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Research Article

Seismic Risk Assessment: A Pre-requisite for Earthquake Disaster Management

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Abstract

The Seismic Risk Assessment is generally carried out for an area which can either be a city, a part of city, a geographical region, administrative region, a state or a country as a whole. The main objectives of seismic risk assessment include quantification and estimation of the consequences of an earthquake event for an area under consideration. The consequences are quantified in terms of losses the area would suffer in the event of an earthquake. The Earthquake Disaster Management can be effectively planned and implemented only when the seismic risk assessment of the area under consideration has been conducted well before the occurrence of the earthquake event. The Earthquake Disaster Management is subdivided into three distinct time phases: pre disaster, during or just after the occurrence of disaster and post disaster management. Since the seismic risk assessment can be used for earthquake disaster management in all the three phases, therefore it is considered as an essential pre-requisite for effective earthquake disaster management.

Keywords: *Seismic Activity, Losses, Fatalities, Injuries, Human Settlement*

Introduction

The major natural seismic activity, like an earthquake, causes damages to the manmade properties and results in human and other casualties and injuries The Seismic Risk Assessment (SRA) is an established method for the assessment of damages and losses that are caused due to these natural seismic activities.

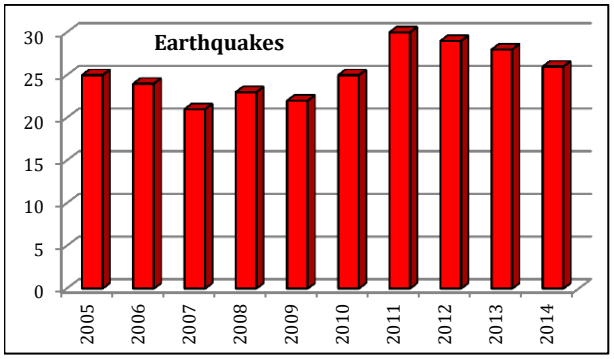

Fig 1: Earthquake occurrence in period 2005 to 2014 AD (Hamza 2015)

The SRA is conducted for a specified habitation area like a city, a part of city, a geographical region, administrative region, a state or a country as a whole. The main objectives of seismic risk assessment include quantification and estimation of the consequences of an earthquake event for an area under consideration. The consequences are quantified in terms of losses the area would suffer in the event of an earthquake. The Earthquake Disaster Management can be effectively planned and implemented only when the seismic risk assessment of the area under consideration has been conducted well before the occurrence of the earthquake event.

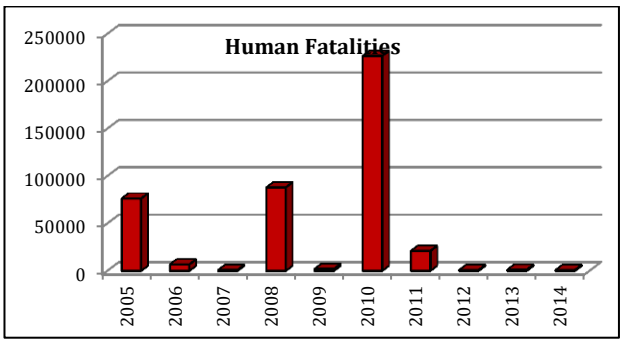

Fig 2: Human Fatalities due to earthquakes from period 2005 to 2014 AD (Hamza 2015)

The number of persons affected by these earthquakes is given in Figure 3 and the damage to the human

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settlements caused due to these earthquakes is given in Figure 4.

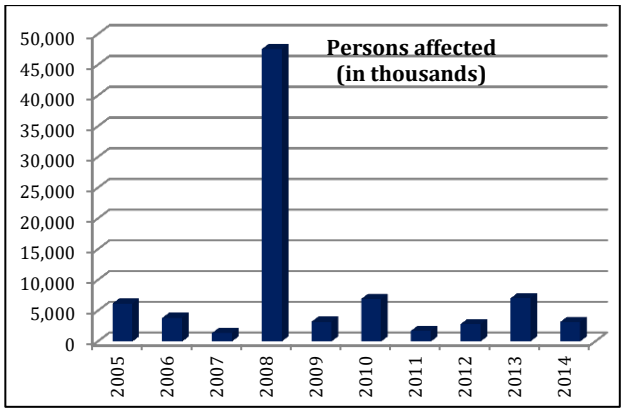

Fig 3: Number of Persons affected by Earthquakes during period 2005 to 2014 AD (Hamza 2015)

