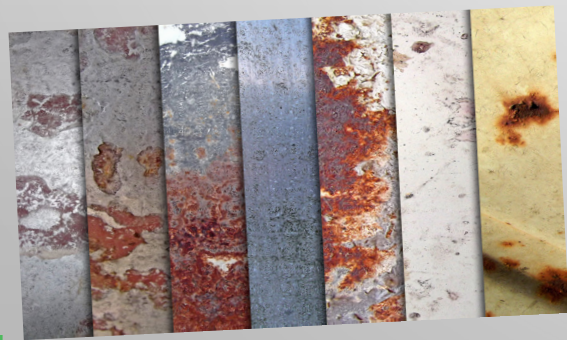


UNISTRUT SEISMIC BRACING & MATERIAL FINISHES



ATKORE'S FAMILY OF PRODUCTS

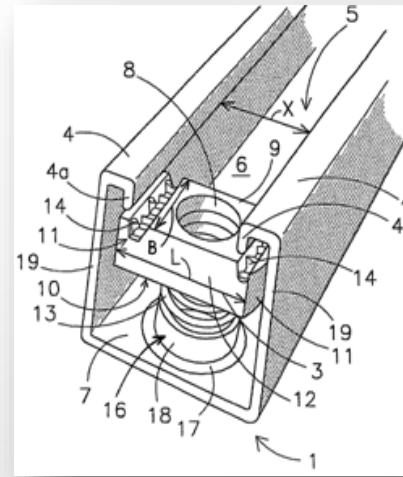


A BIT OF UNISTRUT HISTORY

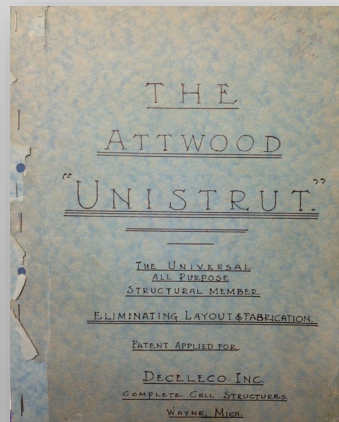
Charles Atwood



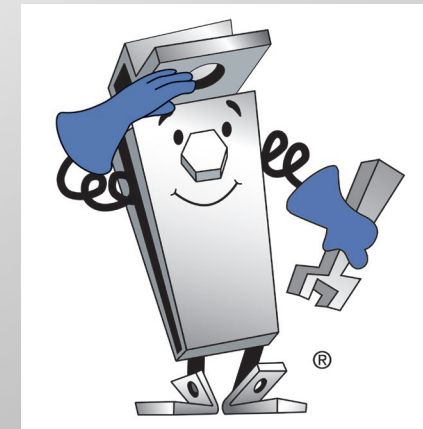
Unistrut Patent



Early Unistrut Catalog (1940)



Mr. Strut

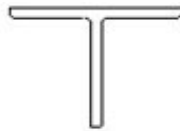


WHY STRUT ?

Other options



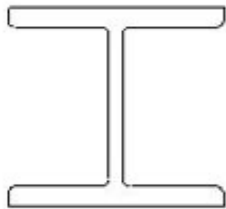
Angles



Tee



Channel



Column



Beam



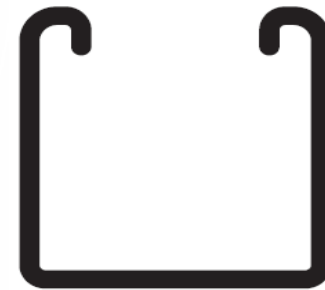
S.H.S



R.H.S



C.H.S



Rolled strut

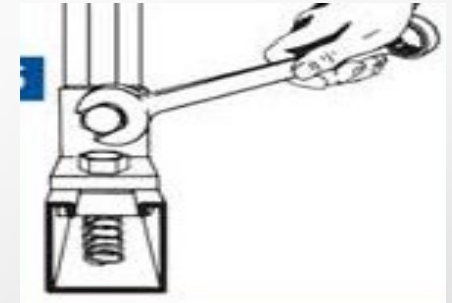
- *100% Adjustable*
- *100% Reusable*
- *No Welding*
- *No Drilling*
- *No Special Tools*

