

Development of Technical Guideline for the Site Specific Liquefaction Analysis and the Seismic Design of Structures to Build the Earthquake Resilient Cities in Bangladesh

1) Updating of the current “Seismic Zoning Map” of Bangladesh, to be incorporated in the next BNBC (2025?).

2) Prepare a proposal to incorporate Seismic Design Provisions in the next BNBC (2025?), in line with ASCE-7 (Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE/SEI 7-16) or later. Organize research works to develop the graphs, maps and other provisions required for this purpose.

3) Preparation of Liquefaction Hazard Map for the major cities of Bangladesh:

Liquefaction can cause massive damage to the structures. Liquefaction is the phenomenon of soil softening caused due to the cyclic shearing of the saturated cohesionless soil during the seismic activity. The catastrophic effects of liquefaction may include the tilting and sinking of the high-rise building, uplift of the underground structures, failure of the pile foundations and so on. Therefore, a proper liquefaction hazard map needs to be prepared for the major cities of Bangladesh to make it better and earthquake resilient. Therefore, one of the major objectives of this study is;

- a) To prepare a liquefaction hazard map for identification of the liquefaction prone area inside the city so that the engineers or city planners can take appropriate precautionary measure prior to design a building in the vulnerable areas or make a master plan for the city.**

4) Preparation of an appropriate methodology for site specific liquefaction analysis:

The most important part of preparing the liquefaction hazard map is to set a guideline for liquefaction analysis of the soil. A large number of researches already exists to identify the liquefiable soil. However, most of the formula used for the identification of the liquefiable soil is developed for a standard soil or the soils for a particular country which may not fit for the existing soils in Bangladesh. The formation of the soil and the soil stratification in Bangladesh is likely to be different from the other countries. Therefore, the suitability of the existing formulas for the identification of the liquefiable soils in Bangladesh needs to be verified. There are, several factors that can potentially affect the liquefaction potential of the soil for example the seismicity of the location, formation and stratification of the soil, existence of the ground water etc. A brief discussion on the dynamic ground stability or the liquefaction potential for foundation

soils is incorporated in BNBC 2020 (Part 6, Chapter 3, Section 3.9.5). However, a detailed guideline of liquefaction analysis is necessary to prepare the liquefaction hazard map. Therefore, the objective of his part is;

b) To set an appropriate guideline for the site-specific liquefaction analysis.

5) Preparation of a design guideline for the piles or retaining structures in liquefiable soil

It is already mentioned that the liquefaction can cause severe damage to the structures resting on a liquefiable soil. The damages of the infrastructures take place in the form of tilting, sinking or failure of the substructures (piles). The piles are failed primarily due to shearing, buckling or excessive bending due to lateral spreading which is the consequence of soil liquefaction. Unfortunately, the current BNBC (BNBC 2020) doesn't include any well-defined design provision for piles subjected to liquefaction or liquefaction-induced lateral spreading. Therefore, the objective of this part is;

c) To incorporate the design provision of piles or retaining structures subjected to liquefaction-induced lateral spreading.

6) Capacity development of the partner Research Institutes to carry out long term research activities in the field of geotechnical earthquake engineering.

Research Partners (Proposed):

1. HBRI

Key Person: Dr. Partha Saha, RE, HBRI

2. Dhaka University (Department of Disaster Science and Management).

Key Person: Dr. Zillur Rahman, Professor.

3. CUET, Department of Civil Engineering.

Key Persons: Dr. Abdur Rahman Bhuiyan, Professor and Dr. Md. Aftabur Rahman, Associate Professor.

Agenda discussed in the Meeting on 11.01.2021:

- 1) Discussion on the outline of the proposal for a Joint Research Program with HBRI
- 2) Discussion on the feasibility of the joint collaboration
- 3) Share innovative ideas (with ppt presentation)
- 4) Open discussion