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UKSIPS

Code of Practice

SIP Technology

www.uksips.org

What are Structural Insulated Panels (SIPS)?

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 UK SIP Association are third party accredited or assessed by the Association for competency.

In all cases it is the insulation core that provides excellent thermal properties due to the limited amount of timber studs required. Equally because of the large format nature of the supplied panels air permeability 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/wrap around for a concrete, steel, oak 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 SIP Association members.

Contents

This Code of Practice is provided by the UK SIP Association for information and guidance purposes only. All work involving SIP technology should be carried out by trained and qualified professionals. Product ratings, system suitability and UK Building Regulation compliance is the sole responsibility of the individual SIPS manufacturer and/or installer and not the UK SIP Association. Many thanks to all Members of the UKSIP Association who have contributed images and illustrations.

Fabric First Approach

Many SIP buildings use the Fabric First approach to reducing carbon dioxide emissions. Fabric First is a popular ethos that has grown from the German Passivhaus standard. This is where energy efficient buildings are created by focusing on the performance of the external envelope of the building, before looking to renewable energy sources or ‘bolt on’ technologies. With the Fabric First approach, elemental U-Values and heat loss are driven down to very low levels, so the building consumes a minimal amount of energy staying warm or cool. With SIP structures, because a significant part of the structure of the building is insulation, excellent U-Values can be achieved for a minimal wall thickness.

Energy efficiency of buildings is generally broken down into three key areas of performance:

- U-Values of building elements
- Ψ-Values (thermal bridging) of element junctions
- Air permeability of the building envelope.

U-Values of building elements deal with the heat loss through the walls, floors, roof, windows and external doors. Ψ-Values (thermal bridging) of element junctions deal with the additional heat loss at junctions in elements, e.g. wall/foundation junction, or at corners. Air permeability of the building envelope deals with the additional heat loss through unplanned air infiltration e.g. around windows or external doors, or air infiltration at service penetrations.

In order to achieve an energy efficient building, each of these areas of heat loss needs to be addressed. With each of these measures of performance the smaller the number the better the building is performing. The energy efficiency of a building is calculated in SAP. This is the Government's ‘Standard Assessment Procedure’ for Energy Rating of Dwellings and is used to calculate the heat loss and carbon emissions from dwellings.

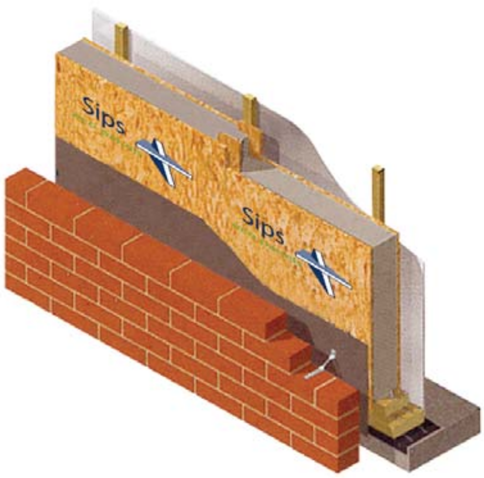
For more information on Fabric First visit: www.fabricfirst.co.uk or look out for Fabric First events: www.fabricfirstevent.co.uk

SIPS Code of Practice

Structural insulated panels (SIPS) are one of the leading ways to construct energy efficient, cost-effective and sustainable buildings. To help everyone understand them better and know how to implement their use correctly, the UK SIP Association supplies this Code of Practice. This Code of Practice includes a handy detailed summary of all the six special Technical Bulletins that have been commissioned in conjunction with TRADA Technology that are intended to provide introductory information on using SIPS. These Bulletins relate to: Acoustics, Durability, Fire, Structure, Sustainability and Thermal performance.

1. Structure – this bulletin covers all aspects of the building phase from walls, floors, roofing cladding and services to tolerances for walls and sole plates. 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 loadbearing capability, racking resistance and wind loading.

2. Fire – all forms of construction need to comply with the fire performance requirements laid down by national Building Regulations. SIPS - based structures will comfortably meet the required levels of fire resistance, given correct design, standards of manufacture and workmanship by the use of fire resistant lining materials.



3. Acoustics – this bulletin covers the improved sound performance levels that can be delivered by SIP panels. SIPS contribute to improved airborne sound insulation for floors roofs, external, internal and separating/ party/ compartment walls. Much like timber studwork, SIP panels rely on the mass and continuity of plasterboard linings to provide the majority of the sound insulation performance.

4. Thermal - 'Fabric First' is a popular ethos that has grown from the German Passivhaus standard. This is where energy efficient buildings are created by focusing on the performance of the external envelope of the building before using or 'bolt on' renewable energy technologies. With SIP structures excellent U-Values, thermal bridging, air permeability and SAP Assessment scores can be achieved.