STEEL OPTIONS COMPARISON CHART

Drilled & Bolted Connection

Welded Connection

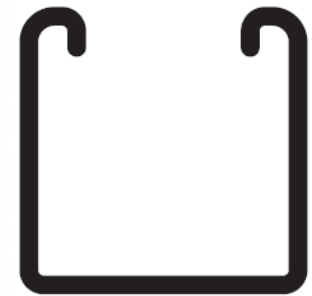
Strut Connection



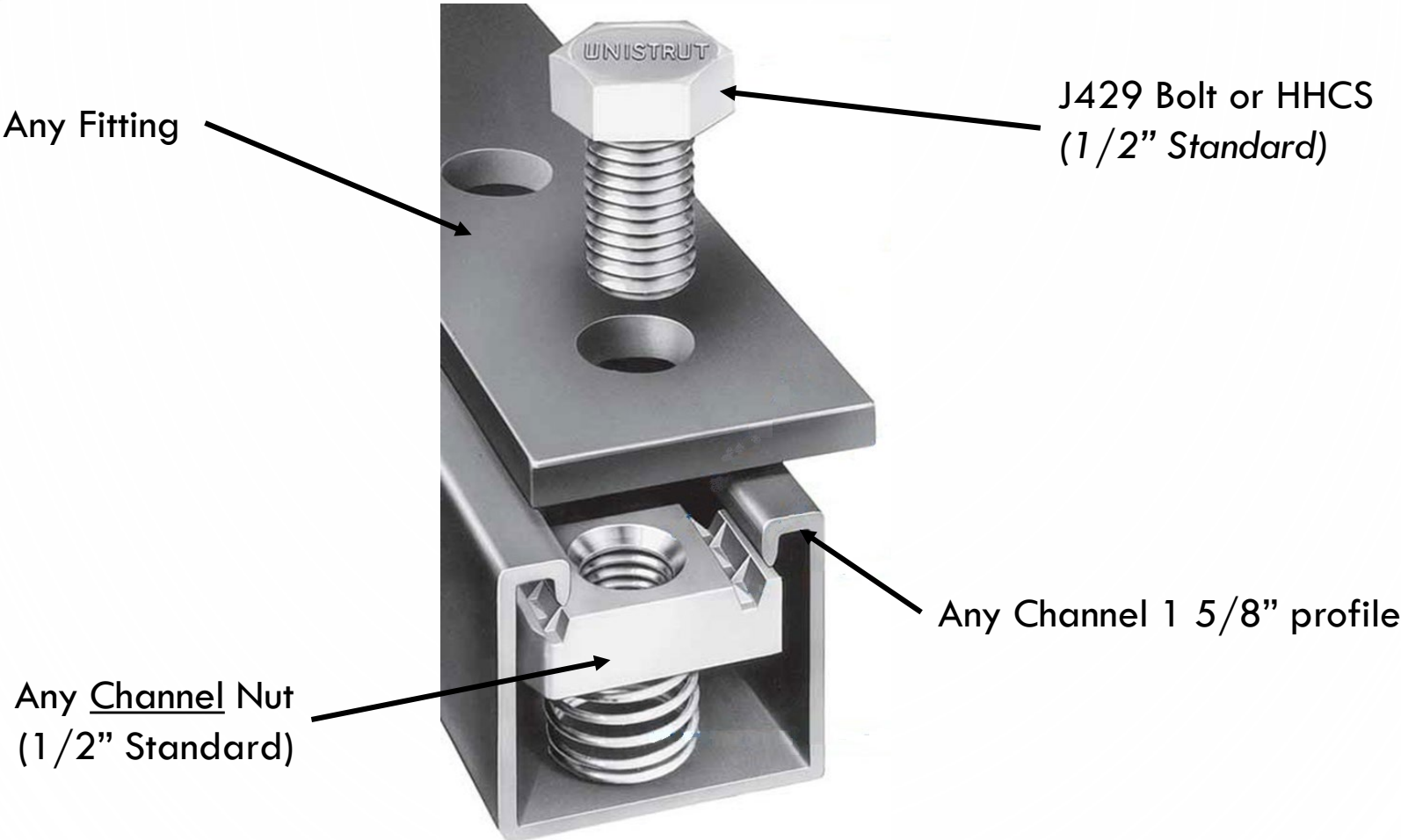
	Welded Connection	Drilled & Bolted Connection	Strut Connection
Equipment Needed	Welding Mask X Welding Torch X Saw Special PPE X Fixturing Equipment X	Saw X Drill Wrench <input checked="" type="checkbox"/>	Saw <input checked="" type="checkbox"/> Wrench <input checked="" type="checkbox"/>
Special Training	Yes X	No <input checked="" type="checkbox"/>	No <input checked="" type="checkbox"/>
Expensive Labor	Yes X	No X	No <input checked="" type="checkbox"/>
Time Consuming	High X	Medium X	Low <input checked="" type="checkbox"/>
Easily Adjustable	No <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input checked="" type="checkbox"/>

