacting work carried out by men and pneumatic tampers, to create incredibly strong, efficient, and attractive homes.
- The benefits of using earth as a building material over other types of material cannot be eliminated by flooding. However, in order to address the ecological issues that earth construction has on the ecosystem, conservational sustainable development methods must be promoted. For the proper application of the enabling laws, government should support the environmental protection organisations. Construction industries must consider how ecological and environmental factors may affect their specifications and must use critical information about building materials to reduce their impact on the environment.

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