# GENERAL ROOF DESIGN DETAILS

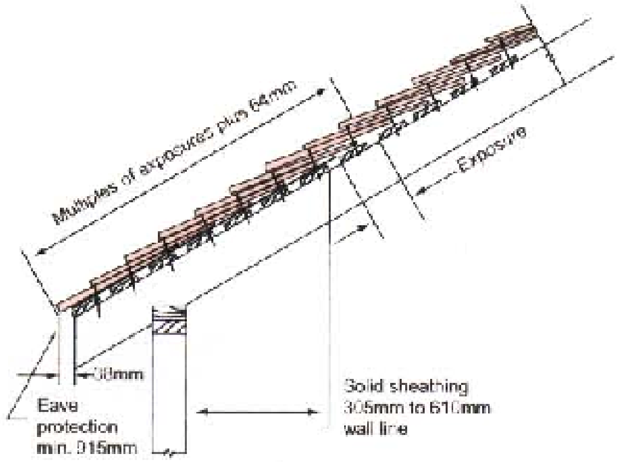



Figure 1: Shingles Applied Over 25 x 38mm Minimum

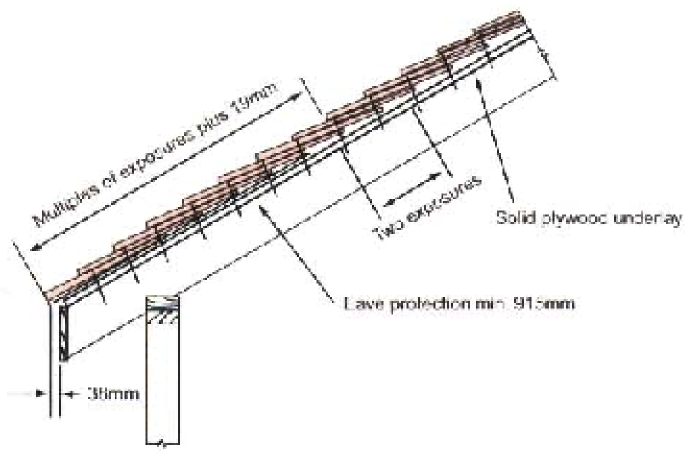



Figure 2: Treated Shingles Applied Over Solid Sheathing

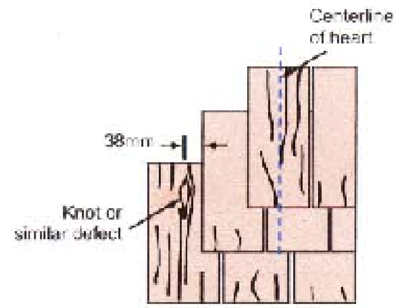



Figure 3: Joint Alignment For Shingles and Shakes

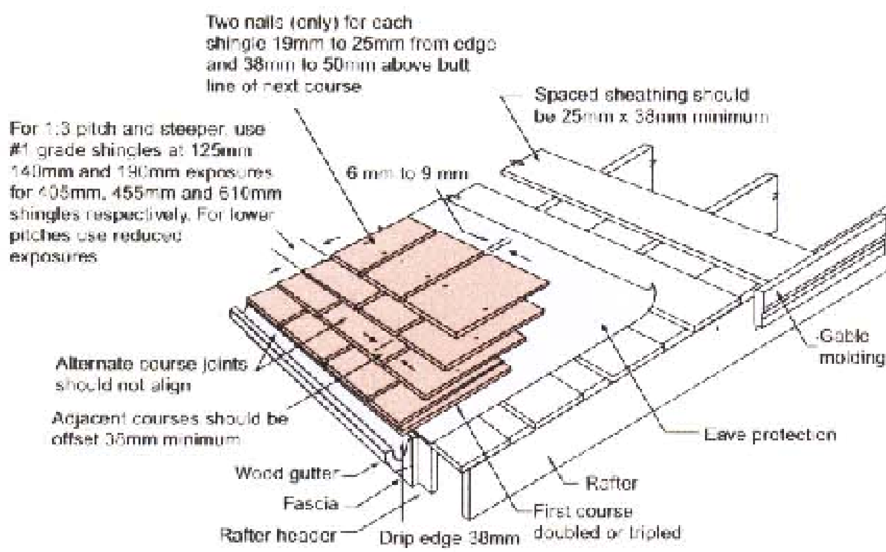



Fig. 4: Shingle Application

# MANSARD ROOF DETAILS

The mansard is particularly well suited to renovation work on pitched roof houses because the upper story can be enlarged without adding extra height to the structure. The conversion of a pitched roof bungalow to a mansard provides a floor area on the upper floor that can be identical to the main floor area.

The low downward slope of the mansard roof line acts visually to reduce the scale of a building and helps to eliminate a boxy appearance. This technique is used frequently on large commercial projects, particularly those near residential neighborhoods It is also a common solution to the problem of avoiding a monotonous appearance on flat-roofed frame apartment buildings.

Properly used, a mansard roof can strengthen the design without substantially increasing construction costs. If raised up above the level of a built-up roof, the mansard can screen out roof penetrations or mechanical equipment.

The variety of mansard roofs is practically infinite. One of the most widely used (and misused) roof designs, its proportions and scale are very important and care should be taken to avoid a mansard roof line that is either too skimpy or too generous.

Two of the most widely used roofing materials on the mansard roof are Western Red Cedar shingles and shakes. Cedar shakes, with their heavier texture and solid appearance, are perhaps more frequently specified for mansards although shingles are also used, particularly when a lighter scale is desired. The light weight and ease of application of shingles and shakes contribute substantially to economical construction. They can be installed over light framing—usually spaced battens—thus affording a considerable saving in both materials and labor as opposed to cladding that requires a solid base. This cost saving factor, combined with their excellent insulating qualities and attractive appearance, contributes to the increasing popularity of shingle and shake mansard roofs.

