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Engineering Geological Understanding after the 2015 Gorkha Earthquake

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Nepal lies in a seismically active region and its history is full of devastating earthquakes. During the past 100 years, four great earthquakes occurred in the Himalaya. From east to west, the sequence includes the 1905 Kangra earthquake (Mw ~7.8), the 1934 Bihar-Nepal earthquake (Mw = 8.1), the 1950 Assam earthquake (Mw ~8.6) and the Gorkha earthquake (Mw = 7.8). After the 1934 Bihar-Nepal earthquake in Nepal, eight major earthquakes hit Nepal, the latest earthquake is the Gorkha Earthquake of April 25, 2015. Although many international and Indian media named this earthquake the Nepal Earthquake, the earthquake epicentre lies in the Gorkha district of Nepal (Fig. 1) and the Government of Nepal officially named it the Gorkha Earthquake.

The Gorkha Earthquake occurred at 11:56 AM Nepal Standard Time on 25 April 2015 with an epicentre 77 km northwest of Kathmandu near Barpak village in the Gorkha district. This earthquake was the most powerful earthquake to strike Nepal since the 1934 Nepal-Bihar earthquake. It is estimated that more than eighty five million people have been affected by the Gorkha Earthquake in Nepal which is equal to one quarter of Nepal's population. As a result of this earthquake, 773,378 houses were damaged (501,201 houses completely destroyed), 8,995 people were killed and more than 22,300 people were injured in Nepal alone. The earthquake shaking was strong in central Nepal and mild in India, Bangladesh, Bhutan and a few parts of south Tibet (China). There were many house damages as well as slope failures in central Nepal. A famous tourist destination of North of Kathmandu, Langtang village of Rasuwa district was completely destroyed and more than 200 people were killed during a single event debris avalanche.

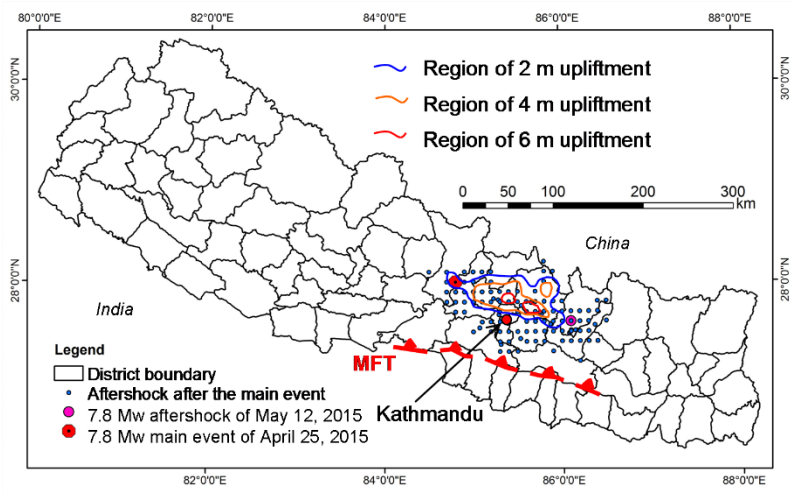

Figure 1: The Gorkha Earthquake location map with epicentre, aftershocks, affected districts and amount of upliftment. earthquake data source is www.nsc.gov.np and upliftment data is cited from ARIA (1).

Earthquake-induced landslides, land subsidence and liquefaction were the three major engineering geological issues which were felt after the Gorkha Earthquake in 14 of the most affected districts of Nepal. From the field observations and measurements, as in the other part of the world, earthquake-induced landslides after the Gorkha Earthquake can also be classified into the following categories: rock falls, shallow landslides, dry debris falls, and deep seated landslides, debris flows and mud flows, valley fill collapse, and cut-and-fill failure. The soft soil of the Kathmandu valley also faced severe differential

settlements and many buildings either subsided or were quite damaged due to land subsidence. Along with land subsidence, a few sand boils appeared in Kathmandu due to liquefaction of the lower strata. The liquefied layer was not at a great depth, normally 2 m -5 m in many cases. Topographical effects on hill settlements during earthquakes is another significant problem which needs to be addressed through suitable structural design of buildings in rural and town areas of the Himalaya.

References:

[1] ARIA (2015), M7.8 Gorkha, Nepal Earthquake, April 25, 2015, http://aria.jpl.nasa.gov/node/43 (accessed on 2015/11/25)