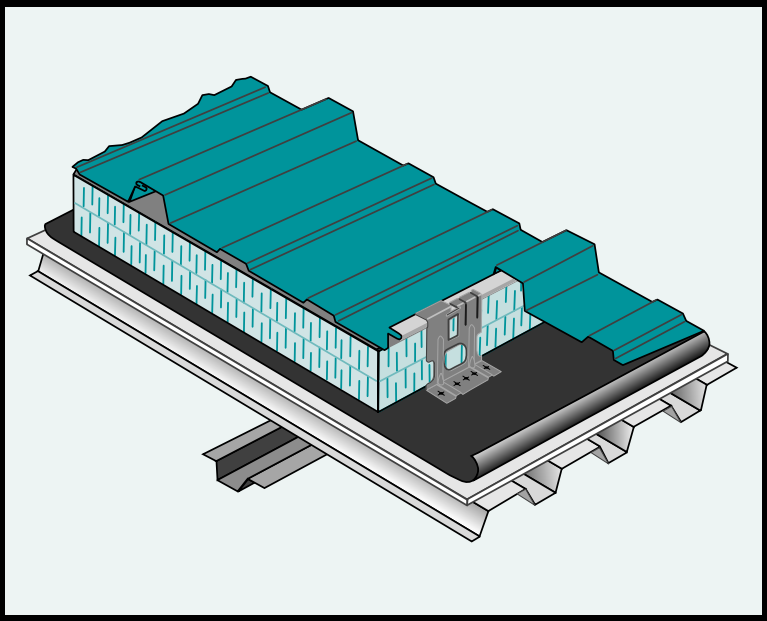


VICWEST

Marquis Systems

Design Manual Marquis Series System

Copyright 1997

By

VICWEST

DESIGN RESPONSIBILITY

THIS MANUAL HAS BEEN PREPARED AS A GUIDE FOR BUILDING DESIGNERS AND EVERY PRECAUTION HAS BEEN TAKEN TO ENSURE THAT ALL INFORMATION PRESENTED IS FACTUAL AND THAT THE NUMERICAL VALUES ARE ACCURATE. HOWEVER, VICWEST ASSUMES NO RESPONSIBILITY FOR DESIGN LIABILITY OR ERRORS RESULTING FROM THE USE OF THIS INFORMATION.

Authors ---------- M. Sommerstein, P. Eng.
B. Mandelzys, P. Eng.

TABLE OF CONTENTS

Notes to The Designer / User

The details contained in this MANUAL are intended to be a design aid. Actual conditions will vary and all situations have not been taken into account. Modifications to suit actual conditions will be the responsibility of the designer or user.

All flashings and trim pieces depicted in these details are VICWEST standard flashings. Other styles can be manufactured to suit your aesthetic needs.

The details and installation procedures shown are recognized as VICWEST standards. Other installation procedures may be used, but should be considered the responsibility of the designer or user.

Marquis Roofing Systems are not structural panels and should generally be installed over a solid substrate or rigid insulation. The enclosed details show the roofing panels applied over rigid substrate.

Metal roofing is susceptible to condensation and its control should be carefully considered. It is the designer's responsibility to determine the need and composition of materials to prevent condensation including insulation, vapour retarders or venting.

Valleys should receive a special underlayment, as they are susceptible to water build-up. If valleys are not kept free of debris and water backs up, intrusion may occur under panels. An underlayment such as bituthene should be put down first, extending a minimum of 4'-0" up from the centre of the valley on each side.

It is not recommended that the Marquis Roofing Systems be used on a slope less than 2:12. Slopes as low as 1:12 can be used if snap cap system is added. Check with a VICWEST representative.

Contact your local VICWEST representative if you have any questions about the use of the Marquis Roofing System or its accessories.

Marquis Roof System

Marquis is the name given to our roll-formed Board and Batten profile. The three profiles available are: the Marquis 300, the Marquis 450 and the Marquis 600. They have rib spacing of 300 mm, 450 mm and 600 mm respectively.

These profiles are used as the outer skin on a wall or roof system. Together with the other components in the system, they can be used as a highly insulated roof system.

The Marquis can be applied on a vertical wall system or on a sloped roof system. The profile can be mitred to form a continuous roof and fascia installation, in conjunction with a batten cap.

CHARACTERISTICS OF THE MARQUIS ROOF SYSTEM

- Attractive; traditional board and batten appearance
- Non-combustible
- Few exposed roof fasteners
- No seaming machine or crimping tool required
- Factory or field installed sealant
- Water tight seam on sloped roofs
- New or retrofit application
- Easily mitred profile allows for a smooth transition from a sloped roof to a vertical fascia by using a brake-formed batten cap over the mitred batten (See detail page 28)
- Panel thickness range: 0.91 mm - 0.46 mm
- Panel coverage: 450 mm and 600 mm
- Rib spacing: 300 mm, 450 mm and 600 mm
- Clip thickness: 1.22 mm and 1.52 mm
- Batten size: 45 mm high x 46 mm wide
- Optional stiffeners: 50 mm x 1 mm
- Insulation thickness: from 13 mm to 254 mm
- Minimum recommended roof slope: 2:12, with snap caps 1:12

UNIQUE FEATURES OF BATTEN SEAM ROOF PANEL

- Unlimited thermal expansion and contraction
- Minimum amount of pieces required; panels and clips only
- Easily mitred for roof to wall transition
- Spring action clip interlock system

Components and Connections

STIFFENER RIBS ROLLED INTO PROFILE

SERIES 300 - - - - - - - - - None
SERIES 450 - - - - - - - - - 2 @ 50 mm Wide
SERIES 600 - - - - - - - - - 3 @ 50 mm Wide

Note:
Shallow stiffeners are rolled into panel flats to reduce oil canning.

Because the panels in a sloped roof are “floating” on the thermal clips, care must be taken to anchor the sheets at the eave or ridge.

COATINGS
Marquis panels are fabricated from galvanized steel coated with one of several possible paint systems to help it resist environmental conditions. Three factors typically have a major impact on the coating system:

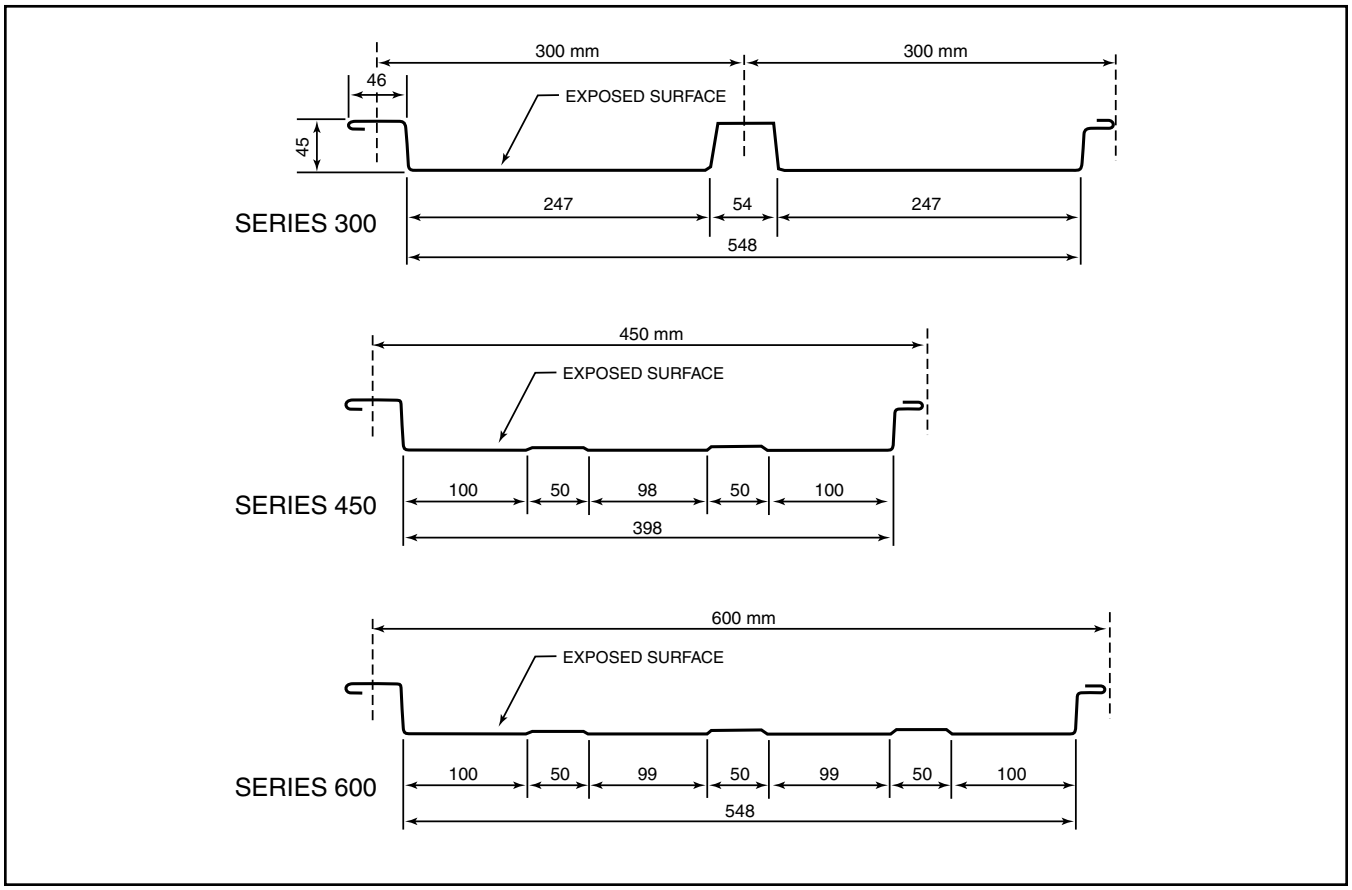
- time of wetness
- presence of sulphur dioxide and nitrogen oxide in the atmosphere (which combine with water to form acid rain)
- presence of chlorides at sea coast locations or close proximity to roads treated with de-icing salts.

Local conditions can have a significant impact on coating selection. In general, however, Canada can be divided into four broad regions:

- East Coast has severe atmospheric conditions due to salt contamination, lengthy time of wetness and acidic precipitation i.e. highly corrosive.
- Ontario/Quebec/Atlantic has acidic precipitation i.e. moderately corrosive.
- West Coast has high precipitation with a mild ph i.e. moderately corrosive.
- Prairies/Northern Ontario has low precipitation and humidity i.e. mildly corrosive.

For additional information on coatings, please contact your VICWEST representative.

MARQUIS PROFILES



THERMAL CLIPS

Thermal clips are formed from 1.22 mm and 1.52 mm Z275 galvanized steel. The 1.22 mm material may also be formed from barrier-coated steel. These clips are shipped without the spring clip assembled, to facilitate nesting in the box. The spring is attached to the clip in the field.

Thermal clips come in a variety of depths from flush mount to depths which accommodate up to 254 mm of insulating material.

Clips are fastened through the gypsum board to the metal deck below with #14-type AB S.M.S.. The number of screws to be used depends on:

(1) Magnitude of wind uplift
(2) Spacing of clips
(3) Thickness of the inner metal deck

For design procedure refer to page 20.
The marquis panel is attached as shown on page 9.

Maximum design uplift for Marquis clips is:

(a) 0.06” (1.52 mm) clip - 171 lbs. (761 N)
(b) 0.048” (1.22 mm) clip - 110 lbs. (489 N)

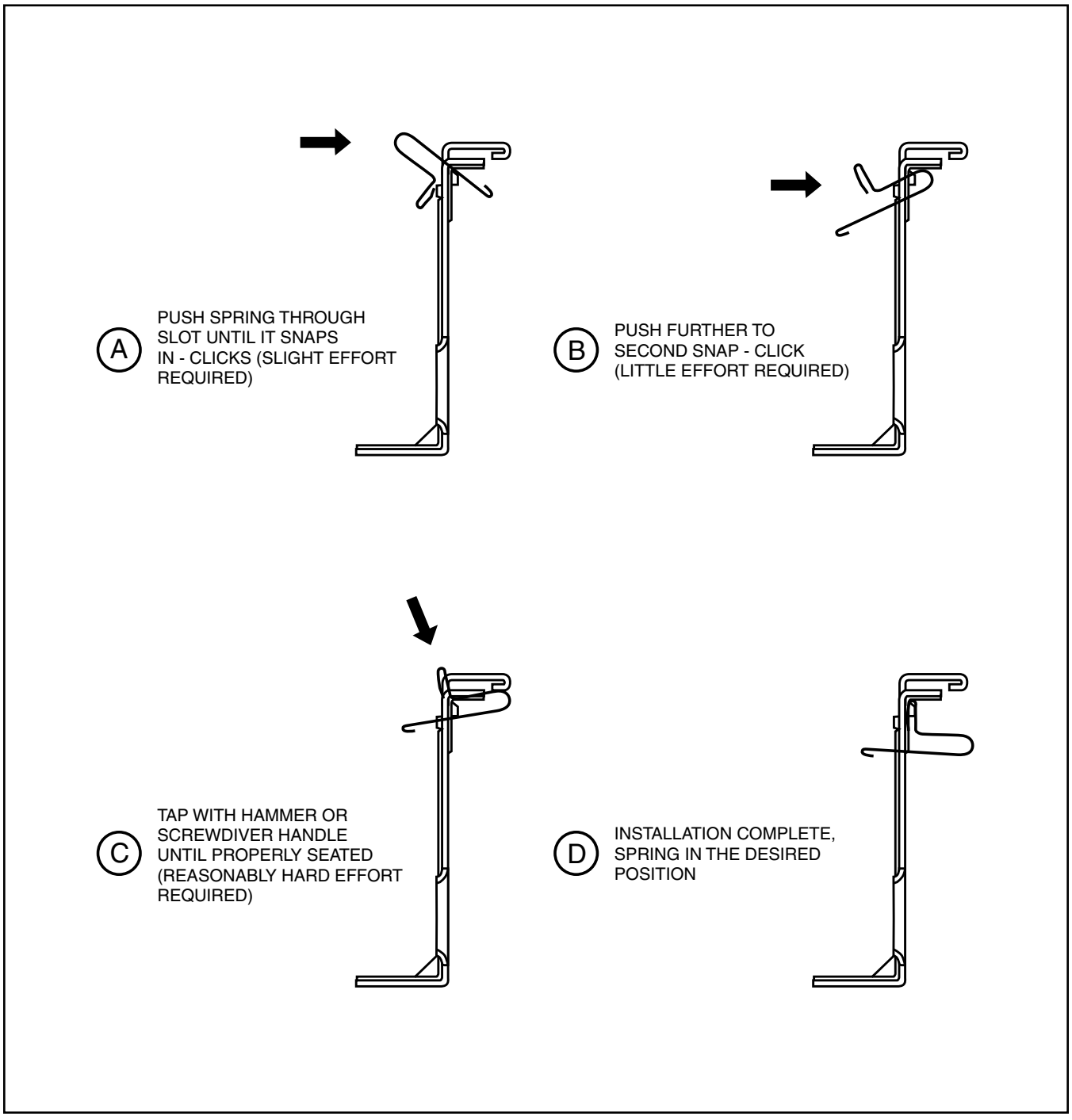
The above is based on a minimum expectation of 30% design wind load reduction on the Marquis clips due to pressure equalization applied to the visible deformation load limit of the clips.

SPRING

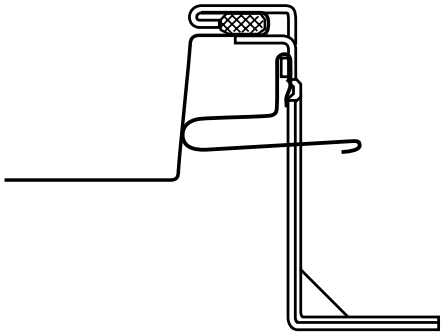
Marquis panel's spring jamming action functions as a spreader for the panel's side lap joint.

