

## Field experience section

# COMMENTS ON SOME EARTHQUAKE DAMAGED BUILDINGS IN NEW ZEALAND

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These comments are derived from experience in inspecting buildings damaged by earthquakes in New Zealand spread over a period of some sixteen years. This work has mostly been done in association with assessors and other professional colleagues. Their views and guidance have been a valuable help in keeping attention mainly directed at the task of finding out what damage has been caused by the particular incident, and thus arriving at a fair evaluation of the claim on an indemnity basis. This has left little time for pursuing studies which might have been more interesting from the technological aspect, and such comment as is offered below must be accepted as a by-product of a professional activity.

The only earthquakes of any consequence personally experienced have been the series felt in Wellington in 1942. This was followed by involvement in some of the resultant reconstruction and remedial work, and this has served as a helpful base reference when visiting places which have experienced a damaging earthquake. These visits have sometimes been shortly after the incident, but often months later, and never to date while the dust was still settling.

Inspections of well over one hundred buildings have been involved as a result of about ten earthquakes varying from minor to major incidents. These have been carried out in Wellington, Dannevirke, Picton, Westport, Gisborne, Greymouth and Inangahua. Most of the buildings inspected have been relatively modest structures and seldom has the damage been in any way dramatic. This is inevitably a very random sample and not a comprehensive survey. Many things noted tend to illustrate what "Punch" used to call - another glimpse of the obvious. In making comment in such circumstances it seems advisable to avoid the particular and treat the subject in a general way.

It is interesting to note that the major part of the claims examined have shown no new structural damage. In many cases no claim at all has been conceded. As a rough approximation perhaps twenty-five percent have shown positive new damage and perhaps fifty percent more have suffered only superficial damage or the reopening of old defects caused by previous earthquakes. It is also interesting that some new damage has been found in a small number of modern buildings erected since the new Model Building Bylaw was introduced in 1935.

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The majority of the buildings have not unexpectedly been from forty to fifty years old and some up to about sixty-five years of age. They have usually been of one or two, and sometimes of three storeys, mostly of the normal type of that era, with brick bearing walls, timber floors, and roof framing, and almost without exception corrugated iron roof coverings. In a great many cases it has been evident that the standard of workmanship has not been high in the initial construction, and the standard of repair and maintenance often regrettably low. Exceptions to this comment would normally be such buildings as Theatres, Hotels and Hospitals which have of necessity been reasonably well maintained, but it has equally become clear after the occurrence of an earthquake that this standard may be no more than skin deep. It is however reasonable to consider that if examination of all the buildings which were not the subject of a claim were made a rather more favourable impression of the general scene might be formed.

In the type of building described above, New Zealand being an active seismic area, it is natural to expect and to find evidence of damage caused by former and often much more severe earthquakes dating back to the first forty years of the century. This pre-existing damage is apparently a source of endless surprise to building owners, who being technical laymen are often quite unaware of the significance of the defects which may well be brought to their notice for the first time by a new incident.

The problem of the older buildings, will of course eliminate itself in time as they become obsolete and are replaced, and future quakes will only act on skillfully designed buildings whose every reaction will have been accurately forecast by computer techniques thus enabling practical and economical precautions to be taken against resultant damage.

It is quite clear that the older bearing wall brick buildings in New Zealand cannot be expected to have the same life span as similar buildings in zones of relative seismic stability where a life of several hundred years is normal. A forty year old building in New Zealand if examined critically can look very old indeed. This can be equally true of well constructed framed buildings which have not been specifically designed to resist earthquake forces as the cost and inconvenience of upgrading them may be uneconomic. Many of these older buildings are potentially dangerous in the event of future earthquake and a quite moderate incident can show that they are hiding a multitude of old blemishes. The unnerving experiences of the occupants of such buildings, with plaster debris showering down around them, has occasionally caused them to be evacuated, abandoned and demolished. Many other owners and occupants continue to use similar buildings for their daily activities from practical or economic necessity.

