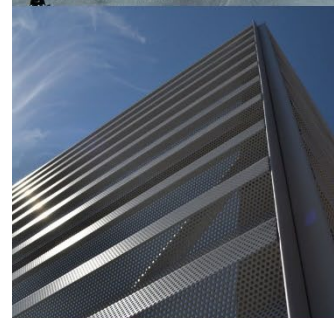


# DESIGN GUIDE



## ENGINEERED ROOFTOP EQUIPMENT SCREENS



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# INTRODUCTION

## PURPOSE OF THIS DESIGN GUIDE

We realize most people don't have to deal with designing rooftop equipment screens very often, if ever. But we do it every day, so we have provided this guide to pass on some of our knowledge and help you design the most effective and economical RoofScreen project possible. This guide is written with the architect/specifier in mind, but anyone intending to use the RoofScreen product will benefit from reading it.

## WHAT THIS DESIGN GUIDE COVERS

In this guide, we will provide an overview of the RoofScreen System including materials and components, features, key design considerations, and the basics of designing and laying out a RoofScreen.

## GLOSSARY

For your convenience, we have assembled a glossary at the end of the document with some of the common terms and phrases used when discussing RoofScreens.

# ROOFSCREEN SYSTEM OVERVIEW

## ENGINEERING

We recommend structural engineering calculations be performed by a licensed professional engineer on all RoofScreen projects before installation. This is a service we offer along with the purchase of the RoofScreen System.

During the design stage of a project, we offer free assistance to architects to ensure projects are designed in a way that makes sense and won't need major revisions during final engineering. Please contact us for more information at 831-421-9230.

## MATERIALS AND COMPONENTS

**TUBING:** 2.5" and 1.5" round steel tubing in 16ga or 11ga, galvanized on the interior as well as a special 3 process galvanized finish on the exterior for superior performance.

**CONNECTOR FITTINGS:** These are 100% stainless steel fittings that will connect the tubes in different configurations, while allowing complete adjustability.

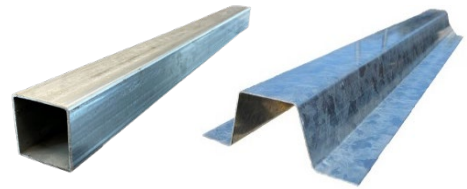


**BASE SUPPORTS:** These are the steel stanchions that mount the RoofScreen System to the roof structure. They are 6"x 6" steel boxes with holes in the bottom for the attachment bolts to the structure. The Base Supports are available in heights ranging from 8" to 14" to accommodate different insulation thicknesses. Extensions are also available when increased height is needed for deeper insulation. See *Dealing with Roof Insulation* on page 19 for more information.



**HARDWARE:** All the nuts, bolts, washers and screws used to secure the Connector Fittings and tubes together are stainless steel.

**HATS AND SQUARE GIRTS:** Hats and Square Girts are interchangeable and are used to span between RoofScreen Frames allowing panels to mount in vertical orientation. 1.5" and 3" deep Hat sections are available in 16ga and 12ga G90 galvanized steel. Square Girts are 2" x 2" available in 14ga G90 galvanized steel.

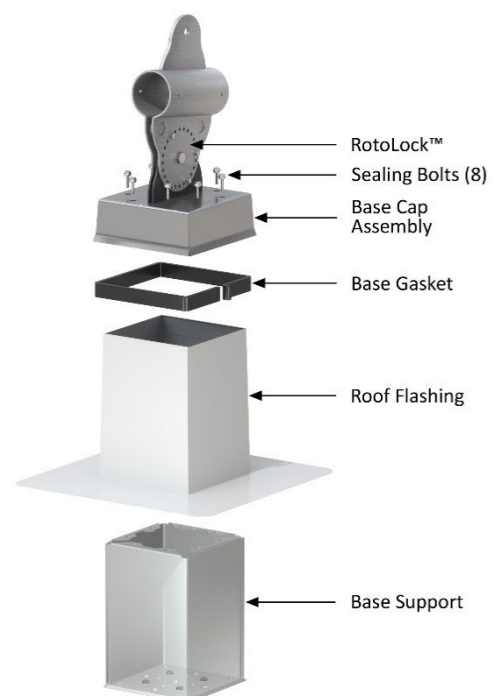


**PANELS:** Refers to the facing or "skin" of the RoofScreen. RoofScreen offers several standard types of steel panels with factory applied paints and textured coatings. We also offer three styles of architectural aluminum louvers and a sound-attenuating panel assembly. Any type of cladding material may be used on the RoofScreen framing system whether sourced through RoofScreen or elsewhere. For more information on panels, please see *Panels and Trims* on page 20.

## FEATURES

**MODULAR:** The frames and components are essentially the same for any RoofScreen, with a few variations (see *Frame Types* on page 8). By changing lengths of framing tubes, frames can be made taller or shorter, and spacing them closer together can make the system strong enough for any wind load. Since Connector Fittings slide on the tubes and the entire system is secured with Self-Drilling Tek Screws after adjustment, the system is completely modular and can be applied to any project requirement.

**WATERTIGHT ROOF ATTACHMENT:** This is the most important part of the RoofScreen System, as we have eliminated the chronic leak problems associated with traditional methods of attaching to roofs. Here's how it works: First, Base Supports are attached to the roof structure (see *Roof Attachments* on page 13 for more information on various types of structures.) The roofers will then install, and roof in, specially fitted Flashing Boots that can be provided by RoofScreen Mfg. or other sources. We offer various types of flashings to accommodate different types of roofing systems. A self-adhesive EPDM gasket strip is applied around the top of the flashing to help protect against ice, snow and splashing water. When the roofing is complete, RoofScreen installers will mount the Base Cap Assemblies, which counter flash 2.4" over the Flashings.



**ADJUSTABILITY:** The tubular design and adjustable fittings allows for unlimited adjustment as illustrated in Figures 1-3 below.

- **Front-to-Back:** The horizontal tube will slide forward and backward in the Base Assemblies allowing the installer to perfectly plane out the face of the screen. To keep the front tube plumb, the Field Connector that connects the diagonal tube will need to be adjusted up or down as indicated by the arrows in Figure 1.

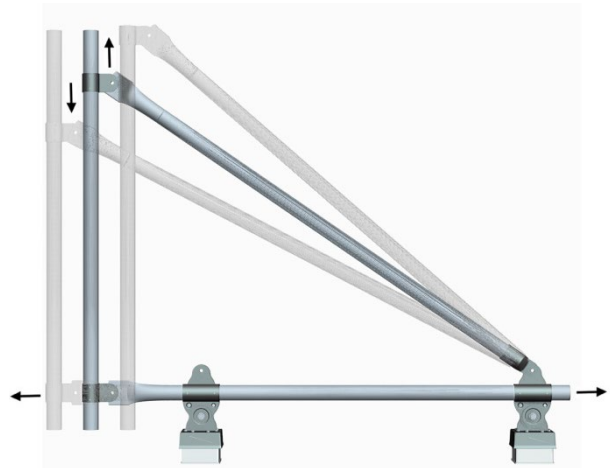


FIGURE 1

- **Tilt:** The front vertical tube will pivot at the connection to the horizontal tube by sliding the connector up or down, allowing it to be installed perfectly vertical or sloped back at any angle.

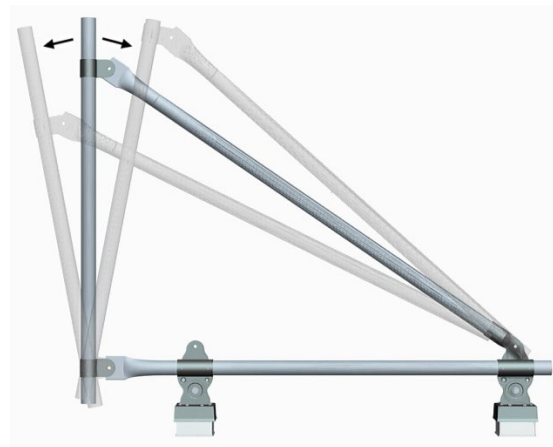


FIGURE 2

- **Side-to-Side:** The horizontal tube will rotate within the two Base Assemblies allowing the frame to be plumbed side-to-side.



FIGURE 3

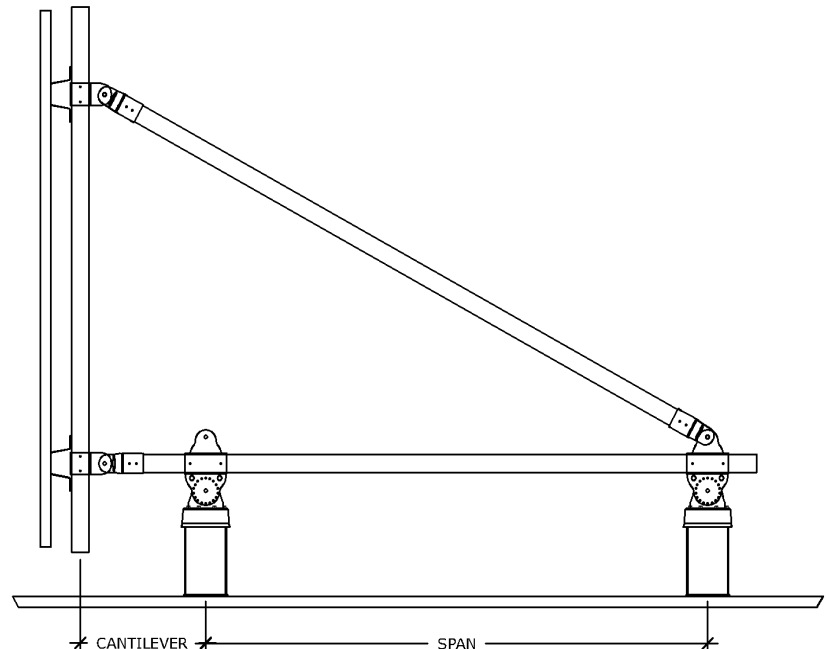
## DEFINITIONS

**FRAMES:** The assembly of Tubes and Connectors, typically in a triangular configuration, mounted on 2 Base Supports (see Figure 4).

**FRAME SPACING:** The distance from frame to frame across the roof. This can vary from 3ft to 20ft depending on the wind load and other factors.

**SPAN:** The center-to-center distance from the front Base Support to the rear Base Support on any given frame. Span can range from 2ft to 12ft depending on frame height, wind loads and other factors.

**CANTILEVER:** Distance from the center of the front Base Support to the vertical tube. The cantilever allows the front-to-back adjustment of the screen to plane out the panels.



**TYPICAL ROOFSCREEN FRAME**

**FIGURE 4**

## DESIGN CONSIDERATIONS

### MUNICIPAL REQUIREMENTS

We highly recommend consulting with the appropriate local building and planning department before designing a RoofScreen. Here are some things to consider:

**LAYOUT:** Some municipalities require the RoofScreen to be completely enclosed with a closable access gate. For instance, they may not accept a “U” shaped screen that is open on the back of the building even though the roof top equipment is not visible.

**HEIGHT:** Most municipalities require the Top-of-Screen elevation to be at least as high as the elevation at the tallest piece of equipment being screened. Some, however, will accept the “line-of-sight” method, meaning that the screen only needs to be tall enough so that equipment cannot be seen from the ground when standing a reasonable (or specified) distance away.



**AESTHETICS:** Most RoofScreens are built with factory painted flush or corrugated metal panels. Some municipalities will not accept these types of panels and require textured panels that simulate stucco. In some cases, planning departments will require the screen material to match nearby roof screen panels, wall cladding or other architectural features to blend with the surrounding architecture. The RoofScreen System is capable of supporting any type of facing materials required. Please feel free to contact us for more information or help with unusual paneling requirements.

**STRUCTURAL:** In new construction projects, the weight and loads from the RoofScreens are typically accounted for in the roof structure. But in retrofit situations where the RoofScreens are being added or increased, most building departments will require that the capacity of the roof structure be checked for the new loading. Codes have become more stringent over time and older buildings often require reinforcement of structural members where point loads from the RoofScreen occur.

