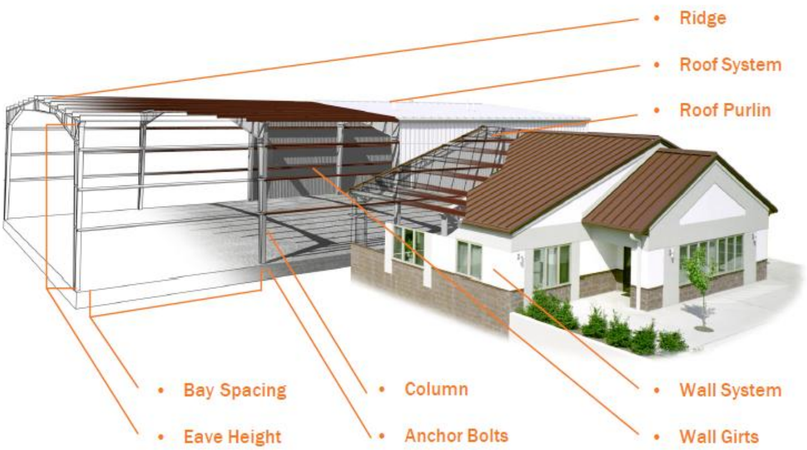
Varco Pruden Buildings Systems Guide

Reference Information for Creating Successful Projects



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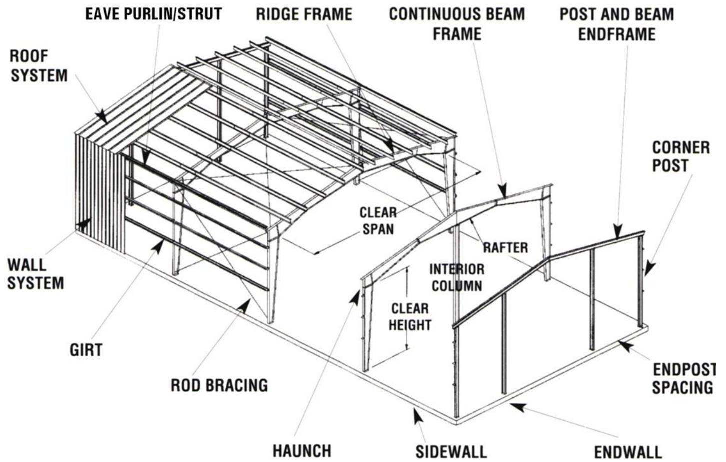
EAVE PURLIN/STRUT
RIDGE FRAME
CONTINUOUS BEAM FRAME
POST AND BEAM ENDFRAME
ROOF SYSTEM
CORNER POST
CLEAR SPAN
RAFTER
INTERIOR COLUMN
WALL SYSTEM
CLEAR HEIGHT
GIRT
ROD BRACING
ENDPOST SPACING
HAUNCH
SIDEWALL
ENDWALL

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VP University Press September 2010 Front Royal, Virginia

The text of this book is (mostly) in Calibri

Manufactured in the United States of America

Printed on Recycled Paper

First Edition July 5, 2010

Second Edition September 30, 2010

Compiled, written, and reviewed in part by Stephen Hudák, Tom Georg, Ron English, Bonny Alphonso, Dave Cleary, Micheal Daniels, and David Hales. This effort would not be possible without the input of many people within the Varco Pruden Buildings' family.

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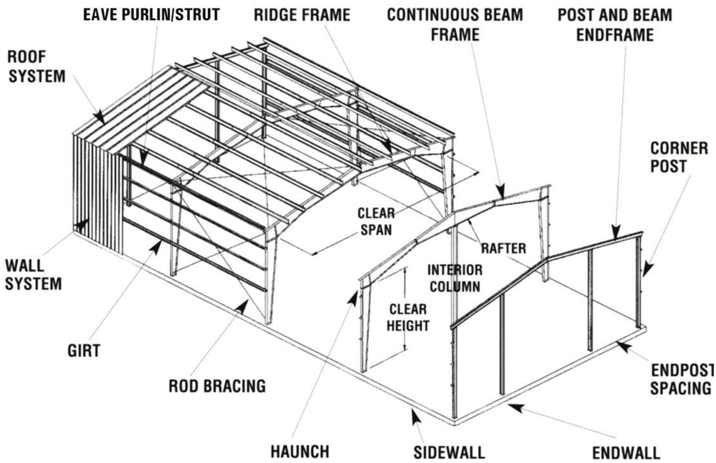
Disclaimer:

The examples and illustrations in this manual are intended to support the discussion topic and in some cases may not be accurate for a condition being considered. They are generally true, but can always be found to not cover some given situation. They have been developed with particular loadings, dimensions, and codes, and are accurate for the situation intended. The charts showing percentages are meant to be approximate or to show the trend of the subject rather than an exact number for all.

With the many variables in construction: loading; geometry; customer preference; etc. it is often difficult to state that “If A is done, then B will result.” Therefore you should take advantage of the power of VPCommand to create varying building project scenarios for your customer.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Product Optimization

In today's competitive environment it is more important than ever to combine your individual sales capability with strong product knowledge. This combination of skills will have a significant impact on the ability to achieve the sales and profit goals of your company while providing building solutions that meet your Customer's needs.

Varco Pruden's Systems Guide designed to: improve your product knowledge for optimum product utilization; deliver better pricing; and refresh and enhance your selling skills specific to VP products.

In any building or bidding opportunity there are three major goals:

- Make the Sale
- Make a Profit
- Meet the Needs of the Customer

All these goals must be met in order to have a successful project. Like the proverbial three-legged stool, if one of these goals is not met – the project will not be successful.

It is quite possible to:

- Make the Sale and Meet the Customer's Needs and not make a Profit.
- Make the Sale, Make a Profit, and not meet the Customer's Needs - which will result in an unhappy Customer with no opportunity for repeat or referral business.
- Meet the Needs of the Customer and Meet the Profit goals of the company, but the price of the project is too high in relation to the perceived value of the Customer resulting in no sale.

In most successful building solution cases, the key is proper communication and interaction with the Customer along with a creative product interpretation that provides the best overall value. A thorough understanding of VP products, construction methods, codes, and customer requirements is required in order to determine the optimum solution.

The purpose of this manual is to help VP Builders and Employees learn product applications that provide a competitive advantage in the market and help illustrate sales techniques that will improve interaction with customers.

The format of this manual adheres to the logical order of VP Command. Each section begins with suggested questions to obtain specific project information from your Customer. Following the questions are ideas and concepts that will help determine the best solution based on the answers to the questions.

Steel building systems follow the definition of a “system” in that independent items (frames, bracing, secondary, sheeting) act together to form a whole. Knowing how to use a building’s components will assist you in meeting the customer’s needs functionally and economically.

We hope the information in this manual becomes a valuable asset and tool in the selling, estimating, and preparation of proposals. The effort, as always, is to help our Builders and their Customers find *The Ultimate Building Solution* for their project.

General Information

The answers to these questions and others will give a foundation, from the first sales call, to help form opinions that will allow you to make decisions that will favor your company and the VP Buildings product in the final proposal. Don't overlook the opportunity to discover answers to questions that will give you an edge on the competition. This will lead to a successful project for everyone.

Questions for the Customer

- **Is a Design Professional involved?**
    - *If so, in what stage are the plans or specifications?*
    - *Is there any flexibility in design or layout changes for process or use flow?*
    - *Is the design professional familiar with Metal Building Systems?*
    - *If not, do you plan to get one involved?*
    - *If not, will you consider design build?*
- **Does the owner have Land and a site plan or survey?**
    - *How is the building to be located on the site?*
    - *Is there a specific building shape required?*
    - *What are the zoning restrictions or covenants?*
    - *Wall material requirements?*
    - *Roof restrictions?*
    - *Mechanical locations?*
    - *Appearance?*
- ***Project requirements***
    - *Appearance requirements?*
    - *Size?*
    - *Look?*
    - *Flexibility?*
    - *Future expansion?*
    - *Safety requirements?*
    - *How many Buildings in the project?*
    - *What is the end use of each building?*

  - *Insurance requirements from their carrier (FM/UL)?*
  - *Budget?*
  - *Time line for completion?*

Questions for the owner

- *Process for making the decision? How – Who – When - Criteria*
- *Lowest price vs. best value?*
- *Expectations of the Builder?*
- *How did you get my name / company?*
- *Who else are you talking to (competition)?*
- *Is the financing in place?*
- *What is the construction schedule?*
- *Is the job bonded?*
- *What are the contract terms?*

Geometry

"What is the flexibility?" with regard to dimensions. Can we change anything to the advantage of the product or must we adhere to the given requirements?

- *Questions for the Customer*
- *What dictates the geometry (width, length and eave height) of the building?*
  - *Clearances?*
  - *Equipment?*
  - *Processes (Process Flow or use)?*
  - *Floor Space (square footage)?*
- ***Roof Pitch (single slope, gabled, unsymmetrical)***
  - *Appearance/ Flexibility – for change – are the dimensions locked in?*
  - *Site Drainage requirements?*
- ***Skewed walls (Easement requirements and/or restrictions)***

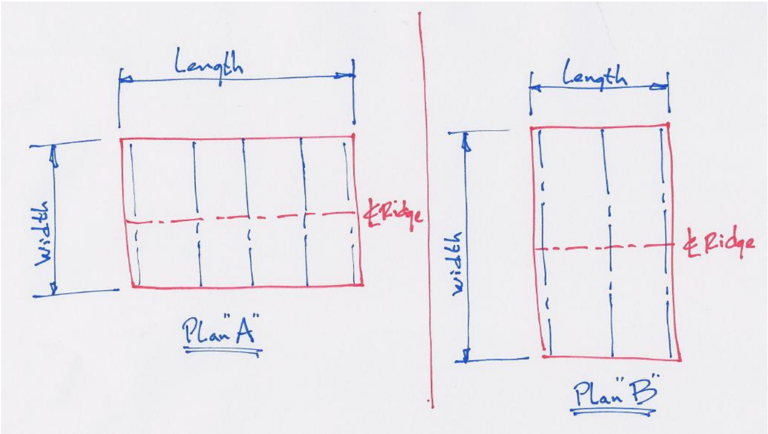
Geometry Optimization Concepts

- **The geometry** (width, length and eave height) of the building?
- **Clearances**
    - Verify the vertical and horizontal clearances that are needed and their locations. This can impact the eave height for vertical clearance and building width for horizontal clearance. Be clear to specify if clear is just at the haunch/knee area or is required throughout the entire length of the frame.
    - Sometimes it is less expensive to increase building width or eave height rather than hold stringent column or rafter depths.
    - For vertical clearances at interior areas it may be cost effective to increase roof pitch rather than raise eave height.
- **Equipment**
    - Understanding the process flow of equipment and building operations will allow the building size to be properly determined. Is there flexibility in the layout or flow?
- **Floor Space (square footage)**
    - Generally it is more economical if the smaller of the two plan dimensions is the width (frame span).

Basic Geometry

Varco Pruden standard dimensioning (width, length) is always dimensioned to the outside face of girts (steel line) and the eave height is typically measured from finished floor to top of purlin line.

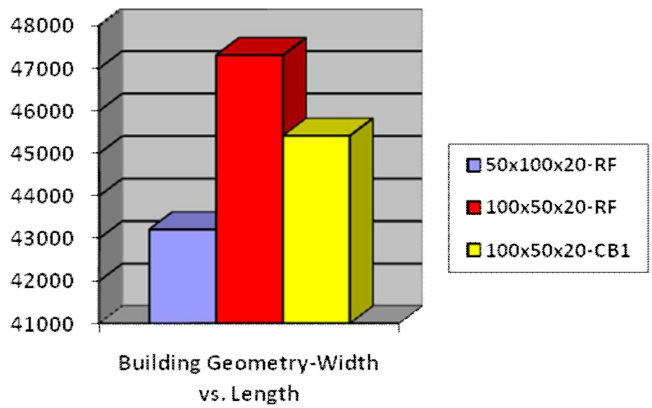
Width as the narrowest dimension - normally when inputting VP Buildings, the smallest dimension should be the width of the building. This will allow the



Plan "A" (making the lesser dimension the width) is normally more economical than **Plan "B"**. As with Geometry and other variables, results will vary depending on loading, etc. You should "run" various scenarios using VPCommand to get your desired result.

frame to have less weight, cost, and also minimize endwall cost. Standard VP nomenclature is to express the width first followed by the length and finally by the height, such as: 50'x100'x20'. This would be the VP nomenclature for a building 50' wide, 100' long and 20' height at the eave (using dimensions in 1/16" increments). [In some cases a building that is more square (equal width and length) may be more economical than a long narrow building.] Pricing your building both ways, however, in VPCommand will insure you get the best, desired result.

Inset girts could be used to obtain more horizontal clear dimension between frames with the same outside dimensions. Be sure to compare the increase in cost to the girts due to simple span condition. On larger buildings with many girts it may make sense to increase the building's overall width and length and use continuous/outset secondary to meet your clearance needs.



1-Building Loading (20psf Live, 20psf ground snow, 90mph wind)

(Note: Results will vary based upon your actual loading conditions and customer requirements inside the building.)

Roof Pitch (Single Slope, Gabled, Unsymmetrical)

- **Appearance/ Flexibility:** See Frame section for effect of changing the roof pitch on each frame type.
    - Generally, gable roof slopes are more cost effective than single slopes. (See the chart on the following pages)
    - Unsymmetrical roof pitches may be desired when one area of the building requires greater clearance than other areas.
- **Site Drainage** requirements: Verify with customer the direction(s) for the roof water drainage. A restriction in direction could dictate using a single slope roof vs. a gabled roof.

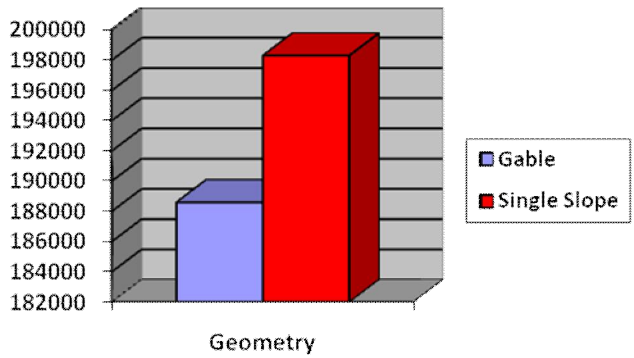
Roof Height Change or Floor Elevation Change

- For sites that are not level, it may be more economical to consider floor elevation changes or roof height changes to minimize column lengths.

Single Slope vs. Gable Slope

- Gable slope buildings are less expensive than single slope buildings in many cases.
- Gables are more economical when the building loads are heavier.
- Gables typically offer larger savings in wider buildings than narrow buildings.
- As always, building codes have some impact on this comparison.

Note: Chart shows the % increase in dollars of Single Slope buildings compared to the price of Gable buildings. All buildings represented in the chart were priced using the same geographic location (20psf Live, 20psf ground snow, 90mph wind). Pricing your buildings multiple ways using VPCommand will insure the best result.



Gable vs. Single Slope Buildings: You should "run" various scenarios using VPCommand to get your desired result.

Skewed walls (Easement requirements and/or restrictions)

- You may have to quote a skewed wall due to easement and/or site restrictions.
- This is not economical on a per square foot building cost on the building but it does offer the maximum use of the site. Sometimes VP's ability to provide skewed walls gives us a competitive edge over the competition
- Skewed endwalls are generally more economical than skewed sidewalls. Additional support beams are typically required at skewed sidewalls for purlin support at the eave.
- Irregular shapes can be modeled in VP Command for unusual site conditions.

Hips and valleys can be input in VP Command where pricing is optimized. The use of VP Command generated hips and vallies is often a competitive advantage over manual design and detailing of the structure.

- Hips and Valleys are generally more economical if symmetrical (45º), rather than skewed.
- The ability to utilize the **pre-defined shapes** in VP Command minimizes the input for the project. Custom shapes can be input as required.

Starting Eave Height for Clearances in VP Command

Many projects require a minimum or specified clearance under the frame of the building.

To get the dimension that is required is a “trial and error” procedure. There are various ways to achieve the required frame clearance on a Building using VP Command. Use the following chart to determine an additional dimension to add to the required clear dimension to get a starting eave height dimension when inputting the job into VP Command. Once the job is run, review the clear dimension designed and make and adjustments as needed. Rerun the job until you are satisfied with the dimensions.

Another method is to specify the depth of the rafter that will yield the required clearance. This method will usually result in a non-competitive (pricewise) design if you restrict the depth less than the program chooses. Input the job and transfer the project for Interactive Frame Design (IA) assistance with a note in the “frames note” section describing what you want. The designer will attempt to design the frame for what is required and return the frame to you based on the starting eave height you have input.

Request assistance from your VP Service Team to help determine the correct eave height to satisfy the requirements.

Clear Eave Height Guidelines for Input Eave Height into VPC:

<u>Guidelines for starting:</u>

Approximate frame add on dimensions to reach a specified clearance

		Live Loads				
Frame Type	*Span*	*12 psf*	*20 psf*	*25 psf*	*30 psf*	*40 psf*
Rigid Frame	30	2'-0"	2'-0"	2'-0"	2'-0"	2'-0"
	40	2'-0"	2'-0"	2'-0"	3'-0"	3'-0"
	50-60	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"
	70-80	3'-0"	3'-0"	4'-0"	4'-0"	4'-0"'
	90	3'-0"	4'-0"	4'-0"	4'-0"	4'-0"
	100	4'-0"	4'-0"	4'-0"	5'-0"	5'-0"
	110	4'-0"	4'-0"	5'-0"	5'-0"	6'-0"
	120	4'-0"	5'-0"	5'-0"	6'-0"	6'-0"
Continuous Beam						
CB-1	80	2'-0"	2'-0"	3'-0"	3'-0"	3'-0"
	100	2'-0"	3'-0"	3'-0"	3'-0"	3'-0"
	120	3'-0"	3'-0"	3'-0"	3'-0"	4'-0"
	140	3'-0"	3'-0"	4'-0"	4'-0"	4'-0"
CB-2	120	2'-0"	2'-0"	2'-0"	3'-0"	3'-0"
	150	2'-0"	3'-0"	3'-0"	3'-0"	3'-0"
	180	3'-0"	3'-0"	3'-0"	4'-0"	4'-0"
CB-3	160	2'-0"	2'-0"	3'-0"	3'-0"	3'-0"
	200	2'-0"	2'-0"	3'-0"	3'-0"	3'-0"
	240	2'-0"	3'-0"	3'-0"	3'-0"	3'-0"
CB-4	200	2'-0"	2'-0"	3'-0"	3'-0"	3'-0"
	250	2'-0"	3'-0"	3'-0"	3'-0"	3'-0"
	300	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"
Continuous Truss						
CT-1, 2, 3, 4	80-140	2'-0"	2'-0"	2'-0"	2'-0"	2'-0"
UniBeam	30-60	2'-0"	2'-0"	2'-0"	2'-0"	2'-0"
Truss Beam	30-40	2'-0"	2'-0"	2'-0"	2'-0"	2'-0"
	50-90	3'-0"	3'-0"	3'-0"	3'-0"	3'-0"
	100-120	4'-0"	4'-0"	4'-0"	4'-0"	4'-0"

If additional collateral loads are used, simply add the amount to the Live Load

Notes:

Notes:

Attachments

What appearance options will be required for the building?

Questions for the Customer

Appearance considerations for attachments

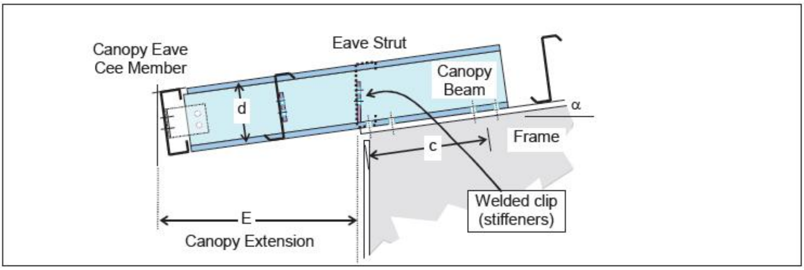
- *Piggyback canopy?*
- *Built-up canopy?*
- *Façade?*
- *Parapet?*
- *Soffit?*
- *Rake extension?*

Optimization Concepts - Appearance considerations

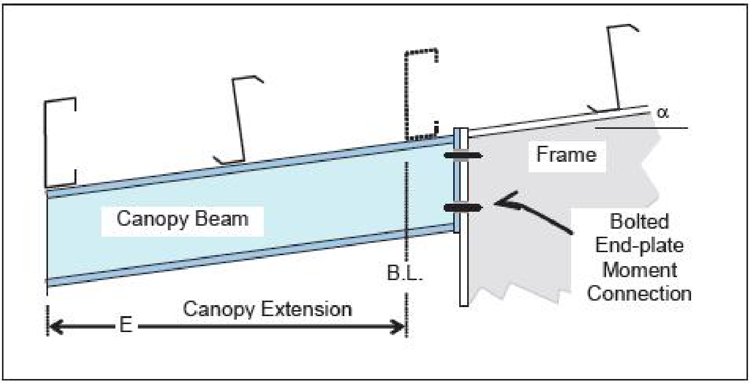
- **Piggyback canopy**
    - Piggyback canopies can be more economical than built-up canopies for canopies up to 6 ft. maximum projection.
    - Piggyback canopies with a soffit make a nice clean canopy by hiding all beams and secondary.
- **Built-up Canopy**
    - A built-up canopy requires a canopy beam and additional flashing under the canopy.
    - Not quite as clean as the Piggyback
    - A built-up canopy can span up to 20 ft. or greater. However, on the larger spans, a lean-to is more cost efficient.
    - A soffit can be installed under the built-up canopy but is not required.

Piggyback canopies are appropriate for cantilevers up to 6’ maximum projection while built-up beam canopies can extend to larger lengths. Both have advantages to be considered. For small overhangs the

Piggy Back Canopy is a better choice than the beam canopy. Piggyback canopies combined with roof extensions are cleanly trimmed and sheeted to hide primary and secondary framing.



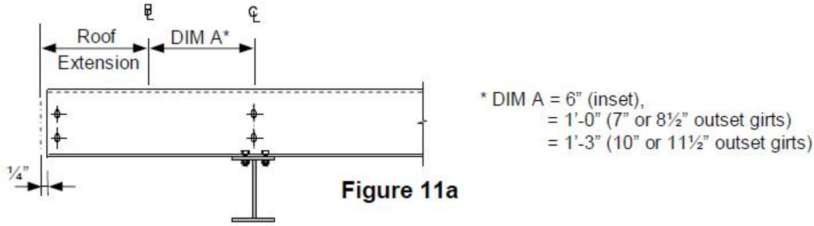
Typical Piggy-Back Canopy
From DP 2.8.1 September 3, 2010



Typical Structural (built-up) Canopy
From DP 2.8.1 September 3, 2010

Rake or Roof extension

- A Rake Extension must be on an endwall.
- A Rake extension can be cantilevered purlins or bolt on. Generally, a cantilevered rake extension can only span up to 6'. Spans beyond 6' require a bolt on extension.
- The outside edge of a rake extension does not have to be straight; they can be skewed, however, a skewed rake extension is more costly than a straight extension.
- A rake extension can be used with or without a soffit. Only add a soffit if it is required.



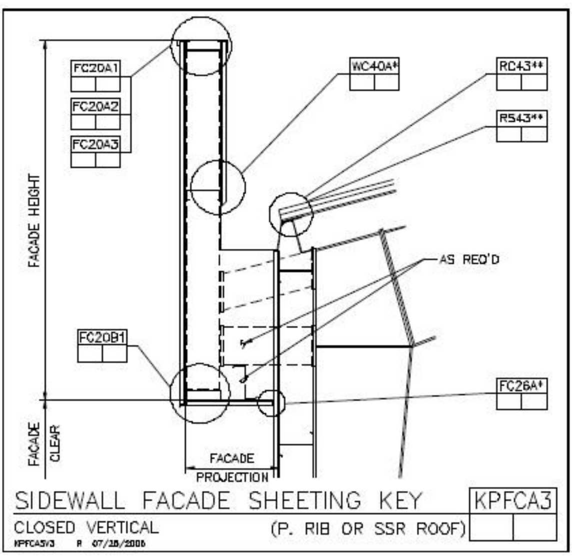
Roof Extension

From DP 4.1 September 3, 2010

Piggy-back Canopy with Rake Extension

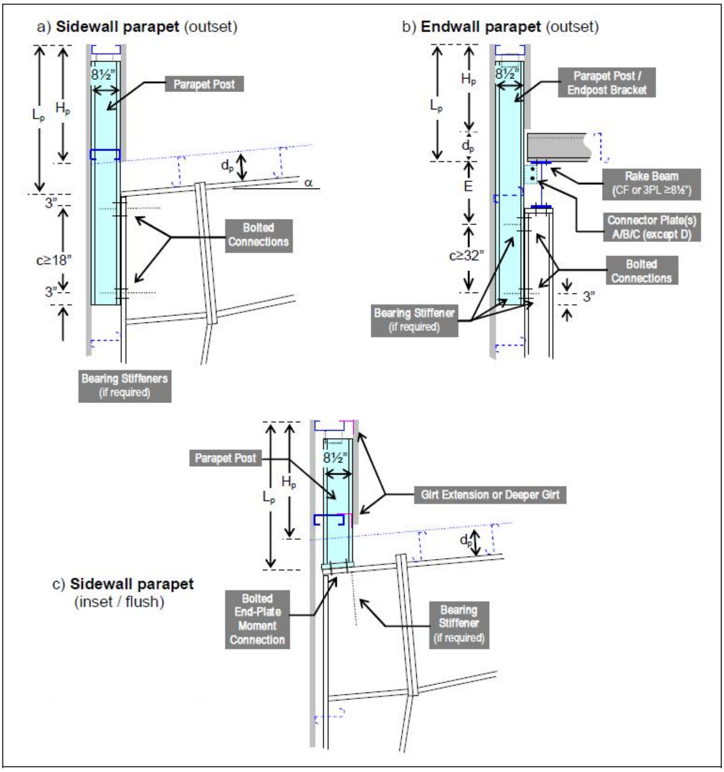
Façade

- The open façade, if allowed, is more economical than the closed façade. The open façade is held outside of the building line and standard gutters can be used. A closed facade requires multi-gutter and is considerably more expensive.
- Endwall facades are normally closed facades, but can be open if required.
- The sloped-mansard façade is generally the most expensive façade system and should be avoided when possible. It is more difficult and costly to erect.
- Many times extending the sidewall above the roofline will serve the same function as a façade at a reduced cost. (See parapets)
- When using the FSX façade a minimum projection of 2’-0” is required to keep the multi-gutter outside of the building line.



Parapet

- A parapet is a wall extension above the roofline. Typically there is no break in the wall plane.
- A parapet requires some type of back sheeting. The back sheeting can be galvalume material rather than the painted wall material.
- A parapet can be stepped rather than full height to save material on large buildings. Locate the step at a column.
- A parapet may be used instead of a Façade.
- Changing the wall girt system to an inset/outset condition with a parapet condition, can accomplish the desired look at less cost than a façade.



Soffit

- Soffits are located below canopies, rake extensions, facades, overhangs, and in building wall offset conditions.
    - Additional framing is required for the support of the soffit panels unless the soffit can be attached directly to the bottom of the purlins.
- Many panels are available for use as soffits.
    - Panel Rib and Vee Rib are the most economical panels.
    - Soffit in VPCommand is input within the **Liner** folder. VPCommand considers the panel on the back side of the main wall or roof as Liner.
    - If the majority of your canopies / rake extensions require soffit panel you should add these items to your VP Command "Default" files so that soffit will automatically be provided.

Notes:

Loading

The building will have to be designed to meet local codes and requirements, but are there any special requirements the customer will require? How does the loading impact the project?

Questions for the Customer

Site location and topography for the building (for code information)

- *Wind exposure on the site?*
- *Collateral loads (examples)?*
- *Ceiling Types (Acoustical, Plaster, etc.)?*
- *Sprinkler Lines?*
- *Lighting?*
- *HVAC Ducts?*
- *Will special deflection requirements need to be considered?*

Optimization Concepts

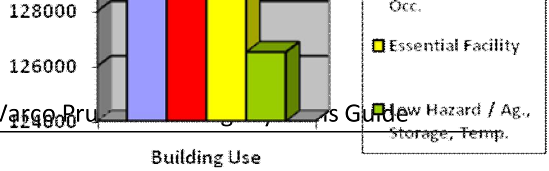
The answer to the questions allows the opportunity to consider the various aspects that pertain to loading.

Codes

- Governing Building Code: It is important to be knowledgeable about the governing code that applies to the project location.

Building Use

- The building use can impact the loading factors for the project
- Essential facilities, hazard material storage or buildings intended for high occupancy etc., will require higher load factors.
- Low hazard / agricultural buildings will decrease the cost.



Note: Building Use sampling building size 100x200x20, 20psf Live, 20spf Ground Snow, 90mph wind. As always, your specific loading and geometry will impact the price of the project.

Importance Factors

Load Type	Standard Occ.	Special Occ.	Essential Occ.
Snow	1.0	1.1	1.2
Wind	1.0	1.15	1.15
Seismic	1.0	1.25	1.5

Snow Exposure Factor
Fully Exposed = 0.90
Partially Exposed = 1.0
Sheltered = 1.1

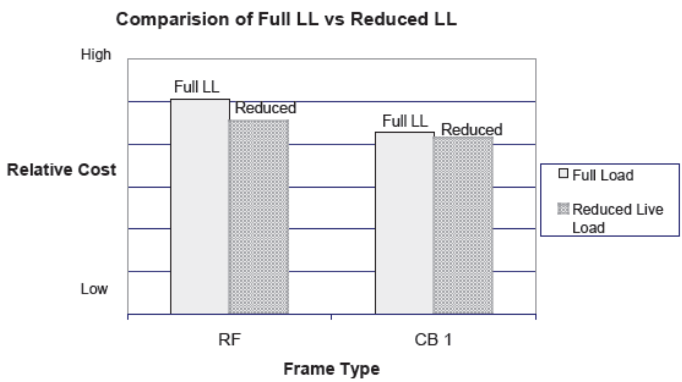
Thermal Factor
Ct = 0.85 (heated, green house)
Ct = 1.0 (heated)
Ct = 1.1 (just above freezing)
Ct = 1.2 (unheated)

Loads

- Live load (most building codes allow a 20 psf reducible live load; the snow load may govern building design.) Some local codes require something higher.
- The higher the load the higher the cost, the lower the load the lower the cost.
- If the specified live load is higher than the governing code minimum, you need to question the reasons.
- If the collateral loads are incorrectly included in the live load you need to separate them.

- Use live load reduction whenever possible to potentially reduce the cost.

All codes allow reductions (except for a few cities). Make sure you are using the loading requirements for the jobsite.



Collateral Load

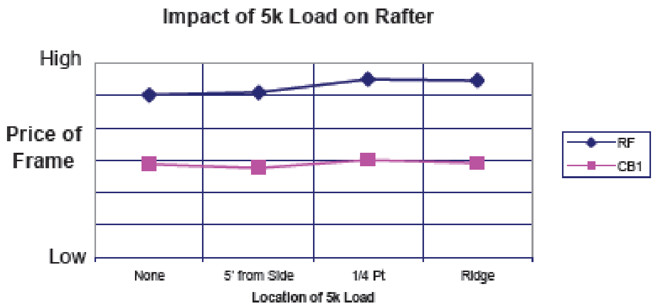
The charts related to collateral loads (shown later in this section) were taken from the "help section" of VP Command and represent typical collateral loads. This is intended as a reference only.

When the collateral loading conditions on a portion of the building differs substantially from the base collateral building load, then an area representing the difference should be input into VP Command to optimize the design. For example, a project has 5 pounds per square foot (psf) collateral load with a specific area containing 8 psf collateral load –define the area (as a special load) and add the 3 lbs - difference to equal 8. Location of the specified area for the collateral load near a frame line or interior column lowers the impact over loads placed in the center of the bay.

Special Collateral Loads and Point Loads

The chart shows the relative price of the frame with a 5 k[1] load at different locations on the rafter. (Note the clear span rigid frame shows more savings than the CB frame.) It is important to the economy of the building to locate concentrated loads near supports rather than at mid bay or span. Even more savings is possible if the loads are located near frame lines or columns.

[1] K (Kip) equal to 1,000 pounds.

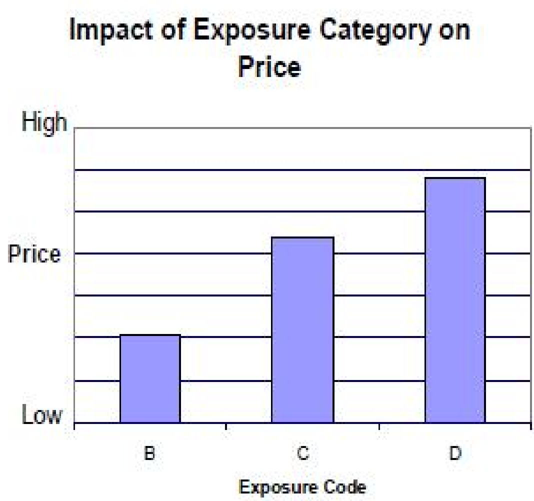


Note: Examples of special collateral loads include, sprinkler, line loads, cable trays, and catwalks. Examples of Point Loads include mechanical units, basketball goals, and scoreboards.

Wind Load

- Exposure "**B**" is defined as Urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger.
- Exposure "**C**" is defined as Open terrain with scattered obstructions having heights generally less than 30 ft.
- Exposure "**D**" is defined as flat, unobstructed areas exposed to wind flowing over open water (excluding shore-lines in hurricane prone regions) for a distance of at least 1 mile.
- Exposure "C" (open terrain) is more severe than exposure "B".
- Wind Exposure "B" generates the most cost effective designs and is acceptable for most areas of construction. Verify with your building code officials who will many times state what the exposure is for a particular job site.

- Buildings which have open walls or partially open walls must be designed accordingly. Open and partially open conditions can greatly affect the design of the building components. Consult with your VP Estimating Department.
- Horizontal drift criteria are based on a 10-year mean recurrence interval. If the project specifications call for something else, you need to contact your VP Service Center for assistance.
- Always remember that defining horizontal drift requirements can be very expensive.



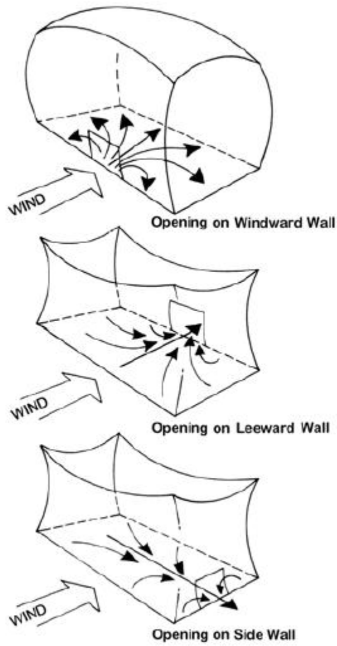


Figure A7.2.3(b)
Influences of Openings on Internal Pressure

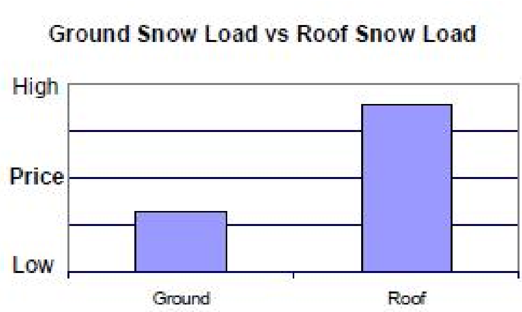
From: MBMA Manual Section A7 – Wind Load Commentary

Dead loads

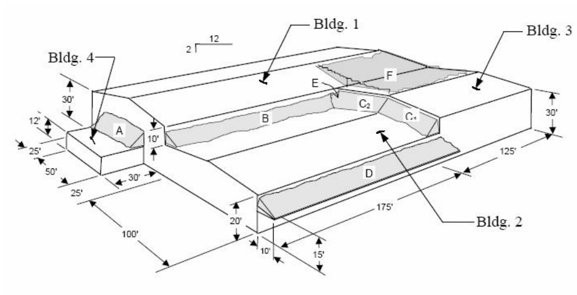
- Other roof construction impacts the dead load
- Built up deck, roof by others, rubber roof, or specific dead load included in the building specs.
- The weight of the mezzanine structure and floor system is considered dead loads.

Snow loads

- Ground snow loads and roof snow loads are not the same. Using the wrong snow load can make a significant difference in the price of the building.



- If a specification does not define the Snow Load as either Ground or Roof you need to have this clarified.
- Roof snow load is a percentage of the ground snow load.
- Specify the proper snow exposure factor (fully exposed; partially exposed; or sheltered)
- VP Command calculates the required snow build up at roof height changes which are correctly input. If a new building is to be constructed adjacent to an existing building with a higher roof, you must add adequate loading for this snowdrift or build up condition [or input a shape into VPC to represent the existing building(s)].



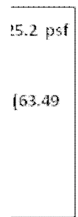


Figure 1.5.14(c)-1
Building Geometry and Drift Locations

Exposure

Note: Charts are for reference only. Your specific loading and building geometry will impact final results.

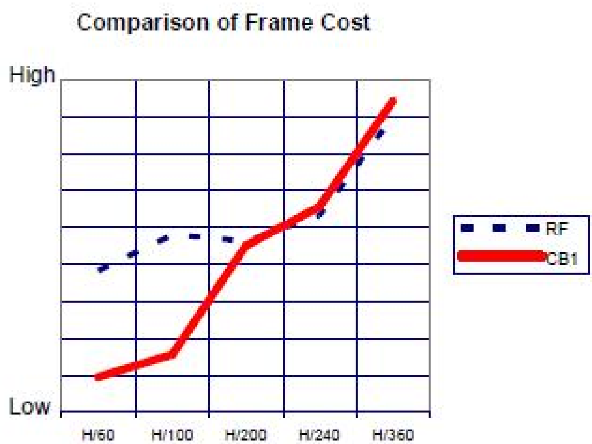
Seismic Loads

- Accurately input the seismic zone. Ss; S1; and Soil Profile.
- The additional weight of masonry and tilt walls supported by our structure adversely affects the cost of the structure in higher seismic zones.
- For larger projects with high seismic loads contact your VP Service center for additional bracing options.
- If the project has concrete or masonry walls contact your VP service center to discuss the possibility of using those walls as shear walls to reduce bracing cost.

Deflection Criteria

- Building deflection and drift requirements may greatly impact the design and cost of the structure.

- More restrictive drift and deflection requirements can increase project cost.



- VP Command Building *Loading / Loads and Codes / Deflection conditions* lists a variety of wall conditions.
- Question specs that are stricter than code
- Contact your VP support person for assistance.
- Look at partial walls impact.

Eave Height

Specified Deflection	H/60	H/100	H/200
20	4”	2.4”	1.2”
25	5”	3”	1.5”
30	6”	3.6”	1.8”
35	7”	4.2”	2.1”
40	8”	4.8”	2.4”

Allowable Movement

Lateral Deflection

Definitions and Background

There are two types of lateral deflection limits: Building drift and In-span deflection of a vertical wall.

The following are definitions that are often used with lateral deflection limits:

Bare Frame Deflection. Typical building drift or frame sidesway criteria expresses lateral movement in terms of "bare frame" deflection. Bare frame deflection considers the stiffness of the frame alone without any help from the roof or wall diaphragm or column base fixety in most cases.

Actual lateral deflections of completed buildings are less than theoretical calculations for "bare frames". The MBMA Building Systems Manual goes into great detail on this subject in Section C5.6 and Appendix A6. The MBMA Manual and the AISC's Design Guide #3 "Serviceability Design Considerations for Low Rise Buildings" both recommend using a 10-year mean recurrence wind pressure instead of 50-year when calculating lateral deflections.

Ten-Year Wind: A 10-year wind pressure can be approximated by 75% of the 50-year wind pressure. AISC's Serviceability paper explains the philosophy behind the 10-year wind: "Ten year recurrence interval winds are recommended due to the non-catastrophic nature of serviceability issues and the need to provide a standard consistent with day-to-day behavior and average perceptions. Fifty-year winds are special events."

Frame Load Sharing: Frame load sharing is an economical design method to reduce the effects of concentrated lateral loads (lateral crane loads) applied on one frame. A lateral force applied to one frame may be distributed to the frames on either side by roof rod bracing or some other physical means. Frame load sharing does not apply to lateral wind or seismic loads. Further discussion of frame load sharing will be addressed in the later section on Crane Buildings.

Load Definition Summary

Dead - Permanent load due to the weight of the metal building system itself including the roof panels, insulation, purlins, and primary frames.

Collateral - Additional dead loads, other than the weight of the building system itself, such as sprinklers, mechanical and electrical systems and ceilings. Collateral loads may be either uniformly distributed or concentrated loads and may not always be located in the same place during the lifetime of the structure.

Roof Live - Temporarily applied roof loads, typically (but not always) erection load or an unspecified minimum live load as required by the governing building code. This would be a uniform load over the entire roof area.

Alternate Span Live - Temporarily applied roof loads to adjacent or alternate spans of a continuous beam (i.e. rafter loading between interior columns). This type of loading condition could occur during erection of a building.

Snow - The load induced by the weight of snow on the structure. Unbalanced Snow- Removing one slope live load of a gable roof, and leaving load on the other side.

Wind - The pressure and suctions on wall and roof areas caused by wind velocities acting in any direction.

Seismic - The horizontal and vertical force acting on a structural system due to the action of an earthquake.

Floor Live - Temporarily applied loads on a floor such as people, furniture, machines, etc.

Floor Dead - Permanent loads due to the weight of the structure including framing, decking and flooring materials.

Auxiliary Live - All dynamic live loads such as cranes and material handling systems. Auxiliary loads are usually concentrated loads that require special design considerations.

Auxiliary Dead - Permanent dead load of cranes and material handling systems.

Rain - Loads imposed on a structure by rainwater standing or running on a roof or mixing with existing snow.

Temperature - Stresses put on building components due to changes in temperature.

D1. Notations

D	= dead load of steel framing system furnished by BlueScope (actual steel weight), crane runway systems, and dead weight of floor systems
C_g, C_u	= user specified collateral load including dead weight of ceilings, sprinklers, permanent equipment, piping, ductwork, HVAC systems, etc.
D_c	= dead weight of the crane system: runway, bridge and trolley, as applicable (see D5)
D_p	= dead weight of partitions
L_c	= live load due to crane lifted loads
L_r	= roof live load due to use & occupancy
L_F	=uniform floor live load due to use and occupancy
S	= uniformly distributed snow load (see D3)
S_d	= drifting snow load
S_p	= partial loading snow
S_r	= rain-on-snow surcharge snow load
S_s	= sliding snow load
S_u	= unbalanced roof snow load
R	= rain accumulation load (not rain on snow surcharge)
W	= wind load
Q_E	= earthquake load, base shear (V) or component force (F_p)
S_{DS}	= seismic spectral response acceleration parameter at short periods
ρ	= redundancy coefficient (=1.3, except where specific condition satisfied use 1.0)
Ω_o	= overstrength factor (between 2.0 and 3.0, except 1.25 for cantilevered systems)

Load Abbreviations

Special Loads (examples)

- Basketball Goals
- Fall Protection
    - HVAC Equipment Location
    - Cranes / Monorails
- Cable Trays
    - Future use for the building structure
    - Future Additions (Lean-to's, additional bays, etc.)
    - Future Loading Changes

Site location for the building (for code information)

- Exposure on the site (see Wind and Snow sections)
    - Possible impact from snow drift load from adjacent structures

Collateral loads (examples)

- Ceiling Types (Acoustical, Plaster, etc.)
- Sprinklers Lines
- Lighting
    - HVAC Duct

Special deflection requirements need to be considered

    - Horizontal and vertical deflection criteria greatly impact the building cost.
- *See serviceability chart for recommendations*

Future use for the building structure

- Future Additions (Lean-to's, add bays, etc.)
- Future Loading Changes

Approximate weights for collateral materials

Walls	Lbs. PSF
Brick	
4".	40
8"	80
12"	120
Hollow Concrete Block (Heavy Aggregate)	
4".	30
6"	43
8"	55
12 1/2"	80
Hollow Concrete Block (Light Aggregate)	
4"	21
6"	30
8"	38
12"	55
Window, glass, frame, & sash	55

Roofs	PSF
Copper or tin	1
Corrugated steel	See Manufacture
3-ply ready roofing	1
3-ply felt and gravel	5 1/2
5-ply felt and gravel	6
Shingles	
Wood	2
Asphalt	3
Clay tile	9 - 14
Slate 1/4"	10
Sheathing	
Wood 3/4"	3
Gypsum 1"	4
Insulation (per 1" thick)	
Loose	1/2
Poured-in-place	2
Rigid	1 1/2

The approximate weights listed are commonly used for calculating the weight of non-steel materials, per the latest **AISC manual**. Weights are measured in pounds per square foot. The above weights are average weights based on typical building materials obtained from standards accepted by the construction industry. The weights of specific materials to be used on any specific project should be verified. Weights of raw materials and material make-up vary from region to region and manufacturer to manufacturer.