Construction details for typical mansard roofs are shown in Figure 6.

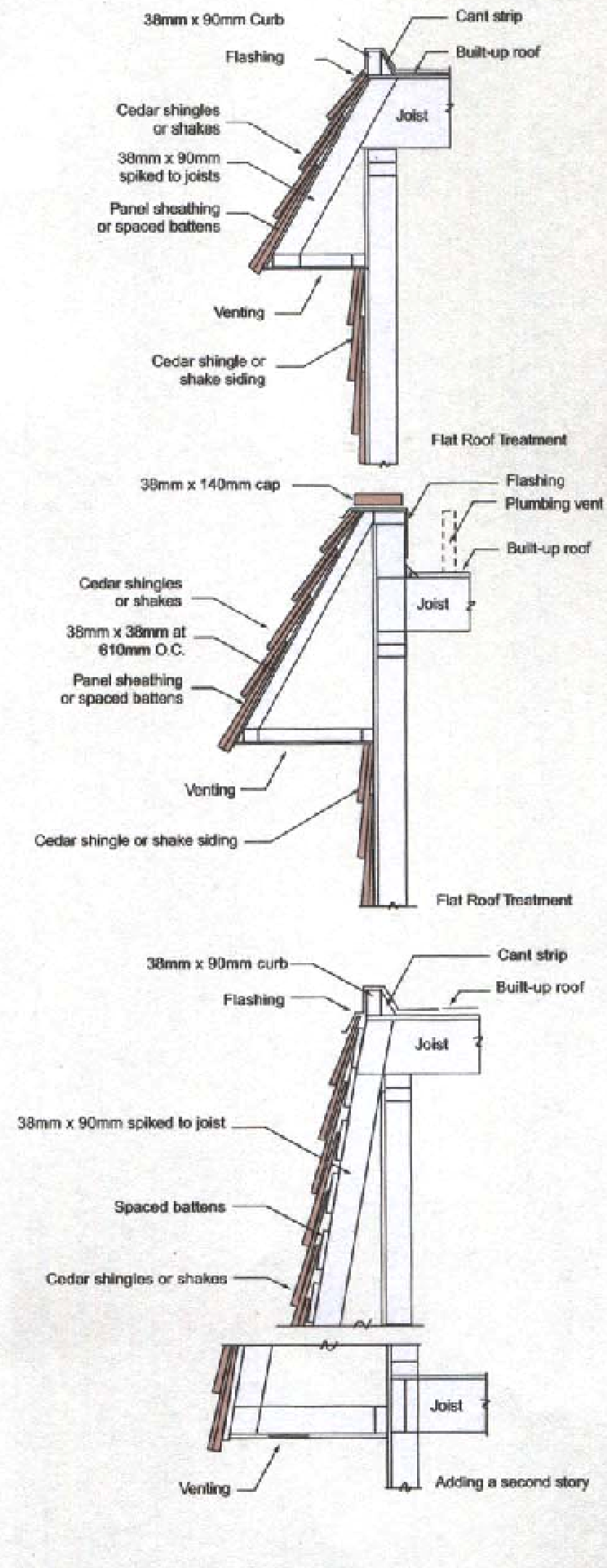



Fig. 6: Shingle and Shake Mansard Roofs

# LOW SLOPE ROOF DETAILS

The minimum roof slope on which shakes and shingles are recommended is 19 degrees. It is possible, however, to apply shingles or shakes successfully to solid sheathed roofs of lower slope providing a special method of application is followed (Figure 7). The prescribed method provides a double roof on which the shingles or shakes are applied to a lattice-like framework embedded in a bituminous surface coating.

A conventional hot-mop (or suitable roll-type) asphalt roof should be applied over the roof deck. With the final hot-mop application 38mm x 90mm spacers of Western Red Cedar or preservative treated lumber are embedded in the bituminous coating. These spacers are installed over the rafters at 610mm O.C. and extend from eave to ridge.

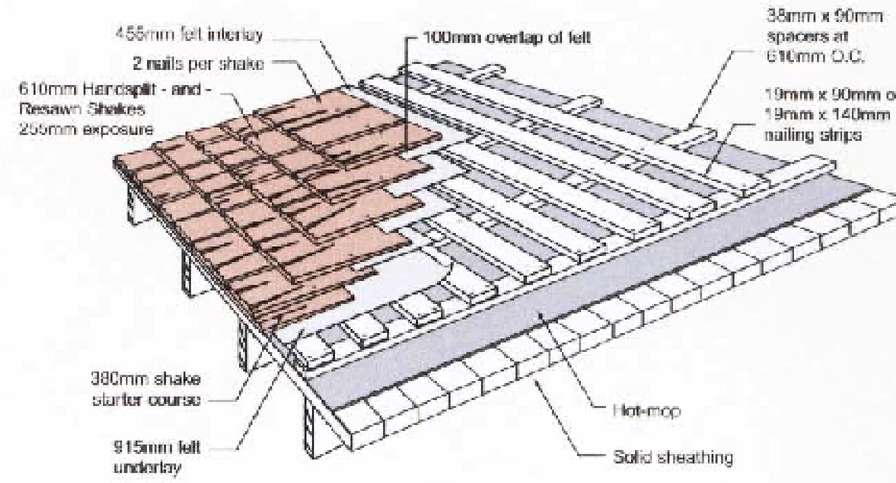



Fig 7: Application of Shakes to Low Slope Roofs

Next, 19mm x 90mm or 19mm x 140mm nailing strips, spaced according to the weather exposure selected for the shingles or shakes, should be nailed across the spacers to form a lattice-like nailing base. For example, if 610mm shakes are to be installed at a weather exposure of 255mm, the nailing strips would also be spaced at 255mm on centers.

Finally, the shingles or shakes are applied in the normal manner with a starter course at the eave and felt interlays between each course of shakes (Figure 7).

