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## **Planning Strategy for Earthquake Prone Area** **Case Study- Gurgaon**

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### **ABSTRACT**

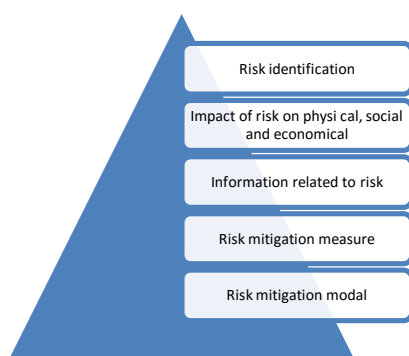
The relationship between man and nature is existing from the birth of man to the earth. In early the relationship of man and nature is friendly as man derives his needs from nature and the end process also easily digest by nature. When man start the over exploitation of the natural resources than natural cycle is disturb. Man is more sophisticated and the end product of man use is not easily digesting by the nature. Some time man dominated on nature and when man thinks that he is superior to nature, nature gives him example that man did not cross the tolerance limit of nature. Today man starts over exploitation of nature. Increasing population and migration to urban area make situation worse. The floating population needs employment, housing, physical and social amenities, so to cater this demand extensive use of land is come into picture. High rise structures, high density area, unplanned development is the component of extensive use of land. This extensive use also brings development in natural vulnerable area like earthquake prone areas. Earth quake is process of geological activity. Earthquake cannot be prevented but the effects of earthquake can be prevented. There are two measure for prevent earthquake effect, first structural and second non-structural. Urban planning is a non-structural measure to prevent earthquake effects. In this article Planning strategy for earthquake prone area is discuss.

Geographical statistics of India show that almost 54% of land is vulnerable to earthquake. Earthquake zoning map of India divides India into 4 seismic zone (zone 2, 3, 4, 5). This is based on the Richter scale. According to earthquake zoning map Himachal Pradesh, Punjab, Kashmir, the North-

East Indian State fall in the category of seismic zone 5, Delhi and NCR belt is fall in the category of seismic zone 4.

Earth quake effect does not end with collapse of structure but earthquake also bring other disaster with them like landslides, Tsunamis, Nuclear Power Plant failure, Industrial explosion, downfall of infrastructure like bridge, dam, water tank and transport linkages. So the earthquake cannot study in isolate manner as a disaster.

### **Approach to study Earthquake risk for Urban Area:**



**Urban area and Earthquake:** Urban areas are the economic generators. The impact of earthquake on urban area is high due to physical and economical development of urban area. Over burden on infrastructure, high density zones, haphazard development, industrial plants, illegal construction makes urban area more vulnerable.

**Role of Urban Planning in Earthquake prone area:** the natural phenomena are not changeable like earthquake and volcanic eruption but the vulnerabilities can be reducing by urban planning through non-structural measures.

1. How much height should be fixing in category of 4 and 5 seismic area?
2. No. of present high rise structures which have not follow the national Building code or any competent authority guidelines?

3. No. of degraded buildings which is not suitable for human habitation
4. No. of house, commercial area and industries were constructed without taking the permission of competent authority?
5. New construction work site and surrounding land use of that area.
6. How many bridges, structures are there which have cross there validity period.
7. List of heritage buildings, old building which are valuable from conservation point of view and not tolerate even small intensity of earthquake or which is situated in seismic zone 4 and 5.
8. Total population is residing in notified building and high rise building. On the basis of this highly dense pocket can be identified which have also weak infrastructure.
9. Industries which produce explosive or its end product is hazardous type situated in the high risk seismic zone and which not constructed under the rule and regulation.
10. Length of gas pipe line, petrol pipe line and surrounding land use.
11. Estimate of total life loss and economic loss due to earthquake.

### **Case Study Gurgaon:**

Gurgaon is situated in the NCR of Delhi and is at distance of 10 k.m from IGI airport, Delhi. Due to its location advantage, it has more urbanization rate then compare to other city of Haryana. In 2011, the Gurgaon urban population is 1042253. In 1991 the population is only 135884 with 33.40% growth rate. But during 1991 to 2001 and 2001 to 2011, the growth rate is 40.73% and 354.65%, respectively. As per proposed population for the perspective year 2031, the density of urban population is 25140 persons per sq km.

