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EARTHQUAKE DAMAGE SCENARIOS FROM 1989 NEWCASTLE EARTHQUAKE SOME PRACTICAL APPLICATIONS TOWARDS FUTURE MITIGATION MEASURES FOR AUSTRALIA

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Earthquakes are the most devastating natural hazard to inflict suffering upon human civilization. Their destructive powers are unleashed, not only in the "earthquake-prone" areas on Planet Earth - the plate margin regimes - but also on the lesser-recognized so-called "stable" and low seismically active regimes - the continents. Today, all nations are striving to save and preserve the "natural" environment - but what about the "man-made" environment, the areas of human development?

For sustainable development, the catch-phrase of the 1990's to improve life-styles into the 21st century, the key element to mitigate the potential effects of future earthquakes on human society is **PREPAREDNESS.** In essence, the concern is that of the vulnerability. This has been aptly, indeed starkly, demonstrated by the many devastating earthquakes, particularly those which have occurred during this decade. The premise is patently obvious: as population increases, the built environment (engineered structures, non-engineered structures, infrastructure - in both urban and rural areas) expands, there by increasing the vulnerability to potential damage. Many disciplines in our society clearly recognize this - science, engineering, medicine, insurance, economics, sociology, government. This, there are two major issues : (a) to prevent loss of human life and injury, (b) to minimize the destructive impact on the built environment. As the 1990's are clearly showing, there are three essential criteria to be addressed : (a) learning the lessons from past damaging earthquakes, (b) implementation of the UN IDNDR program, (c) international collaboration.

Australia's stark reality to earthquake came on 28 December 1989 when the quite moderate ML 5.6 Newcastle earthquake struck the, western-style city and environs with devastating consequences - human lives lost severe damage to the built environment and critical facilities, disruption of economic systems, and distress to the population. This significant event, with the time-coincident inauguration of the IDNDR, were the catalysts upon which the two major issues based on the three broad criteria were addressed towards the mitigation of future earthquake effects in Australia. This is being achieved by the Australian IDNDR project of earthquake zonation mapping of urban areas (based on the international standard methodology adapted for Australian conditions) and joint working relationships with State Governments emergency services authorities. A multidisciplinary approach through an integrated team effort has been adopted, focussing on both hazard and vulnerability in the risk equation.

One of the most important outcomes of this research program has been the practical applications of the results - both á priori and post priori - with nine aspects targeted : earthquake and building codes; land-use planning; disaster planning; emergency management; emergency personnel training; insurance needs; rescue and response; community education; simulated earthquake exercises. In terms of the benefit to the community - certainly what mitigation is all about - the earthquake hazard scenario is that of the "What If ... ?" scenario. The studies reported herein have addressed both the pre-earthquake stage - AWARENESS, PREPAREDNESS - and the post-earthquake stage - RESPONSE, RECOVERY, RECONSTRUCTION RENEWAL - in the mitigation effort. This paper will discussed the following four issues within the scenario, each of which addressed and integrates the three essential criteria stated above.

THE ROLE OF LOCAL GOVERNMENT:

The City of Newcastle was not prepared for an earthquake. There was no City Disaster Plan for earthquake, although the emergency authorities (Police, Fire, State Emergency Services) had contingency plans for other, more common, natural disasters like floods. Local authorities were, as a general rule, given little consideration in terms of their involvement in the types of natural disasters that affected the State of New South Wales. The 1989 Newcastle earthquake changed both perception and fact as the Newcastle City Council assumed a major role in the response and recovery phases of the event. Post-disaster damage assessment, life safety, public health, post-event distress and environmental protection were key issues that the Council addressed in the first few days after the earthquakes, there was a heavy reliance on common sense and close co-operation between all involved agencies. The key to the City's physical and social recovery was the decision making that occurred in the first few days following the 1989 earthquake. An early objective of re-opening the severely damaged Central business district (heart and soul of the City) within days tested both officials and the public. The initial response, and short- and long-term recovery were epitomised by the leadership of the Council, together with the community, has led to a positive reconstruction of the City's physical and social infrastructure, Issues confronting the City in the ensuing six years have included the development of a City Disaster Plan, hazard mitigation programmes, land use and building policies and community education. These have been addressed utilising the practical experience gained in the 1989 disaster and the results of the recently completed earthquake zonation mapping of the City.

