PERFORMANCE OF MODEL REINFORCED CONCRETE CORES FOR TALL BUILDINGS CYCLED IN TORSION

by

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SYNOPSIS

Results from elasto-plastic cyclic torsion tests on two reinforced concrete model tall building service cores are presented.

INTRODUCTION

Almost all tall buildings incorporate service shafts in their construction and in many cases these units are required to resist much of the lateral and torsional loading acting on the buildings. Asymmetry of mass or stiffness of structures often causes torison of buildings during earthquakes and since much of the data available on the torsional performance of service cores is limited to the elastic range a series of reinforced concrete model service shafts have been constructed and tested to determine their elasto-plastic torsional properties.

MODEL TESTS

Two model building cores (Fig 1) were cast in plywood cased polystyrene formwork using 0.3% steel each way in a mesh and concrete mix in ratio by weight:- 2 dolerite (max. size 5 mm): 1 sand: 1 ordinary Portland cement: 0.415 water with no additives. Tests on plane and reinforced specimens gave an average value of 41.6 kN/mm^2 for the modulus of elasticity and 0.16 for Poisson's ratio. Each model was subjected to cycles of pure twisting moment applied at the top.

During the cyclic tests cracks initially formed at the ends of some of the connecting beams during the first few test cycles. Later diagonal cracking occurred in the core walls and cracking at the ends of all connecting beams. At failure of the models additional horizontal cracks were evident near the base of the core walls (Fig 2). The torque rotation record for the twisting moement applied at the top of each model and rotation at 100 mm from the top of each model is given in Fig 3.

DISCUSSION

It is evident from the records for the models that an overall ductility factor in excess of four, which is often regarded as a minimum requirement, is readily obtainable and that several cycles can be accommodated. In order to achieve this the connecting beams had to provide a ductility considerably in excess of four. These beams were not specifically designed to provide a high ductility and were only provided with normal steel reinforcement. If the beam steel was designed to provide high ductility then the overall structural ductility capacity would be improved.

One of the main hazards in high rise shear walls during earthquakes is movement at horizontal construction joints. Shear cores such as represented by the models are often cast using a slipform or continuous shuttering system such that horizontal construction joints are eliminated. The results of the model tests presented here provide a basis for assessing the probable elasto-plastic torsional performance of such structures during a major earthquake.

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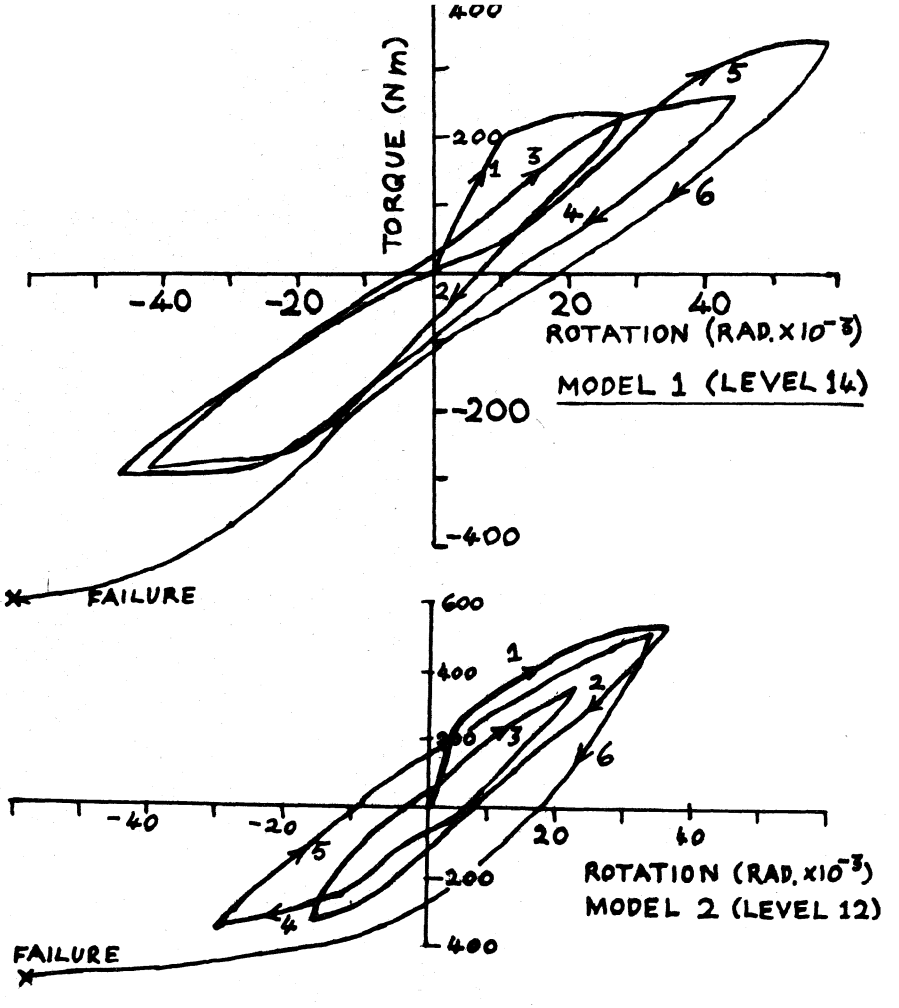

