12.0 INSULATED PANELS

12.1 DESIGN

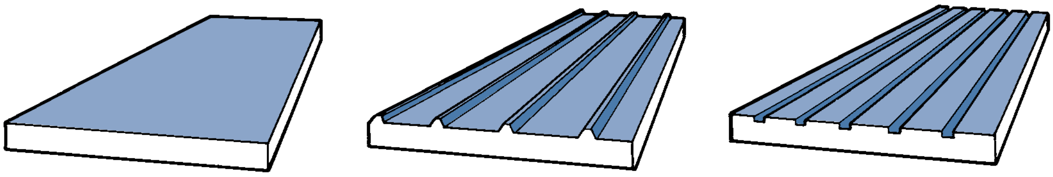
The use of double skin composite or insulated panels for roof and wall cladding requires the same or similar detailing for flashings, penetrations and design considerations that are required for single skin roof and wall cladding described in this Code of Practice. Reference should be made to the relevant section when designing insulated panel systems, as only specific differences are described in section 12.

As insulated roof and wall panels are specialised proprietary systems, few specific details are offered, however the principles of water shedding, fastening and maintenance described in this Code, are all applicable.

Composite or insulated panels are factory made from different core materials laminated and permanently bonded together by adhesive or by foaming in place but acting as a single structural element.

Insulated or sandwich panels have metal facings on both sides, with the space between them filled with an insulating core permanently and continuously bonded to both surfaces. There are three types of sheeting use on bonded panels:

- Flat metal panels (Coolroom)
- Profiled metal panels (Roofing)
- Miniature ribbed panels (Architectural)



The manufacturing process for bonded panels that are adhered together, consists of rollforming the flat or profiled sheeting, followed by the adhesion of the insulation core to both surfaces or skins. There are three methods:

- continuous metal panel production by glueing panels of insulation to metal skins;
- individual panel production;
- continuous metal panel production by foaming;

Site assembled, or built-up systems are also known as composite panels and are of two main types:

- where two profiled sheets have rigid insulation boards adhered to their troughs, having no metal spacers,
- where the sheeting is mechanically fixed on both sides to a structural girt. The girt can however form a thermal bridge, unless spaced away from the structure and this type of built up system commonly uses fibre insulation.

Bonded composite panels develop their strength from the sandwich of skins and insulation, and are made with a tongue and groove side lap detail that incorporates concealed fasteners.

Flat continuously produced panels suffer minor undulations in the metal skins that arise from built-in tensions in the metal coil and introduced during panel manufacture. Panning can be minimised by using an embossed or matt finish or forming minor ribs or swages on the flat face of the panel.

12.2 MATERIALS

The facings or skins of composite panels can be metallic coated or pre-painted steel or aluminium and are either profiled or flat on either or both sides. The internal skin is also known as the liner skin or sheeting.

The thickness of steel metal facing or skin is commonly made of grade ZM 300 and thicknesses of 0.40mm to 0.63mm B.M.T.

Aluminium facings are used in very humid conditions, or a severe marine environment and can be supplied with a mill or embossed surface, or be pre-painted.

12.3 INSULATION CORE

The bonded insulation core material contributes to the panel strength by providing most of the resistance to shear forces, and the depth of the core will determine the panel resistance to deflection.

The core can be made from different types of material all with different insulating values, fire ratings and strengths. The most common are; EPS Expanded Polystyrene, PIR Polyisocyanurate and PPS Phenolic/Polystyrene.

Expanded polystyrene is used for flat factory bonded panels and can be shaped to the profile when the top skin is of profiled metal.

The insulation thickness of a profiled roof panel varies from 30mm - 300mm, and the U-value is based on the average thickness, so to achieve the same insulating value as a flat panel, the profiled roof panel is required to be thicker.

Dense rigid mineral fibre insulation may be selected for applications where fire resistance or acoustic insulation properties are considered to be most important.

Built up or composite panels insulated with extruded closed cell polystyrene, or fibre insulation material, may need to be of a different thickness to achieve the same insulation value.