# HIP AND RIDGE DETAILS

Intersecting roof surfaces at hips and ridges should be capped to ensure a weathertight joint. Site-made or factory assembled hip and ridge units may be used, but both types must have alternate overlaps and concealed nailing (Figure 8). Weather exposures should be the same as the field of the roof. Nails must be longer than those used on the field of the roof and of sufficient length to penetrate 13mm into or completely through the sheathing.

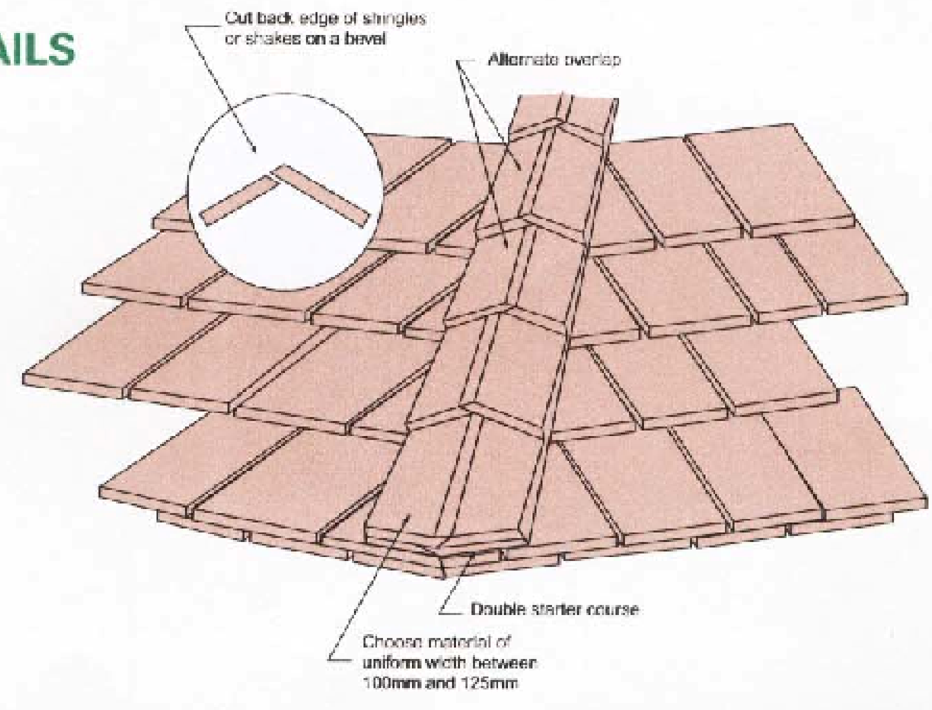



Fig 8: Hip and Ridge Application

# ROOF JUNCTURE DETAILS

Correct construction of roof junctures is vital to ensure weathertightness. In the following cases, where metal flashing is employed, it should be no less than 26 gauge galvanized steel (or acceptable equivalent). It should be painted on both sides with a good metal or bituminous paint. Flashing materials should be painted after bending to maintain the integrity of the coating.

**Convex Juncture**

On this type of juncture (Figure 9) metal flashings should be installed to cover the top 100mm of the wall and the bottom 200mm of the roof slope before the final course of shingles or shakes is nailed to the top of the wall. A narrow band of shingles or shakes—or a strip of wood molding—should be applied horizontally after the final wall course is installed. A double or triple starter course is then applied at the eave, with a 38mm overhang of the wall surface. The roof can then be completed in the normal manner.

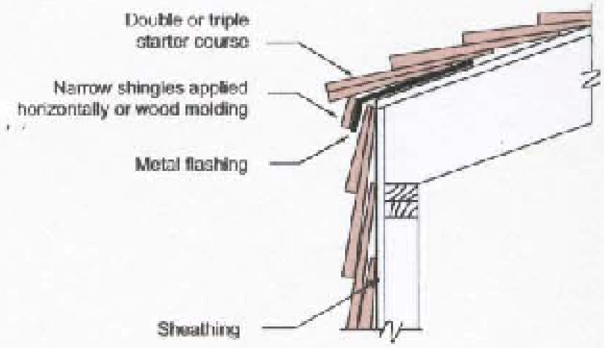



Fig. 9: Convex Roof Juncture

**Concave Juncture**

Metal flashings for the concave juncture (Figure 10) are similar to those for the convex type. They should be installed to cover the top of the roof slope and the bottom 100mm of the wall before the final course of shingles or shakes is installed. The final roof course should be installed so that the tips fit as snugly as possible against the wall at the juncture. A double starter course should be applied at the start of the wall surface and the remaining wall courses applied in the recommended manner.

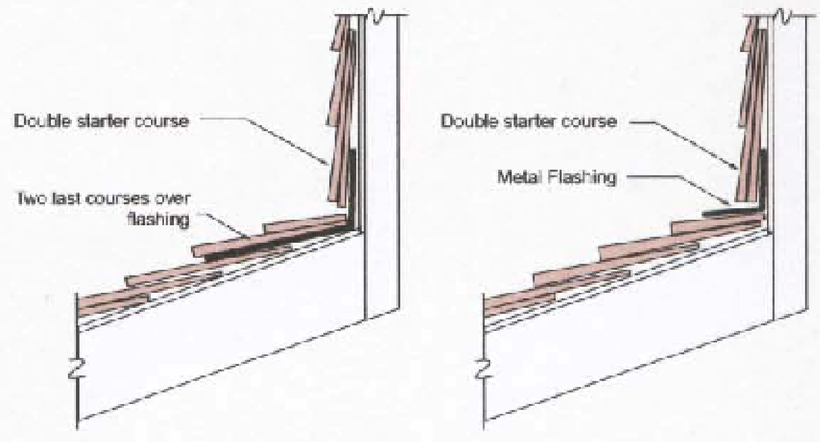



Fig. 10: Concave Roof Juncture

**Apex Juncture**

On this roof juncture (Figure 11) metal flashing should cover the top 200mm of the roof and the top 100mm of the wall. It should be installed before the final course of shingles or shakes is applied to the wall. The recommended sequence of application is to apply shingles or shakes first to the wall, then to the roof. The overhanging roof material is then trimmed flush with the wall. Finally, specially prepared ridge units are applied over the wall-roof juncture so that in each matching pair the roof piece overlaps the wall piece each time.

