

# **PREFABRICATED STEEL BUILDING INSTALLATION MANUAL**





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**SECTION**

**A**

# **SITE & FOUNDATION PREPARATION**





# PREPARATION OF SITE AND FOUNDATION

## 1. General

Before the Mueller prefabricated steel building arrives, the site and foundation should be prepared. This includes leveling the terrain and constructing the foundation. Mueller buildings are typically designed to be placed on a permanent slab. A concrete contractor is highly recommended for this phase of the construction.

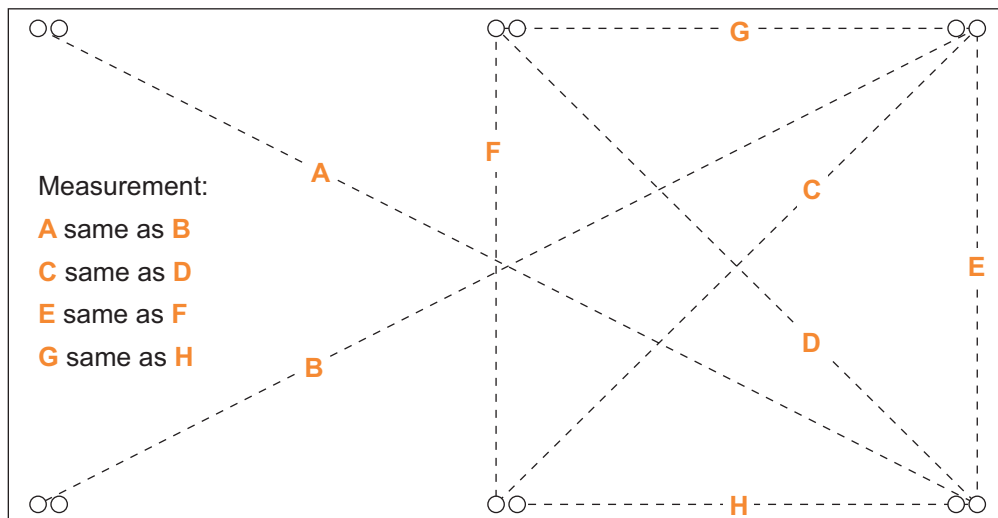
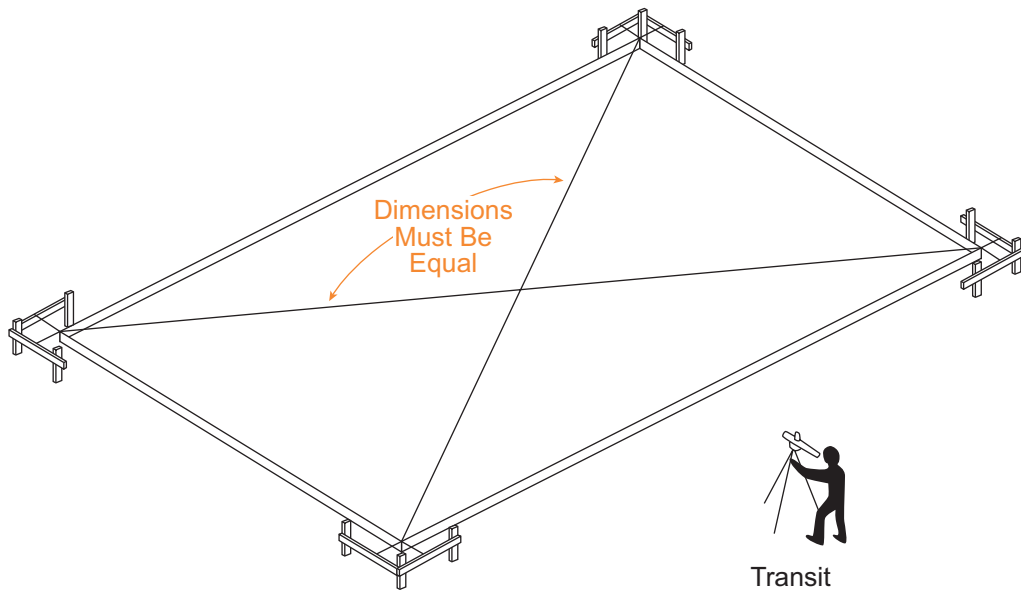
## 2. Procedural Steps

- A. Remove trees, debris, and other items from the building location.
- B. Smooth and level the ground where the foundation is to be made.
- C. Construct the foundation using the materials recommended by your concrete contractor.

**NOTE: Mueller Steel Building Systems will provide blueprints that show placement in the concrete slab. Check the anchor bolt plan thoroughly upon receipt. If you have any questions, call your Mueller Steel Building Systems Salesperson.**

## SQUARING OF FOUNDATION

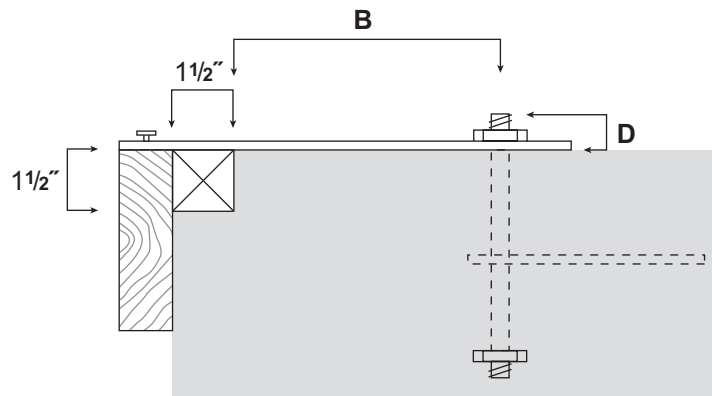
For proper building erection, it is critical the foundation is square. The following examples are suggested to ensure square foundation.



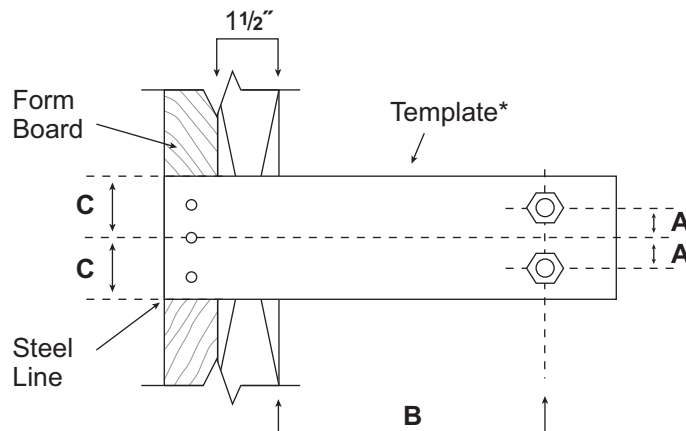


## ANCHOR BOLT SETTINGS

It is extremely important that anchor bolts be placed accurately in accordance with the anchor bolt setting plan. All anchor bolts should be held in place with a template or similar means, so they will remain plumb and in the correct location during placing of the concrete. Check the concrete forms and anchor bolt locations prior to the pouring of the concrete. A final check should be made after the completion of the concrete work and prior to the steel erection. This will allow any necessary corrections to be made before the costly erection labor and equipment arrives.



Projection of anchor bolts "D"  
given on anchor bolt plan



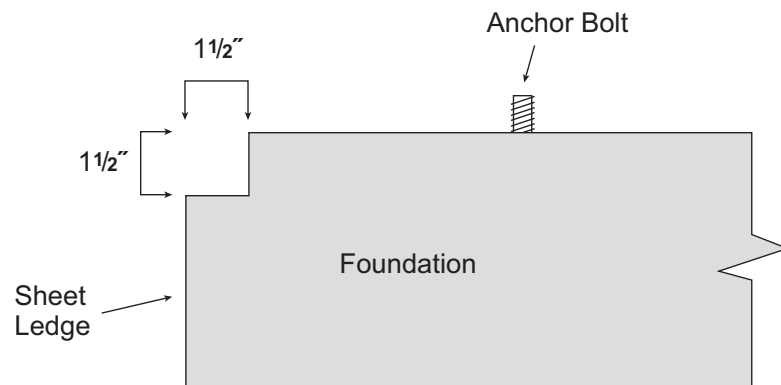
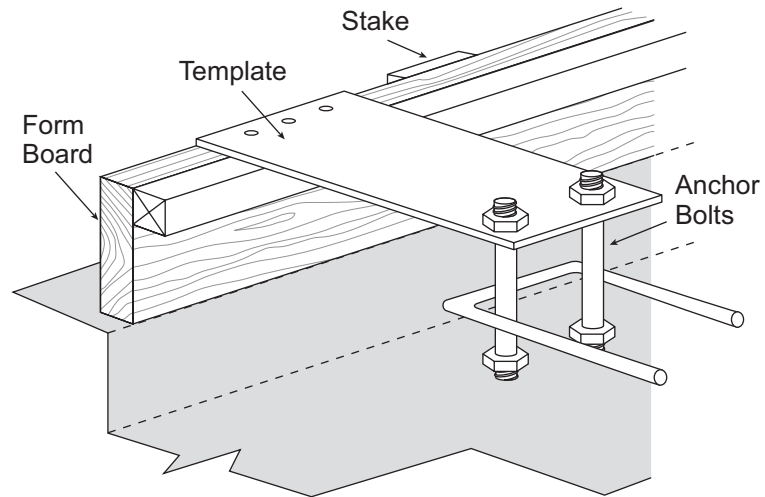
Dimension of A, B and C as  
given on anchor bolt plan

**NOTE: Measurements are from steel line to steel line.**

**\* Template not included.**

## ANCHOR BOLT SETTINGS

Refer to your anchor bolt drawing for proper sizes and dimensions.



**NOTE:** Suggested protrusion is 2 1/2" of threads above concrete.

**SECTION**

**B**

**BUILDING DELIVERY  
AND STORAGE**





## UNLOADING AND PREPARATION OF PARTS FOR ASSEMBLY

The vehicle transporting your building parts must gain access to the building site from the adjacent highway or road. Such access should be studied and prepared in advance of arrival. All obstructions, overhead and otherwise, must be removed and the access route graveled or planked if the soil will not sustain the heavy wheel loads.

A forklift or other type of power loader may be required to unload the truck and move the heavier parts to the proper locations.

When the truck arrives with the building, unload the truck promptly, stack the steel parts evenly on blocks and protect them from the weather.

Unloading and placing the steel parts of the building in the most convenient places for assembly will make the process easier and faster.

**NOTE: Prolonged exposure to the weather before assembly or stacking the steel in a haphazard way can cause the painted parts to become damaged, or the building parts to warp. Protect painted parts from moisture to prevent fading and discoloring and stack the structural steel parts so they will be straight.**

After unloading the truck and before the driver leaves, ensure that all parts have been delivered.

1. Check each part against the delivery receipt. Each part is marked for identification.
2. Sign the delivery receipt if all parts are delivered.
3. If any of the parts are missing, notify the driver and note the missing items on the delivery receipt before signing.
4. Check with your salesperson regarding the missing parts.

# UNLOADING, HANDLING, AND STORAGE OF MATERIALS

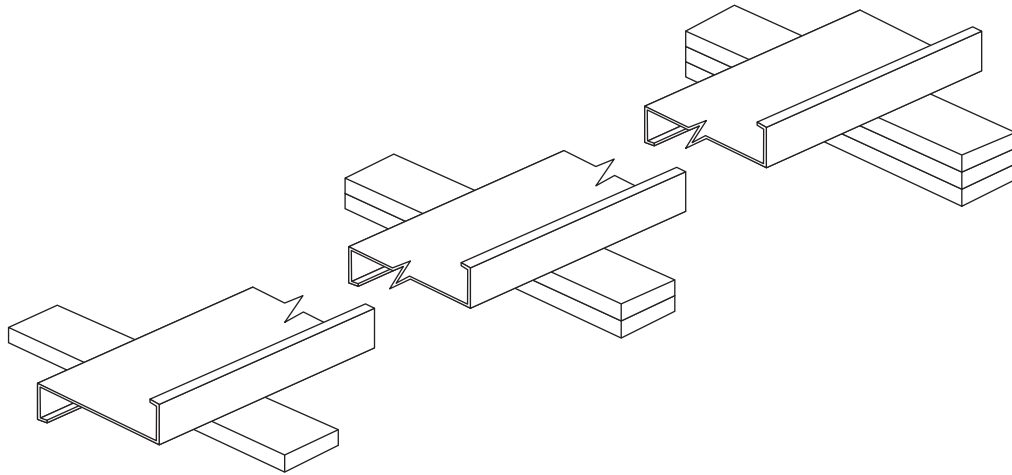
## Structure

A great amount of time and trouble can be saved if the building parts are unloaded at the building site according to a pre-arranged plan. Proper location and handling of components will eliminate unnecessary handling.

Blocking under the columns and rafters protects the splice plates and the slab from damage during the unloading process. It also facilitates the placing of slings or cables around the members for later lifting and allows members to be bolted together into sub-assemblies while on the ground. Extra care should always be exercised in the unloading operation to prevent injuries from handling the steel and to prevent damage to materials and the concrete slab.

If water is allowed to remain for extended periods in bundles of primed parts such as girts, purlins, etc., the pigment will fade and the paint will gradually soften reducing its bond to the steel. Therefore, upon receipt of a job, all bundles of primed parts should be stored at an angle to allow any trapped water to drain away and permit air circulation for drying. Puddles of water should not be allowed to collect and remain on columns or rafters for the same reason.

All primer should be touched up as required before erection.



**NOTE: Piece marks are stenciled on primary structural members.**

## LOCATION OF BUILDING PARTS

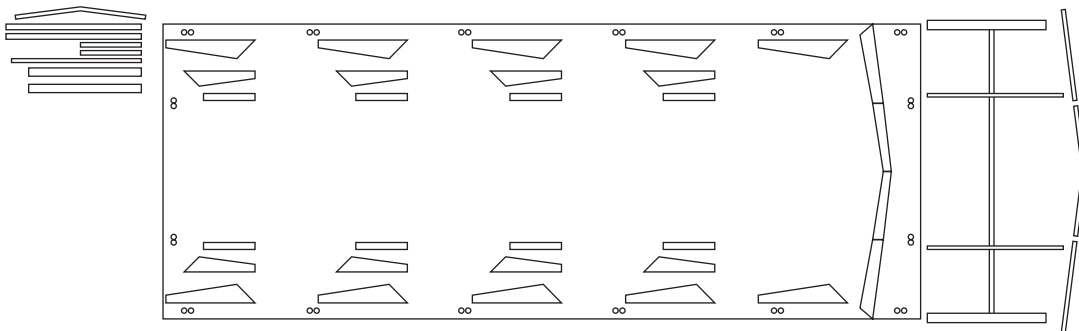
Place the parts around the foundation so they will be in the most convenient locations for installation. For example: place the end columns and rafters at the ends of the building and the mainframe columns and rafters at the sides.

Place the bolts and nuts in a place where they will be accessible to the parts. You may want to screw the bolts and nuts together and place them with the corresponding parts. This will save time as you begin assembling the parts.

Purlins and girts, depending on the number of bundles, are usually stored near the sidewalls clear of other packages or parts.

Sheet packages are usually located along one or both sidewalls off the ground and sloping to one end to encourage drainage in case of rain.

Accessories are usually unloaded on a corner of the slab or off the slab near one end of the building to keep them as much out of the way as possible from the active area during steel erection.



**NOTE: When filing claims either with the carrier or Mueller, Inc., the claim should indicate the item(s) in question:**

- The bundle or container in question (if any)
- The actual quantity received.
- The quantity which should have been received or that which was damaged.

**This is important for quickly retrieving the necessary information.**

**Also, the other information such as numbers, names and addresses should be indicated on claims as well as invoice numbers.**

**These procedures are primarily for your protection. A shortage discovered later can be caused by theft, misplacement or other causes and neither the carrier or Mueller can accept responsibility.**

## CARE AND HANDLING OF MUELLER SHEET METAL

### Delivery

Mueller takes every precaution to ensure that material is delivered to the customer damage free and fully protected from the elements during shipment. When the material is delivered to the customer it then becomes the customer's responsibility to protect the material from the elements, possible theft, and other damage. The following guidelines are recommended:

### Handling: Proper care is required in unloading and handling panel bundles in order to prevent damage.

1. Bundles should remain banded (if possible) during the unloading process. Bundles should never be lifted by the banding material.
2. Lift each bundle as close as possible to its center of gravity.
3. If the bundles are to be lifted with a crane, use a spreader bar of appropriate length and nylon band slings (do not use wire rope slings as they will damage the material).
4. Depending on the panel length, some bundles may be lifted by a forklift. When using a forklift, the forks should be spread to their maximum spacing, and the load centered on the forks. **Sheets over 25' long require two forklifts.**
5. After panel bundles are opened, individual sheets must be handled carefully to prevent panel buckling or damage to the panel coating. When removing a sheet from a bundle it should be rolled off the bundle to prevent scratching of the next sheet. Never drag or slide one sheet over another sheet. Sheets should not be picked up by the ends. Instead, lift the sheet along its longitudinal edge and carry in a vertical position. For sheets over 10' long, two or more people may be required to carry the sheet.



## WALL AND ROOF PANELS

Mueller's wall and roof panels including color coated, galvalume, and galvanized provide excellent service under widely varied conditions. All unloading and erection personnel should fully understand that **these panels are quality merchandise which merit cautious care in handling.**

**Under no circumstances should panels be handled roughly.** Packages of sheets should be lifted off the truck with extreme care taken to ensure that no damage occurs to ends of the sheets or to side ribs. The packages should be stored off the ground sufficiently high to allow air circulation underneath the packages. This avoids ground moisture and deters people from walking on the packages. One end of the package should always be elevated to encourage drainage in case of rain.

All stacked metal panels are subject, to some degree, to localized discoloration or stain when water is trapped between their closely nested surfaces. Mueller, Inc. exercises extreme caution during fabricating and shipping operations to ensure that all panel stock is kept dry. However, due to climatic conditions, water formed by condensation of humid air can become trapped between stacked sheets. Water can also be trapped between the stacked sheets when exposed to rain. This discoloration caused by trapped moisture is often called wet storage stain.

The stain is usually superficial and has little effect on the appearance or service life of the panels as long as it is not permitted to remain on the panels. However, moisture in contact with the surface of the panels over an extended period can severely attack the finish and reduce the effective service life. Therefore, it is imperative that **all panels be inspected for moisture upon receipt of the order.** If moisture is present, dry the panels at once and store in a dry, warm place.

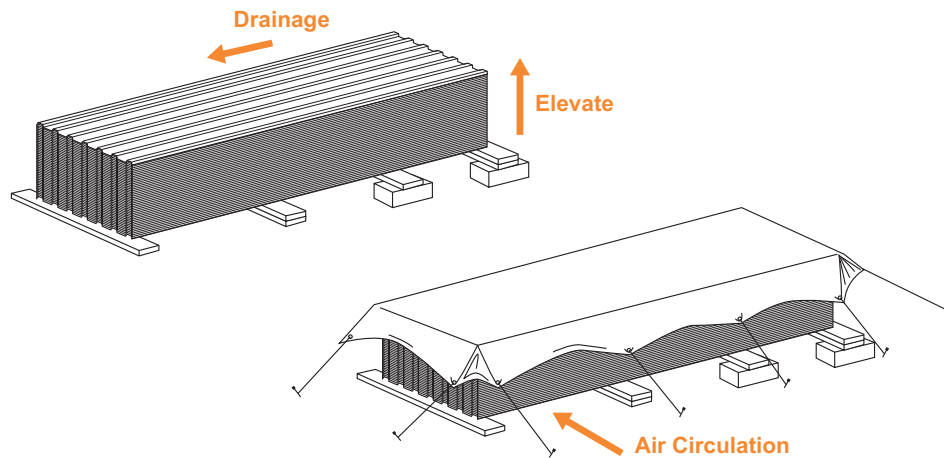
**CAUTION: Care should always be taken when walking on panels. Use safety lines and nets when necessary! Panels can be slippery due to paint finish, wax, oil or atmospheric conditions. Always assume panel surface is slippery and act accordingly.**

## WALL AND ROOF PANELS (continued)

### Storage:

It is recommended that sheets be stored under roof if at all possible. If sheets are to be stored outside, the following precautions should be observed:

1. The storage area should be reasonably level, and located so as to minimize handling.
2. When stored on bare ground, place a plastic ground cover under the bundles to minimize condensation on the sheets from ground moisture.
3. Store bundles at least 12 inches above ground level to allow air circulation beneath the bundle, and to prevent damage from rising water.
4. Elevate one end of each bundle slightly to permit runoff of moisture from the top of the bundle or from between sheets. A waterproof cover should be placed over the bundles to allow for air circulation under the cover.
5. Inspect stored bundles daily and repair any tears or punctures in the waterproof cover.
6. Re-cover opened bundles at the end of each workday to prevent subsequent moisture damage.



### Checking Order At Time Of Delivery

Check each order carefully, as it is unloaded. Report any obvious damage or shortages to the carrier immediately. If damage or shortages are noted after delivery (at time of unpacking) notify your Mueller representative immediately. Have invoice numbers and detailed descriptions of the damage or shortage available. These procedures are for your protection. A shortage or damage discovered later, can be caused by theft, misplacement, mishandling or other causes and is not the responsibility of Mueller, Inc.

**NEVER INSTALL MATERIAL IF THE QUALITY IS IN QUESTION!**

**SECTION**

**C**

**ERECTION OF PRIMARY  
AND SECONDARY  
STRUCTURAL**





## GENERAL INFORMATION

Many methods and procedures are in use for erecting the structural portion of metal buildings. The techniques of raising frames vary from erecting small clear spans and endwall frames in units to erecting the larger clear spans and modular frames in sections. The erection methods used depend strictly on the type of building, the available equipment, the experience level of the crews, and the individual job conditions.

The variations in these factors preclude the establishment of a firm or specific set of erection rules and procedures. Consequently, the erection operation must be tailored by the erector to fit individual conditions and requirements. However, there are certain erection practices, pertaining to structural members, which are in general use and have proven sound over the years. Descriptions of these follow.

Erectors are cautioned not to cut primary members (rigid frame columns, rafters, end bearing frame rafters, interior columns). These are the primary support members for the frame and are designed as such. Any cutting of these members may affect the structural stability. A representative of Mueller's must be consulted prior to attempting alterations of these members.

**NOTE: Do not install any material if its quality is in question. Mueller, Inc. will not be responsible for costs incurred associated with the installation and/or removal of same.**

**WARNING! In no case should building erection be started on green concrete. Anchor bolts may pull loose, concrete spall (chip out along edges) may occur and equipment may crush or crack slab. Consult the project engineer, not Mueller, Inc. on foundation questions.**

## TOOLS AND EQUIPMENT REQUIRED

The types of tools and equipment required in order to assemble and erect the building depend on the size of the building purchased. This part of the instruction manual lists the tools and equipment that are normally required for most buildings. You may wish to use more or less power equipment or different tools than are listed as the need dictates. Whatever tools are used, it is important to remember that using the recommended tools will enable the least effort and best manner of erecting the building.

If a contractor is going to erect the building for you, you will not have to concern yourself with the tool list as most contractors have the necessary tools and equipment that are required. However, reference to the following list may be of value to the contractor if he has never assembled and erected a Mueller Prefabricated Steel Building.

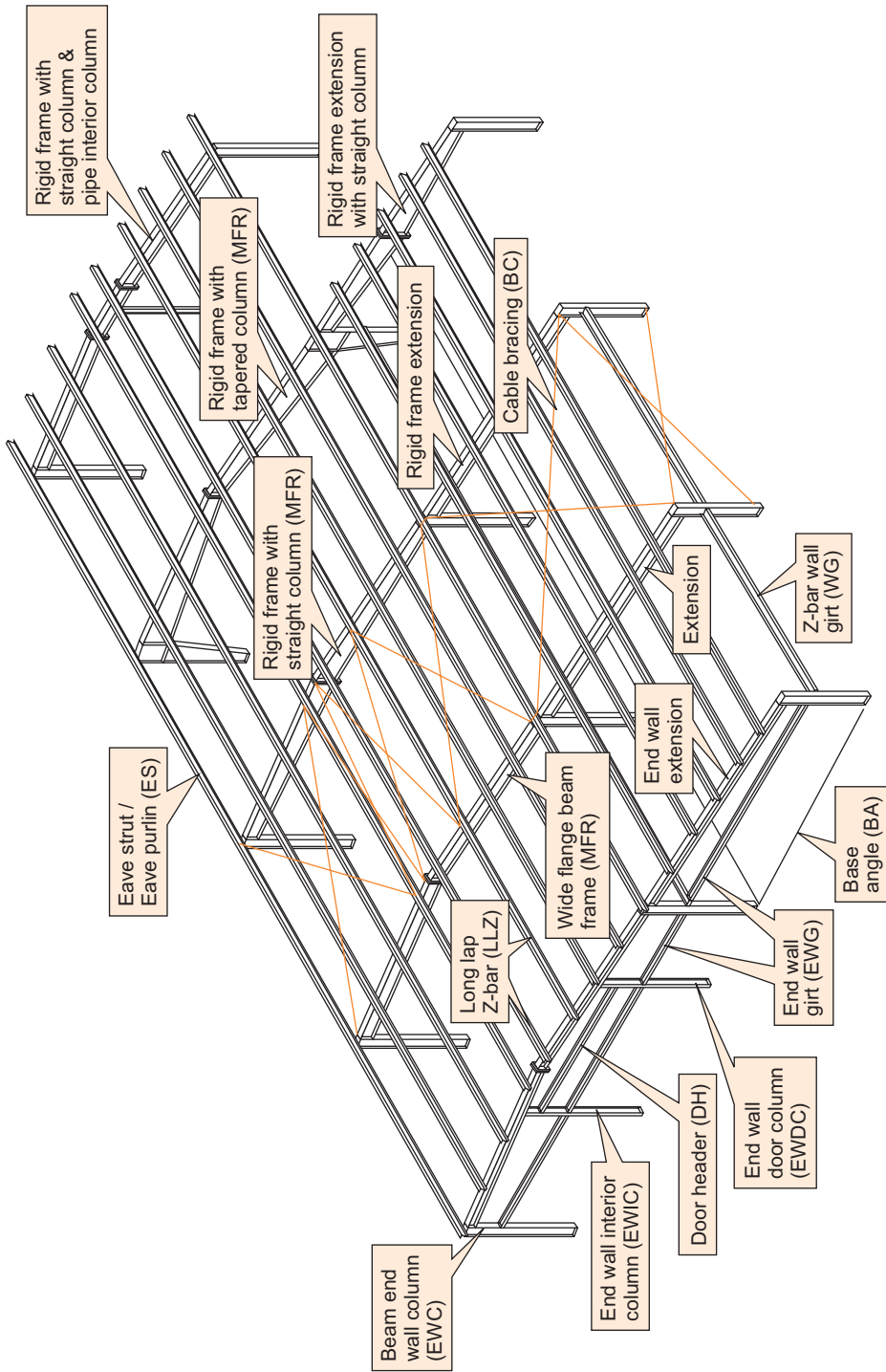
**WARNING! Whenever using any type of power equipment, it is important to follow the manufacturer's recommendations for use. Always be aware of the dangers involved when using electric or air powered equipment.**

### Tools

- |  |  |
|--|--|
| <input type="checkbox"/> Spud Wrench   | <input type="checkbox"/> Channel Locks   |
| <input type="checkbox"/> Hammer  | <input type="checkbox"/> Extension Cord (#10-3, 2/4 way box, 250' long)                        |
| <input type="checkbox"/> Centering punch   | <input type="checkbox"/> Fire Extinguisher (#10)   |
| <input type="checkbox"/> Square  | <input type="checkbox"/> First Aid Kit   |
| <input type="checkbox"/> Complete set of Wrenches (Open-end, socket, box-end)                      | <input type="checkbox"/> Load Binders  |
| <input type="checkbox"/> Pry Bar   | <input type="checkbox"/> Plumb Bob   |
| <input type="checkbox"/> Pipe Wrench   | <input type="checkbox"/> Snips (Large bulldogs)  |
| <input type="checkbox"/> Pliers  | <input type="checkbox"/> Tape measure (12' to 25' long, 100' long for foundation measurements) |
| <input type="checkbox"/> Vise-Grip Pliers  | <input type="checkbox"/> Ladder  |
| <input type="checkbox"/> Drill Bits  | <input type="checkbox"/> Chain   |
| <input type="checkbox"/> Power Drill or Combination Power/Hammer Drill                             | <input type="checkbox"/> Rope  |
| <input type="checkbox"/> Screw Gun   | <input type="checkbox"/> Hoist or Forklift (Should be all-terrain)                             |
| <input type="checkbox"/> Power Wrench (Impact Wrench)  | <input type="checkbox"/> Come-along (Power pull)   |
| <input type="checkbox"/> Nibbler (Electric metal cutter for cutting across the wall & roof sheets) | <input type="checkbox"/> Saw Horses  |
| <input type="checkbox"/> Level (3 feet long minimum)   | <input type="checkbox"/> Tarps   |
| <input type="checkbox"/> Hacksaw   | Safety Equipment: <input type="checkbox"/> Goggles   |
| <input type="checkbox"/> Broom (Push)  | <input type="checkbox"/> Hard Hat  |
| <input type="checkbox"/> Wire Brush  | <input type="checkbox"/> Gloves,   |
| <input type="checkbox"/> Caulking Gun (Open barrel)  | <input type="checkbox"/> Work Boots, etc.  |
| <input type="checkbox"/> Chalk Line (100' long and chalk)  |  |

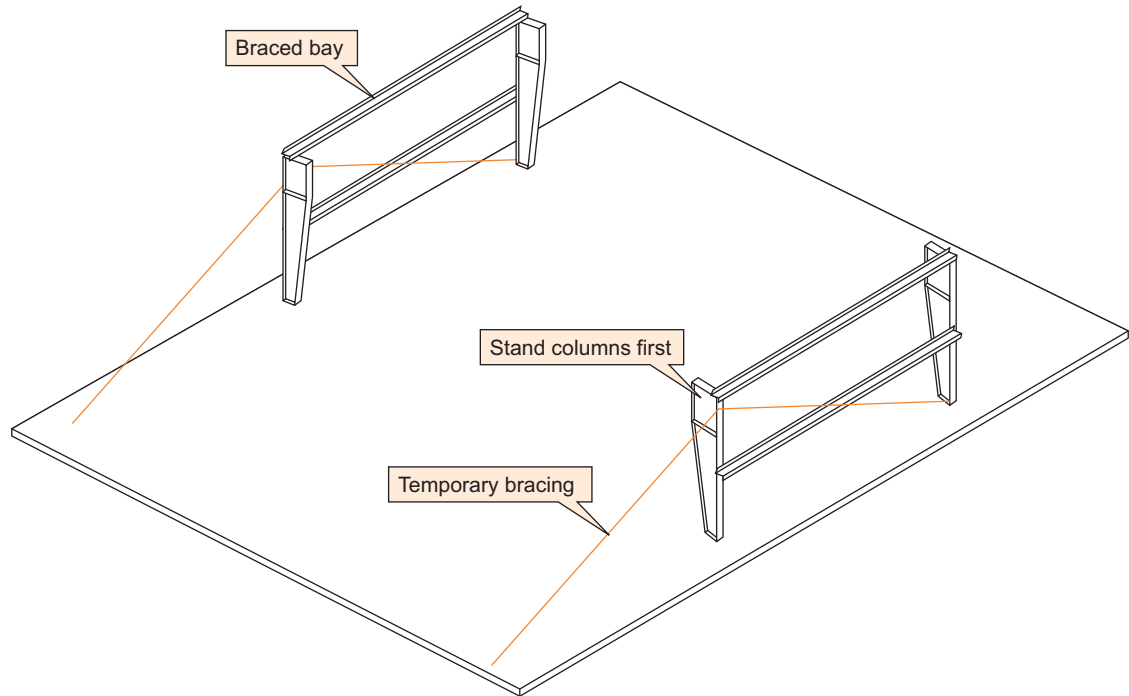
**NOTE: Additional tools may be required depending on the specific requirements of the building.**

# TYPICAL BUILDING PARTS



## RAISING RIGID FRAMES

The intermediate or interior frames nearest the bearing endwall are usually erected first. This bay usually contains the diagonal bracing. The proper completion and plumbing of this first bay is extremely important to the successful completion of the building.



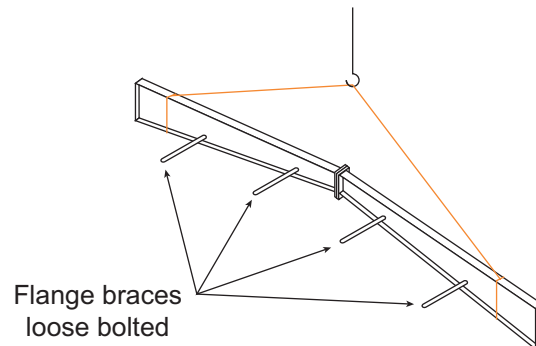
Although several methods are used to erect rigid frames, it has been found most satisfactory to erect the columns first, tie them together with the girts and tighten the anchor bolts\*. On small spans and short eave heights, columns can often be set in place by hand without the use of hoisting equipment. **Temporary bracing should always be installed as soon as sections are lifted in place.**

\*The anchor bolt tension may need to be adjusted to seat the rafter.