12.4 STRUCTURAL

Composite panels are integral units in which the insulation layer together with the two metal skins act as a beam to resist wind and point loads. The synergy acquired by the combined strength and stiffness of the metal and insulation core is far greater than the sum of the component parts, and large spans are possible. The strength and stiffness of insulated panels are determined by both the metal and its thickness, and the core material and its thickness. Using profiled sheeting for one or both faces can further increase the strength, and increasing the thickness of the core will permit the use of larger spans under the same loading conditions.

The number and strength of the fasteners under wind suction loads can limit the maximum purlin spacing. If roof-lights are required, then the maximum purlin spacing will be limited by the strength of the roof-light sheeting. Polycarbonate or G.R.P. barrel vault roof-lighting may avoid this restriction.

Insulated panels, unlike single skin profiles, can support normal foot traffic without damage, because the foam core provides continuous support to the external sheeting to resist deformation and indentation.

All persons walking on the cladding should wear footwear suitable to comply with the safety requirements in ***14.1. Safety,*** and also to avoid marking or scratching the surface coatings.

Structural bonded composite roof panels contribute to site safety because, once fixed, they provide a safe working platform. Fixed panels are fully trafficable at all practical spans, however foot traffic on unfixed panels should be restricted to the roof panel erectors.

12.4.1 SUPPORTING STRUCTURE

Composite panels are supported on purlins or girts, which should be accurately erected to a maximum tolerance of ±3mm and L/600 as due to their inherent stiffness insulated panels do not have the flexibility to follow uneven structures.

Where composite roof panels are required to have end-lap joints, the external sheets are overlapped, and the joint in the lining and insulation is a butt joint. As both sides of the joint require support, and the fasteners are at one side of the joint, the purlins should be wide enough to provide this support.

All transverse laps should be fixed and sealed to prevent the passage of air, water or water vapour.

If composite panels are expected to provide restraint to the purlin or girt flanges, through fixing with oversized holes is required which allows panels to slide under thermal movement, as clips do not provide sufficient restraint. Where fixings are widely spaced panels may not effectively restrain the purlin or girt flange.

Composite panels should not be used in lieu of sag bars as their function is to hold the purlins or girts in their correct location while the panels are erected.

Composite panels have a structural integrity which single skin profiled sheets do not possess, and are able to accommodate penetration openings of 350mm diameter or 300mm square without the need for additional structural supports or trimmers.

Where larger holes are required trimmers should be in place before the erection of the panels.

12.5 THERMAL

Thermal bowing can occur when the two skins are at significantly different temperatures such as north facing walls. e.g. when a coolroom roof panel is in direct sunshine. The effect is accentuated when the external surface is a dark colour, and is more severe for aluminium facings.

A method of limiting the thermal bow is to make stress relief cuts in the panels as follows:

- When a panel is restrained in three or more points a cut completely severing the cold skin may be required at the intermediate point.
- When a panel is attached along its edge, a partial stress relief cut may be required.

The through fasteners or fixing clips are cold bridges, but it has been shown that these are unlikely to increase the U-value by more than 1-2%.

Where the roof panel length is >15m a joint may be required. This can be a sealed lap joint where provision for expansion is provided or a stepped or waterfall detail. ***(see section 5.3.5.3.)***

12.5.1 FIRE

Most panels have a fire resistance when used as a non-loading panel, and the cores are made from insulating foam incorporating fire retardant materials. Fire regulations aim at reducing the risk of death or injury to occupants, the public and the fire service, and this is achieved by the selection of materials which behave in a predictable manner.

Steel and aluminium liners achieve classifications for combustibility, ignitability and surface spread of flame, but for fire resistant wall construction steel skinned composite panels must be used as aluminium has too low a melting point.

Polystyrene cores are not easily ignited behind the metal skins, but can melt and flow out of the panel and must not be used for internal partitions or ceilings, where there is a high fire risk. Polystyrene cored panels must be isolated and protected from radiation from hot flues.

