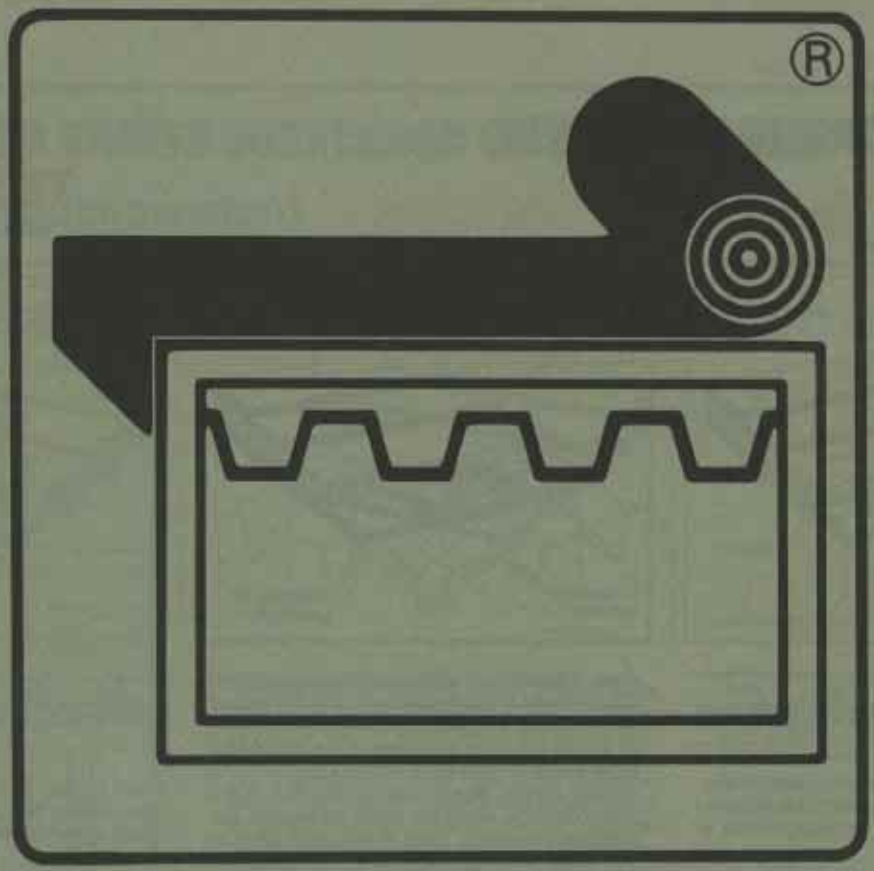
technical specification 6



METAL DECKS

Waterproofing and thermal insulation of metal decking

The corrugated sheet, because of its lightweight and relative cheapness, is being increasingly considered by planners and builders. Coupled with a steel frame structure, it is possible to greatly expand building size without the need for large foundations. The combination of strength, light weight and reduced cost has allowed increased construction, not only of industrial property but sports facilities, meeting halls and many other facilities. Many of the new buildings have been built with flat roofs and these must in all cases be protected by additional waterproofing.

Unfortunately, the same characteristics which make the corrugated sheet so interesting and in some cases irreplaceable can contribute to problems in relation to waterproofing and thermal insulation. Metal sheeting is subject to considerable thermal movement, vibration and flexing and all the stress generated by this movement falls upon the waterproofing membrane. The results of using materials which cannot cope with the movement of metal decking are evident. Many failures have turned the designer away from the flat roof. The development of Torch-on High Performance modified bitumen polyester reinforced membranes will guarantee the long term impermeability of lightweight flat roof decks. It is also necessary when designing the roof deck to ensure that details are carefully thought out, avoiding the possibility of building unnecessary stress into the structure.

INDEX S.p.A. intends with this specification leaflet to illustrate to planners and builders, complete systems covering some of the more common types of waterproofing problems.

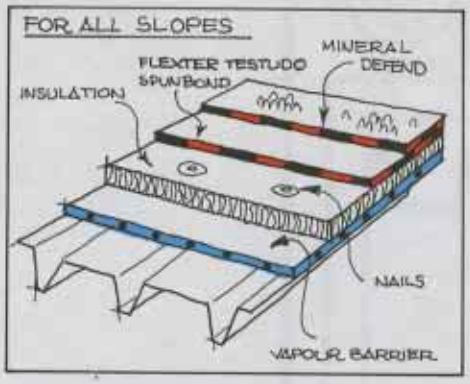
Through the main structure, vibrations caused by the machinery operating inside the building are easily transmitted to the roof. On light weight decks the loadings created by snow and wind, etc. cause the roof deck to flex which, in turn, causes tension in the waterproofing membrane at a point along the overlaps of the metal sheets, and similarly the movements caused even by light winds will make the roof swing and if the material is not properly fixed around the perimeter, wind can cause the waterproofing membrane and the insulation to become detached.

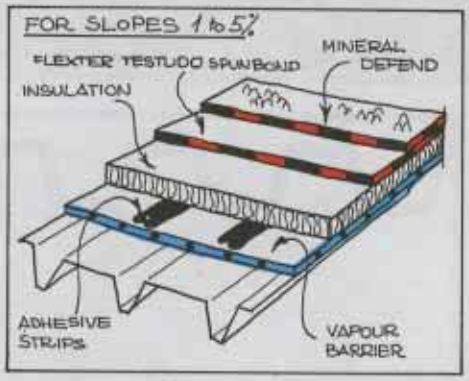
Energy conservation does mean an increase in the thickness of insulation and this is a further reason why traditional roofing felts have broken down. As heat is unable to escape through the roof, extremely high temperatures build up on the roof surface which will dry the felt and make it more inclined to crack under stress. In order to increase the life of a roof it is necessary to use both bitumen and membranes which cope with stress, perform in high temperature and are resistant to ageing. The waterproofing membranes **FLEXTER TESTUDO**and **HELASTA** are endowed with these characteristics. They have high mechanical resistance coupled with excellent elasticity and they are resistant to fatigue, sheer stresses and ageing. Therefore they can be applied and left without heavy protection such as thick paving or gravel.

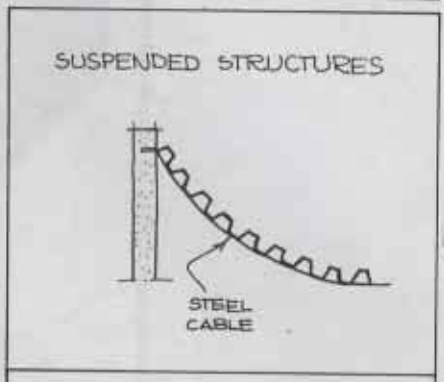
1 WATERPROOFING AND THE

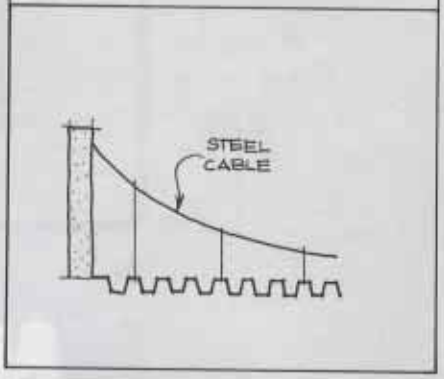
TYPICAL CORRUGATED SHEET

TESTUDO SPUNBOND
with various insulation









technical specification

All surfaces to which the waterproofing membrane will be bonded, including elevations, gullies, joints, etc. should be treated with a coat of bituminous primer.

VAPOUR BARRIER

Where there is the possibility that the area to be covered will have a relative humidity in excess of 80% at 20 °C a **DEFEND ALU** vapour barrier should be used. This is a membrane manufactured from bitumen, modified with atactic polypropylene and reinforced with 6/100 mm thick aluminium foil and fibre glass. The sheet confirming to regulation UNI 8202-23 is totally impervious to water vapour. The sheet will be spot-bonded to the roof surface using a recommended propane gas torch, allowing for a 100 mm overlap at the sides and ends.

