Site Response Study of Jammu City using Micro-tremor Measurements

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ABSTRACT

Micro-tremor measurements are one of the most commonly used methods for site response studies and have been widely used by most of the researchers because of its cost effectiveness. This method gives a realistic estimate of the natural ground frequency and can be applied in the areas where large earthquakes do not occur often. Due to the close relation between the nature of micro-tremors and the fundamental dynamic behavior of the surface soil layer, they are frequently used in the field of hazard estimation. The results of micro-tremor analysis are used as an important input for seismic microzonation studies around the world. Himalayan region is one of the most active seismic zones of the world. As such Jammu city lies in Zone IV on Seismic zoning map of India. It has been rocked by 25 earthquakes in between 1828 to 2005 of magnitude 6.0 or more. Jammu, the winter capital of Jammu & Kashmir state is a fast growing city. The micro-tremor data has been collected from locations covering almost every part of Jammu city using Altus K2 SMA. The data were collected by keeping SMA at each site for few hours. On the basis of natural frequency ($N_f$) the entire study area has been divided into four zones. The natural frequency $N_f$ value shows that the central part of the city is less vulnerable zone, as compared to other parts of the Jammu city. An attempt has been made to compute the vulnerability index ($K_g$), which could be considered as the indicator of higher damaged areas. The results are in good agreement with the past damaging history of the city.

Keywords: Amplification, Earthquake, Microtremor, Natural Frequency, Site Response

INTRODUCTION

Damage occurred in past earthquakes showed that local site conditions have a significant effect on ground motion. Local site conditions, such as upper soil surface cover may cause abrupt changes in recorded intensities of earthquakes and damages in the affected area (Sivaram & Rai, 2012). The importance of site effect increases very much in characterizing seismic...

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ground motions because they may strongly amplify (or de-amplify) seismic motions at the last moment just before reaching the surface of the ground or the basement of man-made structures. The phenomenon responsible for the amplification of the ground motion in areas with soft sediments is the trapping of seismic waves within sediments due to the acoustic impedance contrast (the product between the mean velocity of the seismic wave in a layer and its mean density) between sediments and bedrock. The interference of these “trapped” waves leads to resonances whose shapes and frequencies are well correlated with the geometrical and mechanical characteristics of the structure (Zaharia B. et al., 2008). Every site has its own natural frequency, which depends upon the thickness of soil cover and geological structures present near the site. As the thickness of the soil cover increases the natural frequency decreases. The results of site response studies are one of the important inputs for the preparation of seismic hazard maps of an area. Therefore, site response studies play an important role in seismic microzonation studies (Motamed & Ghalandarzadeh, 2004).

Site response studies on the basis of micro tremor or ambient noise data are one of the well known tools of seismic hazard assessment. (Chauhan, 2004). The present paper aims at presenting the site response study of Jammu city based on micro-tremor data. For this purpose micro-tremor data of Jammu city have been collected and analyzed. The analysis has been done using Nakamura technique to compute the natural frequency and amplification.

**STUDY AREA**

Jammu district derives its name from Raja Jambolchan, the founder of Jammu city. The Jammu district is bounded by district of Rajouri in the west, Udhampur in north and northwest and Kathua in the east and south east. It has an international border with Pakistan too. Jammu city lies in Zone IV on the Seismic Zoning map of India as per BIS – 1983 (2002). It is a fast growing and important city of Jammu & Kashmir State in northern India. Jammu the winter capital of Jammu & Kashmir state, a city of temples, symbol of ancient values and has a distinct image due to its heritage, location and linkages. Situated on a sub hilly area between 32.62° - 32.81°N and 74.76° - 74.97° E at an altitude of 400m above MSL. The city’s sprawl is on both the banks of the river Tawi, which is a tributary of river Chenab. The old city is confined to the right bank; whereas the later expansions of the city have largely taken place on the left bank. Large scale urbanization and industrialization has been observed in last two decades have given rise to what is called now Greater Jammu. The greater Jammu area falls in sub Himalayan region. Physiographically Jammu can be divided into two units; outer plains and outer hills. The elevation of the tract varies from 280-400 MSL. The lower slope of Shiwalik hills having an altitude of 320-400 MSL is called Kandi area. The region is characterized by thirsty soil and very deep water table. It includes the areas on the left bank of river Tawi and only few areas at the right bank of river Tawi. To the north of the outer plains, stands the outermost range of Shiwaliks also called foothills. The Shiwaliks have gentle slope and are covered with boulders and pebbles. It lies mostly on the right bank of the river Tawi (JMC website, 2014).

According to the Census 2011, Jammu city has a population 503,690, out of which 265,346 are male and 238,344 are female. The limits of city increased regularly in the last decade.
Influence of Joint Orientation on the Behavior of Dam Foundation Resting on Jointed Rock Mass Under Earthquake Loading Condition

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