Review on Seismic Hazard Analysis

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Abstract - *EARTHQUAKES POSE A SIGNIFICANT THREAT TO HUMAN ACTIVITY IN MANY PARTS OF THE WORLD, NECESSITATING CAREFUL CONSIDERATION WHILE BUILDING STRUCTURES AND VITAL INFRASTRUCTURE. A BUILDING OR FACILITY SHOULD BE ABLE TO SUSTAIN A CERTAIN AMOUNT OF SHIFTING WITHOUT SUFFERING SIGNIFICANT DAMAGE. THIS IS THE GOAL OF EARTHQUAKE-RESISTANT DESIGN. A DESIGN GROUND MOTION PARAMETER DESCRIBES THE DEGREE OF SHAKING. THE QUANTITATIVE ASSESSMENT OF THE RISKS ASSOCIATED WITH GROUND SHAKING AT A CHOSEN SITE IS A COMPONENT OF SEISMIC HAZARD ANALYSIS. WHEN EVALUATING SEISMIC HAZARDS, UNCERTAINTIES REGARDING THE SIZE, LOCATION, FREQUENCY, AND IMPACTS OF EARTHQUAKES CAN BE EXPLICITLY TAKEN INTO ACCOUNT USING A PROBABILISTIC SEISMIC HAZARD ANALYSIS.*

Key Words*: *Probabilistic Seismic Hazard Analysis, Ground motion parameter, Quantitative estimation

1. INTRODUCTION

In the past century, India has had some of the largest earthquakes in the world. The entire Himalayan belt makes the north-eastern part of the country susceptible to large earthquakes with a magnitude greater than 8.0. It is impossible to change the seismic risk, or the possibility that a place would suffer ground motion as a result of an earthquake. Making artificial systems and structures less vulnerable and more robust to withstand the bottom motion frequently reduces the probability that human habitat would experience earthquakes. A characteristic of seismic danger is that it grows over time.

2. LITERATURE REVIEW

Quantifying the rate (or chance) of surpassing different ground motion levels at a location (or a map of sites) given all potential earthquakes is the aim of seismic hazard analysis (SHA). Cornell was the first to formally establish the numerical/analytical method to PSHA (1968).

2003's (Parvez et al.) A seismic hazard map of the territory of India and the adjacent territories has been made using a deterministic approach based on the computation of synthetic seismograms complete with all necessary phases. In order to create a deterministic seismic hazard map for the Indian region, this effort is the first to use realistic strong ground. For the Indian subcontinent, there aren't many probabilistic hazard maps available Synthetic seismograms with a frequency of 1 Hz have been created on a regular grid of 0.2 0.2 using the modal summation technique. Over the area under consideration, the maximum displacement (Dmax), maximum speed (Vmax), and design ground acceleration (DGA) of the seismic hazard have been gathered and displayed on a regular grid. The estimated peak ground acceleration values match the Himalayan region's observed data extremely closely. The DGA levels are higher than 0.6 g in a few areas of the Himalayan region. The epicentral areas of the big Assam earthquakes of 1897 and 1950 in northeast India suggest the most danger with DGA levels exceeding 1.2-1.3 g.

(2007) Anbazhagan Panjamani et al. The results of the probabilistic seismic hazard analysis (PSHA) for Bangalore, South India, are presented in this paper. The seismotectonic characteristics of the 350 km radius encircling Bangalore as the centre were used in the analyses. In light of the currently available earthquake data, the seismic hazard parameter "b," which makes use of strict and extensive catalogues, has been evaluated using the Gutenberg-Richter (G-R) connection and the Kijko and Sellevoll (1989, 1992) approach. The G-R relation and the Kijko and Sellevoll technique both gave estimates for the 'b' parameter of 0.62 to 0.98 and 0.87 0.03, respectively. The results are marginally better than the previously published "b" values for southern India. Six seismogenic sources were considered in a probabilistic estimate of the seismic threat in the Bangalore area. For a 10% probability of surpassing in 50 years, the quantified hazard values for the rock level peak ground acceleration (PGA) are shown on a grid with a size of 0.5 km by 0.5 km.

