Determining the Seismic Performance of Structural Insulated Panels for New Zealand Buildings

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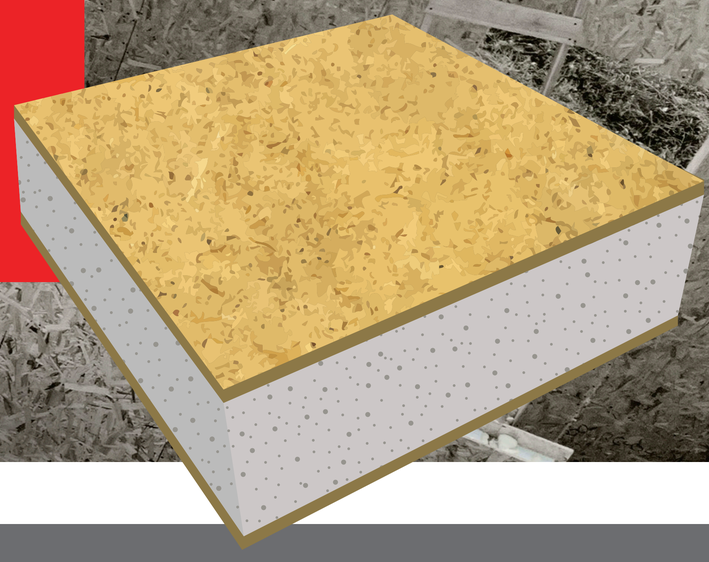
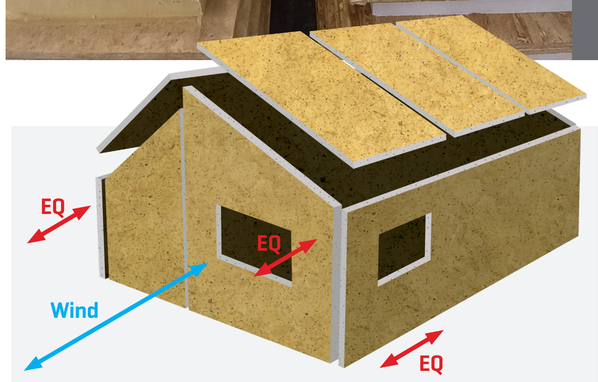


New Zealand has an urgent need for quality housing that can be built quickly and affordably. Using structural insulated panels (SIPs) is one possible solution. SIPs are sandwich panels made of two face layers and an insulating inner core. They can be prefabricated and assembled quickly on site for walls, floors and roofs and are one potential solution which could be used to increase construction speed and reduce overall building cost. While SIPs have been widely used overseas, less is known about their performance in a New Zealand context.

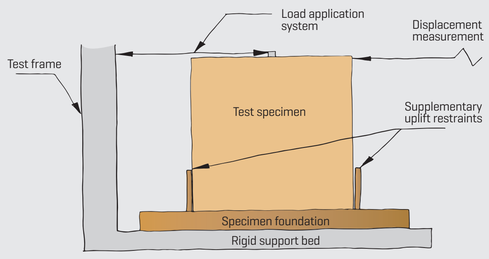
The project aims to:

- Understand how SIP structural bracing systems perform when subjected to seismic loading
- Provide load and displacement data on SIP wall configurations that will be compared with NZBC code requirements and more commonly used residential bracing systems
- Consider durability through cyclic testing of aged SIP specimens and connections
- Support development of a more simplified SIPs consenting process
- Establish consistent ways of evaluating SIPs to ensure they are suitable for New Zealand



Seismic Wall Bracing

- Resists lateral forces from wind and earthquakes
- Roofs (EQ), walls (Wind) and floors (EQ) drive forces
- Bracing walls
  - Resist forces in the plane of wall
  - Carry loads to foundations
- Bracing units (NZS 3604:2011)
  - P21 test
  - Indicative measure of capacity



Seismic Performance Testing

P21 Test Method (BRANZ 2010) to provide information on generic or non-proprietary systems

- 1.2 m x 2.4 m panel specimens
- 90 mm x 45 mm in panel rebates
- 2.8 mm x 50 mm nails, 150 mm o.c.
- P21 end restraints - No other vertical load
- Typical NZS 3604 bottom plate fixings
- No hold-downs (to be included with next round of testing)
- Applied load (kN) and top plate displacement (mm) measured

Hysteresis loops and data used for analysis

- Bracing ratings in bracing units (BUs) for use with NZS 3604 for comparisons

BUs can be converted to kN for SED, but with **caution!**

SIP during P21 testing at BRANZ

SIPS Testing Evaluations

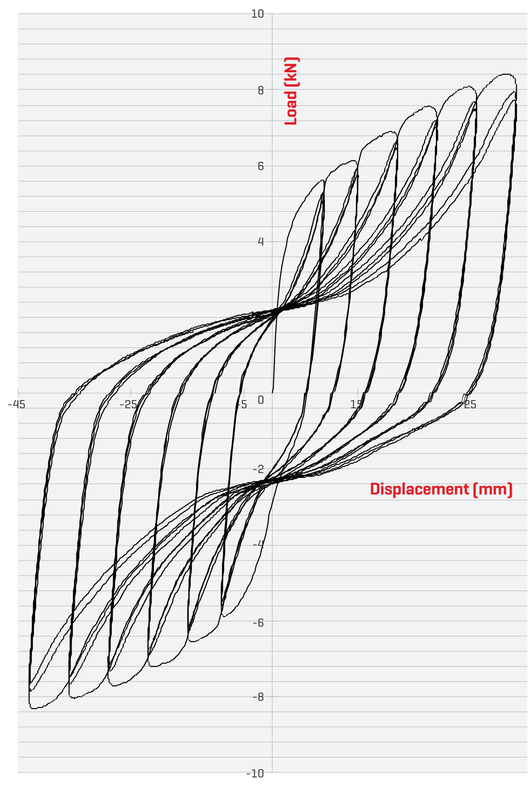
What are we looking at?