Spring is rounded / bent @ about 180° to avoid panel scratching.

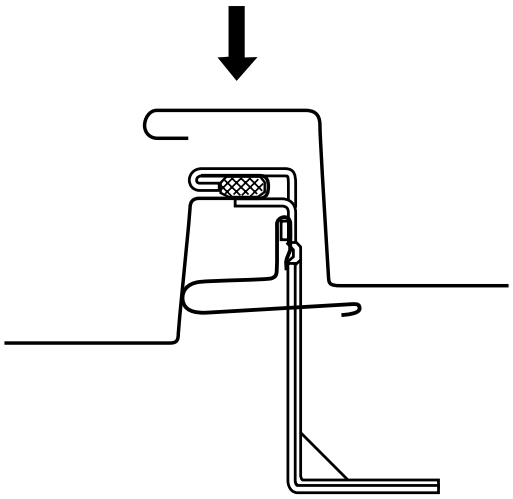
INSTALLATION SEQUENCE OF SPRING TO THERMAL CLIP



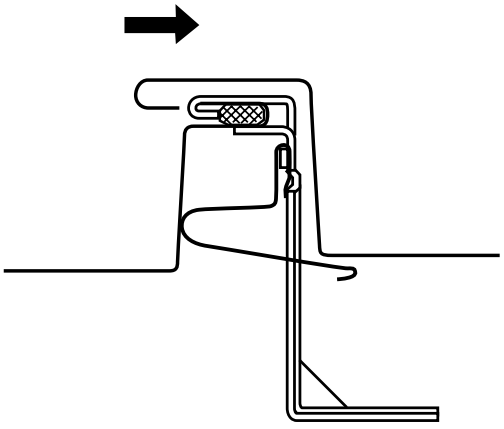
INSTALLATION SEQUENCE FOR MARQUIS PANEL



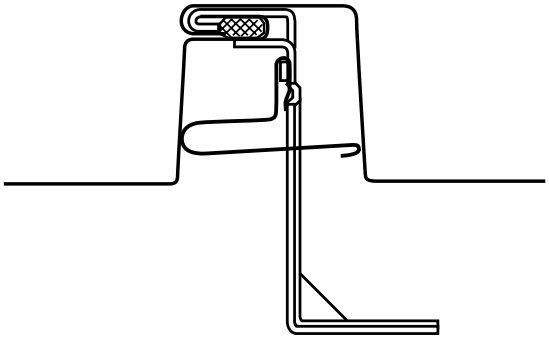
A FEMALE SIDE OF PANEL C/W CLIP AND SPRING IN PLACE.



B MALE SIDE OF NEXT PANEL PLACED AS SHOWN - SPRING IS PUSHED DOWN.

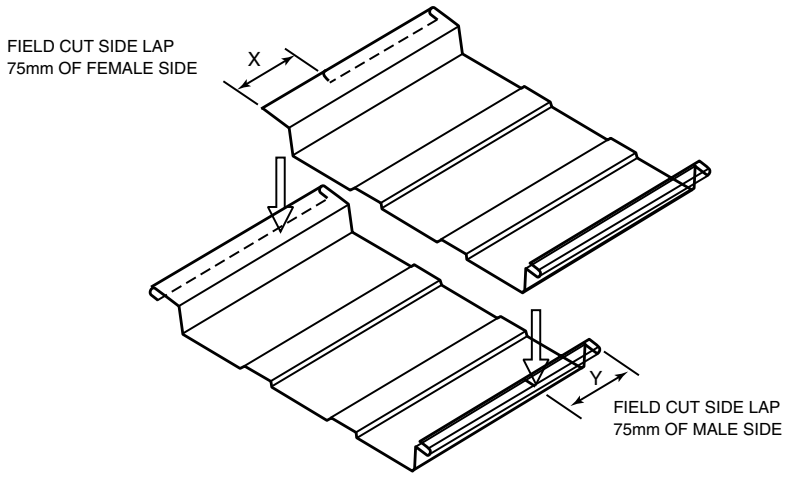


C PANEL MOVED SIDEWAYS TO ENGAGE.



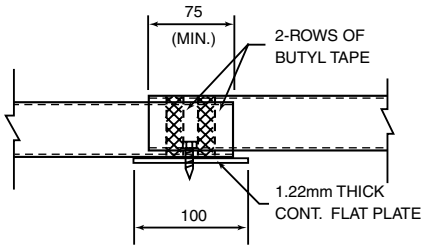
D INSTALLATION COMPLETE - SPRING BACK TO NORMAL POSITION.

FASTENER SPACING ATTACHING MARQUIS PANEL TO SUBGIRTS OR MARQUIS SHEETS OVERLAP

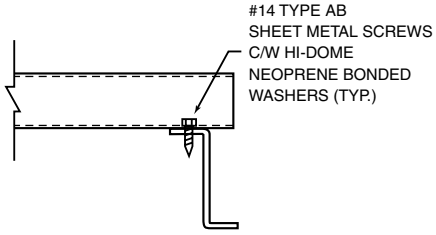


FIELD CUT MARQUIS SIDE LAP FOR PROPER OVERLAP

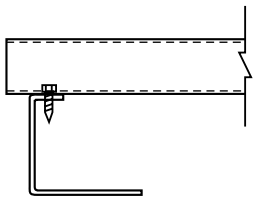
- Fastening Marquis roof sheet to subgirts requires the use of #14 type AB sheet metal screws c/w high dome neoprene bonded washers.
- The number of screws to be used depends on the magnitude of the sliding force as calculated in example on page 21.
- A minimum of 6 screws per 450 mm coverage is recommended and 8 screws for coverage of 600 mm.
- End lap fasteners as a general rule should use the same number of screws as required to fasten to restrain the panel against sliding. The forces acting on the end lap could be calculated resulting, in most cases, in reduced number of screws required.
- See page 11 for example of screws spacing.



TYPICAL END LAP

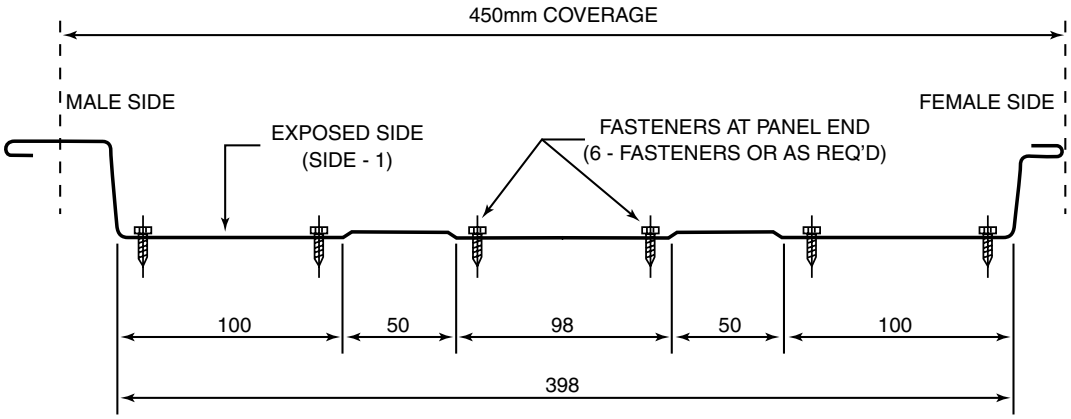


TYPICAL FASTENING
TO Z-BAR SUBGIRT

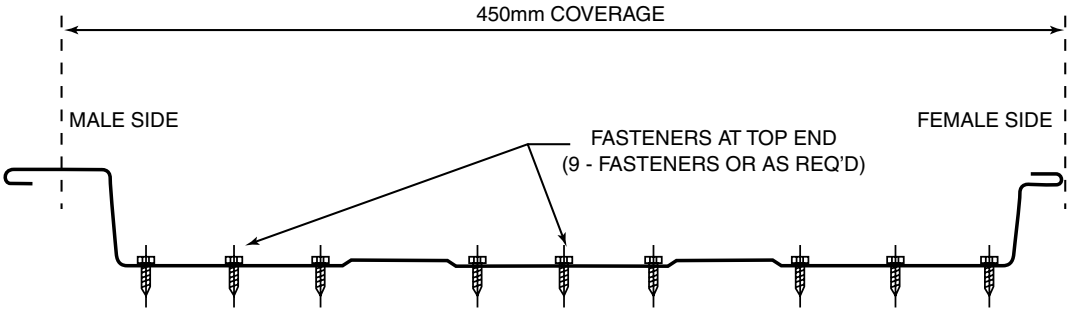


TYPICAL FASTENING
TO CHANNEL SUBGIRT

SAMPLE SCREW SPACING



6 - FASTENERS PER SHEET WIDTH
(450 MM COVERAGE)



9 - FASTENERS PER SHEET WIDTH
(450 MM COVERAGE)

NOTE:
FOR EXACT NUMBER OF FASTENERS REQUIRED
REFER TO DESIGN PROCEDURE AS OUTLINED
ON PAGES 20 AND 21.

Marquis Roof System Design

SNOW LOAD DESIGN (N.B.C. 1995)
(Simplified Method)

Snow loading is typically the major gravity load acting on the Marquis Sheet. It is dependent on the roof condition and geographical location of the building. Loading conditions should be supplied by the customer.

3.1 SNOW LOAD CALCULATION

Information on snow design can be found in the following sources:

1. National Building Code - 1995 - Appendix C
2. User's guide - NBC 1995 - Structural Commentaries (Part 4)

The typical snow load conditions for Marquis Roofs can be summarized as follows:

No Snow Pile-up:

$S = 0.8 (S_S) + S_R$

Snow Pile-up
(on low roof of a sheltered building without snow sliding off upper roof):

$S = 4.00 (S_S) + S_R$

where;

S = design snow load (kPa)

S_S = ground snow load for the area (typically listed under Climatic Information in the Supplement to the National Building Code) (kPa)

S_R = associated rain load for the area (kPa)

Extent of snow pile-up, for snow pile-up with snow sliding off upper roof see NBC 1995 "Structural Commentaries" page 66 and 67.

3.2 PROCEDURES

Given:

Roof Condition	= Low slope roof, no snow pile-up
S_S	= 2.1 kPa
S_R	= 0.4 kPa
S	= 0.8 (2.1) + 0.4
Live Load	= 2.08 kPa
Dead Load	= 0.06 kPa (weight of 24 ga. Marquis Panel)
Total Load on Marquis Panel	= 2.14 kPa

MARQUIS ROOF SYSTEM DESIGN

In this system, gravity loads on the Marquis panel are transferred via rigid insulation to the deck below. For this to work, the insulation must fulfill two requirements.

a. The insulation must completely fill the void between the membrane over the gypsum board and the bottom flange of Marquis panel.

b. The insulation must be sufficiently rigid to transfer the load.

Type 1	- Max. Load = 1.7 Kpa (35 psf)	Fibreglas® 703/AF530 Fibrex® FBX 1240
Type 2	- Max. Load = 2.9 Kpa (60 psf)	Fibreglas® 704/AF545 Fibrex® FBX 1260 Roxul® RXL40
Type 3	- Max. Load = 9.6 Kpa (200 psf)	Fibreglas® 705 Roxul® RXL60

Although not shown here, the deck should be designed to carry the snow load as well as the self-weight (dead load) of the roof system. Typically, the dead load of this roof system is approximately 0.48 kPa.

EXAMPLE:
Based on a loading on the Marquis panel of 2.14 kPa, Fibreglas AF545, 704 insulation should be used. The maximum load permitted on this insulation is 2.9 kPa which exceeds our requirements.

NOTE:
The use of insulations other than the ones shown above is not acceptable until they pass the test program established by ***VICWEST.***

WIND UPLIFT CALCULATION (N.B.C. 1995)

(Simplified Method)

The calculation of wind uplift for a roof system has a number of variables to consider. Using the “simple” procedure in the National Building Code, one normally considers the following:

- Geographic location
- Building height
- Roof slope (wind load is normally higher at perimeter)
- Distribution of wall openings (for internal pressure estimate)
- Roof system (for estimate of distribution of pressure)

Please refer to Commentary of the Supplement to the National Building Code of Canada 1995 for a more complete discussion.

A simplified equation which would cover uplift on the Marquis panel in the majority of cases is shown below:

$$P = q_{1/10} C_e k$$

where;

- **P** = Specified wind uplift normal to the roof surface (kPa)
- $q_{1/10}$ = Reference wind pressure with a 1 in 10 return period for a geographic location. This pressure is shown in Appendix C of the National Building Code of Canada 1995.
- C_e = $(H/10)^{0.2}$ where H is building height in metres. C_e should not be less than 0.9.
- **k** = 5.8 (This value is conservative for roof zones away from the perimeter)

As a general rule, the design wind load should be obtained from the designer. If desired, data covering the previous points may be gathered. Based on this, the wind load on the cladding can be calculated by ***VICWEST*** Engineering and submitted for approval to the designer as the basis for the design.

2.3 PROCEDURES

Given:

Span	=	5'-0" o.c.
Building height (H)	=	20 ft. (6.1 M)
$q_{1/10}$	=	0.38 kPa

Design Wind Load:

$C_e = (6.1/10)^{0.2} = 0.91$

Single Skin Marquis:

$P = q_{1/10} C_e k = 0.38 \times 0.91 \times 5.8$

$= 2.0$ kPa (41.9 psf)

Typical Insulated Marquis Roof:

$P = q_{1/10} C_e k = 0.38 \times 0.91 \times 4.1$

$= 1.4$ kPa (29.6 psf)

2.3.1 For Clip Spacing and Fastener Design Based on Wind Uplift see Procedure Shown on Page 20 and 21.

SLIDING FORCE

(Sliding Force Calculation)

The vertical snow load can be broken down into two (2) components:

a. The force normal (or perpendicular) to the roof surface is resisted by the roof purlins.
b. The force parallel to the roof surface must be resisted by the Marquis supporting elements (light gauge and structural) wherever the panel is fixed against sliding. On a Marquis panel, the fixed point is typically at the eave or ridge. We can refer to this force parallel to the roof as a "sliding force" because it would cause the panel to slide off the roof if it is not fixed properly.