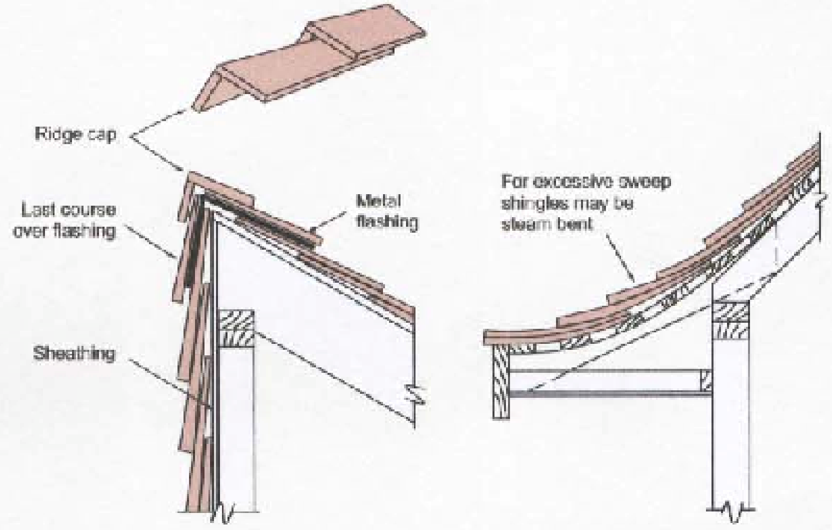



Fig. 11: Apex Roof Juncture and Swept or Bell Eave

**Swept or Bell Eave**

When shingles or shakes are to be applied to a swept or bell eave where the curvature is excessive, it may be necessary to soak them for a period (usually overnight) or steam them prior to installation. A double starter course is employed in the usual manner. Exposure is determined by the slope of the roof and the type of shingle or shake selected.

# ROOF VALLEY FLASHING DETAILS

Most roof leaks can occur where water is channelled off the roof or where the roof abuts a vertical wall or chimney. At these points, metal valleys and flashings are used to assist the shingles or shakes in keeping the structure sound and dry.

Structural members that protrude through a roof should also be flashed at all intersecting angles to prevent leakage. Step flashing should extend under the shingles or shakes and up the vertical surface and should be covered by a second layer of flashing (counterflashing).

Flashing should be pre-painted both sides using a good metal or bituminous paint. Flashing strips which must be bent to sharp angles should be painted after bending. Metal flashing with baked-on enamel coating is available in some areas. Different flashing metals are available in different areas depending on climatic variations. It is good practice to use metals that have proven their reliability under the specific conditions to be encountered. It is important that metal flashing have the same longevity as Western Red Cedar.

**Valleys—Shingles**

For roofs with slopes of 1:1 or greater, valley flashing should extend not less than 178 mm on each side of the valley centerline. For roof slopes less than 1:1, flashing should extend not less than 255mm each side. Valley flashing should be center-crimped, painted galvanized steel or aluminum Valley metal should be underlayed with No. 15 (minimum) roofing felt, but is optional when spaced sheathing is used. Shingles should not be applied with their grain parallel to the valley centerline and those extending into the valley should be cut at the correct angle (Figure 12). Joints between shingles must not break into the valley.

**Valleys—Shake**

On shake roofs it is recommended that a strip of No. 15 (minimum) roofing felt be installed over the sheathing and under the metal valley. This is optional when spaced sheathing is used.

Metal valleys should be center crimped, painted galvanized steel or aluminum and have a minimum total width of 510mm. In some areas, however, flashing width requirements may differ and local building codes should be consulted. Shakes should not be applied with their grain parallel to the valley centerline and those extending into the valley should be cut at the correct angle (Figure 12). Joints between shakes must not break into the valley.