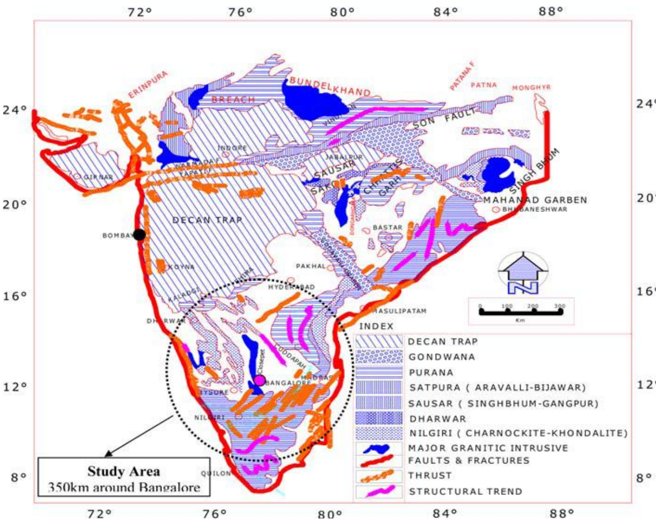

Figure - 1: Peninsular India is the study area, and geotectonic features are present.

2007; Lindholm et al. Peninsular India is given a new probabilistic seismic hazard assessment (PSHA). Three distinct recurrence models—a grid model, a fault model, and a traditional seismic zonation model—have been used to perform the PSHA. The creation of a grid model based on an adaption of the Kernel-based method and a non-parameterized recurrence model, which haven't been used in this field before. For both the stable continental crust and the active crust in the Gujarat region, three relevant attenuation relations have been taken into account in terms of spectral acceleration. (Although Peninsular India has seen a few large earthquakes, like those at Latur and Jabalpur, it typically represents a stable continental zone with little earthquake activity, as shown by our hazard results. On the other hand, our analysis reveals that both the Koyna and Gujarat regions have a sizable risk of earthquakes. a 10% overage's maximum ground acceleration.

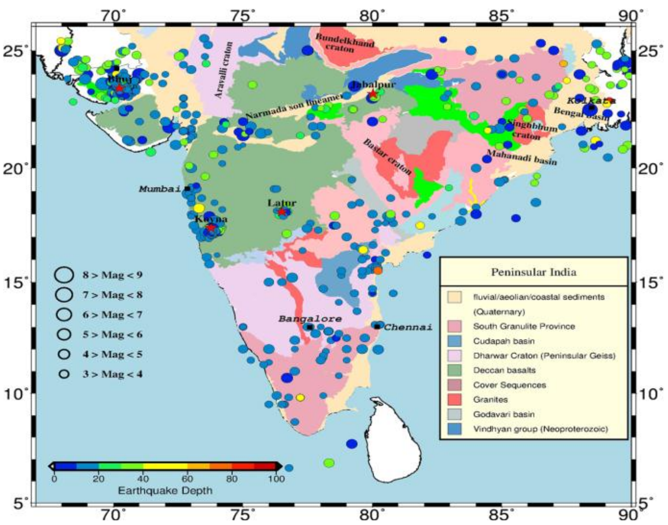

Figure - 2: The Geological Map of India (GSI 2000), which depicts the geology of Peninsular India, including the sites of past earthquakes (circles). The colour and diameter of the circles signify, respectively, depth and magnitude. Red stars denote significant occurrences from the previous 50 years.

(2008) Boominathan et al. a thorough investigation to evaluate Chennai's seismic risk using a deterministic methodology Within a 100 km radius of the study location, seismicity and seismotectonic features have been taken into consideration. The equivalent linear technique was used in conjunction with the SHAKE91 programme to estimate the ground motion parameters while taking into account local site effects for the one-dimensional ground response analysis for 38 typical sites. Corrected blow counts were used to infer the shear wave velocity profile, and the Multichannel Analysis of Surface Wave (MASW) test on a typical site was used to corroborate it.

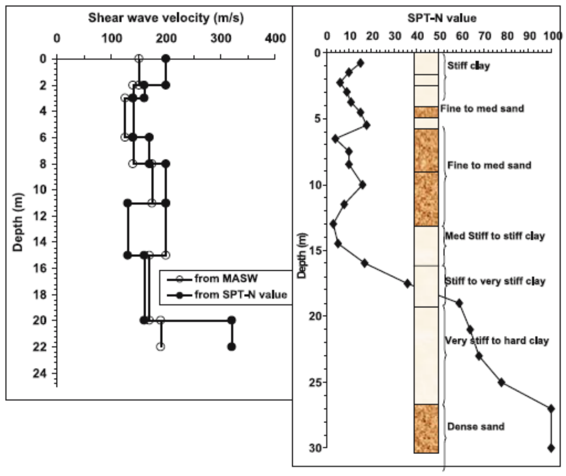

Figure - 3: Shear wave velocity changes when the site's borelog changes.

