Learning from Earthquakes

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Guest Editor's Note

Earthquake engineering profession has learnt more from performance of man-made structures during earthquakes than from laboratory tests or from analytical studies. Damaging earthquakes provide excellent full-scale test results on real-life structures; such results involve no modelling errors or approximations. Moreover, the results are for everyone to see and no sophisticated interpretation of results by the "experts" is required.

India has had an excellent tradition of scientifically studying earthquake effects, of learning from these earthquakes, and of publishing related information for wide circulation. Oldham's memoir[1]1 of the 1897 Assam earthquake (M8.7) was considered by Richter[2] as *one of the most valuable source books in seismology*. Similar memoirs were published by the Geological Survey of India after the 1905 Kangra[3] (M8.6) and the 1934 Bihar-Nepal[42] (M8.4) earthquakes. In fact, after the 1934, the ***Journal*** itself brought out a special issue[5]3entitled *The Great Indian Earthquake*. It is a delight to see this issue more than sixty years later; one cannot but admire the excellent photographs, the easy style of communication targeted at professional engineers, and above all the foresight of its editors.

Since some of the greatest earthquakes of the world have occurred in India, these earthquakes have led to several early developments in earthquake engineering. For instance, the 1819 Runn of Cutch earthquake (M8.3) provided[2] the *earliest clear and circumstantially described occurrence of faulting during earthquakes*. The descriptions of 1897 Assam earthquake provided the *principal model for the highest grade, XII, of the Modified Mercalli intensity scale*. As a consequence of devastation caused by this earthquake, the *Assam-type house* was developed which later became popular in the entire north-east and which is known for its excellent earthquake resistance. After the 1934 Bihar-Nepal earthquake (M8.4), the Geological Survey of India prepared the *Seismic Zone Map of India* in which the country was divided into three seismic zones. After the 1935 Quetta earthquake (M7.6), the Military Engineer Service made a significant attempt at earthquake resistant construction: it required reinforced concrete bands at plinth, lintel, and roof levels in masonry buildings. These are the features we recommend even today for earthquake-resistant masonry buildings.

Unfortunately, after independence the country seems to have lost the vigour in *learning from earthquakes*. Interest is picking up again as a result of four moderate earthquakes in the country in the last ten years, and these four earthquakes are relatively well-documented. However, despite this increased interest the professional engineers have not involved themselves in any significant way in the post-earthquake studies; such

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studies have been left to the academicians. As a result, incorporation of the lessons learnt from damaging earthquakes into engineering practice has been slow. In the developed countries with significant earthquake problems, it is the professional engineers that have been at the forefront of earthquake reconnaissance studies. To quote the famous California structural engineer Henry J. Degenkolb[6] *Some of us used to argue that you shouldn't really get your structural license until you've chased an earthquake...No matter how much you read the reports, the impact doesn't really strike you until you've seen the damage.*

Indian earthquake problem cannot be overemphasized: the entire Himalayan belt is prone to great earthquakes of magnitude exceeding 8.0. Therefore, the Himalayan belt and the Indo-gangetic plains have always been considered highly seismic. With the Koyna (1967), the Killari - Latur (1993) and the Jabalpur (1997) earthquakes, even the peninsular India is no longer considered aseismic. The Koyna earthquake caused major revision to the Indian seismic zone map, and yet another revision of the same is now under way as a result of the Killari-Latur earthquake. For instance, the draft zone map, under consideration of the seismic code committee of the Bureau of Indian Standards, proposes to upgrade the seismic zone for Madras to zone III (from zone II that it is currently in).

The good fortune has been that in recent years, none of the Indian earthquakes have occurred right under a major city. In the *Foreword* for this issue of the ***Journal,*** Professor George W. Housner, a pioneer of modern earthquake engineering[7]4, brings home very forcefully the fact that great or mega disaster may occur if a strong earthquake were to occur under a city which does not have earthquake-resistant constructions. India has large cities located in high seismic zones, and constructions in these cities are not earthquake resistant. We therefore have huge potential for such disasters. For a country like India, priority after the basic poverty issues (food, shelter, health, education) is to save the population from devastation caused by natural disasters. Therefore, professional engineers cannot escape the responsibility of scientifically examining the evidence of past earthquakes and of incorporating the lessons learnt into their professional practice.

Present issue of the ***Journal*** gives an overview of Indian earthquake problem. The specially invited articles, authored by persons intimately connected with the corresponding post-earthquake studies, give an overall perspective on what could be learnt from these earthquakes that is of value to engineering practice in the country. However, it is the sincere hope of the Guest Editor that these articles will motivate the professional engineers in the country to personally undertake to study the effects of future damaging earthquakes in the country (and outside) and to learn from such earthquakes. India can no longer afford to not have a vigorous *learning from earthquakes* programme.

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[1]Oldham,R.D., 1899, *Report on the Great Earthquake of 12th June 1897,* Memoirs of the Geological Survey of India, Vol.29, pp. 1- 379.
[2]Richter,C.F., 1958*, Elementary Seismology*, W.H. Freeman & Co. Inc., San Francisco, USA
[3]Middlemiss,C.S., 1910, *The Kangra Earthquake of 4th April 1905,* Memoirs of the Geological Survey of India, Vol.38, pp 1- 409.

[4]Officers of the Geological Survey of India, and Roy, S.C., 1939, The Bihar Nepal Earthquake of 1934, Memoirs of Geological Survey of India, Vol 73 pp 1-391
[5]*The Great Indian Earthquake,* Special Issue of the **Indian Concrete Journal**, Vol. 8, No. 10, , October 1934, pp. 263-324.
[6]*Henry J. Degenkolb, Connections: The EERI Oral History Series*, (Stanley Scott: Interviewer), Earthquake Engineering Research Institute, USA, 1994, pp. 1-226.
[7]For instance, see *George W. Housner: The EERI Oral History Series*, (Stanley Scott: Interviewer), Earthquake Engineering Research Institute, USA, 1997, pp. 1-275.