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# Durability

This Technical Bulletin 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.

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 STA members.



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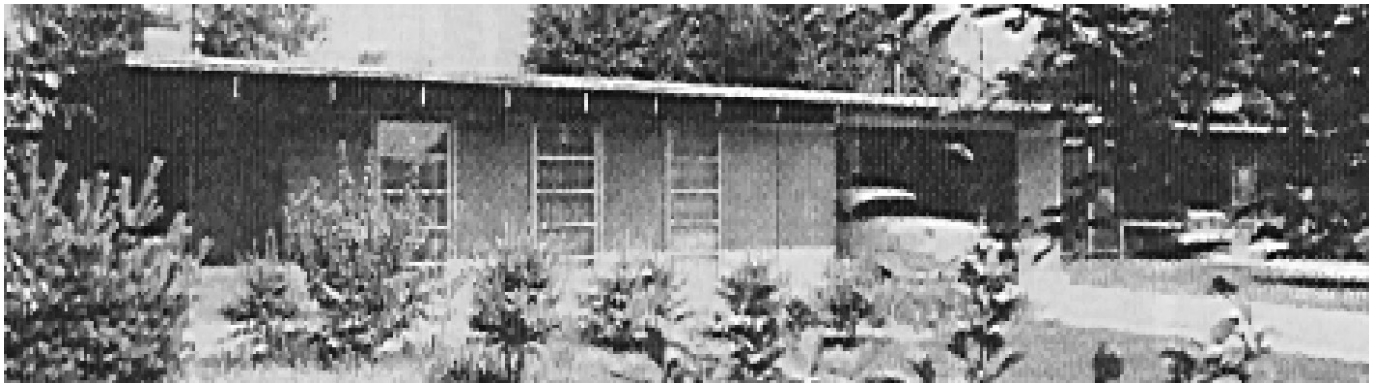
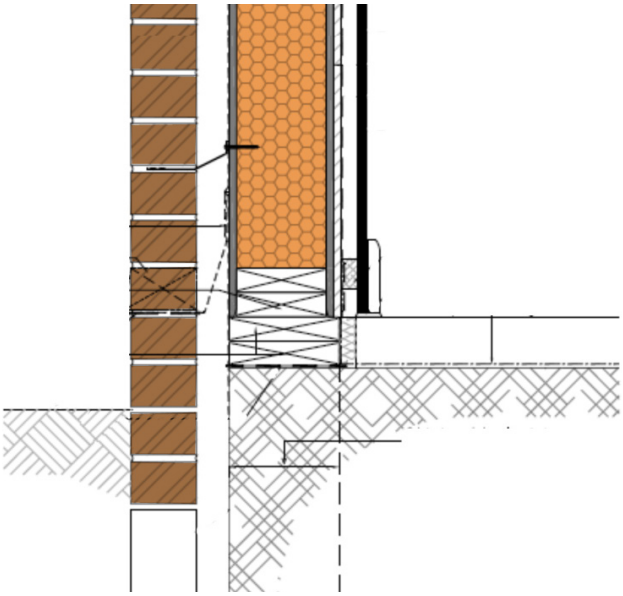


SIPS home built in 1952

## Walls

SIP external wall sections are clad and lined in a similar way to timber studwork buildings. The SIP structure itself is protected from moisture by both the cladding and the breather membrane on the outside of the panel, as well as a cavity. Cladding would normally take the form of masonry such as brick, rendered block work or stone; or lightweight systems such as timber, metal or proprietary render systems. All of these cladding types form the primary line of weather protection to the structure behind. It is worth noting that in the majority of cases, the cladding systems are installed by someone other than the SIP manufacturer and erector. It is therefore important that the cladding installers follow the SIP manufacturer's guidance and, where applicable, standard details.



To ensure that any moisture which does penetrate the cladding does not come into contact with the SIP, a drained and vented cavity is incorporated behind the cladding. This cavity can range from 20mm for timber cladding, up to 50mm for masonry cladding and will incorporate drainage and ventilation gaps at the base. BS 5250:2002 'Code of practice for control of condensation in dwellings' states that an open area equivalent to 500 $mm^2$ per metre should be provided to the external wall cavity. This requirement should be repeated at each floor level if horizontal cavity barriers or cavity trays are installed at floor level.

The final layer of protection for the panel is the breather membrane. This is a water repellent membrane which is also moisture vapour permeable. Any moisture in the SIP can pass through the membrane in the form of vapour, but liquid water from the outside is repelled. Reflective breather membranes can also contribute to the thermal performance of the external wall if the cavity is not ventilated.