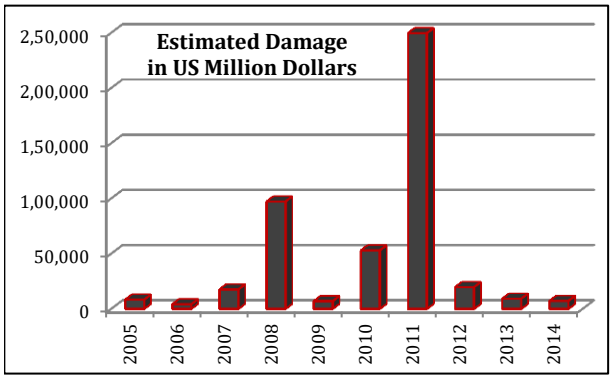

Fig 4: Estimated Damage due to Earthquakes in period 2005 to 2014 AD (Hamza 2015)

The above figures indicate that the major earthquake disasters have occurred between 2005 and 2014 AD with an average of 25 events per year. The large number of reported fatalities in year 2005 was due to earthquake in Kashmir, India (74,648 deaths), in year 2008 due to earthquake in Sichuan, China (87,476 deaths) and in year 2010 due to earthquake in Haiti, (222,570 deaths). If all the disasters are considered, then during the years 2005 to 2014, 71% of the fatalities were reported from medium and low human development countries of which 70% fatalities were due to earthquakes.

It will thus be imperative to identify and estimate the risk due to earthquake for all the human settlements. This will not only provide a stimulus to the design engineer for effectively designing the building structures that can withstand the detrimental effects of the seismic activities but will also facilitate effective disaster management planning.

Seismic risk assessment

The Seismic Risk Assessment (SRA) is a method employed for the assessment of damages and losses that are caused due to the natural seismic activities. The estimation of the consequences of an earthquake event for an area are quantified in terms of physical damage to buildings and other facilities, social losses in terms of number of injuries and fatalities, direct economic losses in terms of building repair costs and loss of contents, indirect economic impacts due to business interruptions and loss of production capacity and losses in terms of disruption of lifelines and critical facilities including medical and emergency services.

The Seismic risk assessment requires inputs from a number of specialized interrelated disciplines apart from general civil engineering and building engineering. These disciplines are GIS and remote sensing, seismology, geology, geotechnical engineering, general economics and risk management etc.(Muddassir et al. 2013; Muddassir & Risbud 1993; Khan & Muddassir 1996a; Ahmad et al. 2010; Ahmad & Muddassir 2014)

Therefore, seismic risk assessment of an area is an outcome of a multidisciplinary approach in which studies related to various disciplines are correlated and integrated in the best possible manner (Khan & Muddassir 1996b; Ahmad & Muddassir 1997).

The main findings and recommendations of such studies need to be presented in a format and language which is user friendly so that it could be easily understood by the stake holders and could be used in decision making easily.

Earthquake disaster management

The Earthquake Disaster Management (EDM) can be effectively planned and implemented only when the seismic risk assessment of the area under consideration has been conducted well before the occurrence of the earthquake event. The Earthquake Disaster Management is subdivided into three distinct time phases:

- Pre disaster,
- During or just after the occurrence of disaster, and
- Post disaster management

Pre-disaster phase: In this phase the disaster mitigation strategies are essentially formulated based on the seismic risk assessment. These strategies include:

- Direct intervention techniques
- Planning of disaster response mechanisms

The direct intervention techniques are the retrofitting and strengthening of structures to reduce the vulnerability of the built environment in general and of the critical medical and emergency facilities in particular.

The planning of disaster response mechanisms is essential for quick and comprehensive provision of relief in case of such disaster event. The estimates of social losses obtained from seismic risk assessment are

used for evaluating the adequacy of existing medical and emergency facilities. Similarly, the estimation of direct and indirect economic consequences of an earthquake from seismic risk assessment is used in the formulation of preventive mitigation strategies.

During or just after the occurrence of disaster: Immediately after the occurrence of an earthquake, the likely impact of the earthquake is obtained with the help of seismic risk assessment, before the actual assessment, for mobilizing emergency relief services.

Post disaster management: The seismic risk assessment is used during the post disaster management for selecting the cost effective alternatives for reconstruction which will have decreased vulnerability features.

However, these seismic risk assessment studies have time and cost dimensions. It is therefore essential that these studies should be formulated in such a way that cost incurred and time spent is optimized.

Conclusion

The Seismic Risk Assessment is an established method for the assessment of damages and losses that are caused due to the natural seismic activities. The main objectives of seismic risk assessment are quantification and estimation of the consequences of an earthquake event for an area under consideration. It provides a background to the design engineer for optimal design of building structures that can withstand the detrimental effects of the seismic activities and also facilitates effective disaster management planning.

The outcome of the seismic risk assessment can be used for effective disaster management in all the three phases. It is therefore concluded that the Seismic risk assessment of an area is an essential pre requisite for Earthquake Disaster Management.

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