

Newcastle Earthquake

Date: 28 December 1989

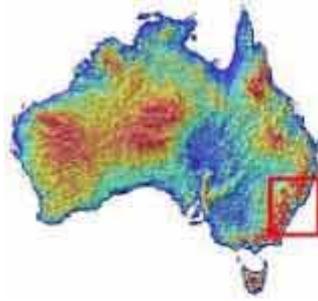
Time (local): 10:29.00 am

Time (UTC): 23:26:57.0

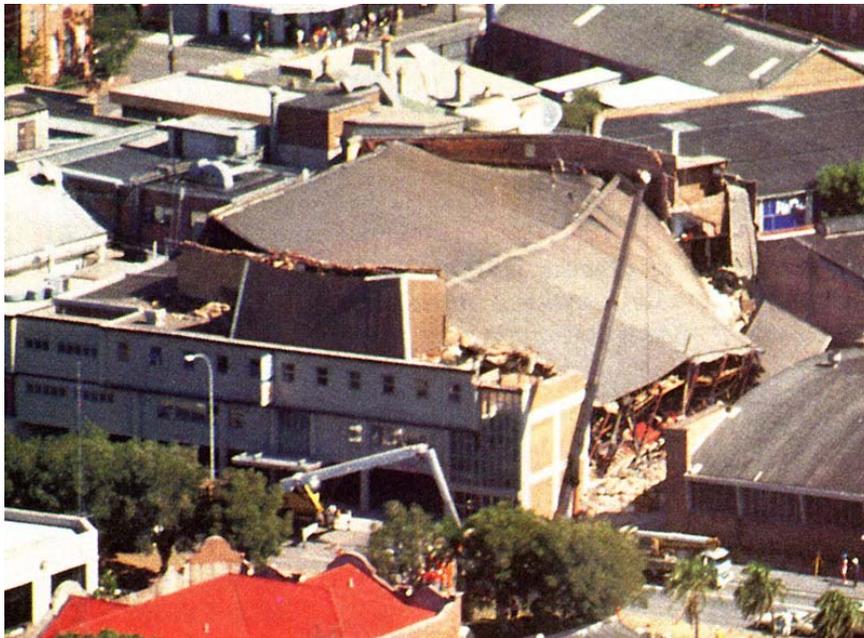
Latitude: -32.946

Longitude: 151.607

Magnitude: 5.6 (ML)



One of Australia's most serious natural disasters occurred when an earthquake shook Newcastle in New South Wales, leaving 13 people dead and injuring more than 160. The damage bill has been estimated at around A\$4 billion dollars, including an insured loss of over A\$1 billion. All the result of just a few seconds of earthquake ground shaking at 10:27am on 28 December 1989 (McCue and others, 1990).



The consequences of this moderate earthquake to Newcastle (Pop. 300 000), an industrial city on Australia's east coast, could so easily have been avoided with the hindsight of history and the application of relatively inexpensive earthquake engineering principles.

The earthquake itself was only moderate even by Australian standards, rated Richter magnitude 5.6, it was barely recorded in New Zealand or Papua New Guinea the nearest neighbouring countries. Indeed, though Australia is popularly considered to have low earthquake risk, earthquakes of this size occur every 18 months or so on average somewhere in Australia although rarely so close to an urban area.

The epicentre (the point on the Earth's surface immediately above the focus which is the point of initiation of rock fracture) was some 15 km southeast of the Newcastle Central Business District (CBD). Characteristic depth phases on distant seismograms confirm that the focus itself was 10 to 12 km deep within the crust under Boolaroo an outer suburb of Lake Macquarie. So, whilst the focus was not at very shallow depth directly beneath the city, the earthquake had a reverse type mechanism and was at a critical azimuth from the city, directing most of the energy in its shear waves directly towards the CBD.



Some of the buildings in Newcastle date back to the 1860s, most of them were either unreinforced masonry (URM) or had URM components such as chimneys, walls, verandahs or access stairs. The proximity of the sea and a large steel works caused widespread corrosion of steel ties between the brick walls or wall and timber frame, and in the suspension ties of awnings and parapets where they existed. As a result all such buildings were highly vulnerable to horizontal shaking.

And last of all the foundation soils in Newcastle; in the inner parts of the city these were alluvium, some of it dredged from the Hunter River, other parts were underlain by former courses of the river now filled either naturally over time or by humans for housing developments. It is well known that the ground shaking on sedimentary layers may be amplified relative to that on bedrock, at frequencies which correspond to the natural frequencies of buildings so damage is exacerbated.

This cocktail of old vulnerable buildings on poor foundations at Newcastle was an accident waiting to happen, as is obvious in retrospect. Could this disaster have been prevented?

There was no warning of this earthquake, but the history of earthquakes in the region (Hunter, 1990) should have been sufficient to alert business and governments to the need for precautions. The earthquake code published in 1979 (AS1170.4) did not require that earthquake resistant design regulations be adopted in Newcastle for new buildings, nor did it require the strengthening of old buildings, but it did encourage owners to do more than just provide the minimum strength.



The lessons are obvious; many other Australian cities have this same combination of conditions; old buildings, inadequate maintenance, brittle URM materials and poor foundations. Furthermore though the written history is short, every Australian city has a record of past seismicity. Few cities have mandatory earthquake building regulations and none have mandatory regulations to strengthen old vulnerable buildings. The consequence of a close even moderate earthquake tomorrow will be similar to that in Newcastle in 1989.

References:

Hunter, C., 1990 - Earthquake tremors felt in the Hunter Valley since white settlement. Hunter Home Publications, Newcastle, 120pp.
McCue, K. F., Wesson, V. and Gibson, G.M., 1990 - The Newcastle, New South Wales, earthquake of 28 December 1989. Bureau of Mineral Resources Journal of Australian Geology and Geophysics, 11, 559-567.