UKSIPS

2 Technical Bulletin Fire

This Technical Bulletin has been commissioned by the UK SIP Association in conjunction with TRADA Technology and is intended to provide the reader with introductory information on using **structural insulated panels** for construction.

Structural insulated panels (SIPs) are prefabricated, high performance, lightweight, building panels that can be used in floors, walls and roofs for residential and commercial buildings. A SIP consists of two high density facings, typically Orientated Strand Board (OSB) which are bonded on both sides of a low density, cellular foam core.

The panels are typically made by sandwiching a core of rigid foam plastic insulation which is bonded to the two structural skins. A strong, structural bond between the three layers is essential to the load bearing ability of the SIP so that high loads can be transmitted by the relatively light units reducing the use of internal studding. SIP walls can bear considerable vertical and horizontal loads with reduced internal studding. The load carried by the SIP is transferred to ground by the OSB skins, held in position by the fully bonded insulation core.

In the UK structural insulated panels are available with a number of different insulation cores; expanded polystyrene (EPS), extruded polystyrene (XPS), polyisocyanate (PIR) and polyurethane (PUR). In all cases the skins are typically OSB although there is increasing research into other forms of load bearing materials.

SIPs are manufactured under closely controlled factory conditions and can be custom designed for each application. The result is a building system that is extremely strong, energy efficient and cost effective. Strict quality control procedures are implemented in the manufacture of SIPs to ensure quality and consistency of panels.

In terms of strength and resistance to fire there is little difference between the different core materials. Both forms of manufacture will comply with the Building Regulations and all Manufacturers in the UKSIPS Association are third party accredited.

In all cases it is the insulation core that provides excellent thermal properties due to the limited amount of timber studs required. Equally air permeability due to the large format nature of the supplied panels is much lower than traditional construction due to the small number of joints in the structure.

There are two fundamental applications for SIPs; full structural and infill for a concrete, steel or engineered timber frame. In all cases the product will be engineered for load bearing capability, racking resistance and wind loading in accordance with the test results obtained by UK SIPs members

For more information please visit www.uksips.org or scan the QR code

Written by

TRADA TECHNOLOGY

General

All forms of construction need to comply with the fire performance requirements laid down by national Building Regulations and there is no difficulty in SIP based structures meeting the required levels, given correct design, standards of manufacture and workmanship.

In considering the complex phenomenon of fires, two main stages are recognised and these are reflected particularly in the testing carried out to determine the fire performance of buildings.

- **Ignition and fire growth:** The behaviour of a material in this stage is termed its 'reaction to fire'and covers aspects such as ignitability, non-combustibility, and the contribution that a material makes to the development of a fire. SIP structures do not contribute to the growth of a fire because they are normally protected with non combustible wall linings.

- **The fully developed fire:** At this stage a material contributes to the fire resistance of an element of building structure (such as a wall or floor). Fire resistance can be defined as the ability of an element to carry on performing a building function in spite of being subjected to a fully developed fire. The fire resistance of a SIP structure is primarily achieved by the use of fire resistant lining materials.

Building Regulations have specified periods of fire resistance as well as surface spread of flame categories that all buildings should comply with regardless of construction type. SIP construction can be designed to meet Class O surface spread of flame and up to 60 minutes fire resistance.

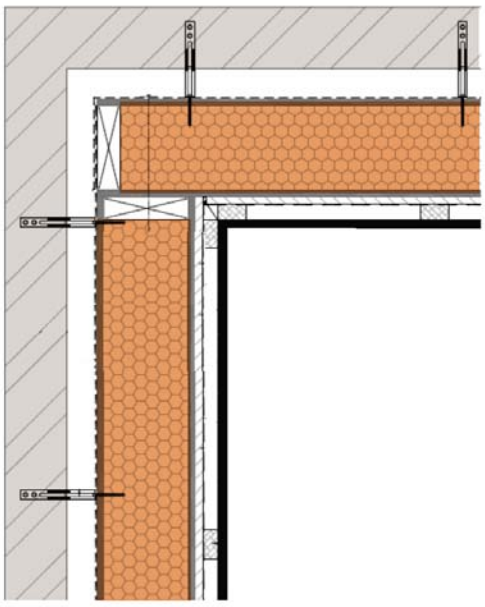
Walls

External walls

The fire resistance of SIP external walls is provided by the wall linings. These wall linings are typically plasterboard, although other types of fire resistant board could also be used.

Typically, one layer of 15mm Type F (fire/high temperature) plasterboard fixed to timber battens forming a nominal service void will provide 30 minutes fire resistance to a SIP wall regardless of the type of SIP or the core insulation material. 60 minutes fire resistance to any type of SIP can be achieved with two layers of 15mm Type F (fire/high temperature) plasterboard fixed to timber battens forming a nominal service void.

Note: For infill walling applications above 18m the external wall must meet the performance criteria given in BRE report BR315/BS8414



Internal walls
Internal walls are typically formed using timber studwork, and so fire resistance is provided by using fire resistant wall linings, in the same way that other building methods use timber studwork internal walls.

Internal non-loadbearing walls will normally require either no specific fire resistance or 30 minutes fire resistance, which can normally be achieved with the use of one layer of 12.5mm plasterboard.

Load bearing internal walls will normally require either 30 or 60 minutes fire resistance, depending on the size and purpose group of the building and/or the fire resistance performance of the elements they support. These periods of fire resistance are normally provided with one or two layers of 12.5mm plasterboard respectively.