5. Durability – the long term performance of a SIP building will be largely dependent on repair and maintenance. During construction the SIP structure may be exposed to the prevailing weather conditions and may be exposed to rain. This is not an issue for SIPS as long as a number of general precautions are followed. Cladding systems can take the form of masonry such as brick, rendered block work or stone or lightweight systems such as timber, metal or proprietary render systems

6. Sustainability – for construction to be sustainable, the basic principles of sustainable development must be adopted. The UK Government's strategy for more sustainable construction widens the basic themes to suggest key actions by the construction industry. These include designing for minimum waste, lean construction, minimising energy use in construction and avoiding pollution. SIPS offer a low embodied energy building system with good long term thermal and airtightness performance and are also able to offer a long design and service life.

The Code of Practice provides the reader with introductory information on using SIPS for construction. You should consult the full Technical Bulletin during planning and construction. The complete Technical Bulletins can be downloaded from the UK SIP Association website. They are free to download after registering your details on: www.uksips.org

Structure

Walls

Walls are manufactured as either small individual panels, typically 1.2 x 2.4m (OSB sheet sized panels) or as larger panels made from multiple or single large format sheets of OSB. Panels with a length or height up to 6m can be manufactured to provide double height spaces or large panels for increased speed of erection.

Once the panels have been manufactured, openings can be formed. These can either be in the form of small framing panels that are site assembled to form the opening, or cut from a large blank wall panel. Solid timber lintels, studs and rails are normally inserted around the perimeter of the opening into the core of the panel. These timbers support any imposed loads from above (lintel, floor or roof loads) and provide a solid fixing for the installation of window or door sets. The location and size of window openings are considered in the site specific structural calculations for racking resistance.

If required, openings can be moved and additional openings formed with relative ease, however the size, location and method of creating these openings must be considered by a structural engineer. Wall panels bear onto the foundations via a preservative treated timber sole plate (sometimes referred to as a locator plate) which is firmly secured to the sub-structure. The purpose of this horizontal timber sole plate is to provide a levelled substrate onto which the wall panel can be fixed and to transfer vertical load to the foundations. The way in which the wall panel bears onto the sole plate can differ between systems. Some systems incorporate a solid timber rail into the base of the SIP which in turn bears onto the sole plate. Other systems do not include this rail, and the inner and outer leaves of OSB fit over the sides of the sole plate.

Either way, the wall panel is nailed or screwed to the sole plate to provide solid location of the panel and resistance to sliding, overturning and uplift forces. As with loadbearing timber studwork buildings, all structural timber should be at least 150mm above external finished ground level and level or above finished floor level. Panels are jointed using either solid timber within the ends of the panels or SIP based insulated splines, depending on the manufacturer's specific system and/or structural requirements.

The splines are fixed into the ends of the panels using either nail, screw or bolt fixings and sealed. At corner junctions long (200 to 300+ mm) specialist screw fixings are typically used to pass through the side of one panel into the end of the adjoining panel. The use of large screws at panel junctions may reduce the quantity of fixings required compared to nailed timber studwork wall junctions.

Currently four storeys is the maximum practical height for loadbearing SIP buildings. Above this, additional structure needs to be incorporated into the building to carry the imposed loads.

SIPS used as infill panels is a practical and economic way of adding thermal insulation and infill structure to steel or concrete frame buildings, and allows a rapid cladding of the structural core with large panels craned into position.

SIP buildings can be designed and built as either a platform or balloon framed structure. Platform framed buildings consist of room height panels with intermediate floors bearing onto the head of the walls panels. Balloon framed buildings consist of storey or building height panels with the intermediate floors hung from the inside of the walls. The floor structures are nailed, screwed or bolted to the head of the lower wall panel or onto a timber ledger fixed to the inner face of the panel. In platform framed structures, the subsequent wall panels are then installed bearing on top of the floor structure above the lower wall panels. This process is then repeated for each storey of the building. Subsequent storey wall panels may or may not use a sole plate/locator plate.

Refer to Technical Bulletin 1 for full details

Racking resistance of a SIP wall is typically 50% greater than that of a timber studwork wall sheathed with one layer of 9mm OSB. Therefore a low rise building designed to be constructed with loadbearing timber studwork, should also work with a loadbearing SIP structure. A structural engineer would need to confirm this by calculation.

Normally the structural calculations will be undertaken by the SIP manufacturer or supplier. SIP manufacturers will have data relating to racking resistance, load bearing capacity as well as flexural and bending strength. These values are based on test data and may vary between panel manufacturers.

Floors

Timber joisted floors used in SIP buildings are the same as those used in timber frame or masonry structures and consist of solid or engineered timber joists and deck, plasterboard ceiling linings and additional acoustic treatments as required.

Other types of floor system can also be used, such as hollow core concrete systems or timber joisted floors with flexible screeds. The imposed loads of the floor should be considered in the design calculations for the building.

Differential movement will occur in a SIP building as with any other timber building system. Timber rails and floor joists will dry and shrink once the building is complete and lead to movement of the building. For every 38mm of horizontal cross gain timber, 1mm of movement is likely to occur. Each building design/system will differ slightly, so an assessment of the likely differential moment should be conducted on a building by building basis. The SIP walls should not experience any significant dimensional changes. As an example, a SIP building with an engineered timber floor zone may experience 3 to 5mm of differential movement per storey.
Differential movement gaps should be calculated based on the floor zone construction and depth of horizontal cross grain timber. Gaps should be left between masonry cladding and window cills as well as at floor zones between cladding supported from the SIP structure.

