1-D SIMULATION OF LONG-PERIOD GROUND MOTIONS IN THE KATHMANDU VALLEY DURING MEDIUM AND LARGE EARTHQUAKES

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Kathmandu valley, housing the capital and most populous city in Nepal, lies in seismically active region of the Himalayan collision zone where large earthquakes occur during certain periods. The valley in central Nepal is a basin formed by drying up of a lake of Plio-Pleistocene origin and has ~ 600 m thick unconsolidated sediments. It has suffered the brunt of past earthquakes due to the wave amplification as a result of basin effect. The impact of an earthquake is directly related to the amplification of seismic waves due to the sediments in a basin. Hence, it is necessary to study the behaviour of seismic waves in the basin to help reduce the damages to infrastructure during earthquake. To meet the aim, seismic records and information of underground structures are necessary. Though previous studies have tried to study the underground structure of the valley, there is still much to be done.

The records of a medium sized (mb4.9) earthquake is used to construct a 1-D velocity model of the basin. The earthquake occurred in 2013 August 30 in Tibet-Nepal border (80 km NE of Kathmandu) was recorded in four accelerometers installed as a collaborative work between Hokkaido University and Tribhuvan University. We used acceleration record from the rock-site station as the input motion to model the velocity structure under three sediment-site stations. Available geological maps and borehole logging data were used as the basis for constructing the velocity models which were tuned with trial-and-error. The SH component of the input motion was band-passed filtered (0.1-0.5 Hz) and passed through the velocity models by using the Propagator Matrix method to simulate the waveform for the sediment sites. The input motion was considered to impinge the basin perpendicularly as the hypocentre of the earthquake was more than 50 km deep. We fixed the shear wave velocity of basement rock as 3.2 km/s based on the 1-D velocity model of the Himalaya region. As the shear-wave profiling carried out in 2011 during the installation of the accelerometers shows the rock-site station to have a shear wave velocity of more than 700 m/s, we considered a ~20 m thick weathered rock layer at the bottom of the basin overlying the fresh bedrock.

We found a good-fit of the simulated waveforms when compared with the observed waveform in the initial S-wave motion of the Tibet Earthquake. We also used the same velocity models to simulate the 2015 Gorkha Earthquake (Mw7.8) and they also showed a good-fit with observed waveforms. Nevertheless, the amplification in the later phases in one of the station couldn’t be simulated properly. The complex basement topography and 3-D basin structure might have played a role in the high amplification in the later phases. We will work further in understanding the 3-D basin structure of the Kathmandu valley in future.

Keywords: Kathmandu Valley, 1-D velocity structure, Propagator Matrix

