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NON-PENETRATING ROOFTOP SUPPORTS FOR MEP & MAINTENANCE APPLICATIONS

Presented by Guy Guillermo, Unistrut Hawaii



This presentation will familiarize you with:

- ◆ engineered non-penetrating pipe and equipment support systems, construction methods and advantages in utilizing these systems
- ◆ the benefits of an engineered pipe and mechanical support



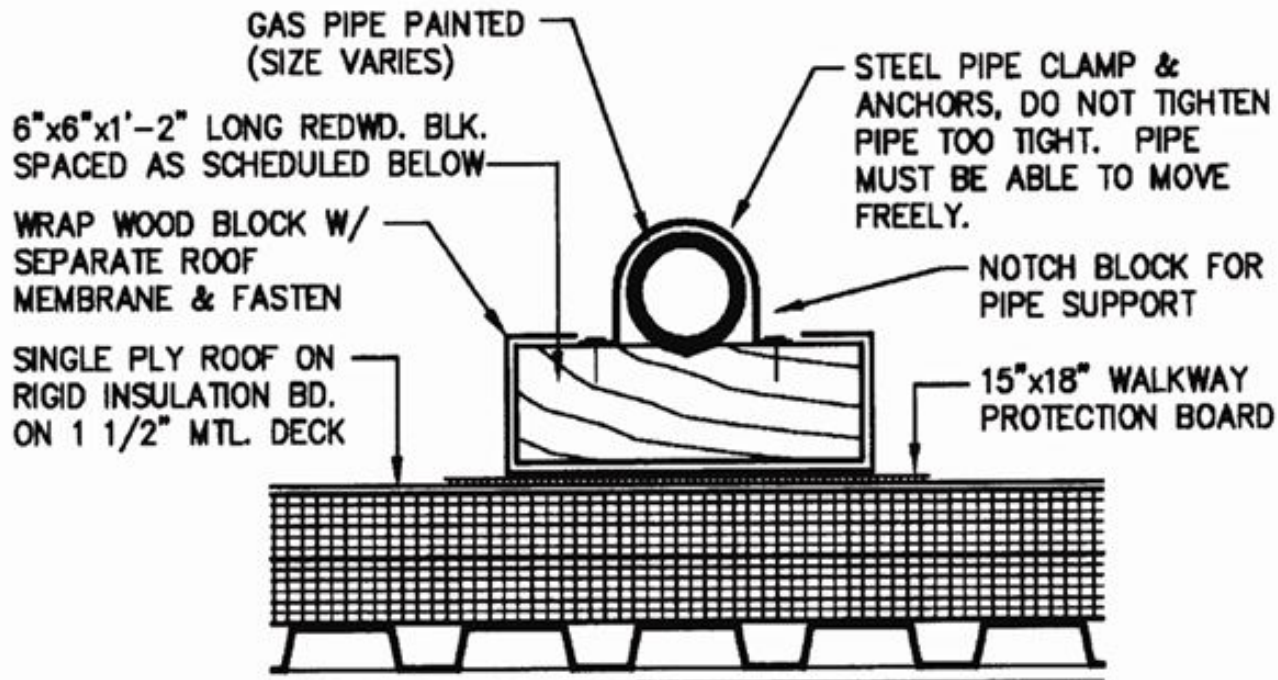
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History of Supports



- ◆ Non-Engineered fabricated supports may not support design loads or properly address distribution of the load to the roof membrane
- ◆ In many cases non-engineered fabricated supports are fabricated based on immediate need and not long term performance.
- ◆ Traditional architectural details reflect this field fabricated methodology.



NOTE:
DO NOT PLACE SUPPORTS NEAR ROOF DRAINS OR IN ROOF VALLEYS.

<u>PIPE SIZE</u>	<u>SPACING (MAX.)</u>
3/4"	6'-0" O.C.
1" - 1 1/4"	7'-0" O.C.
1 1/2"	8'-0" O.C.
2" & LARGER	10'-0" O.C.