## RAISING RIGID FRAMES (CONTINUED)

After the columns have been erected, the ground-assembled rafter is hoisted into place and connected to the columns. The size of the rafter that can be safely handled depends on the equipment available and the experience of the erection foreman. **Generally as many connections as possible are made on the ground.**



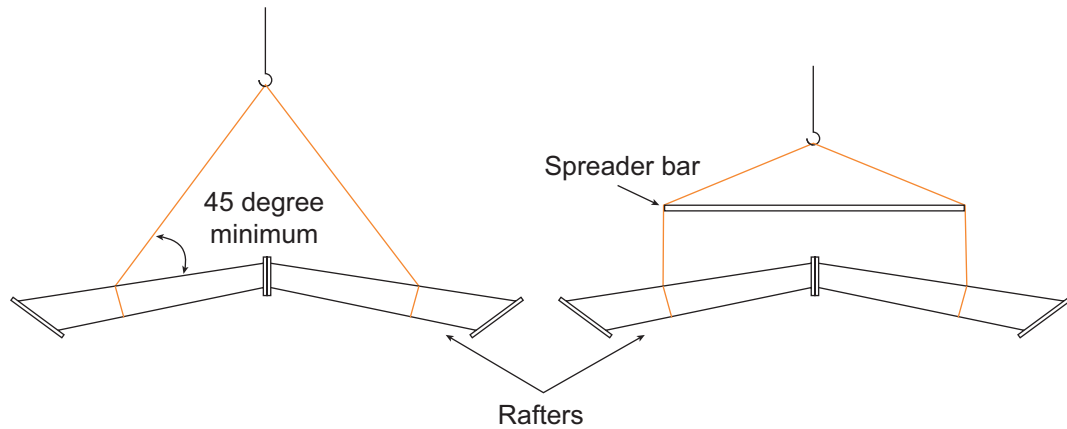
The flange brace should be bolted to the rafter prior to raising in order to save time. **The hoisting equipment should never be released from the rafter until the frame is adequately braced, so it cannot buckle or tip in the longitudinal direction of the building.**

**NOTE: Drawing above is intended as a general rigging method.  
Actual rigging method will vary with member configuration.**

## RAISING RIGID FRAMES (CONTINUED)

### Lifting Cables And Spreader Bars

In all instances the length of the lifting cables should be such that the angle between the rafter and the lifting cables is no less than 45 degrees. To reduce the severe compression stresses at the ridge of the rafters that are created by the angle of lifting cables, a spreader bar is recommended, which allows the lifting cables to be parallel to each other.



**NOTE:** Drawing above is intended as a general rigging method.  
Actual rigging method will vary with member configuration.

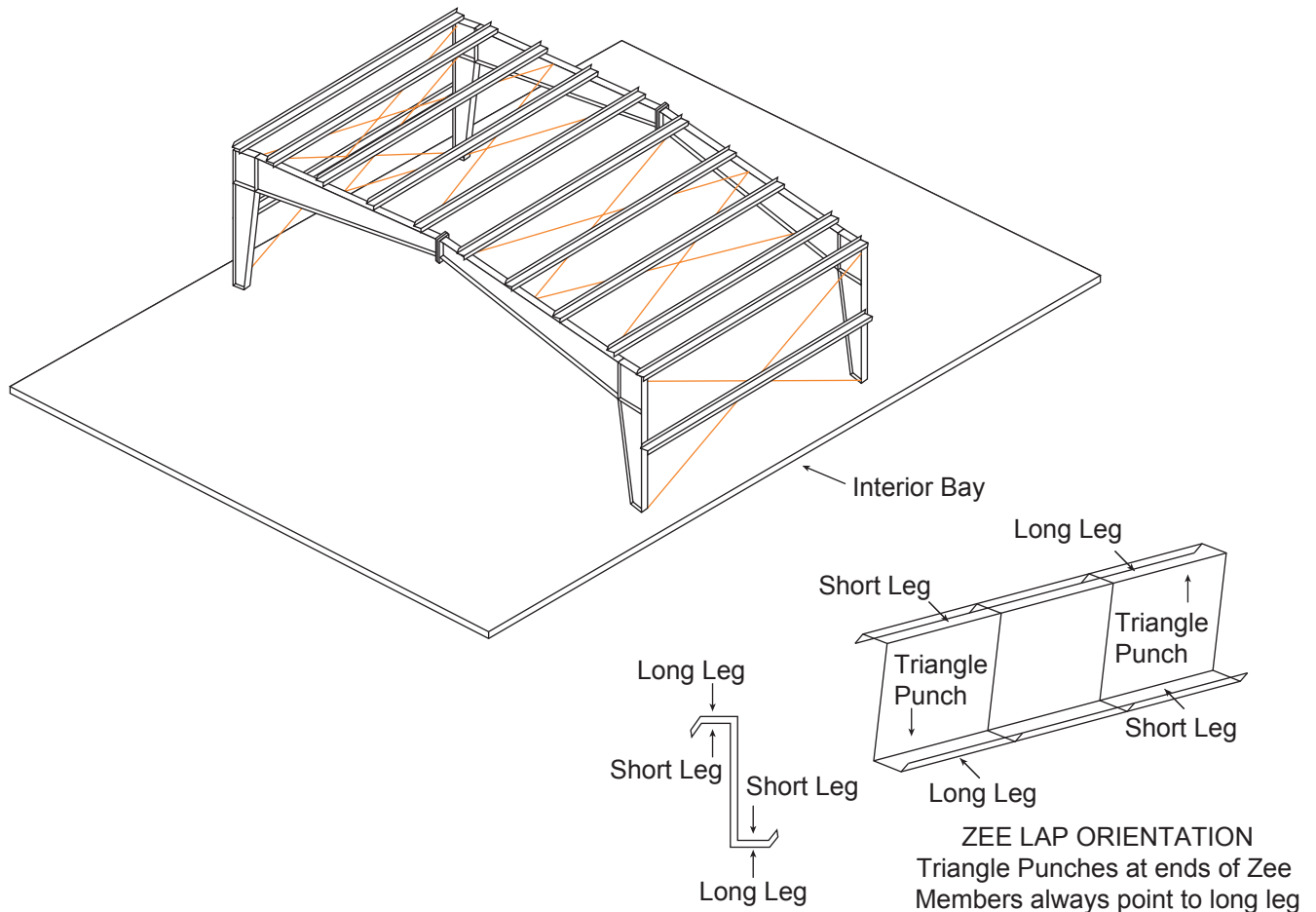
**NOTE:** Stay well in the clear of loads being moved by any lifting device.  
Hands and feet should be kept clear of moving loads and never stand  
under a load being lifted. Remember, **SAFETY FIRST!**

## RAISING RIGID FRAMES (CONTINUED)

### Completing And Plumbing The First Bay

After the first intermediate or interior frames have been set, Mueller, Inc. recommends that all purlins, girts, and eave struts be installed in the braced bay and the entire bay plumbed, aligned and braced before proceeding further. If the building is designed without cable bracing, the erector is responsible for providing temporary erection bracing.

When this bay is properly and accurately plumbed and braced, the remaining members, to a large degree, will automatically plumb and align when installed. Only a final check of the building plumb remains, and few adjustments, if any, will be necessary.



**NOTE:** Zee Lap Orientation should be considered while installing the purlins and girts. On this first bay, placing the long leg of the purlin against the primary framing will facilitate a nesting lap for the next bay of purlins and girts. See erection drawing for Zee Lap Orientation.

## RAISING RIGID FRAMES (CONTINUED)

When the rafters consist of several roof beams, as in the case of wide buildings, a safe procedure of raising by sections and supporting the free end must be followed, regardless of the type of equipment available. In most instances the work proceeds from outside columns inward toward the peak until the entire frame is bolted into place.

The same general procedures of erection apply to either clear span or multiple span frames. In the case of the latter, the support for rafter sections during erection is generally supplied by the interior columns themselves, making temporary supports unnecessary.

Two words of caution concerning the erection of rigid frames are in order. The first is that rigid frames, especially free ends or cantilevered sections should never be left “for the day” in an unsupported, unbraced or unguyed condition. Such practice has resulted in the total loss of considerable amounts of erected steel because of wind. The second word of caution pertains to the additional care required in the erection of multiple span frames compared to clear span frames. Frames with interior columns, because of closer supports, have much lighter sections. They are much more apt to buckle during erection than clear span frames, and consequently require greater care in rigging and handling.

### Connection Bolts

Bolts used to make connections in **secondary framing** members such as the purlins are usually 1/2” diameter, ASTM designation A307. All **primary framing or main framing** connections are made with ASTM A325 bolts, usually 5/8”, 3/4”, 7/8” and 1” diameters. The size and grade of the bolt are marked on the building erection drawings.

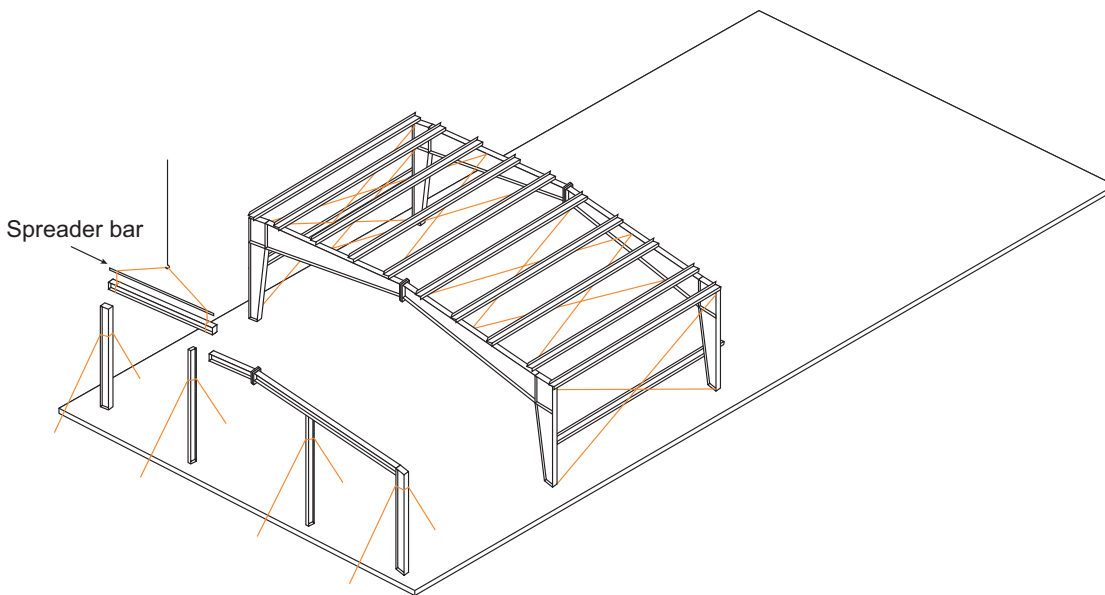
**MAIN FRAME: An assemblage of rafters and columns that support the secondary framing members and transfer loads directly to the foundation.**

**SECONDARY FRAMING: Members that carry loads from the building surface to the main framing. For example – purlins and girts.**

## ERECTING COLUMN AND BEAM ENDWALLS

Column and beam endwalls of 50 feet or less in span may be raised into position and set on the anchor bolts as a unit. All rafters, column, girts (except outside endwall girts which connect to the sidewall girts), door headers, door jambs, clips, diagonal brace rods, etc. should be assembled on the ground with the bolts left finger tight. A spreader bar should be used to raise the endwall frame. Because of the flexibility of the column and beam frames, care must be taken in locating the points of attachment of the cables, and in raising the frame, to avoid bending about the minor axis.

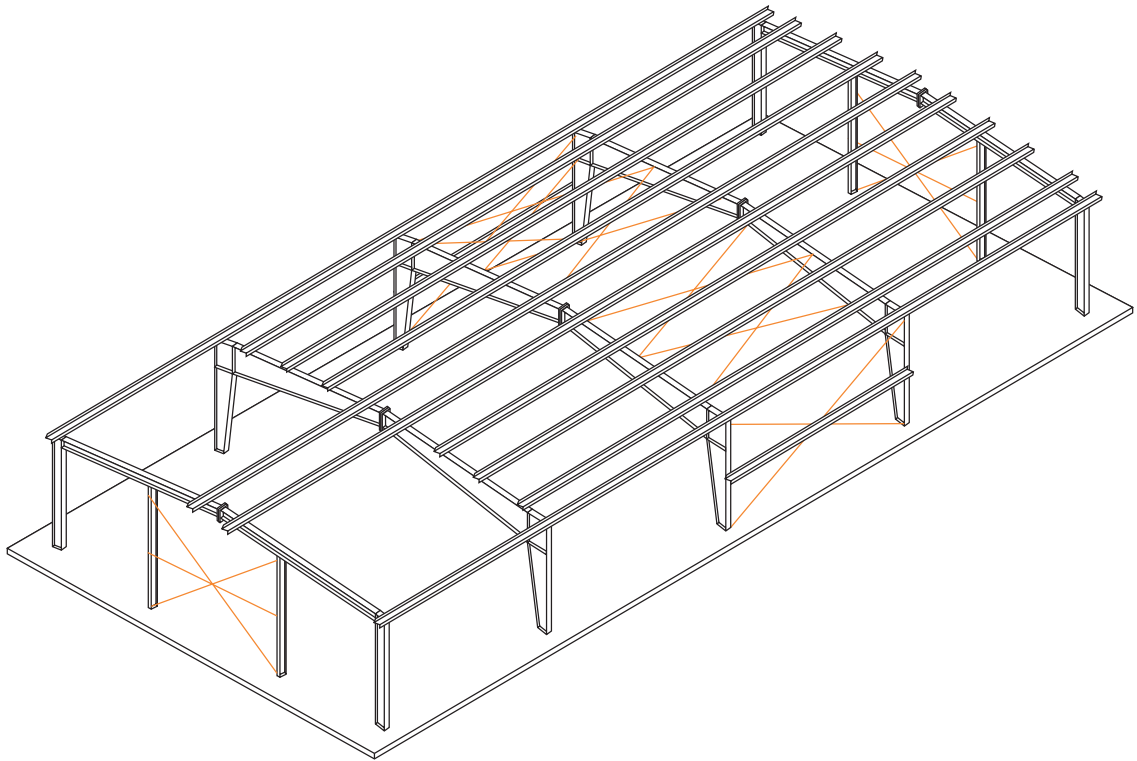
For spans of 60 feet and greater, the columns are usually erected first and then capped with the endwall rafter. The girts, headers, jambs and diagonal brace rods are then added between the end columns. During this erection process, the frame must be properly braced or guyed before the lifting lines are disengaged. Final bolt tightening should be done once the frame is plumb and square.



**NOTE: Drawing above is intended as a general rigging method.  
Actual rigging method will vary with member configuration.**

## ERECTING THE REMAINING FRAMES & EAVE STRUTS

The remaining frames are erected in like manner, initially with only a few purlins being installed in each bay working from one end of the building to the other. To lend overall rigidity to the structure, install flange braces to the purlins at specified locations. All purlin, girt and eave strut connection bolts are left loose so the entire skeleton framework can be plumbed without undue difficulty. The remaining purlins can be positioned on the rafter in each bay to facilitate the completion of the roof framing.



**NOTE: Take precautions to secure structure during assembly. Temporary bracing may be required to stabilize the structure during erection. Never leave the structure unbraced.**

## JOINTS NOT SUBJECT TO TENSION LOADS

Joints not subject to tension loads need only be tightened to the snug tight condition, defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.

### **Joints Subject To Tension Loads**

Two tightening procedures are specified for A325 bolts in joints subject to tension loads, turn-of-the-nut method and direct tension indicator.

Turn-of-the-nut method – When turn-of-the-nut method is used to provide tension, first bring enough bolts to a “snug tight” condition to ensure that the parts of the joints are brought into good contact with each other. Next, place bolts in all remaining bolt holes and bring to “snug tight”. Then additionally tighten all bolts – progressing from the bolts nearest the web, to the free edges. During this operation there shall be no rotation of the part not turned by the wrench.

Tightening by use of a direct tension indicator – Tightening by this means is permitted provided it can be demonstrated, by an accurate direct measurement procedure, that the bolts have been tightened to specified tension.

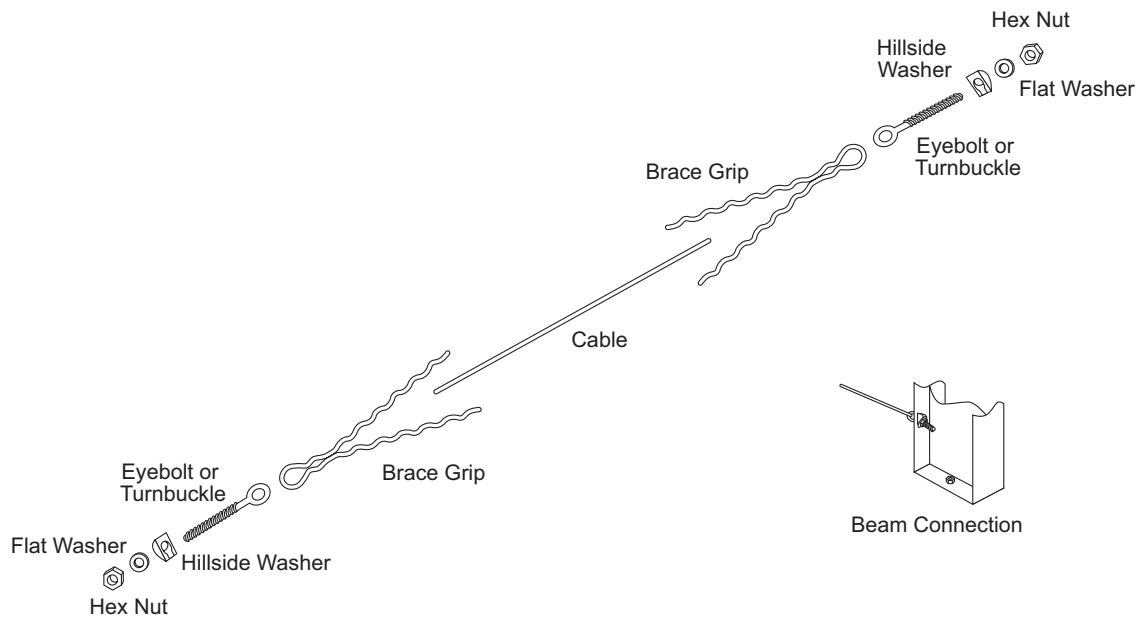
Consult latest edition of the AISC Manual of Steel Construction for more complete instructions for installing high strength bolts.

## ASSEMBLY OF BRACE CABLES

1. Assembly of brace cables:

**NOTE: Cable may have to be field cut to proper length.**

- A. Insert grip through eyebolt.
- B. Begin wrapping the grip around the cable, matching the crossover marks.
- C. Continue until the lasts two wraps are left split the legs and apply separately.
- D. Duplicate this procedure on each end.



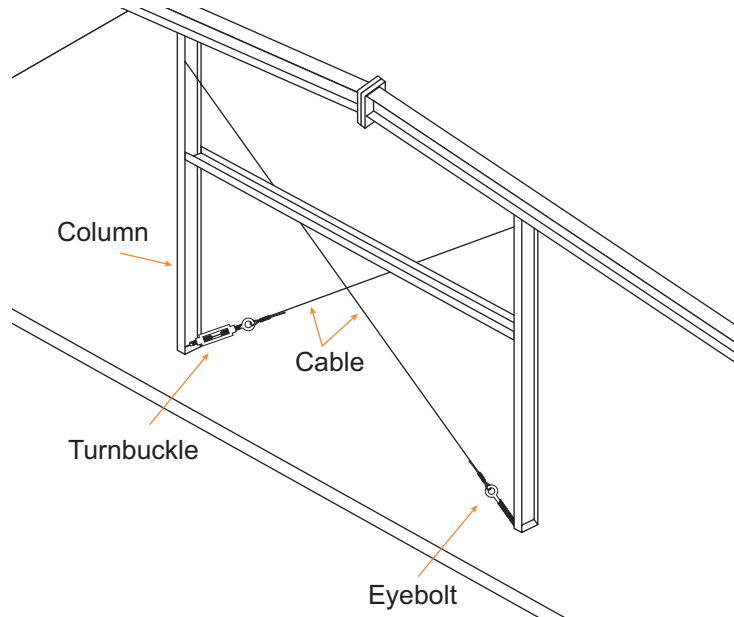
Obtain the proper tension of the strand by tightening the nuts on the eyebolts.

- 2. Insert the "T" section on an angle through slot until round neck rests on web plate then turn brace-eye 90 degrees.
- 3. Then pull brace-eye toward you until "T" section rests against back of web plate, square neck locks brace-eye in place.
- 4. Attach the brace-grip to the brace-eye and then attach the brace grip to the cable.



## INSTALLATION OF WIND BRACING (CONTINUED)

Assemble the next brace cable the same way and connect to the next column to form an “X” with the other cable.



To square the building, measure the length of the diagonals and tighten or loosen the turnbuckle/eye-bolt until the lengths are the same. Double-check by using a square at the corners.

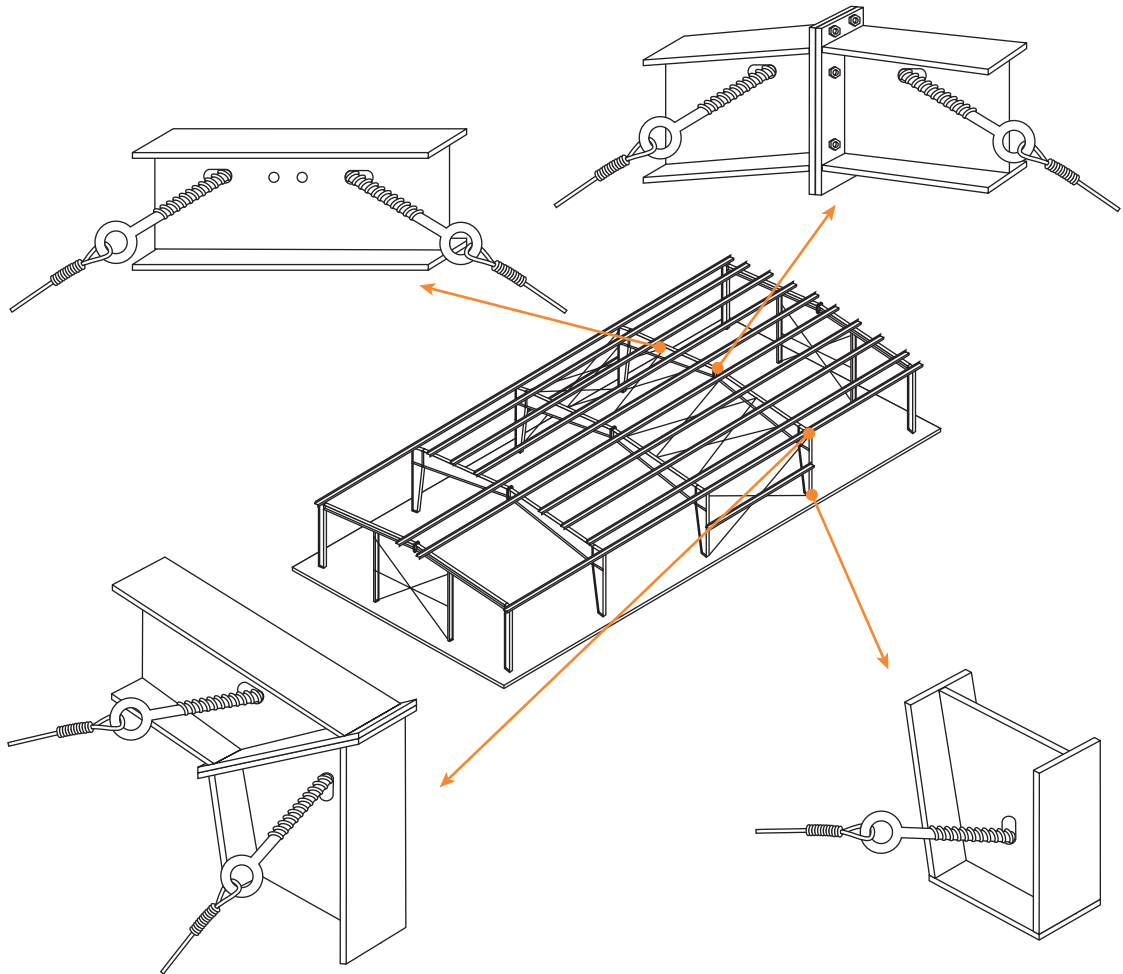
Brace each sidewall frame the same way so that you have an x-brace on each side. Note that the diagonal lengths may vary between the two walls, but should be the same on each x-brace.

Tighten the column anchor nuts after ensuring that the building is square.

The diagonal bracing is cable. It should always be installed as shown on the erection drawing and should be tensioned so that the building will not sway or rock when the wind blows. Care should be taken; however, not to over tighten and bend the structural members. The workman should watch the structural members carefully as he tightens the bracing.

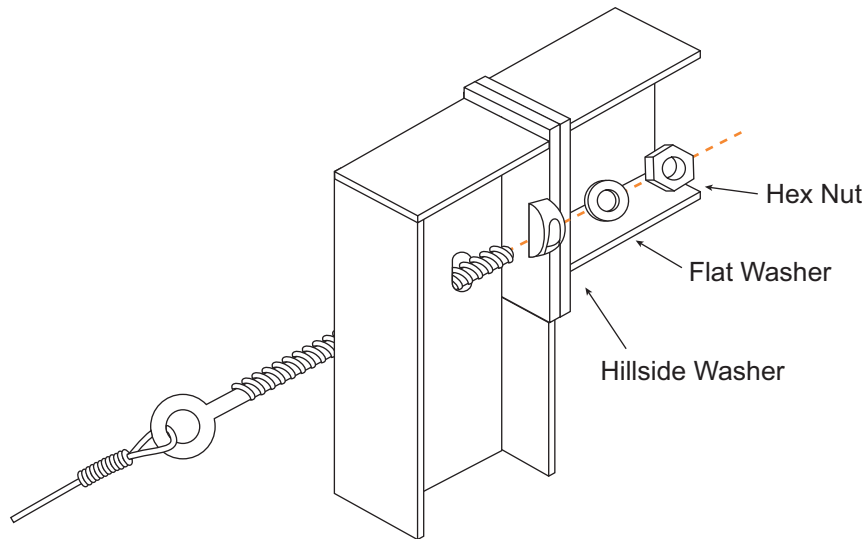
## INSTALLATION OF THE WIND BRACING

Diagonal bracing in metal buildings is critical. They provide support for wind loads or other longitudinal loads, such as those created by an overhead crane in the completed structure. Many times additional temporary bracing is needed to stabilize the structure during erection. The erector should review this requirement, and the erector should provide any additional bracing. On some smaller buildings, diagonal bracing is not needed for the building design, so the erector must furnish any erection bracing needed.



## INSTALLATION OF WIND BRACING (CONTINUED)

### Hillside Washer Installation

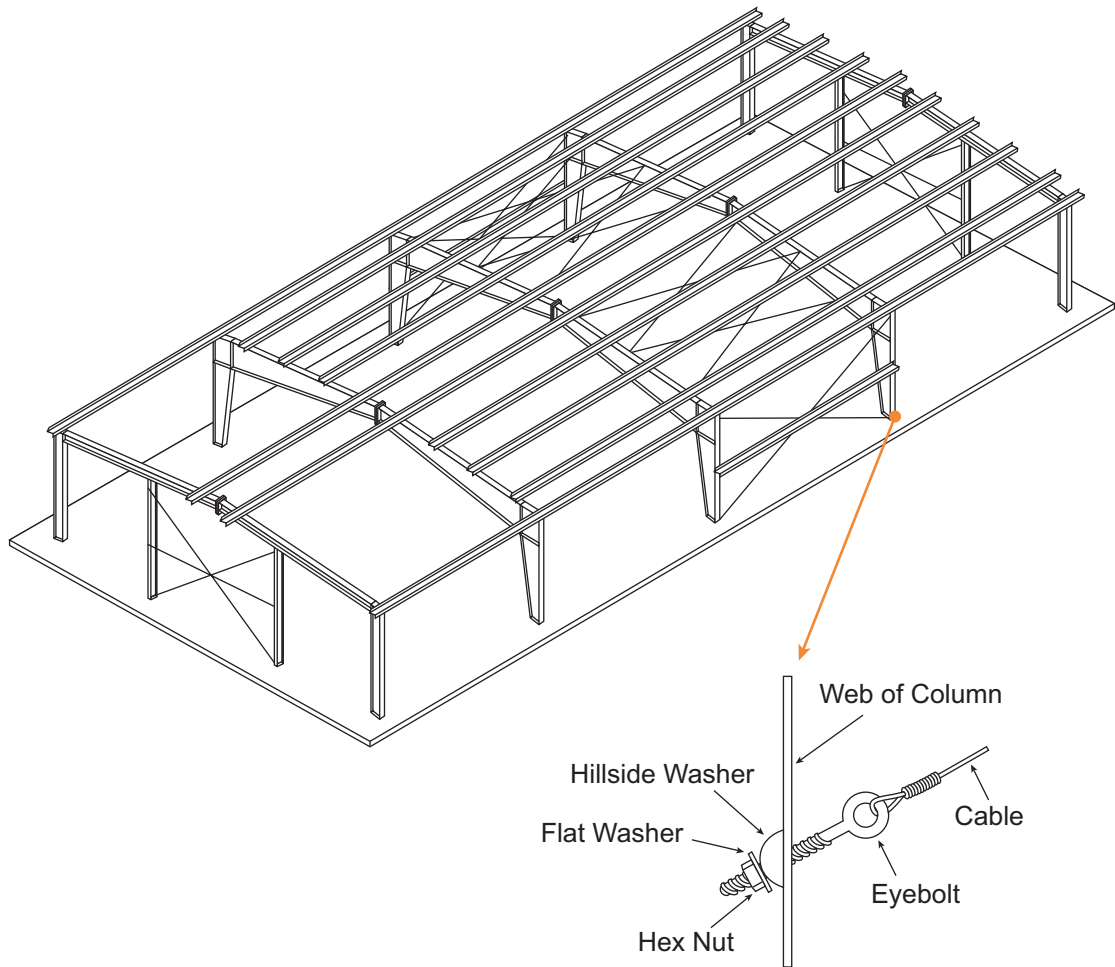


**NOTE:** Hillside washer installation similar at base.

**NOTE:** Care should be taken not to over-tighten the wind bracing. Overtightening the bracing can cause permanent damage to the framing.

## INSTALLATION OF WIND BRACING (CONTINUED)

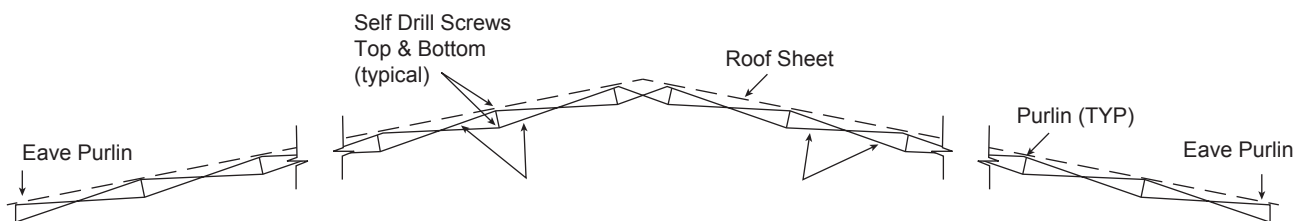
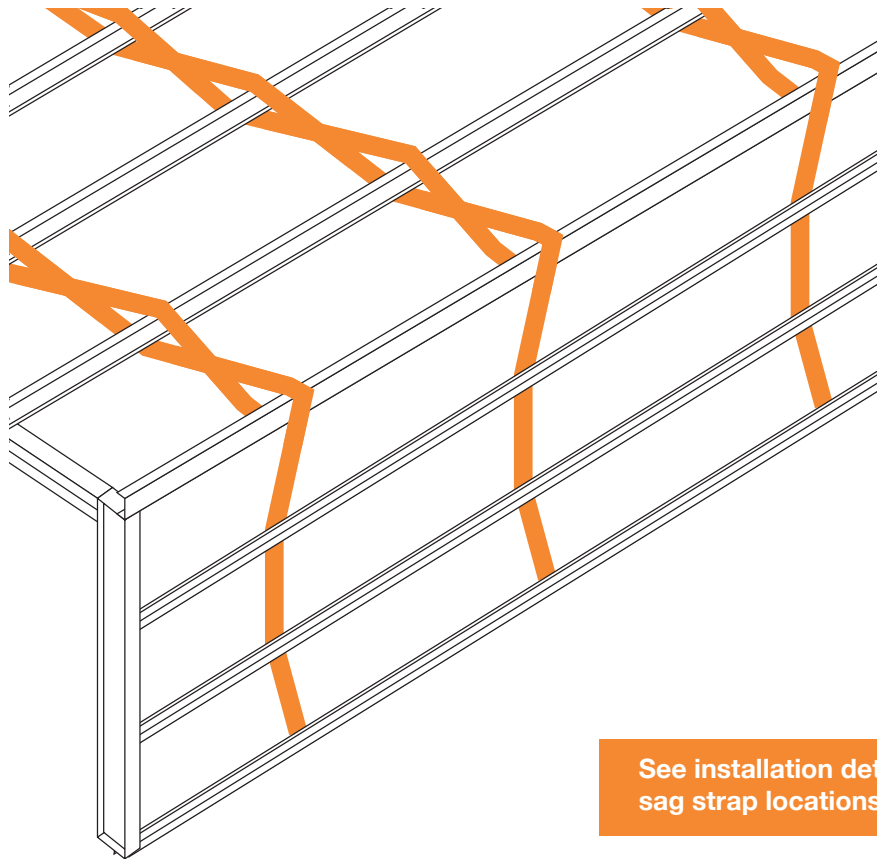
Occasionally the bracing in the wall of a building cannot be installed in the specified bay because of doors or other complications. Usually these can be moved to other bays without affecting the structural integrity of the building. **However, before moving any wind bracing check with Mueller, Inc. Do not remove after building is erected.**



**NOTE: Never modify a Mueller building without first contacting a Mueller representative.**

## INSTALLATION OF SAG STRAP BRACING

When specified, sag strap bracing in metal buildings is critical. They provide stabilization of both purlins and wall girts. Sag straps should always be installed according to the specifications shown on the erection drawing. Not all buildings require sag straps. Before moving or removing any sag strap, check with Mueller, Inc.



On roof purlins, two continuous straps (6" apart) installed taut (no droop or looseness) from top of one member to bottom of adjacent member as shown for entire width of building. Secure each strap to each member with self drill screws.