(2010) Menon et al. A probabilistic seismic hazard contour map is produced for Tamil Nadu and the union territory of Pondicherry based on the ground-motion parameters, PGA and spectral accelerations, at 0.1, 0.5, and 1.0 sec for 2 percent, 5 percent, and 10 percent likelihood of exceedance during a 50-year period. A grid of places spaced 0.2 degrees apart has been used to calculate the area's hazards. A thorough database of earthquakes that occurred between 68 and 88° E longitude and 2 to 20.7° N latitude over a 950-year period has been assembled. The ground-motion predictive equations for shallow crustal intraplate environments, catalogue completeness estimation methods, maximum cutoff magnitude, and probability hazard analysis techniques are all taken into consideration when creating the hazard maps. The seismic code's recommended zoning is contrasted with the danger maps. According to the most recent estimates, the Indian Standards' broad zoning significantly understates the seismic risk in many areas of the state.

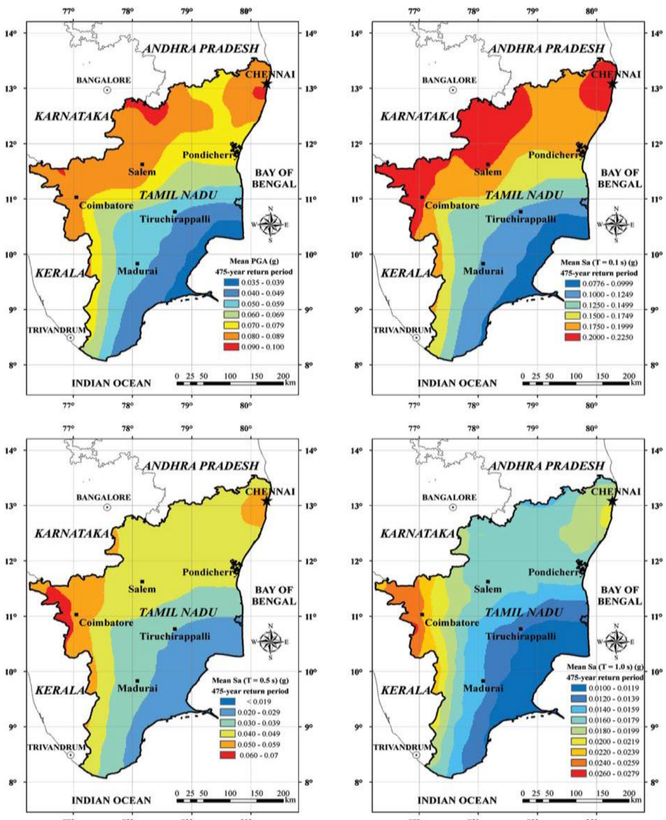

Figure 4 - : TN hazard maps with a 10% chance of surpassing in 50 years for PGA and spectral accelerations at 0, 5, and 1 sec structural periods.

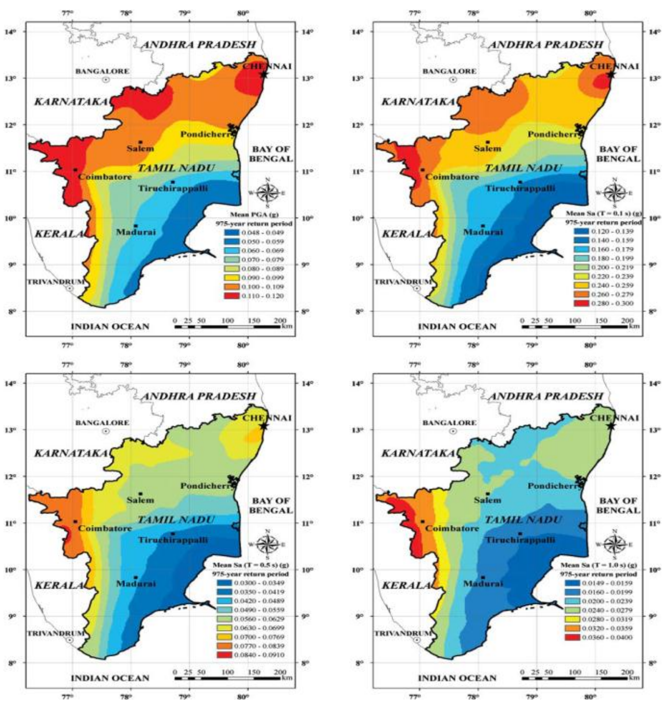

Figure 5 - : TN hazard maps with a 5% likelihood of surpassing in 50 years for PGA and spectral accelerations at 0.1, 0.5, and 1.0 sec structural periods.