8 GAS PIPE SUPPORT

1 1/2" = 1'-0"



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Field Fabricated





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Field Fabricated

- ◆ Failure to provide adequate detail allows a contractor to develop their own support loosely based on an architect's detail
- ◆ Weight distribution is rarely considered when field fabrication takes place
- ◆ Improper support design can cause damage to the roof membrane, roof structure and interior assets



- ◆ In many cases the load carried on the roof has minimal impact on the structural integrity of the roof
- ◆ Most failures that occur, negatively impact the roof membrane or insulation below the membrane as demonstrated in the previous photo



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Support Selection



- ◆ Weight load and job specific conditions (i.e. height and spacing) should be considered when determining proper rooftop support.
- ◆ All supports should be constructed using material that can sustain environmental conditions. (Weather, heat, cold, water, corrosive environments)
- ◆ Wood blocks or supports constructed of wood naturally deteriorate on a rooftop environment
- ◆ All supports must provide a stable base that can adequately distribute the loading to the roof membrane or the roof structure depending on application
- ◆ Support should be designed for load and type of piping whether that be gas, water, steam, ammonia, or air duct



- ◆ Certain pipes exert forces beyond downward pressure
- ◆ Fluid hammer or hydraulic shock is a pressure surge or wave caused when fluid (usually a liquid but also possible as a gas) is forced to stop or change directions suddenly. This force can cause the pipe to move in any direction.
- ◆ Un-insulated metal pipe located on a roof setting with extreme temperature fluctuation will experience expansion and contraction that must be considered when designing a support



- ◆ Overloading occurs when weight point load to the roof exceeds roof membrane or substructure capacity over time.
- ◆ The roof is typically the first thing to fail in a support system.
- ◆ 2 lbs. per square inch is the recognized max load to any roof membrane in regards to rooftop supports.
- ◆ What are the factors that distribute load to the roof membrane?
 - ❖ Base Surface area.



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Overloading of a Support





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Overloading of a Support





What are the factors that affect point loading?

- ◆ Pipe size
- ◆ Pipe Contents
- ◆ Number of pipes
- ◆ Support Spacing
- ◆ To ensure a rooftop support system does not fail over time, proper consideration to loading and base surface area must be evaluated.

Formula for figuring lbs. per square inch on the roof is:

$$\text{Weight applied} / (\text{Base area} \times 2)$$

EXAMPLE: Two 6" pipes at 31.52 lbs. per foot. Supports are at 10' spacing.

$$-(31.52 \times 2) \times 10 = 630.40 \text{ lbs. per support location}$$

-Add the approximate weight of the support at 65 lbs.

$$\text{-Weight applied to roof is } 695.40$$

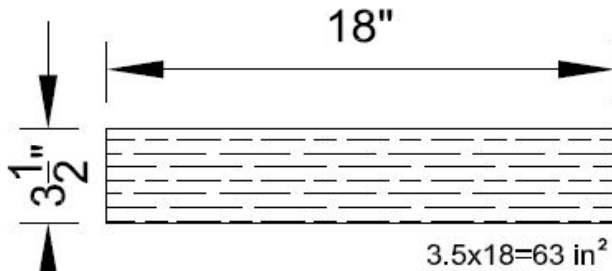
What size is the minimum size of base surface area needed in this scenario? (173.85 square in).



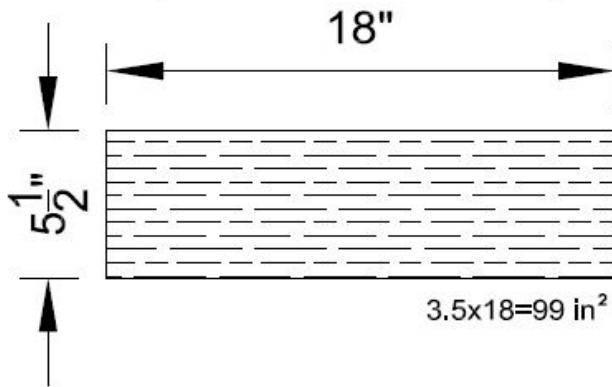
Overloading of a Support

Max weight according to industry standard on 2x4 is 126 lbs.