Please refer to Figure 1 for a diagrammatic sketch of the forces. Based on this sketch, the sliding force may be calculated as follows:

$$\mathbf{P_o} = \mathbf{(L)\ (w)\ (\sin \alpha\ )}$$

where;

$\mathbf{P_o}$	=	Sliding force - (lbs./ft.) or (N/mm)
L	=	Maximum roof length in plan - (ft.) or (m)
w	=	Gravity load on Marquis panel - (psf) or (kPa)
α	=	Roof slope - (degrees)

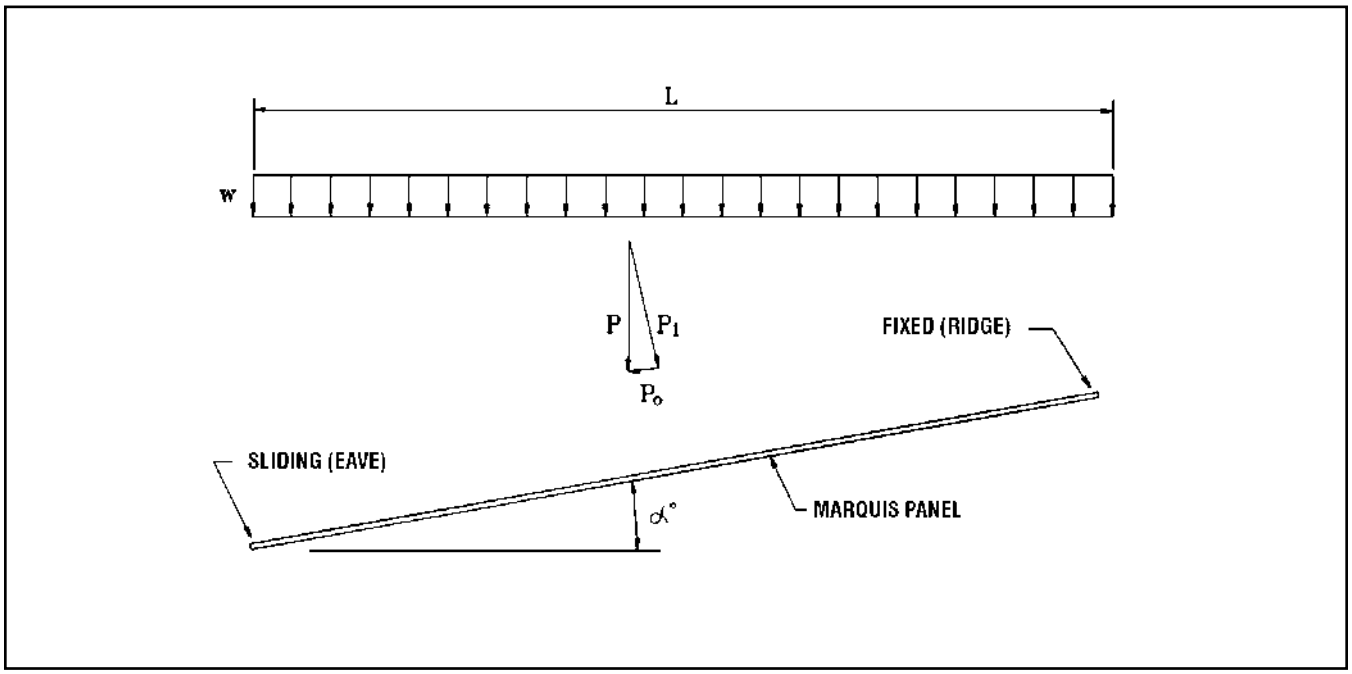


Figure 1 - Sliding Force due to Gravity Load

Given:

Gravity Load	= 45 psf
Roof Length (plan)	= 30 ft.
Roof Slope	= 14 degrees (3:12)
$\mathbf{P_o}$	= (30) (45) (sin 14°)
	= 327 lbs./ft.

THERMAL MOVEMENT

(Thermal Calculation)

The thermal expansion formula for steel is as follows:

Metric: $\Delta_1 = (11.7 \times 10^{-6})(L_1)(T_1)$

Imperial: $\Delta_2 = (6.5 \times 10^{-6})(L_2)(T_2)$

where;

- L_1 = maximum length of roof sheet in millimetres
- L_2 = maximum length of roof sheet in inches
- T_1 = maximum temperature variation in degrees Celsius
- T_2 = maximum temperature variation in degrees Fahrenheit
- Δ_1 = thermal movement in millimetres
- Δ_2 = thermal movement in inches

RIDGE FLASHING

Laboratory testing has been conducted to check the repeated flexing that a typical ridge flashing can handle without cracking. Based on the geometry shown in Figure 2, the flashing can handle a repeated bending range of approximately plus or minus 10 degrees.

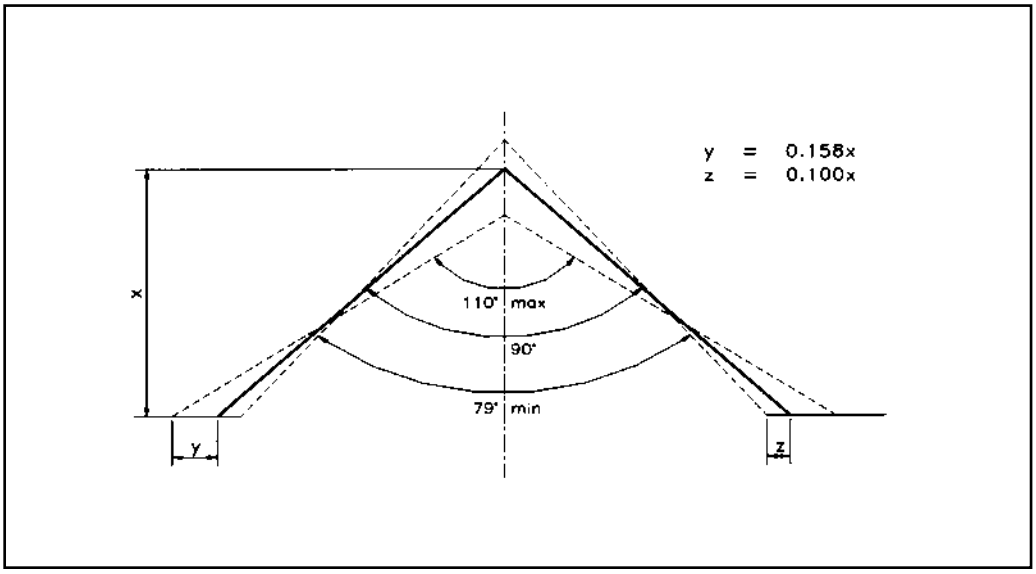


Figure 2 - Allowable thermal movement for "V" flashing

A table has been created to show permitted thermal movement based on the geometry shown on Figure 2.

TABLE FOR PERMITTED THERMAL MOVEMENT

IMPERIAL (INCHES)		
X	Y	Z
0.5	0.08	0.05
1.0	0.16	0.10
1.5	0.24	0.15
2.0	0.32	0.20
2.5	0.40	0.25
3.0	0.47	0.30
3.5	0.55	0.35
4.0	0.63	0.40

METRIC (MILLIMETRE)		
X	Y	Z
15	2	2
25	4	3
40	6	4
50	8	5
65	10	7
75	12	8
90	14	9
100	16	10

If a greater amount of movement is required a sliding flashing connection may be required as shown in Figure 3.

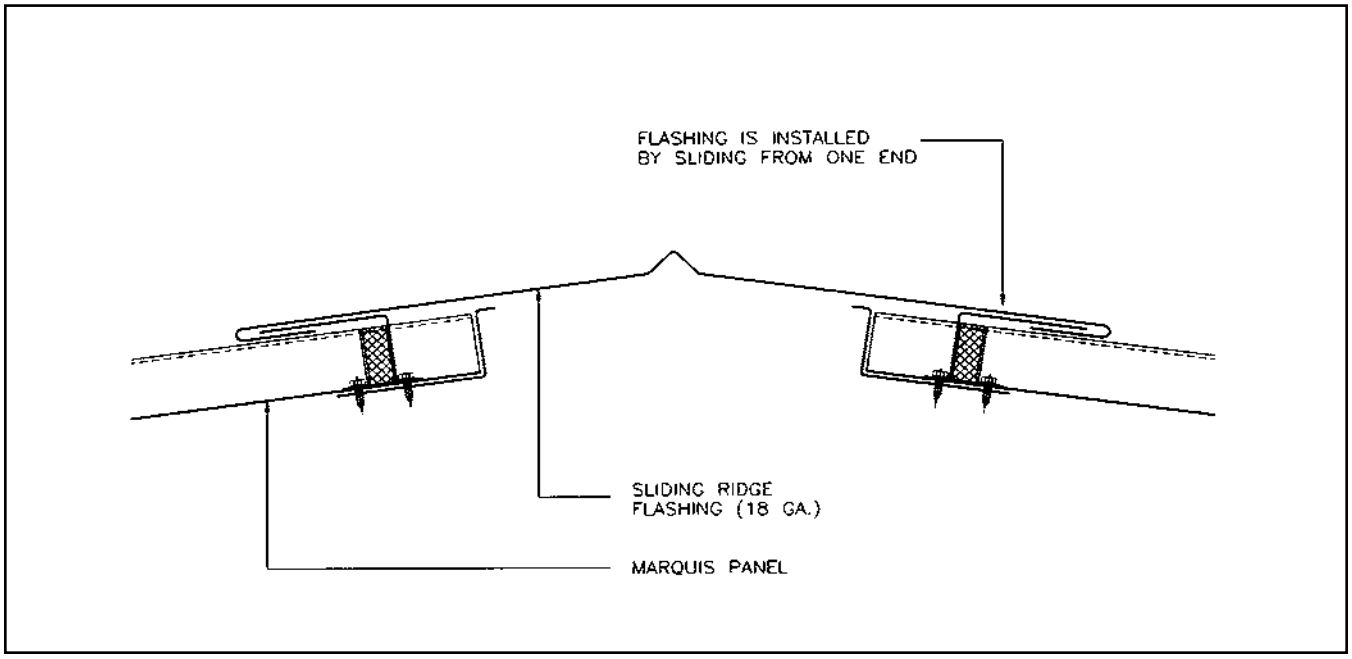


Figure 3 - Sliding ridge flashing

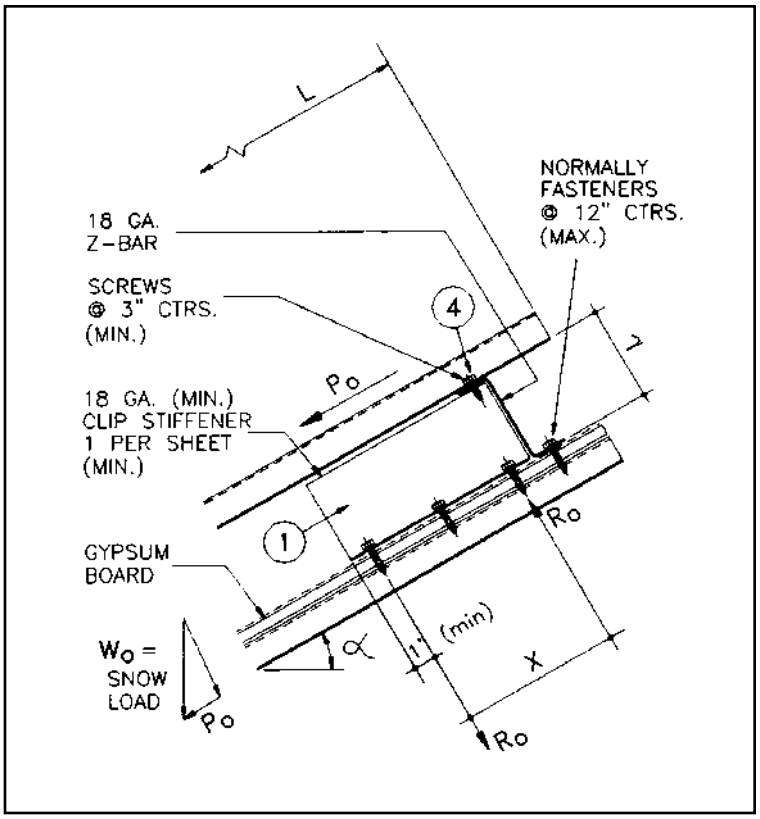
MARQUIS DESIGN PROCEDURE

(For Stiffeners At Eave)

(a) MARQUIS BASIC DESIGN EQUATIONS

1. Table for Pull Out and Shear of #14 Type AB S.M.S.

METAL DECK THICK ▼	ALLOW PULL (R_O) OUT (lbs.) ▼	ALLOW SHEAR (lbs.) ▼	ALLOW SHEAR 1/2" Gypsum Bd. belw. Shts. (lbs.)
.030" (.76 mm)	105	261	142
.036" (.91 mm)	138	345	221
.048" (1.22 mm)	190	500	339
.060" (1.52 mm)	242	541	406



① CLIP SPACING IN FEET:

$$Z_{0(max.)} = \frac{2\,P_0}{S\,W_V} \leq 4.0'$$

② $P_0 = (\,L\,)\,(SIN\,\alpha)\,(COS\,\alpha)\,(W_0)$

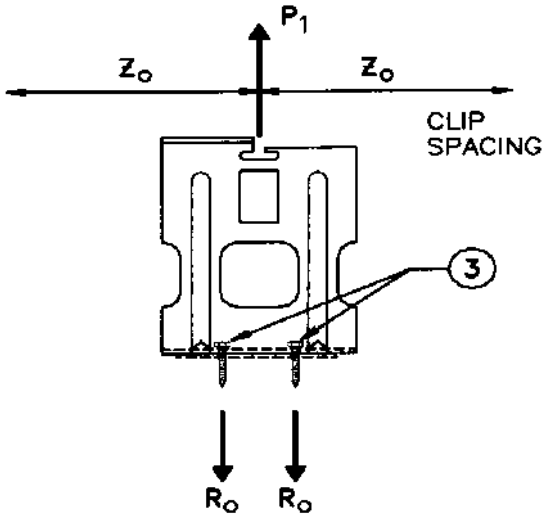
③ $X = \dfrac{(\,P_0\,)\,(\,\gamma\,)}{R_0}$

④ 24 GA. = 228 LBS / SCREW (Allow. R_0)

where S= 1.5 for Marquis 450
= 2.0 for Marquis 600

▼ S.F. = 3.0 (Allow. R_0)

L = Sloped Sheet Length (ft.)
W_0 = Snow Load on roof (psf)
W_V = Wind Uplift (psf)



DESIGN EXAMPLE

GIVEN:

(1) L = 65'-0" γ = 3"
(2) W_S = 37 psf (ROOF SNOW LOAD)
W_V = 30 psf (WIND UPLIFT)
(3) α = 18°
(4) METAL DECK - RD938, 22 Ga.
(5) MARQUIS 450, 24 Ga.

DESIGN:

(a) CLIP SPACING
(b) PROP AND SCREW REQUIREMENTS

SOLUTION:

(a) CLIP SPACING

① Z_0 = MAX. $\frac{2\ R_0}{S\ W_V} \leq 4.0'$

MAX. $\frac{2 \times 105}{1.5 \times 30} \leq 4.0'$

Z_0 = 4.0'
∴ USE @ 4'-0" CTRS.

(b) **STIFFENER ANGLE AND SCREW REQUIREMENTS**

② $P_0 = (L)\ (SIN\ a)\ (COS\ a)\ (W_S)$
$P_0 = (65)\ (SIN18°)\ (COS\ 18°)\ (37)$
$P_0 = 707$ P.L.F.

③ $X = \frac{(P_0)\ (\gamma)}{R_0}$

$X = \frac{(\ 707\ )\ (\ 3\ )}{105} = 20.2"$

∴ MAKE CLIP 24" LONG (18 GA.) SPACED @ 12" CTRS. MAX.

CHECK SHEAR AT CLIP
ALLOW. SHEAR, 22 Ga. = 261 LBS.
(See Table 1)

$\therefore = \frac{707}{261} = 2.71$

∴ USE 3 SCREWS PER CLIP

④ **CHECK SHEAR AT POINT ①**

$\therefore = \frac{707}{228} = 3.10$

∴ USE 4 SCREWS PER FT. WIDTH
= 6 SCREWS / PANEL

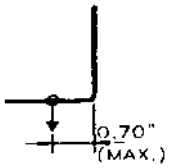
CHECK PULL FORCE AT ANGLE CLIP

$t = \sqrt{\frac{6M}{f\ b}}$

b = 6" f = 33,000 psi
M = 105 x .70 = 73.5 IN. LBS.

