LOW DAMAGE NON-STRUCTURAL DRYWALLS FOR COMMERCIAL MULTI-STOREY STRUCTURES

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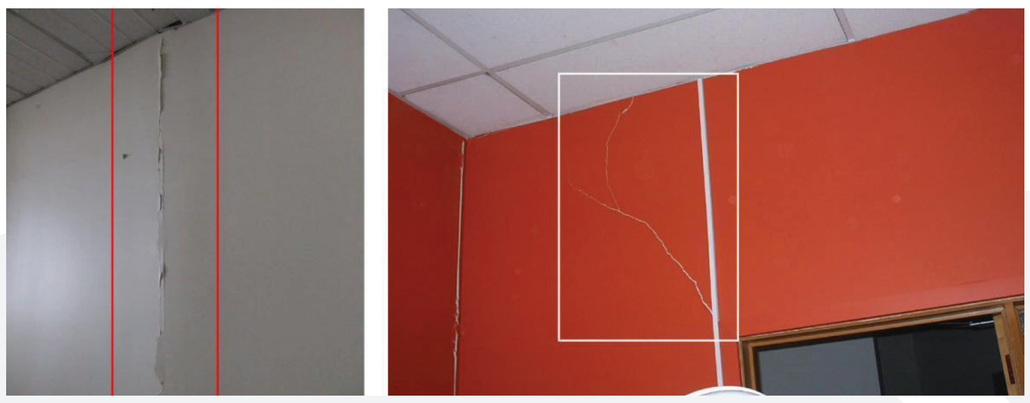
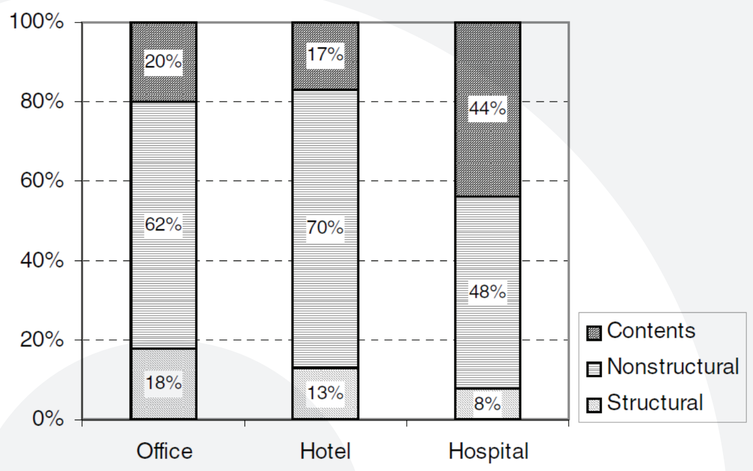
Introduction and statement of the problem

Modern structural systems are generally able to perform well in accordance with the life safety and serviceability limitations defined by the seismic standards. On the other hand, the existing non-structural partition systems are not on par with these structural systems, resulting in a non-uniform serviceability expectation within structures. This usually manifests itself as low or moderate damage to the structural system under a serviceability limit state earthquake while severe non-structural damage can be expected from the non-structural drywall partition systems. Serviceability loss and the resulting downtime of structurally intact buildings was a common occurrence after the Christchurch earthquake in Feb 2011.



Example drywall damage

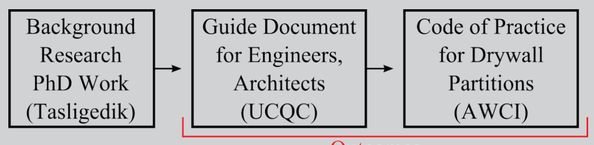
Considering the cost breakdown of non-structural elements within buildings, damage to such components places a large burden on economy. Therefore, seismically resilient drywall partition systems are a must for the general earthquake resilience of New Zealand.



