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## Seismic Performance Evaluation of an RC Building with Brick Walls in Nepal Part 1 Experiments of Brick Walls

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### 1. Introduction

On April 25, 2015, at 11:56 (Nepal local time), a 7.8 magnitude earthquake hit Nepal. Many reinforced concrete (RC) buildings in urban areas especially at Kathmandu were damaged by this earthquake [1]. In Nepal, brick masonry walls are widely used as exterior and partition walls in RC buildings.

According to the Nepalese design standards [2], brick masonry walls are regarded as non-structural elements that do not affect the structural performance of buildings. However, previous studies [e.g. 3] have shown that masonry walls also contribute to strength and deformation performance of RC frames. Therefore, this study investigates brick masonry contributions to the seismic performance of an RC building in Kathmandu.

### 2. Target building for study

The target building is located in the capital city of Nepal, Kathmandu. **Figure 1** shows the location map of the building. The building has five stories above ground (superstructure) and one underground (substructure) with mat/raft foundation. Originally, this building was designed as a 3-story building but it was extended to 5 stories during construction. **Picture 1** shows the northeast and southeast views of the building, and **Figure 2** shows the ground floor plan and the sectional elevation along the X-X axis [4].

The exterior brick walls on the northwest side in the longitudinal direction of the building had plaster finishing on both sides, while the walls on the southeast side had plaster finishing on one side.

### 3. Experiment of brick masonry prisms

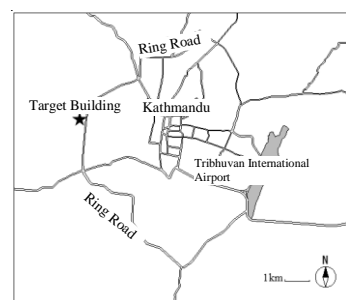
Brick masonry prism specimens were prepared as per the brick masonry walls used in the target building. The specimens were prepared by masons who were engaged in the construction of

the target building with the same materials and process as those of the target building. In order to obtain the strengths and elastic moduli of the brick masonry walls, the following experiments were conducted.

### 3.1 Experimental methods

To determine the effects of plaster finishing on the structural characteristics of brick masonry walls, three kinds of specimens with three different types of plaster finishing (PN without plaster, PO with plaster on one side, PB with plaster on both sides) were prepared as shown in **Figure 3**. The used bricks were burnt brick of the size of 220 mm × 110 mm × 55 mm. The mix proportion of joint mortar was a cement: sand ratio of 1:4 with water to cement ratio of approximately 0.85 and that of plaster mortar was a cement: sand ratio of 1:5 with water to cement ratio of approximately 0.85. However, the water to cement ratio was not measured accurately, as it was arranged by the experience of the masons.

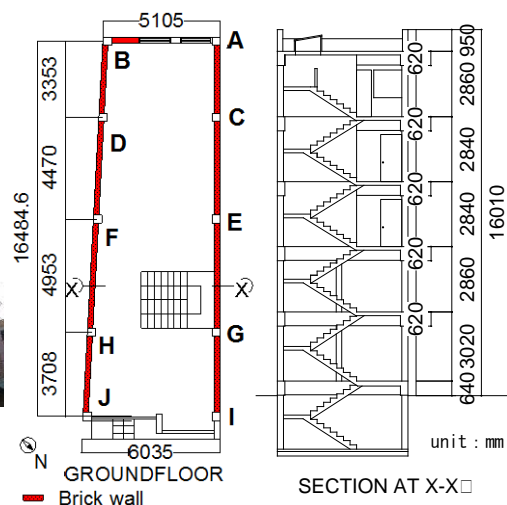
The experiments were conducted at the Material Laboratory in Tribhuvan University, Pulchowk Campus by using Universal Testing Machine (UTM). The measurements were applied loads, and strains in horizontal and vertical directions. The strains in the horizontal and vertical directions were measured by using displacement transducers attached to the specimen as shown in **Figure 4**. **Picture 2** shows the photograph of the specimen during the experiment.