TYPICAL 2x4x18

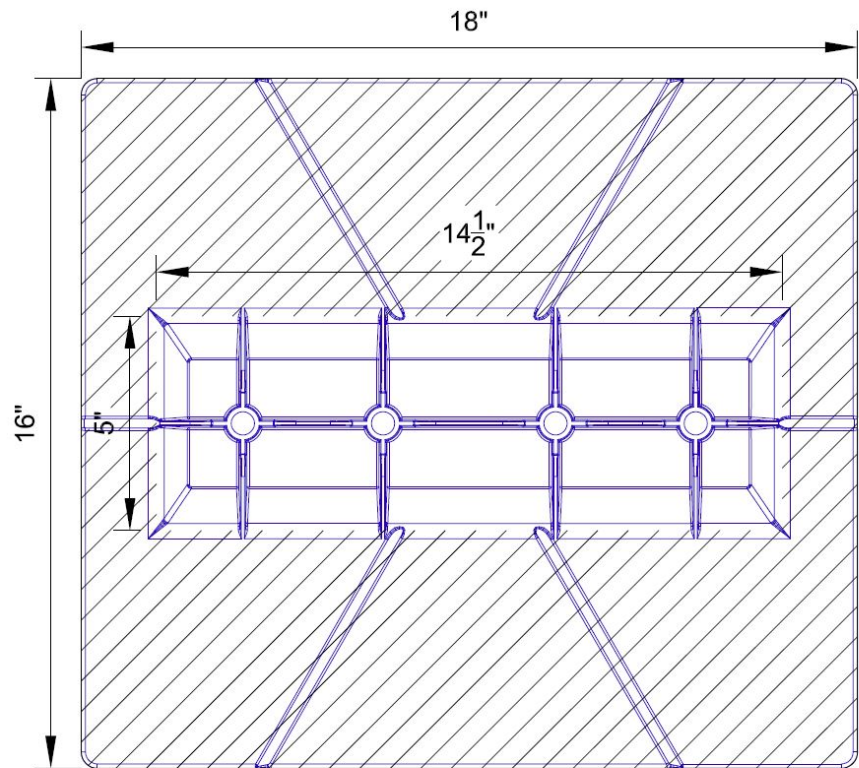


TYPICAL 2x6x18



Max weight according to industry standard on 2x6 is 198 lbs.

Max weight according to industry standards is 431 lbs.



TOTAL SURFACE AREA

$$18 \text{ in} \times 16 \text{ in} = 288 \text{ in}^2$$

$$5 \text{ in} \times 14.5 \text{ in} = 72.5 \text{ in}^2$$

$$288 \text{ in}^2 - 72.5 \text{ in}^2 = 215.5 \text{ in}^2$$



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Engineered Small Supports



- ◆ Small supports are engineered solutions fully assembled for conduit, condensate and gas lines
- ◆ What types of pipe will small supports carry?
- ◆ All small supports incorporate the critical components of any support
 - ❖ Proven durable base designs
 - ❖ Stainless steel or hot dip galvanized metal components
 - ❖ Adjustable height options available
 - ❖ Base size dependent on load carried



Small Supports

- ◆ Small supports for electrical conduit, small condensate lines, and refrigeration lines
- ◆ Polycarbonate base, stainless steel threaded rod for adjustability and hot dip galvanized strut
- ◆ Load carried will determine base size and specification will be written to a max load of 2 PSI
- ◆ This allows for a 2+ safety factor so no damage to membrane or insulation should occur
- ◆ Spacing should be 8' to 10' OC unless otherwise noted in project specifications