Cost breakdown of structural and non-structural components (Miranda 2003)

Project outputs

The background and the theory of this work is based on the past PhD research carried out by Ali Sahin Tasligedik. The output of this project will be a design guide for low damage non-structural drywall partitions aimed at structural engineers, architects and the contractors (to an extent). The outputs of this work will be implemented in the upcoming AWCI Code of Practice for drywall partitions.

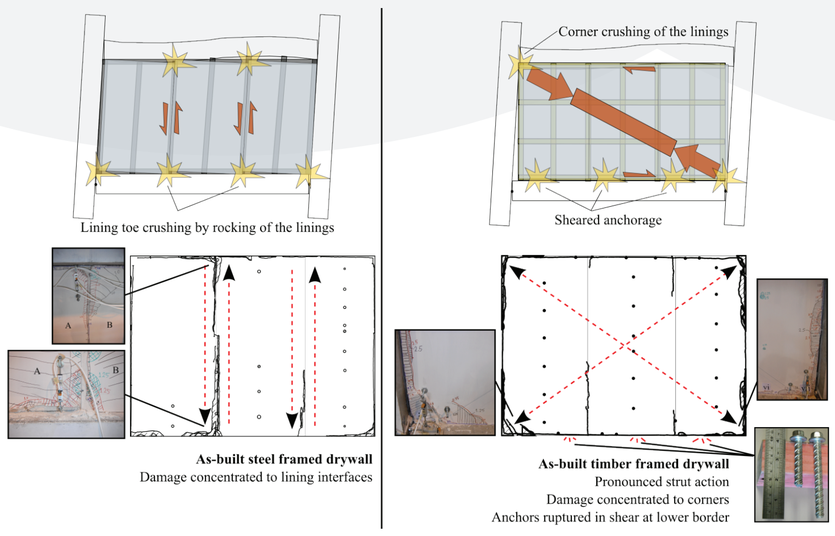


Benefits of a low damage drywall partition

- Significant economic burden can be lifted from the economy after moderate earthquakes.
- Low damage drywalls can be designed for any seismic deflections using any required design drift level.
- There will be no downtime caused by damage to non-structural partition system since the partition will remain operable after moderate seismic events (or even larger earthquakes).