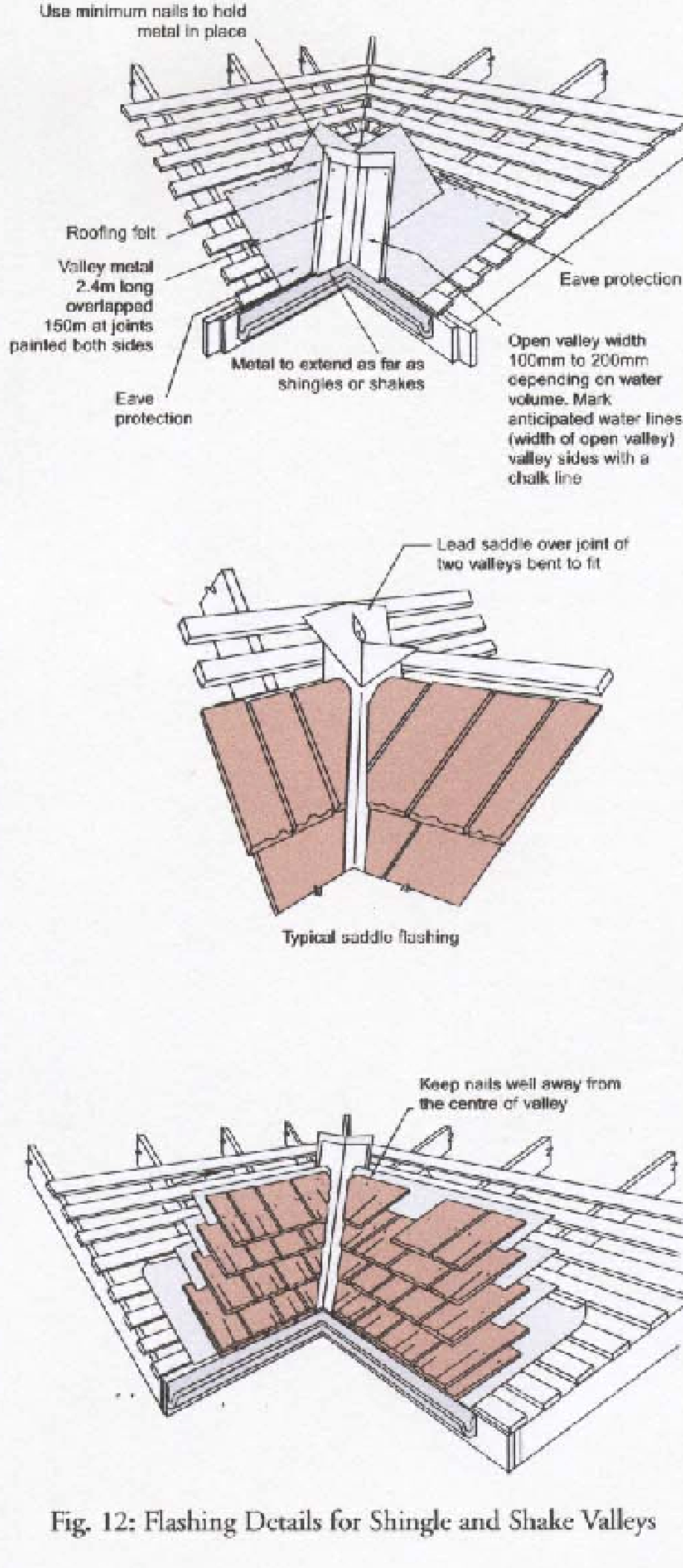
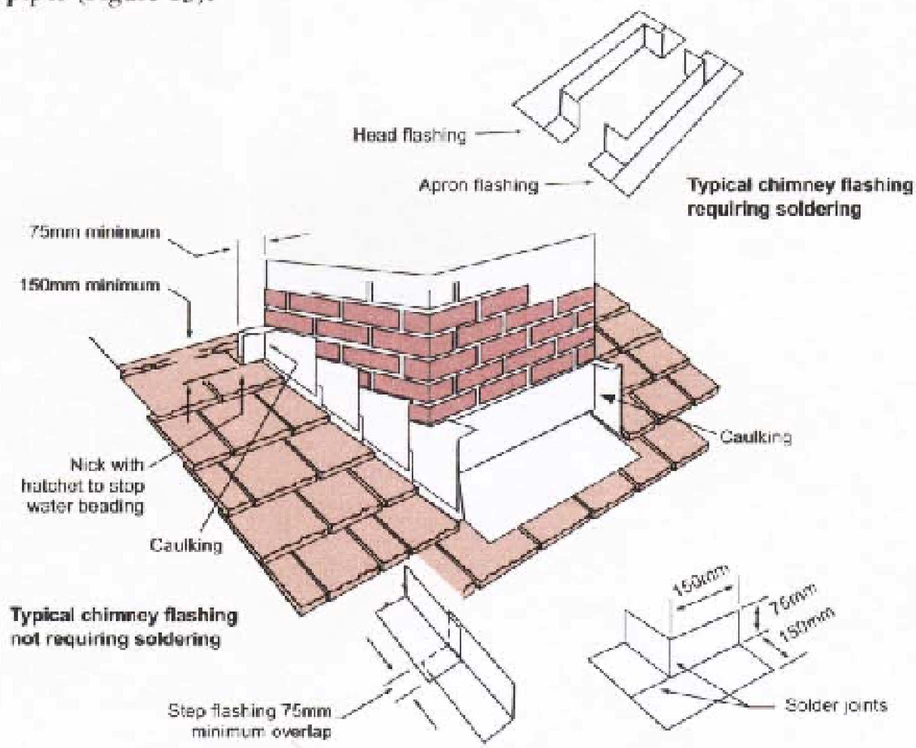


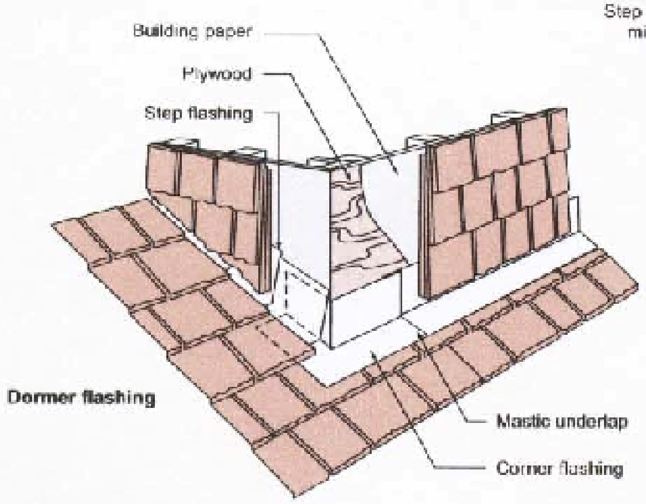

Fig. 12: Flashing Details for Shingle and Shake Valleys

# ROOF PROJECTION FLASHING DETAILS

Recommend construction details for applying metal flashings around typical roof projections such as chimneys and vent pipes (Figure 13).

For roofs and walls, the use of stainless steel, phosphor, or silicone bronze nails is recommended.
Standard shingle nails are 31mm x 1.8mm stainless steel annular ring shanked.
Standard shake nails are 50mm x 2mm stainless steel annular ring shanked.
Nails shall be driven flush but not so that the nail head crushes the wood. They shall be placed approximately 19mm to 25mm from the edges of the shingles or shakes and 38mm to 50mm above the butt line of the following course. Each shingle or shake shall be secured with two nails.



