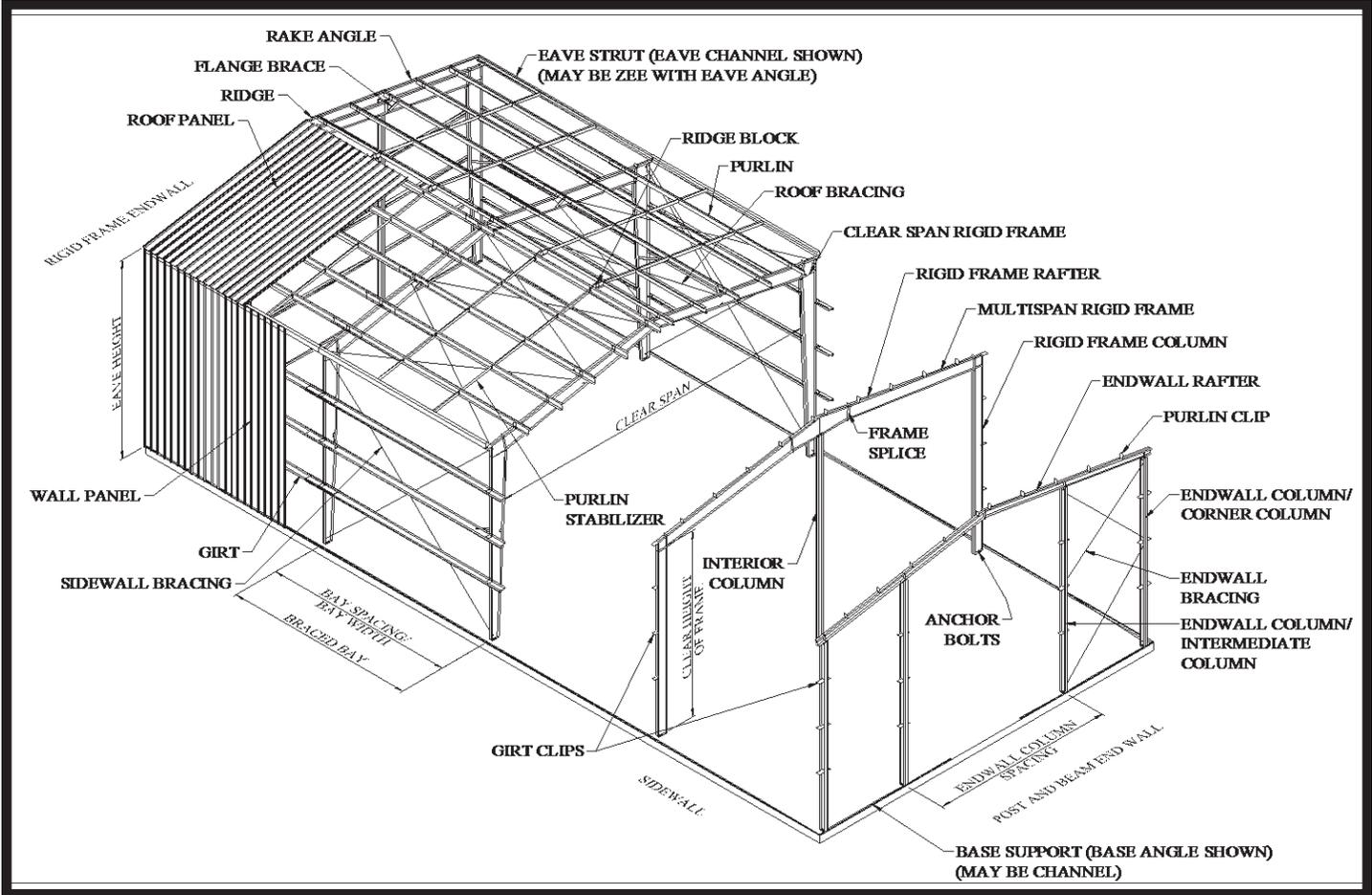
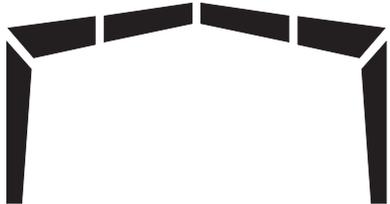


# RIGID FRAME



# CONSTRUCTION GUIDE

**BEHLEN**  
Made Strong



# WARNING!

## INSTALLERS - FALL PROTECTION RECOMMENDED!

**GALVANIZED OR GALVALUME™ COATED** material **SHOULD BE KEPT DRY** to prevent damage. Material should **NEVER BE STACKED OUTSIDE IN THE OPEN AIR WITHOUT AN AIR SPACE BETWEEN EACH SHEET**. Otherwise rain and other moisture will, by chemical action when the material is in contact with each other, produce an oxidation on the surface causing a whitish discoloration on Galvanized material, and a darkish discoloration on Galvalume™ material. Rain or snow will do no harm to material if allowed to run off the surface and the material to dry in due course, but **WATER MUST NOT BE ALLOWED TO GET BETWEEN PARTS IN CONTACT BEFORE THEY ARE INSTALLED**. Therefore, should temporary outdoor storage be necessary, material should be stood on end and spread out at the bottom for easy drainage. Material bundles may also be protected by covering, kept off the ground and sloped to allow air to pass freely through the covering to prevent any moisture accumulation on top or underneath the covering and below the material bundle so that material is not allowed to become wet or damp. **EXTRA PRECAUTIONS SHOULD BE TAKEN DURING PERIODS OF EXCESSIVE HUMIDITY.**

**PRE-PAINTED SURFACE PROTECTION:** If the paint surface becomes scratched due to shipping or on-site handling, the Galvalume™ or Galvanized steel finish will protect the area from rusting. The scratches can easily be touched-up with the application of good-quality paint. Due to occurrences beyond our control while the product is in transit or on the site, we are not responsible for this touch-up procedure.

**STORAGE:** As with all metal materials, pre-painted material must be kept dry prior to application. We accept no responsibility for the performance of any contractor or roofing/siding applicator or for the resulting performance of these products.

**WHEN CUTTING PANELS:** Protect all surfaces from hot metal cuttings so that the cuttings and metal shavings do not melt into the pre-paint surface finish. Remove loose cuttings or metal shavings from all material or cuttings will cause material rusting. Proper techniques must be used when applying products to building.

**HANDLING:** These products may contain oily surfaces and sharp edges and care should be taken.

**CHAIN PROTECTORS (CORNERS) TO BE USED WHEN MOVING BUNDLES.** Spreader bars to be used on long material bundles to prevent buckling.

**STEEL**



**OVEREXPOSURE TO DUSTS OR FUMES GENERATED DURING WELDING OR BURNING STEELS, PARTICULARLY THOSE CONTAINING CHROMIUM OR NICKEL, MAY CAUSE RESPIRATORY DISEASE.**

**HIGH EXPOSURE TO FUMES DURING WELDING OR BURNING OF ZINC COATED PRODUCTS CAN CAUSE REVERSIBLE SHORT-TERM FLU-LIKE SYMPTOMS.**

**PROLONGED SKIN CONTACT WITH COATED STEEL MAY CAUSE SKIN IRRITATION IN SENSITIVE INDIVIDUALS.  
LIMIT INHALATION OF DUST OR FUMES GENERATED DURING PROCESSING.**

**LIMIT SKIN CONTACT.**

**OVEREXPOSURE TO METAL FUMES:** MOVE TO FRESH AIR. SEEK MEDICAL ATTENTION IF NECESSARY.

**SKIN CONTACT:** WASH WITH SOAP & WATER.

**FOR MORE INFORMATION READ THE MATERIAL SAFETY DATA SHEET AVAILABLE FROM OUR OFFICE**

REFER TO INSTALLATION INSTRUCTIONS

USE ONLY SEALING WASHERED FASTENERS WHEN INSTALLING STEEL SHEETS.

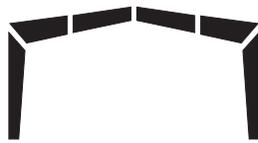
USE EXTREME CARE AND CAUTION AGAINST SLIPPAGE ON ROOF SURFACES. FALL PROTECTION RECOMMENDED WHEN INSTALLING!

**CAUTION - KEEP DRY**

WHEN CUTTING MATERIAL - PROTECT PAINTED SURFACES.  
REMOVE ALL METAL CUTTINGS DAILY!

AVOID MATERIAL CONTACT WITH MANURE, FERTILIZERS, SALT, LIME, CEMENT, ETC.  
THESE INSTRUCTIONS APPLY TO ALUMINUM OR STEEL, PAINTED AND UNPAINTED PRODUCTS.





## **SAFETY FIRST**

This construction guide (the “Guide”) recommends safety procedures to be followed and describes the erection of various building components of the System.

### **SAFETY MUST BE MADE THE TOP PRIORITY ON ALL JOB SITES**

Failure to follow these warnings and take appropriate safety precautions could result in serious injury or death!

Behlen Industries LP (“Behlen”) promotes safety throughout the erection of the Behlen Frameless Building System (the “System”). All parties erecting the System shall assume responsibility for providing safe working conditions and practices during the erection of the System. Caution or warning signs must be heeded and our recommended procedures should be followed, or alternative safety procedures should be put in place in order to make a safety program effective. IF FOLLOWING ANY OF THE INSTRUCTIONS IN THIS GUIDE WOULD ENDANGER ANY WORKER(S), ANOTHER METHOD MUST BE FOUND.

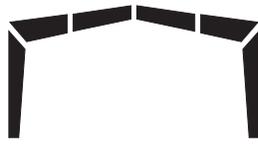
Employers must familiarize themselves with the requirements of Workplace Safety and Health Standards and local codes in their province and put them into practice. The Department of Labour in the United States has established federal safety standards (O.S.H.A.). Employers must strictly follow these requirements and standards and other provincial, state, municipal and local codes, as applicable, and put them into practice.

It is your responsibility to know what hazards exist on the job site and to make these known to all personnel working in and around the job site so that you can work together to take all necessary safety precautions. Caution must be used when moving the various building components of the System. The weight of the lift, safe lifting points, and the capacity of all lifting equipment must be known. All equipment used in connection with the System must be well maintained. Any worn or damaged equipment must be repaired or replaced immediately, especially lifting cables, slings, and other equipment used in connection with the erection of the System.

Attention must be paid to the worksite at all times. Tripping and falling hazards must be eliminated. Various building components of the System have sharp metal edges and gloves and eye protection need to be worn at all times. First-aid equipment must be kept at hand and first aid training should be provided to all persons who erect or otherwise deal with the System. Safety meetings must be conducted regularly. Safety procedures need to be reviewed at each stage of construction and at such other times as necessary.

#### **ROOFING WORK REQUIRES PARTICULAR ATTENTION TO SAFETY:**

- Unsecured panels must never be stepped on. Such panels can easily start sliding.
- Panels will not support the weight of a person at the panel edge.
- Panel ends must not be stood on before they are fastened.
- Workers must maintain a constant awareness of their location relative to the roof edge and exercise extreme caution near the roof edges and openings.
- Frost and dew can create an extremely hazardous surface. Frost-covered roofs must never be stepped on.
- Roof panels must be kept clean of oil and other slippery substances in order to prevent slipping or falling.
- Fall restraints or fall arrests must be used as required by applicable safety regulations.
- Ladders, as well as walking and working surfaces, must have appropriate safety cages, railings, nets, and/or safety lines and tie-offs for workers and for any other persons who could be injured by a lack of such safety devices. These safety devices must be used at all times.



## PREFACE

The recommendations and details contained in this Guide illustrate the erection of the System under standard conditions. This Guide is provided as a supplement to the construction drawings prepared for your specific job. Due to the variations possible with any building, a careful study of the building's Construction Drawings is essential. Custom layouts, details, and parts may be required. In case of a disagreement between this Guide and the construction drawings, the construction drawings shall govern. The erection methods utilized are the responsibility of the erector of the System.

Studying the construction drawings and this Guide before the arrival of the steel components of the System at the job site can help enhance safety and predetermine the following cost-critical requirements:

- Size and scheduling of the work crew.
- Type, size and quantity of tools and hoisting equipment needed.
- Proper erection bracing scheme.
- Proper scheduling of erection sequence.
- Advance notations on Construction Drawings to call out items requiring field location or modification.
- Identification and resolution of questions.

---

**Due to continuing research and development, Behlen reserves the right to modify any of the details and procedures covered in this Guide without notice.**

---

Erection is to be carried out by experienced, qualified erectors. Erectors must be familiar with the contents of this Guide and the building construction drawings. The experience, expertise and skills of the erection crews as well as the equipment available for handling the material determine the quality of erection.

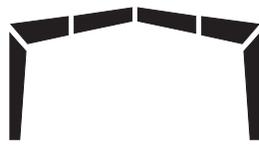
It is emphasized that Behlen is a manufacturer of metal building components and is not engaged in the erection of its products. Opinions expressed by Behlen about erection practices are only intended to serve as a guide for erection of the System. The general contractor and/or erector of the System are solely responsible for accurate, good quality workmanship in erecting the System in accordance with the drawings and details, all applicable codes, and industry standards pertaining to proper erection, including the proper use of erection bracing and the adherence to appropriate safety programs and measures.

NEITHER BEHLEN NOR ITS OFFICERS, DIRECTORS, EMPLOYEES, SHAREHOLDERS, AGENTS, LICENSORS, RESELLERS OR REPRESENTATIVES SHALL BE LIABLE FOR ANY INCIDENTAL, INDIRECT, SPECIAL, EXEMPLARY OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, DAMAGES OR COSTS INCURRED AS A RESULT OF LOSS OF TIME, LOSS OF SAVINGS, LOSS OF REVENUES AND/OR PROFITS, OR LOSS OF GOODWILL, WHETHER FORESEEABLE OR UNFORESEEABLE, THAT MAY ARISE OUT OF OR IN CONNECTION WITH THIS GUIDE, INCLUDING, BUT NOT LIMITED TO, DAMAGES OR COSTS RESULTING FROM INCOMPLETE, UNSAFE, IMPROPER OR INADEQUATE ERECTION OF THE SYSTEM OR COMPONENTS SHOWN IN THE DRAWINGS OR DETAILS OR FOR THE INSPECTION OF ERECTED COMPONENTS, EVEN IF BEHLEN HAS BEEN NOTIFIED OF THE POSSIBILITY OR LIKELIHOOD OF SUCH DAMAGES OCCURRING, REGARDLESS IF SUCH DAMAGES ARE BASED IN CONTRACT, TORT, WARRANTY, NEGLIGENCE, STRICT LIABILITY, PRODUCTS LIABILITY OR OTHERWISE.



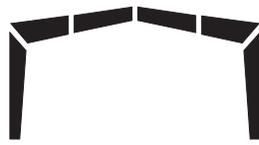
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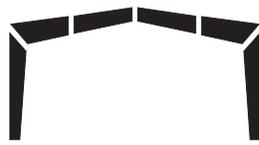
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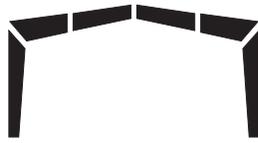
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## 1 - CONSTRUCTION DRAWINGS

Prior to erecting any component, refer to the Construction Drawings for the building to confirm the location of that component. Improper location of components can be costly due to erection time spent disassembling and re-erecting and could result in structural failure.

This section outlines some common features of the Construction Drawings.

### DRAWING VERSION

#### 1. Information Drawings

Drawings issued “For Information” will be clearly marked in the Revision Block on each page. “For Information” drawings are intended for use in coordinating and confirming the various building details before construction begins. **These drawings are to be checked carefully to ensure all aspects of the building are accurate.**

The Information Drawings may be submitted to the buyer For Approval. **Approval by the buyer affirms that Behlen Industries LP has correctly interpreted the overall contract requirements for the metal building system, the accessories, and their location.**

The issue level for these drawings is indicated with a letter. The first issue of “For Information” drawings is issue “A”. These drawings are incomplete and do not reflect the final building details, part numbers, bolts, etc. **Never attempt to erect a building using drawings marked “For Information.”**

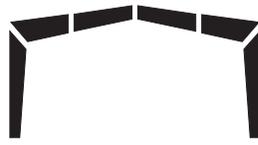
#### 2. Construction Drawings

Drawings issued “For Construction” will also be clearly marked in the Revision blocks. These drawings are intended for use in erecting the building and reflect the final configuration of the building. The issue level for these drawings is indicated with a number. The first issue of “For Construction” drawings is issue “0”.

### DRAWING PACKAGE

A typical Drawing Package contains the following drawings:

1. Erection Drawings
  - Drawing Schedule
  - General Information Sheet and Conformance
  - Anchor Bolt Plan
  - Anchor Bolt Reactions
  - Rigid Frame Elevation(s)
  - Roof Framing Plan
  - Building Elevation(s)
  - Additional drawing(s) (if required)
2. Standard Detail Page(s)



# CONSTRUCTION DRAWINGS

## DRAWING SCHEDULE

DRAWING SCHEDULE		REVISIONS					
DWG #	DRAWING TITLE	ISSUE	YY/MM/DD	ISSUE	YY/MM/DD	ISSUE	YY/MM/DD
1	DRAWING SCHEDULE	A	YY/MM/DD				
1A	GENERAL INFORMATION SHEET AND CONFORMANCE	D	YY/MM/DD				
2	ANCHOR BOLT PLAN	D	YY/MM/DD				
3	ANCHOR BOLT REACTIONS	D	YY/MM/DD				
4	FRONT ELEVATION	A	YY/MM/DD				
5	ROOF FRAMING PLAN	A	YY/MM/DD				
6	LEFT ENDWALL ELEVATION	A	YY/MM/DD				
7	RIGHT ENDWALL ELEVATION	A	YY/MM/DD				
8	FRONT SIDEWALL ELEVATION	A	YY/MM/DD				
9	BACK SIDEWALL ELEVATION	A	YY/MM/DD				

NOTE:  
LETTER ISSUES ARE INFORMATION DRAWINGS.  
NUMBER ISSUES ARE CONSTRUCTION DRAWINGS.

NOTE:  
THIS DRAWING IS A REPRESENTATION OF THE GENERAL BUILDING LAYOUT AT THE TIME OF ORDER AND FINAL CONFIGURATION (OPENINGS, BRACING, GIRT LOCATIONS, ETC.) MAY NOT BE EXACTLY AS SHOWN. SEE THE ELEVATION AND PLAN DRAWINGS FOR THE FINAL CONSTRUCTION CONFIGURATION.

DESIGNER	PROJECT	PRT
DATE	LOCATION	REV
DRAWING SCHEDULE		1
<b>BEHLEN</b>		A
Made Strong		

Illustration 1-1 Typical Drawing Schedule

The Drawing Schedule provides a list of all the Erection Drawings supplied for the specific building, their page numbers, issue levels, and the dates issued. Use this page to ensure that the drawings being used are the latest revision available, and that all pages are present.

If there is a drawing of the building on this page, it will be a simplified version of the building at the time of order. Generally, changes to the building are not reflected in this drawing, as it is intended for illustration only.



## CONSTRUCTION DRAWINGS

### GENERAL INFORMATION SHEET AND CONFORMANCE

This page contains a variety of information about the building. Erectors should familiarize themselves with this information before beginning the erection of any Behlen Industries LP building.

Illustration 1-2 Typical General Information Sheet and Conformance

The two main sections of the General Information Sheet and Conformance are:

1. A660 Certificate of Design and Manufacturing Conformance

This section identifies the building’s manufacturer, size, type, location, design code, design loads, and Design Engineer. This information is necessary to obtain a Building Permit, and is based on the CSSBI Certificate format. Check this section carefully to ensure that all information is correct.

2. General Information

This section contains general information about the manufacture, storage, and erection of the building. The materials and Standards used by Behlen Industries LP are indicated. This section specifies a number of items and Standards for which the Erector will be responsible.

The various Member Section Designations used by Behlen Industries LP to indicate member sizes on the Erection Drawings are explained in this section.



## CONSTRUCTION DRAWINGS

### ANCHOR BOLT PLAN

The Anchor Bolt Plan shows the building dimensions, locations of the braced bays, and the size and location of the anchor bolts. The anchor bolts and dimensions for field located accessories are not shown. The general location of these openings will be indicated and labelled "field".

All dimensions on this drawing must be closely observed. Locate the anchor bolts carefully, following the details provided.

See also "Foundation" on page 28 and "Anchor Bolt and Foundation Check" on page 30.

Ensure that the reinforcing steel for slabs and grade beams will not interfere with the placement of anchor bolts for columns or doors.

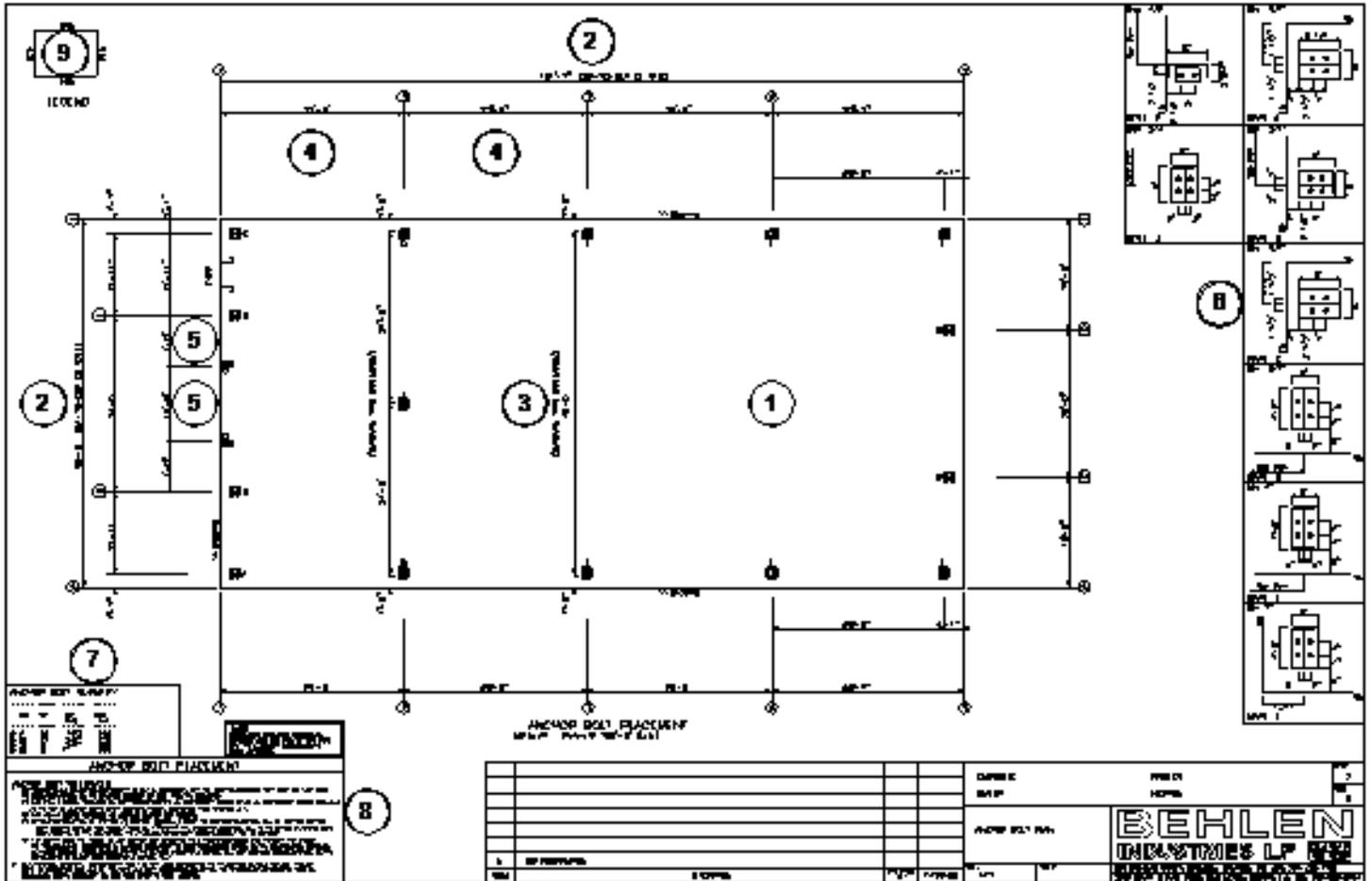
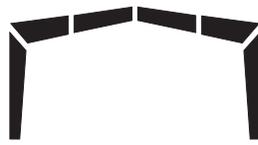


Illustration 1-3 Typical Anchor Bolt Plan



## CONSTRUCTION DRAWINGS

### ANCHOR BOLT PLAN MAIN FEATURES

#### 1. Anchor Bolt Placement Plan

This is the overall plan of the foundation, showing building size, underside of base plate elevation (unless noted in individual details), the location and orientation of columns and jambs, and the Anchor Bolt Detail that applies to each location. The locations of braced bays are also indicated on the plan. **Note that the upper level(s) of multi-tiered bracing may occur in bays other than those indicated here. Consult the Building Elevations to determine the location of any multi-tiered bracing.**

---

**NOTE:** The column/jamb orientations shown on this plan govern over the orientations shown in the individual details.

---

#### 2. “OUT-TO-OUT OF STEEL”

This is the overall dimension of the building measured from the outside face of the girts, known as the Steel Line. Eave and/or gable extensions will not be reflected in this dimension. Normally, this is also the overall dimension of the concrete. If the edge of the concrete will not be at the Steel Line, take extra care when locating the anchor bolts.

#### 3. “MAINTAIN THIS DIMENSION”

This is the critical distance between the column anchor bolts set for a rigid frame. Give special consideration to these dimensions. Inaccurate spacing will force the rigid frame columns out of plumb and prevent the frame connections from mating properly.

#### 4. Column Spacing

These are the dimensions between the centrelines of the column anchor bolt groups. If these dimensions are not maintained, the members framing between the columns will not fit properly. It will also be difficult to plumb the columns. The related Anchor Bolt Details show the dimensions from the Steel Line to the anchor bolts, and from the centre of the group to the anchor bolts.

#### 5. Framed Opening Locations

These dimensions are from the nearest Steel Line, or the centre of the nearest column, to the inside face of the opening jamb. **These dimensions are not to the anchor bolts.** The related Anchor Bolt Detail(s) show the dimensions to the anchor bolts from the Steel Line and from the face of the jamb.



## CONSTRUCTION DRAWINGS

### 6. Anchor Bolt Details

The Anchor Bolt Details show the spacing of the anchor bolts within a group, the location of the group from the Steel Line, and the reference point of the group that is dimensioned on the overall plan. The Endwall (EW) and/or Sidewall (SW) Steel Lines are indicated on the details for reference, if applicable. Any variation in anchor bolt size, quantity, spacing, base plate size, or elevation will be shown on a separate detail. Variations in orientation are not shown on separate details.

---

**NOTE: The various Anchor Bolt Details may reoccur at several locations around the building. The orientation of the Anchor Bolt Details may not match the overall plan at all locations. The details may be rotated or mirrored from the orientations on the overall plan. When setting anchor bolts, orient the group as per the overall plan, using the details for the size, spacing, and offsets of the anchor bolts.**

---

### 7. Anchor Bolt Summary

This chart gives general information about the anchor bolts in the Anchor Bolt Plan.

- The symbols that indicate the bolt diameters.
- The quantity of each bolt size used on the plan.
- The general location of the bolt type indicated.
- Bolt diameter.
- Bolt projection above the underside of the base plate. **If grout will be used under the base plate, increase the projection from the concrete accordingly.**

### 8. Anchor Bolt Placement

These notes set out the tolerances and conditions that the foundation is expected to meet. See also “Foundation” on page 28 and “Anchor Bolt and Foundation Check” on page 30.

### 9. Legend

This diagram indicates the location of the various building walls and their orientation to the Anchor Bolt Plan. The diagram typically shows the Front Sidewall (FSW), Back Sidewall (BSW), Left Endwall (LEW), and Right Endwall (REW). This is also the orientation that is used for the Building Elevation drawings.



### CONSTRUCTION DRAWINGS

#### ANCHOR BOLT REACTIONS

The Anchor Bolt Reactions page provides information about the column base plates, anchor bolts, and the loads that the building will impose upon the foundation. Each column's anchor bolt size and quantity, base plate size, grout (if any), and the reactions are listed by gridline. This information is vital for a proper foundation design.

**RIGID FRAME: ANCHOR BOLTS & BASE PLATES**

Line	Col	Base	Plate	Wid	Len	Thk	QTY
1	A	4	0.750	8.000	14.000	0.500	0.0
1	B	4	0.750	8.000	14.000	0.500	0.0
1	C	4	0.750	8.000	14.000	0.500	0.0

3 \* Frame Lines: 3 4

**RIGID FRAME: BASIC COLUMN REACTIONS (k)**

Line	Col	Base	Plate	Wid	Len	Thk	QTY
1	A	4	0.750	8.000	14.000	0.500	0.0
1	B	4	0.750	8.000	14.000	0.500	0.0
1	C	4	0.750	8.000	14.000	0.500	0.0

**ENDWALL COLUMN: REACTIONS, ANCHOR BOLTS & BASE PLATES**

Line	Col	Base	Plate	Wid	Len	Thk	QTY
1	A	4	0.750	8.000	14.000	0.500	0.0
1	B	4	0.750	8.000	14.000	0.500	0.0
1	C	4	0.750	8.000	14.000	0.500	0.0

**GENERAL NOTES**

- BEHLEN INDUSTRIES ASSUMES NO RESPONSIBILITY OF LIABILITY FOR FOUNDATION DESIGN OR CONSTRUCTION.
- ANCHOR BOLTS NOT BY BEHLEN INDUSTRIES.
- ALL REACTIONS ARE IN KIPS AND FT-KIPS (KN AND KN-M IF METRIC).
- POSITIVE REACTIONS ARE AS SHOWN IN THE SHEET. FOUNDATION LOADS ARE IN OPPOSITE DIRECTIONS.
- BRACING REACTIONS ARE IN THE PLANE OF THE BRACE WITH THE H POINTING AWAY FROM THE BRACED BY THE VERTICAL REACTION IS DOWNWARD.
- LOAD COMBINATIONS ARE TO BE APPLIED AS PER THE APPLICABLE BUILDING CODE FOR FOUNDATION DESIGN.
- ALL BASIC LOADS AND BRACING REACTIONS ARE UNFACTORED.
- SEISMIC REACTIONS ARE FACTORED PER WHAT STATES LOAD COMBINATIONS FOR STRUCTURAL DESIGN.
- BRACING REACTIONS MAY REVERSE.
- BRACING REACTIONS ARE NOT COMBINED WITH BASIC LOADS.
- SEISMIC FORCE MODIFICATION FACTOR (R) FOR ALL COL = 1.5
- HORIZONTAL WIND LOAD ON PARTITION WALLS IS BASED ON 0 psf.
- ASSUMED CONCRETE STRENGTH = 3.0 KSI.
- DOORS AND WINDOWS MUST BE DESIGNED TO WITHSTAND APPROPRIATE WIND LOADS WITHOUT FAILURE.
- BASIC LOAD DEFINITIONS:
  - DEAD - Selfweight of the building system.
  - LIVE - Occupancy, assembly, storage, vehicles, etc.
  - WIND - Wind pressure and suction.
  - WIND-LL - Wind from left to right, with positive internal pressure.
  - WIND-R - Wind from right to left, with positive internal pressure.
  - WIND-LL - Wind from left to right, with negative internal pressure.
  - WIND-R - Wind from right to left, with negative internal pressure.
  - SEISMIC - Seismic force from left to right.
  - SEISMIC - Seismic force from right to left.
  - WIND - Wind from left to right.
  - WIND - Wind from right to left.