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Small Supports

- ◆ Small supports for gas and water lines
- ◆ Polycarbonate base, stainless steel threaded rod for adjustability and polycarbonate roller and axle
- ◆ Polycarbonate roller and axle prevent roller from galling like cast or galvanized roller and axle assemblies
- ◆ Load carried will determine base size and specification will be written to a max load of 2 PSI
- ◆ This allows for a 2+ safety factor so no damage to membrane or insulation occur

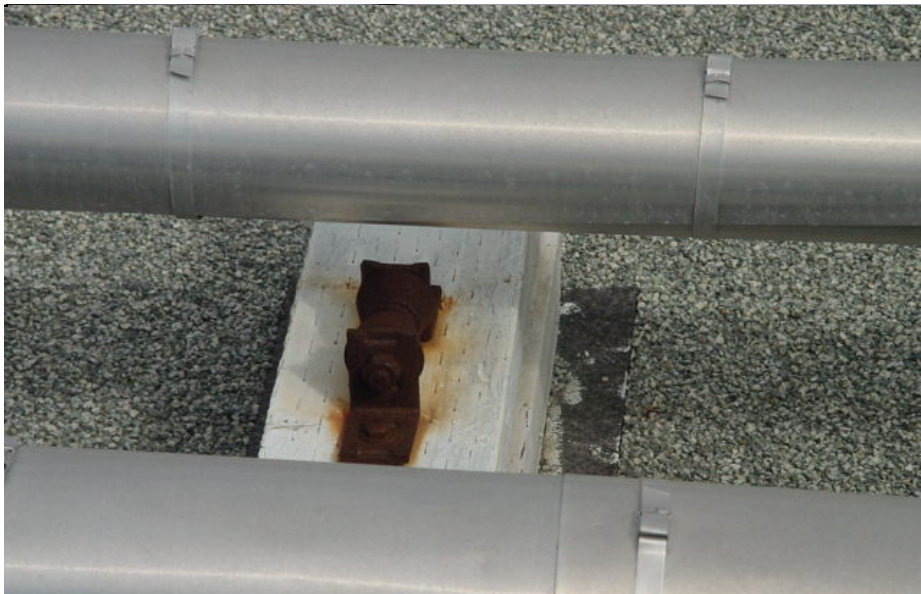




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Small Supports





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Engineered Large Supports



- ◆ Engineered large supports are fabricated based on pipe size and load carried
- ◆ Supports typically utilize 2 bases (more depending on the load carried)
- ◆ Adjustability and actual support component will vary depending on pipe size and media carried
- ◆ All supports including large engineered supports should be engineered to less than 2+ PSI load transfer
- ◆ The 2+ PSI engineering allows for removal of a support for maintenance or re-roof without overloading of surrounding supports.



- ◆ Engineered large supports shall be constructed of durable materials that can withstand the loading and environmental conditions
- ◆ Base sizes will vary depending on size and load of pipe and can range in size from 7-1/2"X10" up to 19"x23"
- ◆ Hanger component will vary from clevis, roller, trapeze or fixed
- ◆ Spacing should be determined based on load with a maximum spacing of 10' OC
- ◆ Bottom bracing and cross bracing is used if height exceeds 36" height off roof



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Engineered Large Supports





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Engineered Large Supports





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Engineered Duct Supports



- ◆ Engineered duct supports are fabricated based on duct size and load carried
- ◆ Supports typically utilize 2 bases (more depending on the width of the duct and load carried)
- ◆ Adjustability and actual support component will vary depending on duct size and type
- ◆ All duct supports should be engineered to less than 2+ PSI load transfer
- ◆ The 2+ PSI engineering allows for removal of a support for maintenance or re-roof without overloading of surrounding supports.