## COST

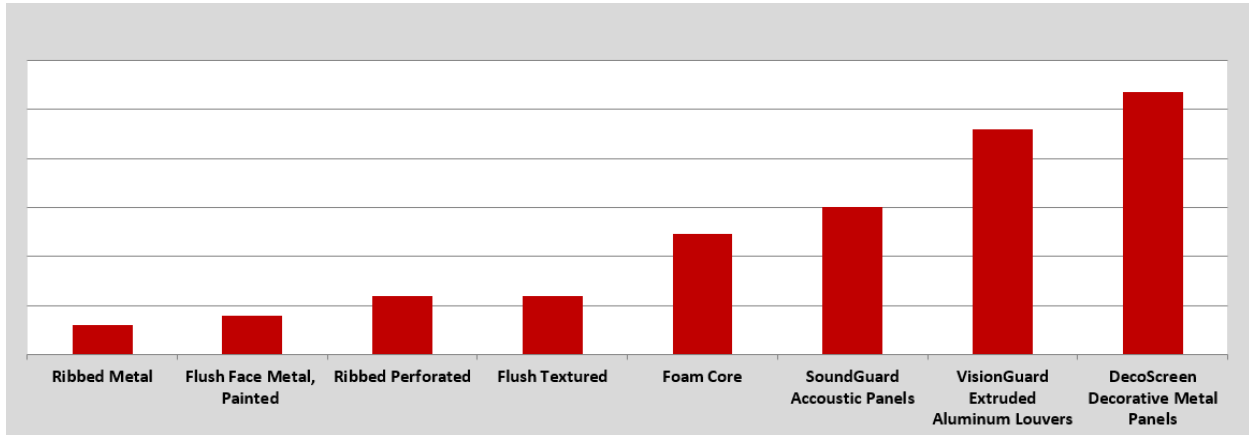
The cost of a RoofScreen system can vary significantly depending on many factors. Here are a few key considerations:

**FRAME HEIGHT:** The biggest factor in the cost of a RoofScreen system is how tall it is. For every additional foot in screen height, the additional cost can increase exponentially. As the screen gets taller, more surface area is subjected to wind loads, and the frames must be constructed with heavier materials and be placed closer together. If cost is a concern, it is well worth the time to determine the required height and try to keep it minimized. It may also be advisable to consult with the mechanical contractor about options for shorter rooftop equipment.

**PANEL HEIGHT:** Minimizing the panel height can also have a dramatic impact on cost. By reducing the panel surface area, the wind load effective area is reduced which may allow the use of lighter materials and increase the frame spacing. Even if the screen needs to be very tall, consider leaving a larger gap between the bottom of the panel and the roof surface if possible. For example, a screen that needs to be 12' tall to cover the tallest rooftop equipment may only need a 6' panel if, due to line-of-sight, you can't see below the panels.

**FRAME SPACING:** The number of frames required also has a significant impact on the system cost. The goal is to put the frames as far apart as possible, but there are many factors that need to be considered. As discussed above, frame height and panel height have a direct correlation to frame spacing, but the type and configuration of the roof structure also plays a big role. The most cost effective way to design a RoofScreen is to have the frames located over the structural members to avoid the need for additional support blocking. However, the spacing of the structural roof members may not be at the optimal spacing to accommodate the frames. For example, if the roof members are spaced at 5ft O.C., and because of the wind load for the project, the RoofScreen frames are only capable of 9ft spacing, then the only choice is to put the frames on every structural member (5ft O.C.). In this example, it might be better to add blocking to the roof system at 9ft O.C. to reduce the number of frames.

**PANEL STYLE:** The following chart illustrates the general cost difference between common panel types. It is also possible to put any type of facing on the RoofScreen framing system, from stucco to aluminum composite panels, and the cost would be affected accordingly.



**PANEL ORIENTATION:** Mounting the panels horizontally on the RoofScreen frames can save money because it eliminates the need for hat sections (horizontal girts). However, panels in horizontal orientation have limited span capacities, so this is only an option when the frames are fairly close together. There are many variables that need to be considered, but as a general rule of thumb, if the frames are less than 8' or 10' O.C. you may want to consider horizontal panels. Please feel free to call our design team for more information or assistance in determining these options.

**LAYOUT:** Keeping the overall layout simple is another way to keep the cost down. Jogs, corners and access gates add cost because they usually require an extra frame at each occurrence. It is usually better to surround several pieces of roof top equipment with a single large RoofScreen than to use several small RoofScreens around individual pieces of equipment. Leaving an opening for access instead of a gate will also save money.

## AESTHETICS

RoofScreens can be designed to blend with the architecture of the building in a way that makes them almost unnoticeable. Conversely, they can be designed to be an accent feature that enhances aesthetics of the building.

**PANELS:** As mentioned above in the Cost Section, the type of panels used can have a big impact on the cost of the system, but if budget allows, don't miss the opportunity to enhance the overall aesthetic of the building with attractive facing on the RoofScreen. RoofScreen offers various standard panel styles (see *Panels and Trims* on page 20), however these are not the only choices. We can source any custom type of panel, or the panel can be sourced and provided by a third party and mounted to the RoofScreen framing. Please feel free to contact us for more information or help with unusual paneling requirements.



**TRIMS:** There are several trim options offered by RoofScreen Mfg. (see [Trims](#) on page 26.) The trim cap can greatly enhance aesthetics of the RoofScreen without adding much cost. RoofScreen can also customize any trim. For instance, a custom cornice style trim cap could be provided to match specific dimensions from a cornice on some other part of the building.

**MANSARDS AND SLOPED SCREENS:** A very common RoofScreen style is a “Tilt Back” screen where the face of the screen is sloped. This is easily done by adjusting the length of the diagonal framing tube to achieve the desired degree of slope. Sloped screens can be challenging in some cases (see [Sloped Frames](#) on page 10.)

Mansard screens, pictured below, can dramatically improve the building’s aesthetics and conceal the roof top equipment at the same time. The mansard screen can sit on top of the roof right at the edge, or can be adapted to cantilever over the roof edge creating a soffit.



**ARCHES AND CURVES:** The flexibility of the RoofScreen framing system allows unlimited creativity. The RoofScreen does not necessarily need to go in a straight line or have a vertical face. For a RoofScreen that curves across the roof, there are several things to consider. The layout of the frames will most likely not align with the structural framing members, so plan on adding structural blocking at the attachment points. This does not apply on concrete decks strong enough for the Base Supports to be set anywhere.

If using vertical panels, they will usually flex to the radius and not need customization. The hat sections that are normally used to mount vertical panels on straight screens cannot be curved. Instead, we use 2.5” round tubing, which can be custom curved for the job and mounted to the vertical frames with special connectors.

If using horizontal panels, the degree of radius becomes very important. If very slight (i.e.  $R=150'$ ) the panels will probably flex to the radius depending on the type of panel used. If the radius is tight, the panels may need to be custom curved for the application. Arched screens are achieved by curving the front vertical tube of the RoofScreen frame. In this application the roof pitch becomes important because there are some

challenges in the layout of the Base Supports to keep the face of the screen in plane when the roof slopes up and down for drainage. If the roof deck is dead flat, this issue is eliminated. If using vertical panels, they will most likely need custom curving to the desired radius. If using horizontal panels, they will probably flex to the radius. Keep in mind that ribbed style panels mounted horizontally on an arched RoofScreen will show dirt on the tops of the ribs and may not look good if the area does not get a lot of heavy rain to keep them washed off.

## DESIGNING A ROOFScreen

In this section we will first cover in detail the technical aspects of the RoofScreen system and discuss many of the options available for designing a screen. The section concludes with technical information on how to layout a RoofScreen.

### FRAME TYPES

The following frame configurations (Figures 5-12) illustrate some of the basic uses of the RoofScreen system. The flexibility of the tube and fitting design allows for virtually any combination of these designs.

**SC3:** The Standard Cantilevered 3 Member frame is the most common RoofScreen frame used. The face of the screen is cantilevered past the front Base Support via the horizontal tube member to allow adjustability during installation (see [Adjustability](#) on page 3).

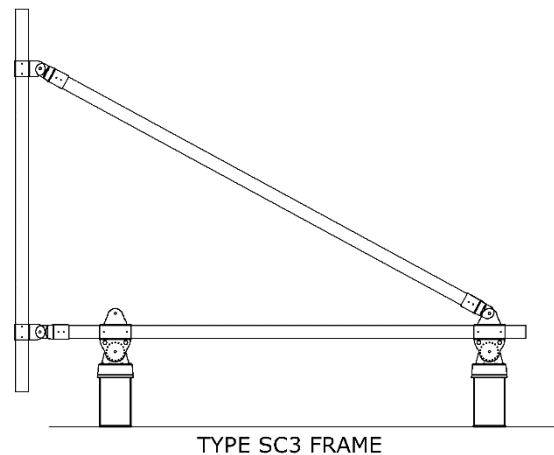


FIGURE 5

**SC5:** The Standard Cantilevered 5 Member frame is essentially the same as the SC3, but with added truss members for additional strength when required. This type of frame is often used when the frames are very tall and the wind load is significant.

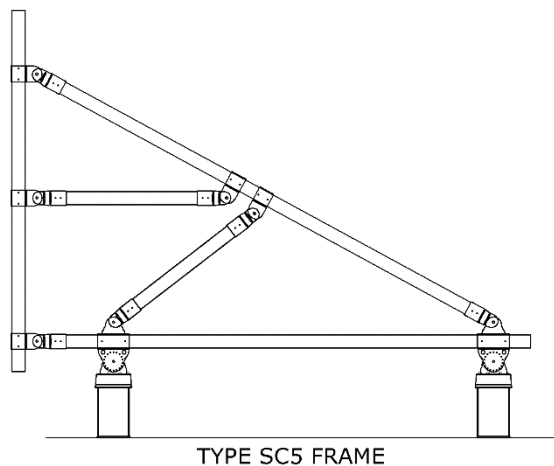
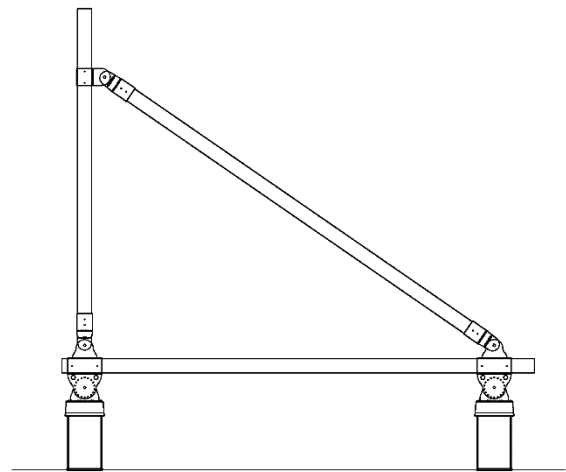


FIGURE 6

**NC3:** The Non-Cantilevered 3 Member frame places the vertical tube directly over the front Base Support. This makes a very strong frame and minimizes the overall roof space needed to mount the frames. However, there are some important limitations to this type of frame that need to be considered. First, there is no front-to-back adjustment in the frame, so the front Base Supports must be installed in a perfectly straight line in order to keep the face panels in plane. Second, the bottom of the panels will need to start high enough to mount to the vertical tube. There are many variables in determining how high the panels must start, but a quick rule of thumb range is 12" to 24" for vertical panel orientation, and 28" to 36" for horizontal panels.

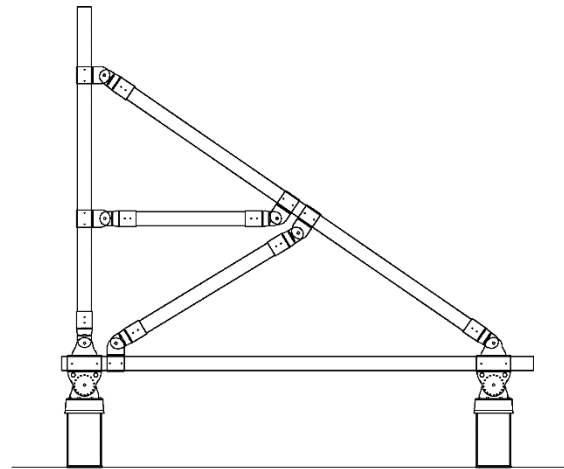
**NC5:** The Non-Cantilevered 5 Member frame is essentially the same as the NC3, but with added truss members for additional strength when required. This type of frame is often used when the frames are very tall and the wind load is significant. For important limitations of this frame type, please see the description above for the NC3 frame.