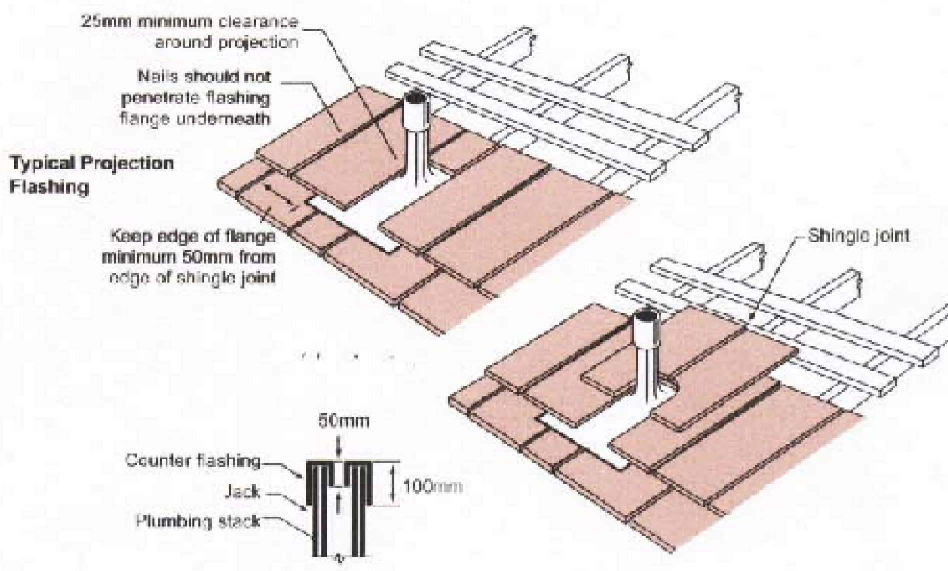




Fig. 13: Flashing Details for Typical Roof Projections

# VENTILATION DETAILS

The importance of good attic ventilation beneath the roof cannot be over-emphasized. Such movement of air will prevent or inhibit condensation of moisture on the undersurface of the shingles or shakes, or on the roof decks. Vents should be provided at the soffits (eaves) as well as at gable ends (screened to prevent ingress of insects), with cross-ventilation desirable. A rule of thumb for adequate ventilation is that the ratio of total net free ventilation area to the area of the attic should be not less than 1:150, with compensation made for screens over vent apertures. Attic fans may be beneficial, these supplying additional movement of air in attic spaces.

Several examples of construction techniques which provide roof ventilation are shown in Figure 14.

# VAPOUR BARRIER GUIDELINES

The decision on whether to use a separate vapour barrier must be made by the designer, based on the type of building, its end use, and its geographic location. A separate vapour barrier is sometimes omitted on a sandwich-type roof deck when the weather-shedding skin is not a membrane-type impervious to the transmission of water vapour. Although some types of rigid insulation have the properties of a vapour barrier, a layer of roofing felt is often placed between the deck and the insulation as an air check. Many specifiers still prefer to use a separate vapour barrier because it prevents vapour from condensing in the insulation, which reduces the overall efficiency.

Where a vapour barrier is used, care must be taken to ensure that the dew point is well to the outside of the vapour barrier in order to prevent condensation on the deck. Ideally, the vapour barrier should be as close as possible to the warm side of the roof, and the thickness of the insulation should be increased as the deck thickness increases to maintain the correct location of the dew point. In unevenly heated buildings such as churches and halls, or buildings such as swimming pools where an unusually high level of moisture is generated, the excess humidity may have to be removed by mechanical means to prevent condensation on the deck. In air-conditioned buildings, use of the cold weather roof system allows a constant flow of air between the insulation and the roofing, helping to reduce the energy required for cooling.

Full details on the cold weather roof system are given on page 14.