On wall girts, One continuous strap from base angle to eave purlin as shown.

**SECTION**

**D**

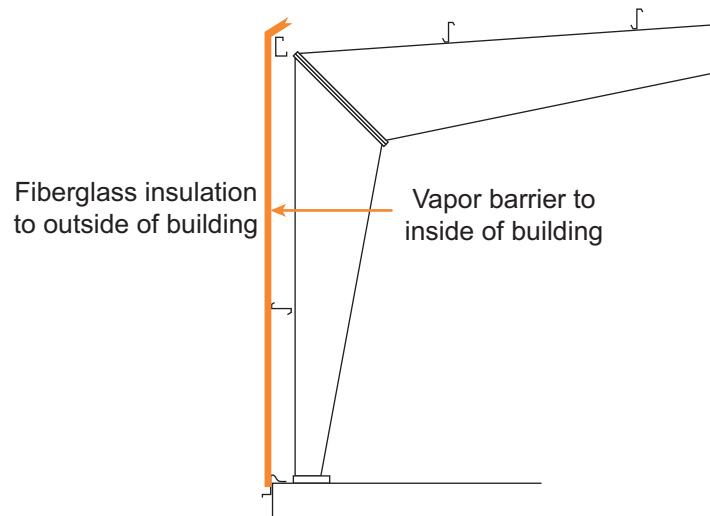
# **INSULATION**





## WALL INSULATION

Fiberglass blanket insulation is the most common type used, and these instructions pertain to this type only. One side of the blanket insulation should have a vapor barrier that must face the inside of the building regardless of whether the insulation is for heating or cooling.



### Wall Insulation Installation

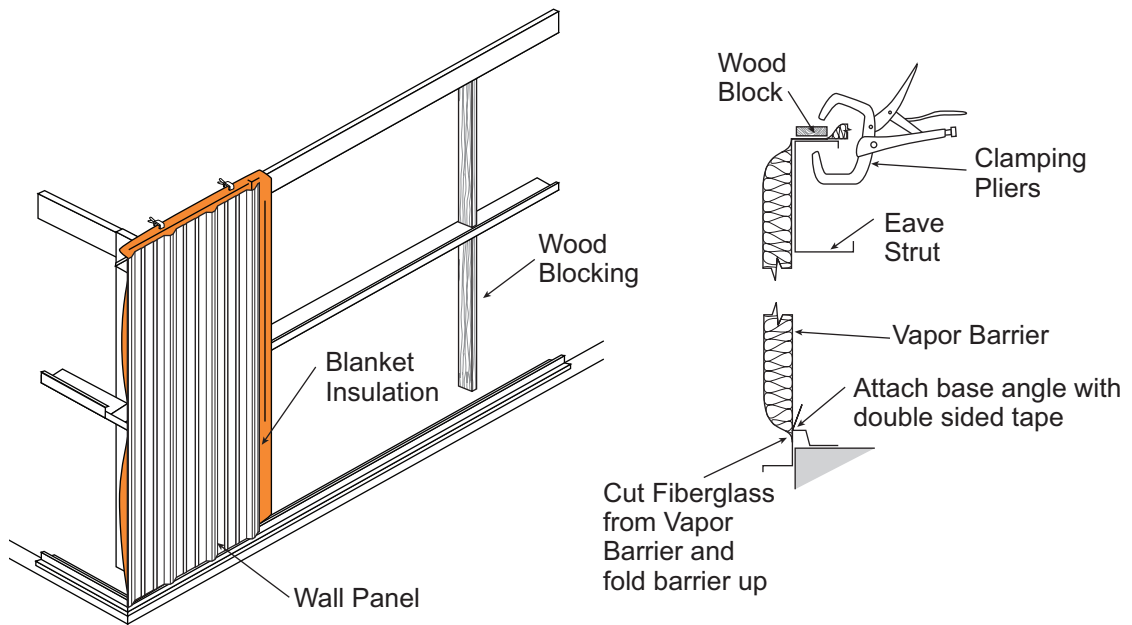
Cut the insulation to length allowing an additional 6" or more to facilitate handling. The wall panel can be used as a guide.

**NOTE: The insulation must compress between the girt and the wall during installation. Insulation too thick or dense to compress adequately will induce waviness or oil canning in certain types of wall panels.**



## WALL INSULATION (CONTINUED)

The first run of wall insulation should be installed so that its forward edge is just ahead of the leading edge of the wall panel. This keeps the forward edge of the insulation ahead of the wall panel for joining the next blanket.

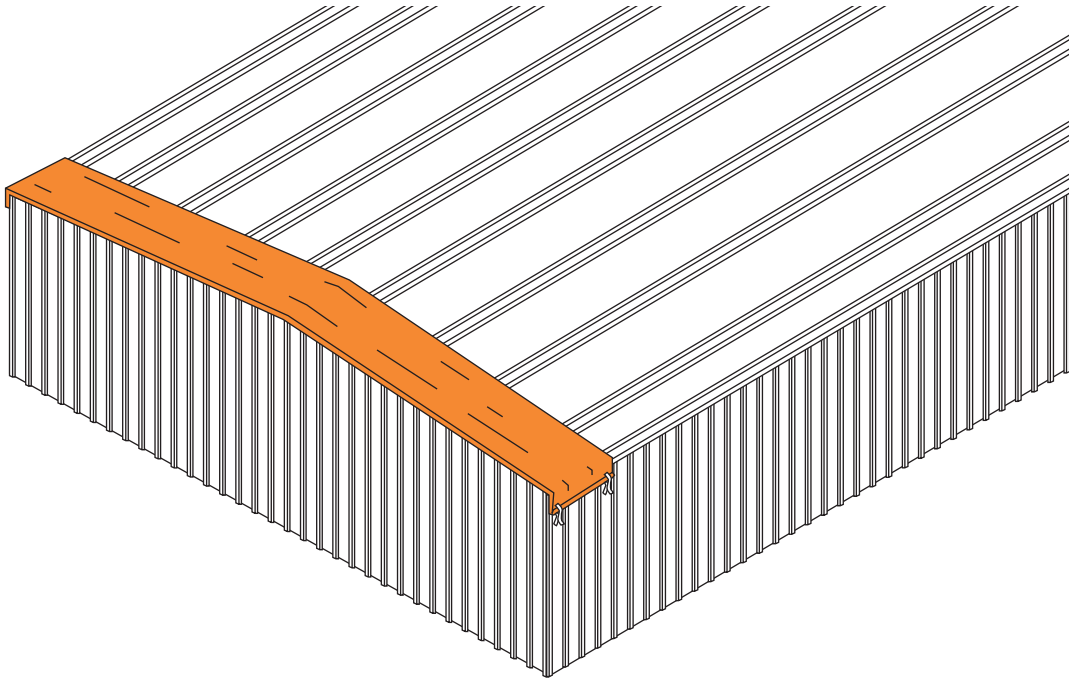


**NOTE:** Do not allow the insulation to wick moisture from the floor.

**WARNING!** Insulation has no load bearing strength. Do not lean or prop material against wall insulation. Observe all proper safety procedures when handling fiberglass insulation, such as dust masks, gloves and long sleeved shirts, to minimize contact with the insulation.

## ROOF INSULATION

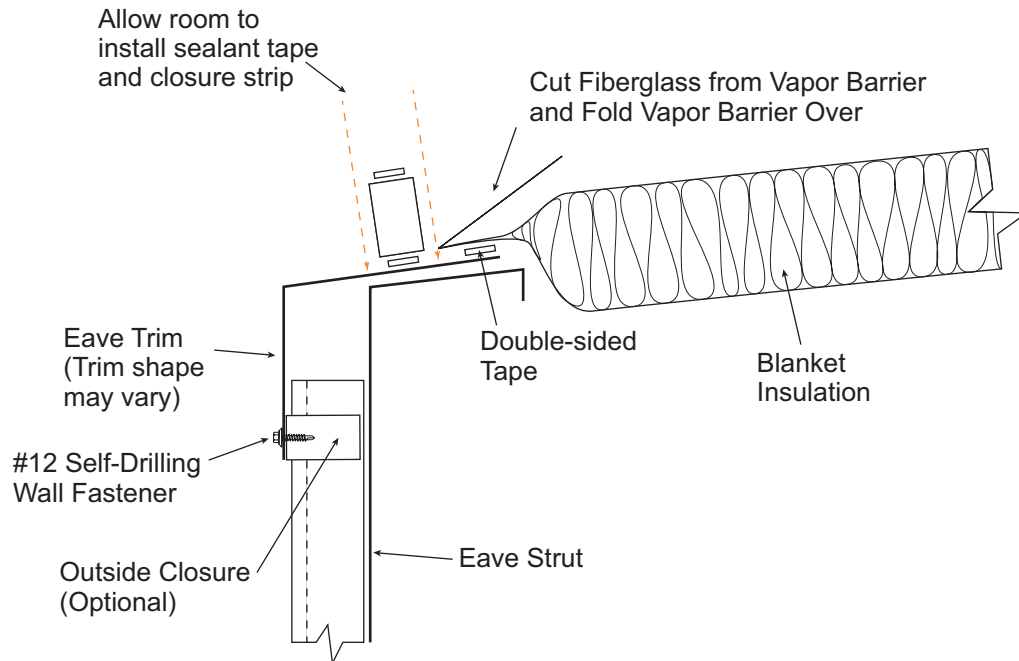
Pre-cut roof insulation to reach from eave to eave allowing approximately 2 feet of additional length to facilitate handling. Hold insulation at one sidewall and roll out insulation across the purlins, vapor barrier to the inside of the building. Stretch the insulation to provide a tight and smooth inside surface.



**NOTE:** Insulation has no load bearing strength. Maintain body weight on approved scaffold or walk boards.

## ROOF INSULATION (CONTINUED)

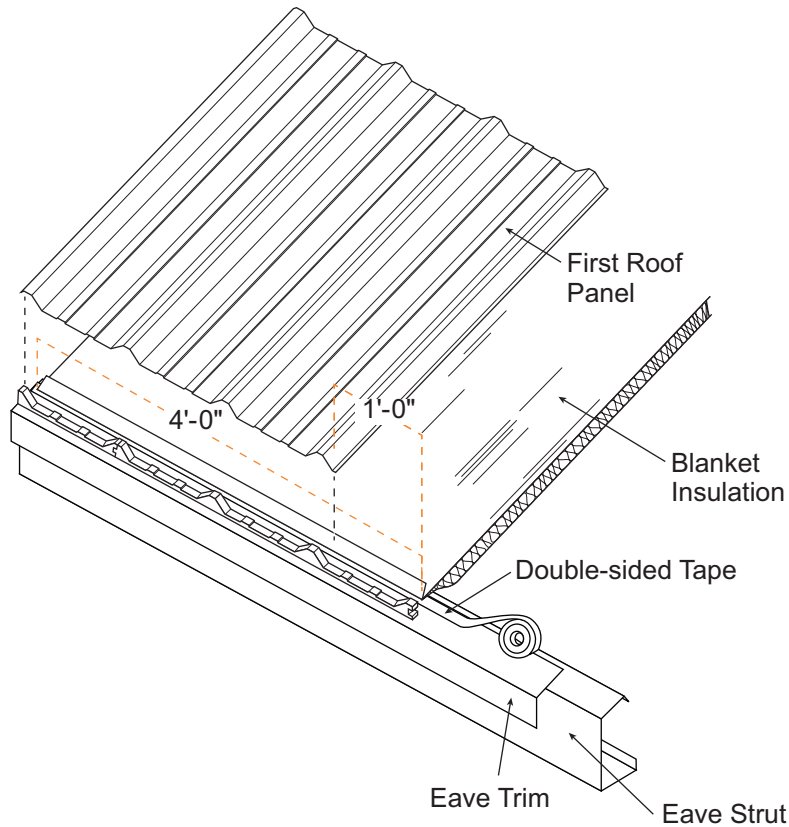
Double sided tape or contact adhesives can be used to hold insulation in place while the roof sheets are being installed. Trim excess insulation to the edge of the eave trim and cut fiberglass approximately 4 inches from end leaving only facing. Fold facing over end of blanket insulation to seal the end.



**NOTE: Do not install more insulation on the roof than can be covered by roof panels before the work period ends. Do not allow the insulation to become wet.**

## ROOF INSULATION (CONTINUED)

Seal insulation sidelap joints by lapping 4" tab side. As on the walls, the general sequence is to install the roof sheets in conjunction with the insulation.



**NOTE:** The insulation sidelap must be lapped to prevent condensation and minimize temperature loss at laps.

**WARNING!** Wipe oil and other slippery substances from roof panels. Do not step on rib of panel, near a crease in the panel, near a side edge or within five feet of the end of unsecured panel. Insulation has no load bearing strength. Maintain body weight on scaffold or walk boards.



**SECTION**

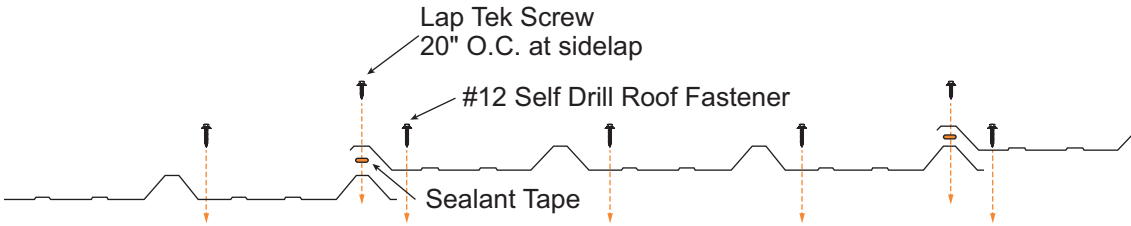
**E**

# **SHEETING**

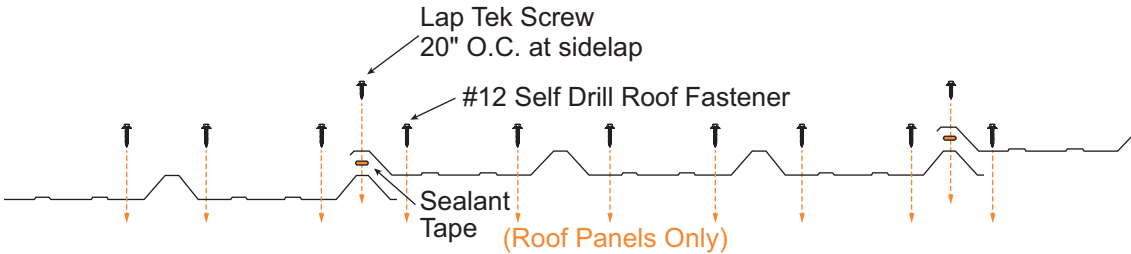




# FASTENER LAYOUT

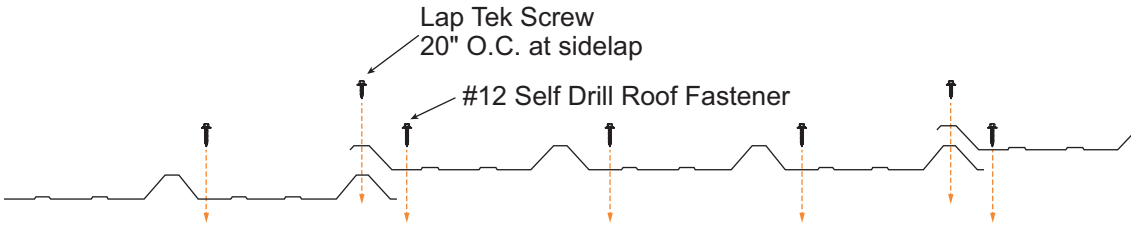


**“R” and “PBR” Roof Panel Fastener Spacing, Intermediate Purlins, Girts, Eave Strut**



**“R” and “PBR” Roof Panel Fastener Spacing, Eave Strut, Wall and Roof Panel End Laps, Ridge Purlin, Base Angle/Girt**

**NOTE: UL 90 Uplift Rated Roofs Require Fasteners At Each Side of High Ribs At All Purlin On Certain “UL” Construction Systems And Eave Strut Locations (Consult Your Specific Requirements Prior To Installation).**



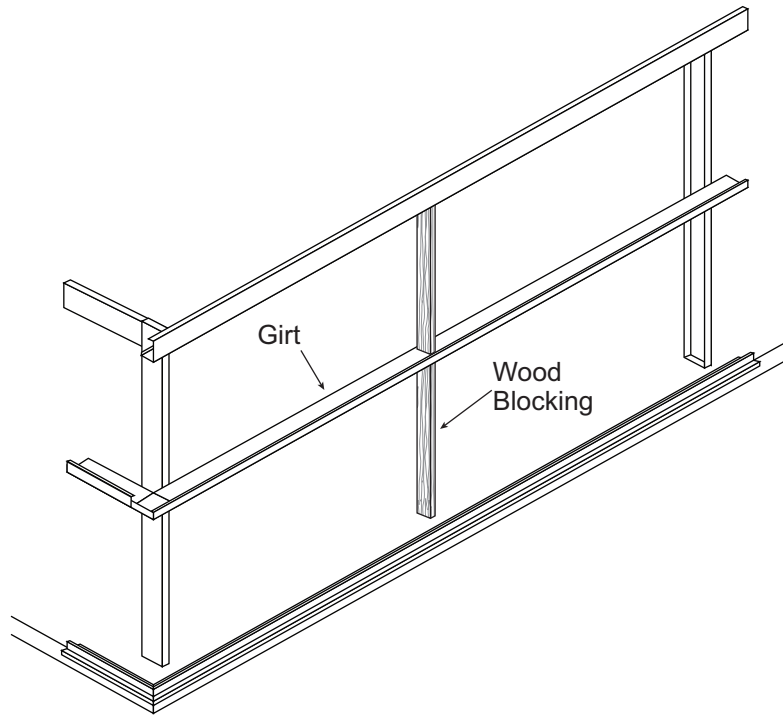
**“R” and “PBR” Wall Panel Fastener Spacing, Intermediate Girts, Eave Strut**

**WARNING! DO NOT OVERDRIVE FASTENERS!**



## ALIGNING THE GIRTS

Installation of the building walls is generally done before the roof. Before starting the wall installation, check to be sure that the eave strut and girts are straight and plumb. One method of aligning the girts is to cut temporary wood blocking to the proper length and install between the lines of girts. This blocking can be moved from bay to bay, which will reduce the number of pieces required. Normally, one line of blocking per bay will be sufficient. Banding can also be used to hold the girts straight and plumb.

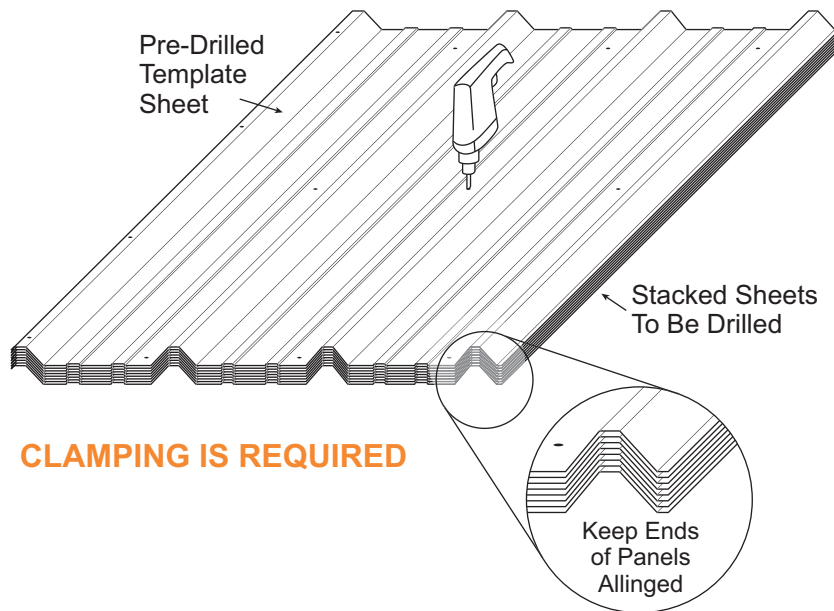


Typical construction of the wood blocking is show below. A 2" x 4" minimum board size should be used. Refer to the cross section framing drawing that accompanied the building to determine the girt spacing.

**NOTE: Blocking should be secured to prevent falling hazzard.**

## SCREW ALIGNMENT

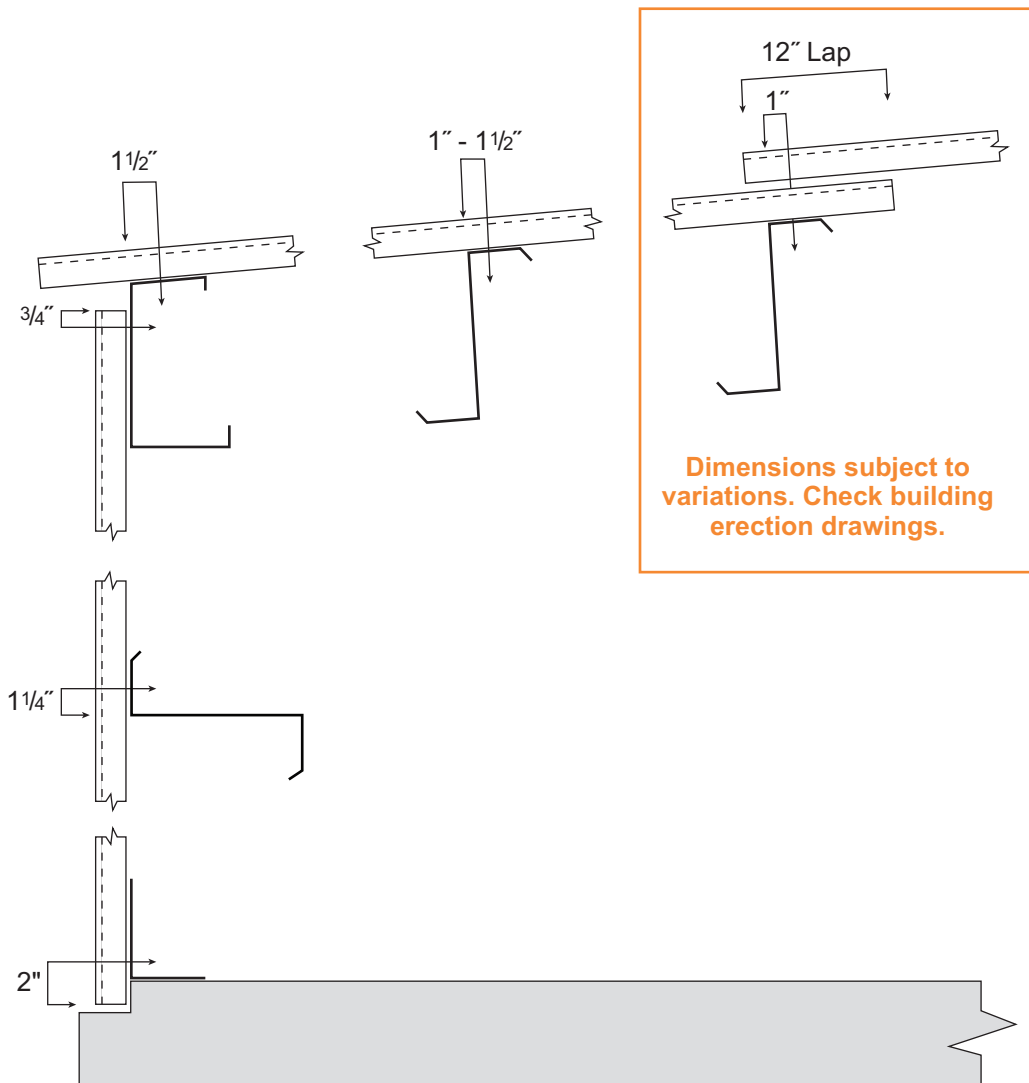
Good alignment of the screws, especially on the wall panels, will give a professional appearance to the wall panel installation. One way this can be accomplished is by pre-drilling holes in the panels at identical locations. Up to 15 panels can be stacked together and drilled using a template panel. Use 1/8" or 5/32" diameter drill bit for panel to structural fasteners and a 1/4" diameter bit for the sidelap clearance holes. **It is important to clean metal shavings off panel surfaces after drilling to avoid rust stains.**



**CLAMPING IS REQUIRED**

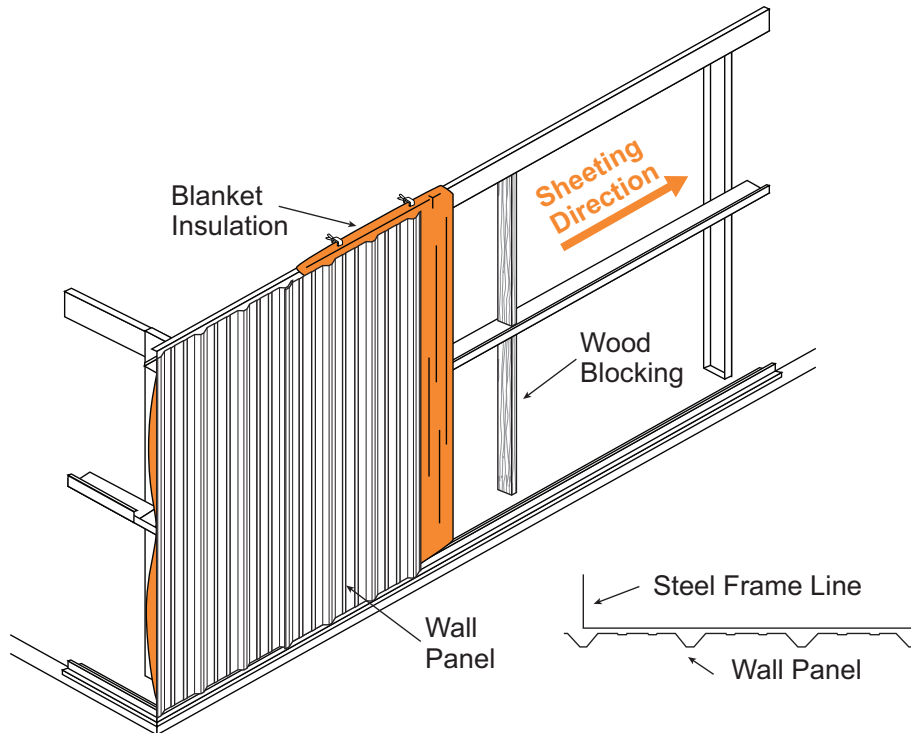
## SCREW ALIGNMENT (CONTINUED)

The template panel should be laid out for the proper screw locations in accordance with the building erection drawings. Since pre-drilling will “hand” the panels, it will also be necessary to select the end of the building from which the paneling is to begin. Before drilling the template panel, it should be checked for proper hole locations against the building framework. Be sure there is no excessive deflection in the purlins and girts.



## INSTALLATION OF WALL PANELS

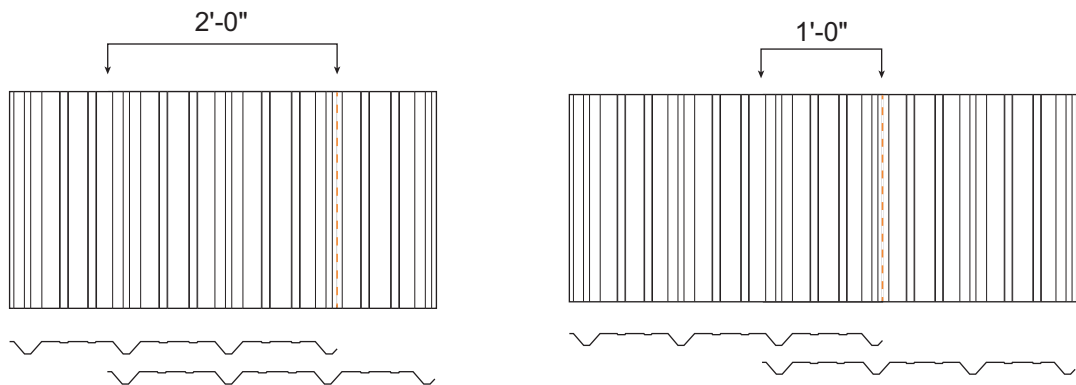
Adjoining panels are installed with the overlapping rib toward the last erected panel. Position panel to structural making sure that it is kept plumb and install fasteners at lapped rib. Check for proper coverage (3' center to center) and correct as necessary. Install remaining fasteners.



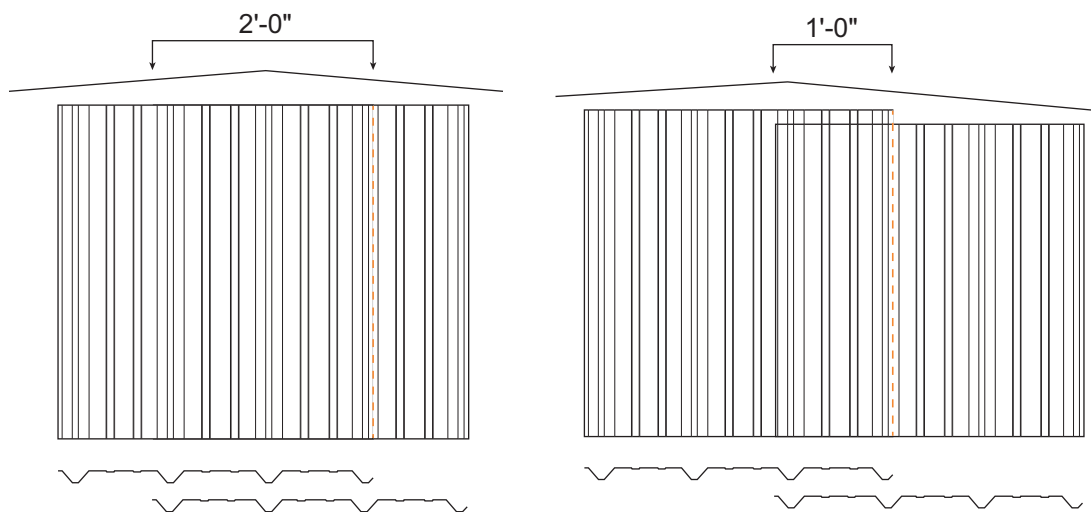
**NOTE: Start first panel with major rib centered with endwall frame.**

## INSTALLATION OF WALL PANELS (CONTINUED)

Backlapping the wall panels 1 foot or 2 foot is routinely done to match panel coverage with the building width and length. On the sidewall this is done with the last panel installed. On the endwall this is normally done near the center and will be marked on the erection drawings.

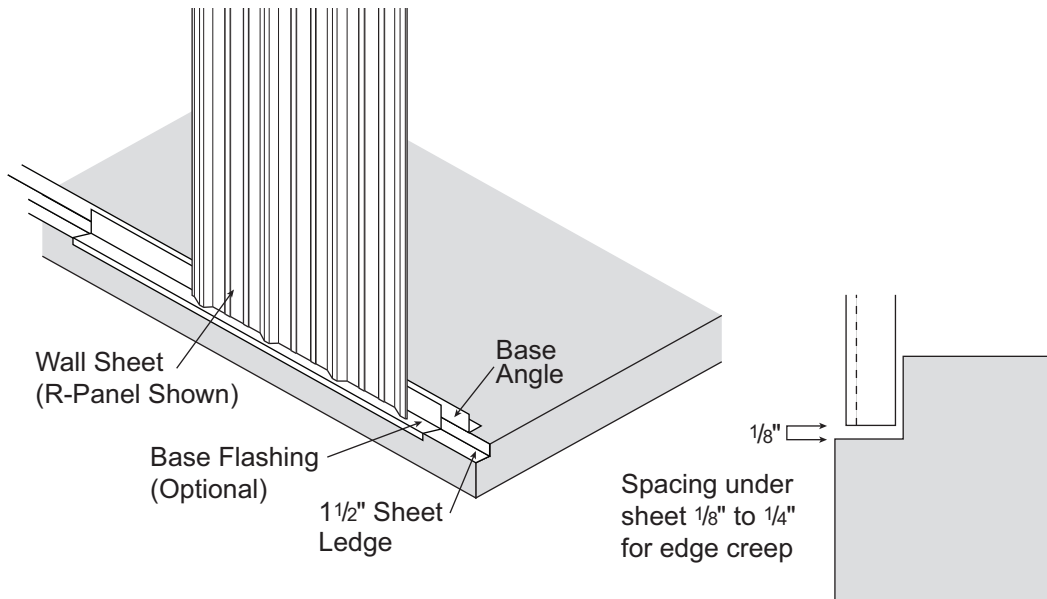


**Sidewall**



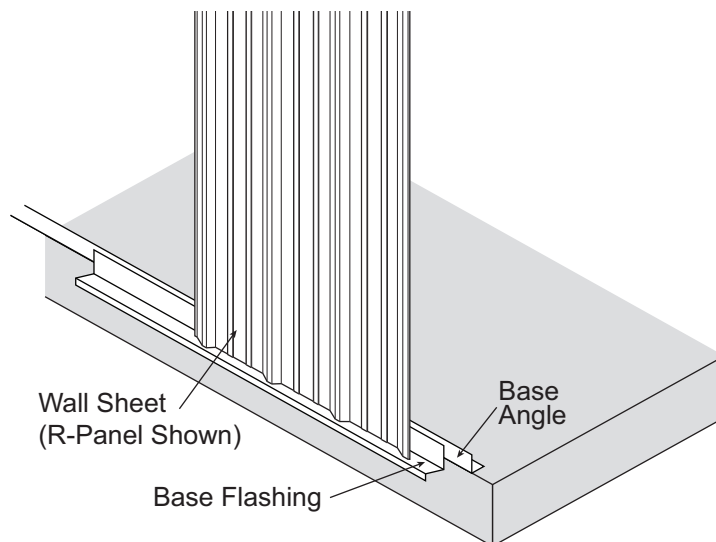
**Endwall**

## STANDARD SHEET LEDGE



**NOTE:** Sheets must be at least two inches off the ground, or rust may occur.

## OPTIONAL SHEET LEDGE WITH EXISTING SLAB



**NOTE:** Sheets must be at least two inches off the ground, or rust may occur.

## FASTENER INSTALLATION

Correct fastener installation is one of the most critical steps when installing roof panels. Drive the fastener in until it is tight and the washer is firmly seated. Do not overdrive fasteners: A slight extrusion of neoprene around the washer is a good visual tightness check.

