A Report on the SYMPOSIUM ON PRACTICAL LESSONS FROM THE LOMA PRIETA EARTHQUAKE held March 22-23 1993, San Francisco

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It is almost four years since the Loma Prieta earthquake of October 17, 1989. Since those ten seconds of shaking many lessons have been learned by all those affected. The objective of this symposium was to share these lessons and experiences so that the impact of future earthquakes on other communities might be minimised.

Before reporting on the symposium content it may be recalled that the Loma Prieta earthquake was Richter magnitude 7.1 with the epicentral region located 100km from the cities of San Francisco and Oakland. Excluding localised site effects, typical felt intensities, in these areas were about MM 7, similar to the expected intensity of a thirty year return period event in the central region of New Zealand. The Loma Prieta earthquake, at least as experienced by two large cities was not a major earthquake. Details of the earthquake and its effects have been published extensively, including a report by the NZNSEE reconnaissance team in this Bulletin, Vol. 23, No. 1, March 1990.

The following six topics were reasonably equally discussed during the symposium:- geotechnical, buildings, emergency preparedness and response, lifelines, bridges and recovery, mitigation and planning. All plenary session papers will be published in due course and copies will be placed in the New Zealand Earthquake and War Damage Commission and Victoria University libraries. Those issues raised at the Symposium and thought to be of special relevance to the New Zealand scene are discussed under headings from each of the above topics.

Geotechnical

It was considered that there were few new lessons learned. Behaviour was generally as expected. For example, ground fracture occurred along pre-existent faults and liquefaction was observed in areas previously identified as being at-risk. The absence of liquefaction on improved sites was noted.

The main concern was that known and well established geotechnical hazards should be more clearly communicated to the public for the purposes of planning and mitigation measures.

Buildings

Although it was observed that most damaged buildings had configurational irregularities, other concerns that were frequently raised indicated other factors also at work. The importance of appropriately skilled personnel to undertake calculation and drawing checks and construction supervision was a reoccurring theme, highlighted by the better-than-average performance of public school buildings which had benefited from full-time site supervision.

Much of the damage sustained to buildings was non-structural. The single largest cause being water damage from fire sprinklers. Damage control and serviceability criteria are areas obviously requiring attention by designers.

Issues raised concerning communication during the structural design process are also very relevant. The need for clients to be involved in decisions concerning the seismic risk and required performance of the building was emphasised. There is certainly a gap between the expectations of clients and the design philosophy of structural engineers. This was illustrated with the case of an structurally undamaged but flexible multi-storey building being retrofitted to prevent a reoccurrence of the violent motions experienced by its frightened occupants. Discussion between both parties at the commencement of designs for both new and retrofitted buildings is recommended to explore the distinction between a "well designed" building and one that is "code complying".

An issue of particular importance to New Zealand Territorial Authorities was the assessment and policies to deal with damaged buildings. It was suggested that procedures and guidelines should be prepared before a damaging earthquake. Decisions affecting the future of damaged buildings, such as at what damage level is demolition required, the level of strengthening required for a damaged building, and the special status of historic buildings are among the many needing to be addressed.

Unreinforced masonry building (URM) retrofitting programmes have been initiated or reactivated by many communities since the earthquake. State legislation introduced in 1992 requires permanent posting of URM buildings to inform the public of the seismic hazard.

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Emergency preparedness and response

It was stressed that Territorial Authorities and bodies responsible for public utilities should identify likely damage and the subsequent problems caused by an earthquake before an event, and to plan accordingly.

Lifelines

The performance of underground services was found to be strongly correlated to the amount of differential movement in the soil measured after the earthquake.

Areas, such as where faults are crossed or areas of soils prone to settlement occur within a utilities distribution network need to be isolated to limit the impact of the expected damage.

Non-structural equipment in water treatment facilities was subject to damage from sloshing effects.

There was found to be a need to educate people about the risks related to gas leakage following an earthquake. This could assist in reducing the length of power outages (of up to 40 hours) that were common. Gas leaks had to be repaired before power was reinstated.

Bridges

A retrofitting program which involved providing restraints to bridge beams is estimated as having prevented 350 bridges dropping their spans. Since the earthquake 1500 more bridges have been retrofitted as part of a very large Californian bridge retrofit programme.

Recovery, mitigation and planning

Recovery plans including appropriate regulations and policies addressing the post-disaster situation need to be in place before, not after a damaging earthquake.

It is believed that in general there is insufficient motivation for mitigation measures to be taken on a personal and community level. Financial incentives are required together with some state involvement, seen as indispensable to successful mitigation programmes

Summary

The impression gained was that there were few new lessons learned, **but many relearned**. Two important implications for New Zealand earthquake engineering practice arising from the Symposium are first, the importance of development and maintenance of quality control in the sense of fitness for purpose in both design and construction, and secondly, the question of 'how well prepared are we?' needs to be addressed. It is suggested that these two subjects could be useful areas of reflection in a future annual conference of this Society.

Acknowledgements

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