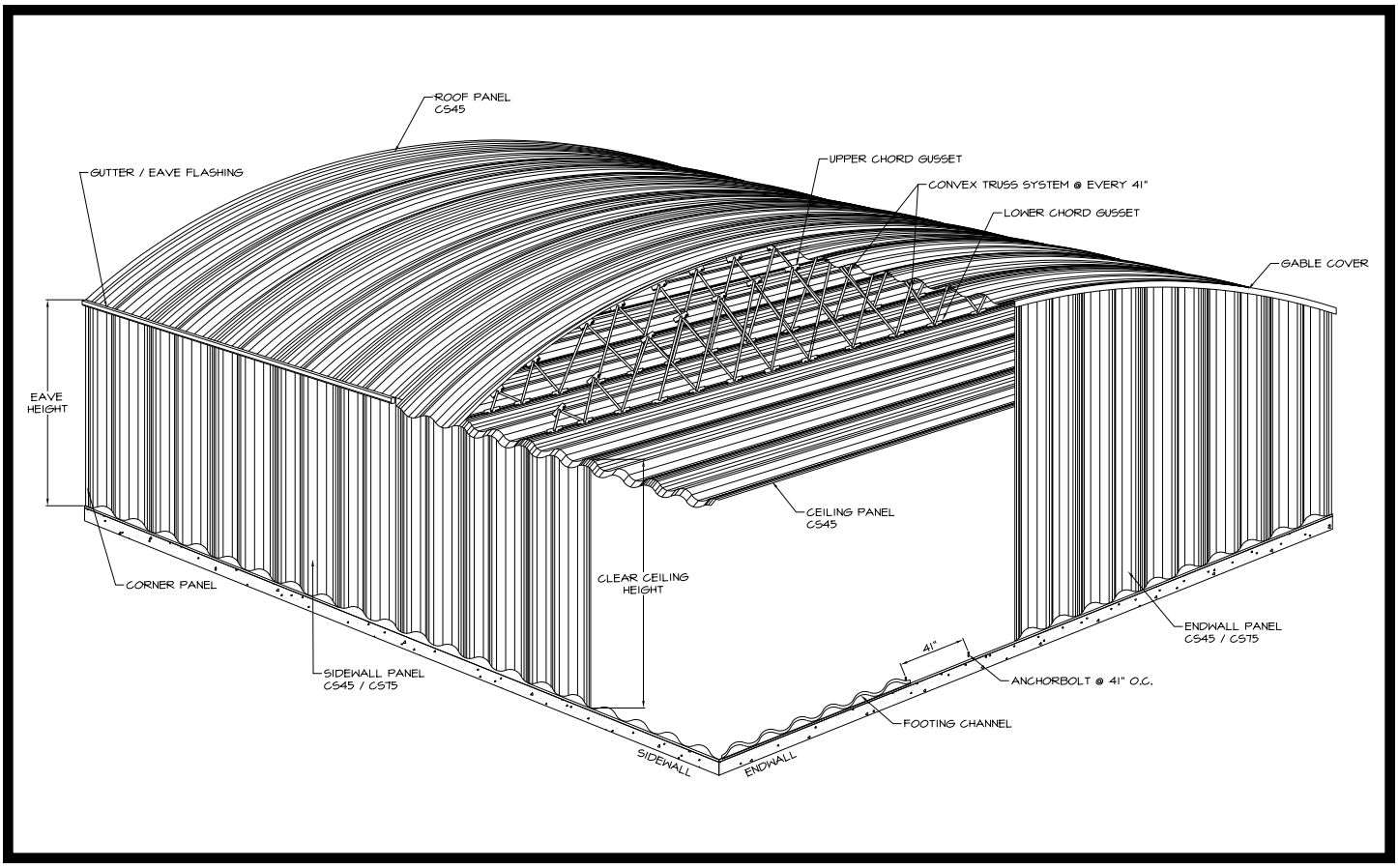
FRAMELESS



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 discolouration on Galvanized material, and a darkish discolouration 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 fi rst 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 modifi cation.
- 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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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. Approval Drawings
   Drawings issued "For Approval" will be clearly marked in the Title Block on each page. "For Approval" 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 Approval 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 Approval" drawings is letter "A". **T**hese 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 Approval."**
2. Construction Drawings
   Drawings issued "For Construction" will also be clearly marked in the Title Blocks and 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. Construction Drawings
   - Drawing Schedule
   - General Information Sheet and Conformance
   - Anchor Bolt Plan
   - Anchor Bolt Details
   - Building Elevation(s)
   - Roof & Ceiling Plan
   - Sealer Application Drawing(s)
   - Ceiling Connector Details
   - Truss Drawing & Details
   - Framed Opening Details
   - Ceiling Access Door Details
   - Gutter & Downspout Details
   - Liner Panel Details
   - Additional drawing(s) (if required)

2. Standard Detail Pages
   - Louvre Cover Details
   - Sealer Application Drawing(s)
   - Footing Channel Details
   - Sealer and Fastener Details
   - Truss Details
   - Ceiling Access Door Details
   - Gutter and Downspout Details
   - Liner Sections and Details
   - Slip Channel Details

1 - CONSTRUCTION DRAWINGS

DRAWING SCHEDULE

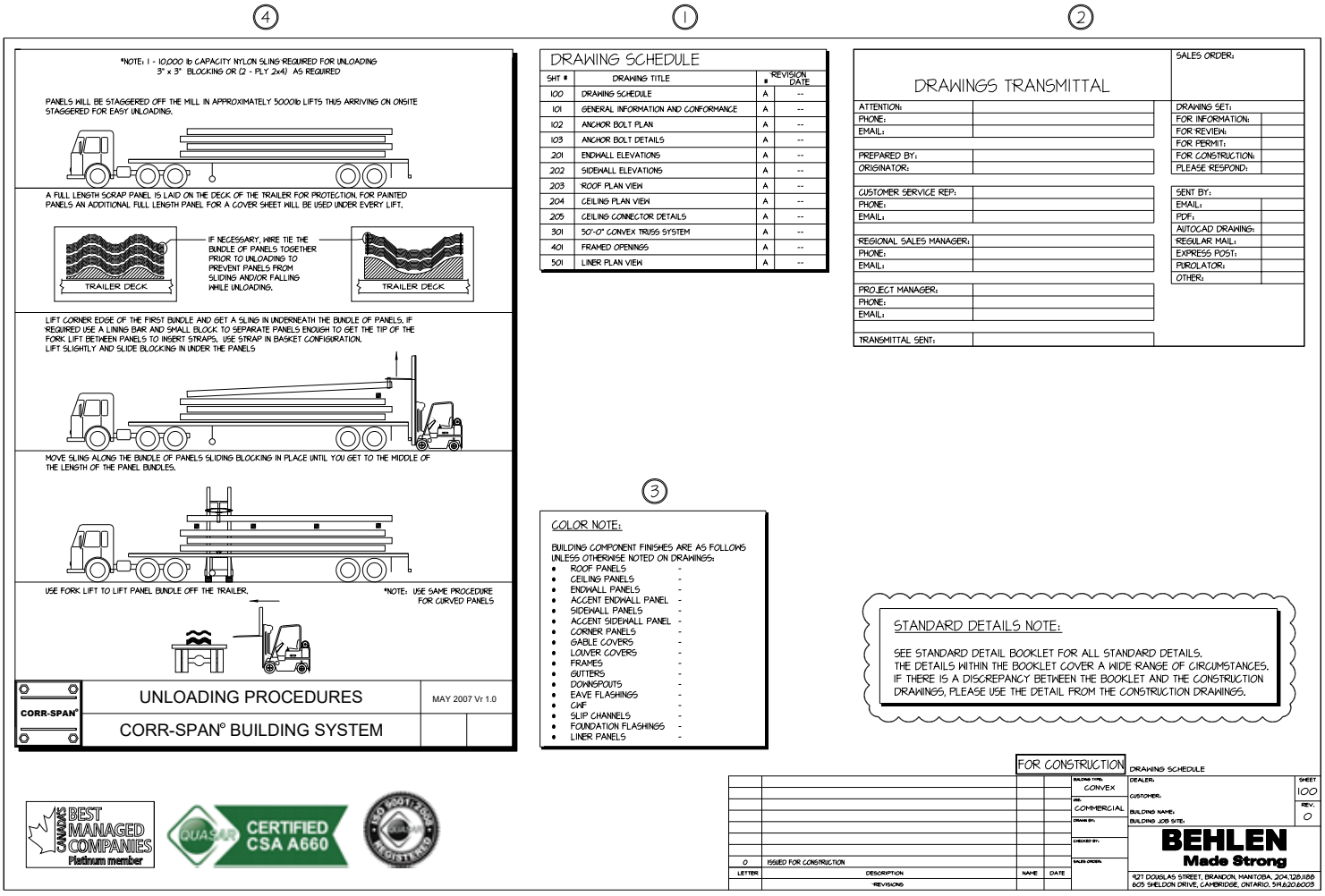


Illustration 1-1 Typical Drawing Schedule

Drawing Schedule Main Features

1. Drawing Schedule

The Drawing Schedule provides a list of all the Construction 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.

2. Drawing Transmittal

This section shows the project sales order number, drawing version, contact information for the dealer and Behlen representatives, date of issue for drawings and the method the drawings are provided. For approval version drawings that require an approval response, an expected response date will be indicated along with check boxes to indicate approval of the drawings or modifications required.

3. Colour Note

Colours for all the applicable building components are summarized in this table.

4. Unloading Procedures

These procedures are to be followed when unloading all bundles of Frameless panels. Additional details regarding the unloading procedures are provided in this guide.

1 - 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.

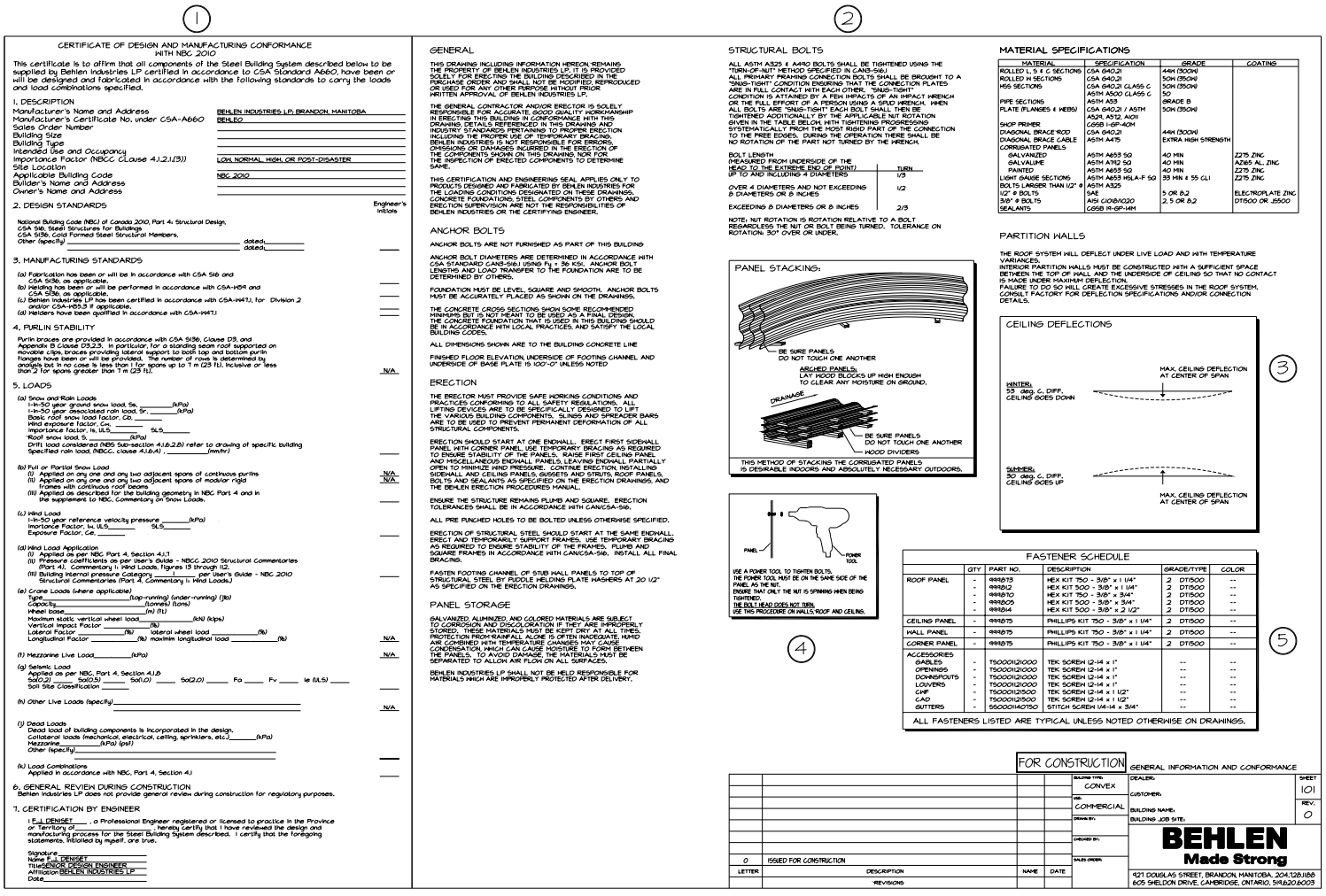


Illustration 1-2 Typical General Information Sheet and Conformance

GENERAL INFORMATION SHEET AND CONFORMANCE MAIN FEATURES

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 (Canadian Sheet Steel Building Institute) Certificate format. Check this section carefully to ensure that all information is correct.

1 - CONSTRUCTION DRAWINGS

2. General Information

This section contains general information about the manufacture, storage, and construction 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 Construction Drawings are explained by this section.

3. Ceiling Deflections

Maximum deflections of the ceiling at midspan of the building. In winter, the ceiling will deflect downwards. In summer, due to temperature differentials, the ceiling will deflect upwards. Partition walls constructed within the building must include a space above the wall to accomodate this movement so that no contact is made under maximum deflections.

4. Fastener Installation

When installing the fasteners, ensure that only the nut is rotated in relation to the bolt. Spinning the bolt can damage the washer and thereby compromise the seal.

5. Fastener Schedule

Fastener quantity, part number, description, grade/type and colour are specified in the table. The fasteners are listed based on the location they are used.

1 - CONSTRUCTION DRAWINGS

ANCHOR BOLT PLAN

The Anchor Bolt Plan shows the concrete dimensions, locations of the framed openings, and the size and location of the anchor bolts. Concentrated reactions associated with framed opening verticals and/or uplift verticals are also shown. All dimensions on this drawing must be closely observed. Locate the anchor bolts carefully, following the details provided.

BEHLEN Industries LP will specify the required diameter for the anchor bolts and the projection above the top of concrete. Anchor bolts are not supplied by BEHLEN Industries LP.

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

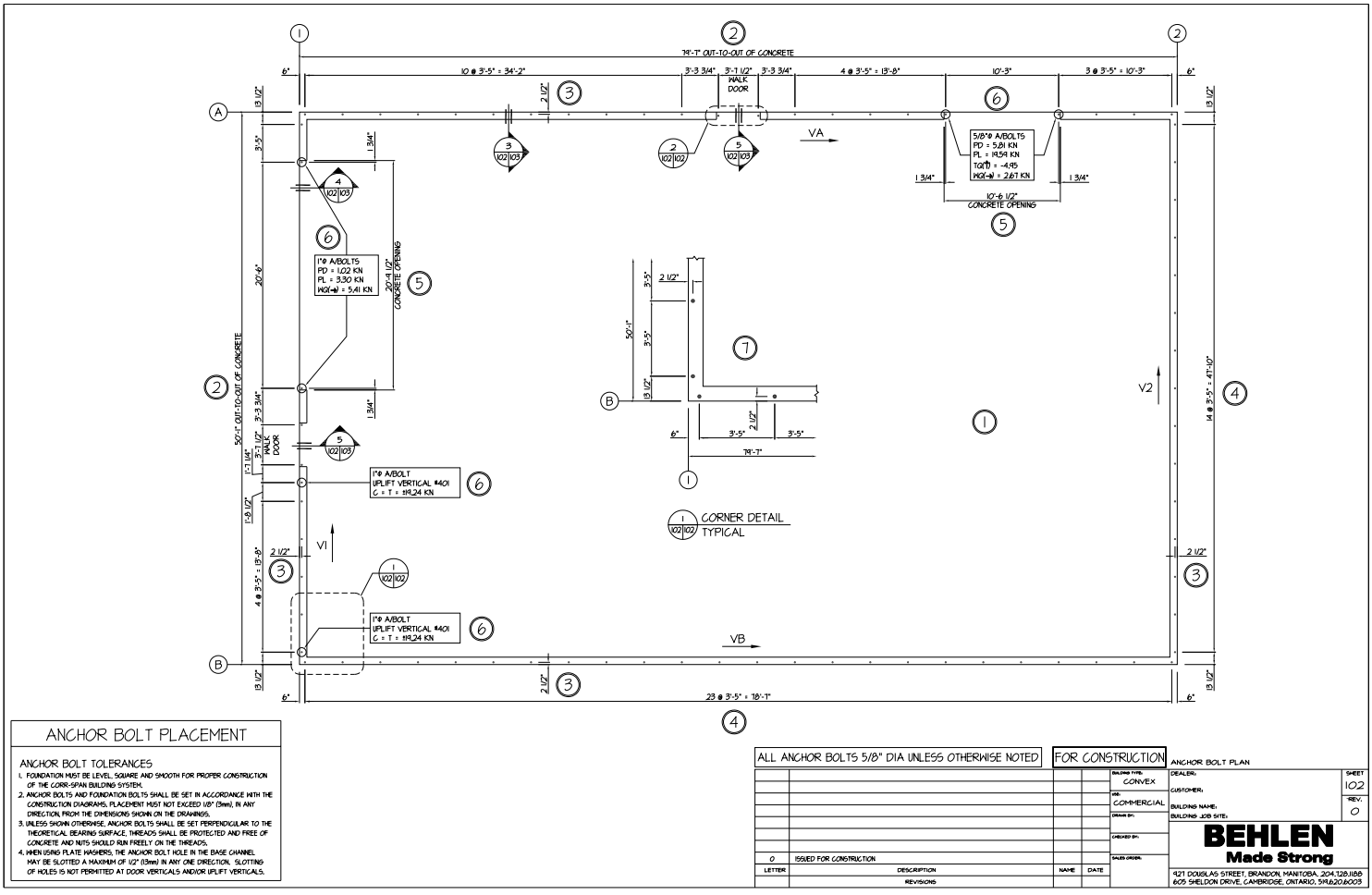


Illustration 1-3 Typical Anchor Bolt Plan

1 - CONSTRUCTION DRAWINGS

ANCHOR BOLT PLAN MAIN FEATURES

1. Anchor Bolt Placement Plan

This is the overall plan of the foundation, showing out-to-out of concrete dimensions, top of stemwall elevation (unless noted in individual details), the location of framed openings verticals and uplift verticals. **Consult the Building Elevations to determine the exact location of any walkdoor and/or window openings.**

NOTE: Foundation must be square and level and anchor bolts must be placed accurately in accordance with the Construction Drawings. The modular nature of the Frameless Building does not allow for imperfections in the concrete or anchor bolts.

