Structure

AS twin skin systems are designed to be supported by steel or timber purlins: liners are supported by and fixed directly to the purlins, whilst weather sheets are supported by and fixed to rails which are held off the purlins by a spacer system. Roof profiles are usually laid with the broad valley resting on the purlin or spacer bar: wall profiles will usually have the narrow valley against the purlin or spacer bar. All 0.7mm thick trapezoidal profiles are suitable for spanning purlins at 1.8m centres. Consult Steadmans' Technical Department for guidance on using the profiles on purlins at centres greater than 1.8m. Steelwork for twin skin systems should be within the tolerances given in BS 5950-2 2001: fixing planes on adjacent purlins should be less than L/600 apart (where L is the purlin spacing). AS sheets should be isolated from preservative treated timber purlins by PVC barrier tape applied to the bearing face of the purlins.

Fixings

Fixings for roof profiles provide restraint against wind uplift forces; those for wall profiles provide restraint and support. Whilst profiles may be fixed through valleys or crowns, Steadmans recommend valley fixing: accurate fixing is easier to achieve, loads on the fixings are smaller, the fixings are less likely to distort the profile, and better compression of the sealant is achieved at end laps.

Fixings should be stainless steel or carbon-steel self drilling screws: those for the weather sheet should have press-on or integral caps to match the colour of the profile and should have a 16mm diameter EDPM washer to prevent water penetration.

Fixings to light and heavy section steel should pass through the steel and leave 5mm of thread exposed on the underside of the section. Fixing to timber must achieve a minimum 40mm embedment.