Reference Figure 4.1.01

Additional Weights for use from Reference Material in VP Command

The above weights are average material weights only based on typical building materials obtained from standards accepted by the construction industry. The weights of specific materials to be used on any specific project should be verified based on the actual materials to be used.

Actual "in-place weights" should be confirmed with the Engineer of Record, or the appropriate building code official.

Note: These are Material Weights only. Any in-place weight must be confirmed with th Engineer of Record, or the appropriate Building Department.

BRICK & BLOCK MASONRY	PSF
4" brickwork	40
4" concrete block, stone or gravel	34
4" concrete block, lightweight	22
4" concrete brick, stone or gravel	46
4" concrete brick, lightweight	33
6" concrete block, stone or gravel	50
6" concrete block, lightweight	31
8" concrete block, stone or gravel	55
8" concrete block, lightweight	35
12" concrete block, stone or gravel	85
12" concrete block, lightweight	55

CONCRETE	PCF
Plain cinder	108
Plain expanded slag aggregate	100
Plain expanded clay	90
Plain slag	132
Plain stone and cast stone	144
Reinforced cinder	111
Reinforced slag	138
Reinforced stone	150

FINISHED MATERIALS	PSF
Acoustic time, unsupported per 1/2"	0.8
Building board, per 1/2"	0.8
Cement finish, per 1"	12
Fiberboard, per 1/2"	0.75
Gypsum wallboard, per 1/2"	2
Marble and settign bed	25 to 30
Plaster, per 1/2"	4
Plaster on wood lath	4.5
Plaster suspended with lath	8
Plywood, per 1/2"	10
Tile, glazed wall 3/8"	1.5
Tile, ceramic mossaic 1/4"	3
Quarry tile, 1/2"	2.5
Quarry tile, 3/4"	5.8
Terrazzo, 1" in stone concrete	8.6

GLASS	PSF
Polished plate, 1/4"	3.28
Polished plate, 1/2"	6.56
Double strength, 1/8"	26 oz.
Sheet A, B; 1/32"	45 oz.
Sheet A, B; 1/4"	52 oz.
Insulating glass, 5/8" with airspace	3.25
Wire, 1/4"	3.5
Glass block	18

LIGHTWEIGHT CONCRETE	PSF
Aeorcrete	50 to 80
Cinder fill	60
Expanded clay	85 to 100
Expanded shale-sand	105 to 120
Perlite	35 to 50
Pumice	60 to 90
Vermiculite	25 to 60

MORTAR & PLASTER	PCF
Mortar, masonry	116
Plaster, gypsum, sand	104 to 120
Plaster, gypsum, perlite, vermiculite	50 to 55

ROOFING	PSF
Built-up	6.5
Concrete roof tile	9.5
Copper	1.5 to 2.5
Corrugated iron	2
Deck, steel without roofing or insulation	2.2 to 3.6
Shingles, ashphalt	1.7 to 2.8
Shingles, wood	2 to 3
Slate, 3/16" to 1/4"	7 to 9.5
Slate, 3/8" to 1/2"	14 to 18
Stainless steel	2.5

STONE (ASHLAR)	PCF
Granite, limestone, crystalline	165
Limestone, oolite	135
Marble	173
Sandstone, bluestone	144
Slate	172

STONE VENEER	PSF
2" granite, 1/2" parging	30
4" granite, 1/2" parging	59
6" limestone facing, 1/2" parging	55
4" sandstone or bluestone, 1/2" parging	49
1" marble	13
1" slate	14

SUSPENDED CEILINGS	PSF
Mineral fiber tile, 3/4" x 12" x 12"	1.2 to 5.7
Mineral board, 5/8" x 24" x 24"	1.4
Acoustic plaster on gypsum lath base	10 to 11

Strength and Serviceability

Building codes and specifications require that every building be designed to satisfy two fundamental criteria – strength and serviceability.

Strength

The building must be designed with adequate strength to resist all environmental and user-imposed loads without structural failure. Structural failure is generally defined as a condition in which one or more of the structural elements of the building lose their ability to resist the forces that they are required to carry in order to maintain the integrity of the building. Structural failures often result in significant problems ranging from roof leaks to total collapse and can pose a threat to property and life.

Serviceability

Each structural system within the building must be designed to provide appropriate serviceability. This means that the structural systems must be able to perform their intended functions without interfering with the buildings operations. For example, a floor system must be designed with the appropriate amount of stiffness. In some cases, when the designer has failed to adequately consider this issue, floor vibrations have been so perceptible that building occupants have refused to work in the building.

In most cases serviceability problems don't represent any immediate danger of structural failure. However, serviceability problems have the potential to significantly reduce a building's usefulness. Therefore, serviceability considerations are often equally as important in the design of a building as its strength.

The AISC's Design Guide #3 "Serviceability Design Considerations for Low Rise Buildings" describes the difference between the two limit states and gives some guidelines.

The serviceability limits on the following pages are recommended guidelines for the design of building components and are based on the AISC's Design Guide #3 "Serviceability Design Considerations for Low Rise Buildings." These values may be overridden by any specifications, applicable local building code criteria, or owner's choice. The criteria set in this document provide recommendations for customer consideration.

Most buildings are required to have an "Engineer of Record" who assumes the responsibility for the building. She is registered to practice engineering in the building location and is responsible for sealing the building documents for the governing municipality. Normally she will specify with the owner's consent the serviceability requirements for the building. When she does not, the only governing measure for design is the governing codes and good engineering practice.

B. BLUESCOPE SERVICEABILITY RECOMMENDATIONS

Component	Loading [3, 8]	Limit
PRIMARY STEEL FRAMES & ROOF / JACK BEAMS **(Solid Web, Open Web & Hot Roll)**		
General	D + 50% Roof Snow ≥ D + 5 psf	Drainage [1]
Supporting Metal Roof or Membrane	Roof Snow or Roof Live or 70% Wind	L/180
Supporting Roof & Ceiling Grid	Roof Snow or Roof Live or 70% Wind	L/240
Supporting Roof & Plaster Ceiling	Roof Snow or Roof Live or 70% Wind	L/360
SECONDARY FRAMING **(Cold Formed Purlins, Truss Purlins, Hot Roll, Built Up, & Bar Joists)**		
General	D + 50% Roof Snow ≥ D + 5 psf	Drainage [1]
Supporting Metal Roof [4]	Roof Live Roof Snow or 70% Wind [6]	L/150 L/180
Supporting Roof & Ceiling Grid	Roof Snow or Roof Live or 70% Wind [6]	L/240
Supporting Roof & Plaster Ceiling	Roof Snow or Roof Live or 70% Wind [6]	L/360
Supporting Membrane Roof [4]	Roof Snow or Roof Live or 70% Wind [6]	L/180

Component	Loading [3]	Limit
STEEL ROOF PANELS & DECK		
Steel panels exposed to weather	Roof Snow or Roof Live or 70% Wind [6]	L/60
Deck w/ membrane or other covering	Roof Snow, Roof Live, or 200 lb Concentrated (1 ft sq)	L/240
LINTEL BEAMS or HEADERS		
Vertically Supporting Walls	Wall Dead Load	L/600 ≤ 0.3" Max or 1° rotation max
FLOOR BEAMS [5]		
Supporting Floor Only	Live Load Live Load + Dead Load	L / 360 L/240
Supporting Floor & Ceiling	Live Load Live Load + Dead Load Dead Load	L / 360 L/240 L / 360 ≤ 1"
Supporting Floor & Plaster Ceiling	Live Load + Dead Load	L / 360 ≤ 1"
Supporting Floor & Partition	Live Load Live Load +Dead Load 50% Live Load	L / 360 L/240 ≤ 3/8 to 1" [2]

Table Notes:

1. Insure positive drainage of roof under load.
2. For moveable and de-mountable partitions refer to the partition manufacturer for additional limits.
3. For deflection design, BlueScope will use code live loads (L or L_r) or uniform snow load (S) as defined by the Code for strength analysis, unless deflection criteria are specified in contract documents.
4. Bar joists that are governed by SJI provisions shall have a maximum deflection of L/240.
5. One inch under the weight of wet concrete + steel deck + steel floor framing
6. Components and cladding wind.
7. 70% wind load factor (also part of IBC footnote) accounts for 50-to-10-year MRI conversion.
8. For Canadian applications the "SLS" factor is 0.75 for wind, and 0.90 for snow loads. Replace 70% Wind with 75%. Similarly, use the reduced snow load (90%) in all instances where Roof Snow is listed.

from: DP 06-02 February 2, 2010

Component Loading Limit 1,3

Notes:

- Deflection limits are based on information obtained from AISC's Design Guide #3 "Serviceability Design Considerations For Low Rise Buildings,"1990.
- Insure positive drainage of roof under load.
- Refer to applicable Building Code for other deflection limits.
- For moveable and de-mountable partitions refer to manufacturer for additional limits.
- Recommended minimum roof slope of ¼: 12 for Standing Seam roofs and ½: 12 for exposed fastener roofs.

Serviceability Recommendations

The following are recommended lateral deflection limits without addressing the serviceability needs for seismic loading.

B. BLUESCOPE SERVICEABILITY RECOMMENDATIONS

Component	Loading[3, 10]	Limit
PRIMARY LATERAL LOAD RESISTING SYSTEM (FRAMES & BRACING) [3, 6, 9]		
Supporting Metal Walls	10 Year Wind	H / 60
Supporting Unreinforced Masonry		1/8" Crack[1]
Supporting Reinforced Masonry		H / 100 [2]
Supporting Concrete Precast/Tilt-up Panels		H / 100
GIRTS, BEAMS, GIRDERS, SPANDREL WALL SUPPORTS [4]		
Supporting steel walls or foam core systems	0.7 x Component & Cladding Wind Loads OR Seismic Loads[7] $= 0.5 \times F_p$	L / 90
Supporting flexible finishes		L/120
Supporting brittle finishes		L/240
Supporting Masonry, Concrete Tilt, or Precast Wall		L / 240 < 1-1/2"
ENDPOSTS & SOLDIER COLUMNS		
Supporting steel walls or foam core systems	0.7 x Component & Cladding Wind Loads	L / 120
Supporting flexible finishes		L / 120
Supporting brittle finishes		L / 240
Supporting Masonry, Concrete Tilt, or Precast Wall [5]		L / 240 < 1-1/2"
STEEL WALL or FOAM CORE PANELS	0.7 x Component & Cladding Wind Loads	L / 60

Notes:

1. 1/8" crack at base of wall with joint control, 1/16" if no joint control. The size of the base crack is defined as: $C = t\Delta/H$
   Where: t = Wall thickness (in)
   Δ = Wall drift from base to top (in)
   H = Wall height (in)
   This criterion could be expressed as a ratio of the wall height as follows.
   $\Delta max = H/(t/C)$
   Where: C = Allowable base crack size (in)

These serviceability limits are intended to prevent excessive cracking in the wall caused by flexure resulting from deflection-induced curvature in the wall. Proper base detailing refers to wall base details that will promote crack formation at the base thus resulting in rotation about the base and limiting curvature related wall flexure. Refer to the AISC Design Guide Series No. 3 for a more detailed discussion.

2. H/100 with consistent base details, H/200 otherwise. (See note 1 for description of proper base details).
3. This serviceability criterion does not apply to earthquake loading unless specifically noted. See Section A.3 above.
4. Spandrel or girt deflections are not considered to be additive to the overall building drift. Each is treated separately.
5. Wind column criteria pertain to horizontally reinforced walls supported by end posts or soldier columns.
6. Building drift limits apply to diaphragm deflection as well as rigid frame drift
7. Wall support deflection criteria under seismic loading is not specified by code. BlueScope standard is established based on engineering judgment and recommendations of Structural Engineers Association of California (SEAOC) Vision 2000 (1995). Full seismic design loads are extremely rare events which is unnecessarily expensive for serviceability criteria. The 50% x F_p load is still a rare event but is the BlueScope recommended deflection criteria for wall support members under seismic loads. F_p loads are per ASCE7 Section 12.11.1 or other code equivalents.
8. Loads used to check deflection are service loads (i.e.- prior to applying load combination factors for ASD, LRFD, or LSD combinations). Serviceability loads are the same for ASD, LRFD methods.
9. For seismic drift limits and applicability of Code prescribed limits see DP 1.4.6 (Section J).
10. For Canadian applications the "SLS" factor is 0.75 for wind loading. Replace 0.7 Wind with **0.75** Wind.

from: DP 06-02 February 3, 2010

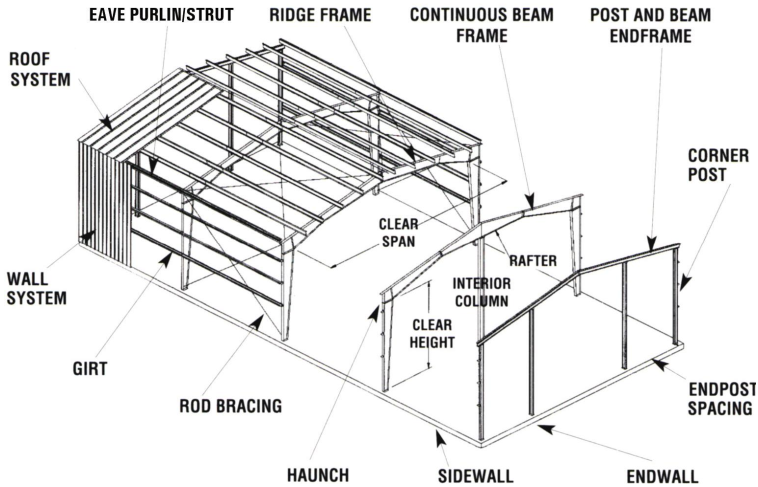
Notes:

Notes:

Notes:

Notes:

Frames:


EAVE PURLIN/STRUT
RIDGE FRAME
CONTINUOUS BEAM FRAME
POST AND BEAM ENDFRAME
ROOF SYSTEM
CORNER POST
CLEAR SPAN
RAFTER
INTERIOR COLUMN
CLEAR HEIGHT
WALL SYSTEM
GIRT
ROD BRACING
ENDPOST SPACING
HAUNCH
SIDEWALL
ENDWALL

Frames

The answers to the questions in this section are vital to the economy of the building. The decisions on framing will greatly affect the project price.

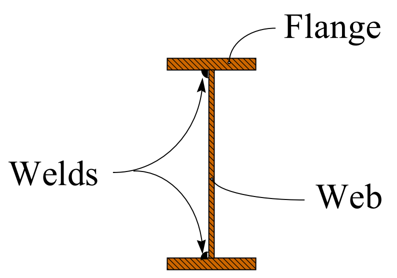
Questions for the Customer

- *Can we use the most economical framing system and bay spacing?*
- *Are there any clearance requirements (horizontal and vertical)?*
- *Can we use the most economical interior column spacing and configuration (pipe, tube, three-plate)?*
- *Are there any restrictions or preferences that would control the selection of Solid Web over Open Web framing? (lighting, mechanical equipment distribution, inside clearances.)*
- *Are there special access requirements for the building (entry, loading dock , specialty doors)?*
- *Can we use the most economical frame design for the roof pitch?*
- *Do you have any limitations/restrictions for the exterior columns (configuration, depth, tapered, straight, supermarket, etc.)?*
- *Can columns be flange braced to walls not by VP?*
- *Are the wall systems load-bearing?*
- *Identify column base conditions and elevations?*
- *Do you expect future expansions to affect the endwall and sidewall design?*

Frame Optimization Concepts

General

Bay Spacing: Optimize the bay spacing for the length of the building. Bay space economy is clearly defined by the best overall building price. In some cases the bay spacing may favor one parameter for the frame spacing and another for the girt and purlin spacing. When you look at the overall building you can design for the overall maximum economy. These charts look at the total building price. They show comparisons for a building 100'x216'x20'. The RF-0 and CB1-0 is for a Ground Snow Load = 0 and the RF-30 and CB1-30 for a Ground Snow Load = 30 psf.



Three-Plate Member

Description:

The term "frame" refers to the main/primary structural system or skeletal structure of the building.

Frames consist of two main types:

Clearspan (Rigid Frame, Rigid Truss): Offers open, unobstructed interiors for optimum space use.

Modular (Continuous Beam, Continuous Truss): Utilizes interior columns for rafter support to give an economical structural system for wide buildings.

Frames contain two main parts:

Column: A fabricated solid web member used in a vertical position to transfer loads from the rafters to the foundation. This member also supports the wall system (secondary and covering).

Rafter: A fabricated member that is the main beam supporting the roof system (secondary and covering).

<u>Buildings contain end frames and interior frames:</u>

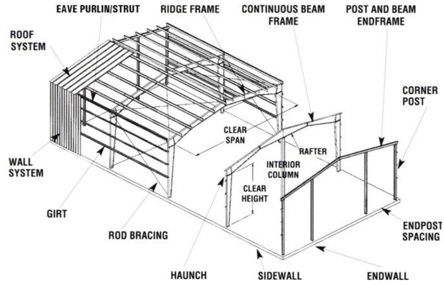
End Frames: These are located at each end of the building. Available end frame types include: post & beam, half-load and full-load. Only a full-load frame is designed for future expansion. Both the half load and full load end frames may or may not have end posts. End frames are discussed in more detail in the section called Endwall Framing.

Interior Frames: Located at interior bays of the building, interior frames are full load frames.

Frames General Information:

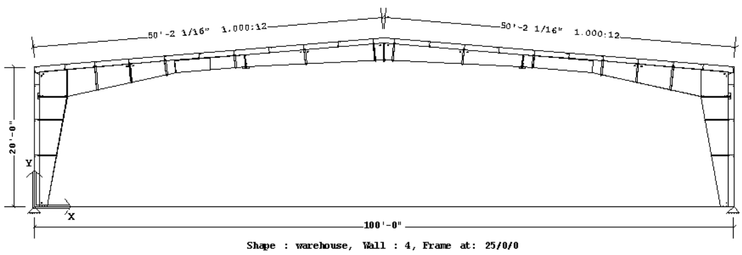
VP Buildings' frames normally consist of tapered (angled, non-parallel flanges) or straight rafters connected to tapered or straight vertical solid web columns. The frames may be designed with a centered ridge, off-center ridge, or as a single slope. Eave heights and spans are dimensioned in increments of 1/16" - within manufacturing limitations. Frames are built with variable roof pitches, as determined by Roof Covering types.

Any sidewall girt placement can be utilized, including outset, inset, or flush mounted. This topic will be covered in greater detail in the "Secondary Framing" section.



Rigid Frames (RF):

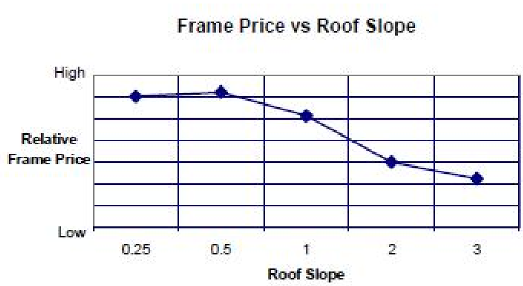
There appears to be some economy in the total building cost of the lighter loaded building around 32'. In the heavier loaded building there appears to be some economy at the 24' bay spacing and again at the 32' bay spacing. Two points show up due to the secondary gauges.



Rigid Frame (Clear Span) Solid Web

Rigid Frame (RF)

- Reducing column depth will increase horizontal drift.
- Horizontal drift can be reduced with fixed base columns. Fixed base columns could increase foundations costs.
- Use only where interior columns are NOT allowed.
- Roof pitch up to 3:12 *may* be more economical than lesser-pitched roofs on some clear spans. This can have a major cost effect on heavier loaded buildings and some larger clear spans.



- 2:12 is generally an optimum roof pitch on normal width rigid frames.

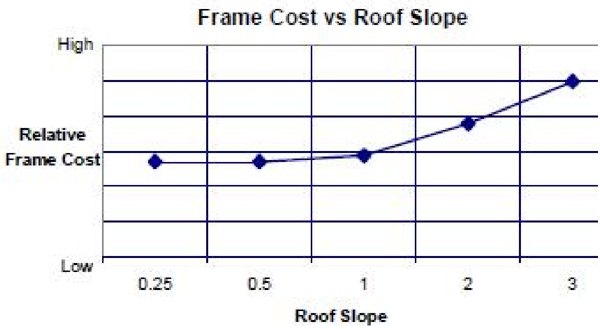
CB-1 Frames

The lighter loaded CB shows some economy at the 24’ bay size and again at the 34’ bay. The heavier loaded frame shows economy in the bay spacing at the 32’ bay space.

Continuous Beam (CB)

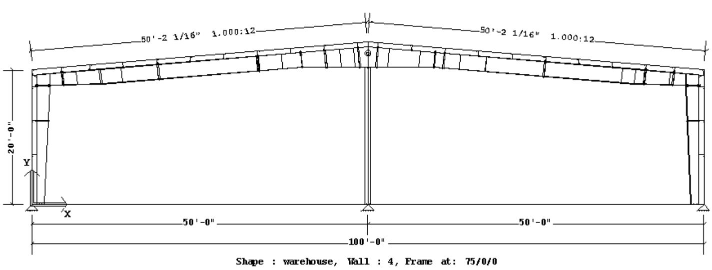
- Good solution for building of any size span where interior columns are allowed.
- In general, the more you reduce the span of a member (frame span, girt and purlin span, etc.) the more you reduce the cost – up to a certain point.
- Remember to consider the additional labor and foundation involved with adding interior columns.
    - The optimum interior column spans will usually be between 40’ and 70’ based on geographic region and building loads. Generally, adding interior columns that create spans less than 30’ are **NOT** economical.
    - Decreasing the span from the sidewalls to the first interior column relative to the interior spans will usually reduce frame costs.
    - Optional interior tube column may be the most economical on interior column lengths exceeding 35 feet.
    - Eliminating exterior columns when there are load bearing masonry walls can be an economical option with CB frames.
- In general, CBs are more economical with lower pitch roofs down to ¼:12.
    - As the eave height increases it becomes more feasible to increase the interior column spacing.

- Horizontal drift can be controlled by



fixing the tops of interior columns (often fixing only the first interior column from each sidewall is the most effective)

- Fixing the base of interior columns is an additional method of reducing horizontal drift but will increase foundation costs.



Continuous Beam (CB-1 Shown) One Interior Column

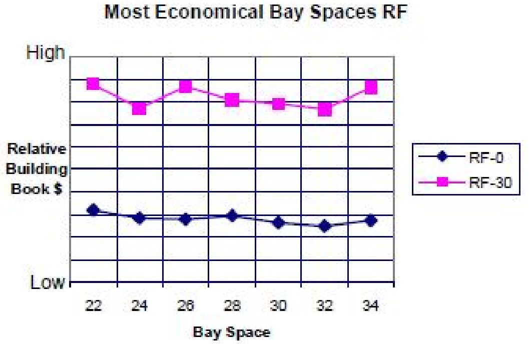
Continuous Beam Frames

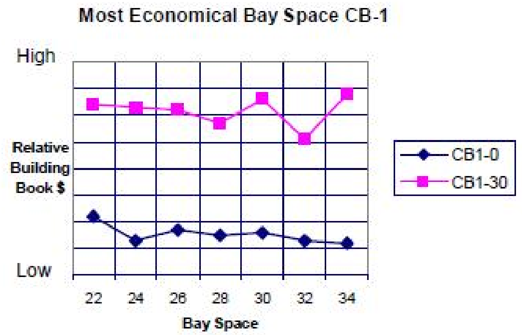
Sugar Grower's Warehouse-Lemartec Engineering & Construction

RF vs. CB-1 Conclusion

The most economical bay space is determined by a combination of factors. Span, eave height, bay space, and loading all influence the outcome of the most economical choices. With VP Command it is easy to run several comparisons and determine how the framing should be designed for the most economy.

If possible make the end bays smaller than the interior bays to decrease the loading on the members





and thus lowering the cost of the secondary and the frames.

Interior Columns used with Interior Frames

Interior columns (at Continuous Beam [CB] or Continuous Truss [CT] frames) exist solely to support something – a rafter, or a crane, or simply a girt – but their proper application is critical. As taught in our Product Seminar, the more you reduce the span of a member, the more you reduce the cost – up to a certain point. For example, placing an interior column in the middle of a 200'-0" spanning frame will significantly decrease the cost of that frame under nearly any loading condition. Adding a second interior column can reduce the cost further. Your loading (Live, snow, etc.) will dictate what interior column spacing makes sense for your specific project. A project in Georgia (with less snow) can have greater interior column spacing than one in Maine – if cost is the driving factor.

It is important to remember that while you may be reducing the cost of your frame, you must consider the additional material and labor cost involved in the foundation and erection of the additional columns. Thus, saving a few hundred dollars on a frame may not justify what you will ultimately spend for total in-place cost and may even lose in flexibility in having the additional interior columns.

Figures 1 and 2 below show the pricing results for Continuous Beam frames containing interior columns at varying spacing under 70 psf and 10 psf Ground Snow respectively. Note that these are for interior frames. ***Generally, Interior column spacing should never be less than 30'-0 and preferably around 40'-0 or greater dependant upon your loading and project needs***.

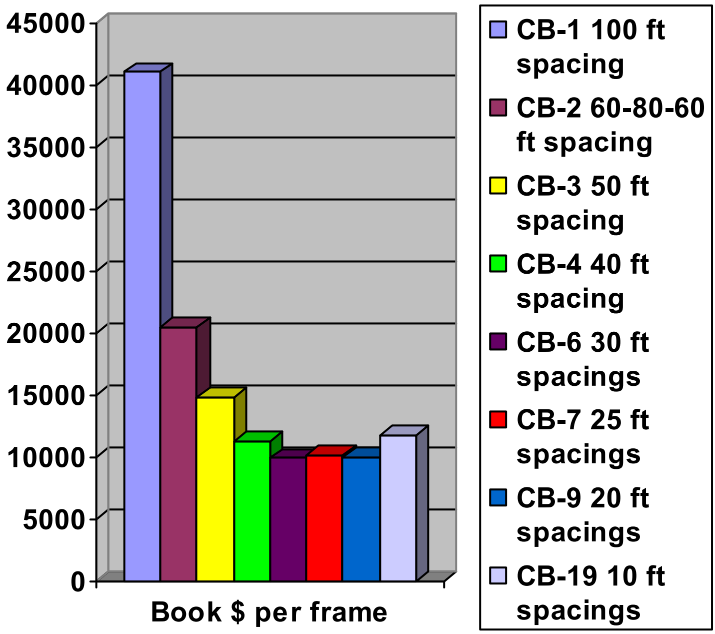


Figure 2: IBC 2006, 10 psf Ground Snow

200w x 250 l x 20 eh – 25'-0 bay spacing

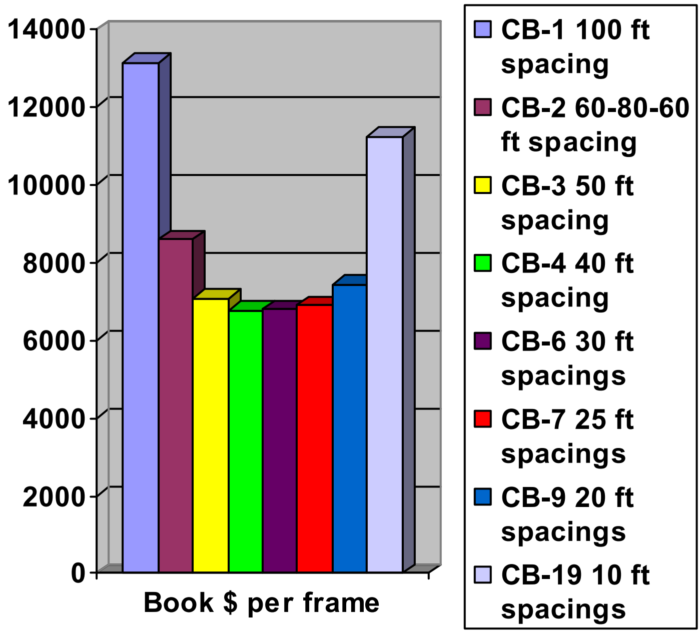


Figure 2: IBC 2000, 10 psf Ground Snow

200w x 250 l x 20 eh – 25'-0 bay spacing building must be considered. CB or CT frames with Interior columns at an economical (and logical) spacing combined with "endposts" is a much better option than using a CB frame with Interior Columns spaced as you would for a typical endframe: for example, 24'-0 center span with 25'-0 spans approaching the sidewalls.

With these endframe conditions in mind, let's talk about interior column orientation. Standard Interior column (IC) orientation at interior frames with three-plate columns is for the IC web to run in the same direction as the main frame (web perpendicular to the sidewall (fig. 3). When ICs are used at an endframe for girt attachment, the column is "turned" or rotated 90 degrees so that the web is now perpendicular to the endwall (fig. 4).

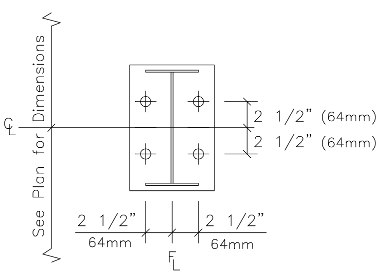


Figure 3: IC detail at interior frame

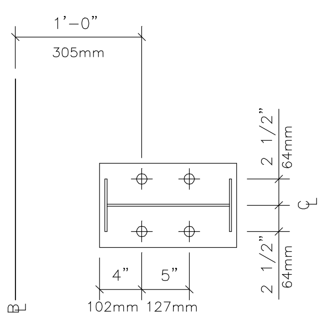


Figure 4: IC detail at end frame

Interior Pipe and Tube Columns

Tube columns may be used at endwalls (as an endpost) when there is a showroom condition with lots of glass, however it is not economical in normal conditions with girts and metal wall panels.

Tube and pipe, but particularly tube, become more cost effective at interior columns on taller buildings

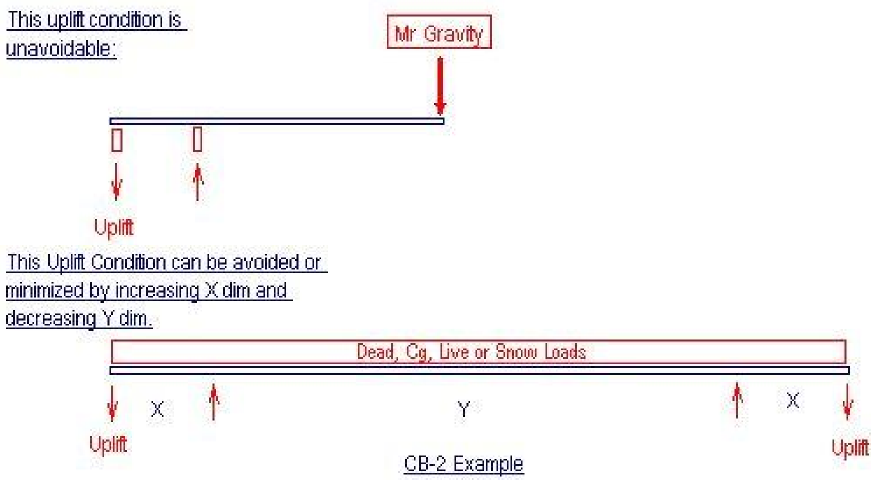


Figure 5: Similar to a "diving board"

where the interior column length exceeds somewhere around 28 feet. At these conditions, it is advisable that both options (tube and three-plate) be run through VPCommand to see which is most economical or more desirable.

Interior Column Spacing near Sidewalls

If an interior column is located too near an exterior column, undesirable and excessive uplift forces may result at the exterior column due to gravity loads – think of a diving board as shown in figure 5 below.

Summary

If you find a situation where you require a vertical supporting member near a sidewall column such as at a shopping center walkway or other, instead of locating an interior column consider using Rigid Frame with an Endpost (or endpost at a CB frame), or even a Rigid Frame with a Lean-to – or other frame keeping in mind not to locate an Interior Column too close to the sidewall column. Remember to consult your VP service Center for assistance. Use the design expertise available to you.

Take advantage of the fast, reliable design of frames in VPCommand. Run alternates with varying interior column spacing keeping in mind that less expensive is not always what suits your customer's needs, but you have a powerful tool in VPCommand and creating different scenarios are quite easy.

Frame Span

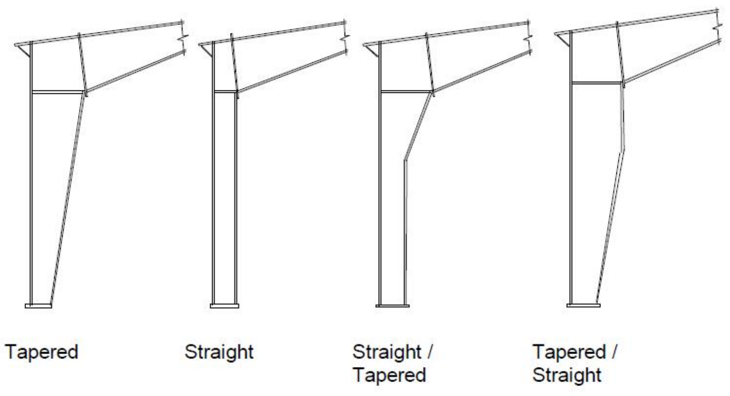
Try to span the frames the shortest dimension of the building to reduce cost. See Basic Geometry section.

Frames and Roof Slope

Generally buildings with symmetrical gabled roofs are less expensive than those using single slope.

Exterior Column Shapes

- Reducing column depth will increase horizontal drift.
- Horizontal drift can be reduced with fixed base columns (Interior &Exterior).
- Fixed base columns will increase foundations costs.



VP Standard Exterior Columns (Cornerpost not shown)

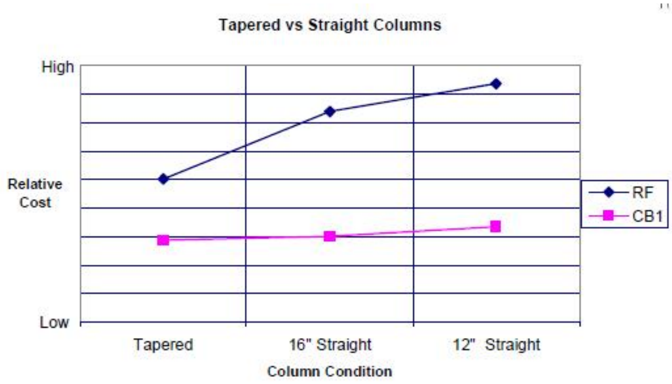
Tapered Column

- The tapered column is usually the most economical shape.

- Consider using with depth restrictions in lieu of straight columns.

Straight Column

- Straight columns are always more expensive than tapered columns
- The shallower the column depth, the more expensive it will be.
- Use vertical bolted columns at all straight and step columns.



Straight-then-tapered (supermarket columns)

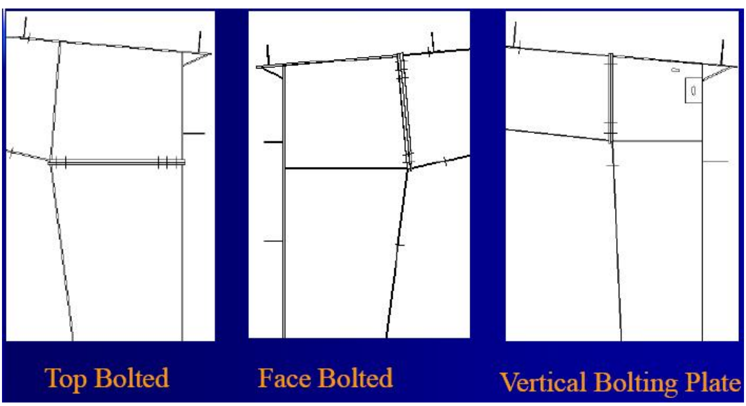
- Use in lieu of straight columns.
- Consider where there is a depth restriction for a certain height and then can be relaxed perhaps above a ceiling or in a supermarket.
- The column type is most economical when the tapered portion is at least 4’ long.

Tapered then Straight Column

- Use when horizontal clearances are dictated in the upper portion of the building such as buildings with cranes.

Rafter to Column Connection

VP's standard column-to-rafter connection will be top bolted unless otherwise specified otherwise by the VPCommand user or designer. If you input a portal brace or portal frame in VPC you will automatically receive the Face bolted connection. You will see the vertical bolting plate option usually when column depth restrictions and roof pitch require such.

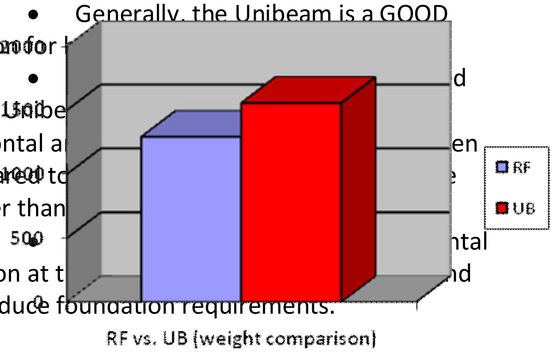


Typical Column to Rafter Connection (Top Bolted is usually Standard)

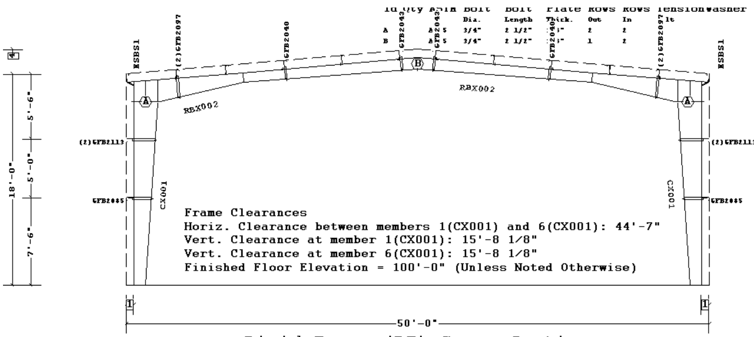
Other Frame Types

UniBeam (UB)

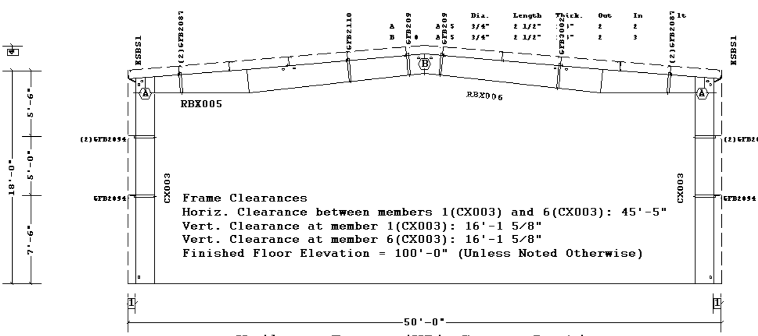
- Generally, the Unibeam is a GOOD solution for …
- … d utilize Unibe…
- Horizontal a… en compared to… e greater than…
- … ntal reaction at t… nd will reduce foundation requirements.



Sample: Building 50 W x 100 L x 18 EH Rigid Frame has less material Weight and therefore less cost under this loading condition. Run scenarios under your specific loading to receive accurate results for your needs.



Rigid Frame (RF) Cross Section

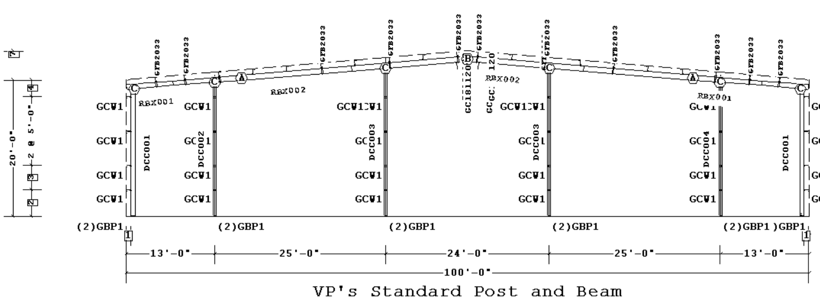


Unibeam Frame (UB) Cross Section

Rigid Frame (RF) vs. Unibeam (UB) Frame Cross Sections from previous example. The UB frame costs more, but gives more Horizontal (45'-5" UB vs. 44'-7" RF) and Vertical (16'-1 5/8" UB vs. 15'-8 1/8")Clearance.

Post and Beam (PB)

- They are most economical when it is designed with gauge material.
    - Consider endpost spacing other than VP Standard spacing for economy. VP's standard endpost spacing is 12'-6" off the ridge (24'-0" center span), 25'-0" intermediate spacing, and whatever is left over less than 25'-0".
    - Reduce spacing to use 7" girts.
    - If 8-1/2", 10, or 11 ½" girts are required expand the spacing to accommodate.
    - If possible, use the same end post spacing at each endwall for most economical bracing design.
    - Use rod bracing between endposts to avoid half-load frames at endwalls with sheeting not by VP, without sheeting, or with large openings.
    - Whenever possible align the end post with the purlins.
    - Post and Beam frames are designed as "pinned" connections as opposed to the "rigid" connections of Rigid Frames, Continuous Beam Frames, etc. Being "pinned" connections the Post and Beam relies on the sheeting and girts for stability. If too much sheeting/girt area is removed



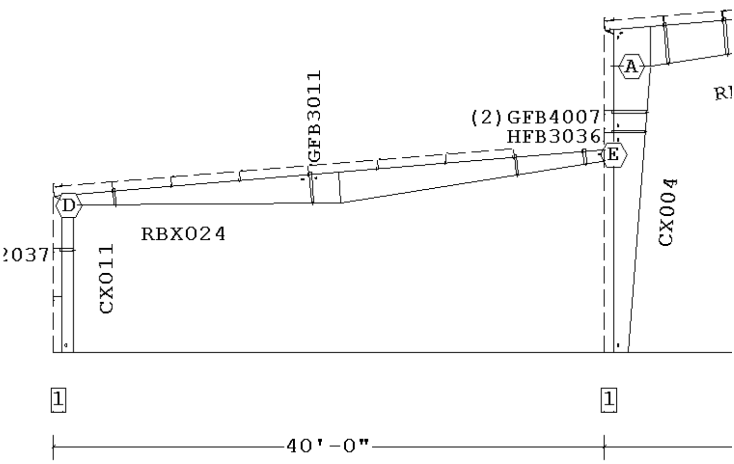
VP's Standard Post and Beam (24'-0" center Endpost span, 25'-0" intermediate Endpost spans)

you must consider a "Half-load" endframe such as a RF or CB with Endposts (or open web framing as desired), or bracing between endposts. Consult with VP engineering for assistance.

- For Future Expansion you may use any frame except a Post and Beam.

Lean –to (LT)

- Consider using a Lean-to at eave with a rigid frame consider using a CB-1 frame. When the lean to span is wide in relation to the building width this option may be more economical.
- Continuous Lean-tos with interior columns are useful for larger Lean-to spans.



Below Eave Lean-To frame shown

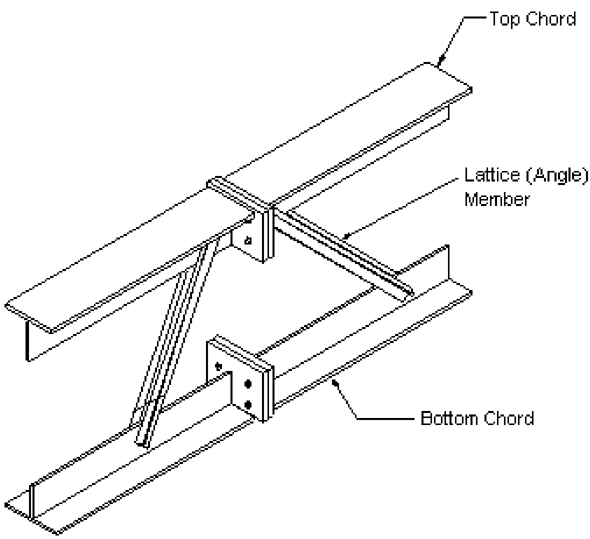
Jack Beam

- Used to eliminate a column and to create open spaces. Contact your service center for pricing and design.

- Interior Jack Beams allow the use of purlins rather than bar joist. This also permits the use of Panel Rib roof covering where bar joist would require SSR covering.