**NC2:** The Non-Cantilevered 2 Member frame is the simplest and most basic frame we offer. It is inexpensive and very fast to install. The same restrictions outlined above for the NC3 frame apply to this frame. This frame uses Round Post Supports, and is a good choice when the roof structure is very strong such as concrete or large I-beams. (See the [Roof Attachments](#) section on page 14 for more information.)



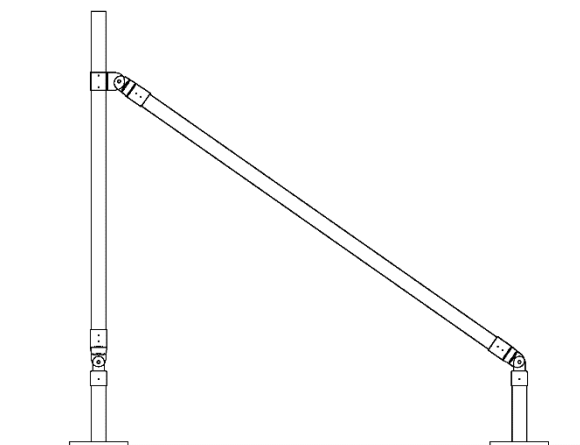
TYPE NC3 FRAME

FIGURE 7



TYPE NC5 FRAME

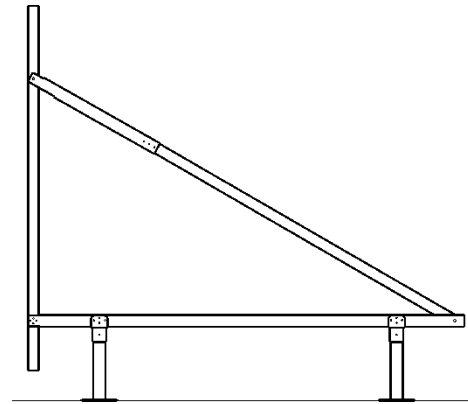
FIGURE 8



TYPE NC2 FRAME

FIGURE 9

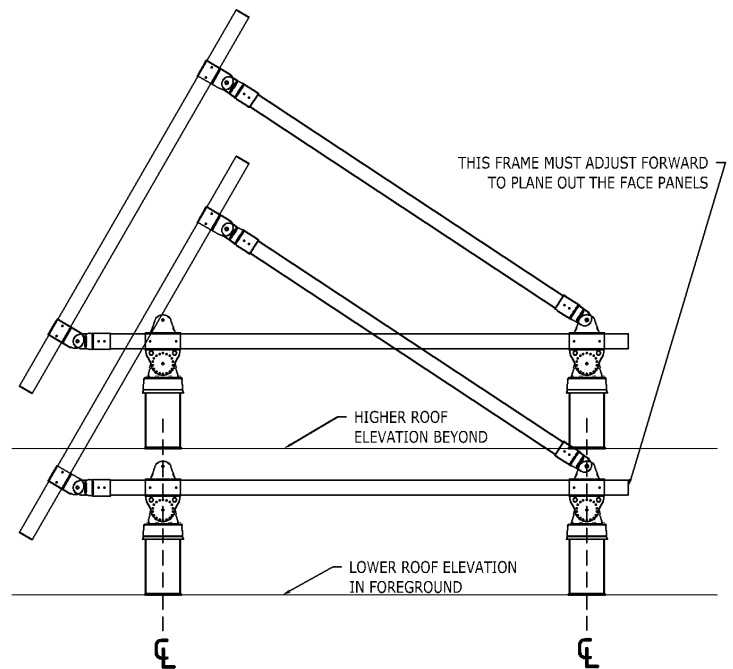
**LT FRAME:** The RoofScreen LT™ is the fastest installing frame we offer. The light-duty frame system consists of 3 square galvanized tube members and our Square Post Support system, which allows adjustment for roof slope and a watertight connection. This system is adjustable during installation and does not require perfect alignment of the front Post Supports from frame to frame.



**FIGURE 10**

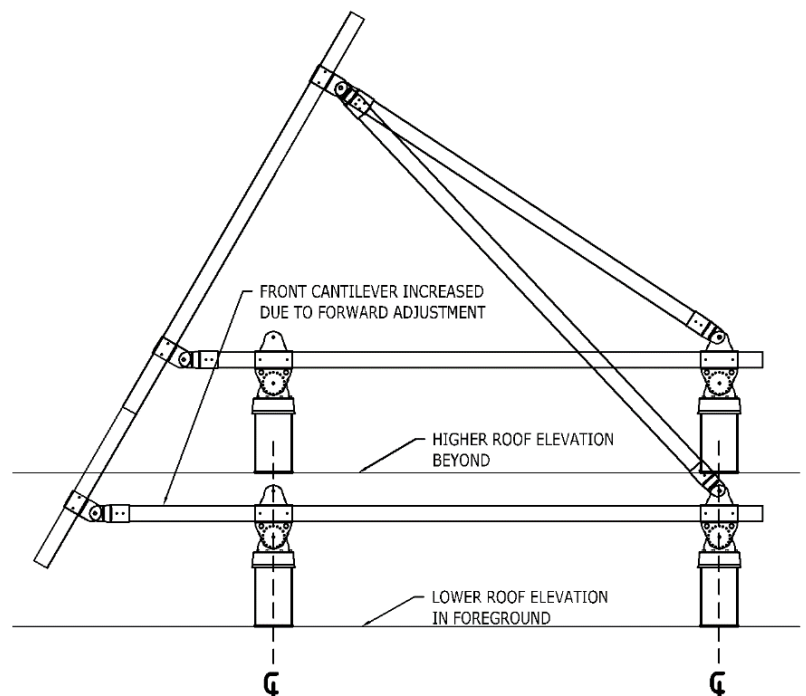
**SLOPED FRAMES:** Sometimes referred to as “Tilt-Back”, Sloped Frames are used to achieve an architectural look similar to a mansard. Typically, the Cantilevered Frames SC3 or SC5 are most suitable for creating a sloped screen. On a perfectly flat roof structure, a sloped frame is as easy and straightforward to install as a vertical frame. However, if there is any roof slope, there are some important considerations that will affect the design, engineering and installation.

In Figure 11 you can see that if the exact same frame, with the Base Supports in a straight line, is at different roof elevations, the face of the screen won't be in plane. The frame at the lower roof elevation must be adjusted forward and the frame must be made taller to allow the face of the screen to be in plane.



**FIGURE 11**

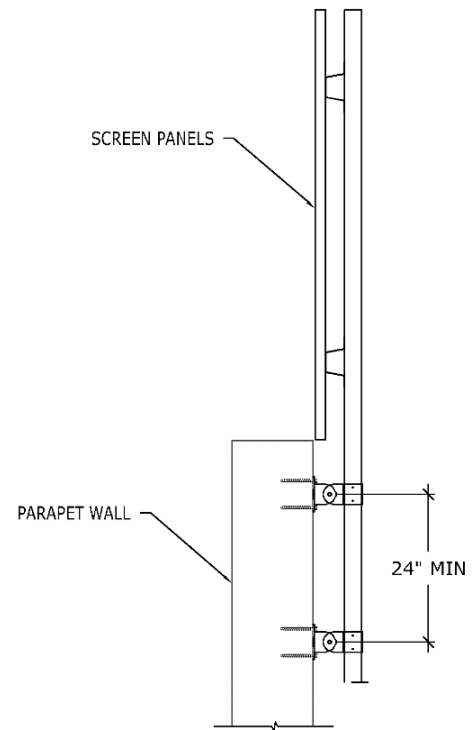
In Figure 12, the frame at the lower roof elevation has been adjusted forward and made taller, putting the face of the screen in plane. Adjusting the frame forward increased the front cantilever (the distance the horizontal tube extends past the front Base Support). This is a critical dimension because it is the weakest part of the frame. As a general rule, if the roof slope is less than 4 inches from the highest elevation to the lowest, no special engineering will be needed and the standard adjustability of the frame will be sufficient. However, if there is more than 4" in elevation change, the excessive front cantilever will weaken the frames to the extent that the frames would need to be closer on center, or customized to make them stronger.

**FIGURE 12**

**WALL MOUNT FRAME:** This simple frame as shown in Figure 13 is an inexpensive way to conceal rooftop equipment that doesn't extend very high above the parapet wall.

Here are several things to consider for a wall mount frame:

- Wall Mount Frames can be mounted on the interior of a parapet wall or on the exterior of a building.
- The parapet wall must be very strong such as concrete or structural steel. Wood or metal stud framed walls seldom have the strength to withstand the additional wind load imposed by the screen.
- The parapet wall must extend high enough above the roof deck to mount the brackets at least 24" apart for it to have adequate strength. Less than 24" between brackets may be possible if the wind load is low and the screen is very short.
- Increasing the distance between the top and bottom brackets will increase the strength and allow the frame to be taller or farther on center. Of course, this requires taller parapet walls.
- RoofScreen offers both standard Surface Mount brackets and special watertight brackets with integral flashing for walls where waterproofing is a concern.



**FIGURE 13**

## SCREEN HEIGHT

When discussing how tall the RoofScreen will be, there is an important distinction between the height of the frames and the height of the panels.

**FRAME HEIGHT:** The frame height is a very critical parameter in the design and engineering of a RoofScreen system. It is also where the most common and costly mistakes are made during the design process. First, it is important to understand our definition of the term. Frame height is the distance from the roof deck (bottom of Base Support) to the top of the RoofScreen. That's fairly straightforward, but when the roof structure has a slope, the question of frame height gets a bit more complicated.

Sloped roofs will have varying Frame Heights. Since the top of the screen is typically at a consistent elevation, the tallest frame on the project is where the roof slope is at its lowest point. The frame design will always be based on the tallest frame since it would be considered the worst case for wind loading and engineering.

A common mistake made is not taking the roof slope into account. For example, as shown in the scenario in Figure 14, one might mistakenly call for a RoofScreen height of 6'-8" since the tallest HVAC units are 6'-8".



However, if the Top of Screen Elevation is to stay consistent, the tallest frame will need to be 9'-8" at the lower end of the roof slope. A difference of 3ft in frame height can have a significant impact on the engineering and design of the frame.

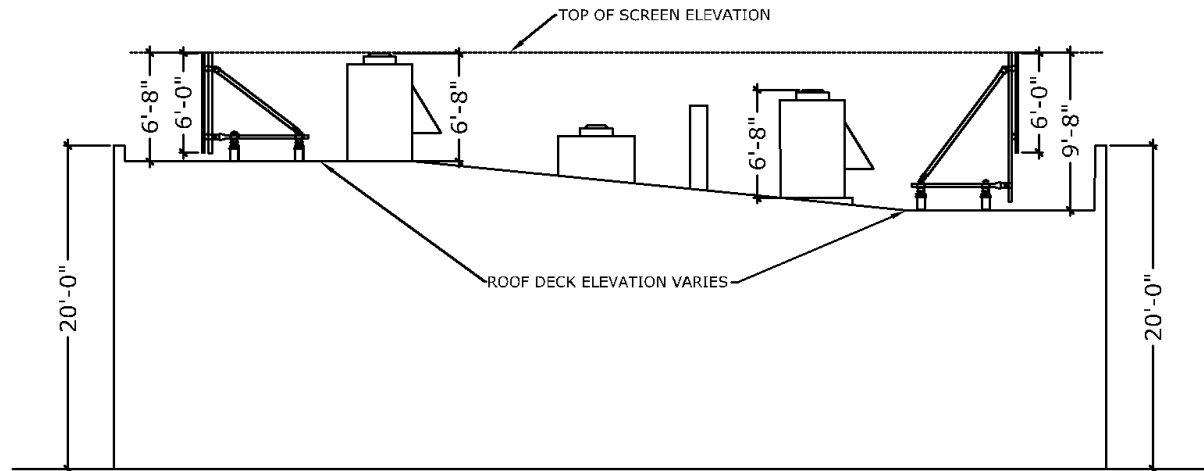


FIGURE 14

**PANEL HEIGHT:** The panel height is also a critical parameter in the design and engineering of a RoofScreen. All of the wind load on the frames, and ultimately transferred into the building structure, comes from panel surface area. Reducing the panel height is the best way to keep loads minimized.