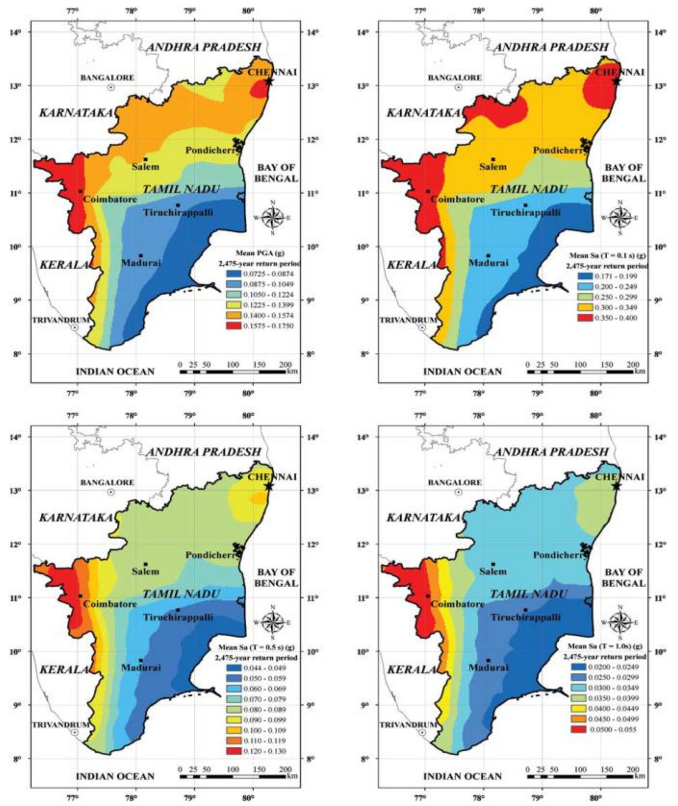

Figure 6 - : The TN hazard maps for PGA and spectral accelerations at 0.1, 0.5, and 1.0 sec structural periods show that there is a 2% chance of surpassing in 50 years.

(2012) Sreevalsa Kolathayar et al. On the basis of the most recent seismicity data (up to 2010), the results of a deterministic analysis of the seismic hazard in India (6-38 N and 68-98 E) are evaluated. The hazard analysis, which considered the different tectonic provinces in the area, used twelve well-known attenuation relations. A total of 27,146 earthquakes with a moment magnitude of 4 or higher were discovered in the research region after the earthquake data from various sources was homogenised and declustered. By taking into account the faults, lineaments, and shear zones connected to earthquakes of magnitude 4 and higher, the sesismotectonic map of the research area was created. In MATLAB, a brand-new tool for smoothing was created. The study area was divided into incredibly small grids of 0.1 0.1 (or around 10 10 km) size to measure the seismic threat. Then, at the centre of each of these grid cells, the danger parameters were determined by accounting for all seismic sources within a 300–400 km radius. Using a deterministic method and MATLAB code, the peak horizontal acceleration (PHA) at the rock level and the spectrum accelerations for periods 0.1 and 1 s have been determined for each grid point. A logic-tree method has been used to account for three potential attenuation models and two alternative source types for each grid point in order to overcome epistemic uncertainty in hazard definition. To compare the outcomes, the evaluation of danger without using the logic tree approach was also completed.

