LIQUEFACTION STUDIES FOR THE SPECIFIC SITES OF BATHINDA REGION (PUNJAB)

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ABSTRACT: This paper presents a general description of liquefaction and a review of some of the recent research based on liquefaction. The study of earthquake-related geological processes has become immensely necessary due to increasing danger on the life and the property of the people after an earthquake. Soil liquefaction following large earthquake is a major contribution to damage to infrastructure and economic loss.It should be notice several analytical and experimental research studies have been devised to study liquefaction. In this paper formulate different formula for the study of liquefaction of Bathinda region(Punjab). In present study we have notice that the most of the Bathinda region(Punjab) has come under zone III which means that the earthquake on that region will be minimum.It has also been found that 01 sites are susceptible to liquefaction. Hence special care must be taken in designing the structures in the region of Batinda.

1. INTRODUCTION

A natural hazard is a natural phenomenon that might have a negative effect on humans or the environment. Natural hazard events can be classified into two broad categories: geophysical and biological. Geophysical hazards encompass geological and meteorological phenomena such as earthquakes, volcanic eruptions, wildfires, cyclonic storms, floods, droughts, avalanches and landslides. Biological hazards can refer to a diverse array of disease, infection, infestation and invasive species.

Natural hazards like earthquake, tsunami, flood, cyclone and landslides pose severe threat to human life and its environment. There is an immense social and financial result following the event of a cataclysmic event. The unfriendly impacts of calamities are considerably more in creating nations where the populace is extremely enormous and the financial elements power the individuals to live in helpless territories. . It is assessed, by and large catastrophic event guarantee 1000 lives and cause harm surpassing one billion US$ every week around the globe.

Various examinations on field and research center demonstrated that dirt liquefaction might be better clarified as a heartbreaking disappointment marvel in which immersed soil misfortunes quality because of increment in pore water weight and decrease in successful worry under fast stacking and the bombed soil gets a level of versatility adequate to allow development from meters to kilometers. Soil liquefaction can cause ground disappointment in the method for sand bubbles, significant avalanches, surface settlement, parallel spreading, sidelong development of scaffold supports, settling and tilting of structures, disappointment of water front structure and serious harm to the life saver frameworks and so forth.

Table 1: Showing the recent natural disasters in India

S.NO	DISASTER	YEAR	PLACE	PEOPLE
1	Chennai Flood	2015	Chennai	300 people killed
2	Nepal Earthquake	2015	Nepal	8900 people killed
3	Assam flood	2016	Assam	28 people died
4	Gujarat flood	2017	Gujarat	224 people killed
5	Bihar flood	2017	Bihar	514 people killed
6	Kerala flood	2018	Kerala	500 people died

2. LIQUEFACTION

Soil liquefaction happens when an immersed or mostly soaked soil generously loses quality and solidness because of an applied pressure, for example, shaking during a quake or other unexpected change in pressure condition, in which material that is conventionally a strong carries on like a liquid.Liquefaction is a seismic tremor instigated ground disappointment marvel saw in soaked sand stores. It includes age of overabundance pore water weight, fractional or complete loss of shear quality of soil, volumetric compression prompting settlement and parallel spreading. The liquefaction capability of a dirt store relies upon a few components, for example, void proportion and relative thickness of soil, profundity of water table, compelling binding pressure, and coefficient of sidelong earth pressure, seismic and geologic history of the site and power, span and different qualities of ground shaking. Past earthquakes, for example, 1964 Alaska seismic tremor, 1989 Loma Prieta quake, 1995 Kobe seismic tremor, 1997 Northridge tremor, 2001 Bhuj seismic tremor and 2011 Christchurch seismic tremor have additionally shown extreme harming capability of soil liquefaction on structures, spans, railroads, ports and different structures.

2.1 Liquefaction Analysis As Per Is: 1893 (Part-1)-2016

Seed and Idriss (1971) proposed systems for SPT-N-based appraisals of liquefaction potential in rearranged way which is created and improved by different researchers. The most regular methods utilizing standard infiltration test (SPT) blow tally pursue these means:

1. Estimation of the cyclic pressure proportion (CSR) actuated at different profundities inside the dirt by the seismic tremor.

2. Estimation of the cyclic obstruction proportion (CRR) of the dirt, for example the cyclic shear pressure proportion which is required to cause introductory liquefaction of the dirt,

3. Evaluation of factor of wellbeing against liquefaction capability of in situ soils.

The factor of wellbeing against liquefaction is characterized as: FSLiquefaction= CRR/CSR. A dirt layer with FS<1 is commonly named liquefiable and with FS>1 is delegated non-liquefiable (Seed and Idriss, 1971). Seed and Idriss (1982) considered the dirt layer with FS esteem somewhere in the range of 1.25 and 1.5 as non-liquefiable

3. STUDY REGION

Bathinda is a city and Municipal Corporation in Southern part of Punjab, India. It is one of the oldest cities in Punjab, India and the current administrative headquarters of Bathinda District. It is in northwestern India in the Malwa Region, 227 km west of the capital city of Chandigarh and is the fifth largest city of Punjab. Bathinda's nicknamed the 'City of Lakes', courtesy of the artificial lakes in the city.