Open Web Frames (Wind Bents and Truss Frames)

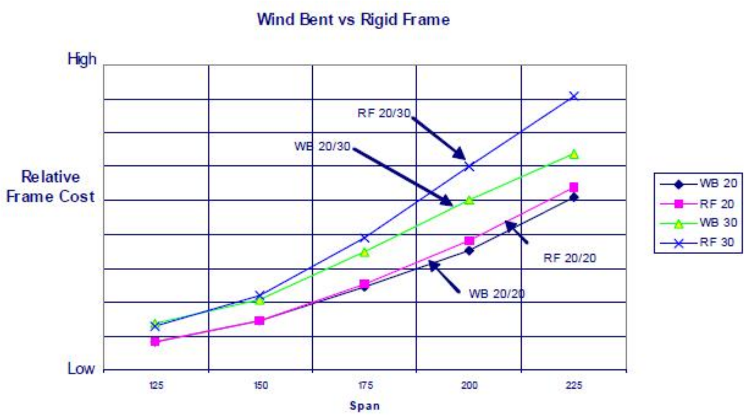
- Excellent frame choice for large clear spans (such as arenas, hangars, sporting complexes, etc.) and heavy loadings.
  - Open Web frames couple the span economy with other benefits of the frame type, which allow for better lighting distribution and



Open Web Framing

mechanical equipment distribution and the frame type is a clear choice.
  - This chart was developed for Wind Bents and Rigid Frames for spans of 125’, 150’, 175’,

200’, 225’ foot spans starting on the left and going to the right of the chart. The 20/30 lines were for 20 psf LL and 30 psf snow load (SL). The 20/20 are for 20 psf LL and 20 psf SL. The bays are all 25’ and the roof pitch was 1:12. It appears the Wind Bent becomes more economical in the 125’ to 150’ span area for these conditions. For other conditions, the optimum span may vary with roof pitch, loads and other conditions.



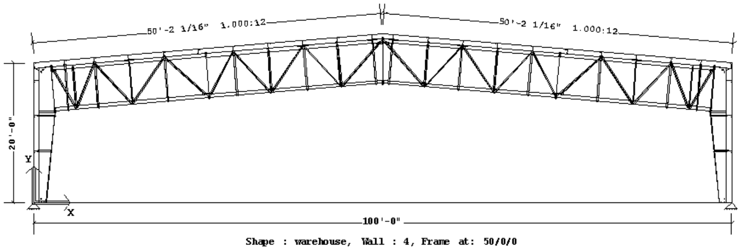
- This frame type is useful when strict vertical deflection requirements exist, such as hangars with large doors.
- Installing mechanical equipment, lighting and sprinklers through web openings can lower eave heights.
- This framing system helps reduce lighting requirements and improves ventilation/air flow.
- Consider sending Open Web frames to Interactive Frame Design (IA) for optimization when there are restrictions for depth, or requirements for interior clearances.

- Good framing system to use as an alternate when a conventional framing system (bar joist) look is required.
- Any depth restriction on the truss will affect the costs.
    - Open Web frames offer a selling advantage against other pre-engineered manufacturers.

Open Web Frames – General Industries, Charleroi, Pennsylvania
Photo courtesy of Don Ivill

Wind Bent

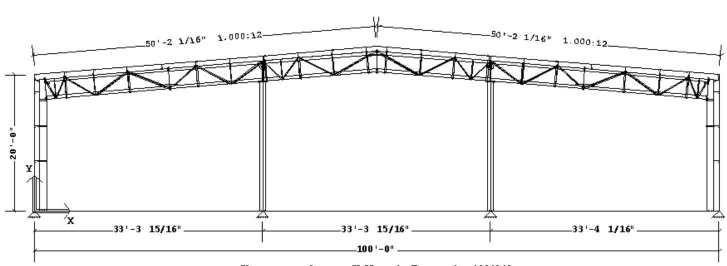
Wind Bent is available with both tapered columns and straight columnsm with tapered being the default. A Wind Bent is a clear span frame with open web rafters. The Wind Bent is also termed a Rigid Frame Truss and CT-0 (Continuous Truss with zero interior columns).



Wind Bent (Rigid Frame Truss) Open Web Clear Span

Continuous Truss

Continuous Truss (CT) is a good solution for building with interior column spacing of more than

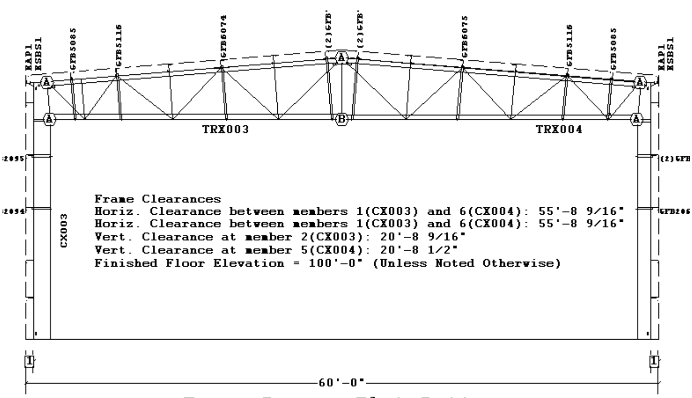


Continuous Truss (CT-2 Shown) Open Web

60'and heavy loading. In CT frames decreasing the span from the sidewalls to the first interior column relative to the interior spans will usually reduce frame costs. CTs are available with both tapered columns and straight columns with tapered being the default.

Truss Beam

Truss Beams (TB) produce smaller horizontal reactions at the base of the column, which may reduce foundation costs. The **Truss Beam and Rigid Frame** have similar costs for comparable conditions when comparing loads and spans. The other benefits of the open web frame type may offer advantages to the project for installation of lighting and mechanical equipment placement. TBs are available with both tapered columns and straight columns with tapered being the default.



Truss Beam - Flat Bottom

Truss Beam with Flat Bottom shown

Frame Cost Comparisons:

The below frame comparisons are based on a building geometry of 180 W x 400 L x 20 EH; 30 psf GS, 90 mph Wind, 20 psf Live.

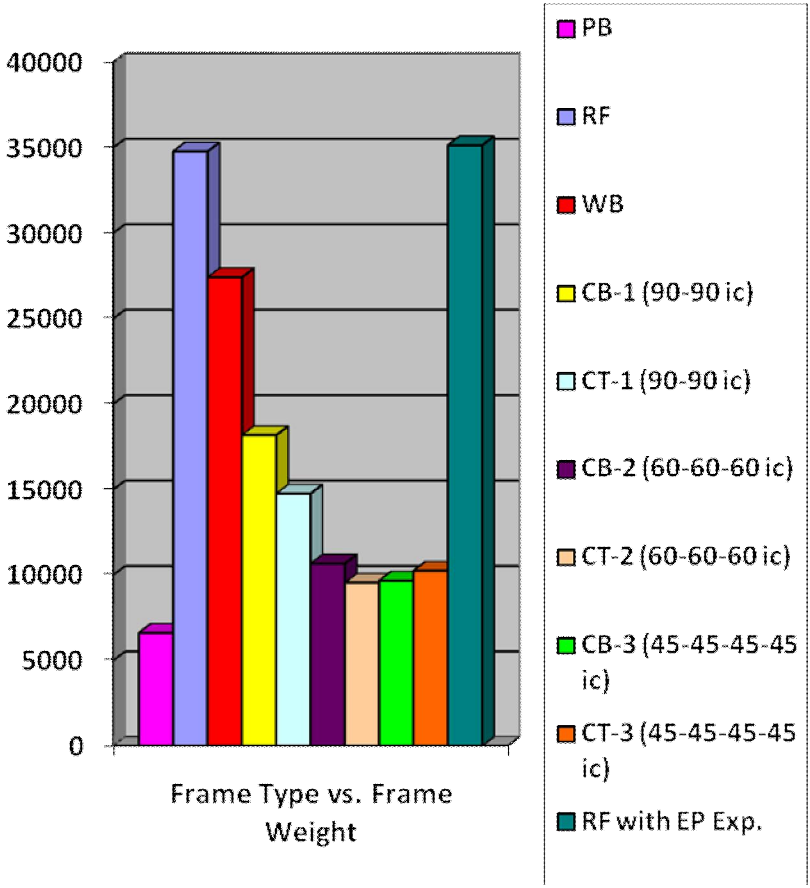
The more steel, the higher the cost - Open Web framing is more economical than Solid Web the larger the tributary area and the heavier the loads. As Interior Columns are added, the tributary is reduced, thus the difference in price between open and solid lessens until the trend is reversed and Solid Web becomes less expensive.

If you are uncertain what frame type to use or interior column is best with continuous beam and continuous truss frames, you can input a building into VP Command, locate various frame types throughout your shape (I used PB, RF, WB, CB-1, CT-1, CB-2, CT-2, CB-3, CT-3, RF w/EP). In my example the CT-2 with Interior Column spacing at 60-60-60 might be desired for it econimical value, ease of erectibility, and open web benefits (placing ducts, wiring, etc. in ewb area).

Remember that results vill vary depending upon your actual geometry and loading conditions.

Open Web Feature:	Open Web Benefit
No interior columns required.	Allows flexibility to create unobstructed interior floor space for building spans of 300'± with no interior support columns required.
The Continuous Truss rafters are open web design.	This allows for the placement of HVAC ducts, sprinkler systems, and electrical to be placed in the continuous truss spaces. This can lower the building height

Open Web Feature:	Open Web Benefit
	required to achieve inside clearances thus reducing the overall construction costs of the building. Less time is potentially required to install the HVAC, sprinklers and lighting.
Improved lighting with lower costs.	Improved lighting dispersal for better interior visibility as in the case of a wide span area. (ex. ice rinks)

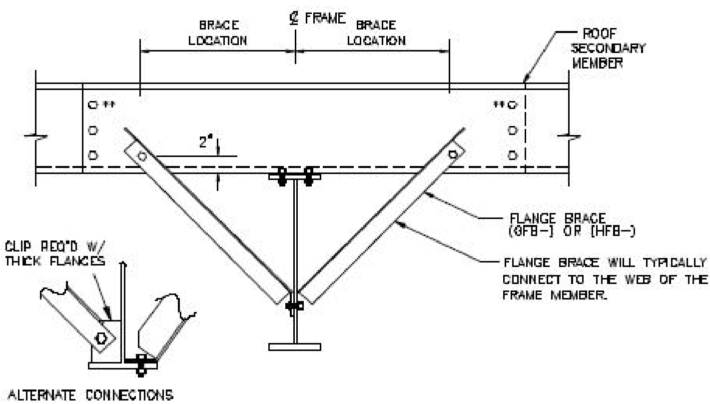


Frame Type vs. Frame Weight:
The greater the weight the greater the cost.

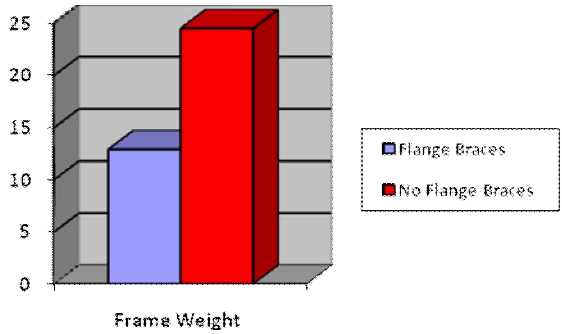
Flange Bracing

Use flange bracing wherever possible to reduce frame costs due to unsupported condition; for example on masonry walls and on liner panels (requires positive attachment to strong element).

Eliminating flange braces on rafter sections is very costly. For rafter conditions that are boxed use flange braces on one side to reduce box width.



Flange Bracing



Frame Weight – Flange Braces Allowed vs. No Flange Braces Allowed – In This Example (100 W x 200 L x 20 EH, CB-1, 20 psf ground snow, 90 mph wind) the frame weight nearly doubled.

Masonry Load Bearing Walls

Where a masonry load-bearing wall exists consider eliminating a frame line, or a column. At masonry load bearing endwalls attach a ledger angle to support the roof purlins thereby eliminating the endframe.

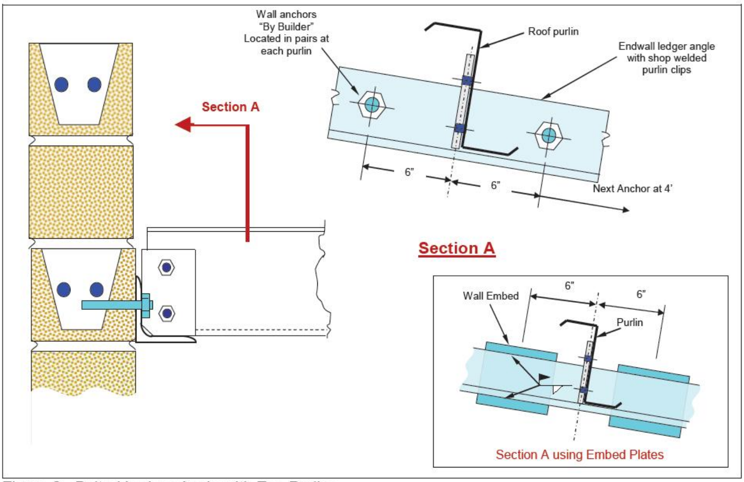


Figure 2 - Bolted Ledger Angle with Zee Purlins

Common Purlin Ledger Angle Detail
(From: Dp 12.4, p 4 of 10, May 2010)

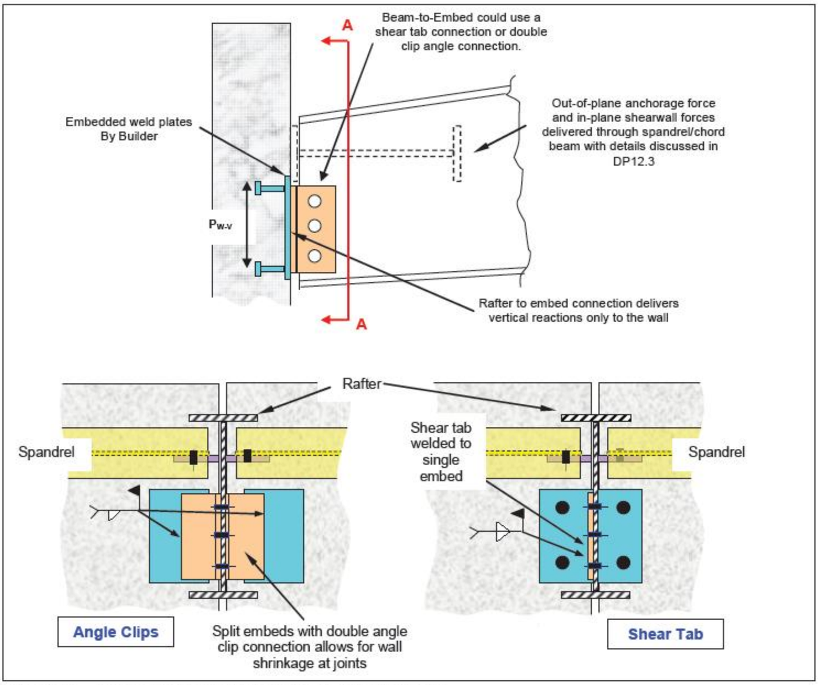


Figure 6 – Frame Web Shear Connection to Wall

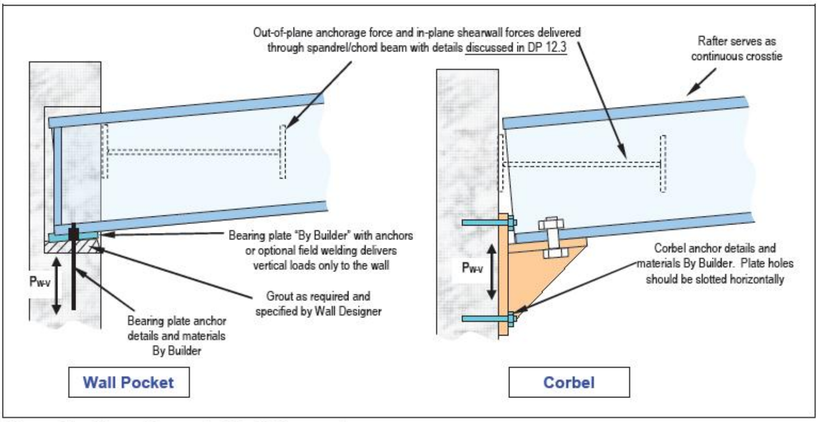


Figure 7 - More Frame-to-Wall Connections

Figures 6 and 7 from: DP 12.5Pages 5 and 6 June 2010

Primary Framing Basics

Primary Framing Feature:	Primary Framing Benefit:
Eave heights greater than 60 feet (subject to building code restrictions).	Your project will be designed to meet your requirements without limitations of any "standard" or predetermined building dimensions. For example, your frames can be designed to accommodate special inside clearances.
Bay spacing flexibility.	Equal or unusual bay spacing of up to 60' with each space being designed to meet your unique specifications and requirements. For Bays >30' soldier columns may be required.
Single slope frames.	Allows the water to drain off the low eave of the building.
Non-symmetrical ridge frames.	For special interior clearance requirements due to machinery or equipment.
Multiple column configurations	This allows you to provide the maximum usage of interior space to

Primary Framing Feature:	Primary Framing Benefit:
available.	meet the owner's requirements.

Notes:

Notes:

Cranes

When cranes are involved in the project, get as much information about the equipment as possible, including the intended use of the cranes.

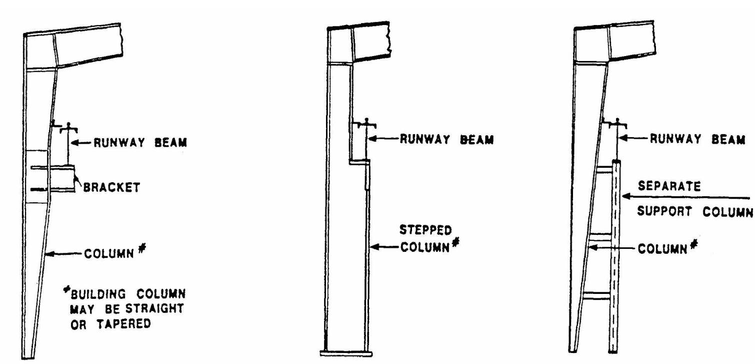
Questions for the Customer

- *Will this building have any crane(s) now or in the future?*
- *If there are multiple cranes will they be operating in the same bay at the same time?*
- *Has the crane(s) manufacturer been determined? If so, is the crane data information sheet available? If not, whom should I contact for detailed crane information?*
- *Who supplies crane accessories & support members (beams, stops, rails etc…)?*
- *What is the crane layout and traveling direction?*
- *Can we use bracing between the interior columns (are there any work flow concerns that would prevent interior bracing)?*

Crane Optimization Concepts

- Make sure you know the classification of the crane (A,B,C,D,E,F – See **Crane Service Classifications** at the end of this section.)
- Know as much as you can about wheel loadings, bridge weight, trolley weight, crane operations, type, clearances, etc. in order to get the best price on the buildings. (See order clarification form) or crane data sheet from supplier.
- Different classifications of cranes dictate the deflection and drift on the building and crane girder system. If a higher classification is used than is required, the price of the building will be impacted.

- Remote controls have the same impact on the building as cab operated. Use pendant controls in lieu of remote controls if possible.
- All buildings with class E or F should be priced by the VP Buildings' Estimating Group.
- Position the crane with the bridge spanning the width of the building rather than the length for best cost.
  - In most cases, smaller bay spacing will be more economical.
  - Smaller cranes can be supported on brackets, larger cranes require independent crane columns or step columns or hybrid-laced columns. Contact your Service Center for additional information.
  - Underhung cranes are supported by the rafter. Top running cranes are supported on brackets or columns. Generally top running crane systems are less expensive than underhung crane systems.



Common Crane to Column Connection

Crane Systems

Serviceability Recommendations

Component Loading Limit 1,3

A. BLUESCOPE SERVICEABILITY RECOMMENDATIONS

Deflection criteria for the design of crane systems and buildings supporting cranes shall be as recommended below.

Table 1 **VERTICAL DEFLECTION**

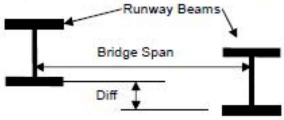
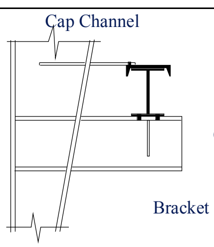
Component	Loading	Limit [1]
CRANE RUNWAY BEAM or Intermediate Support Beams		
Supporting Underhung or Monorail Crane:		
Class A, B or C	Crane Vertical w/o impact	$L_B / 450$
Supporting Top Running Bridge		
Class A, B or C	Crane Vertical w/o impact	$L_B / 600$
Class D	Crane Vertical w/o impact	$L_B / 800$
Class E & F	Crane Vertical w/o impact	$L_B / 1000$
JIB CRANE BOOM	Crane Vertical at End of Boom w/o impact	L / 225
STEEL FRAME (Rafter Vertical Defl.) [4]		
Frames supporting underhung or monorail crane running <u>NORMAL</u> w/ frame. Class A, B or C	Crane Vertical w/o impact	At bracket loc; [5] $(BS_L + BS_R) / 450$
Frames supporting underhung or monorail crane running <u>PARALLEL</u> w/ frame. Class A, B or C	Crane Vertical w/o impact	Throughout Rafter $L_R / 450$
	<u>And</u> Crane Vertical w/o impact + $+\begin{Bmatrix} 0.5\,S \;\ldots\; 13\,\text{psf} < p_g \le 31\,\text{psf} \\ 0.75\,S \ldots\; p_g > 31\,\text{psf} \end{Bmatrix}$	$L_R / 240$
Bracket to bracket differential deflection. 	Crane Vertical w/o impact + $+\begin{Bmatrix} 0.5\,S \;\ldots\; 13\,\text{psf} < p_g \le 31\,\text{psf} \\ 0.75\,S \ldots\; p_g > 31\,\text{psf} \end{Bmatrix}$	$\frac{Diff_{Max}}{\text{Bridge Span}} / 240$

Table 2 **LATERAL DEFLECTION**

Component	Loading	Limit [1]
STEEL FRAME (Bare frame analysis)		
Pendent Operated Crane	Crane Lateral at Runway Elevation [2] or	H / 100 ≤ 2"
Cab Operated Crane	10 Yr Wind	H / 240 ≤ 2"
CRANE RUNWAY BEAM	Horizontal Deflection	L_B / 400
RUNWAY SUPPORTS [3]		
Total Differential Inward Movement	D + 50 Yr Snow	½ inch
Total Differential Outward Movement	If $p_g \le 13$ psf → N/A If13 psf > $p_g \le 31$ psf → 0.5 S If $p_g > 31$ psf → 0.75 S	1 inch

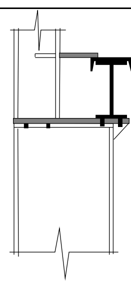
Table Notes:
1. L_B = length of crane support beam from support to support.
   L_R = frame rafter length (column to column)
2. H = drift at runway elevation, however drift at eave height may be used in analysis. Ref AISC Design Guide #3 and AISE Tech Report #13.
3. Lateral differential movement between runway supports (center to center of rail) shall be limited.
4. Vertical deflection for frame design is evaluated independently of runway beam deflection (i.e.- deflection criteria is not additive).
5. BS_L; BS_R = Bay space on left and right side of supporting frame respectfully.

from: DP06-04 February 3, 2010



Top Running Cranes

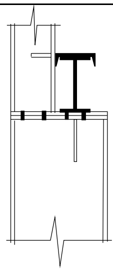
Cranes up to 15 tons



Top Running Cranes
w/ Stepped Column
Alternate Method

Cranes up to 20 tons

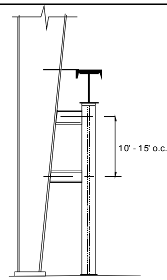
Fixed Base columns sometimes required



Top Running Cranes w/ Stepped Column

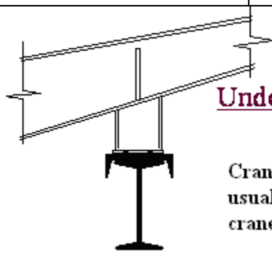
Cranes over 20 tons

Fixed Base columns sometimes required



Top Running Cranes w/ Auxiliary Column

Cranes over 20 tons



Underhung Cranes

Crane up to 10 tons usually small span, light crane systems

Crane Aisle

Crane Service Classifications

2.9.1 Crane Service Classifications

The description of Classifications E and F are for informational purposes only. For design or manufacture of buildings containing cranes with these classifications, see Section 2.11 and "Guide for the Design and Construction of Mill Buildings", AISE Technical Report No. 13 (Ref. B4.15).

Class A (Standby or infrequent service)

This service class covers cranes used in installations such as powerhouses, public utilities, turbine rooms, motor rooms and transformer stations where precise handling of equipment at slow speeds with long, idle periods between lifts are required. Capacity loads are handled for initial installation of equipment and for infrequent maintenance.

Class B (Light service)

This service covers cranes used in repair shops, light assembly operations, service buildings, light warehousing, etc. where service requirements are light and the speed is slow. Loads vary from no load to occasional full rated loads with two to five lifts per hour, averaging 10 feet per lift.

Class C (Moderate service)

This service covers cranes used in machine shops or paper mill machine rooms, etc. where service requirements are moderate. In this type of service, the crane handles loads which average 50 percent of the rated capacity with five to ten lifts per hour, averaging 15 feet, not over 50 percent of the lifts at rated capacity.

Class D (Heavy service)

This service covers cranes used in heavy machine shops, foundries, fabricating plants, steel warehouses, container yards, lumber mills, etc., and the standard duty bucket and magnet operations where heavy duty production is required. In this type of service, loads approaching 50 percent of the rated capacity are handled constantly during the working period. High speeds are used for this type of service with 10 to 20 lifts per hour averaging 15 feet, not over 65 percent of the lifts at rated capacity.

Class E (Severe service)

This type of service requires a crane capable of handling loads approaching a rated capacity throughout its life. Applications may include magnet, bucket, magnet/bucket combination cranes for scrap yards, cement mills, lumber mills, fertilizer plants, container handling, etc., with twenty or more lifts per hour at or near the rated capacity.

Class F (Continuous severe service)

This type of service requires a crane capable of handling loads approaching rated capacity continuously under severe service conditions throughout its life. Applications may include custom designed specialty cranes essential to performing the critical work tasks affecting the total production facility. These cranes must provide the highest reliability with special attention to ease of maintenance features.

From: MBMA Manual Section II - Cranes

Notes:

Notes:

Bracing:

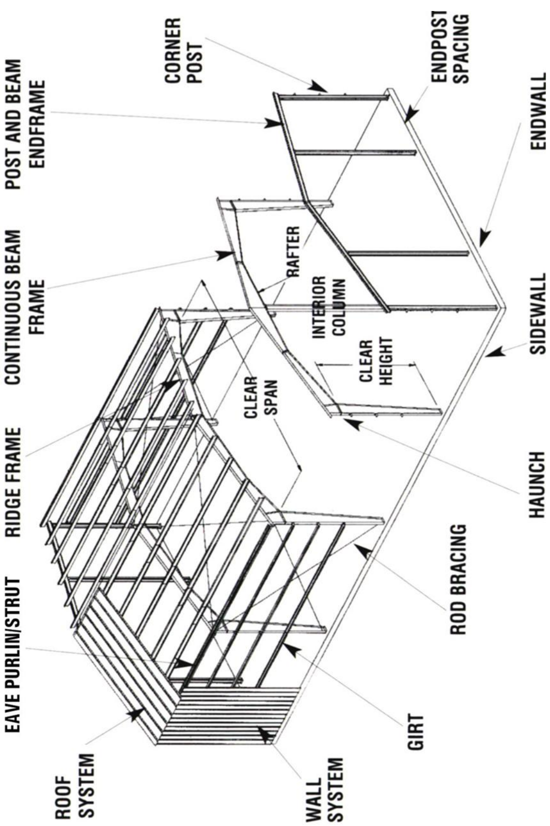
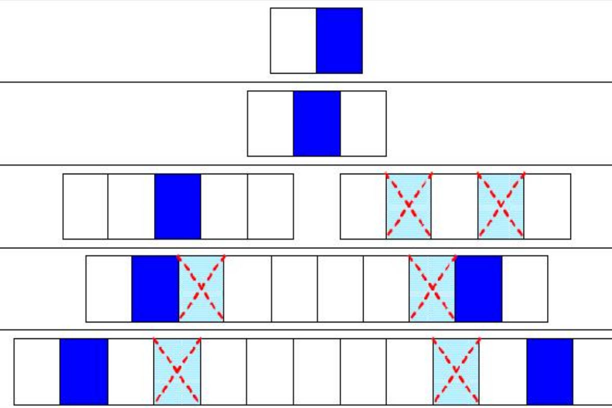
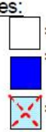

POST AND BEAM ENDFRAME
CORNER POST
CONTINUOUS BEAM FRAME
RIDGE FRAME
EAVE PURLIN/STRUT
ROOF SYSTEM
WALL SYSTEM
GIRT
ROD BRACING
HAUNCH
SIDEWALL
ENDWALL
ENDPOST SPACING
RAFTER
INTERIOR COLUMN
CLEAR HEIGHT
CLEAR SPAN

Table 2 Location of braced bays

Number of bays (n)	Braced Bays: Minimum (default)	Braced Bays: Additional (if more than min. is required)	Roof or Wall Plane
< 3	any one		
3	middle		
4 - 7	middle	2, n-1	
8 - 12	2, n-1	3, n-2	
> 12	2, n-1	4, n-3	



Notes:



= Bay not braced

= Braced bay – primary locations. For available BBNA lateral-force resisting systems see DP 5.4.
The same DP section also explains the permissible combinations of framing systems

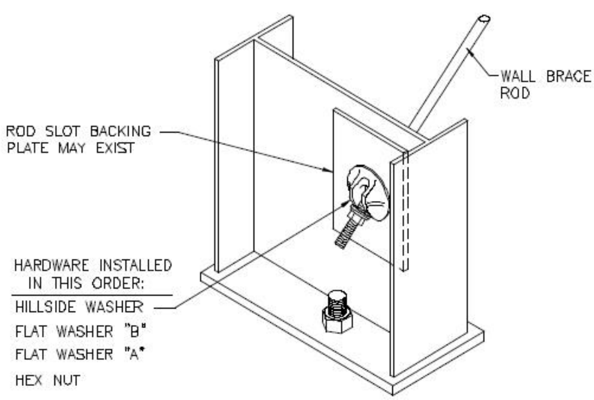
= Braced bay location when additional bays of bracing are needed

Bracing

All buildings require bracing. In this section we want to determine the most economical type and what flexibility is allowed in its location.

Questions for the Customer

- *Are the wall-opening locations defined?*
- *Will the walls be available for rod bracing?*
- *Are there any workflow requirements that would not allow rod bracing or portal frames between interior columns (for wide buildings and mezzanines)?*
- *Can we use bracing in the endwall?*
- *Do you plan any future expansion to the building?*
- *If the walls are masonry/tilt-up can we utilize them as Shear walls?*

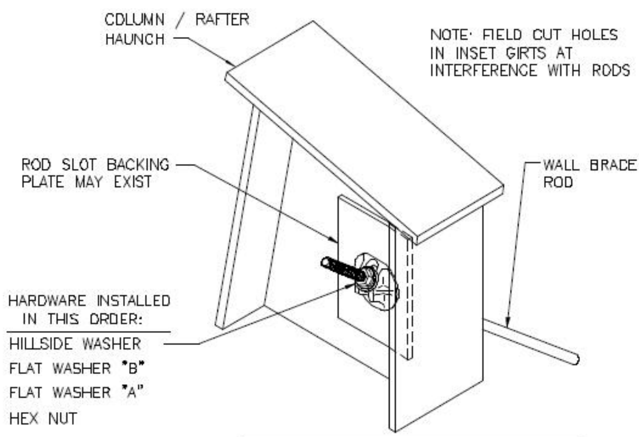


		WASHERS		
ROD DIA.	NUT	A	B	HILLSIDE
3/8"	095321	096408	095872	043657
1/2"	095230	095872	095945	043657
5/8"	095233	095945	095946	043657
3/4"	095235	095946	095947	043658
7/8"	095237	095947	095948	043658
1"	095238	095948	095949	043659
1 1/8"	095239	095949	095949	043659

REV DATE: 07/01/09 | REV NO 00

BR02H1

ROD BRACING THRU ROD SLOT
COLUMN SHOWN / RAFTER SIMILAR



		WASHERS		
ROD DIA.	NUT	A	B	HILLSIDE
3/8"	095321	096408	095872	043657
1/2"	095230	095872	095945	043657
5/8"	095233	095945	095946	043657
3/4"	095235	095946	095947	043658
7/8"	095237	095947	095948	043658
1"	095238	095948	095949	043659
1 1/8"	095239	095949	095949	043659

REV DATE: 09/29/09 | REV NO 01
BR02J1
ROD BRACING THRU ROD SLOT
SIDEWALL COLUMN SHOWN / RAFTER SIMILAR

Wind Resisting Systems

When wind blows against the end wall of a building it creates a longitudinal load that must be transferred to the building foundation. To accomplish this, we use rod bracing in the roof and sidewalls. In essence, standard wind bracing consists of diagonal rod bracing acting as tension members while purlins and girts provide compression and strength to transfer longitudinal wind loads to the building foundation. Additionally, in certain regions, diagonal bracing is used to transfer longitudinal seismic loads to the building's foundation.

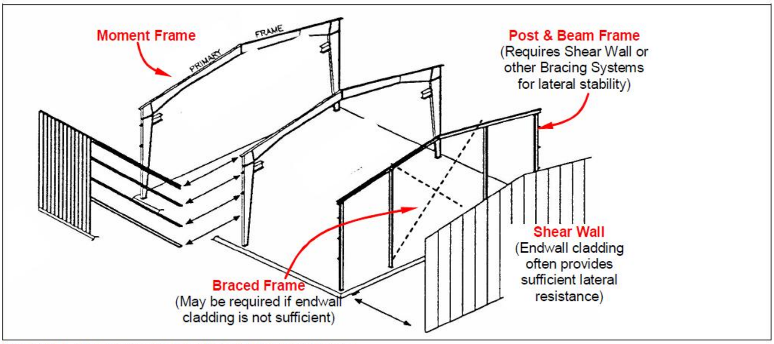


Figure 1 Transverse load resisting systems

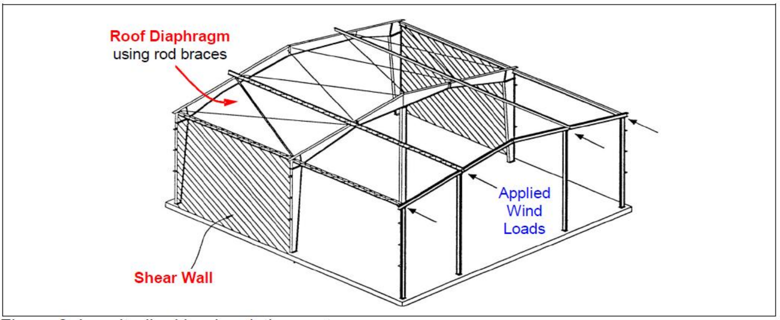


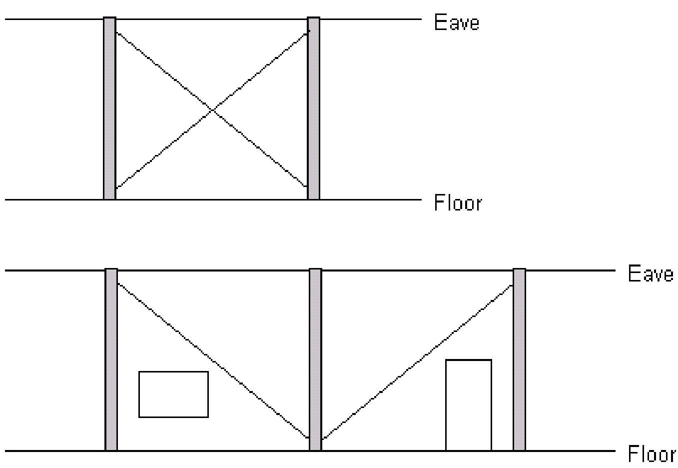
Figure 2 Longitudinal load resisting system

Typical Load Resisting Systems

Bracing Optimization Concepts

Rod Bracing

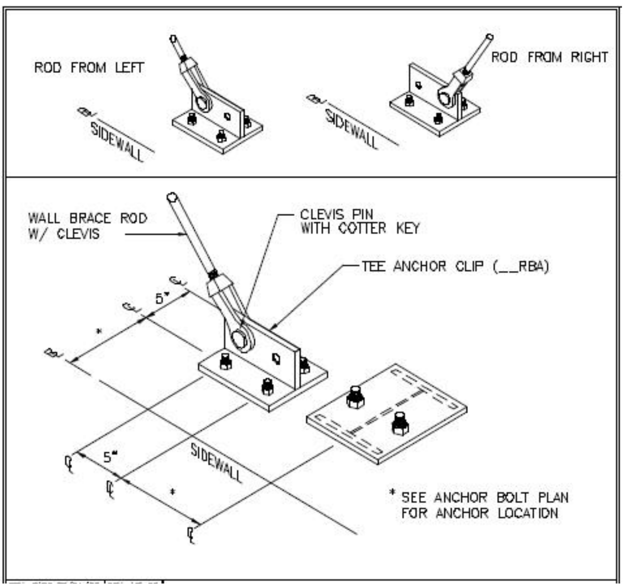
- Rod bracing is most effective at a 45 degree angle.
- X Bracing is always the most economical.
- In large heavily loaded buildings adding one or two more bays of bracing may reduce the overall cost of the bracing. In smaller buildings reducing the number of braced bays may reduce the overall building cost.
- Bracing locations can be moved prior to completing the design of the building (not during construction) as long as they stay in the same wall; they do not have to be in the same bay as the roof bay bracing.



Other Rod Bracing Options: Use of “V” type Rod Bracing in bottom picture eliminates the need for a Portal Brace or Protal Frame.

Alternate Rod Bracing

- Relocate rod anchor to the floor.
- Connecting a rod to a floor anchor will allow the location of a door or window.
    - Using one rod in a bay works as long as you have equal numbers of rods each way. They do not have to be in adjacent bays.

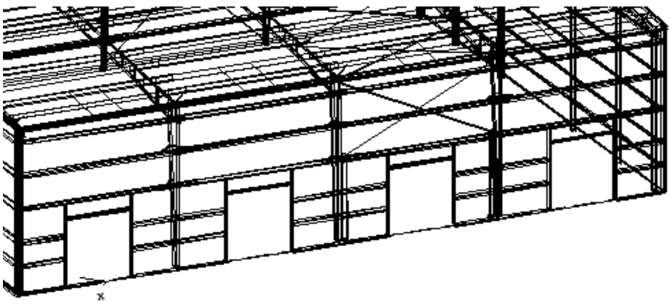


Partial Height Rods

- Most useful when used above openings.
- This procedure can be used with or without a portal frame.
- Without the portal frame requires a compression strut and the column to be special

designed for bending in the weak axis of the column and could be very expensive.

- With a portal frame requires the bracing load from the "X" above to be transferred into the lower portal frame and transferred to the



Partial Height Portal Frame shown in third bay

ground.

Interior Column Bracing

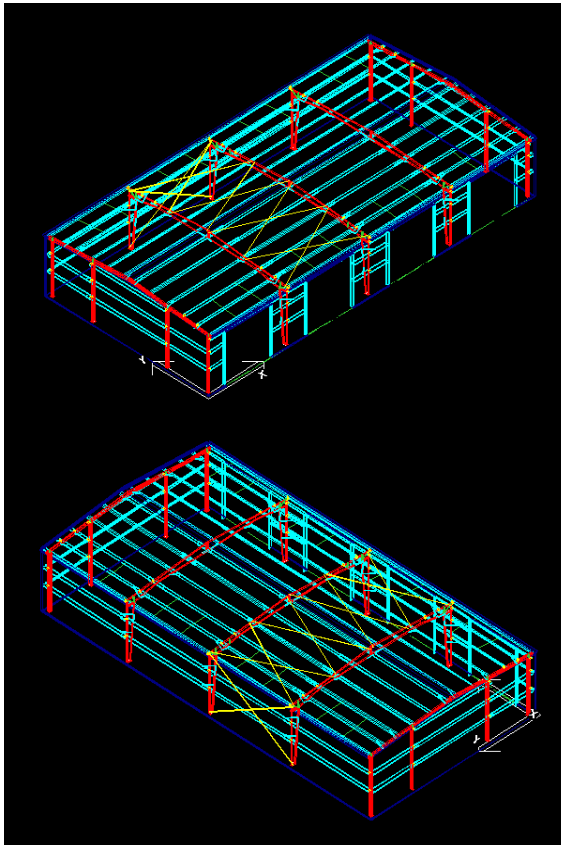
- This can reduce roof and wall bracing costs.
- Particularly useful for extra wide buildings.
- On large buildings, this can be especially effective.
- If a partition wall is to be used it can hide the rod bracing.

Torsional Bracing

- Useful when bracing must be omitted in one sidewall on small buildings.
- Torsional bracing is limited by the following:
    - Rods only are allowed for bracing. No portal braces or portal frames are allowed. Building widths must not exceed 50'-0".

- The eave height must not exceed 18’-0”.
- The wind speed must not exceed 90 mph.
- The roof pitch must not exceed 1:12.

- The building must have 3 or more bays.
- *There cannot be any cranes or mezzanines or other loads (besides roof top units) applied to the building.*
- *The building cannot have a lean-to.*



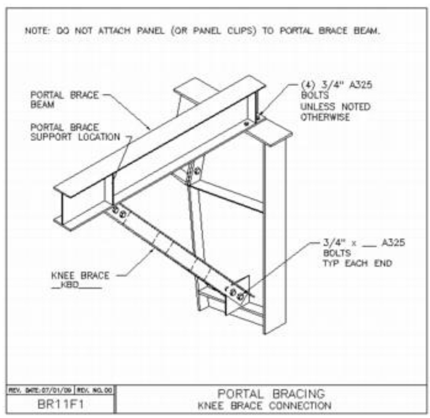
Torsional Bracing: Rods removed from one sidewall

Angle Bracing

- The patterns are the same as rods.
- VP Command will automatically select angle bracing if needed.
- Standard in high wind and seismic areas.

Portal Brace

- See VP Command for applications and limitations.
- Good option for buildings with a lot of openings in the walls.
- More economical than Portal Frames.
- The maximum allowable height for a portal brace is 20 feet.

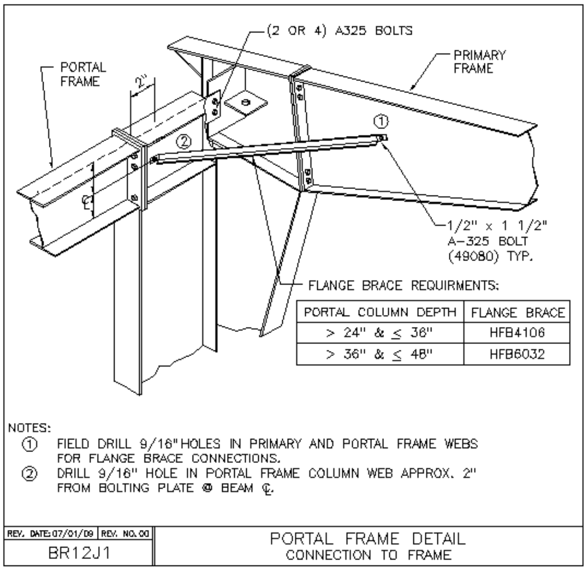


Typical Portal Brace Shown (Actual condition may vary)

- The maximum allowed bay space is 30 feet.

Portal Frames

- The most costly bracing system.
- Should be used when no other options are available.

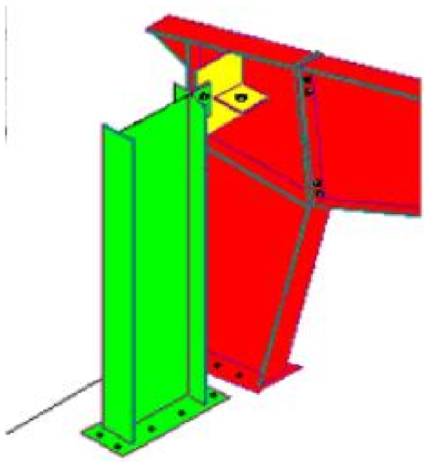


Typical Portal Frame Shown (Actual condition may vary)

Wind Post

- Fixed Base Required
- Wind Post available Both Sides, Left Side and Right Side
- Use on Sidewalls or Endwalls
- Max Eave Height 35’-0”
- Max Column Depth of 24”
- Connection to Main Frame is similar to a Portal Frame with standard holes and bearing type connections
- Standard location is 11 ½" from the Wind Post Frame Column Flange to Main Frame Web

- Seismic loads SDC ≥ B are adjusted based on a Cantilever Column System (R=1.25)
- Canadian Compactness (DP 5.4.4, Section C2) requirement is not automated



Wind Post

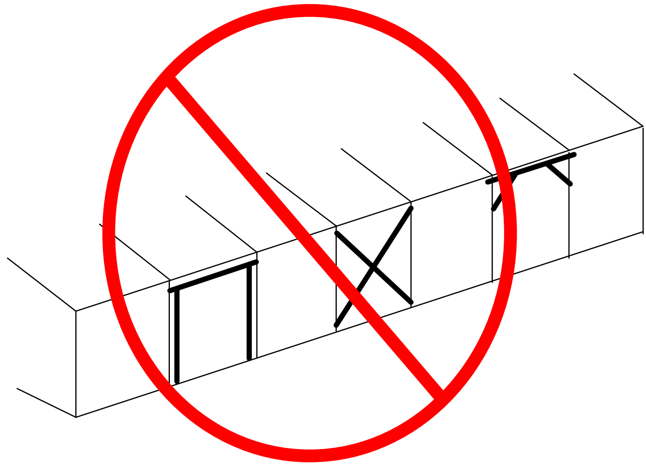
Shear Walls

- Use whenever possible as this can offer an economical solution.
  - May be used with reinforced masonry, concrete tilt or other suitable wall construction when the owners' design engineer is consulted.

