Seismic Vulnerability Reduction of Load Bearing Masonry School Buildings in Nepal

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INTRODUCTION

Seismicity of Nepal

- One of the most earthquake-prone countries in the world (see Fig. 1).
- Has experienced 10 major earthquakes (>6.5M_w) in the past century alone.

2015 Gorkha Earthquake (7.8M_w and MMI of VIII)

- Caused the loss of life of nearly 9,000 people (2).
- About 7,000 school buildings either collapsed or were significantly damaged (see Fig. 2).

Nepalese School Buildings

- Important infrastructure for two reasons: 1) vulnerable aged children use these facilities and 2) used as shelter during natural disasters.
- More than 60% of the national school portfolio consists of Load Bearing Masonry (LBM) buildings, most of which are generally old, have poor material/construction characteristics and lack seismic design features.

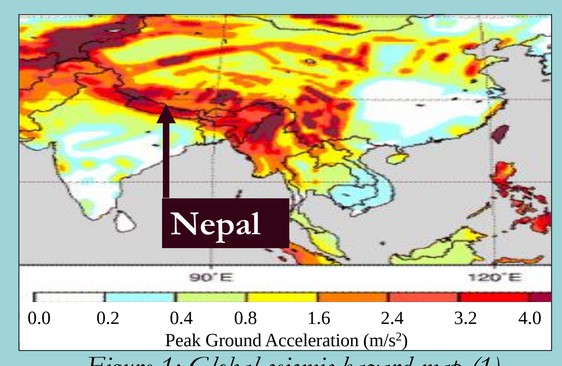

Figure 1: Global seismic hazard map (1).

Figure 2: A stone in mud masonry school building damaged due to the 2015Gorkha earthquake.

RESEARCH QUESTIONS

- What is the seismic risk posed by the school infrastructure in Nepal?
- How do we minimize the seismic casualties and economic losses in future earthquakes?