On a typical RoofScreen project the top of the panel will be at a constant elevation. This provides the most aesthetically pleasing effect when viewing the building from the ground. Figure 14 above illustrates a typical perimeter screen concealing multiple rooftop units. Since the screen goes all the way around the perimeter of the equipment, the top of the screen should be at a consistent elevation. However, if the screen was not a continuous wall, and was broken into multiple separate RoofScreens, they could be built to different Top-of-Screen Elevations if desired.

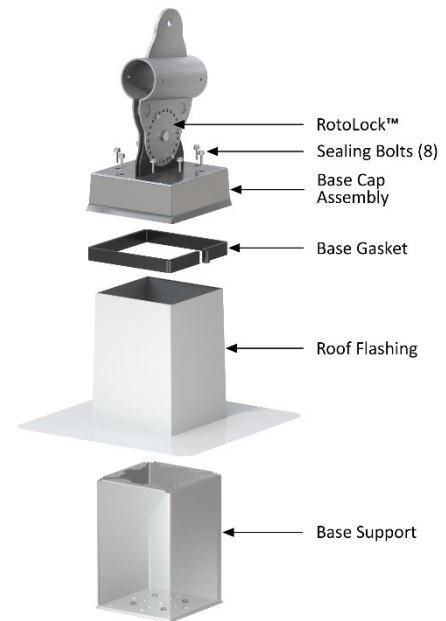
For the bottom of the panel, we recommend leaving a minimum 4" to 6" gap between the panels and the roof deck. This allows water to flow freely under the screen, and prevents buildup of leaves and other debris on the roof. However, panels do not always have to go all the way down. For example, in Figure 14 above, the 6ft tall panel will work fine all the way around since the parapet wall is taller near the lower end of the roof slope. Typically, keeping the bottom of the panel even with the top of the parapet will be sufficient. However, sometimes there is a good reason to run the panels down as low as possible, for example, when there is an adjacent tall building with windows where people could see under the screen.

## ROOF ATTACHMENTS

The RoofScreen system is adaptable to any type of roof structure. In most cases, Base Supports can be installed directly into structural members from above without going inside the building. Occasionally, extra blocking or through-bolts are required.

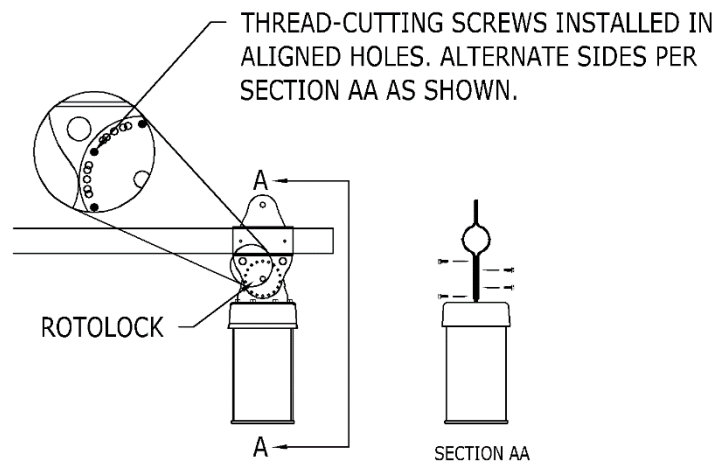
**SQUARE BASE WITH ROTOLOCK:** Our standard attachment system (Figure 15) is designed to mount to various types of roof structures and adjust to the roof pitch with our RotoLock™ feature. The inside bottom plates of the Base Supports have pre-punched holes to accommodate different types of fasteners for wood, steel and concrete.

The system is designed so that the flashing boot can be roofed-in according to industry best practices for roofing, and counter-flashed by the Base Cap Assembly.



**FIGURE 15**

The Base Cap Assembly with RotoLock™ is mounted on top of the RoofScreen Base Support. After adjustment for roof pitch during installation, thread-cutting screws are installed into pre-aligned holes as shown in Figure 16. The quantity of screws required is determined during engineering based on the moment resisting capacity needed (typically 3-6).



**FIGURE 16**

Base Assemblies with RotoLock™ are designed to be used in pairs, connected by our rigid structural tubing as illustrated in Figure 17. When a load is applied to the pair of assemblies connected by rigid tubing, the RotoLocks absorb the torque that would otherwise be transferred into the roof structure.

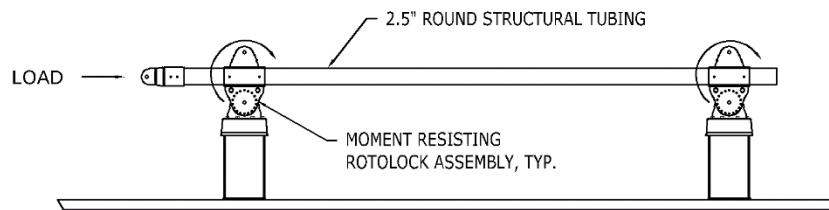


FIGURE 17

**ROUND POST SUPPORT:** The Round Post Support attachment is an option when the moment-resisting RotoLock™ is not required (see Figure 18). This attachment type generally introduces more torque into the roof structure, therefore is best suited for heavy-duty structural members that can resist moment loads (e.g. concrete, steel beams, large wood beams).

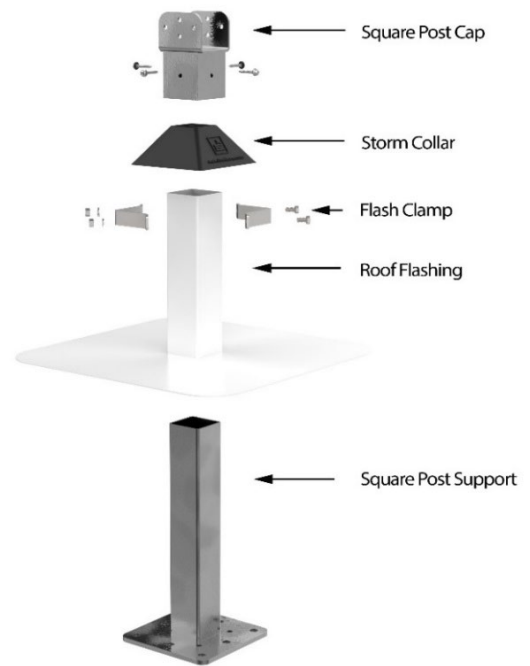
This adjustable-height system consists of a 12" tall Round Post Support that is fastened to the roof structure with fasteners appropriate for the type of substrate being used. An additional Tube Sleeve is installed over the Post Support to allow increased height and adjustability. The Post Cap slips directly over the Sleeve and fastens with sealing Tek Screws. The flashing extends above the connection joint between the Post Support and Sleeve, and is sealed to the Sleeve with a Draw Band & sealant. A neoprene Storm Collar is recommended for added waterproofing.



FIGURE 18

**SQUARE POST SUPPORT:** The Square Post Support attachment is an option when the moment-resisting RotoLock™ is not required (see Figure 19). This attachment type generally introduces more torque into the roof structure, therefore is best suited for heavy-duty structural members that can resist moment loads (e.g. concrete, steel beams, large wood beams).

This system consists of a 12" tall Square Post Support that is fastened to the roof structure with fasteners appropriate for the type of substrate being used. The flashing is sealed to the post with a Square FlashClamp & sealant. A neoprene Storm Collar is recommended for added waterproofing. The Square Post Cap slips directly onto the Post and fastens with sealing Tek Screws.

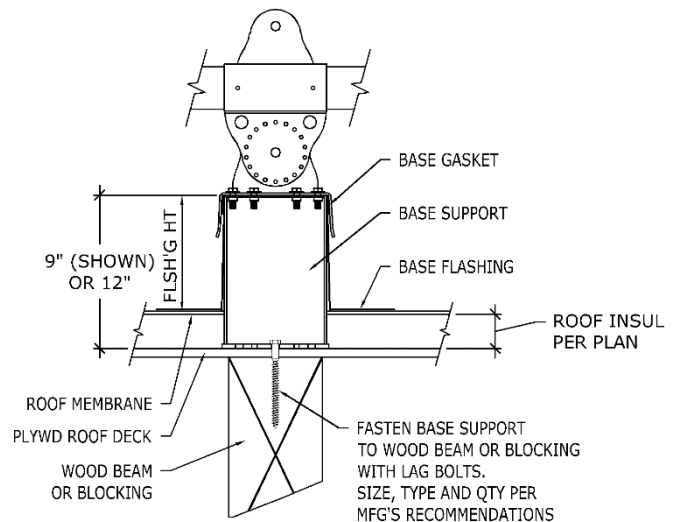


**FIGURE 19**

The following is a list of common attachment types. For illustration purposes, we are showing our Square Base Supports (Figures 20-24). Round Post Supports will use similar methods:

**WOOD FRAMING:** For wood construction, Base Supports are typically mounted on top of the plywood decking, and attached with 3/8" Lag Screws into minimum 4x wood members below. Wood members must also be deep enough for the lag screws to have adequate embedment, which is something that must be calculated by an engineer. Due to the tendency of wood to split, the fasteners should be aligned on the centerline of the member.

2x wood joists, 2x trusses and engineered I-Joists are not wide enough or thick enough for proper attachment. In these cases, we recommend adding 4x wood blocking at the Base Support attachment locations. It is also not recommended to stack 2x wood members flat to gain thickness, because lag screws do not perform as well in multiple layers of wood.



**FIGURE 20**

**OPEN WEB STEEL JOISTS (OWSJ):** For attaching to OWSJ's, Base Supports are typically mounted on top of the metal decking, and attached with (4) Self-Drilling Tek Screws into the steel angles that make up the top chord of the joist below.

Tek Screws are very strong and quite adequate for most applications with steel top chords ranging from  $\frac{1}{4}$ " to  $\frac{1}{2}$ " thick. However, it is also possible to use through-bolts aligned with the gap between the angles of the top chord. Another alternate method is to remove the metal decking and weld the Base Supports directly to the steel top chords.

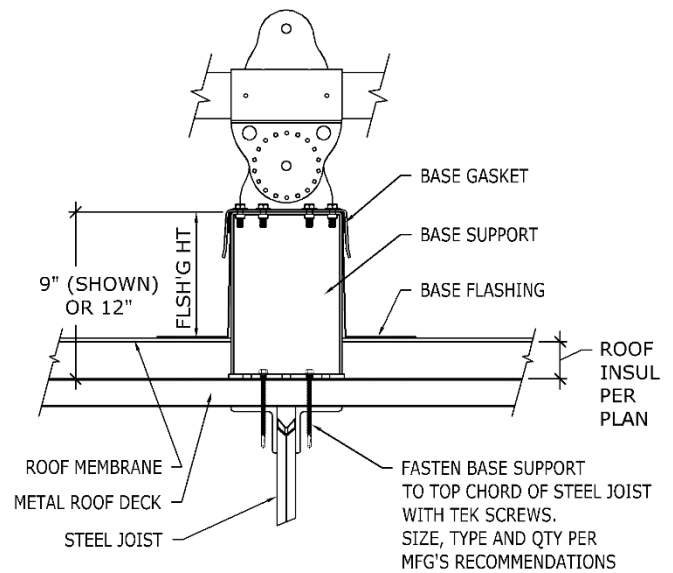


FIGURE 21

**STEEL I-BEAM (WFB):** For attaching to WFB's, Base Supports are typically mounted on top of the metal decking, and attached with (4) Self-Drilling Tek Screws into the steel top flange of the beam. Tek Screws are very strong and quite adequate for most applications, but are limited to a maximum of  $\frac{5}{8}$ " thickness. However, if the top flange is over  $\frac{5}{8}$ " thick, or if otherwise desired, it is also possible to drill out the top flange and use through-bolts, or remove metal decking and weld the Base Supports directly to the beam.