THERMAL INSULATION

In order to ensure that condensation does not occur within the insulation, the thickness of each installation panel must be chosen to ensure that the dewpoint is located above the vapour barrier. To avoid thermal bridging, the panels should be placed side by side and taped. If the total thickness exceeds 60 mm two offset layers each 30 mm thick shall be put down. The insulation should be mechanically fastened to the roof using expansion nails or screws with a 70 mm diameter washer. The density of nailing will vary in relation to the climatic conditions of the area. 5 to 10 nails per m^2 should be used, with a minimum of 4 fasteners per panel applied at the corners, 50 mm from the edge.
For curved roofs the central part of the panels should also be nailed. When two layers are used, the first should be fastened by using one nail only, positioned in the middle of each panel. Mineral cellular aggregates, mineral fibre panels, glass fibre panels, foamed polyurethane of 35 kg/m^3 and expanded polystyrene of 25 kg/m^3 covered by a bituminized felt can be used. On slopes which do not exceed 5% and when the area is not particularly windy, foamed polyurethane and expanded polystyrene can be fixed to the metal sheet or to the vapour barrier using a minimum of three strips per m^2 of a cold extruded adhesive of the **VEDATEX** type (see technical data) using 300 gr/m^2. The vapour barrier should also be bonded to the metal decking using the same procedure. For unfaced insulation, prior to the application of the waterproofing membrane, a bituminised felt of 1,200 gr/m^2 should be bonded to the panels, again following the same procedure.

WATERPROOF COVERING MATERIALS

The waterproofing shall consist of a 4 mm thick **FLEXTER TESTUDO SPUNBOND POLYESTER 4** (I.C.I.T.E. Agrement Certificate No 400/95 membrane based on elastomers and bitumen modified with atactic polypropylene reinforced with a continuous single strand extruded polyester non-woven isotropic fabric. The sheets will have an ultimate longitudinal and transverse tensile stress of 80 kg/5 cm and 70 kg/5 cm respectively, and ultimate L/T elongation of 50%, a hydraulic pressure resistance to burst on free discs including a 177 cm^2 i.e. 3 kg/cm^2 surface and a high resistance to 1,000 fatigue cycles on active slit opening 3 mm in both directions. The sheets should be fully bonded to the insulation using a recommended propane gas torch and allowing for a 100 mm overlaps at the sides and ends. For slopes exceeding 20% the sheets should be mechanically fastened at the top using expansion nails with 50 mm washers with a total of 4 fixings per linear metre applied at the transversal overlaps. Where the material is applied to vertical surfaces, it should be fully adhered, again using a gas torch up to a height of at least 200 mm above the expected maximum water level. A cap sheet of a polymer-bitumen membrane of the type **MINERAL DEFEND 3.5** mm thick, self-protected with a mineral surface. Defend, manufactured using bitumen modified by the addition of atactic polypropylene, elastomers and reinforced with fibre glass, should be laid astride and parallel with the laps of the previous layer and fully bonded to it allowing for a 100 mm overlap and, then being turned and flame-welded on the vertical section to a minimum height of 200 mm above the maximum water level.

LEGEND:

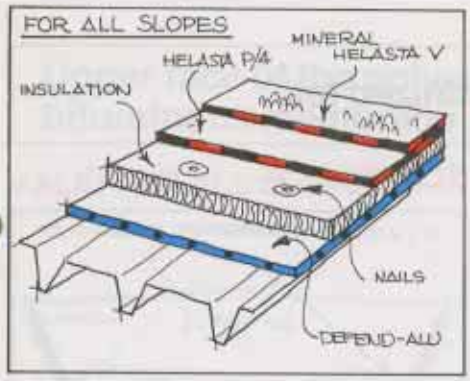
- WATERPROOFING MEMBRANE
- THIS IS NOT A WATERPROOFING LAYER BUT USED FOR ILLUSTRATION PURPOSES
- VAPOUR BARRIER
- THERMAL INSULATION
- MONOLITIC INSULATING PANEL WITH BITUMINIZED FELT, INDUSTRIALLY PRE-APPLIED
- MONOLITIC INSULATING PANEL WITH A MEMBRANE, INDUSTRIALLY PRE-APPLIED

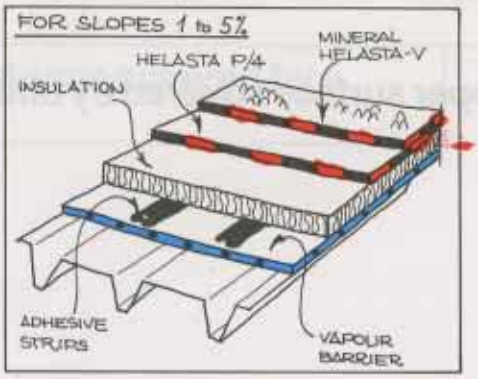
RMAL INSULATION

CORRUGATED SHEETS SUSPENDED ON STEEL CABLES

(structure in subspension)

helasta with various insulation





technical specification

All elevations and surfaces to which waterproofing will be adhered such as gullies, joints, etc. should be treated with an adhesive bituminous primer.

VAPOUR BARRIER

Where there is the possibility that the area to be covered will have a relative humidity in excess of 80% at 20 °C a **DEFEND ALU** vapour barrier should be used. This is a membrane manufactured from bitumen modified with atactic.polypropylene and reinforced with 6/100 mm thick aluminium foil and fibre glass. The sheet confirming to regulation UNI 8202-23 is totally impervious to steam using a recommended propane gas torch, the membrane shall be spot bonded to the surface allowing for a 100 mm overlap. Where the material is applied to vertical surfaces it should be fully adhered to a height of at least 100 mm above the expected level of insulation.

THERMAL INSULATION

In order to ensure that condensation does not occur within the insulation, the thickness of each installation panel must be chosen to ensure that the dewpoint is located above the vapour barrier. In order to avoid thermal bridging, the panels should be placed side by side and taped. If the total thickness exceeds 60 mm two offset layers each 30 mm thick shall be put down. The insulation should be mechanically fastened to the roof using expansion nails or screws with a 70 mm diameter washer. The density of nailing will vary in relation to the climatic conditions of the area, 5 to 10 nails per m² should be used, with a minimum of 4 fasteners per panel applied at the corners, 50 mm from the edge.
For curved roofs the central part of the panels should also be nailed. When two layers are used, the first shall be fastened using one nail only, positioned in the middle of each panel. The insulation consists of mineral cellular aggregates, mineral fibre panels, glass fibre panels, foamed polyurethane of 35 kg/m³ and expanded polystyrene of 25 kg/m³ covered by a bituminized felt. On slopes which do not exceed 5% and for areas which are not particularly windy, foamed polyurethane and expanded polystyrene can be fixed to the metal cover or to the vapour barrier using a minimum of three strips per m² of a cold extruded adhesive of the **VEDATEX** type, using 300 gr/m². The vapour barrier should also be bonded to the metal decking using the same procedure. For unfaced insulation, prior to the application of the waterproofing membrane, a bituminised felt of 1,200 gr/m² should be bonded to the panels, again following the same procedure.

WATERPROOF COVERING MATERIAL

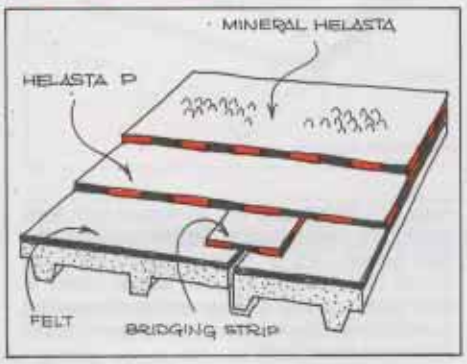
The waterproofing layer should be a 4 mm thick **HELASTA P 4** Agrement I.C.I.T.E. N. 400/93 membrane based on thermoplastic elastomers which show ultimate elongation properties equal to 2,000% and reinforce with a continuous single strand extruded polyester non-woven isotropic fabric. The sheet shall have a longitudinal and transverse breaking point equal to 90 kg/5 cm and to 80 kg/5 cm respectively. It shall show flexibility at a temperature below -25 °C in accordance with DIN 52133 and resistance to 10,000 fatique cycles at a temperature of 0 °C on an active slit opening 3 mm in both directions. When fixing, the membrane should be fully bonded to the insulation using a recommended propane gas torch and allowing for a 100 mm overlap at the sides and ends. For slopes exceeding 20% the sheet should be mechanically fastenened at the top using expansion nails with 50 mm diameter washers, with a total of 4 fixings per linear metre applied at the trasversal overlaps. At the vertical sections the sheet should be turned and fully flame-welded up to a height of at least 200 mm above the maximum water level.
A cap sheet of **MINERAL HELASTA V 3.5** kg should be placed parallel with and astride the laps of the previous layer. Fixing must be by fully flame bonding to the lower surface allowing for 100 mm overlaps and then turned and flame welded on the vertical sections to a height of at least 200 mm above the maximum water level. **MINERAL HELASTA V** is a membrane based on thermoplastic elastomers which show an ultimate L/T elongation in excess of 1,500% and it is reinforced with fibre glass. The sheet shall be flexible at a temperature below −25°C in accordance with DIN 52133 and resistant to 5,000 fatigue cycles at a temperature of 0 °C on an active slit opening 3 mm in both directions with a maximum loss in thickness equal to 50%.