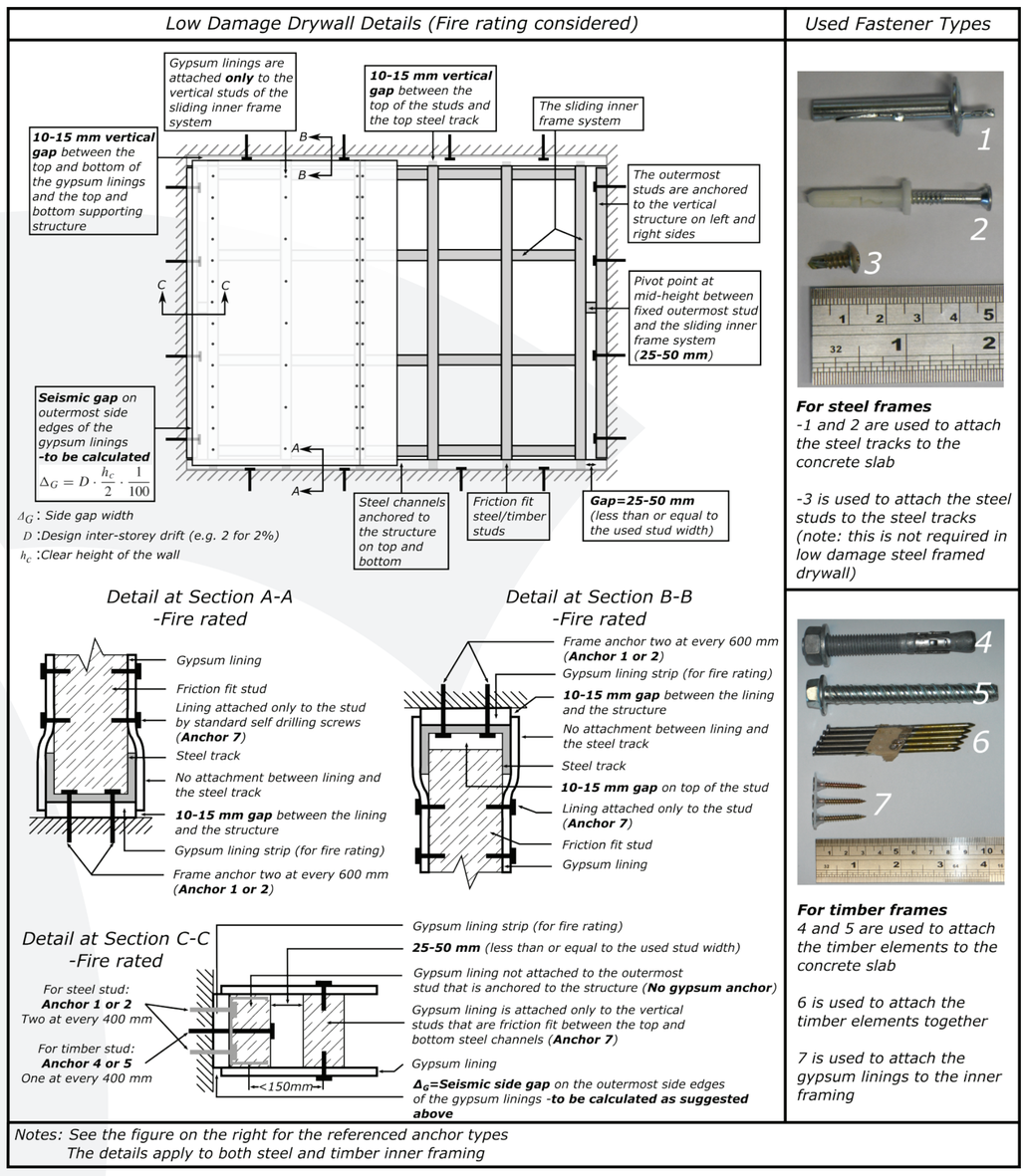
Seismic damage to existing drywall partitions

Existing drywalls have very low displacement capability and undergo seismic damage at very small inter-storey drift levels. Steel framed drywalls suffer damage at 0.3% drift level while timber framed drywalls suffer damage at 0.75% drift level (based on the past experiments).



Seismic drywall details for low damage

The conceptual summary and details of the developed low damage drywalls are shown in the figure below. It should be emphasized that these solutions are referred as low damage solutions and some damage is expected under extreme deflections since the damaging drift level is under complete control of the engineer. However, such damage has been experimentally shown to be very minor plaster damage occurring at extremely high drift levels where the structural damage is expected to be more dominant than the non-structural wall damage.



Low damage drywall detailing

Example application from practice

There are example applications of these low damage drywalls in the construction industry:

1. **Novotel**, Christchurch, New Zealand (Completed construction)

Low damage drywall application at Novotel, Christchurch (courtesy of Frank Kang, Winstone Wallboards)

2. **New Christchurch City Library** (Design stage at Architectus and Lewis Bradford)

Concluding remarks

Considering the cost breakdown of structural and non-structural systems over the total cost of a structure, economic burden resulting from the damage to the non-structural systems is evident. In addition, modern seismic design dictates low serviceability displacement levels in order to protect these elements, which is likely to be exceeded in moderate seismic events. The developed low damage drywall details are very efficient in reducing seismic damage to these components as well as increasing the resilience of drywall partition systems generally. UC Quake Centre is in close collaboration with AWCI to include these details and design methods in the upcoming code of practice for drywall partition construction in New Zealand.

Acknowledgements

We would like to express our gratitude to UC Quake Centre for funding this project. We are also very grateful for the collaboration with Frank Kang (Winstone wallboards), Hans Gerlich and Denis Prout (AWCI). For these system to be adopted in real applications, close industry collaboration is crucial and any communication we are having is greatly appreciated.