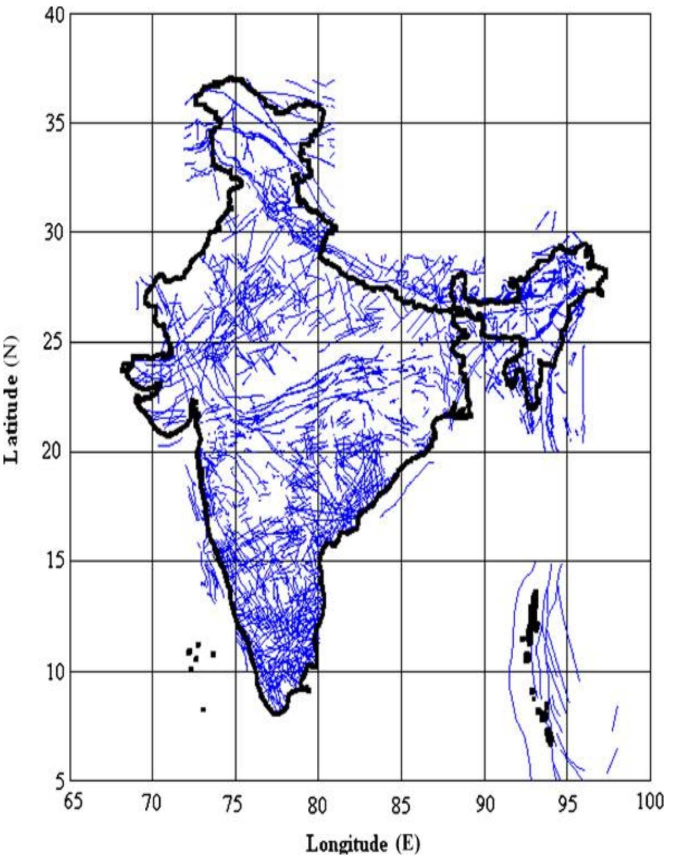

Figure 7 - : India's linear seismic sources have been found

(2013) Vipin et al. The probability of Gujarat's seismic risk was assessed using a logic tree framework, which reduces the degree of ambiguity in risk assessment. Peak horizontal acceleration (PHA) levels and spectral acceleration (Sa) values have each been assessed for a 10% and 2% risk of being reached in the next 50 years. Site amplification and liquefaction, two significant geotechnical impacts of earthquakes, are also assessed while taking into account site characterisation based on site classes. Using performance-based criteria, the liquefaction return period for the entire state of Gujarat is assessed. The maps of PHA and PGA values generated by this study are extremely helpful for lowering the area's seismic risk in the future.

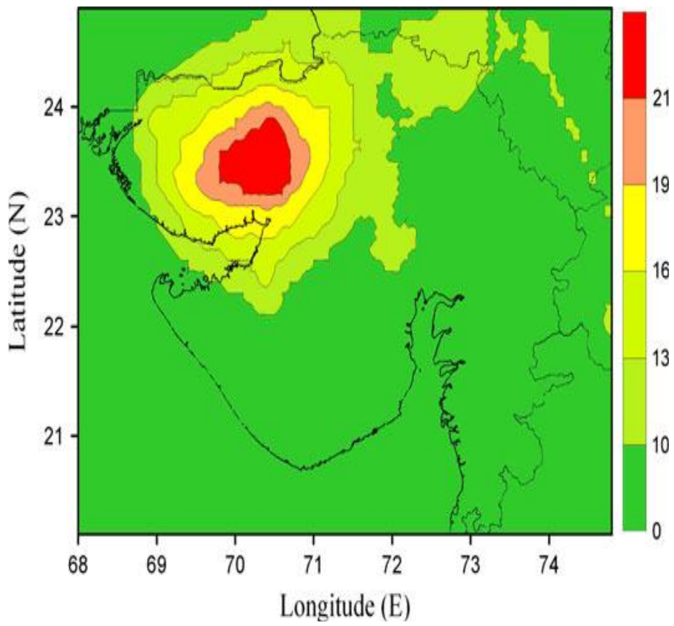

Figure 8 - : A 475-year return period requires geographical variance in N1,60,cs levels to prevent liquefaction.

(2014) (Anbazhagan et al. The Patna district seismic hazard maps use both worst-case deterministic and conventional probabilistic methods to account for the ground motion prediction equations (GMPEs) and maximum magnitudes that are unique to the region). Devastating earthquakes, such as the Bihar-Nepal quakes of 1803 and 1934, have occurred close to the Himalayan active seismic zone, which lies near to Patna. Linear sources and seismic events have been estimated to be 500 kilometres from the district centre of Patna based on historical seismicity and earthquake damage dispersion. Regional rupture features, the Kijko approach, and the maximum observed magnitude (Mmaxobs) have all been used to determine the maximum magnitude (Mmax). For each source, the highest of these three is considered as the maximum likely magnitude. 27 ground motion prediction equations (GMPEs) are found to be suitable for the Patna region. The "efficacy test," which employs log-likelihood, is used to choose appropriate region-specific GMPEs from this group. To map for the worst-case deterministic approach, the 2 and 10% period of exceedance in 50 years, and to estimate the PGA and spectral acceleration at 0.2 and 1 s, maximum magnitude and chosen GMPEs are employed. Furthermore, the deaggregation graphic is created using the seismic hazard results to calculate the magnitude and distance of the contribution of the seismic sources. To estimate PGA and spectral acceleration at 0.2 and 1 s and map for the worst-case deterministic approach and the 2 and 10% period of exceedance in 50 years, maximum magnitude and chosen GMPEs are employed.