**ANCHOR BOLT PLACEMENT**

ANCHOR BOLT TOLERANCES:

- ANCHOR BOLT AND BASE PLATE SHALL BE SET TO THE DESIGN DEPTH, THEY MUST NOT VARY FROM THE DESIGN DEPTH BY MORE THAN 1/8" (3.18 mm).
- ANCHOR BOLT SHALL BE SET TO THE DESIGN DEPTH, THEY MUST NOT VARY FROM THE DESIGN DEPTH BY MORE THAN 1/8" (3.18 mm).
- ANCHOR BOLT SHALL BE SET TO THE DESIGN DEPTH, THEY MUST NOT VARY FROM THE DESIGN DEPTH BY MORE THAN 1/8" (3.18 mm).
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- ANCHOR BOLT SHALL BE SET TO THE DESIGN DEPTH, THEY MUST NOT VARY FROM THE DESIGN DEPTH BY MORE THAN 1/8" (3.18 mm).
- ANCHOR BOLT SHALL BE SET TO THE DESIGN DEPTH, THEY MUST NOT VARY FROM THE DESIGN DEPTH BY MORE THAN 1/8" (3.18 mm).

NO.	DESCRIPTION	CHANGED BY	DATE
0	FOR CONSTRUCTION		

CUSTOMER:	PROJECT:	REV:
DEALER:	LOCATION:	DATE:
ANCHOR BOLT REACTIONS		<b>BEHLEN</b> Made Strong

Illustration 1-4 Typical Anchor Bolt Reactions

#### ANCHOR BOLT REACTIONS MAIN PAGE FEATURES

1. Rigid Frame Anchor Bolts and Base Plates  
 These charts describe the quantities and dimensions of the Rigid Frame base plates and the associated anchor bolts. There is a separate chart for each frame type, with similar frames of the same type grouped together. If the chart represents a group of frames, the frame lines represented will be listed at the bottom of the chart.

The information listed by Grid Line in the chart provides:

- A listing of the frame lines represented
- Number of anchor bolts in the anchor bolt group
- Anchor bolt diameter
- Base plate width, length and thickness
- Depth of grout accounted for at the column



## CONSTRUCTION DRAWINGS

### 2. Rigid Frame Basic Column Reactions

These are charts listing the Reactions at the Rigid Frame base plates under the various loading conditions for which the building has been designed. Each frame line is listed, with each column accounted for. Similar frames which have been grouped together are listed at the bottom of the chart.

### 3. General Notes

This is a list of general information pertaining to the Reactions page. These notes outline the limits of the Behlen Industries LP scope of contract, how to interpret the values provided, and define the load cases.

### 4. Endwall Column and Bracing

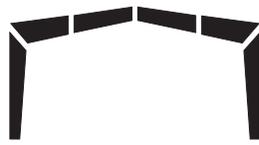
This is a list of Reactions, anchor bolts, and base plates for the buildings Endwall(s). The information provided is similar to that provided for the Rigid Frame(s). The longitudinal bracing reactions are also included here.

### 5. Load Combinations

This is a list of the load combinations for which the building has been designed.

### 6. Anchor Bolt Placement

These notes outline the expected tolerances to maintain when installing the foundation and anchor bolts.



## CONSTRUCTION DRAWINGS

### RIGID FRAME ELEVATION(S)

The Rigid Frame Elevation page(s) show the rigid frames for the building, which gridlines they will be located on, their dimensions, part numbers, and how they are assembled.

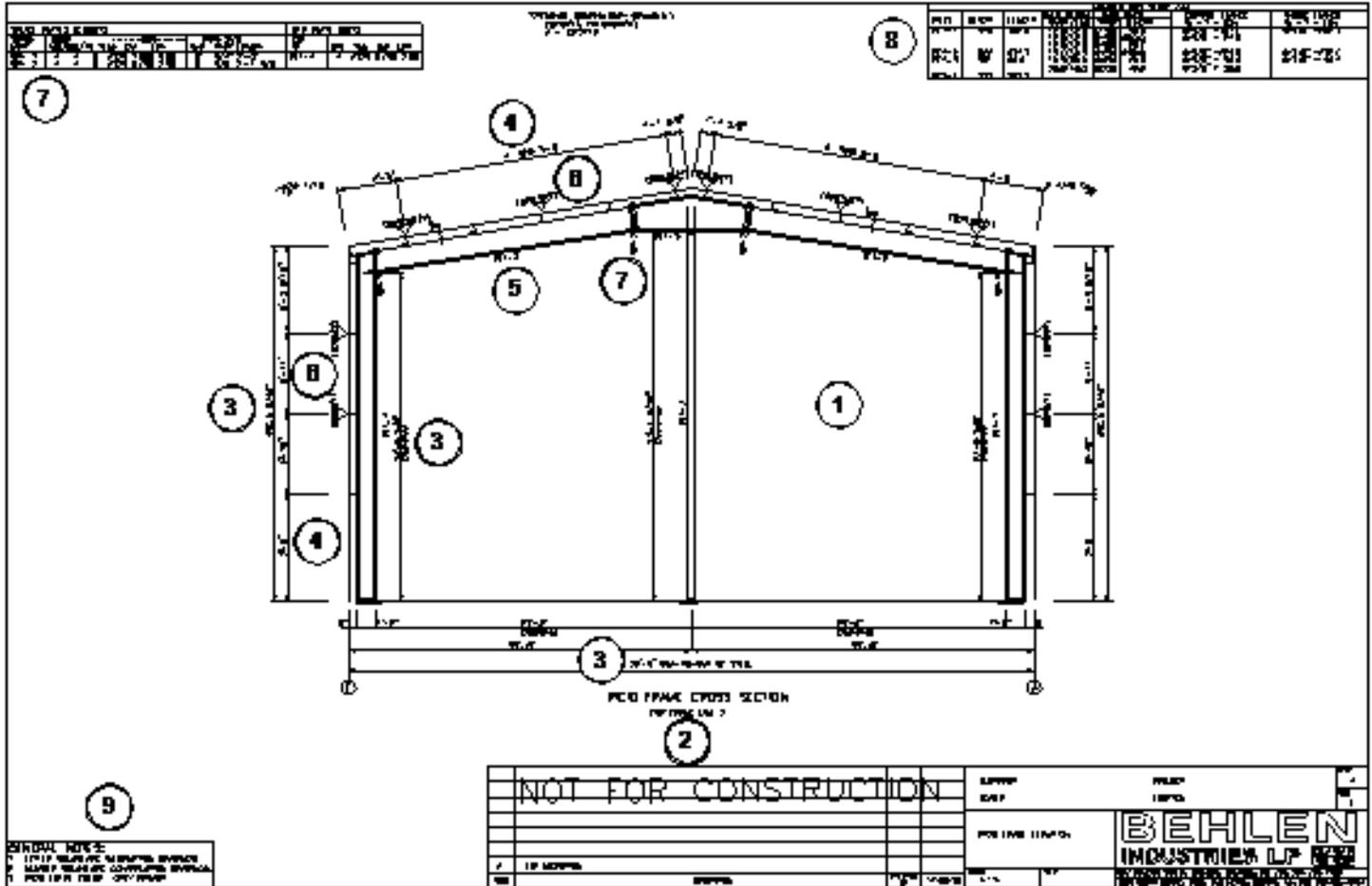


Illustration 1-5 Typical Rigid Frame Elevation

### RIGID FRAME ELEVATION(S) MAIN FEATURES

#### 1. Rigid Frame Elevation

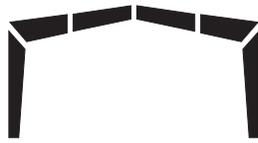
This is a drawing of the assembled Rigid Frame. The layout, part numbers, and finished dimensions of the building are shown.

#### 2. Location

The Building Gridlines where this Rigid Frame is used are listed here. There may be more than one location and they may not be adjacent to each other.

#### 3. Building Dimensions and Clearances

The building dimensions show the overall height and width of the building at the Gridline. These dimensions are from the outside of the girts and purlins (or Thermal System, if applicable). If the building has a Thermal System and/or Thermal Block, determine if they have been accounted for in the building dimensions by comparing the roof and wall depths shown with the girt and purlin depths.



## CONSTRUCTION DRAWINGS

The height and width clearances inside the frame are given. Ensure that these clearances will accommodate any equipment, cranes, partitions, ceilings, or doors in the building. It is not uncommon for the desired location or size of an overhead door to interfere with the most efficient profile of a nearby frame.

### 4. Girt and Purlin Locations

The locations and orientation of the girts and purlins are shown. Dimensions are to the web of the purlin or girt. Ensure that all girts and purlins are located and oriented as shown. There may be clips and/or clip bolt holes on the frame which are not intended to be used at this location. Consult the Roof Framing Plan and Building Elevations to determine where the girt and purlin locations are required. Pay close attention to the orientation shown. Monoslope buildings require the purlin orientation to alternate to increase the stability of the roof system. Purlins, girts and flange braces will not fit properly unless the intended orientation is maintained.

### 5. Rigid Frame Member Part Numbers

The part number for each member will be shown. If a Rigid Frame is to be used at more than one gridline, there may be different part numbers required. In these cases, the different part numbers will be noted here, along with the applicable gridlines. **Using Rigid Frame members at the wrong locations is a costly and time-consuming mistake that can be difficult to correct.**

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Using any building component at a location for which it is not intended can lead to an unsafe building condition.

---

### 6. Flange Brace Locations and Part Numbers

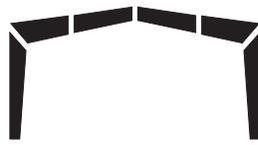
The flange braces for the Rigid Frame are indicated at their proper locations, showing the part number and whether they are needed on one side or two. Flange braces on both sides of the frame are the default. If they are required on one side only, the part number is followed by (1). The standard flange brace part number is related to its size and length. This relationship is given at the top of the page.

### 7. Rigid Frame Splices and Bolts

The various Rigid Frame splice types are indicated at the splice locations. The Splice Plates and Bolts table shows the size, type, and quantity of bolts to use at each splice type. Most often, the splice bolts are Grade A325. Grade A490, or others, may be required, and they will be noted in the table. **Ensure that the proper bolts are used at all locations at all times.**

The second part of this table is the Cap Plate Bolts section. The bolts required for any interior columns will be listed here with the applicable column part number.

Refer to "BOLTED CONNECTIONS" on page 6-1 and the General Information Sheet and Conformance page of the Erection Drawings for proper bolt tightening procedures.



## CONSTRUCTION DRAWINGS

### 8. Member Size Table

This table lists the various properties of each Rigid Frame member. The members and their plates are listed starting at the base of the left-hand (Back Sidewall) column, proceeding to the top of the column, then along the rafter(s) to the right-hand (Front Sidewall) eave, then down the column (if present) to the base. Any interior columns are listed next proceeding left to right. Members that occur on both sides of the building are not listed again. This information can be used to determine the size and strength of a member at any point. The properties listed are:

- Part Number  
Each significantly different member is listed. Members with small differences such as holes, clips or gussets, may not be listed separately if the webs, flanges, and connection plates are the same.
- Weight  
The weight of the individual member is listed here in lbs. or kg.
- Length  
This is the overall length of the member in inches or mm.
- Web Depth  
This is the depth, measured perpendicular to the outside flange, of the member web. The depth is indicated (in inches or mm) as the depth at the start and end of each different web plate.
- Web Plate Thickness and Length  
This is the length, measured parallel to the outside flange, of each web plate.
- Outside Flange  
The width, thickness and length of each outside flange, including column top plates.
- Inside Flange  
The width, thickness and length of each inside flange.

### 9. General Notes

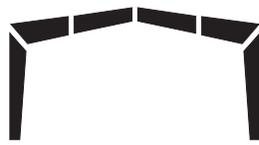
These are notes pertaining to the Rigid Frames for the building in general. Information such as paint type and colour will be listed here.

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#### **NOTE: Imperial Bolts Supplied**

**Behlen Industries LP supplies Imperial bolts with all buildings. Buildings that require metric Erection Drawings will have bolt sizes noted in metric. The bolts themselves will be Imperial and require Imperial sockets and wrenches.**

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### CONSTRUCTION DRAWINGS

#### ROOF FRAMING PLAN

The Roof Framing Plan shows the locations and sizes of the various roof framing components. The roof sheeting is also indicated, along with profile, color, and fasteners.

The connections for the various components are shown in the Standard Detail pages that are provided with the Erection Drawings for the building. Any non-standard connections will be indicated with custom details.

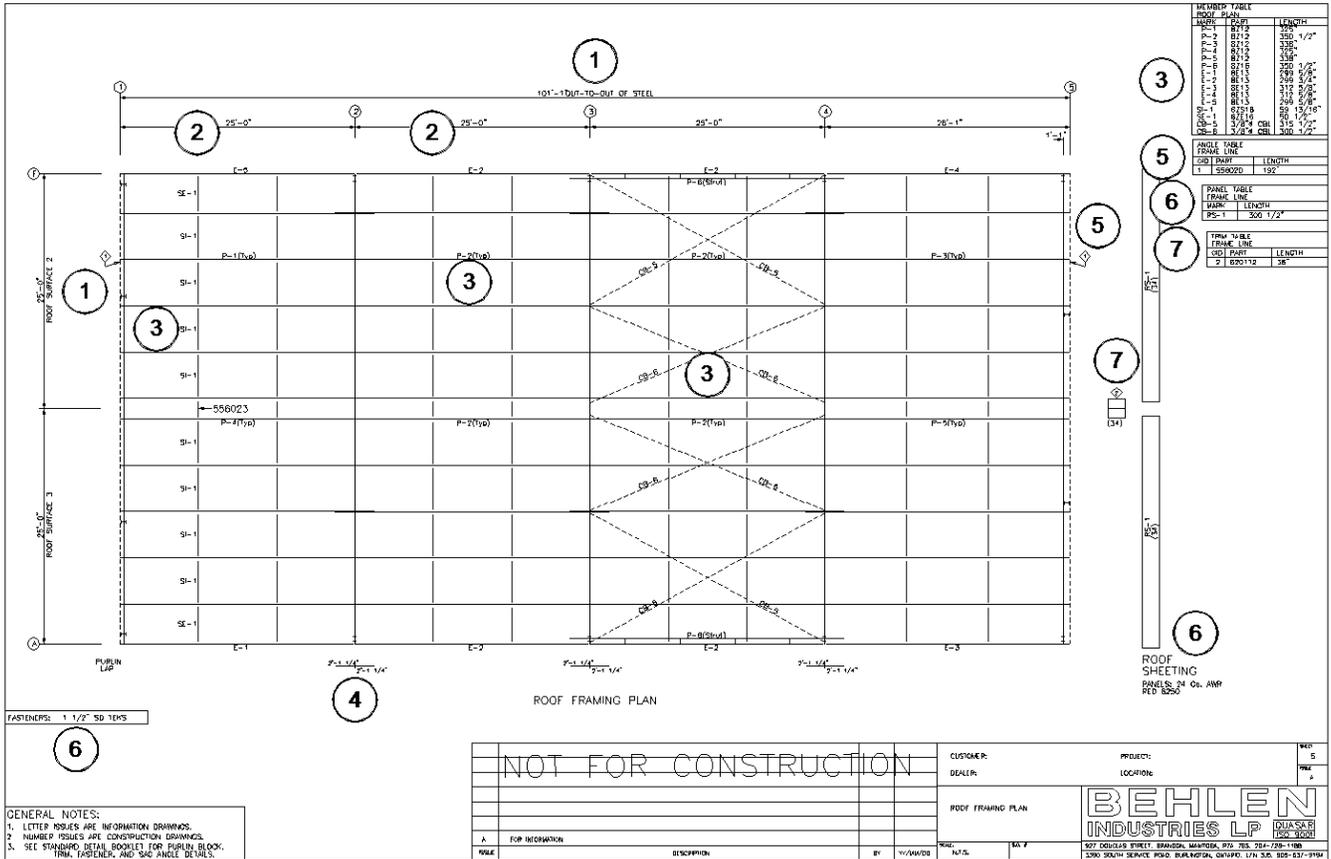


Illustration 1-6 Typical Roof Framing Plan

#### 1. Roof Dimensions

The over-all dimensions of the roof measured from the outside face of the girts at the eave and gable elevation. These will typically match the building dimensions on the Anchor Bolt Plan. Any roof overhangs such as eave or gable extensions will be shown extending past these points.

#### 2. Bay Spacing

These dimensions indicate the distance from frame to frame or from frame to Steel Line. The offset from a post and beam endwall rafter to the Steel Line is not shown.



## CONSTRUCTION DRAWINGS

### 3. Roof Framing

All roof framing members are shown and labelled. Purlins that repeat across the roof surface (that portion of the roof from the eave to the ridge, if any) will have their part number indicated as typical “(Typ)”. Any non-typical purlins will be labelled individually. Refer to the Rigid Frame Elevations for the proper purlin orientations and spacing.

Strut purlins are labelled “(Strut)”. These purlins have been specifically designed to withstand axial loads from the building bracing. Normally, blocking is required between the strut purlins and the adjacent purlins. The strut purlin is typically oriented opposite the adjacent purlin. Screw-down roof panels are to be fastened to the strut purlins. Standing Seam Roof (SSR) systems do not require SSR Clips on the strut purlins, and SSR Clips will not be provided for this. **Do not create a shortage by installing SSR Clips on the strut purlins.**

The Roof Plan Member Table lists the roof framing members, member size, and length (in. or mm).

### 4. Purlin Laps

Purlins normally lap at the rafter to provide increased strength to the roof system. These laps may not be the same on both sides of a rafter, or on all rafters. Proper purlin laps for the roof are indicated on the drawing. Ensure that the purlins extend past the rafter centerline by the length indicated for each side. Install the purlin lap bolts as per the Standard Details provided.

### 5. Roof Framing Angles

Miscellaneous roof framing angles such as Eave and Rake Angles are indicated on the Roof Framing Plan using identification symbols. To determine which type of angle is required at each location, refer to the Angle Table. Each angle, and its part number and length will be listed in the table. The Standard Details provided with the Erection Drawings show the proper installation of these parts. Any non-standard applications will be shown with custom details on the Erection Drawings.

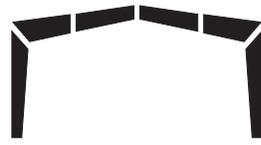
### 6. Roof Sheeting

The Roof Sheeting is normally shown on the Roof Framing Plan. Complicated roof sheeting layouts may require a separate plan. The panel gauge, profile, color, length, quantity, and fastener type are noted on the plan. Panel lengths are typically listed in the Panel Table, with each panel length having a separate label.

Roof Liner, if supplied, is shown in the same manner as Roof Sheeting.

### 7. Roof Trims

Roof trims are indicated using identification symbols. Refer to the Trim Table to determine the part number and length of the trim supplied at each location. Ridge cap quantity is indicated on the plan similar to a panel quantity.



### CONSTRUCTION DRAWINGS

#### BUILDING ELEVATION(S)

The Endwall Elevation(s) and/or Sidewall Elevation(s) show the dimensions and framing for the respective walls of the building. These walls are identified by Grid number and as Left Endwall, Right Endwall, Front Sidewall, or Back Sidewall. The Legend on the Anchor Bolt Plan identifies where these walls are located on the building. Building Elevations are normally oriented looking at the building from the outside.

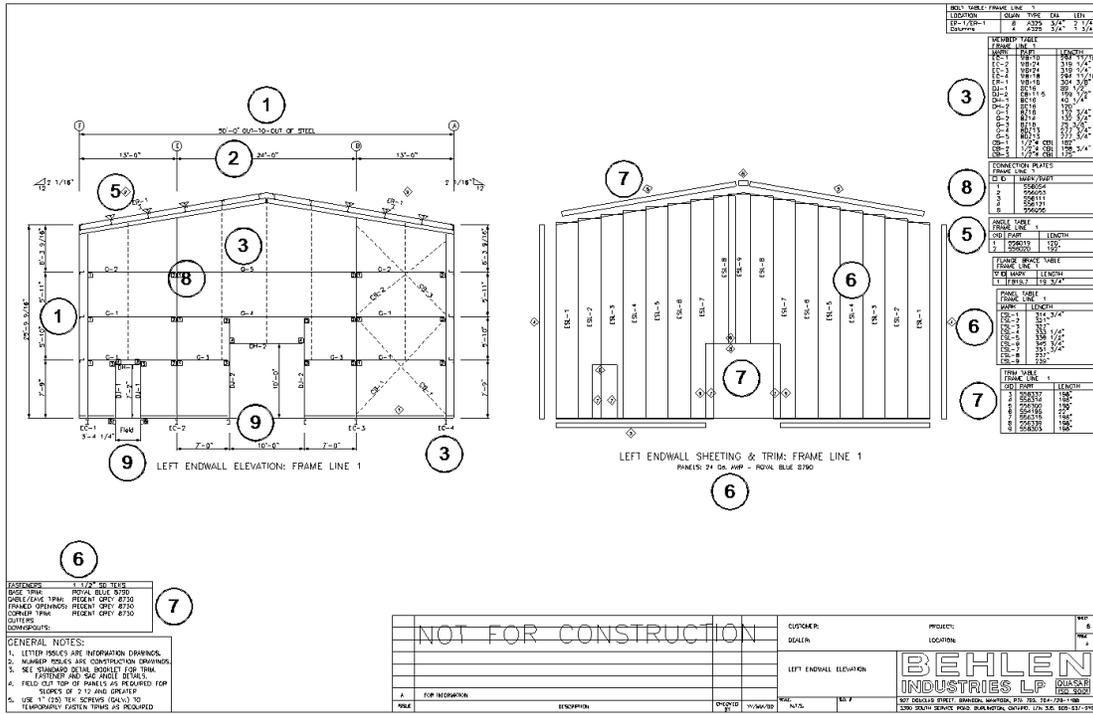


Illustration 1-7 Typical Endwall Elevation

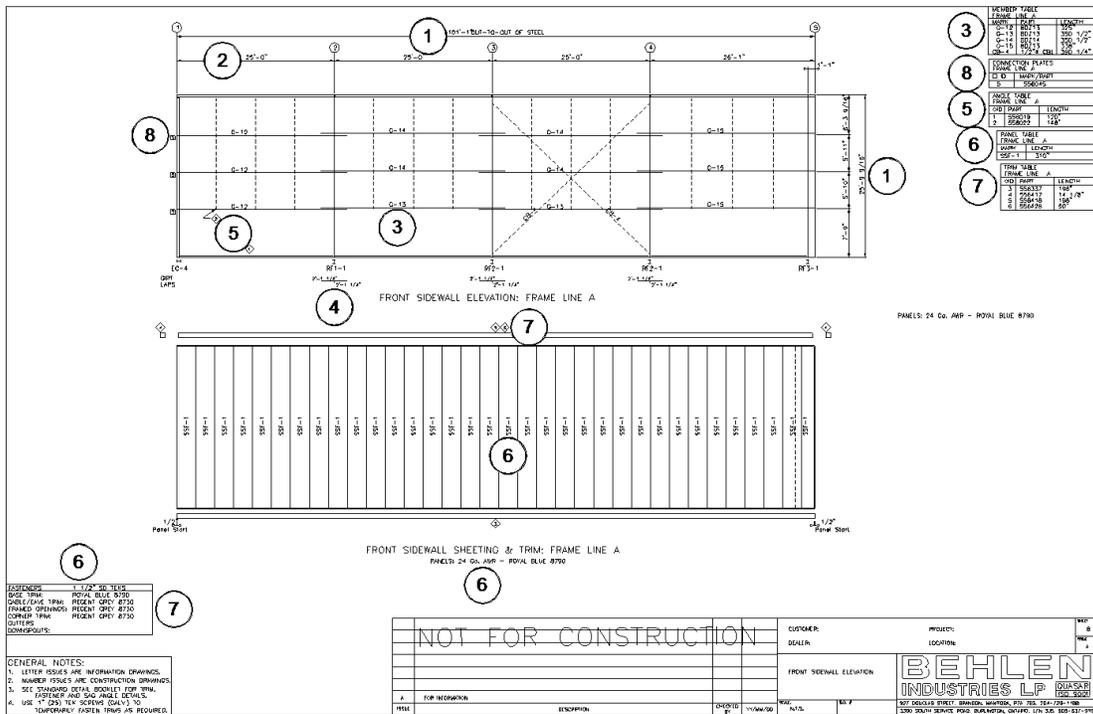
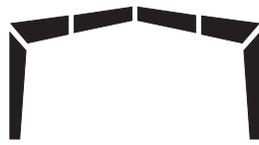


Illustration 1-8 Typical Sidewall Elevation



## CONSTRUCTION DRAWINGS

### 1. Building Dimensions

The over-all dimensions of the wall measured from the outside face of the girts (or Thermal System, if applicable). These will match the concrete dimensions on the Anchor Bolt Plan except in cases where the edge of the concrete is not at the Steel Line. The girt spacing dimensions shown are to the web of the girt.

### 2. Column Spacing

These dimensions are from the building Steel Line to the center of the column, or from center to center of the columns. Endwall corner column locations are commonly not shown here. The column spacing on these drawings will match those on the Anchor Bolt Plan.

### 3. Framing Members

All wall framing members are shown and labelled. The Member Table lists the framing members, member size, and length (in. or mm).

### 4. Girt Laps

Bypass girts normally lap at the column to provide increased strength to the wall system. These laps may not be the same on both sides of a column, or at all columns. Proper girt laps for the wall are indicated as shown. Ensure that the girts extend past the column centerline by the length indicated for each side.

### 5. Wall Framing Angles

Miscellaneous wall framing angles such as Base and Rake Angles are called off on the Building Elevations using identification flags as shown. To determine which type of angle is required at each location, refer to the Angle Table for the wall. Each angle, and its part number and length will be listed in the table. The Standard Details provided with the Erection Drawings show the proper installation of these parts. Any non-standard applications will be shown with custom details on the Erection Drawings.

### 6. Wall Sheeting

The Wall Sheeting is normally shown on the appropriate Building Elevation. Complicated wall sheeting layouts may require a separate drawing. The panel gauge, profile, colour, length, quantity, and fastener type are noted on the drawing. Panel lengths are typically listed in the Panel Table, with each panel length having a separate label.

### 7. Wall Trims

Wall trims are indicated using identification flags. Refer to the Trim Table for the wall to determine the part number and length of the trim supplied at each location. The colours for the various trim locations are listed in a legend. If there are trims on the building having the same profile but different colours, ensure the proper colours are used at the locations indicated.



## CONSTRUCTION DRAWINGS

### 8. Connection Plates and Clips

Loose clips for framing connections are normally indicated using identification flags. Refer to the Connection Plates Table for the wall to determine the part number of the clip supplied for each location. The Standard Details supplied with the Erection Drawings show how the various connections are made. Any non-standard connections will be shown with custom details on the Erection Drawings.

### 9. Framed Opening Dimensions

These dimensions are from the nearest Steel Line, or the center of the nearest column, to the inside face of the opening jamb. Dimensions for openings are the rough opening size. This should be taken into account when ordering the building and when ordering doors, windows, louvers, and other accessories.

- **Factory Located Openings**

All horizontal and vertical dimensions for these openings are shown on the Building Elevation. The framing for these openings does not require field modification to install. All members are cut to length and bolt holes are punched so that they can be installed at the location shown. It is necessary to provide the exact size and location of the opening when the building is ordered.

- **Field Located Openings**

These openings are labelled “field”. The horizontal locations of field located opening jambs are not dimensioned. The sill elevation of elevated field located openings may be dimensioned if it is known. The width and height of field located openings are dimensioned. The header length sets the maximum opening width, although the height can often be modified if necessary. These openings will be shown in their general locations, framing into the members which have been designed to support them, and cutting any girts that are acceptable for the design. The building framing is designed for the opening to be installed in the bay shown, and to be connected to the girts shown. The Erector may move the opening as long as these criteria are met.

## ADDITIONAL DRAWINGS

Additional drawings will be supplied if necessary, and are located in the Drawing Package as required. Wall Liner Elevations, Partition Wall Elevations, Crane Plans, Mezzanine Plans, etc. may be necessary if these items are included with the Behlen Industries LP portion of the building. The general format of these drawings will be similar to the typical drawings discussed.

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### CHECK THE DRAWING REVISIONS!

Always check the Erection Drawing set to ensure that they have been issued “For Construction”, that all drawings are included, and that they contain the latest revision available. Compare the drawings and revision issues to the latest Drawing Schedule. If in doubt, contact Behlen Industries LP before proceeding.

**NEVER ATTEMPT TO ERECT ANY BUILDING USING DRAWINGS ISSUED “FOR INFORMATION”**

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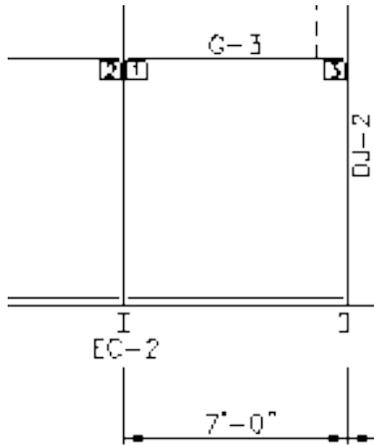
## STANDARD DETAIL PAGES

### 2. Using the Standard Detail Page(s)

To use the Standard Detail Pages, first use the Standard Detail Cover Page to locate the appropriate page based on the area of the building or type of component in question. Determine the detail(s) which apply based on the building options being used.

### 3. Example: Finding a Girt Connection Detail

Illustration 1.7 Typical Endwall Elevation (page 20) and Illustration 1.3 Typical Anchor Bolt Plan (page 10) are Erection Drawings for a building having a post-and-beam endwall. This Example will determine the connection for girt G-3 to Endwall Column EC-2. The girt connection details are not shown on the Elevation, as they are covered in the Standard Details. Finding the required details is a matter of determining some basic options on the building. Illustration 2.2 to Illustration 2.4 are details taken from the Erection Drawings. They indicate that EC-2 is a mill section column, G-3 is an 8" girt, and the outside face of the girt is offset 1" from the column. Illustration 2.1 Standard Detail Cover Page on page 23 lists Drawing SD-03A-Post and Beam Endwall- Mill & Built-Up Erection Details (Illustration 2.5, page 25). This page gives four options for this type of girt connection (Illustration 2.6). Of the options available, Standard Detail FD24 (Illustration 2.7) is the one that matches the framing on the building.