Always use the proper tool to install fasteners. A fastener driver (screw gun) with and RPM of 1700-2500 should be used for self-drilling screws. Discard worn sockets, these can cause the fastener to wobble during installation.



Correct degree of tightness. Note slight circle of sealant



Too tight! Sealant squeezed too thin. Extrudes far beyond fastener head

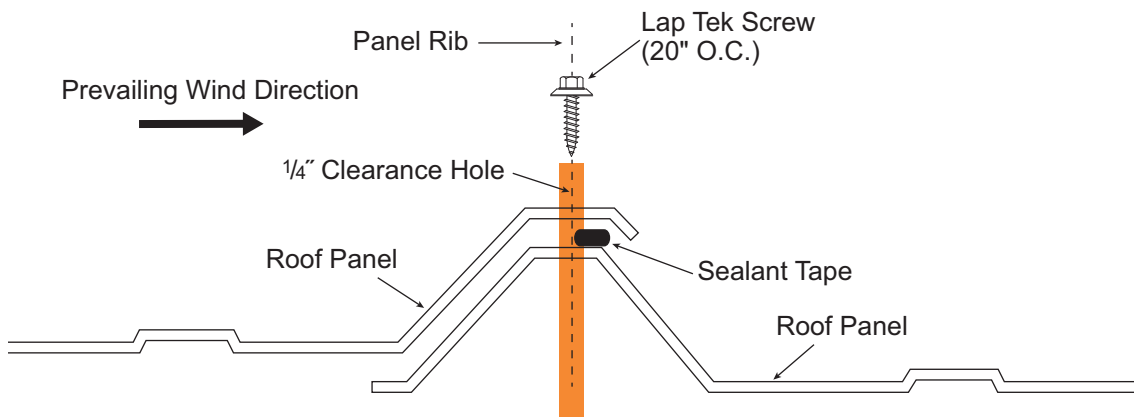


Too loose! Sealant is not compressed to form seal

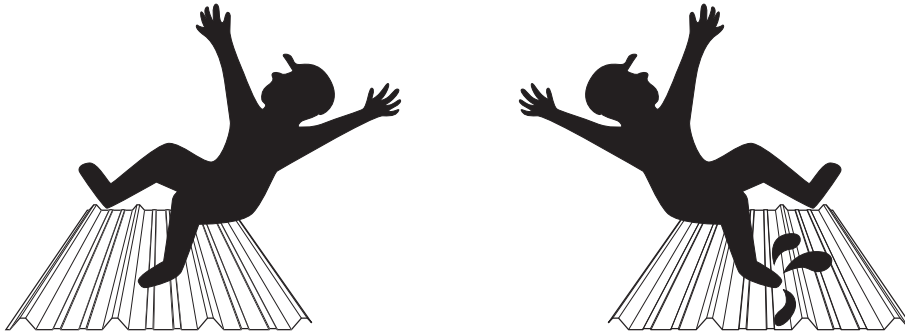
**NOTE: Always remove metal shavings from surface of panels at the end of each work period. Rusting shavings can destroy the paint finish and void any warranty.**

### Sealant Tape

Proper sealant tape application is critical to the weather tightness of a building. Sealant tape should not be stretched when installed. Apply only to clean, dry surfaces. Keep only enough sealant tape on the roof that can be installed in a day. During warm weather, store sealant tape in a cool dry place. During cold weather (below 60 degrees) sealant tape must be kept warm (60 degrees – 90 degrees) until application. After sealant tape has been applied, keep protective paper in place until panel is ready to be installed.



## SAFETY NOTE! CAUTION!!! PANELS MAY BE SLICK



### UNSECURED PANELS MAY SLIP IF STEPPED ON!

Never step on a single unsecured roof panel, or a stack of roof panels laying unattached on the purlins.

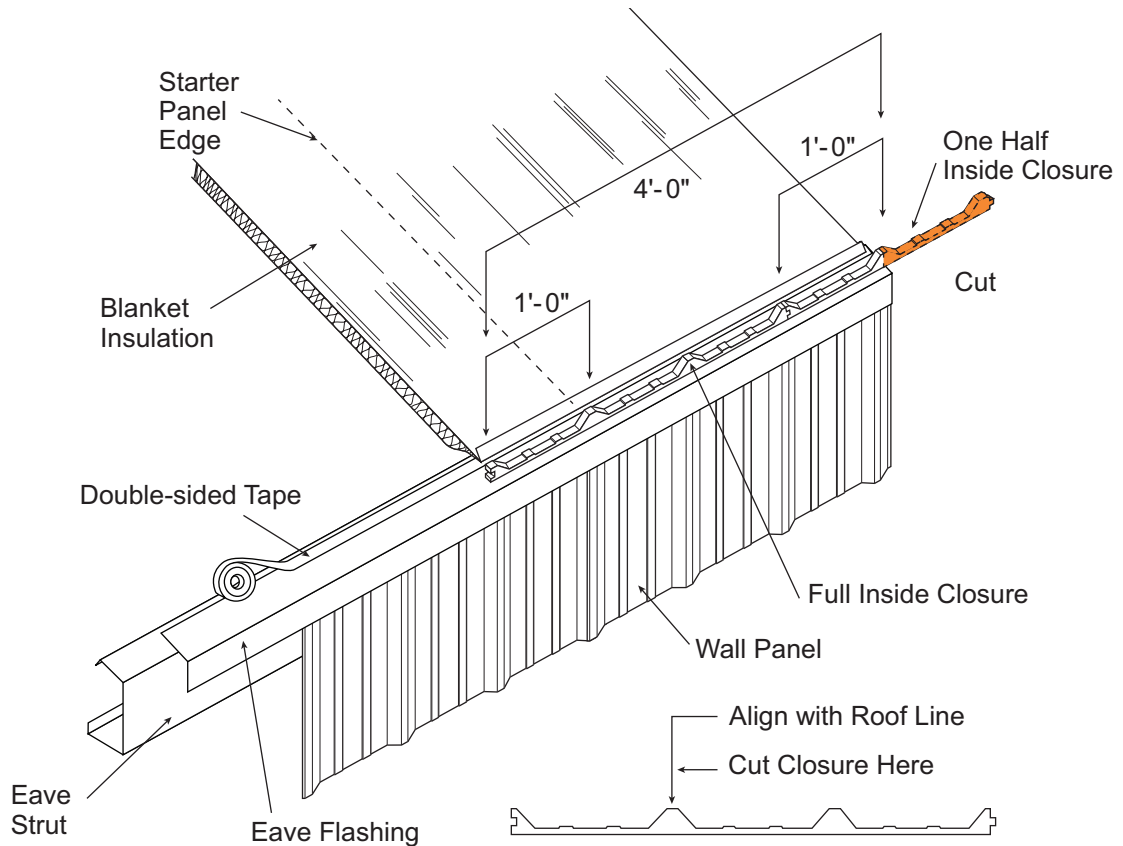
Secure each end of the panel with clamps or appropriate fasteners and place walk boards of adequate size and strength in the flat of any panels not fully secured to the purlins and supported by panels on each side. Walk boards should run the full length of the panel and be fastened together by drilling a hole near the end of each board and tied with rope to the next board. Cut a groove in the bottom of each board so the board will lie flat and not tip back and forth because of the rope.

**NOTE: Always wear rubber sole work boots! When on the roof, use OSHA approved protection devices such as safety lines, safety nets or catch platforms.**



## PREPARING THE EAVE

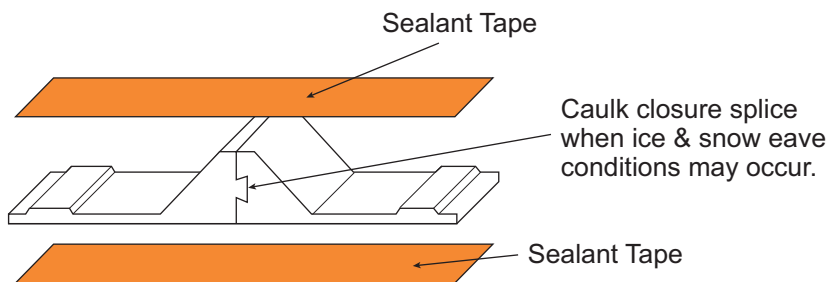
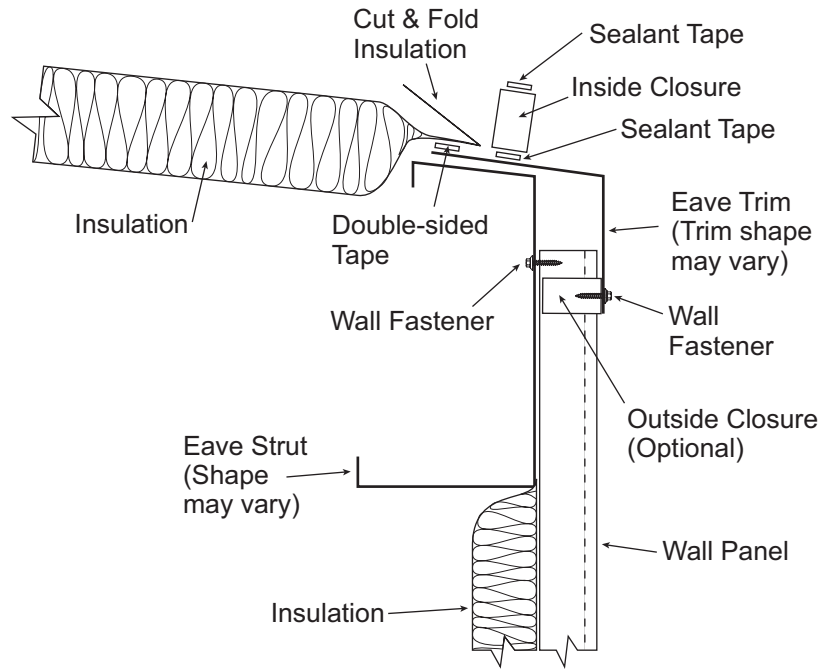
After installing the first run of insulation, prepare the eave for the first roof panel by applying sealant tape along the eave outside of the insulation and leaving release paper in place. Sealant must be applied in a straight line and without voids. Do not stretch the sealant. Use a knife to cut if necessary. Cut an inside closure strip as shown and place starter piece on top of the sealant (removing protective paper from the sealant only as required). Center the first major rib with edge of the endwall frame. Splice a full closure to the starting closure and apply along the top of the eave sealant. If roof is subject to ice and snow build-up, the splice in the closure strip must be caulked to ensure weathertightness.



**NOTE: Insulation has no load bearing strength. Maintain body weight on approved scaffolding or walk boards.**

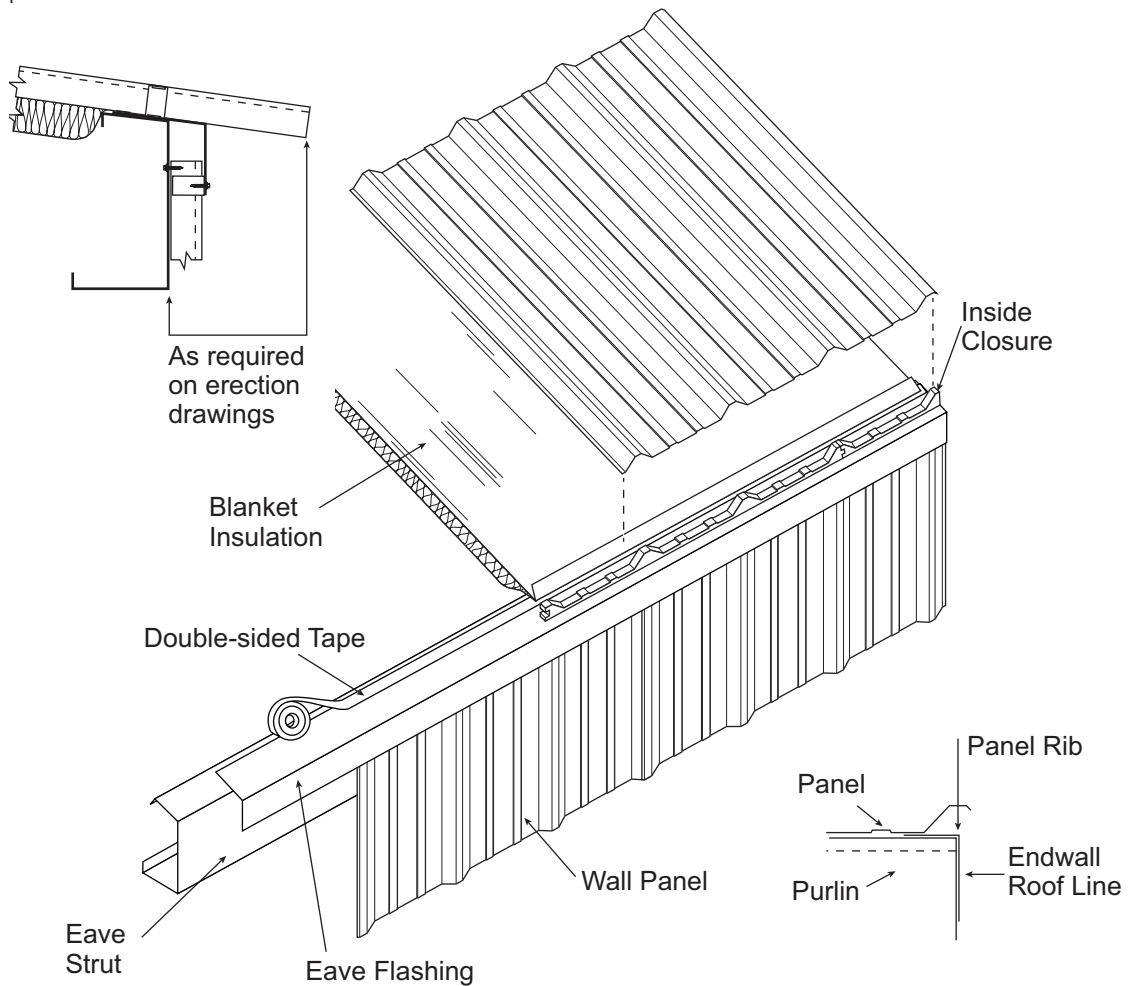
## PREPARING THE EAVE (CONTINUED)

Along the top of the closures that have been placed along the eave, apply a second run of sealant tape. Prior to removing paper backing, check and mark for proper alignment of the first roof panel. Continue sealant tape and closure run along eave in preparation for the next roof panel.



## INSTALLATION OF FIRST ROOF PANEL

Once the eave is prepared, the first roof panel may be installed. Check the erection drawings to determine the roof overhang at the eave. Set the roof panel in place over the inside closure (after removing the paper from the sealant tape) ensuring the major ribs of the panel nest properly with the inside closure. Align the center of the major rib of the panel edge with the edge of the endwall roofline. With the panel properly placed, secure the panel to the structure with appropriate fasteners. If the building requires more than one panel per run, do not install fasteners at the purlin located at the upslope end of the panel. These fasteners will be installed after the overlapped panel is installed.

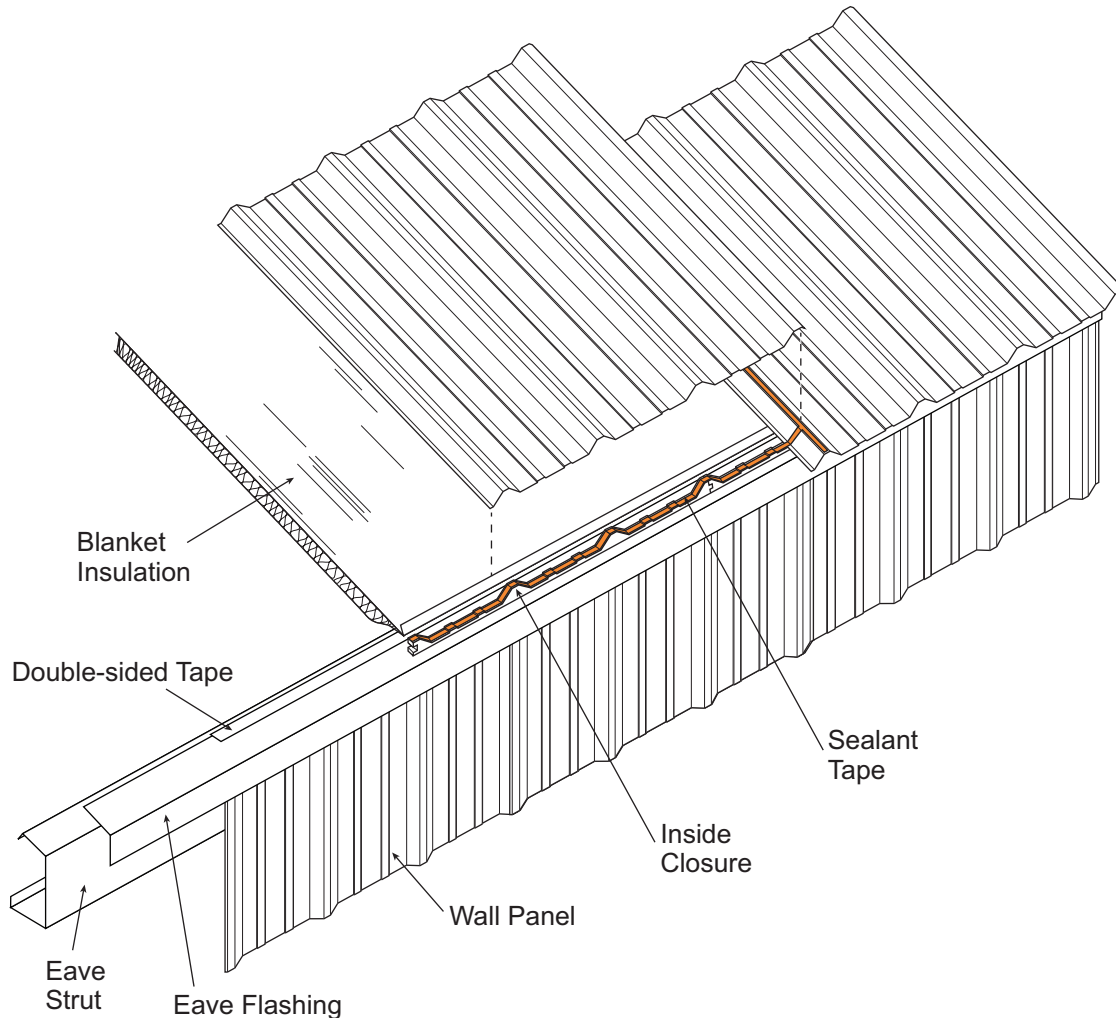


**NOTE:** For a professional finish, roof panel ribs should be in line with wall panel ribs.

**WARNING!** Do not walk on unsecured panels. Wipe oil and other slippery substances from roof panels. **SAFETY FIRST!**

## INSTALLATION OF ROOF PANELS

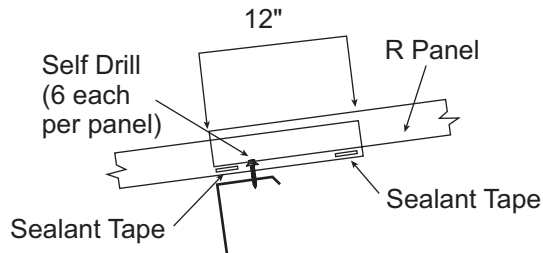
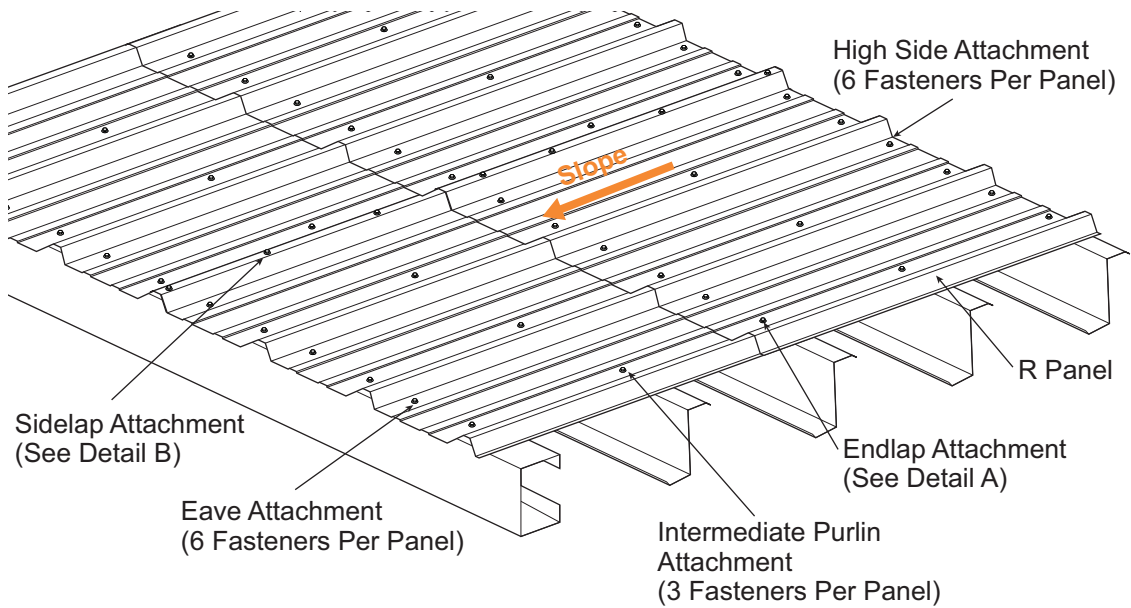
With the first panel run installed and secured, and sidelap sealant applied, the second panel run may be started. Prepare the eave with an inside closure and sealant tape as shown previously. Position the panel so the overlapping ribs will nest properly. Be sure to check for proper overhang and panel coverage. Lap screw the major ribs of the two panels together, and fasten panel to the purlins.



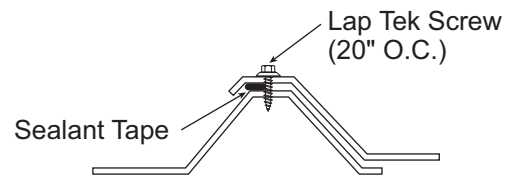
**NOTE:** If peak sheets are being used at the ridge, it is critical that the ribs on the roof panels from both sides align.

**WARNING!** Sweep up all drill shavings from panels at the end of each work period to minimize surface rust and damage to panel finish.

## “R” PANEL



**Detail A**



**Detail B**

### Sidelap

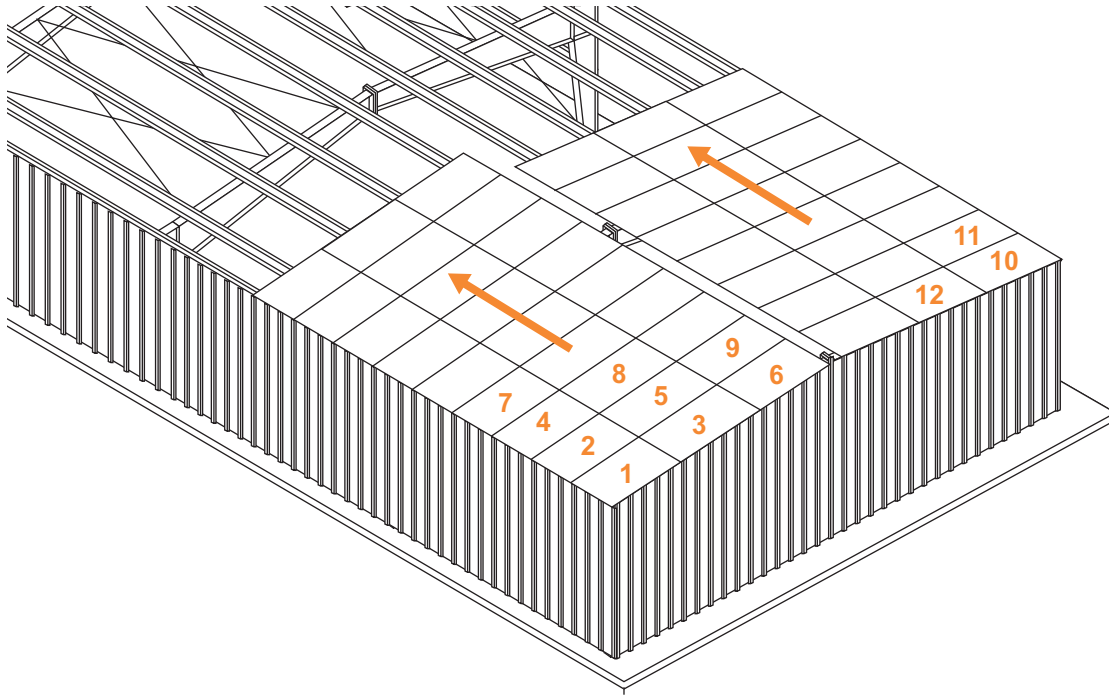
1. Sealant tape must be installed between weather infiltration point and fastener.
2. Install Lap Tek fasteners at 20" on center.
3. When possible, install panels such that sidelaps are nested away from prevailing winds.

### Endlap

1. Double bead sealant tape must be installed between weather infiltration point and fastener.
2. Install self-drilling fasteners on each side of major ribs of panel (two fasteners per foot).

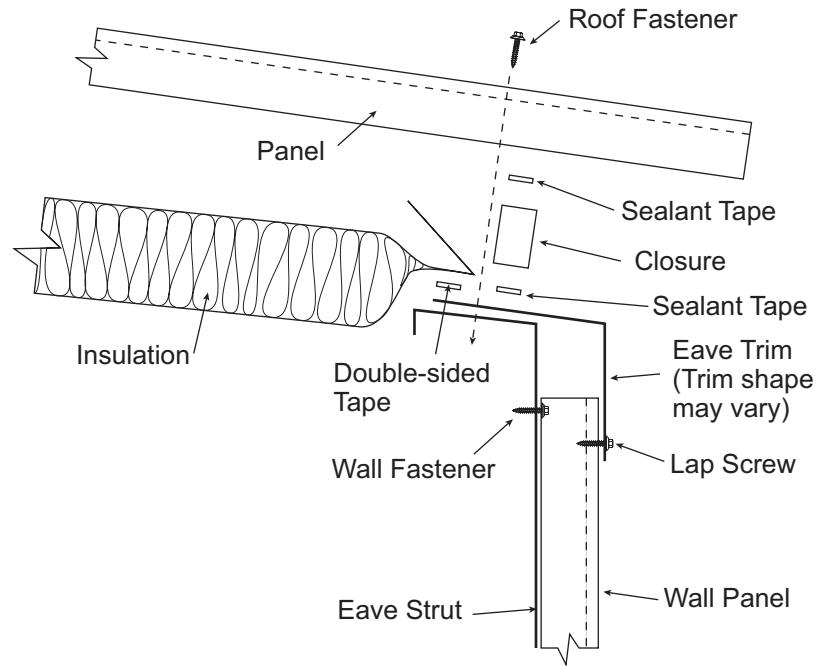
## ROOF SHEETING SEQUENCE

It is recommended that both sides of the ridge of a building be sheeted simultaneously. This will keep the insulation covered for the maximum amount of time and the panel ribs can be kept in proper alignment for the ridge panel. Check for proper coverage as the sheeting progresses. **Note panel-sheeting sequence below.**



**NOTE:** If slippery substances are present on the roof panels wipe them clean immediately to prevent slipping or falling. Workers should maintain a constant awareness of their location relative to the roof edge.

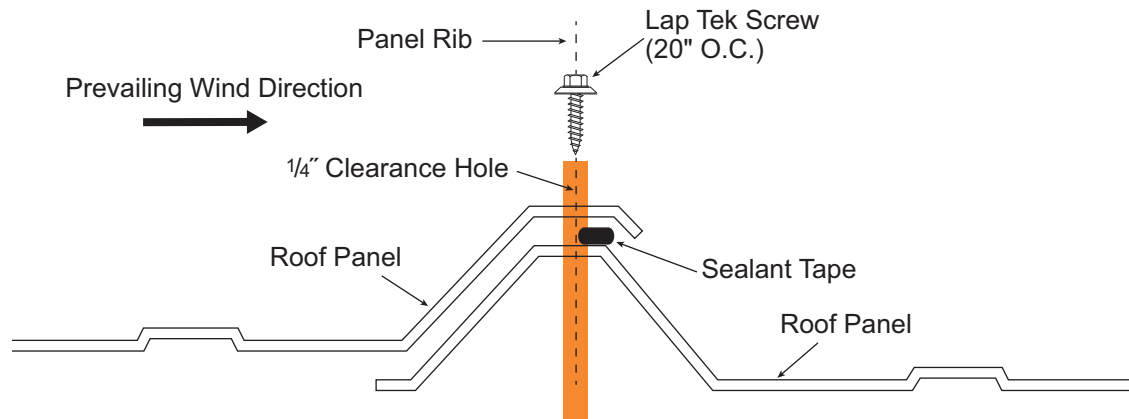
## SECTION AT EAVE



**NOTE:** Check erection drawings for appropriate overhang dimensions.

## SEALING THE SIDELAP

Apply the sidelap sealant tape to the weather side edge of the lower panel's major rib as shown. The sealant tape should only be applied to clean, dry surfaces. With the release paper in place, press firmly along the length of the sealant to ensure proper adhesion. In removing the protective paper from the sealant tape, care should be taken not to pull the sealant tape away from the panel. Install the adjoining panel positioning the overlapping rib with care.

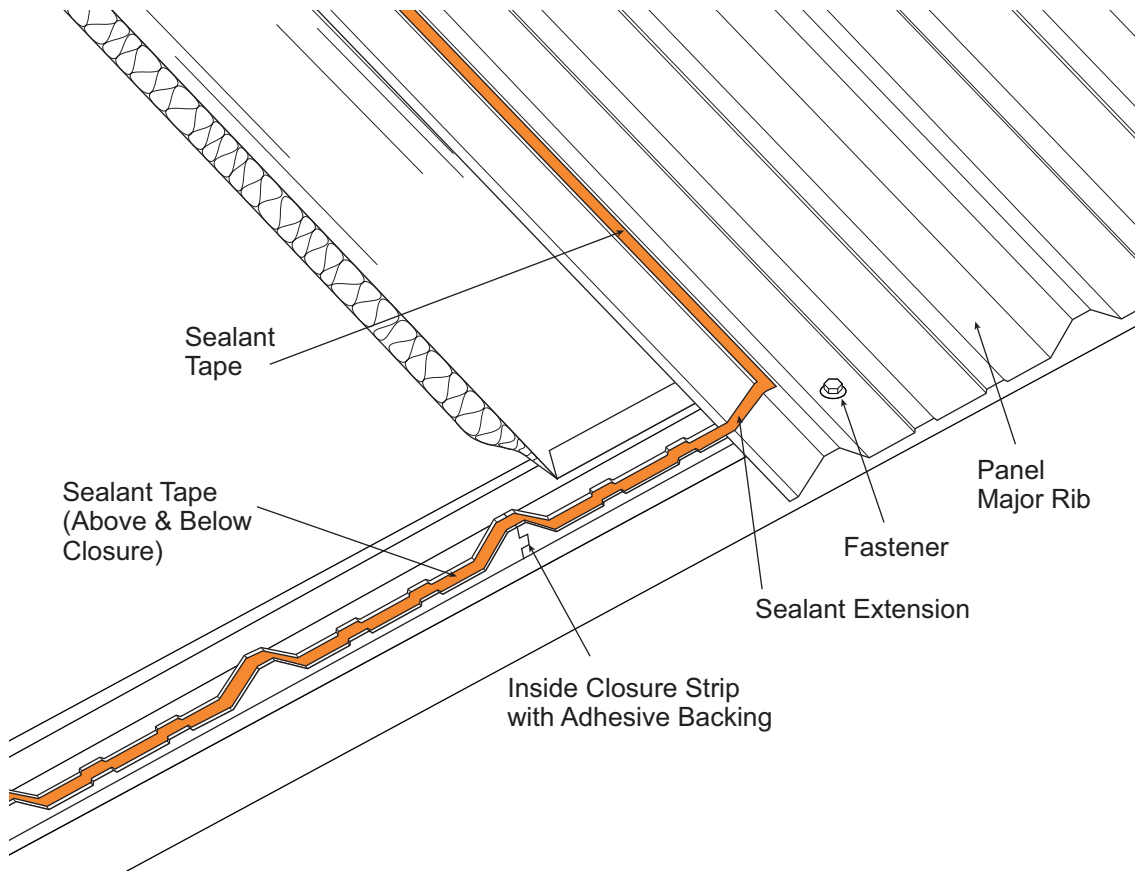


**NOTE: Sweep up all drill shavings from panels at the end of each work period to minimize surface rust and damage to panel finish.**



## SEALING THE EAVE

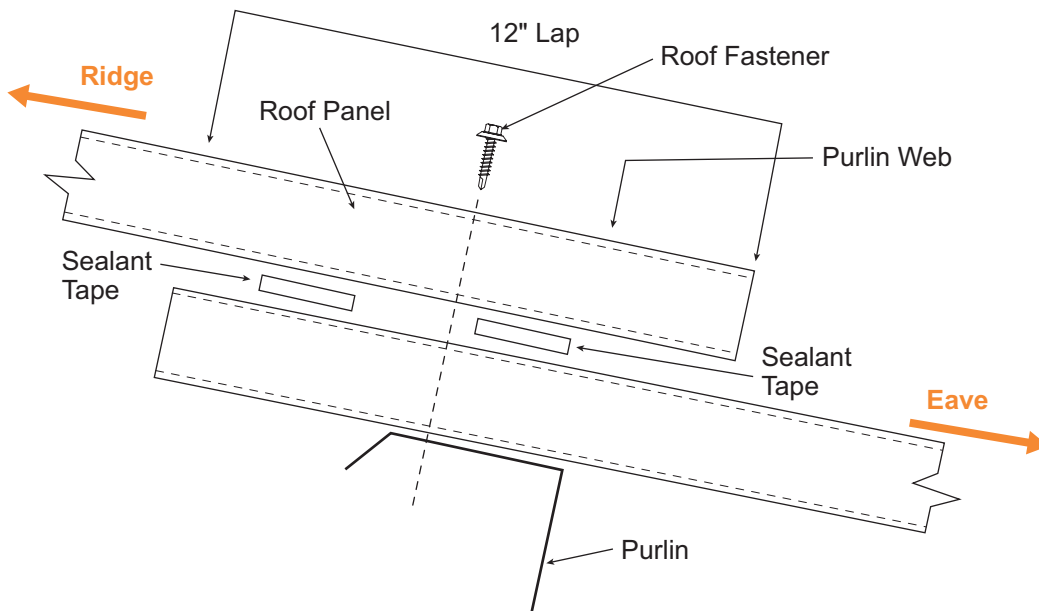
Sealant tape location at the eave is critical. To ensure a weather tight seal, the sidelap sealant must extend down from the top of the rib to the sealant on the eave closure. The sealant extension must splice into the eave sealant tape.