$t = \sqrt{\frac{6 \times 73.5}{6 \times 33000}} = .0471"$

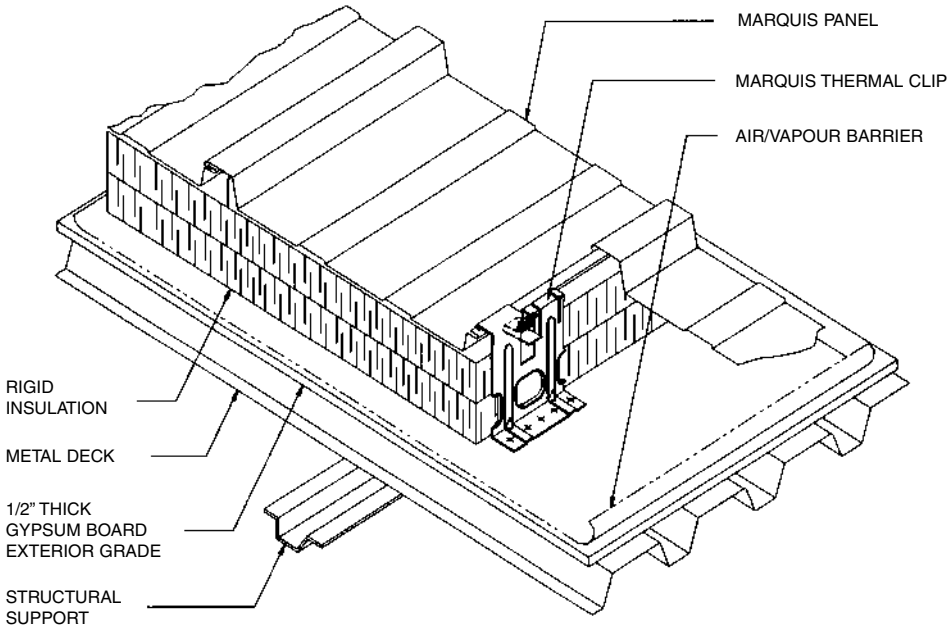
= .0471" < .048" ∴ OK
(USE 18 GA.)



Marquis Insulated Roof System

MARQUIS SYSTEM 3000

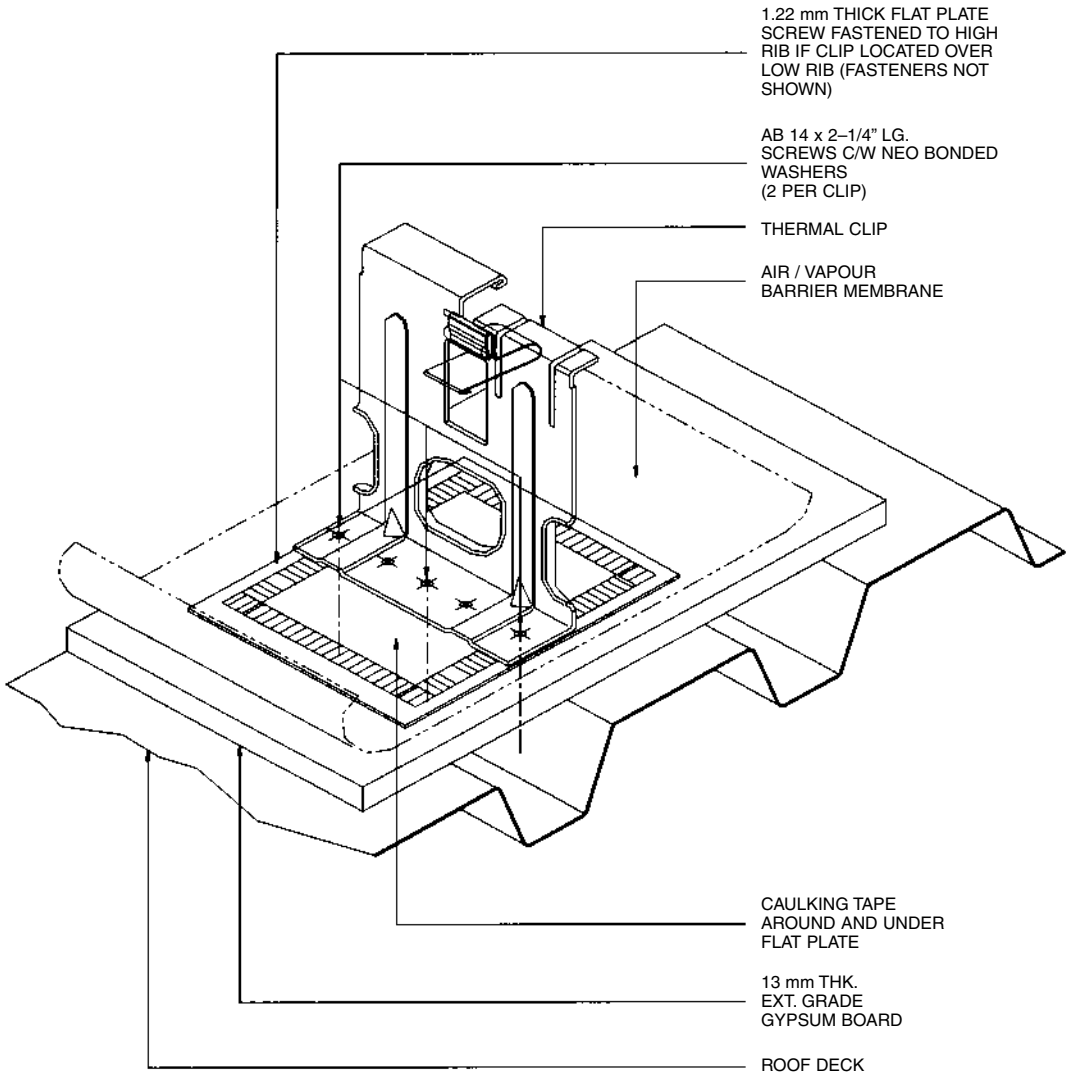
Marquis roof cladding system may be used in various design situations; however, the most typical insulated design is shown below, which is relatively simple to construct and economical to install.



THERMAL CLIP

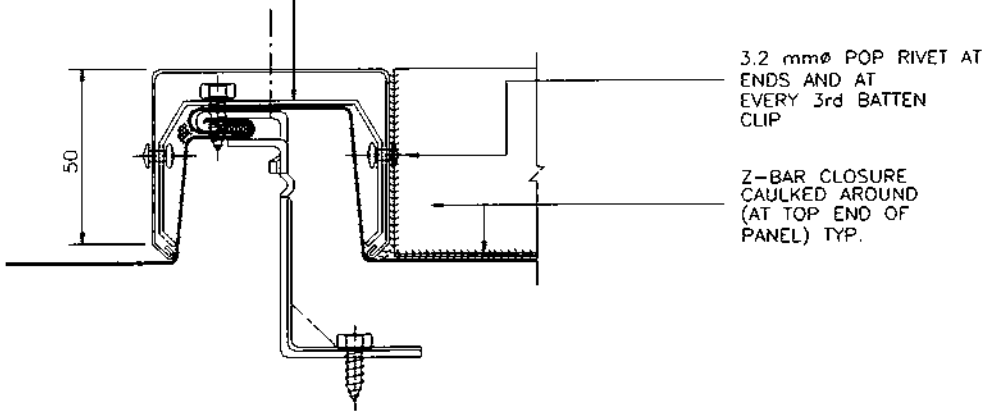
The thermal clip serves as the anchorage for the panel. For compatibility with panel material thickness, the following clip thickness should be used:

MARQUIS PANEL THICKNESS (mm)	THERMAL CLIP THICKNESS (mm)
0.46	1.52 (Clips are heavier for better fit)
0.61	1.52
0.76	1.22
0.91	1.22

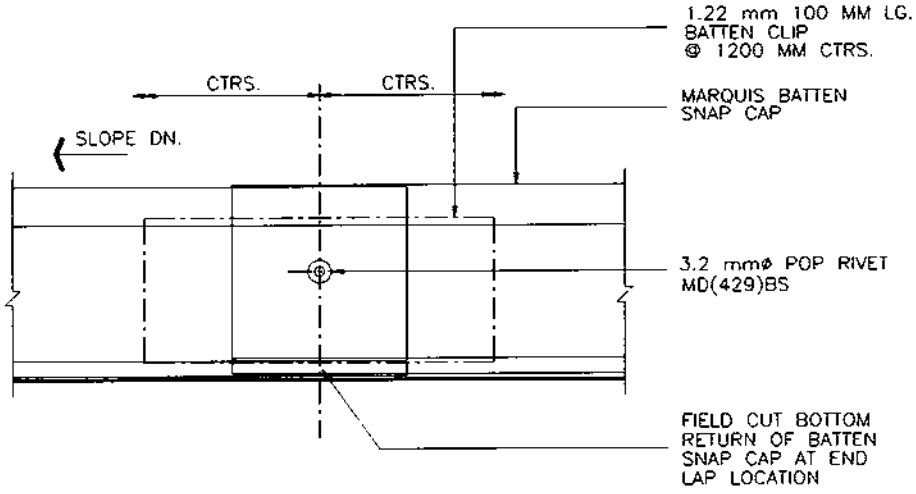


TYPICAL THERMAL CLIP DETAIL
(Plate as required)

SPACING (mm)	MAX. WIND UPLIFT (KPa)
1200	1.2
900	1.5
600	2.0

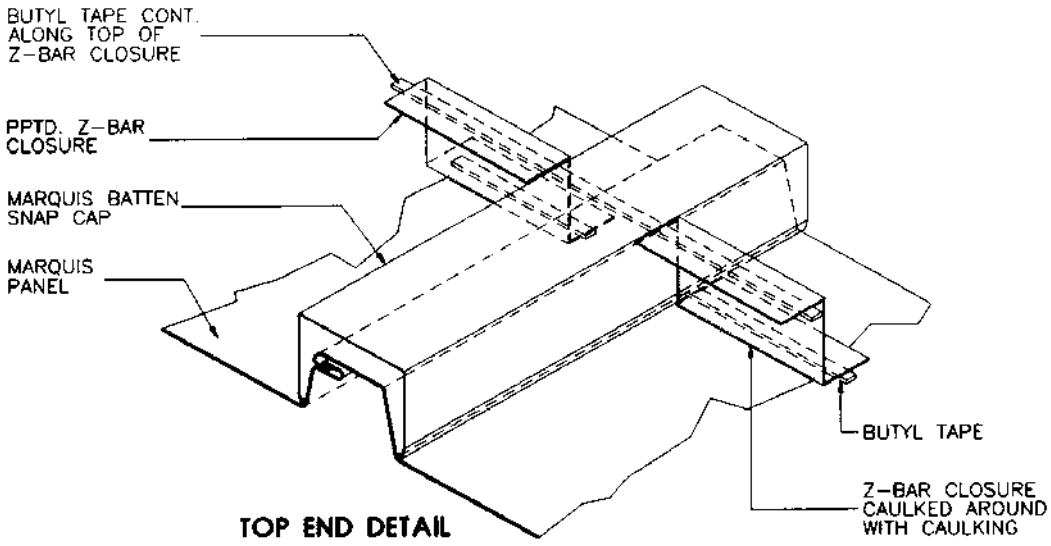


BATTEN SECTION

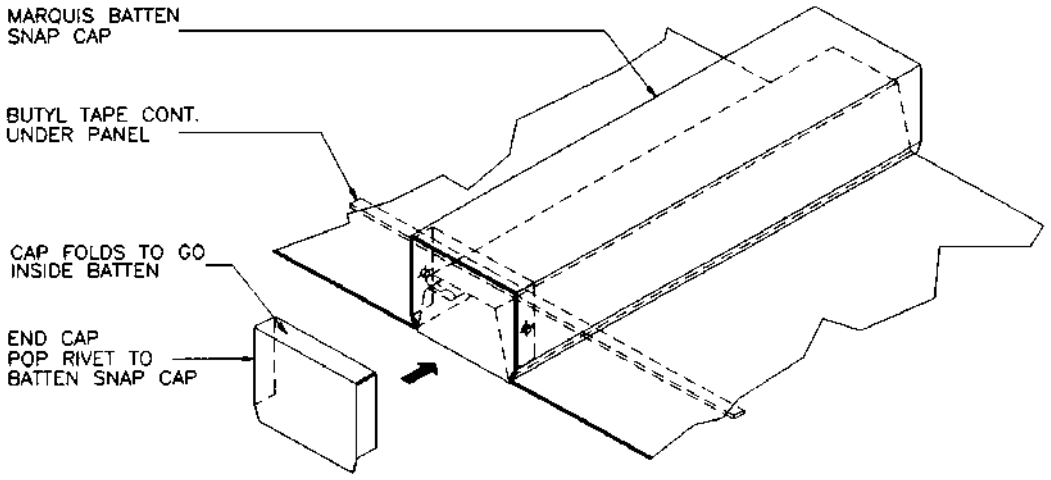


CLIP SPACING

BATTEN SNAP CAP DETAILS
(For roof slopes less than 2:12)