Roofs

SIPS can form both pitched and flat roof structures and can be finished with any form of normal roof covering.

Trussed rafter or cut pitched roofs or timber joisted flat roofs can equally be used, and would be of the same design and construction as for any other build method. Pitched SIP roofs have advantages over traditional cut or trussed rafter roofs. SIP roofs usually consist of large panels supported on purlins and ridge beams. This provides an open, unobstructed roof void that is part of the thermal envelope of the building and ideal for use as a room in roof structure or vaulted ceilings. Openings for roof lights are formed in the same way as similar openings in wall panels.

As with walls, additional or new openings can be formed with relative ease under the guidance of the structural engineer. Coverings for pitched SIP roofs can be any type of covering that may be used on any other type of roof (e.g. tiles, slates, profiled metal etc). A ventilation void must be provided between the SIP and the roof covering, so the use of counter battens before tiling battens, profiled metal roofing or any other covering should be considered. Roofing battens should be fixed to the SIP roof with the use of screws.

Cladding

SIP buildings can be clad with any type of material. As with loadbearing studwork timber framed buildings, the cladding forms a rain screen for the structure behind. Masonry cladding will require wall ties secured to the SIP and built into the masonry cladding. Lightweight cladding, e.g. timber or render systems, can be supported directly off the SIP structure. The cladding type may affect the structural design loads of the building and should be considered at the design stage. As there are minimal solid timber studs to fix the cladding, fixings used must provide adequate pull out resistance through the OSB alone. Screw fixings for wall ties or cladding battens should always be used. Timber frame wall ties or specialist wall ties with screw fixings can be obtained specifically for masonry clad SIP buildings. British Standards and Eurocode 5 give pull out strengths for screw fixings in OSB and can be used in structural calculations.

Services

Experience has shown that it is better not to run services within the thickness of the SIP. Chasing out of a SIP to accommodate services compromises the structural performance of the panel, so a service void is typically formed using vertical timber battens on the inside of the wall. Once services are installed, wall linings are fixed to the battens.

The complete Structure Technical Bulletin can be downloaded from the UK SIP Association website. It is free to download after registering your details on: www.uksips.org

Refer to Technical Bulletin 1 for full details

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.

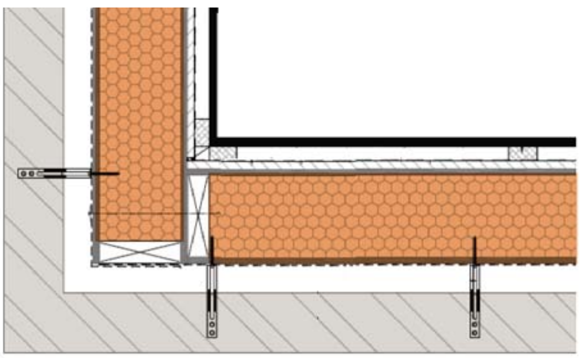
• Ignition and fire growth: The behaviour of a material in this stage is termed its 'reaction to fire' and covers aspects such as ignitability, non-combustibility, and the contribution that a material makes to the development of a fire. SIP structures do not contribute to the growth of a fire because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

Party walls

Depending on the size and type of building, 60 minutes fire resistance is the typical party wall specification for buildings up to six/seven storeys. 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 pattress box inserts or installing the pattress boxes on plasterboard lined timber noggings should be considered.

Floors

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.

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 DCLG (Dept for Communities and Local Government) and conducted at an independent laboratory to determine the performance or SIP systems exposed to realistic fire scenario. Please consult the Fire Technical Bulletin for more information. To obtain a copy of BRE IP21/10 please email info@uksips.org

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

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.

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.

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.

The complete Fire Technical Bulletin can be downloaded from the UK SIP Association website. It is free to download after registering your details on: www.uksips.org

Refer to Technical Bulletin 2 for full details

Walls

External walls

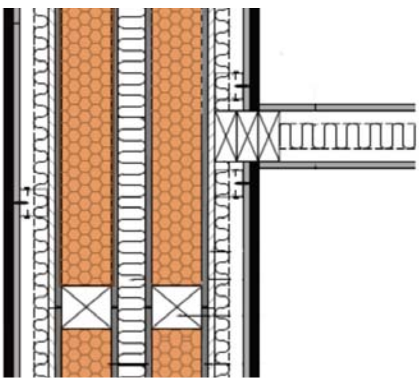
There are no specific requirements for the sound insulation performance of external walls within National Building Regulations. Normally the acoustic performance of an external wall is only considered when a significant external noise source is present, e.g. a building is being constructed near a busy road or rail line etc.

SIPS, much like timber studwork, relies on the mass and continuity of plasterboard linings to provide the majority of the sound insulation performance. If the sound insulation performance of the wall needs to be improved, the use of acoustic rated plasterboard in multiple layers is normal.

An acoustic consultant would need to be involved to determine specification and performance requirements.

