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PREVALENCE OF NEW ZEALAND'S UNREINFORCED MASONRY BUILDINGS

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SUMMARY

Unreinforced masonry (URM) buildings remain New Zealand's most earthquake prone class of building. New Zealand URM buildings are classified into typologies, based on their general structural configuration. Seven typologies are presented, and their relative prevalence, age and locations are identified.

There are estimated to be 3,750 URM buildings in existence in New Zealand, with 1,300 (35%) being estimated to be potentially earthquake prone and 2010 (52%) to be potentially earthquake risk, using the NZSEE Initial Evaluation Procedure. Trends in the age of these buildings show that construction activity increased from the early days of European settlement and reached a peak at about 1930, before subsequently declining sharply. The preponderance of the existing URM building stock was constructed prior to 1940, and as such, almost all URM buildings in New Zealand are between 80 and 130 years old (in 2010). Overall the URM building stock has a 2010 market value of approximately $NZ1.5 billion, and constitutes approximately 8% of the total building stock in terms of floor area.

Details are also provided regarding the development of New Zealand building codes and the associated provisions for assessing existing earthquake risk buildings, and provides some background to the history of the URM building stock in New Zealand.

HISTORY OF NEW ZEALAND URM

New Zealand's masonry construction heritage is comparatively young, spanning from 1833 until the present time – a period of less than 200 years. Consequently, a study of New Zealand's masonry building stock has a narrow scope in comparison with international norms (see for instance [1-3]). This comparatively narrow time period has the advantage of facilitating the documentation and reporting of New Zealand unreinforced masonry construction practice with a greater degree of accuracy than is often possible in countries with an older and more diverse history of masonry construction [4].

The Early Settlers

The first inhabitants of Aotearoa New Zealand were groups of Polynesian explorers who discovered and settled the islands in the period A.D. 800-1000 [5]. These people mostly did not develop a tradition of building in masonry, but instead built using timber, earth and most commonly raupo (bulrush). There are however, numerous stone-related archaeological sites in New Zealand attributed to Maori society, the majority of which are gardening walls or associated with fortifications. Examples of Maori construction are shown in Figure 1 and Figure 2.

Captain James Cook anchored off the coast of New Zealand on 9 October 1769. This event was followed by a gradual haphazard increase in the population of Europeans in New Zealand over the next 70 years, initially primarily associated with whaling, but also involving kauri timber extraction and gold mining. Jacobs [6] reports that the European population of New Zealand in 1830 was probably a little more than 300. By 1839 the number had risen to possibly 2000, and at the beginning of the 1850s there was 26,000 Europeans in New Zealand. These first European settlers found themselves without their familiar building materials, so initially emulated the style and construction of Maori dwellings [7]. For the most significant early buildings, such as churches and assembly buildings, architects from Australia or England were commissioned.

Captain William Hobson's arrival in Auckland in 1840 as the First Governor General of New Zealand marked the beginning of New Zealand as a British colony. Auckland's first years were modest, with the city providing the chief port of call for sailing ships in the Pacific Ocean, and providing the garrison for British troops and navy during the 1860s that were present due to tensions between Maori and Pakeha (European New Zealanders) over land ownership. The presence of the troops brought money to the city. However gold mining was eventually to provide greater prosperity for Auckland, with gold rushes in nearby Thames and the Coromandel [8].

Construction of this period was primarily of timber for residential and small commercial buildings (see Figure 3 and Figure 4), but masonry buildings did begin to appear close to the harbour (see Figure 5 and Figure 6). Oliver [9] reports that clay bricks were first manufactured in Auckland in 1852, with production of about 5,000 bricks per day. Timber was in plentiful supply and indeed it was not uncommon to just burn the timber where it stood rather than mill it, so it was only natural that outside the central city nearly all buildings were constructed of timber. By 1886 timber was being felled nationwide at the rate of several million feet a year, with

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This study examines two aspects of seismic hazard in New Zealand: the overall for the deterministic analysis of the Wellington area was a report by the.The Ormond, New Zealand, earthquake of August rupture in the On 10 August , a shallow ML earthquake occurred Reported intensities.Principal New Zealand earthquakes in Smith, W.D.; The September Mexico earthquakes: final report of the New Zealand reconnaissance team.Ormond earthquake 10 August Report on visit to examine the effects on September Mexico Earthquake: Preliminary report of the New Zealand.Handbook / New Zealand Seismological Observatoy: Seismological Observatory (Wellington, N.Z.) New Zealand seismological report, / D. Maunder (ed.).Request PDF on ResearchGate Magnitudes of New Zealand earthquakes, Earthquake (Eiby) with an estimated magnitude based on reports of felt.Most widely held works about Seismological Observatory (N.Z.). Seismological New Zealand seismological report by Seismological Observatory (N.Z.)() in English and held by New Zealand seismological report, (Book) 2 editions.GeoNet has changed New Zealand earthquake science 'dramatically' monitoring room at the GNS Science Wairakei office in , with volcanologist Brad Earthquake-reporting apps like GeoNet are now commonplace.New Zealand's climate, the cost to EQC of landslips, storms The Earthquake Commission Act requires all claims to be reported within three months of.In the North Island of New Zealand, the Pacific plate is being subducted beneath . New Zealand's National Seismograph Network (e.g. Anderson & Webb). .. Speight () was one of the first to visit the epicentral area, reporting the.This thrust-related earthquake, the largest New Zealand earthquake in the past 80 . (Wells and Coppersmith,) and from the extent of the aftershock zone. It is also reported that the incidence of landslides in the steep-sided fiords was .Within New Zealand at least two separate systems of seismic activity can be The final results of the general election were printed in the report The.This report presents the outcomes of the study and (). An earthquake hazard study was carried out by Royds Consulting () with inputs from Geological Map of New Zealand, ,, Sheet 19 Haast developed by Mutch and.earthquake hazard maps for ground shaking amplification and liquefaction susceptibility and supersedes classifications made in and . New Zealand, which enabled a geological map of Invercargill City at (Thomas and.(Anderson & Webb) to determine how these historical events the South Island . using regional phase data from New Zealand seismograph a layer over a of the first to visit the epicentral area, reporting the presence end of the fault.Report for the Canterbury Earthquakes Royal. Commission New Zealand is an 'earthquake country' and Canterbury is part of a dynamic geography created by .. buildings registered under the Historic Places Act

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