REVIEW ON VARIATION OF SEISMIC HAZARD PARAMETERS AT DIFFERENT PLACES OF INDIA

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ABSTRACT: The present research paper reviews on the different seismic hazards variations in the country. All the thirty-two source zones of the country covered into seven geological regions. A brief highlights of return period along with a review of past PSHA effects for estimating seismic hazard in India. Earthquake catalogue containing all unknown events of medium to large magnitudes are 4≤Mw<5, 5≤Mw<6, 6≤Mw<7, 7≤Mw<8 and 8≤Mw<9. After collecting earthquake raw data following process carried out to the preparation of earthquake data, Z - map used for declustering the data, completeness of the catalogue and recurrence relation of Gutenberg-Richter’s derived a frequency-magnitude recurrence relationship. Seismic hazard analysis describes the potential for earthquake related natural phenomena such as ground shaking, rupture of fault and soil liquefaction, Seismic hazard may be assessed deterministic and probabilistic approach. Deterministic Seismic Hazard Analysis (DSHA) involves the development of a particular seismic scenario consisting of an earthquake of a specified size occurring at a specified location in other words provides a straightforward framework for evaluation of worst-case ground motion. The Peak Horizontal Acceleration (PHA), Peak Vertical Acceleration (PVA) and Peak Ground Acceleration (PGA) values obtained in the past study matches well with the values obtained by other authors studied for different area of the country.

Keywords: Earthquake, DSHA, PSHA, PHA and PGA

1 INSTRUCTION

Seismic hazard analysis is Seismic hazard analysis is typically performed to obtain a characterization surface and sub surface due to earthquake ground motion and liquefaction at a particular site. However, main scope is to the estimation of ground motion hazard, because it causes the largest economic loss in most earthquakes. Ground shaking or ground motion is one of the most important seismic hazards considered in the geotechnical earthquake engineering practice. The other seismic hazards such as the structural hazard, liquefaction, landslides, tsunami etc. depend on the intensity of ground motion and local site characteristics. The ground motions are quantified in terms of ground motion parameters such as its amplitude (e.g., Peak Ground Acceleration, PGA), frequency content (e.g., Fourier acceleration spectra, response spectra) and duration. Seismic hazard analysis (SHA) is carried out to quantify the expected ground shaking that a structure or facility will be subjected during its useful lifetime at a particular site. The probability of ground motion occurrence or its exceedance has been predicted with the knowledge of the seismicity, seismotectonic details of the region and values of Earthquake Magnitude to be used in different parts of the country given in Figure 1.