Internal walls

Building Regulations specify airborne sound insulation performance targets for internal walls. The airborne sound insulation targets are expressed as Airborne Sound Reduction (Rw) and is based on laboratory test data. Intermediate walls in SIP buildings are normally formed using timber studwork and lined with plasterboard. Plasterboard manufacturer's test data should be consulted for wall specifications and performance, although regulation requirements are normally achievable with one layer of plasterboard (15 mm) to either side of timber studs with mineral wool insulation between.



Party walls

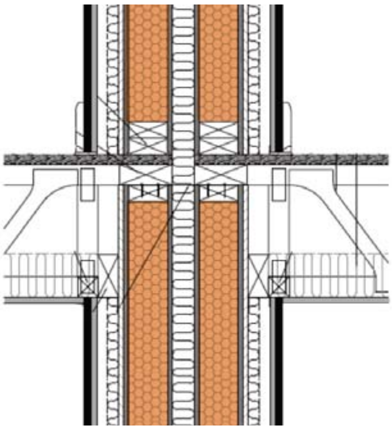
Airborne sound insulation performance targets for separating/party/compartment walls are expressed as Standardised Weighted Level Difference (DnT,w) and depending on local regulations may or may not include a correction for low frequency performance (DnT,w + Ctr). As with internal walls, party walls in SIP buildings are normally formed using timber studwork and lined with layers of plasterboard. Typically these walls would consist of two independent 90mm deep studwork frames separated by a 50mm wide cavity. Acoustic insulation is installed between the studs, and then the wall is lined on each room face with two layers of plasterboard. The timber studwork frames may or may not be sheathed for structural reasons.

These types of wall, although lightweight in their nature, are actually capable of outperforming many masonry party walls. Onsite testing has shown that these types of wall generally achieve airborne sound insulation test results some 10 dB better than Building Regulations minimum standards.

Currently, generic SIP structures are not specifically covered for use with Robust Details timber studwork party walls, and as such on site pre-completion sound insulation testing would need to be carried out to verify the performance.

Alternatively, SIPS can be used to form the two leafs of the party wall. A typical specification would be two independent SIP wall leafs separated by a cavity, usually 50mm. The SIP walls would then be lined on each room face with two or more layers of plasterboard fixed onto timber battens to form a service void.

Floors



Intermediate floors

Building Regulations specify airborne sound insulation performance targets for intermediate floors. The airborne sound insulation targets are expressed as Airborne Sound Reduction (Rw) and is based on laboratory test data. These floors are not subject to pre-completion sound insulation testing on site.

Intermediate floors in SIP buildings would normally be of timber joist construction and are typically identical in makeup to the floors used in timber framed or masonry buildings. A normal specification would be solid or engineered timber floor joists overlaid with a 22mm chipboard deck, 100mm mineral wool between joists and a ceiling of one layer of 15mm plasterboard.

Party floors

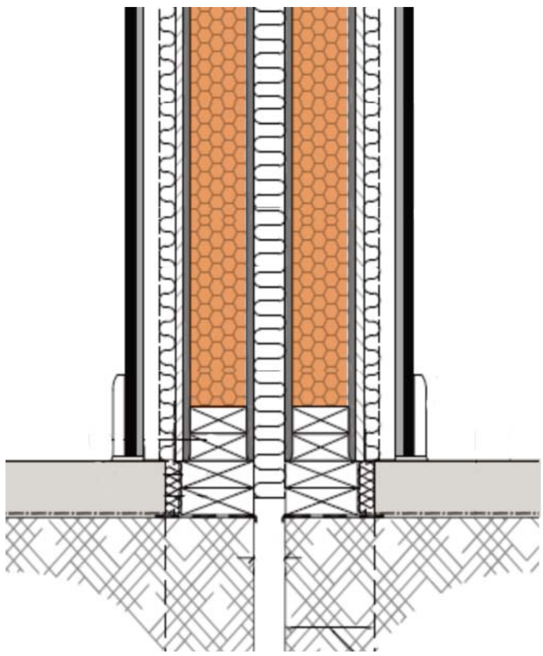
Building Regulations specify an airborne sound insulation and impact sound transmission performance target for separating/party/compartment floors. The airborne sound insulation targets are expressed as Standardised Weighted Level Difference (DnT,w) and depending on local regulations may or may not include a correction for low frequency performance (DnT,w + Ctr).

These are pre-completion testing performance criteria and subject to on site testing. The impact sound transmission performance targets are expressed as Standardised Weighted Impact Sound Pressure Level (LnT,w). These are pre-completion testing performance criteria and subject to onsite testing.
Party floors are generally of timber joist construction, although pre-cast concrete floor systems can be used. Timber joisted floors would usually consist of solid or engineered timber floor joists overlaid with a structural floor deck and an acoustic floating floor system.

A number of acoustic floating floor options exist, but the most common system uses timber and foam resilient battens overlaid with 19 mm plasterboard plank and 22 mm chipboard. Ceilings are normally formed by the use of two or more layers of plasterboard fixed to the underside of the floor joists with the use of acoustic resilient bars. Onsite testing has shown that these types of floor generally achieve airborne and impact sound insulation test results some 5 to 10 dB better than Building Regulations minimum standards.