CORRUGATED SHEETS WITH THE CORRUGATIONS FILLED WITH FOAMED

Monolitic insulating panels

Polyurethane with the upper surface covered by bituminized felt

SLOPE 1 ÷ 5%



technical specification

A)
All elevations and surfaces to which waterproofing will be adhered such as gullies, joints, etc. should be treated with an adhesive bituminous primer.

B) VAPOUR BARRIER

Where it is possible that the area to be covered will have a high vapour content, a butylmastic should be applied along the joints between the panels, and the distance between the fixings of the panels on the main structure shall be of a maximum of 1 metre for the longitudinal joints and 1 fixing per corrugation transversally.

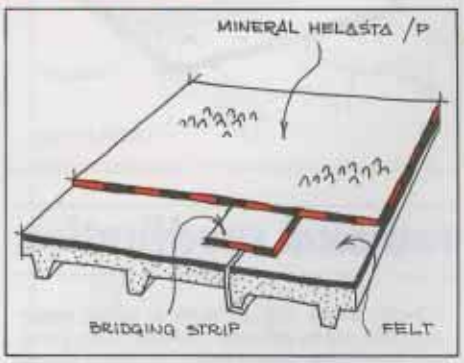
C) BRIDGING

Prior to the application of the waterproofing membrane strips of **HELASTA** should be applied to bridge the gaps in the panels. Strips of **HELASTA P 4** at least 140 mm wide should be fully flame welded.

WATERPROOF COVERING MATERIAL

The waterproofing layer should be a 4 mm thick **HELASTA P 4** membrane based on thermoplastic elastomers which show ultimate elongation properties equal to 2,000% and reinforced with a continuous single strand extruded polyester non-woven fabric. The sheet shall have a longitudinal and transverse breaking point equal to 90 kg/5 cm and to 80 kg/5 cm respectively. It shall show flexibility at a temperature below –25°C in accordance with DIN 52133 and resistance to 10,000 fatigue cycles at a temperature of 0 °C on an active slit opening 3 mm in both directions. When fixing, the membrane should be fully bonded to the insulation using a recommended propane gas torch and allowing for a 100 mm overlap at the sides and ends. At the vertical sections the sheet shall be turned and fully flame bonded up to a height of at least 200 mm above the maximum water level. A cap sheet of **MINERAL HELASTA V 3.5** kg should be placed parallel with and astride the overlaps of the previous layer. Fixing must be by fully flame-welding to the lower surface allowing for 100 mm overlaps and then turned and flame-bonded on the vertical sections to a height of at least 200 mm above the maximum water level.
MINERAL HELASTA V is a membrane based on thermoplastic elastomers which show an ultimate L/T elongation in excess of 2,000% and is reinforced with fibre glass. The membrane shall remain flexible at a temperature below –25°C in accordance with DIN 52133 and resistant to 5,000 fatigue cycles at a temperature of 0 °C on an active slit opening 3 mm in both directions with a maximum loss in thickness equal to 50%.

SLOPE > 5%



technical specification

A) B) C) See previous specification

WATERPROOF COVERING MATERIAL

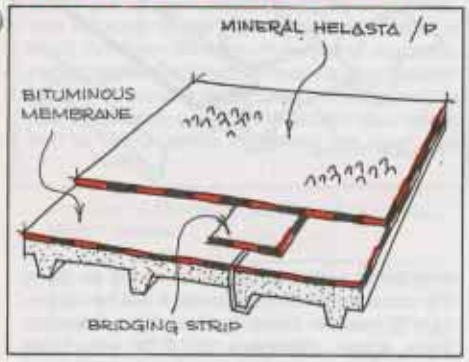
The waterproofing shall consist of a bituminous membrane of the type **MINERAL HELASTA P 4** I.C.I.T.E. Agrement Certificate N. 400/93, self-protected by a mineral slate surface and based on thermoplastic elastomers which show an ultimate elongation of 2,000% reinforced with a continuos single strand extruded polyester non-woven isotropic fabric. The sheet shall have a longitudinal and transverse breaking point equal to 90 kg/5 cm and to 80 kg/5 cm respectively. It shall show flexibility at a temperature below -25 °C in accordance with DIN 52133 and resistance to 10,000 fatique cycles at a temperature of 0 °C on an active slit opening 3 mm in both directions. The membrane shall be fully adhered to the insulation layer using a propane gas torch and allowing for a 100 mm overlap at the sides and ends and then being turned and fully-welded at the vertical sections to a height of at least 200 mm above the maximum water level.

POLYURETHANE

helasta SYSTEM

Upper face of the polyurethane covered by a bituminous membrane

VALID FOR ALL SLOPES



technical specification

A) B) C) See previous specification

WATERPROOF COVERING MATERIAL

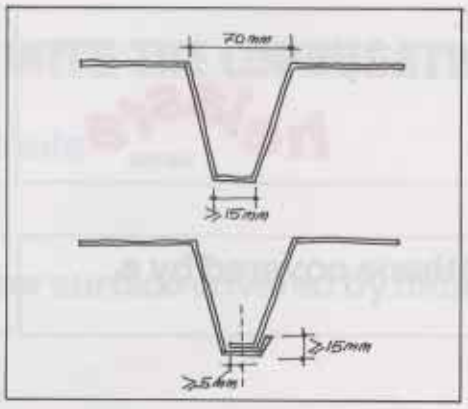
The waterproofing shall consist of a bituminous membrane of the type **MINERAL HELASTA P 4** I.C.I.T.E. Agrement Certificate N. 400/93, self-protected by a mineral slate surface and based on thermoplastic elastomers which show an ultimate elongation of 2,000% reinforced with a continuos single strand extruded polyester non-woven isotropic fabric. The sheet shall have a longitudinal and transverse breaking point equal to 90 kg/5 cm and to 80 kg/5 cm respectively. It shall show flexibility at a temperature below -25 °C in accordance with DIN 52133 and resistance to 10,000 fatique cycles at a temperature of 0 °C on an active slit opening 3 mm in both directions. The membrane shall be fully bonded to the insulation layer using a recommended propane gas torch and allowing for a 100 mm overlap at the sides and ends and then being turned and fully-welded at the vertical sections to a height of at least 200 mm above the maximum water level. For slopes exceeding 20 % the sheets should be mechanically fastened at the top using expansion nails with a 50 mm diameter washer with a total of 4 fixings per linear metre applied between the transversal overlaps.

2 DETAILS AND PARTICULARS

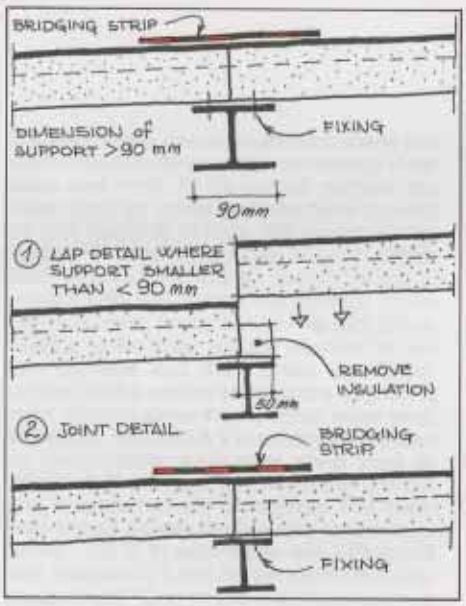
When dealing with the thermal insulation and waterproofing of metal sheeting it must be remembered that there are problems. These are generally attack by moisture, the lightness of the sheet when exposed to the wind forces and the loadings caused by wind, rain and snow accumulation.
Past experience has proved that the use of adhesives only is not always enough to guarantee a good adhesion of the panels to the metal sheeting. Therefore a mechanical fastening may be necessary and all waterproofing membranes should be fully adhered. Application with the cold applied **VEDATEX** type adhesive should be considered only for those panels with sufficient resistance and consistency remembering the wind force limits recommended by the manufacturers. For areas which are particularly windy it will be necessary to increase the number of fasteners for the panels and also for the metal sheets. In order to eliminate permanent inflections all elements such as chimneys, drains, skylights, etc. will have to be sustained using specific supporting elements in addition to the normal supporting structure for the metal deck. To avoid problems caused by the independent movement along the intersecting lines between the different sloped surfaces, specially shaped connecting sheets will be used and the water proofing will be appropriately reinforced in these areas. Furthermore, it is useful to remember that on roofs with a slope under 2% it is frequently possible to have the formation of a counter-slope or subsidence with consequent ponding and the accumulation of stagnant water.
When using perforated sheets to improve the acoustic characteristic of the area to be covered it will be necessary to employ a vopour-barrier such as polythene. Bitumen based membranes should not be used. When the area to be covered has a high relative humidity value only plain sheets can be used. The thermal insulation should be of a non-flammable type and the waterproofing membrane should at least be protected by a mineral surface or better still by a gravel layer (in this case the insulation can be reduced and a loose laid waterproofing membrane without mineral surface can be used). In addition to the problems concerning the planning and application of the waterproofing, proper consideration must be given to the main structure and the decking system. Where appropriate this will be dealt with in the following chapters.