Bathinda is in the northwestern region of India and is a part of the Indo-Gangetic alluvial plains. The exact cartographic co-ordinates of Bathinda are 30.20°N 74.95°E. It has an average elevation of 201 metres (660 ft). Bathinda's climate corresponds to semi-arid with high variation between summer and winter temperatures. Average annual rainfall is relatively low, in a range of 20 mm to 40 mm. In recent times, Summer temperatures of 49 °C (120 °F)] and winter temperatures of 1 °C (about 33 °F) were not unknown in Bathinda, lowest being -1.4 °C (29.48 °F) in the winter of 2013. There has been increasing incidence of various types of cancer in and around Bathinda. It is attributed to the presence of polluting industries and the indiscriminate use of modern pesticides and other toxic materials in farming. Bathinda is the region which comes or lies under the III zone which means that there should be minimum chances of liquefaction occur.

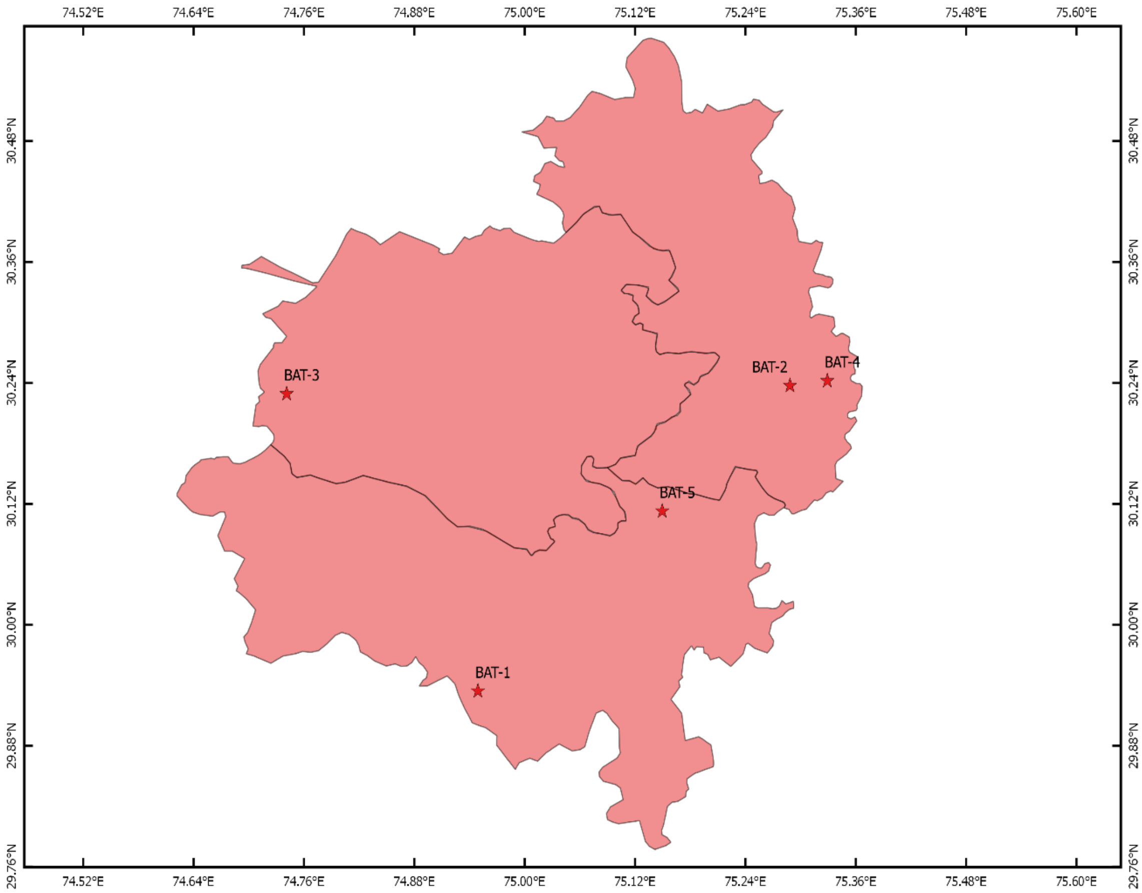

Figure 1: Map of Bathinda Region

4. ASSESMENT OF LIQUEFACTION POTENTIAL

Liquefaction potential assessment has been calculating using simplified procedure given in IS 1893 (Part 1):2016. Hence portraying the location prone to liquefaction hazard is prominent for evaluation and reduction of seismic risk through appropriate method. The most common procedure used in engineering practice for the assessment of liquefaction potential of sands and silts is the simplified procedure. The procedure which may be used either standard penetration test (SPT) blow count or cone penetration test (CPT) tip resistance or shear wave velocity (Vs).

