SIMPLIFIED ENGINEERING GEOMORPHIC UNIT BASED SITE CHARACTERIZATION OF DHAKA CITY DAP AREA

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1. INTRODUCTION

The strong ground motion characteristics of engineering bedrock (Vs > 760 m/s) can be significantly changed (amplified or de-amplified) due to local site conditions i.e., subsurface soil conditions. For example, the earthquakes of 1995 Kobe, 1989 Loma Prieta, 1985 Mexico, 1964 Alaska, and 1964 Niigata earthquake witnessed the effects of site conditions. Therefore, it is a prerequisite to analyze the site response to know the local site effects for performance-based seismic design to make a seismic resilient society. In this study, we have analyzed the site response of Dhaka city Detailed Area Plan (DAP) area considering simplified engineering geomorphic unit.

2. METHODOLOGY

First, we prepared a simplified engineering geomorphic unit map of the Dhaka DAP area. To verify the simplified engineering geomorphic unit and delineate unit-wise engineering properties we collected both standard penetration test (SPT) borehole lithologs with various lab test results and downhole seismic test data. Later, to execute site response analysis we selected nine strong ground motion (from PEER NGA WEST2) data considering the similar response spectra to the Bangladesh National Building Code (BNBC) 2020 response spectra (target response spectra) for Maximum Credible Earthquake (MCE) and SB-type soil condition (Shear Wave Velocity 360 m/s to 800 m/s) [1]. Finally, non-linear site response has been performed using DEEPSOIL [2].

3. RESULTS

Engineering geomorphic map has great importance for seismic risk-sensitive land use planning. From the borehole data, we identified three major types of soil profiles considering the geomorphic units. They are Pleistocene over-consolidation clay/Pleistocene Madhupur clay (OC), Holocene Alluvium (HA), and Landfill (LAN). Further, Pleistocene over-consolidation clay/ Pleistocene Madhupur clay (OC) is divided into OC 1, OC 2, and OC 3 based subsurface soil layer. Similarly, Holocene Alluvium (HA) and Landfill (LAN) are also divided as HA1, HA 2, and LAN-OC, LAN-HA respectively. LAN-OC and LAN-HA mean landfill is underlain by over-consolidation clay and Holocene alluvium respectively. Figure 1 shows the simplified soil profiles of all geomorphic units of the study area. The geomorphic unit-based, OC 1 and HA 2, response spectra for nine selected input ground motion is illustrated in figure 2.

Figure 1 Soil profiles of OC, HA, and LAN

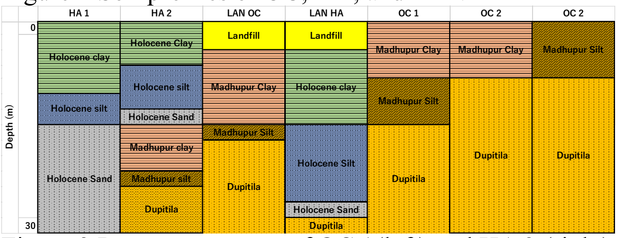


Figure 2 Response spectra of OC 1(left) and HA 2 (right)

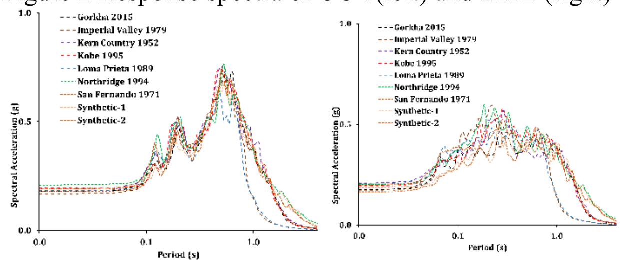
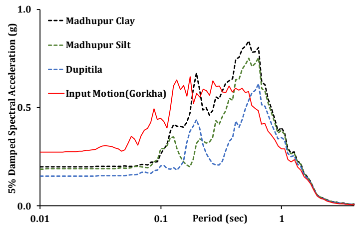


Figure 3: Layer-wise response spectrum of overconsolidated clay (OC 1) for the Gorkha earthquake



4. CONCLUSIONS

For the selected earthquake ground motions, the near-surface soil response of the DAP area shows de-amplification of acceleration in the short period and amplified acceleration in the long period. The outcome of this study can be used to prepare a seismic risk-sensitive land use plan for the future development of the DAP area of Dhaka.

REFERENCES

[1] Ancheta, Timothy D., et al. PEER NGA-west2 database. Vol. 172. Berkeley, CA: Pacific Earthquake Engineering Research Center, 2013.

[2] Hashash, Y. M. A. (2017). DEEP SOIL 7.0 User Manual.

[3] Rahman, M. Z., Siddiqua, S., & Kamal, A. S. M. M. (2021). Site response analysis for deep and soft sedimentary deposits of Dhaka City, Bangladesh. Natural Hazards, 106(3), 2279–2305. https://doi.org/10.1007/s11069-021-04543-w.