Some prudent building owners, or those fortunate enough to have insured against earthquake risk and to have collected a claim, have spent their own or the insurance company's money in remedial strengthening and repair schemes. Such buildings invariably show positive improvement in relation to enhanced safety and reduced incidence of subsequent damage. This is particularly clear when they are compared with neighbouring buildings which may only have received superficial repairs. It is not uncommon however to find that the cash resources available have only allowed a part of the building to be strengthened. It has been reassuring to find that most, if unfortunately not all, auditoriums examined were to some extent strengthened in the mid 1930s, and some indeed in a very adequate way. It has been disturbing to find some buildings of a public nature with the bare minimum of rather ineffective remedial work carried out after past earthquakes and still in daily use. It is questionable whether such buildings are in fact fit for continued use, and this is only finally brought home to owners and users by a moderate earthquake exposing the existing defects to view. That this may result initially in a claim for "total loss" is one of the hazards of assessment work, and sometimes it requires months of patient negotiation to bring owners to a realisation of the true state of their buildings as they were before the current incident.

The Emergency Regulations in force after 1942 enabled the Wellington City Council to serve notices on owners and much valuable removal of potential hazards, remedial work, and strengthening was done. Comparisons with other places where recent earthquakes have occurred suggests that this work has considerably reduced the risks in the moderate range of future earthquakes. It would however be unwise to regard the present situation with complacency or the work done as completely adequate.

It is clearly desirable in the public interest that all such now sub-standard buildings should be swept away as soon as the country's economy can permit. The 1968 amendment to the Municipal Corporations Act relating to buildings potentially dangerous in an earthquake is a first step, and the effect of this legislation will undoubtedly be felt in the next few years. It is well that the community should realise that many properties now considered to be quite desirable, and often returning high percentages on capital outlay, may rapidly deteriorate in value to virtually no more than that of the land.

One feature constantly appearing in this group of buildings is the damaging effect of corroded steel both exposed and concealed. Many times has "earthquake damage" been found to have its origin in rusted hoop-iron bonding in brickwork, reinforcing in concrete work, or exposed steel frames and arch bars at brick openings. Apart from causing positive rupturing of brick and concrete work before any earthquake occurs, such defects extend and develop under shock.

It is noticeable that buildings built in several stages at different dates, or those that have been extensively altered after their original construction are usually more prone to damage than homogeneous or unaltered buildings. Such frequently incorporate toothed ends of brick walls used for later extension, party walls

shared between two buildings, the shallow block bonding of new walls to old, existing external walls being used to serve later adjoining buildings, etc. These features are all likely built-in seats of later earthquake damage.

Some buildings have been built with an eye to future extension but have never been completed. It is perhaps not surprising to find that a one hundred foot long wall and parapet having a return front wall, but only light timber framing as a back wall, has suffered damage to the parapet. It is equally to be expected that when the offset of the displacement is inspected it is found that the major part of the movement took place years previously, and that no repair work had then been done.

It is also noticeable in these relatively small buildings to find that irregularity in plan and sectional shape normally gives reduced resistance to shock compared with simple and regular shapes, and reasonable division into compartments by cross walls.

It is not uncommon to find that after an earthquake has hit a centre the local authority will cause barriers to be erected to keep people away from dangerous masonry, and require tomming up of other work. Such precautions are usually more than justified and are sometimes followed up with demolition orders or strengthening requirements, issued one suspects, with the purpose of persuading owners to action, but with the knowledge that to date existing legislation somewhat lacked for teeth. This situation will change with the recent amendment to the Municipal Corporations Act. In a particular case a detailed examination at leisure of a hastily tommed up dangerous structure revealed that the crack between front and side walls had been in positive existence for perhaps twenty five years. The current incident had merely displaced previous patching and revealed an old smoke impregnated crack. Enquiry brought out the fact that the adjoining building had burnt and one storey had been removed some nine years previously.