**Figure 1**  
Location map of target



**Picture 1** Overview of target building



**Figure 2** Ground floor plan and elevation

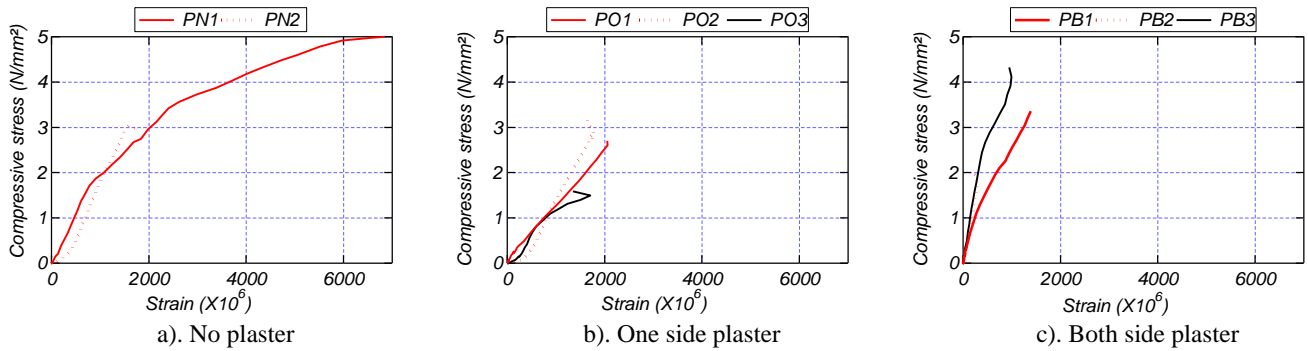


Figure 5 Stress-strain relationship

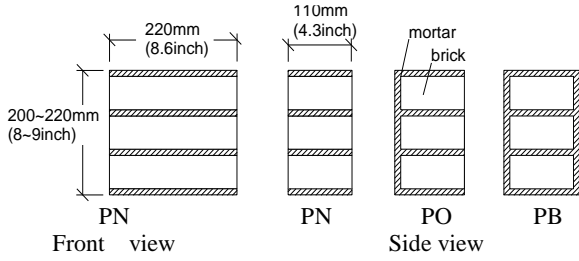


Figure 3 Specimen dimensions

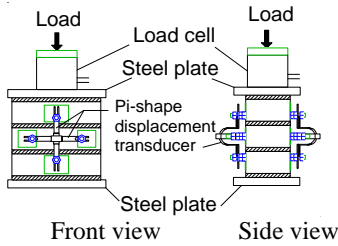


Figure 4 Test setup



Picture 2 Experiment

Table 1 Results of compression tests

	Elastic Modulus (N/mm <sup>2</sup> )	Compressive Strengths (N/mm <sup>2</sup> )
PN1	2192	5.1
PN2	2278	3.0
Average	2235	4.1
PO1	2108	2.7
PO2	2032	3.2
PO3	1935	1.6
Average	2025	2.5
PB1	4777	3.4
PB2	5394	2.0
PB3	6506	4.3
Average	5559	3.2

strengths of brick masonry prism specimens with three types of plaster finishing were obtained. The elastic modulus was significantly higher in the case with plaster on both sides, while the compressive strength was not affected by the plastering work.

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3.2 Experimental results

This paper reports the compression test results of the prism specimens, which will be used in the analysis of Part 2. The values of the elastic moduli and compressive strengths from the tests are shown in Table 1, where the compressive strength was calculated by dividing the maximum load by the gross cross-sectional area of the specimen. The compressive stress-strain relationships are shown in Figure 5, where the compressive strain was obtained by dividing the output of the displacement transducer by its gauge length. The elastic modulus on Table 1 was the initial slope with approximate linear stiffness of the stress-strain relationships in Figure 5. From the table, we can see that the elastic modulus of PB series with plaster on both sides was significantly higher than those of PN and PO series with plaster on one side and without plaster, respectively. However, the compressive strength was not affected by the presence of plaster.

4. Summary

From the experiments, the elastic moduli and compressive

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