Once fire has been established within the foam core, Fire Services are unable to trace or extinguish it and then the building should be regarded as unsafe.

Because the use of nylon bolts may jeopardise the integrity of the building during a fire, other mechanical connections should be used if the building is required to have a fire rating or is considered a likely fire risk.

N.B. Fire ratings are available for non-load bearing applications.

Aluminium skinned composite panels, nylon bolts or polystyrene cores must not be used where the building is required to have a fire rating or is considered a likely fire risk.

12.6 CONDENSATION

Metal facings are effectively impervious to penetration by vapour, while polystyrene insulation has a closed cell structure, which does not permit significant transmission of vapour. Interstitial condensation cannot occur without the presence of vapour in the insulation so to prevent this it is necessary to seal all laps and gaps.

The side-lap joints require sealing to prevent condensation on the overlapping edge of the external sheeting. Transverse laps, joints and ridges should also be fastened and sealed.

When composite panels are used as cold store insulation a complete and continuous vapour barrier is essential to prevent inward moisture vapour pressure. Any discontinuity will result in a build up of ice which can destroy the panel.

12.7 ACOUSTIC

Acoustic insulation properties are related to cladding mass and as composite panels are relatively light they do not have inherently good acoustic insulation properties. They can be installed with sealed joints to reduce airborne sound and they can perform as well as some built-up systems.

Acoustic absorption depends on the nature of the lining, which if flat and metal, absorbs very little acoustic energy, and it may be necessary to install additional acoustic lining systems.

12.8 FIXING

Composite roof panels with trapezoidal ribs are through-fixed with a load spreading washer on the rib, and require sealing at the side-laps, whereas flat concealed fix composite panels require more complex jointing systems.

Profiled cladding side laps require to be stitched at the rib at 500mm centres with a strip sealant of approximately 9mm x 3mm or similar. ***(see side lap fasteners section 5.4.2.)***

The through fixings may also be pan fixed or located on a mini-rib or swage within the trough, but purpose designed fasteners are required to maintain the weather seal between the metal skin and the washer. Pan fasteners should not be over-tightened as this will cause shallow dents around the fastener head and washer. The washer should have a minimum diameter of 25mm to provide good pull-over strength.

All fixings must have a pullout strength and frequency to equal the wind design load. *(see fasteners section 7.8.1.)*

The maximum practical length of panels is restricted to approximately 25m as greater lengths may present handling problems because of the panel weight. Where a transverse joint is required there are two options:

- At end-laps, the lining and insulation is butt jointed over the purlin, and a 150mm overlap is formed in the external weather skin only using two lines of sealant. The sealant should be silicone or preformed strips, and be positioned at the top and bottom of the lap. With flat or wide pan profiles to provide a secure seal additional sealed rivets or stitching screws are required through the top skins only. This detail is only suitable where the roof pitch is >10° and where the maximum length is <15m.
- Where the pitch is below 10° or the length is >15m a stepped or waterfall joint is required. ***(see section 5.3.5.3.)***

The bottom skins of composite panels have an integral side lap with a re-entrant sealing space which acts as a vapour control, but in high risk applications such as food processing buildings, textile mills and indoor swimming pools, an additional sealer strip is required at the lining.

