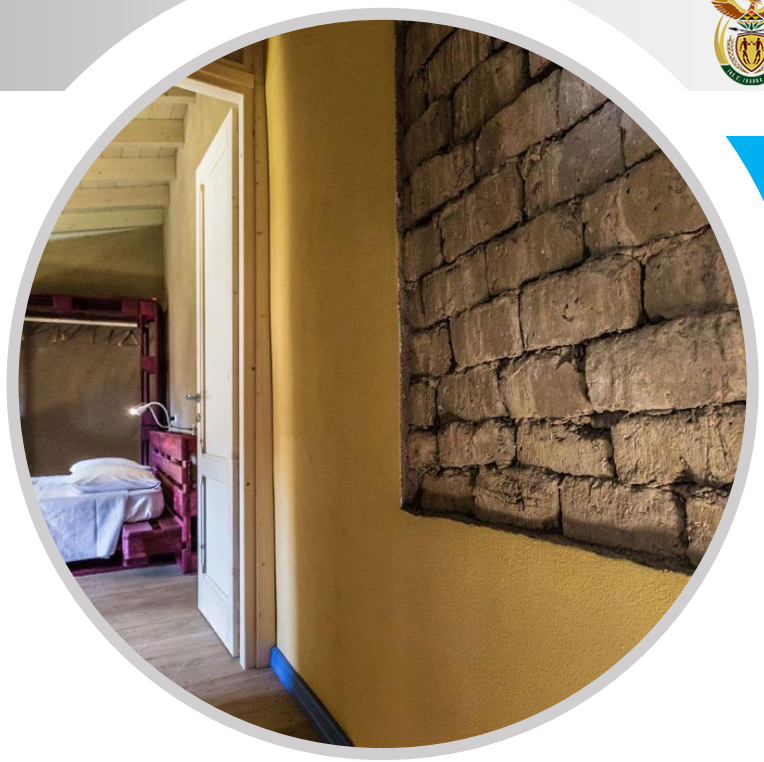

SUSTAINABILITY FACTSHEET #06

Unfired clay bricks: Structure, Applications and Developments

Unfired clay bricks were first used in Mesopotamia around the third millennium BC. Almost a third of the world's inhabitants live in houses made of earth.

Earth masonry is not “fired” like conventional clay bricks, eliminating the use of fossil fuels during production. Unfired masonry units are air-dried after manufacture, to reduce shrinkage and improve strength. Unfired clay bricks offer a cost-effective form of construction with very low environmental impact.

Technical Contributors

Lodewijk Nell
Technical Consultant - EcoMetrix Africa

CBA Technical Committee

This project is co-funded by the European Union

CLAYBRICK.ORG

EXECUTIVE SUMMARY

RATIONALE FOR UNFIRED CLAY BRICK PRODUCTION AND USE

The use of earth masonry declined after the end of the nineteenth century with the development of new construction materials. However, the need to curb GHG emissions and reduce the energy consumption arising from fired clay bricks, has created interest among clay brick manufacturers, researchers, architects and engineers to further look develop further the properties of earth masonry or unfired clay units (GreenSpec, 2018).

Unfired clay materials generally have excellent sustainability characteristics: low carbon emissions, very low waste, high recyclability and no detrimental health impacts. In the building envelope, they can inhibit condensation, give thermal mass and acoustic insulation. By regulating the relative humidity of internal air, they can significantly reduce the risk of respiratory diseases and asthma triggers (BRE, 2011).

CHARACTERISTICS OF UNFIRED CLAY BRICKS

Compared with many alternative products, unfired clay bricks are a low-impact building material and have one of the longest histories of any building material. The basic properties of unfired clay bricks make them a robust, fire-resistant material, with the benefits of thermal mass and the capacity to moderate internal humidity levels. Unless stabilized, unfired clay masonry is not resistant to prolonged water exposure and should normally be protected from rain.

However, their loadbearing ability is limited. Thin walls of unfired clay are best suited to non-loadbearing partition walls within a weatherproof building envelope (BRE, 2011).

The general advantages and disadvantages of unfired clay bricks are summarized below.

Table 1 – General Advantages and Disadvantages of Unfired Clay bricks
Source: GreenSpec (2018).

ADVANTAGES	DISADVANTAGES
• Reusable and recyclable • Very low embodied energy • Very low waste • Rapid production process • Very low embodied energy • No GHG emissions during manufacture	• Generally non load-bearing • Will degrade with prolonged exposure to water • Any transportation can add to the embodied energy • Restrictions on internal decoration

In the UK, traditional unfired clay brick buildings are commonplace in some areas of East Anglia. The modern use of unfired clay (green) bricks offers opportunities for much thinner clay brick wall construction (approximately 105 mm) than traditional practice (150–300 mm) (BRE, 2011). Thinner walls also reduce the structural loading and increase available space inside buildings.

Unfired clay bricks can absorb significantly more moisture from the air than either concrete bricks or fired clay bricks, thus being more effective at regulating internal humidity levels in a building (GreenSpec, 2018). The amount of moisture that will be absorbed by the walls in a 4 x 4 x 2.4m high room with a 100mm wall thickness is illustrated in the figure below.