LEFT ENDWALL

Illustration 2-2 (Part of 1.7)

MEMBER TABLE		
FRAME	LINE	
MARK	PART	LENGTH
EC-1	WBx10	284 11/16"
EC-2	WBx24	319 1/4"
EC-3	WBx24	319 1/4"
EC-4	WBx18	294 11/16"
ER-1	WBx18	304 3/8"
DJ-1	SC16	89 1/2"
DJ-2	CBx11.5	158 1/2"
CH-1	BC16	40 1/4"
CH-2	BC16	120"
G-1	BZ16	132 3/4"
G-2	BZ14	132 3/4"
G-3	BZ18	75 3/8"
G-4	BDZ13	277 3/4"
G-5	BDZ13	277 3/4"
CB-1	1/2" CBL	182"
CB-2	1/2" CBL	138 3/4"
CB-3	1/2" CBL	175"

Illustration 2-3 (Member Table from 1.7)

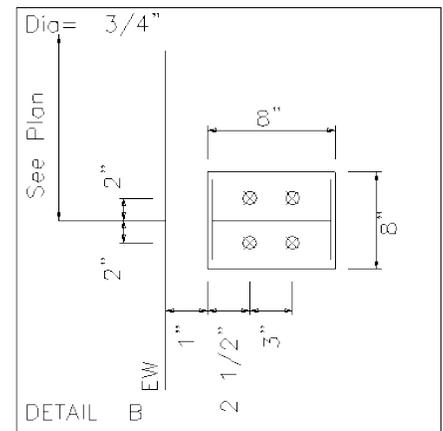


Illustration 2-4 (Detail from 1.3)



### STANDARD DETAIL PAGES

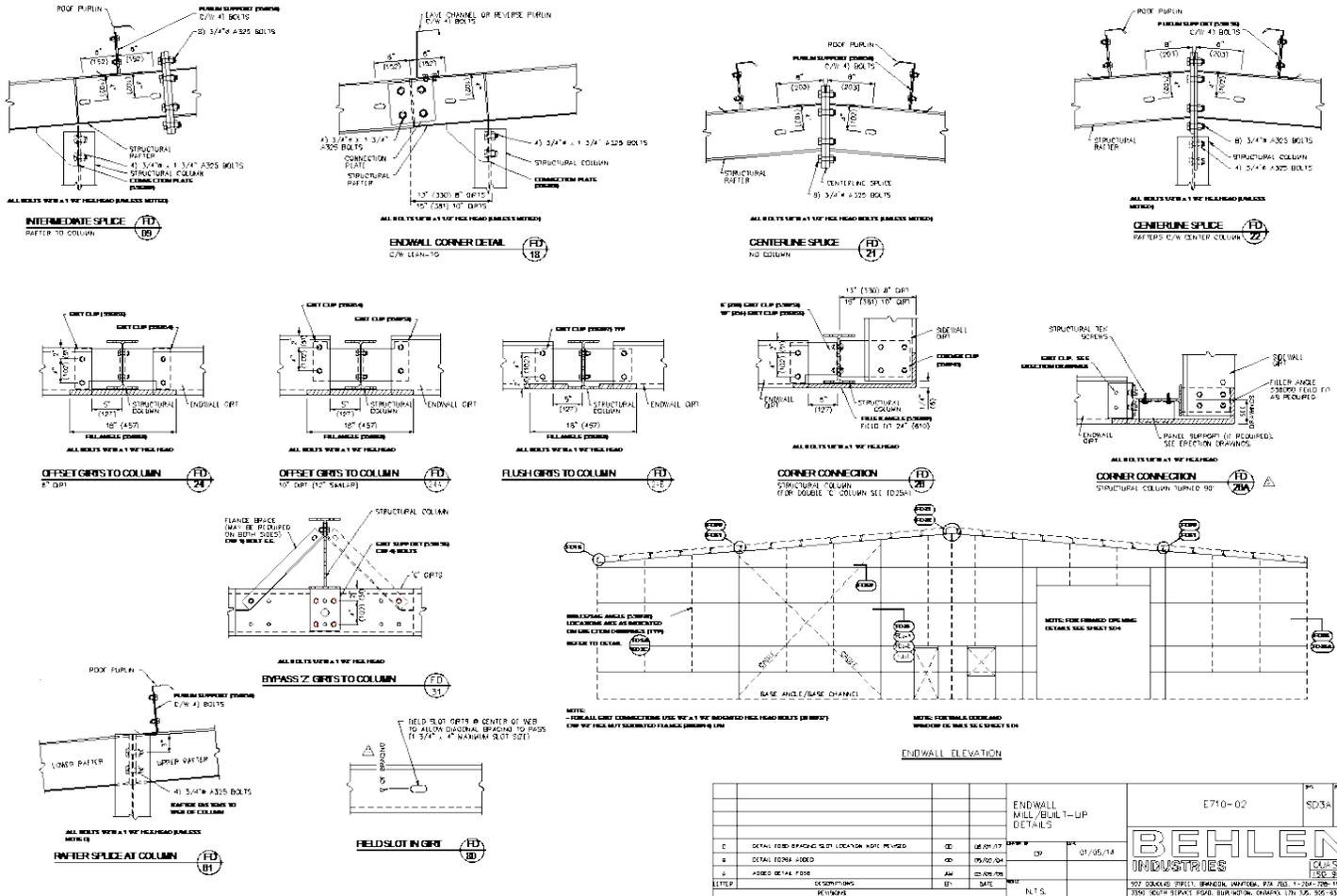


Illustration 2-5 Typical Standard Detail Page SD-03A

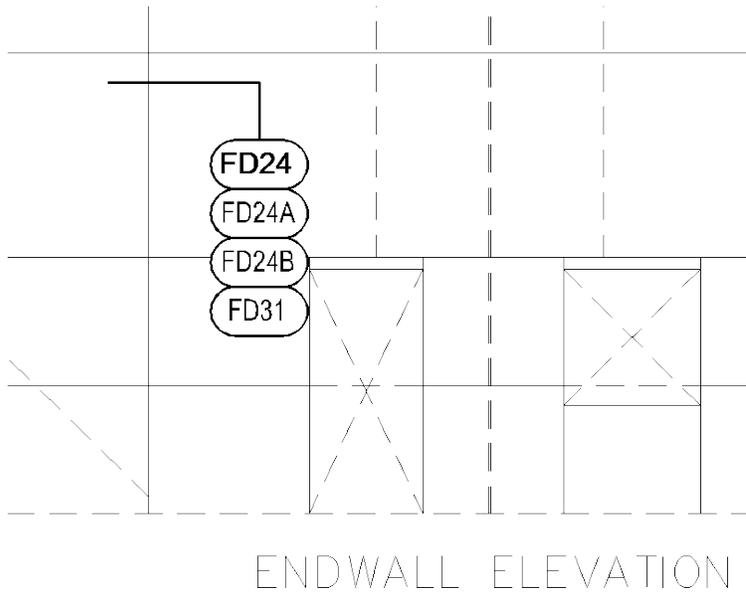
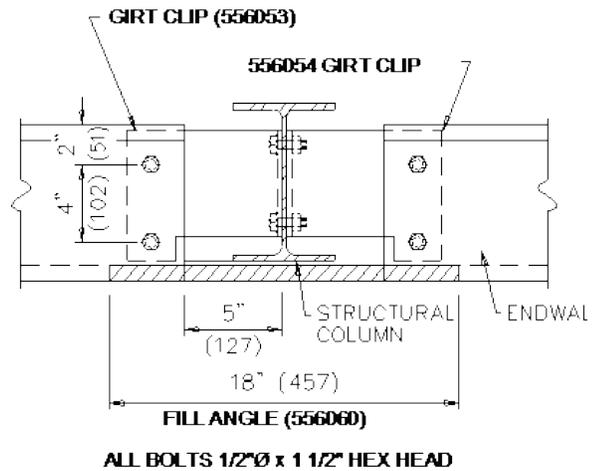


Illustration 2-6 (Part of 2.5)



### OFFSET GIRTS TO COLUMN

8" GIRT

FD 24

Illustration 2-7 (Part of 2.5)



## **3 - SITE PREPARATION**

### **Site Preparation**

The CISC Code of Standard Practice for Structural Steel documents standard practices of the structural steel fabrication and erection industry. Section 7 of this code addresses the responsibilities of the various parties involved in the steel building erection process. Clause 7.3 of this code outlines the expectations and responsibilities of the Client, General Contractor and Erector with respect to the construction site conditions.

### **Access to Site**

Before any material is delivered to site, ensure that efficient access has been obtained. Material delivery should proceed smoothly and without costly delays if proper preparations have been made.

- **Power Line Clearance**  
Always watch for potential interference from overhead and/or buried cables. Have overhead lines moved well away from areas where equipment will be operating. Always locate lifting and unloading equipment well away from overhead lines.
- **Access from Roadway**  
If trucks are expected to enter the site, ensure that there is sufficient turning space and there is a suitable approach. Ensure that the trucks will have a suitable surface to drive upon.
- **Equipment Access to Building Slab**  
Provide a ramp for equipment to get on and off the slab without damage. Keep the weight of the equipment off the edge of the slab. Locate the equipment access away from anchor bolts and other embedded items. Never allow heavy equipment onto a slab until it has cured.
- **Lifting Equipment**  
Obtain suitable equipment for lifting and moving the various building components.
- **Optimize Equipment Use**  
Unload building components from the truck(s) as close as possible to their installed location. Consult the Erection Drawings to determine where the components will be required. Whenever possible, plan the unloading process to lead into the erection process. Use and locate equipment and material so that erection can begin as soon as the truck(s) are unloaded.

### **Equipment and Tools**

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**Proper tools of suitable size increase production and decrease the possibility of injury and rework. Keep equipment well-maintained and as clean as possible. Equipment that is in top shape will not only operate better, it will be treated with more respect by the crew.**

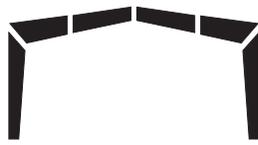
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A spreader bar used with a fork lift or crane is one piece of equipment that is essential in unloading panels. The spreader bar, when used properly, reduces the possibility of buckling long panels when they are being lifted from the bed of the truck. Unloading primary and secondary structural steel can also be facilitated by the use of a spreader bar. This technique is very simple and is recommended over the use of shake-out hooks.

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**Be certain of lift and reach requirements for all crane work.**

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## SITE PREPARATION

The following is a list of basic tools and equipment that should be available in sufficient quantity on any job site. This is a general list of items and additional equipment may be required.

1. Safety Equipment including gloves, hard hats, safety lines, safety goggles, etc.
2. First Aid Equipment.
3. Fire Extinguishers.
4. Crane, Fork Lift, or Boom Truck suitable for the work to be done.
5. Spreader Bars.
6. Slings.
7. Tie-Offs (Steel Cable).
8. Erection Bracing for stabilization of partially erected framing.
9. A well-organized Tool Truck.
10. Storage Shed.
11. Proper screw guns operating at 1900-2500 RPM rated at 4 amps or higher (always use a positive clutch and a magnetic, depth-locating socket).
12. Power Cords with multiple outlets (use cords of sufficient gauge for the equipment and distance).
13. Acetylene Torch.
14. Scaffolding.
15. Ladders.
16. Level and/or Transit.
17. Metal-cutting saw with blades.
18. Nibbler.
19. Snips.
20. Drills and Bits.
21. Measuring Tapes and Squares.
22. Sockets from 1/4" to the largest bolt size on the job (check Erection Drawings).
23. Extensions for Sockets.
24. Spud Wrenches.
25. Open-End Wrenches.
26. Crescent Wrenches.
27. Impact Wrench.
28. Locking Pliers.
29. Drift Pins.
30. Electric Welder and welding goggles, etc..
31. Blind Rivet Gun.
32. Caulking Gun.
33. Brooms, mops, rags, etc.



## SITE PREPARATION

### Foundation

The efficient erection of a steel building hinges on the quality of the foundation installation. The foundation must be square, straight, and level. All dimensions shown on the Anchor Bolt Plan must be carefully observed. Locate the anchor bolts carefully, following the details provided. Use templates to hold the anchor bolts firmly in position so they will not settle or be knocked out of alignment before the concrete hardens.

The use of a transit and/or level is recommended when laying out the foundation. Measure the width and length on each side and from corner to corner of the building and each bay to ensure the layout is square. Installing the building components and getting the building straight and square will be much easier if the foundation is accurate.

---

**Ensure that the foundation has had time to cure properly before attempting to erect the building.**

---

Behlen Industries LP expects foundation and anchor bolt installation to meet the requirements of CAN/CSA-S16-01. CISC Code of Standard Practice for Structural Steel, which is referenced by CAN/CSA-S16-01, specifies the acceptable tolerances for the anchor bolt placement in Section 7 (see also Appendix D). Anchor bolts must not vary from the dimensions shown on the Erection Drawings by more than the following (see also Illustration 3.1 on page 29):

1. 1/8" (3mm) center to center of any bolt within an anchor bolt group, where an anchor bolt group is defined as the set of anchor bolts which receives a single fabricated steel shipping piece;
2. 1/4" (6mm) center-to-center of adjacent anchor bolt groups;
3. Maximum accumulation of 1/4" (6mm) per 100' (30 480 mm) along the established column line of multiple anchor bolt groups, but not to exceed a total of 1" (25mm). The established column line is the actual field line most representative of the centers of the as-built anchor bolt groups along a line of columns;
4. 1/4" (6mm) from the center of any anchor bolt group to the established column line through that group.

Items 2, 3, and 4 also apply to offset dimensions, shown on the Erection Drawings, measured parallel and perpendicular to the nearest established column line for individual columns shown on the drawings to be offset from established column lines.

Anchor bolts are to be set perpendicular to the bearing surface, threads protected and free of concrete, and nuts should run freely. Shear pockets are to be cleaned prior to steel erection.



**SITE PREPARATION**

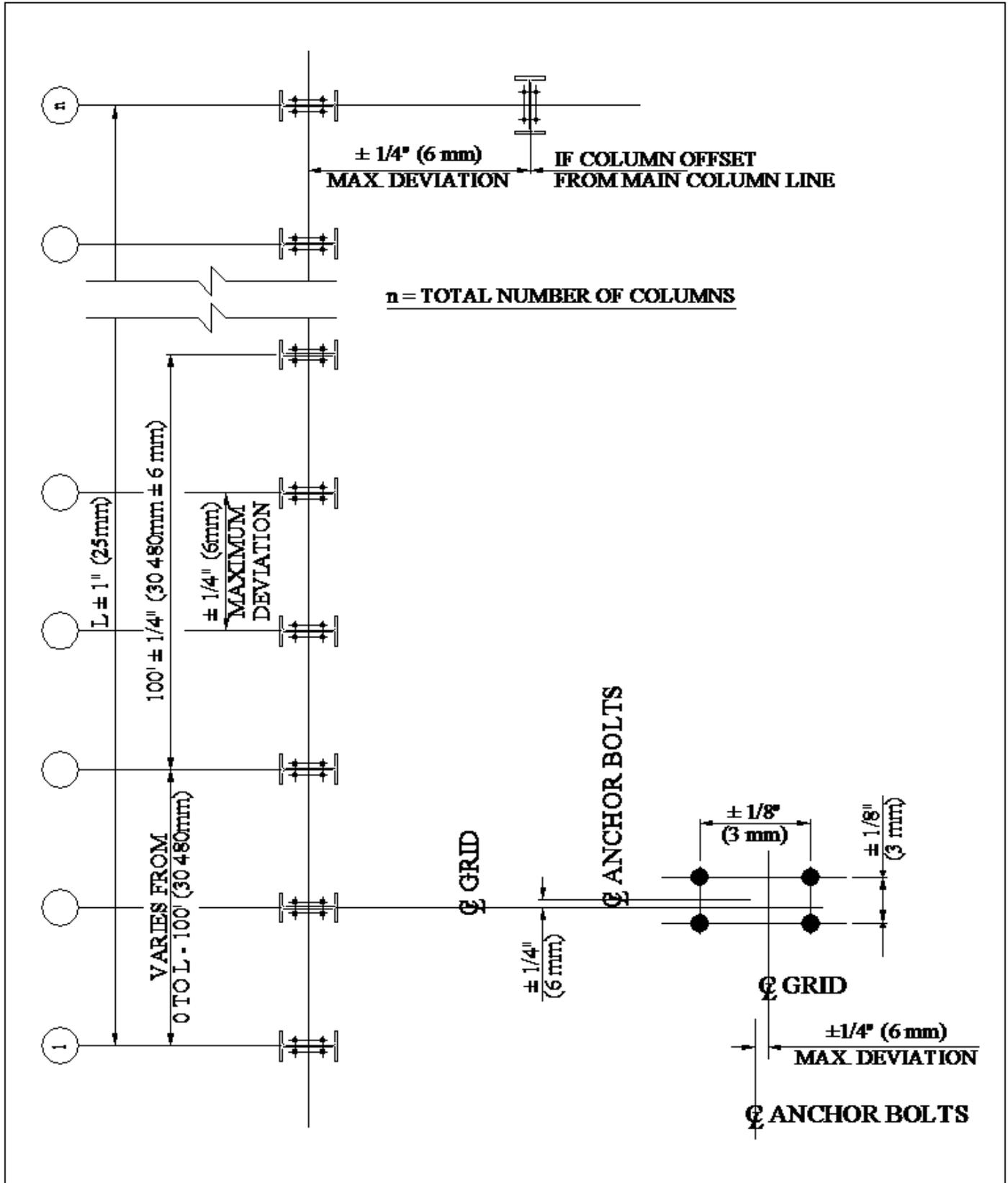


Illustration 3-1 Anchor Bolt Tolerances as set out in CISC Code of Standard Practice for Structural Steel Appendix D.



## SITE PREPARATION

### Anchor Bolt and Foundation Check

The foundation and the anchor bolts should be checked well before the delivery of the building. This will allow time for corrections to be made before erection begins. At the time the anchor bolts are checked, nuts and washers should be located and bolts should be cleaned and greased.

Anchor bolts should be checked for projection, spacing, size, level, square and quantity. Check the anchor bolt placement for square (see Illustration 3.2). Dimensions 1 and 2 must be equal. Dimensions 3 and 4 must be equal for each bay. Check that the anchor bolt placement tolerances have been met.

The foundation should be cleaned at the areas where the columns are to be set, including shear pockets, and smoothed if necessary. Any necessary base plate leveling devices should be installed and checked. The edge of the concrete should be straight and smooth to accept the base angle or channel and trim.

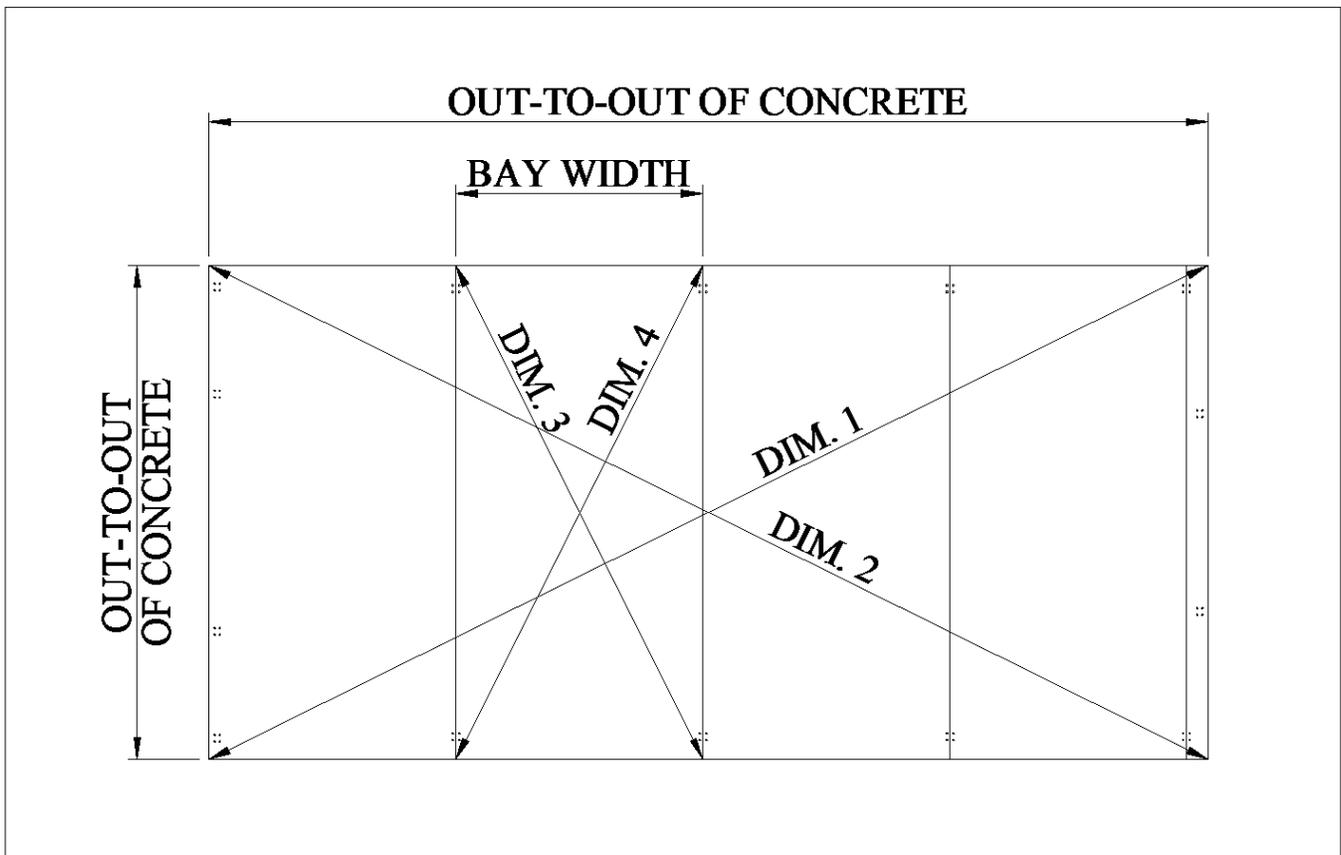


Illustration 3-2 Foundation Check



## **SITE PREPARATION**

### **Received Shipment Checks**

It is the Erector's responsibility to properly inspect the building components after they have been delivered to site. Upon receipt of building materials, inspect the shipment carefully for shortages or damage. Compare the shipment to the accompanying Packing List to ensure that all materials are accounted for. Some items are received in bundles or boxes (such as trim and panels) and are signed for as such. Note any shortage or damage on the Bill of Lading before signing it as receiver of the shipments. If damages or shortages are noted on the Bill of Lading and verified, replacement parts will be shipped.

Behlen Industries LP is not responsible for unloading, nor for packaged or nested materials, including, but not limited to, fasteners, sheet metal, "C" and "Z" sections and cladding panels that become wet and/or damaged while in the possession of others. Packaged or nested material that becomes wet in transit must be unpacked, separated and dried by the Erector.

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**Any shortage or damage is to be noted on the Bill of Lading and reported to Behlen Industries LP Customer Service Department within 48 hours of receipt of load. Phone (204) 728-1188.**

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### **SAFETY FIRST!**

**Inspect all shipments for loads that may have shifted in transit before releasing any tie-downs!**

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## 4 - MATERIAL HANDLING

### Proper Temporary Outdoor Storage

**Caution:** Proper loading, unloading and handling techniques must be used at all times. Handle material and material bundles carefully to avoid damage to the shape or finish. Panel bundles are especially large and unwieldy, and care must be taken to avoid material damage or personal injury. Behlen Industries LP is not responsible for damages and/or injury resulting from improper material handling or storage.

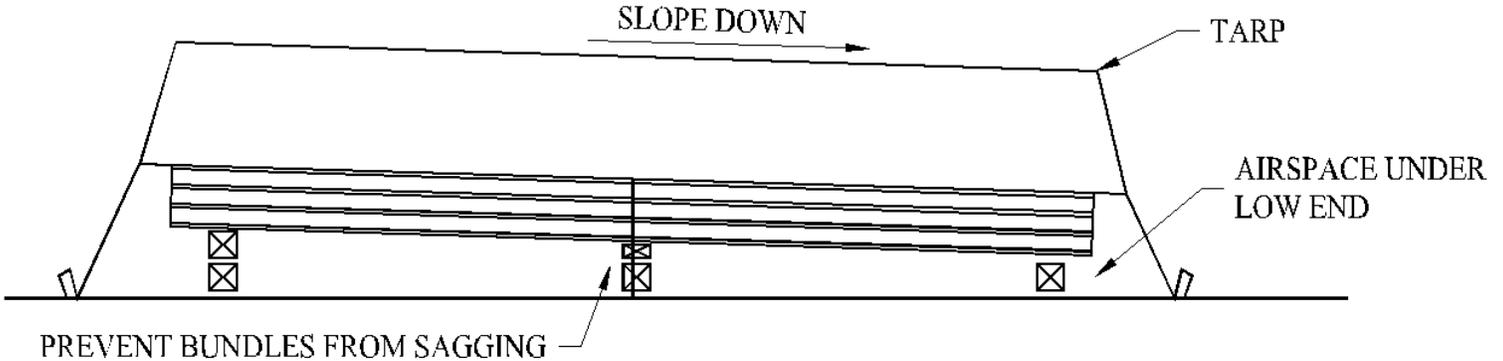


Illustration 4-1 Proper Temporary Outdoor Storage

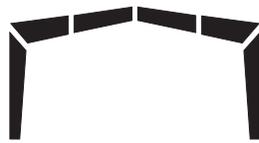
**Note:** Wet material or bundles must be dried before storage to avoid unsightly water marks.

**When separating bundled materials, especially panels, lift the pieces apart without sliding. Burred edges will damage the finish of bundled material and/or injure workers if care is not taken.**

Galvanized, aluminized (Galvalume) and coloured materials are subject to corrosion and discoloration if they are improperly stored. Short-term job site storage of girts, purlins, roof and wall covering may be tolerated, provided care is taken to keep these materials dry at all times. Under-roof storage is, of course, the most desirable. When materials are to be stored outdoors, they should be placed at an angle sufficient to promote good drainage. In addition, several inches of clearance must be provided between the lower end and the ground to allow ventilation. Long material should be blocked in the center to prevent center sag and resultant water accumulation.

Protective tarps should be placed to ensure good ventilation. Never cover material with plastics. Plastic will trap moisture and lead to rusting.

Whenever possible, store material out of direct sunlight, and away from site traffic. Store material away from chemically aggressive substances such as cement and salt, and away from materials that may stain the surface, such as paint, oil and grease.



## MATERIAL HANDLING

### Handling Panel Bundles

Bundles of panels are heavy and awkward and must be handled by crane or forklift. The bundle must be properly supported to avoid buckling the panels. Panels up to 20'-0" long may be handled by forklift, keeping the forks spread as far as possible. However, some means of supporting the load beyond the forks may be required. Do not attempt to transport open bundles; re-bundle the panels before moving.

Panels over 20'-0" should be lifted by a crane. Use a spreader bar to distribute the weight of the bundle. Use nylon straps, not wire rope, to support the panels every 10'-0". Wire rope will damage the panels. Do not leave more than 1/3 of the panel length unsupported.

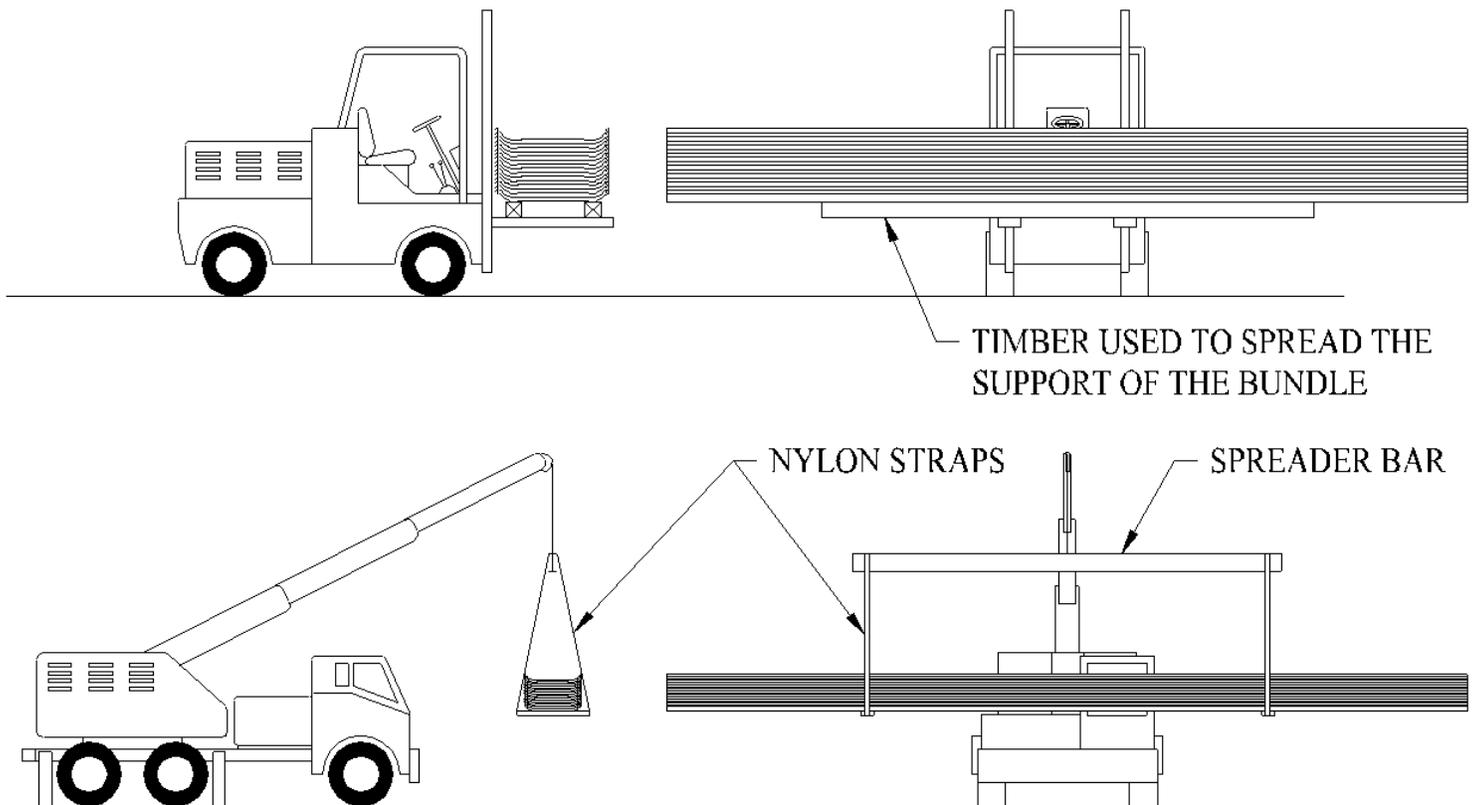


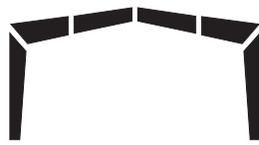
Illustration 4-2 Panel Bundle Support

Normally, two people can handle individual panels easily. The weight of a 45'-0" panel is approximately 124 pounds (57kg). Long panels should be supported in the middle by a third person, dolly, or other means. To avoid buckling, carry the panel on its edge, not on the flat.

Installers should wear gloves when handling unpainted Galvalume panels. The salts from bare skin will react with the finish, leaving blemishes. Also, wear rubber-soled shoes on the roof to avoid marking the finish.

### SAFETY FIRST!

Inspect all shipments for loads that may have shifted in transit before releasing any tie-downs!



## MATERIAL HANDLING

### Loading Panels onto the Roof

To facilitate installation of the roof panels, panel bundles may be lifted to the roof if precautions are taken to prevent damage to the structure.

- Locate the panel bundles directly over a frame  
Purlins may not be designed to carry the concentrated load imposed by bundles of roof panels.
- Do not place bundles over jack beams
- Install and tighten all bolts, flange braces, cross bracing, and purlins on the frame before placing panel bundles on the roof.
- Install blocking under the purlins where the panel bundles will be placed.  
This is to prevent the extra weight from causing the purlins to roll over.
- Remove blocking after the panels have been installed.

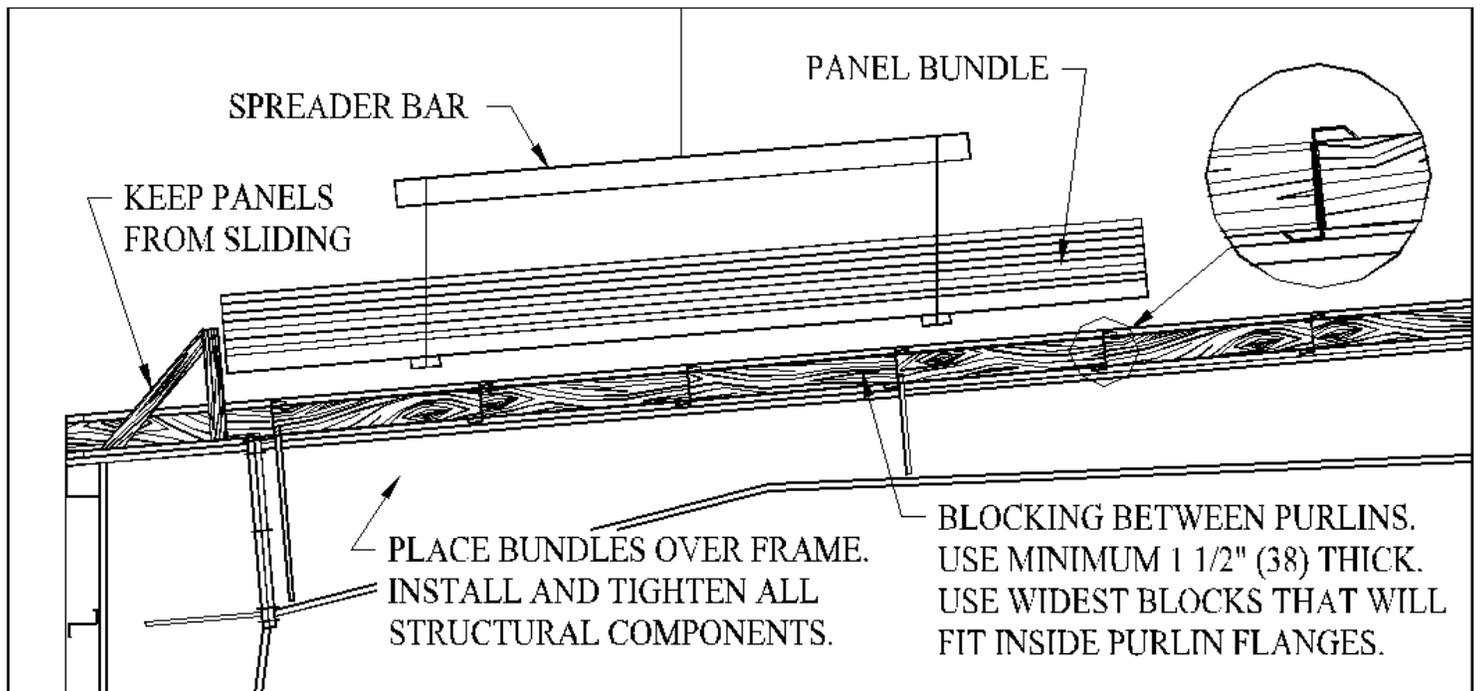


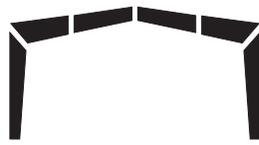
Illustration 4-3 Placing Panel Bundles on the Roof

Carefully consider the arrangement of the bundles on the roof. Determine how much roof will be covered by each bundle and space them accordingly. Orient the bundles the same way they will be installed. Avoid placing bundles where they will interfere with string lines, traffic, equipment, etc.