**NOTE:** Workers should maintain a constant awareness of their location in relation to the roof edge at all times.

## SEALING THE ENDLAPS

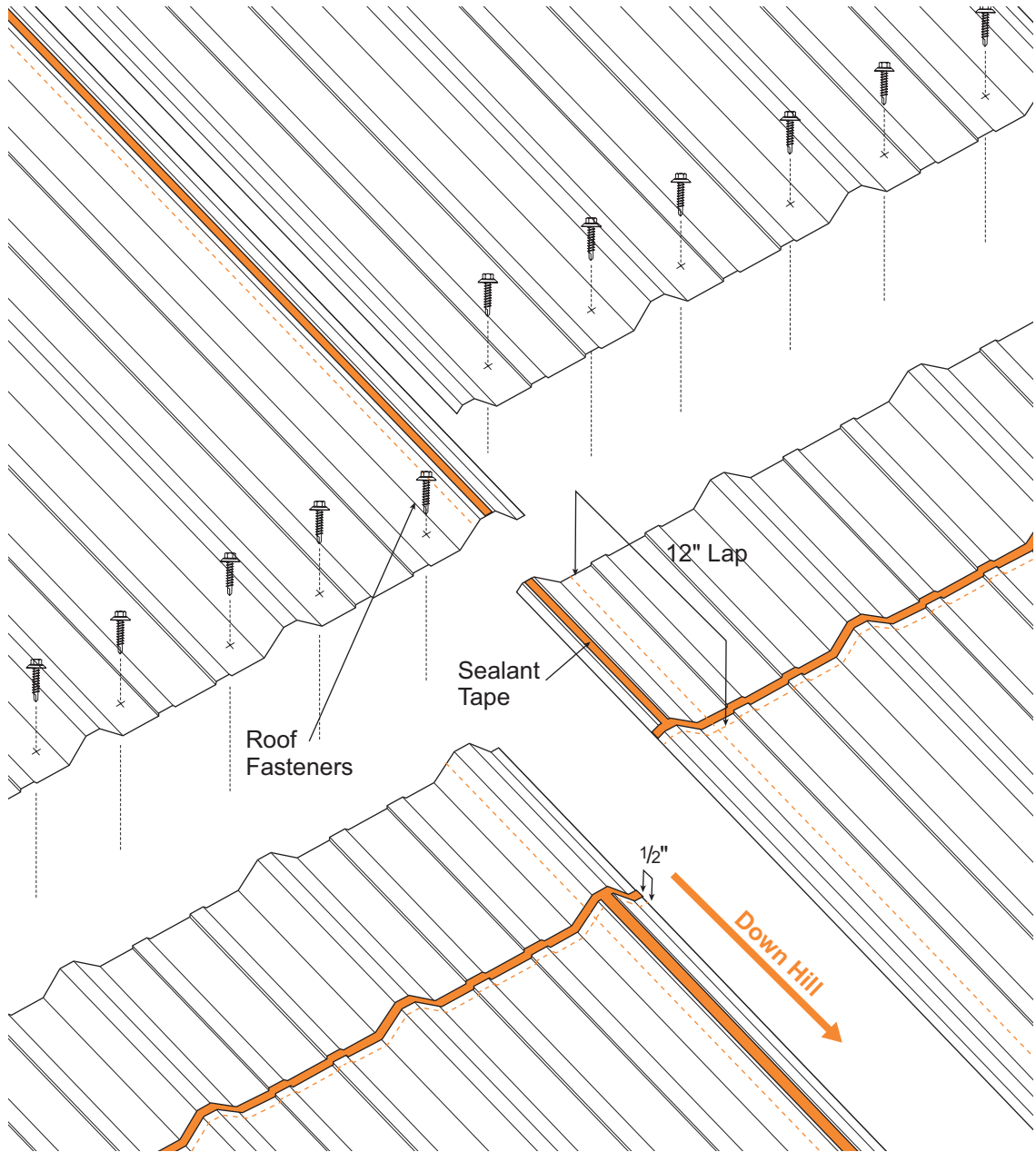
At the panel endlaps place a run of sealant tape across the full panel width  $\frac{1}{2}$ " below the fastener line. The panel endlaps have a 12" minimum overlap located over a purlin as shown. Locate the fasteners 1" above the purlin web according to the fastener layout.



**NOTE: Do not step on panel endlaps until fully secure with fasteners.**

## PANEL ENDLAPS AND TRANSLUCENT PANELS

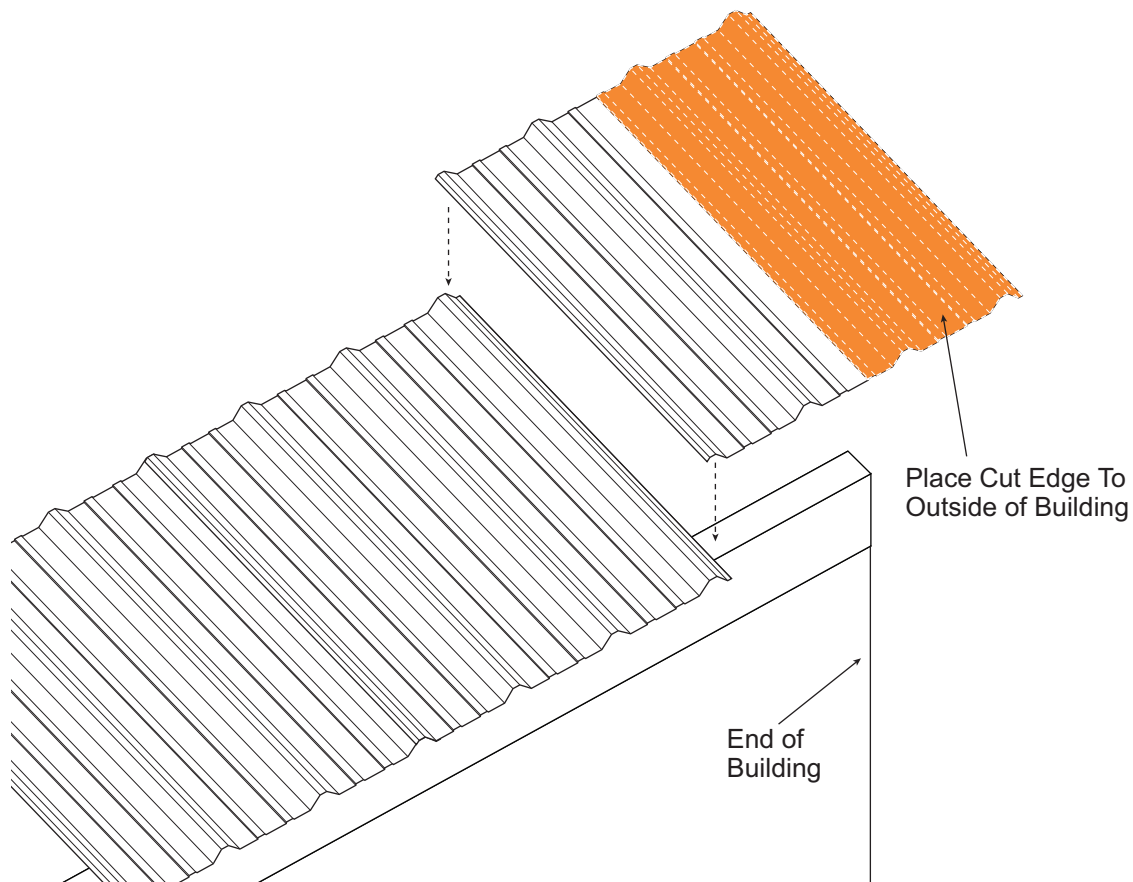
Apply sealant tape to far side of major rib to complete seal at panel lap.



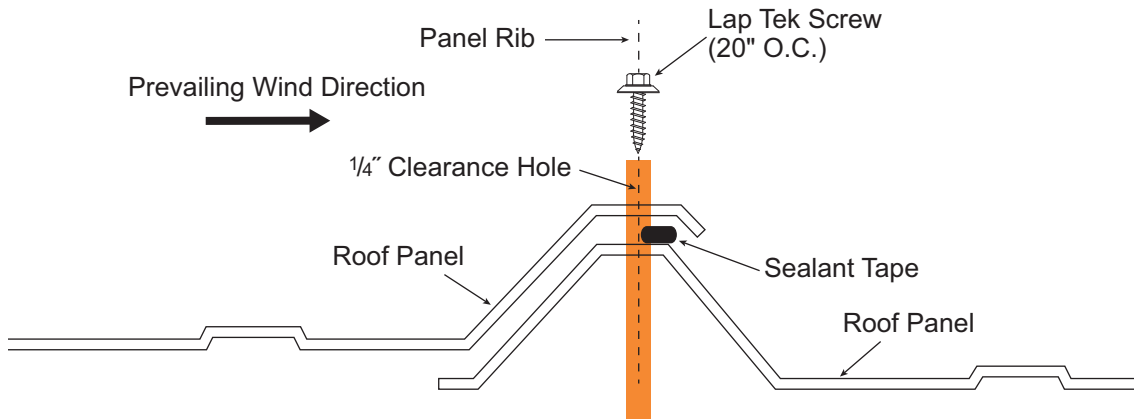
Screw pattern repeats on the upper, middle and bottom purlins of all translucent panels.

## INSTALLATION OF FINAL PANEL

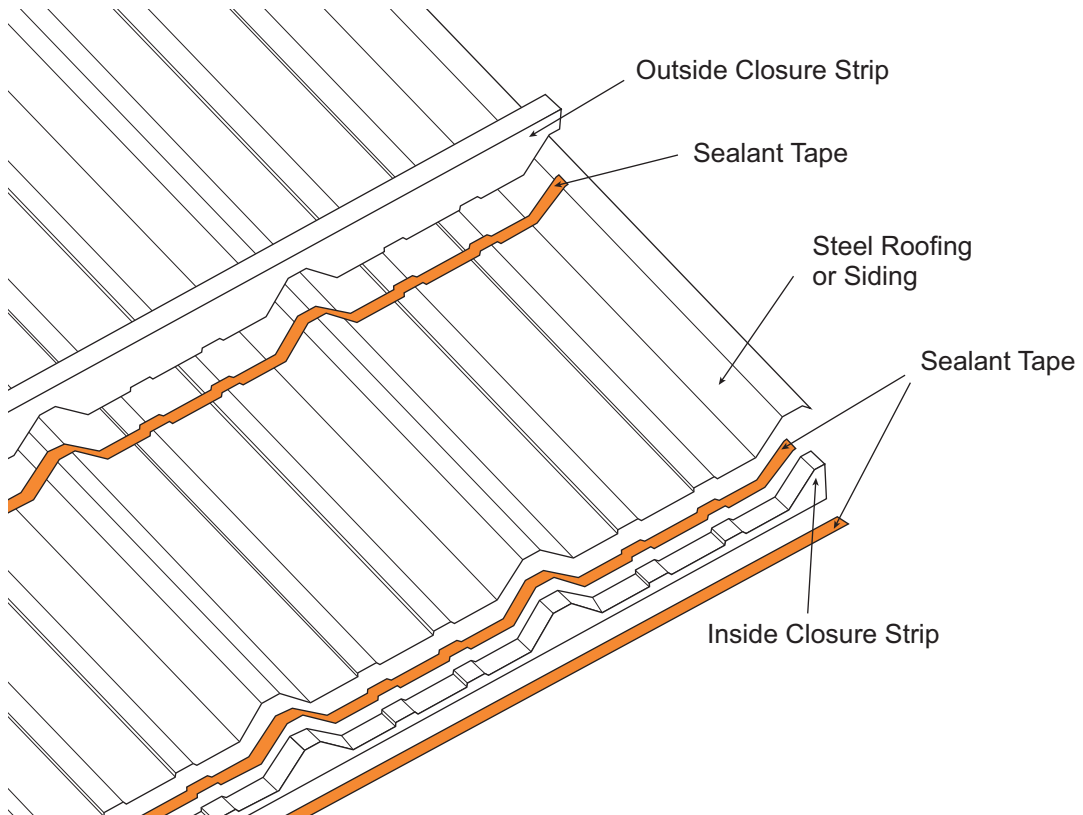
While backlapping the last roof panel (to match panel coverage with the building length) is routinely done, this installation method can compromise the integrity of the roof by trapping moisture between the panels. This moisture could, in time, create an environment conducive to rust and metal failure. **Manufacturer recommends field cutting the final panel lengthwise to create the desired panel width necessary to finish off the building.** The cut edge of the panel should always be installed on the outside edge, not the lap edge. The “narrow” panel should be handled with care, and foot traffic avoided until the final panel is completely installed.



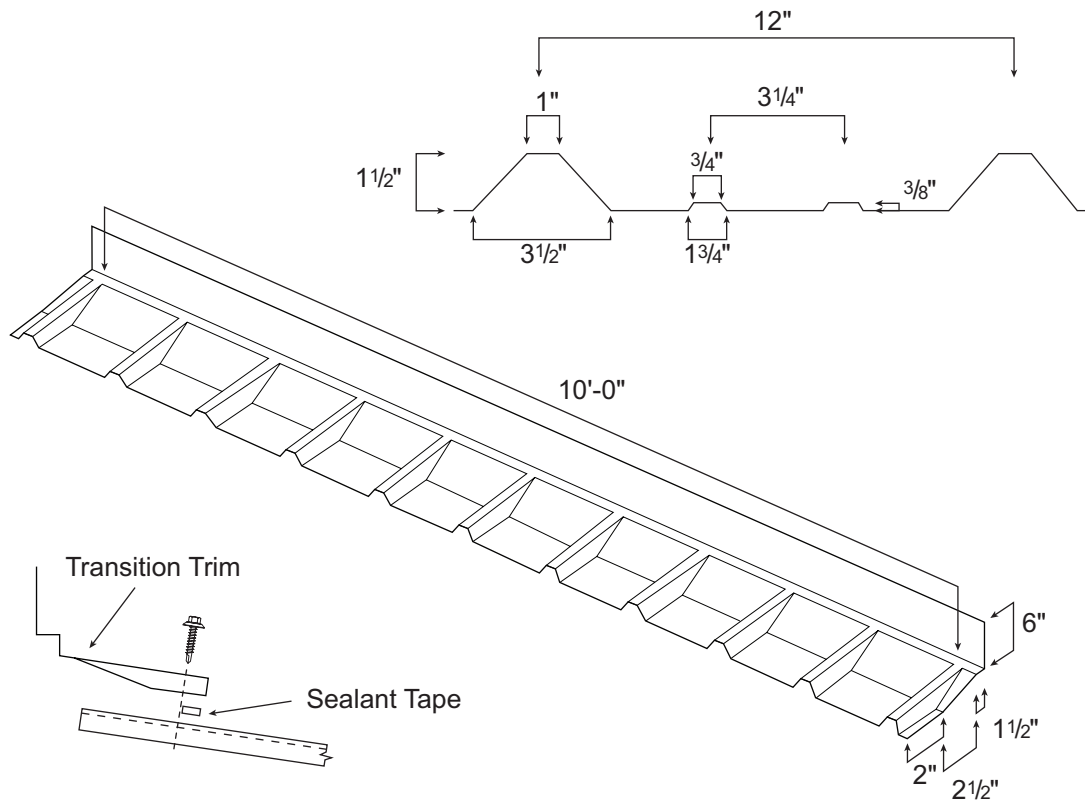
## ROPE SEALER PLACEMENT



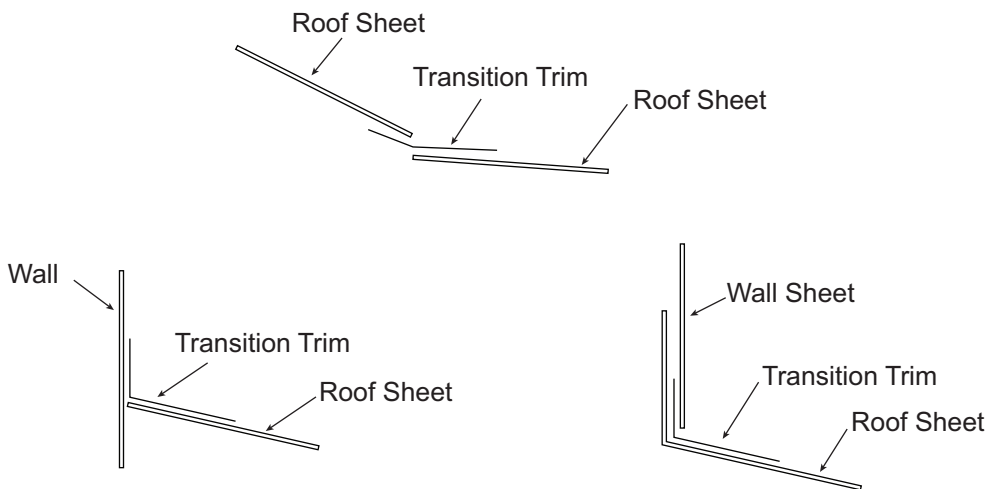
### Inside & Outside Closure Placement



# DIE FORMED TRANSITION TRIM



## Multiple Uses



## SAFETY PRECAUTIONS FOR ROOFING WORK

Manufacturer strongly recommends that erection employees be continuously trained in safe and productive work practices. Working on the roof area in the installation of roof structurals, insulation or roof panels requires proper training, correct equipment and constant alertness to minimize the danger of falls. Hard hats should be worn on job sites to prevent injury from falling objects. Safe work practices on all erection duties should be carefully reviewed with erection crews prior to beginning each job.

**NEVER STEP ON SKYLIGHTS OR TRANSLUCENT PANELS!**



**WARNING! Panels May Collapse If Not Properly Secured.**

Roof panels must be completely attached to the purlins and to panels on either side before they can be a safe walking surface. **Skylights or translucent panels can never be considered as a walking surface.**

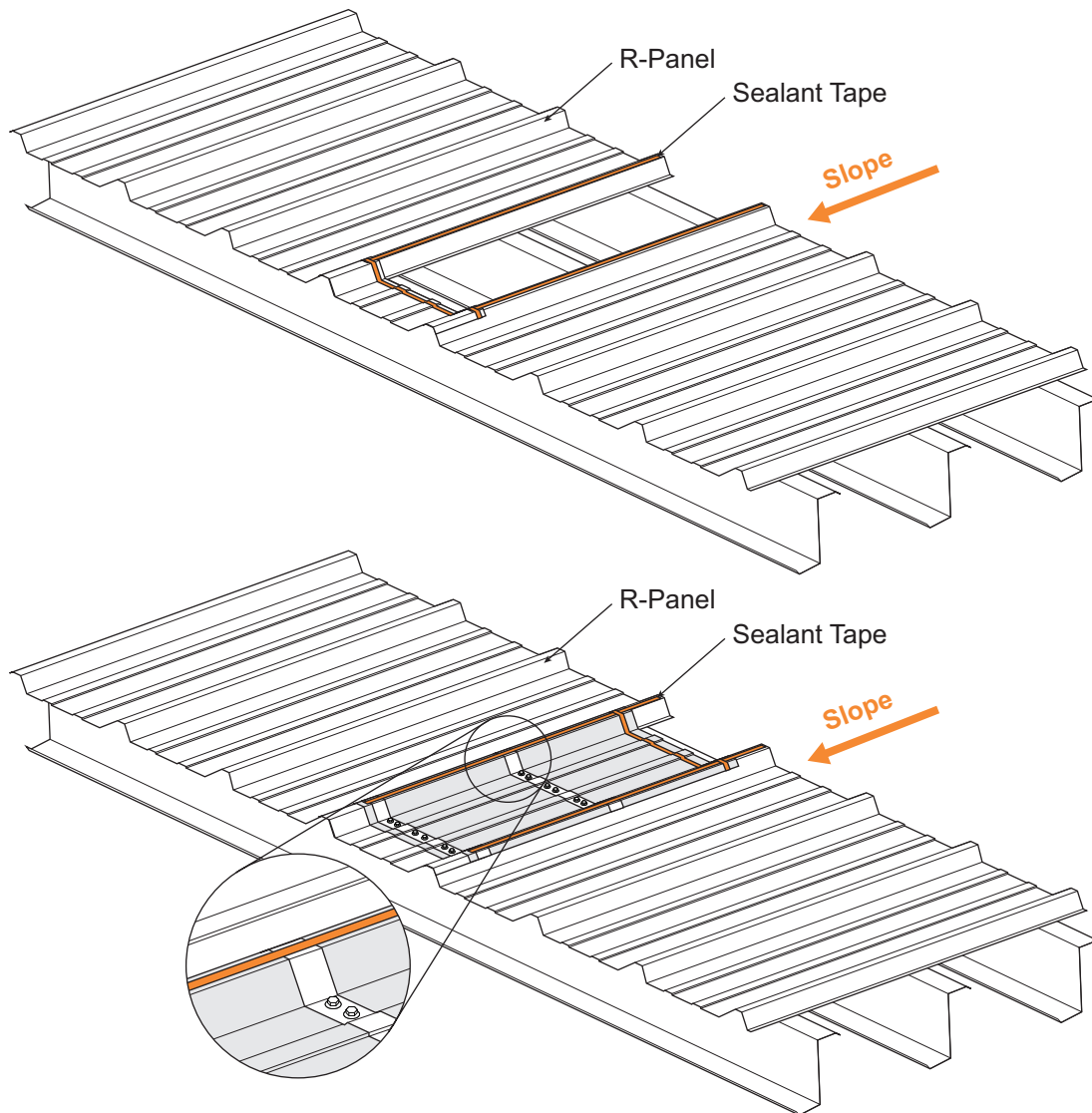
**PARTIALLY ATTACHED OR UNATTACHED PANELS  
SHOULD NEVER BE WALKED ON!**

### **DO NOT:**

1. Step on rib at edge of panel.
2. Step near crease in rib at edge of panel.
3. Step within 5 feet of edge on unsecured panel.

A single roof panel must never be used as a work platform.

## UL 90 TRANSLUCENT PANEL INSTALLATION



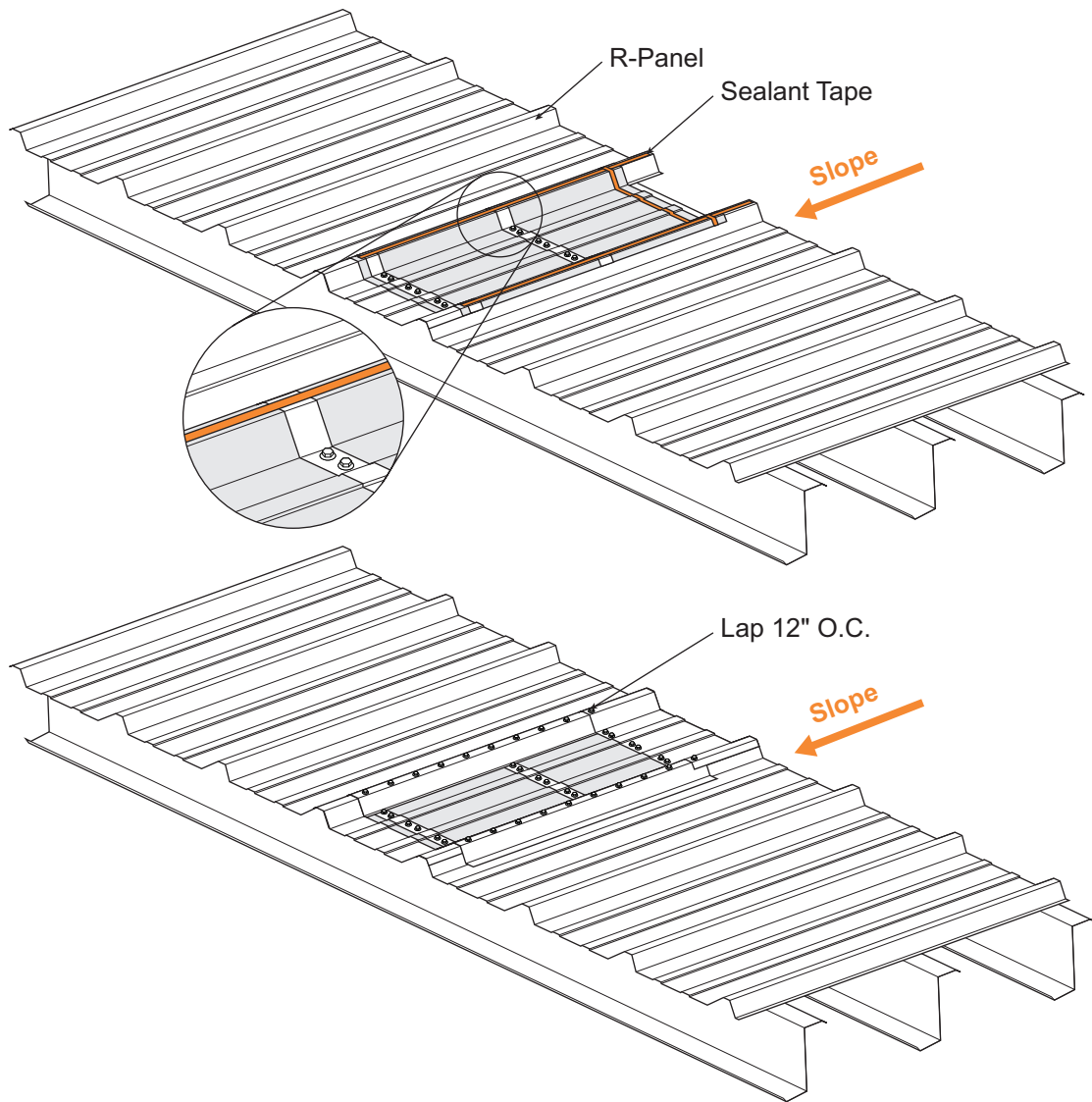
Install roof panels, leaving the light-transmitting panel run open, except for lower light transmitting panel run panel. Install sealant tape to panel sidelaps and across panel width as normal.

Lay light transmitting panel in place overlapping lower metal panel 12". Do not install any fasteners at this time. Install sealant tape down light transmitting panel side laps. Apply double run of sealant tape across light transmitting panel width at lower and middle purlins. Sealant tape should align with beginning and ending edge of top flange of purlin. At the upslope end of light transmitting panel, apply double run of sealant tape for endlap.

Install 3" long pieces of "R" panel over light transmitting panel at the lower and middle purlins. Attach to purlins with six fasteners per piece of "R" panel. Fasteners must go between the two runs of sealant tape that were installed previously.



## UL 90 TRANSLUCENT PANEL INSTALLATION (CONTINUED)



Apply sealant tape across sidelaps of 3" long pieces of "R" panel. Be sure the light transmitting panel sidelaps have a complete run of sealant tape on top of the light-transmitting panel.

Install "R" panel hat section to each side of light transmitting panel with lap screws at 12" O.C. Apply sealant tape down each hat section to just downslope of exposed sealant tape running across light transmitting panel. Also apply additional sealant tape up each side of hat section aligning and sealing to the exposed sealant tape running across light transmitting panel.

Install upper metal panel in light transmitting panel run and fasten as at a normal endlap.

**SECTION**

**F**

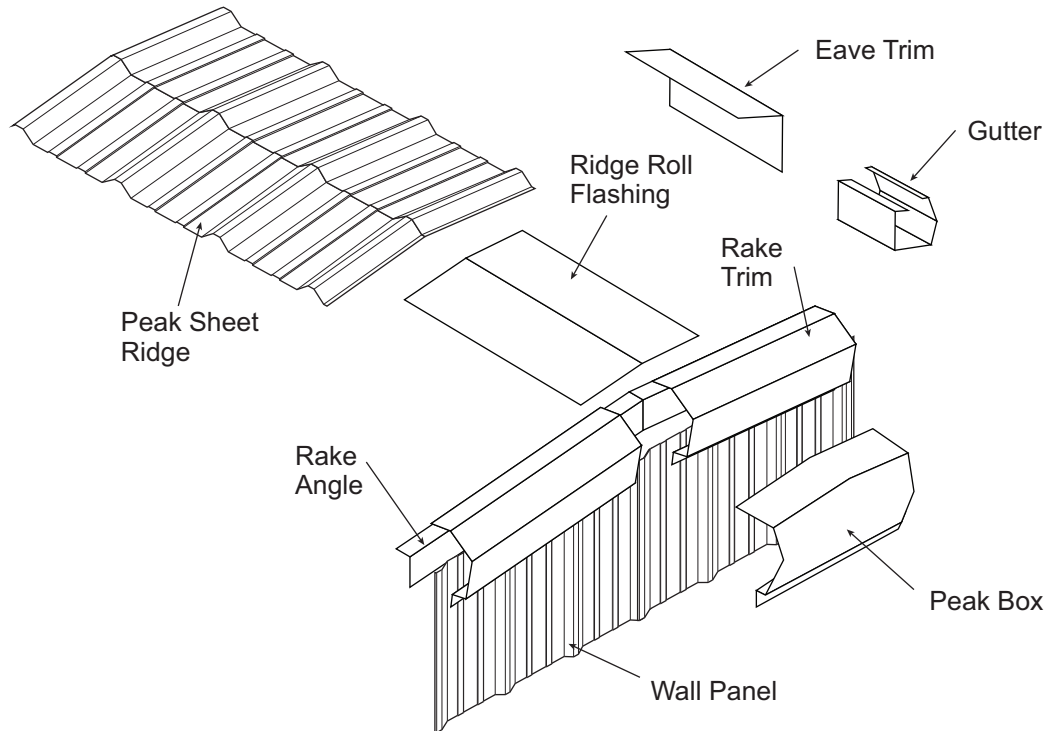
**TRIM**





## FLASHING, GUTTER AND TRIM

The correct installation of flashing, gutters, and trim cannot be overemphasized. The overall appearance of the finished building depends primarily on the quality of the installation of the flashing, gutters and trim. Keep all gutter and flashing lines straight. Make all bends sharp and neat. Be sure edges are not jagged, dented, crimped, or serrated. End joints and laps must be closely controlled.

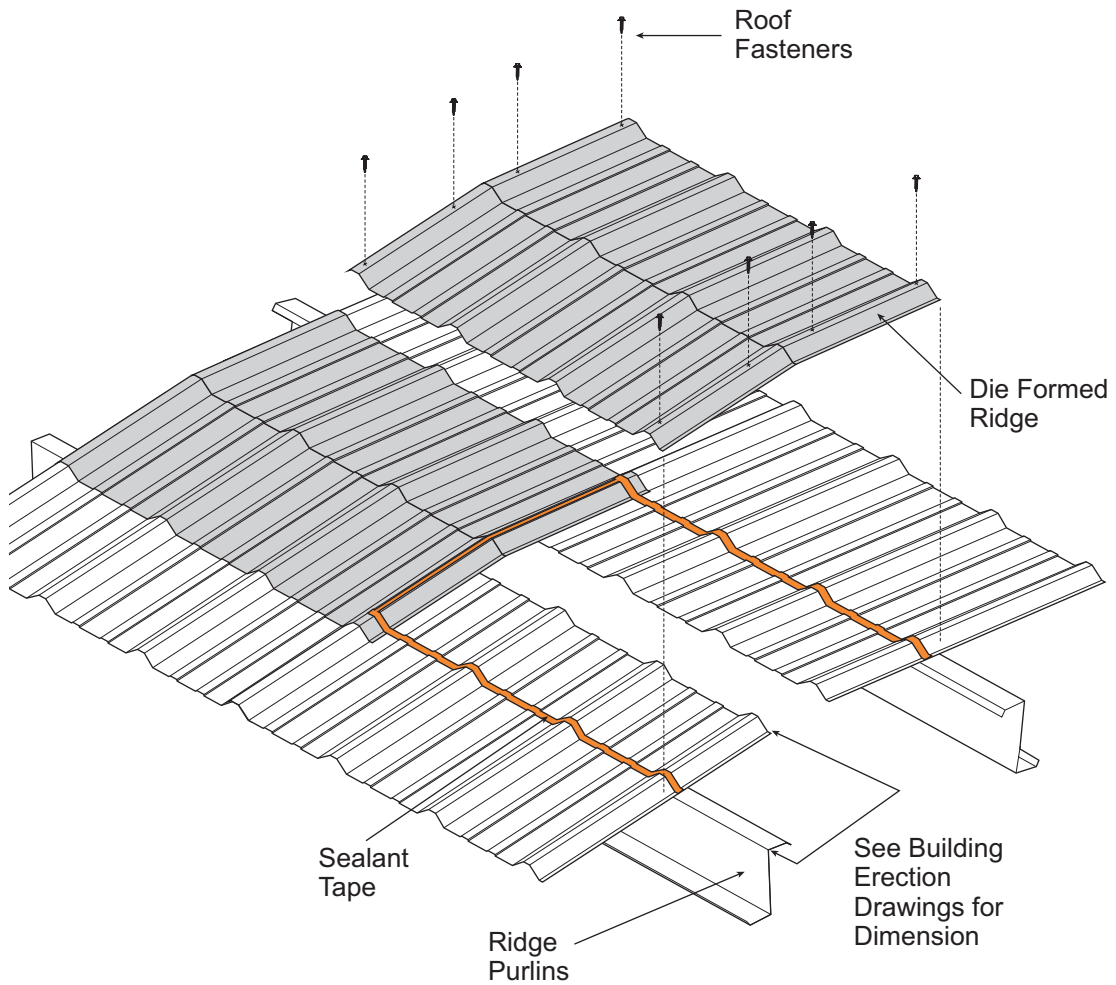


**NOTE:** Flashing should be stored off the ground to avoid moisture and handling damage. Elevate one end of the package above the lower end to encourage drainage in case of rain. Always wear gloves when handling sheet metal.