---

2. "OUT-TO-OUT OF CONCRETE"

This is the overall dimension of the concrete. All gridlines represent the outside of concrete lines. For buildings using CS75 wall panels, this is also the building out-to-out of steel dimension, or the Steel Line. For buildings using CS45 wall panels, the Steel Line is 1/2" (12.7mm) from the concrete line. As such, the out-to-out of concrete dimension will be 1" larger than the out-to-out of steel dimension. Eave extensions will not be reflected in this dimension.

3. Anchor Bolt Offset Dimension

This is the critical distance between the concrete line and the centreline of the anchor bolts. Give special consideration to these dimensions. Inaccurate anchor bolt offset will force the wall panels out of plumb and prevent the panel seamlines from mating properly.

4. Anchor Bolt Spacings

These are the dimensions between the adjacent anchor bolts. The anchor bolt spacings are multiples of 41" (1041mm), which corresponds to the width of the Frameless panels. These dimensions must be maintained in order to keep the building plumb and square.

5. Framed Opening Locations

For buildings that include a stemwall, the concrete opening dimension at the framed opening is shown in reference to the nearest anchor bolt that is located at an increment of 41" (1041mm). Locations of anchor bolts for filler channels, to accommodate non-standard framed opening widths, may also be shown.

6. Concentrated Reactions

Concentrated or point loads reactions are shown at framed opening verticals and uplift verticals, as required. Anchor bolt diameter is specified at locations of concentrated reactions. Anchor bolt diameter at locations of concentrated loads may differ from the remainder of the building.

7. Corner Detail

The Corner Detail shows the spacing from the concrete line to the first anchor bolt. This critical dimension must be maintained in order to keep the building plumb and square. Additional details may be added, as required, to clarify the anchor bolt requirements.

1 - CONSTRUCTION DRAWINGS

ANCHOR BOLT DETAILS

The Anchor Bolt Details page provides information about the anchor bolts, base channel, and the loads that the building will impose upon the foundation. This information, combined with the concentrated reactions on the Anchor Bolt Plan, is vital for a proper foundation design.

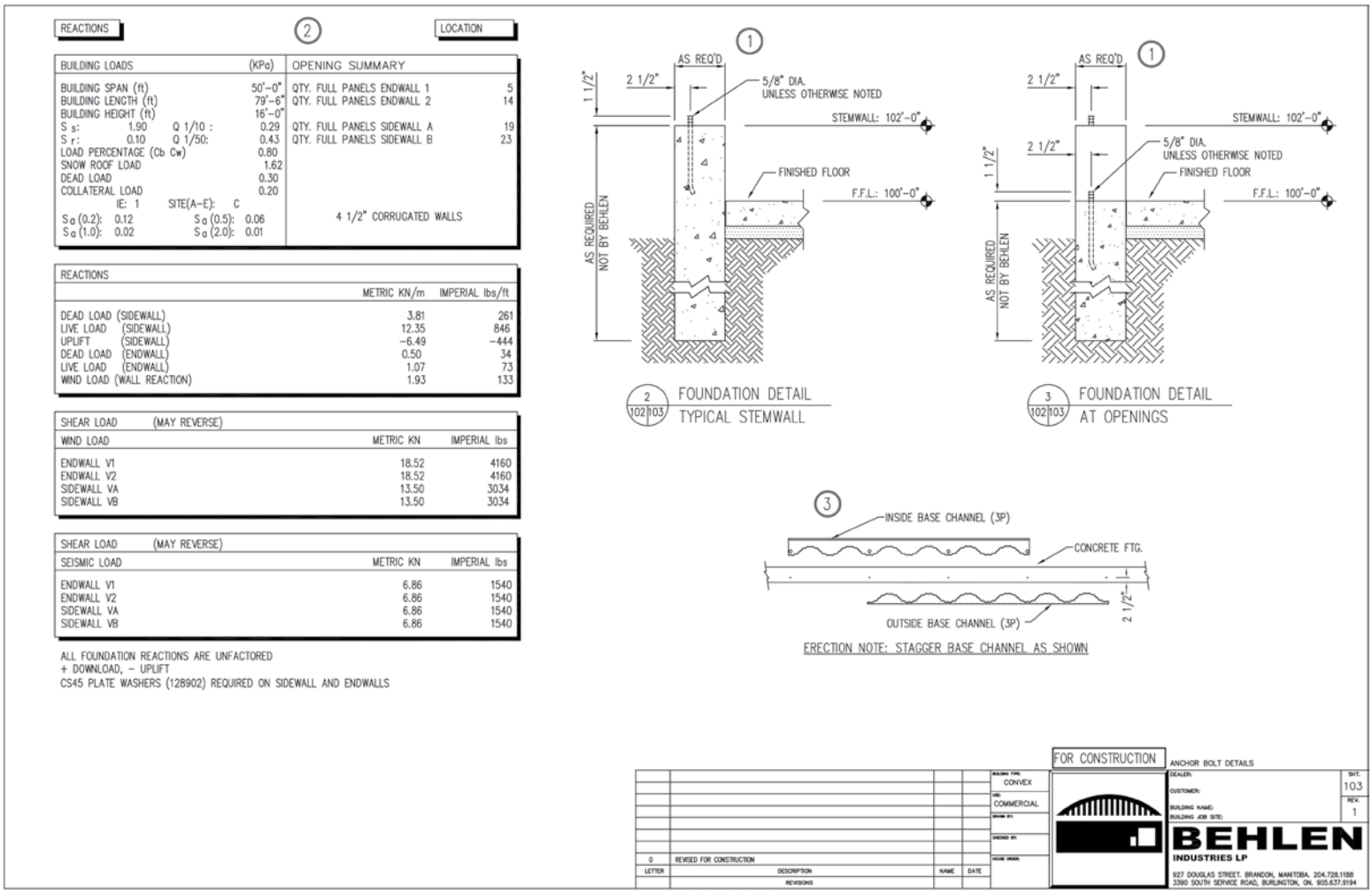


Illustration 1-4 Typical Anchor Bolt Details

ANCHOR BOLT PLAN MAIN FEATURES

1. Foundation Details

For buildings that include a stemwall, the top of the stemwall elevation (or underside of base channel) is specified for the typical wall section and at framed openings. The Anchor Bolt Offset Dimension is provided, as was specified on the Anchor Bolt Plan. The typical anchor bolt diameter is shown in these details. The anchor bolt projection above the top of concrete is also shown. **Note: Foundation details shown in the Construction Drawings are for reference only. BEHLEN Industries LP assumes no responsibility for the design of the foundation.**

1 - CONSTRUCTION DRAWINGS

2. Building Reactions

The first table summarizes the design loads for the building. The next set of tables list the gravity and wind load reactions, wind shear reactions and the siesmic shear reactions. This information is critical for a proper foundation design.

3. Walk Door Detail

This detail outlines the non-typical anchor bolt spacing and offsets required at single walk door framed openings.

BUILDING ELEVATION(S)

The Endwall Elevation(s) and/or Sidewall Elevation(s) show the height dimensions, framed opening dimensions, wall panels, and flashings/components for the respective walls of the building. These walls are identified by Grid number and as Endwall 1, Endwall 2, Sidewall A, Sidewall B. Building evelations are normally oriented looking at the building from the outside.

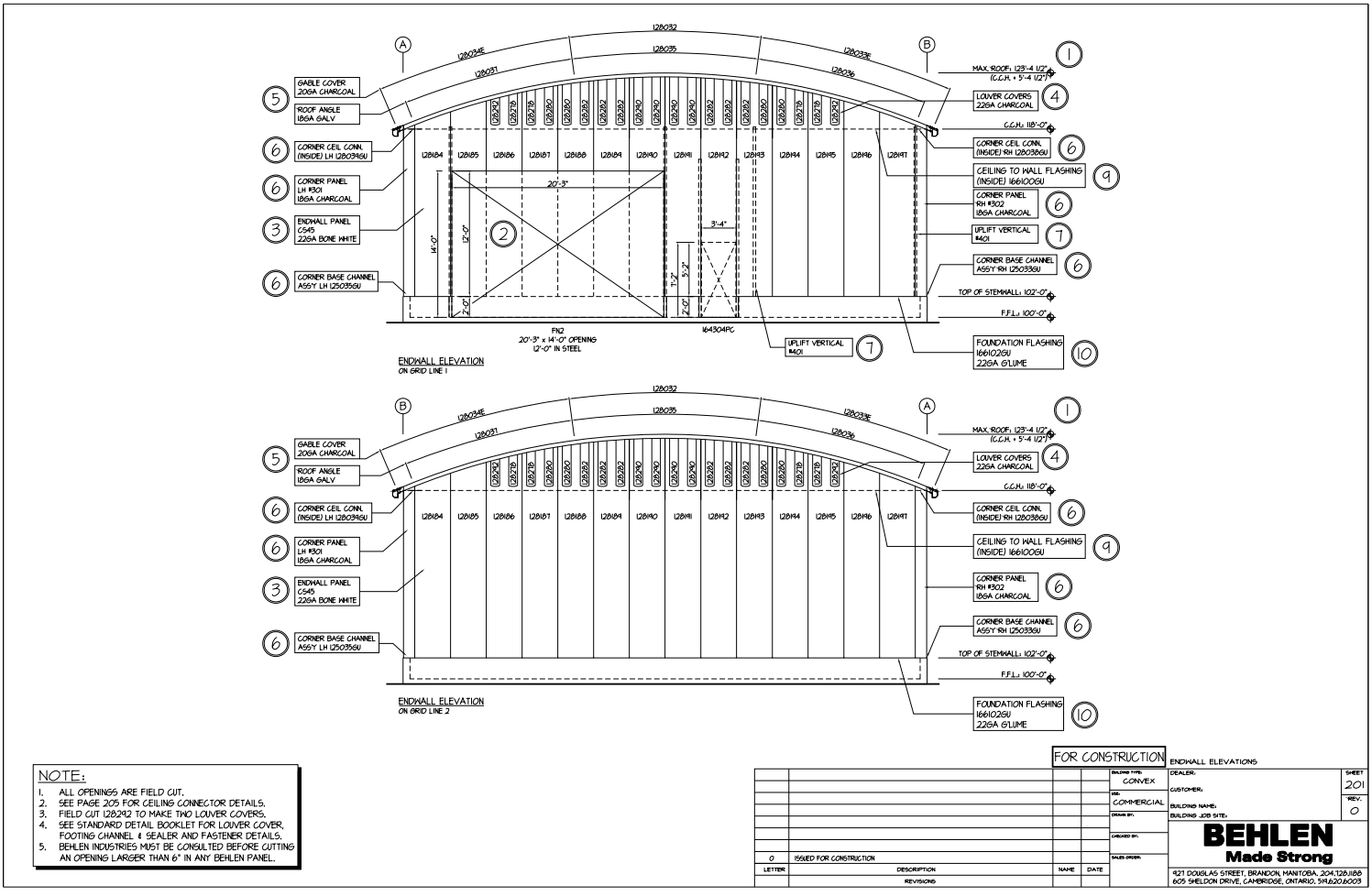


Illustration 1-5 Typical Endwall Elevation

1 - CONSTRUCTION DRAWINGS

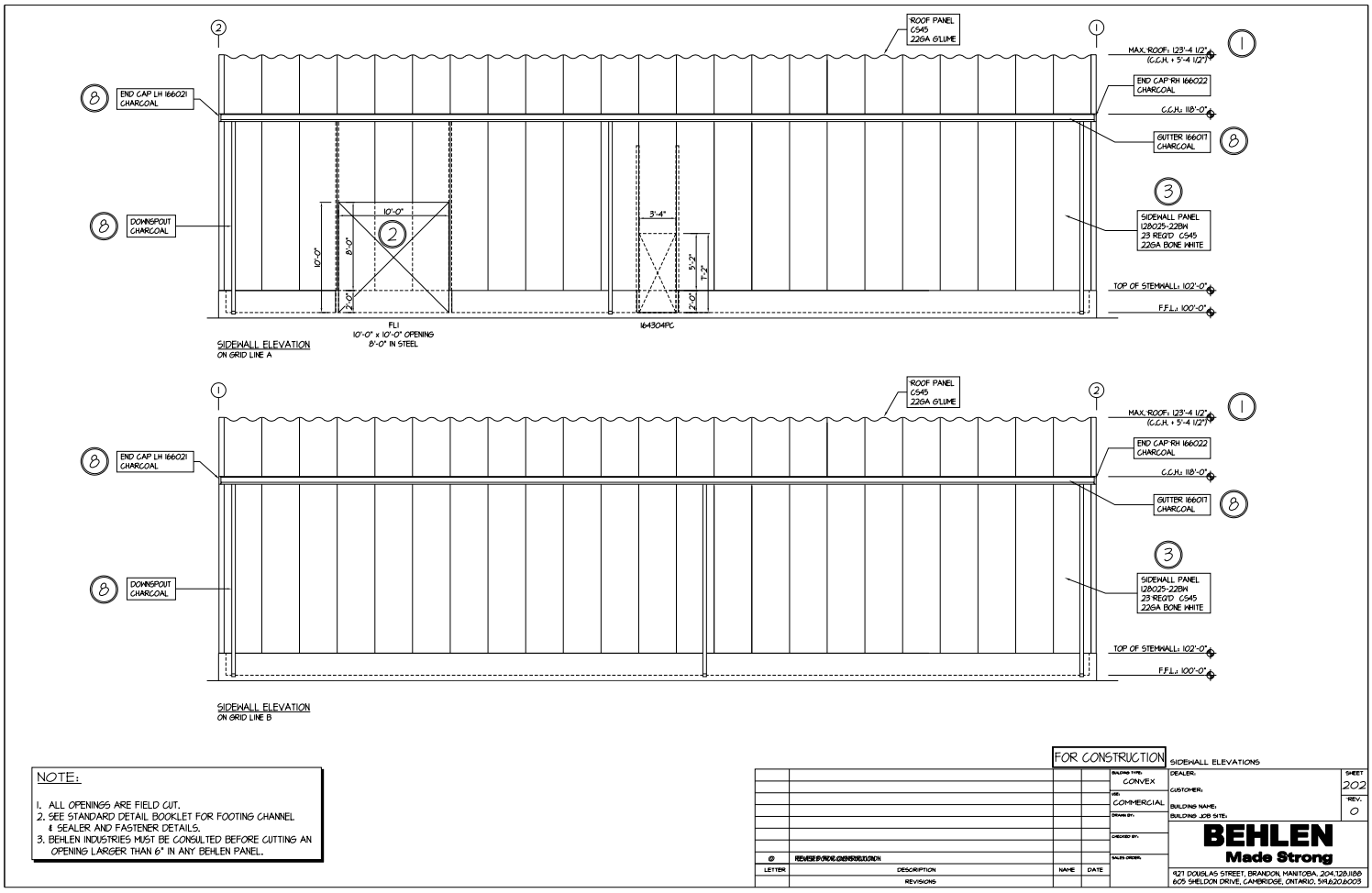


Illustration 1-6 Typical Sidewall Elevation

1. Height Dimensions

The top of the stemwall height, clear ceiling height (C.C.H.) and maximum roof height are measured from the finished floor elevation.

2. Framed Opening Dimensions

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. If the wall panels at the framed openings require field cutting, there is a note in the bottom left corner of the elevation drawing advising accordingly. A model number is provided for each framed opening. Refer to the Framed Opening Detail Drawings for framing and member details for each model.

NOTE: Standard framed openings widths are: 10’-0”, 13’-5”, 16’-10”, 20’-3”, 23’-8”, 27’-1”, 30’-6”. Non-standard framed opening widths are accommodated by the use of filler channels.

BEHLEN Industries LP must be consulted before cutting an opening larger than 6” in any BEHLEN Panel(s).

1 - CONSTRUCTION DRAWINGS

3. Wall Panels

Wall panel profile (CS45 or CS75), gauge and finish are specified. For sidewalls, the part number and quantity are also specified. For endwalls, the part number for each panel is shown on the drawing.

4. Louver Covers

Louver Cover gauge and finish are specified. Follow the part numbers and respective locations, as shown on the Construction Drawings. The shorter louver covers at the start and end of the endwalls will require field cutting one longer piece for use at two locations. This requirement will be noted in the louver cover detail and in the notes in the bottom left corner of the elevation drawing. When installing louver covers, it is important to maintain a minimum 2” gap between the top of the louver cover and the top of the endwall panel. This gap is critical in providing proper ventilation of the attic space.

5. Roof Angle & Gable Cover

Roof Angle & Gable Cover gauge, finish and part numbers are shown. Follow the part numbers and respective locations, as shown on the Construction Drawings.

6. Corner Components

Corner Panels, Corner Base Channels and Corner Ceiling Connectors are identified. The part numbers are specified. The gauge and finish are also specified for the Corner Panels.

7. Uplift Verticals

Uplift Verticals are shown where required by design. The Uplift Verticals are typically either channels or HSS sections. The part number is specified.

8. Gutter & Downspout Components

Gutter, Downspout, and End Caps are specified. The finish is specified for each part. Refer to the Gutter & Downspout Details in the Constructions Drawings for installation information.