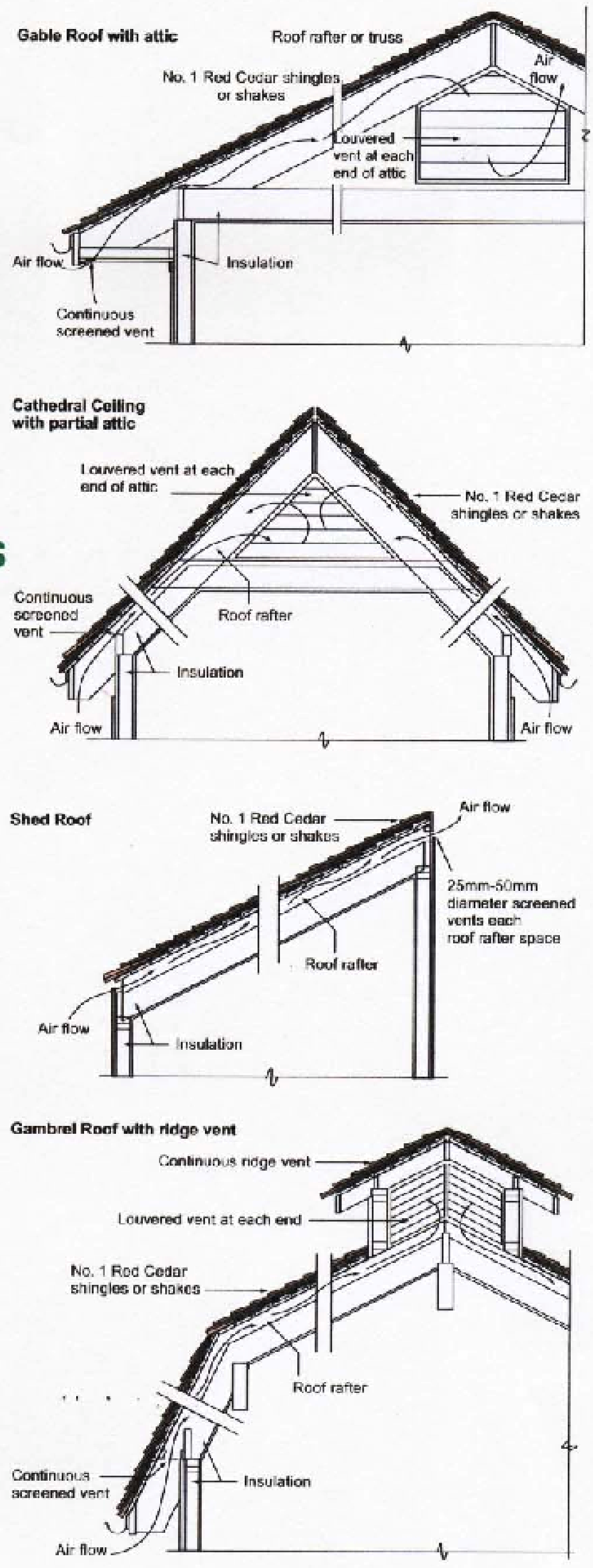



Fig. 14: Ventilation Details

# SPECIALTY ROOF DECK DETAILS

### Wood Deck

Wood decks form an ideal base over which to apply cedar shingles or shakes, since they can be attached in the conventional manner.

Where a layer of insulation, normally one of the rigid types, is to be included, the problem of how to fasten shingles or shakes is created. The use of abnormally long nails driven through the shingles, the insulation, and into the deck below is generally unsatisfactory, and horizontal strapping will be required to overcome the fastening difficulties (Figure 15). When strapping is used, fewer nails penetrate through the insulation to the deck, and greater thermal efficiency is achieved by reducing the number of conductors. In addition, the lengths of the nails may be chosen to prevent the points from protruding through the deck where they may mar the inside face.

If ice-damming is a potential problem or if reverse condensation is likely to occur, such as may be encountered in an ice arena, the cold weather roof system should be used in conjunction with horizontal strapping, and ventilation must be provided at the eaves and at the peak. In buildings such as ski cabins that may be subjected to heavy snow loads, it is usually necessary to fasten wood members (typically 38mm x 90mm on edge) from ridge to cave on the roof deck and place the rigid insulation between. Strapping is then applied across the top of these members, giving a ventilated air space and avoiding compression of insulation (Figure 16).

The need for strapping can often be completely eliminated by the use of a false plywood deck, immediately over the insulation, to which the shingles or shakes are directly fastened (Figure 17). Exterior-grade sheathing panels are ideal for this purpose, since they provide a strong, smooth surface. However, under certain conditions of pitch and loading, there may be a tendency for the entire roof above the decking to creep downwards, bending the nail fastenings and compressing the insulation, thereby reducing its efficiency. In such cases, it is often desirable to install the vertical members as previously described.

### Nails

If the shingles or shakes are nailed directly through rigid insulation, a number of problems may be encountered. For instance, the longer nails have thicker shanks which tend to split the shingles or shakes. In addition, movement of the shingles or shakes as they go through natural expansion and contraction cycles caused by wetting and drying, have a tendency to enlarge the holes in the insulation, thereby reducing its efficiency. For this reason, the use of strapping or false plywood deck is again recommended.