**WARNING!** Mueller trim comes with a protective film coating to aid in the prevention of scuffing. Do not allow this film to be exposed to the sun. Exposure will bond the film to the metal making removal difficult.

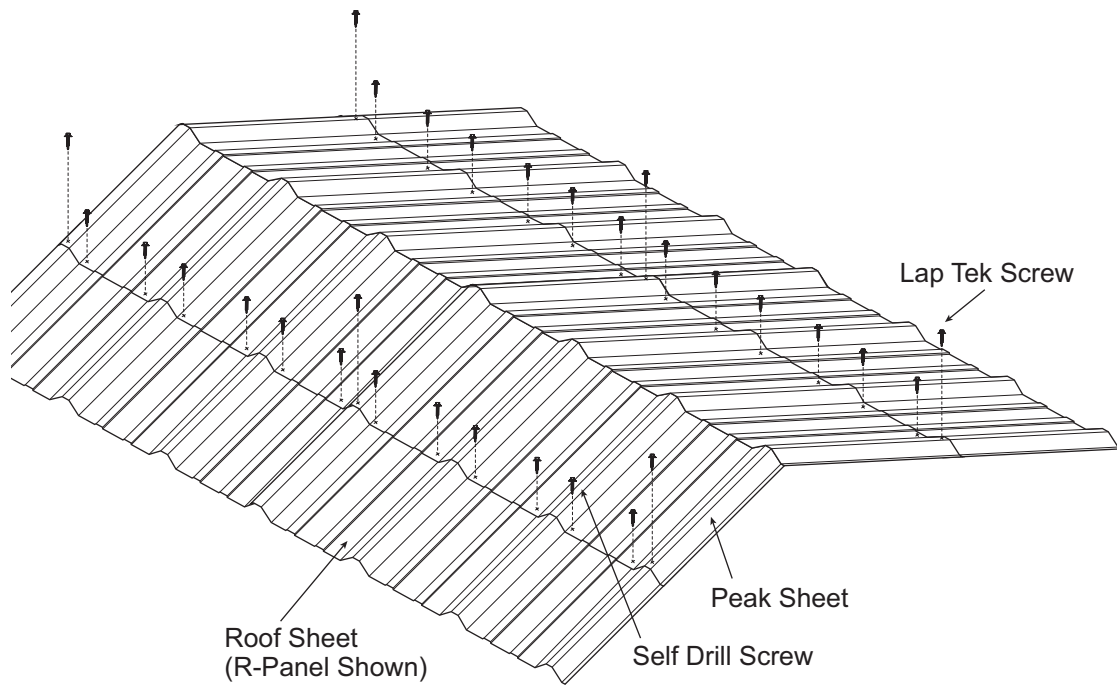
## PEAK SHEET RIDGE INSTALLATION

Peak sheet ridge panels are to be installed as each side of the roof is sheeted. This will aid in keeping both sides of the roof aligned. After having installed a run of panels on each side of the roof, apply sealant to the panels as shown. Set die formed ridge panel in place and install lap and purlin fasteners. Apply sealant tape along the top of the leading rib to prepare for the next sidelap.

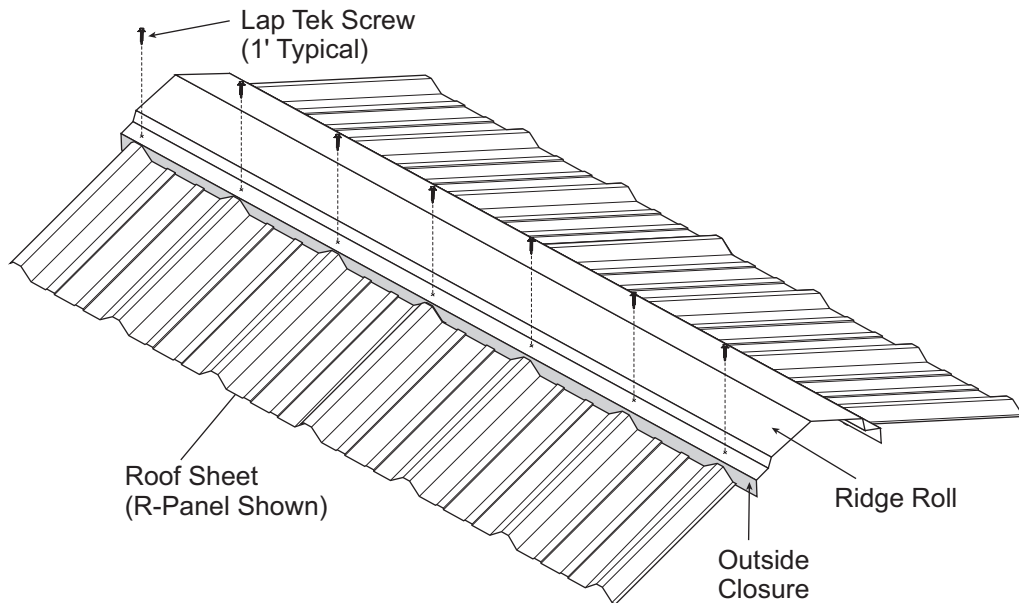


**NOTE: Do not walk on unsecured ends of panels.**

## TYPICAL SCREW PLACEMENT ON PEAK SHEETS



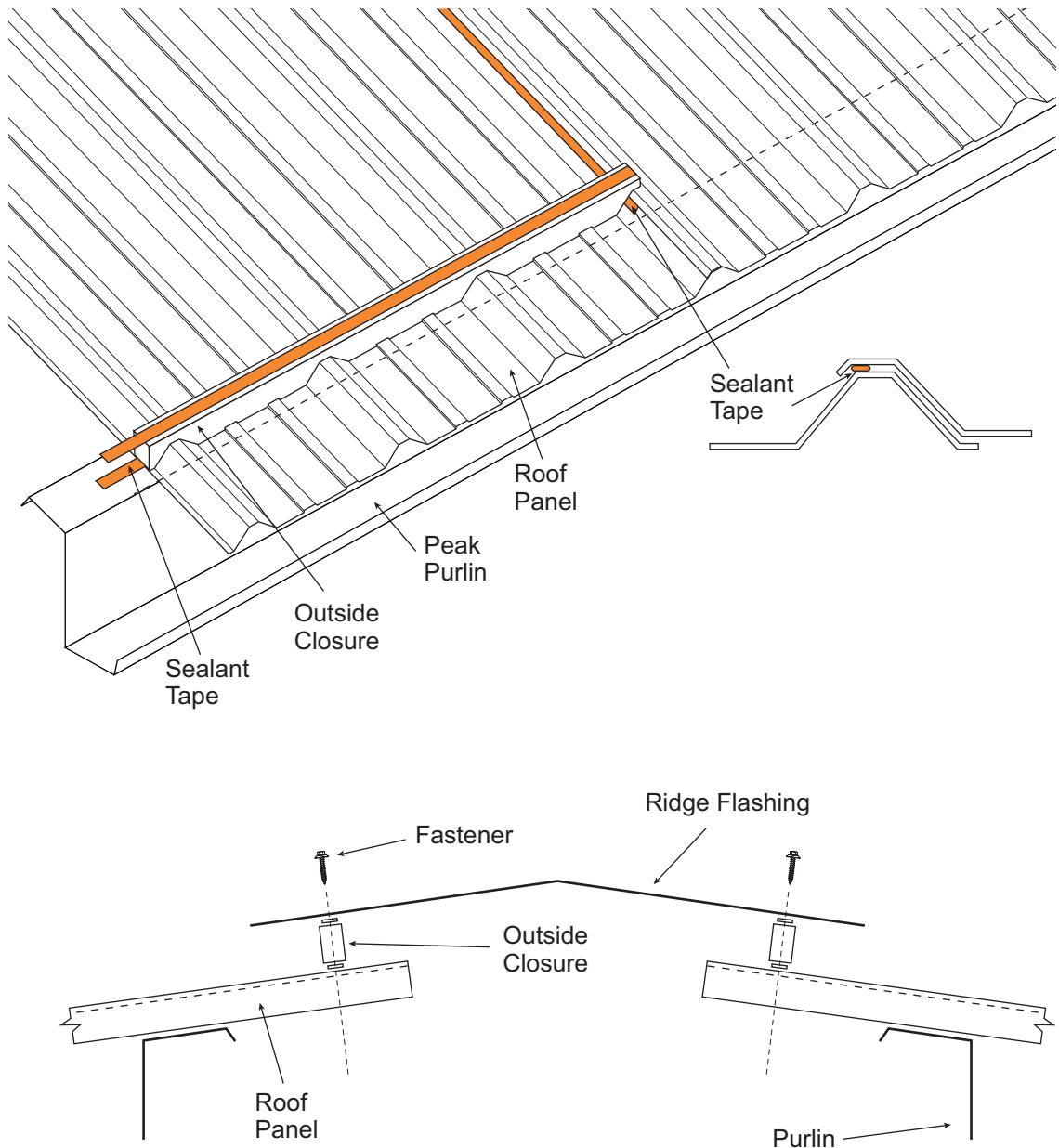
## TYPICAL SCREW PLACEMENT ON RIDGE ROLL



## SEALANT TAPE APPLICATION AT RIDGE FLASHING

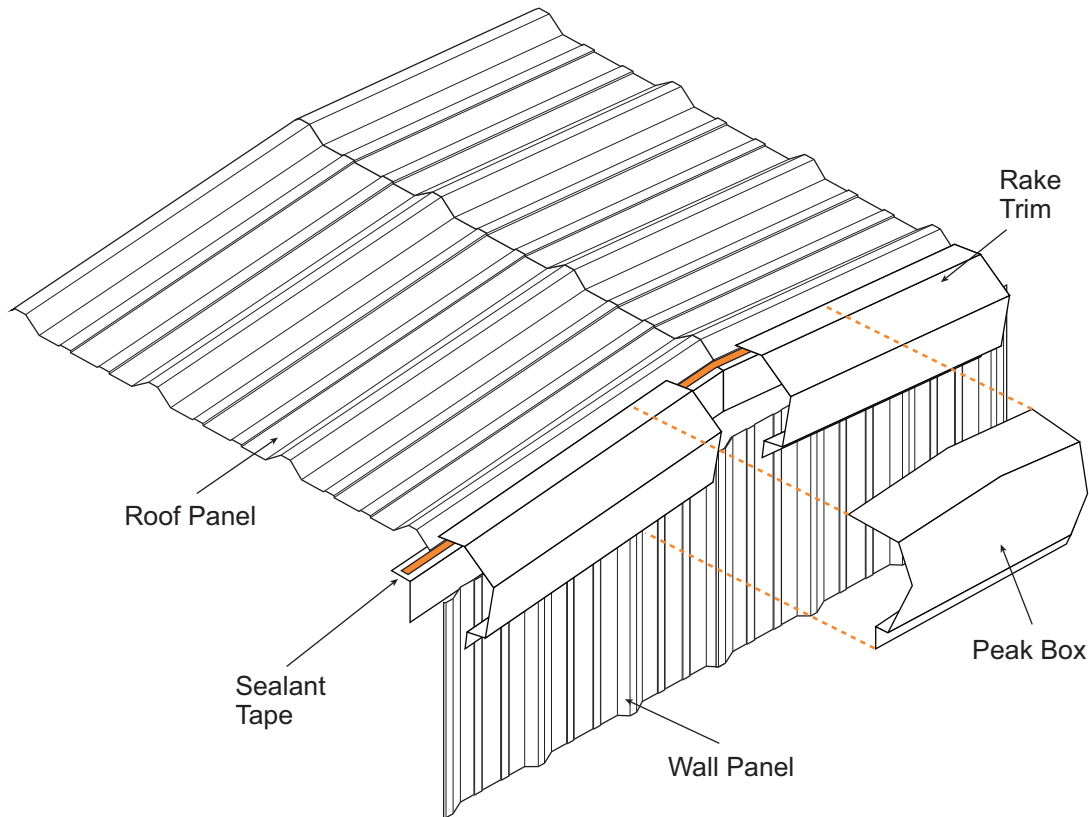
Apply panel sidelap sealant tape as shown for building with ridge flashing and outside closures. The sealant tape is placed along the inside edge of the major rib from the ridge purlin web line to the upper end of the panel.

### Ridge Flashing Detail



## RAKE TRIM AND PEAK BOX INSTALLATION

Rake trim and/or peak box should lap over rake trim a minimum of 2 inches. Attach to wall panel with lap tek screws. Peak box may be attached to rake trim with lap tek screws or rivets. Seal the connection at the roof panel with sealant tape or caulk.



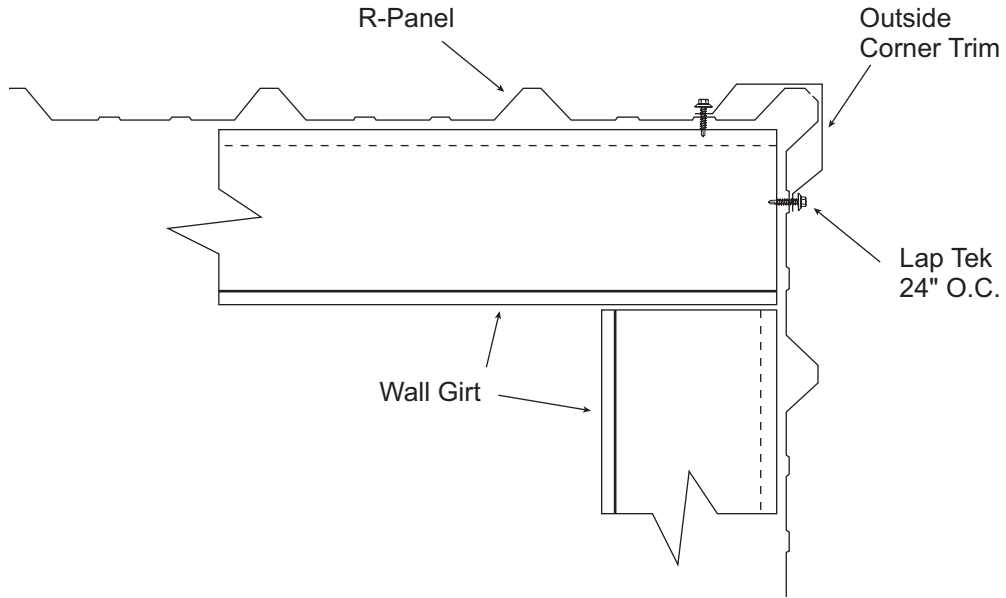
**NOTE:** Mueller recommends an outside closure under bottom edge of rake trim, to prevent birds from nesting in trim. this works well with buildings with less than 2:12 slope.

**NOTE:** If last rib is removed, cut 1" beyond the wall sheet line, then fold edge up.



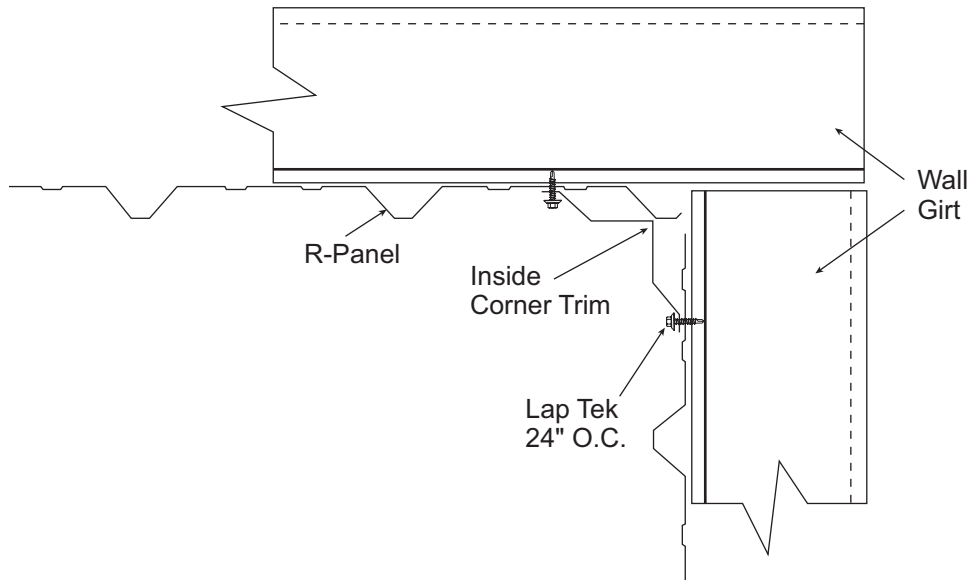
# CORNER TRIM

## Outside Corner Detail



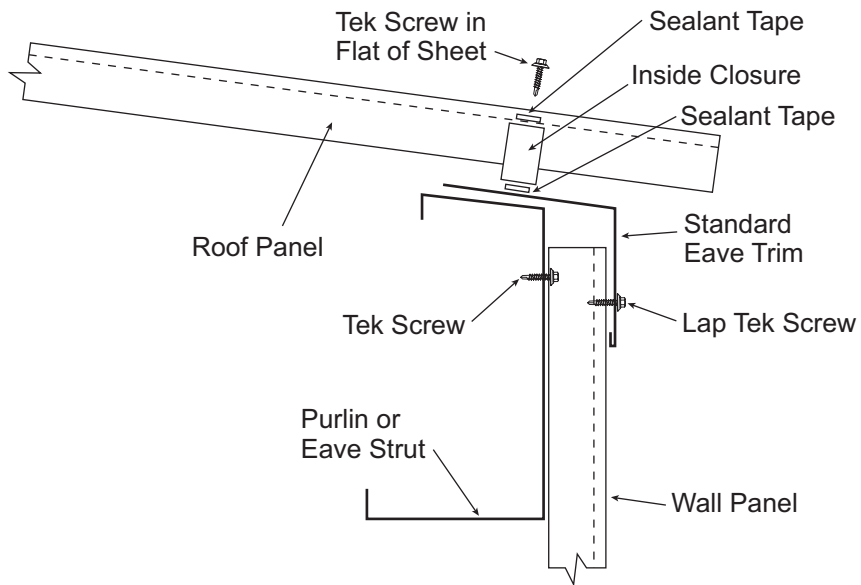
## Inside Corner Detail

(Used with liner panel condition only)