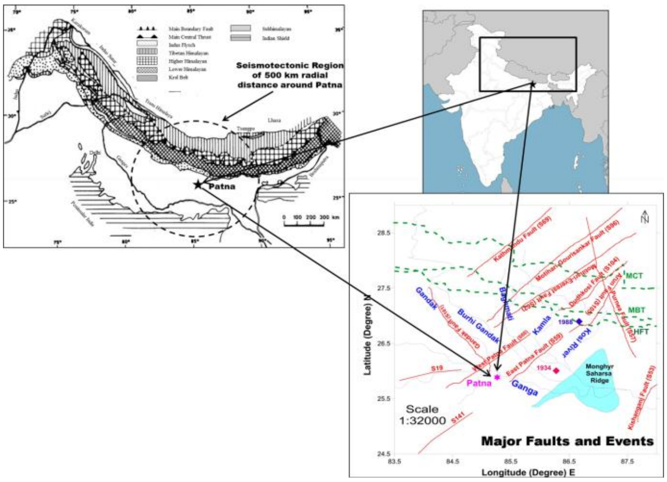

Figure 9 - : To estimate PGA and spectral acceleration at 0.2 and 1 s and map for the worst-case deterministic approach and the 2 and 10% period of exceedance in 50 years, maximum magnitude and chosen GMPEs are employed.

To estimate PGA and spectral acceleration at 0.2 and 1 s and map for the worst-case deterministic approach and the 2 and 10% period of exceedance in 50 years, maximum magnitude and chosen GMPEs are employed, has a likely seismic hazard specific to that site based on the ground motion connections reported in a companion study (Prabhu Muthuganeisan et al. 2016). Seismic recurrence parameters are calculated for all known likely sources using an updated earthquake inventory. For return durations of 475 and 2475 years, the contour maps of likely spectral acceleration at 0 s, 0.2 s, and 1 s (5 percent damping) are shown. To estimate PGA and spectral acceleration at 0.2 and 1 s and map for the worst-case deterministic approach and the 2 and 10% period of exceedance in 50 years, maximum magnitude and chosen GMPEs are employed. Additionally, the hazard levels in the areas close to Bilaspur and Chamba are higher than those described in the literature.

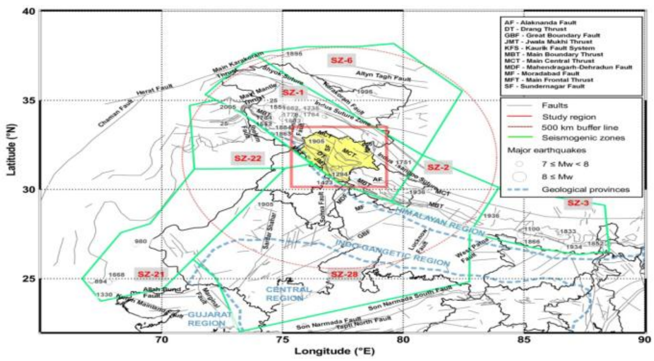

Figure 10 - : PGA and spectral acceleration at 0.2 and 1 s to be estimated, and mapping for the worst-case deterministic approach, the 2 and 10% period of exceedance in 50 years, maximum magnitude and chosen GMPEs are employed.

2016 (NitishPuri et al.) The seismic study region has had seismic sources. Each seismogenic source has been given its maximal magnitude. The National Disaster Management Authority of India developed a ground motion prediction equation for the Indo-Gangetic area. Peak ground acceleration and reaction spectrum have been calculated for the state's A-type sites using cutting-edge deterministic seismic hazard analysis methods. In order to validate them for further practical application. Calculation of seismic loading of the construction of earthquake-resistant structures in Haryana, the produced spectra can also be employed.