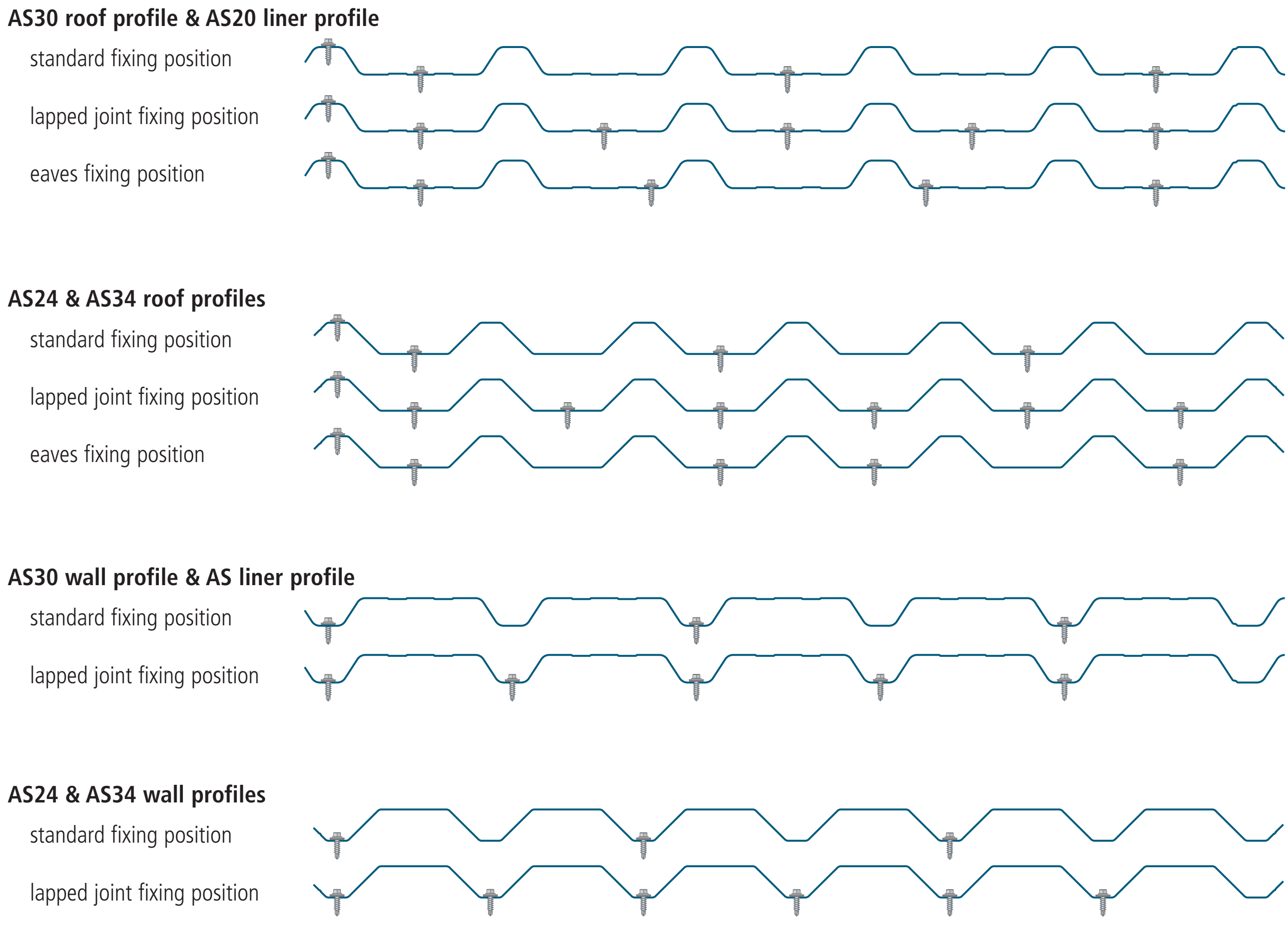

Figure 01: Fixing positions for roof and wall profiles - to achieve optimum sealant compression

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Fixings continued

The 0.4mm thick liner sheets should be restrained by support bar brackets, which are set at 1m centres on each purlin. Washered fixing screws may be used to provide temporary restraint during installation. The 0.7mm thick liner sheets should be fixed as shown on page 18 of the Steadmans Twin Skin Systems technical brochure.

Weather sheets should be fixed directly to the support bars. Each weather sheet requires three fixings (in alternate valleys) at intermediate purlins, four fixings at the eaves and one fixing in each valley at laps. Consult Steadmans' Technical Department for guidance on fixing sheets in extreme exposure conditions.

AS13/3/990 corrugated profiles should be fixed through the crowns of the corrugations. Profiles should be fixed at every second crown at each end (including laps), and at every third crown over intermediate purlins: stagger the fixing pattern across multiple intermediate purlins (there must be a fixing in each side lap).

Laps

Side laps between sheets are formed by lapping the female side of one sheet over the male crown of the adjacent sheet. The exposed edge of the lap should face away from the prevailing wind.

Side laps of liner sheets should be sealed with polyband plastic backed butyl sealant strip 50mm wide by 1mm high. Side laps of weather sheets should be sealed with butyl sealant strip 6mm wide by 5mm high. Weather sheet side laps on roofs should be stitched with 23mm long self drilling screws at 450mm centres.

End laps are required in roofs with two or more tiers of sheets. End laps are formed by lapping the upper weather sheet 150mm over the lower sheet. End laps of liner sheets should be sealed with a run of 4mm butyl bead sealant applied 10 - 15mm up slope of the fixing line and fixed with 25mm fasteners.

End laps of weather sheets should be sealed with two runs of butyl sealant strip 6mm wide by 5mm high applied 10 - 15mm from each end of the lap and fixed with 25mm fasteners.

Note: at end laps all metal and GRP weather and liner sheets should extend a minimum of 50mm beyond the fixing line (see figure 02).

Side laps between rooflight inner sheets and liner sheets should be sealed with polyband plastic backed butyl sealant strip 50mm wide by 1mm high. End laps should be sealed with a run of 4mm bead sealant 10 - 15mm above the fixing line. Side laps between rooflight outer sheets and AS weather sheets should be sealed with 6mm wide by 5mm high butyl sealant and stitched with 23mm self drilling fixings or laplocks (see figure 36). End laps should be sealed with two runs of 8mm diameter butyl sealant applied 10 - 15mm from each end of the lap.

Where four sheets overlap additional runs of butyl sealant are required between the male and female crowns of all four sheets to prevent air leakage.

The inner and outer sheets of rooflights can be lapped over the metal sheets on both sides to facilitate fixing. Junctions between rooflights and profiles should be protected with flashings or foam fillers to prevent thermal insulation intruding onto rooflights.