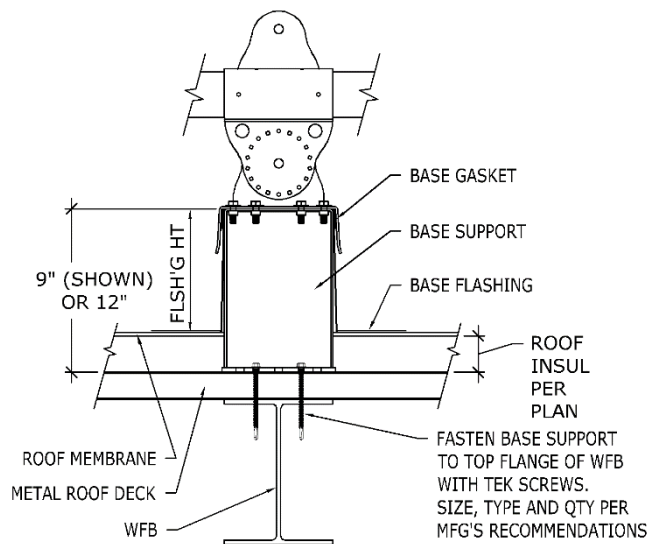
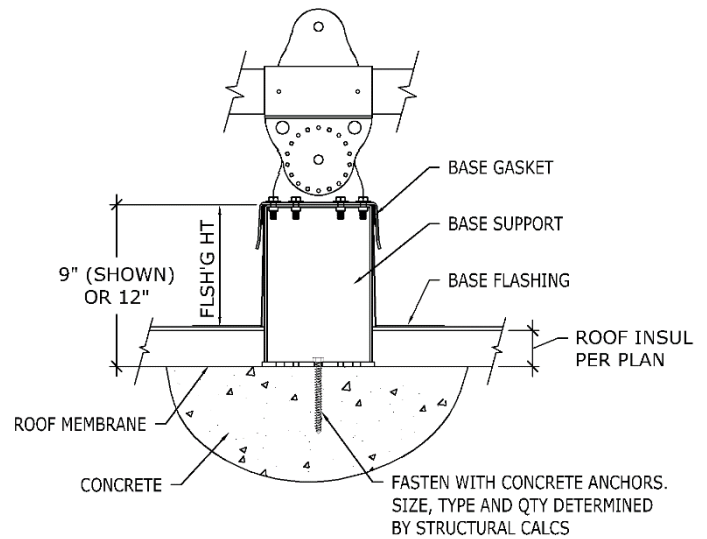


FIGURE 22

**STRUCTURAL CONCRETE SLAB:** For attaching to concrete slabs, Base Supports are typically attached with concrete expansion anchors. One important note is that the concrete anchors require the slab thickness to be 4" minimum.

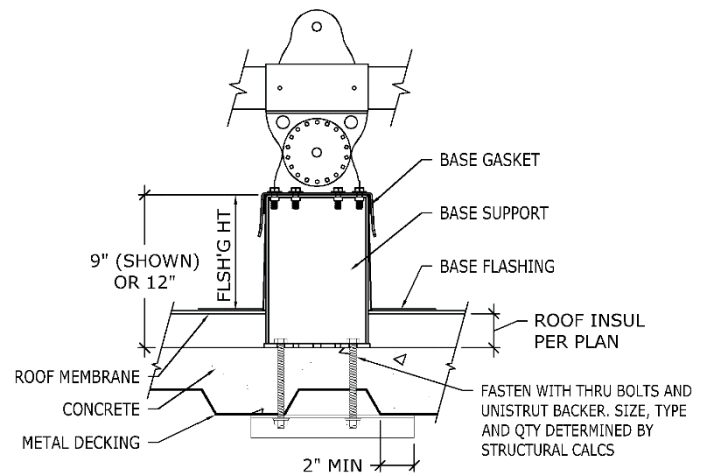
If the slab thickness is less than 4", or if it is otherwise desired, it is also possible to drill out the concrete and use through-bolts. If through-bolts are used it is recommended to use plate washers on the underside.



**FIGURE 23**

**STRUCTURAL CONCRETE OVER METAL DECKING (COMPOSITE):** For attaching to composite roof decks, the Base Supports are typically through-bolted with a Unistrut backer plate underneath.

It is unusual, but if the slab thickness is 4" or greater above the high flute of the metal decking, it is acceptable to use expansion anchors.



**FIGURE 24**



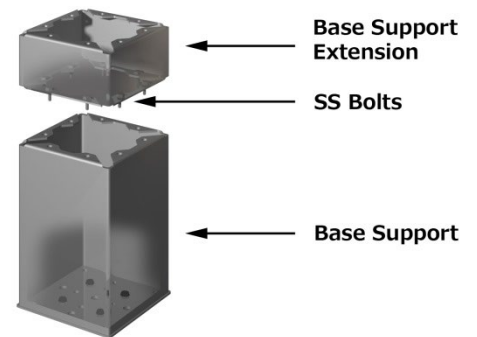
**DEALING WITH ROOF INSULATION AND FLASHING HEIGHTS:** RoofScreen Base Supports need to attach directly to the structural decking, so the rooftop insulation plays a big role in determining the correct combination of Base Support heights and, if required, Base Extensions to achieve the proper height above the insulation.

It is common in the roofing industry to adhere to the rule that any roof penetration should be constructed so the roofing and roof flashing can extend up at least 8" above the roof surface. This standard was set many years ago, and is generally accepted as the best roofing practice. However, the 8" standard was adopted by the industry for penetrations with open, unsealed tops that would not prevent water from entering. The RoofScreen Roof Attachment system is different. The EPDM rubber gasket applied at the top of the flashing is compressed against the flashing by the watertight Base Cap during installation, creating a seal preventing water, ice and snow from entering.

RoofScreen Mfg. performed successful independent lab testing on the Roof Attachment System with only a 3" flashing height, and had no leaks. Copies of the test report are available upon request. RoofScreen has also successfully negotiated the relaxation of the 8" standard with multiple brand name roofing materials manufacturers.

The decision on the height of the flashing above the roof membrane ultimately falls on the roofing contractor and the roofing material manufacturer. RoofScreen highly recommends consulting both, and obtaining approval in writing for anything less than 8", especially if a roof warranty is involved.

By using the appropriate Base Supports, combined when necessary with Base Extensions (see Figure 25), most insulation thicknesses can be accommodated. One important note is frames become weaker and require closer on-center spacing as the Base Supports get taller, so it is advisable to keep the insulation thickness minimized if possible in the areas where the RoofScreen frames will be located.



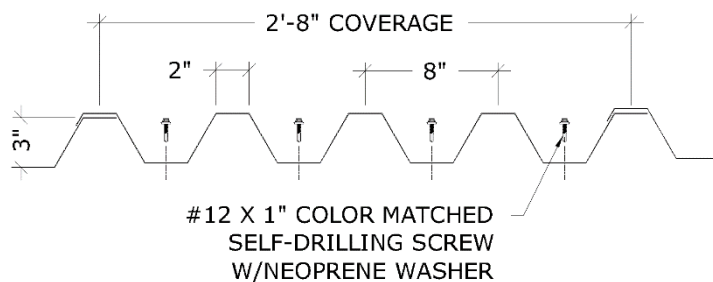
**FIGURE 25**

**ROOF FLASHING:** RoofScreen offers specially fitted flashing boots for all types of roofing materials. Please contact us for more information. Please also view our Flashings Product Data Sheet here: [RoofScreen Flashing PDS.pdf](#)

## PANELS AND TRIMS

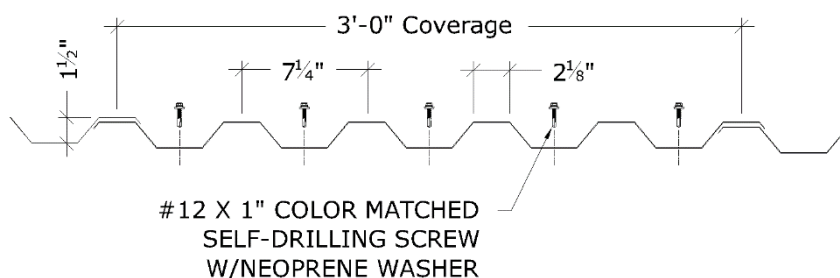
In this section we will detail some of the technical aspects of the standard panels we offer. We will also discuss the differences between vertical and horizontal panel orientation, and detail the methods for mounting them to the frames.

**3" DEEP RIB:** This panel is the best choice for horizontal applications with high wind pressures. The 3" deep profile gives it a greater spanning capability than any of our other standard panels.



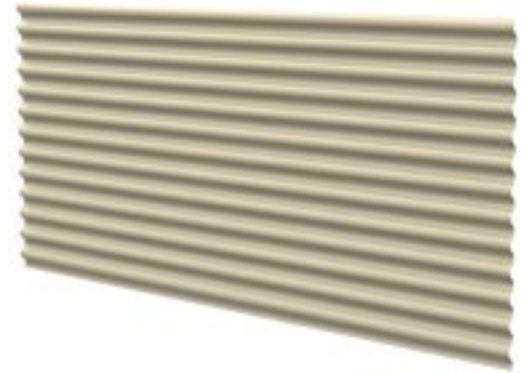
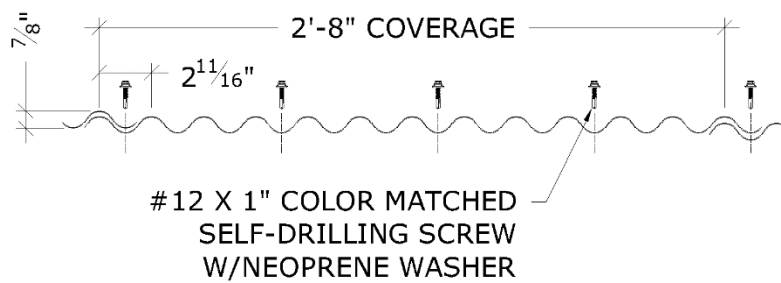
- **Material:** 24ga steel standard. Other gauges may be available.
- **Finish:** Factory applied Kynar.
- **Colors:** Choose from standard color chart.
- **Installation:** Orient vertical or horizontal. Fasten with color matched exposed fasteners.

**7.2 RIB:** Due to its 1 1/2" deep profile, the 7.2 Rib Panel has excellent spanning capabilities, making it an economical choice with a high strength to cost ratio.



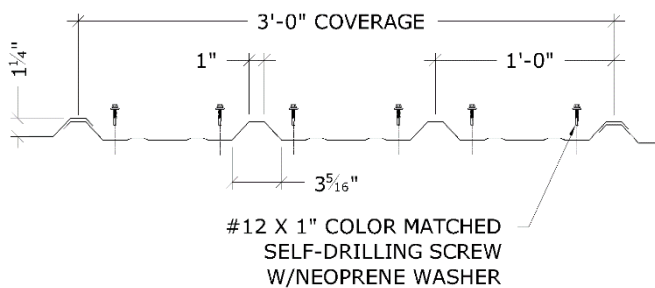
- **Material:** 24ga steel standard. Other gauges may be available.
- **Finish:** Factory applied Kynar.
- **Colors:** Choose from standard color chart.
- **Installation:** Orient vertical or horizontal. Fasten with color matched exposed fasteners.

**CORRUGATED:** Due to its shallow profile, the Corrugated Panel has limited spanning capabilities, but is an excellent and economical choice for horizontal and vertical applications where the supports are closer together.



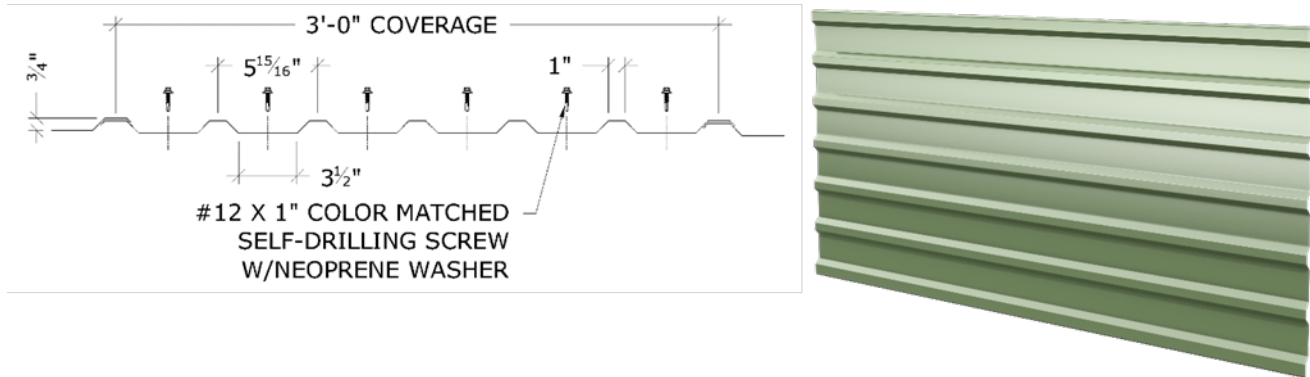
- **Material:** 24ga steel standard. Other gauges may be available.
- **Finish:** Factory applied Kynar.
- **Colors:** Choose from standard color chart.
- **Installation:** Orient vertical or horizontal. Fasten with color matched exposed fasteners.

