IN PRACTICE

Saving the earth

The use of rammed earth in UK architecture is on the rise. *Scott Boote*, associate at Webb Yates Engineers, makes the case for using this ancient method in contemporary construction

SEBASTIAN LAAN LOMAS & JEFFREY HART

Strawbale Workshops by Grain Architecture, Suffolk, 2019

This scheme in the Suffolk Coast and Heath Area of Outstanding Natural Beauty, is a redevelopment of a dilapidated cowshed. The 32m-long by 5.2m-wide building houses two workshops linked by a covered outdoor dining area with Mediterranean-inspired orange lime-rendered walls. Specialising in the use of natural materials, Grain Architecture has ensured low embodied energy through precisely this. The scheme has been built out of compacted rubble trench foundations with limecrete, brick plinth walls with slate, recycled glass insulation under a rammed earth floor, timber frame walls with infill and straw bale insulation, internal clay plaster, external lime render and sheep's wool/rigid wood fibre board insulation.

For a long time contemporary earth buildings in architecture were often stereotyped as 'Earthships' in the deserts of New Mexico, 'eco' visitor centres or aid projects completed on gap years. But could this vernacular building method be a viable low-carbon approach in a world of risk-averse clients and inflexible supply chains?

Most modern multistorey buildings are now concrete, steel, or increasingly timber post and beam framed structures. These have non-structural external walls formed with metal studwork or concrete blocks at huge environmental cost. As we move towards 2030's carbon and energy targets, adopt circular economy principles and engage with the AJ's own RetroFirst campaign, architects and engineers must commit to greater levels of investigation, testing and analysis at the very start of a project. Gaining an understanding of the availability and suitability of local materials should begin with exploring the soil beneath our feet, and could lead to savings in both manufacturing and transport emissions.

Rammed earth is seen by some as primitive, or associated with poverty. Yet it can be rendered, clad, painted, plastered, dry-lined or sealed and so used as a direct replacement for energy-hungry clay bricks or concrete blocks. It is formed largely from aggregates – sands and gravels – with a small clay content acting as a binder. The moisture content must be carefully controlled: too much water will lead to shrinkage and cracking; too little and the constituent materials will not bind together. Nonetheless, it allows for much faster construction than cob or adobe mud buildings. With the right preparation, the material can be used at scale. There is no reason why rammed earth shouldn't be used for a new office block or housing scheme.

Your building will not wash away if you get the details right. Most of the Great Wall of China is rammed earth; the Great Pyramid of Giza too, and there are many examples in the UK of rammed earth buildings more than 200 years old. It is true to say that rammed earth is less durable than, say, a fired clay brick. But a softwood stud will rot very quickly if not protected from the elements; this is anticipated and understood and buildings are designed and detailed to account for it. In a similar fashion, earth buildings are typically constructed on a more durable plinth and protected by an increased roof overhang. Alternatively, courses of slate, tile or brick can act as 'speed bumps', slowing the flow of water over the wall's surface and reducing erosion. Natural and man-made admixtures can be introduced to further improve durability.

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Earth walls are often relatively thick, but the thickness can be harnessed, providing thermal mass and moisture buffering to regulate internal environments without the usual complex, layered approach of modern construction.

The material has very low embodied energy but needs to be insulated in cooler climates. The density of rammed earth is similar to clay brickwork or concrete

JIM STEPHENSON

Bushey Cemetery by Waugh Thistleton Architects, 2016

Shortlisted for the RIBA Stirling Prize in 2018, Bushey Jewish Cemetery is formed of a series of rammed earth structures, chosen for their monumental properties. Complementing the simple timber reception building and *porte-cochère*, two rammed-earth prayer halls connected by a cloistered colonnade sit on a stepped concrete upstand, lit within by full-width west-facing glazing in the stepped ceiling. Neither Waugh Thistleton nor the client, United Synagogues, had previous experience of using the method and so worked with British-based associate Bill Swaney, an Australian stabilised rammed-earth specialist, who built a sample wall section using 500mm-thick rammed-earth blocks composed of sand, limestone, gravel, 5 per cent cement and clay spoil from nearby swales.

blockwork and the constituent materials are almost identical. As a result, the thermal performance is comparable. However, using earth construction could easily reduce the carbon footprint of a wall by two thirds.

Construction costs are similar to conventional masonry, but the use of site-won or local material will ensure it remains value for money. Recycled and crushed concrete, brick and stone can all be used to form the bulk of the rammed earth material, which then requires only a small admixture of dried clay. To use a baking analogy: if you need only pay for one egg, you can make a cheaper cake.

Meeting our climate commitments will require new ways of working and thinking. The current linear design approach, ending with contractors and subcontractors installing mass-produced products, will need to be replaced, at least in part, with a greater focus on circularity. Materials will be sourced from whatever is locally available and tested, analysed and certified project-by-project. In this context, using site-won demolition or excavation materials in the fabric of a new project seems obvious.

PETER COOK

Yorkshire Sculpture Park by Feilden Fowles, 2019

Not exactly rammed earth construction, but inspired by the technique and the aesthetic, Feilden Fowles' RIBA Stirling Prize-shortlisted visitor centre for Yorkshire Sculpture Park undertook extensive research into concrete mixes to achieve the right 'land art' feel. The architect looked at rammed earth early in the design process to reinforce the building's natural presence, opting instead for a layered, pigmented in situ concrete with local aggregates added to the mix for durability and thermal performance. It also emulates the sandstone bedrock geology of the area.

JONTY WILDE

MARIO CUCINELLA ARCHITECTS/WASP

TECLA by Mario Cucinella Architects and WASP, 2019

Italian practice Mario Cucinella Architects and 3D printing specialists WASP started construction of their TECLA project at the end of 2019. A prototype for a 3D-printed dwelling near Bologna, the model uses entirely re-usable, recyclable clay taken from the local terrain. Construction materials supplier Mapei has studied the clay materials and identified key components within the raw earth mixture to create a print-optimised product which is essentially another form of rammed earth construction. If successful, the system could become a new circular housing model.

CobBauge project

This is an EU-funded project for a new generation of cob homes. The team, which is formed of six French and British partners, is looking at cob as a more energy-efficient alternative to bricks and mortar. The vernacular construction technique, commonly found in the Channel Regions of France and Great Britain, is formed of a mixture of earth (from the site), water and fibre (such as straw or hemp) and can be used to create new techniques and methods for the preservation of buildings, while bringing substantial reductions in carbon emissions. Co-funded by the European Regional Development Fund and led by University of Plymouth professor Steve Goodhew, the project runs until 2023 and will be piloted on a house in east Suffolk designed by Hudson Architects, which will be occupied and monitored.

HUDSON ARCHITECTS