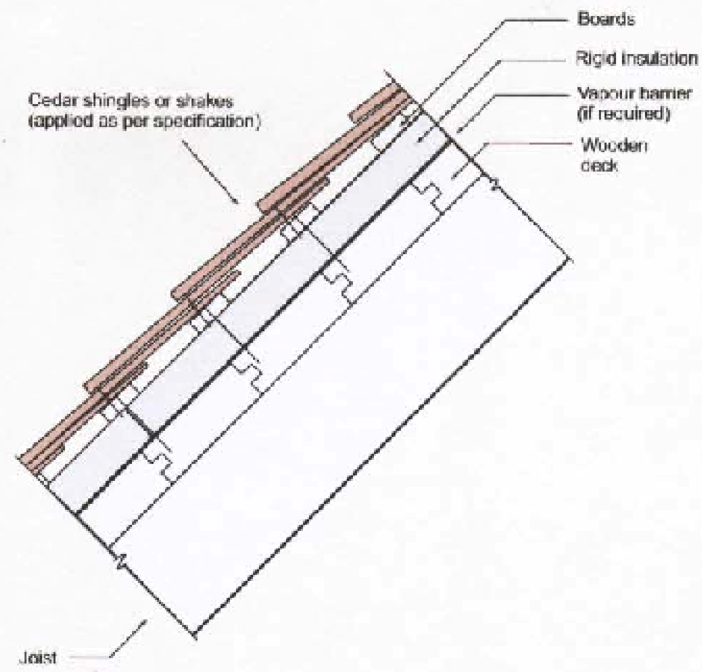



Fig. 15: Specialty Roof Deck – Strapping over Insulation

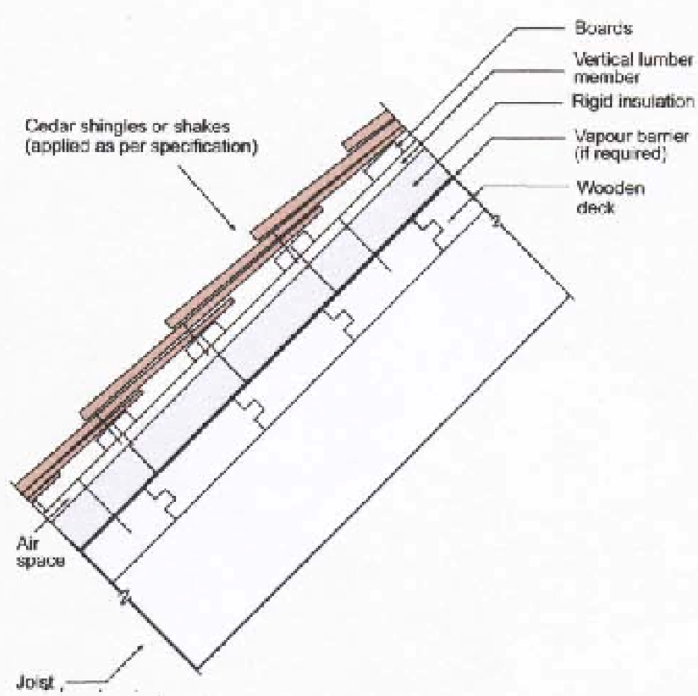



Fig. 16: Specialty Roof Deck – Vented Roof

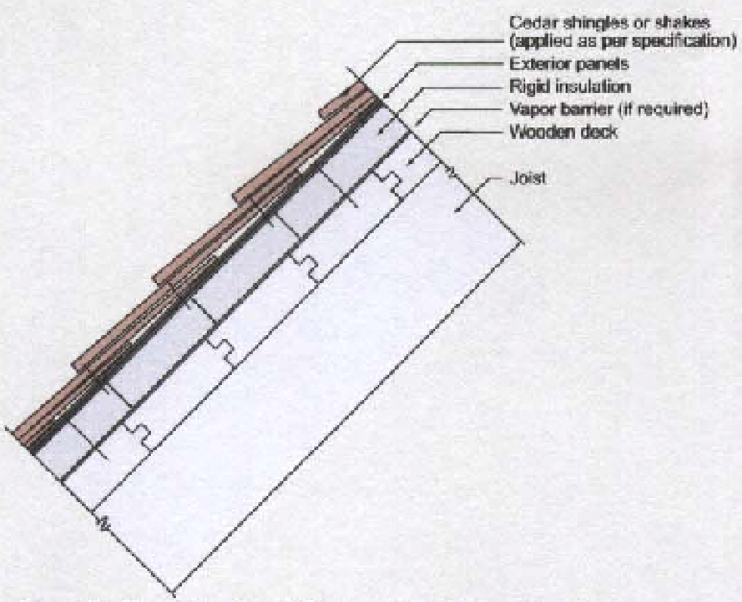



Fig. 17: Specialty Roof Deck – Panels over Insulation

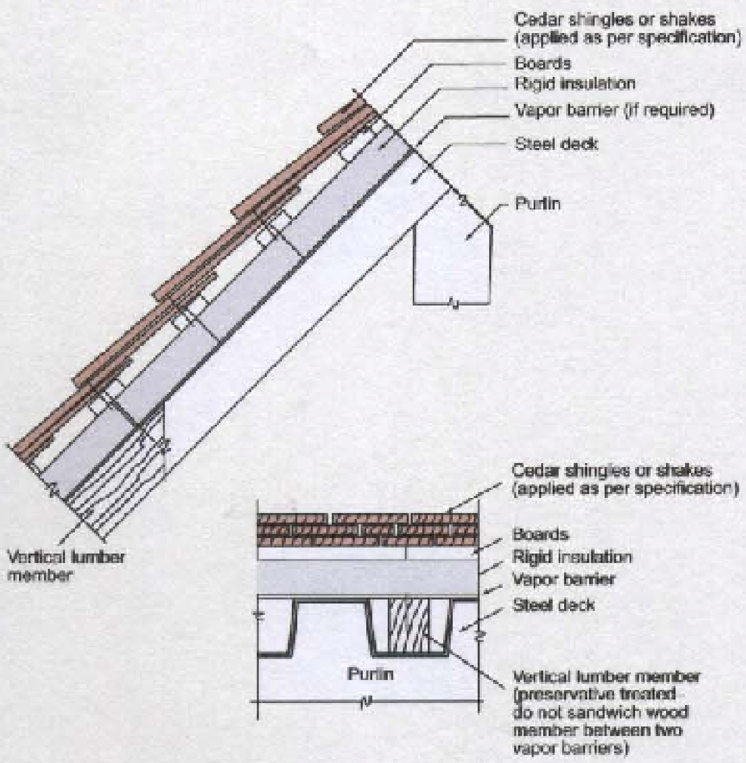



Fig. 18: Specialty Roof Deck – Steel Roof

**Rigid Insulation**

Numerous types of rigid insulation are now in use, and may be made from expanded polystyrene beads, rigid urethane laminate, low density fiberboard, or from fast-setting liquids poured on-site. They vary in thickness up to more than 50mm and in length and width depending upon the manufacturer. All these types are efficient insulators and are usually of sufficient density to hold the weight of a normal roof covering without the need for lumber bridging.

**Metal Deck**

The covering of metal decks with shingles or shakes presents a rather unique problem. These decks are often used for economic reasons, but they generally require a finish roofing capable of shedding the weather. In addition, aesthetic considerations often require that the deck itself be covered with a material such as Western Red Cedar shingles or shakes to provide a pleasing finish. When a metal deck is to be covered, consideration should be given to the use and placing of vapour barriers. If insulation is placed on top of a metal deck, the entire roofing system must be taken into account. For example, wood members must not be sandwiched between two vapour barriers. If this is unavoidable, the wood member should be preservative treated before installation. In some cases, the seams in a metal deck can be sealed to create an effective vapour barrier. Boards or a panel deck must be used as a nailing base for the shingles or shakes, supported by vertical lumber members fixed to the deck. This can be achieved in a number of ways:

1. On a corrugated deck, vertical lengths of lumber are fastened to the deck and horizontal boards or panels are applied across the vertical pieces. If insulation is required, it is best placed on top of the vertical members, held in place by the nails fastening the boards or panels to the members (Figure 18).
2. On a sheet deck, or where the corrugations are very shallow, it may be necessary to use angle clips to attach the vertical members to the deck. The clips should be nailed to the lumber and bolted or screwed to the deck. Boards or panels are then applied as before.

If there is a likelihood of excessive moisture buildup, as may be encountered in ice arenas, the cold weather roof principle can be employed, supplemented by mechanically produced air flow if necessary.