**R PANEL:** Due to its shallow profile, the R Panel has limited spanning capabilities, but is an excellent and economical choice for horizontal and vertical applications where the supports are closer together.



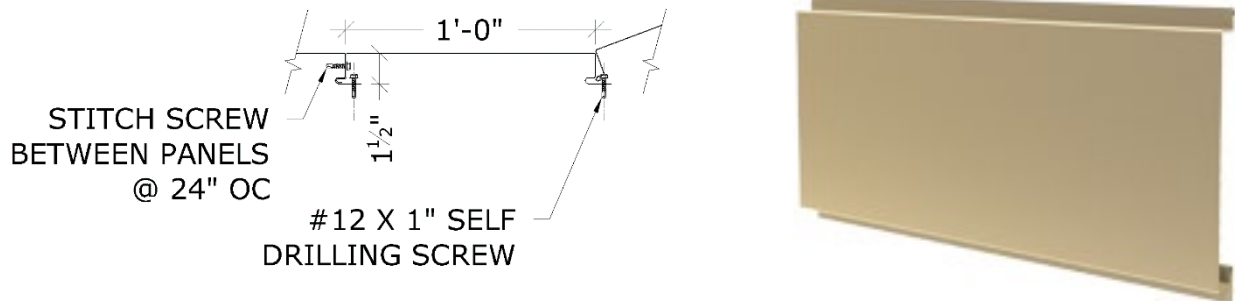
- **Material:** 24ga steel standard. Other gauges may be available.
- **Finish:** Factory applied Kynar.
- **Colors:** Choose from standard color chart.
- **Installation:** Orient vertical or horizontal. Fasten with color matched exposed fasteners.

**U PANEL:** This inexpensive panel is an excellent choice for vertical applications. Because of the shallow profile it is not capable of spanning long distances, so it is not typically used horizontally unless the frames are spaced close together.



- **Material:** 24ga steel standard. Other gauges may be available.
- **Finish:** Factory applied Kynar.
- **Colors:** Choose from standard color chart.
- **Installation:** Orient vertical or horizontal. Color matched exposed fasteners.

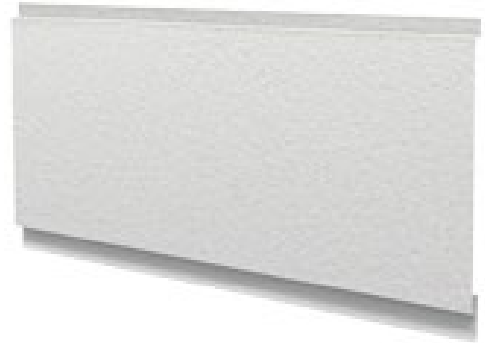
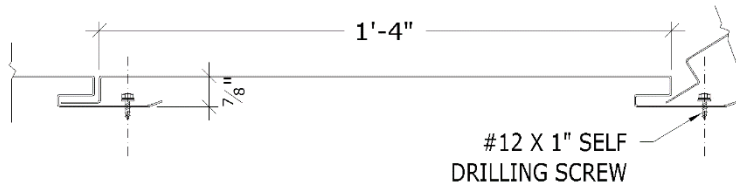
**FLUSH:** For a high-quality look with minimal shadow lines, the flush panel is an excellent choice. The finish is smooth and the panels lock together with the fasteners concealed in the laps.



"Oil-canning", a slight rippling effect due to expansion and contraction, is an inherent property of flat metal products, and is not a cause for rejection. Non-ribbed style panels are particularly vulnerable to oil-canning. For more information, please see our technical bulletin here: [RoofScreen Oil-Canning Bulletin.pdf](#).

- **Material:** 24ga steel standard. Other gauges may be available.
- **Finish:** Factory applied Kynar.
- **Colors:** Choose from standard color chart.
- **Installation:** Lock together with concealed fasteners. Designed primarily for vertical applications. If used horizontally, special precautions must be used to minimize oil-canning. Contact our sales team for more information.

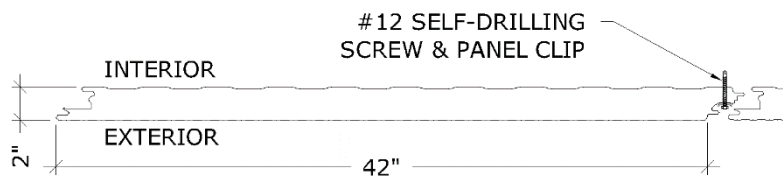
**FLUSH TEXTURED:** Textured panels provide a much softer look that blends well with stucco or concrete buildings. This is a locking panel with concealed fasteners.



“Oil-canning”, a slight rippling effect due to expansion and contraction, is an inherent property of flat metal products, and is not a cause for rejection. Flush Textured panels are less vulnerable; however, oil-canning can occur on any non-ribbed style of panel. For more information, please see our technical bulletin here: [RoofScreen Oil-Canning Bulletin.pdf](#).

- **Material:** 20ga steel.
- **Finish:** Factory applied textured paint.
- **Colors:** Choose from standard color chart or Custom match to any color (no additional cost).
- **Installation:** Lock together with concealed fasteners. Designed primarily for vertical applications. If used horizontally, special precautions must be used to minimize oil-canning. Contact our sales team for more information.

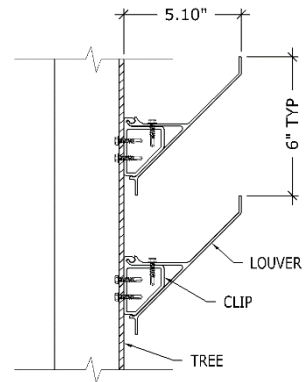
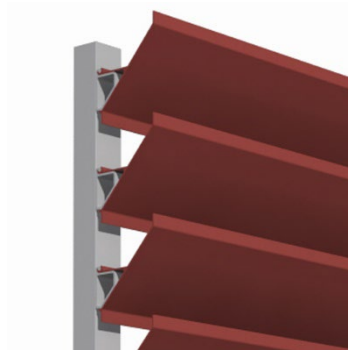
**FOAM CORE:** The foam core panel is foam insulation sandwiched between 2 layers of metal. It provides a large flat panel that has excellent spanning capabilities and it won't oil can.



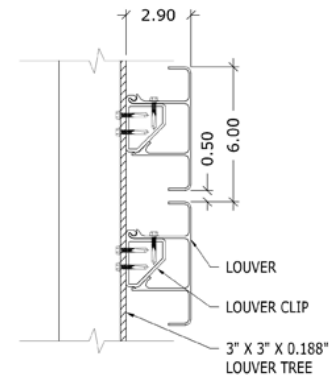
- **Material:** 24ga steel standard, smooth or Stucco Embossed.
- **Finish:** Factory applied smooth Kynar paint or optional textured finish.
- **Colors:** Choose from standard color chart.
- **Installation:** Lock together with concealed fasteners. Designed primarily for vertical applications. If used horizontally, the panels will not lap end to end, so special backing plates and trim covers must be used.

**LOUVERS:** RoofScreen offers three styles of continuous blade aluminum louvers. Louvered systems can provide a dramatic architectural look as well as allow plenty of air flow when the screen is close to HVAC equipment.

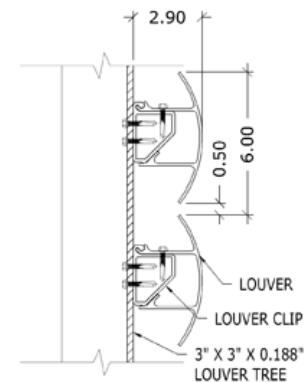
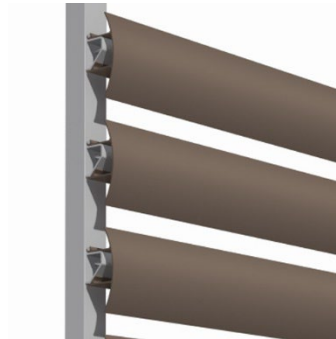
**Angled  
Louver**



**Slatted  
Louver**



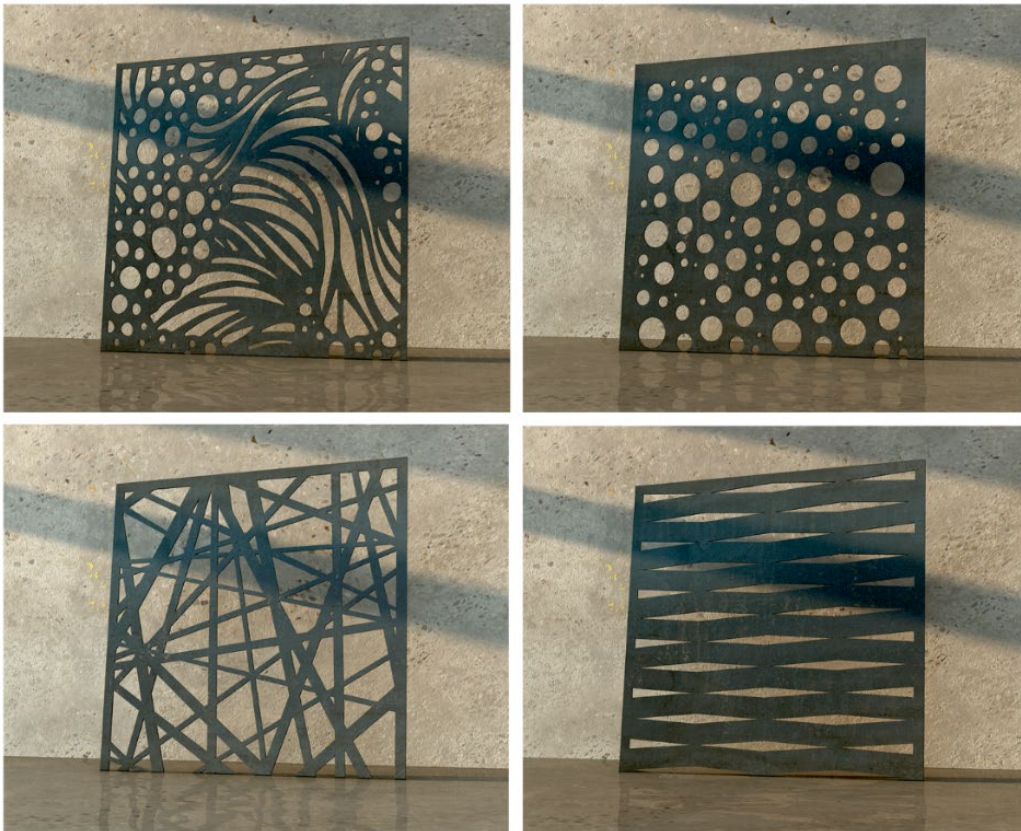
**Curved  
Louver**



- **Material:** .100" thick 6063 T6 extruded aluminum.
- **Finish:** Paint finish meeting AAMA 2605
- **Colors:** Choose from standard color chart. Custom colors available. Woodgrain finishes available.
- **Installation:** Continuous blades lock and snap into specially designed Clips and Trees. Installation may be vertical or horizontal. Corners and end conditions may be covered with color matched trim. Welded mitered corners are available upon request.