Users can also loose their concern as the quake recedes in time. One carefully tommed cracked brick arch is recalled, which at the next visit had been restored to a clear gangway as the tomming was inconvenient.

Most local authorities in serving notices on owners are careful to avoid stating that the requisition is a result of the particular earthquake but rather that the earthquake is the occasion of serving the notice. It is however almost always interpreted by owners as a measure of the damage caused by this latest quake. In one or two cases it has not been possible on examination to identify any new damage to a building served with such a notice and no claims have been granted. But one can usually agree without question that the owners would be very wise to carry out the work suggested by the local authority.

One interesting and probably rare sidelight is where an owner had a scheme of alterations to an old building under consideration just before the occurrence of an earthquake. This incident demon-

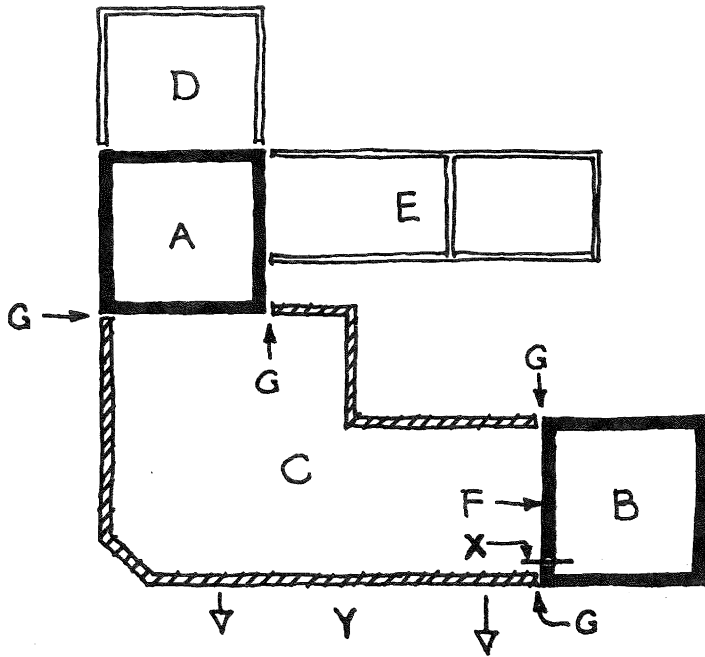
strated all the old and some new defects in the building, and the earlier scheme needed to be reappraised. Professional advisers need always to approach such old buildings with caution and give a down to earth assessment of the qualities and defects of an old building, although they may not always be believed or thanked for their opinion by the owners concerned.

Building settlements are sometimes confused with earthquake damage and are sometimes the cause of unreasonable claims. Recollection brings to mind one owner who, when presented by the assessor with the architect's report which attributed the damage to previous settlement, agreed that the report was quite correct but that it was worth trying on anyway. Damage caused by settlement unless properly repaired is prone to later extension by earthquake.

Poor workmanship and the less adequate standards of tradesmanship of forty years ago will always be found out by an earthquake, and not necessarily the most recent one. A recurrent trouble is the habit of laying bricks in stretching bond without adequate header courses. An example has been seen thus with up to seven or eight courses high of stretchers topped with a coping of three parallel stretchers, and it was in a very precarious condition. Parapets like this are dangerous without seismic movement.

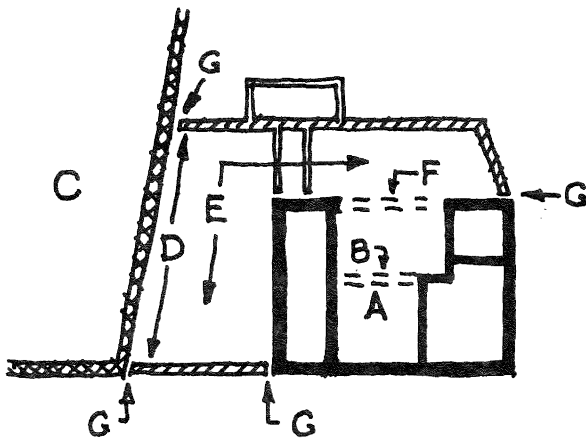
It is surprising what will survive an earthquake at times. An example is recalled of a one storey shop with an ornate parapet weighing about twenty-five tons balanced on a five inches wide steel joist and two cast iron columns. This survived an earthquake which did major damage to another building not far away. When one stood on the back ledge of the parapet it was very easy to make the whole thing sway. The earth movement was apparently and fortunately in the direction of the length of the parapet, and as far as is known it is still there.

