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Sustainability

What does sustainability mean?

One of the more widely quoted definitions of sustainability is "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

It is important that the buildings we construct today are designed with this in mind. Ensuring long term durability, good in-service performance, ease of maintenance and modification as well as considering the impact of the construction process itself are all very important factors when considering sustainable construction.

SIPs offer a relatively low embodied energy building system with good long term thermal and air tightness performance and are also able to offer a long design and service life (in excess of 60 years).

Sustainable construction

At the end of the 20th century, it was acknowledged that the current performance of construction was unsustainable. The construction industry was subject to a large degree of criticism and regarded as underperforming and having low productivity. The UK Government's sustainable construction strategy emphasised the need for change within the industry.

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.

Materials used in the construction of SIPs

SIPs are constructed by laminating layers of Oriented Strand Board (OSB) to an insulating foam core. Most, if not all, 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.

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6 SIPS TECHNICAL BULLETIN

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The European Timber Regulations (EUTR) now means that all timber entering Europe must be legally sourced. In addition, nearly all of the structural softwood used in the UK construction industry will come from certified renewable sources in UK and Europe. This means that the solid timber elements used in the construction of SIPs should be legally and responsibly sourced and come from sustainable managed forests.

The insulating foam core to the SIP will normally be either expanded polystyrene (EPS), Polyisocyanurate (PIR) or polyurethane (PUR). All new builds require significant quantities of insulation to be incorporated into the structure to achieve the requirements of the Building Regulations and the Code for Sustainable Homes. Although there are embodied energy implications in using these types of insulation materials, and at present most types of insulation do not use renewable materials, many construction types including masonry and timber frame use similar or the same types of insulation as SIPs in their construction.

SIPs generally achieve BRE Green Guide ratings of A and A+ for wall and roof elements. The Green Guide recognises more than just embodied energy when awarding ratings for products and systems. Aspects such as climate change, water usage, human toxicity, waste disposal and others are considered when applying ratings, so products and systems which achieve A and A+ ratings are considered to have a low overall environmental impact.

Manufacture of panels

Structural Insulated Panels 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.

Larger off cuts of timber and board material can be used in the production of other panels or ancillary components. Sawdust from untreated timber can be used as animal bedding. Off cuts of treated timber and board material may also be used as biomass fuel to heat the SIP production facility or in power stations.

Off cuts of insulation material may be re-used if large enough, or more normally recycled by the manufacturer where the facility exists. Inevitably, some waste will go to landfill, but this would normally be far less than similar insulation waste generated on a construction site.

Images courtesy of SIPS Eco Panels

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 air tightness. SIP buildings are able to offer exceptional levels of air tightness and minimal thermal bridging.

External wall and roof panels contain minimal timber studs within the depth of the insulation and 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.

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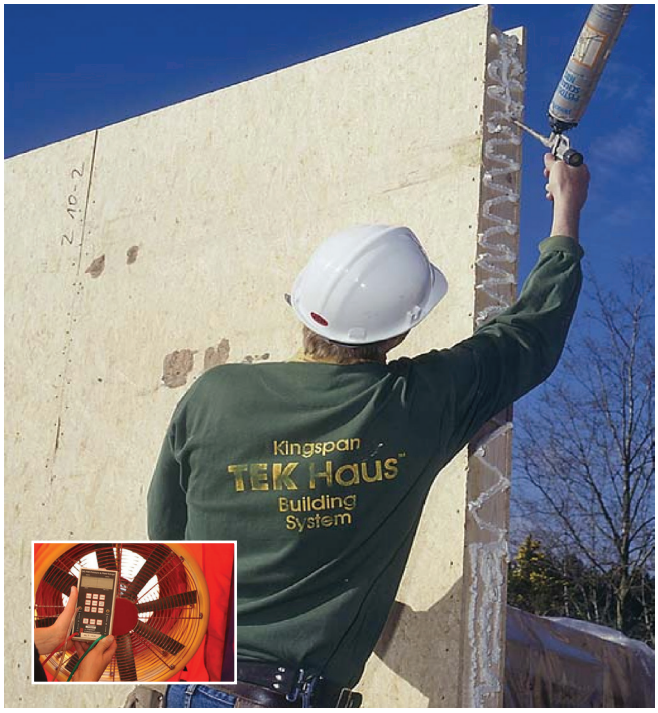

Image courtesy of Kingspan TEK

Image courtesy of SIP Building Systems

Junctions between panels are normally sealed or bonded with adhesive making the panel junctions relatively air tight, often less than 2 ACH (air changes per hours when tested at 50Pa pressure). SIPs will also usually incorporate an air tight vapour control layer on the warm side of the wall and roof panels which can be lapped and sealed at junctions, further enhancing the air tightness performance of the building envelope. It is through these two approaches that exceptional levels of air tightness (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 coheating tests on completed buildings that some buildings do not perform as well as predicted. This can often be due to air leakage into the insulation layers (sometimes called wind washing) or by poorly fitted insulation materials leading to thermal bypass. 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.

These energy efficiency measures ensure that, over the whole life of the building, the energy used in the manufacture of the SIP is more than offset by the reduction of energy used for heating (and cooling) the building.

A number of studies have been undertaken into the embodied energy of SIPs versus other construction methods. One particular study at Anglia Ruskin University showed that, depending on the exact method of construction and building form, a SIP building would offset its carbon emissions from construction after typically circa 10 years.

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. Similarly 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. If the SIP shell is then clad with a lightweight cladding system such as sustainably sourced timber cladding, further savings in weight, foundations and embodied energy can be made versus a masonry clad structure.

6 SIPS TECHNICAL BULLETIN

STRUCTURAL TIMBER ASSOCIATION
Building solutions in timber

Release of dangerous substances VOCs and formaldehyde

Off gassing of dangerous substances is a topic which the public is starting to become more aware of. SIPs consist of OSB and foam insulation. OSB is manufactured from strands of softwood timber and adhesive resins. The resins used in the production of OSB are typically phenol formaldehyde; however the off gassing from this type of adhesive is minimal and the quantity used is very low. Some OSB manufacturers use adhesives which contain no formaldehyde. Insulation materials such as EPS and PUR do not contain any CFCs, HCFCs, Formaldehyde and do not release any VOCs.

Building modification, extension and repurposing

As the needs of building occupants change over time, homes are modified to fit with the aesthetic desires or practical requirements of the owners. Modifications to masonry structures are well understood and undertaken regularly. SIPs are still relatively new to the construction industry and so there is less general knowledge about undertaking modifications to these structures, although they are no harder to modify than other types of building.

The ways in which buildings work, regardless of construction method, are similar. 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 straight forward 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.

Where substantial modifications are being considered to an existing SIP building the original manufacturer should be consulted where possible or specialist advice should be sought. The Structural Timber Association can make recommendations in this regard if required.

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. Lengths of solid timber, such as floor joists and internal timber stud walls, can be easily removed to be re-used. Depending how the building was constructed, and the SIP manufacturer's specific system, it may be possible to remove the fixings securing panel together and to remove individual panels without damage. 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. If necessary, the OSB and foam core can be stripped apart and recycled at end of life.