1 - CONSTRUCTION DRAWINGS

ROOF & CEILING PLANS

The Roof Plan and Ceiling Plan show the panel gauges, panel splice information and opening information. Additional information regarding snow drift loads, auxiliary loads, etc, will be shown.

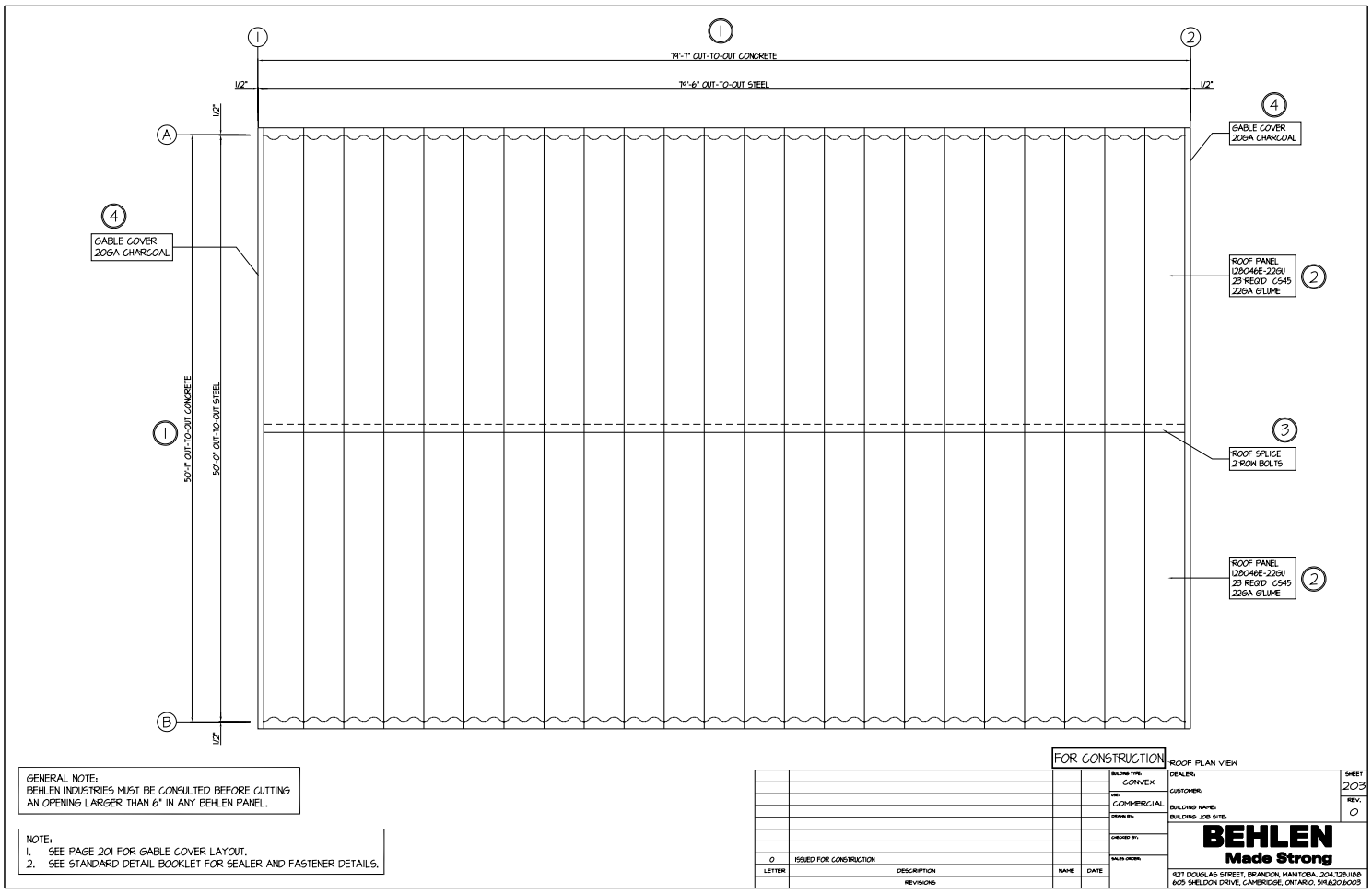


Illustration 1-7 Typical Roof Plan

1 - CONSTRUCTION DRAWINGS

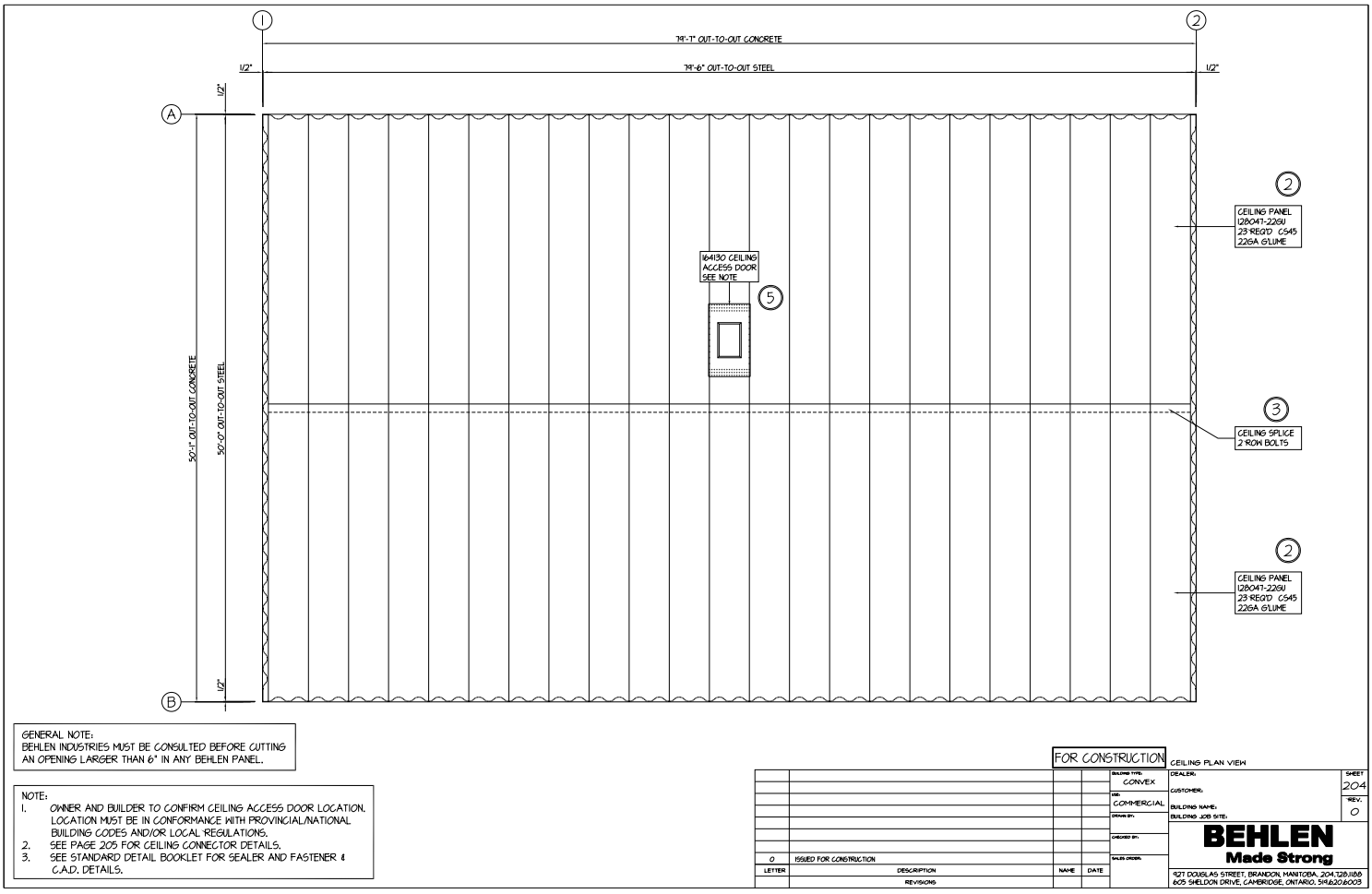


Illustration 1-8 Typical Ceiling Plan

1. Gridline Dimensions

These dimensions are the concrete dimensions. For CS75 this will also be the steel dimension. For CS45, the steel dimension will be 1" less than the concrete dimension shown.

2. Roof/Ceiling Panels

The panel profile, gauge and finish is specified. For Convex and Dubl Panl® buildings, the roof and ceiling panel profile will be CS45. For single panel buildings it may be CS45 or CS75. In some instances two gauges will be specified for the roof and/or ceiling. For these situations, it is critical to review the Construction Drawings to determine the correct panel sequence. If two gauges are shown, alternating for the building length, the first and last panel will always be of the heavier gauge. Areas requiring reinforcing for snow drift loads or auxiliary loads will be clearly shown in the Construction Drawings.

3. Panel Splice(s)

The location(s) of splices in the roof and ceiling panels are shown. The number of rows of bolts required for the splice also is shown. If the bolt grade specification, as required by design, is nonstandard, specific instructions on the required bolt grade and location required will be shown. It is imperative that the splices are constructed as shown in the Construction Drawings.

1 - CONSTRUCTION DRAWINGS

4. Gable Cover

Gable Cover gauge and finish are shown. Follow the part numbers and respective locations, as shown on the Building Elevation(s).

5. Ceiling Access Door(s)

The quantity of Ceiling Access Door(s) are shown. For Ceiling Access Door location guidelines, follow the installation instructions on the Ceiling Access Door Details in the Construction Drawings.

6. Miscellaneous Openings

Additional openings in the roof and ceiling panel will also be shown, as required by the customer.

NOTE: BEHLEN Industries LP must be consulted before cutting an opening larger than 6” in any BEHLEN panel.

1 - CONSTRUCTION DRAWINGS

CEILING CONNECTOR DETAIL(S)

The Ceiling Connector Detail(s) show the ceiling connector part numbers, quantities and locations for construction.

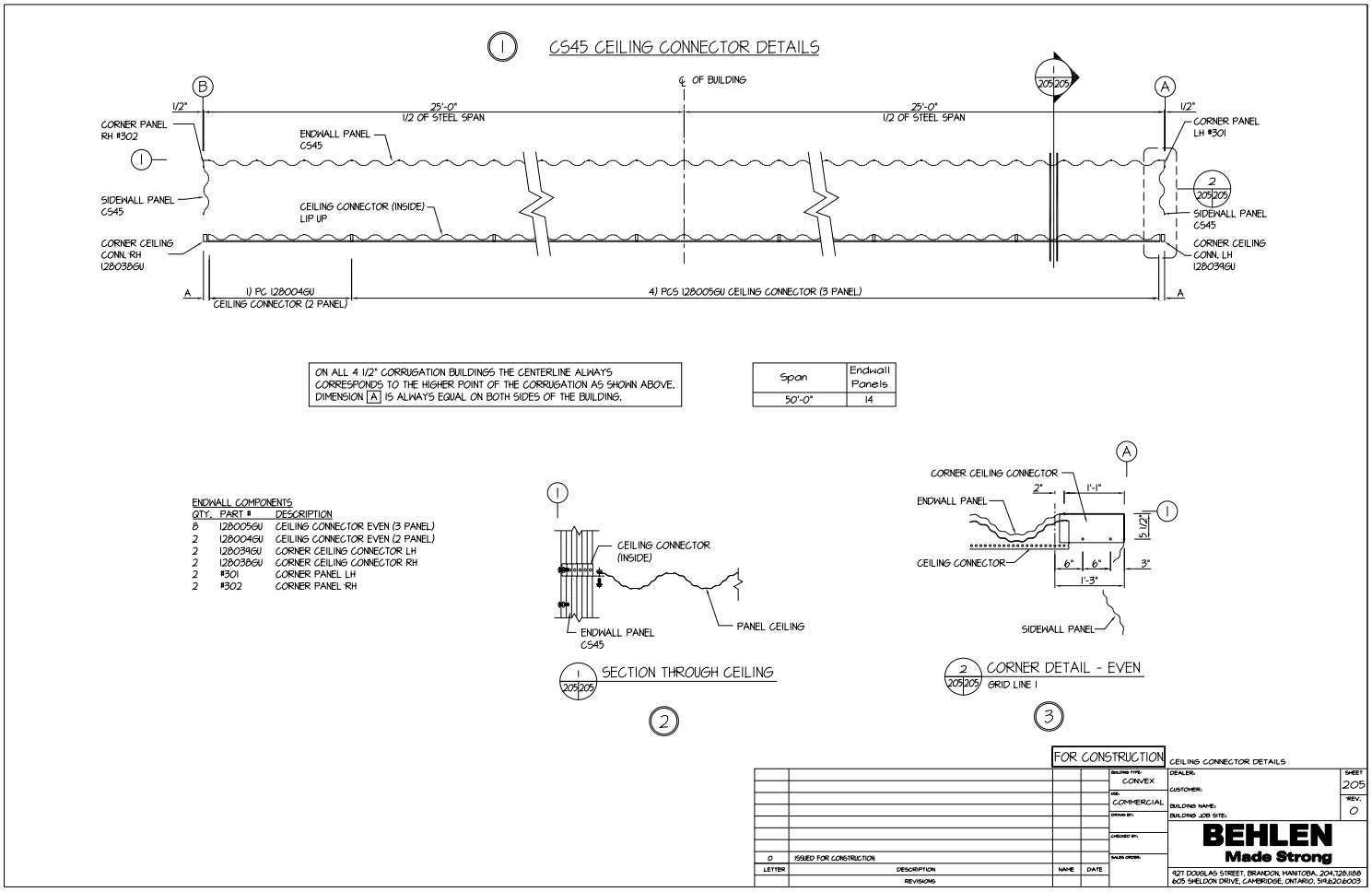


Illustration 1-14 Ceiling Connector Details

CEILING CONNECTOR MAIN FEATURES

1. Ceiling Connector Plan View

Connection of ceiling panel to endwall panel is shown. Follow the part numbers and respective locations, as shown on the Ceiling Connector Details page plan view.

2. Section Through Ceiling

Connection of ceiling panel to endwall panel is shown. Refer to the Sealer Application Drawings for sealer requirements at this connection.

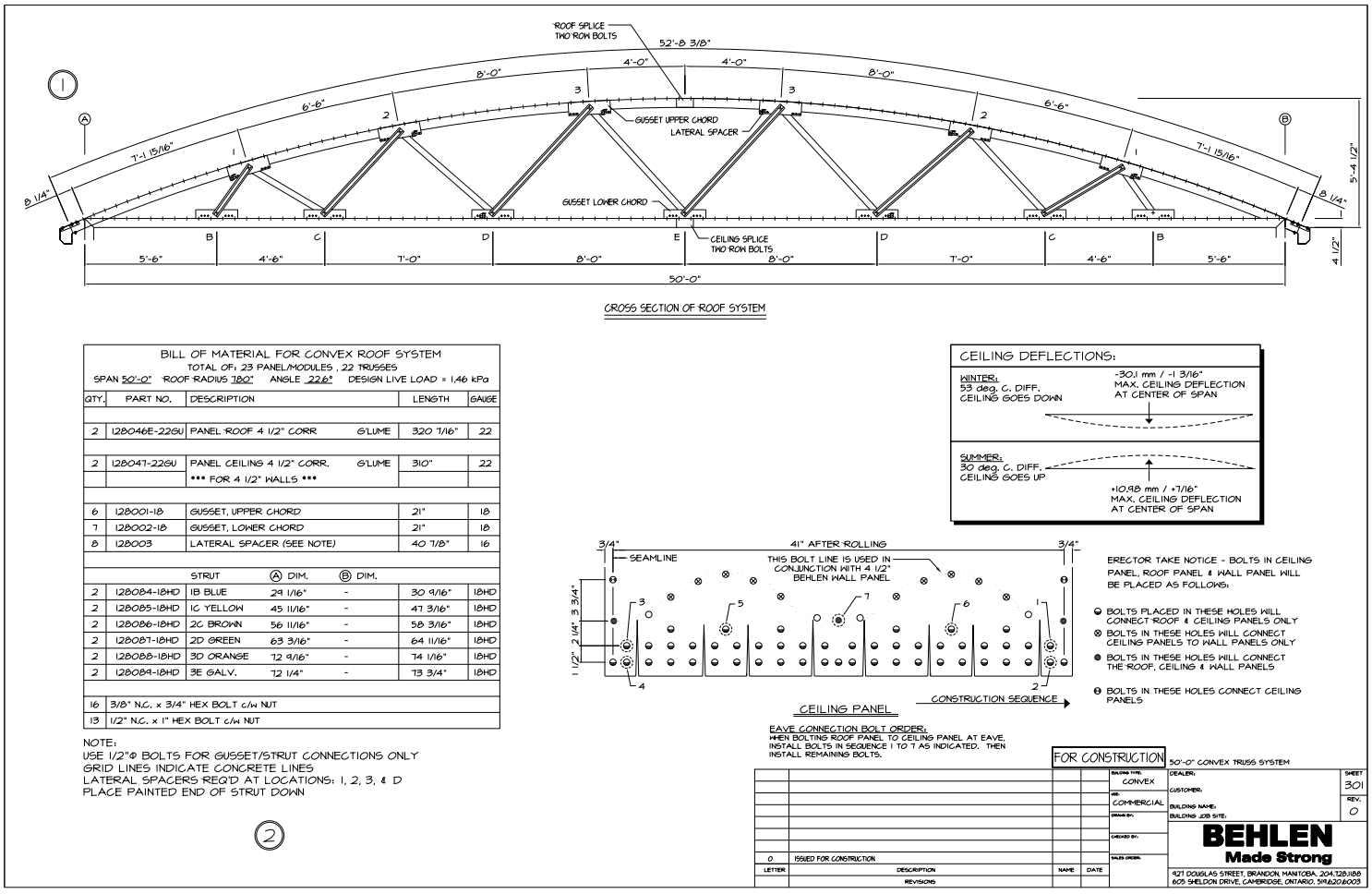
3. Corner Detail

Connection of corner ceiling connector is shown.

1 - CONSTRUCTION DRAWINGS

TRUSS DRAWING(S) & DETAILS

The Truss Drawing(s) show the truss components and their respective locations. Ceiling deflections and bolting patterns are also shown. Truss details are also provided to further illustrate the connection requirements.