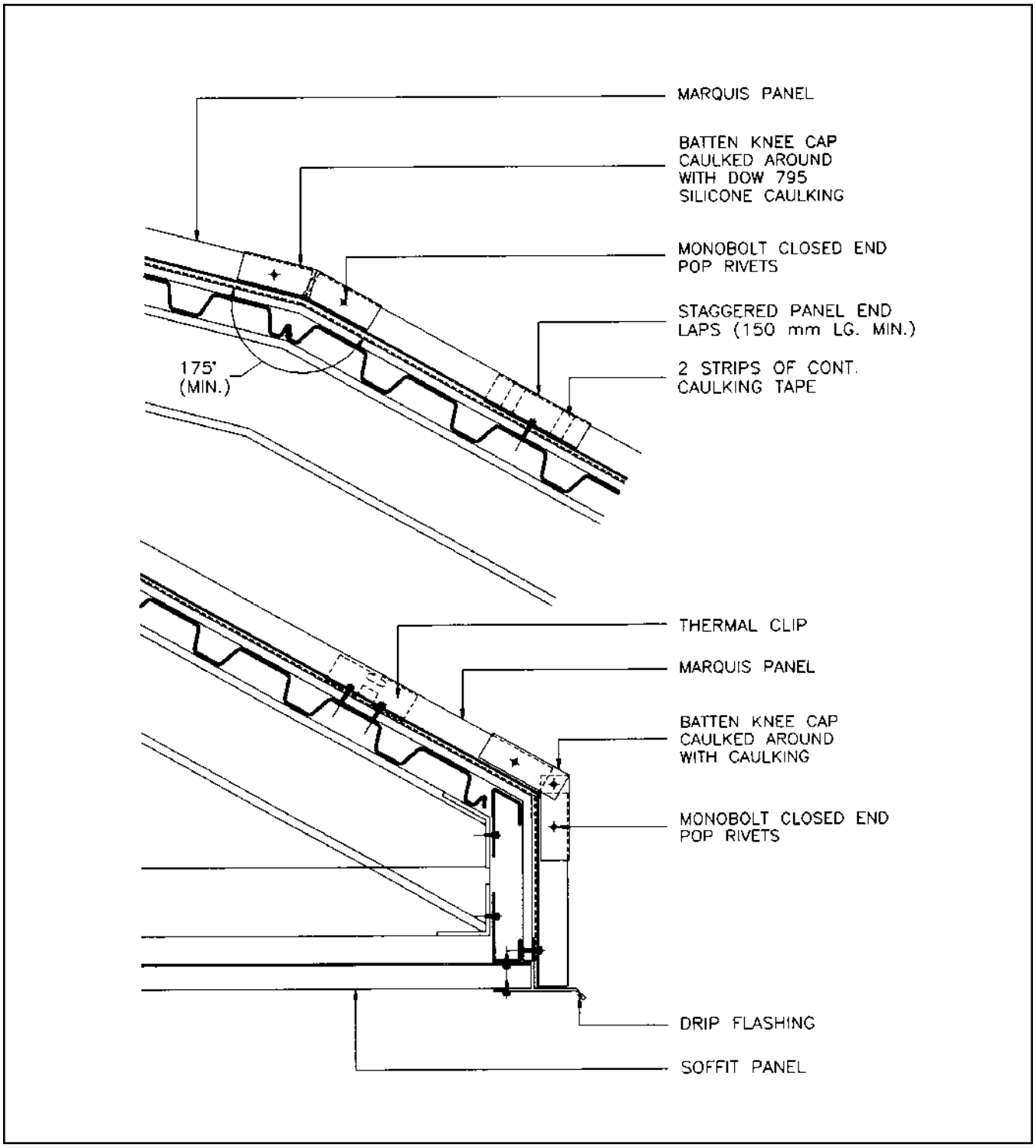


TOP END DETAIL

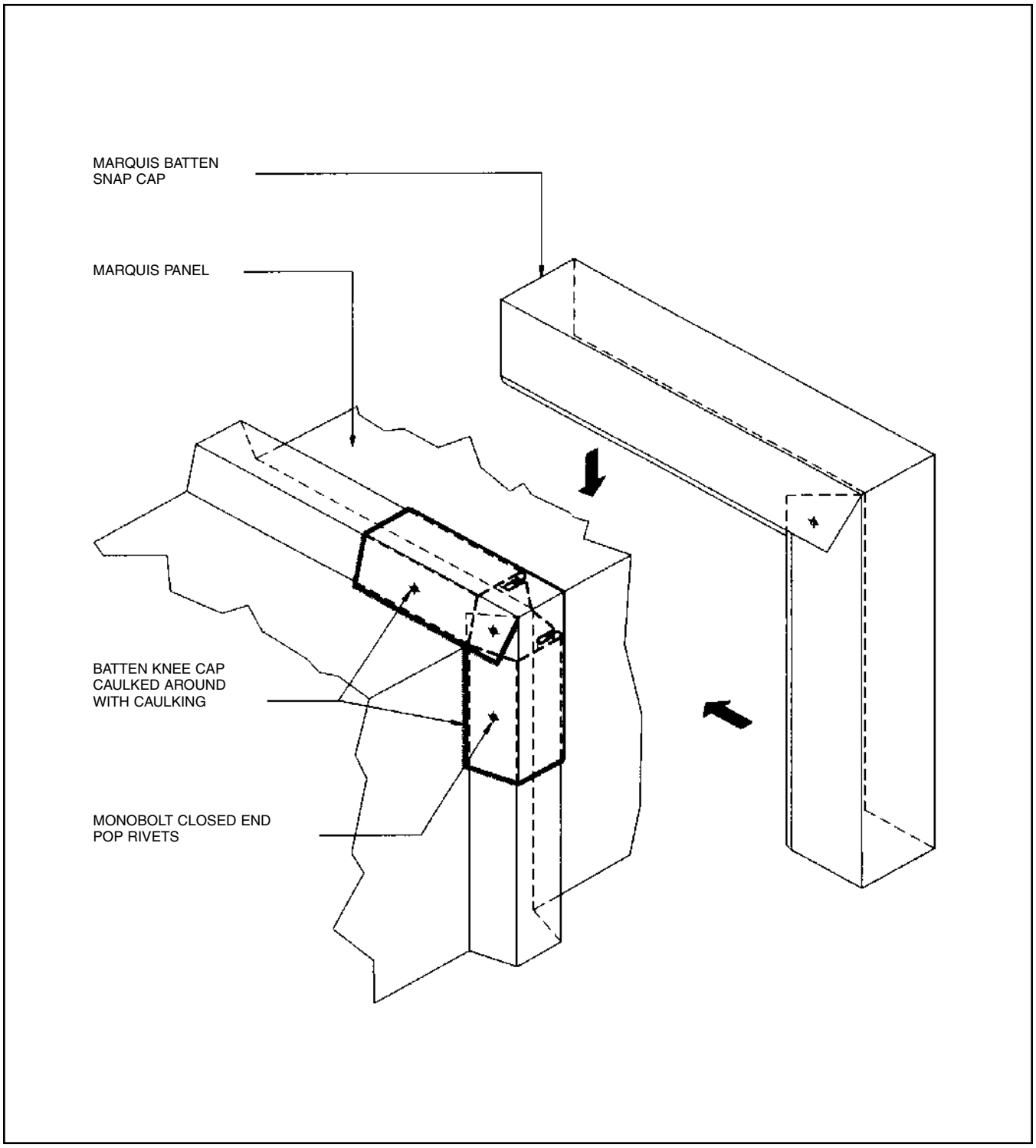


BOTTOM END DETAIL

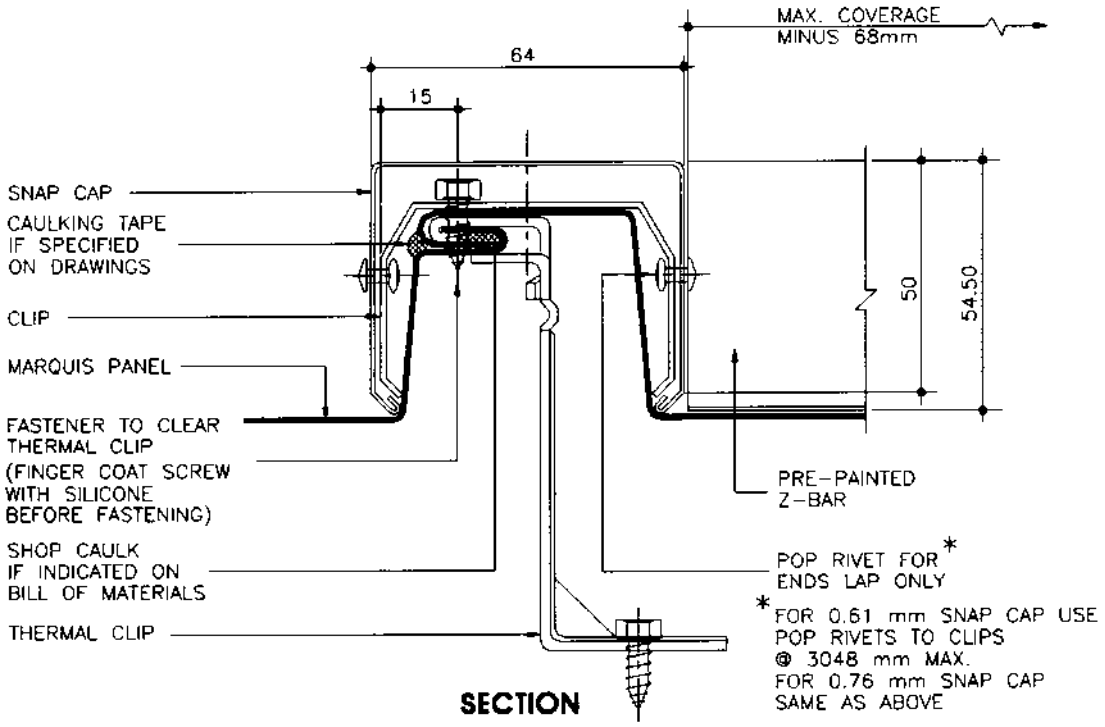
TOP AND BOTTOM END DETAIL OF PANEL SNAP CAP



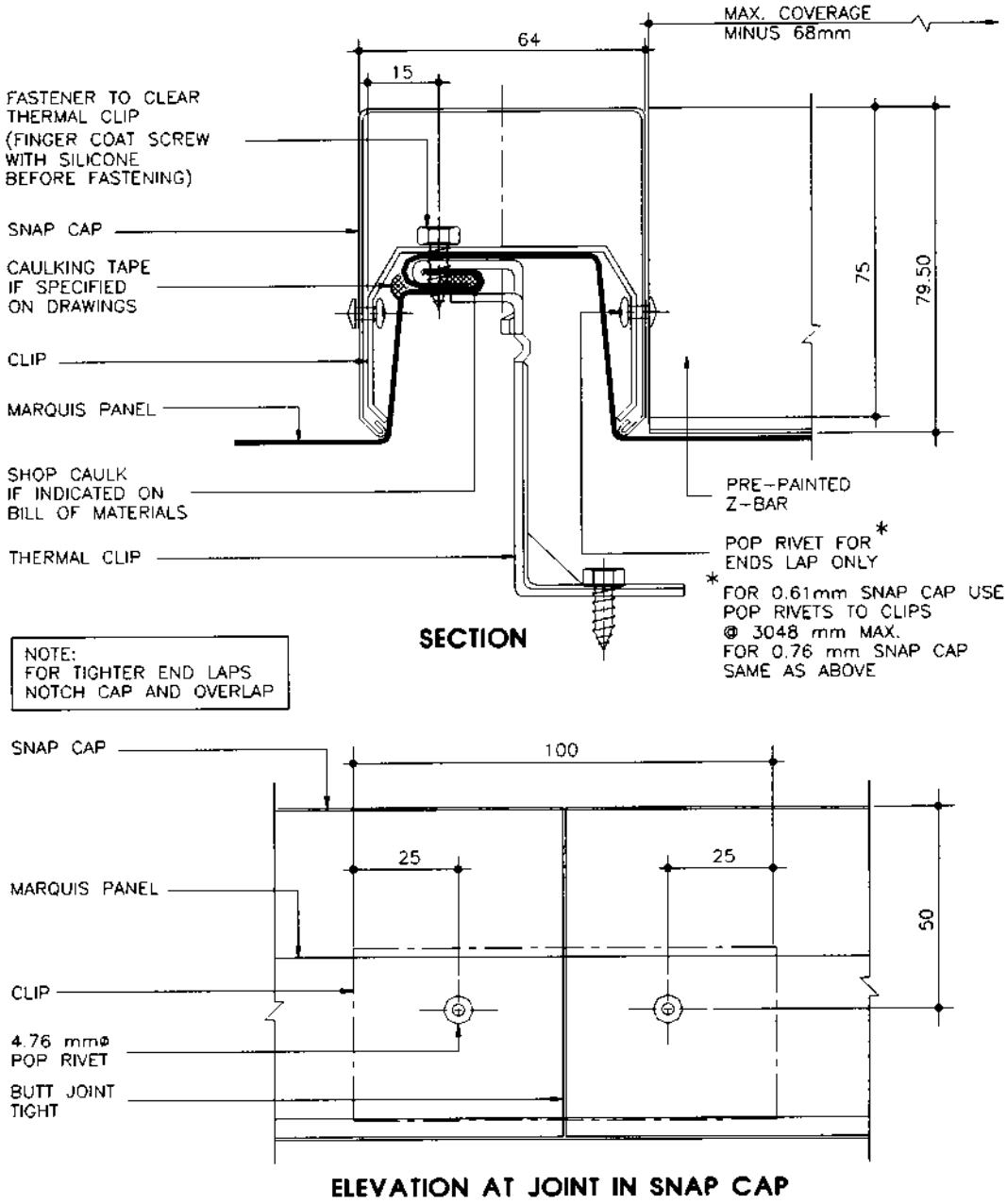
MARQUIS ROOF DETAIL
WITH KNEE CAP



TYPICAL DETAIL AT MITRED JOINT



50 mm SNAP CAP DETAIL



75 mm SNAP CAP DETAIL

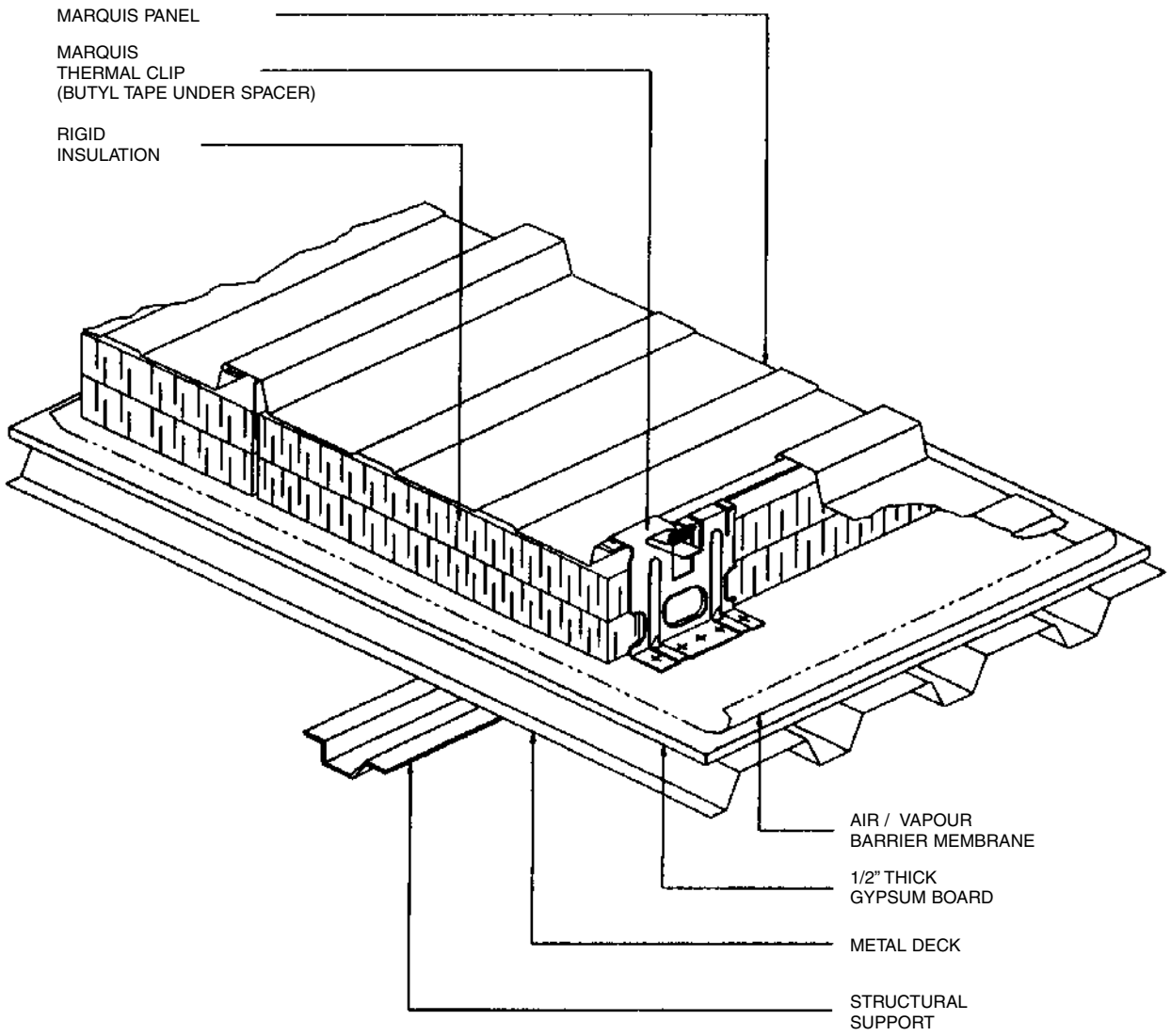
Typical Details For Insulated Marquis

Marquis Roof System is versatile enough to accommodate a wide variety of individual building needs.