MATERIAL – CHANNEL

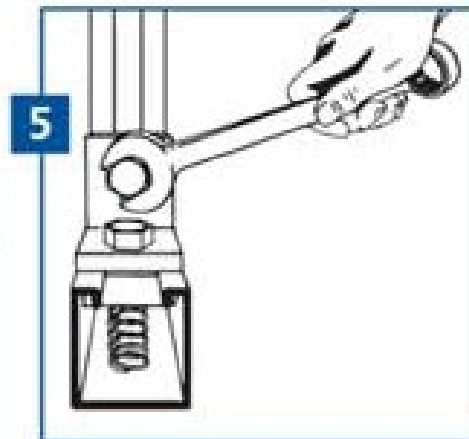
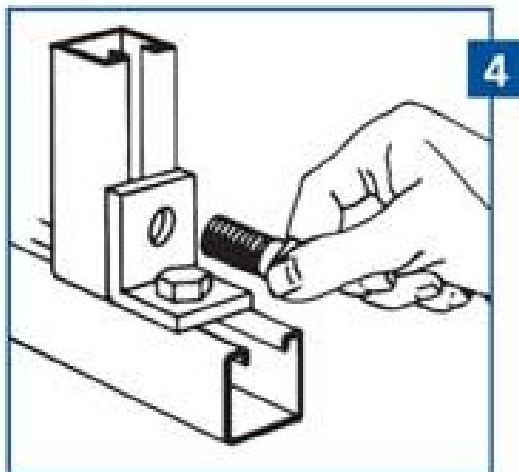
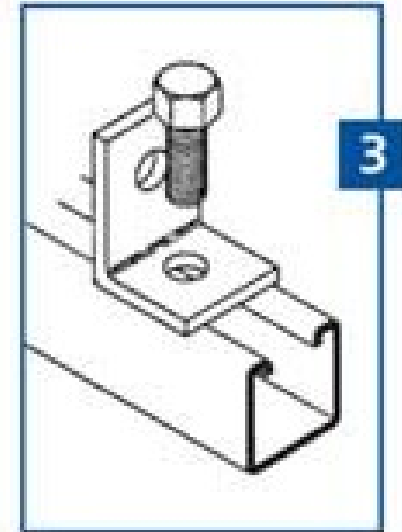
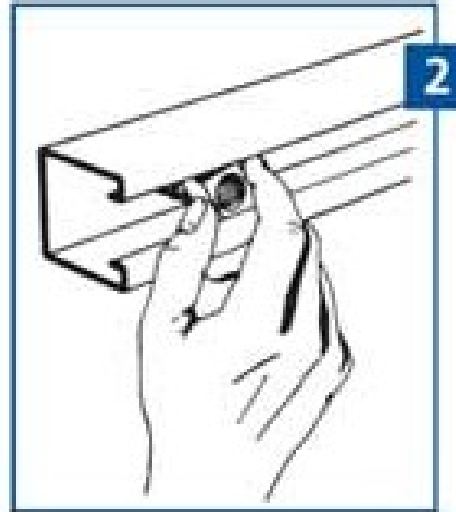
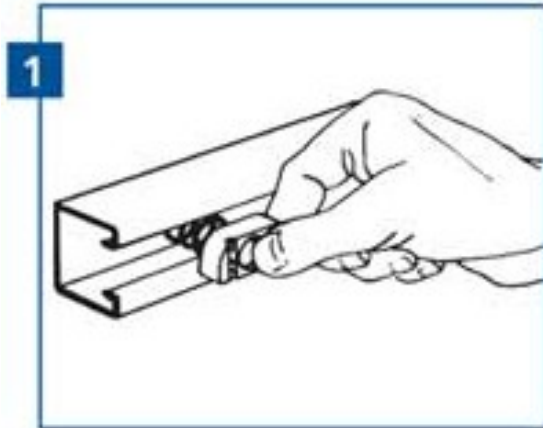
- ASTM A1011 SS GRADE 33
 - STRUCTURAL GRADE
 - SS IS STRUCTURAL STEEL – NOT STAINLESS STEEL
 - YIELD STRENGTH = 33,000 PSI
- COLD FORMING INCREASES YIELD STRENGTH
 - RECOGNIZED AND ALLOWED BY **AISI**
 - INCREASED YIELD STRENGTH = 42,000 PSI
 - USED FOR ALL BEAM & COLUMN LOAD CALCULATIONS