2 LITERATURE REVIEW

To understand the evolution of seismic hazard estimation or the peak ground acceleration estimation, mathematical theories used in order to simulate or represent the seismic wave propagation the past researches were studied. Efficient work has been done by many researchers using deterministic and probabilistic seismic hazard estimation has been reviewed in this literature. Seismicity of India has been addressed by many researchers in particular Kaila et al. (1972), Chandra (1977), Ramalingeswara Rao and Sitapathi Rao (1984), Tandon (1992), Khattri (1992), Parvez et al. (2003), Bilham (2004) and Iyengar and RaghuKanth (2004). As per IS 1893 (2002), seismic
study area falls in the zones II and III in the seismic zonation map of India. S T G Raghu Kant and R N Iyyangar (2007) are studied statistical analysis in the recent years for Peninsular India. For Seismic analysis; require attenuation relationship for a particular region. The Statistical analysis was made in order to simulate the earthquakes and arrive at an attenuation relation for buildings with 5% damping, the relation is dependent on the soil amplification and source to site distance. The approach is validated by comparing analytical results of the present model with instrumental data of two strong earthquakes in PI. Sreevalsa Kolathayar et al. (2012) estimated the seismic hazard of entire India using deterministic method and Seismotectonic map was created including the lineaments and faults responsible for earthquakes of magnitude more than 4.0. Entire India was confined into the grids of size 10x10km at each intersection the hazard parameters were estimated considering the seismic sources falling within the circle of radius of 400km, ground motion at rock level, spectral accelerations were evaluated at 1s and 0.1 sec. Uncertainty of source was taken care by applying the logic tree method and at each grid point three ground motion prediction relations were used. Ghasemi H et al. (2006) has used the stochastic method to simulate the past earthquake of June 22 year 2002 known by the name earthquake of Changoure-Avaj. The fault of size 25x18km was modeled into the faults of size 5x3 km. site amplification factor were evaluated using horizontal to vertical ratio, the simulated amplitude and response spectra were in good agreement. Jayant Nath Tripathi (2006) had been carried out study on the area of Kutch region of Gujarat which is one of the most seismic prone regions of India. The region has witnessed the earthquake of magnitude of 7.7. Different probabilistic models are Weibull, Gamma and Lognormal were used to estimate occurrence of large earthquakes may be greater than 5 or 6 in a definite time interval after observing the past earthquakes, the past observation was for magnitudes more than 5 and over 180 years. To estimate the earthquake parameter maximum likelihood concept was used. the results were interval of occurrence for Mw>5 was 20.18 it was 36.32 for Mw>6. as per Lognormal and Gamma methods the cumulative probability was 0.8 after 27 years and with Weibull method after 28 years and after 32 years it was 0.9 for all methods, for M>6 the cumulative probability reaches 0.8 after about 47 years for all methods. Probability of occurrence for M>5 was very high between 28 and 42 years it was 47 to 54 years for M>6. B K Rastogi and A G Chhatre (2014) had studied seismotectonic and geological study of area around the nuclear power plant for assessment of earthquake and tsunami hazard. Using deterministic approach spectral acceleration is estimated considering source, path and receiver effects. Tsunami that may get generate at Andaman-Sumatra and Makran source were modelled with the arrival time, wave height and inundation distance. Pallabee Choudhury et al. (2013) established strong ground motion acquisition centre across Gujarat for real time ground motion management, using deterministic method with site specific ground motion was applied for the entire states; vulnerability for different types of buildings was evaluated in different cities of the states by using estimated PGA and Mercalli intensity values. The presence of varied geological and soil types in the state made a greater impact in understanding the source site distance, soil dynamics and amplification on the response spectral acceleration. Sarika S. Desai and Deepankar Choudhury (2014) Mumbai city, the 4th most densely populated city in the world and is administrative capital of Maharashtra, is created by nature after the conglomeration of land mass over past 180 year. The earthquake with the magnitudes greater than 3.5 were studied and the study region included the greater Mumbai, thane and other important parts of the Mumbai. Deterministic approach was used the uncertainty was included through logic tree approach. Peak ground accelerations for Maximum Credible and safe shutdown earthquake were evaluated at rock level and concluded that the southern part of the Mumbai was at greater risk.

3 SEISMICITY IN INDIA CONTINENT

Koyna (17.322°N, 73.804°E) lies on the western flank of Peninsular India. The seismicity in this region is believed to be associated with the reservoir loading (Gupta and Rastogi, 1974; Gupta et al., 1972; 2002). It was also observed that the 10 December 1967 (Mw = 6.5) Koyna earthquake could be related to this tectonic feature (Krisha Brahman and Negi, 1973). Geological observations point out the existence of a NNE trending strike slip fault, passing through Koyna (Harper et al., 1979; Talwani, 1997; Gupta et al., 1999; 2002). The Koyna fault striking approximately in a NNE direction passes very close to the Koyna reservoir.

Chennai city (13.0833°, 80.2833°E) is located in the southern part of Peninsular India (PI) on the coromandel coast of Bay of Bengal. The seismic hazard map drawn by Bureau of Indian Standards in 2002 has shifted Chennai from Zone II (lower activity zone) to Zone III (higher activity zone) due to the increased seismicity (earthquakes like Latur 1993, Jabalpur 1997, Bhuj 2001) of the PI. Though it is in Zone III (low to moderate seismicity region), there are no major faults causing earthquakes in this region.

Bangalore City (12.9714°N, 77.5932°E) located southern part of Peninsular India of Zone I (lower
The details information about seismic events and the seismic sources was identified from City region. The initial estimates of ground motion parameters like PHA, PHV, PGA and bed rock motions obtained at the level of bed rock using deterministic and probabilistic methods.

Mumbai City (19.0759°N, 72.8775°E) located the southern part of India, seismic hazard estimation and an attenuation relation produced for finding out the Peak Ground Acceleration (PGA) for regions of Mumbai has been formulated by Iyengar and RaghuKanth (2004). Based on the faults and seismic hazard activity gives a reasonable estimate of earthquake hazard of city area. Developed uniform hazard response spectra and average weights have been used for the analysis presented by Raghu Kanth and Iyengar (2006) for Mumbai City.

Ahmadabad City (23.0225° N, 72.5714° E) is capital of Gujarat has located central western most state of India, Gujarat region has been subdivided into three major regions: they are Kachchh region, Saurashtra region and Mainland Gujarat region. Studied the Deterministic and Probabilistic Seismic Hazard Analysis, obtained Peak Ground Acceleration for entire state of Gujarat and also introduced seven ground motion prediction equations (GMPEs) including attenuation relation.