### CAUTION!

Any time material is staged by locating it on the structure, precautions must be taken that no permanent deformation or other damages are caused to the steel frame. Building components, whether individual items or piles or bundles of material, can impose concentrated loads in excess of the building's capacity.

Some method must be used to prevent the panels from sliding or blowing off the roof. Do not leave loose panels unattended. Bundles must be secured before leaving the job site.



## MATERIAL HANDLING

### Layout of Components

To avoid time-consuming repeated handling of material and the associated damage, loss, etc., consider the placement of the separate building components around the building site before unloading begins. When possible, unload the components from the truck(s) and stage them as close as possible to the location where they will be required. If parts must be stored away from the assembly area, arrange the parts so they can be accessed in the order they will be required.

Whenever possible, orient the parts themselves to maximize access for clip/flange brace attachment and to minimize rotation after lifting.

### CAUTION!

Any time material is staged by locating it on the structure, precautions must be taken that no permanent deformation or other damages are caused to the steel frame. Building components, whether individual items or piles or bundles of material, can impose concentrated loads in excess of the building's capacity. While it is desirable to have the building components arranged as conveniently as possible, avoid cluttering the work site. Insufficient workspace will lead to tripping hazards, damaged material, and an unsafe, inefficient job site.

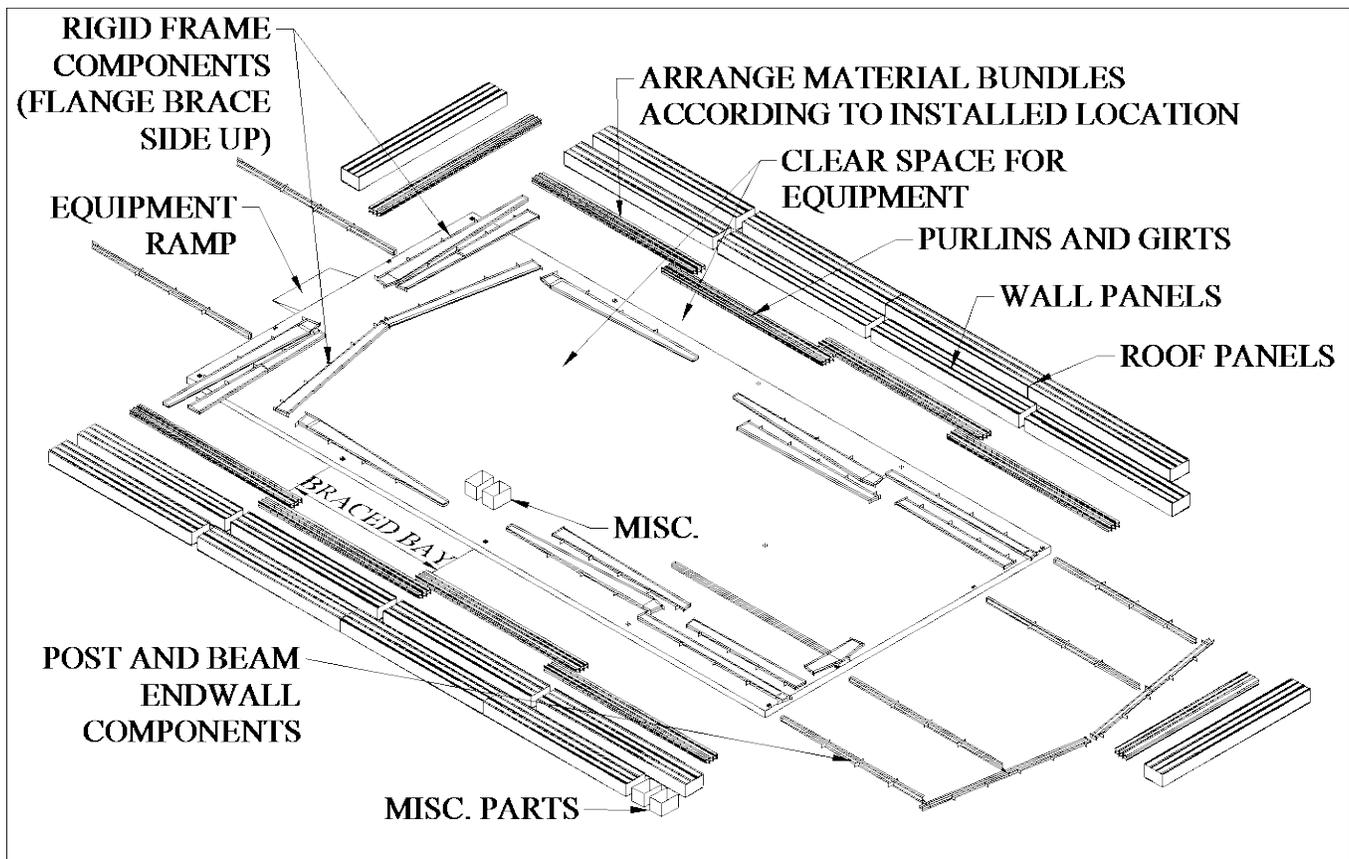


Illustration 4-4 Building Components Staged after Unloading



## MATERIAL HANDLING

### Paint

The Behlen Industries LP standard paint for structural steel is a single shop coat of primer. This paint is applied to protect the steel from rust during transportation and while the building is being erected and is not designed for long-term exposure to the elements. It is the Erector's responsibility to protect the steel if it is to be stored on site for any length of time. Primary steel should be covered and safely stacked in an upright position. The staging location must be well drained or the steel must be raised off the ground. Structural steel that is allowed to sit in mud or water will rust quickly. Water that is allowed to pond on flanges and webs can cause the primer to lift and flake off the steel over time. Behlen Industries LP will not be held responsible for paint damage from ponding water. It is the Erector's responsibility to touch-up shop primer that has been damaged during erection.

Although some damage to the shop coat of primer is unavoidable, care in handling the material will minimize the amount of field touch-up required. Proper storage, as mentioned, is critical.

Lifting and moving the components should be done with care. Lift the components clear of the ground or other objects before moving or turning. Dragging components will scrape the primer from surfaces, as well as causing a build-up of dirt that must be cleaned off before the touch-up paint can be applied.

Minimize traffic around the staged structural steel. Equipment that comes into contact with the steel will invariably damage the paint. Foot traffic on the building components should also be discouraged as it leaves scuffs and muddy footprints that will require attention. Also, structural steel tends to be hazardous to walk on, especially when stacked.



## 5 - BRACING

### Erection Bracing

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**NOTE:**

Behlen Industries LP does not supply or design the erection bracing required to erect the preengineered steel building system. The instructions and illustrations in this Guide are solely intended to represent the fact that erection bracing is required during erection, and are not to be interpreted as representing proper erection bracing configurations, components or anchorages.

CAN/CSA-S16-01, Section 29, and CISC Code of Standard Practice for Structural Steel, Section 7, require the use of erection bracing which can withstand all of the loads on the uncompleted structure, including wind, equipment, and equipment operation. The Erector is to ensure that there is an adequate margin of safety in the uncompleted structure. Erection bracing is to remain in place undisturbed as long as required for the safety and integrity of the structure.

Roof and wall panels are an integral part of the pre-engineered steel building system. Until the paneling is completely installed, the building cannot be considered fully braced. **DO NOT REMOVE THE ERECTION BRACING UNTIL PANEL INSTALLATION IS COMPLETE.**

Prepare a detailed plan for the erection bracing and the timing of its installation and removal before the erection commences. Take into account all loads that will be imposed on the building at the various phases of erection, including temporary piles of materials and the work of other trades.

Construction loads may be greater than the design loads required for the building by the building code and must be accounted for. For instance, the partially erected steel building can present more surface area to the wind than when the exterior panels have been fully installed, yet the strength of the building system may depend in part on the bracing of the purlins and girts by screw-down panel systems. Similarly, light gauge purlins and girts may need to be roped or blocked to prevent them from fluttering in the wind.

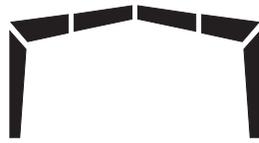
Install the necessary erection bracing before each component is detached from the lifting equipment. To minimize crane time, attach erection bracing cables to the components before lifting and secure as soon as the components are in place.

Do not rely on the anchor bolts to temporarily secure columns during erection. Ensure that the foundation and anchor bolts are suitable for any and all erection induced forces.

Frames having interior columns require special attention. Due to the additional support of the interior columns, the members are lighter than those of clear-span frames. These members are more apt to buckle during erection and require more care when lifting and bracing. Never leave the free end of an uncompleted frame without proper bracing.

Ensure that the structure is adequately braced at the end of each work day.

---



## BRACING

### Permanent Bracing

The building bracing is designed to stabilize the completed building against the various loading conditions it will experience. Wind, seismic and crane loads are some of the more common loads considered. The building system has been designed to withstand these loads using the building components as shown on the Erection Drawings, and in the locations called for. Any alteration of the bracing system may weaken the building.

Changes in door and/or window locations may interfere with bracing locations. Before making alterations to any bracing components, consult Behlen Industries LP for direction. Redesign of the bracing components may be necessary, depending upon the building configuration and the bracing loads.

### WARNING!

**ANY UNAUTHORIZED ALTERATION OF THE BRACING SYSTEM COULD RESULT IN AN UNSTABLE BUILDING CONDITION.**

During erection, the permanent bracing should not be fully tightened until the framing it is connected to has been properly plumbed and squared.

Cable and rod bracing is to be installed as shown on the Erection Drawing and Standard Details and tightened to a taut condition. Take care not to over-tighten cable or rod bracing. There will be sag in the cable or rod even when it has been properly tightened. Structural members should not be deformed when tightening the bracing. Ensure that the hillside washers are flat against the framing and parallel to the plane of the bracing.

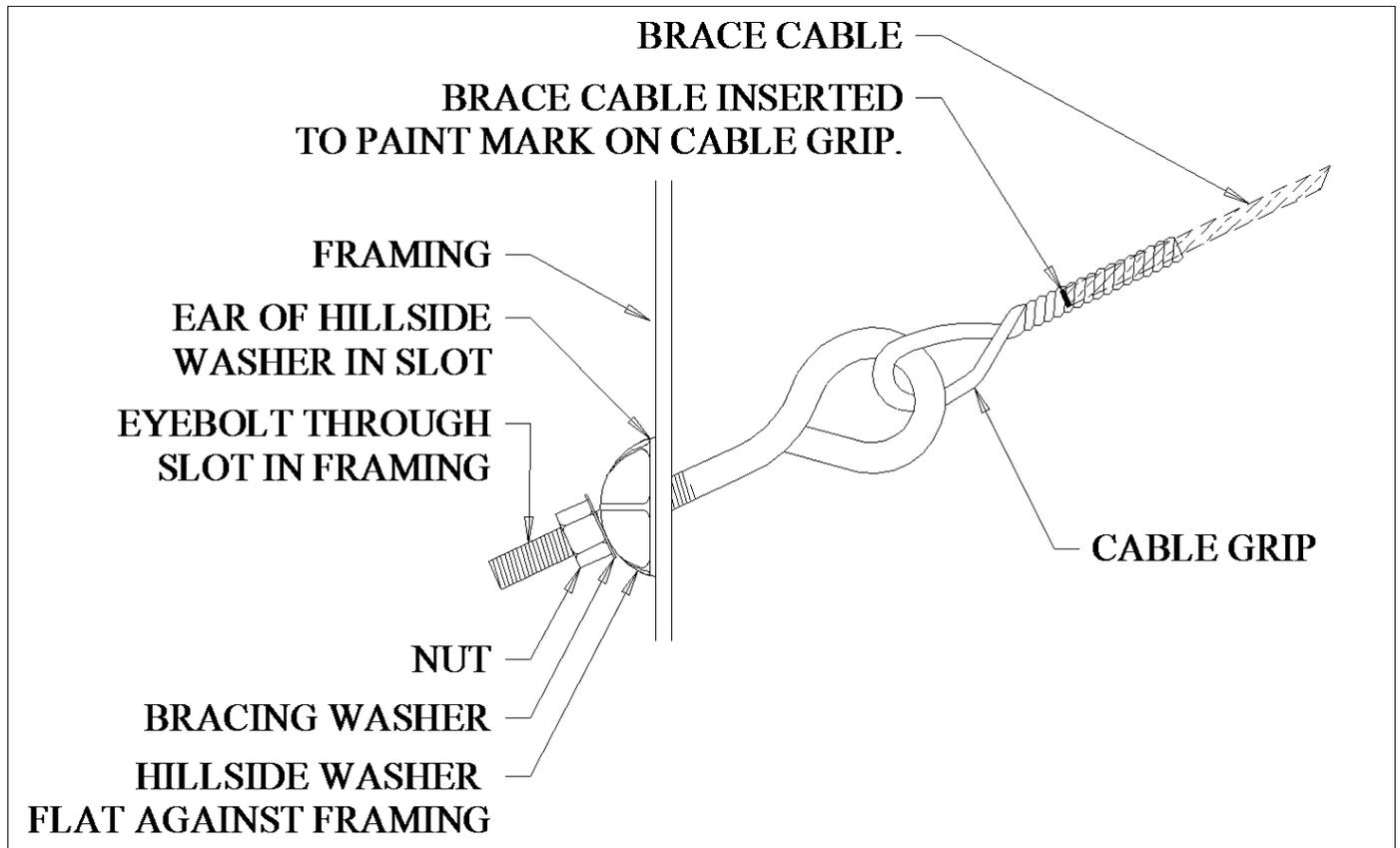
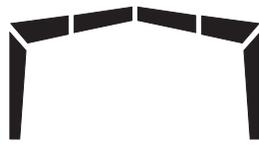


Illustration 5-1 Cable Bracing Connection (Rod Bracing Similar)



## BRACING

Brace cables are normally shipped with the necessary cable grips and eyebolts installed. If it is necessary to install a cable grip in the field, it can easily be done by one person as shown in Illustration 5.2. Removal is the reverse of installation.

Handle cable grips with care. Protect from corrosion and distortion. Installation is to be done by hand - do not use tools.

Cable grips are to be installed only on smoothly contoured hardware that will not swivel. Cable lay direction must match cable grip.

**CABLE GRIPS MAY BE REMOVED AND RE-INSTALLED A MAXIMUM OF TWO TIMES.**

If a cable grip is removed after it has been installed longer than 3 months, it must be replaced.

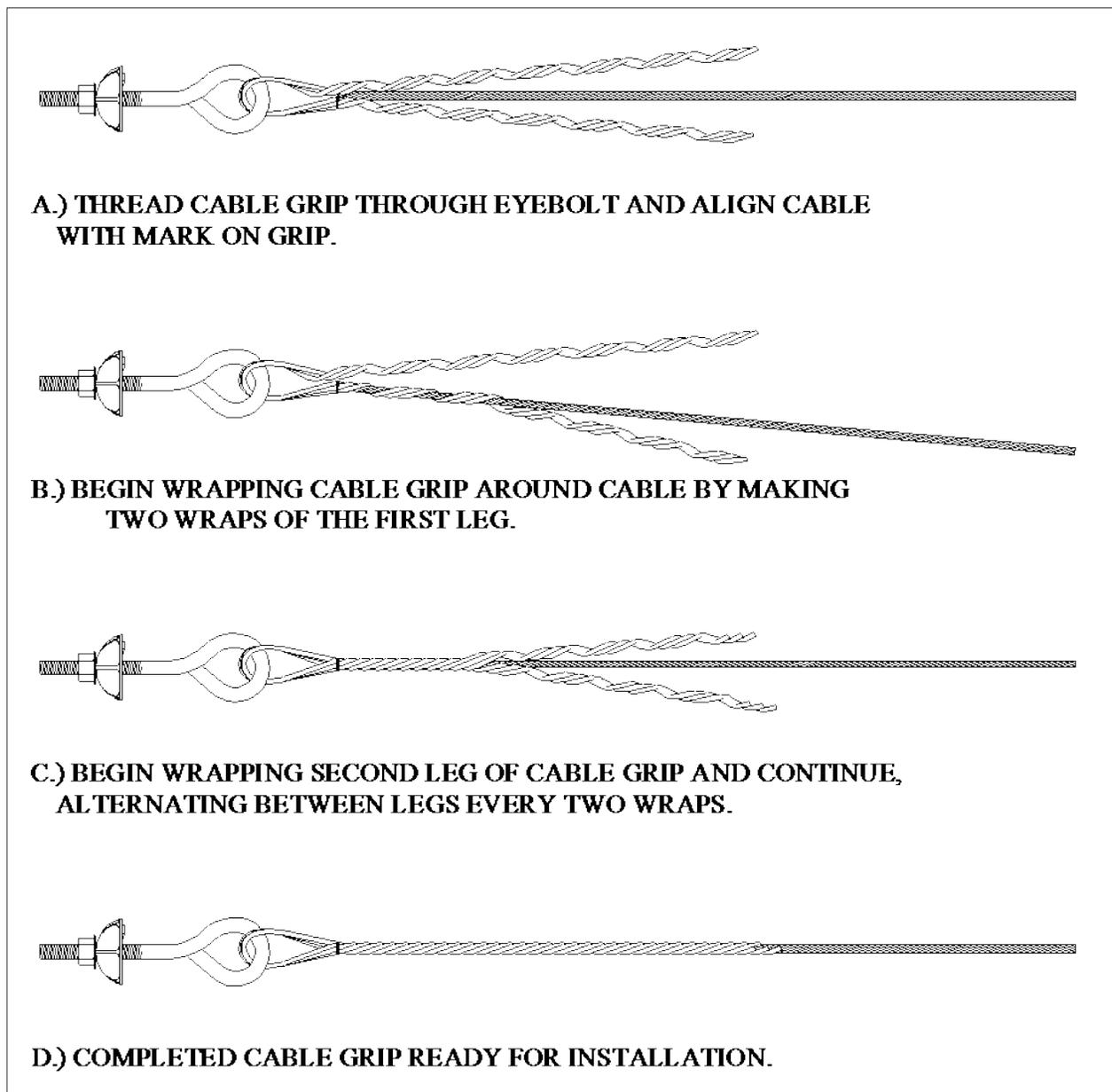
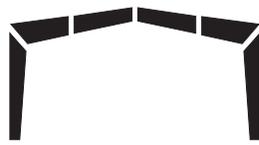


Illustration 5-2 Cable Grip Installation. Removal is reverse of installation.



## BRACING

### Bracing Slots

Flush girt systems will require the installation of the permanent rod or cable bracing through the girts. After installing the girts, field locate 1 3/4" (44mm) wide X 4" (100mm) long (MAXIMUM SIZE) slots in the girt webs where the bracing will pass through. Make the slots as small and smooth as possible, rounding the corners of the slots to prevent concentrated stresses at sharp corners. Locate the slots no more than 1" (25mm) from the center of the girt web depth. Oversize slots and/or slots close to the flange will weaken the girt(s).

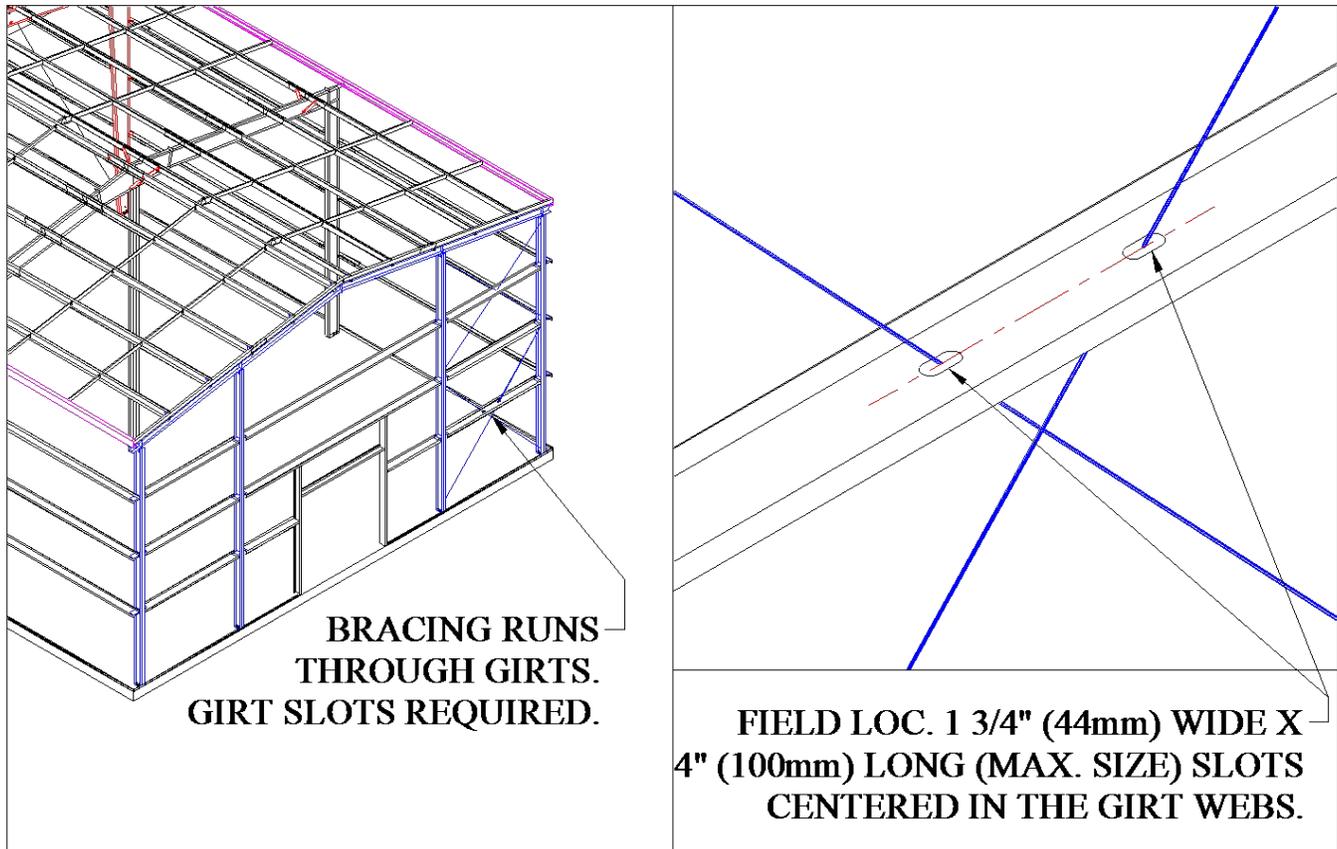
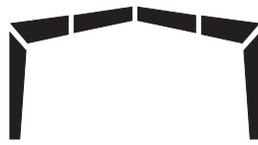


Illustration 5-3 Field Located Slots in Girts for Cable/Rod Bracing



## 6 - BOLTED CONNECTIONS

### Snug-Tight

“Snug Tight” is defined as the bolt tightness attained by a few impacts of an impact wrench or the full effort of a man using a spud wrench to bring all plies in a joint into firm contact. Re-snugging may be necessary in large joints where bolts that have been tightened may be loosened by the tightening of subsequent bolts.

### Turn-of-Nut

The only method to pre-tension bolts to the required values in Table 6-1 is “Turn-of-Nut” tightening as specified in CAN/CSA-S16-01. In “turn-of-nut” tightening, enough bolts shall be brought to a “snugtight” condition (see above) to ensure that all plies are in firm contact with each other, after which all remaining bolts are installed and “snug-tightened”. When all bolts are “snug-tight” each bolt shall be tightened additionally by the applicable nut rotation given in Table 6-2.

Bolt Tension					
Bolt Size		A325		A490	
In.	mm.	kips	kN	kips	kN
3/4	19	28	125	35	157
7/8	22	39	174	49	218
1	25	51	227	64	285
1 1/8	29	56	249	80	356
1 1/4	32	71	316	102	454

Table 6-1 Bolt Tension

Bolt Length (measured from the underside of the head to the extreme end of point).	Turn
Up to and including 4 diameters	1/3
Over 4 diameters and not exceeding 8 diameters or 8” (200mm)	1/2
Exceeding 8 diameters or 8” (200mm)	2/3

Table 6-2 Nut Rotation from “Snug-Tight” Condition.

Note: Nut rotation is relative to bolt regardless of the nut or bolt being turned. Tolerance on Rotation: 30° over or under.

Bolts tightened by “turn-of-nut” method should have the outer face of the nut match-marked with the protruding bolt point before final tightening. Marking permits visual inspection that actual nut rotation has been achieved. Such marks can be made using a crayon or dab of paint after bolts have been brought up snug tight.

### Bolt Tightening Sequence

In both cases (Snug-Tightening and Turn-of-Nut), bolt tightening is to progress systematically from the most rigid part of the connection to its free edges.

### Connections Not Subject to Tension Loads

Bolts in connections not subject to tension loads or where loosening due to vibration or load fluctuations are not design considerations need only be “Snug Tightened”.

### Connections Subject to Tension Loads

Bolts in connections subject to tension loads, such as rigid frame splice bolts, are to be pre-tensioned to minimum tension values as shown in Table 6-1 using the “Turn-of-Nut” method.



## **7 - ERECTION SEQUENCE**

Prior to erecting any component, refer to the Erection Drawings for the building to confirm the location of that component. Improper location of components can be costly in erection time (disassembling and re-erecting) and could result in structural failure.

Interior columns require particular attention to ensure proper orientation. Interior columns can have a bevel at the top that may not be immediately obvious and may not be sloped in the same direction as the roof. Consult the Anchor Bolt Plan and any orientation marks on the columns and/or Erection Drawings before positioning the column(s). The typical location for orientation marks is near the base of the column.

The following Erection Sequence contains basic erection information and has been used successfully in erecting Behlen Industries LP frame buildings. Variations may be required due to special circumstances, or an Erector may have developed other methods. Refer to the Erection Drawings for the building at all times for specific information on part location and details. The method actually utilized is the responsibility of the Erector.

**Typical Sequence:**

**Erect First Braced Bay. (Page 44)**

**Erect Adjacent Bay(s). (Page 52)**

**Erect Post and Beam Endwall(s) and End Bay. (Page 53)**

**Rigid Frame/Expandable Endwalls. (Page 56)**

**Miscellaneous Framing. (Page 57)**

**Perform Final Check. (Page 58)**

**SAFETY FIRST!**

Inspect all shipments for loads that may have shifted in transit before releasing any tie-downs!



## ERECTION SEQUENCE

### Flange Bracing

The flange braces are an integral part of the pre-engineered building system. The strength of the building components depends on all flange braces being installed properly at the locations shown on the Erection Drawings.

The flange braces can be loosely bolted to the columns and rafters before they are lifted into position to facilitate installation. As soon as the primary steel is positioned, all purlins and girts that will receive flange braces are to be installed, and the flange braces properly connected. Bolts should be snug.

**Note:** Although the partially erected building does not need to carry its full design load due to snow, etc., the freestanding frames are under considerable stress from self-weight, wind, and erection forces. Ensure that the structural steel is properly stabilized by properly installing all flange braces and their associated purlins and girts.

Illustration 7-1 shows proper installation of standard flange braces. Special flange bracing will have brace types and bolts indicated by details and/or notes on the Erection Drawings.

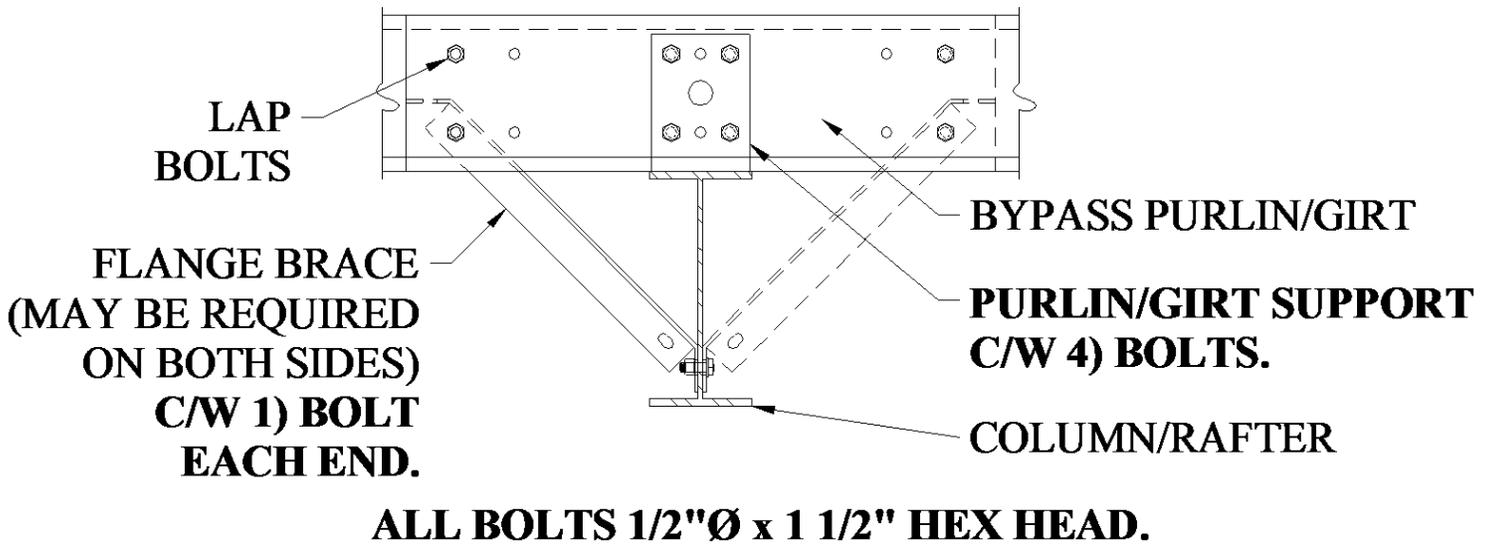
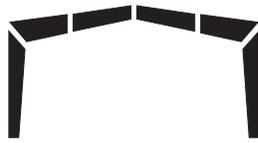


Illustration 7-1 Standard Flange Brace Installation



## ERECTION SEQUENCE

### Erect First Braced Bay

Begin construction at a braced bay. While the building is under construction, take great care to provide the framing with as much stability as possible. The best way to do this is to erect, brace, and square a braced bay first and work out from there. This framing will provide stability and alignment for the uncompleted building. When erecting large buildings with more than one braced bay, erect subsequent braced bays as soon as possible to reduce the loads on the first bay.

#### 1. Prepare Frame for Lifting

With the columns on the slab, install the required flange brace and girt clip components. Assemble the rafter components on the slab including all splice bolts and flange braces (See Illustration 7-2).

**Note:** Upon erecting the frames, it is imperative that the flange braces are installed as soon as possible. The structural stability of the frames depends on the flange braces. The number of rafters that can be bolted together and lifted at once depends on the equipment and crew available. Structural frame splice bolts are to be installed according to the “Turn-of-Nut” method (page 51).