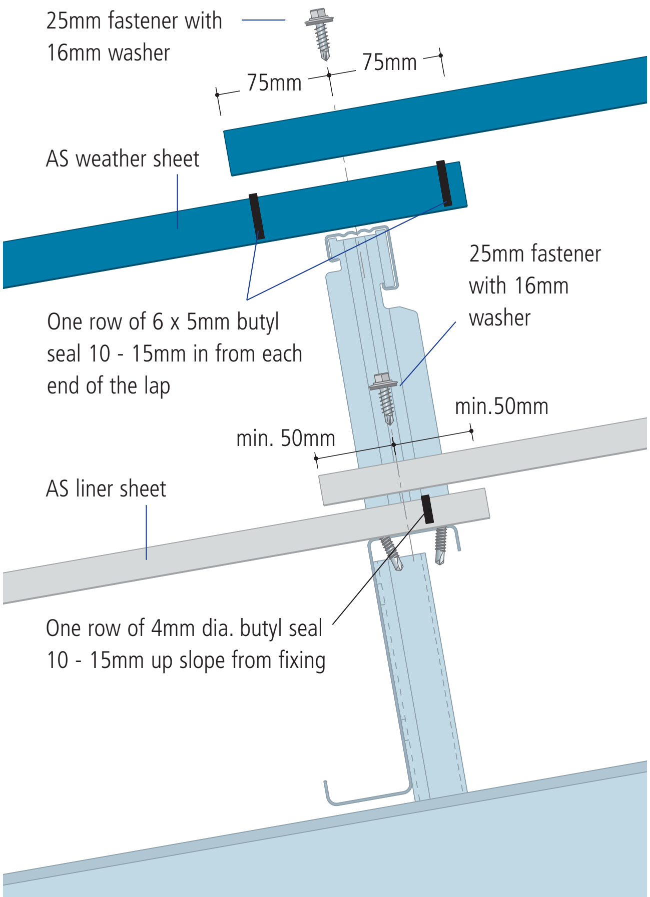

Figure 02: End lap fixing details - roof profiles
(Note: insulation omitted for clarity)

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Fire

AS20/1000 and AS30/1000 profiles used as internal liners provide class O resistance to surface spread of flame and can be used to form roof and wall linings without any additional treatment. All AS series weather sheets achieve an AA rating against external spread of flame and may be used on any location on the roof.

The AS Fire Resistant Wall System, which includes two 80mm layers of Rockwool Firesafe insulation, achieves 125 minutes integrity and 35 minutes insulation when tested to BS 476-22:1987 (Warrington Fire Safety test report 150032 Issue 2). Full specification details of the Fire Resistant Wall System are available from Steadmans Technical Department.

In England & Wales and Northern Ireland a standard AS twin skin system may be used on walls more than 1m from a boundary: see Approved Document B section 13 (England & Wales) and Technical Booklet E (N. Ireland) for details of boundary conditions. Walls within 1m of a boundary should be constructed with the AS Fire Resistant Wall System.

In Scotland the AS Fire Resistant Wall system should be used for all walls which require a fire resistance period. See Scottish Building Standards Technical Handbook Section 2 for details of boundary conditions and fire resistance requirements.

Thermal performance

Carbon emissions from non-domestic buildings must now be 23.5% less for naturally ventilated and 28% less for mechanically ventilated than those predicted for a comparable building which would have met the requirements of Part L 2002. Energy use and emissions must be calculated using the Simplified Building Energy Model (SBEM), either by using iSBEM (a free software tool available from the DCLG) or by using an accredited simulation tool. Whilst designers will now have to consider building form, efficiency of services and the use of low or zero carbon energy generation they will still have to address fabric heat losses:

Conduction losses: although fabric U-values are no longer recognised as a means of demonstrating compliance with Part L they still have a substantial effect upon overall rates of carbon emission. The U-value achieved by a twin skin system depends on the depth of insulation specified (see Table 28).

Thermal bridging: SBEM takes account of heat losses at junctions between building elements by means of their linear thermal transmittance values (psi values). Psi values for junctions and perimeters in the twin skin systems are shown in table 29 on page 4.

Air leakage: whilst the regulations for England and Wales and N. Ireland set an air leakage limit of 10m^3/m^2/hr @ 50Pa (15m^3/m^2/hr for Scotland), designers may choose to base their SBEM calculations upon lower rates. When correctly detailed and installed a twin skin system will contribute to achieving a low air leakage rate.

Work which involves increasing the capacity of building services in existing buildings (described in Approved Document L2B) may require improvements to the thermal performance of building elements. One means of achieving that would be to replace existing roof or wall profiles with a twin skin system.

Table 28: Roof and Wall U-values for twin skin systems

U-value (W/m^{2}K)	Insulation thickness (mm)	
0.35	130	U-values based on the use of mineral wool insulation with a thermal conductivity of 0.04W/mK
0.30	150	
0.25	180	
0.20	220	
0.16	280	

The calculations have been carried out in accordance with the recommendations of MCRMA Technical Paper 14 'Guidance for the design of metal roofing and cladding to comply with approved document L2:2001', using finite element analysis computer program HEAT2. This program is fully compatible with BS EN ISO 10211-1:1996 'Thermal bridges in building construction. Heat flows and surface temperatures - General calculation methods' and so meets the requirements of Approved Document L.

