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# A LCA Protocol for Thermal Mass Based on Overheating in Future Climates

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Designers using Life Cycle Analysis (LCA) within their design methodology are now highly reliant on Environmental Performance Declarations (EPDs) and the draft BS EN 16449:2014 adopted by the timber industry, using a sequestering carbon accountancy method, making the case for other structural materials (concrete, steel) difficult on a LCA basis.

Unlike steel, concrete has physical properties of thermal mass which makes it advantageous to temper the interior environment of buildings. Previous studies (Hacker et al, 2008) have made assumptions that need further exploration including: concrete surface usefulness, ventilation rates, user profiles and shading devices. As with previous thermal modelling studies no proper presentation of parameters has been given, so an evaluation of the quality of the inputs cannot be made.

The thermal case for concrete is marginal with current regulatory tools; UK building regulations only estimates the thermal mass properties of materials and Passivhaus PHPP calculation has no evaluation of passive mass thermal storage. Other dynamic simulation software models thermal mass to a range of accuracies.

For the initial 'cradle to gate' penalty for concrete to be correctly assessed its impact has to be taken for the operational life cycle phase of the building. This can only be conducted by a dynamic computerised energy model. In the identification of times of overheating an evaluation can be made on when an air conditioning system would be installed.

Methodology
A model is built using Energy plus software which is able to handle the parameters for thermal mass. A detailed methodology is described to measure thermal mass and its influence for an inner London location allowing for replicability and verification of the model by others as a set procedure.

As the calculation requires a long term perspective to be taken, future climate tapes are used to establish when artificial cooling would be necessary. Natural and forced unconditioned ventilation at differing times of day are used to optimise heat transfer to increase thermal mass effectiveness. The method of overheating criteria is assessed by the CIBSE standardised method and TM52 (2013) to establish adaptive comfort within the space along with the type of weather files used.

Results
The thickness and location of the thermal mass within the model is optimised with realistic profiles for occupancy, ventilation and other inputs within the dynamic thermal model.

Given the above results, evidence is presented on how much concrete could be used in buildings and under what circumstances to obtain an LCA advantage. This gives a more accurate calculation method and design guidance on where and when heavy thermal mass products should be used.