Roof

There are no specific requirements for the sound insulation performance of roofs within national Building Regulations. Normally the acoustic performance of a roof is only considered when a significant external noise source is present. As with most lightweight building systems, the use of multiple layers of plasterboard can help to reduce noise transmission to the rooms below. An acoustic consultant would need to be involved to determine specification and performance requirements.



The complete Acoustics Technical Bulletin can be downloaded from the UK SIP Association website. It is free to download after registering your details on: www.uksips.org

Refer to Technical Bulletin 3 for full details

Thermal

‘Fabric First’ is a popular ethos that has grown from the German Passivhaus standard. This is where energy efficient buildings are created by focusing on the performance of the external envelope of the building, before looking to renewable energy sources or ‘bolt on’ technologies.

Energy efficiency of buildings is generally broken down into three key areas of performance:

- U-Values of building elements
- Ψ-Values (thermal bridging) of element junctions
- Air permeability of the building envelope – heat loss through unplanned air infiltration e.g. around windows or external doors, or air infiltration at service penetrations.

U-Values of building elements deal with the heat loss through the walls, floors, roof, windows and external doors.

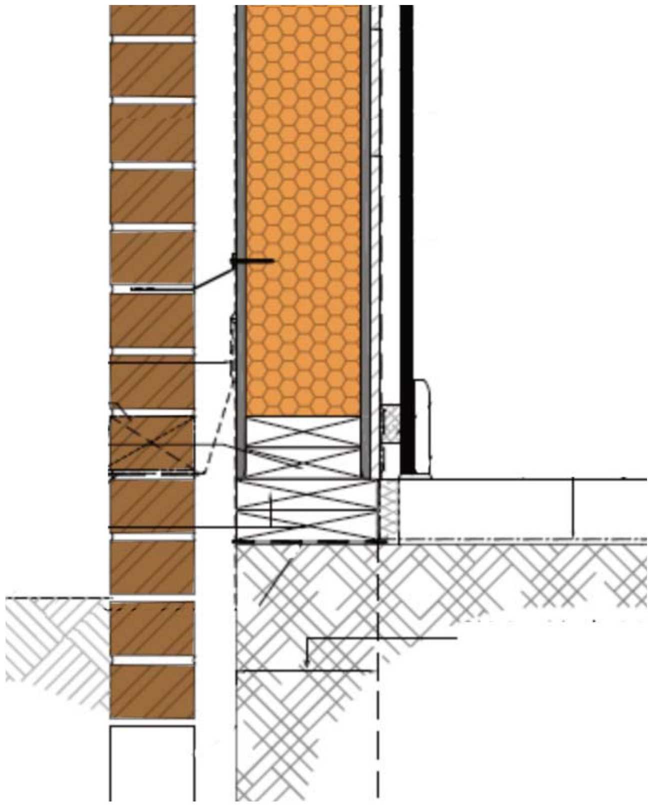
Ψ-Values (thermal bridging) of element junctions deal with the additional heat loss at junctions in elements, e.g. wall/foundation junction, or at corners.

Walls

Most newbuild developments will have external wall U-Value targets of between 0.1 W/m^{2}K and 0.2 W/m^{2}K, which SIPS can easily achieve. The SIP itself provides the greatest contribution to the overall U-Value of the external wall. In most instances U-Value targets will dictate the overall thickness of the SIP, rather than structural or any other requirement.

Reflective breather membranes and vapour control layers can also provide a worthwhile contribution to the overall U-Value of the external wall. Reflective membranes, coupled with an adjoining air gap create a low emissivity void which can enhance U-Values by as much as 0.02 W/m^{2}K.

The SIP manufacturer should be able to conduct U-Value calculations based on their system and client specifications. If U-Values better than those achievable with the SIP alone are required, additional insulation could be installed to the inside or outside of the SIP. The thickness and type of insulation would need to be considered, and condensation risk calculations conducted. A drained and vented cavity should be maintained behind the external cladding.

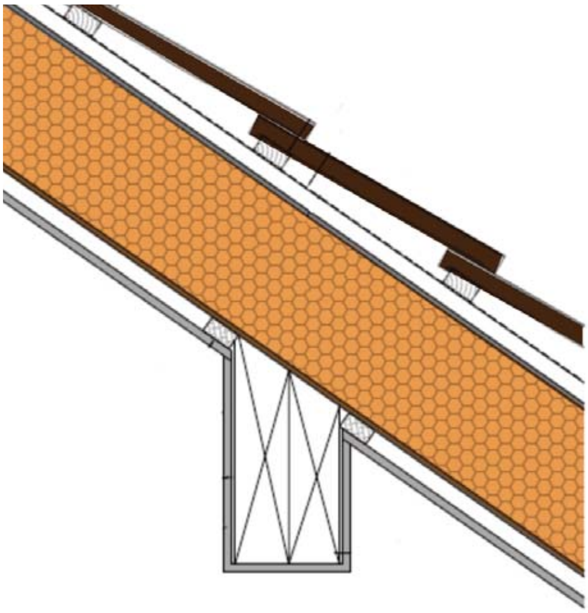


Roofs

Both pitched and flat roofs can be formed using SIPS. These roofs are classified as ‘cold’ roofs, i.e. the structure of the roof passes though the insulation and is subject to a temperature gradient. SIP roofs, whether pitched or flat, will require a ventilation void between the SIP and the roof covering. SIP roof panels can be of any thickness, although most manufacturers will make panels between 100mm and 250mm thick. Most newbuild developments will have roof U-Value targets of between 0.1 W/m^{2}K and 0.18 W/m^{2}K which SIPS can easily achieve.