Bracing Caution!

You **CANNOT** mix bracing types on the same wall. However, they can be different on opposite wall or within the same bay as in a partial height portal frame condition.

VPCommand will not allow these combined in same bay.



DO NOT mix bracing types within the same wall plane. You may have different bracing types on walls in different planes, i.e. the front wall may contain rod bracing and the back wall may have portal bracing.

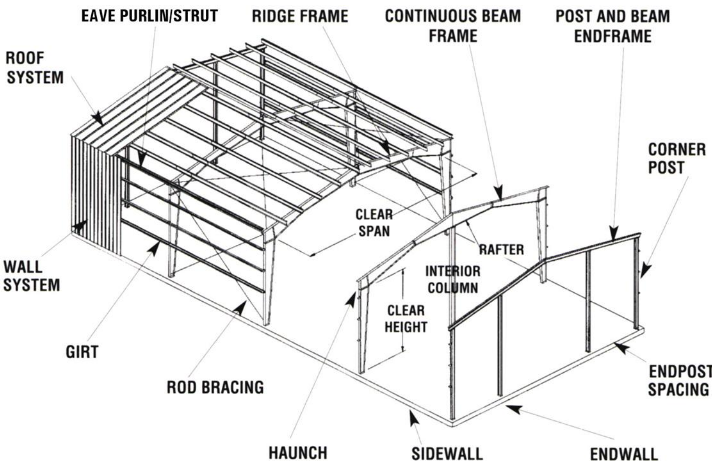
Temporary Bracing for Erection

Temporary Bracing

- It is the responsibility of the erector to design and provide for all temporary bracing. This includes size, type, location, and quantity.
- **Never** begin erecting a building without having temporary bracing on site along with a plan for installing and securing it.
- As erection proceeds, all brace rods, flange braces, struts, purlin/girt laps should be installed prior to panel installation.
- All buildings will require temporary bracing during erection.
Do not remove temporary bracing until wall and roof coverings are installed.

Notes:

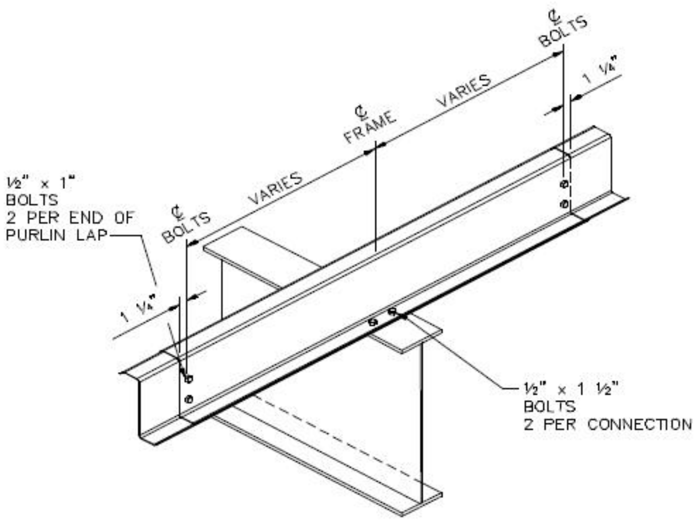
Secondary:


EAVE PURLIN/STRUT
RIDGE FRAME
CONTINUOUS BEAM FRAME
POST AND BEAM ENDFRAME
ROOF SYSTEM
CORNER POST
CLEAR SPAN
RAFTER
INTERIOR COLUMN
WALL SYSTEM
CLEAR HEIGHT
GIRT
ENDPOST SPACING
ROD BRACING
HAUNCH
SIDEWALL
ENDWALL

Secondary

Secondary is one of the largest components of a project. The proper selection of the secondary type will impact the economy of the overall project.

VP's secondary standard is G-30 galvanized steel with an acrylic coating. Bronze, Gray, and Red Oxide are available as options.



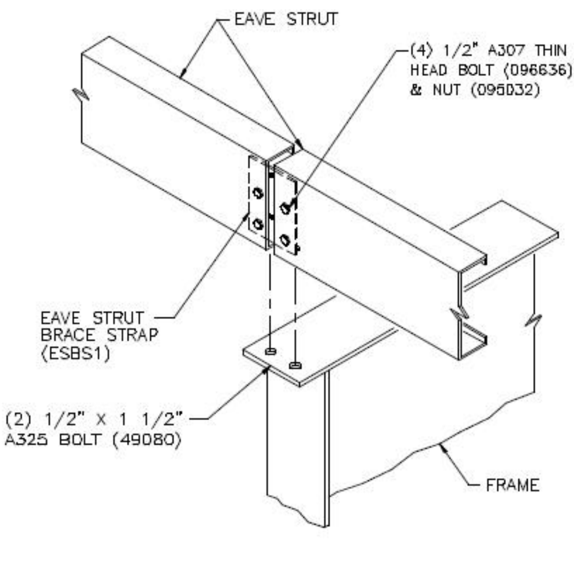
Continuous Purlins at Interior Frame

Questions for the Customer

Secondary Roof

- *Do you have a requirement for the roofing secondary that would prevent using purlins or would dictate the use of bar joist?*
- *Do you have Factory Mutual (FM) requirements?*

- *Are there roof-openings, if so what are the locations and what type are they? Who will be supplying the sub-framing for the roof top openings?*
- *Are there any loads applied to the roof secondary (sprinkler – ceiling tiles etc.)?*
- *Can we vary the bay spacing for the most economical secondary framing? Smaller endbays can save money.*
- *Is the building environment corrosive?*



Eave Strut at Interior Frame

Secondary Wall

- *Have the wall openings been located?*

- *If masonry is used on the walls, are they self-supporting walls, or will the walls require support from the building?*
- *Can outset girts be used for economy? Continuous spanning secondary members are typically less expensive than simple span.*
- *Can we use the most economical bay spacing for the wall system?*
- *Is the building environment corrosive? Special coatings for the secondary may need to be considered.*
- *Will wall lights be required?*
- *If liner panels are required are they partial or full height?*
- *What base condition will be required (base girt or base angle)?*

Secondary Optimization Concepts

Secondary: Roof

- The bay spacing that is chosen will affect the price of the secondary, as well as the primary frames. The most economical building solution should consider the combined cost of both the primary and secondary.
- As a general rule: 7” purlins (to be used with Panel Rib roof only) may be effectively utilized up to 25’ bays depending on loading.
- 8 ½” purlins and 10” purlins can be effectively utilized up to 30’ bays (depending upon loading).
- 11 ½” purlins can be effectively utilized up to 40’ bays (depending upon loading).
- When using purlins in lieu of bar joist you have the option of using Panel Rib Roof covering. A floating roof system (SSR, SLR) must be used on bar joists or truss purlins.

- Pricing your building(s) multiple ways with VPCommand will insure the most economical result.

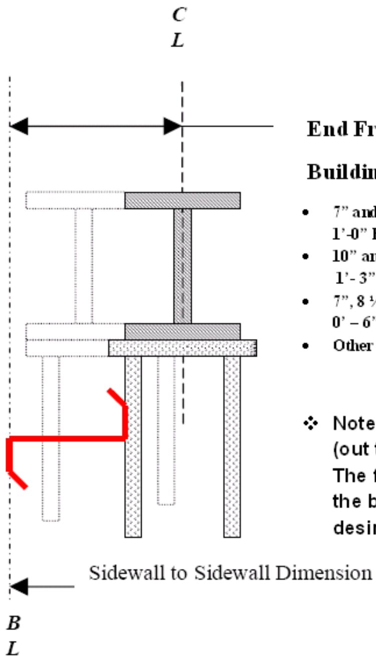
The below example represents a building 100 W x 150 L x 20 EH, 50 psf Ground Snow (31.5 roof), 5 bays at 30'-0. Under that heavy snow and large bay the 8 ½" purlins required an intermediate spacing of 4'-0" while the 10" deep purlins designed at the standard 5'-0" spacing. While costing slightly more, the 10" purlins yielded 24 less total purlins, thus saving on erection.

Your actual loading and geometry will affect the outcome of your price. Run various scenarios to get the best results.

Secondary Offset

VP's standard overall dimensioning (width x length x eave height) is measured to the outside of secondary (girts at width and length; eave height at top of purlin line). This outside of secondary dimension is called the building line. The width and length dimensions of a building remain intact and the dimension from the building line to the outside flange of column, post (or other vertical primary framing member) van vary which brings the primary framing member towards or away from the building line. In other words, the primary framing member moves, not the building line.

VP's standard offset dimensions for outset (continuous, bypass) girt condition is most commonly 8½". You may also have outset 7", 10", or 11 ½" outset girts. As noted, continuous outset girts (in which the girts lap to gain strength) are usually more economical than inset girts, but when you require more interior room from inside frame to inside frame you can choose inset girts. VP's standard inset girt condition is 1 5/8". Any other dimension may be input into VPCommand.



End Frame Location Dimensions

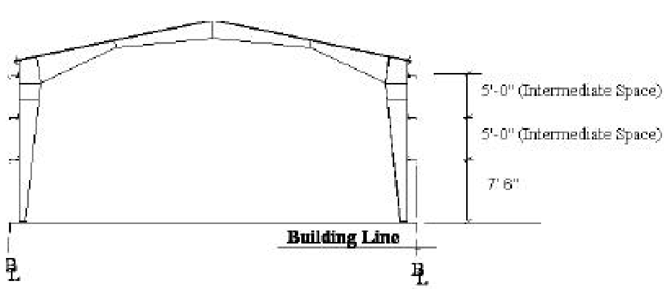
Building Line to Centerline:

- **7" and 8 ½" Outset/Bypass Endwall Girts**
  1'-0" BL to CL Frame
- **10" and 11 ½" Outset/Bypass Endwall Girts**
  1'- 3" BL to CL Frame
- **7", 8 ½", 10", and 11 ½" Inset/Flush Endwall Girts**
  0' – 6" BL to CL Frame
- **Other as Desired**

❖ Note that the overall building dimension (out to out of Building Line) do not change. The frame is moved toward or away from the building line to accommodate the desired offset.

Standard Endframe Offset Dimensions

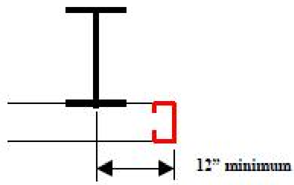
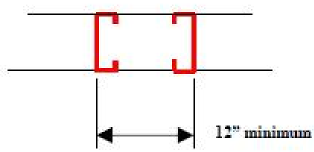
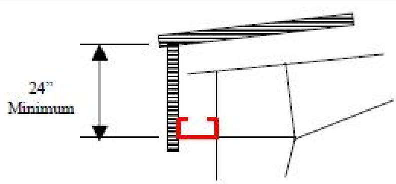
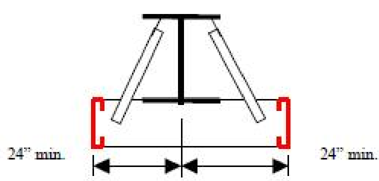
The first girt in a Varco-Pruden Building can be either a "zee" or "cee" shaped girt. The continuous "zee" girt is normally located at 7'-6" above finished floor. The girts above this are "zee" shaped and usually spaced at 5'-0" on-center up to the eave line. This spacing may vary depending on the load imposed on the girts. Some wind loads may require additional girts for panel design, etc. Check with your Service Center for more information.



Notes:

Minumum Recommended Framed Opening Clearances

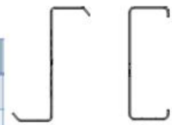
Recommended Framed Opening Clearances

	**12" minimum from centerline of column or end post to inside face of framed opening jamb.**
	**12" minimum between framed openings in the same bay.**
	**24" minimum from header to eave.** *Note:* On some very deep frames, the flange brace on the first purlin may interfere with a framed opening that is close to the frame.
	**24" clear on at least one side of a column for flange braces.** Note: When there are framed openings on both sides of a column within 24", and if the framed opening height is 2/3 or more of the eave height, then the column must be designed as unsupported. VP Command will detect this condition and design accordingly.

Depths - 7", 8 1/2", 10", 11 1/2" (All may be used as Purlins or Girts)

✓ Struts & non-struts are "grouped" in the same bay.

Thickness	7"	8 ½"	10"	11 ½"
17 Gage (0.060)	√	√	√	
16 Gage (0.068)		√	√	√
15 Gage (0.073)	√	√	√	√
14 Gage (0.079)		√	√	
13 Gage (0.088)		√	√	√
12 Gage (0.098)	√	√	√	
11 Gage (0.113)	√	√	√	√

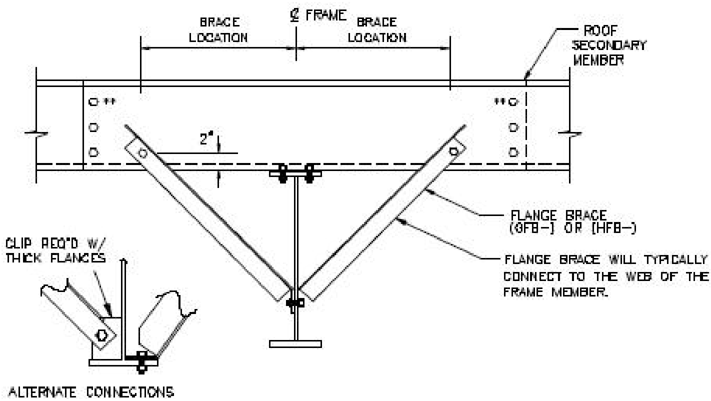


8 1/2" purlins

10" purlins

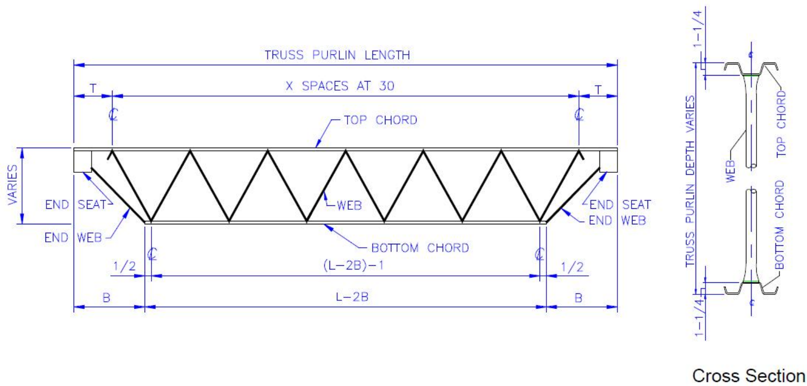
Secondary Gage Information
(7" purlins available with Panel Rib Roof only)

8 ½" vs. 10" Purlin Test



Flange Bracing

Truss Purlin



Truss Purlin
from: DP 4.4.1 February 3, 2010

Truss purlins are used as roof secondary structurals when bay spacing exceeds the limits of standard zee purlins. Truss purlins directly support the roof loads sustained by the roof panels. Truss purlins are constructed of cold-formed, lipped hat section chords and continuous, cold-formed round tubing diagonals.

- Truss purlins span range is a minimum of 14’-6” up through 60’-0” inclusive.
- Truss purlins are available in two member depths: 20.5” and 29.5” (29.5” is the default).
- Truss purlins are available with two end seat depths; 2.5” and 8.5”.

Bar Joist

Note: Bar Joist over 60’ top cord cannot rely on SSR for top cord support.

- Bar Joist spans are effective from 40’ to 80’ bays.

- Bar joist spans of 60’ or greater long span joists must be used. Long span joist are considerably more expensive and should be avoided if possible
    - Panel Rib cannot be attached to bar joist. The rigidity of the bar joist will eventually cause the fasteners to slot the holes and cause the roof to leak.
    - When you use Bar Joist you must use SSR, SLR, or composite roof covering.

    - **Purlin spacing** can impact your insulation system for the project.
    - When using bar joist the piping, ductwork, and wiring can be installed within the bar joist system possibly providing additional clearance.
    - Ceiling Liner panels are not commonly used with bar joist systems. If they are required VP can provide a composite roof system.

FM (Factory Mutual) requirements

If you have FM requirements you will have to comply with special conditions.

- Strapping may be required in the end bays.
- Additional purlins probably will be required in the edge zones, corner zones, or possibly the entire roof.
- VP has solutions for FM I-60, I-75, I-90, I-120 uplift requirements with Standing Seam Roof panels (SSR). Contact your VP Service Center for VP Command input and pricing assistance.
- Contact the customer’s insurance carrier to verify *minimum* requirements.

Roof Openings

- RTU (Roof Top Unit) locations greatly affect their price. Accurate location is critical for final pricing and design.

- Locating RTU's close to an interior column, or close to the haunch is the most economical location for a roof load.
- Who is supplying the sub-framing for the roof top openings?
- Are there any collateral loads applied to the roof secondary (sprinkler – ceiling tiles – lighting etc.)?

Roof Loading

- Application of collateral or point loads on secondary members requires exact locations to achieve accurate pricing.
- When the collateral loading conditions of a portion of the building differ substantially from the base collateral building load, then an area representing the difference should be input into VP Command to optimize the design.
    - i.e., Project has 5 lb. collateral load, one area has 8 lb. collateral load – define the area and add the 3 lbs. difference to equal 8. (See Loading section for discussion)
- The location of the specified area for a collateral load near a frame line, or an interior column will lower the cost versus a location in center of the bay.
- Any special roof covering system impacts the design of the secondary.
- If you are using composite roof covering, panel by others, or any non-VP roof covering system contact your VP Service Center.
- Use Order Clarification form, section "Cladding not by VP" information, forms are located in the Supplemental Price Book.

Miscellaneous Roof Secondary Concerns

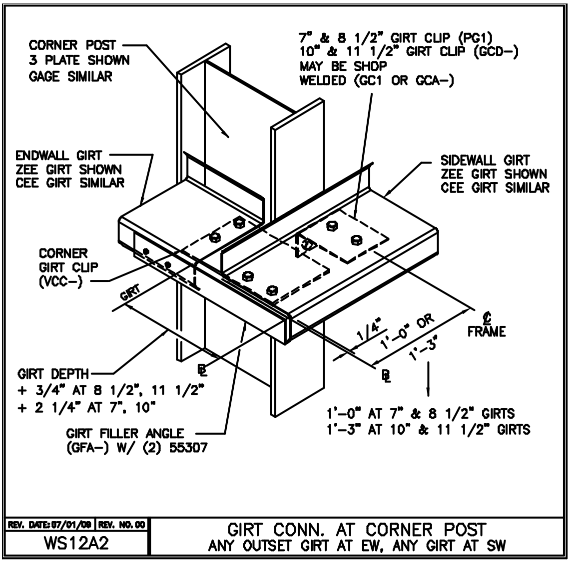
- Can we vary the bay spacing for the most economical secondary framing?
- Smaller endbays can save costs.
- As a general rule, the endbay length is most effective at approximately 85% of the interior bay length
- Wider bays increase secondary costs
- What is the building environment? Should we consider a special coating for the secondary if we have a corrosive environment?
- Galvanized coating may be less expensive than special painted, i.e. epoxy or finish coat

Secondary: Walls

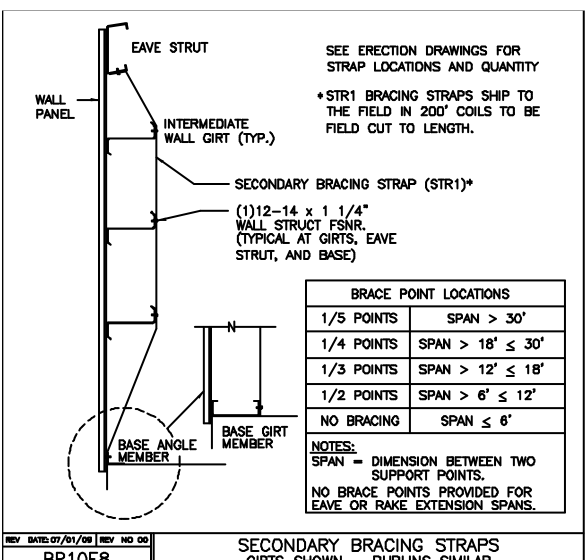
- Do you know the locations of the framed openings?
- When applying the loading onto secondary members it is more economical to be specific on location so costs can be optimized.
- Framed opening locations can impact the location and type of bracing.
- Whenever possible use your sills and headers as the wall girts for ease of erection.
- Masonry walls can impact the design of the secondary.
  - Is the wall load bearing?
    - Who provides the support at the top of the masonry?
    - What deflection criteria, has been specified for the wall.
    - Does VP supply wind beams?
    - If VP supplies the wind beam, the required deflection criteria should be specified. The wind beam may also be utilized to transfer wind or seismic forces into the masonry or tilt. Utilize flange

braces from the masonry or tilt to the wind beam whenever possible

- Do you have a preference for the girt conditions (inset or outset)?
- Outset (continuous) girt design is the most economical at bay spacing larger than 25'.
- Bay Spacing will affect the cost of the wall secondary but there is a greater impact on the roof secondary.
- Continuous girts have higher erection costs than simple span girts.
- Do you have a preferred secondary profile (C or Z's)?
- Standard VP wall secondary will be the "Z" profile. "C" profile girts are simple span and will be more expensive than continuous girts.
- Do you need wall lights?
- If you are using any wall lights, try to work within the system-generated wall girt spacing to avoid adding girts for additional costs.
- Do you need liner panels? If so, partial or full height?
- If you are using any liner panel try to work within the system generated wall girts spacing to avoid adding girt for additional costs.
- What base condition do you need (base girt or base angle)?
- A base girt will help with costs when a liner panel is going to be used.
- Two base angles will be less material cost but the installation of one base girt can be a savings.
- For choices of girt depths to use: check using 7" depth when bay spacing is less than 25 feet. Be sure to compare pricing.



Endframe Offset (Outset Girst Shown)
See VP Command for Current Details



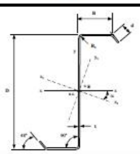
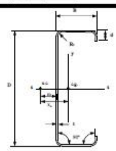
BRACE POINT LOCATIONS	
1/5 POINTS	SPAN > 30'
1/4 POINTS	SPAN > 18' ≤ 30'
1/3 POINTS	SPAN > 12' ≤ 18'
1/2 POINTS	SPAN > 6' ≤ 12'
NO BRACING	SPAN ≤ 6'

NOTES:
SPAN = DIMENSION BETWEEN TWO SUPPORT POINTS.
NO BRACE POINTS PROVIDED FOR EAVE OR RAKE EXTENSION SPANS.

Secondary Bracing Straps
Wall Panel Not By Varco Pruden

Standard BlueScope secondary structural purlin and girt members are cold-formed steel stiffened "Z" or "C" sections. The following section depths and thickness are available for 7", 8½", 10" and 11½" members.

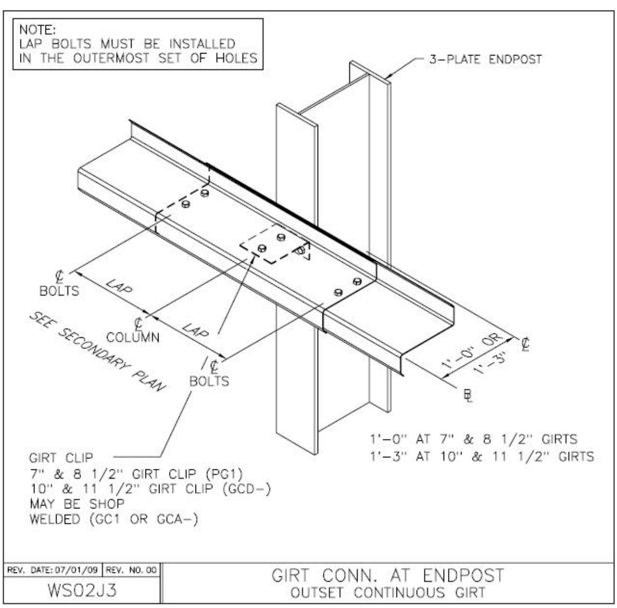
Table 1: Available C and Z Secondary Sections

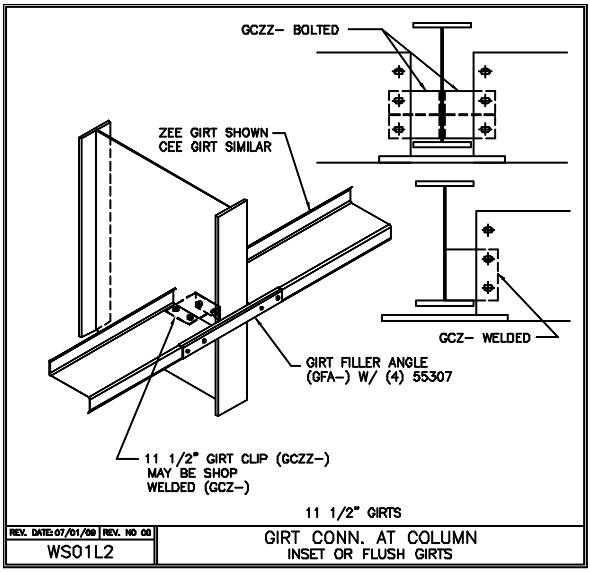
Shape	Depth	Available Thickness						
		0.060"	0.068"	0.073"	0.079"	0.088"	0.098"	0.113"
	7"	x		x			x	x
	8½"	x	x	x	x	x	x	x
	10"	x	x	x	x	x	x	x
	11½"		x	x		x		x
	7"	x		x			x	x
	8½"	x	x	x	x	x	x	x
	10"	x	x	x	x	x	x	x
	11½"		x	x		x		x

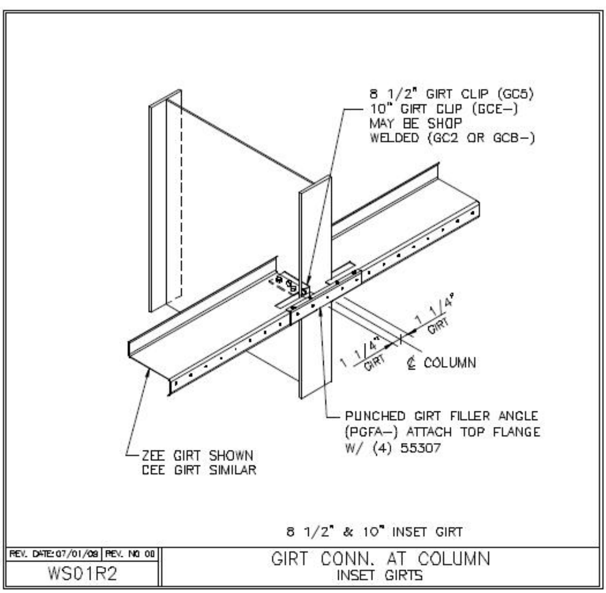
Secondary Structurals - ZEE and CEE Members

From DP 4.1

(7" purlins to be used with Panel Rib Roof only)




GCZZ- BOLTED
ZEE GIRT SHOWN
CEE GIRT SIMILAR
GCZ- WELDED
GIRT FILLER ANGLE
(GFA-) W/ (4) 55307
11 1/2" GIRT CLIP (GCZZ-)
MAY BE SHOP
WELDED (GCZ-)
11 1/2" GIRTS
REV. DATE: 07/01/09 | REV. NO 00
WS01L2
GIRT CONN. AT COLUMN
INSET OR FLUSH GIRTS


8 1/2" GIRT CLIP (GC5)
10" GIRT CLIP (GCE-)
MAY BE SHOP
WELDED (GC2 OR GCB-)
1 1/4" GIRT
1 1/4" GIRT
℄ COLUMN
PUNCHED GIRT FILLER ANGLE
(PGFA-) ATTACH TOP FLANGE
W/ (4) 55307
ZEE GIRT SHOWN
CEE GIRT SIMILAR
8 1/2" & 10" INSET GIRT
REV. DATE: 07/01/09 | REV. NO 00
WS01R2
GIRT CONN. AT COLUMN
INSET GIRTS

Notes:

Notes:

Framed Openings

Framed openings are required in metal panel walls for doors, windows, vents, louvers, etc.

What we want to determine in this section is the quantity and location for all required wall openings.

Questions for the Customer

- *How many, what size and will framed openings be required?*
- *What types of doors are required?*
- *Will the doors be supplied by VP or others?*
- *Are there any future or field located openings?*

Framed Opening Optimization Concepts

- Set the jamb extension to terminate into the first girt above the header elevation. Every time a continuous girt is interrupted you add material cost to the secondary members.
- Accurately locating the opening(s) during estimating can save you money in the long run. If possible, do not locate an opening within 2' of a column centerline to allow for column flange brace.
- When possible locate openings to allow rod bracing in sidewall.

Notes:

Openings

Openings are created in VPCommand when multiple buildings are joined together – creating the opening(s) at the common wall(s). The default for VPC is to remove all material (secondary, panel, insulation) so that one could literally walk through the common area. You can put this material back in by changing the parameters within the Openings folder of VPC. If you need to remove material for items such as brick, block, masonry, glass, or actually open you should create these at the "Covering" level(s) of VPC.

Questions for the Customer

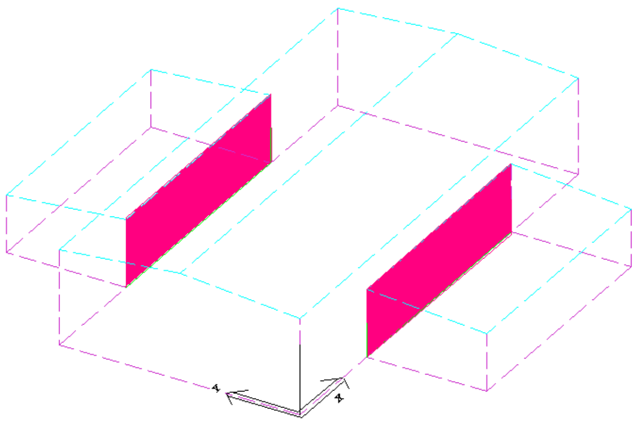
- *Are there any areas of the building wall that are open to the elements (no wall covering or secondary) such as covered loading docks?*
- *Are there any building layouts that will be abutting each other?*
- *Will there be covering or wall material on the common wall?*

Opening Optimization Concepts

Areas that are open to the air will change the loading of the building and will also be of importance to the mechanical equipment supplier if heating or air movement is involved.

In VP Command, when buildings abut (having common wall regions), the common wall is considered open unless it is changed to include common wall material. This condition is important to understand when pricing the project since loads are removed from the opening.

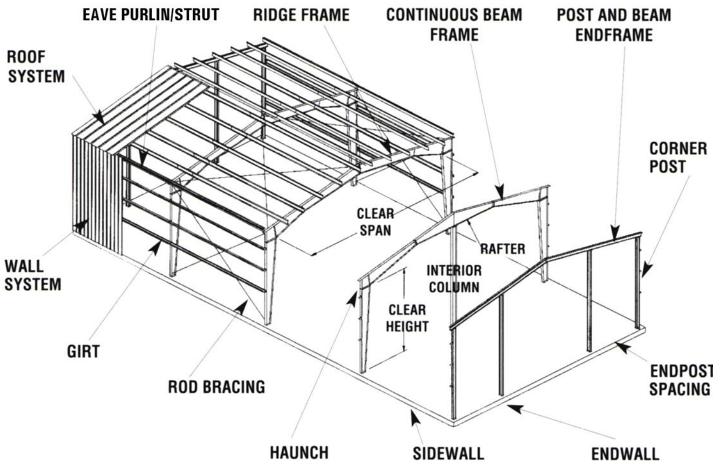
When putting material back in an opening, be aware that VP Command has created an opening at each touching surface. Only change the parameters of the opening *on the wall in which you wish to be sheeted* – do not revise both facing openings or you will have sheeting and girts face-to-face.



This project shows "openings" at the common walls where the Lean-tos meet the sidewalls of the main structure. (Note: VPCommand will show the open portion in a Salmon color. Emphasis added to this graphic for clarity.

Notes:

Covering:


EAVE PURLIN/STRUT
RIDGE FRAME
CONTINUOUS BEAM FRAME
POST AND BEAM ENDFRAME
ROOF SYSTEM
CORNER POST
CLEAR SPAN
RAFTER
INTERIOR COLUMN
CLEAR HEIGHT
WALL SYSTEM
GIRT
ROD BRACING
ENDPOST SPACING
HAUNCH
SIDEWALL
ENDWALL

Covering

What is the most economical way to supply covering that meets the owner's requirements and the desired appearance? As noted in the previous section on "Openings" if you require material that is not supplied by VP (brick, glass, etc.) you should input these at the "Covering" level of VPC and not at the "Openings" level.

Covering Questions for the Customer

Roof Covering

- *What type of roof covering is required for your building?: Panel Rib (PR), Standing Seam Roof (SSR), Architectural profile (SLR-type), membrane?*
- *Is a specific color / finish required?*
- *Standard VP Color?*
- *Special Color?*
- *What is the roof pitch for the building? Panel Rib Roof minimum is ½:12; SSR and SLR minimums are ¼:12.*

Wall Covering

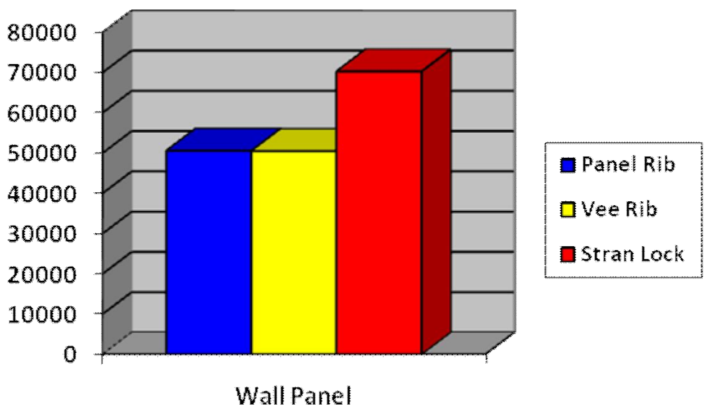
- *What type of wall covering do you need for your building?: Architectural profile, PR, Stranloc (available through VP Components), Vee-Rib, etc.?*
- *Masonry?*
- *Concrete Tilt Wall?*
- *Stud Construction?*
- *Curtain Wall?*
- *Is the wall a specific color / finish required?*
- *Standard VP Color / finish?*
- *Special Color / finish?*

Covering Optimization Concepts

- Most economical is the lightest gauge.
- Utilize standard colors as much as possible.
- Verify what warranties are required for the panel finishes.
  - KXL performance is better than SP. SP finish available with Liner Panel only.
  - Controlling sheet lengths in order to eliminate a lap can be cost effective, especially for Standing Seam Roof (SSR). Panel lengths over 48' may require special freight.
  - Choose the most economical panel type for the building. For example, Panel Rib roof may be an economical choice in lieu of SSR depending on the use of the building
  - Trim packages vary with the panel.
  - Panels not by VP may increase the cost of secondary support members and may require additional secondary strapping.

Wall Covering

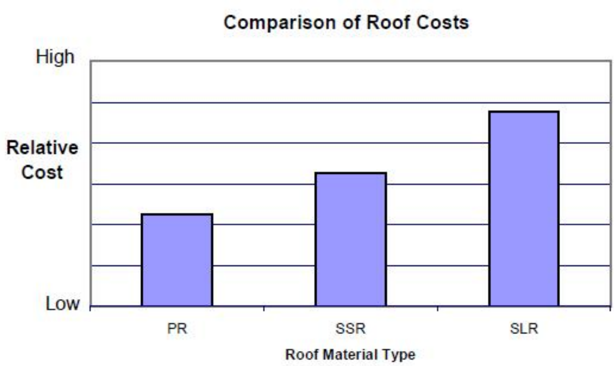
Once the initial decision is made to use metal walls, there are many other considerations including profile, color and trims. The chart shows the change in price on the same building with different wall materials and trim.



Wall Panel Comparison

Roof

Using metal roof systems has become a standard in most buildings because of the longevity and performance of the available systems. The chart shows the relative cost difference in systems using KXL.



SSR (Standing Seam Roof)

Standing Seam: - the ultimate in quality roof systems. SSR is comprised of factory formed panels which are interlocked and machine seamed in place, yielding a single unit membrane. SSR panels provide 24" net coverage with a 3" high rib seamed together at the side laps. Panel attachment to the roof purlins, or bar joist, is made with an SSR clip. SSR clips are provided with sliding tabs, interlocking with seamed SSR panels and provide 1 5/8" of panel movement in either direction (ridge to eave).

SSR ridge assembly consists of stainless steel seam caps attached to SSR ridge panels that are field seamed together along the center of the ridge. An optional SSR module control strip maintains the 24" spacing that is critical for roof integrity. The SSR roof panel comes with a 2" factory notch on both ends of the male leg and can be installed from left-to-right or right-to-left on the building. Thermal Block and Super Block are other options available for SSR. SSR panel is available in Roof Pitches from ¼:12 to 6:12.

Panel Rib Roof

Panel Rib is well-established as an economical, quality roof. Standard PR panels are Galvalume with self-drilling fasteners and 36" coverage. Primary ribs are $1^{3}/16$" high at 12" on-center with minor ribs in between. Side laps are one full major rib utilizing an anti-capillary bead and a purlin bearing edge for added support. PR roofs are available in 26, 24 or 22 gage. Galvalume, and Kynar 500 (KXL) or Hylar 5000 paint finishes are also available. Roof pitch for Panel Rib is ½:12 minimum with no maximum roof pitch.

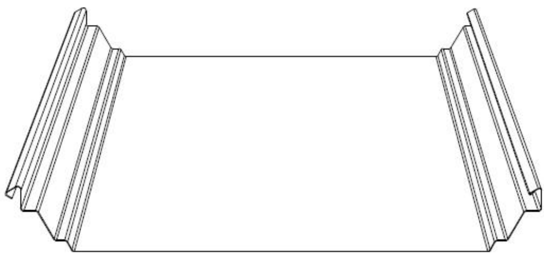
SLR II

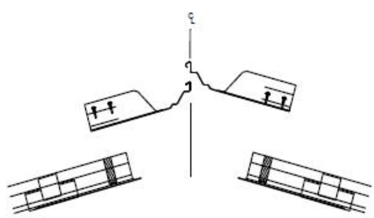
Span Loc Roof (SLR II)

SLR II: This roofing system is comprised of factory formed panels which are interlocked and machine seamed in place - yielding a single unit membrane. It is a visually appealing architectural standing seam roof system that offers maximum design flexibility and aesthetics plus durability and is available in a variety of KXL colors. SLR II panels provide 16” nominal coverage with a vertical 2” high rib seamed together at the side laps. Panel attachment to the roof purlins, or bar joist, is made with an SLR II clip. The clips are designed to accommodate thermal expansion and contraction. Thermal Blocks are required for SLR II.

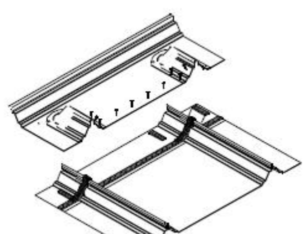
Roof Covering Specifications

SSR

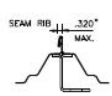




SSR Ridge Detail



SSR Ridge View

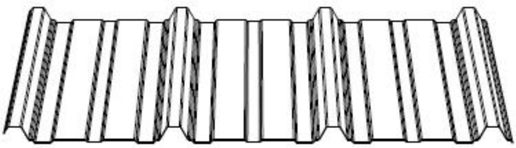


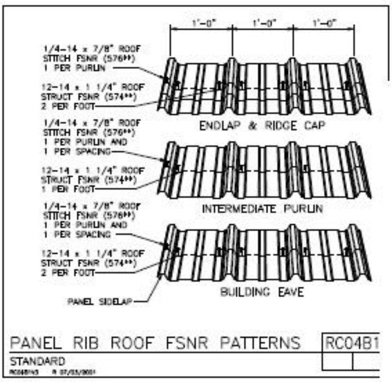
SSR SEAM

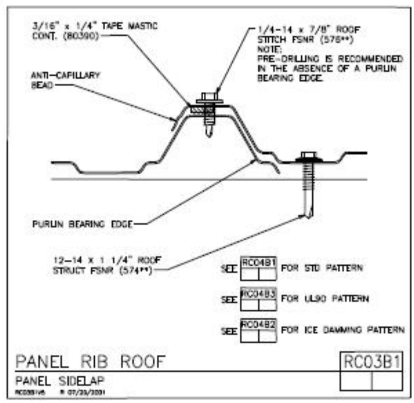
SSR Feature	**SSR Benefit**
The material used for the SSR roof panel is 24 gage ASTM a 446 Grade D, 50,000 PSI yield strength steel. Optional material is 22 gage ASTM A 466 Grade D, 50,000 PSI yield strength steel. The SSR panel is only available with twenty year finishes and coatings, Galvalume or KXL. The rake and eave also have long life KXL, 70% Kynar 500 or Hylar 5000 coating. Exposed fasteners are self-drilling stainless capped with bonded EPDM washer. Sealant, tape mastic, and the closures used meet or exceed the highest industry standards. The SSR roof system can be provided with an optional UL-90 uplift rating. Several insulation options are available: Fiberglass blanket insulation can be up to 6" in thickness or rigid board insulation up to 3½" thick. Optional "Superblock" or	The standard materials used are 33% thicker than the 26 gage materials often used on a roof system. This allows for greater structural strength of the system. 22 gage material is offered for even greater environmental loads and roof traffic. The SSR roof system uses only the highest quality finishes and coatings available to assure that the system maintains the look and functionality for which it was designed. Finishes are warranted for 20 years. Attention to the smallest details assures a quality roof system. All components used are designed to create a long lasting roof system of the highest quality. The UL rating can impact the insurance costs for your building. The higher UL-90 rating can lower the insurance cost for contents. The energy required to heat and/or cool the building can

SSR Feature	**SSR Benefit**
"Thermal blocks" are available.	reduce the operating costs of the structure by increasing the in-place R-value of the insulating system used.
Staggered End Laps	"Superblocks" or "Thermal blocks" can increase the insulation's thermal efficiency by nearly 20%.
Used on Purlins, WideBay Truss Purlins or Bar Joist	In place R-19 can be attained with the optional UL-90 uplift rating. End laps are staggered 5' standard with a 2" notch, which produces less material to Seam. This also makes the panel capable of being sheeted in either direction. SSR can either be installed on purlins, WideBay Truss Purlins, or Bar Joist. Panel Rib is only allowed to be installed on Purlins.

Panel Rib Roof



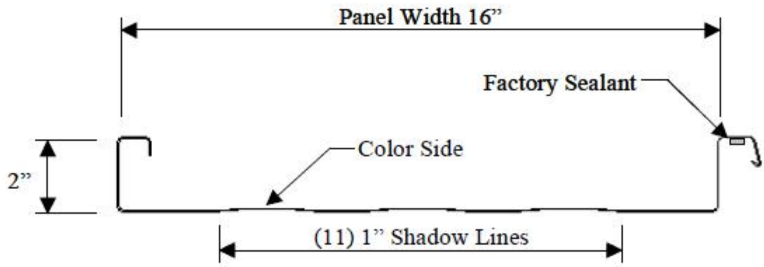




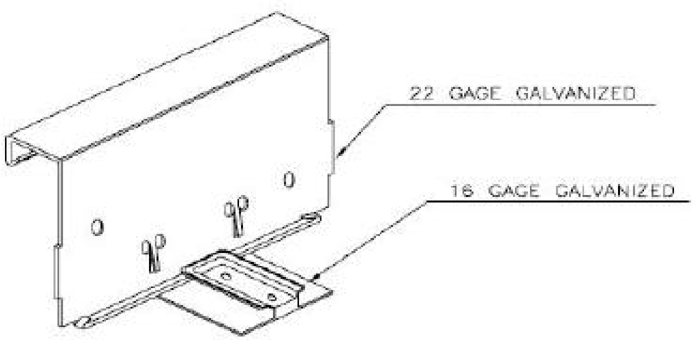
Panel Rib Roof (See VPCommand for Current Details)

Panel Rib Roof Feature	**Panel Rib Roof Benefit**
The high rib of the Panel Rib panel is 1^{3}/16" above the panel surface.	Places the critical panel-to-panel side lap well above the drainage surface of the panel, completing the joint with sealant assures a weathertight connection.
The panel is roll formed with a bearing edge at the panel side lap.	The use of a bearing edge assures that all panel-to-panel connections are tight and secure by providing a solid base for the fasteners to penetrate both panels.
Installation includes a bead of sealant at all panel-to-panel connections. Sealants used meet or exceed the highest industry standards.	The sealants used are designed to maintain a long life seal and assure weathertight connections for the Panel Rib roof.
Panels are formed with an anti-capillary bead.	This diverts the water and assures a weathertight roof system at panel laps.
Self-drilling fasteners with bonded washers are used at all exposed fastener locations.	Self-drilling fasteners eliminate the need to pre-drill the panels, and the EPDM washer provides a positive closure of each roof penetration.
Insulation up to 6" thick can be used with the Panel Rib roof system.	Calculated "R" value of 19 can be attained with 6" insulation.

