

Research Article

Need of Seismic Risk Assessment of Informal Urban Human Settlements in Formulation of Disaster Prevention Strategies

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Abstract

Due to rapid urbanization particularly in developing country like India, the formal growth of proper housing and commercial infrastructure development fails to cater to this requirement resulting in informal growth of non-engineered housing and commercial construction, inadequately designed multistory buildings and poorly planned street system. It is also observed that there is a total absence of health and social infrastructure including medical and emergency services in such unplanned urbanization. In the event of any major natural seismic activity, like an earthquake, huge damages to the manmade properties and human casualties and injuries may occur in such informal human settlements. Therefore, there is a need to conduct seismic risk assessment to estimate the probable damages and losses that may be caused due to these seismic activities which may then be utilized in formulation of disaster mitigation strategies.

Keywords: Urbanization, Seismic Activity, Losses, Fatalities, Injuries, Informal Human Settlement

Introduction

The rapid urbanization is a worldwide phenomenon and soon half of the world population will reside in urban areas. The total urban population is expected to reach 5 billion by 2030 while rural populations will begin to contract by 2015 onwards. In year 2030, the urban population is projected to increase to 54.5 percent and 53.5 percent from 39.9 percent in Asia and 39.7 percent in Africa respectively. In India the urban population was 285 million in 2001 which will increase to 550 million in 2021. The number of cities with population of more than 1million will increase to 75 from 23 during this period (Moreno *et al*, 2007).

It has been observed that the rapid pace of urbanization particularly in developing country like India is not being augmented by the formal growth of proper housing and commercial infrastructure development. This is resulting in huge informal growth of non-engineered housing and commercial construction, inadequately designed multistory buildings and poorly planned street system. The growth of these informal urban human settlements completely lacks the health and social infrastructure including medical and emergency services. It is expected that in the event of any seismic activity, like

an earthquake, huge damages both to the buildings and humans may occur in such informal human settlements. Therefore, there is a need to conduct seismic risk assessment to estimate the probable damages and losses that may be caused due to these seismic activities which may then be utilized in formulation of disaster mitigation strategies.

Major world disaster events

During the years 2000-2010, a closer look at the disaster events worldwide, as given in Table 1 and Table 2, brings forth the point that except for the Tsunami of 2004 all other earthquake events impacted urban centers thereby causing a number of deaths and injuries. Further, seismic events such as earth quakes and tsunamis were the deadliest (McClellan *et al*, 2010). The abovementioned data indicate an upward trend in the annual number of natural and human made disaster events reported worldwide. According to U.N. report on human settlements, human made disasters are likely to have their greatest impact in urban settlements. With these trends it can be concluded that without major changes in the management of disaster risk and of urbanization processes, the losses due to urban disasters are likely to increase in future. The management of disaster can be effectively carried out once the estimates for the seismic risk is available for the informal urban settlements.

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Table 1: World Disaster Events during period 2000-2010 AD (McClellan *et al*, 2010)

	Number of events	Mortality	People affected	Economic damage (US \$millions, 2005 prices)
Avalanches/ landslides	191	7864	1801	1382
Earthquakes, tsunamis	297	391,610	41,562	113,181
Extreme temperatures	168	60,249	7503	16,197
Floods	1310	90,237	1,292,989	208,434
Volcanic eruptions	50	262	940	59
Windstorms	917	62,410	326,252	319,208
Industrial accidents	505	13,962	1372	13,879
Miscellaneous accidents	461	15,757	400	2541
Transport accidents	2035	69636	89	960

Table 2 Major World Disaster Events during period 2000- 2010 AD (McClellan *et al*, 2010)

Popular Name	Main Countries affected	Date of event	Type of hazard	Main cities affected	Total number of deaths	Total number of affected	Total damages US\$
Haiti earthquake	Haiti	12 Jan 2010	Earthquake	Port-au-Prince	222,570	3,400,000	n/a
Sichuan earthquake	China	12 May 2008	Earthquake	Beichuan, Dujiangyan, Shifang, Mianzhu, Juyuan, Jiangyou, Mianyang, Chengdu, Qionglai, Deyang	84,476	45,976,596	85 Billion
Cyclone Nargis	Myanmar	2 May 2008	Tropical cyclone	Yangon	138,366	2,42,000	4 billion
Java earthquake	Indonesia	27 May 2006	Earthquake	Yogyakarta	5,778	3,177,923	3.1 billion
Kashmir earthquake	Pakistan	8 October 2005	Earthquake	Muzaffarabad	73,338	5,128,000	5.2 billion
Hurricane Katrina	United States	29 August 2005	Tropical cyclone	New Orleans	1,833	500,000	125 billion
Mumbai floods	India	26 July 2005	Flood	Mumbai	1,200	20,000,055	3.3 billion
South Asian tsunami	Indonesia, Sri Lanka, India, Thailand, Malaysia, Maldives, Myanmar	26 December 2004	Earthquake and tsunami	Banda Aceh, Chennai (some damage)	226,408	2,321,700	9.2 billion
Bam earthquake	Iran	26 December 2003	Earthquake	Bam	26,796	267,628	500 billion
European heatwave	Italy, France, Spain, Germany, Portugal, Switzerland	Summer 2003	Extreme heat	Various	72,210	Not reported	Not reported
Dresden floods	Germany	11 August 2002	Floods	Dresden	27	330,108	11.6 billion
Gujarat earthquake	India	26 January 2001	Earthquake	Bhuj, Ahmedabad	20,005	6,321,812	6.2 billion

Seismic risk assessment of informal urban settlements

Urban settlements are becoming larger and more numerous both by means of natural population growth and migration. The economic forces that are

responsible for this urbanization are also responsible for creating inequality in the urban environment particularly in the developing countries. When people are excluded from the formal housing sector due to various reasons they are forced to live in places which are known as informal urban settlements.

These informal urban settlements may be further categorized into different categories. In India the following categories exist in various cities:

1. Unauthorized colonies
2. Slums
3. Squatter settlements

These informal urban settlements are characterized by non-engineered construction, inadequately designed multistory buildings and poorly planned street system. There is total absence of health and social infrastructure including medical and emergency services. Hence, within a larger formal city system, these Urban-sub-systems exist which are more vulnerable to natural disasters.

The following factors are identified to be contributing to the increased vulnerability of such areas.

1. High population exposure due to concentration of housing in below standard construction.
2. Absence of or ageing infrastructure.
3. Dependence of population welfare on proper functionality of lifetime systems such as transportation, power, water and communication.
4. Inadequate public health, public safety and education facilities.
5. Weakness of preparedness programs and response and relief capabilities.

Conclusion

The phenomenal growth of informal urban settlements both in magnitude and size requires a comprehensive seismic risk assessment for estimation of probable damages and losses that may occur due to any seismic activity.

Therefore, specific vulnerability studies needs to be conducted to determine the vulnerability of these settlements as compared to that of the whole city. This assessment will then be utilized in formulation of disaster mitigation strategies.

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