On Monday the 14th of November at approximately 12:20am a 7.8-magnitude earthquake struck the South Island of New Zealand. The quake directly impacted the cities of Christchurch, Kaikoura and Wellington, however the tremor intensity covered a wider geographic area. Following the earthquake a team of engineers including, Gavin Robertson (Engineer), Andy Reid (Engineer) and Sam Leslie (XLam) visited the recently constructed Kaikoura District Council (KDC) building to assess the impact of the earthquake.

The KDC building is a 3-storey office development comprising a Potius floor and roof structure, LVL beams and columns, and Cross Laminated Timber (CLT) walls. The building design included 15 CLT/LVL-composite rocking shear walls, each approximately 13m high x 3.4m wide, which are post-tensioned to the foundations. Each wall was constructed with continuous Macalloy® Post Tensioning Bars running down the centre.

The shear walls are fitted with threaded rod energy dissipaters, more commonly known as “fuses”. These fuses are fixed to either side and dampen out seismic energy from the earthquake. In a seismic event the walls are designed to rock back-and-forth which introduces ductility into the overall structural timber building system. This back-and-forth action significantly reduces loads on both the building and its foundations. The fuses are located on the outer faces of the panels so they can be easily replaced if activated. The combination of dissipation and post-tensioning results in a low damage solution which significantly reduces downtime following a seismic design level event.

Prior to the inspection of the site, the team discussed the likely damage to the building. The only area expected to show permanent damage following the earthquake was the yielding of the fuses. On inspection the mass timber KDC building lived up to its reputation of earthquake resilience and performed extremely well. There was very little sign of damage, other than slight cosmetic cracking to the pavement and some movement at the joints between elements. There was no sign of the walls rocking, or activation of the fuses. This suggests the building has capacity to withstand an event even larger than that experienced on the early morning of 14th November.

It is widely known that timber performs inherently well in earthquake events and is one of the major benefits of using mass timber construction materials and processes. Timber is about 20% the weight of concrete, and has a very high strength-to-weight ratio. Typically, the finished weight of a mass timber building will be about half that of an equivalent concrete structure. If the mass in a building can be reduced, the force required to resist the acceleration caused by earthquakes is also reduced.
Case Study

Following the earthquakes, the building has been used as a post-disaster headquarters with a number of military, police and hospital staff inhabiting the office spaces. Anecdotally it is reported that both the Mayor and CEO of Kaikoura District Council were extremely happy with how their building had performed.

The rocking shear wall technology found within the KDC building has been used in a number of buildings throughout New Zealand. In 2015, XLam was also used for a number of shear walls for a retail building in Richmond. This building was designed with 14 rocking shear walls, however without post-tensioning. The design in the Richmond building relies on gravity to re-centre the walls after an event. The building also has a concrete mid-floor which provides sufficient gravity load to assist in resisting the seismic overturning forces. As with the KDC building, threaded rod energy dissipaters either side dampen out seismic excitation.

Mass timber construction offers considerable benefits for those building in seismic zones. The recent earthquake events in Kaikoura are an unfortunate consequence of living in New Zealand, however as this case study highlights, local design technology and non-traditional construction materials are leading the way for a safer community.

Our vision is to be the leading provider of sustainable solutions for commercial and residential construction throughout New Zealand, Australia and beyond.

XLam is the first and only manufacturer of cross laminated timber in the Southern Hemisphere. For further information about seismic design and building in earthquake prone areas, please contact the team at XLam via our email address: enquiries@xlam.co.nz

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