INFLUENCE OF BED JOINT ORIENTATION ON THE BEHAVIOUR OF BRICK MASONRY UNDER CYCLIC LOADING

by

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CERTIFICATE

This is to certify that the thesis entitled **"Influence of Bed Joint Orientation on the Behaviour of Brick Masonry Under Cyclic Loading"** being submitted by **R. Senthivel** to the Indian Institute of Technology, Delhi for the award of the Degree of Philosophy in Civil Engineering, is a record of bonafide research work carried out by him. **Mr. R. Senthivel** has worked under our guidance and supervision and has fulfilled the requirements for the submission of this thesis, which to our knowledge, has reached the requisite standard.

This thesis, or any part thereof, has not been submitted to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

This thesis presents an experimental investigation of behaviour of sand plast brick masonry under cyclic loading inclined to bed joints. Three loading regimes were employed for the study: uniaxial cyclic compression and tension, biaxial cyclic compression – compression, and biaxial cyclic compression – tension.

In the first phase of the study, uniaxial cyclic tests were conducted in the compression and tension states. Scaled brick masonry square panels with five different bed joint orientation comprising 0°, 22.5°, 45°, 47.5° and 50° to the horizontal were tested for this study. In the loading regime considering uniaxial compression, three types of test were conducted for each loading case: (i) Monotonic test. (ii) Cyclic test consisting of repeated loading-unloading, in which peak of each loading cycle coincided approximately with the monotonic curve. The stress strain hysteresis obtained from this load case exhibited a locus of common points known as common point curve. (iii) Cyclic test consisting of repeated loading-unloading, wherein the load was released in each cycle when the reloading curve intersected the initial unloading curve, until the points of intersection stabilises at a lower bound point. The locus of these lower bound points is termed as the stability point curve.

A general equation is proposed for the determination of the envelope stress-strain curve, common point curve and the stability point curve. Mathematical model is also presented to predict loading-unloading response at different values of plastic (residual) strain.

Cyclic tests were conducted on brick masonry panels under biaxial compression – compression for five different bed joint orientations. A range of four principal stress ratios were considered. For each principal stress ratio, the stress – strain hysteresis, the envelope curve, the locus of common points, the locus of stability points and the plastic deformation curves were determined. Analytical curves similar to those established for uniaxial cyclic compressive behaviour were developed to define the envelope, the common point and the stability point curves. Mathematical formulation based on stress invariants was proposed for modelling the failure interaction curve in the compression – compression stress state region.

Cyclic tests were also conducted on brick masonry panels under biaxial compression – tension. A range of four principal stress ratios were considered. Due to low tensile strength of plain masonry, the envelope curve and the common point curve could be established for only two principal stress ratios. Mathematical expressions were proposed for envelope and common point curves. A mathematical expression was proposed for representing failure interaction curve for biaxial compression – tension stress state region was proposed.

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