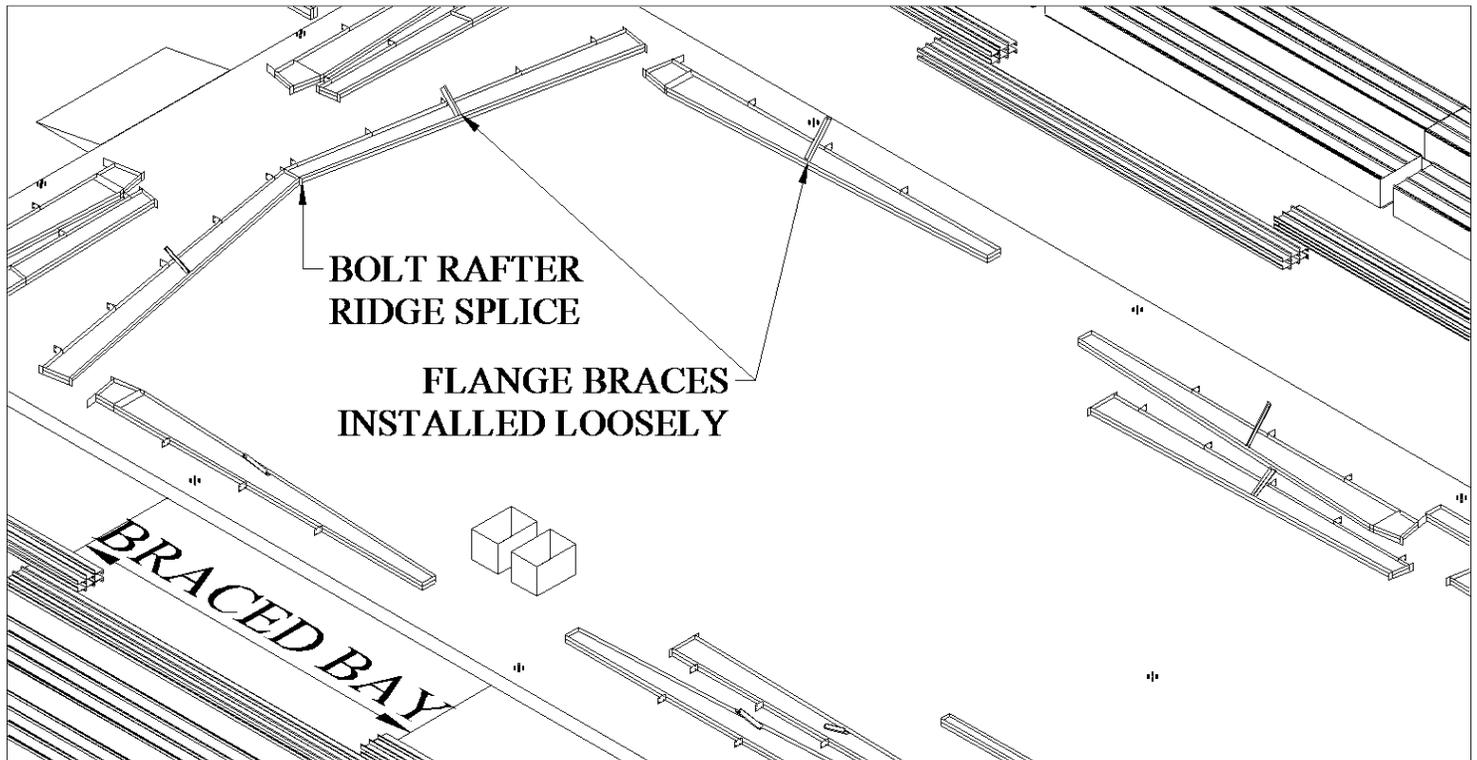
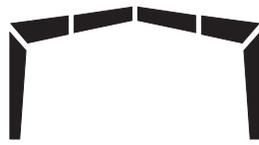


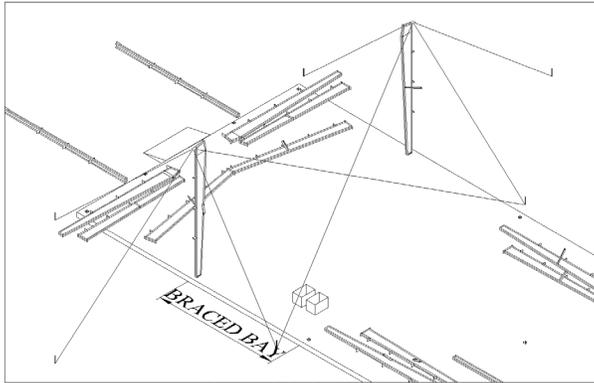
Illustration 7-2 Prepare Frame for Standing



## ERECTION SEQUENCE

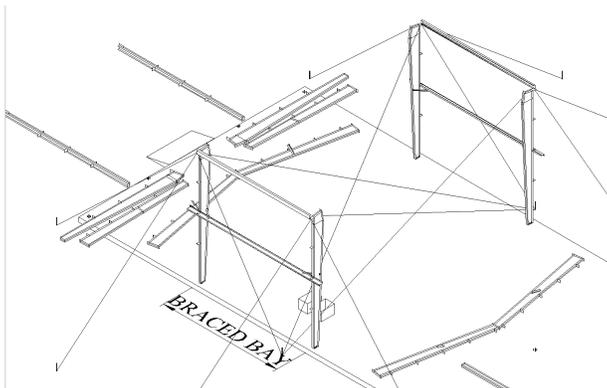
### 2. Stand First Columns

To minimize the time rafters will be standing without permanent bracing, erect the columns for both frames before installing the first rafters. See Step 7.1 to Step 7.3.



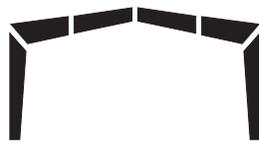
#### Step 7.1) Stand and Brace First Columns

Erect the columns of the first frame in the braced bay. Install erection bracing to provide stability for the erected structure in all directions. Ensure bracing does not interfere with upcoming erection procedures.

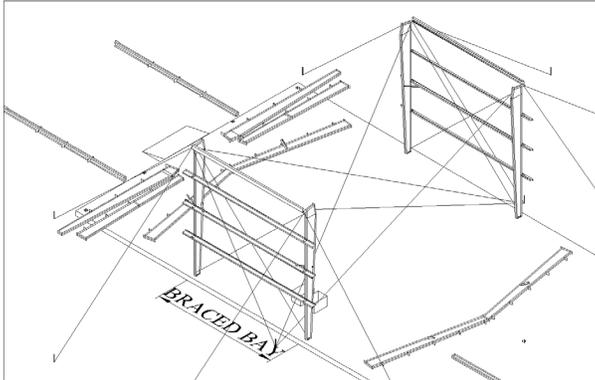


#### Step 7.2) Stand and Brace Second Columns

Stand the columns for the second frame in the braced bay. Install additional erection bracing as required. Tie the sidewall columns together by installing the eave struts, brace struts and/or strut girts and/or flange bracing girts for the braced bay as indicated on the Erection Drawings. Ensure that flange braces are attached.



## ERECTION SEQUENCE



### Step 7.3) Add Remaining Girts and Check Columns

Install any remaining girts and check that the flange braces are secured.

Install the permanent sidewall cross bracing from column to column on both sides of the bay. Refer to “Permanent Bracing” on page 38.

Stand and brace any interior columns after carefully checking their orientation, and snug-tighten their anchor bolts. Check that the columns are located accurately and are sufficiently plumb and square to facilitate rafter and roof bracing installation. Any necessary column adjustments will be easier to make before rafter installation.

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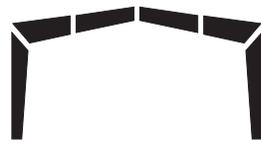
**Note:** The rafters will impose large loads on the columns. Ensure that the girts, flange braces, and sidewall bracing have been installed before the rafters are lifted into place.

---

### **CAUTION:**

**BRACE ALL FRAMING PROPERLY DURING THE DAY AND OVERNIGHT. UNEXPECTED WINDS WILL BRING INADEQUATELY BRACED FRAMING DOWN BEFORE BRACING CAN BE ADDED.**

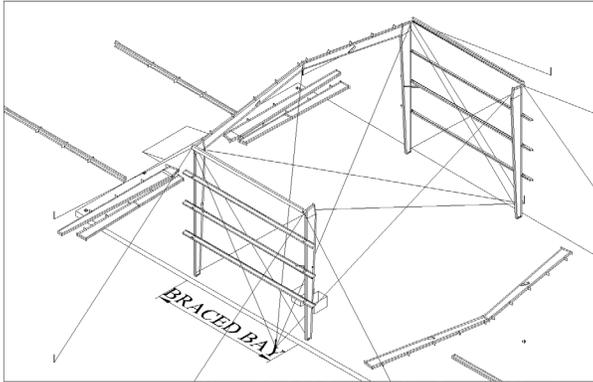
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## ERECTION SEQUENCE

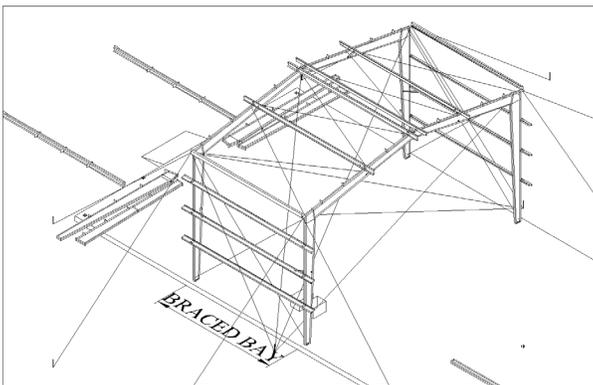
### 3. Lift and Install Rafters

Once the columns have been secured and straightened, proceed with erecting the rafters for the braced bay. See Step 7.4 to Step 7.6.



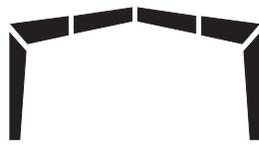
#### Step 7.4) Install and Brace First Rafter

Using a lifting method best suited for the weight and size of the assembled rafter, erect the first rafter into place. Bolt the rafter to the supporting columns. Install erection bracing for the rafters.

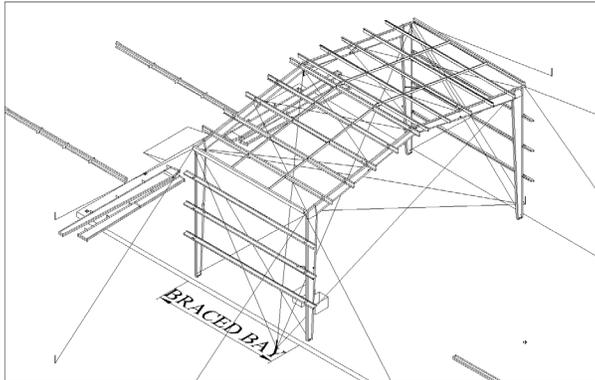


#### Step 7.5) Install and Brace Second Rafter

Raise the second rafter into place and bolt to the columns. Install additional erection bracing as required. Working from the center of the building to the eaves, tie the rafters together by installing the ridge purlins, struts and/or strut purlins and/or flange bracing purlins for the braced bay as indicated on the Erection Drawings. Bolts should be snug. Ensure that flange braces are attached. Completely install the permanent roof cross bracing from eave to eave.



## ERECTION SEQUENCE



### Step 7.6) Install Purlins and Stabilizers

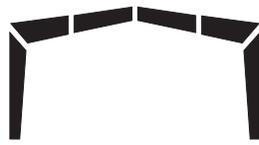
Beginning at the center of the building and working to the eaves, install remaining purlins and check that all flange braces are in place. Bolts should be finger tight. Install ridge blocks and purlin stabilizers according to the Erection Drawings and Standard Details. The purlin stabilizers align and brace the purlins. They are a crucial part of the roof system and must be installed as shown on the drawings.

---

**The cross bracing must be installed completely from side to side of the braced bay. Omitting bracing components weakens the overall structure.**

**Permanent bracing should not be tightened until the braced bay framing is plumb and square.**

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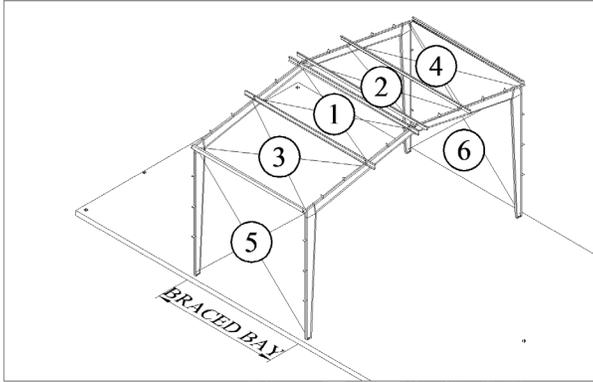


## ERECTION SEQUENCE

### 4. Plumb and Square Braced Bay Frames

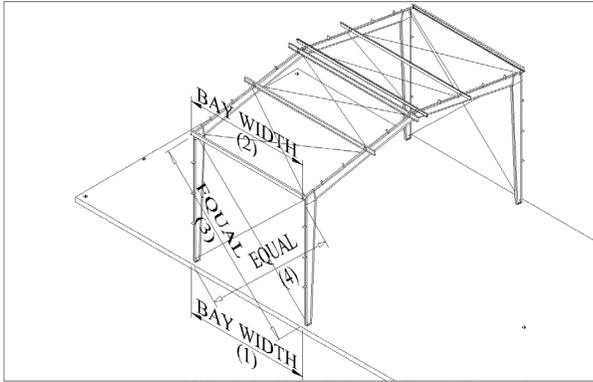
After the braced bay frames are stabilized, they must be made plumb and square. This will facilitate the installation and alignment of the remaining framing.

**Note:** For the purposes of this section, and arrangement of a cross-bracing X and its struts will be referred to as a “Bracing Tier.”



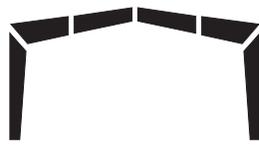
### Step 7.7) Order for Bracing Tier Alignment

When squaring the building, check and adjust each Bracing Tier for alignment. Begin at the center or ridge of the building, and work toward the sidewalls as shown.

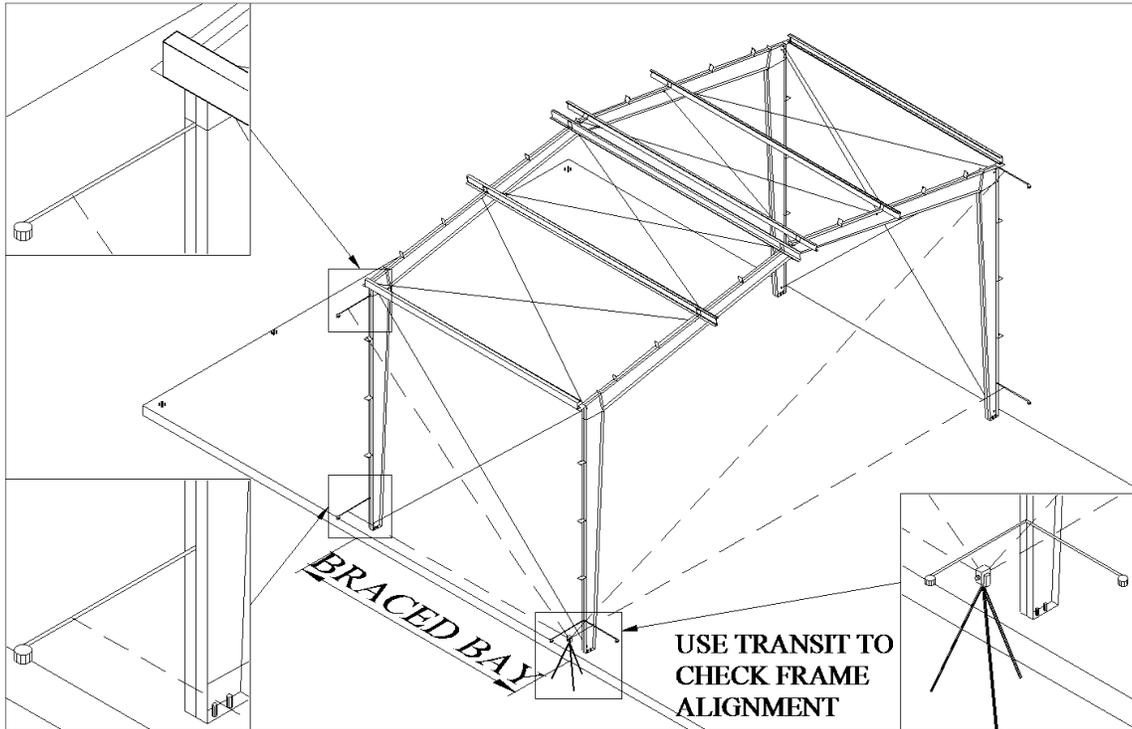


### Step 7.8) Bracing Tier Check Dimensions

Checking each Bracing Tier as shown will ensure that the columns and rafters are parallel and square. Dimension 1 must equal dimension 2. Dimension 3 must equal dimension 4.

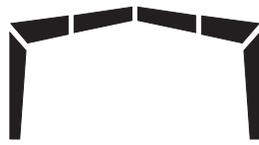


## ERECTION SEQUENCE



### Step 7.9) Check Alignment of Overall Frames

Ensure that the overall frames are plumb, square and parallel to each other and to the foundation. Especially on large buildings, the use of a transit is recommended to check the frames. Sight parallel and perpendicular to the correct frame line and measure the offset of the frame at the bracing connection points. When reading the offset of the frame, take into account any changes in web or flange thickness. The outside face of the flange moves at thickness transitions while the inside face remains constant. Set the centerline of the web at the frame line regardless of the web thickness.



## ERECTION SEQUENCE

### 5. Tighten Bolts and Bracing

Once the framing for the braced bay is square and plumb, tighten the bolts and bracing. See “BOLTED CONNECTIONS” on page 6-1 for bolt tightening procedures.

Snug tighten the column anchor bolts. **Do not over-tighten the anchor bolts. Anchor bolts do not require pre-tensioning and attempting to do so can pull them out of the foundation.**

Tighten the frame splice bolts using the “Turn-of-Nut” method.

Snug-tighten the girt, purlin and eave strut bolts. Tighten all bracing connections. Draw Cable and Rod Bracing taut by tightening the end nuts.

**Do not over-tighten the Cable or Rod Bracing. There will be sag in the cable or rod even when it has been properly tightened. Structural members should not be deformed when tightening the bracing.**

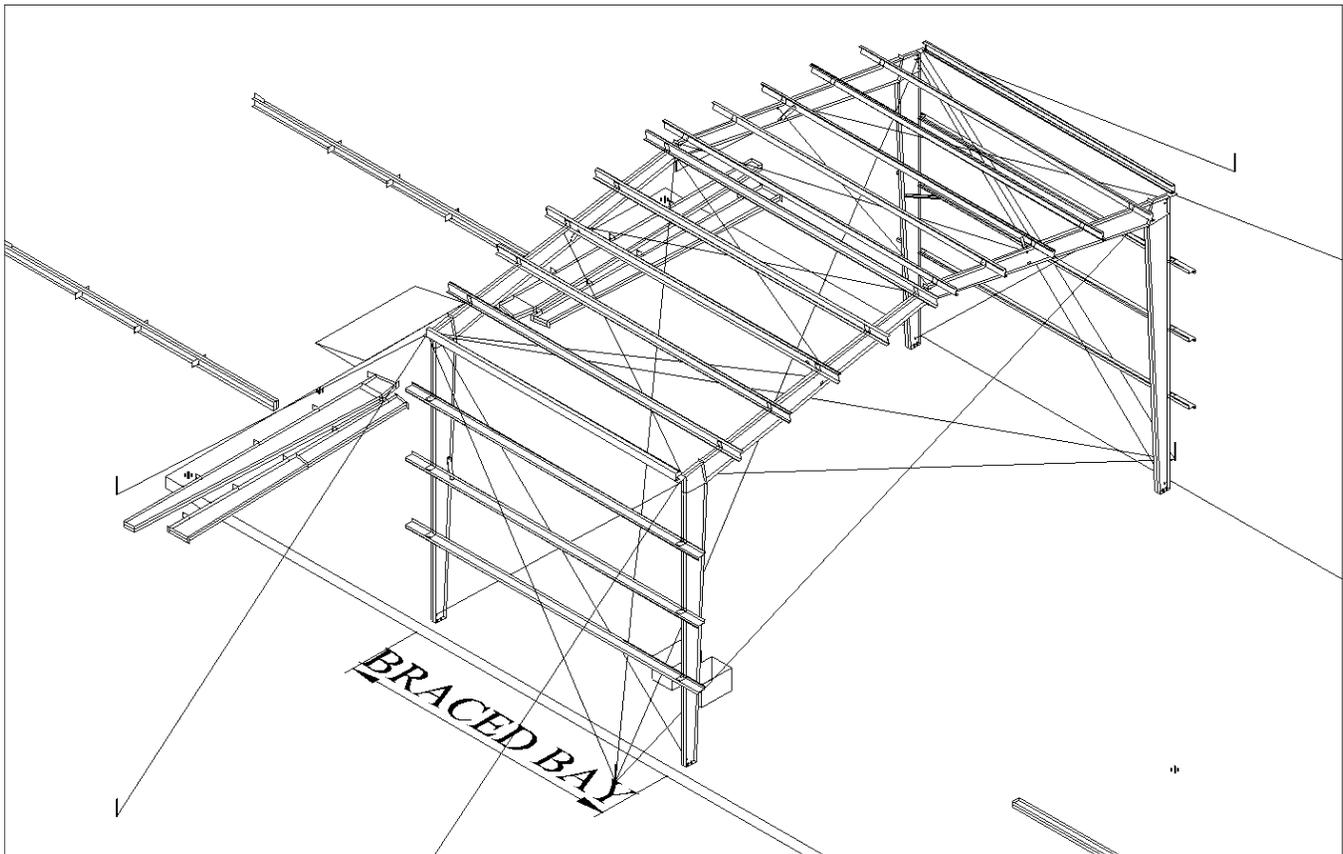
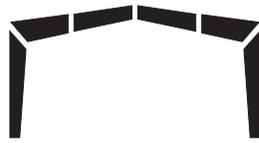


Illustration 7-3 Completed Braced Bay



**ERECTION SEQUENCE**

**Erect Adjacent Bay(s)**

Bays adjacent to the interior braced bay may be erected next. If the adjacent bay is an end bay, see “Erect Post and Beam Endwall(s) and End Bay” page 53 or “Rigid Frame/Expandable Endwalls” page 56 depending on the type of endwall. Follow the same sequence described for the first braced bay on all of the remaining interior bays. Continue to erect the remaining frames, girts and purlins one bay at a time, providing additional stability and erection bracing as required. Plumb all columns and align the frame properly and true. After each interior frame is erected, install all of the girts and enough of the purlins and eave struts to stabilize the frame. As a minimum, install ridge purlins, flange bracing purlins, and purlins in line with bracing connection locations. Install all ridge bridging and flange braces, and tighten the bolts for each frame before moving on to the next bay.

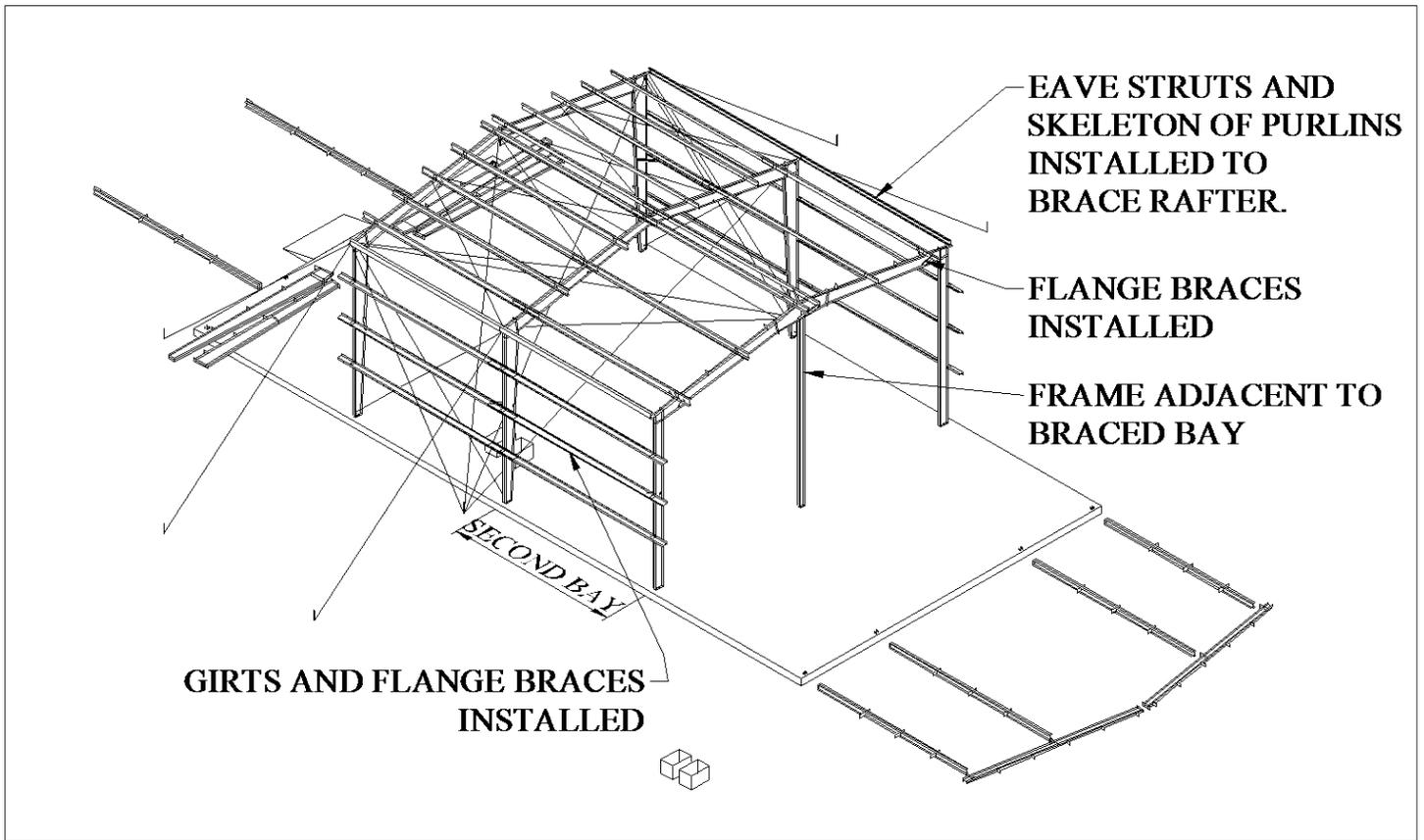


Illustration 7-4 Adjacent Frame Erected and Braced by Light Gauge

At continuous girts/purlins, install the lap bolts in the outer-most holes that are next to the end of the girt/purlin. Illustration 7-5 shows the proper bolt locations in a typical lap.

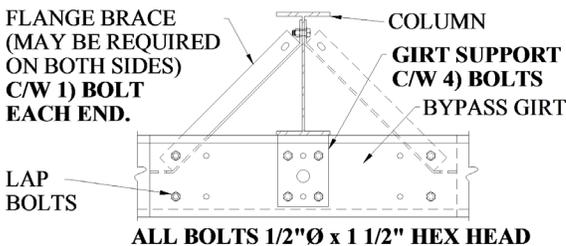


Illustration 7-5 Lap Bolts



## ERECTION SEQUENCE

### Erect Post and Beam Endwall(s) and End Bay

The methods used to erect Post and Beam Endwalls depend upon the size and arrangement of the endwall and the framing members. The available equipment and expertise of the crew must also be taken into account.

The method used to erect the endwall must be given serious consideration and is the responsibility of the Erector. Post and Beam Endwalls tend to have slender framing which is easily damaged if not handled properly. Post and Beam Endwall members must be braced in all directions before the lifting equipment is disengaged.

The location, size and quantity of endwall columns will vary due to building size, design loads and opening requirements. Short, sturdy, closely spaced members are easier to work with than long, slender, widely spaced members are. The height and width of the building will also determine how much of the endwall can be assembled on the ground and lifted into place as one unit.

#### 1. Single or Modular Lift

It may be possible to assemble the post and beam endwall complete with girts on the ground (Illustration 7-6), and tilt it into place as one unit or in modules. If this method is to be used, take great care not to buckle the columns or rafters. Be careful that the weight of any framing for openings does not damage girts while the endwall is being lifted. The endwall framing can be stabilized using temporary and/or permanent bracing before the lifting equipment is disengaged (Illustration 7-7). If sufficient equipment is available, a skeleton of purlins closest to the columns, eave struts and girts can be installed to stabilize the framing in addition to the erection bracing (Illustration 7-8).