Delhi City (28.61441°N, 77.20852°E) determined the regional seismic recurrence relations city area on a grid size of 1 km x 1 km by Iyengar and Ghosh (2004). In this study the researcher has estimated maximum potential magnitude of the Himalayan faults in the northern part of India. Das et al (2006) carried out PSHA for northeast India and they computed the uniform hazard response spectra for 100 year return period at a few cities and developed a new attenuation model for pseudo-spectral velocity.

Kolkata City (22.6758°N, 88.3686°E) is a state of West Bengal, in this area the author has been studied seismic hazard analysis at bedrock level of Tollygunge area has been carried out considering all seven seismogenic sources around Kolkata. 1 D seismic wave propagation software SHAKE 2000 has been used and comparison has been made with the generated site specific response spectra of the given area.

North East India (NEI) estimated Attenuation correlations and compared with the empirical estimates and recorded PGA data of the Indo-Burma earthquake. NEI is considered as one of the very strong seismic regions in the world. In this part of India has an extremely complex tectonic and geologic set up are provided due to large number of earthquakes will be occurring. Most of the earthquakes in the region of NEI are caused due to the south–north and the west–east movement of the Indian plate (Chen and Molnar 1990).

**Table 1 - Important Earthquakes in India**

<table>
<thead>
<tr>
<th>Place</th>
<th>Year</th>
<th>Magnitude</th>
<th>Casualty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kutch</td>
<td>June 16, 1819</td>
<td>8.5</td>
<td>---------</td>
</tr>
<tr>
<td>Jabalpur</td>
<td>June 2, 1927</td>
<td>6.5</td>
<td>---------</td>
</tr>
<tr>
<td>Indore</td>
<td>March 14, 1938</td>
<td>6.3</td>
<td>---------</td>
</tr>
<tr>
<td>Bhadrachalam</td>
<td>April 14, 1969</td>
<td>6.0</td>
<td>---------</td>
</tr>
<tr>
<td>Koyna</td>
<td>December 10, 1967</td>
<td>6.0</td>
<td>&gt;200</td>
</tr>
<tr>
<td>Latur</td>
<td>September 30, 1993</td>
<td>6.3</td>
<td>&gt;10,000</td>
</tr>
<tr>
<td>Jabalpur</td>
<td>May 22, 1997</td>
<td>6.0</td>
<td>&gt;55</td>
</tr>
<tr>
<td>Bhuj</td>
<td>January 26, 2001</td>
<td>7.6</td>
<td>&gt;20000</td>
</tr>
<tr>
<td>Kashmir</td>
<td>October 8, 2005</td>
<td>7.6</td>
<td>&gt;130,000</td>
</tr>
<tr>
<td>North East India</td>
<td>April 25, 2015</td>
<td>7.8</td>
<td>&gt;8,900</td>
</tr>
<tr>
<td>Northern India</td>
<td>May 12, 2015</td>
<td>7.3</td>
<td>&gt;218</td>
</tr>
</tbody>
</table>
5 SEISMIC RISK ASSESSMENT

Natural hazards, particularly earthquakes usually occur without warning. Even though the occurrence of earthquakes is inevitable, the diminution of social and economic setback during an earthquake can be achieved through a comprehensive assessment of seismic hazard and risk. Risk assessment is one of important in the losses estimation from an earthquake in a community over period of time. When these losses are identified, then it becomes suitable for the community to evaluate the benefits of various measures such as, preparedness and emergency responses, to reduce losses. Seismic risk assessment is a three step process, i.e. risk identification, risk estimation and risk evaluation.

6 CONCLUDING REMARKS

In this present paper gives an insight into ground motion, deterministic and probabilistic seismic hazard studies carried out for various regions in India. Existing literature on the historical seismicity of whole country of India have been revived and also comprehensive understanding for seismogenic zones of the southern peninsular shield. The seismic hazard is high along the plate boundary regions are North and North East India. Koyna, Bhuj regions and along the shield region are observed highest hazard. Strong ground motion of earthquakes recording in the region would be essential to develop region specific attenuation relations. The Indian seismic code (1893, 2002) divides the country into four zones, viz. Zones II, III, IV and V. The various researchers in recent times, the seismotectonic provinces of the country developed. Attenuation relations and it is very essential to determine for future earthquakes affects.

7 REFERENCE