THE ROLE OF THE ENGINEER:

The role of the professional engineer following a major disaster, such as an earthquake, is important in all of the post-disaster situation. The 1989 Newcastle earthquake gave the City's engineering fraternity the opportunity and experience in handling such an event. Because Australia had no significant record of devastating earthquakes in urban areas, the damage to buildings and infrastructure had not been expected, either in codes, design or construction. As elsewhere in the world, the majority of existing buildings and infrastructure has not been designed or constructed to sustain nominal earthquake

loadings. No strategies by Governments (Federal, State or Local) were in place to regularly check the status of buildings and their constituent materials to ensure they had maintained structural adequacy over their life. Many lessons were learnt form the 1989 Newcastle earthquake and these have been applied in a most practical sense in the restoration of the City of Newcastle buildings, services and human elements. Relevant information form significant overseas earthquake and the earthquake zonation mapping project has also been integrated. Many strategies are now being implemented. Design and construction standards have been improved, even for the simplest of structures. Further measures need to be taken. These include the modification of educational courses for engineers to include the assessment of damaged structures, emergency services to involve structural engineers in building damage assessment, and Governments to address the mitigation of structural hazards.

EMERGENCY SERVICES PLANNING AND TRAINING:

Based on the practical applications of the lessons from the 1989 Newcastle, Australia, and other overseas earthquakes (particularly 1989 Loma Prieta, 1994 Northridge and 1995 Kobe) and the results of our program of earthquake zonation mapping of urban areas in Australia, various earthquakes mitigation measures are currently in progress. To date, these have focussed on specific localities within the State of Queensland and on the Cities of Newcastle and Brisbane. They constitute risk management processes involving identification, familiarisation, analysis and risk response planning. Matters of public policy related to local government planning, including response, rescue and the time factor for reconstruction and renewal, encompassing both the physical and human environments (that is - awareness, preparedness, response and recovery) are being considered. Two initiatives directed to all levels of emergency services personnel are currently in progress : (a) education training activities are being conducted through lectures, seminars, workshops and simulated earthquake exercises (both table-top and full-scale), (b) specific manuals to be used as guidelines for earthquake disaster planning are being prepared.

SIMULATED EARTHQUAKE EXERCISES:

As part of the above program, a real-time, full-scale, simulated earthquake exercise - "BRISQUAKE 93" - was held on 12 October 1993 for the City of Brisbane and Environs, Australia. This was developed and conducted to better prepare the counter disaster agencies to such an unexperienced disaster. The premise of community disruption and property destruction by an earthquake is well established - such as the 1989 Newcastle and other recent overseas earthquakes. The aim of "BRISQUAKE 93" was to assess preparedness and identify deficiencies of the Brisbane Disaster District to deal with generic issues involved in the immediate aftermath of an earthquake event, including : awareness; command, control and coordination; search and rescue; transport and evacuation; disruption to essential utilities; engineering issues; community health and welfare. The earthquake scenario was for an ML 6.0 to occur at 0600 hours (local time) with the epicentre about 20 km from the City centre, followed by an aftershock of ML

4.5 at 1430 hours. Planning was undertaken over several months and included seminars and pre briefings for all relevant agencies. For this exercise, 85 personnel from 15 agencies were activated. More than 100 serials (specific damage occurrences and incidentals) requiring response from both single and multiple counter disaster agencies formed the exercise scenario. One major aspect, new to emergency services authorities in this region, was the emphasis on the geological controls to damage. The exercise was considered as achieving a high level of success, clearly showing the value of such an activity to emergency personnel.