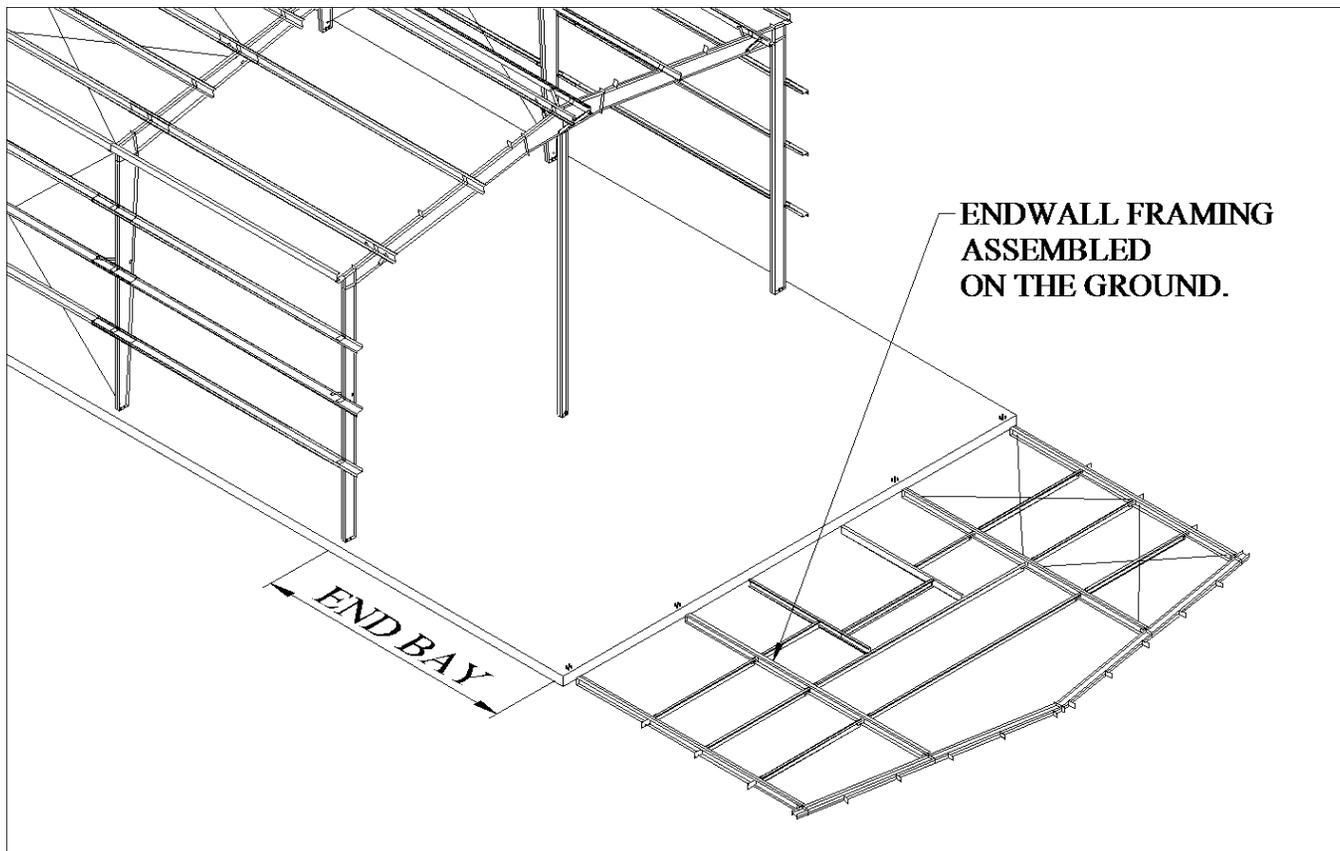


Illustration 7-6 Post and Beam Endwall Assembled for Single Lift



## ERECTION SEQUENCE

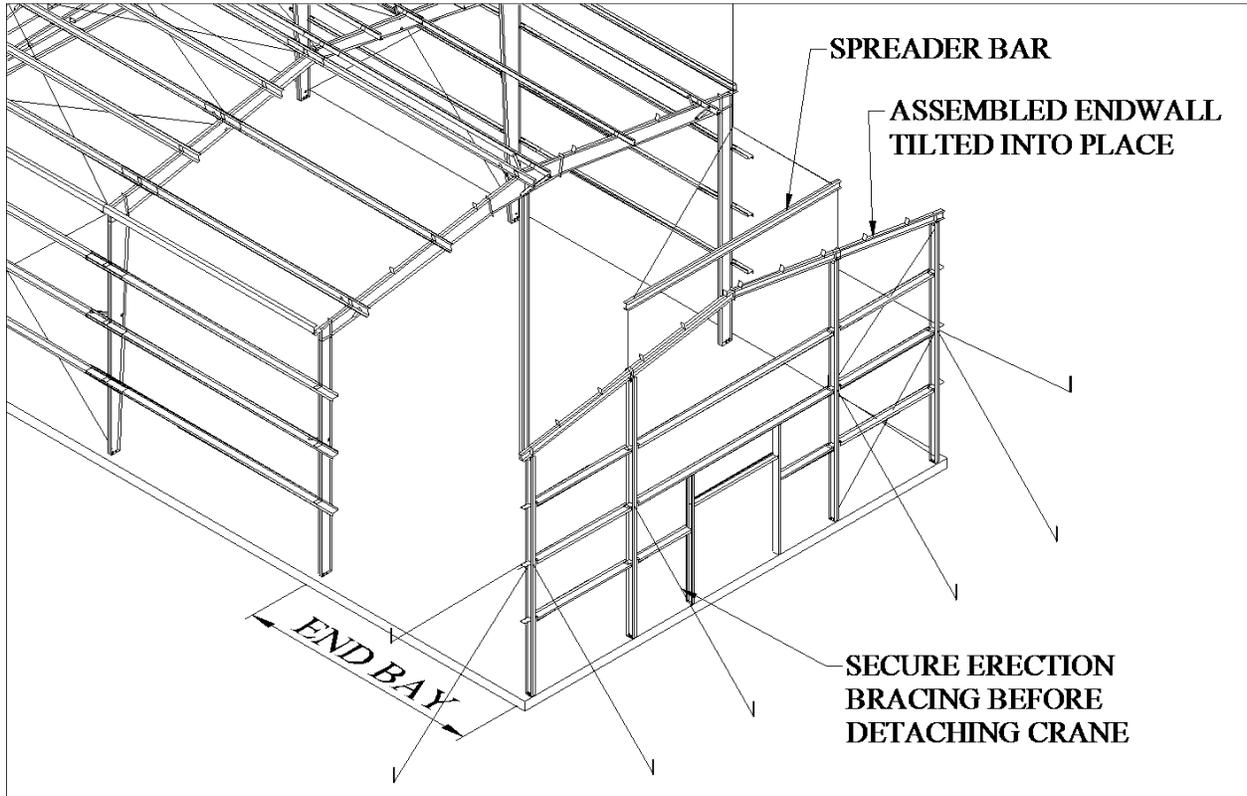


Illustration 7-7 Endwall Tilted into Position and Braced Using Erection Bracing

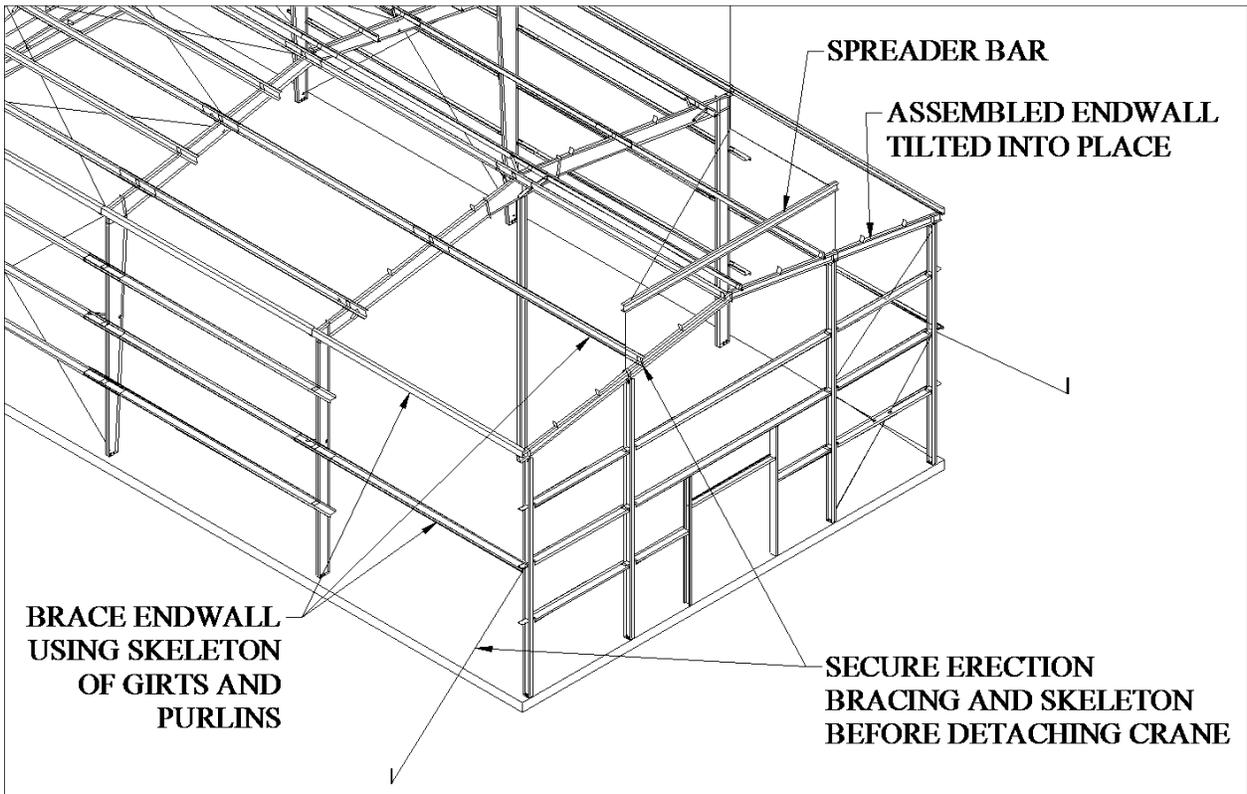
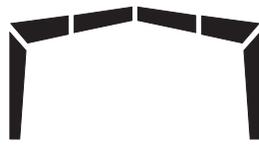


Illustration 7-8 Endwall Tilted Into Position and Braced Using Light Gauge and Bracing



## ERECTION SEQUENCE

### 2. Individual Lifts

The Post and Beam Endwall framing members may have to be lifted into position individually. The endwall columns are raised into position and braced using temporary and/or permanent bracing before the rafters are lifted into position.

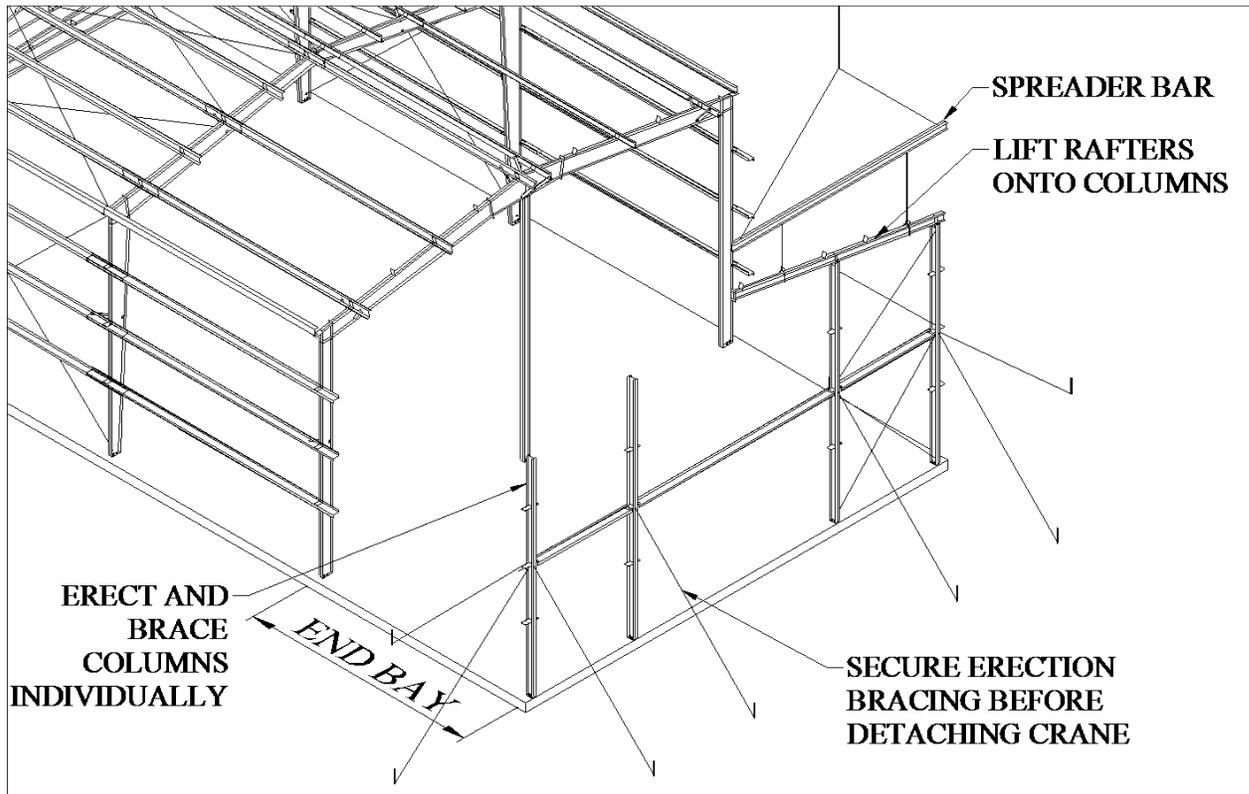


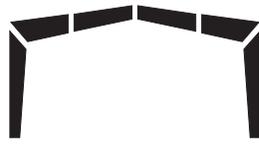
Illustration 7-9 Endwall Members Raised and Braced Individually

### 3. Stabilize Framing

Whether the endwall is erected using single, modular, or individual lifts, the framing must be stabilized as soon as possible as construction progresses by installing the eave struts, ridge purlins and the purlins closest to the endwall columns. Tall columns will require the installation of one or more girts to prevent buckling.

### 4. Finish Framing

Plumb and square the endwall using erection bracing, and install all remaining girts, purlins, flange braces, permanent bracing, purlin stabilizers, etc as per the Erection Drawings and Standard Details.



## ERECTION SEQUENCE

### Rigid Frame/Expandable Endwalls

Erect the frames for Rigid Frame and Expandable Endwalls using the same procedures outlined under “ERECT FIRST BRACED BAY”, on page 44 and “ERECT ADJACENT BAY(S)”, on page 52 above. Any wind posts for the endwall can then be raised into position and installed as per the Erection Drawings and Standard Details.

Once the framing is in place, install all girts, purlins, flange braces, framed openings, etc. as per the Erection Drawings and Standard Details.

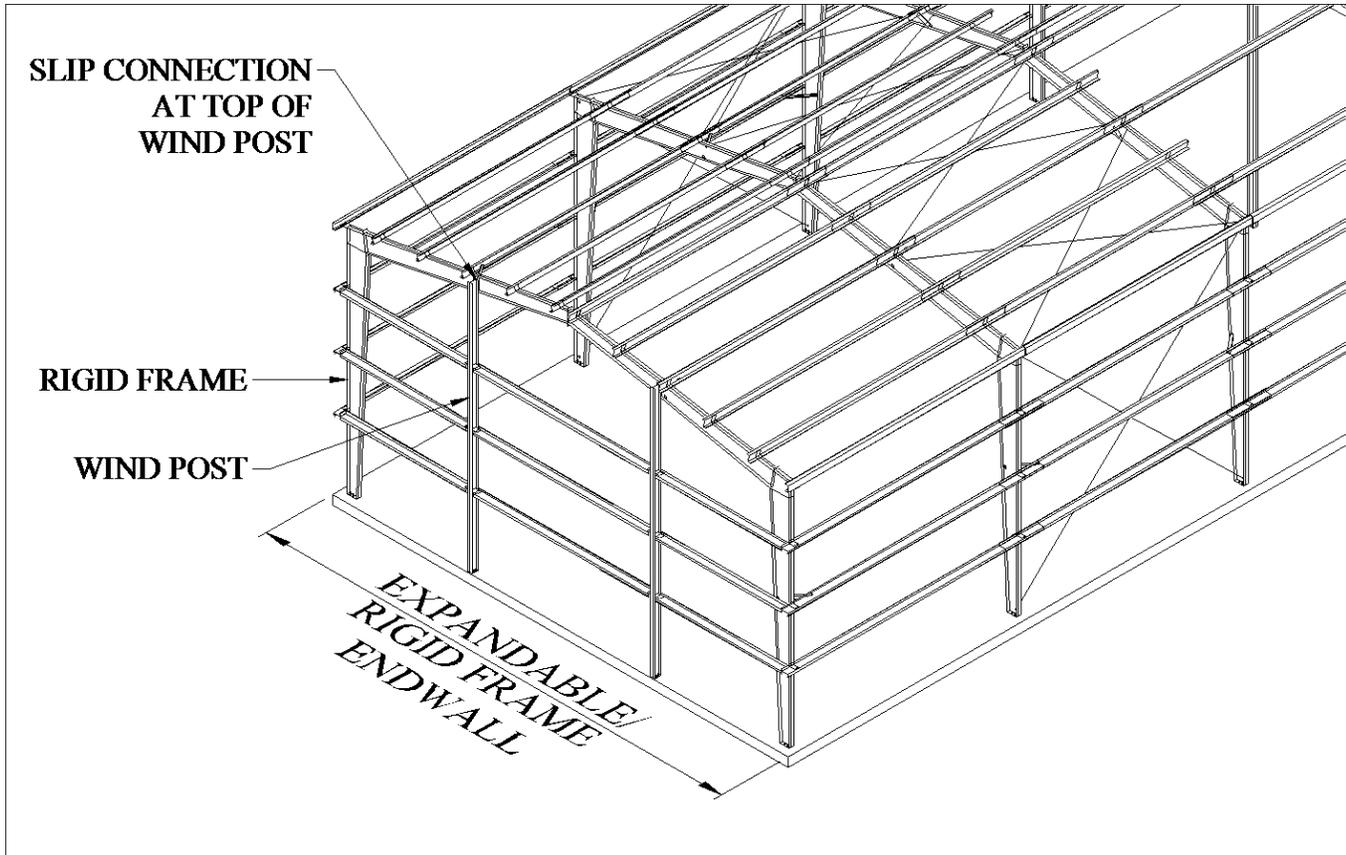
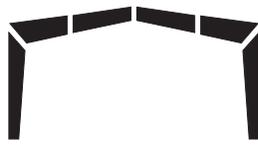


Illustration 7-10 Rigid Frame/Expandable Endwall Erected

#### NOTE:

Do not confuse the wind posts with interior columns. The interior columns are designed to support the Rigid Frame rafters and must be in place before the rafters are installed. The wind posts are designed to support the girts only and are not to be used to support the Rigid Frame.

The wind post-to-rigid frame connection is normally designed to allow the rigid frame to deflect. Slip connection bolts are not to be fully tightened. Doing so will create vertical load for which the wind post has not been designed.



## ERECTION SEQUENCE

### Miscellaneous Framing

Once the Primary and Secondary framing has been installed, there are a number of field located components that are required to complete the framing. These components are to be installed as accurately as possible to maintain the overall fit and finish of the building. The various field located components are supplied based on the locations and quantities specified in the Erection Drawings and Standard Details. Make efficient use of the material supplied to avoid creating a shortage.

Many of the miscellaneous framing members are to be installed using self-drilling screws. For best results, use locking pliers to hold the component(s) in position before driving any screws. Always ensure that all plies of material are in firm contact before driving any screws. If desired, 1/4" pilot holes can be predrilled in the outside plies of material.

Any time the screw threads become stripped, the screw must be replaced by driving an adjacent screw or replacing the screw with one having a larger diameter.

Some of the more common components are:

1. Base Angle or Channel

The base angle or base channel is fastened to the foundation flush with the Steel Line using powder-actuated fasteners (not by Behlen Industries LP) @ 24" (610mm) o/c. Avoid installing the base support inside of the concrete edge as the wall panel fasteners will dimple the panel. Seal the base angle or base channel to the foundation to help prevent leaks. Sealer is supplied for this based on a reasonably smooth concrete surface. If the concrete is rough or uneven, use additional sealer (not by Behlen Industries LP).

2. Rake Angle

The rake angle is to be installed on top of the purlins and flush with the outside face of the girts unless noted on the Erection Drawings. Splices are to be made at a purlin.

3. Eave Angle

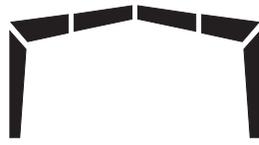
The eave angle is to be installed on top of the purlins and flush with the outside face of the girts unless noted on the Erection Drawings. The eave angles are to be butted together. Standard eave angles are often supplied with a lip on one leg to help avoid having them slide off the edge during installation. This lip is not provided to serve as a locator. Always locate the eave angle according to field conditions.

4. Brace/Sag Angle

Brace/sag angle is installed on the inside face of girts to brace the girt flange. This bracing not only holds the girts straight for appearances, but also greatly affects the strength of the girts. Always install the brace/sag angles where shown on the Erection Drawings.

5. Field Located Openings

The field located opening location(s) shown on the Erection Drawings are intended to ensure that the opening(s) will fit and are connected to the intended framing. These locations are based on the best available information at the time of design. Before installing any of these openings, confirm all locations and sizes.



## ERECTION SEQUENCE

### Perform Final Check

Before proceeding with paneling, inspect the building thoroughly to ensure that all components have been installed correctly, and all bolts and fasteners are installed and tightened properly.

Do not begin paneling the building until all components have been properly installed, and the building is plumb and square. **DO NOT REMOVE THE ERECTION BRACING UNTIL PANEL INSTALLATION IS COMPLETE.**

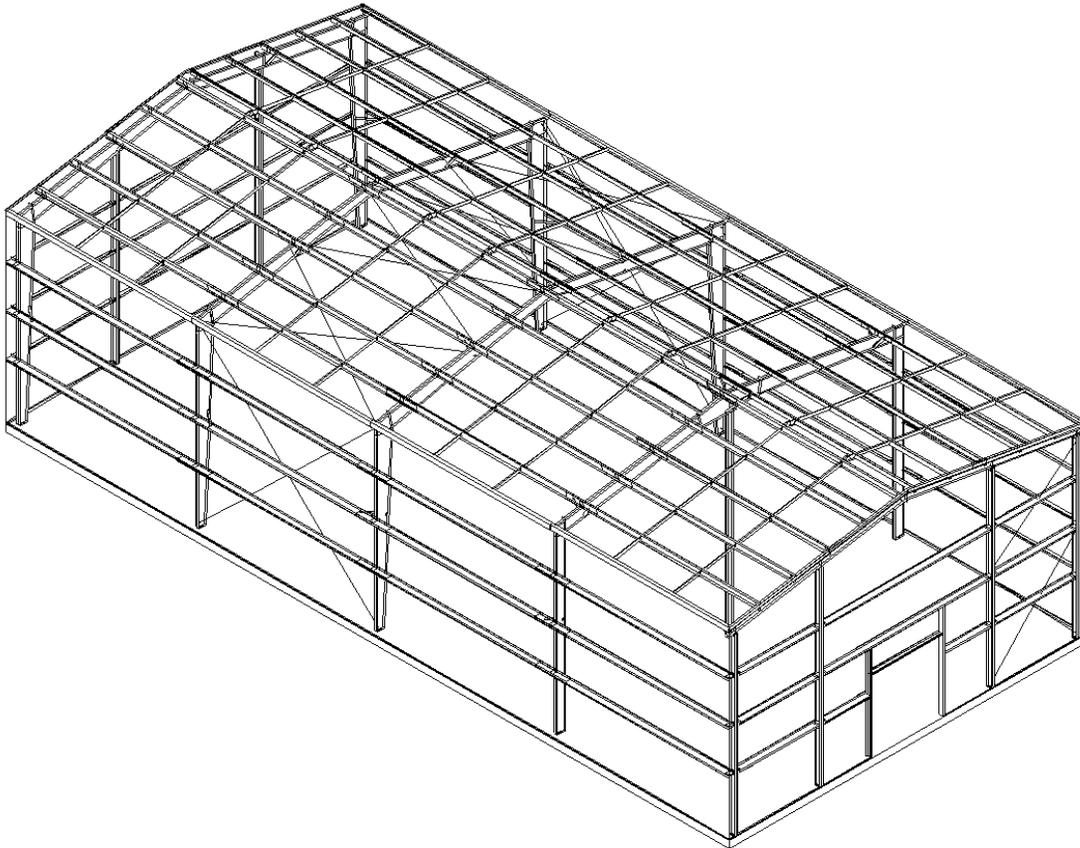
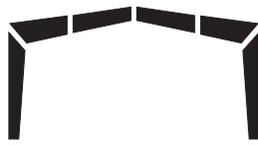


Illustration 7-11 Building Framing Ready for Final Check before Panelling



## **8 - PANEL**

Panel, trim, sealer and fastener details are given in the Standard Details and the Erection Drawings. This Guide will provide information regarding installation procedures and sequence, and identify some areas that require special attention.

### **Appearance**

The overall appearance of the building depends mainly on the quality of the panel and trim installation. Make every effort to keep all seams straight and even. All cuts must be straight and neat. All bends must be straight, even and sharp. Good workmanship is crucial. By being inconspicuous, neat trim joints will give the building a professional appearance. Poor workmanship is glaringly obvious and small mistakes can give an otherwise acceptable building a shoddy appearance.

### **Rain Screen Principle**

The exterior wall panel system is designed to work on the rain screen principle. The wall panel shields the building from wind, rain, etc. while being vented to the exterior to reduce the pressure differential between the inside and outside of the wall cavity, and the flow of moisture into the cavity. Any moisture that finds its way into the wall cavity must be able to make its way to the outside. It is not recommended that the exterior cladding panels and trims be sealed at the joints. Make all joints tight and neat, always placing the upslope layer on top for runoff. Closures are not used at the top or base of the wall panels to seal the panel. Closures are used at large trims (such as eave and gable trims) to act as a barrier against nesting birds, etc.

One exception to the rain screen principle is the uninsulated building. In order to keep out light, wind, dust and snow, closures are used at the top and base of the wall panels and windows and doors. The absence of insulation eliminates the need to prevent moisture build-up in the wall cavity. The wall panel and trim seams are not sealed.

Another exception to the rain screen principle is an area susceptible to drifting snow or ice build-up. An example of this would be the junction of a lean-to roof to a high wall. The presence of saturated snow in these areas can create water penetration into the building if the wall panels and trims are not sealed. These wall areas must be panelled, trimmed and sealed as if they were a roof surface. Sealer will be supplied to seal the panel and trim seams from the roof surface to a height of 5' (1524mm). Unless noted, 1/8" x 1/2" (3 x 13) sealer (3209030) is supplied for this purpose.

To prevent water penetration at the base of the building, ensure that property is properly drained and graded away from the building, taking surrounding property elevations into account. The foundation should be properly raised above the grade to accommodate spring flooding, heavy rains, etc. Snow drifts should be removed from the perimeter of the building. Snow should never be piled against the building.



## PANEL

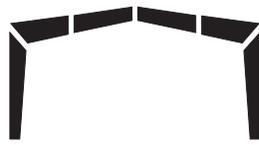
### Paneling Safety

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#### **SAFETY MUST BE MADE THE TOP PRIORITY ON ALL JOB SITES.**

Follow all applicable safety guidelines, both customary and statutory, to ensure worker safety. This Guide illustrates the installation of the various components. It is the responsibility of the builder or erector to ensure that the installation is carried out safely. If following any of these instructions would endanger any worker(s), another method must be found.

- Do not use the roof panels as walking platforms. The unfastened panels will not support the weight of a person at the edge. Provide walking platforms for workers who must walk on the unfastened panels.
  - Provide railings and safety lines and tie-offs for workers and see that they are used at all times.
  - Exercise extreme caution near the roof edges and openings, including the ridge.
  - Blanket insulation can offer a false sense of security. Stay alert to avoid stepping or leaning onto the insulation.
  - Never step on an unsecured panel. Such panels can easily start sliding.
  - Do not stand at the panel ends before they are fastened to the framing.
  - Pay attention to the worksite. Do not tolerate tripping or falling hazards.
  - Frost and dew can create an extremely hazardous surface. Do not step onto a frost-covered roof.
  - The various components have sharp metal edges. Wear gloves and eye protection at all times.
  - Conduct safety meetings regularly.
-



## PANEL

### Sealants

The sealants supplied and specified have been carefully chosen for their suitability to their application. Behlen Industries LP recommends that the highest quality non-skinning butyl, urethane or silicone polymer sealants be used to assure lasting performance on the roof. It is important that the sealants do not contain any acid residue, as it may react with the Galvalume finish.

Avoid stretching tape mastic during application. This makes the mastic strip smaller in places and compromises the seal. Using finger pressure, press the mastic tape into the panel corrugations as it is unrolled to apply a uniform strip.

Leave the backing paper on the mastic tape as it is applied. The backing tape should remain in place until the overlapping material is ready to install. This will protect the sealer from dirt and help prevent it from becoming disturbed. If the sealer is disturbed or contaminated, it must be replaced before proceeding.

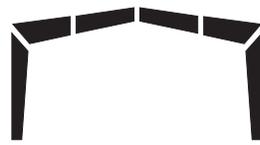
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### NOTE:

Joint preparation is key to sealant performance. All surfaces to be weather sealed must be sound, clean, dry, and free of any oily residue.

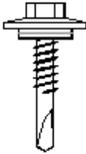
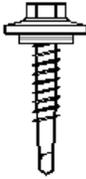
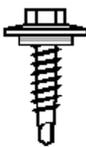
After applying an exposed bead of caulking, use a small spatula or similar tool to feather the edges of the bead to the base material. This will improve the seal, extend the life of the joint and reduce the accumulation of dust and dirt.

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**PANEL**

Screws

<p><b><u>1/4-14 x 3/4" STITCH SCREW</u></b></p>  <p><b>USE:</b> (c/w washer) Fastening panel and trims to panel and trims.  <b>DRILL POINT:</b> TEK 1  <b>MAX MATERIAL:</b> 0.380" (9.7)  <b>DRILL/TAP CAPACITY:</b> 0.03" - 0.095" (0.76 - 2.4)</p>	<p><b><u>#12-14 x 1" SD TEK SCREW</u></b></p>  <p><b>USE:</b> (c/w washer) Fastening panel, light gauge and clips to light gauge.  <b>DRILL POINT:</b> TEK 2  <b>MAX MATERIAL:</b> 0.310" (7.9)  <b>DRILL/TAP CAPACITY:</b> 0.036" - 0.210" (0.91 - 5.30)</p>	<p><b><u>#12-14 x 1 1/2" SD TEK SCREW</u></b></p>  <p><b>USE:</b> (c/w washer) Fastening panel, light gauge and clips to light gauge.  <b>DRILL POINT:</b> TEK 2  <b>MAX MATERIAL:</b> 0.810" (20.6)  <b>DRILL/TAP CAPACITY:</b> 0.036" - 0.210" (0.91 - 5.30)</p>
<p><b><u>#12-14 x 2" SD TEK SCREW</u></b></p>  <p><b>USE:</b> (c/w washer) Fastening panel, light gauge and clips to light gauge.  <b>DRILL POINT:</b> TEK 3  <b>MAX MATERIAL:</b> 1.525" (38.7)  <b>DRILL/TAP CAPACITY:</b> 0.036" - 0.210" (0.91 - 5.30)</p>	<p><b><u>#12-24 x 1 1/2" STRUCTURAL TEK</u></b></p>  <p><b>USE:</b> (c/w washer) Fastening panel, light gauge and clips to heavy framing. Use to fasten SSR Clips, etc. to joists and to fasten Sag Angle to 12Ga. girls.  <b>DRILL POINT:</b> TEK 5  <b>MAX MATERIAL:</b> 0.625" (15.9)  <b>DRILL/TAP CAPACITY:</b> 0.250" - 0.500" (6.36 - 12.72)</p>	<p><b><u>#12-24 x 2" STRUCTURAL TEK</u></b></p>  <p><b>USE:</b> (c/w washer) Fastening panel, light gauge and clips to heavy framing. Use to fasten SSR Clips, etc. to joists and to fasten Sag Angle to 12Ga. girls.  <b>DRILL POINT:</b> TEK 5  <b>MAX MATERIAL:</b> 1.125" (28.6)  <b>DRILL/TAP CAPACITY:</b> 0.250" - 0.500" (6.36 - 12.72)</p>
<p><b><u>1/4-14 x 1 1/4" SSR CLIP SCREW</u></b></p>  <p><b>USE:</b> (no washer) SSR Clips to light gauge framing (through up to 4" (100) blanket insulation). Also used for Metal Eave Closures and Eave Plates at the eave.  <b>DRILL POINT:</b> TEK 3  <b>MAX MATERIAL:</b> 0.710" (18.0)  <b>DRILL/TAP CAPACITY:</b> 0.036" - 0.210" (0.91 - 5.3)</p>	<p><b><u>1/4-14 x 2" SSR CLIP SCREW</u></b></p>  <p><b>USE:</b> (no washer) SSR Clips to light gauge framing (through 4" - 6" (100-152) blanket insulation).  <b>DRILL POINT:</b> TEK 3  <b>MAX MATERIAL:</b> 1.460" (37.1)  <b>DRILL/TAP CAPACITY:</b> 0.036" - 0.210" (0.91 - 5.3)</p>	<p><b><u>1/4-14 x 1 1/8" ENDLAP SCREW</u></b></p>  <p><b>USE:</b> (c/w washer and stainless capped head) SSR panel screw. Use at endlaps, enddams and eave support.  <b>DRILL POINT:</b> TEK 1  <b>MAX MATERIAL:</b> 0.395" (10.0)  <b>DRILL/TAP CAPACITY:</b> 0.03" - 0.095" (0.76 - 2.4)</p>
<p><b><u>#17-14 x 1" AB TAPPER</u></b></p>  <p><b>USE:</b> (c/w washer and stainless capped head) Replacement screw for stripped #12 or #14 screws. Panel and/or light gauge applications.  <b>DRILL POINT:</b> AB  <b>MAX MATERIAL:</b> 0.685" (17.4)  <b>DRILL CAPACITY:</b> Pilot hole required.</p>	<p><b><u>#10 x 1 1/2" WOOD SCREW</u></b></p>  <p><b>USE:</b> (c/w washer) Panel to wood framing.  <b>DRILL CAPACITY:</b> Up to length of screw.</p>	<p><b><u>1/4-14 x 7/8" STAINLESS CAPPED STITCH SCREW</u></b></p>  <p><b>USE:</b> (c/w washer and stainless capped head) Fastening panel and trims to panel and trims on SSR roofs.  <b>DRILL POINT:</b> TEK 1  <b>MAX MATERIAL:</b> 0.380" (9.7)  <b>DRILL/TAP CAPACITY:</b> 0.03" - 0.095" (0.76 - 2.4)</p>

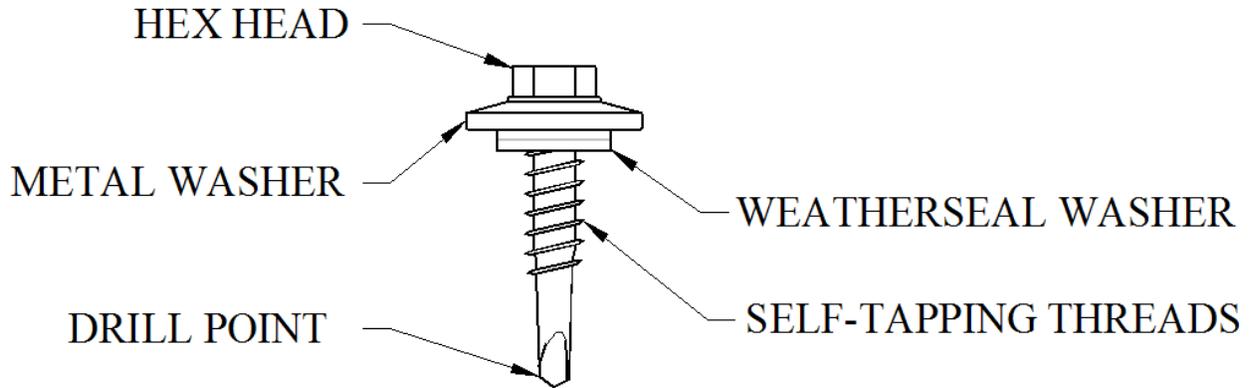
**About the Fastener Table**

The Fastener Table above shows the screws commonly supplied, their use, and their material and drilling capacities. Special applications may require the use of uncommon screw types, and these will be indicated in the Building Erection Drawings, if required. The Maximum Material Capacity indicates the total thickness of material that the screw can effectively fasten, including all plies of metal and any wood and/or compressed insulation, etc. The Drill/Tap Capacity indicates the total thickness of base metal into which the screw can drill and form threads without breaking.