METAL SHEETS

In order to avoid loading problems when walking on the roof and also in the application of the vapour barrier, the insulation panels and the waterproofing membrane, the maximum distance between the corrugations should be 70 mm at the top and a minimum of 15 mm at the bottom. At the overlap there should be a return leg of at least 15 mm (see diagram). The overlaps at the top will be of 50 mm circa. When prefabricated panels are used the panels will be butt jointed if the supporting girder is 90 mm wide or with a 50 mm overlap if the width of the girder is between 50 and 90 mm. For the last case it is necessary to cut away a slice of insulating foam from the lower panel.
The fastening of the metal sheets to the structure should be calculated in relation to the wind force and the building height and for those areas which are particularly exposed the metal

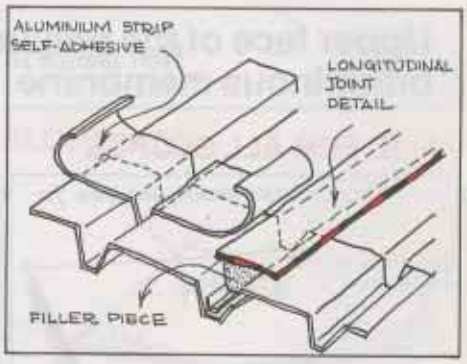


sheets should be fixed at every corrugation. When the vapour barrier is fabricated using sealants or self-adhesive aluminium strips, the fixing of the side overlaps, which are generally positioned at 1 metre centres should be increased to one every 50 cm and at the end laps, fixing should be at every corrugation.

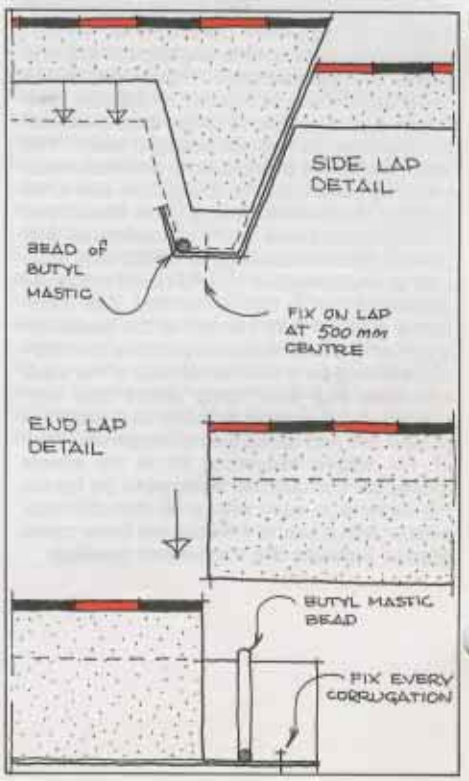


VAPOUR BARRIER

Perforated corrugated sheets should not be used when the area to be covered is liable to produce a high level of vapour. For all other situations, when using perforated sheet, it will be necessary to apply a fire-resistant vapour-barrier (dry-applied aluminium sheets reinforced with glass or asbestos felt).
When plain corrugated sheets are used it is not always necessary to employ a vapour barrier. It is only necessary when the relative humidity within the building during the cold season is 5 gr/m³ higher than the external relative humidity. Areas such as animal breeding houses, swimming pools, very busy meeting halls, Industry where a high level of water vapour is present, industrial kitchens, etc. will require a vapour barrier. The vapour barrier can also be fabricated by using self-adhesive aluminium strips applied astride the end laps of the metal sheets and for the side laps a flame-welded **DEFEND ALU** membrane should be applied. When applying the **DEFEND ALU** make sure that there is support for the membrane or that the profile has been filled up with a strip of insulation material. When this system is used,



in order to avoid circulation of humid air along the corrugation of the sheets, it will be necessary to seal the sheet at all overlaps, intersections, edges, chimneys, etc. If the area to be covered shows a high relative humidity and prefabricated panels are used, butile mastic seals should be constructed at all overlaps and side stitching at 500 mm centres. This system should provide an adequate vapour barrier.

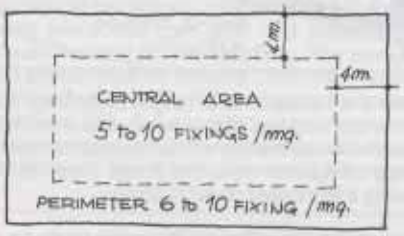


OF APPLICATION

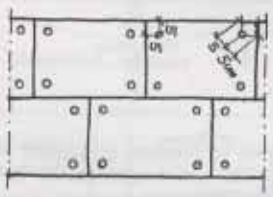
THERMAL INSULATION

Prior to and during installation, all insulation panels should be stored away from dampness and humidity. At the end of each working period, all insulated areas should have a waterproofing membrane applied and care should be taken to ensure that there is no danger of moisture entering the panels already laid. Panels will be laid side by side and if the total thickness exceeds 6 cm, two off-set layers should be applied. The density of the fasteners will vary in relation to the climatic conditions of the area. Use 5 to 10 nails per m² but on a 4 metre wide strip around the roof perimeter the number of fasteners should be increased to 6 to 10 nails per m². The minimum number of fasteners for each panel should be of 4 fixings, one for each corner, with a minimum distance of 50 mm from the edge of the panel. Common nailing of several adjacent panels is not acceptable. For curved roofs it will be necessary to nail at the centre part of the panels also. When two or more layers of panels are used, the

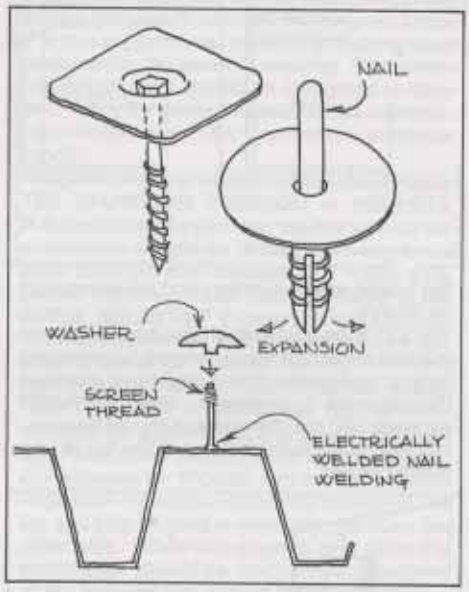
FIXING DISTRIBUTION ON A TYPICAL ROOF AREA