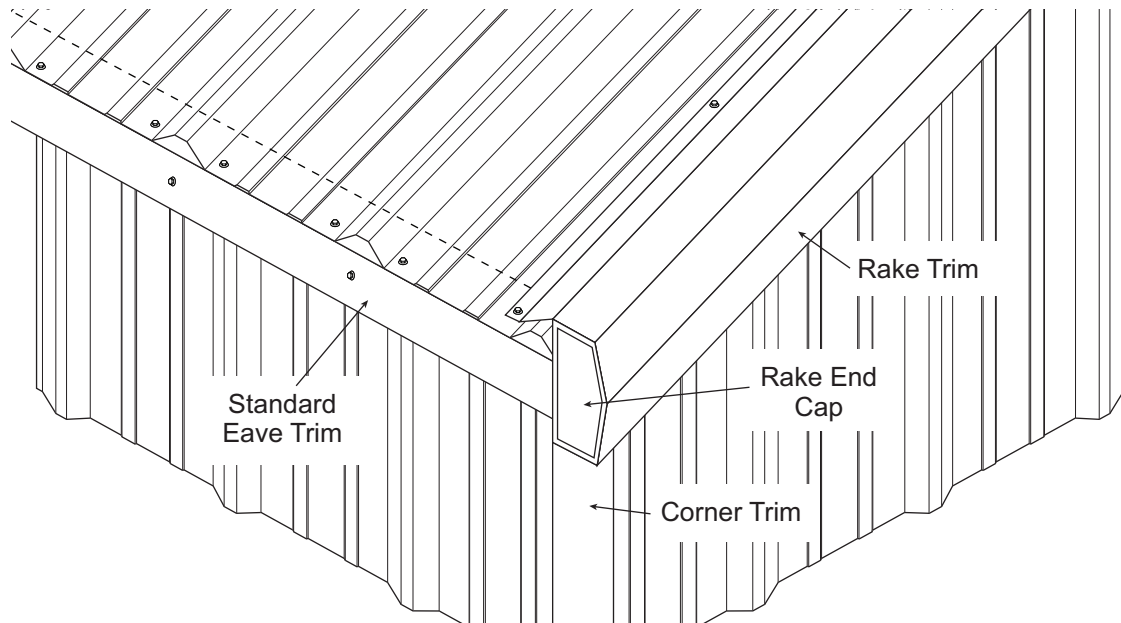


**NOTE: Install corner trim with lap tek faseners 24" O.C.**

## STANDARD EAVE TRIM

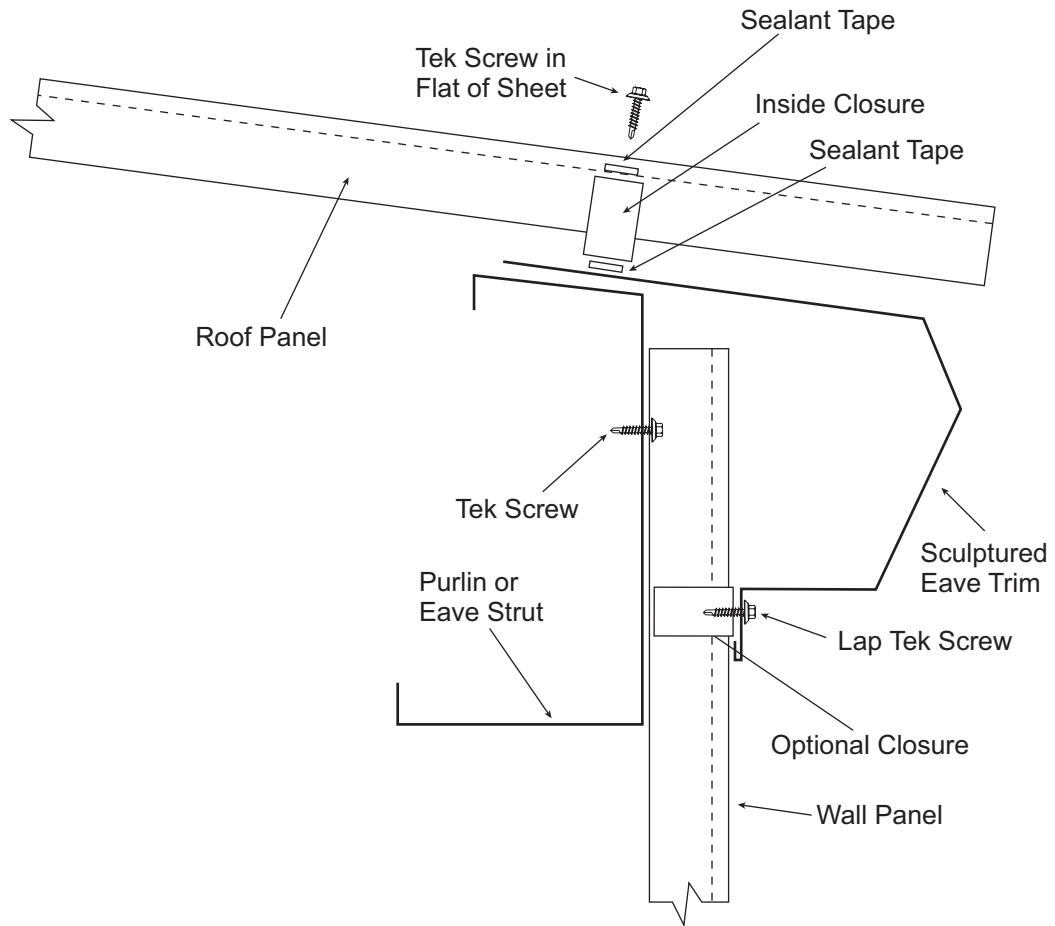


### Standard Eave / Sculptured Rake Trim With Rake End Cap

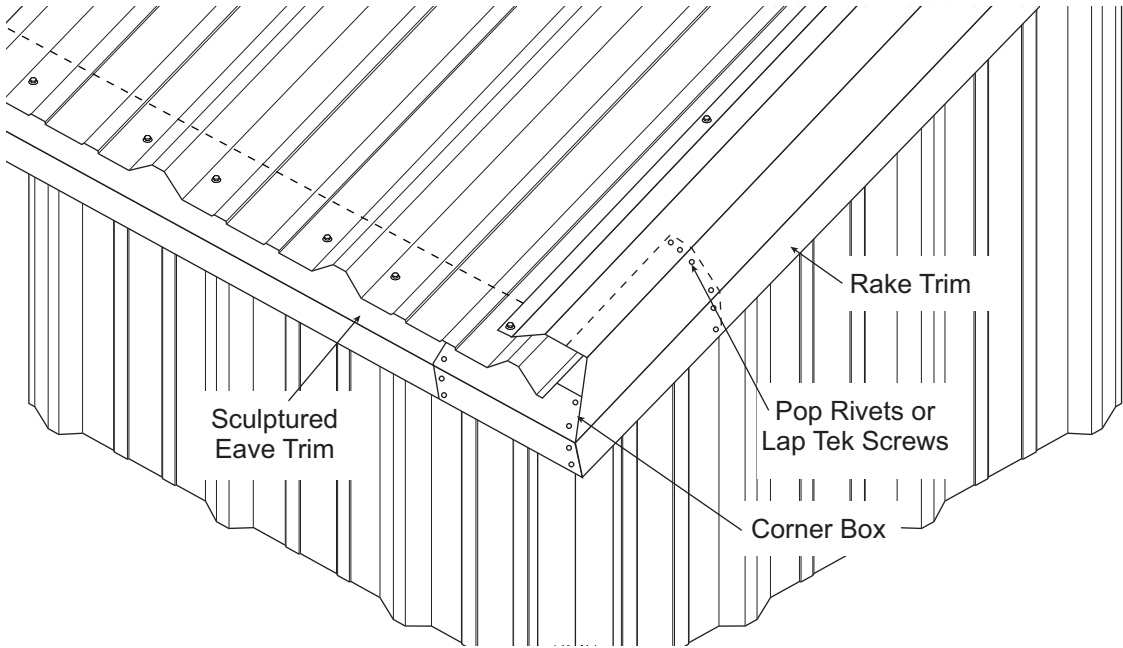


**NOTE:** Roof sheet should extend 2" to 3" past eave trim.

# SCULPTURED EAVE TRIM

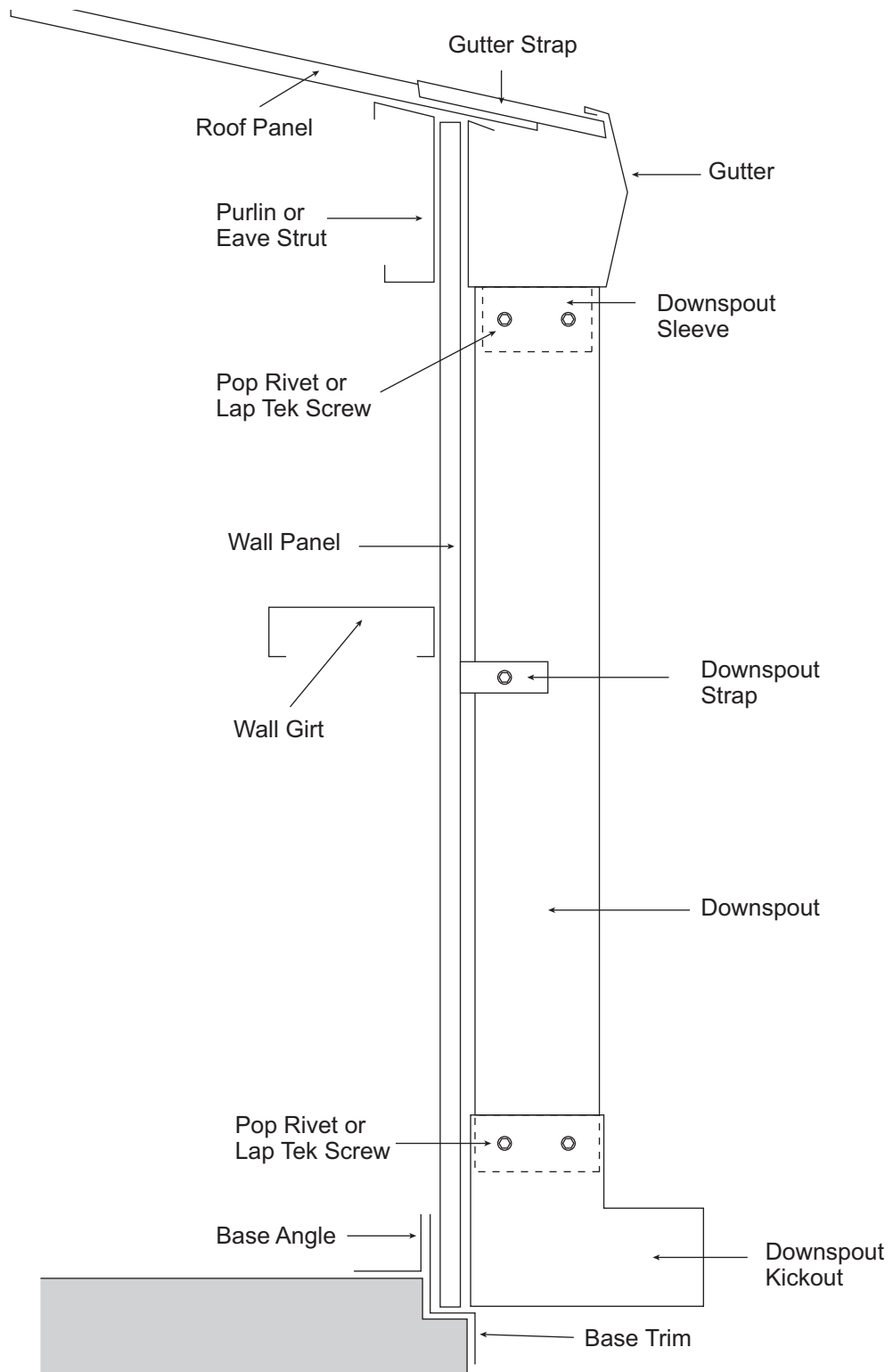


# SCULPTURED EAVE / RAKE TRIM WITH CORNER BOX

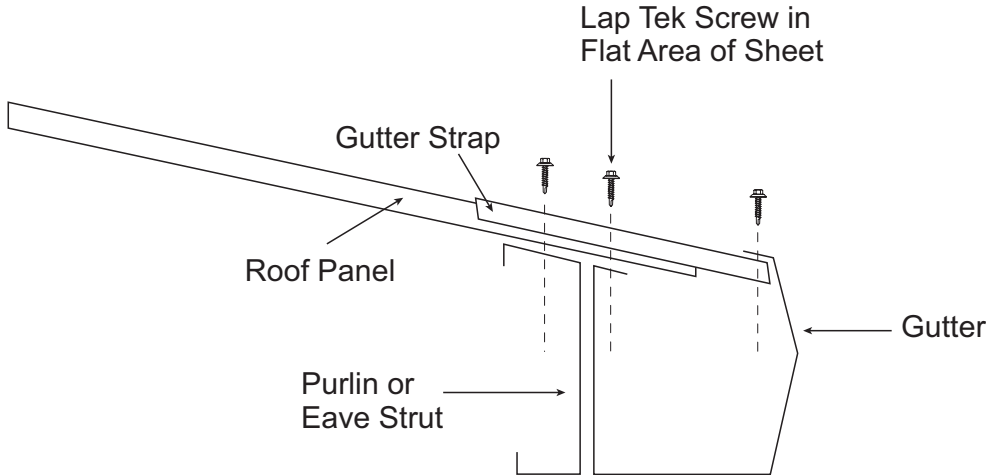


**NOTE:** Roof sheet should extend 2" to 3" past eave trim.

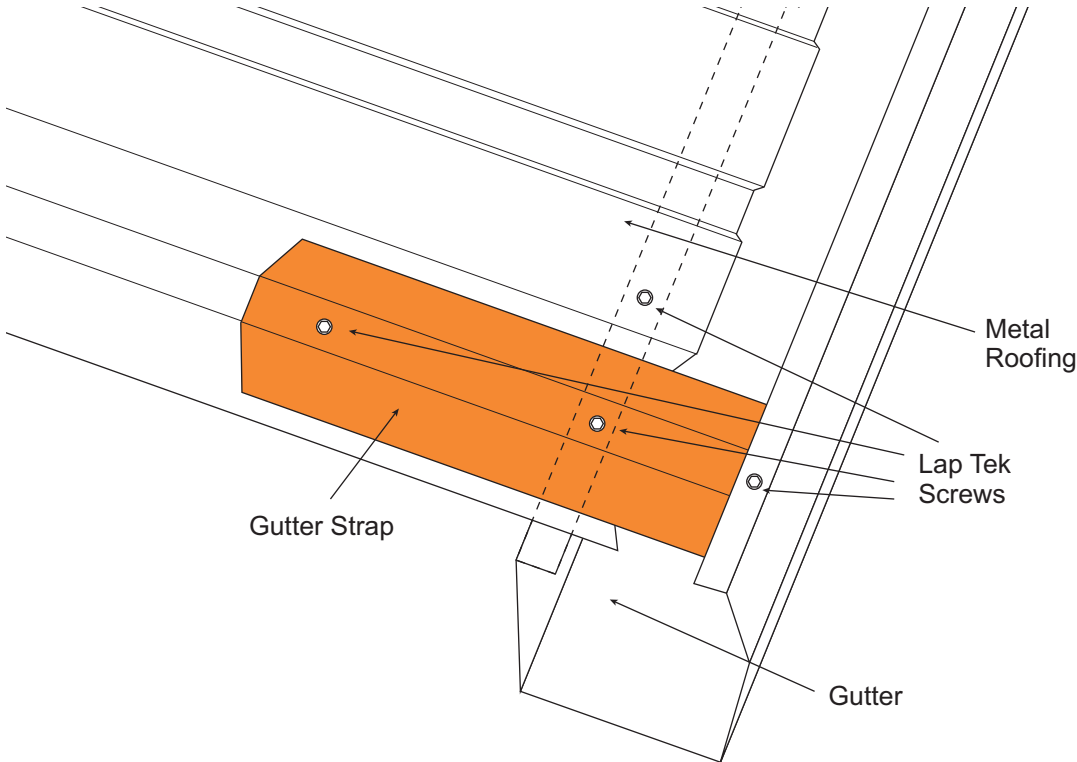
# MUELLER GUTTER SYSTEM DIAGRAM



# GUTTER STRAP INSTALLATION

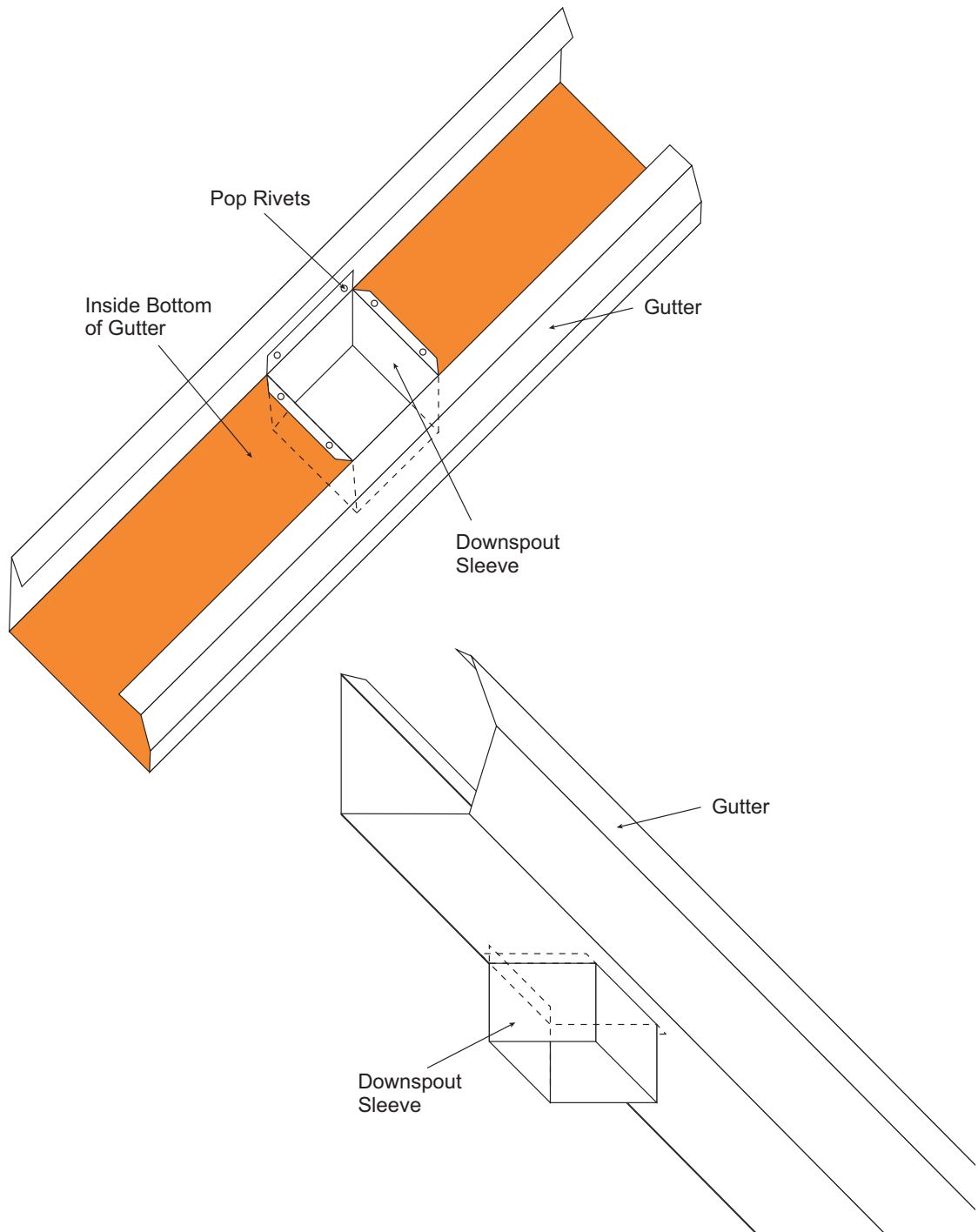


**Screw Placement Side View**

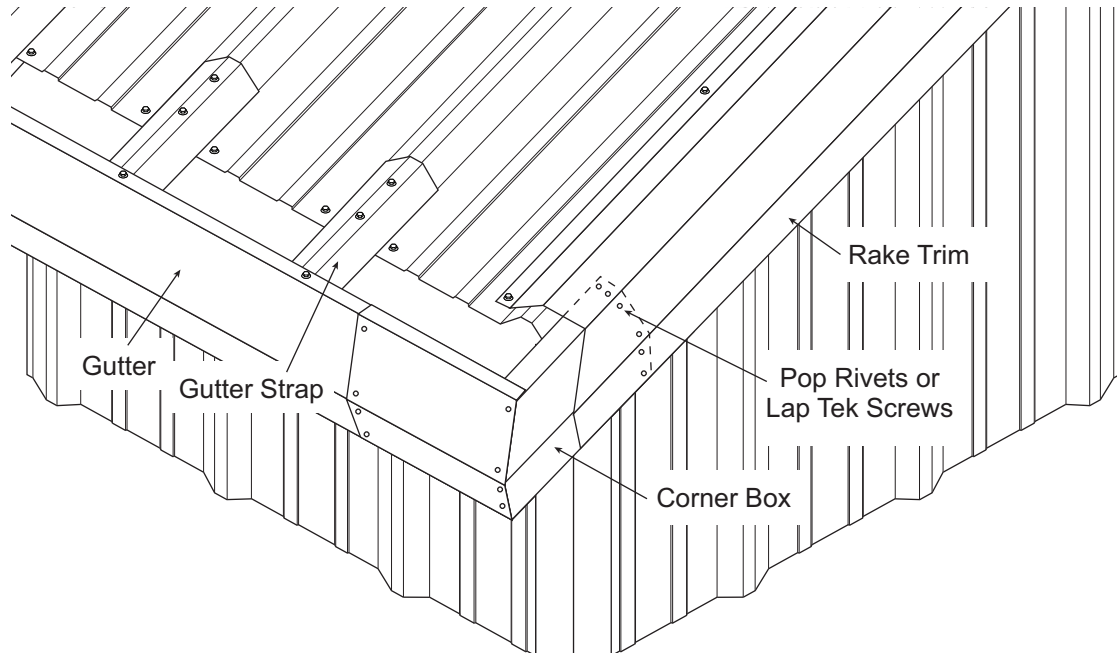


**Screw Placement Top View**

# DOWNSPOUT SLEEVE INSTALLATION



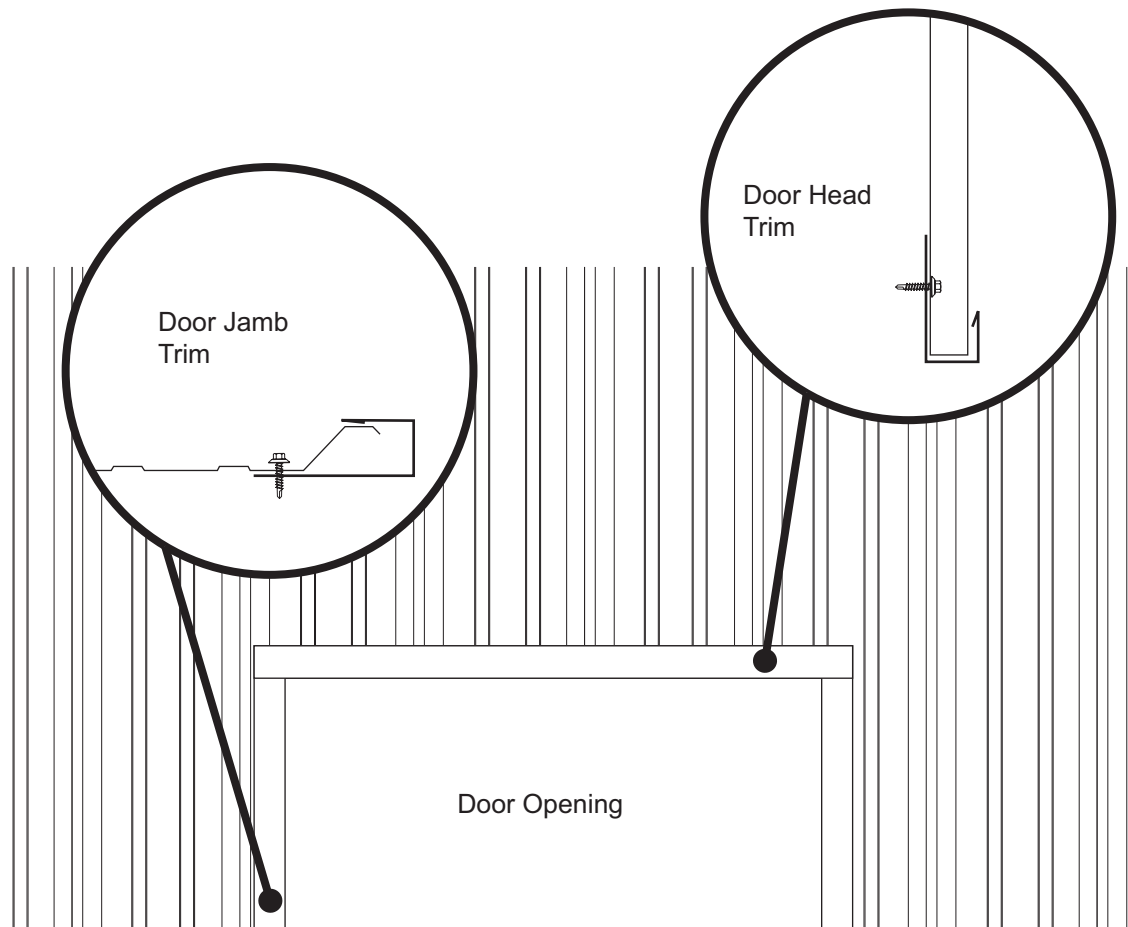
# GUTTER WITH CORNER BOX





## DOOR TRIM INSTALLATION

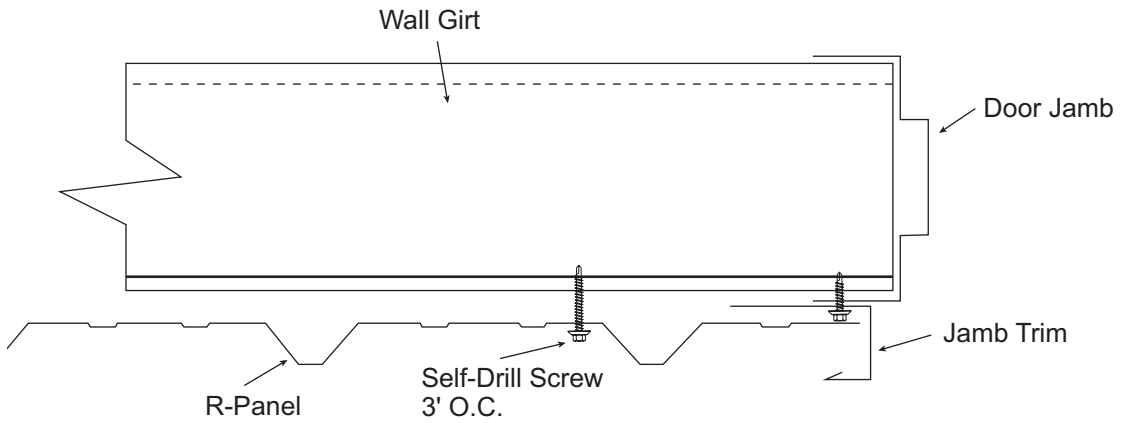
“J” trim pieces are provided to trim out edges around framed openings. “J” trim pieces should be attached to door columns and header before wall sheets are attached. After trim is attached, the trimmed wall sheets can be inserted behind the “J” trim then screwed down in place.



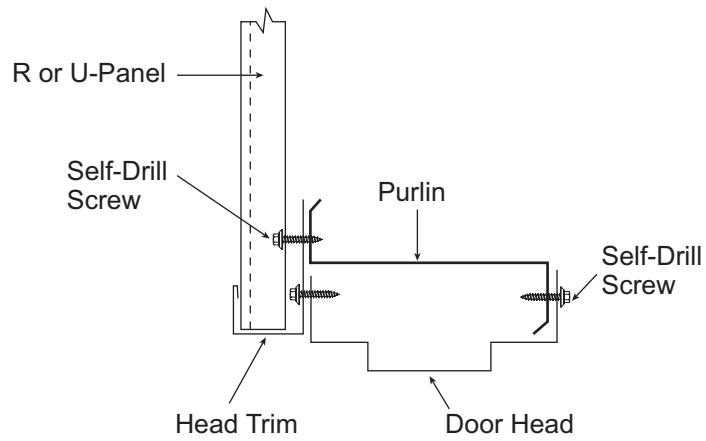
**NOTE:** Clean all metal shavings from wall sheets to ensure against damage to the coating.

# TYPICAL DETAILS – HEAD/JAMB

## Jamb



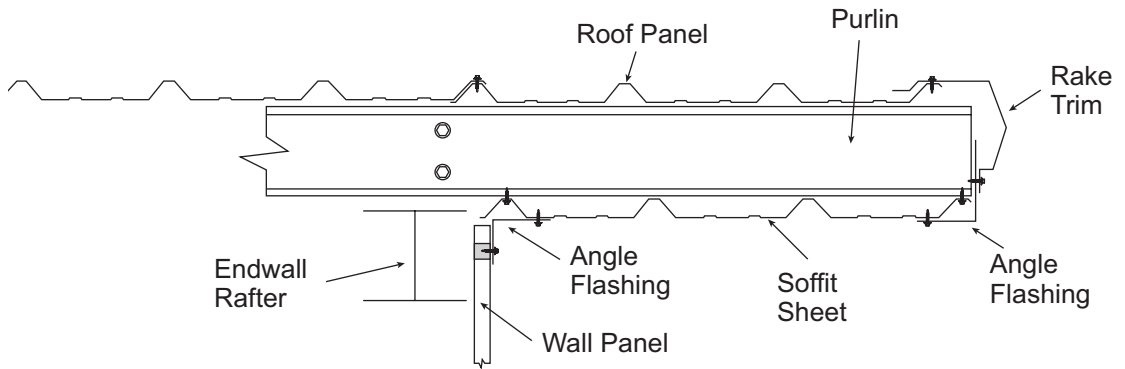
## Head



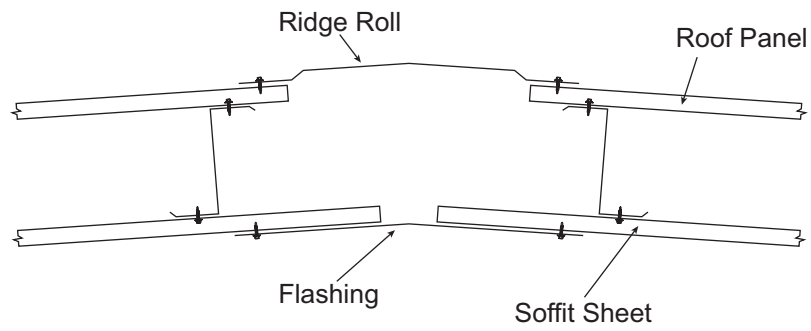
**NOTE: Install jamb and head trim with self-drilling fasteners at 3' O.C.**

# OVERHANG TRIM DETAILS

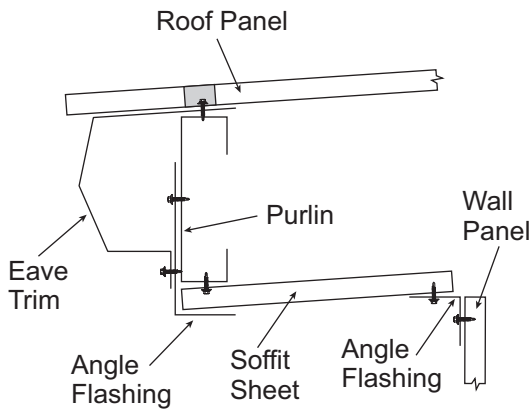
## Endwall Overhang



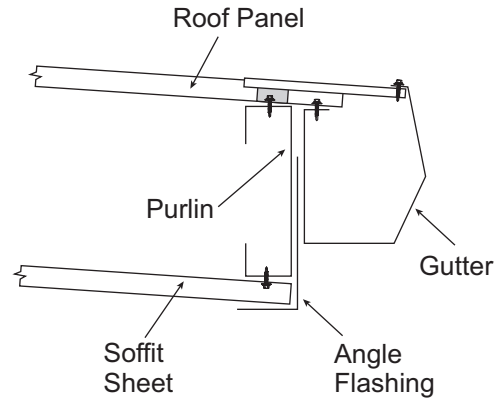
## Endwall Overhang At Ridge



## Sidewall Overhang With Eave Trim



## Sidewall Overhang With Gutter



**SECTION**

**G**

**DOORS AND  
ACCESSORIES**

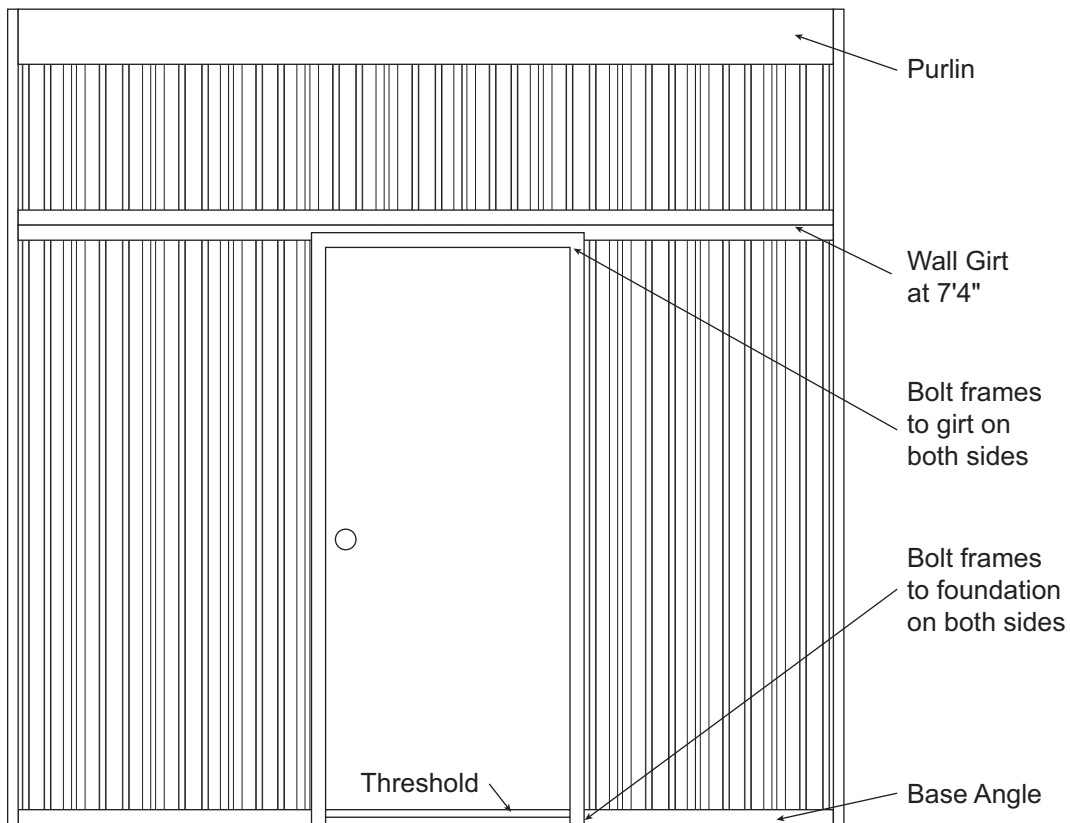




## PERSONNEL DOORS

Personnel (walk-in) doors can be installed at any location in the building. Wall girts below the standard level of seven feet four inches will have to be cut out for the doorframe.

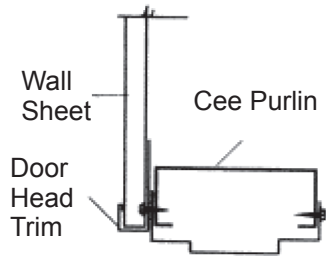
After deciding where the door is to be located and before the wall sheets are installed, attach the doorframe to the foundation and the wall girt or girts. The doorframe can be bolted to the girt and foundation where and however desired. The base angle will have to be cut out in the door opening.



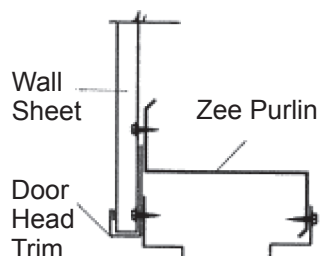
Make sure the doorframe is square so the door will fit and open and close properly.

After the doorframe is installed and squared, the door can be placed on the hinges, the doorknob and locks installed, and the threshold plate placed at the bottom of the door opening.

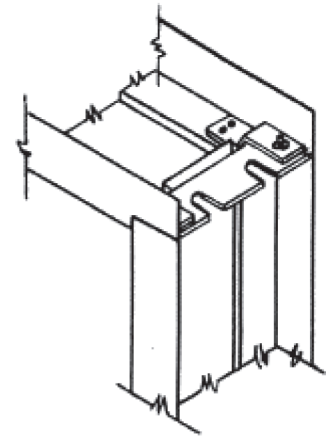
# METAL BUILDING DOOR FRAME



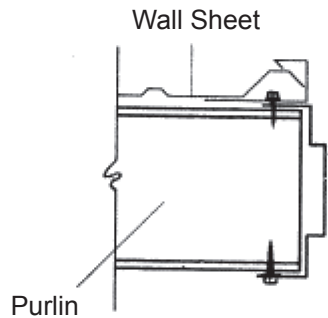
**Head Section**



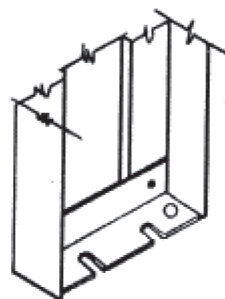
**Head Section**



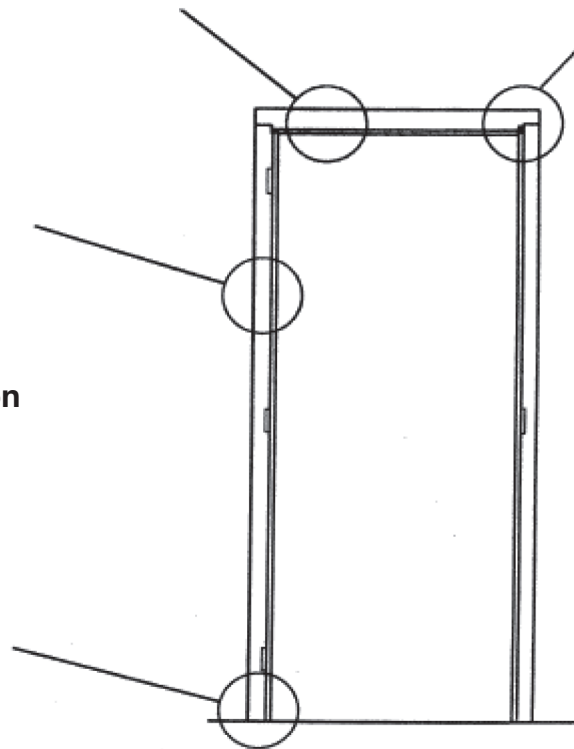
**Corner Connection**



**Intermediate Purlin Connection**



**Sill Anchor**



**Standard Frame Details  
No Sub-Frame Required**

## **ROLL-UP DOORS INSTRUCTIONS FOR ASSEMBLY**

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Included with Roll-up Doors. See Package.

## **WINDOW INSTALLATION**

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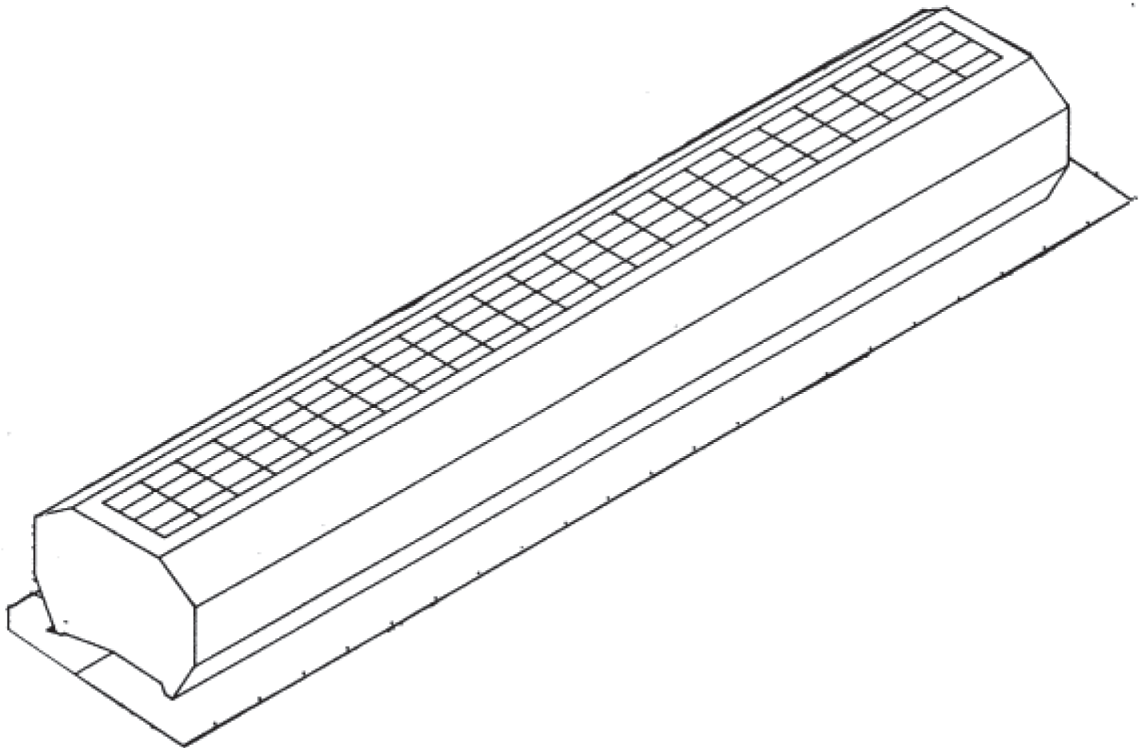
See manufacturer's instructions.



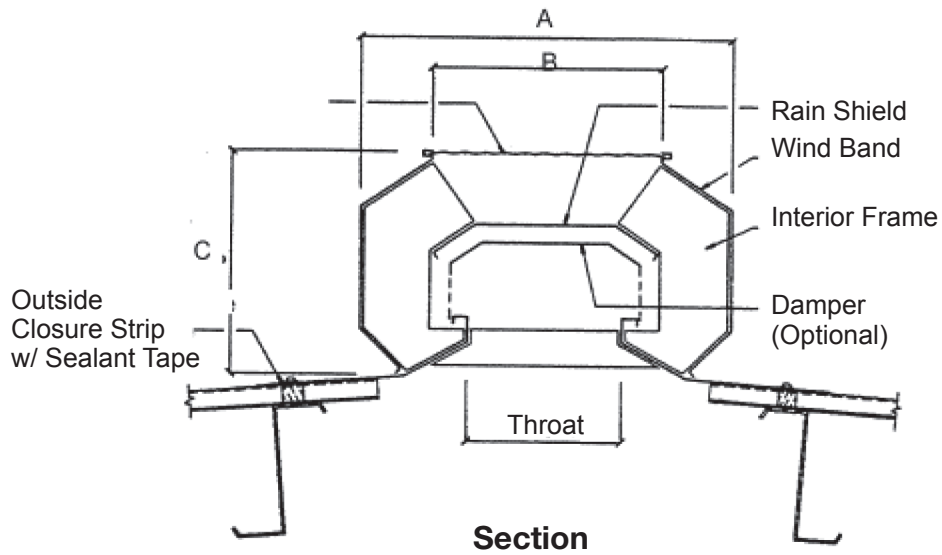
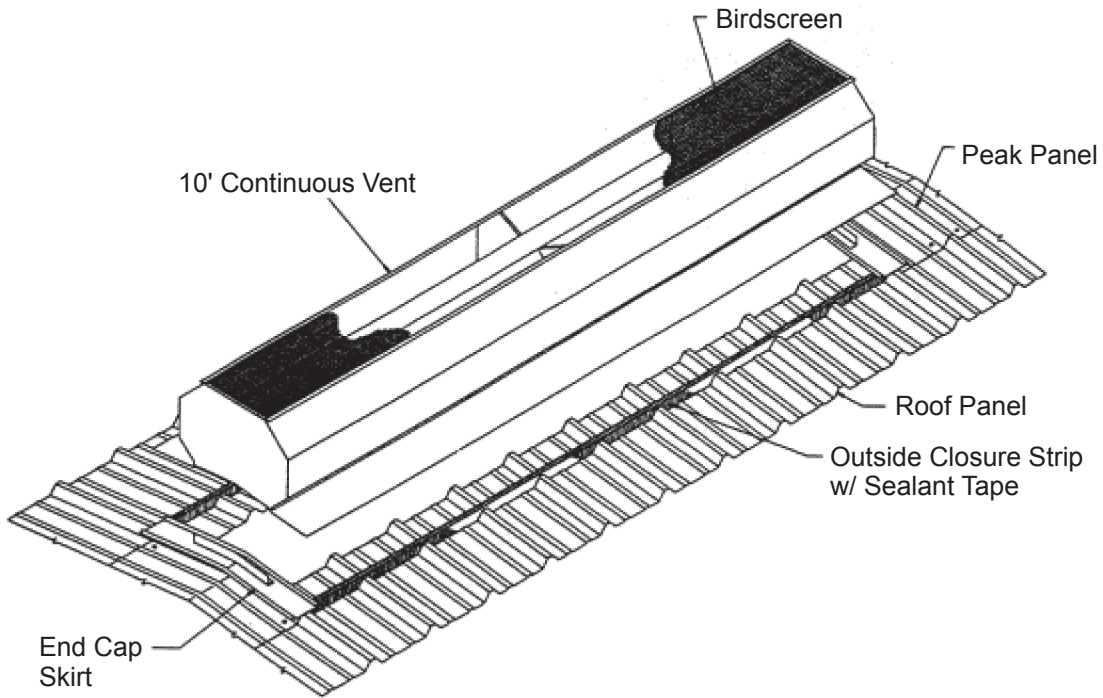
## VENT INSTALLATION

### Roof Ventilators (Optional)

1. Ventilators may be installed on the roof ridge after the roof sheets are on and before the ridge roll or peak sheet is installed. The ventilators are ten feet long and usually are installed at the peak and between two rafters.
2. Cut out the ridge roll or peak sheet to fit the opening of the ventilator. Ensure that the opening is cut correctly so the ventilator will fit properly and provide enough lap over the opening to prevent leaks. (The roof sheets may need to be trimmed to maximize venting).
3. Place the ventilator over the opening. Use molded rubber outside sealers to fill the gaps between the ventilator flange and the roof sheets.
4. Attach the ventilator to the roof sheets with lap tek screws. Screw through the vent skirt to the tops of the roof sheet ribs.
5. Locate the vent adjusting pull chains as desired. (According to vents instructions).