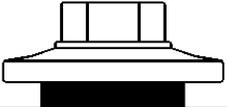


**PANEL**

Self-Drilling Screw Installation



TYPICAL SD TEK SCREW

PROPER SEATING OF SCREWS		
		
<b>OVERDRIVEN</b>	<b>PROPERLY DRIVEN</b>	<b>UNDERDRIVEN</b>
The weatherseal washer has been damaged by too much compression and/or cut by the turning metal washer. The seal will only be short-term.	The weatherseal washer has been compressed but not damaged. Washer is just visible.	The weatherseal washer has not been compressed enough to seal.

1. Equipment

For best results, use proper screw guns operating at 1900-2500 RPM rated at 4 amps or higher. Always use a positive clutch and a magnetic, depth-locating socket. Ensure that the screw head fits snugly into the socket and is completely engaged. If the screw head cannot be fully inserted, tap the magnet deeper into the socket.

Locking pliers will hold the plies of material together until the screws have drilled through all layers. They will also hold the material securely in position, freeing both hands and helping to prevent wandering trim and panel lines.



## PANEL

### 2. Installation Technique

Proper installation technique will greatly improve the performance of the self-drilling screws. The following tips should be followed.

- Adjust the depth locator on the screw gun(s) for proper washer seating.
- Use the proper fastener for the job. If the threads engage before the hole has been completed, the plies will separate and/or the drill point will break. If the material is too heavy, the screw will break before tapping. If the material is too light, the screw will not provide long-term service. The screw table on page 60 gives Total Material and Drill/Tap Capacities of the various screws.
- Do not push too hard when drilling, as too much pressure will burn out the drill point. Correct pressure will allow the screws to drill and tap without binding.
- When drilling through insulation, ease up on the pressure until the drill point contacts the framing. Striking the framing can damage the drill point.
- Keep the plies in contact when fastening. Whenever possible, locking pliers should be used to hold the parts in position and in firm contact.
- Lapped purlins and girts may not be in close contact. Avoid striking the bottom layer with the drill point when the top layer is penetrated. If the bottom layer cannot be drilled through before the threads engage, pre-drilling may be required.
- In the event that a screw strips out, it must be replaced by another screw; either in another location using the same size screw, or in the same location using a larger screw. At locations exposed to the weather, the stripped screw must be removed and replaced with a larger screw. The #17-14 x 1" AB tapper is commonly used to replace stripped screws.
- Always use the screws that have been provided for each location. Improper screw usage can lead to shortages on other areas of the building. The Standard Details specify the screws to use at standard locations. Custom details and accessories not covered by the Standard Details will be provided in the Erection Drawings for the building. Always use screws which are color-matched to the material being fastened.



## PANEL

### 3. Screw Alignment

Good alignment of the screws, especially on the wall panels, gives a professional appearance to the installation, which is critical in achieving customer satisfaction. One way this can be accomplished is by pre-drilling screw holes in the panels at identical locations. Up to 15 panels can be stacked together and drilled using a template. Use a 1/8" or 5/32" (3mm or 4mm) drill bit for panel-to-framing fasteners, and a 1/4" (6mm) bit for the sidelap clearance holes on the overlapping leg only.

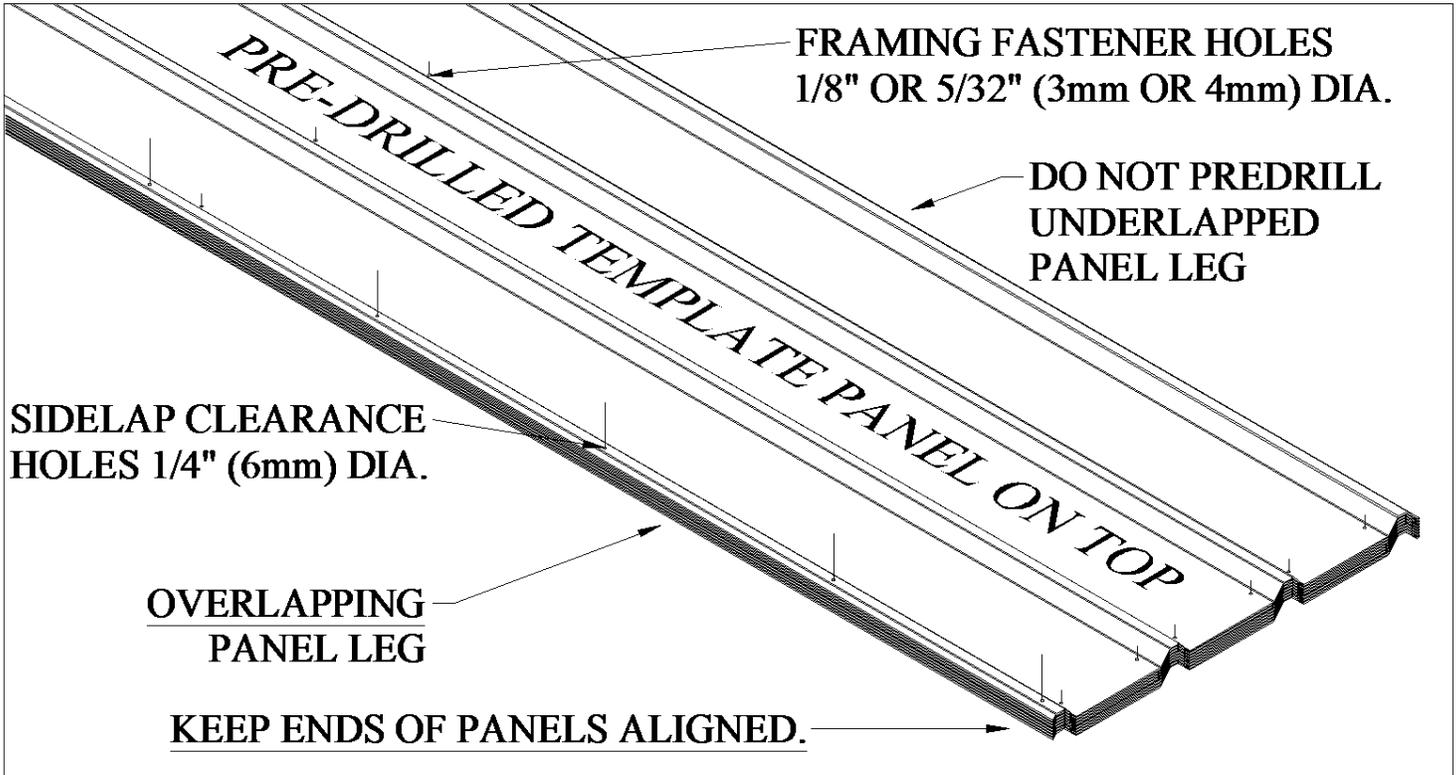


Illustration 8-1 Using Pre-Drilled Template Panel to Ensure Screw Alignment

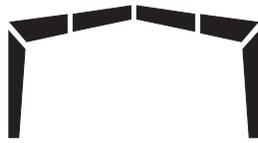
#### NOTE:

If a template panel is to be used, it is critical to ensure that the holes in the template are located in the correct location. Consider installing the template panel on the building, then removing it for template use. If this method is used, consider making the temporary installation 3" (76mm) to one side of the panel's final location. This will avoid screw hole conflicts.

It is also critical to ensure that purlin and girt alignment is maintained so the screw holes will line up properly.

Watch for changes in purlin/girt locations and only pre-drill as many panels as can be used.

**CLEAN THE METAL SHAVINGS FROM THE PANEL SURFACE IMMEDIATELY TO AVOID RUSTING AND/OR SCRATCHING THE FINISH.**



## PANEL

### Preparation

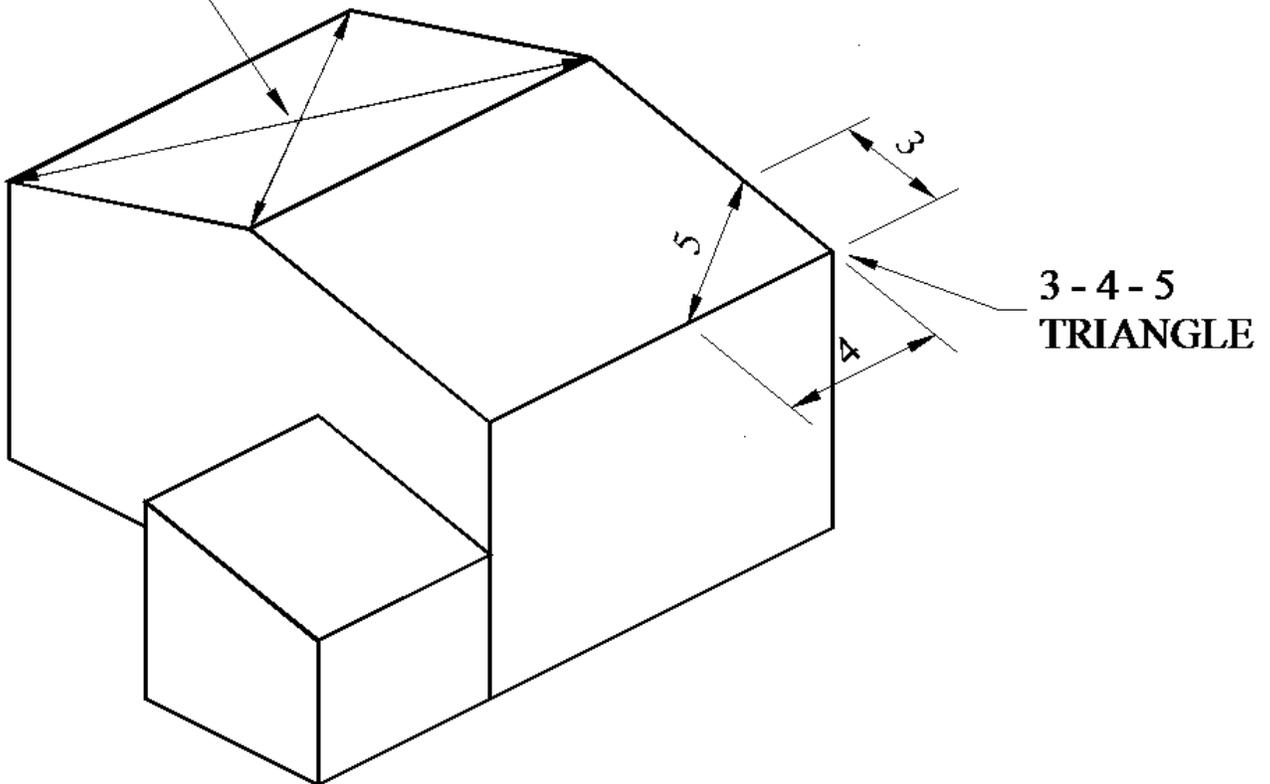
#### 1. Roof/Wall Geometry

The roof and wall surfaces must be straight and square before beginning to install the panels. Proper installation of the first panel run is imperative, as it will set the alignment for the rest of the panels.

**Do not remove the Erection Bracing until the panel has been completely installed.**

The building should already have been brought to a plumb and square condition while being erected (see ERECTION SEQUENCE). If the panelling is being installed on an existing structure, or by a separate contractor, a check of the building geometry is required. Two suggested methods of determining that the roof and walls are square are: corner-to-corner and the 3-4-5 triangle.

### CORNER - TO - CORNER

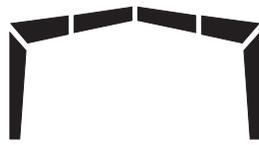


#### 2. Corner-To-Corner

Check the roof geometry by measuring diagonally across the roof surface from ridge to eave. The two dimensions should be identical. This is the easiest way to check roof geometry, but may be impractical on large roofs. Procedure is similar for checking wall geometry.

#### 3. 3-4-5 Triangle

Check the roof geometry by measuring along the gable from the eave at a multiple of 3. Next, measure along the eave, from the same point, a multiple of 4. The diagonal distance between the two points should be an exact multiple of 5. Repeat this process as required to determine building geometry. Procedure is similar for checking wall geometry.



**PANEL**

4. Purlin/Girt Alignment

Before beginning panel installation in any bay, ensure that the purlins and girts are straight and perpendicular to the roof or wall surface. Allowing the purlins or girts to rotate or sweep out of line will affect the screw line, panel end laps, and the structural integrity of the framing. Panel endlaps, roof/wall transitions, and ridges are particularly sensitive to the alignment of the substructure. Members that have rotated will have a reduced load-bearing capacity and can make panel installation difficult.

One **temporary** method of maintaining purlin or girt alignment is to cut and install 1 1/2" (38mm) thick blocks as shown. The blocks should be as wide as possible (5 1/2" (114mm) minimum). At least one row of blocking in a bay should be used. Use additional rows as required. If the building uses purlin stabilizers, temporary blocking in the roof may not be necessary. **This temporary blocking is not a replacement for purlin stabilizers or brace/sag angle. These items are to be used where noted.**

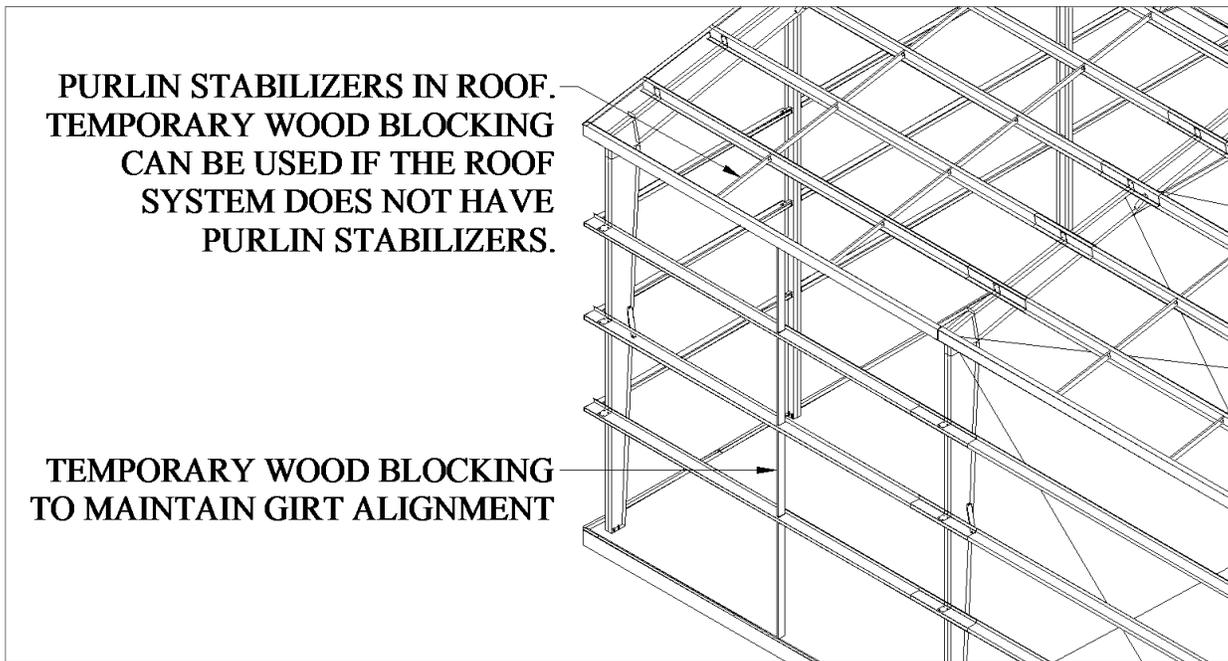


Illustration 8-2 Temporary Blocking

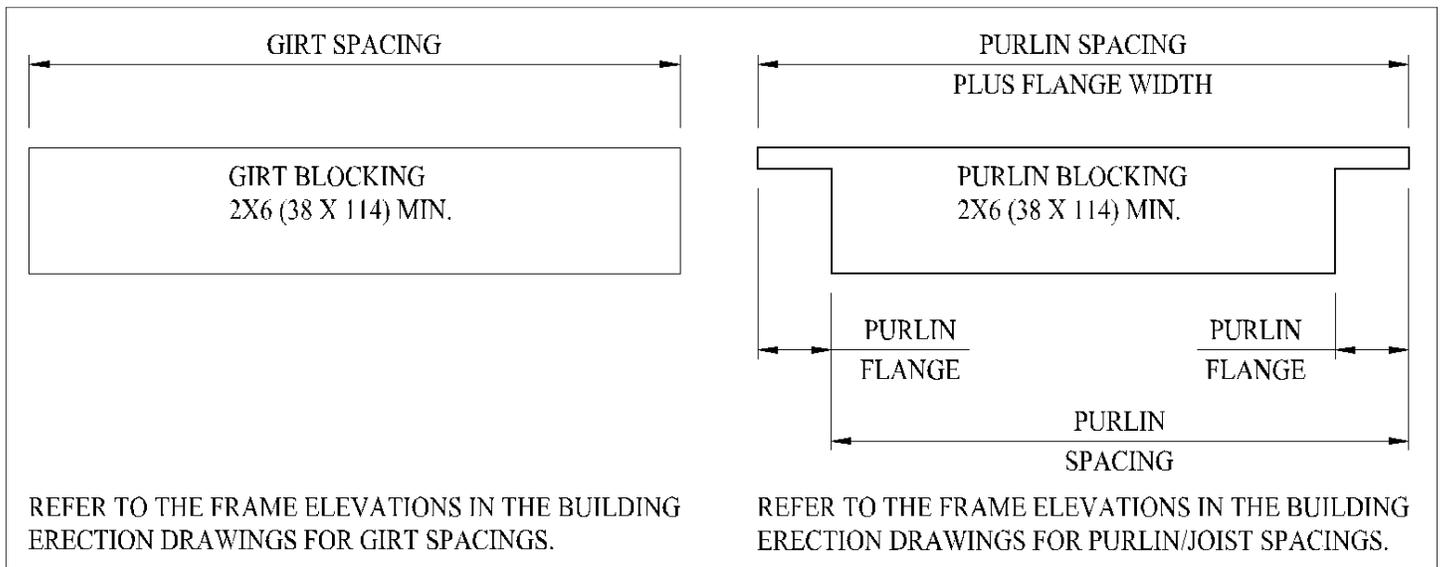


Illustration 8-3 Suggested Temporary Blocking Dimensions



## PANEL

### Start Point and Direction of Installation

Before any panels are installed on a roof or wall surface, develop a plan for the panel layout that will make the most efficient use of labour and materials. Check the locations of building corners, doors, windows, and height and width transitions to place panel seams and ribs in the most convenient locations. See Illustration 8.4 for some options to consider when installing AWR panel at a corner. Whenever possible, avoid using narrow strips of panel at the sides of doors and windows. Consider installing the wall panel so the seams will be less visible from high-traffic areas. Roof panel should be installed so the seams face away from prevailing winds to avoid driving rain. Adjust the paneling start point accordingly.

All panel systems except SSR24 Standing Seam Roof may be installed from either direction by turning the panels end for end. Refer to the SSR24 Installation Guide and the Standard Details for information pertaining to SSR24 Standing Seam Roof installation. For other profiles, refer to the Standard Details for the profile for proper installation details.

Cut the last panel on the building surface to width, always placing the cut edge under the trim to keep it from sight and out of the weather. Erectors will often back-lap the last panel to avoid cutting it to width. This practice should be avoided, especially on the roof. Trapping moisture between the panels can lead to premature deterioration.

Never step onto a roof panel that has been weakened by field cutting until it has been completely fastened to the framing. Panel start locations may be suggested on the Erection Drawings. It is impossible to predict the preferences of individual Erectors in various site conditions. The Erector must make the final decision after taking the building layout into account.

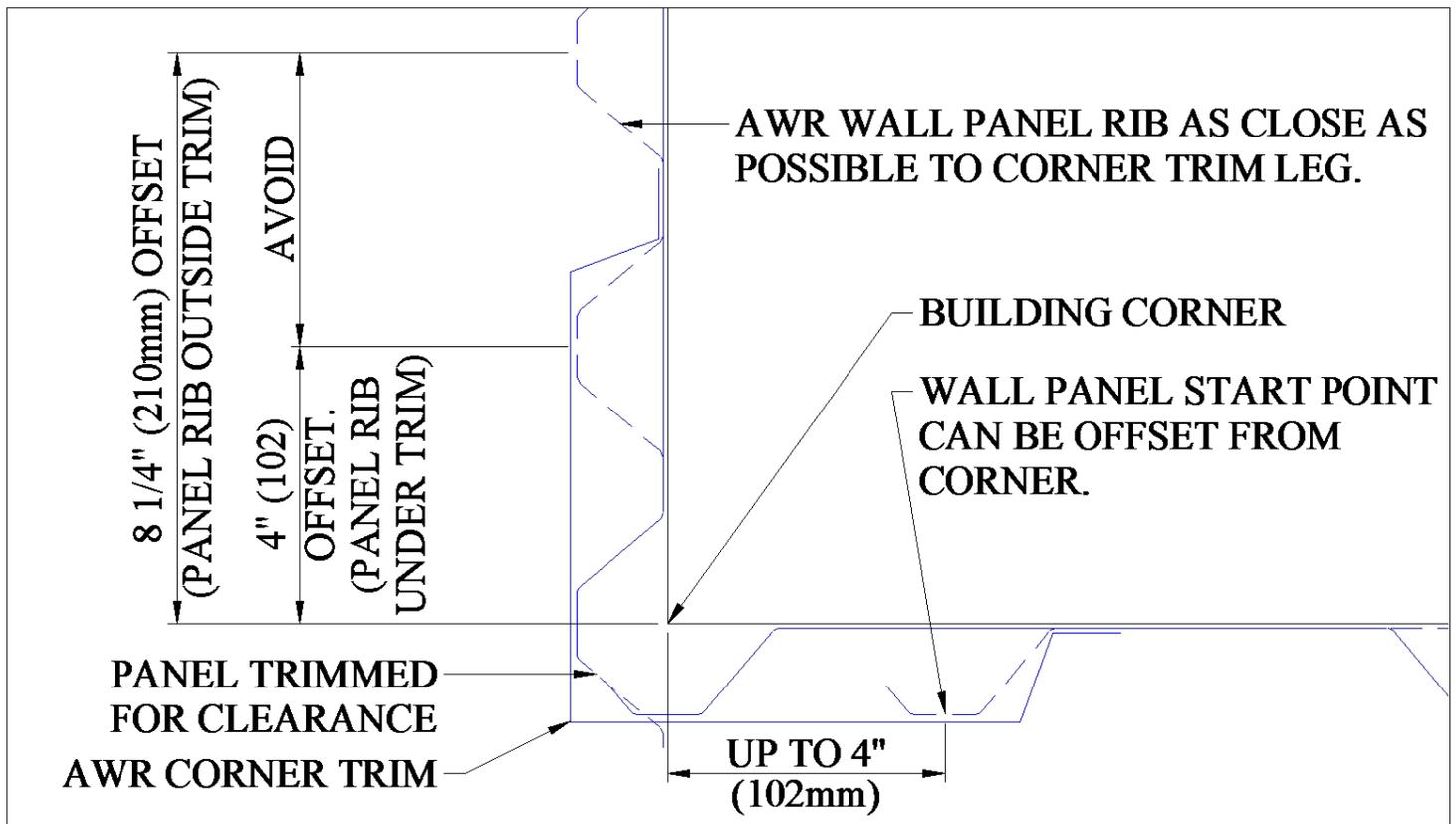
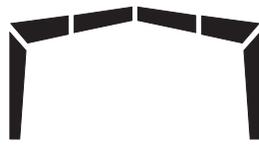


Illustration 8-4 AWR Wall Panel Offset Limits to Consider at Corner Trim



**PANEL**

**Wall Panel Installation**

Once the panel installation direction and the start point have been determined, panel installation can commence. Check each panel for plumb and for spacing. Make adjustments as required.

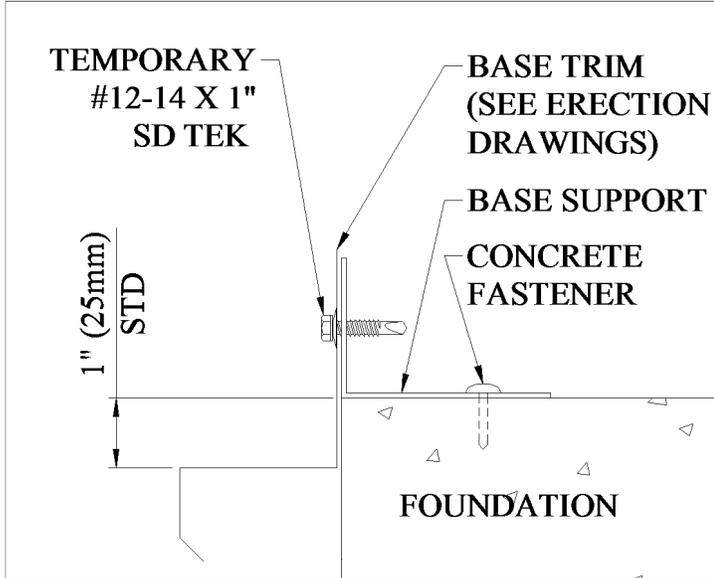


Illustration 8-5 Tack Base Trim in Place

Tack the Base Trim in place before installing the insulation or panels. Check the Standard Details for standard installation and the Erection Drawings for any custom details that may be required. Use a few #12-14 X 1" SD Tek screws to hold the trim in place temporarily. Remove the temporary fasteners as the wall panels are installed.

General practice is to install the wall panel in sequence with the insulation. Apply the first blanket of insulation and clamp it securely in place. Pluck the insulation from between the facing layers at the base support. This helps prevent "pillowing" of the panel and wicking of water into the insulation.

Align the first panel carefully at the chosen start point. Check panel alignment for plumb using a level or transit and clamp securely in position. Fasten the panel, trim excess insulation, and repeat.

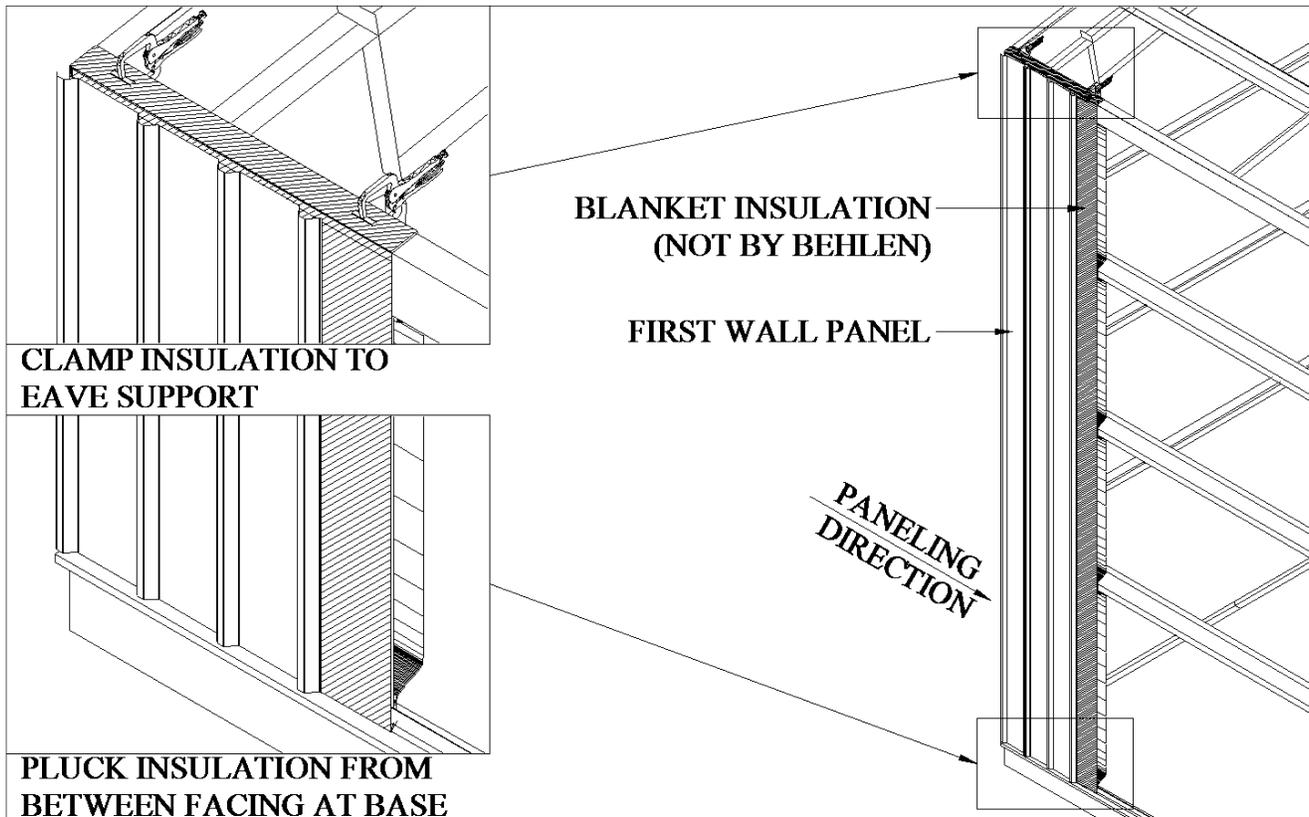


Illustration 8-6 First Wall Panel Installed. Check Alignment Carefully.



## PANEL

### Trims

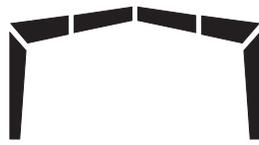
Most trims are supplied in standard lengths and must be cut to fit. Before cutting the trims, determine where the trims will be used and how to make the best use of the material supplied. Most trims are supplied in sufficient quantity to avoid the use of small pieces of drop-off. Hidden trims such as primary eave trims and base trim may require the use of all the material supplied.

As a general rule, use a single length of trim whenever possible. Any time a trim is cut to length, the shortest piece of drop-off that meets the required length should be used. Keeping the drop-off material organized will make this easier to do.

Installation of the flashing and trim is a vital phase of the building construction. Weather-tightness and appearance depend on quality workmanship and the best skilled workers available should be employed for this task. Cuts must be straight and accurate. Miter and lap all joints neatly and tightly, giving careful consideration to water drainage

Ensure that all panel cuts are covered. Cuts made around windows and doors must be made neatly and located so that they will be hidden by the opening trims.

Never allow trim lines to wander. Small deviations from a straight or square line are easily noticed. Before fastening any piece of trim, mark the proper location with a chalk line for the full length of the joint whenever possible. Hold the trim firmly in position while it is being fastened. Locking pliers with padded jaws are best suited for this operation.