FIXING ON PANELS



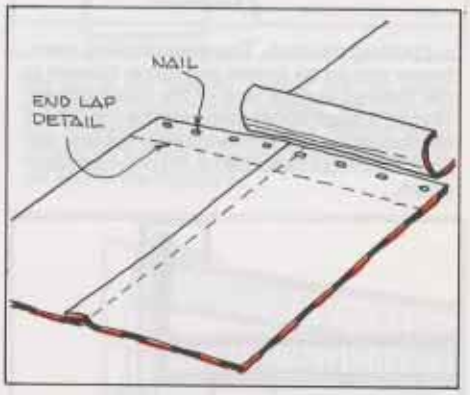
lower panel should be fixed only with a central fastening whilst the last layer should be fixed to the metal cover following the procedure previously described. On reliefs the panels can be fixed using hot oxidized bitumen with a nailed fixing at 300 mm centres along the top; alternatively, a mechanical fastening only can be used and in this case the number of nails should be increased. When the panels are to be protected by a layer of gravel (heavy protection) the insulation can be fixed using hot melted oxidized bitumen, by nailing at the centre of each panel, or with a strip of **VEDATEX** type adhesive. When an adhesive is used, and this should only be applied to plain galvanised uncoated decking sheet, it would be quicker to employ a 3-way extruder to apply the adhesive strips to the ribs of the metal sheets applying a minimum of 3 strips per m². When bonding to the 4 metre wide strip at the perimeter of the roof, 4 strips of adhesive should be used and depending on the possible wind loading this may need to be reinforced with mechanical fasteners. The mechanical fastening can be achieved by using screws, aluminium expansion nails, welded screws, etc. having a 70 mm diameter washer of galvanised steel or, in the case of fixing with screws a recess which can accept the screw head. There are now several



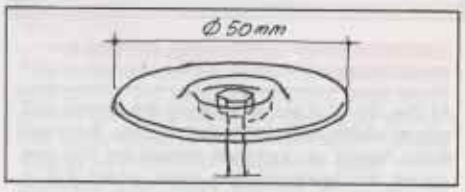
types of plastic fastener on the market. Whilst these are produced by specialised companies, it should be remembered that the minimum resistance of the complete screw/washer should be above 90 kg.

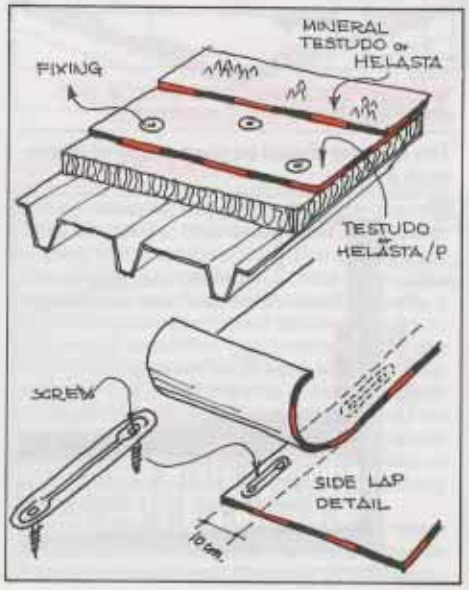
WATERPROOF COVERING MATERIAL

The first membrane must always be carefully bonded in order to withstand wind forces, therefore on those insulations which cannot be directly flame-bonded it will be necessary to apply a layer of felt with a minimum weight of 1,200 gr/m². Application may be made by cold adhesive or hot bitumen. The membrane may then be flame-bonded to this surface.
If the insulation to be used has a surface which is dusty it is recommended that a coat of primer be applied prior to laying the waterproof membrane. Consult the insulation manufacturer for recommendations regarding the correct primer. In areas of high wind, bituminous adhesives can be supplemented by the use of mechanical fasteners fixed through the first waterproofing membrane. The second layer, in this instance the cap sheet, should be fixed by complete flame-bonding. Some European countries favour the use of a special fixing along the side laps which is used prior to sealing. Where this procedure is carried out, a single layer waterproofing system may be adopted. For slopes exceeding 20% the membrane should be mechanically fastened at the top using 4 nails per linear metre applied under the overlap at the top of the sheet.



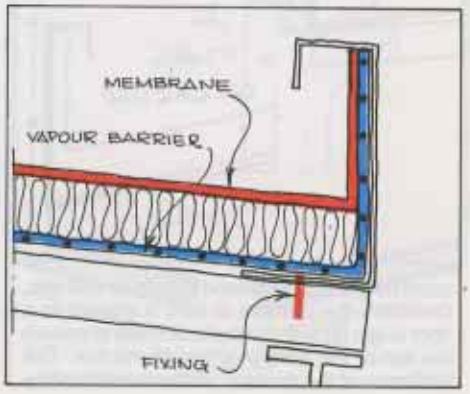
The fixing should have a 50 mm diameter zinc plated or galvanised washer. Screws or expansion nails may be used but the face of the washer should be recessed so that when in position the screw head does not protrude above the plate.





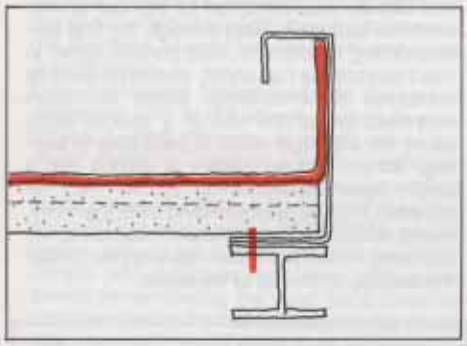
UPSTANDS, KERBS & CLOSURES

Where the roof butts against a vertical section, a prefabricated metal upstand should be fixed to the decking sheet. The vapour barrier and the waterproofing membrane should be extended up the vertical face and fully flame-bonded; insulation, if included, should also be

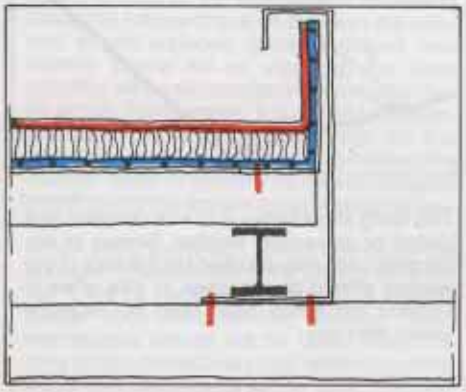


2 DETAILS AND PARTICULARS OF APPLICATION

fixed to the upstand.
Where a prefabricated closure or kerb is to be used, this can be fixed through the steel work

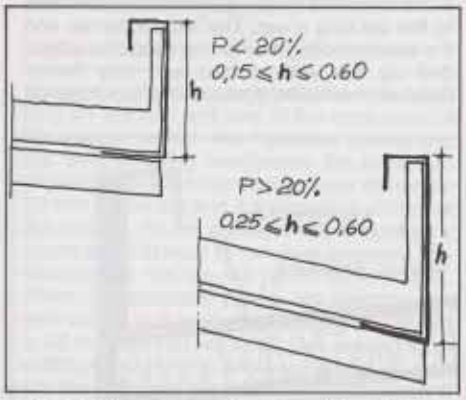


supporting the deck. The waterproofing membrane should be turned and flame-bonded to the internal vertical face of the closure piece. Should a much larger fascia trim be used, it will be necessary fo fix an additional upstand behind the trim as described in the previous paragraph.

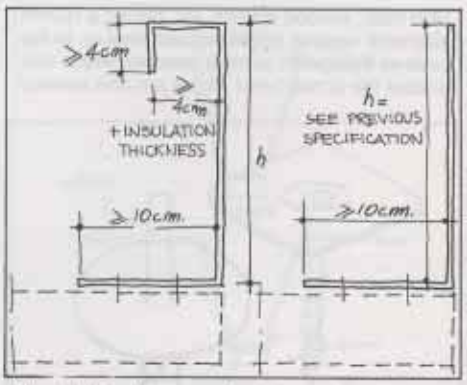


DIMENSION OF UPSTANDS, KERBS & SKIRTINGS

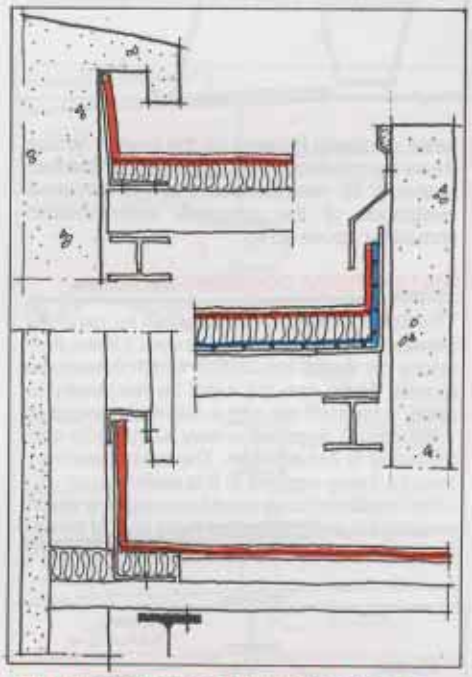
At the top of a slope or along the lateral roof edges which run parallel to the slope, the minimum height of upstands should be 100 mm above the waterproofing level, whilst if it is positioned transversally at the bottom of and at right angles to the slope, the minimum height should be 150 mm on slopes of up to 20% and 250 mm where slopes exceed 20%. The maxi-



mum height of the upstand should be 600 mm. Generally the upstand or kerb is shaped as a right angle (L) with the top bent down to protect the top of the waterproofing membrane. The thickness of the upstand will be determined by

