

Performance of Structural Insulated Panels (SIPs)

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Introduction

One of the main components of timber frame domestic dwellings is the wood stud wall diaphragm. The structural components of a wood stud wall diaphragm are normally grade C16 dimensional timbers and Oriented Strand Board (OSB). Wall diaphragms are usually 2.4m high and consist of studs at 600mm centres fixed to the top and bottom runners (header and footer) and this is either single or double sheathed with OSB. The frame is normally constructed off-site and insulated with mineral wool on-site.

Structurally Insulated Panels (SIPs) provide an alternative to the use of wood studs, which for 150 years have gone unchallenged as the dominant structural system in low-rise, wood framed construction.

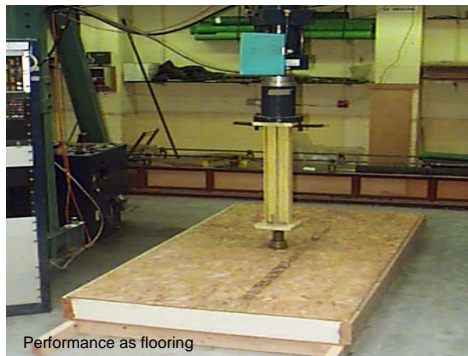
Construction of SIPs

There are two main fabrication techniques:

- an industrial adhesive is applied to a pre-cut foam core and then the core is cold pressed between two pieces of facing (panel boards) until the adhesive is cured; and
- the foam is poured into pre-spaced facings and the foam cures to bond to the facings. Either method produces a single solid building element that provides both structural and insulation qualities. These panels can be produced in varying sizes and thicknesses depending on application and thermal/structural requirements.

Advantages of SIPs

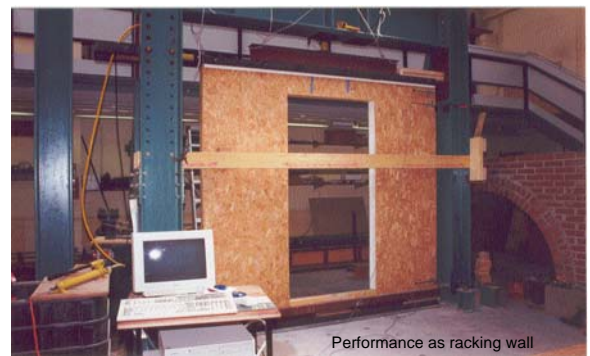
- SIPs utilise a stressed-skin principle where the overall strength of the panel is much greater than the strength of the components, thus reducing the need for structural framing.
- Compared with standard frame construction, SIPs can be inherently more energy efficient. Part of the efficiency improvement is attributed to the insulating properties of the foam. A substantial improvement is also associated with the reduced need for framing members, which can operate as "thermal bridging".



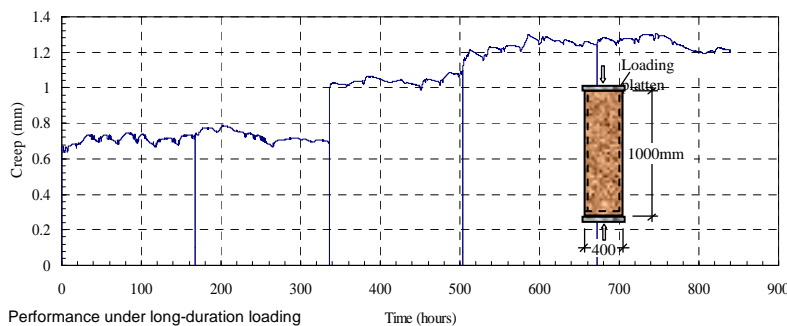
Performance as flooring



Performance as load-bearing wall



Performance as racking wall



Performance under long-duration loading

Time (hours)



Combined bending and direct axial compression



Site Erection

Structural Performance

Although SIPs have been used extensively as an alternative structural system to conventional framing for residential and light commercial buildings, to date little independent data is available on their structural performance and behaviour.

SIPs are predominately subjected to:

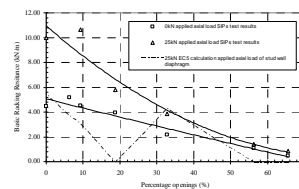
- vertical loads (direct compression)
- transverse wind loads (combined bending and axial compression)
- in-plane lateral forces imposed by wind and or seismic loading (racking loads).

Conclusions

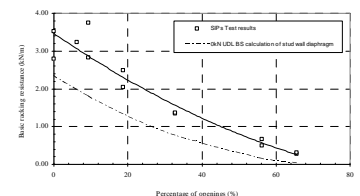
SIPs are a sustainable and cost efficient alternative to traditional stud wall diaphragms. SIPs have improved insulation qualities due to a reduction in cold bridging, they satisfy all other building regulations.

The comparative study carried out on the effect of size and position of openings has illustrated that:

1. Walls with openings constructed of SIPs are structurally more efficient than stud walls of comparative framing material and fastener spacings.
2. The methodology in BS 5268 design allowing for percentage openings is in line with the experimental results.
3. Design to EC5 is very much dependent on the width and position of openings.



Basic racking strength test results of SIPs compared with comparable stud wall designed to EN 1995-1-1:2004(E) cl 9.2.4.3 (Method B)



Effects of opening size on racking strength of walls: Normalised basic test racking strength of SIPs compared with similar stud wall designed to BS 5268: Section 6.1: 1996