Table no. 1 land use distribution

Sr. No.	Land use	Area (in hect.)	Percentage (%)	Land use % as per UDPFI
1.	Residential	16905	49.91	35-40
2.	Commercial	1616	4.77	4-5
3.	Industrial	4613	13.61	10-12
4.	Transport and Communication	4428	13.08	12-14
5.	Public Utilities	608	1.8	--
6.	Public and Semi Public	2027	5.98	12-14
7.	Open Space	2928	8.64	18-20
8.	Special Zone	114	0.34	--
9.	Defence Land	633	1.87	--
<b>Total land</b>		<b>33872</b>	<b>100</b>	<b>--</b>

Source: Final Development Plan of Gurgaon - Manesar Urban Complex 2031 A.D. & UDPFI Guidelines

Above land use table show that area under Residential and Public and Semi Public activity is below the standards given in UDPFI.

**EARTHQUAKE RISK IN GURGAON:** Gurgaon is situated in seismic zone 4.3. The entire region of Gurgaon falls in high risk seismic zone IV and corresponds to MSK intensity VIII making it highly vulnerable to Earthquakes. The major tectonics features affecting Gurgaon are as follows:

- The Sohna Fault
- Junction of Aravali and Alluvium near Delhi
- Moradabad Fault
- Delhi Moradabad Fault
- Delhi-Haridwar Fault

The NCR has fairly high seismicity with general occurrence of earthquakes of 5-6 magnitude, a few of magnitude 6-7 and occasional incident of 7.5-8.0 magnitude shocks<sup>1</sup>. The most important earthquake which affected Gurgaon was on 27th August, 1960 with the magnitude of 6.0. The presence of these Faults makes earthquake condition more vulnerable because fault and ridges is very sensitive to primary and secondary waves which produce from

<sup>1</sup> Disaster Management Plan Gurgaon, 2011

earthquake. Pockets with high rise buildings or ill-designed high rise areas exist without specific consideration of earthquake resistance. Similarly unplanned settlements with sub standard structure are also prone to heavy damage even in moderate shaking.

**Developing area under Threat:** In Gurgaon infrastructure provision is at its starting phase, the existing infrastructure is over burden due to rapid urbanization. New development takes place in Gurgaon to cater the urbanizations. In Haryana there is no height restriction of the building for group holding using colony and commercial colony. If the building having height 30m and above clearance from the National airport authority of India will be required and for those building which have height more than 60m the clearance for structural stability was required from the institution like IIT, Punjab Engineering College (PEC), Regional Engineering College/National institute of technology etc and for fire safety clearance from Institute of fire Engineers Nagpur will be required<sup>2</sup>. After this notification of removal of height restriction, many developers submit their proposal for high rise structure.

### **Some fact about Earthquake risk in Gurgaon**

- Total 22% area is coming under earthquake risk and 32% population is living in this earthquake vulnerable area<sup>3</sup>.
- No height regulation for the Group Housing and Commercial activity.
- Old Gurgaon have high vulnerability of earthquake risk as major Infrastructure is laying in old Gurgaon which has already over burden and outdated.
- The secondary risk from earthquake is also high. Earthquake impact not end with collapse of building but the earth quake secondary effect came into the result like fire, Infrastructure failure, health risk, cut off

<sup>2</sup> Town and Country Planning Department, Haryana

<sup>3</sup> Unpublished thesis, April 2010, Verma Sunil, G.R.D School of Planning, G.N.D.U, Amritsar

from other area to approach effected area due to narrow streets and Industrial explosion.

- In Gurgaon sector 34 and 35 record unplanned industrial growth which has no safety measure from earthquake and fire. Total 3400 workforce resides in this area which have on risk.
- In development plan of Gurgaon the projected population is 42.50 lacs, and area of 16,905 hectares has been reserved for residential purpose with net residential density of 250 person per hectare<sup>4</sup>. So high net density increase the vulnerability in earthquake risk.

### **Planning Strategy to Mitigate Earthquake Risk in Gurgaon**

The main focus of the urban planner is welfare of the people. To achieve this target spatial planner deal with the control development according to need of people. There are two type of measure to mitigate the earthquake risk, one is structural and other is non-structural. For a Urban planner non-structure measure is more important. Non-structure measure covers the development control and zoning regulation.