SLR II



SLR II (Standard in VPCommand as shown: 2” high, 16” wide)



SLR II Clip
Pictures from DP 25.4 September 3, 2010

SLR II Feature	**SLR II Benefit**
The SLR II roof is 2" in height at the high rib.	The extended rib height places the interlocking seam a full 2” above the drainage surface of the panel, assuring weathertightness at the panel seams.
The interlocking rib is at a 70° bend that is formed using a mechanical seaming tool.	The use of the mechanical seaming tool allows for the seam to be completed without overstressing the material. This assures a tight seam along the length of the interlocked high rib.
The female leg of the high rib has a factory applied sealant.	This assures that the correct amount of the proper sealant is used in the high rib. When the high rib is completed, the sealant is compressed creating a weathertight seal at all panel-to-panel side laps.
Standard panels are available in lengths up to 42’and lengths upto 60’ with special handling and permits.	The longer panel lengths provide for greater building spans with fewer panel endlaps required for the roof system.
Concealed two-pieced clip system attaches the panel to secondary structural and allows for total thermal movement up to 1".	The use of the concealed clips assures that no roof penetrations

SLR II Feature	**SLR II Benefit**
When panel endlaps are required they are overlapped a full 5" with a staggered location off the secondary members and a panel stiffener. Two beads of sealant are applied on the lower panel.	are required to secure the panel to the secondary structural members. This allows the ridge flashing to absorb the thermal expansion and contraction of the roof system in response to temperature change. This assures that the panel-to-panel endlaps are not restricted in movement by a secondary member. The reinforcing plate assures that a secure connection is made panel-to-panel. The sealant assures that the connection is weathertight.
The material used for the SLR II roof panels are ASTM A-792 Grade 50B, 50,000 PSI yield strength steel, 24 gage for SLR II.	The standard materials used are 33% thicker than the 26 gage materials often used on a roof system. This allows for greater structural strength of the system. 22 gage material is offered for even greater environmental loads and roof traffic.
The SLR II panel is only available with twenty year finishes and coatings and KXL finish. The rake and eave also have long life KXL, 70% Kynar 500 or Hylar 5000 coating.	The SLR II roof system uses only the highest quality finishes and coatings available to assure that the system maintains the look and functionality for which it was designed.
Exposed fasteners are self-drilling stainless capped with bonded EPDM washer. Sealant, tape mastic, and the closures used meet or exceed the highest industry standards.	
The SLR II roof system can be provided with an optional UL-90	

SLR II Feature	SLR II Benefit
uplift rating. The life cycle cost of an SLR II Roof is less than a built-up or EPDM roof. Several insulation options are available: Fiberglass blanket insulation can be up to 6" in thickness or rigid board insulation up to 3½" thick. "Thermal blocks" are required on SLR II.	Finishes are warranted for 20 years. Attention to the smallest details assures a quality roof system. All components used are designed to create a long lasting roof system of the highest quality. The UL rating can impact the insurance costs for your building. The higher UL-90 rating can lower the insurance cost for contents. This greatly lowers the long term maintenance and repair costs of the roof system. The energy required to heat and/or cool the building can be reduced the operating costs of the structure by increasing the in-place R-value of the insulating system used. “Thermal blocks” increase the insulation's thermal efficiency by nearly 20%. In place R-19 can be attained with the optional UL-90 uplift rating.

Notes:

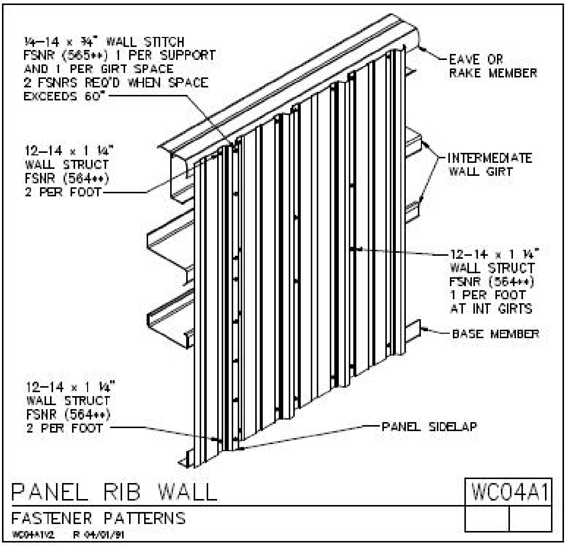
Wall Panels

Wall Covering

Wall covering can be any of VP Buildings' standard wall panels including Panel Rib, Vee Rib, or Reversed-Rolled Panel Rib. These items may be combined with other material such as block, brick, or others.

Panel Rib

Panel Rib wall panels provide 36" net coverage with $1^{3}/16$" deep primary ribs at 12" on-center with minor ribs in between. Side laps are one full major rib utilizing a capillary grove. The wall panels span from the base to the eave (except where the eave exceeds 41'). Panel Rib panels offer a "crimped" base and a "notch" at the eave (only available with PR roof) resulting in a better seal and available savings through fewer required building



materials (e.g., base trim and closure strips). Panel Rib comes standard in KXL or Galvalume finish.

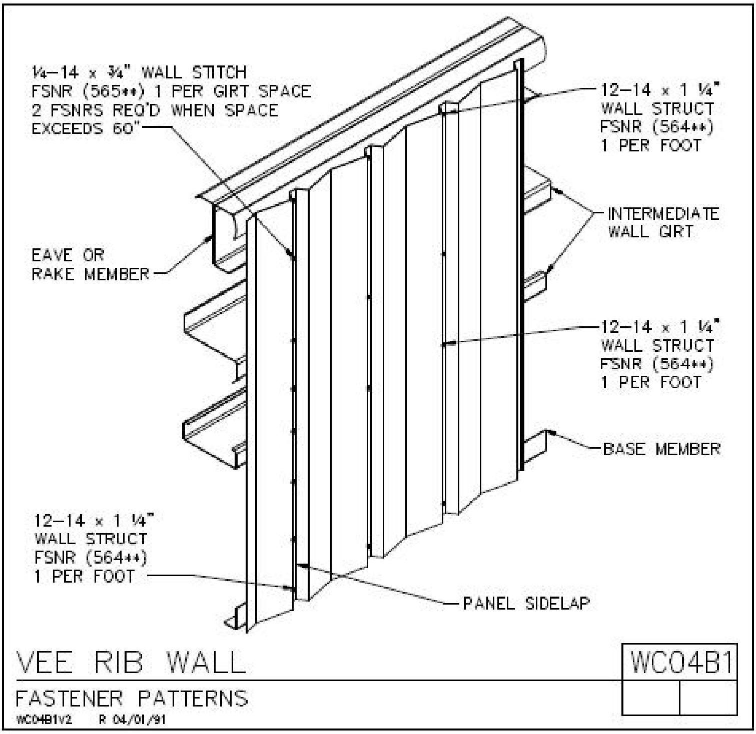
PR Wall Feature	**PR Wall Benefit**
Base of panel can be crimped or square cut.	Crimp eliminates the need for base trim or notching the slab. The crimped panel also provides weather and rodent protection. This saves both time and cost during construction of the project.
Notched at the eave of the panel when they are used with a Panel Rib roof.	This provides a secure fit between the wall and the roof panel, and also can eliminate the need for eave fascia and closures to complete the building. This feature saves both time and cost during construction of the buildings.
Panels are 36" wide with lengths up to 41'.	This allows more coverage with fewer panel endlaps and quicker to install.
Fasteners are color matched to the wall.	A cleaner, unbroken appearance can be attained without requiring panel end laps.
Panels are fabricated from U.S. 26 gage, ASTM A466, grade D yield strength steel.	This adds to the overall appearance of the

PR Wall Feature	PR Wall Benefit
Panels are also available in 24 gage and 22 gage material. Panels are formed using galvanized (G-90) material that is coated using KXL paint finishes. Panels can be installed with insulation up to 6" thick using a variety of insulation facings.	project allowing the fasteners to blend in with the wall panels. This provides the optimum balance of material usage and structural strength. This allows for greater structural strength of the system. 24 and 22 gage materials are offered for even greater environmental loads. This assures that the wall panels will provide long life protection and retain their appearance over many years. The energy efficiency of the building insulation system can be incorporated into the project to lower the life cycle heating and cooling expenses.

Notes:

Vee Rib Wall

Vee Rib wall panels are architecturally styled panels which provide 36" net coverage with primary ribs at 12" on-center recessing 1¼" into the building. This provides a "semi-concealed" condition for the fasteners which are installed inside these ribs. Vee Rib panels are installed with a continuous trim at the eave and base with closures. Vee Rib panels have an embossed, KXL finish and are available in the same gages as Panel Rib.



Vee Rib Wall Feature	Vee Rib Benefit
Panels are 36" wide with lengths up to 41'.	This allows more coverage with fewer panel endlaps and quicker to install. A cleaner, unbroken appearance can be attained without requiring panel laps.
Panels are installed using a base trim.	The base trim provides a finished look to the wall system without the need to notch the slab. This saves both time and cost during construction of the project.
Self-drilling fasteners are color matched to the wall panel and eliminate the need for plastic color caps.	This adds to the overall appearance of the project allowing the fasteners to blend in with the wall panels.
Panels are fabricated from U.S. 26 gage, ASTM A466, grade D yield strength steel.	This provides the optimum balance of material usage and structural strength.
Panels are also available in 24 gage and 22	This allows for greater structural strength of the system. 24 and 22 gage materials are offered

Vee Rib Wall Feature	Vee Rib Benefit
gage material.	for even greater environmental loads.
Panels are formed using galvanized (G-90) material that is coated using KXL paint finishes.	This assures that the wall panels will provide long life protection and retain their appearance over many years.
Panels can be installed with insulation up to 4" thick using a variety of insulation facings.	The energy efficiency of the building insulation system can be incorporated into the project to lower the life cycle heating and cooling expenses.
The major ribs are 12" on-center with a deep sculptured appearance.	This provides a clean and sharp architectural appearance to the wall system.
The Vee Rib surface is embossed.	This reduces glare and adds to the overall appearance of the wall system.

Reverse-Rolled Panel Rib

RPR panel is an attractive, high quality, low maintenance panel based on a “reverse-rolled” version of VP’s standard Panel Rib design.

RPR is a 36” wide panel with a 1 ¼” rib profile. Available in lengths of up to 41’, RPR can provide continuous coverage from foundation to eave eliminating the need for end laps and assuring superior weathertightness. Panels comes standard in strudy 26 gage steel or 24 and 22 gage options.

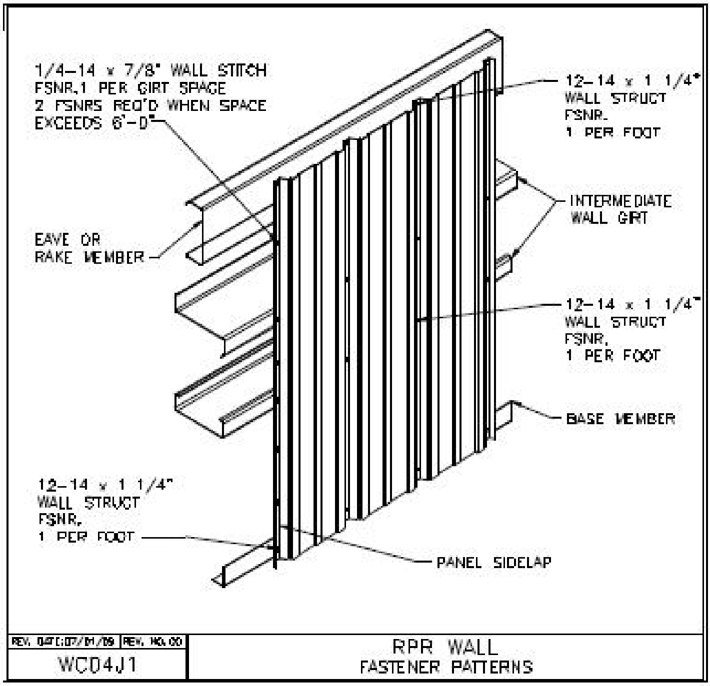
RPR panel’s deeper profile accommodate up to 6” of faced blanket insulation or up to 2 ½” of rigid board, crating a more thermal efficient building envelope.

Available in life-long KXL fininsh with 70% PVDF (Kynar 500 or Hylar 5000). RPR panel offer a choice of 13 attractive colors.

RPR’s recessed fastener locations give the panel a semi-concealed profile with bold architectural lines. RPR comes with a complete trim package including gutter and rake trim, corner and base trim to provide an attractive finished appearance. VP also offers a full line of high quality accessories including doors and windows designed to give years of trouble-free service.

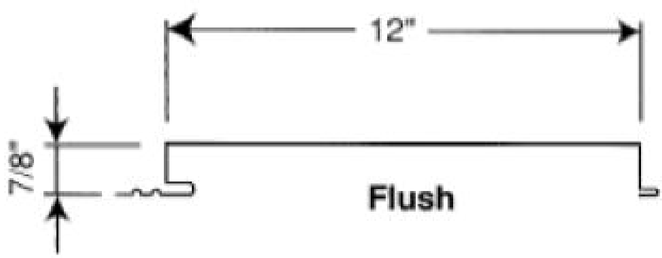
RPR Features	RPR Benefits
Base square cut with base trim.	The base trim provides a finished look to the wall system without the need to notch the slab. This saves both time and cost during construction of the

RPR Features	RPR Benefits
Panels are 36" wide with lengths up to 41'.	project. This allows more coverage with fewer panel endlapsand quicker to install.
Fasteners are color matched to the wall.	A cleaner, unbroken appearance can be attained without requiring panel laps.
Panels are fabricated from U.S. 26 gage, ASTM A466, grade D yield strength steel.	This adds to the overall appearance of the project allowing the fasteners to blend in with the wall panels.
Panels are also available in 24 gage and 22 gage material.	This provides the optimum balance of material usage and structural strength.
Panels are formed using galvanized (G-90) material that is coated using KXL paint finishes.	This allows for greater structural strength of the system. 24 and 22 gage materials are offered for even greater environmental loads.
Panels can be installed with insulation up to 6" thick using a variety of insulation facings.	This assures that the wall panels will provide long life protection and retain their appearance over many years.
	The energy efficiency of the building insulation system can be incorporated into the project to lower the life cycle heating and cooling expenses.


1/4-14 x 7/8" WALL STITCH
FSNR,1 PER GIRT SPACE
2 FSNRS REQ'D WHEN SPACE
EXCEEDS 6'-0"
12-14 x 1 1/4"
WALL STRUCT
FSNR.
1 PER FOOT
INTERMEDIATE
WALL GIRT
EAVE OR
RAKE MEMBER
12-14 x 1 1/4"
WALL STRUCT
FSNR.
1 PER FOOT
BASE MEMBER
12-14 x 1 1/4"
WALL STRUCT
FSNR.
1 PER FOOT
PANEL SIDELAP
REV. DATE:07/01/09
REV. NO. 00
WC04J1
RPR WALL
FASTENER PATTERNS

FP-12 Soffit Panel

FP-12, a concealed-fastener panel, offers a high quality and low maintenance option for providing a smooth, flush appearance on your building. Manufactured to install easily, the FP-12 panel incorporates a hidden fastener attachment and advanced side joint design. The panel can be installed at 4'0" (on center) over open framing and offers superior wind disengagement resistance performance. Also, the 7/8" profile depth of panel allows for field application of sealant, if required for installation. Available in either 24 or 22 gage, FP-12 panel has a PVDF finish and come in a varity of standard colors.



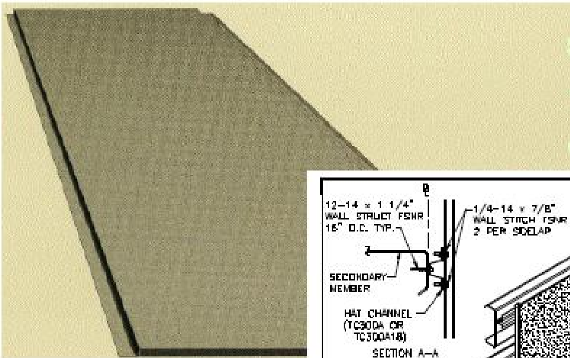
FP-12 Flush Panel Shown

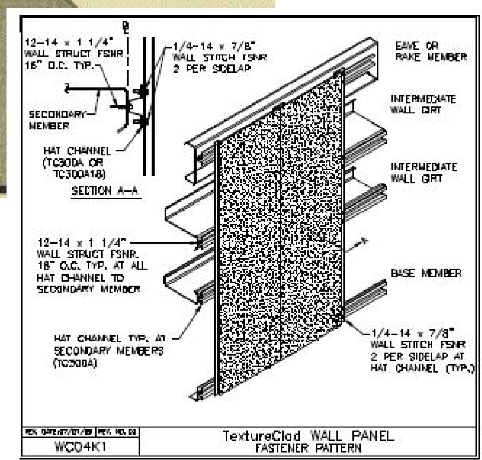
Texture Clad

The stucco-like appearance of TextureClad will satisfy most local building ordinances that prohibit other metal wall panel applications. The panels are durable and provide protection from UV rays.

Each TextureClad panel is manufactured from 20 gauge-galvanized steel. Panel width is 16” with a 1 ½” flange on one end and a ½” lock flange on the other edge. The top flange is finished with a double 90-degree flange and the bottom is finished with a single 90-degree flange. Formed ends allow the panel to nest end-to-end for stacking up a vertical wall, allowing for taller elevation applications. Installation of panel over weatherproof membrane is recommended.

Factory applied textured finish is composed of a fiber reinforced poly/aggregate composition, which adheres to the pre-painted panel surface. The panels are available in a variety of colors. TextureClad comes with a 10-year warranty for the panel and finish. The panel is available in four depths 2”, 2.5”, 3”, and 4”.





Texture Clad (See VP Command for current details)

Thermal Clad

ThermalClad panels are a one-piece construction composed of panel each side with a middle polyurethane foam core. The advanced polyurethane core provides enhanced insulation values that significantly lower heating and cooling costs. Concealed attachment with clips and fasteners at the side joint of the panel offer a clean high profile appearance.

The wall panel is a 36" wide, 26 gage exterior panel, stucco embossed, concealed fastener, and R value of 32.3.

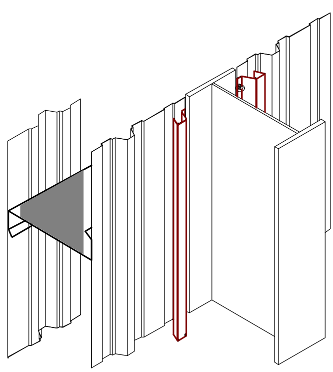
The roof panel is a 42" wide panel, 24 gage exterior panel, stucco embossed, concealed fastener, 2" high SLR rib and R value 32.2.

Liner

Liner may be required to protect the interior surfaces (covering, girts, frames and insulation), and to also provide a finished appearance to the building.

Questions for the Customer

- *What is the purpose of the liner?*
- *Will a liner be used at the roof or will the walls be the only liner panel requirement?*
- *What type material (wood, metal, etc.) is being used?*
- *If metal, what gauge panel is required?*
- *What is the height of the liner panel?*
- *Will the bracing interfere with the liner panel?*
- *Will the wall rods have to be cut through the girts or do we go to another type of bracing?*
- *Will flange braces fastened through the liner panel be allowed? Removal of flange braces will make the columns or rafters unsupported which will make them more expensive. If you only require no flange bracing at a partial height liner condition, state so, and allow flange bracing above for more economical framing.*



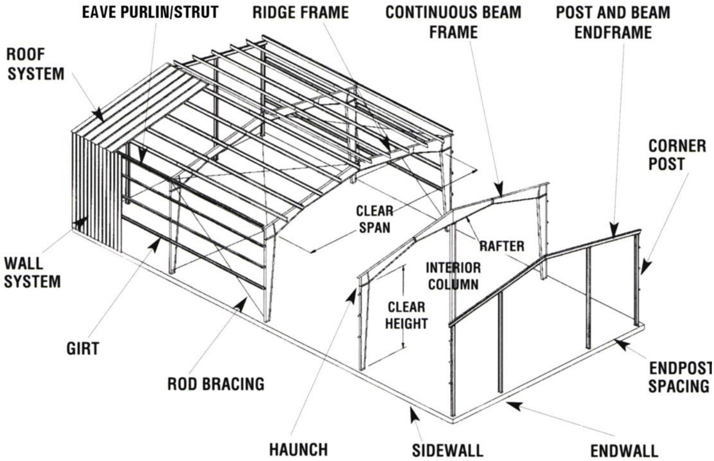
Liner Panel at Outset Girts Shown

Liner Panel Optimization Concepts

- Most economical is the lightest, 28 gauge, liner available.
- Utilize standard colors as much as possible.
- Verify what warranties are required for the panel finishes. Use SP finish as much as possible.

Notes:

Insulation:



EAVE PURLIN/STRUT
RIDGE FRAME
CONTINUOUS BEAM FRAME
POST AND BEAM ENDFRAME
ROOF SYSTEM
CORNER POST
CLEAR SPAN
RAFTER
WALL SYSTEM
INTERIOR COLUMN
CLEAR HEIGHT
GIRT
ROD BRACING
ENDPOST SPACING
HAUNCH
SIDEWALL
ENDWALL

Insulation[2]

The complex, technical process of building most any permanent structure requires attention to detail from concept to the final entry on a punch list. Specifications are written to meet the expectations of the owner, as well as comply with building codes and to protect the interest of a number of parties, including the architects, engineers, contractors, vendors, lending institutions, government agencies, and, of course, the owners.

One crucial aspect covered by the specifications is the heating and cooling of the structure. An effective insulation solution that addresses the initial cost and long term operating expenses associated with the building's life cycle must be met.

When ambiguous specifications for the design of the thermal envelope are misinterpreted, both initial construction and annual operating costs may be higher than necessary. Given the increased emphasis on energy conservation, as well as the rising cost of energy and broader acceptance of ASHRAE standards over the past decade, there is keen interest in providing cost-effective insulation methods for the thermal envelopes of buildings. Clear and concise thermal performance specifications will help ensure that buildings will meet energy usage expectations and, in turn, save money. Since the ASHRAE standards require a building's insulation system to generate an ***in-place*** U-value, the past methods of specifying and installing insulation must be challenged and changed throughout the industry to comply with the new expectations.

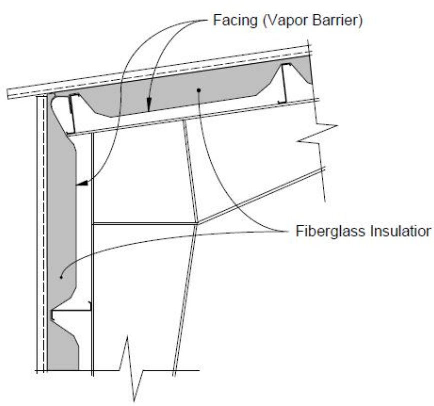
Most misinterpretation of insulation specifications arises when wall and ceiling manufacturers fail to test their product as installed. This can seriously

[2] By David Hales

affect the heating and cooling of a building. It is not enough to test the insulation in a standard environment; it must be tested as actually installed on the building. This is commonly referred to as an ***in-place*** testing method.

The key is to maintain a close relationship with your mechanical contractors and engineers. When they read a certain specification for insulation, they usually assume it to be an ***in-place*** value. If the insulation they are considering does not have an ***in-place*** value, then the amount of insulation specified would be incorrect. The engineer must then over compensate the HVAC design for the reduced performance of the improperly tested insulation in order to sufficiently heat and cool the building. This can quickly increase the life-cycle cost of operations in the building. There are many software packages available making it easier to run several insulating options to identify the most economic solution.

It is important for the specifying community to become more educated on the performance of various insulation materials, systems and installation practices so



this does not happen. The key to solving this problem is to insist on ***in-place*** values that are substantiated by a recognized testing agency. A Hot Box test procedure can accurately determine how an entire system will perform once constructed.

In-Place Values

The following reflect the ***in-place*** values of VP Buildings' roof and wall assemblies with various material and installation methods. All faced insulation used in these test results possessing the NAIMA 202-96 quality designation and was laminated under strict adherence to the National Insulation Association's (NIA) 404 standards:

- Panel Rib Roof with 3" of faced blanket insulation R= 7.7 (single layer over purlin)
- Panel Rib Roof with 4" of faced blanket insulation R= 8.4 (single layer over purlin)
- Panel Rib Roof with 6" of faced blanket insulation R= 12.7 (single layer over purlin)
- Panel Rib Wall (Vee Rib) with 3" of faced blanket insulation R= 7.6 (single layer over girt)
- Panel Rib Wall (Vee Rib) with 4" of faced blanket insulation R= 8.3 (single layer over girt)
- Panel Rib Wall (Vee Rib) with 6" of faced blanket insulation R= 12.6 (single layer over girt)
- SSR Roof with 3" of faced blanket insulation, no Thermal Block R= 9.5 (single layer over purlin)
- SSR Roof with 4" of faced blanket insulation, no Thermal Block R= 11.3 (single layer over purlin)
- SSR Roof with 6" of faced blanket insulation, no Thermal Block R= 12.6 (single layer over purlin)
- SSR Roof with 3" of faced blanket insulation and Thermal Block R= 10.3 (single layer over purlin w/Thermal Block)

- SSR Roof with 4” of faced blanket insulation and Thermal Block R= 12.3 (single layer over purlin w/Thermal Block)
- SSR Roof with 6” of faced blanket insulation and Thermal Block R= 15.8 (single layer over purlin w/Thermal Block)
- SSR Roof with 6” of blanket insulation and a 3” SuperBlock R= 19.0 (4” faced layer over purlin, and 2” unfaced layer over SuperBlock)
- SSR Roof with 7” of blanket insulation and a 3” SuperBlock R= 22.8 (4” faced layer over purlin, and 3” unfaced layer over SuperBlock)

Another important factor when installing insulation is to determine the proper vapor retarder that needs to be applied. The “perm” rating associated with the facing indicates the rate of vapor transmission through the material. The best rating in the metal building industry is a .02. It provides a significant vapor retarder that is required to keep the insulation dry and capable of performing at an optimum level.

Insulation Considerations

Here is a checklist of things to remember when working on future projects:

- Understand the code requirements for each project. Just because you erect several buildings in the same geographical market does not mean that they have the same insulation requirements.
- Make sure the insulation is specified to represent an ***in-place*** value that is supported by ASTM Hot Box testing procedures.
- Challenge the insulation specifications that are vague and ambiguous.
- Insist on using fiberglass insulation that is manufactured, laminated and is certified to

possess the NAIMA 202-96 and NIA 404 quality standards.

- Consider VP's 6" SuperBlock system when installing roof insulation. It has a tested **in-place** R-19 value and is protected by U.S. Patents.
- A seven-inch system is also available. It has a tested ***in-place*** value of 22.8 and meets ASHRAE roof standards for all states except some locations in Alaska.
- "R" and "U" values are the reciprocal of each other.
- Contact your VP District Manager or Laminator to assist you in understanding the various insulating options through the VP Buildings Insulation program.

VII. Building Energy Conservation[3]

7.1 General

Energy conservation is an important consideration for building owners and designers that is regulated through local and national codes. These codes are evolving, becoming more stringent, and being better enforced. Understanding energy conservation requires a basic understanding of the theory, terms, and construction practices. Good planning and proper use of energy conservation principles will pay off in long-term economic gains for the owner, comfort for the occupants and reductions in maintenance and modification to the building as it ages.

[3] Section VII Building Energy Conservation from: Metal Building Systems Manual. 2006. Cleveland, Ohio.

7.1.1 Heat Transfer Fundamentals

Heat transfer is the term commonly used to indicate the movement of heat (energy) from one region to another. Minimizing heat transfer is the role that insulating materials play in conserving energy. The driving force for heat transfer is the difference in temperature between two regions, or surfaces, and will occur in a direction from hot to cold. The three basic mechanisms of heat transfer are as follows:

1) Conduction - the process by which heat will transfer through a solid material. Heat will transfer through the material from hot to cold by means of molecular contact.

2) Convection - the transfer of heat by means of a moving fluid such as air or water. Heat is picked up by a moving fluid and transported to another region.

3) Radiation - the transfer of heat by means of electromagnetic waves.

7.1.2 Measurement of Heat Transfer

The amount of heat transferred is measured in British Thermal Units (BTU). One BTU is equivalent to the amount of energy required to raise one pound of water by one degree Fahrenheit (F). Several interrelated properties are used to measure the ability of a material to permit heat flow through it.

Thermal conductance (C) is a measure of the rate (measured in BTU's per hour) that heat will flow through an insulating material. Materials that have lower conductance values will allow less heat to flow through them.

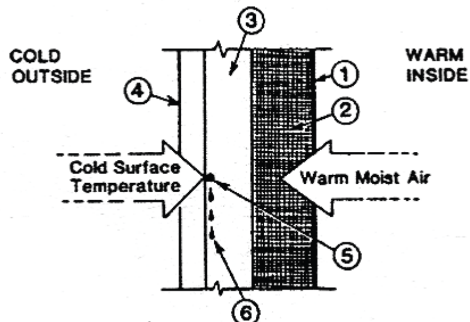
Thermal resistance (R) is a measure of a material's ability to resist the passage of heat. Thermal resistance is often expressed using the common term “R-value”. Materials with higher resistance values allow less heat to flow through them. Thermal resistance is the reciprocal of the thermal conductance. For multi-layer systems, the total resistance (Rt) is the sum of the individual resistance of each layer.

Thermal transmittance (U) is the total rate that heat will flow through a given assembly including the effects of surface air film resistances. Thermal transmittance is often expressed using the common term "U-value" or "U-factor". A lower U-value indicates that less heat will flow through an assembly. Thermal transmittance (U) is the reciprocal of the total thermal resistance, Rt.

7.2 Condensation

7.2.1 The Condensation Process

The condensation process occurs when warmer moist air comes in contact with cold surfaces such as framing members, windows, and other accessories, or the colder region within the insulation envelope (if moisture has penetrated the vapor retarder). Warm air, having the ability to contain more moisture than cold air, loses that ability when it comes in contact with cool or cold surfaces or regions. When this happens, excessive moisture in the air is released in the form of condensation. If this moisture collects in the insulation, the insulating value is decreased (see Figure 7.2.1.1) as wet insulation has about the same heat conductance value as water.



1. Vapor Retarder
2. Insulation
3. Cold (attic) region
4. Weather barrier (panel)
5. Dew point surface (Typical - can vary within wall cavity)
6. Condensation

Figure 7.2.1.1

Method of Condensation

In dealing with condensation, air may be considered to be a mixture of two gasses - dry air and water vapor. One thousand cubic feet of air at 75° F can hold up to 1.4 pints of water. At 45° F, the same volume of air can hold only 0.5 pints. Relative humidity is a percentage measurement of the amount of water vapor present in the air in relation to the amount it is capable of holding at that temperature. For example, 50% relative humidity indicates the air is carrying one-half of the maximum amount of moisture that it is capable of containing at the given temperature. Cold, outside air is usually much drier than warm inside air. Therefore, the indoor relative humidity can be lowered by bringing in outside air to mix with and dilute the moist inside air. At 100% relative humidity, the air is “saturated.” The temperature at which the air is saturated and can no longer hold the moisture is called the dew point temperature (see Table 7.2.4.1 for more information). Whenever air temperature drops below its dew point, excess moisture will be released in the form of condensation. Condensation problems are most likely to occur in climates where temperatures frequently dip to 35° F or colder over an extended period of time.

7.2.2 Condensation Control

Two things must be present for condensation to occur: warm moist air, and cool surface temperatures below the dew point. The proper control of these two factors can minimize condensation. In metal building systems, we are concerned with two different areas or locations: **visible condensation** which occurs on surfaces below dew point temperatures; and **concealed condensation** which occurs when moisture has passed into interior regions and then condenses on a surface below dew point temperature.

7.2.2.1 Visible Condensation

To effectively control visible condensation, it is necessary to reduce the cold surface areas where condensation may occur. It is also important to minimize the air moisture content within a building by the use of properly designed ventilating systems.

7.2.2.2 Concealed Condensation

Concealed condensation is the most difficult to deal with and can be the most damaging to any kind of structure. This type of condensation may be controlled in metal buildings by the proper use of vapor retarders and by minimizing moisture content within the building by proper ventilation. Additional condensation control can be accomplished by venting the cavities of the walls and roof.

7.2.3 Vapor Retarders

A vapor retarder is used to inhibit the passage of warmer moist air into the inner regions of the roof or wall system. The proper selection and installation of the vapor retarder can help control condensation problems in a building. Vapor retarders are rated by the amount of moisture that can pass through them. The lower this rating, called a perm rating, the less vapor transmission will occur and the more effective the vapor retarder will be. There are various types of vapor retarders available, such as:

1. Structural Membranes, including rigid steel sheets or other impermeable material.

2. Flexible Membranes, such as foils, coated papers, or plastic films. Usually, these membranes are rated by “perm” of 1.0 or less, per ASTM E-96. (The most familiar to the metal building industry are the membrane retarders laminated to fiberglass blanket insulation). Plain white vinyl with a perm rating of 1.0 is not an effective vapor retarder, especially in buildings with a high relative humidity.

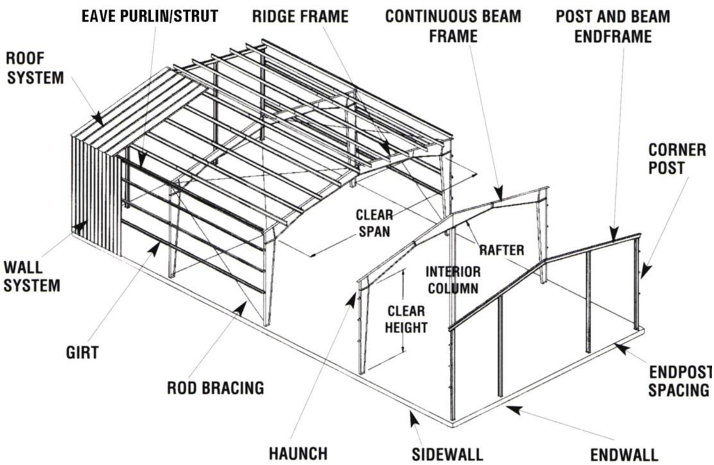
3. Coating Membranes, which includes paints.

Proper Sealing of the Vapor Retarder

1. When installing either a membrane type or structural type, make sure that all seams, laps and joints are properly sealed. Sealing a vapor retarder may be achieved by gluing, taping, overlapping, or stapling according to the insulation supplier's recommendations.
2. In the case of a membrane type retarder, make sure that any punctures or tears in the material are repaired.

Notes:

Trim:


EAVE PURLIN/STRUT
RIDGE FRAME
CONTINUOUS BEAM FRAME
POST AND BEAM ENDFRAME
ROOF SYSTEM
CORNER POST
CLEAR SPAN
RAFTER
INTERIOR COLUMN
WALL SYSTEM
CLEAR HEIGHT
GIRT
ROD BRACING
ENDPOST SPACING
HAUNCH
SIDEWALL
ENDWALL

Trim

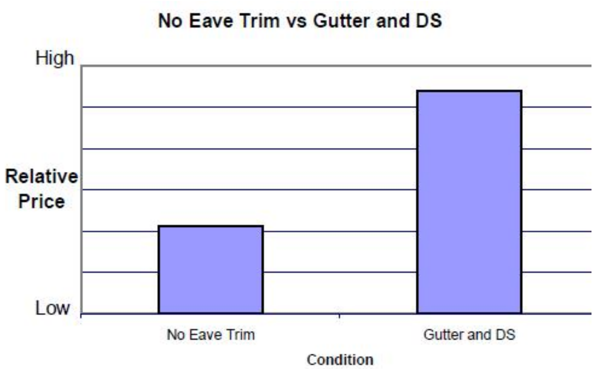
Trims affect the overall appearance of the building. This section is to help determine the owner's desire for simple or more complex details.

Trim Questions for the Customer

- *What trim conditions are required?*
- *Will VP supply the trim at the adjacent wall material?*
- *Will the building have gutters & downspouts?*
- *Exterior Gutters*
- *Interior Gutters*
- *What color trim is required?*

Trim Optimization Concepts

- Identify the proper trim required for the building (i.e., do not specify gutters and downspouts if not required).



- Trim can be any standard KXL color without additional cost impact.
- If panels are not by VP, identify who will supply the trim conditions.

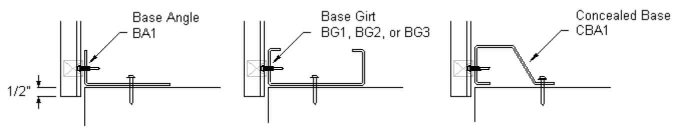
- If SMACNA[4] trim detailing is required, it is available from AEP-Span at an additional cost.
- Avoid interior gutter if possible.

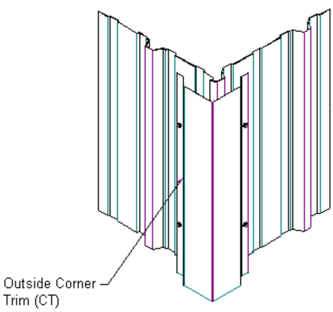
[4] SMACNA – Sheet Metal and Air Conditioning Contractor's National Association

Trim Conditions

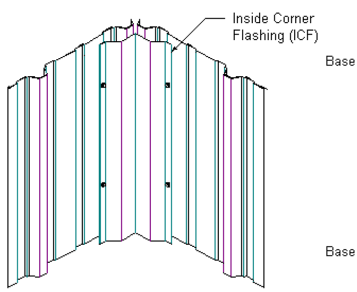
The following represent some common VP trim conditions. Please see the Standard Erection Details (SEDs) for actual condition.