The SIP manufacturer should be able to conduct U-Value calculations based on their system and client specifications. As with walls, if U-Values better than those achievable with the SIP alone are required, additional insulation could be installed to the inside or outside of the SIP. The thickness and type of insulation would need to be considered, and condensation risk calculations conducted.

For more information and details on SIPS roofing layers, battens, membranes and linings for pitched and flat roofs please consult the Thermal Technical Bulletin 4.



Thermal Bridging & Ψ-Values

Thermal bridging occurs in all construction types and is caused by areas of reduced insulation or where an element passes though the insulation. Timber has a lower thermal resistance than the insulation materials placed between the framing members. Therefore greater heat flow occurs through studs, plates, rails and joists than in other areas of the external wall or roof structures. This increase in thermal conductivity is referred to as thermal bridging. In general, thermal bridges can occur at any junction between building elements or where the building structure changes.

Repeating thermal bridges

The additional heat flow resulting from repeating thermal bridges is included in the calculation of a particular building element U-value that contains these thermal bridges, such as studs in timber frame walls. SIP walls and roofs contain solid timber around window and door openings, and may contain solid timber at panel junctions. The proportion of solid timber within a SIP element will be entirely dependent on the building type and size and should be considered on a site by site basis, but the timber content can be as low as 4%, versus an average of 15% for timber framed buildings.

Non-repeating thermal bridges

The additional heat flow resulting from this type of thermal bridge is determined separately, either by the numerical calculation method given in BS EN ISO 10211-1 or by computer modelling using finite element modelling software and is known as a Ψ-Value.

Recent changes to Building Regulations now require that non-repeating thermal bridging is considered when calculating the energy consumption and CO_2 emissions from buildings. Ψ-Values are specific to each building system, as well as each individual building, and so would generally be calculated on a project specific basis.

Airtightness

Building Regulations require that unplanned air leakage into, or out of, the building is controlled. SIP buildings are able to provide very good levels of airtightness due to the panelised construction methodology. A SIP building would normally incorporate a vapour control layer onto the warm (inner) side of the external walls. This primarily controls the movement of moisture vapour through the wall, as well as being an effective air barrier.

The vapour control layer/air barrier can be lapped and sealed at wall junctions, as well as lapped and sealed at the junctions with other external elements. As with all construction methods, particular attention should be paid to sealing of windows and doors, as well as service penetrations of the building envelope. With SIPS it is also normal practise to seal the splines at panel junctions with either mastic or expanding foam products. This, coupled with the vapour control layer/air barrier, is key to the excellent airtightness achievable from SIPS.

It is important to understand that buildings with very low building fabric air leakage rates will require additional ventilation measures. Typically these will take the form of Mechanical Ventilation Heat Recovery (MVHR) units. MVHR units mechanically control the movement of air into and out of a building whilst recovering latent heat in the exhaust air.

The complete Thermal Technical Bulletin can be downloaded from the UK SIP Association website. It is free to download after registering your details on: www.uksips.org

Refer to Technical Bulletin 4 for full details

Durability

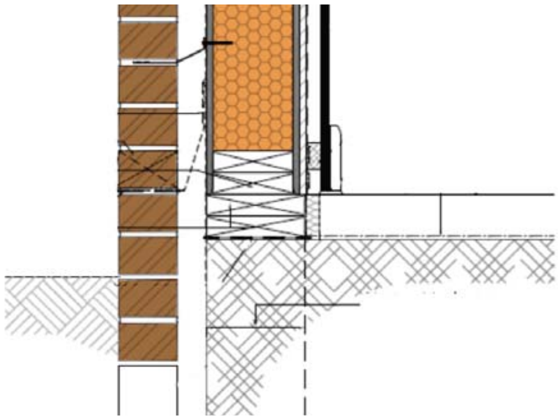
Walls

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.

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.

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.



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 and level or above finished floor level. This is also a requirement of some warranty providers.

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

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 onsite 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.

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.

Future Modifications

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. 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 complete Durability Technical Bulletin can be downloaded from the UK SIP Association website. It is free to download after registering your details on: www.uksips.org

Refer to Technical Bulletin 5 for full details

Sustainability

SIPS offer a relatively low embodied energy building system with good long term thermal and airtightness performance and are also able to offer a long design and service life. They also provide minimum waste, are a lean construction method, minimise energy use in construction and avoid pollution.

Materials used in SIPS

SIPS are constructed by laminating layers of Oriented Strand Board (OSB) to an insulating foam core. Most OSB used in the manufacture of SIPS will come from manufacturing plants in the UK or Europe and will be made from sustainably sourced softwood timber.