## PANEL

### Roof Panel Installation

Roof panel installation is typically done after the wall panels have been installed. Panelling both sides of the roof at the same time is recommended. This will keep the insulation covered for the maximum amount of time and the panel ribs can be kept in proper alignment for ridge cap installation.

**Note:** Checks and corrections for proper coverage and alignment should be made as installation progresses. Small variations can accumulate over the length of the building surface, creating a shortage or an unappealing building.

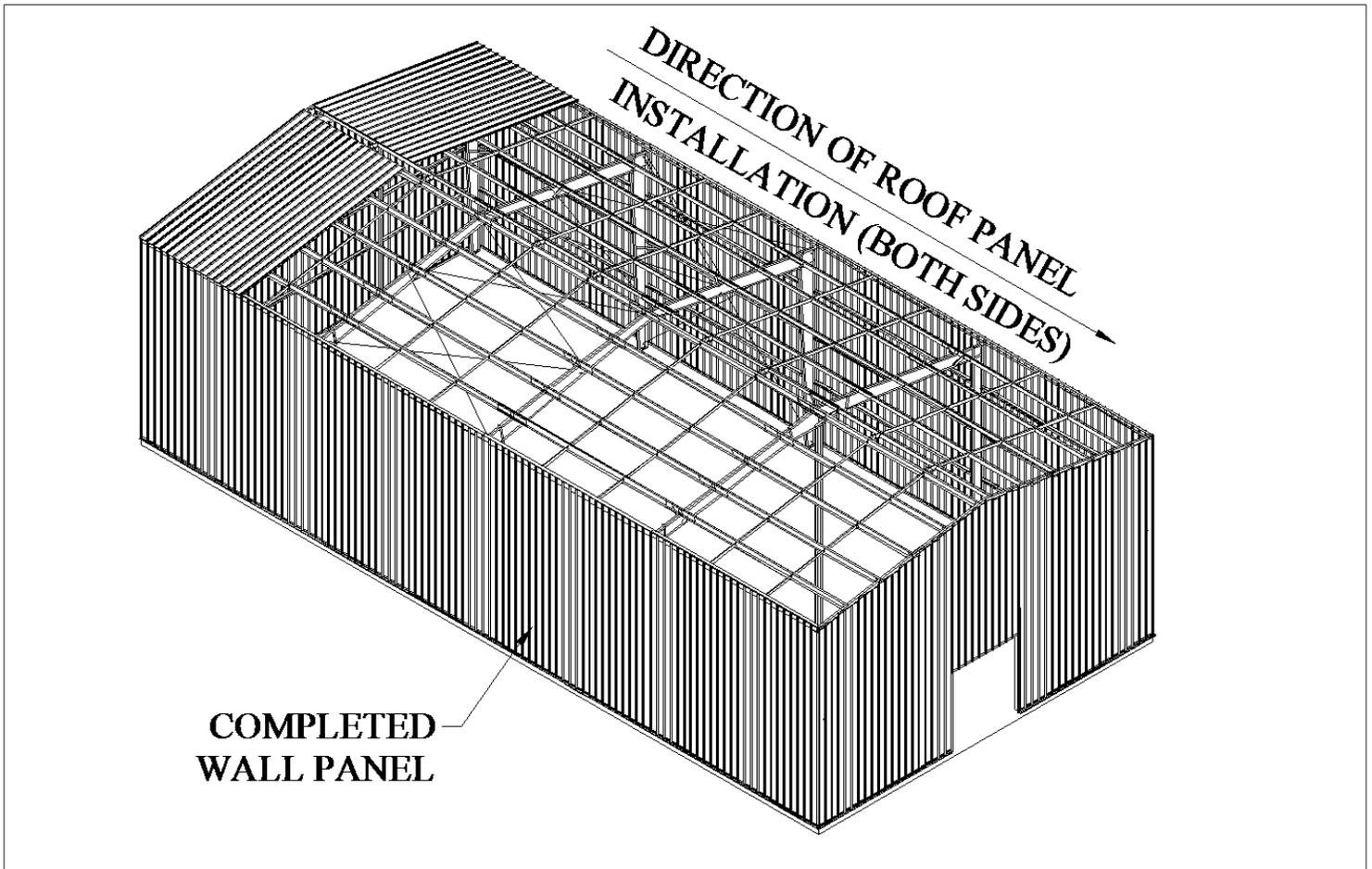
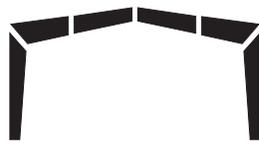


Illustration 8-7 Panel Both Sides of Roof Simultaneously After Wall Panel Installation

**Note:** The roof is particularly vulnerable to water penetration at the eave, especially if a gutter is used. Snow, ice and leaves can plug the gutter, causing water to back up against the roof. Seal all joints carefully, watching for multiple plies of material, and taking care to keep screws behind or in the sealer.



## PANEL

### 1. Eave

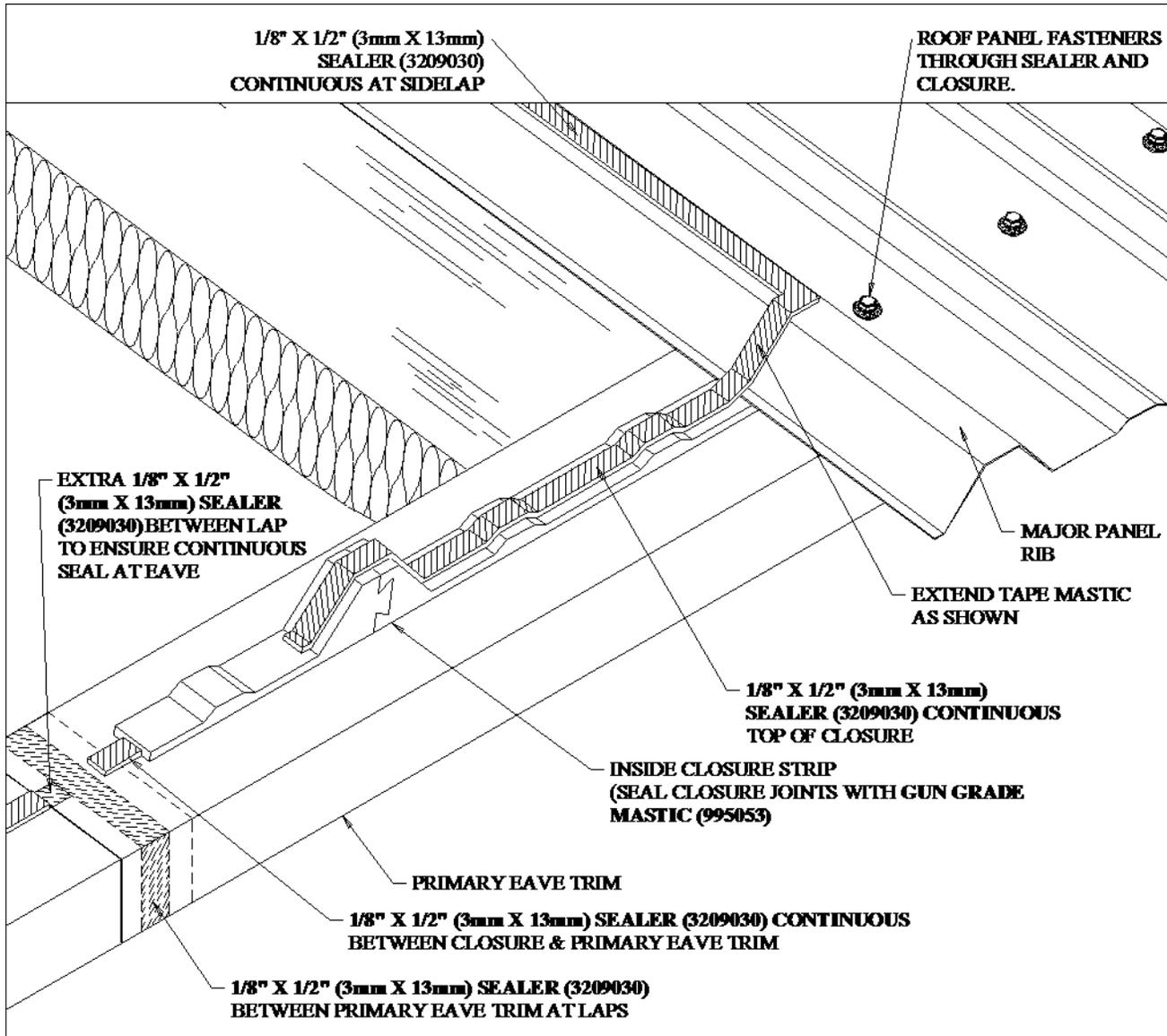
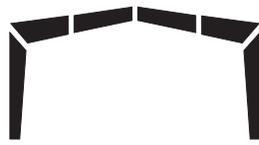


Illustration 8-8 Sealing the Eave

Tape mastic location at the eave is critical to ensure a weather-tight seal. The side lap mastic must extend down from the top of the rib to the mastic on the eave closure. The mastic extension from the panel side lap must splice into the mastic on top of the eave closure. The primary eave trim laps must have extra tape mastic between laps that will splice into the continuous mastic on top of the primary eave trim.

**Note:** Check that the panel overhangs at the eave and ridge/lap purlin are correct before setting the panel into the sealer. If necessary, trial fit the overlapping panel before removing the backing paper from the sealer tape. If the sealer is disturbed, it must be repaired before proceeding.



## PANEL

### 2. End Laps

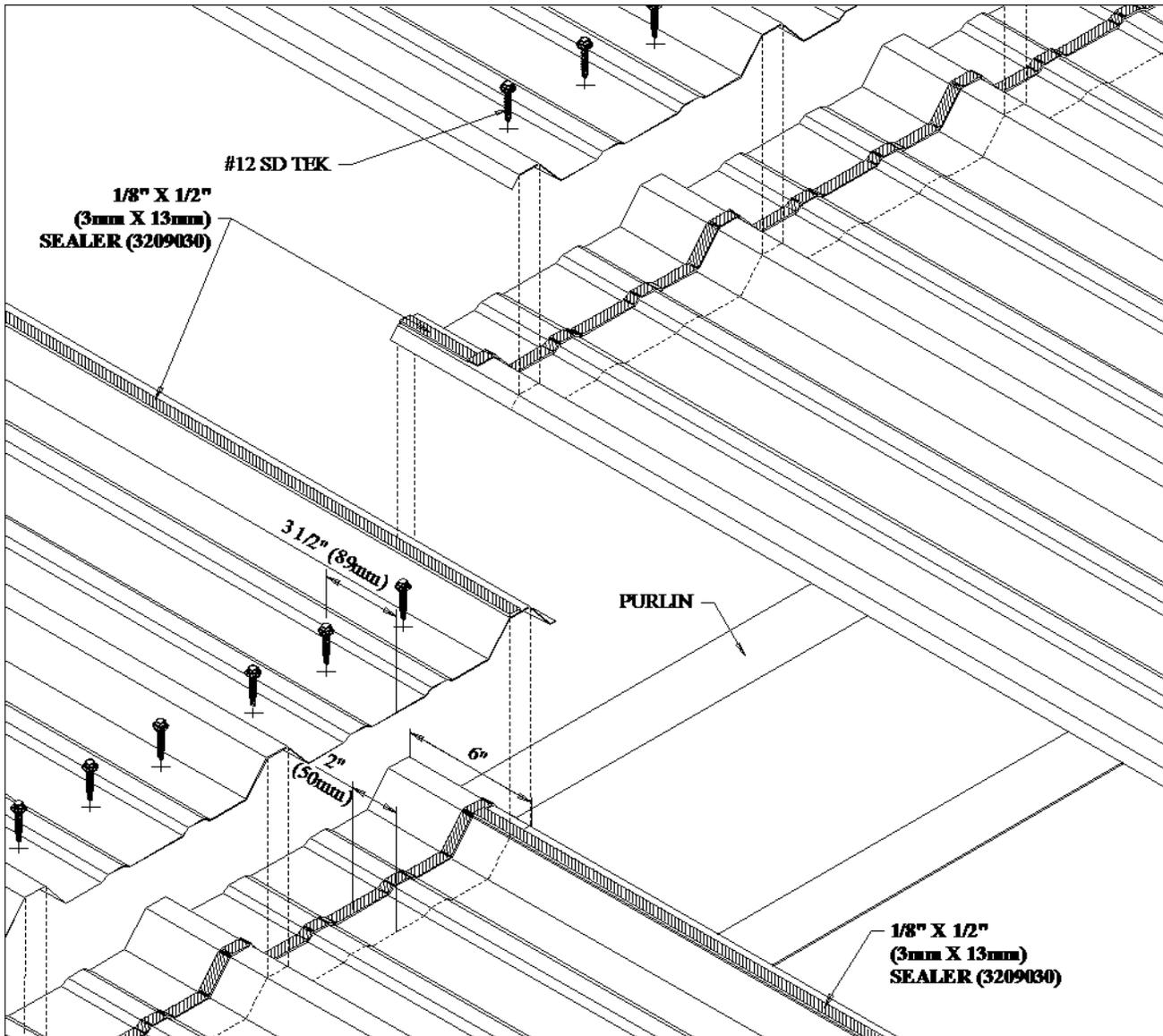
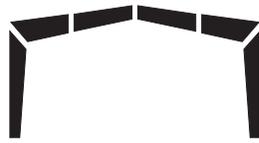


Illustration 8-9 Sealing End Laps

There are four plies of panel at the end lap/side lap junction. Tape mastic placement at this joint is critical to ensure a weather-tight seal. The side lap mastic must extend down from the top of the rib to the horizontal endlap mastic. The mastic extension from the panel side lap must splice into the endlap mastic. Similarly, the side lap mastic must make a continuous seal between all plies.

### 3. Ridge Caps

Sealing the Ridge Caps to the roof panel is done the same manner as an Endlap. Install the roof panels on both sides of the roof simultaneously, applying the ridge caps as installation progresses. This will keep the roof panels on both sides of the ridge in line with each other, and allow small adjustments where necessary.



## 9 - GLOSSARY OF TERMS

The following glossary defines some of the terms used in this Guide and the steel building industry. Terms not normally used by Behlen Industries LP will reference the term normally used. As well, Illustration 9.1 Part Location Drawing, on page 83, illustrates some of the most common components and where they might be located on a building.

**ACCESSORY:** A building product that supplements the building structure and coverings such as door, window, skylight ventilator, etc.

**ANCHOR BOLTS:** Bolts used to anchor structural members to the foundation.

**BASE ANGLE:** An angle secured to the foundation and used to attach the bottom of the wall paneling.

**BASE CHANNEL:** A channel secured to the foundation and used to attach the bottom of the wall paneling.

**BASE FLASHING:** A Flashing at the base of the wall panels used to shed water away from the building.

**BASE PLATE:** A plate attached to the bottom of a column that rests on a foundation and is secured by anchor bolts.

**BAY:** The space between the main frames measured parallel to the sidewall.

**BEAM:** A structural member, usually horizontal, that is subject to loads perpendicular to its length.

**BRACED BAY:** A bay in a building which contains bracing.

**BRACING:** Building components used in roofs and walls to transfer loads to the foundation. Also used to plumb and square buildings but not designed to replace erection bracing.

**BRACING TIER:** A configuration of structural cross (X) members and struts.

**BRACKET:** A structural support projecting from a wall or column to 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 bridge that in turn moves longitudinally on a runway made of beams and rails.

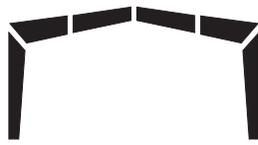
**BUILDING:** A structure forming an open, partially enclosed, or enclosed space constructed by a planned process of combining materials and components to meet specific conditions of use.

**BUILDING LENGTH:** The dimension of the building, measured perpendicular to the main framing, between Endwall Steel Lines.

**BUILDING WIDTH:** The dimension of the building, measured parallel to the main framing, between Sidewall Steel Lines.

**BYPASS (GIRTS/PURLINS):** A roof or wall framing system where the Purlins or Girts are completely outside the flanges of the Rafters or Columns.

**C.I.S.C.:** Canadian Institute of Steel Construction



## GLOSSARY OF TERMS

**C.S.A.:** Canadian Standards Association.

**C.S.S.B.I.:** Canadian Sheet Steel Building Institute.

**C.W.B.:** Canadian Welding Bureau.

**CABLE GRIP:** A helically formed high-strength-steel wire component used to connect a steel brace cable to an eyebolt or similar hardware.

**CAMBER:** Curvature of a flexural member in the plane of its web before loading.

**CANOPY:** A projecting roof system that is supported and restrained at one end only.

**CANTILEVER:** A building component, typically a beam or rafter, which extends beyond its support so that one or both ends are not supported.

**CAPILLARY ACTION:** The action that causes movement of liquids when in contact with two closely adjacent surfaces such as panel sidelaps.

**CAULK (CAULKING):** To seal and make weather-tight joints, seams, or voids by filling with a waterproofing compound or material. Also, the sealing material used.

**“CEE” SECTION:** A member cold formed from sheet steel in the shape of a block “C” that may be used either singly or back to back. Also known as a Light Gauge channel.

**CLEAR-SPAN FRAME:** A Rigid Frame having no Interior Columns.

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

**CLOSURE/FOAM CLOSURE:** A resilient strip of foam or neoprene, flat on one side and formed to the contour of ribbed Panels on the other side, used to close openings created when joining metal panels to flashings.

**COLUMN:** A main member used in a vertical position on a building to transfer loads to the foundation.

**COMPONENT:** A part used in the Building System.

**CORNER TRIM:** A preformed Flashing to close the intersection of Sidewall and Endwall Panels.

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

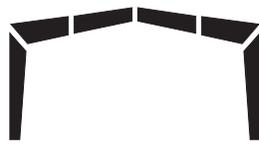
**CRANE BEAM:** The member that supports a crane rail. Supports may be columns or rafters depending on the type of crane system. On under-slung bridge cranes, the runway beam also acts as the crane rail.

**CURB:** A raised edge on a concrete floor slab or roof accessory.

**DOWNSPOUT:** A conduit used to carry water from the gutter of a building.

**DRIP FLASHING:** A Flashing used at the top and bottom of windows and doors to shed water away from the building.

**EAVE:** The line along the sidewall formed by the intersection of the roof and wall Steel Lines.



## GLOSSARY OF TERMS

**EAVE EXTENSION:** An extension of the roof beyond the Sidewall (Eave) of the building.

**EAVE HEIGHT:** The vertical dimension from finished floor to the Eave.

**EAVE STRUT:** A structural member located at the eave of a building that supports roof and wall paneling.

**EAVE TRIM:** A trim at the eave of the building.

**END BAY:** The bays adjacent to the Endwalls of a building.

**END FRAME:** A frame in the Endwall of a building.

**ENDWALL:** The exterior edge of the building that is parallel to the main frames of the building.

**ENDWALL COLUMN:** A vertical member located at the endwall of a building, which supports the girts. In post and beam endwalls, the endwall columns also support the Endwall Rafter.

**ENDWALL RAFTER:** A structural beam located at the endwall supporting roof purlins.

**ERECTION:** The on-site assembling of prefabricated components to form a complete structure.

**ERECTION BRACING:** Bracing used and supplied by the Erector during construction to hold the building components in position until the building is capable of supporting itself.

**ERECTION DRAWINGS:** Plans and erection instructions which identify all individual parts in sufficient detail to permit the proper erection and installation of the metal building system furnished by the manufacturer.

**EXPANDABLE ENDWALL:** A building Endwall designed to support a future expansion of the building length.

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

**FACADE:** A decorative band of panels or other materials at or around the perimeter of the roof.

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

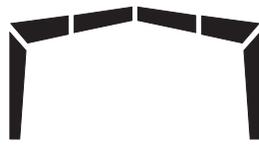
**FIELD:** The “job site”, “building site” or general market area.

**FINISHED FLOOR ELEVATION:** The theoretical elevation of the surface of the ground floor concrete slab. Used as a reference elevation for the building.

**FLANGE BRACE:** A bracing member used to provide lateral support to the flange of a structural member.

**FLASHING:** Light gage materials used to close and finish roof transitions, roof openings and wall openings.

**FLUSH (PURLINS/GIRTS):** A roof or wall framing system where the outside flanges of the Purlins or Girts are flush with the outside flanges of the Rafters or Columns.



## GLOSSARY OF TERMS

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

**FRAME:** See Framing.

**FRAMED OPENING:** Framework which surrounds an opening in the wall or roof of a building.

**FRAMED OPENING TRIMS:** The Flashings and Trims used to finish Framed Openings.

**FRAMING:** The Primary and Secondary Members (columns, rafters, girts, purlins, bracing, etc.) which are assembled to make up the skeleton of a structure to which the Panels are to be attached.

**GABLE:** The triangular portion of the endwall from the level of the eave to the ridge of the roof.

**GABLE EXTENSION:** An projection of the roof beyond the Endwall of the building.

**GABLE TRIM:** A Flashing designed to close the opening between the roof and endwall panels.

**GIRT:** A horizontal structural member that is attached to sidewall or endwall columns and supports wall paneling.

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

**GROUT:** A non-shrinking mixture of cement, sand and water used to fill cracks and cavities. Often used under base plates or levelling plates to obtain uniform bearing surfaces.

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

**GUTTER:** A sheet metal channel installed at an eave, valley, or parapet for the purpose of carrying water from the roof to the downspouts.

**HAUNCH:** The intersection of a Rigid Frame column and rafter at the eave.

**HEADER:** The horizontal framing member located at the top of a framed opening.

**HIGH-LIFT DOOR:** An Overhead Door that is raised vertically as high as possible before folding away from the wall.

**HIP:** The line formed where two adjacent sloping planes of a roof meet.

**ICE DAM:** A build-up of ice, which forms a dam on the roof covering along the eave of the building.

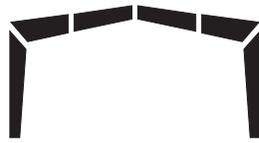
**INTERIOR COLUMN:** A column in a rigid frame which is located between the sidewall columns and provides support to the rigid frame rafter(s).

**“J” TRIM:** A J-shaped Trim used to cover Panel edges and ends at doors, windows, soffits, interior corners, etc.

**JACK BEAM:** A beam used to support another beam or rafter and eliminate a column support.

**JAMB:** A vertical framing member at the side of a framed opening.

**JOIST:** A horizontal structural member that transfers load from the floor or roof Panels to the beams or rafters.



## GLOSSARY OF TERMS

**KNEE:** See Haunch.

**LEAN-TO:** A building, normally having a Monoslope roof, which is partially supported on one side by another structure.

**LIGHT GAUGE:** Generally, steel having a thickness between 8ga. and 18ga. Also, a term used to describe the Secondary Steel framing on a building.

**LIGHT-TRANSMITTING PANELS:** See Translucent Panels.

**LINER:** Sheet metal panels, normally applied to the inside face of the purlins and/or girts, to provide an interior finish. In the case of a thermal roof or wall, the panel is applied to the outside face of the purlins and girts.

**MASONRY:** Anything constructed of granular materials such as brick, concrete block, ceramic block, and concrete.

**MASTIC:** Caulking or sealant furnished in rolls.

**MEZZANINE:** An intermediate level between floor and ceiling occupying a partial area of the floor space.

**MILL SECTION:** Steel sections (angles, channels, S sections, W sections, etc.) having standard dimensions and properties, which are formed by rolling mills while the steel is in a semi-molten state.

**MONOSLOPE:** A building having a roof sloping in one direction only. Used to designate a building that has a single-slope roof with 2 or more independent columns.

**MULTI SPAN FRAME:** A Rigid Frame having Interior Columns.

**NBC:** National Building Code.

**NIBBLER:** An electric hand tool used to cut sheet steel.

**OFFSET (PURLINS/GIRTS):** A roof or wall framing system where the outside flanges of the Purlins or Girts are outside the flanges of the Rafters or Columns by a distance less than the depth of the purlins or girts. Standard offset is 1" (25mm).

**OVERHEAD DOOR:** A door consisting of horizontally hinged sections, equipped with hardware and tracks that roll the door into an overhead position clear of, and immediately above, the door opening.

**PACKING LIST:** A list that calls out by quantity and part number each assembly or piece of material to be shipped for a building.

**PANEL (ROOF/WALL):** A thin (30ga. to 22ga.) sheet of steel having various profiles, used to cover the roof or wall of a building. The panel provides protection from the elements, rigidity for the building system, and aesthetic appeal.

**PARAPET:** That portion of the vertical wall of a building that extends above the roofline at the intersection of the wall and roof.



## GLOSSARY OF TERMS

**PART NUMBER:** A unique part identification. Also called a mark number or piece mark.

**PARTITION:** An interior wall.

**PEAK:** The uppermost point of the Gable.

**PEAK SIGN:** A sign attached to the peak of the building at the endwall showing the building manufacturer.

**PINNED CONNECTION:** A connection between building components that is meant to provide support without preventing the rotation of the connected component(s). Also known as a simple connection.

**PITCH:** See Roof Slope. Also, the distance between holes or bolts, measured parallel to the centerline, or web, of a member.

**PONDING:** The gathering of water in low or depressed areas on a roof.

**PORTAL FRAME:** A Rigid Frame configuration designed to brace a building system where X-bracing is not permitted.

**POST AND BEAM ENDWALL:** A structural system consisting of a series of rafters supported by columns. Used as the end frame of a building.

**PRE-PAINTED COIL:** Coil steel that receives a paint coating prior to the forming operation.

**PRIMARY EAVE TRIM:** A flashing used to close off the intersection of the roof and sidewall exterior panels. Provides a smooth, continuous surface onto which the roof panels are sealed.

**PRIMARY MEMBERS:** The main load-carrying members of a structural system, including columns, rafters, and beams.

**PRIMER:** The initial coat of paint applied in the shop to the structural framing of a building for protection against the elements during shipping and erection.

**PURLIN:** A horizontal structural member attached to the rafters and which supports roof panels.

**RAFTER:** A Primary framing member supporting the roof system.

**RAKE:** The intersection of the plane of the roof and the plane of the gable.

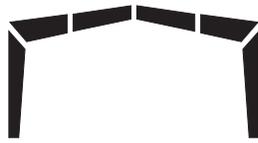
**RAKE ANGLE:** Angle fastened to purlins at rake for attachment of endwall panels and roof panels.

**RIDGE:** The highest point on the roof of the building, which describes a horizontal line formed by opposing sloping planes of the roof Steel Line.

**RIDGE CAP:** A transition of the roofing materials along the ridge of a roof.

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

**RIGID FRAME ENDWALL:** A building endwall having a Rigid Frame for the primary framing.



## GLOSSARY OF TERMS

**ROOF COVERING:** The exposed exterior roof skin consisting of panels, attachments, flashing and sealants.

**ROOF CURB:** A raised area on the roof to flash and support mechanical equipment, skylights, etc.

**ROOF OVERHANG:** See Eave Extension and/or Gable Extension.

**ROOF SLOPE:** The angle that a roof surface makes with the horizontal. Usually expressed in units of vertical rise to 12 units of horizontal run.

**RWL (RAIN WATER LEADER):** See Downspout.

**SSR (STANDING SEAM ROOF):** A Roof Panel system employing clips screwed to the supporting roof framing. Panels are fastened to the clips by seaming. This roof system is free to expand and contract with changes in temperature.

**SAG ANGLE:** A member used to brace a girt or purlin in the direction of its weak axis.

**SAG ROD:** See Sag Angle.

**SCREW DOWN ROOF:** A roof system where the panels are fastened directly to the roof framing supports using screws through the panel into the framing.

**SCUPPER:** An opening through a parapet or facade designed to direct the flow of water out through the face of the gutter rather than through a downspout.

**SEALANT:** Any material used to seal cracks, joints or laps to protect against leaks. May be used in liquid and semi-solid forms.

**SECONDARY MEMBERS:** Members that transmit loads to primary members. In a metal building system, this term includes purlins, girts, struts, diagonal bracing, portal frames, flange braces, headers, jambs, sag angles, and other miscellaneous framing.

**SELF-DRILLING SCREW:** A screw that combines the functions of drilling and fastening. See Stitch Screw, Tek Screws and Structural Tek.

**SELF-TAPPING SCREW:** A screw that taps its own threads in a pre-drilled hole. Grade 304 Stainless Screws are self-tapping.

**SHEET:** See Panel (Roof and/or Wall).

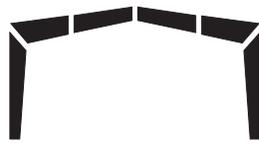
**SHIM:** A piece of steel used to level base plates or for packing between structural members.

**SHIPPING LIST:** See Packing List.

**SIDEWALL:** An exterior building wall, typically perpendicular to the main frames, that represents one extent of the building width.

**SILL:** A horizontal framing member at the base of a window or other framed opening.

**SINGLE SLOPE:** See Monoslope.



## GLOSSARY OF TERMS

**SLIDING DOOR:** A door with one or more leaves, which opens horizontally by means of an overhead guide or bottom track.

**SOFFIT:** Material that covers the underside of an overhang.

**SPAN:** The distance between supports.

**SPECIFICATIONS:** A statement of particulars of a given job, as to the building size and the type, quality, and performance of the workmanship, materials to be used, and the terms of the contract.

**SPLICE:** A connection in a structural member or between structural members.

**STEEL LINE:** The plane of the exterior surface of the wall or roof framing. Normally the plane of the inside face of the exterior Panel. Building length and width are measured to the Steel Line of the endwalls and sidewalls.

**STITCH SCREW:** Screws which drill their own hole but do not tap threads, making them suitable for fastening through 0.03" - 0.095" (0.76mm - 2.4mm) of steel material. Used to fasten panel and trim to panel and trim.

**STRUCTURAL TEKS:** Also known as Tek 5 screws. Screws having fine threads (usually 24 threads per inch) which drill their own holes and tap their own threads through 0.250" - 0.500" (6.36mm - 12.72mm) of steel, making them suitable for fastening to structural steel. Thicker steel requires pre-drilling of the holes. The fine threads make these screws unsuitable for use as stitch or tek screws.

**STRUT:** A brace fitted into a framework to resist force in the direction of its length.

**TEK SCREWS:** Screws having coarse threads (usually 14 threads per inch) which drill their own hole and tap their own threads through 0.036" - 0.210" (0.91mm - 5.30mm) of steel, making them suitable for fastening to light gauge material. Used to fasten panel and trim to light gauge framing and to fasten accessory angles, such as rake angles, to light gauge framing.

**THERMAL BLOCK:** A spacer of low thermal conductance material.

**THERMAL SYSTEM:** A system of liner panel (installed on the outside face of the purlins and/or girts), raised clips, hat bars and exterior panel used to provide an insulation space on the exterior of the building.

**THROUGH-FASTENED ROOF:** See Screw-Down Roof.

**TORQUE WRENCH:** A wrench containing an adjustable mechanism for measuring and controlling the amount of torque or turning force to be exerted. Often used in tightening the nuts of high strength bolts.

**TRANSLUCENT PANELS:** A fiberglass light-transmitting panel formed to the profile of the specified cladding panel.

**TRIM:** The light gauge metal used in the finish of a building, especially around openings and at the intersection of surfaces. Often referred to as Flashing.

**TUBE CAULK:** Caulking or Sealant furnished in tubes for application using a caulking gun.



## GLOSSARY OF TERMS

**TURN-OF-NUT METHOD:** The preferred method of pre-tensioning high strength bolts. See “BOLTED CONNECTIONS” on page 6-1.

**VALLEY:** The sloping or horizontal line formed where two adjacent sloping planes of a roof meet and drain toward each other.

**VAPOUR BARRIER:** Any material placed on the warm side of insulation to prevent moisture penetration.

**VERTICAL-LIFT DOOR:** An Overhead Door that is raised vertically for the full height of the door.

**WALL COVERING:** The exposed exterior panels, attachments, trims, and sealants.

**WATER-PROOF:** A surface that will not permit penetration of water even when submerged.

**WEATHER-TIGHT:** A surface that resists the penetration of the elements under normal operating conditions. Proper drainage is required.

**WIND BENT:** See Portal Frame.

**WIND POST:** A vertical member supporting a wall system, designed to withstand horizontal wind loads.

**“ZEE” SECTION:** A member in the shape of a block “Z”.







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