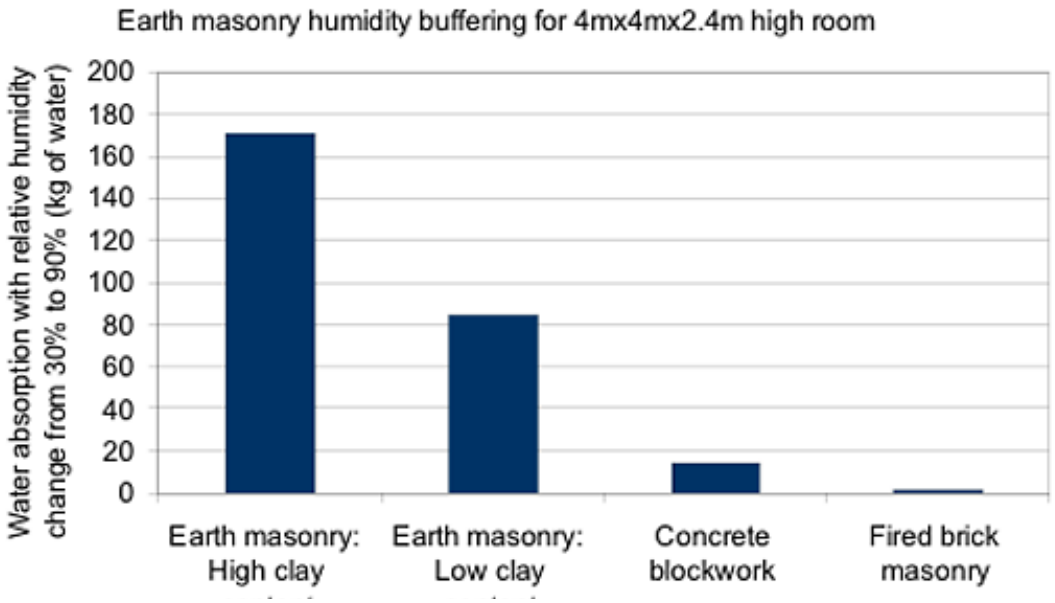

Figure 1Moisture buffering capacity of earth masonry Source: GreenSpec (2018).

Unfired clay blocks are traditionally bonded with clay- or lime-based mortar. Recent work has shown, however, that such traditional mortars are not necessarily suitable for thinner walls, and sodium silicate or lignosulfonate-stabilized clay-based mortars will provide higher bond strengths (BRE, 2011).

Cold Clay Bricks Innovation in Malawi

In November 2017, TNO, a Dutch sustainability company focused on boosting the sustainable competitive strength of industry and the well-being of society, embarked on an identification mission to Malawi. The mission's objective was to explore possibilities for collaboration with local entrepreneurs in Malawi on the development and production of cold ceramic bricks.

As part of an ongoing project, TNO has been investigating the potential of a technology to produce high quality bricks, comprising clay and different waste streams without the need for heating or firing.

Clay bricks in Malawi have traditionally been produced in clamp kilns, where the main fuel used for firing is fire wood. This has inevitably resulted in high deforestation levels in some parts of the country as well the emission of a significant amount of GHGs. Moreover, the resulting clay bricks are often of poor quality with waste in the form unburnt or poorly burnt brinks from the production process often constituting 40 percent within a fired clamp (TNO, 2017).

As a result, the ministries of Housing and Natural Resources in the country have indicated their ambition to ban the traditional practices used for clay brick making in the country, in order to curb deforestation and reduce carbon emissions. Furthermore, the ministries hope that this would prompt the clay brick market in the country to seek more innovative ad sustainable ways for clay brick production.

Essentially the cold brick production technology of TNO, utilizes an alkali-based activator, to chemically bind the clay and the different raw materials (sand, different types of waste, fly ash etc.). The suitability of a specific clay composition with TNO's technology is case dependent, having worked very well with Malawian clay resources. The resulting bricks from TNO's cold brick demonstrations in the country showed a compressive strength of 70 MPa; ten times higher than the strength required in Malawi. Moreover, the bricks the resulting bricks have an attractive and smooth aesthetic, making them attractive for use in the Malawian housing market, which has a huge demand for clay bricks.

The project is still ongoing and TNO will investigate other countries where the technology could potentially be applied, including South Africa.

Figure 2: Cold Clay Bricks in Malawi Source: TNO (2017).

REFERENCES

BRE TRUST. (2011). *Unfired Clay Masonry: An Introduction to Low-Impact Building Materials* [Online].

- https://www.bre.co.uk/filelibrary/pdf/projects/low_impact_materials/IP16_11.pdf [Accessed 10 September 2018].

GreenSpec (2018a). *Unfired Clay Bricks* [Online].

- http://www.greenspec.co.uk/building-design/unfired-clay-bricks/ [Accessed 12 September 2018].

GreenSpec (2018b). *Unfired Clay Bricks and Structure* [Online].

- http://www.greenspec.co.uk/building-design/unfired-clay-bricks/ [Accessed 12 September 2018].

TNO. (2017). *Cold Ceramic Bricks Do Have Potential in Malawi*.

- https://www.tno.nl/en/about-tno/news/2017/12/cold-ceramic-bricks-do-have-potential-in-malawi/ [Accessed 09 September 2018].

For further information:
The Clay Brick Association of South Africa
Website: www.claybrick.org