Plasterboard manufacturers will have various systems or plasterboard specifications that are able to achieve these periods of fire resistance, however one layer of 12.5mm plasterboard should provide 30 minutes fire resistance, and two layers of 12.5mm of plasterboard should provide 60 minutes fire resistance. Plasterboard manufacturer's specification and test data should be used to substantiate performance.

Party walls
Party walls may be constructed from either timber studwork or SIPs depending on acoustic performance requirements, client specification or SIP manufacturer preference.

Depending on the size and type of building, 60 minutes fire resistance is the typical party wall specification for buildings up to six/seven stories. Load bearing SIP structures are unlikely to exceed this size.

Timber studwork party walls normally consist of two separate leafs of timber studwork separated by a cavity. 60 minutes fire resistance is provided by the use of 30mm of plasterboard fixed directly to the studs, which is also sufficient to meet acoustic requirements.

SIP party walls normally consist of two separate leafs of SIP separated by a cavity. 60 minutes fire resistance is provided by the use of two layers of 15mm of Type F (fire/high temperature) plasterboard, which is also sufficient to meet acoustic requirements, fixed via timber battens to the SIP party wall structure.
Ideally services which penetrate the plasterboard linings should not be installed on party walls. Some National Building Regulations prevent this. If services are to be installed, the use of proprietary fire resistant patress box inserts or installing the patress boxes on plasterboard lined timber noggings should be considered.

Floors

Floors in SIP buildings are typically solid or engineered timber joists, or hollow core concrete systems. Fire resistance to timber joisted floors (solid or engineered) is provided by using plasterboard linings of the required thickness.

Solid timber joisted floors can achieve 30 minutes fire resistance with one layer of 15mm plasterboard and 60 minutes fire resistance with two layers of 15mm plasterboard. Plasterboard manufacturer's test data should be consulted for exact specifications. Engineered floor joists are not as robust as solid timber joists when exposed to fire due to their reduced section size. The joist manufacturer should be asked to provide a specification for achieving the required periods of fire resistance, which is likely to require thicker plasterboard than for solid timber joists.

SIP fire resistance testing

BRE information paper ref: IP21/10 summarises the results of a number of fire resistance tests conducted on small and large scale samples of SIP buildings. These tests were funded by CLG, Communities and Local Government and conducted at an independent laboratory to determine the performance or SIP systems exposed to realistic fire scenario.

In addition, small scale tests consisted of fire resistance testing of 1200x1800mm samples of 150mm thick SIP wall. Both EPS and PUR type SIP systems were tested as well as different configurations of plasterboard and service penetrations.

The large scale tests consisted of four two storey SIP structures with a footprint of 4m x 3m. The first floors were loaded out to represent typical domestic floor loads. The second floor loads were varied to represent the imposed loads on two to four storey buildings.

The walls and ceilings were lined with plasterboard and the buildings filled with timber cribs to provide the fire load. During the tests, temperatures within the buildings reached in excess of 1000°C.

It is worth noting that in all of tests conducted testing both 30 and 60 minutes fire resistance, failure of the floor structure dictated the overall test duration and failure mode. These floors were engineered timber joisted floors overlaid with chipboard and lined with plasterboard. These sorts of timber joisted floor are used in the vast majority of low rise domestic dwellings, regardless of overall construction type.

Note: In all instances current UK Building Regulations define minimum performance standards.

Roof

Generally roof structures do not require specified periods of fire resistance unless the roof structure forms an escape route, or the roof void is a habitable space.

If the roof is a habitable space, the floor to the room-in-roof would need either 30 or 60 minutes fire resistance. Normally these floors are either timber joists or large room-in-roof trusses and fire resistance would be provided in a similar way to the protection of timber joisted floors with the use of plasterboard.

If the roof structure forms a means of escape, fire resistance requirements would need to be considered on a project specific basis.

Cavity barriers

Cavity barriers are designed to limit the spread of smoke and fire through cavities or concealed spaces. National Building Regulations vary on their location requirements to close cavities, however they all require that the edges of cavities are closed, and cavity barriers are provided at compartment wall and compartment floor junctions with external walls or other compartment walls. Additional cavity barriers may be required depending on building type, size and variations in national Regulations.

Every cavity barrier should be constructed to provide at least 30 minutes fire resistance. Cavity barriers are normally made from:

- Timber at least 38mm thick.
- Polythene sleeved mineral wool, or mineral wool slab, in either case under compression when installed in the cavity.
- Wire reinforced mineral wool blanket at least 50mm thick.
- Calcium silicate, cement based or gypsum based boards at least 12.5mm thick
- Steel at least 0.5 mm thick.

Other third party approved products may also be suitable, including intumescent products. National Regulation should be consulted for specific guidance on the construction of cavity barriers.

The requirements to install cavity barriers in a SIP building are the same as load bearing timber studwork buildings.

Boundaries

If a building is constructed within 1m of a relevant or notional boundary, the specified periods of fire resistance (30 or 60 minutes) are required to the structure of the building from the outside as well as the inside.

Depending on cladding types, masonry cladding may provide sufficient fire resistance to the SIP structure behind. If the cladding cannot provide adequate fire resistance, layers of fire resistant board material may need to be installed over the outer face of the SIP.

General guidance on fire

As with any other construction type, smoke alarms should be fitted and tested regularly. Further information on smoke alarms and general fire safety in the home can be found on the government's website:
www.direct.gov.uk/en/HomeAndCommunity/InYourHome/FireSafety/DG_10030963