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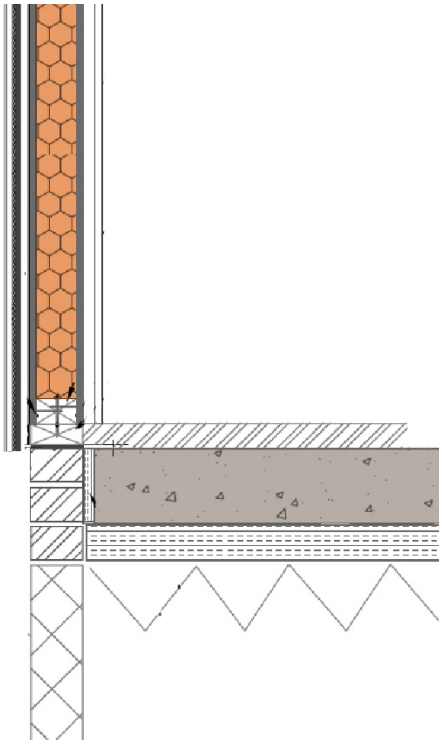
As with other timber based building methods, it is important to keep the base of the building above external ground level to mitigate the risk of ground water coming into contact with the SIP. It is recommended that the lowest structural timber (usually the sole plate) is at least 150mm above external ground level. This is also a requirement of some warranty providers.

Ensuring that the base of the SIP is above external ground level is normally relatively straight forward, however the provision of level access into the building can sometime cause issues with ground level and the position of the wall panels. In these cases it is normal to provide an upstand of masonry or concrete.



## Roofs

SIPs used as roof structures will generally be finished in a similar way to other timber roof systems. It is worth noting that SIP roofs are not warm roof systems. A warm roof is where all of the insulation is installed above the structure. With a SIP roof, the structure (OSB) is on both the warm and cold side of the insulation, and so should be treated as a cold roof. The terms warm and cold have no relevance to the level of insulation and the use of the roof space but purely refer to the location of the structural elements in relation to the insulation.

Cold roof systems (pitched or flat) require a ventilation void between the roof covering and the SIP to ensure that the structure is not subjected to a condensation risk. Pitched roofs will normally be overlaid with a breathable roofing membrane, counter battens and then tiling battens to provide the required drainage and ventilation space. Flat roofs will normally be overlaid with a breathable roofing membrane, furrings forming a ventilation void and then a deck and roofing membrane. Roof membranes or systems (e.g. profiled metal roofing) should not be installed directly on to the SIP roof panels.

The guidance given in BS 5250:2002 regarding ventilation voids and ventilation openings are valid for SIP roof structures and should be followed. In most roof designs, a Vapour Control Layer would be required to mitigate any risk of interstitial condensation formation within the SIP. This VCL also doubles as an air barrier.

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## Under Construction

During construction the SIP structure may be exposed to the prevailing weather conditions and may be exposed to rain. During a normal construction phase, this is not an issue for SIPs as long as a number of general precautions are followed.

Any panels which need to be stored on site before erection should be stacked on level bearers off the ground, and loosely covered with a tarpaulin. Once erection of the structure is underway, the building should be weather-tight very quickly, due to the speed of build offered by SIP systems. Once the building is erected, the whole structure is wrapped in breather membrane which will protect the structure until the cladding systems are installed.

If the panels do get wet, it is important to ensure that they are allowed to dry. Panels should not be tightly wrapped in plastic, instead they should be loosely covered to promote the movement of air and drying.

In larger multi-storey structures, e.g. hotels or blocks of apartments, where a longer build programme is envisaged, phasing of the erection of the structure to achieve early weather-tightness may be required to minimise the ingress of water during the erection of the structure.

Once the SIP structure is erected and the building made weather-tight with the installation of breather membranes, windows and doors, any moisture that has entered the building should quickly dissipate. All structural timber (including the OSB boards of the SIP) should be at a moisture content of 20% or less before any additional insulation, vapour control layer and internal linings are installed. Generally the time taken to install first fix services into the building will be sufficient time to allow the structural timbers to dry. The external cladding system can be installed at any time.

## Future Modifications

Future alterations and extensions to SIP structures pose no more of a risk than alterations to 'traditional' structures. The key areas to consider for continued longevity are maintaining the weather tightness of the cladding at junctions between new and old areas of the building, maintaining the drained and vented cavity and ensuring that flashings and cavity trays are installed and lapped correctly with the breather membrane.

External ground level should not be raised and the external wall cavity must not be fully filled with cavity wall insulation.

## General Maintenance

As with any construction method, the long term performance of the building will be largely dependent on repair and maintenance, as required. For instance, it is important to ensure that guttering and rain water down pipes are regularly checked and cleaned to ensure that water runoff is collected and diverted away from the building. Flashings around the roof should be checked and repaired or replaced as necessary. If the build is clad in render, any cracks or damage to the render should be repaired promptly.

The above examples are for illustrative purposes, and general good 'housekeeping' practise should be employed.