- 1. Residential and Commercial Area:** According to nature of town or city the percentage of residential and commercial land use is define. In earth quake prone area planning strategy is require to determine the location and percentage of residential and commercial use. For example in residential area the density should be low, it can be control by the height regulation, plot size, provide park and open space and provide wider roads. The residential area should be segregated in plotted and flatted development. Different zoning regulation for different type of land use should be provided in earth quake affected areas. The core of the city in Indian context has use for the commercial purpose. The core area has oldest area of the city and have a character of mix land use. The infrastructure is also old and

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<sup>4</sup> Final Development Plan of Gurgaon - Manesar Urban Complex 2031 A.D.

not updated with time. Second the intensive use of land of the space in commercial area increase the vulnerability. In day time the density is high in the commercial area. The new concept of malls and multiplex attracts large mass of people and it increases the vulnerability and it leads to adverse out come by earthquake. So the location of mall and multiplex should be place in open and low density area with better accessibility.

- 2. Public and Semi-Public Area:** Public sector facility is easier to control than private sector facility. So the placing of activity in a seismic prone area can reduce the vulnerability. Hospital, fire brigade, administration block, school and emergency services should be place at a location where the earthquake risk is low and do not put services and facility at one place. It should be equally distributed in the city; this is because an important principal is deconcentration of elements of risk service provided by one central facility are always more at risk than those provided by served smaller facility. The distribution of service and facility is that if one fails than second can serve the area and they should be integrated to each other also. The main example of risk due to concentration of activity at one place seen in Mexico city where central telephone exchange and radio station collapse due to earth quake in 1985 and communication in the city is completely cut and information cannot be sent to people and rescue team on time.
- 3. Industrial Area:** The effect of earthquake is two types; one is primary effect which directly caused by earthquake itself and second is secondary effect. For example in a earth quake prone area chemical plant or hazard base industries is located then there is increase in vulnerability of industrial disaster due to earthquake. Different type of industrial plant should be place in a city after calculation of seismic risk in the area. So the location of hazard base industries should

place according to wind direction and away from high density residential area.

**4. Traffic and Transport:** This is main component of land use in all type of city. It is like nerves system which circulates knowledge to brain. If this system fails then no felling reach to brain. Same case is happen at the earthquake time. Over bridges, railway network, metro corridors, under passes, air services fails due to earthquake. Power failure can stop the metro or trains. Collapse of over bridge stop traffic at one place and cut the city or area from another part. the circulation system must be design in a way that it not affected by earthquake. For this the circular road system is avoid in the earthquake prone area and redial system should be introduce; because vehicle access to a specific point is less likely to be cut by a road blockage in a circular road system than in radial one.

**5. Physical Infrastructure:** The effect of earthquake is more vulnerable when the physical infrastructure is fail in urban area. Water supply, water treatment plant, sewerage network, sewerage treatment and power substation are more affected from earthquake. The failure of the power station and collapse of electric pole make situation worse. To reduce the vulnerability from earth quake special planning consideration can be helpful. Like the utility network not lay down in long lengths. Network that inter connect and allow more than one route to any point are less vulnerable. Electrical lines should be laid down underground with flexibility in them.

**6. Park and Open Space:** Parks and open spaces reduce the vulnerability from earthquake. These areas can be converted into camp area during emergency time. As per the UDPFI Guidelines 2.5 sq. meter per person area is require for park and open space. The



temporary shelter can be provided in these areas, the overall site provides 20 to 40 sq. meter space for each person<sup>5</sup> (it include Infrastructure, but excludes land for agriculture.

**Conclusion:** There are two type of mitigation tool for reducing the vulnerability from earthquake, one is structure and second is non-structure. The non-structure measure can be more use because it controls the development in earthquake prone area. Planning norms and standards can control haphazard development in these areas and careful planning approach can reduce the vulnerability. Planning plays an important role because it plans for three stage which are:

- (1) Before the disaster ( Mitigation Phase)
- (2) During the disaster (Response Phase)
- (3) After the Disaster (Recovery Phase)

So earthquake effect can be reducing by using the planning strategy in earthquake prone areas.

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<sup>5</sup> Urban Planning and Governance: A new Paradigm



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