Two parameters are required for the assessment of liquefaction susceptibility of soils i.e. cyclic stress ratio (CSR) which implies the cyclic stress induced by the earthquake and Cyclic resistance ratio (CRR) of the soil which implies the resistance of soils towards liquefaction. The ratio of CRR to CSR gives the factor of safety (FOS).Generally, if the FOS value is less than 1, the site is considered to be liquefiable and if it is greater than 1, the site is considered to be non-liquefiable. However, soil that has a FOS slightly greater than 1.0 may still liquefy during an earthquake.After site response analysis, the amplification factor and rock PGA, for all the sites has been calculated for the assessment of liquefaction potential. The magnitude of an earthquake is taken as 7.0. The Soil PGA obtained from Equivalent linear analysis is used for assessment.

For general understanding, the susceptibility level can be related to factor of safety as per the following Table 2 as proposed by Sitharam et al (2005).

Table 2: Susceptibility Index of Liquefaction Hazard

S.NO	Factor of Safety Range	Severity Index
1.	FS<1	HIGH
2.	FS 1 to 2	MODERATE
3.	FS 2 to 3	LOW
4.	FS>3	NIL
5.	NON LIQUEFABLE (NL)	NIL

In view of the above table, factor of safety at each site has been calculated and liquefaction susceptibility index varies from moderate to high as reported in Table 3. Contour map showing the distribution of factor of safety in the Bathinda region is shown in Figure 3

Table 3: Liquefaction Potential of Various Sites in Bathinda Region

SITE CODE	REGION	MIN. FOS	SEVERITY INDEX
A23	BATHINDA	0.92	HIGH
A29	BATHINDA	1.30	MODERATE
A30	BATHINDA	1.15	MODERATE
A32	BATHINDA	1.29	MODERATE
A34	BATHINDA	1.04	MODERATE

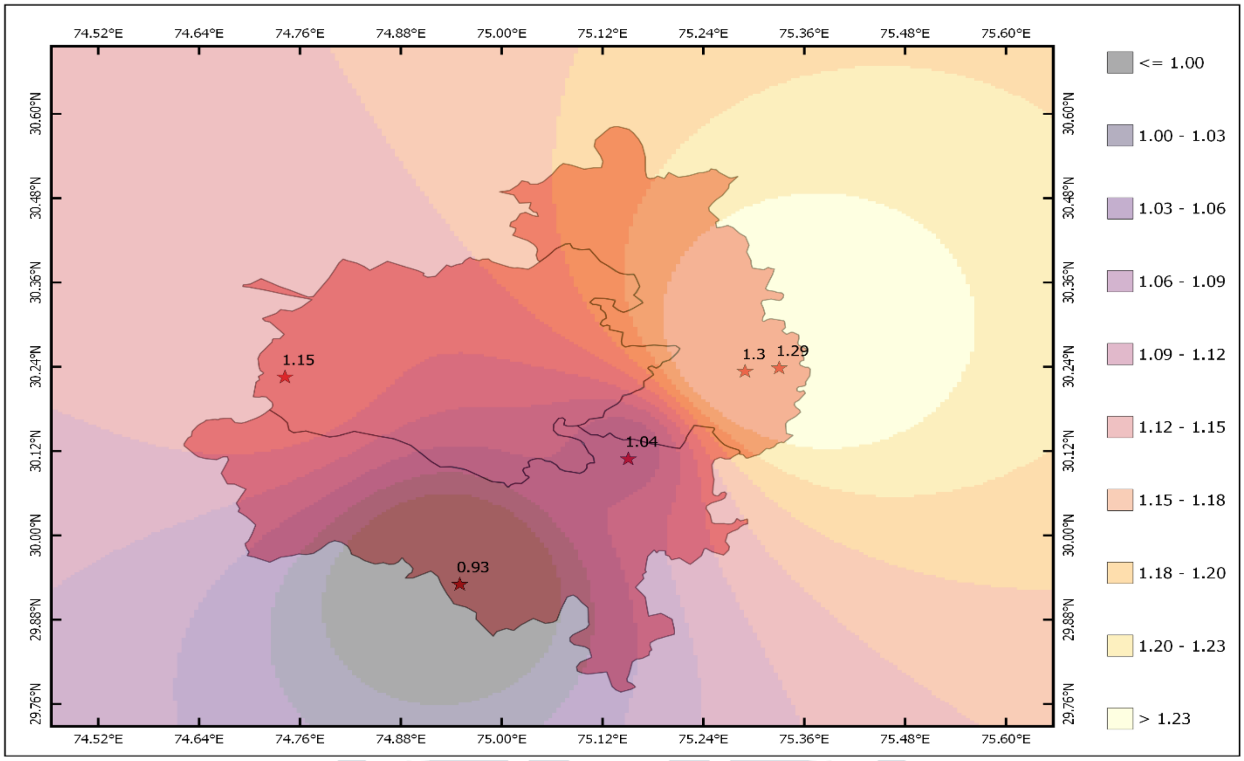

Figure 3: Contour map showing the distribution of factor of safety in the Bathinda region.

5. CONCLUSION

It was observed during the assessment of liquefaction that out of 5 sites, 01 sites are found to be susceptible to liquefaction with high range of severity index (FS<1). It may be due to shallow water table and lesser SPT-N values. It should be notice that from the above table 3 that special care must be undertaken while designing of buildings in the liquefiable susceptible sites as identified above. This study shows the importance of site specific GRA in order to ascertain the stability of the structures against natural hazard in future.

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