BILL OF MATERIAL FOR CONVEX ROOF SYSTEM TOTAL OF: 23 PANEL/MODULES , 22 TRUSSES SPAN 50'-0" ROOF RADIUS 180" ANGLE 22.6° DESIGN LIVE LOAD = 1.46 kPa						
QTY.	PART NO.	DESCRIPTION			LENGTH	GAUGE
2	128046E-226U	PANEL ROOF 4 1/2" CORR		G'LUME	320 7/16"	22
2	128047-226U	PANEL CEILING 4 1/2" CORR.		G'LUME	310"	22
		*** FOR 4 1/2" WALLS ***				
6	128001-18	GUSSET, UPPER CHORD			21"	18
7	128002-18	GUSSET, LOWER CHORD			21"	18
8	128003	LATERAL SPACER (SEE NOTE)			40 7/8"	16
		STRUT	Ⓐ DIM.	Ⓑ DIM.		
2	128084-18HD	1B BLUE	29 1/16"	-	30 9/16"	18HD
2	128085-18HD	1C YELLOW	45 11/16"	-	47 3/16"	18HD
2	128086-18HD	2C BROWN	56 11/16"	-	58 3/16"	18HD
2	128087-18HD	2D GREEN	63 3/16"	-	64 11/16"	18HD
2	128088-18HD	3D ORANGE	72 9/16"	-	74 1/16"	18HD
2	128089-18HD	3E GALV.	72 1/4"	-	73 3/4"	18HD
16	3/8" N.C. x 3/4" HEX BOLT c/w NUT					
13	1/2" N.C. x 1" HEX BOLT c/w NUT					

NOTE:
USE 1/2"Φ BOLTS FOR GUSSET/STRUT CONNECTIONS ONLY
GRID LINES INDICATE CONCRETE LINES
LATERAL SPACERS REQ'D AT LOCATIONS: 1, 2, 3, & D
PLACE PAINTED END OF STRUT DOWN

Illustration 1-15 Truss Drawing

TRUSS DRAWING MAIN FEATURES

1. Truss Drawing

Upper and lower gusset spacing is shown with location nodes. Location nodes for the upper chord are numbers. Location nodes for the lower chord are letters. Follow the part numbers and respective node locations, as shown on the Truss drawing. Roof and Ceiling Panel splice information is specified. Locations for Lateral Spacers are also shown.

2. Truss Bill of Materials

Truss components are listed within this table. Strut to Gusset bolt requirements are specified. Follow the part numbers and respective node locations, as shown on the Truss Drawing.

1 - CONSTRUCTION DRAWINGS

FRAMED OPENING DETAILS

The Framed Opening Details show the frame components and their locations.

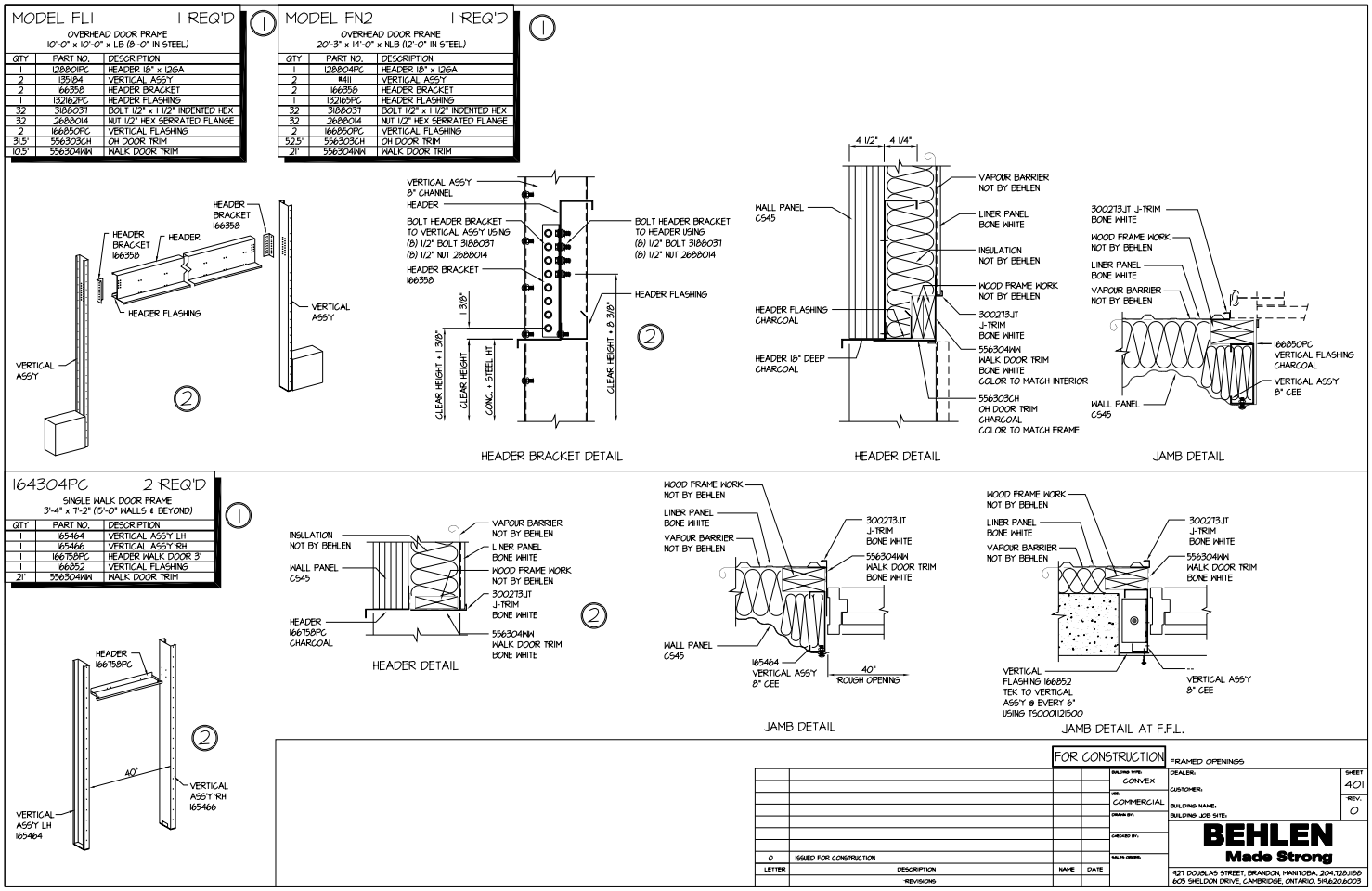


Illustration 1-17 Framed Opening Details

TRUSS DRAWING MAIN FEATURES

1. Frame Bill of Materials

Framed opening components are listed in table form. Included in the bill of materials is the framed opening model number, quantity, type of opening and framed opening size. Refer to the Building Elevation(s) for the opening locations, as labeled by the model number.

2. Isometric and Sections

Simplified isometric drawing of the main framed opening components is shown. A section of the header and vertical are shown calling off components listed in the frame bill of materials. Insulation and secondary wood support is shown for reference only and is not supplied by BEHLEN Industries LP. Actual finishing details are the responsibility of the erector and may differ from that shown.

NOTE: BEHLEN Industries LP must be consulted before cutting an opening larger than 6” in any BEHLEN panel.

1 - CONSTRUCTION DRAWINGS

LINER PLAN VIEW

The Liner Details show the location for the liner and flashings. Follow the part numbers and respective locations, as shown on the Liner Details in the Construction Drawings. Refer to the Standard Detail Pages for liner panel views, details, and sections showing component part locations with recommended sealer, fastener, and flashing details.

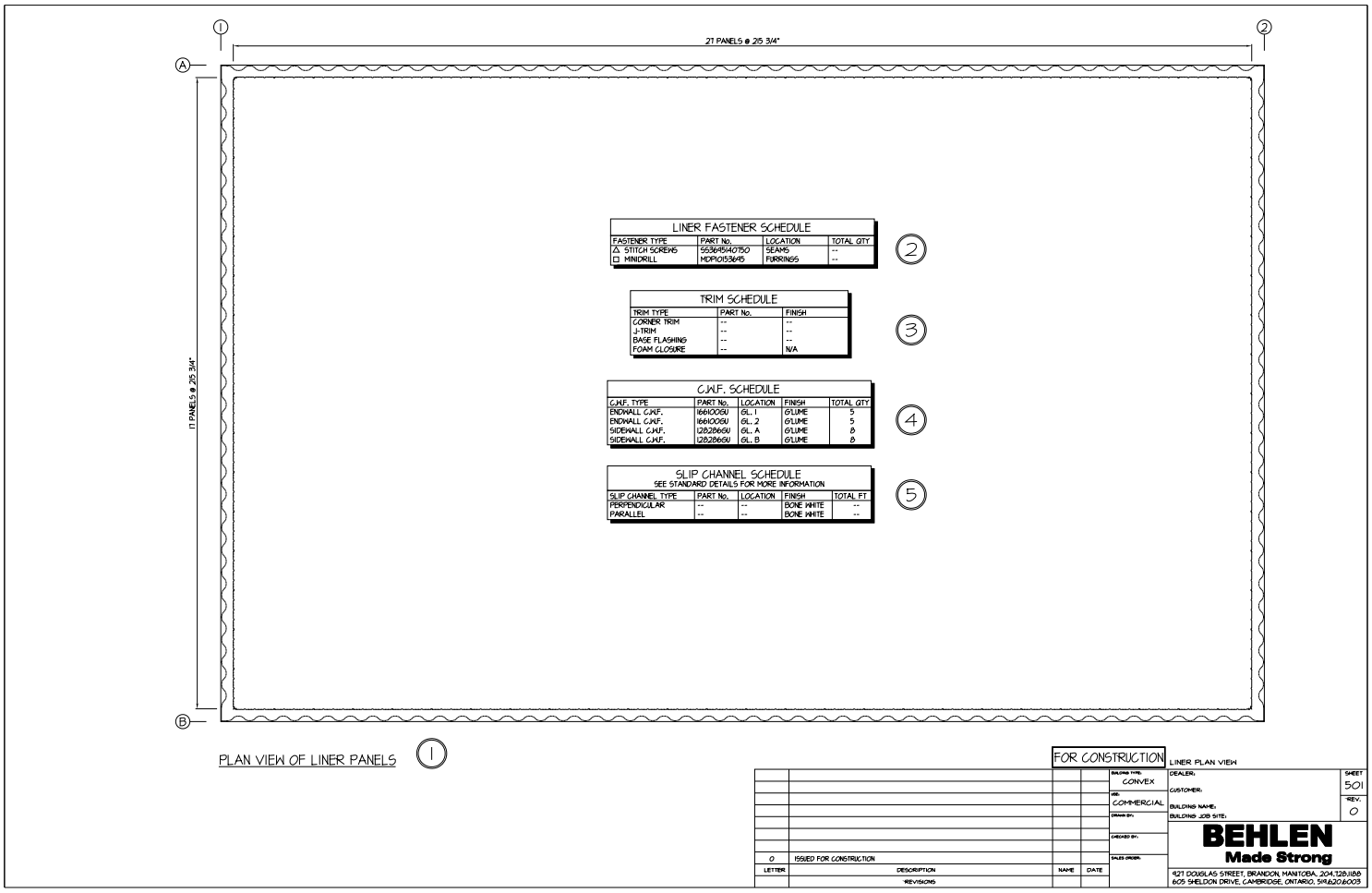


Illustration 1-21 Liner Plan View and Detail Drawing

1 - CONSTRUCTION DRAWINGS

LINER DRAWINGS MAIN FEATURES

1. Plan View of Liner Panels

Quantity and length of the liner panels are dimensioned on the simplified plan view drawing.

2. Liner Fastener Schedule

Liner fastener type, part number, location used and total quantity provided, listed in table form.

3. Trim Schedule

Liner trim and closure type, part number and finish listed in table form.

4. Ceiling to Wall Flashing (C.W.F.) and Slip Channel Schedules (when included in the building package)

Part type, part number, location, finish and quantity provided, listed in table form. Refer to the standard detail pages for installation, sealer and fastener details.

1 - CONSTRUCTION DRAWINGS

ADDITIONAL DRAWINGS

Additional drawings will be supplied if necessary, and are located in the Drawing Package as required. Canopy Details, Partition Wall Elevations, etc. may be included if these items are included in the contract and supplied by BEHLEN Industries LP. The general format of these drawings will be similar to the typical drawings discussed above.

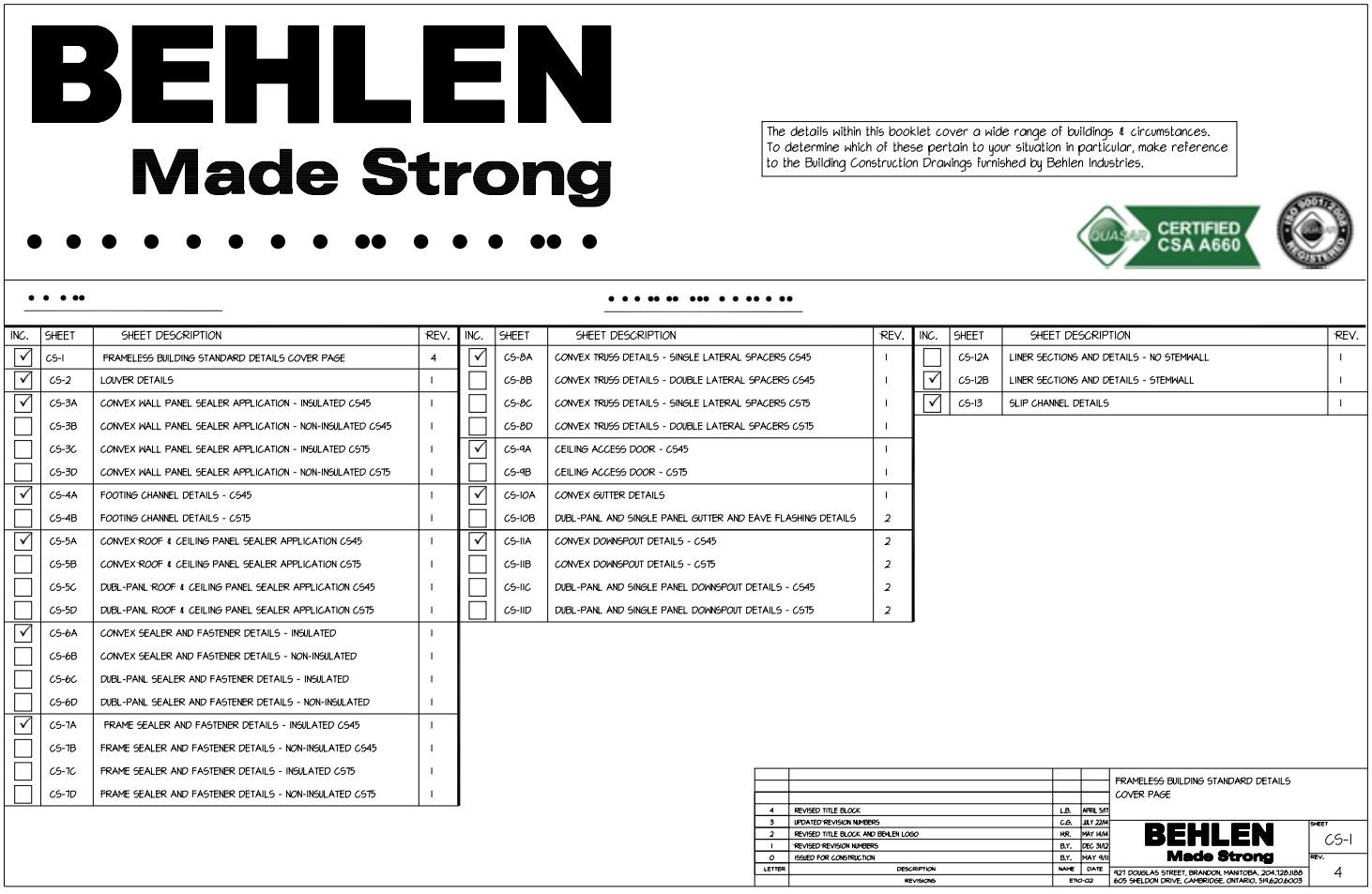
CHECK THE DRAWING REVISIONS!

Always check the Construction 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 APPROVAL"

STANDARD DETAIL PAGES

Most Construction Drawing Packages include Standard Detail Pages. These drawings show the Standard Details that apply to the type of building supplied. The Details are arranged on pages that address the various areas of the building. The building type (Convex, Dubl Panl®, Single Panel), wall panel profile, building accessories, etc. determine which Standard Detail Pages apply to the building. Each page contains details which show the standard method of making the various connections based on common building options. The general format of these drawings will be similar to the typical



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The details within this booklet cover a wide range of buildings & circumstances. To determine which of these pertain to your situation in particular, make reference to the Building Construction Drawings furnished by Behlen Industries.

