
Article - Earthquake Strengthening

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Earthquake Strengthening

The earthquake strengthening of existing buildings has become a topic of intense interest to property owners particularly in the last two years when territorial authorities have engaged engineers to identify earthquake prone buildings within their area. In doing so, they are discharging an obligation under the Building Act.

The process is a tortuous one, as many owners of smaller, older buildings have discovered.

STEP

The council engages external consultants to make an assessment of the building. Their work includes a review of any existing drawings, a street-side inspection of the building and based on this, plugging in various values into a standard form. The form is one developed by the NZ Society for Earthquake Engineering, and is intended to assess the earthquake resistance of the subject building compared with current requirements.

Since many buildings were designed for design for an earthquake coefficient of 0.1 or without consideration of earthquakes at all, and the current requirements can require an earthquake coefficient of up to 0.65, it is not surprising that many buildings will be deemed to be earthquake prone.

Where the strength of the building is considered to be less than 33% of the current requirements, it is deemed to be earthquake prone.

The current requirement is that the owners should engage their own engineer to make a more refined assessment of the strength of the building.. to identify structural elements (such as walls) and other mitigating factors which add to the earthquake resistance of the building,

Often in older concrete buildings, it is demonstrated that buildings have elements which in total take the building over the 33% threshold. For the other buildings, the Council requires that the building be strengthened and brought over the 33% threshold.

The good news is that many Councils allow owners 15 years to get the work done. This was an extension from the original 10 years. When many Councils

found that they themselves were the proud owners of many earthquake-prone buildings.

Earthquake strengthening can be an expensive and disruptive process, and many owners have procrastinated and delayed action. In some cases the buildings in question are apartments owned by Body Corporates whose members are private householders.

When buildings are apartments, if they are brought up to 33%, that may be the end of the matter as the building is unlikely to undergo a change of use, or to have work needing a building consent in the future.

For a commercial building, where it is likely that in the future there could be a change of use or at least building work requiring a building consent, the answer is not so simple. The current rule is that in such cases, the building is required to comply as closely as possible to current code requirements (not only for earthquake strength, but also for fire, (and in the case of residential conversion, energy efficiency, sound proofing, ventilation etc.

It is not possible here to provide more than a glimpse of the extent of the problem, however two case studies illustrate some of the difficulties.
(Some details have been omitted to protect the privacy of the owners.)

CASE A

Building A was a three storey building designed in the 1960s one bay wide x 5 bays long, designed for an earthquake coefficient of 0.1. The concrete columns were small while the beams were large and neither were detailed for ductility. Worst of all the concrete blockwork was not reinforced. The building had commercial tenants on the lower two floors and a rough "apartment" on the top of questionable provenance. The owner wish to remodel the existing apartment and add another floor -a common way of adding value to an investment.

Under the current requirements this would have required the building to be brought up as close as practicable to current code levels.

As this would have been uneconomic, the owner decided, after much soul-searching, that he was not add another floor, forego the anticipated profit and proceed only with the refurbishment of existing apartment to avoid the cost of earthquake strengthening.

The gotcha however, was that the Council did not accept that the existing residential use was legally established (even though it had been collecting residential rates for many years.) The upgrading of the apartment would therefore be subject to a resource consent application, and the upgrading of everything from energy efficiency, acoustic standards, fire as well as earthquake strength. Having gone this far, the owner agreed to a system of steel braces (knee braces and K braces) in order to proceed.

At this stage the Council required the deep soil of the locale (as well as the non-ductile detailing) to be included in assessing the earthquake coefficient which was now in about 0.66. In addition, the Council required the short column effects of a row of slit windows (in an unreinforced concrete block wall) to be taken into account.

Increasingly frustrated, the owner sought a second engineering opinion, which demonstrated (miraculously) that the doing exactly nothing to the building would bring it as close a practicable to the current code.

That is not the end of the story, because the owner, having finally got a building consent requiring no structural strengthening, nevertheless decided not to proceed, either because it was not sufficiently profitable or for other private reasons.

The building not previously identified as an earthquake prone building is now identified as such, but it has been demonstrated and accepted by the Council that doing nothing has brought it as close a practicable to current code.

CASE B

Building B was an old brick building with a plaster façade considered to have historic worth. More than 10 years ago it was identified as an earthquake prone building requiring strengthening. A system of light-weight steelwork was added to holding the building elements together, but the main earthquake resistance was taken up (at the insistence of the then-owner) by an adjoining new building to be constructed. Provision was made for adding another storey to the existing. The land titles of the two buildings were amalgamated to ensure the continued support of the old building by the new.

Some 10 later the buildings were subdivided and sold in the full knowledge of their interdependence. The new owner of the old building proceeded immediately to demolish parts of the building in anticipation of upgrading the existing and adding another residential floor (cutting off his rental stream). His concept was to add something mimic the frontage of the existing. However the Council want the upper level to be completely different from the existing, set back from the street and furthermore required the rear brick wall of an old shop (which in reality is exactly that) to be preserved for the sake of architectural integrity.

Since another floor was being added, the Council required the combined two-building structure to comply as close as practicable to the current code. Since the owner of the new building was extremely unlikely to be caught up in any earthquake strengthening, the only course of action was to disconnect the two buildings and to strengthen the older brick building ad initio. In our view this was uneconomic and impractical. The owner, again in frustration, sought second engineering opinion which was, in effect that, of course, it could be done. In indeed it could, by building new steel frames and foundations inside the existing, to support some old brick walls.

Having come thus far the owner was willing to proceed. However in another gotcha, the Council then required the pounding of the two separated, but very intimately close buildings to be considered. The

steel frames would need to be stiffened considerably to comply with the restrictions of pounding.

(Alternatively it was suggested, we could linked all five buildings in the block together.)

Both these two cases illustrate the extreme difficulty of developing small buildings.

Owners often no idea of what they have let themselves in for by buying an apparently affordable investment building for development, often with either no engineering advice or advice required within 48 hours allowed to confirm a purchase.

Subsequent difficulties which arise, do nothing to enhance the confidence of the owner in the engineering profession (which, represented by two consultants and the Council doing their best) has produced unsatisfactory, indeed, nonsense) answers to their problems.

To prospective purchasers of old buildings, our advise would be: be very clear what you want to do and allow time and sufficient budget for a thorough investigation into whether a resource consent might be granted with acceptable conditions, and to whether it is practical and economic to carry out the earthquake strengthening to the required level taking account the type of building, its location in relation to earthquake faults, and the possible presence of deep soils and proximity to adjoining building which might pound together in an earthquake.

However, the owners of many years standing of building which are now considered to be earthquake prone do not have the

luxury of not proceeding with a purchase.