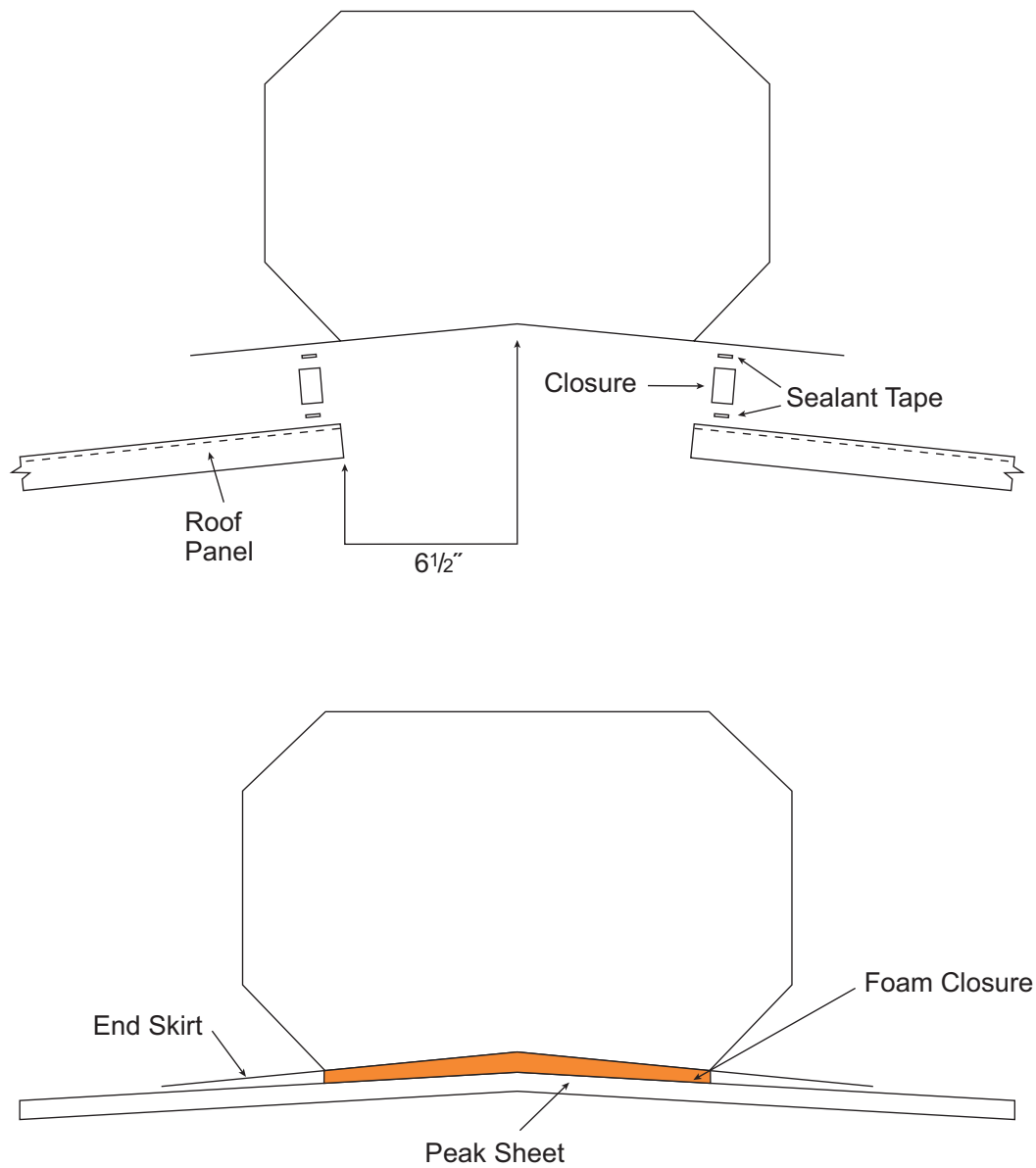


# CONTINUOUS RIDGE VENTILATORS



Throat	Ga.	A	B	C
9"	26	22	12 ¾	15 ¼
12"	26	28 ¼	17 ¼	19 ½

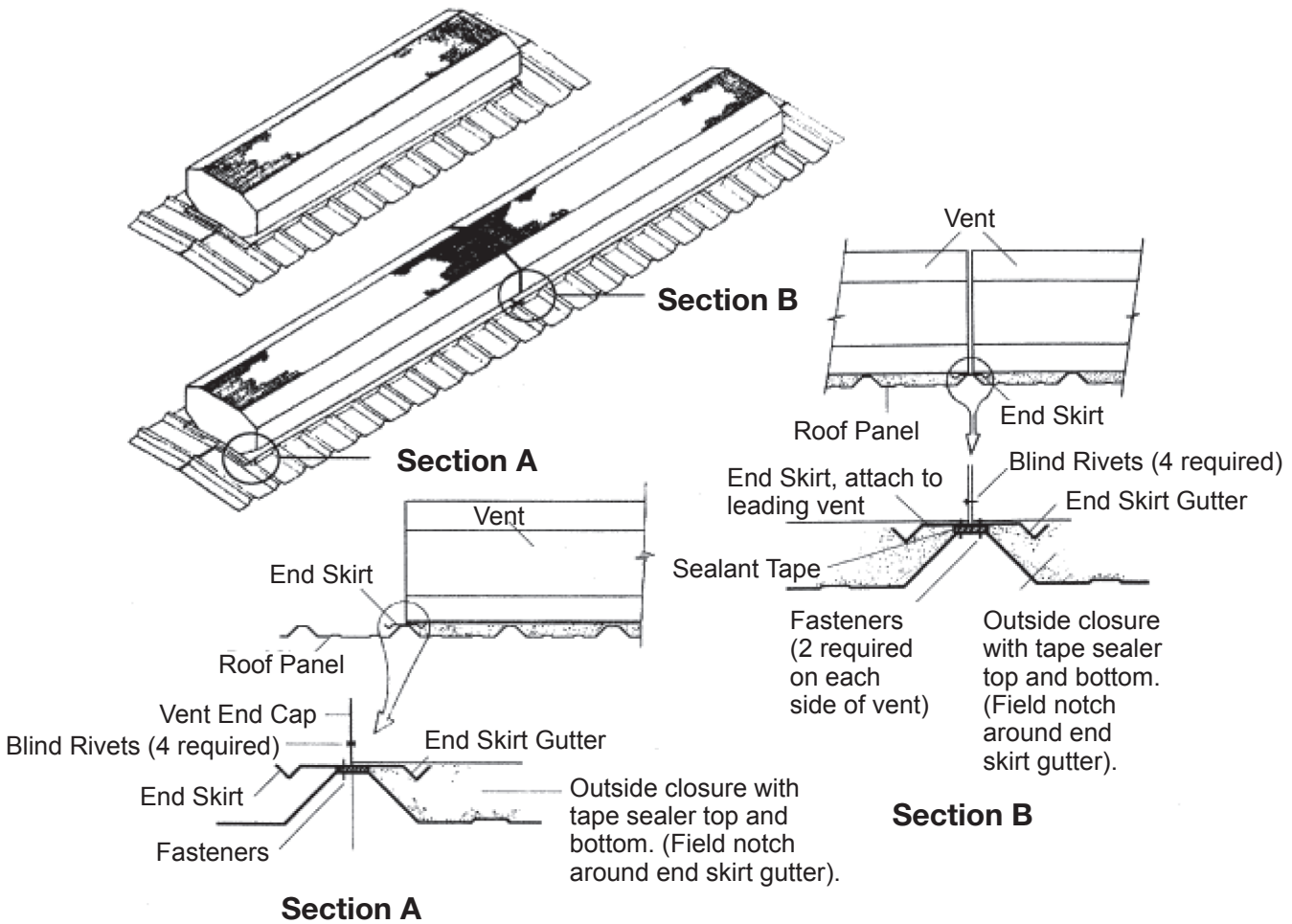
## VENT SEALERS



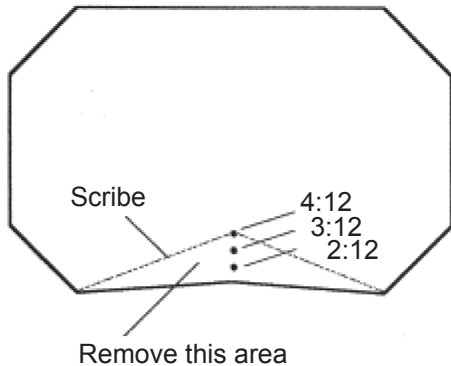
### Roof Pitch Less than 1:12

Install the end cap for 1:12 pitch roof slope and foam closure with tape sealant top and bottom.

# VENT INSTALLATION

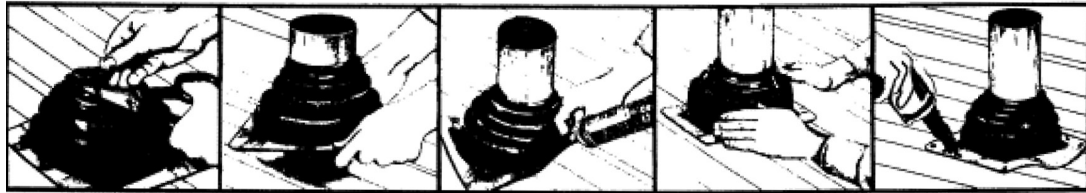


## Roof Pitch Greater Than 1:12



End cap is factory pre-cut to 1:12. The three dots embossed in the end cap represent 2:12, 3:12 and 4:12 roof pitches. Select the appropriate dot to represent the roof pitch, scribe two lines from lower corners of the end cap, intersecting at the dot. Remove the area described by the scribe lines and install the end skirt.

# PIPE DECK FLASHING INSTALLATION



**1. TRIM**

Cut opening to 20% smaller than pipe diameter.

**2. SLIDE**

Slip pipe flash over pipe.

**3. SEAL**

Apply urethane/silicone sealant between pipe flash and roofing.

**4. FORM**

Bend aluminum base to fit irregularities. Use large slot screwdriver to press into tight angles.

**5. FASTEN**

Complete the seal using common weather-resistant fasteners.

## Selection Chart

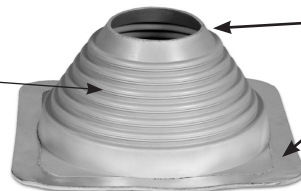
Master Flash Number	Pipe Size	Base Dimension	Opening Diameter
1	1/4" - 2"	4 1/2"	Closed
2	1 1/4" - 3"	6"	7/8"
3	1/4" - 4"	8"	Closed
4	3" - 6"	10"	2 1/2"
5	4" - 7"	11"	3 1/2"
6	5" - 9"	12"	4"
7	6" - 11"	14"	5"
8	7" - 13"	17"	6"

**Note:** Numbers 1 & 3 are closed top. When using pipe flash on very steep pitched roof or surface with deep corrugation, use next largest size for increased flange flexibility.

## Material Information

Material	Neoprene	EPDM	Silicone
Guarantee	10 years	20 years	20 years
Temperature Range	-45 degree to +200 degree	-65 degree to +250 degree	-100 degree to +450 degree
Applicable	ASTM D2000, M2 BC 510 A14, B14, C12, F17, Z1, Z2, Z3	ASTM D2000, M3 BA 510 A14, B13, C12, F17, Z1, Z2, Z3	ASTM D2000, M4 GE 505 A19, B37, C12, F19, Z1, Z2, Z3

Tough EPDM, silicone or Neoprene rubber resists weathering, ultraviolet light and cracking.



Pipe opening is quickly and easily customized on the job.

Aluminum base bends to form a perfect seal on all roof pitches, contours or surface irregularities. Square flange design adapts to any roofing material.

**Note:** Specify Neoprene when Pipe Flash is to be exposed to petrochemicals.

**GLOSSARY:**

**METAL BUILDING TERMS  
& DEFINITIONS**



# METAL BUILDING TERMS AND DEFINITIONS

**Anchor Bolt Plan:** A plan view showing the size, location and projection of all anchor bolts for the metal building system components, the length and width of the foundation (which may vary from the nominal metal building size). Column reactions (magnitude and direction) and minimum base plate dimensions may also be included.

**Approval Drawings:** Approval drawings may include framing drawings, elevations and sections through the building as furnished by the manufacturer for approval of the buyer. Approval by the buyer affirms that the manufacturer has correctly interpreted the overall contract requirements for the metal building system and its accessories, and the exact location of accessories in the building.

**AISI:** The American Iron and Steel Institute.

**AISC:** The American Institute of Steel Construction.

**AISE:** American Iron and Steel Engineers.

**Aluminum-coated Steel:** Steel coated with aluminum for corrosion protection.

**Anchor Bolts:** Bolts used to anchor structural members to a foundation or other support. Usually refers to the bolts at the bottom of all column and doorjamb.

**Architectural Drawing:** A drawing that shows the plan view and/or elevations of the finished building for the purpose of showing the general appearance of the building, indicating all accessory locations.

**ASCE:** American Society of Civil Engineers.

**Astragal:** A closure between the two leaves of a double swing or double slide door to close the joint.

**Automatic Welding:** A welding operation utilizing a machine to make a continuous, unbroken weld.

**Auxiliary Loads:** All specified dynamic live loads other than the basic design loads which the building must safely withstand, such as cranes, material handling systems, machinery, elevators, vehicles, and impact loads.

**Awning Window:** A window in which the vent or vents pivot outward about the top edge giving the awning effect.

**AWS:** American Welding Society.

**Base Angle:** An angle secured to the perimeter of the foundation to support and close wall panels.

**Base Plate:** A plate attached to the base of a column that rests on the foundation or other support, usually secured by anchor bolts.

**Bay:** The space between frame centerlines or primary supporting members in the longitudinal direction of the building.

**BBC:** Basic Building Code (See BOCA).

**Beam:** A primary member, usually horizontal, that is subjected to bending loads. There are three types: simple, continuous and cantilever.

**Beam and Column:** A primary structural system consisting of a series of rafter beams supported by columns. Often used as the end frame of a metal building system.

**Bearing Plate:** A steel plate that is set on the top of a masonry support on which a beam or purlin can rest.

**Bent:** Primary member of a structural system.

**Bill of Materials:** A list of items or components used for fabrication, shipping, receiving, and accounting purposes.

**Bird Screen:** Wire mesh used to prevent birds from entering the building through ventilators and louvers.

**Blind Rivet:** A small-headed pin with expandable shank for joining light gauge metal. Typically used to attach flashing, gutter, etc.

**Block or Board Thermal Insulation:** Rigid or semi-rigid thermal insulation preformed into rectangular units.

**BOCA:** Building Officials and Code Administrators International Inc.

**Bonded Roof:** A roof that carries a written warranty with respect to weathertightness for a stipulated number of years.



## METAL BUILDING TERMS AND DEFINITIONS

**Brace Rods:** Rods or cables used in roof and walls to transfer loads such as wind loads, and seismic and crane thrusts to the foundation. (Also often used to plumb buildings but not designed to replace erection cables.)

**Bracing:** Rods, angles or cables used in the plane of the roof and walls to transfer loads, such as wind, seismic and crane thrusts to the foundation.

**Bracket:** A structural support projecting from a wall or column on which to fasten another structural member. Examples are canopy brackets, lean-to brackets, and crane runway brackets.

**Bridge Crane:** A load-lifting system consisting of a hoist that moves laterally on a beam, girder, or bridge that in turn moves longitudinally on a runway made of beams and rails. Loads can be moved to any point within a rectangle formed by the bridge span and runway length.

**Builder/Contractor:** A general contractor or sub-contractor responsible for providing and erecting metal building systems.

**Building Code:** Regulations established by a recognized agency describing design loads, procedures, and construction details for structures. Usually applying to designated political jurisdiction (city, county, state, etc.)

**Built-Up Section:** A structural member, usually an "I" section, made from individual flat plates welded together.

**Butt Plate:** The end plate of a structural member usually used to rest against a like plate of another member in forming a connection. Sometimes called a split plate or bolted end plate.

**"C" Section:** A member formed from steel sheet in the shape of a block "C", that may be used either singularly or back to back.

**Camber:** A predetermined curvature designed into a structural member to offset the anticipated deflection when loads are applied.

**Canopy:** Any overhanging or projecting roof structure with the extreme end usually unsupported.

**Cantilever:** A projecting beam that is supported and restrained at one end only.

**Capillary Action:** That action which causes movement of liquids when in contact with two adjacent surfaces such as panel sidelaps.

**Cap Plate:** A plate located at the top of a column or end of a beam for capping the exposed end of a member.

**Caulk:** To seal and make weather tight the joints, seams, or voids by filling with a waterproofing compound or material.

**Channel – Hot Rolled:** A member formed while in a semi-molten state at the steel mill to a shape having standard dimensions and properties.

**Clip:** A plate or angle used to fasten two or more members together.

**Closure Strip:** A resilient strip, formed to the contour of ribbed panels used to close openings created by joining metal panels and flashing.

**Cold Forming:** The process of using press brakes or rolling mills to shape steel into desired cross sections at room temperature.

**Collateral Load:** All specified additional dead loads other than the metal building framing, such as sprinklers, mechanical and electrical systems, and ceilings.

**Column:** A primary member used in a vertical position on a building to transfer loads from main roof beams, trusses, or rafters to the foundation.

**Continuity:** The terminology given to a structural member, as if there were no connections.

**Contractor:** See "Builder".

**Coverings:** The exterior roof and wall covering for a metal building system.

**Crane:** A machine designed to move material by means of a hoist.

**Crane Rail:** A track supporting and guiding the wheels of a bridge crane or trolley system.

## METAL BUILDING TERMS AND DEFINITIONS

**Crane Runway Beam:** The member that supports a crane rail and is supported by columns or rafters depending on the type of crane system. On under hung bridge cranes, a runway beam also acts as a crane rail.

**Curb:** A raised edge on a concrete floor slab or skylight.

**Curtain Wall:** Perimeter wall panels that carry only their own weight and wind load.

**Damper:** A baffle used to open or close the throats of ventilators.

**Dead Load:** The dead load of a building is the weight of all permanent construction, such as floor, roof, framing, and covering members.

**Deflection:** The displacement of a structural member or system under load.

**Design Loads:** Those loads specified in building codes published by Federal, State, County, or City agencies, or in owners' specifications to be used in the design of a building.

**Diagonal Bracing:** See "*Brace Rods*".

**Diaphragm Action:** The resistance to racking generally offered by the covering system, fasteners and secondary framing.

**Door Guide:** An angle or channel guide used to stabilize or keep plumb a sliding or rolling door during its operation.

**Downspout:** A conduit used to carry water from the gutter of a building to the ground or storm drain.

**Drift Pin:** A tapered pin used during erection to align holes in steel members to be connected by bolting.

**Eave:** The line along the sidewall formed by the intersection of the planes of the roof and wall.

**Eave Height:** The vertical dimension from finished floor to the eave.

**Eave Strut:** A structural member at the eave to support roof panels and wall panels. It may also transmit wind forced from roof bracing to wall bracing.

**Elastic Design:** A design concept utilizing the proportional behavior of materials when all stresses are limited to specified allowable values.

**End Frame:** A frame at the endwall of a building to support the roof load from one half the end bay.

**Erection:** The on-site assembling of fabricated components to form a complete structure.

**Erection Drawings:** See "*Framing Drawings*".

**Expansion Joint:** A break or space in construction to allow for thermal expansion and contraction of the materials used in the structure.

**Fabrication:** The manufacturing process performed in a plant to convert raw material into finished metal building components. The main operations are cold forming, cutting, punching, welding, cleaning and painting.

**Fascia:** A decorative trim or panel projecting from the face of a wall.

**Fenestration:** Windows or other panels of glass; their numbers and location.

**Field:** The "job site", "building site", or general market area.

**Filler Strip:** See "*Closure Strip*".

**Finial:** Gable closure at ridge.

**Fixed Base:** A column base that is designed to resist rotation as well as horizontal or vertical movement.

**Flange:** The projecting edge of a structural member.

**Flange Brace:** A bracing member used to provide lateral support to the flange of a beam, girder or column.

**Flashing:** A sheet metal closure which functions primarily to provide weathertightness in a structure and secondarily, to enhance appearance.

**Footing:** A pad or mat, usually of concrete, located under a column, wall, or other structural member, that is used to distribute the loads from that member into the supporting soil.

## METAL BUILDING TERMS AND DEFINITIONS

**Force:** The action of one body on another body that changes or tends to change its state of rest or motion. A force may be expressed in pounds (Newtons), kips, or other similar units and may act in any one of the following ways:

- A. Compression force: A force acting on a body tending to compress the body, (Pushing action).
- B. Shear force: A force acting on a body that tends to slide one portion of the body against the other portion of the body. (Sliding action).
- C. Tension force: A force acting on a body tending to elongate the body. (Sliding action).
- D. Torsion force: A force acting on a body that tends to twist the body.

**Foundation:** The substructure that supports a building or other structure.

**Framed Opening:** Frame work (headers and jamps) and flashing which surround an opening in the wall or roof of a building; usually for field-installed accessories such as overhead doors or powered roof exhausters.

**Framing:** The primary and secondary structural members (columns, rafters, girts, purlins, brace rods, etc.) that go together to make up the skeleton of a structure to which the covering can be applied.

**Framing Drawings:** Plans and erection instructions which identify all individual parts in sufficient detail to permit the proper erection and installation of all parts of the metal building system furnished by the seller (also known as Erection Drawings).

**Gable:** A triangular portion of the endwall of a building directly under the sloping roof and above the eave line.

**Gable Roof:** A ridged roof that terminates in gables.

**Galvanized:** Coated with zinc for corrosion resistance.

**Girder:** A main horizontal or near-horizontal structural member that supports vertical loads. It may consist of several pieces.

**Girt:** A secondary horizontal structural member attached to sidewall or endwall columns to which wall covering is attached and supported horizontally.

**Glaze or Glazing:** The process of installing glass in windows and doors.

**Grade:** The term used when referring to the ground elevation around a building.

**Grade Beam:** A concrete beam around the perimeter of a building carrying an exterior wall.

**Grout:** A mixture of cement, sand, and water used to fill cracks and cavities. It is often used under base plates or leveling plates to obtain uniform bearing surfaces.

**Gutter:** A channel member installed at the eave of the roof for the purpose of carrying water from the roof to the drains or downspouts.

**Gusset Plate:** A steel plate used to reinforce or connect structural elements.

**“H” Section:** A steel member with an “H” cross-section.

**Haunch:** The deepened portion of a column or rafter, designed to accommodate the higher bending moments at such points. (Usually occurs at connection of column and rafter.)

**Header:** A horizontal framing structural member over a door, window or other framed opening.

**High Strength Bolts:** Any bolt made from steel having a tensile strength in excess of 100,000 lbs. per square inch. Some examples are ASTM A-325 and A-490.

**Hinged Base:** See “*Pin Connection*”.

**Hip Roof:** A roof that rises by inclined planes from all four sides of a building. The line where two adjacent sloping sides of a roof meet is called the Hip.

**Hoist:** A mechanical lifting device usually attached to a trolley that travels along a bridge, monorail, or jib crane. May be chain or electric operated.

**Hood (Door):** The metal flashing used over exterior slide door track along the full length of the door header to protect the tracks from weather and to conceal them for aesthetic purposes.

## METAL BUILDING TERMS AND DEFINITIONS

**Hot-Rolled Shapes:** Steel sections (angles, channels, H-beams, etc.) which are formed by rolling mills while the steel is in a semi-molten state.

**ICBO:** International Conference of Building Officials.

**Impact Load:** An assumed dynamic load resulting from the motion of machinery, elevators, cranes, vehicles, and other similar moving forces.

**Impact Wrench:** An electric or pneumatic device used to tighten nuts on bolts.

**Insulation:** Any material used in building construction to reduce heat transfer.

**Internal Pressure:** Pressure inside a building that is a function of wind velocity, and number and location of openings.

**Jack Beam:** A beam used to support another beam or truss and eliminate a column support.

**Jack Truss:** A truss used to support another truss or beam and eliminate a column support.

**Jib Crane:** A cantilevered boom or horizontal beam with hoist and trolley. This lifting machine may pick up loads in all or part of a circle around the column to which it is attached.

**Jig:** A device used to hold pieces of material in a certain position during fabrication.

**Kick-Out (Elbow):** (Turn-out) a lower downspouts section used to direct water away from a wall.

**Kip:** Unit of measure equal to 1,000 pounds (4.4 KN).

**Knee:** The connecting area of a column and rafter of a structural frame such as a rigid frame.

**Knee Brace:** A diagonal brace designed to resist horizontal loads usually from wind or moving equipment. This member normally has the lower end connected to a column and the upper end connected to an eave strut.

**Lean-to:** A structure such as a shed, having only one slope or pitch and depending upon another structure for partial support.

**Leveling Plate:** A steel plate used on top of a foundation or other support on which a structural column can rest.

**Liner Panel:** A panel applied as an interior finish.

**Live Load:** Live load means all loads, including snow, exerted on a roof except dead, wind and lateral loads.

**Load Indicator Washer:** A washer for high-strength bolts in which pre-tension load can be measured as a function of amount of compression on raised portions of the washer.

**Loads:** Anything that causes a force to be exerted on a structural member. Some different examples are:

- A. Dead Load
- B. Impact Load
- C. Roof Live Load
- D. Seismic Load
- E. Wind Load
- F. Crane Load
- G. Collateral Load
- H. Auxiliary Load

**Louver:** An opening provided with fixed or movable, slanted fins to allow the flow of air.

**Main Frame:** An assemblage of rafters and columns that support the secondary framing members and transfer loads directly to the foundation.

**Manufacturer:** A party who designs and fabricates a Metal Building System.

**Manufacturer's Engineer:** An engineer employed by a manufacturer who is in responsible charge of the structural design of a Metal Building System fabricated by the manufacturer. The manufacturer's engineer is typically not the Engineer of Record.

**Masonry:** Anything constructed of materials such as bricks, concrete blocks, ceramic blocks and concrete.

**MBMA:** Metal Building Manufacturers Association.

**Metal Building Fiber Glass Insulation:** A grade of fiberglass insulation blanket specifically manufactured for lamination to a vapor retarder.

## METAL BUILDING TERMS AND DEFINITIONS

**Moment:** The tendency of a force to cause rotation about a point or axis.

**Moment Connection:** A connection between two members which transfers the moment from one side of the connection to the other side, and maintains under application of load the same angle between the connected members that exist prior to the loading. Also, a connection that maintains continuity.

**Moment of Inertia:** A physical property of a member, which helps define strength and deflection characteristics.

**Monolithic Construction:** A method of pouring concrete grade beam and floor slab together to form the building foundation without forming and pouring each separately.

**Monorail:** A single rail support for a material handling system. Normally a standard hot-rolled H-Beam.

**Multi-Span Building:** Buildings consisting of more than one span across the width of the building. Multiple gable buildings and single gable buildings with interior posts are examples.

**Oil Canning:** A waviness that may occur in flat areas of light gage, formed metal products. Structural integrity is not normally affected by this inherent characteristic and therefore is only an aesthetic issue.

**Overhead Doors:** See "*Sectional Overhead Doors*".

**Parapet:** That portion of the vertical wall of a building that extends above the roof line.

**Peak:** The uppermost point of a gable.

**Personnel Doors:** A door used by personnel access to and exit from a building.

**Pier:** A concrete structure designed to transfer vertical load from the base of a column to the footing.

**Pin Connection:** A connection designed to transfer axial and shear forces between connecting members, but not moments.

**Pitch:** The peak height of a gabled building divided by its overall span.

**Portal Frame:** A rigid frame so designed that it offers rigidity and stability in its plane. It is generally used to resist longitudinal loads where other bracing methods are not permitted.

**Post:** See "*Column*".

**Post and Beam:** See "*Beam and Column*".

**Pre-painted Coil:** Coil of metal that has received a paint coating.

**Primary Framing:** See "*Main Frame*".

**Public Assembly:** A building or space where 300 or more persons may congregate in one area.

**Purlin:** A horizontal structural member that supports roof covering.

**Rafter:** The main beam supporting the roof system.

**Rake:** The intersection of the plane of the roof and the plane of the endwall.

**Rake Angle:** Angle fastened to purlins at rake for attachment of endwall panels.

**Rake Trim:** A flashing designed to close the opening between the roof and endwall panels.

**Reactions:** The resisting forces at the column bases holding the structure in equilibrium under a given loading condition.

**Rib:** The longitudinal raised profile of a panel that provides much of the panel's bending strength.

**Ribbed Panel:** A panel that has ribs with sloping sides and forms a trapezoidal shaped void at the side lap.

**Ridge:** The horizontal line formed by opposing sloping sides of a roof running parallel with the building length.

**Ridge Cap:** A transition of the roofing materials along the ridge of a roof; sometimes called ridge roll or ridge flashing.

**Rigid Connection:** See "*Moment Connection*".

## METAL BUILDING TERMS AND DEFINITIONS

**Rigid Frame:** A structural frame consisting of members joined together with moment connections so as to render the frame stable with respect to the design loads, without the need for bracing in its plane.

**Rolling Doors:** Doors that are supported at the bottom on wheels that run on a track.

**Roll-up Door:** Door that opens by traveling vertically.

**Roof Covering:** The exposed exterior roof surface consisting of panels.

**Roof Live Load:** Loads that are produced (1) during maintenance by workers, equipment, and materials, and (2) during the life of the structure by movable objects and do not include wind, snow, seismic or dead loads.

**Roof Overhang:** A roof extension beyond the endwall or sidewall of a building.

**Roof Slope:** The tangent of the angle that a roof surface makes with the horizontal, usually expressed in units of vertical rise to 12 units of horizontal run.

**Roof Snow Load:** That load induced by the weight of snow on the roof of the structure. Usually obtained by taking a fraction of the "Ground Snow Load".

**Ropeseal:** See "*Sealant*".

**Runway Beam:** See "*Crane Runway Beam*".

**Runway Bracket:** A bracket attached to the column of a building frame, which supports the runway beam for top-running cranes.

**Sag Member:** A tension member such as rods, straps or angles used to limit the deflection of a girt or purlin in the direction of its weak axis.

**Screwed Down Roof System:** See "*Through-fastened Roof System*".

**Sealant:** Any material that is used to seal cracks, joints or laps.

**Sealant Tape:** Caulking or sealant normally used in sealing roof panel laps.

**Secondary Framing:** Members that carry loads from the building surface to the main framing. For example – purlins and girts.

**Sectional Overhead Doors:** Doors constructed in horizontally hinged sections. They are equipped with springs, tracks, counter balancers, and other hardware that roll the sections into an overhead position, clear of the opening.

**Seismic Load:** The lateral load acting in any horizontal direction on a structural system due to the action of an earthquake.

**Self-Drilling Screw:** A fastener that combines the functions of drilling and tapping.

**Self-Tapping Screw:** A fastener that taps its own threads in a predrilled hole.

**Shipping List:** See "*Bill of Materials*".

**Shop Primer Paint:** The initial coat of primer paint applied in the shop.

**Side Lap Fastener:** A fastener used to connect panels together at their side lap.

**Sidewall:** An exterior wall that is perpendicular to the frames of a building system.

**Sidewall Overhang:** See "*Roof Overhang*".

**Sill:** The bottom horizontal framing member of a wall opening such as a window or door.

**Simple Connection:** See "*Pin Connection*".

**Simple Span:** A term used in structural design to describe a beam support condition at two points which offers no resistance to rotation at the supports.

**Single Slope:** A sloping roof in one plane. The slope is from one wall to the opposite wall.

**Single Span:** A building or structural member without intermediate support.

**Skylight:** A roof accessory to admit light, normally mounted on a curbed framed opening.

## METAL BUILDING TERMS AND DEFINITIONS

**Slide Door:** A single or double leaf door that opens horizontally by means of sliding on an overhead trolley.

**Slope:** See “*Roof Slope*”.

**Snow Load:** See “*Roof Snow Load*”.

**Snug Tight:** The tightness of a bolt in a connection that exists when all plies in a joint are in firm contact.

**Soffit:** A material that covers the underside of an overhang.

**Soldier Column:** An intermediate column used to support secondary structurals; not part of a mainframe or beam and column system.

**Span:** The distance between supports of beams, girders, or trusses.

**Specification (Metal Building System):**

A statement of a set of Metal Building System requirements describing the loading conditions, design practices, materials and finishes.

**Splice:** A connection in a structural member.

**Spud Wrench:** A tool used by erectors to line up holes and to make up bolted connections; a wrench with a tapered handle.

**Square:** Term used for an area of 100 square feet.

**Standing Seam:** Side joints of roof panels that are arranged in a vertical position above the roofline.

**Standing Seam Roof System:** A standing seam roof system is one in which the side laps between the roof panels are arranged in a vertical position above the roof line. The roof panel system is secured to the roof substructure by means of concealed hold down clips attached with screws to the substructure, except that through fasteners may be used at limited locations such as at ends of panels and at roof penetrations.

**Stiffener:** A member used to strengthen a plate against lateral or local buckling. Usually a flat bar welded perpendicular to the longitudinal axis of the member.

**Stitch Screw:** A fastener connecting panels together at the sidelap.

**Stress:** A measure of the load on a structural member in terms of force per unit area.

**Strut:** A member fitted into a framework that resists axial compressive forces.

**Tapered Members:** A built up plate member consisting of flanges welded to a variable depth web.

**Tensile Strength:** The longitudinal pulling stress a material can bear without tearing apart.

**Thermal Block:** A spacer of low thermal conductance material.

**Thermal Resistance (R-Value):** Under steady conditions, the mean temperature difference between two defined surfaces of material or construction that induces unit heat flow through unit area. Note: Thermal resistance and thermal conductance are reciprocals. Thermal resistances are R-values, to obtain the U-factor, overall thermal transmittance; the R-value for either materials or constructions must first be evaluated because, by definition, the U-factor is the reciprocal of the sum of the individual R-values.

**Through-Fastened Roof System:** A through-fastened roof system is one in which the roof panels are attached directly to the roof substructure with fasteners which penetrate through the roof sheets and into the substructure.

**Ton:** 2000 pounds.

**Track:** A metal way for wheeled components; specifically, one or more lines of ways, with fastenings, ties, etc., for a craneway, monorail or slide door.

**Translucent Light Panels:** Panels used to admit light.

**Transverse:** The direction parallel to the main frames.

**Trim:** The light gage metal used in the finish of a building, especially around openings and at intersections of surfaces. Often referred to as flashing.

## METAL BUILDING TERMS AND DEFINITIONS

**Turn-of-the-Nut Method:** A method for pre-tensioning high strength bolts. The nut is turned from the “Snug tight” position, corresponding to a few blows of an impact wrench or the full effort of a man using an ordinary spud wrench, the amount of rotation required being a function of the bolt diameter and length.

**Uplift:** Wind load on a building that causes a load in the upward direction.

**Valley Gutter:** A channel used to carry off water from the “V” of roofs of multi-gabled buildings.

**Vapor Barrier:** Material used to retard the flow of vapor or moisture to prevent condensation from forming on a surface.

**Ventilator:** An accessory, usually used on the roof, that allows the air to pass through.

**Walk Door:** See “*Personnel Door*”.

**Wall Covering:** The exterior wall surface consisting of panels.

**Web:** That portion of a structural member between the flanges.

**Web Stiffener:** See “*Stiffener*”.

**Width:** The dimension of the building measured parallel to the main framing from sidewall to sidewall.

**Wind Bent:** See “*Portal Frame*”.

**Wind Column:** A vertical member designed to withstand horizontal wind loads.

**Wind Load:** The load caused by the wind from any horizontal direction.

**X-Bracing:** Bracing system with members arranged diagonally in both directions to form an “X”. See “*Bracing*”.

**“Z” Section:** A member cold formed from steel sheet in the shape of a “Z”.