QUASAR CERTIFIED CSA A660

ISO 9001:2008 REGISTERED

INC.	SHEET	SHEET DESCRIPTION	REV.
☑	CS-1	FRAMELESS BUILDING STANDARD DETAILS COVER PAGE	4
☑	CS-2	LOUVER DETAILS	1
☑	CS-3A	CONVEX WALL PANEL SEALER APPLICATION - INSULATED CS45	1
☐	CS-3B	CONVEX WALL PANEL SEALER APPLICATION - NON-INSULATED CS45	1
☐	CS-3C	CONVEX WALL PANEL SEALER APPLICATION - INSULATED CS75	1
☐	CS-3D	CONVEX WALL PANEL SEALER APPLICATION - NON-INSULATED CS75	1
☑	CS-4A	FOOTING CHANNEL DETAILS - CS45	1
☐	CS-4B	FOOTING CHANNEL DETAILS - CS75	1
☑	CS-5A	CONVEX ROOF & CEILING PANEL SEALER APPLICATION CS45	1
☐	CS-5B	CONVEX ROOF & CEILING PANEL SEALER APPLICATION CS75	1
☐	CS-5C	DUBL-PANL ROOF & CEILING PANEL SEALER APPLICATION CS45	1
☐	CS-5D	DUBL-PANL ROOF & CEILING PANEL SEALER APPLICATION CS75	1
☑	CS-6A	CONVEX SEALER AND FASTENER DETAILS - INSULATED	1
☐	CS-6B	CONVEX SEALER AND FASTENER DETAILS - NON-INSULATED	1
☐	CS-6C	DUBL-PANL SEALER AND FASTENER DETAILS - INSULATED	1
☐	CS-6D	DUBL-PANL SEALER AND FASTENER DETAILS - NON-INSULATED	1
☑	CS-7A	FRAME SEALER AND FASTENER DETAILS - INSULATED CS45	1
☐	CS-7B	FRAME SEALER AND FASTENER DETAILS - NON-INSULATED CS45	1
☐	CS-7C	FRAME SEALER AND FASTENER DETAILS - INSULATED CS75	1
☐	CS-7D	FRAME SEALER AND FASTENER DETAILS - NON-INSULATED CS75	1

INC.	SHEET	SHEET DESCRIPTION	REV.
☑	CS-8A	CONVEX TRUSS DETAILS - SINGLE LATERAL SPACERS CS45	1
☐	CS-8B	CONVEX TRUSS DETAILS - DOUBLE LATERAL SPACERS CS45	1
☐	CS-8C	CONVEX TRUSS DETAILS - SINGLE LATERAL SPACERS CS75	1
☐	CS-8D	CONVEX TRUSS DETAILS - DOUBLE LATERAL SPACERS CS75	1
☑	CS-9A	CEILING ACCESS DOOR - CS45	1
☐	CS-9B	CEILING ACCESS DOOR - CS75	1
☑	CS-10A	CONVEX GUTTER DETAILS	1
☐	CS-10B	DUBL-PANL AND SINGLE PANEL GUTTER AND EAVE FLASHING DETAILS	2
☑	CS-11A	CONVEX DOWNSPOUT DETAILS - CS45	2
☐	CS-11B	CONVEX DOWNSPOUT DETAILS - CS75	2
☐	CS-11C	DUBL-PANL AND SINGLE PANEL DOWNSPOUT DETAILS - CS45	2
☐	CS-11D	DUBL-PANL AND SINGLE PANEL DOWNSPOUT DETAILS - CS75	2

INC.	SHEET	SHEET DESCRIPTION	REV.
☐	CS-12A	LINER SECTIONS AND DETAILS - NO STEMWALL	1
☑	CS-12B	LINER SECTIONS AND DETAILS - STEMWALL	1
☑	CS-13	SLIP CHANNEL DETAILS	1

LETTER	DESCRIPTION	NAME	DATE
4	REVISED TITLE BLOCK	L.B.	APRIL 5/11
3	UPDATED REVISION NUMBERS	G.B.	JULY 22/04
2	REVISED TITLE BLOCK AND BEHLEN LOGO	H.R.	MAY 14/04
1	REVISED REVISION NUMBERS	B.Y.	DEC 31/02
0	ISSUED FOR CONSTRUCTION	B.Y.	MAY 9/01
	REVISIONS	ETHO-02	

FRAMELESS BUILDING STANDARD DETAILS
COVER PAGE

BEHLEN Made Strong

SHEET CS-1 REV. 4

427 DOUGLAS STREET, BRANDON, MANITOBA, 204.728.1165
605 SHELDON DRIVE, CAMBRIDGE, ONTARIO, 519.620.6003

1 - CONSTRUCTION DRAWINGS

drawings discussed above.
This page provides a list of the various Standard Detail Pages available and the revision level of each. The pages or sections which have been supplied for the building are indicated by the appropriate check box(es). 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.

SEALER DETAIL PAGES

In all cases when sealer is applied along the seamlines of the panels, it is to be located on the weather side of the hole. The paper can be temporarily left on the sealer to prevent dirt and debris from sticking to it. The paper on the sealer must be removed before the parts are installed.

Sealer application is shown in relation to the construction sequence displayed. Actual location of sealer is to be determined by the erector based on the construction and/or lap sequence for the specific project.

Correct sealer application is a critical component in establishing the vapour barrier membrane of the FRAMELESS building. Review the Construction Drawings to determine the sealer requirements. Additional sealer or caulking shall be applied, where required, to ensure a proper seal is maintained at all locations. Roof and ceiling panel end lap splices are one such location where additional sealer is required. Deficiencies in the vapour barrier membrane can lead to condensation problems within the attic space.

Wall sealer application will differ for insulated and non-insulated buildings.

2 - PACKING LISTS

Construction Drawing Packages that are sent to site with the building include a Packing List. All of the parts that are supplied as part of the building package will be listed in the Packing List. The Packing List is set up such that each page refers to a specific component group. There is a description of the component group at the top of the page. The typical Packing List contains the following component groups:

- Roof System
- Wall Panels
- Components
- Nuts, Bolts, Sealer
- Framed Opening Components (one page per framed opening model number)
- Gutters & Downspouts
- Miscellaneous Components
- Liner Package

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Detailer: Checker: **22-Aug-17**

PACKING LIST		**DEALER:**				**Sales Order**	
Page 1 of 1	MODEL **RS**	**1**	**DESCRIPTION:**	**50'-0" CX ROOF SYSTEM**			
QTY	**PART NO.**	**CODE**	**PART DESCRIPTION**				**COLOR #**
47	128046E-22**GU**	P	Panel Roof Extended	**1 Extra**		**22GA G'LUME**	
47	128047-22**GU**	P	Panel Ceiling 50'	**1 Extra**		**22GA G'LUME**	**PWPC**
44	128084-18**HD**	P	STRUT HD 30 9/16"	BLUE	1B		**18HD**
44	128085-18**HD**	P	STRUT HD 47 3/16"	YELLOW	1C		**18HD**
44	128086-18**HD**	P	STRUT HD 58 3/16"	BROWN	2C		**18HD**
44	128087-18**HD**	P	STRUT HD 64 11/16"	GREEN	2D		**18HD**
44	128088-18**HD**	P	STRUT HD 74 1/8"	ORANGE	3D		**18HD**
50	128089-18**HD**	P	STRUT HD 73 3/4"	GALV	**6 Extra** 3E		**18HD**
150	128001-18	A	Gusset Upper Chord 2	**6 Extra**			
175	128002-18	A	Gusset Lower Chord 2	**7 Extra**			
192	128003	A	Lateral Spacer	**8 Extra**			

Illustration 2-1 Typical Packing List - Roof System Component Group

2 - PACKING LISTS

PACKING LIST PAGE MAIN FEATURES

1. Packing List Description

This outlines the component group for the respective page of the Packing List.

2. Quantity

The quantity shown is the quantity for the particular part number that is required for the respective component group. In cases where the part is used in more than one component group, only the quantity required for the respective component group will be shown. For example, when framed openings are assigned different model numbers but have the same vertical part number, the part number is shown on each of the framed opening model Packing Lists, but only the quantity required for that particular framed opening model is shown.

3. Part Number

Part numbers are used as component identifiers. Part Numbers are listed for each item within the component group. Part Numbers correspond to that shown on the Construction Drawings. Refer to the Construction Drawings for the specific application of each part.

4. Part Description

Part Descriptions are used to give a brief description of the component. Gauge, color, length or other identifiers, as applicable, may also be included in the Part Description. On occasion, the Part Description in the Packing List may not exactly match description on the Construction Drawings. This occurs when standard components are used in a “non-typical” application. For example, the standard part number 128286 will have a Part Description of “Flashing Ceiling-Wall No Holes” on the Packing List, but could be specified on the Construction Drawings as “Eave Flashing” due to its function on the building. The part number will be specified the same in both locations.

For special cases, such as remote access projects, export projects, or where specifically required in the contract, extra building components are supplied. The part description will identify how many extra components have been supplied. For example, in Illustration 2.1 above, part number “128046-22GU” has a Part Description of “PANEL ROOF 50’ 1 Extra”, which implies 1 extra piece is supplied.

3 - ERECTION PLAN

A very early plan for erection is important. It should be as early as bidding the project. At the very least, a plan should be in place before you take delivery of your building. This plan will help you in unloading your building so that minimal amount of work is needed for labour and erection time of your Frameless Building.

Things to consider when making your Erection Plan:

1. Condition of the foundation floor and job site
The condition of the floor inside your Frameless building and the condition of the ground around your project are very important to your plan. You should take into consideration how much space is available to you for maneuvering during construction.

2. The reach and capacity of your crane
This tells you the area where the crane will be working and where to stage material.

3. Decide which end you will start erecting the building
This will tell you where to stage your material. You should start so your building is blocking any prevailing wind.

4. Your equipment
Will you be using a forklift? If not, decide how far away your panels can be staged.

5. Seasonal weather conditions are also important for staging material
Heavy rains, high winds, and even strong sunshine can all play a part in staging material properly. If you will require snow removal during your erection time, plan to stage your material accordingly.

6. Amount of labour available
The number of people on your crew will dictate the amount of equipment that will be needed for unloading the trucks upon arrival and for erection of the building.

7. Other sub-contractors working on the same location should be considered in your plans.

4 - EQUIPMENT AND SPECIALIZED TOOLS

There is quite a variety of tools and equipment that can be used for erection.

EQUIPMENT:

1. A crane is the most common equipment for raising the building components. Also can be used for unloading the trucks. (See Photo 4-1)

Photo 4-1

2. A forklift can be used for moving material to and from a staging area and can also be used to unload the trucks. (See Photo 4-2)

Photo 4-2

3. A scissor lift can be used outside or inside the building. This can be used for wall panel work, fall protection, or interior work. (See Photo 4-3)

Photo 4-3

4 - EQUIPMENT AND SPECIALIZED TOOLS

4. Running gear for the scaffold is appropriate when there is rough terrain on the jobsite. (See Photo 4-4)

Photo 4-4

5. Occassionally a roof ladder will be needed. The roof of a Frameless building is not particularly steep. It can be navigated easily when it is clean and dry. When it is not, something similar to the roof ladder shown here (Photo 4-5) simply made of rope and boards or as elaborate as parachute strap, will be needed. (See Photo 4-6)

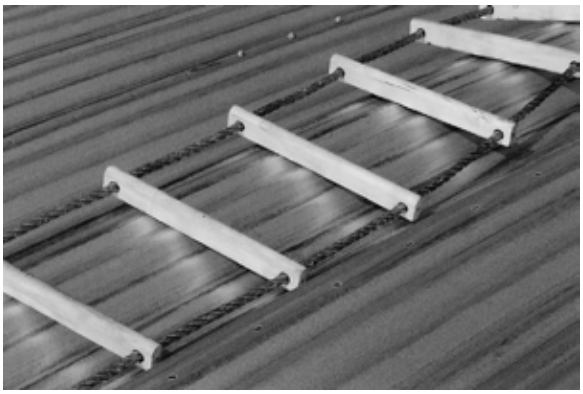

Photo 4-5

Photo 4-6

6. A scaffold system which will support the building system and be mobile. (See Photo 4-7)

Photo 4-7

4 - EQUIPMENT AND SPECIALIZED TOOLS

7. Lifting cables for wall, ceiling, and roof panels. (See Photo 4-8)

Photo 4-8

8. Spreader bar for raising pre-built trusses. (See Photo 4-9)

Photo 4-9

9. Heavy lifting rig for unloading panels from the trucks. (Optional) (See Photo 4-10)

Photo 4-10

4 - EQUIPMENT AND SPECIALIZED TOOLS

TOOLS:

Some of these tools may only be necessary to save time or improve the final product. Other tools may be necessary for unique jobs and special projects.

- 1/2” drive electric or battery impacts for installing bolts and 1/4” drive for self-drilling screws.
- #4 Phillips tips to adapt to impacts.
- Aligning pins, also called drift punches. (see Photo 4-11)
- Tools for cutting panels. Such as sawzall, L-Head grinder, hand held cut-off saw (12” or 14”), or a plasma cutter if available.
- Tapered Uni-bits for opening clean holes.
- 1/2” drive sockets.(Impact grade) 9/16” , 3/4”, 15/16”, 1-1/8”, 11/16”. These will have to be in the deep-well variety also.
- 1/2” drive-6” extensions. (Impact quality)
- Electric chords for corded tools.
- 14 ga. Electric shear.
- Electric or battery drills.
- C-clamp vise grips with pads. (11R in the vise-grip brand)
- 2-lb. Ball-pean hammer.
- Claw hammer (20 oz.).
- 100’ tape measure-steel.
- Tin snips. Right and Left hand off-set. Right and Left hand regular cut.
- Nylon rope. (5/8” diameter)
- 5/16” braided wire cable. Cable clamps for the same.
- Small chain approximately 1/4” diameter.(for lifting rigs)
- 25’ tape measures.
- Step ladders.
- Extension ladders.
- Wrenches (9/16”, 3/4”, 15/16”, 1-1/8”, 11/16” open and closed end)
- 1/2” drive ratchet.
- Cable come-alongs.
- Heavy duty ratchet straps.

Photo 4-11

4 - EQUIPMENT AND SPECIALIZED TOOLS

- Markers and carpenters pencils
- Set of taps with T-handle
- Drill bits of various sizes
- Large plumb-bob/magnet
- Speed-square
- 4’ level
- Universal joint of impact quality. (1/2” drive)
- Small pliers
- Push brooms
- Roll of tie-wire
- Safety glasses and hand cleaner
- Apron or bolt bags
- Nut setters for battery drill. (5/16”, 1/4”, and 3/8”)
- Caulking guns
- Surveyors level

5 - UNLOADING TRUCKS

Now that you have a plan in place, you need to start preparing to unload the trucks from BEHLEN.

First Steps:

Photo 5-1

- Make arrangements with BEHLEN so your crew and equipment are ready the day the trucks are scheduled to arrive.
- Ensure you have the right equipment available for unloading your building.
- One option for unloading panels is a lifting cradle available for purchase from BEHLEN. This will unload bundles of panels of any size, making it easy to accommodate the weight capacity of your equipment. The lifting cradle can lift as much as 5 tons or as little as 5 panels. (See Photo 5-1)
- As you are unloading, check for any discrepancies or shortages / damages and report to your CSR within 48 hours.

Unloading the Bundles:

Photo 5-2

- BEHLEN loads the trucks with panel bundles staggered at the ends. This makes them easier to pick up.
- Simply use a strap around the end that is staggered in order to lift the bundle just enough to EVENLY place wood blocks under the bundle. These bundles are very modest in weight, they net a maximum weight of 5,000lb lifts. Even a small fork lift can handle the weight. (See Photo 5-2)
- If necessary, wire tie the panels within the bundle together prior to unloading to prevent panels from sliding and/or falling while unloading.

IMPORTANT: When unloading long panels take care to lift them properly to avoid buckling the panels. Longer panels require the use of equipment that can use wider picking or lifting attachments, such as the spreader bar style. A forklift can be used on short panels.

Deciding Where to Place the Unloaded Panels and Other Miscellaneous Parts:

- There are many factors that go into deciding where to unload the material. The best method of staging the material is placing it so that it doesn't have to be moved until you install it.
- If you don't have a lot of room on your job site, you can:
  - Place the material on the building platform. For this option it needs to be placed so that it is used up by the time you reach that area.
  - Place it a long way from the building platform so that it is out of the way. The greater distance from your work area means it will be out of the way, but you will need a forklift to bring your material closer as you erect.
- Place the miscellaneous items such as bolts, nuts, sealer and trim material where they will be in a secure location but conveniently accessible during erection. A good location for these items that you would like inside the building during erection is directly under your scaffold. Doing so will put these items inside the structure once you move your scaffold system the first time.

5 - UNLOADING TRUCKS

Protecting the Panels and Storage Information:

All the materials need to be protected from the sun, wind and moisture. The best way to accomplish this is to store them inside another structure. When storing stuff outside, every effort must be made to protect them without creating or trapping moisture. When covering to protect from the environment, care must be taken not to disrupt air flow that will keep materials dry.

- Form blocks should be used to keep the panels from flattening when stacked together. These blocks are available from BEHLEN and should be spaced no further apart than 8’ and no further than 4’ from the end of the stack. Form blocks must be aligned directly above and below each other from the top to the bottom of the stack to keep panels from deforming. (See Photo 5-3 and 5-4)

- Flipping the panels over when unloading will place them in the position needed for construction, saving the ground crew from having to flip them individually when needed. To flip the stack when unloading, use the “choker” method. By choking the lift to one side the stack will be on edge as it is unloaded and can be correctly oriented on the ground. This will also aid in draining the oil on the panels which will make them safer to work on when constructing the roof system.

- Curved panels will also be better protected from moisture if stored with the centre of the panel bowed upwards.

- Flat panel stacks should always be sloped to drain any moisture accumulation from the panels.

Photo 5-3

Photo 5-4

5 - UNLOADING TRUCKS

Proper Care for Painted Panels:

When you have painted panels with paper between them or panels with plastic adhered to them you must take extra precautions.

- If there is a chance of rain, the paper should be removed immediately. The moisture will remain in the paper and ruin the integrity of the panel finish.
- Panels protected by plastic only require that the plastic be removed from the top panel that it is exposed to sun. Many days exposed to the sun will make it very difficult to remove the plastic.

6 - PRE-ERECTION PREPARATION

The idea of pre-erection preparation is to complete as much of the building as possible without the expense of the equipment and manpower that it takes for the actual erection procedure. This will save you time and money. Completing the following steps on the ground will make it much quicker and easier for erection later.

1. Ensure all tools are checked and are ready for use. (see Section 4 - Equipment and Specialized Tools for a list of recommended tools).

2. Crew should be briefed on their positions in advance of starting. A safety meeting informing them of any possible dangers should also be held before proceeding.

3. Check the concrete for level and square conditions. This will also include checking the anchor bolts for correct increments and straight line condition. Anchor bolt locations, diameter and projection should be checked against the BEHLEN construction drawings supplied with the load. The design of the building does not allow for imperfections in the concrete or anchor bolts. See Table 6-1 for the measurements to check the anchor bolts.