VP Standard Trim - Base of Wall

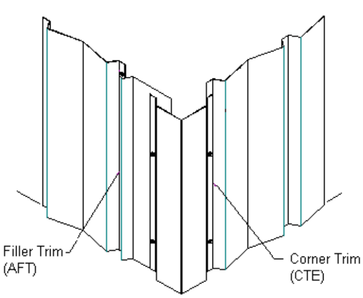




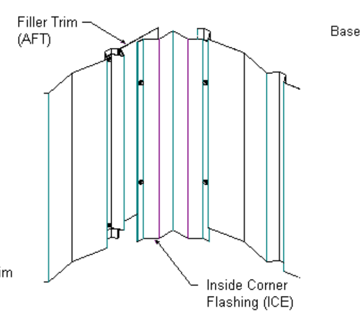
PR Outside Corner



PR Inside Corner

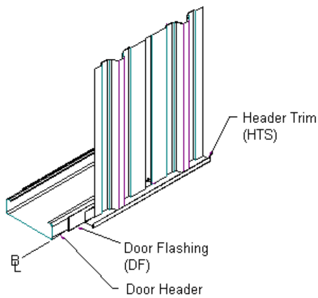


VR Outside Corner

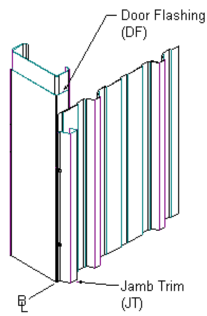


VR Inside Corner

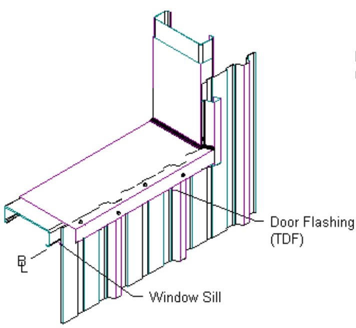
VP Standard Trim Framed Openings



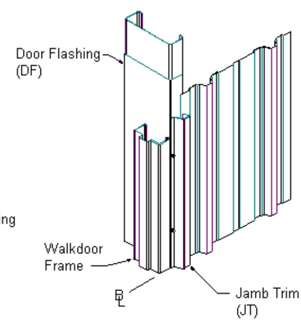
Header
(PR shown, VR similar)



Jamb
(PR shown, VR similar)

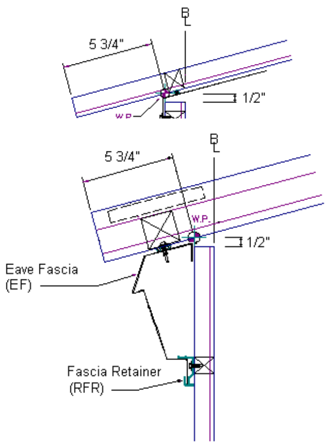


Sill
(PR shown, VR similar)

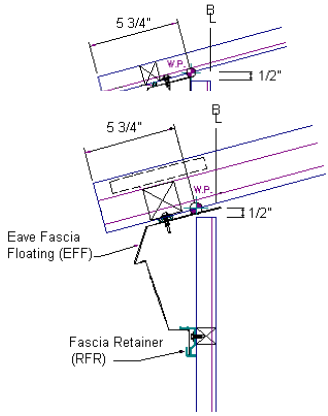


Walkdoor
(PR shown, VR similar)

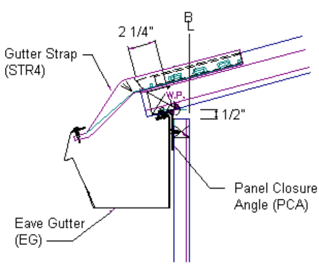
VP Standard Trim - PR Low Eave



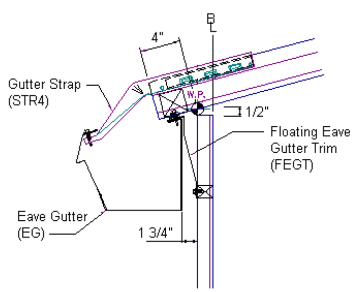
Eave Fascia
3 runs of Fixed Clips
at the Low Eave
(PR, RPR & VR Walls)



Floating Eave Fascia
3 runs of Fixed Clips
near the Middle of the Roof
(PR, RPR & VR Walls)

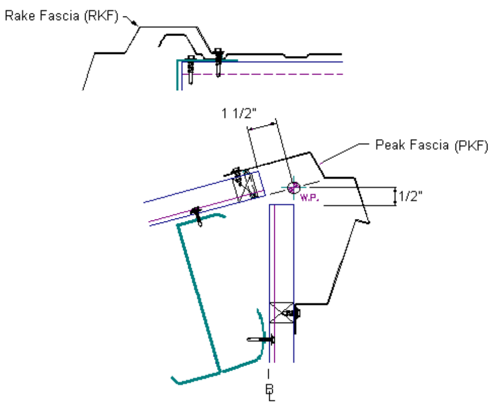


Eave Gutter
3 runs of Fixed Clips
at the Low Eave
(PR, RPR & VR Walls)

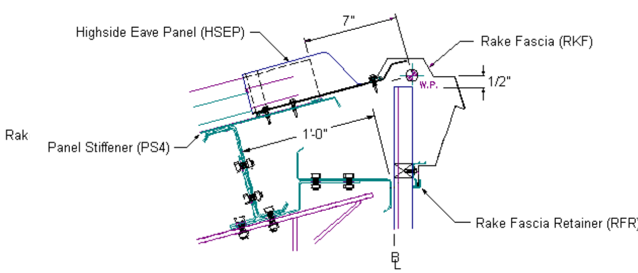


Floating Eave Gutter
3 runs of Fixed Clips
near the Middle of the Roof
(PR, RPR & VR Walls)

VP Standard Trim - Rake

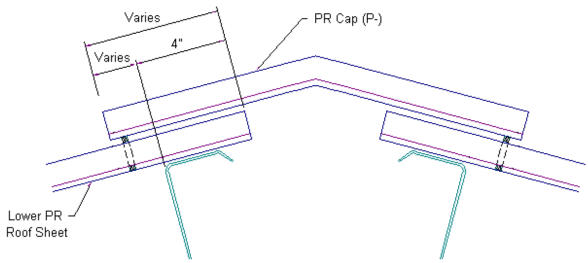


PR Roof - Peak Fascia (PR, RPR & VR Walls)

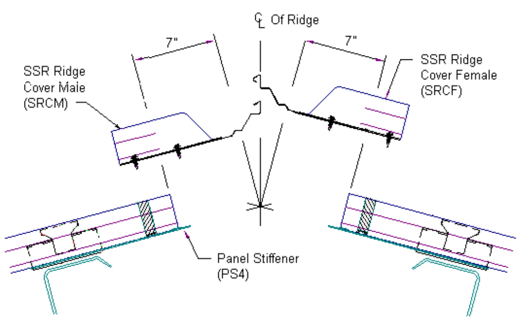


SSR Roof - Highside Fascia (PR, RPR & VR Walls)

VP Standard Trim - Ridge

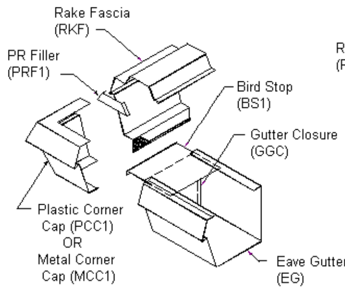


PR Ridge
At > 2:12, use a Ridge Roll Flashing (Not Shown)

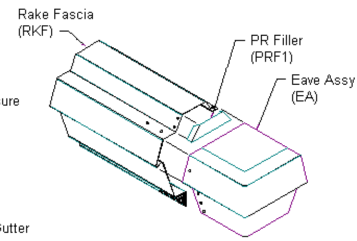


SSR Ridge

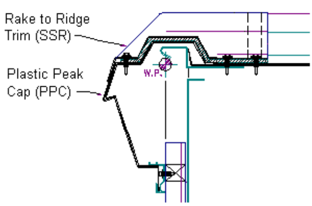
VP Standard Trim - Miscellaneous



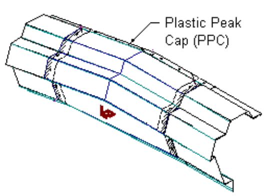
Eave Gutter Corner



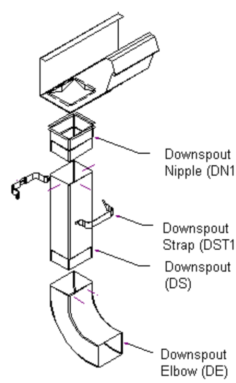
Eave Fascia Corner



SSR Plastic Peak Cap

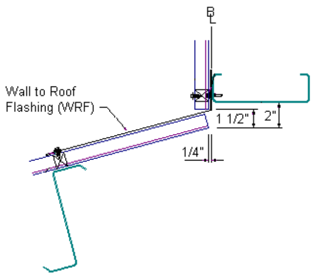


PR Plastic Peak Cap
(Metal Peak Cap (SPC) Similar)

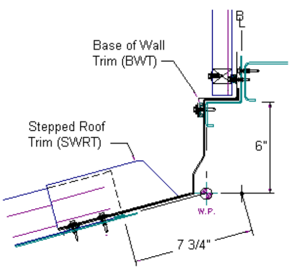


Downspouts

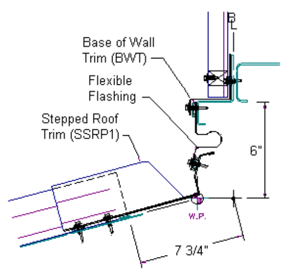
VP Standard Trim - Wall to Roof



Wall to PR Roof
(PR, RPR & VR Wall)

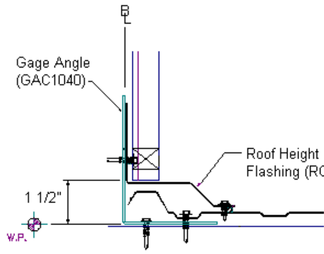


Wall to SSR Roof - Metal
(PR, RPR & VR Wall)

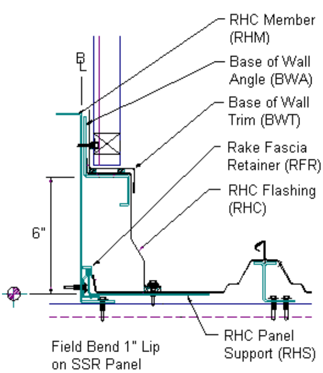


Wall to SSR Roof - Flexible
(PR, RPR & VR Wall)

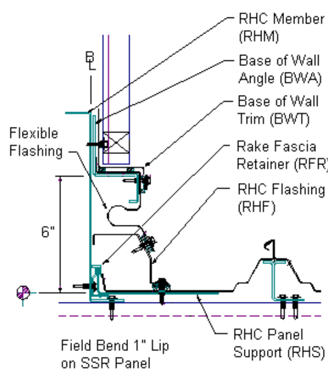
VP Standard Trim - Roof Height Change



PR Roof Height Change
(PR, RPR & VR Wall)



SSR Roof Height Change - Metal
(PR, RPR & VR Wall)



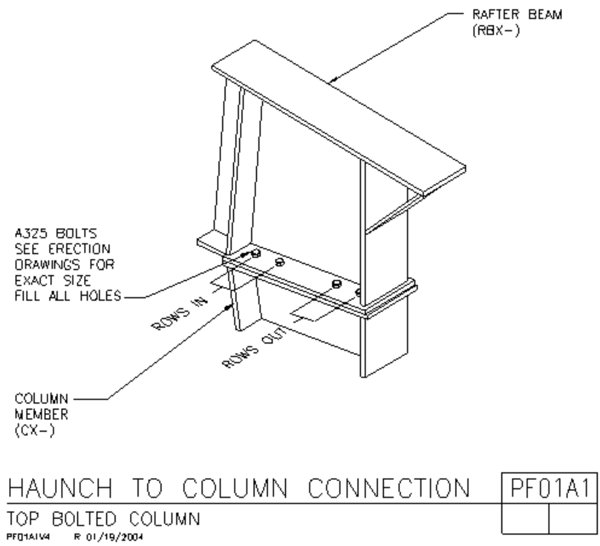
SSR Roof Height Change - Flexible
(PR, RPR & VR Wall)

Trim SEDs details are categorzed as follows in VPC and on Erection Drawings.

This will assist you to find a detail quicker by knowing how they are labeled.

Description	Detail Description	VPCommand Description
Primary Framing Details	PF01A1	PF01A1.emf
Bracing Details	BR01A1	BR01A1.emf
Wall Secondary Details	WS01A1	WS01A1.emf
Roof Secondary Details	RS01A1	RS01A1.emf
Roof Covering Details	RC01A1	RC01A1.emf
Wall Covering Details	WC01A1	WC01A1.emf
Wall Accessory Details	WA01A1	WA01A1.emf
Roof Accessory Details	RA01A1	RA01A1.emf
Façade Details	FC01A1, FS01A1, KPFS01A1, KPFC01A1	FC01A1.emf
Concrete Masonry Details	CM01A1	CM01A1.emf
Erection Notes	EN01A1	EN01A1.emf
Mezzanine Details	MF01A1	MF01A1.emf
Crane Details	CR01A1	CR01A1.emf
All Anchor Bolt Details	AB01A1	AB01A1.emf

For example, if I was looking for a detail on Primary Framing I would look at SEDs starting with PF.



Notes:

Notes:

Liner Trim

Liner trim is to protect and hide the raw edges of the panels. This is an appearance option and needs to be determined if it is desired by the owner.

Trim Questions for the Customer

- *Will interior trim be required where liner panels are required?*
- *How detailed will the trim requirement be on the interior of the building?*

Liner Trim Optimization Concepts

- Interior liner trim is not required in many installations. Be sure it is a requirement of the project before it is added.
- If it is required, determine how elaborate the requirement will be.
- In VP Command the liner can include the soffit of any overhangs, so be careful to include what is required in these areas.

Notes:

Accessory

A wide range of accessories are available. The purpose of this section is to determine the quantity, location and types of accessories required.

Accessory Questions for the Customer

- *What types and quantities of door/windows should VP supply?*
- *What type of door hardware is required?*
- *Do you want wall-lights on the building?*
- *Will there be louvers on the building?*
- *What type roof curbs, ridge vents, tuf-lites or skylights will VP provide on this project?*
- *Are there any other "Special" accessories VP can supply?*

Accessory Optimization Concepts

- VP doors and windows usually do not require framed openings.
- Door hardware is expensive; make sure you understand what will be required.
- While accessories will increase the cost of a building, they also offer another area in which the service to the customer can be enhanced. Don't overlook the ability to provide any accessory that is required. VP Components[5] can greatly assist with special accessory needs.

[5] VP Components: phone – 877-983-7663; www.vpcomp.com

Accessory Description:

Accessories are components that can be added to a building in order to develop a complete building package. The selection of accessories is dependent on the type of roof and/or wall panel with which the accessory is to be provided. Accessories are broken down into two categories:

Accessory Product Information:

Net Accessories:

"Net" accessories are items such as personnel doors, windows, louvers, roof vents, wall lites, roof Tuf Lites and more. These accessories are not subject to price adjustments.

- **Framed Openings:** Are located in VP Command as specified by the Builder. These openings vary in size. They include jambs, headers, clips, bolts, fasteners, support girts, jamb extensions (where needed) jamb and header cover flashing, panel trim at jambs and headers. Openings for personnel doors, windows, and louvers are typically field located. Jambs and header will match secondary unless opening will not design. Then it will increase by 1 ½” until correct design depth is found.

- **Walk Door Kits:** Standard walk doors provided by VP are self-framing and self-flashing. Both single and double doors are available with flush panels, half-glass panels or narrow-lite panels.

There are multiple hardware options available for the doors. The selection list found in VP Command is a Knock Down (KD) Door kit. Another option in VP Command and the Supplemental Price Book are Pre-Assembled and provided by Dominion Building Products.

- **Window Kits:** Standard windows provided by VP are self-framing and self-flashing. Various styles and sizes of windows with different types of glass are available. Some of the windows available in VP Command are: 2060 Fixed, 3040 Horizontal single hung, 3030 Horizontal Slide, 6030 and 6040 Horizontal Slide. Mullion Channels are available in order to locate windows side-by-side. The windows in the Supplemental Price Book are Pre-Assembled and provided by Dominion Building Products.

- **Louvers:** The louvers offered by VP are self-framing and self-flashing. Louvers available in VP Command are 3030 units with either fixed or operable blades for Panel Rib and Vee Rib walls. Other sizes are available by contacting your Service Center for Pricing.

- **Walk Door Canopies:** These canopies are pre-assembled units and include mounting angles, rods, fascia and drain. They are available in 4'-6”× 4' and 7’-6” × 4' unit sizes within VP Command.

- **Apex 20 Vents:** These are 20" diameter vents (At Ridge or Sloped) complete with bird screen, damper and pull cord. They also include a mounting base with fasteners and mastic. They should be added using VP Command.

- **Ridge Ventilators:** Ridge ventilators are 10' long units which can be used as a single unit or as a continuous unit. Options are for either 9" or 12" throat sizes. They include bird screen, damper and operating chain, closures, fasteners and mastic.

- **Wall Lites:** Wall Lites are nominally 3' × 5' white fiberglass reinforced plastic panels configured to match Panel Rib or Vee Rib wall panels. They are available with or without a UL-25 flame spread rating.

- **Roof Tuf Lites:** Roof Tuf Lites are white woven fiberglass plastic panels which are configured to match Panel Rib and SSR roof panels. The Tuf Lite for Panel Rib is nominally 3' × 10'; the Tuf Lite for SSR is nominally 2' × 10'. Tuf Lites are available with or without condensation pans, UL-90 uplift rating and UL-25 flamespread rating. Fasteners, mastic, and insulation trim are included with each Tuf Lite.

- **Tuff-Dome Skylite:** Domed skylight with a “built-in-curb” designed to work with VP’s roof panels. The superior weather resistance of the polycarbonate material allows for better light trasmiision while resisting yellowing, cracking, or fading.Tuf-dome is available in either insulated or non-insulated models. They come complete with support framing and installation kit that includes fasteners and mastic.

- **Dektites:** These are EPDM flashing units which can be utilized when pipes penetrate wither roof or wall panels. Sizes are available for varying pipe diameters; in addition, some sizes are available for high temperature and Retro-fit applications.

- **Roof Curbs:** These special ordered curbs are specifically made to fit every VP roof panel profile and can be priced using the Supplemental Price Book. Other sizes are available by contacting your Service Center for Pricing.

Notes:

Pricing

The purpose of this section is to determine any optional warranty costs that may be required that influence the price of the project.

Warranty

Warranty Questions for the Customer

- *Are Warranties other than the standard material warranties required?*
    - *Weather tight warranty*
    - *Optima Warranty*
- *What Warranties are required on the panel finish*
    - *SP 10 year finish (for liner panel only)*
    - *SP 20 year finish (for liner panel only)*
    - *KXL 20 year finish*

Warranty Optimization Concepts

The cost of warranties should never be included in a project unless it is a requirement to satisfy the owner. Make sure you understand VP Buildings' offering in this area.

Also, make sure you understand your involvement in the warranty when it is offered.

See the Warranties section within the Supplemental Price Book section of Order Entry for the latest offerings.

Notes:

Deck Frame

Description

Deck Frame is the utilization of VP Buildings' economical three plate materials, open web rafter materials, conventional structural shapes, bar joist, and conventional "B" deck materials to design, manufacture, and deliver the most economical building structure. Deck Frame projectscan be combined with any type lightweight non-metal roofing system commonly used in the conventional construction market today.

By combining the ease of Metal Buildings with conventional roof systems, you generate many more choices of building design. You can have Metal or Non Metal Roofing Systems, Metal Wall or Hard Wall Systems, Solid Rafter system or Open Web Rafter Systems. These designs meet current trends, as well as provide some aesthetic appearances, such as Level Parapet or Top of Wall, Interior Drainage, better Water Management, and Framing for new Single Ply Roofing Systems.

Features of Deck Frame projects:

Deck Frame merges VP Buildings' designs and products with the design and products of the Conventional Construction market.

Deck Frame - Framing options:

- Open Web Rafter Members
- Three Plate Solid Web Rafter Members (both straight and tapered)
- Three Plate Straight "H" columns, Tapered Columns, or Tube Columns

Deck Frame Secondary options:

- Conventional Bar Joist
- WideBay Purlin System
- Hot Rolled Shapes
- Cold Rolled Purlins

Deck Frame Bracing:

- No Roof Rod Bracing
- Metal Deck for Diaphragm Bracing

Deck Frame: Multiple Exterior Wall applications:

- Load Bearing Tilt Wall
- Load Bearing Pre-cast Wall
- Load Bearing Masonry Wall
- Exterior Columns for Non-Load Bearing Wall systems
- Cold Formed Secondary Steel Girts for Metal Wall Application

Deck Frame: Roof applications:

- B-Deck
- All available gauges
- Painted or Galvanized
- Pinned, Screwed, Welded, or Mechanically fastened
- Acoustical Deck Products
- Architectural Deck Products
- Design for Flat of Tapered Insulation Systems
- Lightweight Non-metal Roofing Systems

Deck Frame Roof products:

- The VP Deck Frame Systems works great with any lightweight non-metal commercial roofing system…
- EPDM (Rubber Roofing)

- TPO (Thermoplastic Polyolefin)
- Built-up 2 and 4 ply systems
- ….with any type of Attachment
- Ballasted
- Batten-in-seam
- Mechanically Fastened
- Fully Adhered.

Advantages of the Deck-frame product will produce a “The Winning Combination” of the strength and economy of VP Buildings’ engineered eonstruction eystems, the aesthetics and function of conventional construction methods, with the best advantage being that there is one-source responsibility for design, fabrication, and delivery

Deck Frame Estimating:

All Deck-Frame construction projects quotes, and service is performed out of your location Service Center. You will need to contact your Estimating Manager with Project Information, and she will quote the project.

Each project is evaluated, and a preliminary design must be looked at. So Deck-Frame projects take longer than a normal project to quote. This is generally up to two weeks from the time the information is received.

Notes:

Hybrid

Hybrid Description

Most pre-engineered buildings are single story, manufacturing or warehouse. Once a pre-engineered structure moves into large cranes, multi-level mezzanines, and large clear spans (250' or greater), it is hard to design because of our manufacturing abilities. Hybrid Construction is an economical alternative to "Conventional" Steel Buildings combining conventional hot rolled shapes and plate girders with typical pre-engineered structural components, secondary steel, covering, and trim to design and construct the most efficient building structure and enclosure possible.

Hybrid Estimating:

All hybrid construction projects, quotes, and services are performed out of Memphis. You will need to contact your BDM or PDM with Project Information, and they will contact the Estimating Group in Memphis. Each project is evaluated, and a preliminary design must be looked at; hybrid projects take longer than a normal project to quote. This is generally up to two weeks from the time the information is received in Memphis.

Cost Savings

Cost savings up to 30% and greater on some projects when compared to “conventional” steel design. Each project is totally different, so careful consideration must be given on each job. Following are some situations where savings were great.

- Saved over $6 million on an 800,000 s.f. Steel Processing Facility.

- Savings of over $1 million on a 180,000 s.f. Mfg. Facility.

- Saved of over $120,000 on an 80,000 s.f. Aircraft Hangar.

- Saved of over $300,000 on a 185,000 s.f. Aircraft Hangar

Typical Buildings that can considered for Hybrid construction

- All Buildings with Class “E” or “F” Cranes

- Buildings with class “A”, “B”, or “C” Cranes that are 40 ton or greater capacity

- Crane buildings where the Crane rail heights are greater than 60 ft.

- Arenas with clear span of greater than 250 ft. or where due to loading requirements frames will not design in VP Command

- Aircraft Hangars with over 200 ft. spans and strict deflection limitations

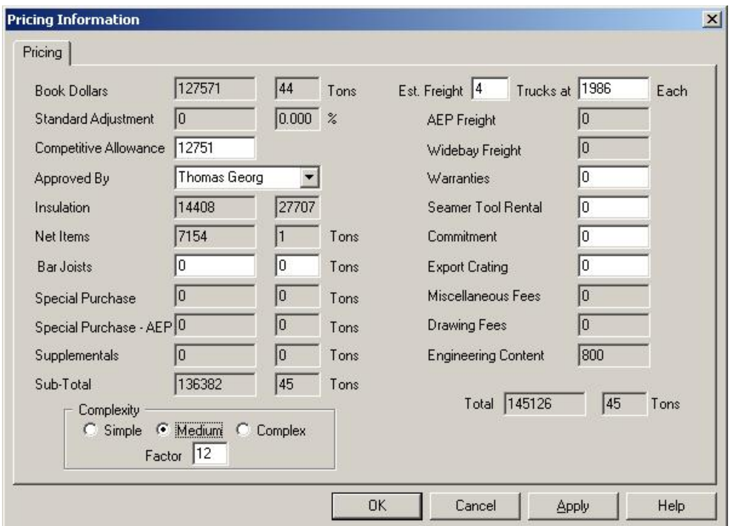
- Aircraft Hangars where large door openings prevent the normal use of sidewall columns

- Aircraft or long-span buildings where the side wall columns are taller than 60 ft.

Notes:

Pricing Information

The Pricing Information section of VPC will allow you to input addition items that affect price such as your Competitive Allowance, Warranty Information, SSR Seamer Rental, Freight, etc. You should also calculate the building's complexity (see following section and the Help screens within VPCommand).



VPCommand Pricing Information screen
February 5, 2010

Metal Buildings Manfacturer’s Association Complexity

MBMA Complexity - Simple

A rectangular building w/ solid web frames, purlins on the roof (any depth), SSR or PR roof panel, solid sheeted walls (PR or VR), double or single slope roof, standard rod bracing, user imposed point loads allowed, and any standard accessories.

Standard Building Accessories:

Walk doors, windows, louvers, skylights, vents, liner panels, eave gutter, etc.

MBMA Complexity - Medium

A building with any Category "B" or "C" items, but no more than (8) complexity points.

Category "B" Items (Each one counts as 2 complexity points)

Open web frames, facades (vertical & mansard), skewed end walls, South FL code, SLR roof, canopies over 10'-0", concealed fastener wall (Span Loc, etc.), cranes up to 20 ton (class "C") perpendicular to frames, roof extensions over 8'-0", masonry wind beams, sliding door (max 20' x 20'), furnish mezzanine system, monorails not perpendicular to the frames, roof height change, parapets, partitions, mini-warehouse.

Category "C" Items (Each one counts as 4 complexity points)

Special facades, skewed sidewalls, single hip, single valley, single jack beam, hanger doors, bi-fold doors, dormers, cranes under 20 ton (class "C") not perpendicular to frames, cranes over 20 ton (class "C") perpendicular to frames.

MBMA Complexity - Complex

A building with any Category "D" items, or more than (8) complexity points.

Category "D" Items (Each one counts as 8 complexity points)

Both skewed sidewalls & end walls, cranes over 20 ton not running perpendicular to the frames, any class "D" crane multiple hips or valleys, multiple jack beams, octagon shapes, multiple level mezzanines.

MBMA Complexity - Factor
Total number of Complexity Points.

Category "B" Items (Each one counts as 2 complexity points)

Open web frames, facades (vertical & mansard), skewed end walls, South FL code, SLR roof, canopies over 10'-0", concealed fastener wall (Span Loc, etc.), cranes up to 20 ton (class "C") perpendicular to frames, roof extensions over 8'-0", masonry wind beams, sliding door (max 20' x 20'), furnish mezzanine system, monorails not perpendicular to the frames, roof height change, parapets, partitions, mini-warehouse.

Category "C" Items (Each one counts as 4 complexity points)

Special facades, skewed sidewalls, single hip, single valley, single jack beam, hanger doors, bi-fold doors, dormers, cranes under 20 ton (class "C") not perpendicular to frames, cranes over 20 ton (class "C") perpendicular to frames.

Category "D" Items (Each one counts as 8 complexity points)

Both skewed sidewalls & end walls, cranes over 20 ton not running perpendicular to the frames, any class "D" crane multiple hips or valleys, multiple jack beams, octagon shapes, multiple level mezzanines.

Notes:

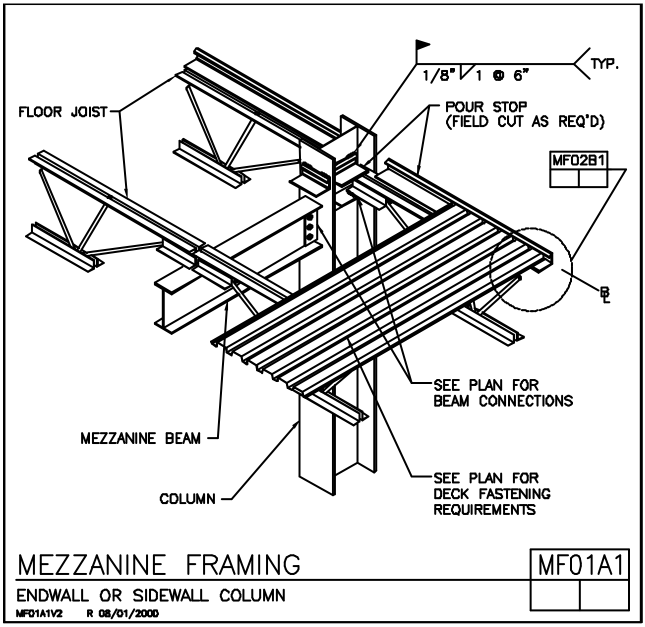
Other Topics

These topics may be outside the normal input of VP Command, and may require consultation with VP for pricing. The purpose of this section is to determine if these elements are required in the project. Refer to VP's order clarification documents to assist with these additional building features.

Questions for the Customer

Mezzanines

- *Is there a mezzanine or elevated floor in the project?*
- *If there is a Mezzanine is it supported by our building structure or is it an independent structure?*
- *What will the mezzanine be used for (this will control the design live load)?*
- *Will stairwell openings be required? If so, what size and location?*
- *What will the Mezzanine floor material be?*
    - *Poured concrete (thickness)*
    - *Lightweight concrete (thickness)*
    - *Gypsum*
    - *Grating*
    - *Steel Plate*
    - *Wood*
- *Can the mezzanine be used to help brace the building?*
- *What are the required clearances for the mezzanine*
- *Finished Floor elevation*
- *Clearance below the mezzanine steel*
- *Clearance above the mezzanine to bottom of roof*



Items that VP Buildings **WILL NOT** include in a mezzanine, and will be the Builder Responsiblity:

- Concrete
- Concrete Design
- Concrete Embeds (i.e. studs, WWF, etc.)
- Reinforcing (i.e. WWF, Rebar, etc.)
- Reinforcing Design

Builder Supplied Mezzaine Information When VP Buildings supplies a mezzanine structure, the Builder must supply the information listed below.	
Deck Design	This can be obtained from VP Buildings, Inc. or from a local source. It is the Builder's responsibility to have the deck designed for resisting lateral loads and to span from joist to joist if not obtained by VP Buildings.
Joist Spacing	If the Builder purchases the mezzanine deck from other sources, VP must be informed as to what joist spacing must be in order to support the decking. If VP is supplying the mezzanine deck and joists the we will supply required Joist Spacing.
Loading	The Builder should provide VP with the required loading information for the mezzanine. This would normally consist of the Live Load and the Dead Load of all Builder supplied items. Sometimes a partition load is also used for mezzanine design.
Clearance Dimensions Under the Mezzanine	Clearance from the finished floor to the bottom of the mezzanine structure is usually critical.
Floor Thickness	This varies depending upon the type of decking used. Most commonly the floor is composed of a metal decking topped with concrete.
Clearance Dimensions Above the Mezzanine	The dimension from the top of the mezzanine floor to the underside of the building rafters is usually very critical.

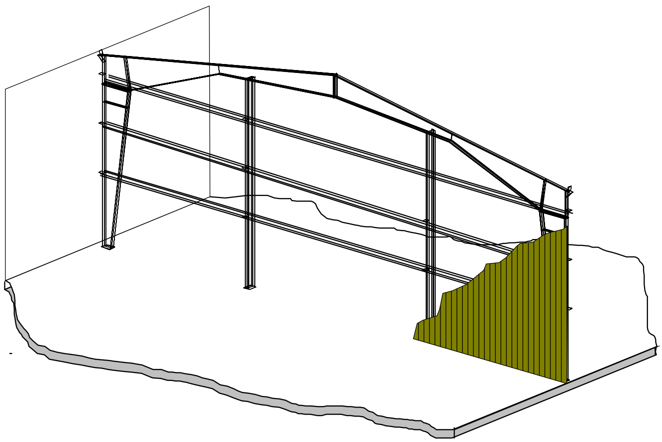
Facades and Parapets

See previous sections on facades and parapets for more information.

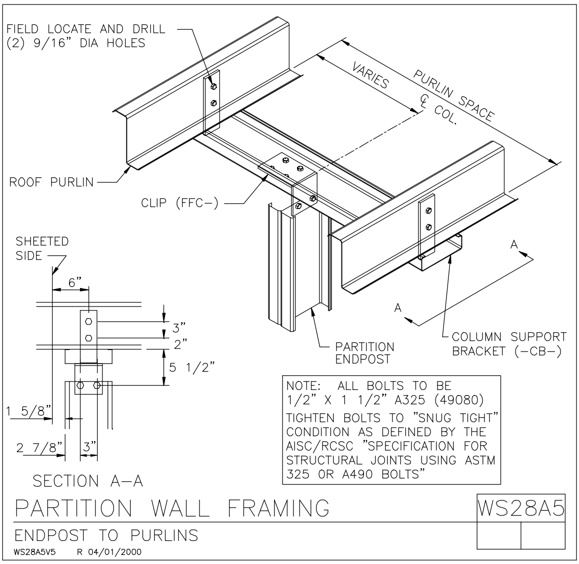
- *What is the reason for having a Façade/Parapet?*
    - *Is it an architectural element?*
    - *Designed to enhance the look of the building?*
    - *Is it to cover Roof Top Units (RTU) and/or roof slope?*
- *What type of material is used for construction of the Façade/Parapet?*
    - *Define the geometry of the Façade/Parapet, i.e., open or closed, mansard vs. straight.*
    - *Height?*
    - *Projection?*
    - *Etc.*

Partitions

- *What is the function of the Partition wall?*
    - *Fire protection.*
    - *Noise reduction.*
    - *Restrict or control air flow and/or smoke*
    - *Insulate portion of the building.*



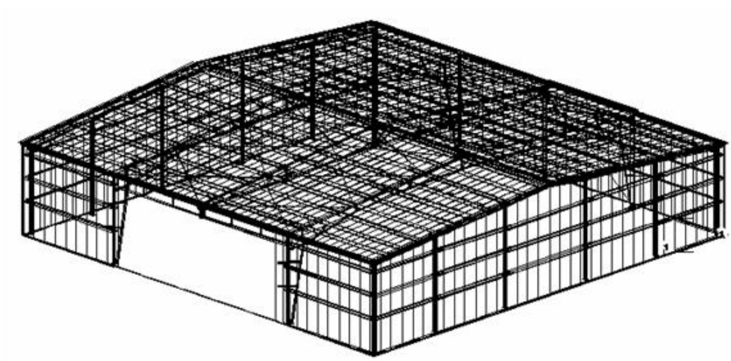
Partition at frame line shown (partition may be any direction)



Partition not at a Frame Line

Carrier / Jack Beams

These structural members act as both Primary and Secondary to approach wide bay applications. Jack Beams (solid web members) or Jack Trusses (open web members) permit extra wide bay spacing while using an economical purlin system. These interior members are typically utilized with either a Continuous Truss or Continuous Beam system to eliminate the need for a column where an open space is required for machinery, storage, or other purposes.



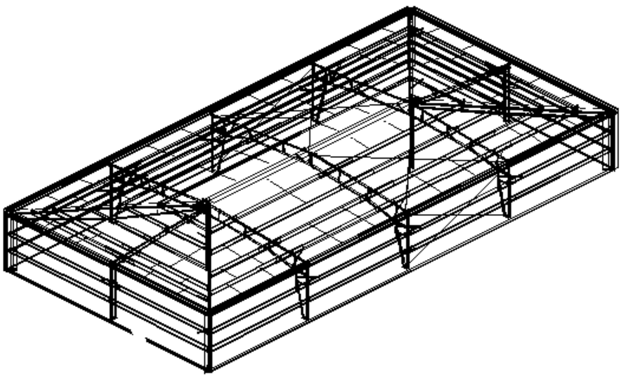
Jack Beam/Frame at Sidewall Shown (Jack Beams may be used to "jack-out" interior framing locations as well)

Other Topics Optimization Concepts

- Mezzanines can be a major element of the building project. Find out as much as you can from the owner about what he needs, then determine the best approach to providing the mezzanine. If it is to be by VP, the framing of the materials will be critical to the economy of the building.
- Facades and parapets may be required to change the appearance of the building or to make a statement in the marketplace. They may be to support signs or to provide a required appearance of the building. Whatever the reason, they can be an expensive element of the building. In addition, there are some methods of constructing Facades that are more expensive than others. Before quoting the more expensive alternatives, make sure they are required.
- Partitions are usually required to separate functional areas in a building. The proper application of materials is necessary to provide the best solution. VP can provide partitions with metal panels. If other materials are required, it may be more economical to use metal studs to achieve the partition.
- Partitions can run any direction. VPCommand allows the flexibility to have diagonal partitions if desired.

Hips and Valleys

VP Command has simplified the input, design, detailing, and manufacturing of most hip and valley buildings.

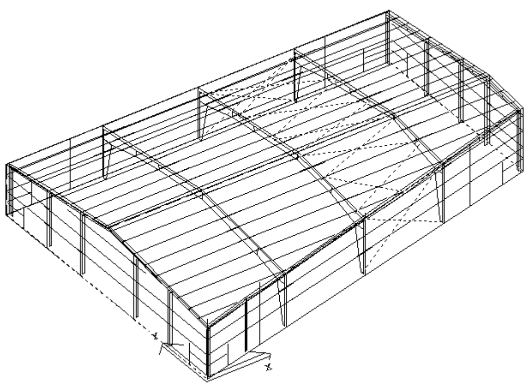


Hip Building from VP Command

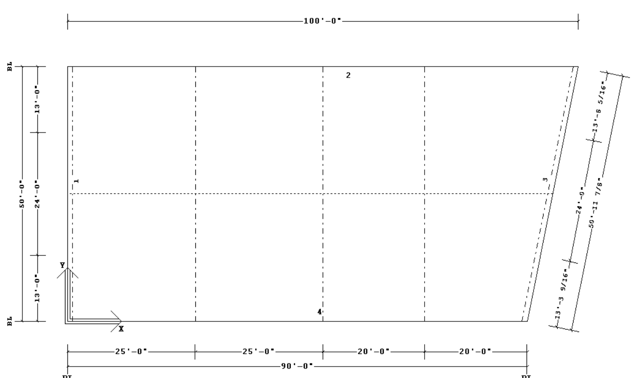
Hips and Valleys

Skewed Walls

Occasionally non-rectangular (skewed wall) buildings are required, often to meet building site requirements. VP Command provides for the simplified input of such building shapes.



Skewed Sidewall with Purlin Support Beams shown



Skewed Endwall

Roof Expansion

Table 1: Roof Panel Maximum Slope Length Limits

Roof Panel	Structural Support	Expansion Joint Type: Standard Eave	Expansion Joint Type: Mid-slope Anchorage	Expansion Joint Type: Stepped Joint
SSR	Z-Purlins w/ Metal Wall [3]	320'	520'	1040'
SSR	Joist, T/P, WBTP and/or Hardwalls [1, 3]	260'	520'	1040'
SLR II	Z-Purlins w/ Metal Wall [3]	220'	na	320'
SLR II	Joist, T/P, WBTP and/or Hardwalls [1, 3]	160'	na	320'
SLR II	Braced Purlins [2]	160'	na	320'
Panel Rib	Z-Purlins	150'	na	300'
Panel Rib	Joist, T/P or WBTP [1]	Not permitted	Not permitted	Not permitted
Panel Rib	Braced Purlins [2]	120'	na	240'
Roof Deck[1]	All	Since roof decks are not exposed to elements (i.e.- steel is below insulation), expansion criteria is governed by Sec C below.		

Notes:

1. **Joists, Truss Purlins (T/P) or Wide Bay Trussed Purlins (WBTP)** have restricted lateral movement and thermal stress relief from lateral movement cannot be relied on. For these applications screw-down roofs are "not permitted" and Standing Seam roofs have been limited to the maximum movement of their sliding clips.
2. **Continuously Braced Purlins** from eave-to-ridge limit the amount of purlin lateral movement that can be relied on for thermal stress relief. Screw-down roof limits have been lowered and Standing Seam roofs have been limited to the maximum movement of their sliding clips.
3. **Metal Walls** as referred to here does NOT include foam panels. Foam panels should be treated as hardwalls.

B1. Longitudinal Expansion and Contraction

Metal buildings are particularly tolerant of expansion and contraction of the structural system. Bolted connections with oversized holes minimize accumulation of the thermal effects, particularly when non-continuous roof secondaries are used. And flexible materials are able to absorb thermal movement that actually occurs. However, some guidelines are required.

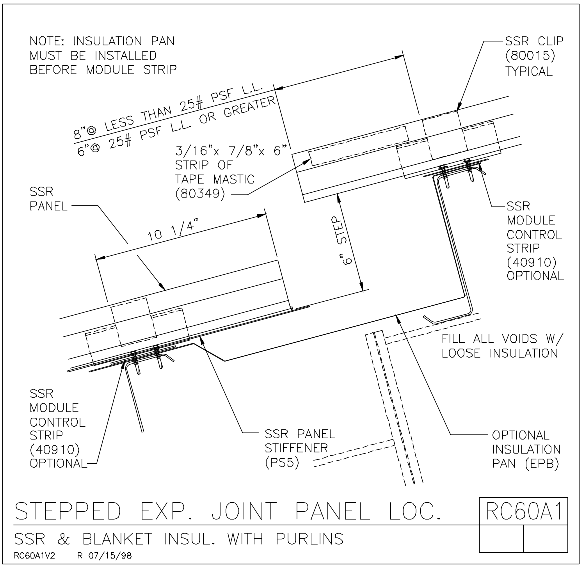
Table 1: Basic Building Length Limits (Pinned base columns and symmetrical longitudinal stiffness)

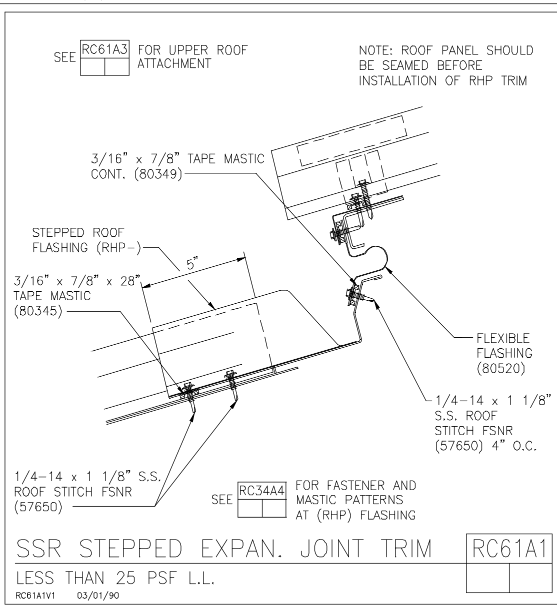
Wall Type*	Heated?	Cooled?	Roof Structural**	Length Limit
Metal	Yes	Yes	Simple Span	1500***
	Yes	No	Simple Span	1230
	No	No	Simple or Cont	720
	Yes	Yes	Continuous	1370
	Yes	No	Continuous	1030
Non-Metal	Yes	Yes	Simple Span	820
	Yes	No	Simple Span	620
	No	No	Simple or Cont	360
	Yes	Yes	Continuous	680
	Yes	No	Continuous	510

* Metal Walls include single skin and foam panels

** Simple Span structurals include Simple Span Z's, C's, Truss Purlins, WideBay Trussed Purlins and Bolted Bar Joists.

*** Limited by upper limit of 1500' length. See comments on page 3

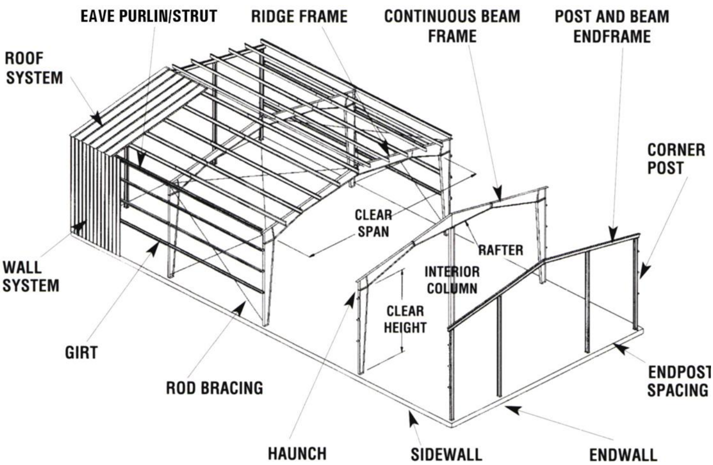




Typical SSR Stepped Expansion

Notes:

VP Command


EAVE PURLIN/STRUT
RIDGE FRAME
CONTINUOUS BEAM FRAME
POST AND BEAM ENDFRAME
ROOF SYSTEM
CORNER POST
CLEAR SPAN
RAFTER
INTERIOR COLUMN
WALL SYSTEM
CLEAR HEIGHT
GIRT
ENDPOST SPACING
ROD BRACING
HAUNCH
SIDEWALL
ENDWALL

Additional VP Command (VPC) Items[6]

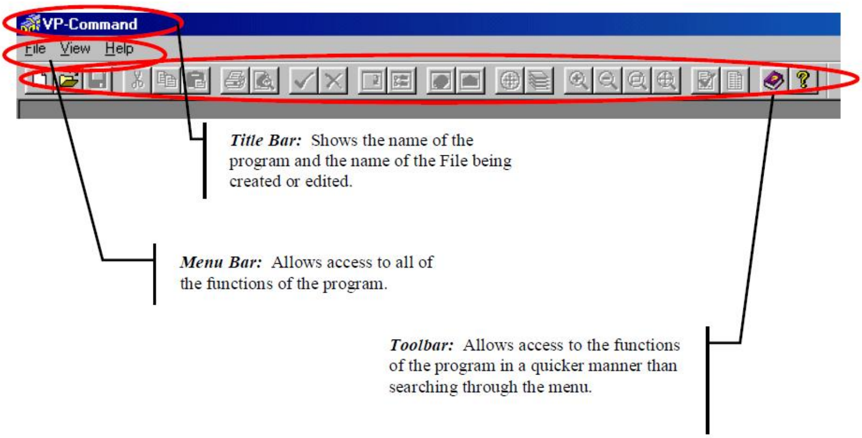
Building Editor: This function is where you will spend the majority of your VPCommand time. The Building Editor is where you define your project, applying geometry, loading, panel types, framing and secondary types, etc. to create the project, as you desire.

Drawings: This function allows you to generate preliminary drawings such as Anchor Bolt layouts, Frame Cross Sections, Standard Erection Details, etc. The VPC drawing option also allows you to generate any VPC drawing to a ".dxf" or ".dwg" file format for use in CAD packages.

Read-me File: This option will display information relative to VPCommand and what has been added for the current version you have loaded.

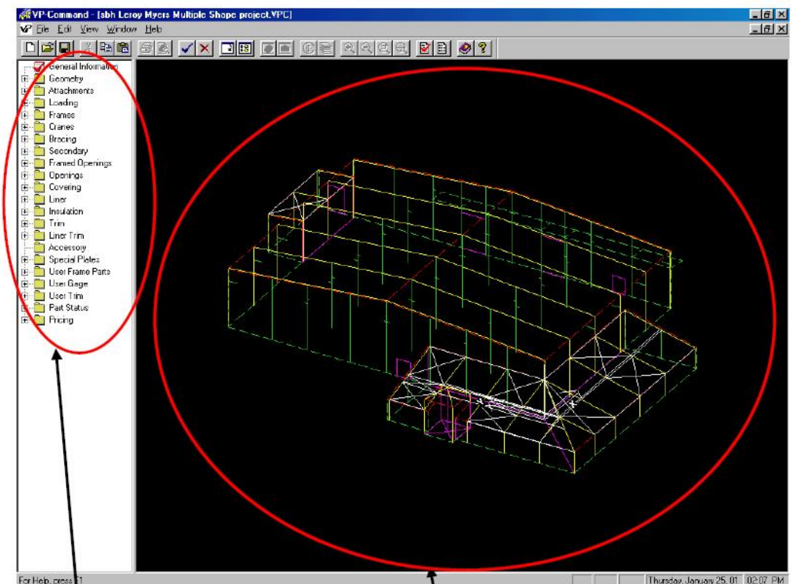
[6] By Stephen Hudák

VPCommand Building Editor



See VP Command Building Editor for latest Descriptions

VPCommand Tree and Graphics Pane View



Tree: The left hand portion (white area) of the window is known as the Tree. The Tree contains files and folders to which you will provide information pertaining to your Building shape.

Graphics Pane: The right hand portion (black area) of the window is known as t Graphics Pane. This area will display th results of your input into the Tree. Show a three dimensional representation of yo Building Shape.

VPCommand Tree Description

The "***Tree***" is where the majority of the action takes place in VPCommand. The tree is the left-hand portion of the screen within the Building Editor function. The right-hand portion of this screen is called the "Graphics Pane" which we will discuss later in more detail. A "Tree" in the VP Command sense is similar to a real, living tree that has larger branches, and smaller branches extending from the larger branches.

The Tree has a "hierarchical" set of folders for each available topic. Webster's dictionary defines a hierarchy as "a system of church government by priests or other clergy in graded ranks". What does this definition have to do with VPCommand you may ask? Absolutely nothing! Another definition of hierarchy is "*a group of persons or things arranged in order of rank, grade, class, etc*".

Think of a hierarchy as an upside-down pyramid, with the large base containing a majority of information for a topic (for ex., frames, covering, etc.) going down to the tip of the pyramid containing more detailed information for that topic (for ex., the flange thickness of a column, the sheeting direction of panels on a particular wall, etc.). Items listed in the Tree follow this "upside-down flow". Information contained at one level (consider Covering) applies to ALL folders and/or files within that topic unless changed at a lower level. If changed, information from that point downward within the topic applies.

Let's think about this hierarchy, files, and folders stuff another way. Consider socks. Yes, I said socks, those things you wear on your feet. Think of your sock drawer as a Folder. Within that drawer-folder are contained your socks. The drawer is the Folder, the socks are the files. Within that main drawer-folder, you may wish to create compartments in the drawer to separate your socks according to color. In this case, the main drawer is a folder called “socks” containing other compartment-folders called “Black Socks” and “White Socks”. The socks in each compartment are the files. If you get really obsessive-compulsive, you can further break down your socks in each compartment according to their fabric, the day of the week in which to wear them, etc.