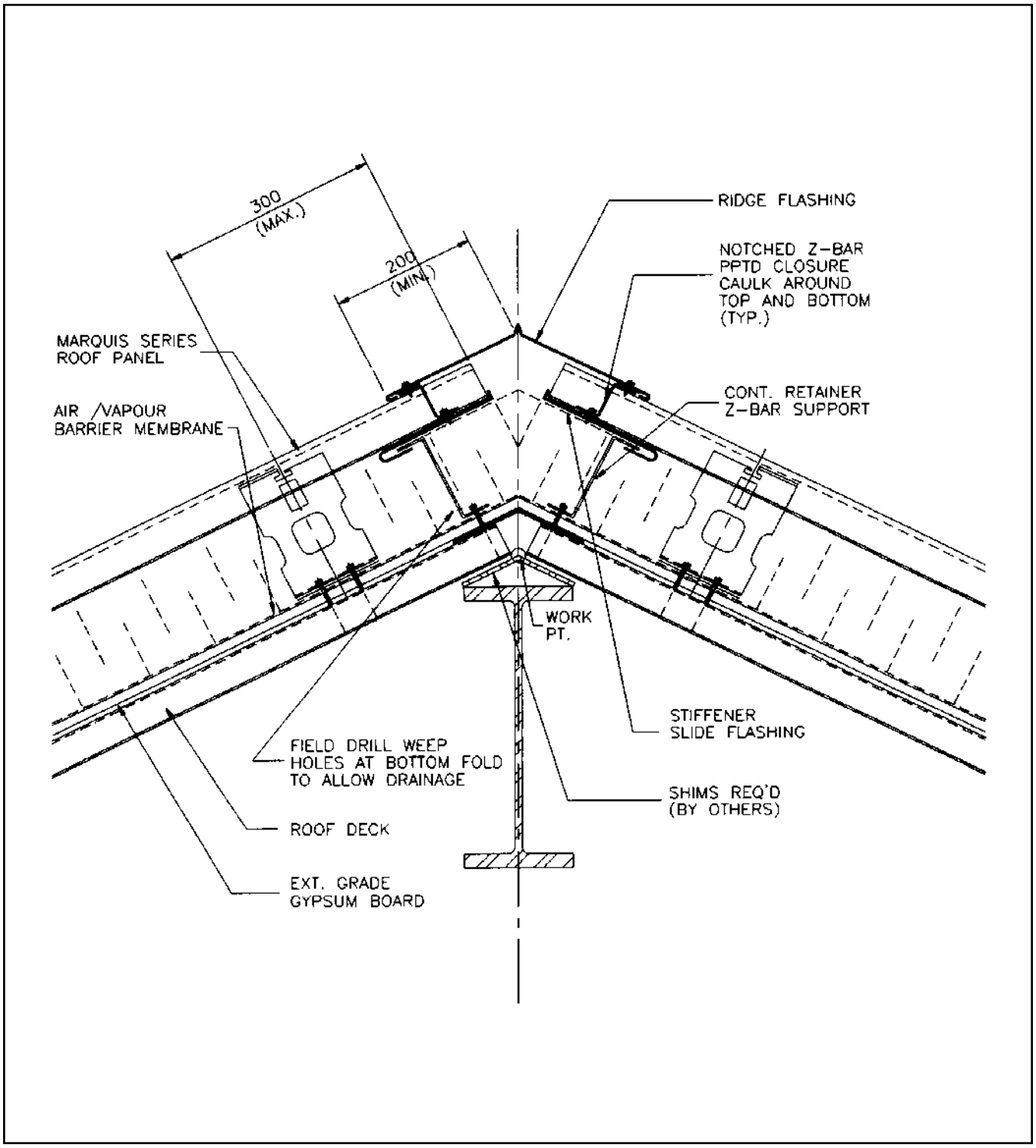
It can be combined with VICWEST long-span deck to reduce the weight and cost of the supporting structural system.

The following Details illustrate the various possibilities.

TYPICAL DETAILS FOR INSULATED MARQUIS

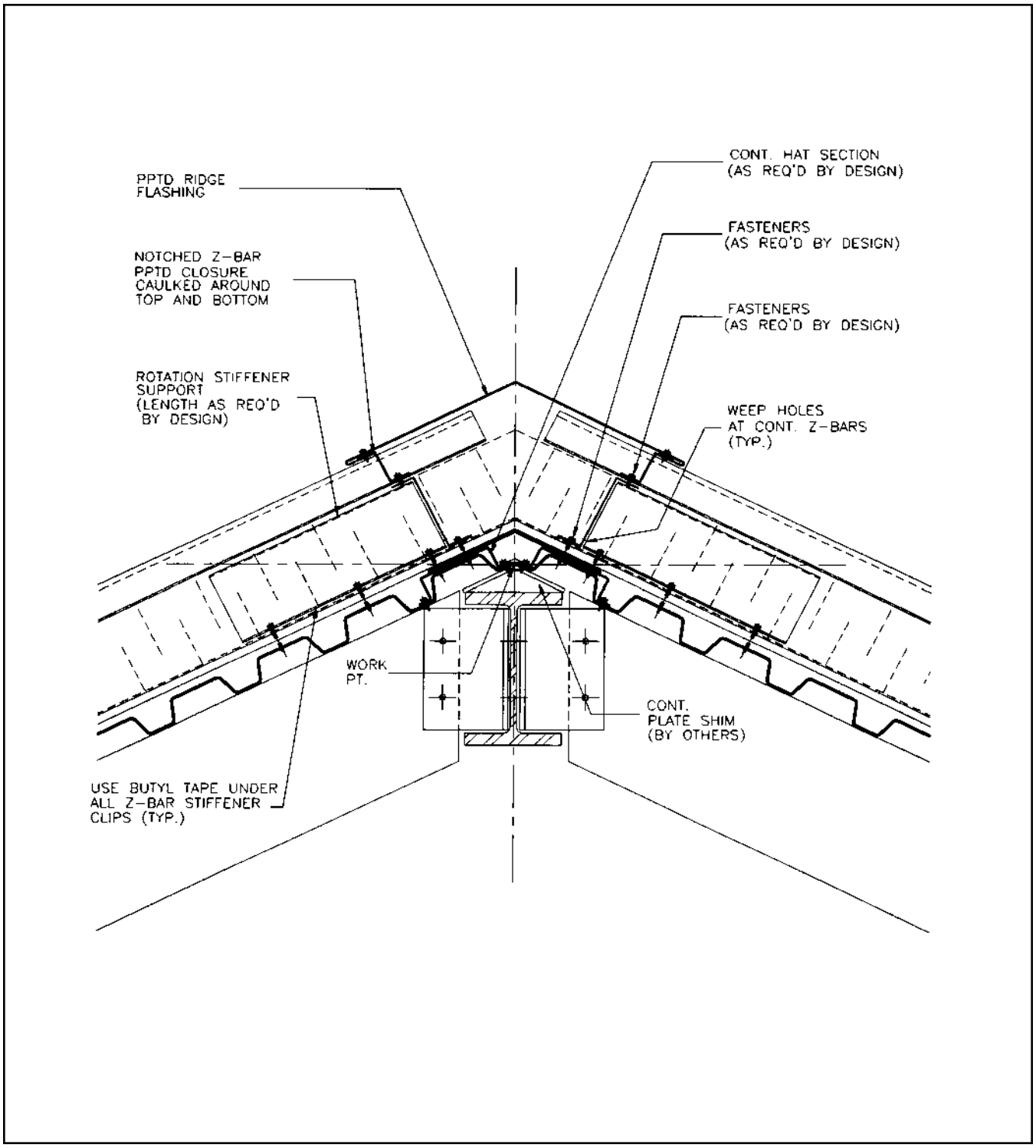


TYPICAL MARQUIS SYSTEM

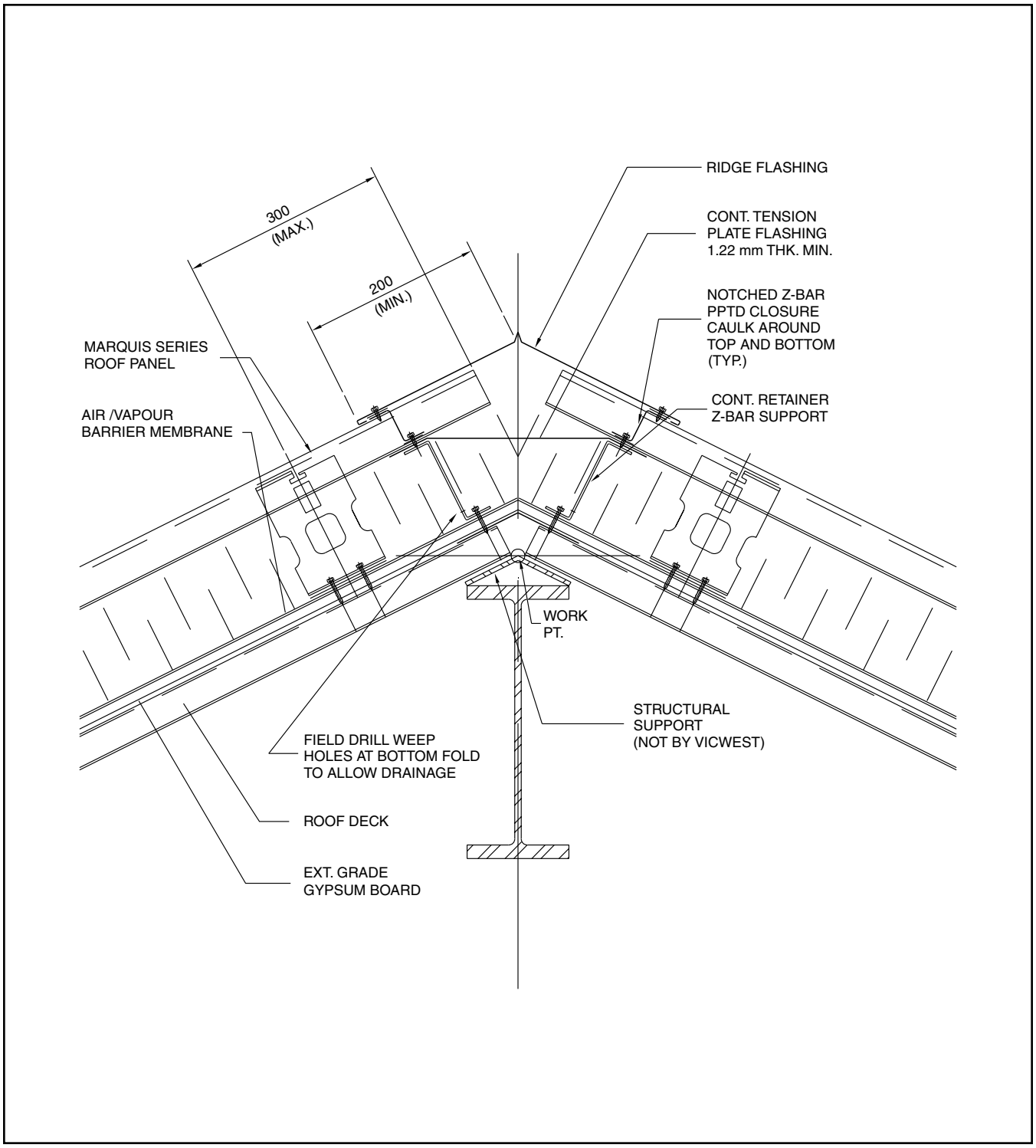


ROOF RIDGE DETAIL
(Sliding condition - panels anchored at eave)

Typical Details for Insulated Marquis

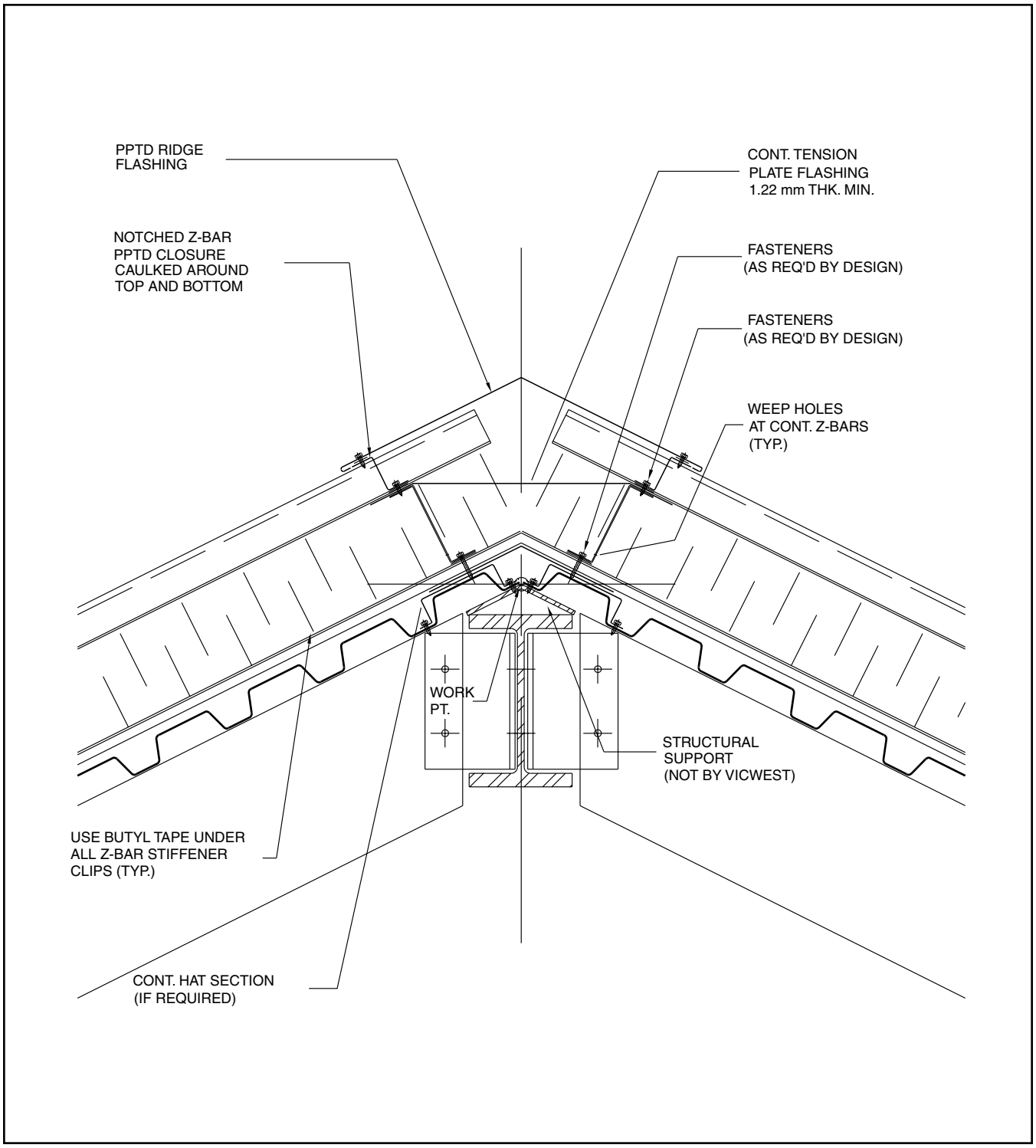


ROOF RIDGE DETAIL
(With stiffeners - panels are allowed to slide at eave)