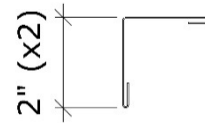
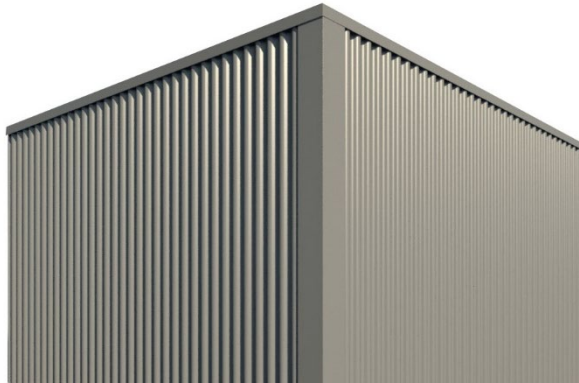
**DECORATIVE METAL:** RoofScreen offers Decorative Metal Panels to be utilized in a variety of ways. From equipment screen paneling to ornate facades, these laser-cut panels can add an intricate blend of artistry and refinement to any project. Panels come in several materials ranging from 1/8" – 1/4" to suit a wide range of applications. Choose from our Standard Patterns available on our website, or contact us to create a custom design.



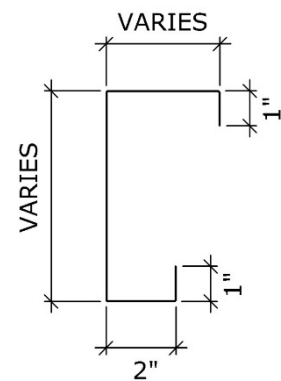
- **Material:** Aluminum; Stainless Steel (Brushed or 2B); Corten Steel.
- **Fasteners:** Exposed fasteners, color matched to panel; Counter Sunk fasteners, color matched to panel.
- **Finish:** Powder Coat finishes meeting AAMA 2604 or 2605.
- **Colors:** Choose from our Decorative Metal color chart.
- **Patterns:** Choose from our Pattern Chart or contact us for custom designs.

TRIMS: RoofScreen offers various standard trim options as shown. We can also customize the trims to meet specific requirements or styles.

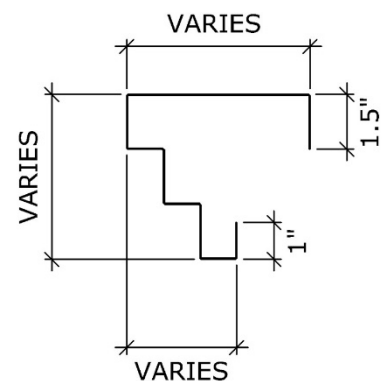
**Standard  
Trim**



**Box  
Trim**



**Stepped  
Trim**



**PANEL ORIENTATION:** Panels can be mounted vertically or horizontally on RoofScreen Frames. The panel orientation is not only an aesthetic choice; it also has some important design implications.

- Vertical panels as shown in the photos to the right are mounted to horizontal members, typically Hat Sections, which span from frame to frame. The Hat Sections are very strong and allow a greater distance between frames to be achieved compared to horizontally mounted panels. In vertical orientations, the panels only need to span between the Hat Sections, which is typically not a great distance. For this reason, many of the weaker style panels can be used vertically.

Depending on the height of the panels and wind loads for the project, the frame spacing when using vertical panels can range from around 4' all the way up to 20' O.C.



- When mounting the panels horizontally as shown in the photos to the right, Hat Sections are not used and the panels span the distance from frame to frame. This means the panels must be strong enough to resist the wind pressure for the full distance between frames.

Many of the lower profile panels can only span about 5' to 6' even at relatively low wind pressures, so they are usually not good choices for horizontal panels. The deeper ribbed styles like the 7.2 Rib and 3" Deep Rib panels can work with frame spacing up to about 10' or 12' at the lower wind pressures.



## ROOF LAYOUT

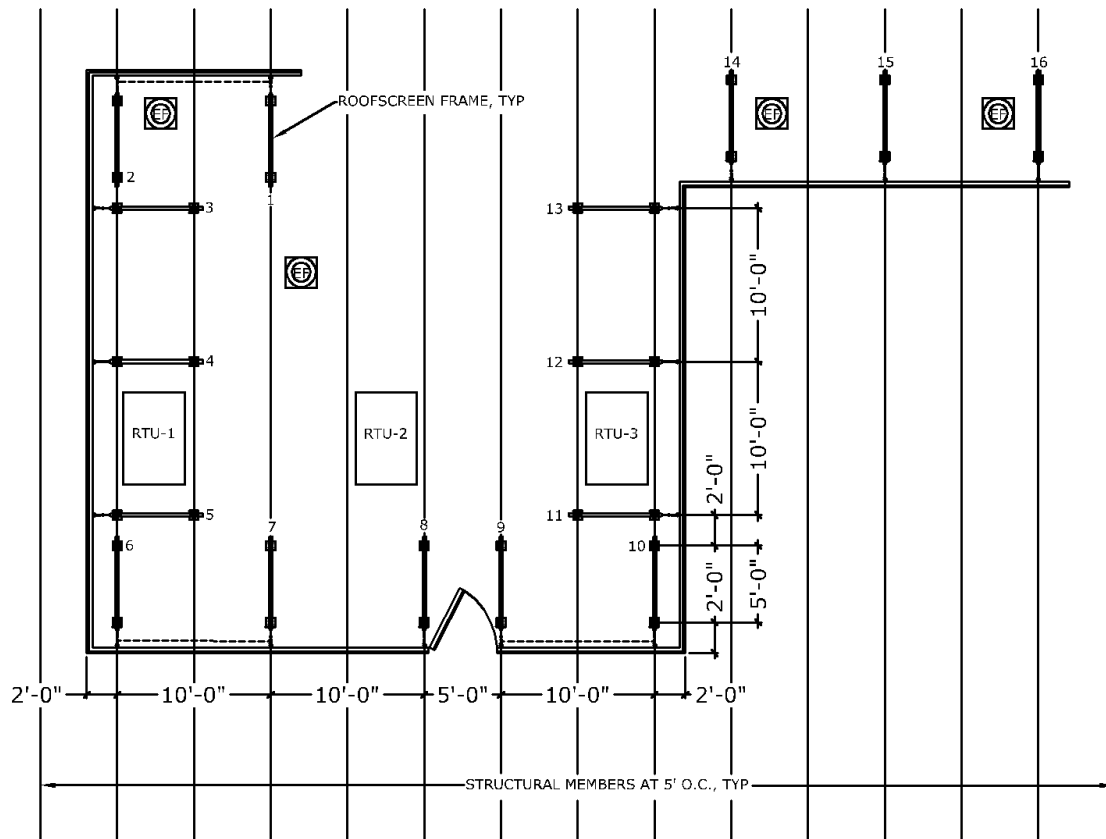
In order to lay out the RoofScreen you must first know the type of frame to be used, its maximum allowed spacing, and its minimum/maximum span. Our design team is happy to help you choose the most appropriate frame configuration or review your layout. Our design team can be contacted at 831-421-9230.

**ROOF STRUCTURE:** Once the frame spacing and span are determined the next step is to look at the roof structure. Decking of any type is seldom strong enough to resist the point loads from a RoofScreen, so the Base Supports must mount to something structural. Here are some common types of roof structures and how the RoofScreen layout will be affected by each:

- **Wood Framing (4x min):** Wood framing members that are at least 3 ½" wide are large enough for the Base Supports to be fastened with lag screws. Wood members must also be deep enough for the lag screws to have adequate embedment, which is something that must be calculated by an engineer. Plywood decking is never strong enough to resist the point loads, so the frames must be located over the wood beams, or additional wood blocking between beams may be added if required. For more information and detail view, please see *Wood Framing* in the Roof Attachment section on page 16.
- **WOOD FRAMING (2x):** 2x wood members (e.g., joists, trusses, TJI's, etc.) are not wide or thick enough to support and fasten the 6" square Base Supports. Therefore, additional 4x blocking should be added at the Base Support locations. For the layout, this means the frames may be located just about anywhere on the roof and the blocking can be placed accordingly. For more information and detail view, please see *Wood Framing* in the Roof Attachment section on page 16.
- **Steel Framing:** Steel framing members such as wide flange beams or open web joists are usually wide enough and thick enough to adequately attach the Base Supports with Tek Screws or through-bolts. These types of framing members are typically used in combination with metal decking, but since the decking is seldom, if ever, strong enough to resist the point loads, the frames must be located over the steel members. Additional steel members (blocking) may be added if required. For more information and detail view, please see *Open Web Steel Joists*, or *Steel I-Beam* in the Roof Attachment section on pages 16 - 18.
- **Concrete Slab:** When the structure is concrete slab, the Base Supports can mount anywhere so the layout becomes fairly easy. For more information and detail view, please see *Structural Concrete Slab* in the Roof Attachment section on page 18.
- **Composite:** When the structure has a composite deck (concrete over metal decking) there is a higher likelihood the deck can handle the point loads between support members. However, if the decking span is large and the point loads from the RoofScreen are high, it may be necessary to locate the frames over, or near, the structural members below. For more information and detail view, please see *Composite* in the Roof Attachment section on page 18.

**FRAME SPACING:** For any situation where the RoofScreen frames will be mounted to structural members, the maximum frame spacing becomes a very important factor. For example, if the structural members are spaced at 5' O.C., the RoofScreen frames can be 5', 10' or 15' on center. But if the frame being used has a maximum on-center spacing capacity of 8', the only choices are to put the frames at 5' O.C. or to add blocking to provide attachment points every 8'.

Figure 26 shows an example layout with structural members at 5' O.C. The assumed RoofScreen frames have a maximum spacing limitation of 11' so they have been placed every other joist at 10' O.C. when possible.



**FIGURE 26**

**SPAN:** The distance between the front and rear Base Support (Span) on each RoofScreen frame should also match the spacing of the structural members so when the frames are mounted perpendicular to the roof framing, the Base Supports will still land on a structural member. In the example in Figure 26, the span is set to 5' to match the spacing of the joists. On frames 1-2, 6-10 and 14-16, the span could be shortened if the frames have that capability.



**CANTILEVER:** The most common type of RoofScreen frame includes a front cantilever. Please see the section titled *Frame Types* on page 8 for more information. When laying out a project with cantilevered frames, keep in mind that the face of the screen will be a certain distance away from the front Base Supports. The typical dimension for the cantilever is 16" from the center of the Base Support to the center of the vertical tube. Add the depth of the horizontal girts plus the panel depth for the distance to the face of the screen. In the example in Figure 26, the cantilever is 2'-0" to the face of the screen.

**OUTSIDE CORNER LAYOUT:** It is important to lay out a RoofScreen corner correctly so it can resist wind loads in both directions. Referring to Figure 27, notice frame 6 is on the structural member closest to the corner. On the opposite side, frame 5 should be placed as close to the corner as possible but still maintain at least 2' space between Base Supports to allow for proper roofing. To help resist wind loading, each outside corner also requires a Lateral Brace. The brace connects from the high end of the vertical tube on the frame closest to the corner, and connects to the low end of the vertical tube on the adjacent frame. See Figures 27 and 28.

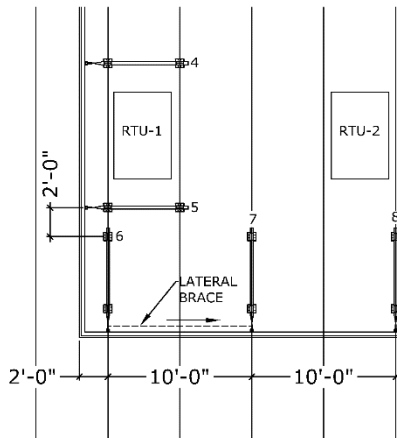


FIGURE 27

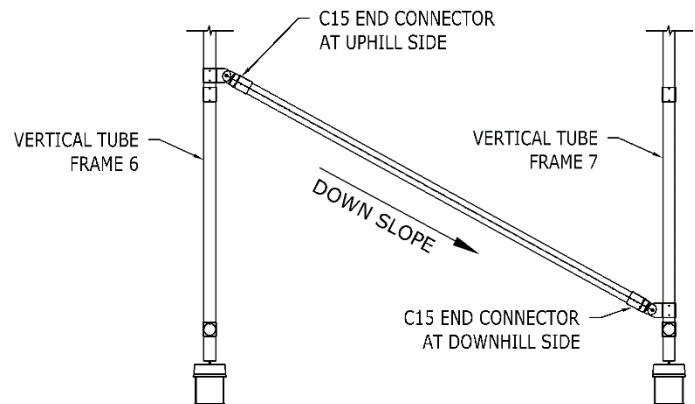


FIGURE 28

**INSIDE CORNER LAYOUT:** A typical corner layout for an inside corner is shown in Figure 29. One frame must be placed within 2' of the corner (frame 13 in the example). The next frame on the opposite side (frame 14) should be placed as close as possible to the corner. Due to the layout of the structural members in the roof, it may be difficult to get the frame close to the corner. The sum of the distance from each frame (13 and 14) to the corner cannot exceed the maximum frame spacing capacity for the frame being used. In the example, the frames are engineered for 10' O.C. and the sum of the distances to the corner for frames 13 and 14 totals 5'-4", so the frames are well within the required distances.