Sustainable timber will come from managed forests and will be certified by an organisation such as FSC or PEFC. A number of UK based manufacturers of OSB use home-grown timber in the manufacture of their products.
It is also possible that the manufacturer has used a proportion of recycled material. Nearly all of the structural softwood used in the UK construction industry will come from certified renewable sources in UK and Europe. SIPS generally achieve BRE Green Guide ratings of A and A+ for wall and roof elements.

The European Timber Regulation (EUTR) now means that all timber entering Europe must be legally sourced and Due Diligence employed.

Manufacture of panels

SIPS are constructed in two main ways: one is to bond sheathing boards to blocks of expanded or extruded polystyrene, most commonly using solvent free polyurethane adhesives. The other method is to inject liquid foam insulation between two boards, allowing it to expand and adhere to the boards under pressure.

Whole life costs

Many SIP buildings use the Fabric First approach to reducing carbon dioxide emissions. Rather than offsetting energy usage (and carbon emissions) with bolt on technology, the heating (and cooling) demands of the building are reduced to the lowest levels practically possible through insulation and airtightness. SIP buildings are able to offer exceptional levels of airtightness and minimal thermal bridging.

External wall and roof panels contain minimal timber studs within the depth of the insulation. Typically solid timber is restricted to around openings and at corners. Junctions between panels may use solid timber, but equally may use insulated splines, and so heat loss due to repeat thermal bridging is minimised. Junctions between panels are normally sealed or bonded with adhesive or screwed making the panel junctions relatively airtight, often less than 2 ACH (air changes per hours when tested at 50Pa pressure). SIPS will also normally incorporate an airtight vapour control layer on the warm side of the wall and roof panels which can be lapped and sealed at junctions, further enhancing the airtightness performance of the building envelope. It is through these two approaches that exceptional levels of airtightness (less that 1 ACH) can be achieved.

It is also worth considering the actual performance of a building versus the design. It has been shown, through co-heating tests on completed buildings that some buildings do not perform as well as predicted. A SIP building is more likely to achieve the design performance in use due to the solid nature of the insulation and panel, the continuity of insulation and the robust detailing of panel junctions.

Additional savings

SIP structures are typically low in weight and so additional savings in embodied energy can be made in the design of foundations and supporting structures through the use of less concrete. The use of SIPS may allow sites to be used that were not deemed suitable for typical masonry construction, e.g. sites with poor ground conditions.

Modification & Maintenance

SIPS are still relatively new to the UK construction industry so there is less general knowledge about undertaking modifications to these structures, although they are no harder to modify than other types of building.

Floors joists and roofs trusses in SIP buildings are the same as those in timber frame and masonry construction. Many internal walls will be non-load bearing timber stud work, and so can be modified or removed easily without any other work required to the structure. Internal load bearing walls will need to be identified.

Modifications and removal of timber stud or SIP internal walls, as in masonry construction, will require lintels or beams to be installed to span areas of walls that are removed and support the structure above. Providing adequate support for these beams at bearing ends usually entails the installation of additional timber studs or posts to carry the loads down the foundations, but this type of work is relatively straightforward and generally requires no specialist skills.

Modifications to SIP external walls can also be easily carried out by trained personnel. For instance, a window opening can be turned into a door opening by simply cutting out the panel below the window and making good, but consideration should be given to the removal of the 'sole plate' and the treatment of the reveal details.

Depending on the design of the building and the SIP manufacturer's specific system, new openings can be made or existing openings widened with ease. If the floor system incorporates a ring beam onto which floor joists bear, no lintels are normally required within the panels themselves. This means that openings can easily be modified without having to introduce additional elements of structure such as new lintels or beams. If lintels are present over openings, these will be supported on cripple studs at either end. A new lintel and supporting studs would need to be fitted after modifications to the opening are made.

Deconstruction and recycling of old buildings

At the end of a buildings life, it is important to try and reuse and recycle as many components and materials as possible. There are many organisations and local companies that specialise in the reclamation and sale of building materials. Many SIP manufacturers produce standard sized panels, i.e. 1.2m by 2.4m, and so panels may be re-used in the construction of another building, or sold to the public via reclamation yards for the construction of garden offices, industrial buildings and other similar types of building.

The complete Sustainability Technical Bulletin can be downloaded from the UK SIP Association website. It is free to download after registering your details on: www.uksips.org

Refer to Technical Bulletin 6 for full details

Approved SIP Installer Scheme

SIPCheck, the UK SIP Association Approved Installer Scheme defines the processes for applying for and assessing Approved SIP System Installer status with the UK SIP Association. The aim of the Scheme is to ensure that Approved Installers are competent to undertake the installation of SIP technology and systems.

SIPCheck encompasses those members of the UK SIP Association who actively install SIPS technology and systems.

The UK SIP Association approves installers as competent to install defined SIP systems. Installers must be assessed by the UK SIP Association as meeting the industry perfromance requirements before approval and surveillance is carried out by the UK SIP Association.

The provider of the SIP system to be installed must be satisfied that the proposed installer is capable of installing it competently and in accordance with the SIPCheck documentation and must provide written confirmation to the UK SIP Association in this regard.