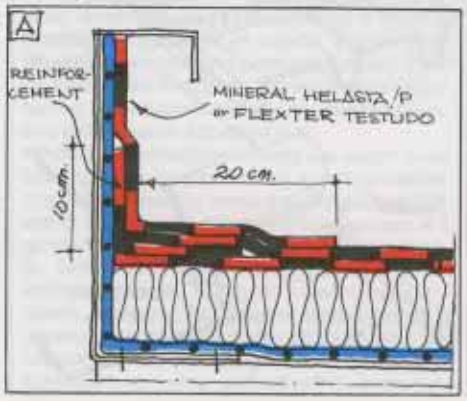


the height, where overlaps occur these should be 30 mm.
The top of the upstand can also be straight and in these cases the membrane will be protected by a cover flashing or by a preformed recess in the concrete or brickwork. When the height exceeds 300 mm the upstand should be secured with a mechanical fixing at the top at one metre centres.

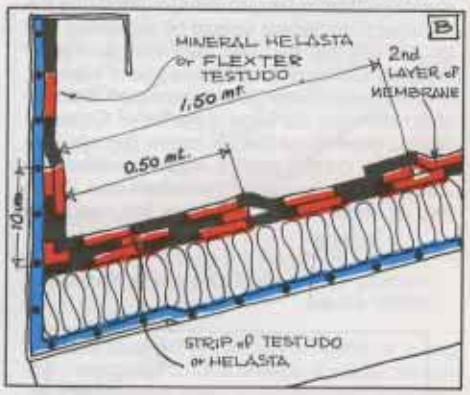


WATERPROOFING COVERING OF THE UPSTANDS, KERBS & SKIRTINGS

The upstand should be given a coat of bituminous primer:

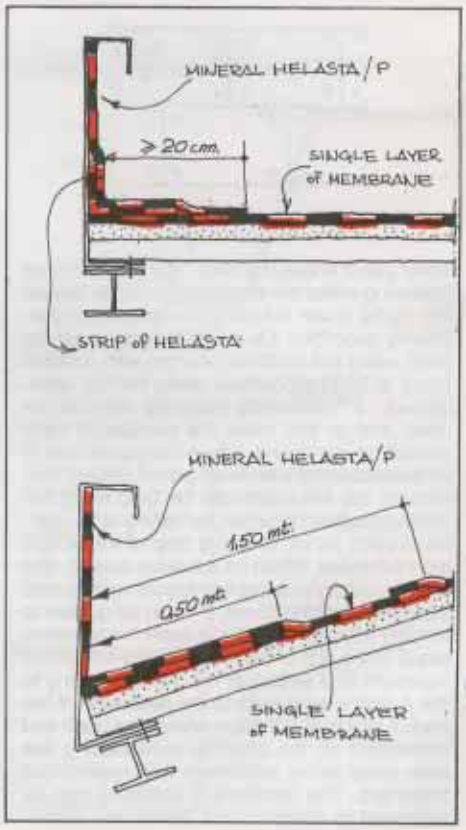


A) 200/250 mm wide strip of **FLEXTER TESTUDO SPUNBOND** or **HELASTA P 4** should be flame-welded at the corner where horizontal and vertical sections meet. Finally a layer of **MINERAL FLEXTER TESTUDO** or **HELASTA** will be flame-bonded from the top internal part of the upstand then turned and welded to the horizontal area for a distance of at least 200 mm.
B) In the instance where the upstand is at the bottom of a slope the reinforcement at the base should be considerably enlarged and overlaps should not be made against the run of water. If thermal insulation has to be turned

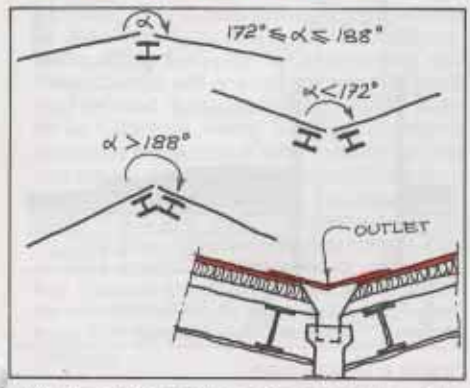


into the upstand to a height exceeding 300 mm, the bonding of the membrane should be reinforced at the top with a mechanical fastening using four nails per linear metre or by using a fabricated cover flashing.

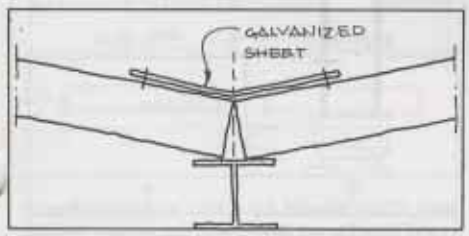
Covering of upstands on prefabricated panels using a single layer of water-proofing membrane.



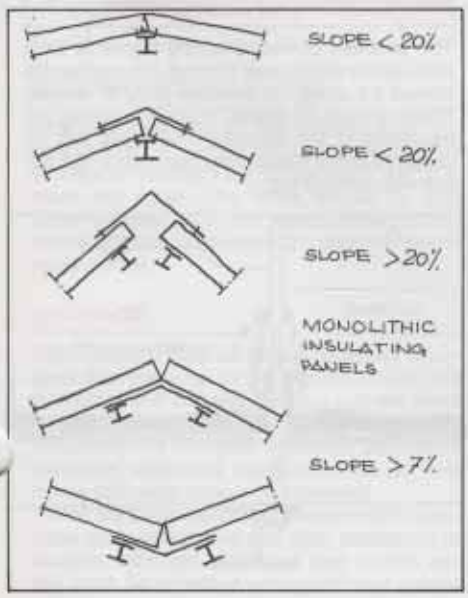
DETAILS AT VALLEY AND RIDGE



Where a ridge or valley is formed and the pitch is in excess of 8° from horizontal each element of the roof must have an independent supporting rail. Sufficient space must be left between the supports, in the case of a valley gutter, to allow the insertion of rainwater outlets. Where the roof pitch is less than 8° it may be possible to position one support to hold both elements. If the roof slopes do not meet at the valley the gap should be bridged using a once bent metal cover piece 200 mm girth and ideally this should be fixed on one side only. The insulation should then be brought down each slope to meet in the valley. When the roof slope is less than 20% the ridge should be shaped in such a way that no gaps are present. If it is not possible for the sheets to meet at the ridge

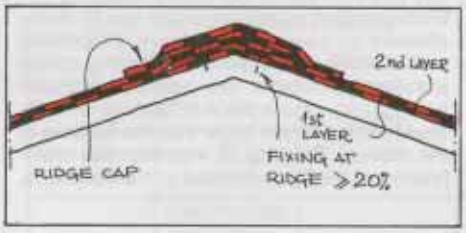


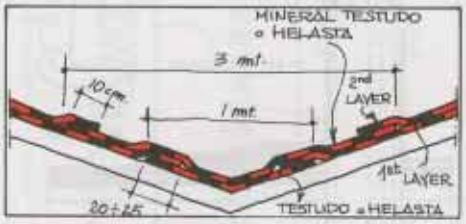
continuity should be secured by the use of a galvanized metal ridge piece 200 mm girth which should be once bent and then fixed on



one side only. For roofs with a slope of over 20% a galvanized metal ridge piece should always be used. When prefabricated insulated panels are used and the slope is less than 7%, a 90 mm wide supporting rail positioned in the centre will be sufficient whilst for slopes of over 7% two supports and an internal flashing fixed underneath the panel is required. The waterproofing mantle should be reinforced at ridge and valley by using two bituminous membranes reinforced with the 'non-woven' polyester fabric.