In conclusion it is of interest to recall some human reactions from people encountered in the course of this work. The Arbitrator who remarked that he did like that bit about the fern growth in the cracks, but apparently overlooked it in his award: the Legal Adviser who was constrained to propound an entirely new theory of indemnity insurance to include the use of buildings: the tipsy owner who spun dangerously round his own parapet-top flag pole: the charming young wife who on being told that the quite substantial cheque would go to the mortgagor asked that at least they might see it on the way: and the Cook who said rather disparagingly - earthquake! you should have been in Wellington in 1942, that was an earthquake.

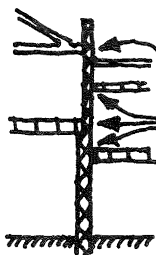


- A 1905 3 storeys
- B 1905 2 storeys
- C 1911 3 storeys
- D } Later 1 storey
- E }
- F Wall of C raised 1 storey on wall of B
- G Tothing new to old.
- X 2" wide vertical crack
- Y Top storey wall displaced outward, roof & ceiling timbers pulled off plates and dropped 2" to 3"

No 1 HOTEL BUILDING  
Scale: 32'-0" to 1"



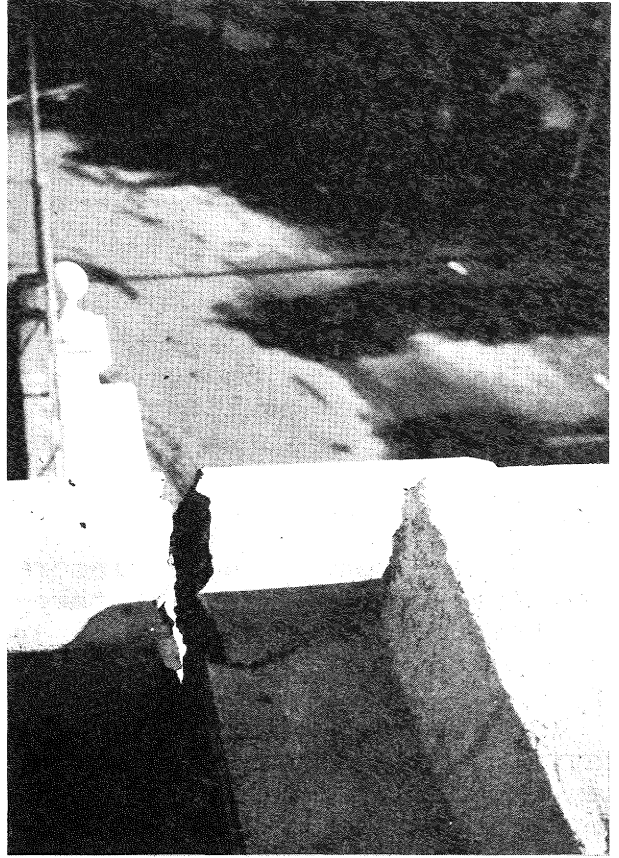
- A 1904 2 storeys 40'x30'
- B 1921 Internal wall removed
- C 1921 Adjoining building built, 2 storey wool store
- D 1923 Purchase half width of party wall
- E 1923 2 storey addition
- F Remove part of former external wall.
- G Block bonding new to old
- X Damage to party wall



