China Scholarship Council 2019

Description of the project: Modelling of rammed earth structures

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Nowadays, rammed earth construction is attracting renewed interest throughout the world thanks to its “green” characteristics in the context of sustainable development. Firstly, using a local material (soil on site or near the site), rammed earth has a very low embodied energy and environmental impact compared to traditional materials, for example concrete; given the construction industry’s significant contribution to greenhouse gas production, championing more environmentally-responsible technologies is a priority to meet future climate change targets. Secondly, rammed earth houses present advantageous living comfort due to substantial thermal inertia and the material’s ability to regulate internal humidity. Rammed earth is therefore an attractive alternative construction technique, offering the potential for comfortable living without the need for active heating and cooling, significantly reducing energy consumption during operation.

Because of the variety of soil composition in different locations and a general lack of research on the behaviour of rammed earth structures, no comprehensive design and construction provisions for them exist in the same way that there are for steel and concrete structures. There are only some guidelines and handbooks (such as New Mexico-USA, New Zealand and Zimbabwe Codes) which can only give basic recommendations. Hence, rammed earth structures are traditionally based on “rule of thumb” design methods. Generally, such an approach comprises overly-large safety factors and incurs greater construction costs. However, it may also result in unsafe structures in areas with severe environmental loads such as heavy snow loads, storms or earthquakes. Improving THM behaviour characterisation will permit more accurate prediction of material and building performance, expediting comprehensive design solutions.

In this work, we would like to propose a new calculation method for the THM behaviour of a rammed earth structure by considering meteorological site data as well as results from laboratory characterisation tests, such as durability and sensitivity to water, thermal properties, mechanical characteristics in compression, tensile strength, shear strength and dynamic characteristics. The proposed THM approach will be then implemented in a finite element code for the numerical simulations. A well-characterised rammed earth structure in the region (Dehlingen)

will be used as a case study to validate the THM framework. In the next stage, the model will be used to simulate THM behaviour of rammed earth structures situated in other regions of France and around the world.