More than just bracing ratings:

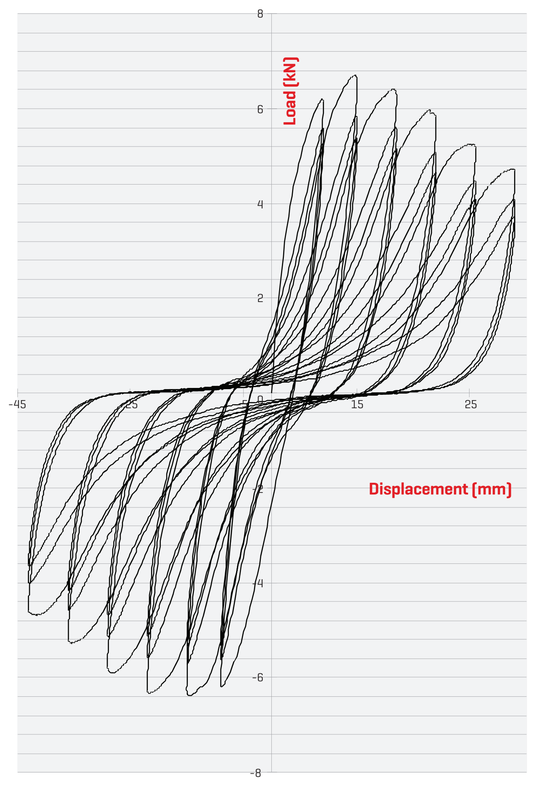
- Strength
- Stiffness
- Shape of loops
- Energy dissipation/ductility
- Failure and damage

Comparisons with other bracing systems

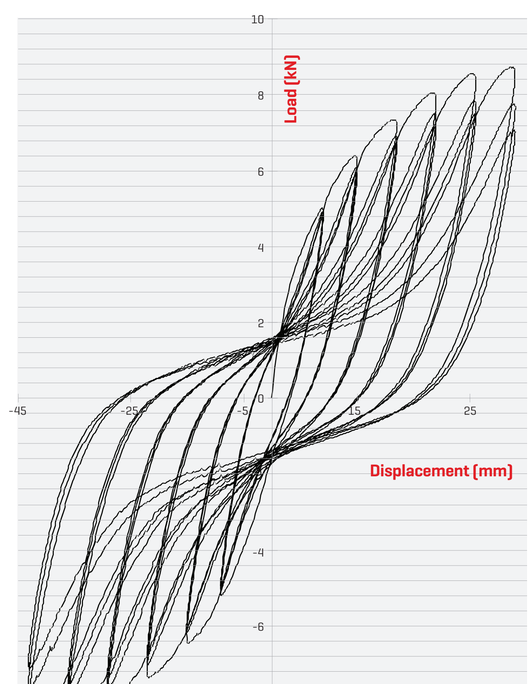
- SIPs with no hold-downs (A)
- Plasterboard (B)
- Plywood (C)
- Fibre cement (D)
- Combinations
- Deformation compatibility



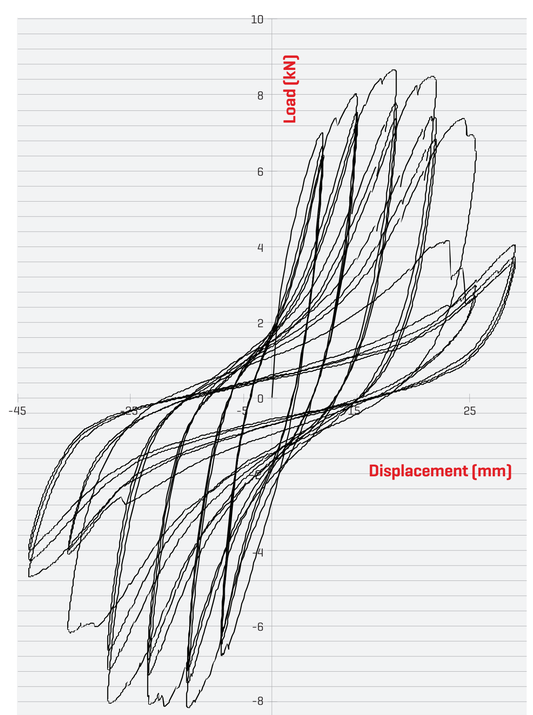
SIPs with no hold-downs (A)



Plasterboard (B)



Plywood (C)



Fibre cement (D)

Seismic test results

Significant energy dissipation and good ductility

Bending/yielding of nails around perimeter

Damage

SIPs – fasteners only, no significant damage to skin materials

Very little crushing around nails

Comparisons

Compared to systems with hold-downs

Less damage and superior load recovery

Controlled energy dissipation

Similar to plywood shear walls

Observed damage during P21 testing

Continuing research

- Testing SIPs with hold-downs
- Combination testing of SIPs and other bracing systems
- System interactions
- Deformation compatibility
- Longer SIP walls
- Different types of SIPs?

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EARTHQUAKE COMMISSION
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