Astride the valley a 1 metre wide piece of **FLEXTER SPUNBOND TESTUDO** or **HELASTA P 4** should be laid and then the first layer of the membrane should be applied allowing for at least 200/250 mm overlaps. A 3 metre wide strip of **MINERAL FLEXTER TESTUDO** or **MINERAL HELASTA P 4** should be laid and then the first layer of the membrane should be applied allowing for at least 200/250 mm overlaps. A 3 metre wide strip of **MINERAL FLEXTER TESTUDO** or **MINERAL HELASTA P 4** should be applied running through the valley. Finally, the second layer will be bonded to it allowing for 100/200 mm overlaps. At the ridge each membrane should be taken over the top and fully bonded at least 200 mm down the other side. When the slope is over 20% the menbranes should be mechanically fastened at the top and this should be protected by a 500 mm cover strip of **MINERAL FLEXTER TESTUDO** or **MINERAL HELASTA P 4.**

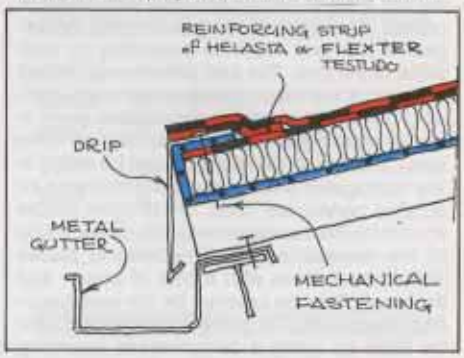




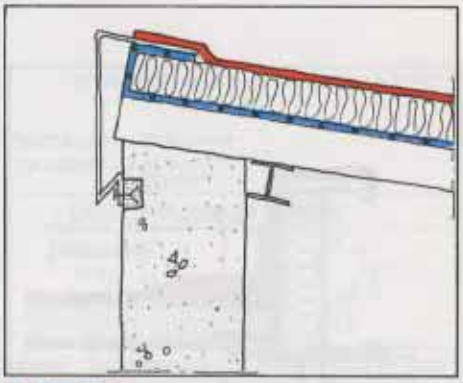
VERGES AND EAVES

Where waterproofing meets the edge of a roof there is a need to take water either into a gutter or away from the side of the building. There are many ways of achieving this detail. One of the easiest is to use a metal flashing to provide a drip. The galvanized metal flashing should be laid on the insulation and inserted under the waterproofing layer for at least 100 mm. Both surfaces of the flashing should be coated with a bituminous primer. The flashing should be mechanically fastened to the corrugated sheet through the insulation using expansion nails or screws applied every 500 mm and on every overlap of the corrugated sheet.

Where insulation is present a base sheet should be laid and then the vapour barrier should be turned over the edge of the insulation and bonded to the top surface. The flashing should then be fixed, as previously described, and a 200 mm wide reinforcing piece of **TESTUDO** polyester should be bonded over

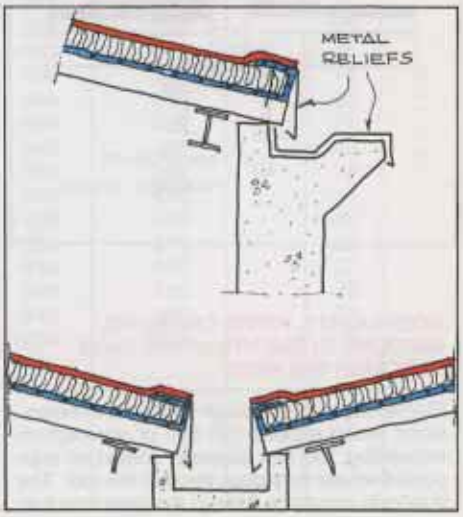


the top of the flashing. Finally, the cap sheet should be applied, fully bonded. If the drip is not feeding into a gutter, the bottom edge should be formed to enable fixing to the vertical wall of the structure.



GUTTERS

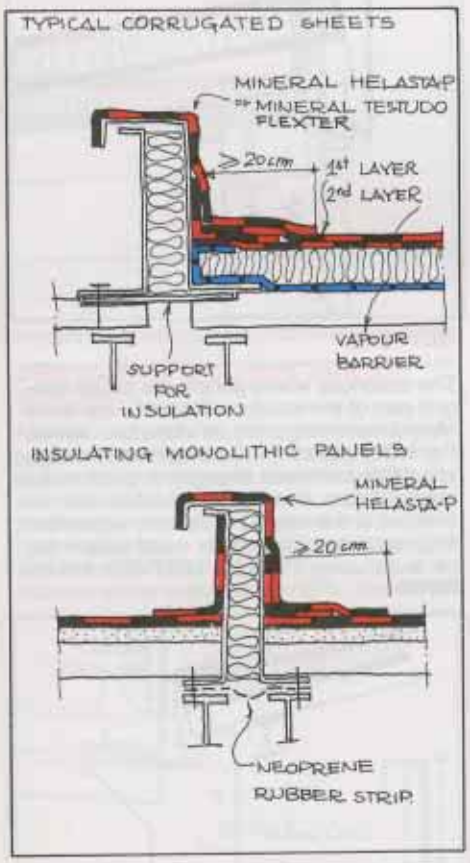
The instances where gutters are not an integral part of the structure, the roof edge detail should be constructed as described above. For valley gutters the main roof waterproofing should be continued through the gutter and a separate cap sheet inserted which will be overlaid at the edges by the main waterproofing cap sheet. Concrete or metal gutters can be lined using **FLEXER TESTUDO SPUNBOND.**



2 DETAILS AND PARTICULARS OF APPLICATION

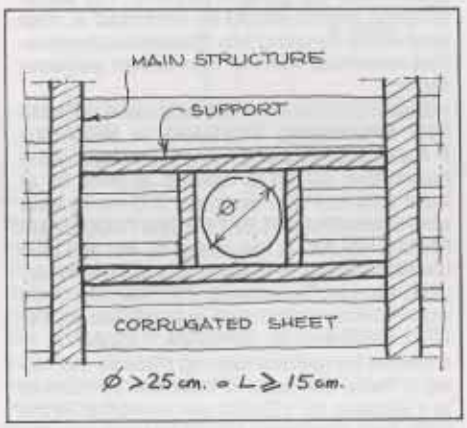
EXPANSION JOINT

The expansion joint should be built in relief, therefore when the joint crosses a slope line, the top area should be provided with drainage outlets. The metal decking underneath the edges of the joint must be supported on both sides of the joint. The joint should be protected by using a two piece prefabricated metal bridging piece based on the dimensions given in the chapter 'Upstands, Kerbs, Skirting'. The base should be 100 mm wide and be nailed to the corrugated sheet. When prefabricated insulated panels are used, the bridging pieces should be fixed to supporting rails on each side of the expansion gap. The bridging pieces should be treated with a coat of primer and these will then be covered by the waterproofing membrane. The gap within the joint should be filled by using a compressible insulating material (glass fibre) which is supported by a metal plate which is fixed on one side only. The application of the waterproofing mantle should be carried out according to the chapter 'Upstands, Kerbs, Skirting', type (A) or type (B) if one of the sides of the joint directs water flow.



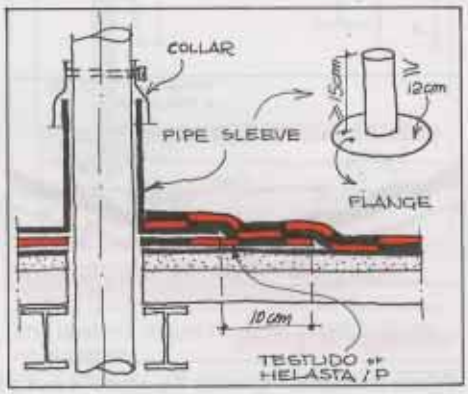
ROOFLIGHTS, PIPES, CHIMNEYS, GIRDERS, ELEMENTS WHICH PASS THROUGH THE ROOF

Elements passing through the roof with dimensions which exceed 150 mm or downspouts exceeding 150 mm diameter should be supported where they pass through the roof. The supports should be fixed to the main structure and enabling the metal decking to be fixed to the sub structure thereby giving additional support to the decking. When pipes and elements do not exceed the above described dimensions it will not be necessary to build a sub frame.

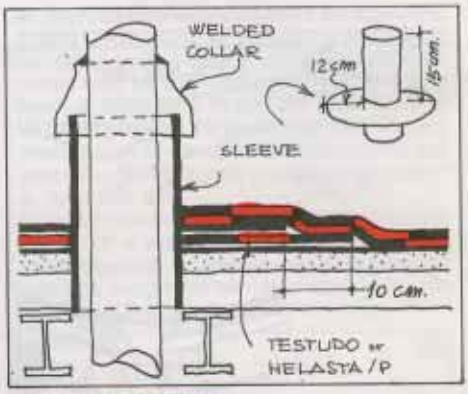


PIPES, CHIMNEYS, GIRDERS, ETC.

