ABSTRACT

Most of the loss of life in past earthquakes has occurred due to the collapse of buildings, constructed in traditional materials like stone, brick, adobe and wood, which were not initially engineered to be earthquake resistant. In view of the continued use of such buildings in most countries of the world, it is essential to introduce earthquake resistance features in their construction. But there are a number of socio-economic constraints such as lack of concern about seismic safety due to the infrequent occurrence of earthquakes, lack of awareness that buildings could be made earthquake resistant at a small additional cost only. Other normal priorities on financial aspects of the daily life of the people, scarcity of cement, steel as well as timber in developing countries in general, lack of skill in seismic construction techniques with suitable design and the unorganized nature of the building sector which do not permit the adoption of high level of safety in the buildings for the masses.

Revolutionary changes in the construction method such as Base isolation, Dampers may not be feasible to adopt in practical masonry construction due to lack of knowledge and increase in cost. By doing some simple modifications in the traditional masonry construction methods it is possible to make it earthquake resistant. And also if appropriate resources and building materials are made available, it may be possible to construct buildings which can withstand the effects of earthquakes without any appreciable damage.
The code of practice for brick masonry IS 4326 : 1993 suggests the use of lintel band to integrate the structure and thus introduce a rigid box like behaviour. Though the code recommendations are based on the experiments carried out elsewhere, the problem is still a complex one because each type of building is unique in construction features like properties of block used, different ratio of binder to sand used in mortar, thickness of mortar and provision of openings. In the research works carried out in the past on brick masonry a number of contributions to strength and stiffness have been made. So far, the effects of seismic forces on masonry constructed using Compressed Stabilzed Earth Blocks (CSEB) have not been considered in these research studies. Here, an attempt has been made to study the behaviour of CSEB masonry with and without earthquake resisting features. This investigation consisted of a series of experiments to study the basic properties of materials used in block, suitability of CSE block in masonry construction and behaviour of building models constructed using CSE blocks in dynamic loading.

This experimental study aims at making extensive use of raw earth as the main building material, thereby using a local resource to help in developing the technologies that are energy saving, eco-friendly and sustainable particularly in earthquake and this research has been oriented towards the development of a cost effective technology. The shortcomings, principally low mechanical characteristics, unsatisfactory resistance to weathering and liability to volume changes, especially in the case of clayey soils, can be corrected by combining chemical and mechanical action.
In this investigation six numbers of 3D models with reduced scale 1:3 constructed using Compressed Stabilized Earth Block (CSEB) from locally available soil were subjected to shake table tests. Three models (H2, S2, M2) of three different blocks such as hollow solid and modified solid blocks were constructed with earthquake resisting features (EQRF) that have horizontal bands at plinth level, sill level, lintel level and vertical bands near the openings and corners to control the building vibration and another three models (H1, S1, M1) of the same blocks were without EQRF. To examine the seismic capacity, the models were subjected to long-period ground motion by large amplitude by many cycles of repeated loading in shake table; the test specimen was shaken repeatedly until failure. The test results from Hi-end Data Acquisition system showed that the model with EQRF behaves better than that without EQRF. The behaviour of three type models with EQRF was compared with the corresponding block models without EQRF. The overall behaviour of three blocks was also compared mutually. And also the behaviour of CSEB models are compared with four models constructed using country fired brick of English and Rat rap Bond.

A comparison between the results of experiments and the FEM analysis by ANSYS predictions is made, particularly concerning the acceleration, displacement response and the damage patterns have also been carried out in this dissertation. And also the results are validated with a mathematical model of modified Discrete Element Method (DEM). From the study it is concluded that the CSEB block models constructed with EQRF performed better than CSEB models without EQRF. This modified masonry
model with eco-friendly material combined with EQRF is used to improve the
behaviour of masonry building. The data obtained from the experimental
works were given as train set in Artificial Neural Network (ANN) and a tool
was created in Matlab software for analysing various blocks.

In order to postpone the collapse of masonry buildings, it is
recommended to provide horizontal joint reinforcement to connect the
masonry walls and tie-columns. It is recommended that the CSE block
masonry model with earthquake resistant features be adopted extensively as it
is able to sustain seismic load and is also cost effective.