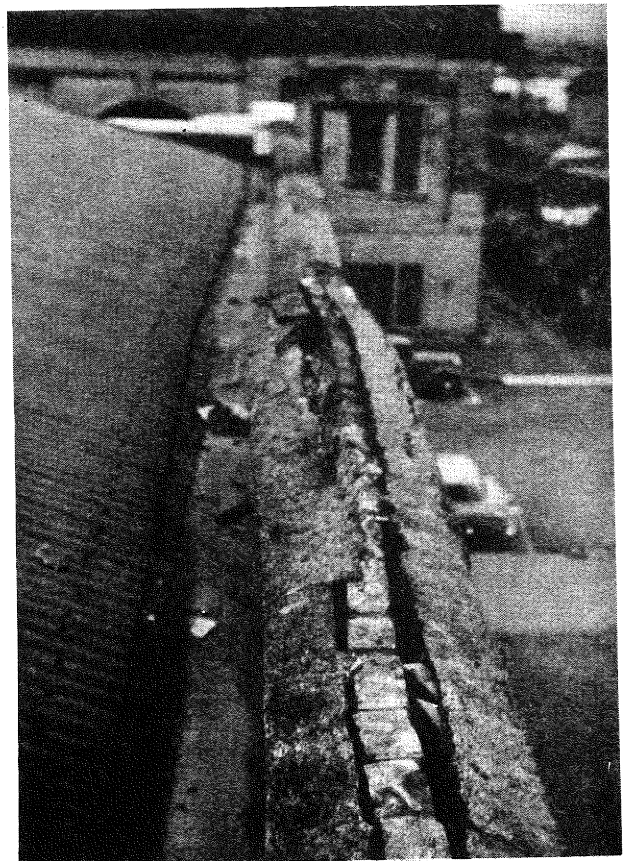
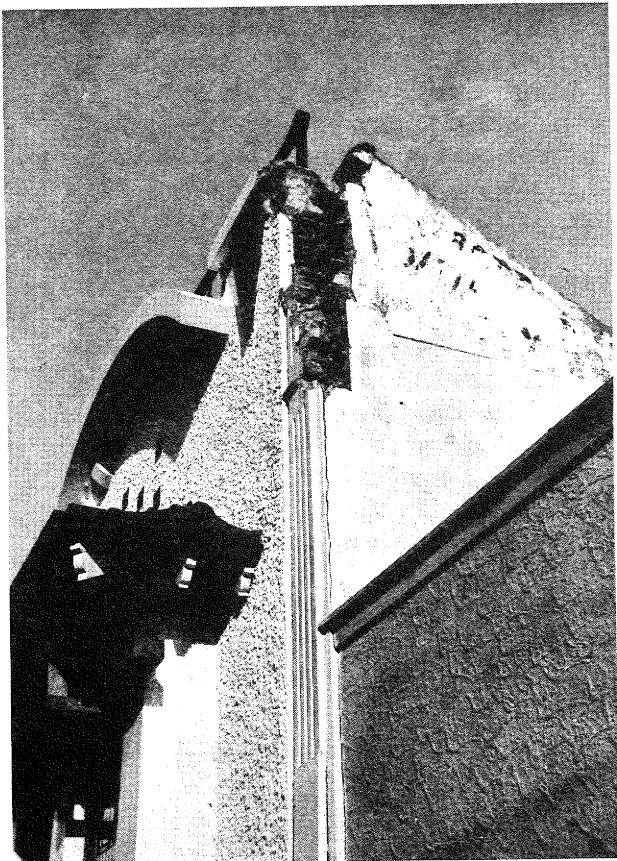
Section H Party Wall D

No 2 BOARD OFFICE BUILDING

TWO EXAMPLES OF NON-HOMOGENEOUS BUILDINGS WHICH ARE PRONE TO DAMAGE



New 2" crack associated with 70 foot long front wall moving outward.



An old crack impregnated with smoke from fire nine years previously.

A parapet built in stretching bond.