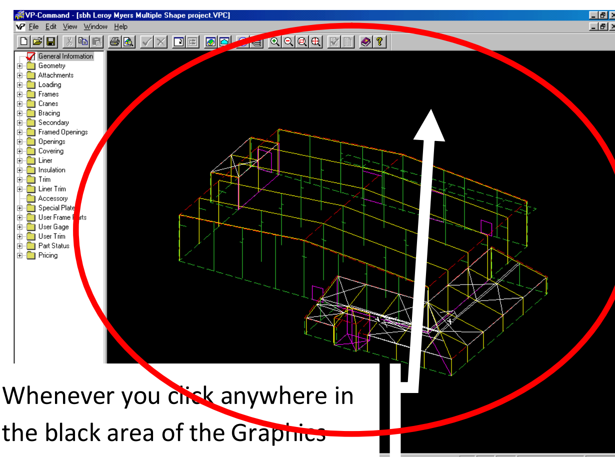
Now, with this socks stuff in mind, let’s look at it in VPCommand terms. Consider Covering. Covering is the main sock drawer-folder. Within this folder are compartments called “Default Information” and “Data” (White and Black Socks). Within the Default Information and Data folders are additional folders and files (Wool Socks, Tuesday Socks, etc.). Information contained in the Default Information folder is applied to all folders and/or files below, unless changes are made. For example, the Default Information may contain Panel Rib Roof (White Socks). If I move down to my Shape folder and change my roof panel to SSR (Green Socks), the green socks will take precedence for my shape. It will not, however, have any effect at the upper lever folders. If I add green socks to my white sock drawer, it will always contain green socks until I remove them! Thus, my shape will always have SSR until I change it at the shape level. If you make a change in the tree, you have taken ownership of that file and your change will be maintained until YOU modify or delete it!

Continuing our discussion of the Tree and how to work within it, see the following pages to look at the Toolbar and how it changes to allow functions applicable to the Tree as well as a discussion of the various catrgories within the tree.

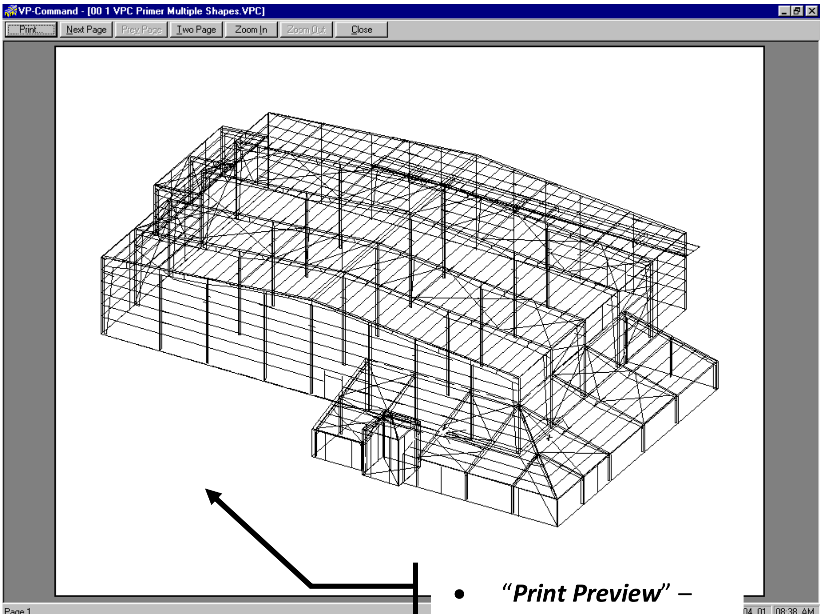
The Graphics Pane

The Graphics Pane (the right hand portion of the window) will display the results of your input into the Tree. This pane will default to a three dimensional view when you first open an existing or create a new project but you may rotate your building shape(s) to any desired viewing angle. You may also print any view of your building you see displayed on your screen.

You should always take advantage of the Graphics Pane to check for interference in your building such as bracing conflicts with framed openings.



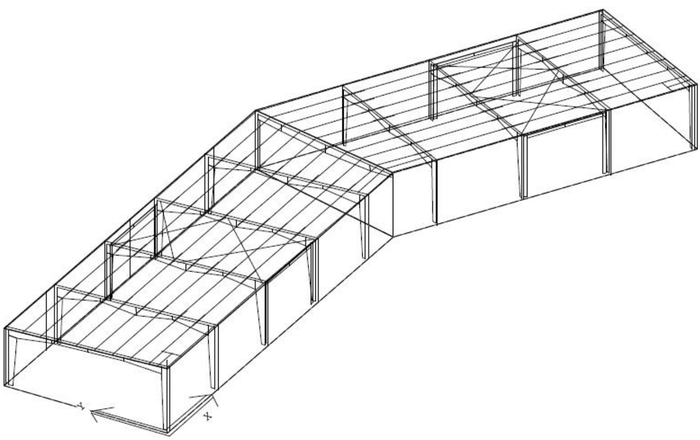
Whenever you click anywhere in the black area of the Graphics Pane, the proper toolbar functions will become active.



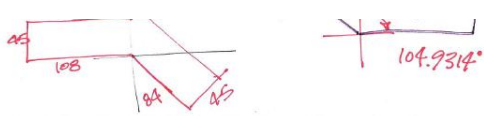
- "***Print Preview***" – view of what is in the Graphics Pane. Anything shown in the Graphics Pane may be printed. You can create some attractive Presentation Drawings using this function combined with the ***Rotation*** option to get any view you desire.

VPC Input Basics

When you are ready to begin inputting your project into the VPCommand Building Editor, I recommend using a sketch. For simpler buildings, this may be nothing more than a "napkin-sketch" and for the more complicated projects; this may consist of a full set of Architectural drawings. Either way, I usually make my own sketch so that I can begin thinking in "VPCommand Terms".



Resulting VPC input made easier with previous sketch



Sample VPC Sketch

Every VPCommand project, no matter how complicated, will consist of Geometry (length, width, eave height, roof pitch, etc.) and Frames (types, locations, etc.). All buildings will also have Loads placed on them, panel types, trim conditions, etc. Having good defaults built will save you input time and insure accuracy.

The order in which the "Tree" is laid out makes for a very logical input order flow. Begin with the ***General Information*** section (inputting your Customer's Information, Jobsite Location, etc.) and following through each level (skipping those in which you do not need to modify information) and finishing up with the ***Pricing*** Folder (inputting freight, warranties, special adjustments, etc.). In Lesson 1 (obtained in a Training Session or on the VP University web site) you use techniques that will apply to 99 % of the buildings you will input, from the building's Basic Geometry through designing your project and running Reports and Drawings.

VPC Defaults

<u>What are "Defaults"?:</u> Think of Default projects as a baseline or beginning point. A Default building contains information that will be applied to the project you create using this default. The intent of Defaults is to save you input time and to insure accuracy for your projects. The less information you have to input, the less chance for error or forgetting items. We will look at each item in the "Tree" of the Building Editor and look at some considerations you should make pertaining to *YOUR* default projects.

<u>What can be Defaulted?:</u> Basically, any information that is not "dimensional" can be defaulted. Items such as Loads and Codes, Panel Information (types, finishes, colors, etc.), trim preferences, etc. can be defaulted. Some Dimensional items such as a 10 x 12 framed opening centered in a bay of a wall cannot be defaulted. The 10 x 12 framed opening can be defaulted, but its location cannot. Building Geometry, as well, cannot be defaulted (length, width, eave height, etc.)

<u>How many Defaults can I have?:</u> You can have as many defaults as you wish. Some users have defaults for all possible roof and wall panel conditions (SSR-PR, PR-PR, SSR-VR, etc.), some have Defaults for various loading conditions in the counties and/or states they work. But the key is to have good defaults that work for you! It is important to name your defaults something you can relate to. I have adopted the method of abbreviating my defaults as follows: ***<u>2006 IBC Warren County, Virginia SSR PR EG CR 4r 3w.</u>*** To me this means, *Standing Seam Roof, Panel Rib Walls, Eave Gutter and Downspouts, Crimped Base, 4" and 3" insulation in the roof and walls* respectively with *2006 IBC loading in Warren County, Virginia.* Use any name designation that makes sense to you.

<u>Updating Defaults:</u> Update your default projects as often as needed. If you find yourself making repetitive changes to a lot of your projects, such as adding 3" VRV insulation, then simply open your default and apply this change. ***However, if you are using old defaults, you must update these or delete and create new Default projects in order to take advantage of the VP Buildings standard product default conditions.*** With each new version of VPC, read the included documentation as well as the "Read-Me" file to see what is new.

Notes:

Description of VPCommand (VPC) Colors

Frames: Red Frames indicates that the frame designed and detailed completely.

Frames: Yellow indicates that the frame has not been designed or Interactive Design is required. This member has not priced.

Secondary: Cyan (Light Blue) Secondary indicates the secondary has designed and detailed.

Secondary: White Secondary indicates that the secondary has not been designed or that design has failed for that member. This member has not priced.

Bracing: Yellow Bracing indicates that the bracing member has been designed and detailed.

Bracing: White Bracing indicates that the bracing member has not been designed or that design has failed for that member. This member has not priced.

Trim: Salmon (Pink) Trim indicates that a trim segment has generated. You must verify on the Reports if there are any unpriced trim items.

Trim: Red-Dashed Lines indicate that the trim segment has not been generated.

Other VPC Color Designations:

Building Lines: Lime Green-Dashed

Purlin Channel Bracing: Lime Green

X-Y Axis: White

Wall Panel Members: Magenta (Pinkish

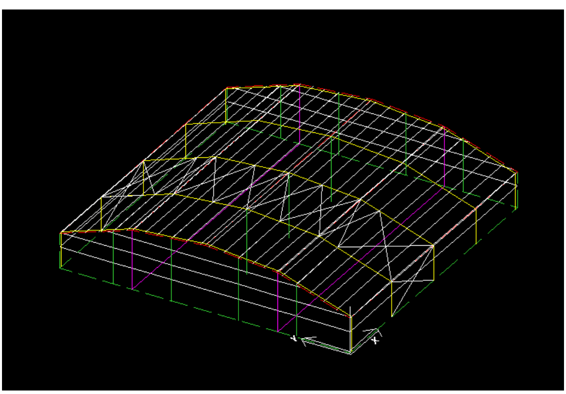
Roof Panel Members: Magenta (Pinkish

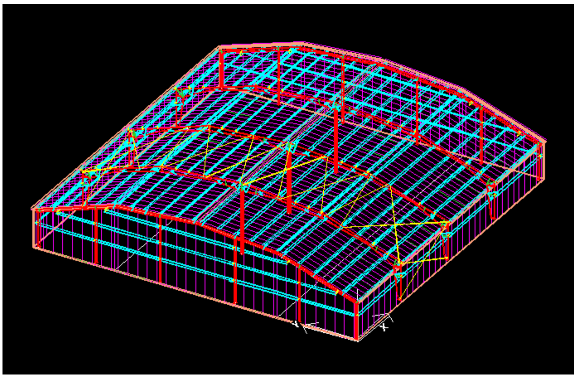
Frame Holes: White

Frame Clips: Yellow

Frame Stiffeners: Lime Green

Flange Braces: Cyan (Light Blue)





Reviewing Drawings and Details

In your never-ending quest to make certain that you receive the parts and pieces you believe you are inputting into VPCommand, following are some recommendations. This is the ***minimum*** items I complete on any VPC file I input.

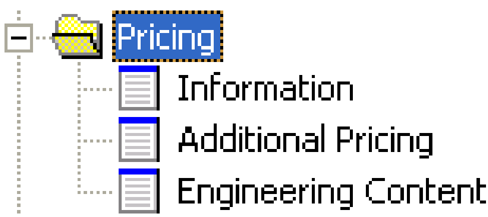
1. Thoroughly review ***Input Report***.
2. Complete and Save ***VPC-Run*** **(Run / Run All)** function
3. Visually Review the resulting "***Colors***" in the Graphics Pane in the Building Editor. See ***VPC-Tip #2*** on the VP University website for more information on this.
4. Run and Review ***Pricing*** and ***Edit Check*** Reports. Look for the asterisks (*), and address as necessary. Generating a Pricing

will prompt you to review the Engineering Content.

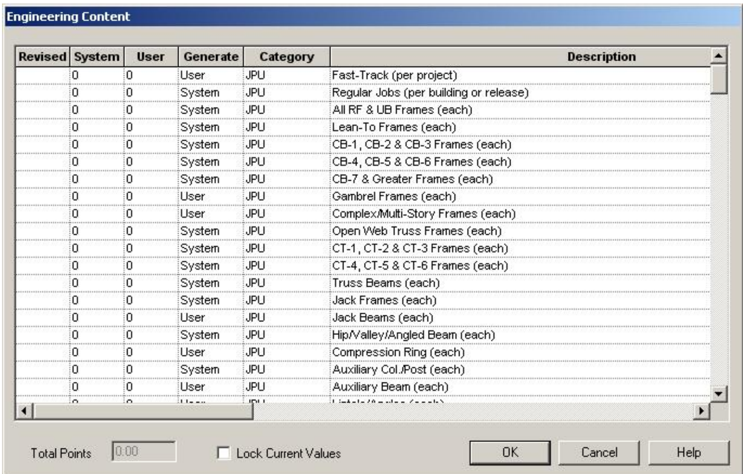
5. When I feel I am getting what I need, I generate some ***Drawings*** and the ***Standard Erection Details SEDs***) to review (you can view these on screen or print out if you desire). If my SEDs show Panel Rib roof details, and I thought I input SSR, chances are that my Input is not correct. A common mistake is to have SSR on the main roof, and then I input a canopy and forgot to set this up in my Default accordingly or forgot to change it during input.

How To Use the Engineering Content Screen

Follow these steps:



- Open the pricing folder and double click the Engineering Content to review the conditions.



Revised	System	User	Generate	Category	Description
	0	0	User	JPU	Fast-Track (per project)
	0	0	System	JPU	Regular Jobs (per building or release)
	0	0	System	JPU	All RF & UB Frames (each)
	0	0	System	JPU	Lean-To Frames (each)
	0	0	System	JPU	CB-1, CB-2 & CB-3 Frames (each)
	0	0	System	JPU	CB-4, CB-5 & CB-6 Frames (each)
	0	0	System	JPU	CB-7 & Greater Frames (each)
	0	0	User	JPU	Gambrel Frames (each)
	0	0	User	JPU	Complex/Multi-Story Frames (each)
	0	0	System	JPU	Open Web Truss Frames (each)
	0	0	System	JPU	CT-1, CT-2 & CT-3 Frames (each)
	0	0	System	JPU	CT-4, CT-5 & CT-6 Frames (each)
	0	0	System	JPU	Truss Beams (each)
	0	0	System	JPU	Jack Frames (each)
	0	0	User	JPU	Jack Beams (each)
	0	0	System	JPU	Hip/Valley/Angled Beam (each)
	0	0	User	JPU	Compression Ring (each)
	0	0	System	JPU	Auxiliary Col./Post (each)
	0	0	User	JPU	Auxiliary Beam (each)

Engineering Content Screen (See VPCommand for latest screen)

<u>Revised</u>: Show the status of the condition. If the condition was added by the system it will show No, in that the status of that item was set but has not been changed by the user. If the user has modified a system generated or user input item the status will show Yes.

<u>System</u>: Shows the quantity of system detected conditions.

<u>User</u>: Shows the quantity of user input conditions.

<u>Generate</u>: Shows the type of condition, either System or User. A system condition should be detected by VP Command automatically. A user condition must be entered by the user.

<u>Category</u>: Shows the category of input the condition is in. JPU stands for Job Processing Units used internally by Varco Pruden.

<u>Description</u>: Shows a brief description of the condition.

All system generated quantities should be verified by the user before final pricing. Any quantities that are incorrect may be overridden by typing the correct quantity in the user quantity field. To type a quantity, simply click in the desired field and type the number.

When all user changes are complete you can click the Lock Current Values check box so that the engineering content values will not change if the job is re-run. This should only be used when the pricing is finalized.

Once all input is complete click OK and save the project.

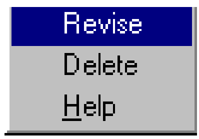
Engineering Content Charges

Each point added in the engineering content list is worth $100 engineering fee. An itemized break down of conditions and points is shown at the end of the pricing report. There is also a new category on the pricing summary to show the net engineering fee added.

Tree Tips:

- ***Double clicking*** on a file acts as the "***Revise***" function to access the appropriate window.

- "***Left-Clicking*** to select, then



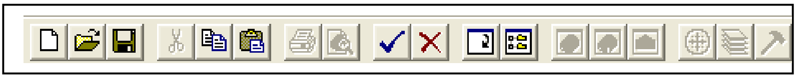
Right-Clicking" the mouse in the tree will activate a "***Pop Up***" menu of available options.

- The "***Menu***" also allows for options to be performed. Note that the Menu will activate options depending upon whether you are in the "***Tree***" or the right hand "***Graphics Pane***". Options that are "*grayed-out*" are not available.

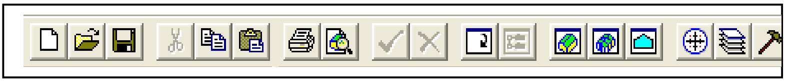
VP Command Toolbar

The "***Toolbar***" allows for various options to be performed. Note that the Toolbar will activate icons dependent upon whether you are in the "***Tree***" or the right hand "***Graphics Pane***". Options that are "*grayed-out*" are not available.

Toolbar with Tree Selected:



Toolbar with Graphics Pane Selected:



- Hitting the "***F5***" key on the keyboard or selecting the ***refresh icon*** from the toolbar will "*collapse*" (close all open folders) and "*refresh"* the Tree.

- Clicking the ***plus sign (+)*** to the left of a folder will open or expand that folder.

- Clicking the ***minus sign (-)*** to the left of a folder will close or contract that folder.

- ***Double clicking*** on a folder will open a closed folder and close an open folder.

- You may "***Drag-and-Drop***" certain information from one VPCommand file to another.

- Hitting the "***Tab***" key on the keyboard will advance the cursor within a window to the next input field, highlighting that item, to allow for easy modification of the field.

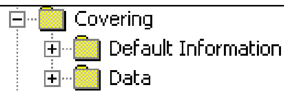
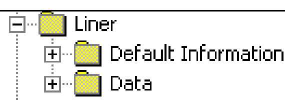
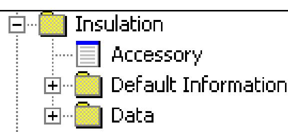
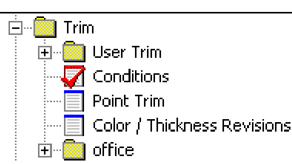
- Hitting "***Shift – Tab***" on the keyboard will back the cursor within a window to the next input field, highlighting that item, to allow for easy modification of the field.

- Use the "***Notes***" tabs within VPCommand windows to better clarify your intentions.

VP Command Tree Layout:

VPC Category	Description
General Information	**General Information** contains names, addresses, etc. of the jobsite and Builder. You also control your order options such as primer preferences, order types, and English/Metric needs.
Geometry Insert a new Shape office	**Geometry** is where you define the building envelope dimensions such as width, length, eave height, roof pitch, ridge locations, etc. There are well over 100 "pre-defined" shapes for your use. There is a "custom" shape input method for those rare times you cannot find a pre-defined shape.
Attachments office Wall 1	**Attachments** to VPC are additional items that are attached to your main structure; these include: canopies, rake extensions, partitions, parapets, facades, and mezzanines.
Loading Loads and Codes Load Cases office	**Loading** is where you input your environmental loads such as Wind, Snow, Seismic, as well as your building code and other special loading needs.

VPC Category	Description
Frames Notes Default Information Schedule Locations Data Member Data	The **Frames** folder is where you input and define the parameters of your Primary Framing members such as RFs, CBs, etc. You can revise the base elevation, depths, as well as many other frame contraints.
Cranes Schedule	The **Cranes** folder is where you define and locate your desired crane information.
Bracing Default Information Locations Member Data	**Bracing** includes items such as rods, portal braces and portal frames ,and wind posts.
Secondary Default Information Spaces Member Data Erection Marks	**Secondary** is for the wall and roof member types depths, continuous or simple, outset, inset, or other as well as their location and geometry (CEE, ZEE, other).
Framed Openings Schedule office	The **Framed Openings** folder is for the framing and trim options of overhead and vertical lift doors as well as any other opening you wish to define that contains jambs, headers, sills, trims, etc.
Openings office	**Openings** are created automatically by VPC when shapes have a "common" wall region such as Lean-Tos, Roof Height Changes, and any other structure where wall planes touch. The default by VPC is to remove all material (sheeting, gits, insulation,

VPC Category	Description
	etc.) You can override the parameters of the openings if you wish to put back some of the items.
	**Covering** is for VP exterior (and partitions) surfaces for the input of SSR, PR, VR, and any other standard VP product. You also define surfaces that are not by Varco Pruden (NBVP) such as brick, masonry, glass, etc. as well as portions that are completely open. The **Openings** folder should only be used to “put back” material that VPC initially removes.
	**Liner** is the back or underside covering of walls, roofs, canopies, etc. This is also where you define soffit.
	**Insulation** contains input for fiberglass, rigid board, or no insulation as well as insulation accessories such as patch and double-stick tape and other items.
	**Trim** contains standard VP items such as eave gutter, rake fascia, wall panel base conditions as well as many other required items to trim your VP building.

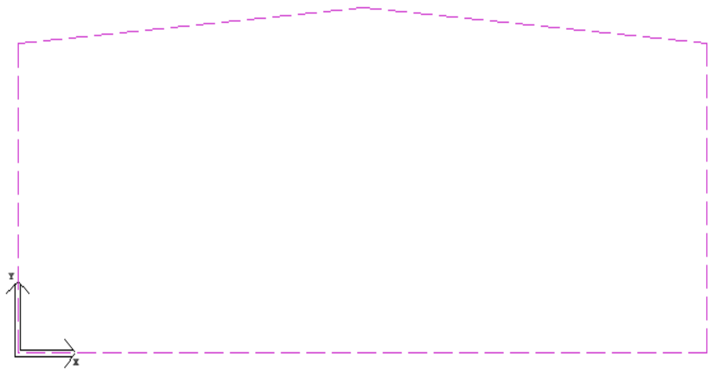
VPC Category	Description
Liner Trim Conditions Color / Thickness Revisions office	**Liner Trim** allows you to define your desired trims when using liner panels.
Accessory	**Accessory** items are for wall and roof and contain such items as walk doors, windows, vents, etc.
User Clips User Frame Parts User Gage User Trim	The **User** folders are for VP's internal use only to create special items in VPC.
Part Status Accessory / User Added office	**Part Status** allows you to control which items to design and price. This feature may be combined with the "Existing Shape" check box in the Geometry window to turn off or on certain items you may wish to price, for example, at an existing building.
Pricing Information Additional Pricing Engineering Content	The **Pricing** folder allows you to input special discounts, warranty and freight information, SSR seamer rental as well as defining the project's complexity.
Reports Insert Reports	**Reports** contain any information you may wish to view for your project such as Pricing, Reactions, Calculations, and many, many more.
Drawings Insert Drawings	The **Drawings** folder here in the Tree of the Building Editor allows you to view or print

VPC Category	Description
	only various erection drawings. It is recommended that you use the separate "Drawings Editor" if you wish to modify drawings. There you can create dxf, dwg, as well as 3D models, and add text, lines, details, etc.

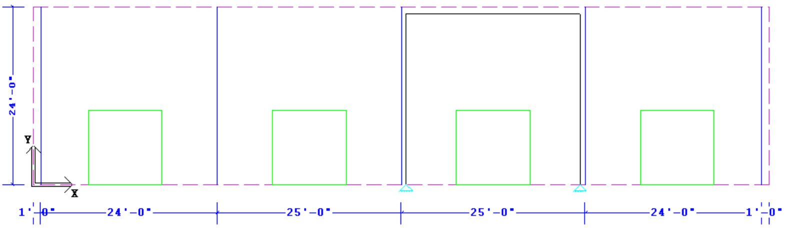
Notes:

View: From wall plane

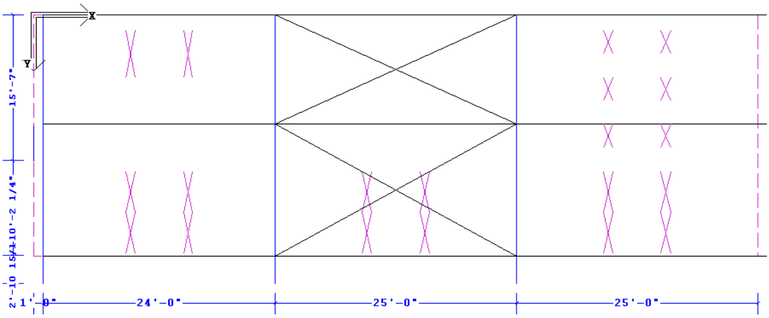
Endwall: Always from left to right as viewed



from outside the building.



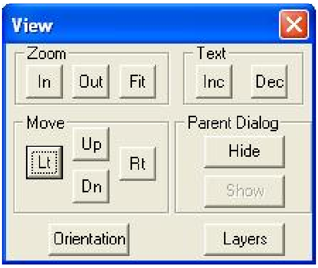
Sidewall: Always from left to right as viewed from outside the building



Roof Plane: Ridge at the top, eave at the bottom, always from left to right.

View Button:

This button allows the user to do five functions: Zoom, Text, Move, Parent Dialog, Orientation, and Layers. These are all graphic functions that the program will allow you to use in the Tree Pane when the button is activated.

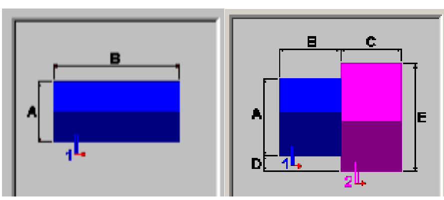


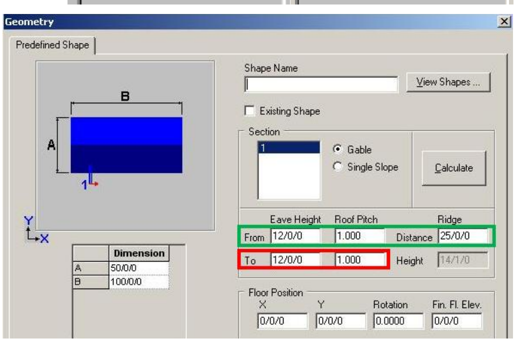
Parent Dialog will allow you to hide or show the screen you are working on so that you can see more of the graphics pane.

Section: From-To Reference Points

The "From" eave height is represented by a "Green" section arrow, and the "To" eave height is represented by a "Red" arrow. Note that for some pre-defined shapes the "Green-From" arrow is absent. The "Green-From" arrow is then taken to be opposite the "Red-To" arrow.

The more complicated shapes will clearly show both the red and green arrows.



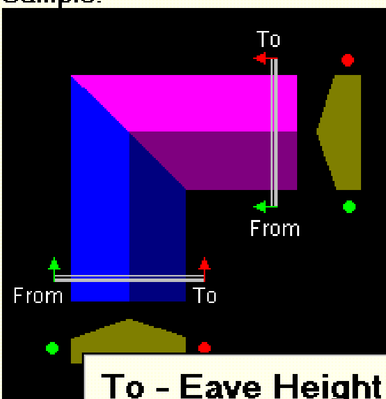


The Section can also be referenced as standard architectural sections with the "***Left***" arrow being "***From***" and the "***Right***" arrow being

From - Eave Height

In this edit box, enter the Eave Height for the left side of the section. Viewed from the "Section Cut Line", the left side may be indicated by a green arrowhead.

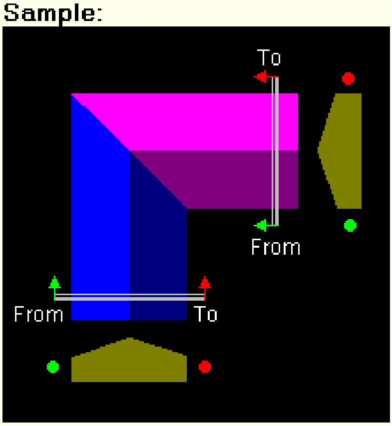
Sample:



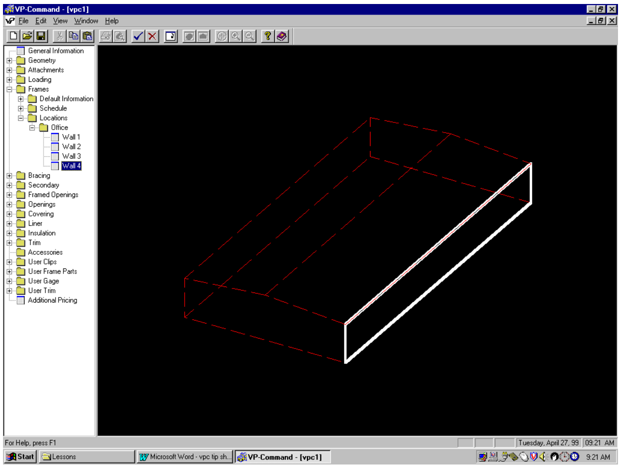
To - Eave Height

In this edit box, enter the Eave Height for the right side of the section. Viewed from the "Section Cut Line", the right side may be indicated by a red arrowhead.

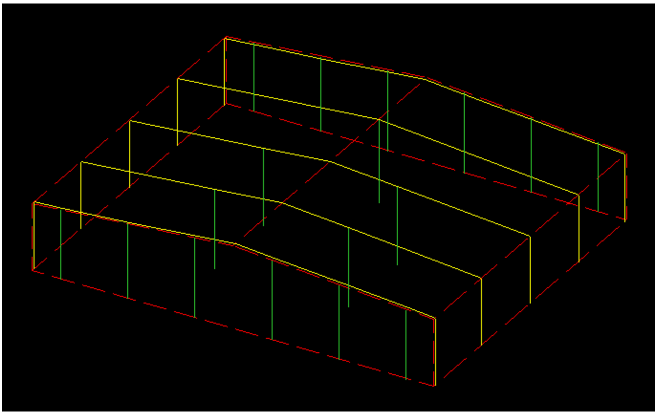
Sample:



"Along" Wall – Locating Frames



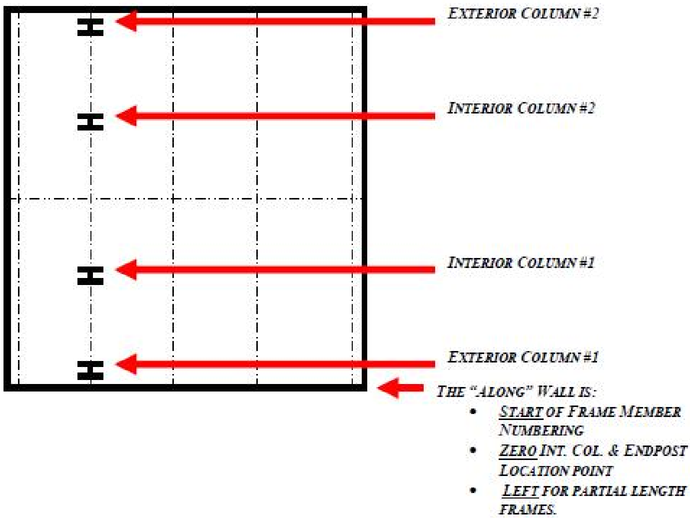
The wall surface you select to locate frames is known as the "***Along***" wall. This wall will be the "Start" point when locating; interior columns, endposts, and is the "***Left***" point for partial length frames. This "along" wall will also number exterior and interior columns beginning at this wall.

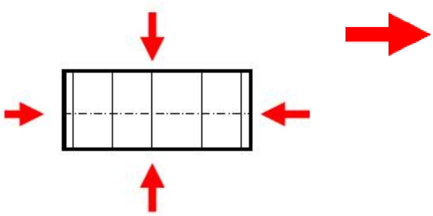


"Frame" Numbers vs. "Frame Line" Numbers

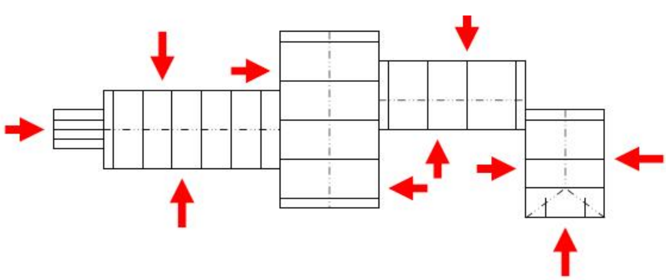
VPCommand differentiates between ***frame numbers*** and ***frame line numbers***. Frame line numbers are designated as Frame line 1, Frame line 2, Frame line 3, etc. and are generated when you complete a "Run" which designs and details your building, whereas Frame *numbers* are literally the number of that frame going from ***left to right as you are facing the wall surface standing outside your shape***. Frame numbers have nothing to do with the "Along" wall! They are counted as 1, 2, 3, etc., at each surface as you are facing that wall.

Using frame numbers is very convenient for complex shapes. You simply count the frames from left to right as you face the selected wall rather than trying to figure out if this is frame line U7, or frame line B, etc.





Arrow represents "*View*" direction. Frames are numbered "left-to-right" as facing this surface. Left hand edge of surface is "Zero" reference point for inserting frames. Framed Openings can be located from either left or right edge of surface as well as from frame numbers.



Notes:

VPCommand Parts Status

The VP Command Parts Status section can be used to control which parts and pieces you wish to price. For example, you can use this to remove material at existing building conditions. There may be times you wish to leave some items to design, detail, and price for existing buildings such at a wall that is higher than the new shape. You can leave the required secondary, trim, etc. to "run" and use for the existing building.

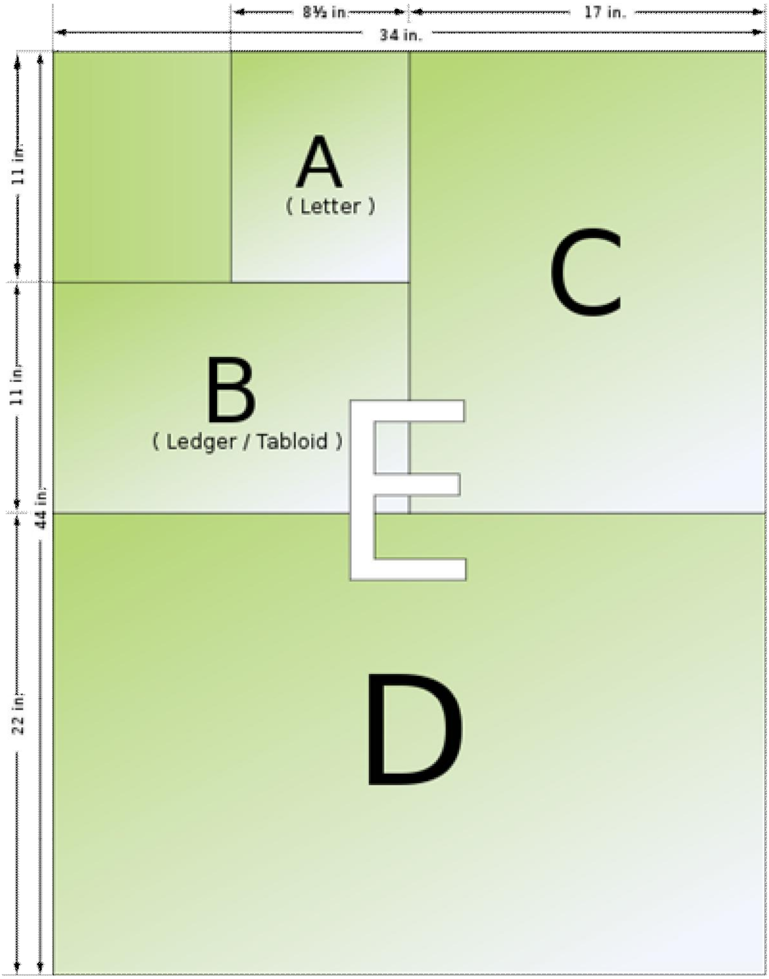
In the geometry section of VPC there is a check box for "existing shape." You may use this to specify the entire shape as existing and thereby "turning off" all items (pertaining to the existing shape) at the Parts Status level.

VPCommand Drawings

In the VPC Building Editor there is a folder for "Drawings." In this level you can view and print Drawings. When you create drawings they are "as designed" at that time; if you revise anything within VPC any created drawings are not updated, your must create new ones.

The "VPC Drawings Editor" offers more flexibility and options concerning drawings. At the function you can create, plot, revise, etc. your drawings. You can create "dxf" and "dwg" files as well as three-dimensional models to use in your other drawing applications.

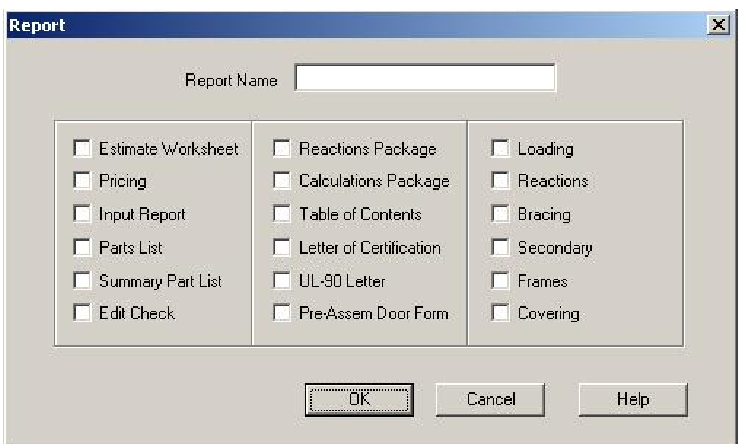
See the "Help" section within the drawing editor for additional information.



From: http://en.wikipedia.org/wiki/Paper_size June 23, 2010

VPCommand Reports

Inside the VPC Building Editor you can generate many reports. Some common are the **Input** (a reflection of what you have input and what will be designed, detailed, and priced), **Pricing** (what has been designed and priced as well as showing an "asterisk" (*) indicating what has not been priced and where you need to look to address these unpriced issues, **Edit Check** (which listing more information as to what the unpriced conditions are), and **Reactions** (showing preliminary foundation reactions), etc.



Notes:

Order Entry System

The VP Order Entry System (OE) is a live web portal that provides a quick and efficient means of transferring VP Command Building Estimates and Building Orders between your office and VP Buildings. In addition, it offers direct access to many other valuable resources offered by VP Buildings.

- **Transfer VP Command files back and forth to VP Estimating**
- **Transfer Building Orders to VP**
- **Attach Order/Estimate Clarification Forms** (OCFs) as well as any other email-able documents such as digital photos, drawings (pdf, please), and any MS Office format files. For instructions, log onto the Order Entry System, click on **Help**, then **Online Help**, and go to the **Order Entry How-tos** in the lefthand column for website or login assistance, just call VP Software Support at 877-874-3579.

The Tool Bar on the Help Screen (Help / Online Help) contains links to important additional VP Related Web tools. Some of the most common are:

VPU - VP University

Course descriptions, Updated schedules, and Registration Forms, VP Command Tips - Short reviews addressing over 50 (and growing) common VP Command issues.

- VPCommand Lessons - All VPC Lessons from Level I, and II classes for you to review.

- Downloadable VP Product Seminar modules for your use

- Lots of other material…

Supplemental Price Book

This Online manual contains all of the tools, guidelines, policies, definitions, and terms and conditions applicable to your everyday dealings with VP Buildings that are not addressed on VP Command. Here you'll also find:

- Quote Assistance Request Forms (VP Command estimate assistance cover sheet)
- Quote Request Form (attach to drawings for Complete Estimates)
- Order Clarification Forms Standard questions and forms for specific conditions
- Seamer Rental / Purchase costs and rental period definition
- Warranty Information
- Owners' Preventative Maintenance Manual
- Phone numbers and addresses for Service Center personnel as well as Sales contacts
- Freight Calculator to determine real-time current freight costs (subject to escalation)
- and lots more

VP.Com

Direct access to VP's public website

VP Marketing

This website provides access to many tools which will help you become more successful. Marketing Tools such as Literature, Direct Mail, Coop advertising, and Yellow Pages Ready to use press release templates, print ads, and VP Logos, VP Builder Hall of Fame Contest and Image Archive for your use, Economic and Market

Information for your assigned Trade Area, Updates from Varco Pruden Marketing, Systems, and R&D Departments. Also available at: www.vpmarketinginfo.com.

VP Components

Online pricing and ordering of components only. Great typical details! Also available at: www.vpcomp.com.

VP Builder Site

The www.vpbuilder.com site is for accessing the latest schedule of training sessions as well as to obtain pre-class material.

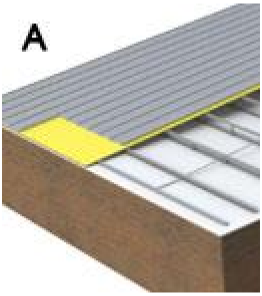
VARCO PRUDEN ROOF SYSTEMS [7]

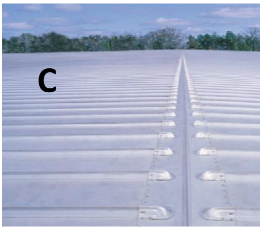
VP Roofing

Retrofit and Re-roof Solutions

Building owners looking for a way to stop roof leaks, reduce maintenance cost and improve the appearance of their facility are finding the answer with VP Roof Systems and their local Varco Pruden Builder. Whether your current roof is a non-metal or a metal roof…flat or sloped, Varco Pruden Roof Systems can provide a solution that gives you long-term, weather-tight protection and fewer roofing headaches.

7 http://www.vp.com/Products/ProductDescriptions/VPRoofSystems.aspx February 18, 2010





Benefits of a Varco Pruden Retrofit or Re-roof solution include:

- A roof system designed to meet the highest industry standards for quality and performance
- A selection of panel options and architecturally attractive colors
- The option of adding slope to flat roofs, eliminating "ponding" and problems related to standing water
- Increased energy-efficiency with additional insulation and "cool paint" formulations

Products from Varco Pruden Roof Systems include:

(A) Built Up Slope Structural - Ideal for applications when a project requires positive roof drainage to prevent water from standing on the roof surface. A built- up slope also allows for additional insulation, improving energy-efficiency and reducing heating and cooling costs.

All structural materials are made from durable, galvanized steel, can be installed over the current structure without interrupting on-going business operations are designed and manufactured to give years of trouble-free service.

(B) SLR Roof Sheeting - An architectural roof panel designed to give improved aesthetics while providing long-term weather-tight performance. Made from sturdy 24 or 22 gauge galvalume steel and coated with highest quality kynar/hylar paint finishes, SLR panels meet the highest industry standards for roof sheeting. Optional, cool color paints can provide additional thermal efficiency and help reduce "heat-island" effects.

(C)SSR Roof Sheeting - Varco Pruden’s most recognized roof solution, this engineered panel is ideal for low-slope applications as low as ¼’:12. The 3" tall ribs are field seamed to provide a sealed membrane surface that stands up to the toughest weather challenges. SSR’s patented seamed ridge cap provides additional weather protection and VP's unique sliding clip allows the roof to respond to thermal changes and reduce panel wear

Each Varco Pruden Roof System project combines the advantages of superior roof engineering and design with warranted, proven products. Your local Varco Pruden is your local source for complete information and assistance with your project needs. To find out more about Varco Pruden Roof Systems and to get in touch with your local contact, send your request to vproofinfo@vp.com

Fast Track

(as of February 2010. See Fast Track input for current options)

Fast Track Loads:

Standard building use, collaterals, snow, wind & seismic,
Max Wind, 140 MPH
Max Snow, 100 PSF
Geometry: Width: 20’ to 250’ wide
Length: 30’ to 750’
Eave Heights: 10’ to 30’
Roof Pitches: 1/4 to 6:12 pitch
Single Sloped: max high eave 35’
Gable Buildings: both symmetrical & unsymmetrical
Note: The ridge can be offset up to 20% of the building width from the center.