2017 (Anbazhagan et al.) Using probabilistic and deterministic techniques, a seismic hazard map for Kanpur city is created that accounts for the area's distinct seismotectonic characteristics within a 500-km radius. Using the regional rupture characteristics technique, the greatest probable earthquake magnitude (Mmax) for each seismic source has been calculated and compared to the highest magnitude actually felt using the Mobs max, Mobs max + 0.5, and Kijko techniques. Based on the results of the "efficacy test," the top 27 applicable ground motion prediction equations (GMPE) were selected. Additionally, various Mmax values and the chosen GMPE were given varied weight factors in order to determine the final hazard value. For worst-case scenarios with 2 and 10% probabilities, peak ground acceleration and spectral acceleration at 0.2 and 1 s were computed and mapped. Peak ground acceleration (PGA) for DSHA, 2 and 10 percent probability in 50 years, and DSHA varied from 0.04 to 0.36 g, 0.02 to 0.32 g, and 0.092 to 0.1525 g, respectively. Three vulnerable sources were taken into account when developing a normalised site-specific design spectrum based on deaggregation at the city centre. The outcomes are contrasted with the most recent earthquakes, which occurred in Sikkim in 2011 and Nepal in 2015, as well as with the Indian seismic code IS 1893.

2017 (Dhar et al.) earthquake risk brought on by the amplified seismic waves in coastal Odisha. By analysing geomorphological features and the thickness of the unconsolidated soil layer, seismic dangers have been assessed. Determining locations with a high likelihood of accumulating loose, unconsolidated sediment as well as other factors that affect the deposition of loose, unconsolidated soil in the area required morphometric analysis of the DEM data. For the coastal region of Odisha, a soil amplification susceptibility map has been created using the weighted overlay method. Seismic activity is strongly structurally controlled in the Mahanadi basin. Isoseismic patterns may lengthen due to lineament patterns, which are primarily directed in the WNW-ESE, NE-SW, and NNW-SSE directions.

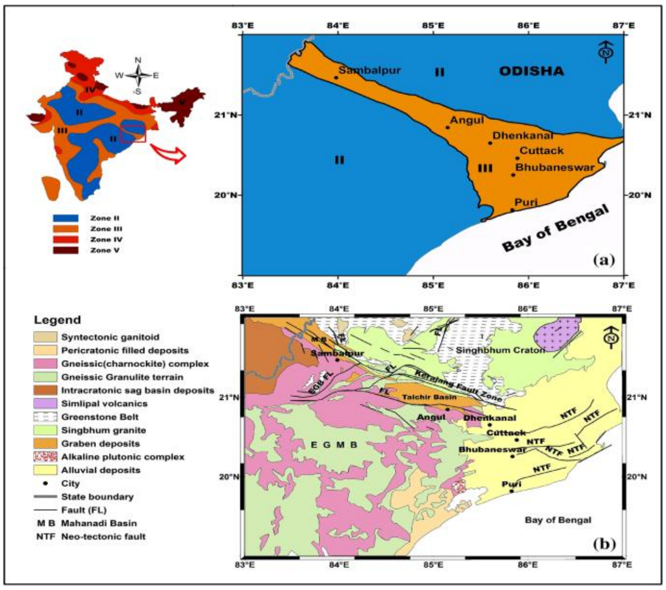

Figure 11- : A modified version of the Indian map from BIS 1893–2002 showing the study region's location and the geology of coastal Odisha in and around seismic zone III.

3. CONCLUSION

Conclusions reached after conducting a literature review. With the exception of anomalous source areas, stable continental regions (SCRs) were typically believed to be free from the risk of possible earthquakes. Peninsular India is one of the oldest and seismically most stable landmasses of the Indian plate, located at latitudes 10 to 28° N and 68 to 90° E. However, recent seismic history reveals that this area has been the site of more than five destructive earthquakes with magnitudes more than Mw 6.0, underscoring the significance of seismic hazard assessment for the area. Since Cornell established the technique for calculating seismic danger, it has undergone extensive development and implementation (1968). The advantages of probabilistic seismic hazard analysis (PSHA) are well known. Depending on how one specifies the seismicity model, the PSHA can be done in a number of different ways. Proper assessment of the territory's seismic hazard is necessary for determining the likelihood of future destructive earthquakes, which is one of the repercussions of earthquakes in a region.

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