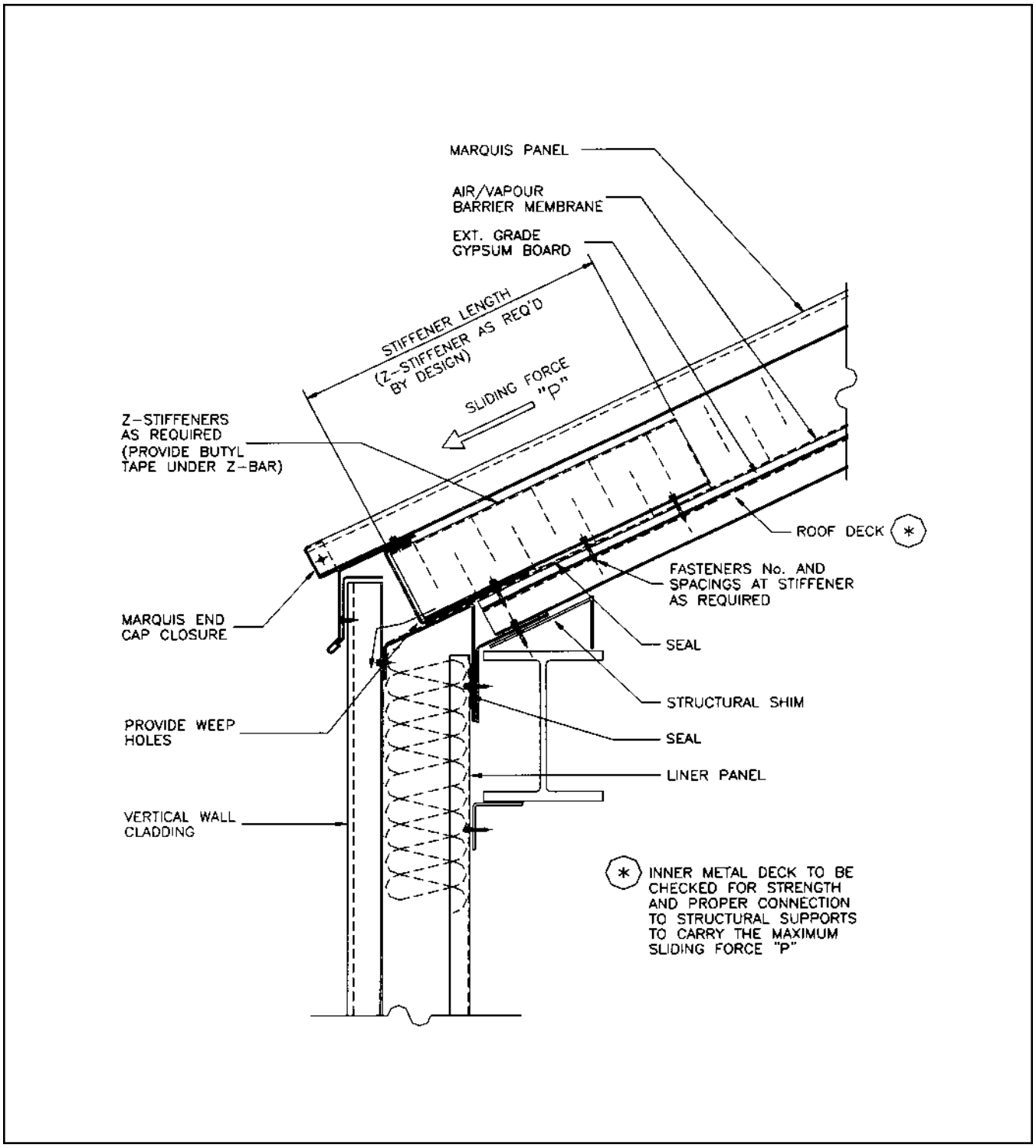


ROOF RIDGE DETAIL
(With tie strut across ridge - panels are allowed to slide at eave)

Typical Details for Insulated Marquis

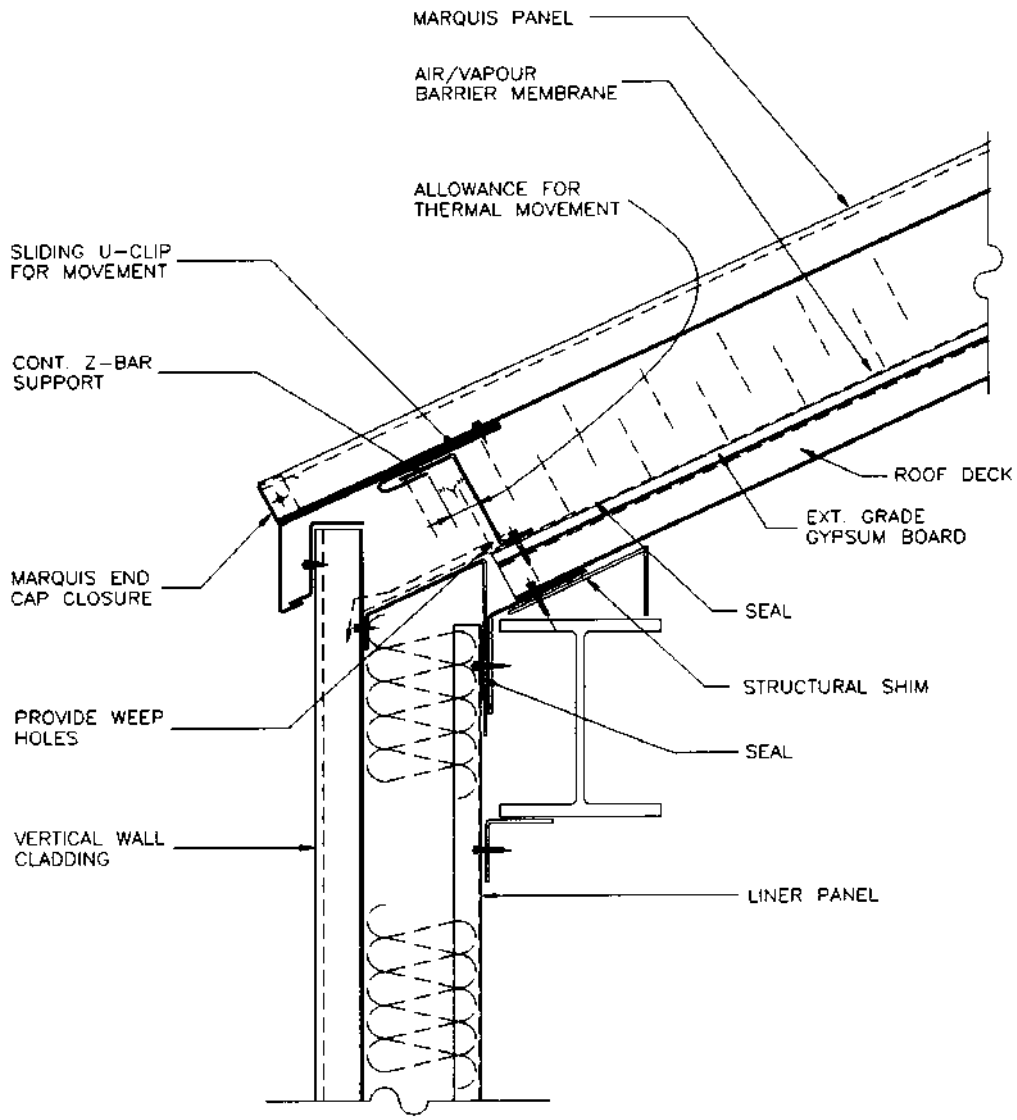


ROOF RIDGE DETAIL
(With tie strut across ridge - panels are allowed to slide at eave)

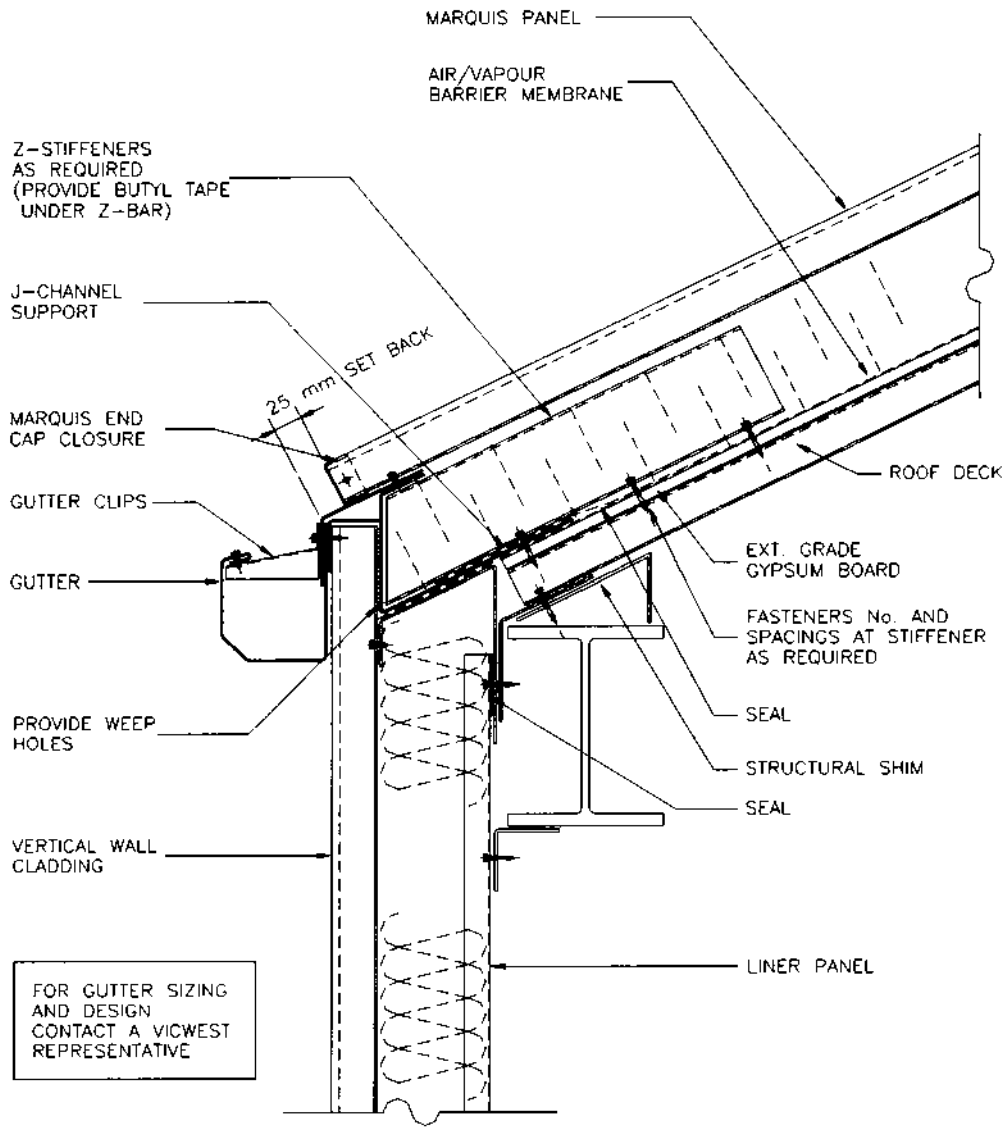


ROOF DETAIL AT EAVE
(Fixed condition - panels are allowed to slide at ridge)

Typical Details for Insulated Marquis

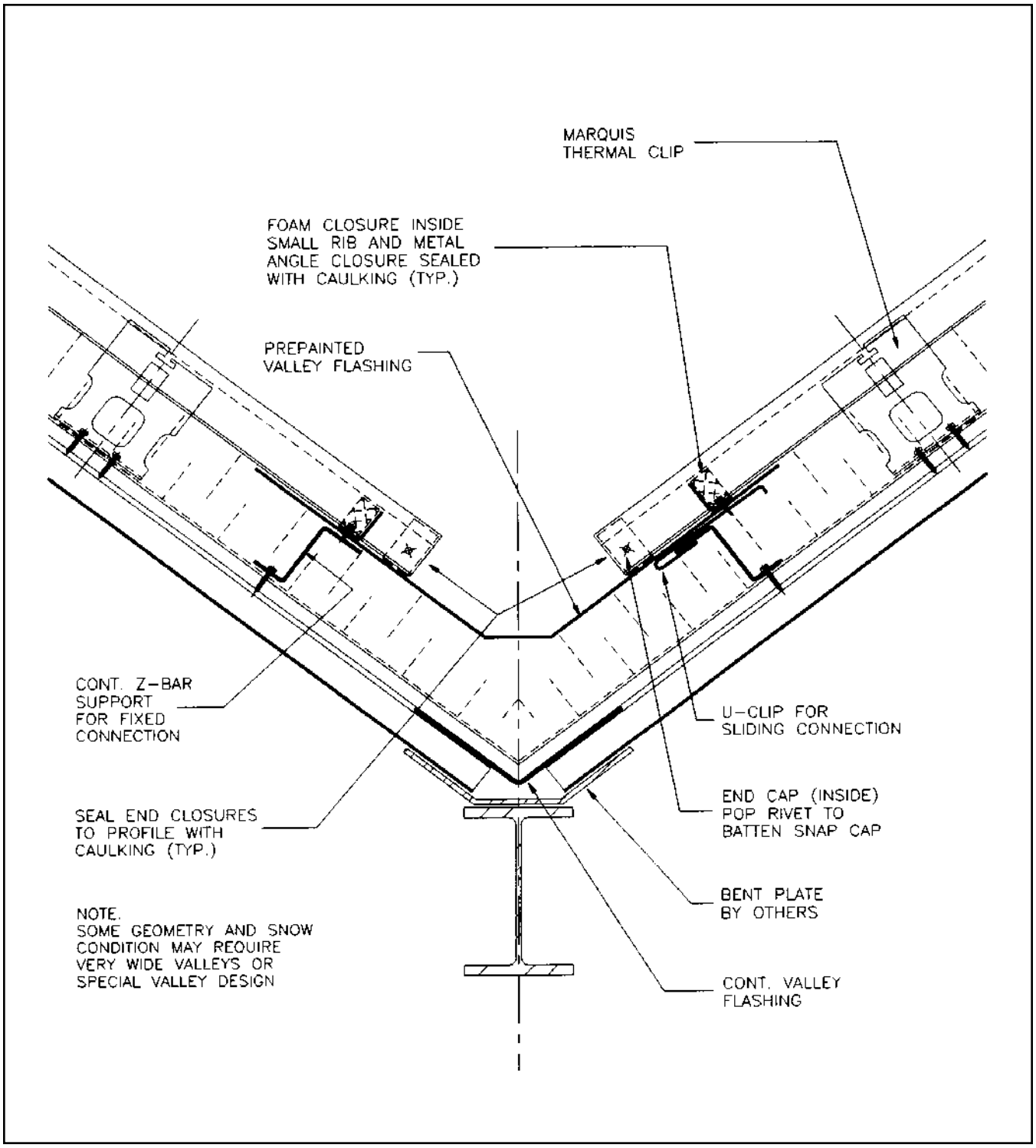


ROOF DETAIL AT EAVE
(Sliding condition - panels are fixed at ridge)

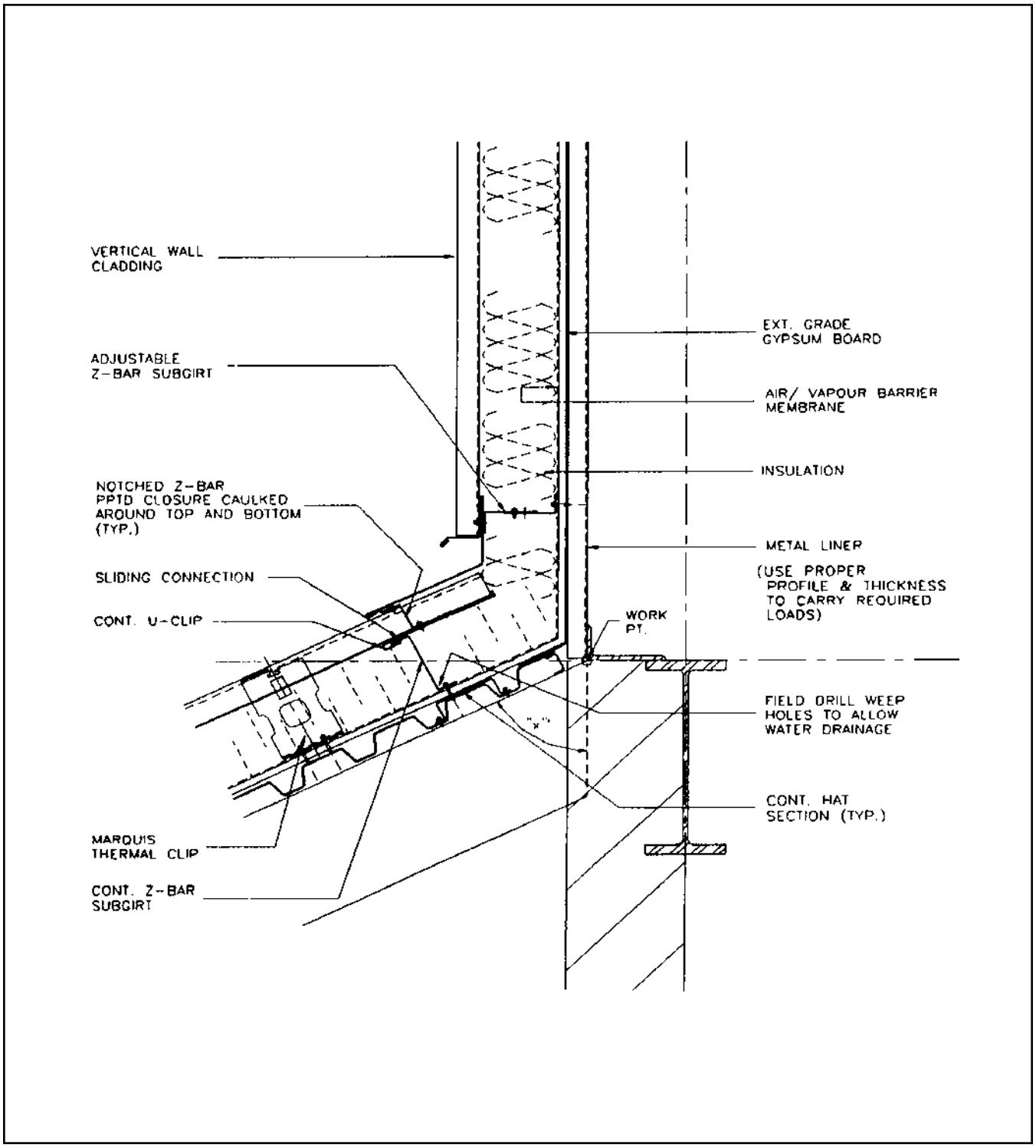


ROOF DETAIL AT EAVE
(With gutter - fixed condition)