METHODOLOGY

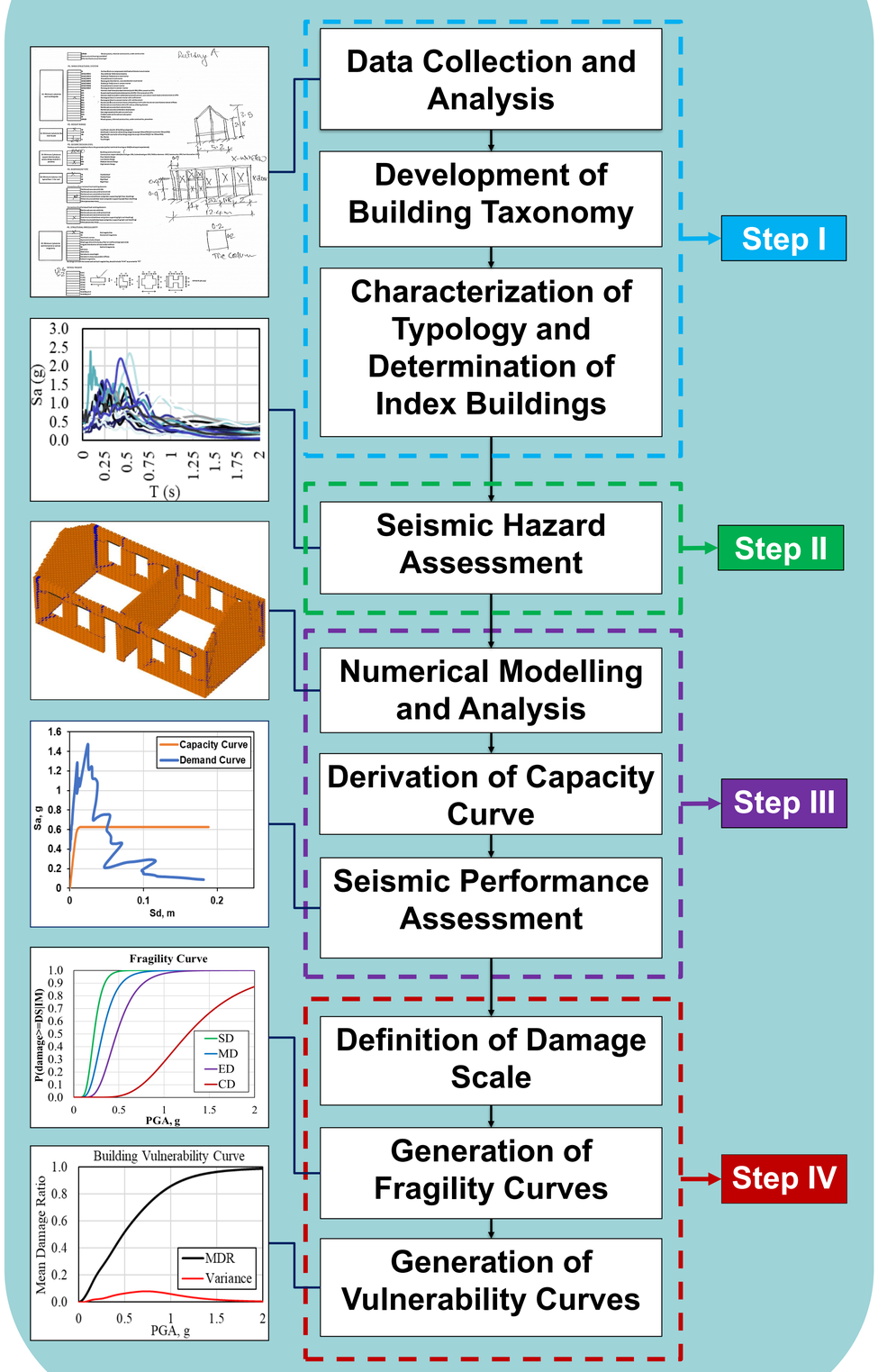

Figure 3: Research methodology used in the present study.

RESULTS & DISCUSSION

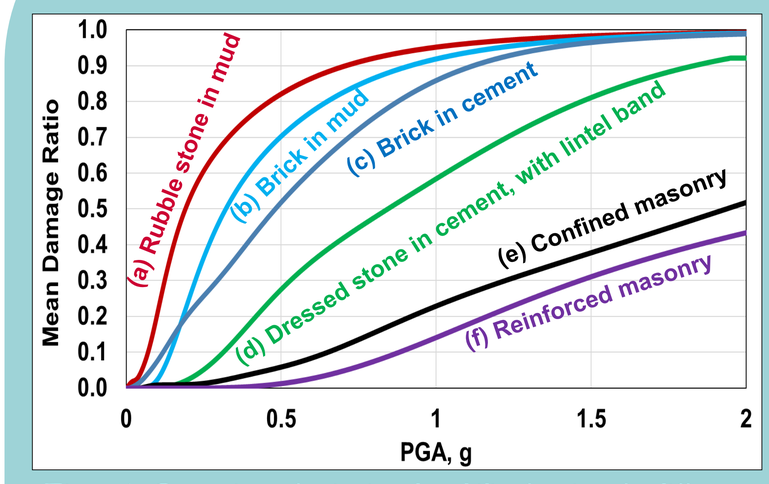

Figure 4: Comparison of seismic vulnerability functions for different typologies of LBM school buildings (note that all the index buildings are single-storied & have comparable architectural features)

Figure 5: A dressed stone in cement mortar URM school building with a lintel level band beam.

From Fig. 4, the following observations are drawn:

- Traditional Nepalese LBM school buildings [i.e. (a), (b) and (c)] present high seismic vulnerability.
- Vulnerability of traditional dressed stone in cement mortar masonry with lintel band beam (Fig. 5) is comparatively low [(d)].
- Modern masonry construction types such as confined and reinforced masonry [i.e. (e) and (f)] show significantly low vulnerability i.e. very good seismic performance.

CONCLUSIONS

- ✓ Seismic performance of traditional Nepalese LBM school buildings can be improved by applying effective retrofitting techniques e.g. by installing lintel/roof level seismic bands.
- ✓ Seismic design should be made mandatory in the construction of new LBM schools.
- ✓ If there is a need for replacement of existing school buildings, modern masonry construction types such as confined and reinforced masonry, which have better seismic performance, should be promoted.

References:
1. Giardini, D., Grünthal, G., Shedlock, K. M., & Zhang, P. (1999). The GSHAP global seismic hazard map. Annals of Geophysics, 42(6).
2. NPC (2015). Nepal earthquake 2015: Post Disaster Needs Assessment, National Planning Commission, Government of Nepal.

More information and contact:
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