No.	Length	No.	Length	No.	Length	No.	Length	No.	Length	No.	Length
1	3'-5"	18	61'-6"	35	119'-2"	52	177'-8"	69	235'-9"	86	293'-10"
2	6'-10"	19	64'-11"	36	123'-0"	53	181'-1"	70	239'-2"	87	297'-3"
3	10'-3"	20	68'-4"	37	126'-5"	54	184'-6"	71	242'-7"	88	300'-8"
4	13'-8"	21	71'-9"	38	129'-10"	55	187'-11"	72	246'-0"	89	304'-1"
5	17'-1"	22	75'-2"	39	133'-3"	56	191'-4"	73	249'-5"	90	307'-6"
6	20'-6"	23	78'-7"	40	136'-8"	57	194'-9"	74	252'-10"	91	310'-11"
7	23'-11"	24	82'-0"	41	140'-1"	58	198'-2"	75	256'-3"	92	314'-4"
8	27'-4"	25	85'-5"	42	143'-6"	59	201'-7"	76	259'-8"	93	317'-9"
9	30'-9"	26	88'-10"	43	146'-11"	60	205'-0"	77	263'-1"	94	321'-2"
10	34'-2"	27	92'-3"	44	150'-4"	61	208'-5"	78	266'-3"	95	324'-7"
11	37'-7"	28	95'-8"	45	153'-9"	62	211'-10"	79	269'-11"	96	328'-0"
12	41'-0"	29	99'-1"	46	157'-2"	63	215'-3"	80	273'-4"	97	331'-5"
13	44'-5"	30	102'-6"	47	160'-7"	64	218'-8"	81	276'-9"	98	334'-10"
14	47'-10"	31	105'-11"	48	164'-0"	65	222'-1"	82	280'-2"	99	338'-3"
15	51'-3"	32	109'-4"	49	167'-5"	66	225'-6"	83	283'-7"	100	341'-8"
16	54'-8"	33	112'-9"	50	170'-10"	67	228'-11"	84	290'-5"		
17	58'-1"	34	116'-2"	51	174'-3"	68	232'-4"	85	293'-10"		

Table 6-1 Anchor Bolt Measurements

6 - PRE-ERECTION PREPARATION

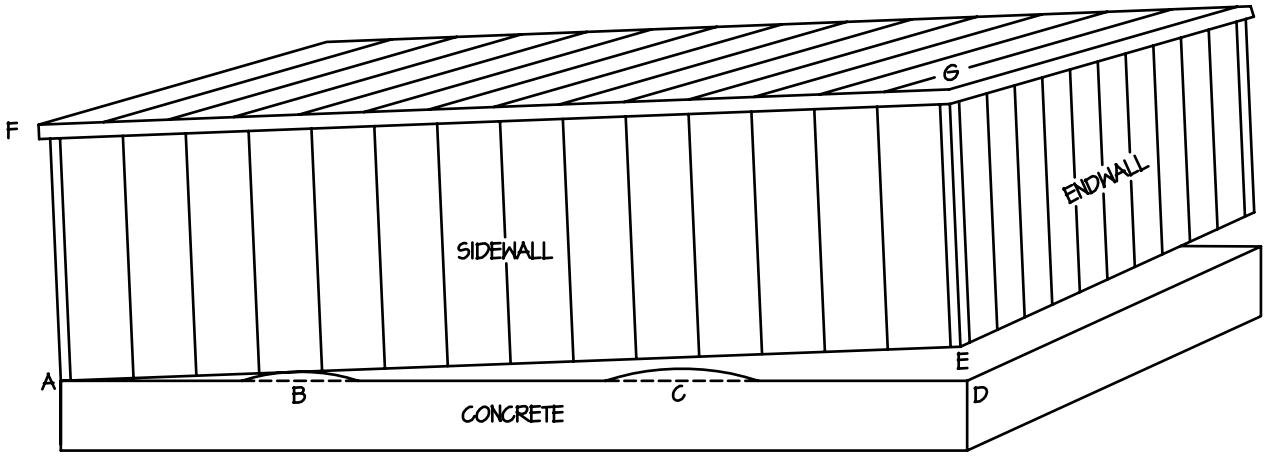

Illustration 6-1 Box Frame Principle

See Illustration 6-1 for an example. The erection started at Point “A”. For ease of assembly, Line AE should be a straight line, and therefore will have to rest on two points. If erection started at Point “A”, the panel would touch at Point “A” and Point “B” in the example shown. This will cause all points from “B” to “D” to rise above the concrete.

- There is not an easy solution to the problem of the unlevel concrete. The seriousness of the problem is partially dependent on the degree of variance from level.

- In any case, unlevel concrete will cause erection problems which will increase costs and reduce the quality of the finished building.

4. The base channel can be put into place.
- You must use the sponge rubber properly and the correct base channel, alternating the laps as shown in the construction drawings.

Photo 6-1

Photo 6-2

6 - PRE-ERECTION PREPARATION

- The sealer tape can also be placed on the base channel at this time. Locate the sealer tape below the holes on the corrugated lip of the outside base channel. Leave the paper on the sealer tape until ready to install wall panels to avoid debris sticking to the tape. (see Photo 6-1 and 6-2)

IMPORTANT: When you install the base channel it is a good idea to install it completely around the building. This is a secondary way to check the correctness of your anchor bolts and your building size.

5. a) Prepare lifting equipment for the panels. You will need something similar to the cables shown in Photo 6-3.

- These four cables have chain links on the ends with a bolt through the link. The bolts are fastened to the seamline holes, ensuring the cables will not come unhooked. This is especially important in windy conditions.

- The same cables work well with the wall panel, though only two cables are required.

Photo 6-3

IMPORTANT: You will also need some ropes with hooks on the end for guiding the panels and trusses into place.

b) Prepare a lifting rig for your trusses. The one shown in Photo 6-4 works very well.

- This lifting apparatus is made from a very light weight trussed pipe with chains hanging from the pipe.

- The last link has a bolt through the link that will not come loose in adverse conditions.

- The pipe is approximately 21’ long, will lift up to 40’ of truss and can be carried by one person.

Photo 6-4

IMPORTANT: You will also need a rope for a tag line to guide the trusses into place.

6. Build your trusses on the ground. It is much easier and faster to build them on the ground and raise them into place with the crane.

- A rented crane is not required at this stage of the project.

- Build the trusses in an area that is out of the way, but accessible to your crane without carrying them by hand.

Photo 6-5

6 - PRE-ERECTION PREPARATION

- If trusses are built within the building area, ensure they will be gone before your building reaches that area.
- See Photo 6-5 for an example of how to stage the trusses.
- All trusses can be built in advance or some can be saved for work on a windy day.

Photo 6-6

Photo 6-7

7. Now is a good time to prepare anchoring systems; similar to the ones show in Photo 6-6 and 6-7.

- Anchoring is required to provide temporary stability for the building and requires planning prior to starting erection.
- Some contractors use screw type ground anchors which screw into the ground with an eyelet on top.
- A heavy and stable object can be used to anchor the building to when the ground is hard or frozen.
- It is very important to anchor the building temporarily. Mother Nature can be unpredictable.

8. The openings for your doors and windows should be cut at this time.

- Large openings such as overhead doors can be assembled on the ground with the panels attached and installed as a complete section of the wall. This can save time and money to complete this before equipment and a full work crew arrives on the jobsite. (See Photo 6-8)

Photo 6-8

9. Endwall panels should be sorted and staged where needed. Keeping in mind you will need only the correct panels to install at first, leaving some of them out. (See Section 9 - Erection Guidelines).

6 - PRE-ERECTION PREPARATION

10. Choose a scaffolding system that will function within your erection plan.

- Scaffold should be capable of supporting the load of the building and its compartments.

- There are many different styles of scaffold systems:
  * Photo 6-9 shows a typical system for a small project
  * Photo 6-10 shows a scaffold system with a guardrail for the ceiling area that moves with the scaffold
  * Photos 6-11, 6-12, and 6-13 show different styles of larger systems.

Photo 6-9

Photo 6-10

Photo 6-11

Photo 6-12

Photo 6-13

- Regulations may dictate the type of scaffolding system due to the area of your jobsite.

- Regardless of the system being used, ensure that the supports are set at the correct height.

- Verify that the scaffolding system being used meets the regulations and safety standards in your area.

6 - PRE-ERECTION PREPARATION

- Typically the walk platform will be approximately 6’ below the ceiling height and the screw jacks will have approximately 18” of adjustment for raising and lowering the ceiling.

- The ceiling supports should be spaced between 8’ and 10’ apart. The length of the supports should be determined as follows. The supports should not extend more than 24” beyond the scaffold. The length should be one panel longer than the number of sections erected per move. Example: If erecting two panels per move use the supports equal to three panels in length. The orientation and amount of scaffolding used will dictate how many panels can be erected per move. Supports should be a minimum of 4” x 4” timber. 6” x 6” timber or aluminum beams should be employed for larger spans. Loads will dictate these requirements.

<u>IMPORTANT:</u> The wheels or running gear should be able to accommodate the terrain and the weight of the scaffolding being used.

---

11. The corner panels should be bolted onto the sidewall panel with the tie down angle attached to the top. (See Photos 6-14 and 6-15).

Photo 6-14

Photo 6-15

12. The ceiling connectors need to be bolted to the first row of ceiling panels. (See Photo 6-16)

- Sealer can also be applied to the ceiling at this time, as per the sealer application guidelines on the Construction Drawings.

- The location where the gusset attaches to the ceiling should also be marked at this time. These locations can be found on the truss drawing in the Construction Drawings.

Photo 6-16

6 - PRE-ERECTION PREPARATION

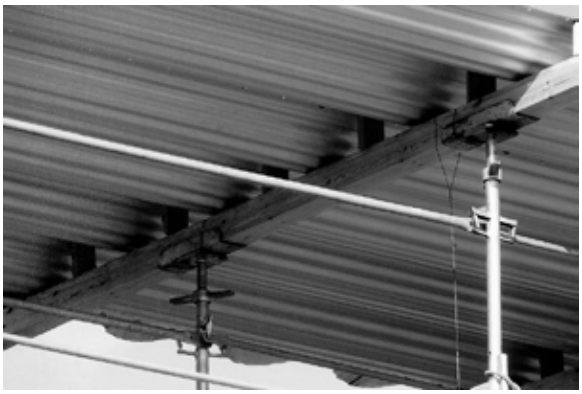

Photo 6-17

Photo 6-18

13. Cut 2.4 blocks 4-5/8” long.

- At least one block will be needed for every corrugated hump that will rest above the supports at any one given time. (See Photo 6-17 and 6-18)

IMPORTANT: These blocks will help to maintain the increments of the ceiling panel and keep it from stretching out. They are very important to keep in place until the supports are let down to move scaffold.

- It is very important not to cut corners, place one block in EVERY valley.

14. Any material you wish to be inside the building can be moved to the front of the scaffold or under it. When the scaffolding is moved the first time, these materials will then be inside the building.

7 - MISCELLANEOUS PARTS AND ACCESSORIES

IMPORTANT: Follow the details on the construction drawings for all parts and accessories.

See below for extra procedures.

CEILING ACCESS DOORS

- When you install the ceiling access door, cut the opening slightly larger than the 2'x3' size of the frame that penetrates through the ceiling. It may take a couple of trimming attempts to get a proper fit.
- Grind and brush the but edge.
- The edge can be painted with a zinc-based paint or a cold galvanizing treatment. The paint will keep the cut edge from rusting or oxidizing.
- After the access door is installed, apply sealant as specified on the Construction Drawings. This sealant around the frame will give the finished product a professional look.

GUTTERS

- The gutter should be installed using the details on the Construction Drawings.
- When the gutters are spliced together, apply sealant as specified on the Construction Drawings.
- Take extra care when attaching the downspouts to the gutter. Use sealant and caulk around the downspout where it attaches to the gutter.

WINDOWS AND DOORS

- It is best to cut all panels for openings before the panels are installed.
- Install the verticals as the building is erected.
- Lap the walls in order to place all cut edges behind solid panels.
- Treat all your cut edges. Grind, brush, and paint. (see CEILING ACCESS DOORS for more details on this process)
- The best method of installing headers and sills in framed openings is to leave out all bolts in the verticals within 3 feet, or more, of header or sill. Bolts can be installed after the frame is plumb and square.
  *This will allow for movement in the vertical to get a good fit and the correct size of the frame.

7 - MISCELLANEOUS PARTS AND ACCESSORIES

MASTER FLASH

- BEHLEN recommends the use of a product called Master Flash to ensure a proper seal around a roof penetration for small to medium sized pipes.
- They are made in many different diameters and the rubber top can be cut to fit many different sized pipes.
- The bottom is very flexible and can be attached to any style corrugation.
- Master Flash can be purchased through BEHLEN Industries LP.

Photo 7-1

RETROFIT MASTER FLASH

- This style of Master Flash can be used after the pipe has been installed and fits the BEHLEN corrugation very well.
- They are self-sealing on the bottom where they attach to the panel. It is always best to use a small amount of flexible sealant to guarantee a proper seal. There are many different styles available through BEHLEN Industries LP.

Photo 7-2

8 - IMPORTANT ITEMS TO MAINTAIN

There are three things that must be maintained during the construction of your building. These are the most important rules to follow. The rest of the procedures will refer to these three items many times.

1. Critical Increments
2. Straight Lines
3. Box frame

CRITICAL INCREMENTS

The increments associated with Frameless Steel Buildings can become very critical because of the nature of a possible progressive error. One eighth of an inch is not much of an error, but the same error done sixteen times becomes two inches. Frameless Steel Building increments are multiples of 41", as noted in Section 5 - Pre Erection Preparation.

STRAIGHT LINES

Straight lines are another critical component of a Frameless Steel Building. The shortest distance between two points is a straight line. Now, keeping this in mind, when you have something that isn't straight, you have changed the measurement between those two points.

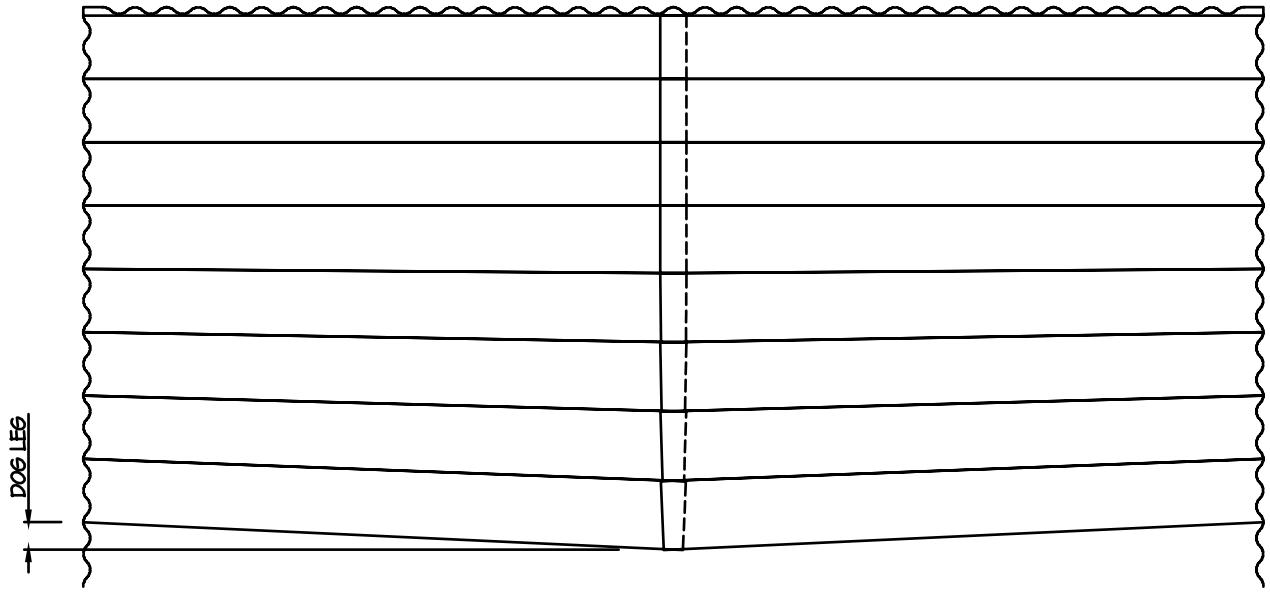

Illustration 8-1 Dog Leg Principle

<u>IMPORTANT:</u> A situation involving lines that are NOT straight will result in a bad fit in the direct location and will create a bad fit and more problems in many other areas of the building. (See Illustration 8-1 and 8-2)

8 - IMPORTANT ITEMS TO MAINTAIN

BOX FRAME
The Box Frame is another important component. The Frameless Steel Building is built as a solid box. EVEN THOUGH THE PANELS ARE FLEXIBLE, THE BOX FRAME IS NOT.

The box frame principle has no tolerances for mistakes such as concrete being out of square, not level, or incorrect anchor bolts. The concrete foundation must be correct within very small tolerances in order to build this box one component at a time.

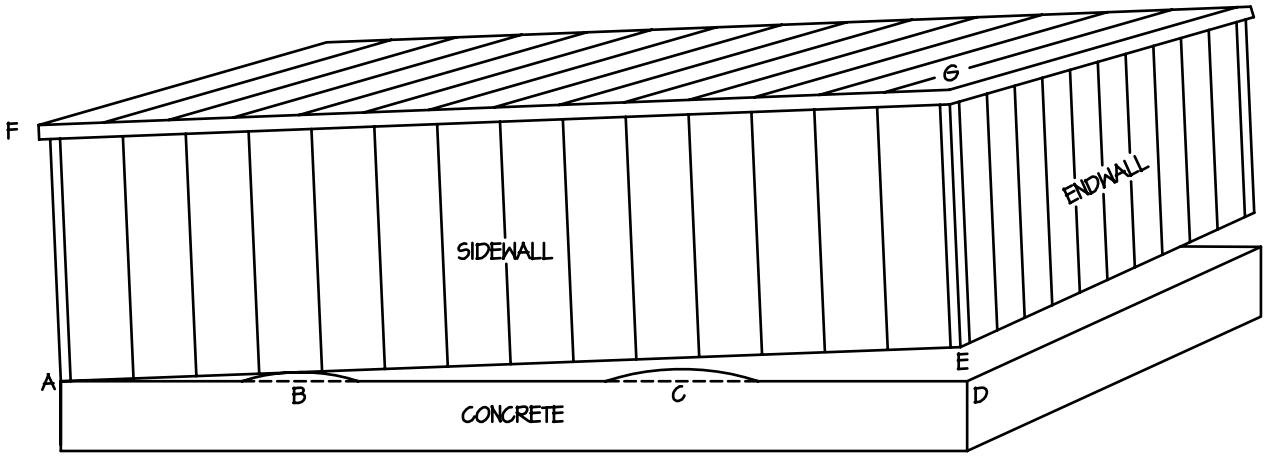

Illustration 8-2 Box Frame

Any of these three items that is not maintained will make the other two items go off course. Most problems won't be noticed until all three items have gone astray. When this happens it will take as many panels to fix it or more as it took to get off course. If your building started to go astray and it took you 60' of building to notice, it will take you another 60' to fix it. Therefore, if you maintain these three items with every panel installed, you will have problem free erection. This will also create cost efficient erection.