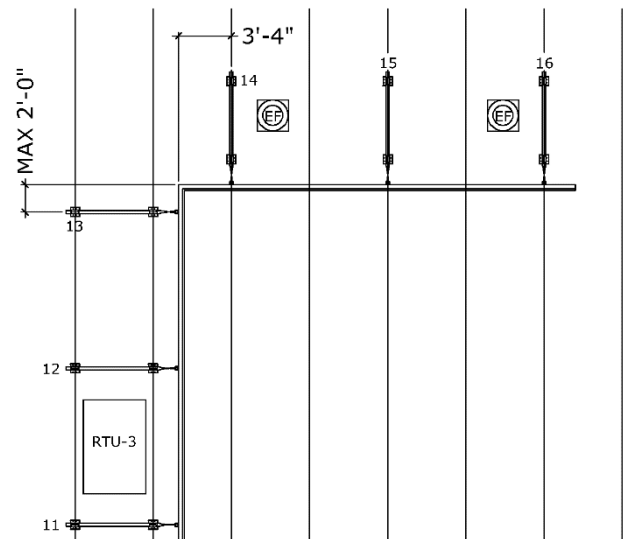
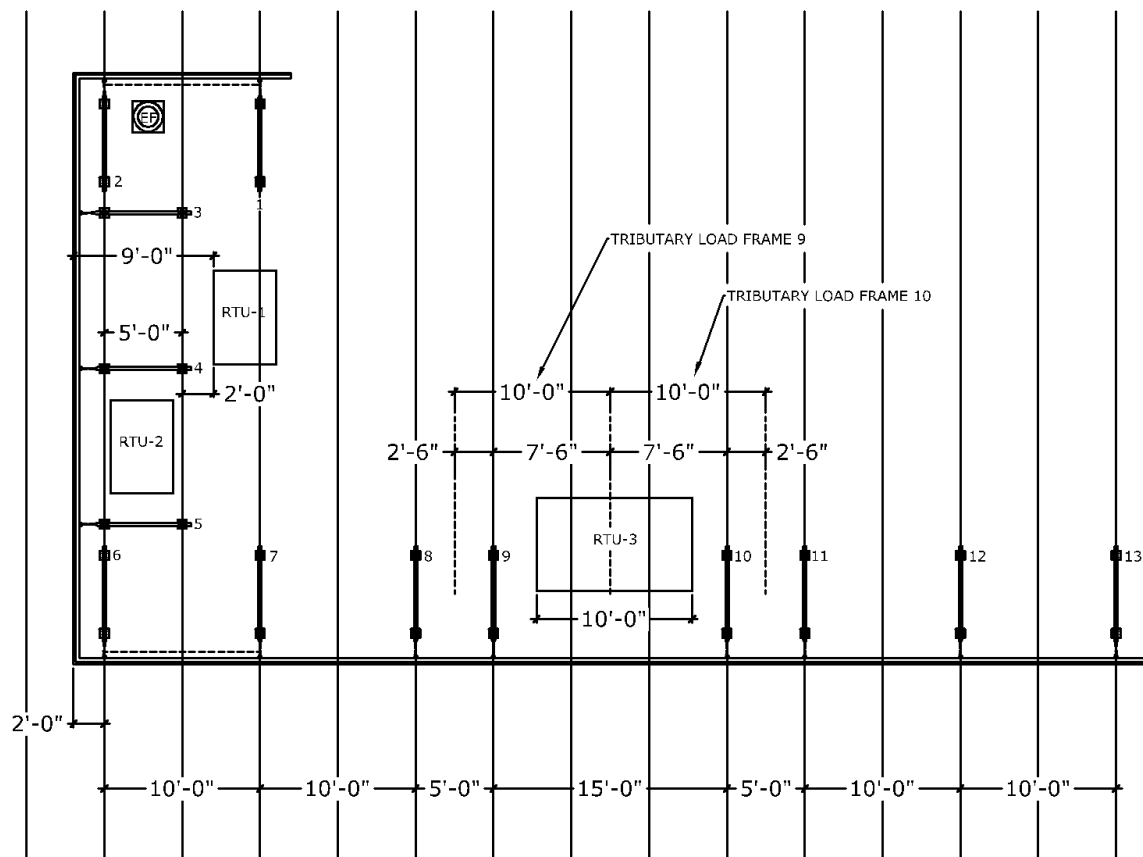


FIGURE 29



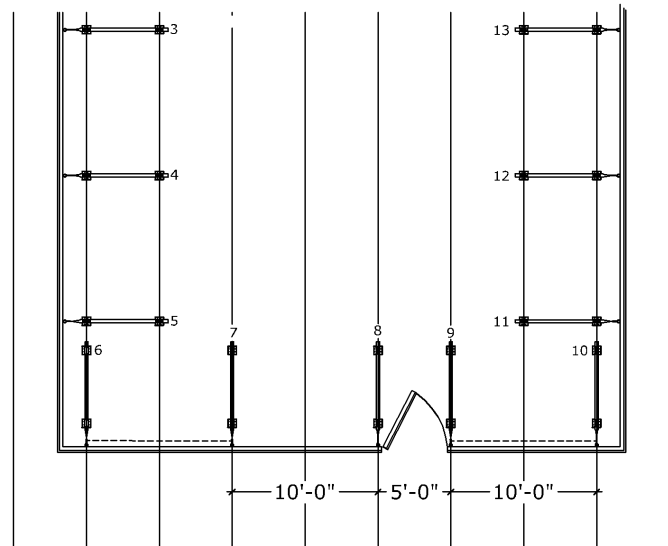
**DEALING WITH ROOF EQUIPMENT:** When laying out the frames around rooftop equipment, it's important to leave enough room for the frames, the front cantilever, and room to walk around and service the units. In the example in Figure 30, see the clearances around frame 4 and RTU-1. The frames have a span of 5' and cantilever of about 2'. Leaving another 2' clearance around the units, the total distance from the face of the screen to the roof top unit is about 9'. It is possible to straddle the units (see RTU-2 between frames 4 & 5) when the frame spacing is far enough on center. When placing frames close to rooftop equipment, be careful not to interfere with service access doors on the equipment. It is advisable to check with the HVAC contractor and local codes for minimum clearance required by code, but a good rule of thumb is 30".



**FIGURE 30**

In a situation where the rooftop equipment is too large to fit between the frames at the maximum on-center frame spacing, it is possible to allow larger spacing if the tributary load on each frame does not increase beyond the maximum spacing value. For example, see RTU-3 in Figure 30. The unit is 10' wide and the frames are engineered for a maximum spacing of 10'. So the space between frames 9 and 10 can be increased to 15' by putting extra frames only 5' away on either side (frames 8 and 11) because the tributary load on frames 9 and 10 are still 10'. For each frame, tributary load is calculated by adding half the distance to both adjacent frames.

**ACCESS GATES:** The RoofScreen Gate Kit is designed for a maximum width of 5' and requires frames to be located on each side for support. Gates must open towards the inside of the RoofScreen. Referring to Figure 31, the frames supporting the gate land on the joists that are spaced 5' apart, which is just right for the gate opening. If the joists were 10' O.C., the gate could not be installed on this side of the screen without adding blocking to support the extra frame. When this happens, it is usually better to locate the frame on the side of the screen where the frames are perpendicular to the joists, so the frames can be located at any distance necessary.



**FIGURE 31**

Another option for access is to leave an opening in the screen instead of using a gate. This reduces cost and can sometimes simplify the layout. An opening can be any size desired as long as a frame is located within 2' of each end of the screen.

## SUMMARY

As you can see, there is a great deal that goes into a RoofScreen design. Our goal is to make it as easy for the designer/architect and installer as possible. We sincerely appreciate that you took the time to review this document and we hope that it proves to be helpful.

As always, we are happy to assist you in any way that we can to design and specify our product. Please do not hesitate to call us 831-421-9230.

## GLOSSARY

<u>BASE SUPPORTS:</u>	Formed steel stanchions that mount the RoofScreen System to the roof structure. They are 6"x 6" boxes with holes in the bottom for the attachment bolts to the structure. The Base Supports come in 8", 10", 12" and 14" tall sizes to accommodate different insulation thicknesses.
<u>CANTILEVER:</u>	On our type SC (standard cantilevered) frames, the vertical tubes and panels are extended out past the front Base Support. We refer to this as the frame's <i>cantilever</i> .
<u>CONNECTOR FITTINGS:</u>	Formed stainless steel parts used for connecting frame tubes together and anchoring to the structure.
<u>FRAMES:</u>	The assembly of Tubes and Connectors, typically in a triangular configuration, mounted on two Base Supports.
<u>FRAME HEIGHT:</u>	The distance from the roof deck (bottom of Base Support) to the top of the RoofScreen. Roofs with slope will have varying Frame Heights. Since the top of the screen is typically at a consistent elevation, the tallest frame on the project is where the roof slope is at its lowest point.
<u>FRAME SPACING:</u>	The distance from frame to frame.
<u>HATS AND GIRTS:</u>	G90 galvanized Hat Channels or Girts are typically used to span the distance from frame to frame and provide a mounting surface for louvers or vertical metal panels.
<u>HORIZONTAL PANELS:</u>	When the ribs or seams of the panels are oriented horizontally vs. mounted vertically.
<u>ORIENTATION:</u>	Refers to the direction the panels are mounted, whether oriented vertically or horizontally.
<u>PANELS:</u>	Refers to the facing or "skin" of the RoofScreen. RoofScreen Mfg. offers several standard types of steel panels with factory applied paints and textured coatings.
<u>PANEL HEIGHT:</u>	Not to be confused with Screen Height and Frame Height, this is the total height of the panel itself, regardless of how tall the screen and frames are.
<u>ROOF ATTACHMENTS:</u>	The assembly of parts making up the watertight, structural mounting point for the RoofScreen system to mount to a roof structure.
<u>ROOF FLASHING:</u>	Pre-fabricated boots which fit over the RoofScreen Base Supports and extend onto the roof surface for proper roofing and waterproofing.
<u>SCREEN HEIGHT:</u>	Not to be confused with Panel Height or Top-of-Screen Elevation, the Screen Height refers to the total height of the RoofScreen from the structural deck to the top of the screen. This is also the same as Frame Height.
<u>SPAN:</u>	The center to center distance from the front Base Support to the rear Base Support on any given frame.

<u>ROTOLOCK:</u>	This is the locking feature built into the patented RoofScreen Roof Attachment system that reduces the torque loads into a roof structure.
<u>TEK SCREW:</u>	A special type of Self-Drilling machine screw capable of fastening into steel up to ½" thick without pre-drilled pilot holes.
<u>TOP-OF-SCREEN ELEVATION:</u>	The distance from the average level of adjoining ground to the top of the RoofScreen. Often the <i>Finished Floor Elevation</i> is used as the datum point.
<u>TRIMS:</u>	To finish the raw edges of the RoofScreen, bent metal trim pieces are fabricated from the same material and finish as the panels, and installed on the edges and top of the screen.
<u>TUBING:</u>	1.5" and 2.5" round galvanized steel tubes are used as the main structural elements of the RoofScreen frames.
<u>VERTICAL PANELS:</u>	When the ribs or seams of the panels are oriented vertically vs. mounted horizontally.