

# Effect of roof diaphragm on masonry structures under dynamic loading

Navaratnarajah Sathiparan\*

*Department of Civil and Environmental Engineering, Faculty of Engineering, University of Ruhuna, Sri Lanka*

*(Received February 15, 2014, Revised July 2, 2015, Accepted October 14, 2015)*

**Abstract.** The structural collapse of masonry structure under dynamic loading displays many possible failure mechanisms often related to interaction between structural components. Roof collapse is one of the major damage mechanisms observed in masonry structures during an earthquake. Better connection between the roof diaphragm and walls may be preventing roof collapse, but it can affect other failure mechanisms. In spite of this fact, less attention has been paid to the influence of the roof diaphragm effect on masonry structures and little research has been implemented in this field. In the present study, the roof diaphragm effect on the unreinforced masonry structure under dynamic loading has been experimentally investigated. Three one-quarter scale one-story adobe masonry house models with different roof conditions have been tested by subjecting them to sinusoid loading on a shaking table simulator. Phenomena such as failure pattern, dynamic performance of masonry structure were examined.

**Keywords:** masonry; roof diaphragm; shaking table test; shear resistance; drift

---

## 1. Introduction

Past earthquakes have emphasized the vulnerability of the masonry structures, mostly due to the lack of effective connection between structural components. Major types of damage patterns observed during earthquakes in this type of building;

- In-plane failures
- Out-of-plane failures
- Failure due to lack of corner connections
- Diaphragm related failures
- Material disgregation (in poor earthen masonry)
- Delamination (in multi-leaf walls with poor mortar)

Unreinforced masonry structures are in fact characterized by weak connections between the different structural elements and tend to exhibit collapses. Horizontal inertia force development at the roof transfers to the walls acting either in the weak or in the strong direction. If all the walls are not tied together like a box, the walls loaded in their weak direction tend to out-of-plane failure. To ensure good seismic performance of masonry structures, all walls must be joined properly to the

---

\*Corresponding author, Ph.D., E-mail: [nsakthiparan@yahoo.com](mailto:nsakthiparan@yahoo.com)