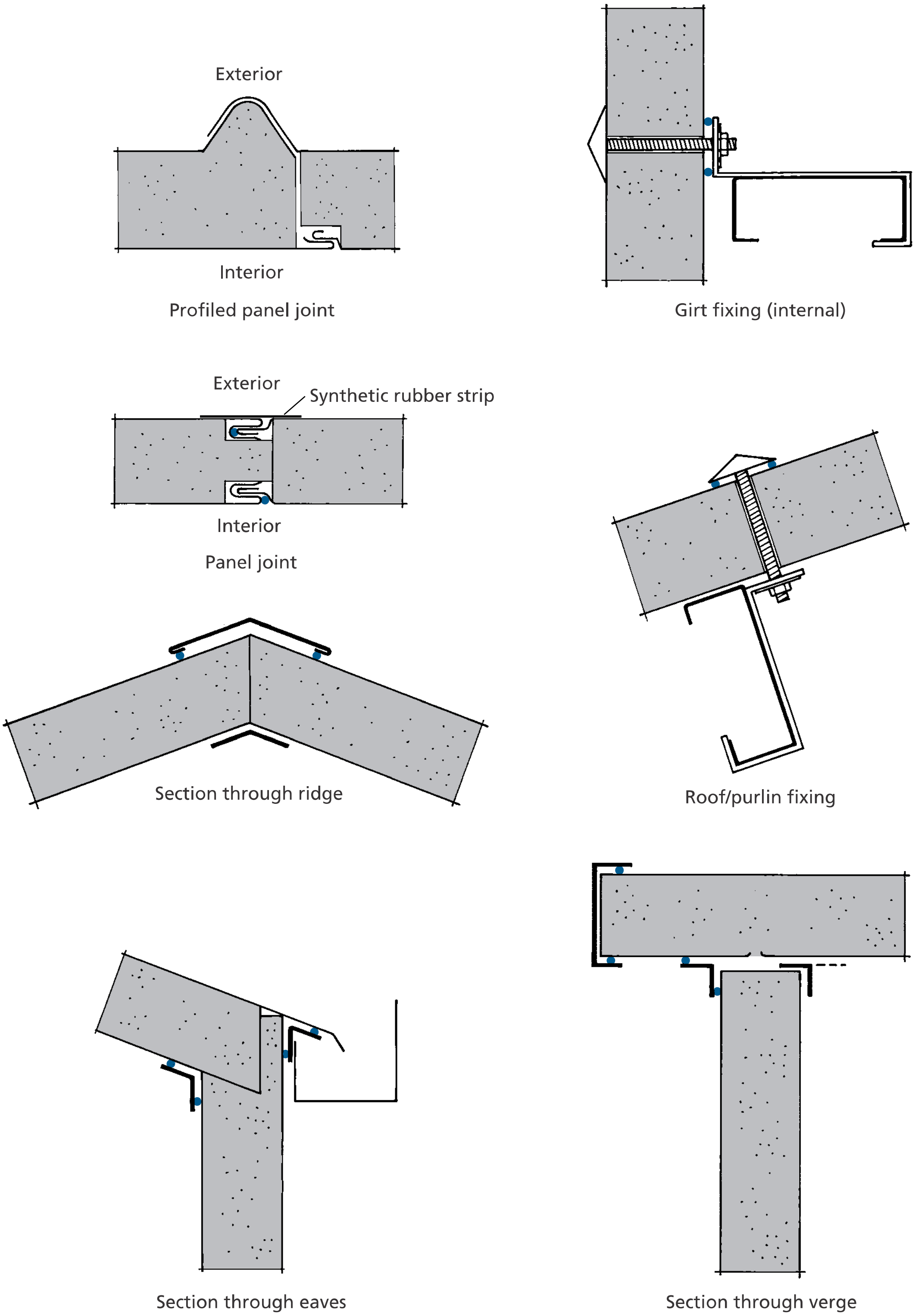
Concealed fix systems may be used on very low pitches to conceal the fasteners from the weather and from view.

12.9 FLASHINGS

Flashings detailing is similar to that used with single skin roof and wall cladding or built-up systems, but there are minor differences that may influence design choices, and special requirements that should be addressed.

The panels at the ridge should be sealed and the lining closed with a metal trim mounted on the ridge purlins. Any gap between the ends of the composite panels should be insulated to eliminate cold spots or cold bridging, and this can be done with in-situ injected foam or mineral fibre. In high humidity applications the liner trim should be sealed to the panels, and at end laps or any gaps foam injected to provide a vapour tight seal.

Eaves panels should have the ends turned down to direct water to drip into the gutter, and to have a metal flashing to cover the exposed end of the insulation and metal liner.



Drawings 12.9