The UK SIP Association assessment and surveillance of installers of SIP Systems is based on a three party arrangement: the UK SIP Association, the SIP System provider and the Approved Installer, with defined roles and responsibilities:

Approved Installer

The Approved Installer is responsible for:

- Ensuring that installation of SIP Systems are carried out in accordance with SIPCheck and the SIP System Provider's Installation Manual (including completion of all relevant documentation where necessary).
- Maintaining a register of Approved Installer Representatives (Approved Installer Reps.) and assessing the ability of these personnel to meet the requirements of this Scheme Document.
- Notifying the SIP System Provider of changes with regards to Approved Installer Representative's details.

The Approved Installer Representative must be able to demonstrate that they are fully conversant with the contents and requirements detailed within the SIP System Provider's Installation Manual and associated documents as well as all other factors that could affect the success of an installation including but not restricted to:

- Storage and handling of materials
- Suitability and preparation of the site
- Installation techniques
- Repair and maintenance of the product
- Finishing work
- Material specification
- Health and safety
- Adherence to all statutory requirements applicable to the project
- Maintaining robust documentation identifying all work in progress and completed installations
- Responding to the UK SIP Association for requests for ongoing and completed installations
- Acting on any actions raised during inspections
- Maintaining relevant records.

SIP System Provider

The SIP System Provider is responsible for:

- Assessing an Installer before they apply for approval under the SIPCheck scheme
- Training and approving the Installer's Approved Installer Reps. such that the SIP System Provider considers them to be competent to oversee the consistent installation of SIP Systems in accordance with the Installation Manual
- Advising the UK SIP Association of additions and deletions or moves to another installer to the list of Approved Installer Reps. in a timely manner.
- Maintaining their Installation Manuals and other relevant documentation under this scheme.

UK SIP Association

The UK SIP Association is responsible for:

- Checking (at least annually) the Approved Installer is maintaining a register of Approved Installer Reps.
- Inspecting each card-carrying Approved Installer Rep. at least twice each calendar year
- Maintaining/administrating the Approved Installer Scheme documentation
- Assessing the installer wishing to be approved (i.e. providing Approved Assessors), and once approved, carrying out regular surveillance visits to maintain the approval status.

For more information, details and fees on becoming registered as an Approved Installer under the SIPCheck scheme visit: www.uksips.org phone 01743 290 011, or email: info@uksips.org

Further Reading

Additional information on the wider technical aspects of SIPS construction and more details on many of the points raised in all six Technical Bulletins can be found here:

BRE
including Green Guide, BREEAM and product testing
www.bre.co.uk

BSRIA
Airtightness
www.bsria.co.uk/services/compliance/airtightness/

BSi
BS 5250:2002 'Code of practice for control of condensation in dwellings'
www.bsigroup.com/en-GB/

BM TRADA
Certification, testing, technical training and information on timber and wood products
www.bmtrada.com

EUTR
EU Timber Regulation, sustainable timber sourcing and advice

National Measurement Office
www.bis.gov.uk/nmo/enforcement/EU-Timber-Regulation

Central Point of Expertise on Timber (CPET)
www.cpet.org.uk

Fabric First Principles
Fabric First
www.fabricfirst.co.uk

Passivhaus (BRE affiliated)
www.passivhaus.org.uk

Passivhaus Trust
www.passivhaus.org.uk

Structural Timber Association
Formerly known as the UK Timber Frame Association (UKTFA), detailed information on the use of structural timber products and systems within the UK construction industry including guidance on Fire Safety.
www.structuraltimber.co.uk

Structural Insulated Panel Association (SIPA)
USA-based sister organisation to the UK SIP Association -
www.sips.org

UK Building Regulations Approved Documents
www.planningportal.gov.uk/buildingregulations/approved documents

UK SIP Association
www.uksips.org

UK Green Building Council
Facilitating dialogue between industry and Government to promote greener approaches in the construction sector.
www.ukgbc.org

Zero Carbon Hub
The Zero Carbon Hub helps to understand the challenges, issues and opportunities involved in developing, building and marketing low and zero carbon homes.
www.zerocarbonhub.org

UK SIP Association Membership – Join Up

The UK SIP Association is one of the leading trade associations in the timber and construction sectors and is the only organisation exclusively representing the SIP industry in the UK. It engages in a wide variety of issues and requirements that are relevant to the effective promotion and exploitation of SIP construction methods. Membership is open to all organisations involved with or that have an interest in SIP technology. Our members come from across the entire supply-chain and are united by a commitment to stringent standards of quality and service to their customers.

Free Trial Membership
If you would like to find out more about what the UK SIP Association has to offer, we are offering a 3 month trial membership. With the free trial membership, you will be given access to our Members Area - via our log in button – where you can view a limited set of the information available to our members. New member categories include Manufacturers, Engineer/ Consultant, Processor/Supplier, Architect, Installers and Professionals.

Trial Membership will last for 12 weeks from point of approval by the Association Board and you can upgrade to full membership at any time and take advantage of a wealth of industry information. To apply for membership, please visit **www.uksips.org/join**