Typical Details for Insulated Marquis

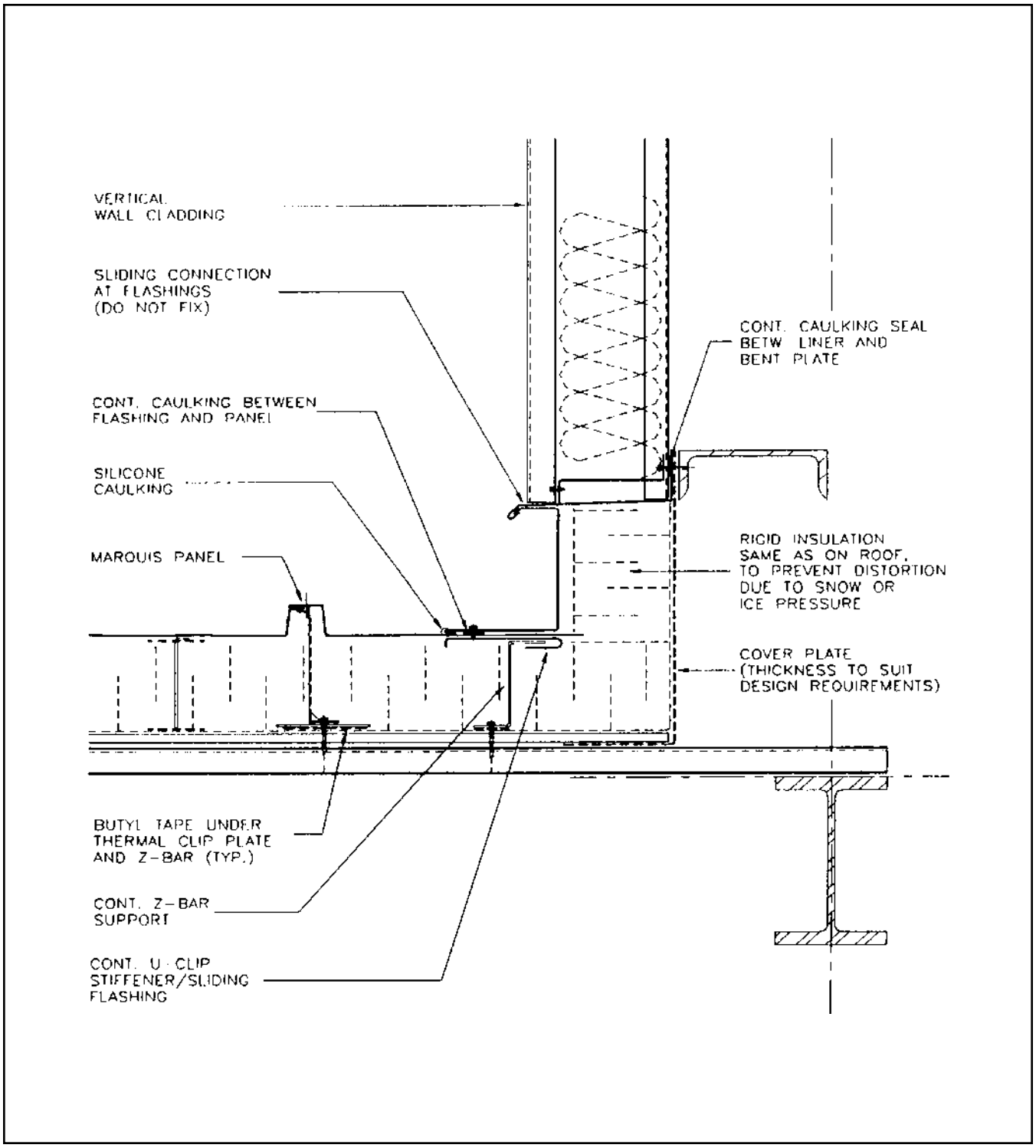


ROOF VALLEY DETAIL
(One side fixed, one side sliding condition)

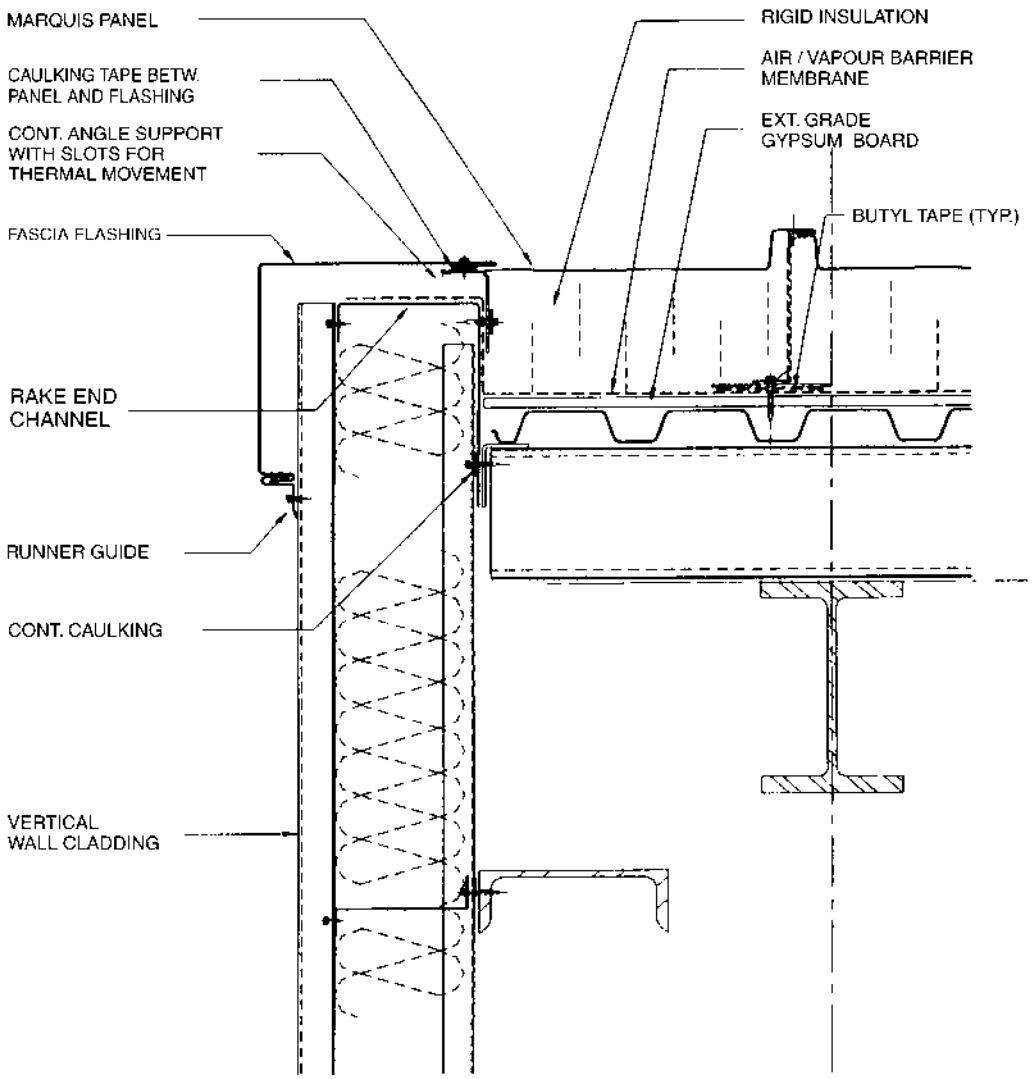


HIGH AND LOW ROOF DETAIL
(Sliding condition)

Typical Details for Insulated Marquis

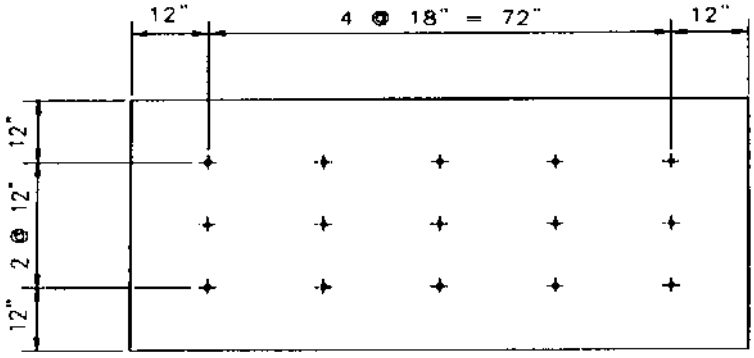


HIGH AND LOW ROOF DETAIL
(Sliding condition)

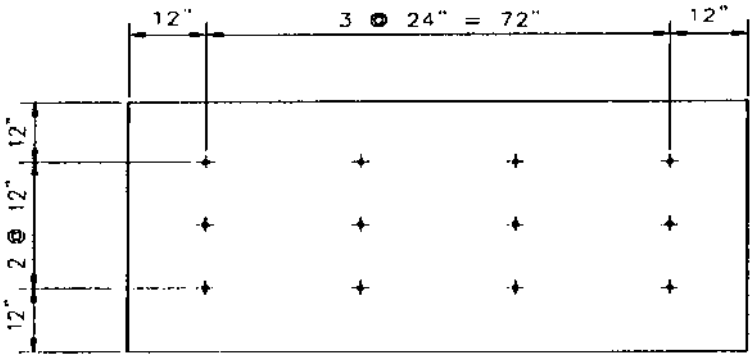


ROOF END DETAIL

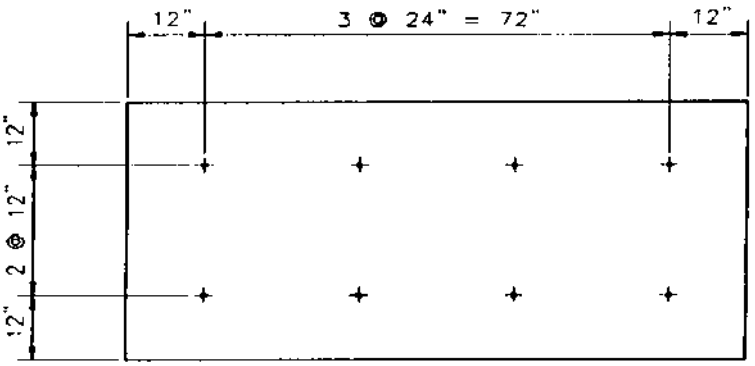
Typical Details for Insulated Marquis



UPLIFT ≤ 38 PSF
15 FASTENERS /BOARD



UPLIFT ≤ 30 PSF
12 FASTENERS /BOARD



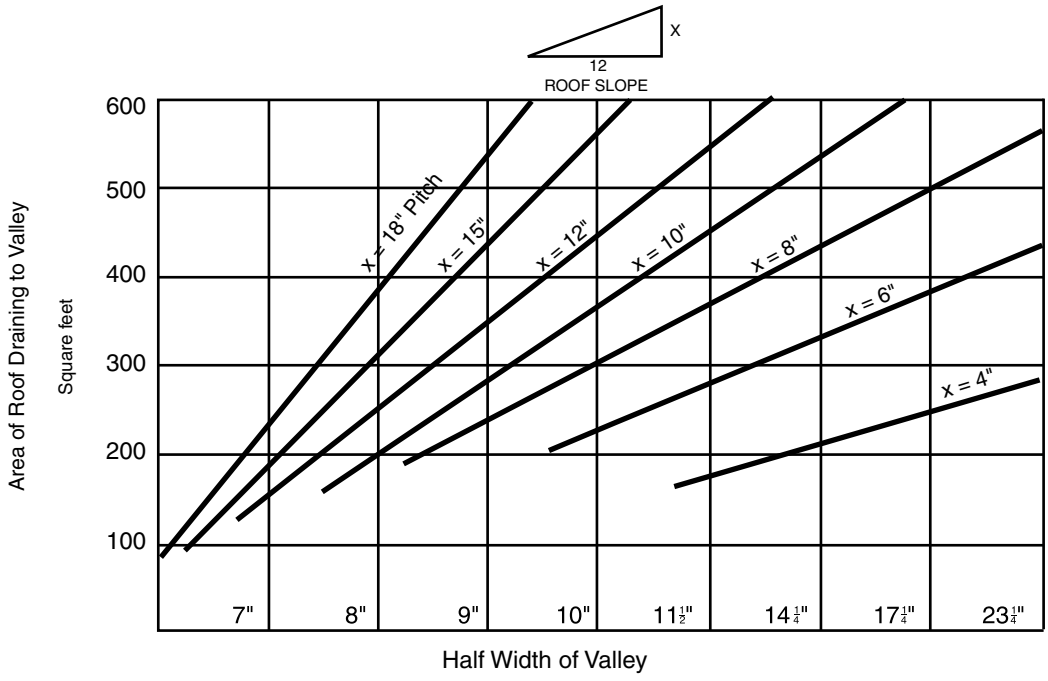
UPLIFT ≤ 20 PSF
8 FASTENERS /BOARD

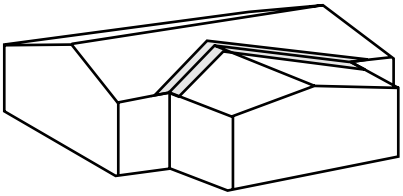
FASTENERS:
Screws (Dekfast, etc.) c/w large diameter plate washer to eliminate pull-over of fastener head anchored to 0.030" core (0.76 mm) Roof deck.

GYPSUM BOARD FASTENING TO METAL DECK

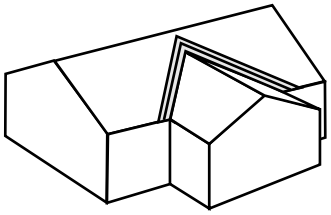
VALLEY FLASHING

MINIMUM VALLEY FLASHING SIZE

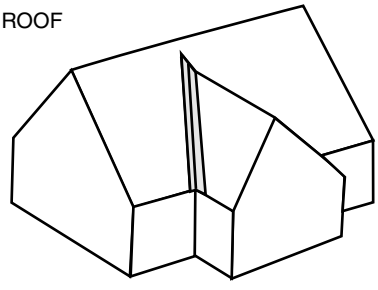




LOW PITCH ROOF



MEDIUM PITCH ROOF



STEEP PITCH ROOF

NOTE:

For roof slopes with “X” less than 4”, use max. blank size available with half valley a min. of 24”.

Significant snow or ice condition may require wider valley and local rib reinforcement when ice or snow may cross valley to damage panel on opposite side.