Fast Track Frames:

Rigid Frames 20’ to 120’
CB-1, 80’ to 140’
CB-2, 120’ to 210’
CB-3, 160’ to 250’
CB-4, 200’ to 250’
CB-5, 240’ to 250’
Base of columns can be adjusted
Note: Tapered exterior columns only and the interior columns are equally spaced.
Endframes: Single Zee, 20’ to 250’, 1, 2, 3 & 4:12 even pitches only
Post & Beam
Rigid Frames w/endposts, 20’ to 120’
Rigid Frames, full load, w/endposts 20’ to 120’
Standard & special endpost spacings
Bays: Mixed is allowed, 15’ to 32’

Note: There is a maximum variance in bay width of ±30%

Fast Track Bracing:

Panel diaphragm considered before adding diagonals
Wall Rods
Must use Rod Bracing option available
Portal Braces up to code maximum
Portal Frames

Fast Track Current Available Building Codes

1997 Uniform Building Code
1999 National Building Code (BOCA)
1999 Standard Building Code
2000 IBC with 2003 DC Supplement
2000 International Building Code
2002 Kentucky State Building Code with 2003 Supplement
2002 NYS Building Code
2002 Wisconsin State Building Code
2003 Indiana Building Code
2003 International Building Code
2003 Minnesota State Building Code
2003 Virginia Uniform Statewide Building Code
2004 Florida Building Code with 2005 Supplement
2004 Florida State Building Code
2005 Connecticut Building Code
2005 National Building Code of Canada
2005 North Dakota
2005 Ohio Building Code
2005 Vermont Building Code
2006 Georgia State Amendments
2006 International Building Code
2006 North Carolina State Building Code
6th Edition Massachusetts
7th Edition Massachusetts
2007 Florida State Building Code
2007 Minnesota State Building Code

Fast Track Secondary:
Roof, 7”, 8½” 10” and 11 ½” purlins
Walls: 7”, 8½” 10” and 11 ½” outset, standard inset and flush inset

Fast Track Roof Panels:
Panel Rib Roof or SSR
Note: VP standard colors only
Wall Panels: Panel Rib, Vee Rib or RPR Panel
Note: VP standard colors only

Fast Track Framed Openings:
Up to 24’ wide x 18’ tall (cannot be closer than 2’ below eave height)

Fast Track Liner:
8’ high with standard trim
Panel Rib
RPR Panel

Fast Track Trim:
VP standard
Eave Fascia: Eave Trim
Eave Gutter
Notch, no trim, Panel Rib only
Notched Eave Gutter, Panel Rib
Base Trim: VP standard
Base Trim w/ base angle
Base Trim w/ 8 ½” base girt
Base Trim w/ concealed base
Crimp w/ base angle
Crimp w/ 8 ½” base girt
Crimp w/ concealed base
Canopies: Piggy back, 2’ to 6’ projection, @ eaves only
3-plate straight, 2’ to 6’
3-plate flat bottom, 2’ to 12’

Note: 3-plate canopies may be located from 8’ A.F.F. to 2’ below the eave

Fast Track Insulation:

Standard options

Fast Track Accessories

Accessories: Same as in VP Command

Notes:

How to Price a VP Building[8]

Five Pricing Methods

There are two methods you can use to fully estimate a VP Building in your office.

1. - For simple buildings, we provide the **VP Fast Track** pricing system, accessible online, within Order Entry.

2. - For other buildings, you should utilize VP's proprietary **VP Command** software leased by your firm. Based upon your level of expertise, you may be able to model many varied structures onto VP Command in your office. Running the building file you have created in your office, you will be able to generate estimates, preliminary drawings and preliminary engineering data.

The final *three* methods involve the partial or complete involvement of VP's Estimating Group.

3. - The third method is a **shared effort**, initiated by you, the builder, inputting the project into VP Command in your office and then transmitting the file to VP Estimating for assistance in completing the quote. This method is the most frequently used of the five shown here and requires you to fax or e-mail the VPC Quote Request form, along with the OCF Standard Questions forms.

[8] By Dave Cleary

4. - Sometimes a design/build project is complex and modeling the project onto VP Command is simply beyond your level of expertise. In this case, we ask you to send sketches, drawings, VP's Price Confirmation request sheets along with the OCF Standard Questions form to VP Estimating. VP Estimating can complete quotations for complex design/build projects. We will work closely together with you and your team using our best value-engineering skills to generate a complete estimate.

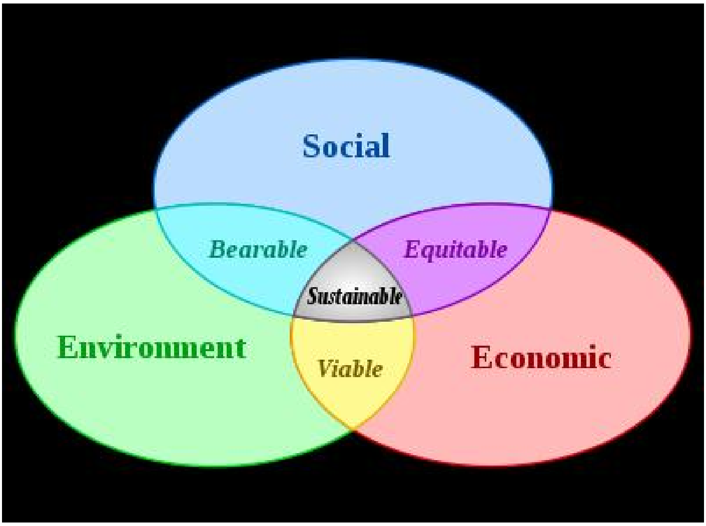
5. - If a design professional has prepared Plans and Specifications for a project which clearly shows all of the environmental loads, building geometry, and other parameters required for the project, VP Estimating can complete the estimate. As in method 4, we ask that you send the VP Price Confirmation request sheets and the OCF Standard Questions form with the drawings and specifications.

Varco Pruden Buildings - 5 Pricing Methods

Builder role indicated by "**X**" on grid	Quote 99% By Builder		50/50	Quote 99% by VP	
	VP Fast Track	**Full VP Command**	**VP Command with Assist**	**Complete Estimate**	**Plans and Specifications**
Approx.Quote Turnaround Time	30 minutes	1 or 2 hours	2-5 days	2 to 3 weeks	
VP Fabricated Products					
Book Dollars & Tons					
Required Documents	None				
VPC Input by Builder	**X** - Input Fast Track Building Into Special Fast Track Input Screens on OE System. Discount, Insulation, Fees and Freight are automatically calculated.	X	X		
VPC Quote Request			X		
Price Confirmation				X	X
OCF Std Questions			X	X	X
OCF Forms for Specific Conditions / Requirements					
Insurance/SBA					VP Estimating to determine special requirements during review of plans and specifications.
Frame Clearances					
Mezzanine					
Cranes			**X** - Builder to submit applicable		
Parapets		Now in VPC !!			
Facades			Order Clarification Forms		
Roof Loads					
Masonry			shown in left hand column.		
Wall NBVP					
Color Verification			OCF Forms are available		
Door Order					
Window Order			through Supplemental Price Book		
Insulation					
Roof Ponding			or from VP Estimating.		
EPDM Info					
Existing Bldg Info					
Other Pricing Steps					
Special Allowance		Call District Manager for Competitive Allowance			
Insulation Pricing		Pricing in VP Command is competitive!! Call DM for special needs.			

Notes:

Green / Sustainable Construction



Sustainable Development

Sustainable development has been defined as balancing the fulfillment of human needs with the protection of the natural environment so that these needs can be met not only in the present, but in the indefinite future.[9]

A **sustainable building**, or **green building**[10] is an outcome of a design philosophy which focuses on increasing the efficiency of resource use — energy, water, and materials — while reducing building impacts on human health and

[9] Source: http://en.wikipedia.org/wiki/Portal

[10] Source: http://en.wikipedia.org/wiki/Green_building

the environment during the building's lifecycle, through better “siting,” design, construction, operation, maintenance, and removal. Though green building is interpreted in many different ways, a common view is that they should be designed and operated to reduce the overall impact of the built environment on human health and the natural environment by:

- Efficiently using energy, water, and other resources
- Protecting occupant health and improving employee productivity
- Reducing waste, pollution and environmental degradation

USGBC

The U.S. Green Building Council (USGBC) defines green building as “…those that incorporate design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants in five broad areas[11]”:

1. Sustainable site planning
2. Safeguarding water and water efficiency
3. Energy efficiency and renewable energy
4. Conservation of materials and resources
5. Indoor environmental quality

LEED expands this definition to include “Innovation of Design” or “Innovation in Operations” to

[11] Source: Yudelson, Jerry. Green Building A to Z. New Society Publishers. 2007. Canada.

include items that go above and beyond the basic green building principles such as: green educational programs; green cleaning; green power purchasing; construction waste management; etc. Having a LEED certified professional on your project can help you immensely in achieving the desired certifications.

LEED v3.0 credit categories and their point distribution are:

- Sustainable Sites (SS) – 12 points
- Water Efficiency (WE) – 10 points
- Energy & Atmosphere (EA) – 30 points
- Material & Resources (MR) – 14 points
- Indoor Environmental Quality EG) – 19 points
- Innovation in Operations (IO) – 7 points

In order to design a building that can be certified as a green building under LEED (Leadership in Energy and Environmental Design) several factors/activities must be incorporated into the design. Those factors and activities are listed below:

Sustainable Sites

- Building should not be developed on prime farmland, land located near the 100-year flood plain, land located within 100 feet of a wetland, or on existing public parkland. Building should be developed, preferably, within existing urban areas to preserve green spaces and reduce urban sprawl. Ideally, the building should be developed on cleaned up and rehabilitated brown-fields.

- Orient the building to reduce heat loss in the winter and heat gain in the summer. Use plantings to block wind and direct sunlight.

- Site disturbance should be kept to a minimum. Buildings with small footprints are preferred.

- Maintain existing vegetation located more than 40 feet from the building or 5 feet from roadways and walkways. If the site was previously developed, minimize paving and add green areas on the building site.

- Minimize storm water runoff. Provide a means to filter the runoff through plants and settling basins before it is discharged to sewer.

- Reduce outdoor light pollution by specifying shields on outdoor lighting.

- Water Efficiency

- Specify natural landscaping that requires little to no artificial irrigation. If irrigation is required, specify drip irrigation.

- Reduce domestic water use by specifying water conserving toilets, urinals, and showers.

- Capture and use rainwater for irrigation, makeup to cooling towers, and washing cars.

- If local building codes permit, consider using rainwater to flush toilets.

Energy and Atmosphere

- Have the building commissioned by a designated Commissioning Authority.

    - Energy performance of the building must meet or exceed the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 90.12.

    - No chlorofluorocarbon (CFC) containing equipment permitted in the building.

    - When practical, use renewable energy resources like solar, wind, and biomass[12].

    - Reduce or eliminate the use of hydrochlorofluorocarbon (HCFC) containing equipment.

- Provide a means to measure ongoing energy and water consumption.

    - When practical, buy electric power from a green power provider (wind farm).

    - Indoor Environmental Quality

    - Building design must comply with ASHRAE Standard 623 and ASHRAE Standard 554.

- No smoking in the building.

---

[12] **Biomass**, a renewable energy, is biological material derived from living, or recently living organisms, such as wood, waste, and alcohol fuels

- Carbon dioxide can be monitored to measure ventilation effectiveness.

- Design must insure good ventilation effectiveness.

- Contractor must develop and follow an indoor air quality management plan during construction.

- Specify building materials that emit little to no volatile organic compounds (VOC).

- Indoor chemical pollution sources must be isolated and their emissions exhausted.

- Building occupants should have a high degree of control over their environment including views/daylight from outdoors.

Materials and Resources

- An area in the building must be designated for the storage and collection of recyclables.

- It is preferred to reuse materials from existing buildings.

- Recycle 50 to 75% of the construction waste.

- When practical, specify salvaged material.

- Specify materials with recycled content.

- Specify materials that are located within 500 miles of the site.

- Specify rapidly renewable materials like bamboo, pine, and wheat grass.

- Use only wood grown on tree farms that use certified practices.

Notes:

Notes:

Varco Pruden Buildings History

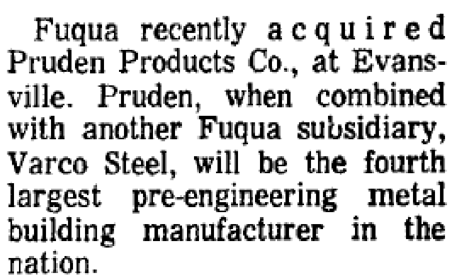
Varco Pruden Buildings is the combined, albeit separate vision of two great men, Robert G. Varner and Clark Prudhon.

While Mr. Prudhon was changing the landscape and building industry in Evansville, Wisconsin, Bob Varner was seeking his own way in Pine Bluff, Arkansas. Their differing educational backgrounds somehow

Clark Prudhon (in 2009) stands in front of his first building erected in 1954

In actuality, the histories of the companies that were merged to form Varco-Pruden date back to the late 1940's, and represent over one hundred years of pre-engineered metal building experience.

Robert G. (Bob) Varner began his steel operation just after the conclusion of World War II. His first building was completed in 1946. In 1950 Clark Prudhon started his business, manufacturing farming

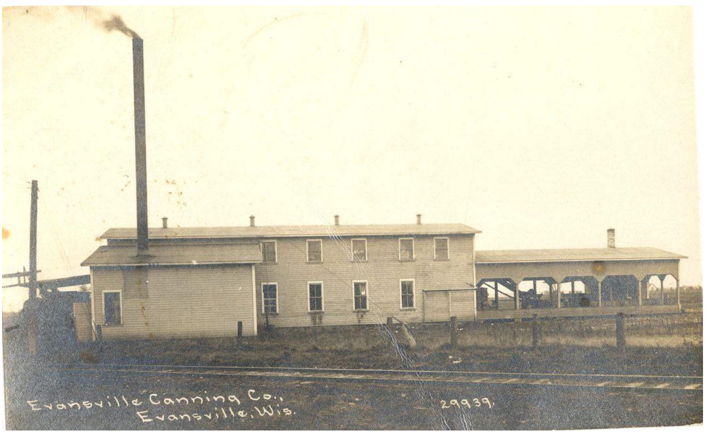


Fuqua recently acquired Pruden Products Co., at Evansville. Pruden, when combined with another Fuqua subsidiary, Varco Steel, will be the fourth largest pre-engineering metal building manufacturer in the nation.

Portion of article from Daily Northwestern Evanston, Illinois May 29, 1968

equipment, in Evansville, Wisconsin.

In 1968 Fuqua Industries of Atlanta, Georgia founded VP, as a corporate entity. The metal building subsidiary, which Fuqua founded, brought together two successful regional manufacturers, Varco Steel, Inc. and



Evansville Canning Company, Evansville, Wisconsin
The original Pruden Products factory building

Pruden Products. Initially, there were three operating units in the Fuqua building segment. Two of these, the Pine Bluff, Arkansas and Kernersville, North Carolina plants came from Varco Steel, Inc. The Evansville,

Varco Pruden – Evansville, Wisconsin

Wisconsin plant was the former Pruden Products Company. When the merger was finalized, the new company was named Varco-Pruden Buildings. Within a year Varco-Pruden took steps to achieve a national

Varco Pruden - St. Joseph, Missouri

market presence adding a fourth plant on the west coast. The plant in Turlock, California gave VP a presence in all major markets. As a result of its quality products, enhanced capacity, and Custom Concept, VP experienced phenomenal growth. It was so successful, in fact, that it came to the attention of other companies in the construction industry who wished to expand their operations. Dombrico, Inc., the U.S. subsidiary of Dominion Bridge of Montreal, Canada, acquired Varco-Pruden in 1971. This

Varco Pruden – Rainsville, Alabama

acquisition was Dominion Bridge's first significant incursion into the United States by Dominion Bridge's U.S. subsidiary, Dombrico, Inc. Varco-Pruden was purchased from Fuqua Industries, Inc., and had annual sales of about $25 million. Just three years later, in 1974, Dombrico, Inc. changed its name to AMCA International to reflect its dual American and Canadian company interests.

From 1970 to 1980, Varco-Pruden Buildings steadily added new customers and introduced innovative products. As a result, two additional plants were added in order to increase VP's manufacturing capacity. Varco-Pruden's fifth plant in St. Joseph, Missouri was built in 1980. This facility became a full production facility in 1986. The sixth VP manufacturing facility was purchased in 1985. It is located in Rainsville, Alabama.

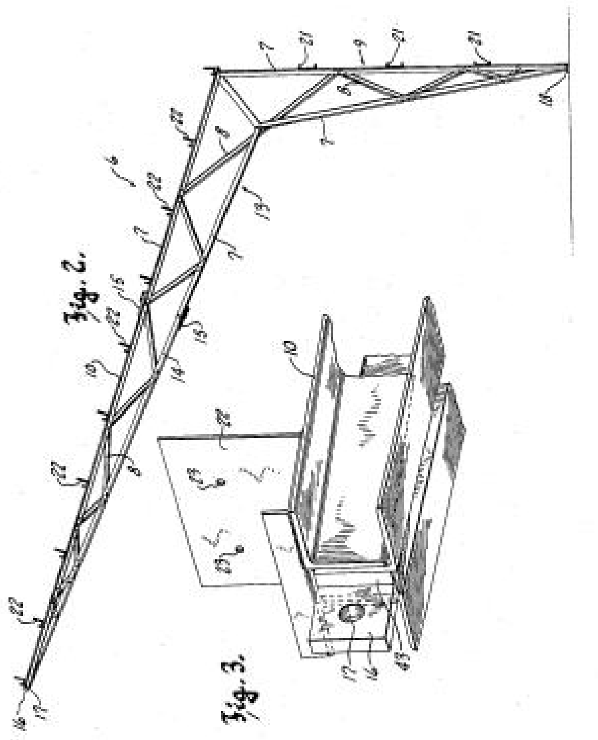
Stran Steel Quonset Huts - 1944
http://www.quonsethuts.org/huts/index.htm

Just a year and a half later in June 1990 the AMCA Buildings segment was renamed to reflect our parent company's new identity. AMCA International changed its name to United Dominion Industries Limited and VP became a United Dominion Company. In April 1991, Stran Buildings, a sister United Dominion Company, was consolidated with Varco-Pruden to increase VP's size, operating base, and resources. The move added two manufacturing facilities, one in LaGrange, Georgia, and one in Van Wert, Ohio. Both facilities have since been shut down. Stran had operated as a major provider of building systems for 54 years, having designed and produced the Quonset Hut, famed during World War II. Beginning as the Stran-Steel Service Center of Great Lakes Steel in 1937, National Steel Corporation owned Stran until 1983 when AMCA International purchased most of its assets.

Sept. 15, 1959 C. PRUDHON 2,904,139

METAL BUILDING FRAME TRUSS UNIT

Filed Jan. 6, 1958 3 Sheets-Sheet 2



Inventor
Clark Prudhon
By
Attorney

Clark Prudhon's Truss Patent – 1959
http://www.freepatentsonline.com/2904139.pdf

The year 1992 saw the release of VP Command, VP's revolutionary building design system. VP has always been ahead of the competition regarding its computer systems and VP Command launched the company even further ahead.

In 1997, The LTV Corporation, a publicly owned company, purchased Varco-Pruden Buildings at that time changed its name to VP Buildings, Inc. LTV (originally standing for Ling, Temco, & Voight), the third largest U.S. steel maker, was a fully integrated steel producer and the second largest domestic supplier of flat rolled steel for the automotive, appliance and electrical markets. LTV formed a new wholly owned subsidiary into which VP Buildings and AEP-Span in Dallas, TX were placed. This new subsidiary was called VP Buildings, Inc. The VP Components Group was located in Dallas, TX and began in 1999 as an exclusive component suppler for VP Builders and is considered a branch of VP Buildings, Inc.

In 1998, VP Buildings, Inc. acquired United Panel Inc., which produces Fiberstone panel systems exclusively for VP Builders and located in Mt. Bethel, Pennsylvania. This product line was sold through the VP Components Group.

In 2000, VP Buildings, Inc. signed a Joint venture with Trache Tee to provide nested Tee hangers for VP Buildings, Inc. Builders and also purchased Graham FRP Composites Ltd. of Inglewood, Ontario, Canada.

The year 2000 also saw the creation of VP University (VPU) – Varco Pruden training department. Under the direction of Dr. Edward C. Champagne VPU formalized functional training as well as enhanced the training options available to our builder family. Today, VPU conducts training seminars throughout North America along with many world-wide joint venture efforts.

On September 19, 2001 GRUPO IMSA of Monterrey, Mexico acquired VP Buildings Inc. GRUPO IMSA was founded over sixty years ago as Industrias Monterrey. Its productive activities were mostly oriented to the Mexican marketplace, establishing a leadership position in the manufacture and distribution of galvanized steel sheet production and products for the construction and packaging industries. Today GRUPO IMSA has productive activities in Mexico, but also in the United States, Argentina, Chile, Brazil, Venezuela, and Guatemala, and exports to the five continents.

Grupo IMSA was broken into four major components: Enermex - Batteries and Auto parts; Imsalum - Aluminum Products; Imsatec - Steel and Plastic Products; and IMSA Acero – Steel Processed Products. VP Buildings, Inc. became part of Imsatec Division. While AEP Span, United Panel, and FRP Graham were combined with Imsatec's other like businesses to better service North America.

In 2007 Ternium of Argentina acquired Grupo IMSA's assets, including Varco Pruden Buildings, Inc.

The most recent chapter in VP's storied history began in February 2008 when it was purhcased from

Ternium by BlueScope North America.[13] BlueScope is headquartered in Austrailia.

In October of 2009 Varco Pruden opened Varco Pruden Roof Systems[14] to specifically give independent authorized Varco Pruden builders assistance with roofing products and pricing. The team, located in Memphis, will work exclusively on roofing; with focus on re-roof, retrofit, and new conventional construction projects

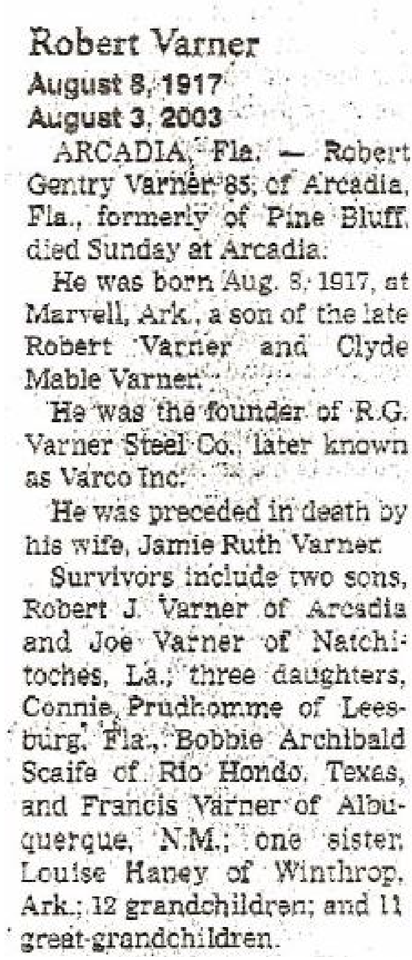
13 http://memphis.bizjournals.com/memphis/stories/2008/01/28/daily37.html

14 http://steelguru.com/news/index/2009/10/01/MTE0MTk2/Varco_Pruden_launches_new_business_unit_exclusively_for_roofing.html

VP Buildings, Inc. Service Center History

The Arkansas facility was begun when Robert G. (R. G., Bob) Varner started his steel business in Stephens, Arkansas at the conclusion of World War II. Utilizing used oil field tubing and innovative welding techniques, he developed a method to design and fabricate structural members to build wide span, post-free buildings having heavy load bearing capabilities. The first project he and his four "welder" employees built was an ice plant in Stephens, which was completed in 1946. During the early years, employees fabricated the pipe truss beams, and also erected the building.

By 1951 Varner's business had grown so that he needed additional fabrication space. Therefore, the operation was moved from Stephens to a building on Highway 65 North in Pine Bluff, Arkansas. A year later, on June 1, 1952, Varner incorporated his business as R. G. Varner Steel Products, Inc. In 1954, Varner bought land at the Toney Field airport north of Pine Bluff and erected a building of his own. By this time the work force was up to 15 employees.



Robert Varner
August 8, 1917
August 3, 2003

ARCADIA, Fla. — Robert Gentry Varner, 85, of Arcadia, Fla., formerly of Pine Bluff, died Sunday at Arcadia.

He was born Aug. 8, 1917, at Marvell, Ark., a son of the late Robert Varner and Clyde Mable Varner.

He was the founder of R.G. Varner Steel Co., later known as Varco Inc.

He was preceded in death by his wife, Jamie Ruth Varner.

Survivors include two sons, Robert J. Varner of Arcadia and Joe Varner of Natchitoches, La.; three daughters, Connie Prudhomme of Leesburg, Fla., Bobbie Archibald Scaife of Rio Hondo, Texas, and Francis Varner of Albuquerque, N.M.; one sister, Louise Haney of Winthrop, Ark.; 12 grandchildren; and 11 great-grandchildren.

Rogert G. Varner Obituary
Courtesy of Jack Hatcher 2008

Robert George Varner
Photo Courtesy of Robin Varner Davis

Business continued to grow and by 1957, Varner Steel made another move to 17th Avenue and the Cotton Belt Railroad in Pine Bluff. The work force had grown to 25 employees. At the 17th Avenue location, the company added other types of framing to the original truss beams. Additionally, Varner went from "junior I beam" purlins and girts to 7" broken gage C's and Z's.

In 1959, the company's first rigid frame building was erected. With sales in excess of two million dollars, the company name was officially changed to Varco Steel, Inc. on July 31, 1962.

Robert G. Varner (right) at Florida Trade Show
Photo Courtesy of Robin Varner Davis

The following description, written by Mr. RG Varner's granddaughter Robin Varner Davis, lovingly tells of a great man.

> To understand where he ended up in life, you have to see how he got there. RG Varner was a native of South Arkansas who had, over the years, been in several businesses, taken bankruptcy twice and held many different jobs. One of his very first jobs was a door-to-door salesman, selling shirts, shoes and dress coats. He even sold cattle from the back of his pick-up truck. RG Varner was in the scrap iron business, the tire business, sold oil field pipes and even

drove a Grey Hound bus. He also built and owned a drive-in movie theatre. I guess you can say that he was the jack-of-all-trades.

He never backed down from an opportunity, so when a friend asked him if he could buy some oil field pipe and put together steel trusses to frame a building, he accepted, and that is where it all began. In 1948, he began building metal buildings around the area, eventually starting RG “Bob” Varner Steel Products, Inc. He did lose money on one of his first jobs, but that would be the last. His next big project was to build a brick plant in Holly Springs, Mississippi using the oil field pipe. It was a success and in a short time, Varner Steel was building brick plants east of the Rockies from Kansas to Maine.

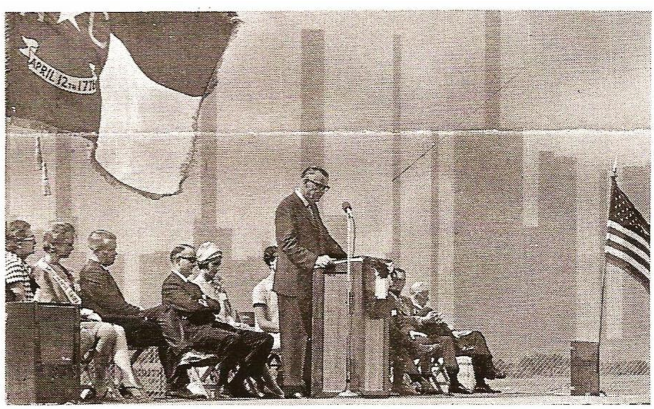
RG Varner moved his company to Pine Bluff, Arkansas in 1956 and continued to grow his business. He became a pilot making it easier for him to do business. As his business grew to larger cities, he began to run into restrictions on local building codes. This is a story worth mentioning. One job, in Richmond, Virginia almost got the best of him. He was being filed with an injunction that was going to force him to take down a building that was already built. He challenged them to load the building to the code requirement. RG Varner suggested that bricks be placed on the roof and that if there were any kind of failure or deflection, he would remove the entire building. But the best thing, showing his true personality, was that he offered to personally sit in a rocking chair under the loaded roof through the entire test. What happened next was typical of how he approached everything, television cameras, reporters, and bystanders watched in amazement as this crazy man sat in his rocking chair reading the morning paper while each brick was being added. Well, the building didn't fall and there was no deflection. From this point, the company became known as Varco-Pruden and RG Varner was well on his way to accomplishing the American Dream.

During the time of Varco-Pruden, he

R.G.Varner Steel Products, Inc.
Robert G. Varner Third from Left
Photo Courtesy of Robin Varner Davis

landed a job in Arcadia, Florida building a large metal building for Central Transformer, which was also headquartered in Pine Bluff, Arkansas. This was his first encounter with Arcadia, Florida, but as you will see later was not his last. Varco-Pruden was very successful over the years and was eventually sold in 1968 for $1 million dollars. RG Varner must have sold a solid foundation because the company continued to grow.

Just four years later (1966), annual sales had grown to more than six million dollars and the announcement was made that a new plant would be



Governor Dan K. Moore of North Carolina formally dedicates Varco-Carolina.

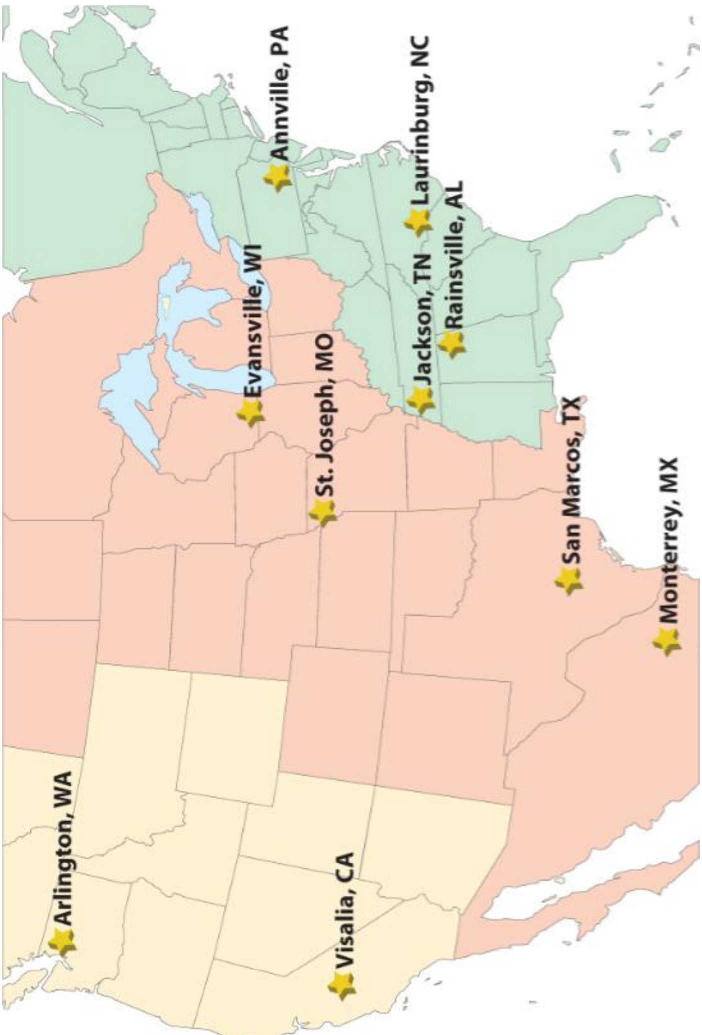
From Varco Sparks Newsletter June 1967

built in Kernersville, North Carolina. The new plant was put into operation toward the end of 1966. The Kernersville facility thrived until it closed its manfacturing operation in December 2009. The engineering and administration functions still remain.

Varco-carolina Facility
From Varco-Sparks Newsletter June 1967

In 2009 BlueScope began converting its familial facilities into BlueScope Manufacturing operations. The first such fully functional is in Visalia, California. The conversion continues with plans for completion in 2011.

Varco Steel, Inc. 1967
From Varco Sparks Newsletter June 1967



BlueScope Manufacturing Facilities

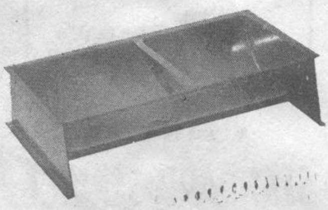
BUSINESS

Pruden Manufacturing Co. Begins Operations Here

New Firm Makes Poultry, Hog Feeders, Ventilating And Drying Fans

Evansville's newest industry, the Pruden Manufacturing Co., began production here last week after moving into its new quarters at the old canning factory the week of July 15.

The firm, which manufactures poultry feeders and waterers, hog feeders, and ventilating and drying fans, had been operating during the last four years in Fort Atkinson. The reason for the move, according to Clark Pruden,



2-Foot Hog Trough

president of the company, was the need for more space. Additional space of a suitable nature was not available in Fort Atkinson.

Prior to the formation of his company, Mr. Pruden had been associated with the James Manufacturing Co., makers of the Jamesway line of farm equipment.

In addition to manufacturing these sheet metal products, Pruden will raise broiler chickens at the canning factory site in collaboration with John Antes.

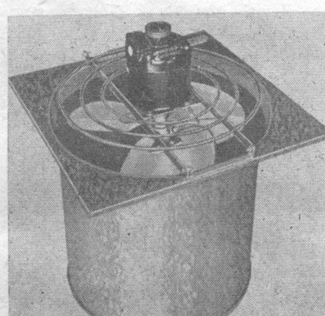
foot lengths. The two-foot model is illustrated on this page.

Also illustrated is a hand poultry feeder which holds 115 pounds of feed. The feeder will serve turkeys as well as laying hens.

Three items made by the company which are not illustrated are a 10-foot chicken and a 10-foot turkey waterer and a 20-inch crop drying fan for drying up to 1,000 bushels of ear corn. The Pruden Co. will distribute corn cribs in conjunction with the drying fan it manufactures.

Pruden is married and has three children: Pearl 11, George 7, and Gene 4. They have all been living in Evansville since July 15.

"We like it here in Evansville," Pruden said, "and we think we'll get along just fine. The park especially appeals to us and we have been getting fine cooperation from the Union Bank and



20-Inch Ceiling Fan

Trust Co., and the cooperation of the bank is an important part of any business."

First Pruden Products
August 5, 1954

The Evansville, Wisconsin service center was established in 1950, by Clark Prudhon. Originally incorporated in Fort Atkinson, Wisconsin, Pruden Products (changed to *Pruden* to reflect the phonetic pronunciation) manufactured poultry feeders and ventilation fans for the farm industry. The company quickly outgrew its initial facility. In 1954 the company purchased a 20,000 square foot building, which had previously housed the Fall River Canning Company and relocated to Evansville, Wisconsin.

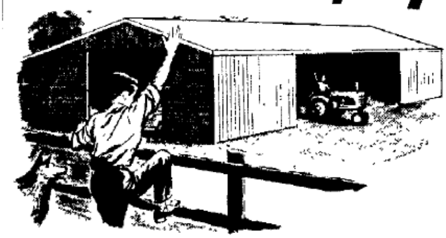
During the summer of 1954, Pruden Products delivered its first steel building frames to a local farmer. They were designed to be used with wood purlins and girts. Others buildings closely followed this first venture into the buildings industry. By early 1963, the company offered an all steel building with purlins, girts, and panel rib roofing and siding. The year 1963 also saw several plant expansions including the addition of a 10,000 square foot office building. Total manufacturing, warehousing, and office area exceeded 75,000 square feet at this time. Pruden Products continued its steady growth. Within three years, additional space was added.

STORAGE DRYING

Now you can harvest your crops early, at your convenience. Cut field losses to a minimum. Dry around the clock without having to "shut off the dryer."

You can have all this for about 1/3 the initial cost of conventional batch dryer. Drying costs will be pennies instead of nickels per bushel. Best of all, your grain will always be top quality. Heat control allows various. drying speeds. Every unit is custom engineered with the farmer in mind.

the Rancher, by Varco...



Clear span --- No floor ties gives stronger, larger capacity

BUILDINGS DESIGNED FOR

- **Grain Storage, Drying**
- **Cattle, Hogs, Poultry**
- **Machinery, Equipment**

Varco Buildings Are HANDSOME, ECONOMICAL, LABOR SAVING STRUCTURES

Better buildings --- for less

Added strength and durability — the must features for safe, profitable grain storage. Strength is built into Varco buildings, no awkward floor ties are necessary. It's a solid, clear-span building fabricated from a new, higher-grade steel. STRAIGHT SIDEWALLS, better roof pitch facilitate easier filling. Permanent and almost maintenance-free, Varco grain buildings are easily and quickly adapted to many other uses after serving their grain storage duties.

FOR YOUR POSITIVE ASSURANCE EVERY VARCO GRAIN STORAGE BUILDING IS WARRANTED.

ONLY 5% DOWN

See us about a complete line of Chief or Varco farm buildings. We offer a complete planning and erection service to our customers . . . or a "do-it-yourself" plan. Either way, it'll pay you to see us before buying any farm building.

BORROW 95% OF COST FROM THE GOVERNMENT AT LOW INTEREST. PAYS FOR ITSELF. LET US GIVE YOU COMPLETE DETAILS FROM START TO FINISH WITHOUT OBLIGATION.

Sale Prices

ON ALL ORDERS WRITTEN BETWEEN NOW AND JULY 15

Act Now!

THE SHRIVER-VAN HORN COMPANY

Jefferson, Iowa

Phone 6-3121

The Shriver-Van Horn Co. advertisement

From The Jefferson Bee - 1961

Completed in 1966, the 44,000 square foot facility was officially dedicated and placed into operation by then Governor Warren Knowles in a public address to over 400 residents.

In 1968, Pruden Products joined Varco Steel Company (owned by Fuqua Industries) to form Varco-Pruden. In September of the same year, a 19,200 square foot structure was added bringing the total Evansville operation to over 125,000 square feet. Over the years, additions of 40,000 square feet to the plant area and the construction of a 22,000 square foot shipping and warehouse building have brought the plant to its total current size. The plant occupies an 80-acre site and consists of 235,000 square feet of office and manufacturing space.

Fuqua recently acquired Pruden Products Co., at Evansville. Pruden, when combined with another Fuqua subsidiary, Varco Steel, will be the fourth largest pre-engineering metal building manufacturer in the nation.

Portion of article from Daily Northwestern
Evanston, Illinois May 29, 1968

Varco Pruden Buildings – Kernersville, North Carolina ca. 2007

The North Carolina facility began operations in 1966 when Varco Steel, Inc. (located in Pine Bluff, Arkansas), expanded its operations to the east coast, creating the first building systems manufacturer in North Carolina. VP-Carolina began operations on 23 acres in a 100,000 square foot facility. During that first year, approximately 120 employees produced 150 tons of steel per week. Since 1967, the operation has shown continuous growth. In 1976, 4,500 square feet of additional storage and manufacturing space was added to the Panel Area. Two years later, a 16,400 square foot addition was added to the Frames Area, providing a 15% increase in production capacity. In 1981 an additional 4,165 square feet of office space was added to help support increased sales and production requirements. Then in 1983 a 1,860 square foot addition was made to the Engineering Department. Two years later, in 1985, 1,200 square feet of space was added to the Shipping

Area. In 1989, both the office and the plant were increased by 6,000 square feet.

2009 saw the end of an era as the Kernersville facility produced its last steel. In 2010 the office was sold to Carolina Cast Concrete and the Engineering, Services, other functions moved to an office in Greensboro, North Carolina.

St. Joseph, Missouri Facility

The California service center was founded in 1968; the facility's early years were characterized by change. The plant originally, for example, was to have been operated by Rheem-Dudley, a subsidiary of Fuqua Industries. However, plans changed in 1968 when Fuqua Industries decided to operate the west coast plant as a Varco-Pruden facility. Initially, all production was done in Santa Fe Springs, California until work could be started on the new plant. In January 1969, work on the new VP facility in Turlock, California was started. Three months later, in March, a small group of employees began fabricating steel at a temporary site in Newman. In April, this small manufacturing operation was moved to another location in south Turlock. Finally, in May, the entire operation was moved to the Turlock site. By the end of June, the 140,000 square foot facility was fully enclosed and the first beams were being manufactured. Within a year, all administrative operations were consolidated at the Turlock location with the completion of the main office building. In 1977, the first of four additions was completed, adding 2,700 square feet. In 1981 and 1985, the service center added an additional 6,400 square feet of warehousing area to better serve Builders. Similarly, nearly 10,000 square feet of painting area and other additions were added in 1982 and 1988 to improve quality levels and the facility's ability to be responsive to customers' needs.

The end of 1990 added another 2,400 square foot addition added to accommodate the growing technical staff. This latest addition brought total office space to 17,800 square feet. Overall, the original 140,000 square feet located on 18 acres has grown to nearly 160,000 since 1969.

The Service Center enjoys a centralized location in the San Joaquin Valley and grew from a handful of employees to become a major employer in the area. By 1994, the facility had grown to employ over 260 people on two shifts with production capacity in excess of 800 tons per week. The California Service Center had grown to become the dominant building systems manufacturer in the western U.S. Approximately 200 authorized VP Builders are served by the Center.

In 1980, the Missouri facility was built. This initial construction consisted of 65,200 square feet of building, which housed solid web production. Phase I also marked the introduction of the newest manufacturing technology to Varco-Pruden. Phase II construction was started in August 1984 and consisted of a 52,585 square foot addition to the original facility. This expansion houses roll-forming equipment for roof and wall panel, and secondary framing. Full-line production began in July 1985. Completion of the Phase II expansion brought the Missouri facility to a total of 147,485 square feet of manufacturing and office space on a 19-acre site.

Varco Pruden – Rainsville, Alabama
ca. 2007

In the forty years since R. G. Varner established his business, Varco-Pruden has become an active leader and innovator in the commercial construction industry. As a result of the ever-increasing sales volume in the East, the Rainsville, Alabama Manufacturing Plant was purchased by AMCA in 1984 and assigned to the North Carolina Service Center for increased manufacturing capacity. This facility is located on 23 acres and provides 116,000 square feet of manufacturing space. The Rainsville Plant provided the basis for a 39% increase in production capacity between 1984 and 1987, specifically with the addition of open web framing capability.

In 1991, a former Stran[15] plant location in Van Wert, Ohio was merged into the family. The Ohio Service Center's total manufacturing and office square footage was in excess of 150,000 square feet, located on 27 acres of land. The plant produced in excess of 500 tons per week without panel products. The facility, employing around 100 people, was temporarily closed on September 27, 2002. In 2004 the Van Wert, Facility was permanently closed.

Stran Steel Advertising Sign ca. 1970

VP Buildings, Inc. is continually making capital improvements at all facilities to maintain its place as a global leader in building systems.

Varco Pruden is headquartered in Memphis, Tennessee. The present 41,000 square-foot facility located at 3200 Players Club Circle opened September 18, 1997.[16]

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15 http://www.quonsethuts.org/huts/index.htm

16 http://www.memphisdailynews.com/editorial/Article.aspx?id=17582

Varco Pruden Buildings
Memphis, Tennessee

Varco Pruden Buildings, Inc. Service Center Locations:

Turlock, California

Evansville, Wisconsin

Greensboro, North Carolina

Rainsville, Alabama

Pine Bluff, Arkansas

Memphis, Tennessee

St. Joseph, Missouri

VP Components - Memphis, Tennessee

Notes:

Conclusion

This manual is designed to assist you in becoming an expert on the many ways to approach a project. Two things to remember when designing and estimating a project are:

1. Find out the customer's specific needs on a project.
2. Apply the products in a creative way to achieve the project's objectives.

By identifying your customer's wants and needs, you will understand the true project goals, which will create a unique advantage over your competition. This edge can win you the project.

Another purpose of this manual is to give tips on how to determine a project's needs *before* you pitch the project to the owner. First, you must discuss the product applications with the owner or specifier in order to determine what and how the VP products will be used.

The more questions that are asked and answered on the front-end will determine how the project proposal is structured. The VP Buildings' product line is one of the most versatile in the industry and can be adapted to suit the project's specific needs.

We hope that this manual is a useful tool for our Builders in the process of selling, designing and estimating projects. If you have any questions concerning any applications in this manual, please contact your VP Service Center. With your customer-focused proposal and VP's superior performance, we can create *The Ultimate Building Solution* for your customer.

Disclaimer:

The examples and illustrations in this manual are intended to support the discussion topic and in some cases may not be accurate for a condition being considered. They are generally true, but can always be found to not cover some given situation. They have been developed with particular loadings, dimensions, and codes, and are accurate for the situation intended. The charts showing percentages are meant to be approximate or to show the trend of the subject rather than an exact number for all.

With the many variables in construction: loading; geometry; customer preference; etc. it is often difficult to state that “If A is done, then B will result.” Therefore you should take advantage of the power of VPCommand and the experts within Varco Pruden Buildings to create varying building project scenarios for your customer.

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Varco Pruden Buildings – Systems Guide

In today's competitive environment it is more important than ever to combine your individual sales capability with strong product knowledge. This combination of skills will have a significant impact on the ability to achieve the sales and profit goals of your company while providing building solutions that meet your Customer's needs.

VP's Systems Guide is designed to: improve your product knowledge for optimum product utilization; deliver better pricing; and refresh and enhance your selling skills specific to VP products.

In any building or bidding opportunity there are three major goals:

- *Make the Sale*
- *Make a Profit*
- *Meet the Needs of the Customer*

2010 VP University Press