9 - ERECTION GUIDELINES

The first day of erection is the most important day of your project. On day one it is critical to achieve enough building to safely tie down. It is very difficult to safely tie down a few erected panels. Tying down a box frame is much safer from the elements and your crew should always be prepared for all types of unexpected inclement weather.

There are many different methods to erect a Frameless Steel Building structure. Even though the following method can vary somewhat, some procedures must always be followed. The panel number being referred toin the coming section coincides with the following drawing (Illustration 9-1). Here are the steps that are recommended to achieve cost-efficient and problem-free erection:

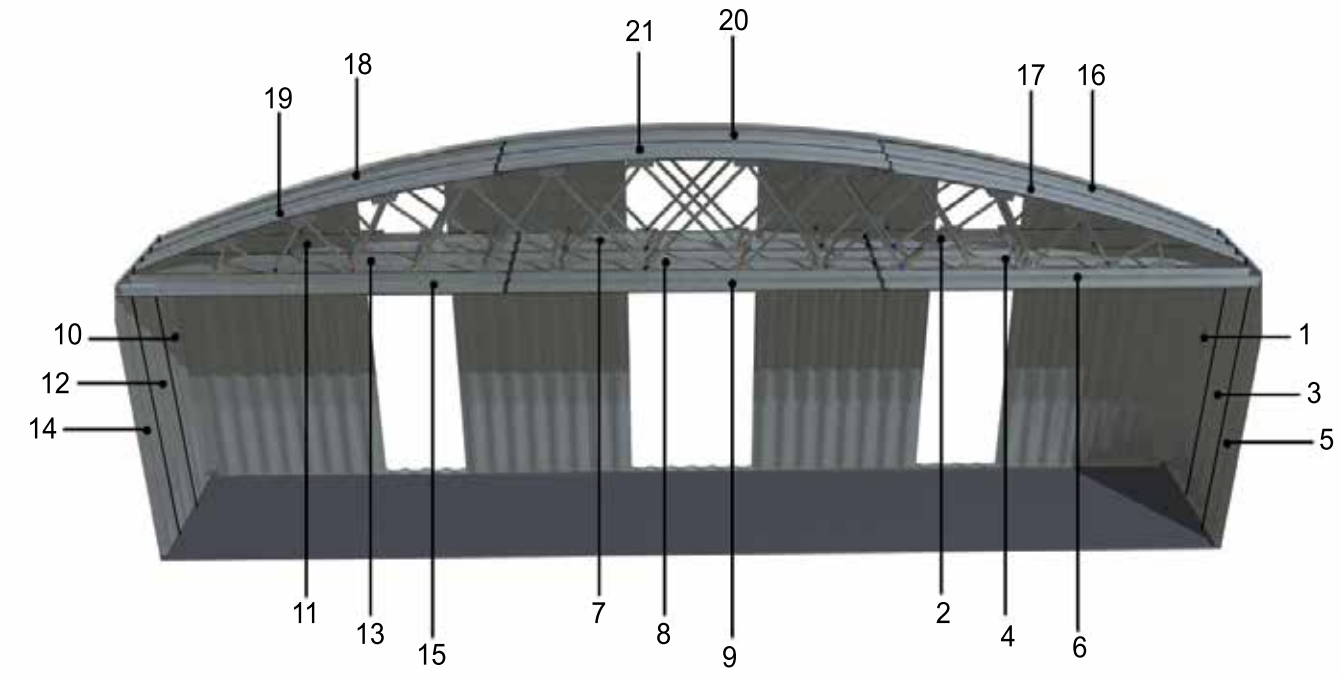

Illustration 9-1

9 - ERECTION GUIDELINES

STEP 1

- Remove the paper from the sealer tape on the base channel. Only remove enough paper to install the current panel.
- Raise the wall panel #1 into place. This panel will already have the corner panel, the tie down angles and anchoring cables attached.
- Bolt the connection at the bottom and anchor the cables to pre-arranged ground anchors at about 45 degrees.
- It is not important to have all the bolts installed at the bottom of the sheet right away. It is important to have the correct holes bolted first.
- The humps and valleys should be bolted first to conform the panel to the exact shape of the base channel. This will ensure that all the bolts will fit at the bottom.
- Try to get the panel as close to plumb as possible. The most practical method is using a plumb bob attached to a magnet at the top of the panel. This method will tell you how plumb you are in either direction. Improper storage, etc, can lead to panels that are not always straight enough for a carpenter level.

STEP 2

- Raise ceiling panel #2. This panel and all ceiling panels to follow should have the trusses and lateral spacers placed on the panel before it is raised.
- The small convex will allow you to fold the trusses and place them on the ceiling.
- Have them built in advance in sections that allow one man to handle the bundle size.
- Attach ceiling panel #2 to the top of wall panel #1.
- The bolt sequence is found in the Construction Drawings.
- Tie down the other end to the scaffold supports and scaffolding.
- Place the wood blocks between the supports and the humps of the ceiling panel, as shown in Photo 9-1.

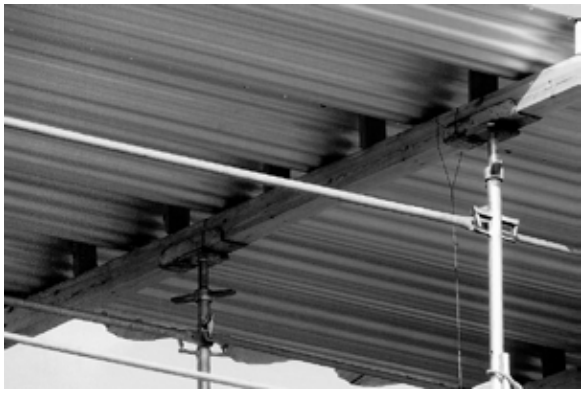

Photo 9-1

STEP 3

- Start installing end wall panels.
- Start with the one that attaches to the corner panel. This will give you some stability.
- Check your plumb-bob to get walls as plumb as possible.
- Leave out enough panels to let the wind pass through the end of your building, though never leave out more than two consecutive panels.
- Endwall panels can only be installed until the end of the first ceiling panel is reached.

9 - ERECTION GUIDELINES

- In the case of small buildings during a period of no inclement weather, ceiling panels can be installed all the way across the building before the endwall panels are started.
- Photos 9-2, 9-3, and 9-4 show the different styles of construction.

Photo 9-2

Photo 9-3

Photo 9-4

STEP 4

- Check to make sure the first wall panel, with the cables attached, is perfectly plumb.
- Raise wall panel #3, ceiling panel #4 and then raise wall panel #5 and ceiling panel #6 in that order.
- All bolts should be tightened as you install them. The ceiling panels have a tendency to flatten out at this time. You need to install all the blocks under the ceiling panels.
- To maintain the correct increment for the top of the wall, install a come-along on top of the ceiling near the wall panel. Usually about 2’ to 3’ away from the wall.
- Ratchet straps can also be used if they are the heavy style.
- Another strap needs to be installed at the ceiling panel end lap location. This one can be the first bolt hole away from the lap, if there are no gussets interfering. (The location of the gussets should have already been marked in your preparation.)
- These straps will control your ceiling increments and should be installed on every end lap of the ceiling panels and at the wall to ceiling location.
- The straps are not to be removed until they are needed for the next set of panels.
- In order to maintain a trouble-free erection, these straps cannot be eliminated for any reason. (See Section 8 - Important Items to Maintain)

9 - ERECTION GUIDELINES

STEP 5

- Continue across the building with ceiling panels #7, #8, and #9.
- When the new ceiling panel is attached at the lap connection, a STRAIGHT LINE must be maintained with the ceiling. This can be done by:
  * Getting perfect alignment with the bolt holes in the laps.
  *Have another crew memeber check by eyesight from a distance.
  *Attach another come-along close to the end of the panel as not to interfere with the lap. These come-alongs must be attached before the next ceiling panel is placed at the end.
- It is imperative to maintain these straight lines and increments as per Section 6 - Pre-Erection Plan.
- Continue installing end wall panels across the building. More anchors bolted to the end wall panels and attached to the ground will be needed as the building progresses.

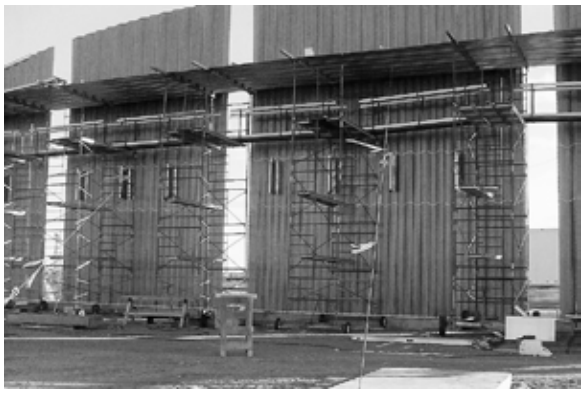

Photo 9-5

- It is advised to anchor the building as progress is made.
- Note anchoring in Photo 9-5.

STEP 6

- The last section of the building is very similar to the first.
- Raise wall panel #10 with a corner panel, tie down angles and anchoring cables already attached.
- Then raise ceiling #11. Check all straight lines.
- Raise wall panel #12 and ceiling panel #13. Then wall panel #14 and ceiling panel #15.
- Attach the come-alongs at the proper place to maintain the increments of 41” per panel.
- Install the blocking under the ceiling.
- More endwall panels can be added at this time.
- This now completes enough of the box frame to be fairly safe from windy conditions, if anchored properly.
- Tighten all anchor bolts in the concrete that are involved with the vertical panels that are installed.

9 - ERECTION GUIDELINES

STEP 7

- Attach the roof angle to the top of the endwall panels. This will make a curved connector to attach your first roof panel. (See Photo 9-6)
- Leave these bolts loose temporarily to ensure a better fit with your first roof panel.
- Some of these bolts will need to be reversed because of the interference with the gussets that attach to the underside of the roof panel.

Photo 9-6

STEP 8

- With gusset location marked on the ceiling panels earlier, now the trusses are ready for erection.
- Trusses for this building were built on the ground previously or they were placed on the ceiling panel before it was raised.
- Stand them up and bolt them in place. Make sure that all your gussets face the same direction.
- Large trusses, which cannot be folded, can be raised to the ceiling with a spreader bar. This is shown in Photo 9-7. This very light 21' of trussed pipe can lift up to 40' of truss.
- Bolt the lower gussets to the ceiling in the locations that you previously marked on the ceiling panels.

Photo 9-7

- The lateral spacers can now be installed at the upper and lower gussets. Once the lateral spacers are connected, the lifting chains can be disconnected.
- The lateral spacers have a tab at each end that alternates in direction at every truss.
- There are three possible holes in the gusset that can be used to bolt the lateral spacers. They will be bolted by alternating the holes you are using from the centre hole to the left and back to the centre. Which half of the gusset they are located on will be denoted on the truss drawing of your Construction Drawings.
- This can be done by step ladder or by small scaffold as shown in Photo 9-8 and 9-9 (on page 63).
- The truss and lateral spacer bolts should all remain loose at this time.

Photo 9-8

9 - ERECTION GUIDELINES

IMPORTANT: Always refer to Construction Drawings for correct location of the lateral spacers.

STEP 9

- To prepare for the roof panels:
- Install the sponge rubber on top of the wall area, where the roof attaches to the ceiling. The location is shown on the Construction Drawings.
- Sealer can be applied to the roof panels while they are on the ground. The location of the sealer is shown in the Construction Drawings for your building.

IMPORTANT: Sealer is always installed on the weather side of the holes.

Photo 9-9 (associated with STEP 8)

- Roof panel #16 can be raised with the same four cable lifting rig that was used on the ceiling panels.
- A rope is suggested to guide the panel into place. In windy conditions two ropes are recommended. Four ropes can be used in very windy conditions (two ropes from the top and two ropes from the bottom) (see Photo 9-10).

IMPORTANT: At any sign of severe panel movement with the ropes being used, it is time to stop raising panels.

Photo 9-10

- Attach roof panel #16 at the top of the wall area, and then attach to the roof channel with the bolts facing up and loose.
- Bolts are only tightened loosely because they are temporary until the gable cover is installed.
- The roof panel should also be bolted to the lateral spacers. Use a weather seal washer under the bolt head at this location. All bolts through the roof should be tightened as you go.
- Roof panel #17 should be raised into place. Placing both roof panels on the roof makes for a much more stable roof for the crew who are working on them.

STEP 10

- Install roof panel #18 and #19 the same manner as panels #16 and #17.

9 - ERECTION GUIDELINES

STEP 11

- Roof panels #20 and #21 can now be installed.
- First bolt the end lap at one end. Then the side lap. The last end lap at the other end should be left unbolted until the last roof panel is in place.
- Look at the hole alignment to verify that the ceiling supports are at the correct elevation. If it is not correct, raise or lower the supports to get a good alignment at the last lap.

IMPORTANT: Supports cannot be raised as much on the first panel in the area of the end wall.

- An arch will probably be formed in the ceiling to get the roof to fit in the centre.
- When the proper height is achieved, bolt the last end lap.
- The truss bolts can also be tightened.
- The lateral spacer bolts in the ceiling location can be tightened. The lateral spacer bolts in the roof location should be left loose only where they attach to the gusset. (See Section 10 - Troubleshooting for more details)

STEP 12

- When the entire roof is complete, the leading edge of the roof panel should be bolted to the gussets with on bolt in each. This keeps the last truss from sagging when you lower the supports.
- A roof ladder, as shown in Photo 9-11, should be used when the surface of the panels is slippery. Such as when it is covered in oil, frost, rain, ice, or snow.

Photo 9-11

STEP 13

- When all the bolts are installed and tightened, the supports can be lowered. It is not necessary to lower the leading edge jacks, only lower the trailing jacks. This will make it much easier to return the supports to the proper height.
- Scaffolding can now be moved 6’10”. This is the width of two panels. This will keep the supports under the last panel line that is not completed. (see Photo 9-12)
- The supports can be raised up to prepare for the next set.
- Raise the jack on the trailing side that was previously lowered. Raise this side until pressure is being placed on the last truss that was installed.

Photo 9-12

9 - ERECTION GUIDELINES

- Remember to put the blocks back in. Without these blocks the corrugation of the ceiling panels will fflatten.
- If the floor surface is level, the front jacks will always remain in the proper position.
- Another example of a mobile guardrail system is shown in Photo 9-13.

Photo 9-13

STEP 14

- When the first set is complete, ensure all anchor bolts have been tightened where the panels are installed.
- Attach gutter straps on the roof in the same manner that bolts were installed on the roof panels as per the Construction Drawings.

STEP 15

- Repeat steps 1-14.

IMPORTANT: Keep in mind that very small errors will multiply into very large problems due to multiple panels. Every panel that is placed must be checked for straight lines and increments.

STEP 16

- The full endwall can be installed when the building is at least half as long as it is wide (as long as there are some openings such as doors and windows). This endwall will provide support for wind load against the side of the building.
- If there are no openings, one panel should be left out in the middle of the endwall. This will release any excessive uplift on the rest of the building due to wind pressure.

STEP 17

- The last end wall is the final wall of the box frame.
- The first step to complete the last endwall is to attach the ceiling to wall connector to the last ceiling panel.
- Next install all the panels in order from left to right or from right to left (there is no difference between either direction) (See Photo 9-14).

Photo 9-14

- If the increments and straight lines were maintained as the building progressed, this last wall will fit very well.

IMPORTANT: The order of these step by step procedures can vary by the order of installation for each component depending on weather conditions, the size of your crew, and the availability of equipment.

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10 - TROUBLESHOOTING GUIDE

The following are trouble-shooting steps and methods for correcting mistakes.

Lateral Spacers to Gusset Connection

- Lateral spacers are purposely made 1/8” less than 41”. This facilitates adjustments that may be required to maintain the proper increments.

- Because the roof tends to shrink and the ceiling tends to stretch the method of connecting the lateral spacer to the gussets differs for each.

- At the roof, this connection should be left loose. If tightened the increments will begin to shrink by 1/8” per panel. At every third seam line you will need to shim the connection with a 3/8” nut. This will insure that your increment for three panels is 10’-3” as it should be. Once this is done you can go back and tighten the connection. At this point the roof system is stiff enough that the tab on the lateral spacer will bend slightly to meet the gusset. This will keep the lateral spacer from forcing the roof panel to a 40 7/8” increment.

- At the ceiling this connection should be tightened as it is being installed. Come-a-longs are used to keep the ceiling panel increments correct and the lateral spacer will not pull the ceiling to 40 7/8” on its own.

- If a situation occurs when the ceiling has stretched beyond the 41” increments, the lateral spacer will now allow you to use the come-along to pull it back to 40 7/8”. By doing this you can make a 1/8” correction per panel and soon you will be back to the proper increment.

Checking Walls for Plumb

- Accurately check wall for plumb.

- Some wall panels may have become slightly bowed from improper storage. This makes a four foot level very inaccurate.

- The best method is a transit that will move vertically. Also a common plumb bob works very well.

- The most important thing about checking the walls is detecting very earyl if the walls are beginning to move in or out, in a direction parallel to the building span. If they do move out of plumb it is essential to detect this problem at an early stage.

- There are two things that can make this situation happen:
  1. One problem is the ceiling panels are being lined up improperly by a slight fraction of the hole each time. To correct this, the ceiling panels must be moved back in the opposite direction that was previously lining up wrong. It will take as many lines of ceiling panels to fix this problem as it took to get it out of the plumb, maybe more.