In order to obtain a correct and secure application of the waterproofing, all protrusions through the roof should be positioned at least 500 mm from joints, roof edges, skylights, etc. Waterproofing round a cold pipe can be easily effected by using a pipe sleeve. Proprietary pipe sleeves with integral weathering collars are readily available. The pipe sleeve should be installed using a piece of Testudo or Helasta which is 100 mm larger than the flat base of the sleeve. The strip of waterproofing membrane will be flame-bonded to the insulation,

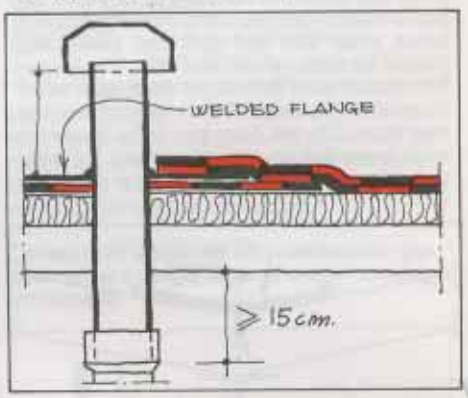


then the upper face will be heated and the pipe sleeve will be set in position. Finally, further layers of waterproofing will be applied and dressed up the face of the sleeve. The head of the pipe sleeve will be protected by a watertight weathering collar. In the case of hot pipes, the pipe sleeve should be 50 mm wider than the piping and it will be taken down below the level of the internal face of the decking sheet. Where the temperature of the pipe is in excess of 200°C the sleeve should be 150 mm larger to allow 50 mm of mineral wool insulation to be installed.



SMALL VENT PIPES

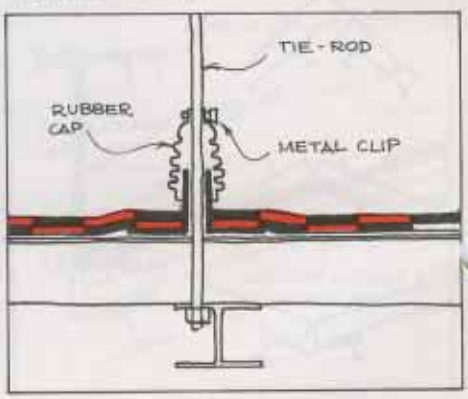
Small metal vent pipes of up to 150 mm which do not protrude more than 150/250 mm above the roof may have a plate welded to the pipe. This should be provided in its lower part, with a truncated pipe which will go down for 150 mm underneath the roof. In order to re-establish the vapour barrier, a strip of **TESTUDO** should be applied to the uncovered part of the insula-



tion. Care should be taken to ensure that a good bond is achieved with the vapour barrier and that there is sufficient material to weld to the outer waterproofing membrane.

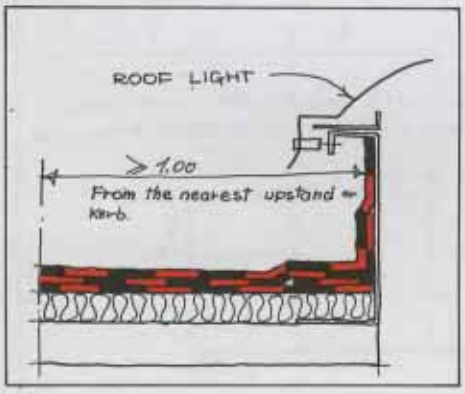
TIE-RODS, SUPPORTING CABLES OF A SUSPENDED ROOF STRUCTURE

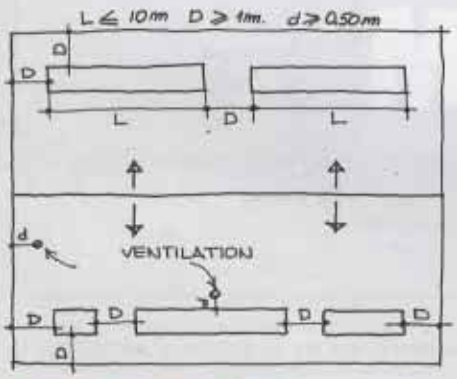
The problem of waterproofing round tie-rods and cables which pass through the roof can be solved by using an inverted gully or sleeve. These should be placed in position during the mounting of the tie-rods. The collar will be sealed using a rubber cap clamped to the tie-rod with a metal clip.



ROOFLIGHTS, VENTS, ETC.

As already mentioned, additional support must be used to reinforce the area around rooflights. The rooflight kerb may be prefabricated and assembled on site or a unit complete with kerb may be used. If site assembled, refer to chapter on 'Upstands, Kerbs, Skirtings'. Rooflights should be positioned at least 1 metre from the roof edges, and expansion joints 500 mm from pipes and other protrusions. To ensure adequate drainage of water, rooflights should not be more than 10 metres long and not less than 1 metre apart. The application of waterproofing material should be carried out in accordance with the details given under the chapter (part B) dealing with Upstands, Kerbs & Skirtings.



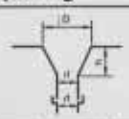


MAINTENANCE WALKWAYS

Specified walkways for maintenance staff may be indicated by positioning 1 metre wide strips of mineral finished **TESTUDO** or **HELASTA** to mark the route. The strips should be fully flame-welded on to the waterproofing membrane after the application of a coat of bituminous primer.

DRAINAGE

Each outlet should be so positioned as to ensure that the area to be drained should not exceed 1,000 m² and that the furthest point from each outlet does not exceed 30 metres. Where outlets are liable to exceed 250 mm in diameter, additional support for the decking below the outlet should be arranged.
There are a number of proprietary outlets available manufactured in cast iron, aluminium or plastics although fabricated lead outlets are still used. To provide a waterproof seal a piece of membrane 100 mm larger than the outlet flange should be loose laid on the area where the outlet will pass through the roof. If insulation is used, a recess to accept the piece of material should be made. The spout of the outlet will pass through the piece of waterproofing material to which the flange of the outlet will then be flame-bonded. The main roofing membranes will then be fully bonded over the top having been star cut and turned and moulded into the mouth of the outlet. All surfaces of the outlet should be primed before bonding.
When it is not possible to incorporate an overflow pipe through a parapet it is advisable to reduce the surface area which each outlet will drain. The table below has been compiled on the basis of 3 litres/min. per m².

Drain with cylindrical opening			Drain with conical opening				
Drainage area m²		Minimum diameter of outlet	Drainage area m²				
∅ normal	∅		∅ normal	∅ increased	D (cm)	d (cm)	h (cm)
	see chapter "overflow pipe"			see chapter "overflow pipe"			
50	33	8	71	47		8	
64	43	9	91	61		9	
79	53	10	113	75		10	
95	63	11	136	91		11	
113	75	12	161	107		12	
133	88	13	190	127		13	
154	103	14	220	147		14	
177	118	15	253	168		15	
201	134	16	287	191		16	
227	151	17	324	216		17	
254	169	18	363	242		18	
284	189	19	406	270		19	
314	209	20	449	300		20	
346	230	21	494	329		21	
380	253	22	543	362		22	
415	277	23	593	394	D = 2 d about	23	h = 1.5 d
452	302	24	646	430		24	
490	327	25	700	466		25	
530	400	26	758	570		26	
570	472	27	815	680		27	
615	550	28	880	785		28	
660	625	29	945	890		29	
700	700	30	1000	1000		30	
755	755	31					
805	805	32					
855	855	33					
908	908	34					
960	960	35					
1000	1000	36					

AGREMENT CERTIFICATES AWARDED

FLEXTER TEST. SP. POL. 4:

I.C.I.T.E.	N. 400/95
UBAtc	N. ATG 1616
BBA	N. 90/2497/C - 90/2519
CSTB	N. 5/92-924
BAM	N. 280/86

HELASTA P 4

I.C.I.T.E.	N. 400/93

2 DETAILS AND PARTICULARS OF APPLICATION

OVERFLOW

In regions which experience high rainfall, overflows should be incorporated into the initial design. These should be positioned where they are below the level of any kerbs around rooflights or upstands on pipes or flues. Overflows should be of a dimension which would drain water away and prevent it from rising above the overflow outlet.