- ◆ Cross bracing is recommended for all duct 36" or greater off the roof
- ◆ Bands can also be used on spiral/round duct, but the support must be enclosed
- ◆ Support pads 2" larger than the base on all four sides



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Engineered Duct Supports





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Engineered Duct Supports





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Engineered Equipment Supports



- ◆ Engineered equipment supports are fabricated based on size and load of the mechanical unit
- ◆ Supports typically utilize 4 bases (more depending on the load carried)
- ◆ Light duty supports are very economical, but cannot exceed 200 lbs.
- ◆ Heavy duty support utilize either bar grating or stamped steel planking
- ◆ Bar grating is used when the unit is attached to the support
- ◆ Optional vibration isolation devices can be integrated into the design but is normally considered by RTU Manufacturer



- ◆ Engineered equipment supports shall be constructed of durable materials that can withstand the required loading and environmental conditions
- ◆ Base sizes will vary depending on load and can range in size from (LD unit 7-1/2"X10") up to (HD unit 19"x23")
- ◆ Engineered equipment supports can be designed for one single mechanical unit or multiple
- ◆ Mechanical supports keep the unit clean from debris, well ventilated, and can drain water from the unit



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Engineered Equipment Supports





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Engineered Walkways and Crossovers



- ◆ How often are these found in specifications?
 - ❖ Not very often
- ◆ How can we determine if a crossover is needed?
 - ❖ Smashed insulation on pipe
 - ❖ Depressed insulation of the roof
 - ❖ Roof access needed beyond a pipe or duct run
 - ❖ Access needed to a different roof elevation
 - ❖ Code compliant



- ◆ OSHA 1910
- ◆ Angle of Rise and Run for stairs
 - ❖ Between 30 degrees and 50 degrees
- ◆ Minimum Dimensions
 - ❖ 30" wide
- ◆ Handrail heights
 - ❖ 42" on landings and 36" on stairs
- ◆ Clearance step height above 30" (Fuel & Gas code)



- ◆ Chiller towers and large HVAC equipment are usually installed on structural steel or concrete curbs which elevates the equipment beyond the reach of a average man
- ◆ Ladders and other devices are used to access repair and maintain the equipment
- ◆ Most devices do not adequately elevate a person and in many cases are unsafe and present fall hazards
- ◆ According to OSHA the top cause of deaths in a commercial construction area are due to falls of 4 feet or less



- ◆ An engineered walkway or access platform should comply with the intent of the OSHA regulations on handrails
- ◆ Any elevated walkway in excess of 30” above a finished roof should have handrail at 42” and a mid-rail at 21”
- ◆ Engineered walkways should be non penetrating and removable for ease of repair and reroof
- ◆ Walkways should be constructed of durable materials that can withstand the loading and environmental conditions



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Engineered Walkways and Crossovers

Field Constructed:

Wood doesn't last, and
legs dig into roof.



Engineered:

Safe for roof, and
all maintenance personnel.





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Engineered Walkways and Crossovers





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Engineered Walkways and Crossovers

Field Constructed

Engineered





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Engineered Walkways and Crossovers





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Engineered Walkways and Crossovers

- ◆ Ladders are required in certain instances





- ◆ Pipe and equipment supports are engineered on a job basis to support a multitude of pipe, duct, equipment and access platforms
- ◆ All systems are to be engineered based on loads generated
- ◆ Bases are to be formed using polycarbonate, stainless steel or hot dip galvanized
- ◆ Polycarbonate bases are to be UV stable and perform under all weather conditions
- ◆ Roof membrane, structure, wind, seismic and spacing should all be considered when designing a system



- ◆ All structural components should be constructed durable materials that can withstand the loading and environmental conditions
- ◆ All loads should be transferred to the roofing membrane at 2 PSI or less so as to not cause damage to the membrane, insulation or interior via leaks
- ◆ Most roofing systems today carry a 20 year warranty, a engineered pipe support system should carry a matching warranty of 20 years
- ◆ Can provide engineering stamps for projects that require certifications in all 50 states

MAHALO

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