Control of condensation

Part C2 of the Building Regulation requires designers to prevent harmful condensation forming on or within building elements. To minimise the risk of condensation designers should arrange for the extraction at source of moisture generated by activities and processes within the building and adopt forms of construction which will not trap moisture within building elements. Designers should observe the guidance in BS 5250:2002.

A twin skin system is unlikely to be affected by surface condensation as the insulation will keep the temperature of the liner sheet above dew point. Designers should assess the risk of surface condensation at linear thermal bridges using the method in BRE IP 17/01 and the temperature factors (f-values) shown in table 29.

The high vapour resistance of the liner sheet and the correct application of butyl seal at liner sheet junctions will inhibit interstitial condensation. Designers should assess the risk of interstitial condensation using the method in BS EN 13788:2002 and the guidance in BS 5250:2002.

Table 29: Psi & f-values for profile junctions and perimeters

Junction	Psi value (W/mK)	f-value
Eaves (fig 03)	0.03	0.95
Verge (fig 09)	0.03	0.95
Ridge (fig 07)	0.02	0.96
Parapet (fig 17)	-0.11	0.83
Parapet gutter (fig 15)	0.69	0.49
Valley gutter* (fig 13)	1.26	0.73
Wall - ext corner (fig 29)	0.02	0.94
Wall - int corner (fig 28)	-0.06	0.96
Wall - drip (fig 27)	0.33	0.74
Door/window head (fig 33)	0.50	0.58
Door/window jamb (fig 32)	0.49	0.59
Window sill (fig (fig 34)	0.50	0.60
Industrial door head	0.43	0.74
Industrial door jamb	0.42	0.74

* use twice the value for a full gutter
Note that values are only applicable to the components on the detail.
Changes to the detail will alter values

Drainage

AS twin skin systems are intended for roofs with a minimum slope of 4°; if the roof includes rooflights the minimum slope is 6°. Gutters and downpipes should be designed to collect rain and snow falling on the roof and discharge it safely. Drainage capacity should be determined according to BS EN 12056-3:2000.

The U-value of a factory formed insulated gutter should be slightly higher than that of the twin skin roof to ensure snow and ice melts first in the gutter.

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Rooflights

Illuminance: the area of rooflights required to illuminate the building interior depends upon the type of activities taking place. BS 8206-2:1992 Code of practice for daylighting gives guidance. Table 30 shows how to achieve the recommended levels.

Thermal performance: with the adoption of the whole building compliance method in Part L there is no maximum permitted area for rooflights: designers must assess the performance of rooflights as part of the SBEM evaluation. The only limits on rooflights are that no rooflight may have a U-value worse than 3.3W/m^{2}K and the area weighted U-value of all rooflights must not exceed 2.2W/m^{2}K: triple skin site assembled rooflights can be supplied to meet those limits.

Solar gain: Part L requires designers to ensure solar gains in summer will not be excessive. TM37 contains guidance and calculation methods.

Safety: rooflights must provide safety levels appropriate to the frequency of roof access. All Steadmans rooflights offer a non-fragility rating of class B on installation. However, for standard 2.4kg gauge rooflights that level of non-fragility may not be maintained over their 25 year service life. Where rooflights must be non-fragile throughout their service life Steadmans recommend the use of 3.0kg gauge rooflights. Consult Steadmans for further guidance.

Table 30: Rooflight areas

Characteristics of activity / interior	Level of illuminance req. (lux)	Recommended min. rooflight area (% of floor area
Interiors used occasionally, with visual tasks confined to movement and limited perception of detail e.g. bulk stores	100	10%
Continuously occupied interiors, with visual tasks not requiring perception of detail e.g. loading bays, plant rooms	200	10%
Moderately difficult visual tasks, colour judgement may be required e.g. sports and assembly halls, packing, general offices, engine assembly, retail shops	300 - 500	13% - 15%
Difficult visual tasks, accurate colour judgement required e.g. drawing offices, inspection, electronic assembly	750 - 1000	17% - 20%

*Table based on research by Institute of Energy and Sustainable Development, De Montford University for illuminance in the horizontal plane - rooflight area should be greater where illumination is needed in the vertical plane e.g. where vertical racking is used.

** Figures for the level of illuminance required are taken from CIBSE Guide A (table 1.12)