Microzonation of Seismic Input

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1 Introduction

Microzonation has generally been recognized as the most accepted tool in seismic hazard assessment and risk evaluation and is defined as subdivision of a region into zones that have relatively similar exposure to various earthquake related effects. In other words, seismic microzonation is the process of estimating the response of soil layers for earthquake excitations and thus the variation of earthquake characteristics is represented on the ground surface. Seismic microzonation is the initial phase of earthquake risk mitigation and requires multidisciplinary approach with major contributions from geology, seismology and geotechnical engineering. The basis of microzonation is to model the rupture mechanism at the source of an earthquake, evaluate the propagation of waves through the earth to the top of bed rock, determine the effect of local soil profile and thus develop a hazard map indicating the vulnerability of the area to potential seismic hazard.

Nepal lies in highly seismically vulnerable region, lying between collisions of Indian to the Eurasian plate and moving continuously resulting devastating earthquakes within this region. The Himalaya evolved as a result of collision between the Indian and Eurasian plates around 50 million years ago. At present, the Indian plate is converging at 5cm a year towards the Eurasian plates. Because of its tectonics, the Himalaya is one of the active seismic belts on the globe. Not many people in Nepal realize that Nepal is among the high risk countries in terms of earthquake occurrences. Moreover, different literatures have mentioned that accumulated slip deficit is likely

As the seismic wave travels from its source to the surface, the first part of its path is in rock. The last part, usually not greater than several tens of meters, is traveled through the soils overlying the bedrock. It was recognized as early as 350 BC by the Greek scientist Aristotle that soft ground shakes more than hard rock in an earthquake. The characteristics of ground surface motions, i.e. peak acceleration amplitudes and shapes of response spectra, are strongly dependent on the local soil conditions. Therefore, a local site effect analysis should be conducted to evaluate the response of local soil condition that is caused by the motion of the bedrock immediately beneath it. Peak accelerations at the surfaces of soil deposits are slightly greater than peak accelerations on rock when these values are small, and somewhat the reverse at higher acceleration levels. At higher acceleration levels, the low stiffness and nonlinearity of soft soils often prevent them from developing peak ground accelerations as large as those observed on rock. Local site conditions also influence the frequency content of surface motions and hence the response spectra they produce.

2 Site Response Analysis

One of the most important and commonly encountered problems in earthquake engineering is the evaluation of ground response. Site response may be described as the forced vibration of the column of soil above the base rock for the earthquake induced rock level displacement. It is estimated that under many circumstances the site response is predominantly due to the SH waves propagating vertically through the soil layers. Ground response analyses are used to predict ground surface motions for the development of design response spectra.

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3 Concluding remarks

In order to mitigate earthquake risk and initiate preparedness plans of an urban area, it is essential to estimate the possible consequences of the future earthquake considering past experiences and researches, it is recognized that earthquake damage is generally larger over soft sediments than on firm bed rock outcrops. Realizing these facts and issues this study covers some aspects of seismic microzonation in the Kathmandu valley using the one dimensional numerical approach SHAKE 2000 for the response analysis. Among the input parameters the determination of shear wave velocities, selection of proper strong ground motion data and evaluation of existing soil information up to bed rock level were the first preliminary works in this research. The main aspects were:

- Determination of shear wave velocity

Due to lack of shear wave velocity data in Kathmandu
valley up to bedrock level and limited shear wave velocity data up to 30m depth the standard penetration results (N-values) of the subsurface sediments of the Kathmandu valley are used to derive the shear wave velocity up to 20m depth. An empirical relation proposed by Ohata Y. and Goto, derived from the alluvial plain of Japan was used here.

- Selection of the soil information up to bedrock level: Altogether 14 soil profiles were used for this analysis. Among them, most of the soil information was taken from a database prepared by JICA. Also available litho logs prepared by the Department of Mines and Geology were used for the determination of soil information up to bedrock.

- Output Results from Seismic Response analysis using the SHAKE2000:

The response analysis is carried out for the Center of Kathmandu region which is surrounded by 10-active faults and contour for maximum PGA at surface was drawn. Response analysis at the surface of Center of Kathmandu city is obtained by using SHAKE 2000. The program developed was used to generate the peak ground acceleration at surface which was found to be 0.266g for DMG1, 0.2657g for DMG2, 0.261g for DMG3, 0.263g for DMG4, 0.253g for DMG5, 0.268g for DMG6, 0.268g for DMG7, 0.253g for DMG8, 0.2652g for DMG9, 0.267g for DMG10, 0.253g for DMG11, 0.253g

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References