  2. The other reason for this problem is the concrete is out of square. This problem should have been discovered in the pre-erection items and will now add substantially to the erection time of the structure. Each ceiling panel will need to be shifted and partial holes that do not line up with this type of adjustment will possibly need to be drilled. Use a UNI-BIT to drill. This will avoid making the holes too large.

10 - TROUBLESHOOTING GUIDE

- If the walls are out of plumb the opposite way, this means that the panel is leaning to the left or right as you are looking at the wall from the outside of the building.
  * The bottom of the panel is bolted in a fixed position. The top can stretch and the wall seams will no longer fit and the bottom of the panel will not fit properly.
  * This will not happen if the come-along was placed on top of the ceiling, close to the wall connection.
  * The fix for this problem is to place this come-along on top of the ceiling and pull it back a little shorter than it should be until the wall returns to a plumb condition.

Checking Lines and Increments

- Constantly check the straight lines and increments of the building.
- A 100’ tape is commonly used to check the increments of the ceiling panels at each lap location.
- Always measure from the start of the building.
- All components must be in straight lines together with each other. The wall panels, ceiling panels, trusses and roof panels should stay aligned with the anchor bolts.

Adjusting Supports

- When adjusting supports to make the first connection in the centre of the roof panel, a good fit will not always be achieved on the first roof panel in the centre. This is partially due to the outdoor temperatures during erection.
  * In warmer weather, more arch will have to be put in the ceiling to connect the top roof lap. This condition is caused by the contraction and expansion of the panels.
  * The first ceiling panel cannot be arched very much because of the connection to the wall.

Accomodating an Out-of-Square Slab

- Having an out-of-square slab will increase the time of erection. If a check of the slab is done at the time of the pre-erection plan, complications can be minimized.
- If the problem of an out-of-square slab is known in advance of the pre-erection plan, a couple inches out of square can be accommodated by slotting the base channel within the tolerances specified on the Construction Drawings and moving it before work begins.
- If the slab is still a little out of square after notching the base channel, the ceiling panels will have to shift at the seam line location each time a new ceiling line is installed.
- In a situation of the concrete not being level, this problem can be accommodated by shifting the wall panels up and down within the tolerances of the holes.

<u>IMPORTANT:</u> This solution is only effective if the problem was discovered during the pre-erection plan, and the out of level problem is rather small and gradual.

- All of these methods increase your erection time. Severe concrete problems can also degrade the quality of your building.

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The Dog Leg

- The Dog Leg is a problem that can happen to ceiling panels. It is a situation when the ceiling is no longer in a straight line.

- See Illustration 8-1 of a dog leg which has become worse with each row of panels. The width of the building is no longer the same as when construction started.

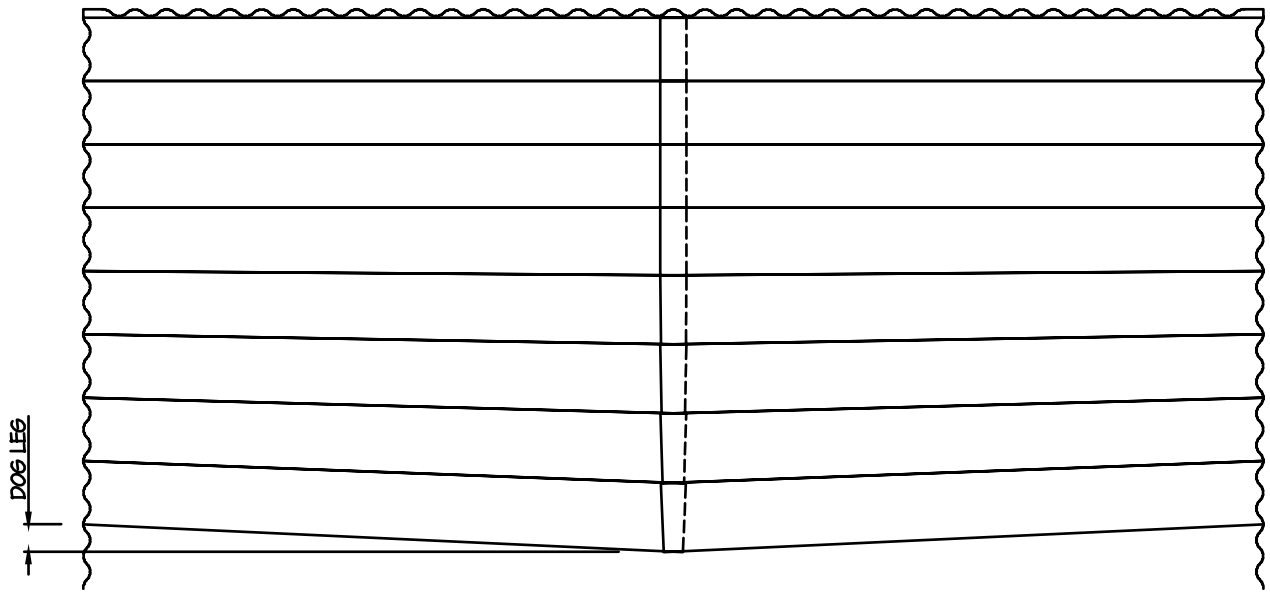

Illustration 8-1 Dog Leg

- This makes the holes in the seam lines not line up, changes the width of the building, causes misalignment of the ceiling with the roof and the trusses. The next line of ceiling panels will continuously be put out of alignment.

- This situation can progress to many other problems if not caught in time or prevented from the outset of construction.

- The come-alongs that are used on top of the ceilings at the lap area will prevent this problem. If this step was overlooked, the come-alongs need to be used to pull the ceiling back an extra 1/8” per ceiling line until it is straight.

- The sooner a problem is spotted, the easier it will be to fix and if it can be prevented at the beginning, it will result in a trouble-free and cost efficient erection.

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Drilling and Expanding Holes

- There may be instances when a hole will need to be drilled or expanded to get the bolts to fit well.

- The best method in all cases is the uni-bit. (Shown in Photo 10-1). This style of drill bit will take out material from both directions in order to minimize the area needed to be covered with the washer.

- The uni-bit is also the best option to use instead of an aligning punch to increase the size of the hole. Aligning punches are best used for moving panels for a good fit, but will oblong the hole and deform the panel. If this happens, the panels will not lay flat together and maintain a good seal.

Photo 10-1

Aligning Layers of Material

- There is an area with 6 layers of material coming together in a one hole connection. This is on top of the wall panel where the ceiling and roof panels also bolt together.
  * This connection should be aligned with a punch or drilled to alignment after the two wall panels are in place.
  * When the ceiling panels are installed the same procedure should be used as for the wall panels.
  * Use a punch or drill to prepare a good fit before trying to align this hole.
  * Use a hammer to pound down this location, as the radius of the hump is increasing in this location every time another panel is added.

- When this radius is not maintained closely, the interior parts (such as the sidewall ceiling to wall flashing) fail to maintain a quality appearance.

- It will also be very difficult to bolt this connection after the last roof panels are in place.

- Prepare the hole every time a new layer is installed before the next panel is added.

Checking Panels

- Always check the panels to see if they are the proper panel for the location before moving them into place.

- Some panels are identical except for gauge.

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Precautions for Installing HSS Verticals

- These verticals are structural tube sections with pre-drilled and tapped holes. These can be difficult to line up with the panels because of the threaded holes.
- The panel that installs onto the vertical first should be pre-drilled larger with a uni-bit. Approximately 1/2” to 5/8” is appropriate.
- This needs to be done only if another panel fits over the top of the holes that are being enlarged. This will allow an easier fit for the last panel installed on the vertical.
- The last panel installed is often the most prone to not fitting well. Start by bolting this panel in the middle and work in both directions.
- An alignment punch can be driven into the pre-threaded hole without much damage to the threads. This will minimize the error if any.
- The uni-bit is also needed here to align the panels with the vertical. The uni-bit will do little to no damage to the holes that are already tapped into the vertical.
- The final prep for the bolt is to use a 3/8” tap and a T-handle to clean out the threads.

Call in an Expert

- When a problem arises with your building that you are unsure of, it is advisable to consult your Customer Service Representative at BEHLEN Industries LP.

11 - TIPS & HINTS FOR A SUCCESSFUL BUILDING

1. The normal attic insulation guide for Frameless Steel Building projects is to use blow-in type insulation. Walking on this will degrade the R-factor of the insulation. Some buildings have mechanical equipment that needs to be accessed throughout the years. The economic solution to this would be to use fiberglass batt-insulation in the path to the mechanical equipment where the foot traffic will take place. The fiberglass batts will spring back in good condition. Very heavy traffic will of course also degrade fiberglass and in such cases, a raised walkway would be recommended.

2. When you are unloading the trucks keep in mind that all the bundles of panels need to be flipped over. When the bundles are strapped, do it in a way as to turn the bundles over as they are unloaded. This will eliminate the need to fl ip everything over later and save the crew time.

3. After a couple of moves of the scaffold have been completed, it is a good time to move more material under the protection of the roof that has just been completed. Even painted material such as trim will stain from the elements. These items should be unpackaged and separated in order to dry out the material. A good place to do this is the new area just built with a roof over it and walls to protect from wind, rain, and snow.

4. When adjusting supports on the scaffolding keep in mind that it is very easy to let the building down into place rather than raise it up into place.

5. Make sure to never tighten any truss components until the last roof panel is in place and fits properly. Tightened trusses will not raise or lower.

6. If the pre-check of the concrete shows some dips or humps in the side-wall area, these problems can be compensated for. When the wall panel is installed in the dip or hump location, gradually raise or lower the building slightly by raising or lowering the hole alignment in the wall panel seam line. This will shift the building up or down to accommodate imperfect concrete. Compensating for out-of-square concrete in this manner can only be done successfully if the problem is identified in the pre-erection preparation phase of the project.

7. A slightly out of square slab can be corrected with the movement of the base channel. This is done by slotting the holes in the channel within the tolerances specifi ed on the construction drawings. Anytime poor quality concrete has to be accommodated, it will cost more time and money. Early detection is a must.

8. For painted material that has become scratched, use touch-up paint that is included in the building package. Follow the application guidelines that accompany the touch-up paint.

9. When attaching the downspout to the gutter, pre-drill the holes in the downspout. Holes can also be pre-drilled in the downspout brackets where it attaches to the wall and the downspout before they are attached to the wall. Doing so will keep the fasteners from trying to thread two materials at the same time.

10. It is a good idea to place some carpet remnants on top of the wood supports where they come into contact with the ceiling. This will keep the wood from leaving a mark on the ceiling.

11. When trusses become large, the step ladder should always stay on the back side of the truss for the protection of the crew. The crew can also use a stick with a drift pin taped to it to raise up the last lateral spacer for the crew on the step ladder. As shown Photo 11-1.

11 - TIPS & HINTS FOR A SUCCESSFUL BUILDING

Photo 11-1

12. If, when the last end wall is being installed and the side walls are leaning slightly, start in the corner where the side wall is leaning into the building. For every end wall panel installed, shift the seam line up slightly in the tolerances of the holes. This will accomodate a slight lean of the building.

13. Always remember to tighten the anchor bolts every night for the portion of the building erected that day.

14. There are times when it is necessary to cut a hole in the panels for mechanical purposes. As a general rule a hole up to 6” in diameter can be cut without using a special frame or extra reinforcement. It is always prudent to check with BEHLEN before cutting holes in the panels as there are some instances when special engineering for snow and wind loads has been applied.

15. Having a digital camera on the job at all times is a good idea. If you encounter some diffi culties or just have questions it may be easier to explain your problems to a BEHLEN specialist using photos. E-mailing a photo can save a lot of explaining.

16. After the base channel has been installed, it is advisable to place the sealer while the channel is still dry and clean. Remove the paper only just before installing the panel. This will keep the sealer clean from debris.

17. When installing the screws in the gutter splice, place the screws in the bottom of the gutter fi rst. This is the area that requires the best fit.

18. Weather seal washers are provided for the bolts used to fasten the roof panel to the lateral spacers. These washers have a rubber base. They should also be used where the hole size is damaged in the roof from aligning pins and punches.

19. If at any time a hole needs to be made larger than it already is, the best method is with a tapered uni-bit (see Photo 11-2). When a punch is used to open the hole the material gets bent and will create an area that doesn’t lay flat together. This can cause a leak in the roof. When the uni-bit is used, material is taken out from all directions and will allow the material to lay flat.

Photo 11-2

20. The uni-bit is also a great help when you are installing HSS verticals. These are the verticals that are of structural steel and pre-drilled with threaded holes. The holes can be enlarged on the first panel that is to be fitted to the vertical. This panel gets covered with another panel. The holes in the underneath panel can be enlarged to 1/2” or even larger. This will make the three items easier to align when installing the last panel. The holes on the top panel can also be enlarged but only slightly. When both panels are layered onto the HSS vertical a punch should be driven into the hole approximately in the centre of the HSS. A full hole is needed in the centre and then work up and down until it is bolted completely. Driving a punch into the threaded holes just use the uni-bit to open the panel hole to right size and drill part of the starter thread out.

11 - TIPS & HINTS FOR A SUCCESSFUL BUILDING

21. At the top of the wall panel where the two panels lap together requires attention to ensure a suitable fit. The best way to handle this is to bend the crimp of the first wall panel up before installing the next panel. After this panel is bolted in place, bend the crimp back down and line up the two holes by driving a punch into the hole and ream this out until it is a sufficient size. This will prepare this area for the ceiling which also has a hole that needs to line up with this same hole. When the two ceiling panels are bolted in place drive a punch into this hole to align what are now 4 layers of metal. Ream sufficiently. There are also two layers of roof panels that have to also fit in this area. When the first roof panel is bolted in place, once again drive a punch into this hole. It will take some force to drive the punch into this hole. Continue in this process until the last roof panel is in place. The idea is to prepare the last hole before the next panel is placed. Waiting till the end it is too late to bring the radius down into normal size. Driving the punch into this hole for every layer of metal has shortened the radius of the hump in this location. EACH LAYER OF METAL HAS A TENDENCY TO INCREASE THE SIZE OF THAT PARTICULAR HUMP MAKING THE ALIGNMENT MORE DIFFICULT. DRIVING DOWN THE SIZE OF THE HUMP WILL ALLOW THE INTERIOR TRIM TO FIT MUCH BETTER WITH THE CORRUGATIONS.

22. When something becomes diffi cult, contact BEHLEN before it gets impossible.

12 - GLOSSARY OF TERMS

ANCHOR BOLTS: Bolts used. (not supplied by Behlen Industries LP)

BASE CHANNEL (INSIDE AND OUTSIDE): Connection plates between wall panel and foundation.

CEILING CONNECTOR: Structural member connecting ceiling and end wall panel.

CEILING JACK: Structural curb in the ceiling.

CEILING PANEL: Bottom chord of truss - 4 1/2" corrugated profile (CS45) only.

CORNER BASE CHANNEL: Connection plate at building corners and foundation.

CORNER CEILING CONNECTOR: Connection member between ceiling panel and wall panel at building corners.

CONVEX: Building system incorporating trusses with a horizontal bottom chord and radiused top chord.

CORRUGATED PANEL: Structural panel roll formed with either 4 1/2" (CS45) or 7 1/2" (CS75) deep corrugations.

CONCRETE CURB HEIGHT: Difference in height between the finished floor elevation and the underside of base channel.

DUBL PANL®: Building system incorporating trusses with parallel bottom and top chords with a slope of 1 : 82 on the end wall.

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

EAVE TRIM: Flashing with gutter profile used to cover the end of the roof panel edge at the eave.

END WALL: Non load bearing CS45 (4 1/2") or CS75 (7 1/2") corrugated wall panel.

END WALL CEILING TO WALL FLASHING (C.W.F.): Flashing from the ceiling panel to the liner panel at the endwall.

EXTERIOR CLOSURE: Corrugated flashing for exterior wall panels.

FILLER CHANNEL: Used for non standard framed openings.

FURRING CLIP: Spacer clip between the corrugated wall panel and the liner panel, used with furring strips to build the insulation cavity.

FURRING STRIP: Horizontal wood or like member (not supplied by BEHLEN Industries LP) attached to the furring clips for installation of the liner panel.

GABLE TRIM: Flashing between the end wall and roof panel at the gable.

GUSSET (UPPER & LOWER): Connection plate between roof/ceiling panels and struts.

GUTTER SPLICE PLATE: Connection plate between two adjacent gutters.

HANGER STRAPS: Strap used to fasten the gutter to the roof panel.

ICE CHANNEL: Member fastened to roof panel near the eave to prevent ice from sliding off the roof. (not supplied by BEHLEN Industries LP)

12 - GLOSSARY OF TERMS

LATERAL SPACER: Member between gussets of adjacent trusses.

LOUVER COVERS: Trim to cover louvering in corrugated panels.

LOUVERED PANELS: Corrugated panels with stamped louvering.

PRECOAT: Painted Finish applied to coiled steel before roll forming process.

POST-PAINTED: Painted Finish applied after the roll forming process.

ROOF ANGLE: Structural member used to connect roof panel to end wall panel.

ROOF JACK: Structural curb in the roof.

ROOF PANEL: Top chord of truss in a Dubl-Panl® or Convex - 4 1/2" corrugated profile (CS45) only. Structural roof panel in a Single Panel - 4 1/2" corrugated profile (CS45) or 7 1/2" corrugated profile (CS75).

ROOF SUPPORT: Channel located at the interior bearing locations of the roof panel in a single panel building.

ROUGH OPENING: Inside dimension of a structural framed opening.

SADDLE BRACKETS: Gutter supports.

SIDEWALL: Load bearing CS45 (4 1/2") or CS75 (7 1/2") corrugated wall panel.

SIDEWALL CEILING TO WALL FLASHING (C.W.F.): Corrugated closure fl ashing from the ceiling panel to the liner panel at the sidewall.

SINGLE PANEL: Building system incorporating structural roof panels designed to span from support to support with a slope of 1 : 82 on the end wall.

STRUT: Web member between roof panel and ceiling panel.

TRUSS: Combination of roof panel, ceiling panel and struts.

UPLIFT VERTICAL: Channel or HSS Member at locations of overturning reactions.

VERTICAL: Door or window rough opening jamb.

WALL GUSSET: Connection plate between wall panel and struts in a Dubl-Panl® building.

WALL JACK: Structural curb in the wall.

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