EFFECTS OF GROUNDWATER LEVEL FLUCTUATION ON SUPERSTRUCTURE'S SEISMIC BEHAVIOUR IN DHAKA CITY

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During an earthquake, site surface ground motion is different in terms of amplitude and frequency content in comparison to the bedrock motion. These changes are due to dynamic response of subsoil layers. This dynamic behaviour is a function of strain level of soil and pore presser level. In Dhaka city, during the monsoon seasons, because of high precipitation, the ground water level goes up in some areas. This, in turn, may result in a higher pore water pressure during an earthquake, which consequently filters some of the high frequency content of the earthquake motion and amplifies some other frequencies. In this study, the effects of such changes (both in ground motion frequency content and in amplification factor) and their effects on superstructure's behaviour are calculated.

At first stage, the site soil profile is modelled and analysed by use of one dimensional nonlinear site response analysis. The soil profile is modelled using an equivalent system of spring and dashpot as shown in Figure 1.

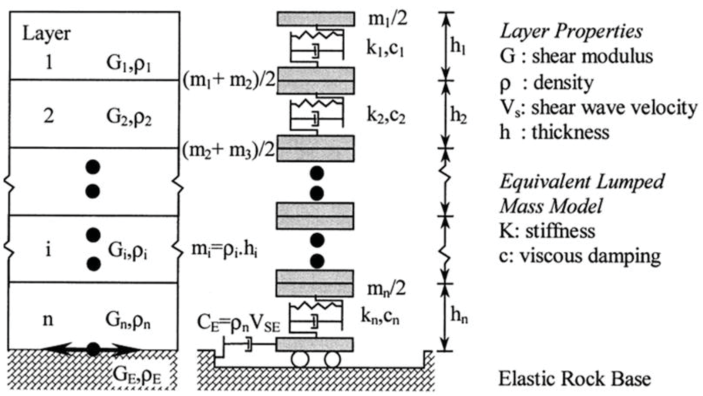

Figure 1. Idealized subsoil layer modeling for nonlinear site effect analysis (Hashash and Park, 2001).

The deformation of subsoil layers due to earthquake shaking generates irreversible deformation in soil that results in excess pore pressures development. This excess pore pressure reduces the soil effective stress and soil strength. The model proposed by Matasovic and Vucetic (1995) is used in this study to account for pore pressure as a function of number of cycles and cyclic strain.

The ground motion time histories used as input are gathered from BUET University and altered to represent the hard rock site spectra according to Bangladesh National Building Code (BNBC-2017). The site response analysis is conducted considering different levels of the ground water level.

At second stage, the surface ground motion time histories from previous stage are used as an input for nonlinear time history analysis of three different architypes of concrete structures (i.e. low, mid, and high-rise). These structures have been designed according to BNBC code. For this end, the ETABS software is used and the hinges modelled as per ASCE 41-17. The generalized backbone is shown in Figure 2.

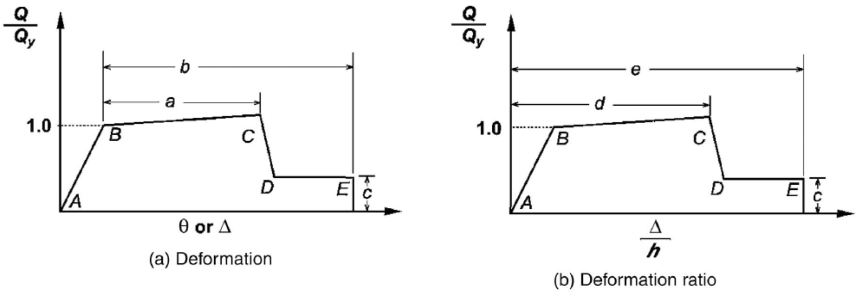

Figure 2. Generalized force–deformation relation for concrete elements (ASCE 41-17).

Results show that the frequency content of surface motion would be affected by generated pore pressure at all earthquake levels, but no significant change in structural behavior at service and design earthquake levels observed. At MCE level, the long periods of earthquake ground motion would amplify a bit and the taller building with the higher period is affected more.

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