FIG. 3 TORQUE ROTATION CYCLES (TORQUE AT TOP)

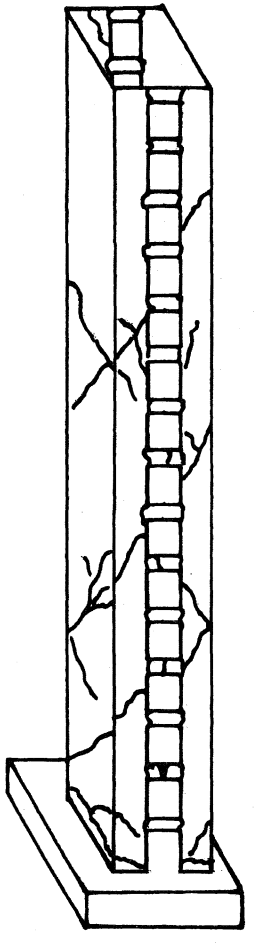

FIG. 2 CRACK PATTERN OF MODEL

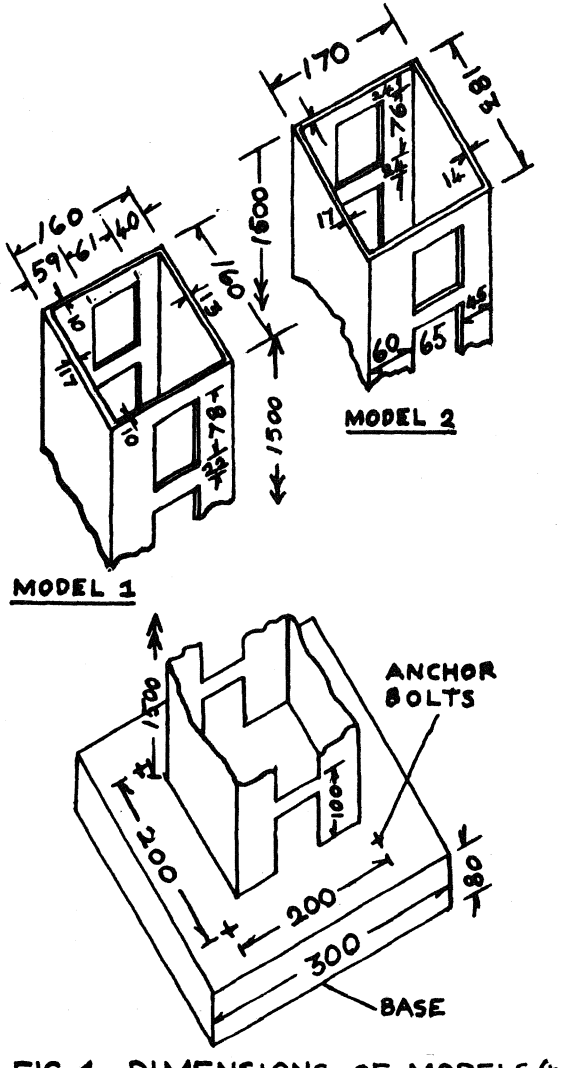

FIG. 1 DIMENSIONS OF MODELS (mm)