THE UNISTRUT SYSTEM PROCESS



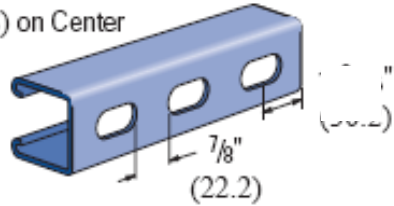
“IT’S JUST THAT SIMPLE”



- *100% Adjustable*
- *100% Reusable*
- *No Welding*
- *No Drilling*
- *No Special Tools*

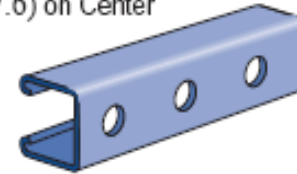
CHANNEL – PIERCING OPTIONS

Slots are
 $1\frac{1}{8}"$ (28.6) x $\frac{9}{16}"$
 $2"$ (50.8) on Center



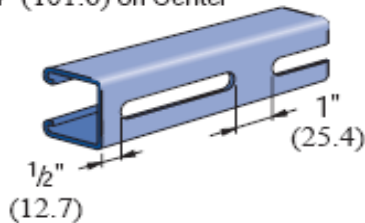
“T”

$\frac{9}{16}"$ (14.3) Dia. Holes
 $1\frac{7}{8}"$ (47.6) on Center



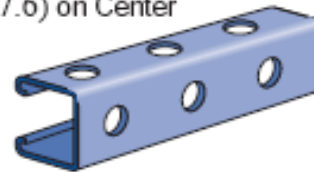
“HS”

Slots are
 $3"$ (76.2) x $1\frac{3}{32}"$ (10.3)
 $4"$ (101.6) on Center



“SL”

$\frac{9}{16}"$ (14.3) Dia. Holes
 $1\frac{7}{8}"$ (47.6) on Center

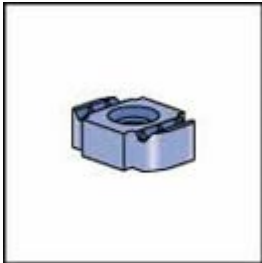


“H3”

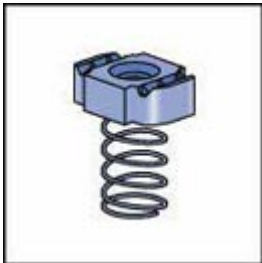
“T” / :	85%
“W”:	85%
“HS”:	90%
“H3”:	85%
“SL”:	85%

CHANNEL NUTS

Types



Lowest cost
No tangling of spring in box



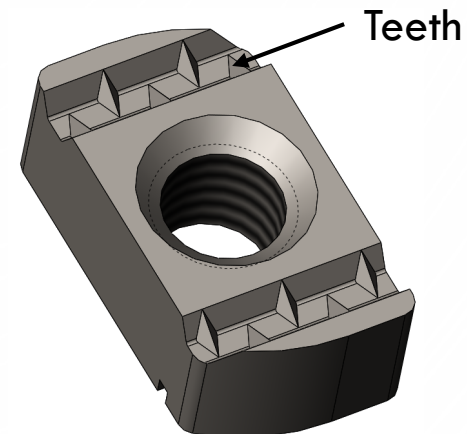
Easy installation
Stays in position hands-free



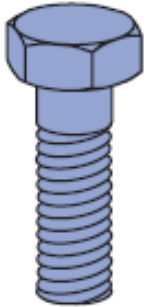
Easy installation
Stays in position hands-free
No tangling of spring in box

Product Features

- Locks into channel when rotated clockwise
- Teeth “bite” into channel flange for superior holding strength
- Rounded edges for operator safety
- Sizes available: #8 to 7/8”



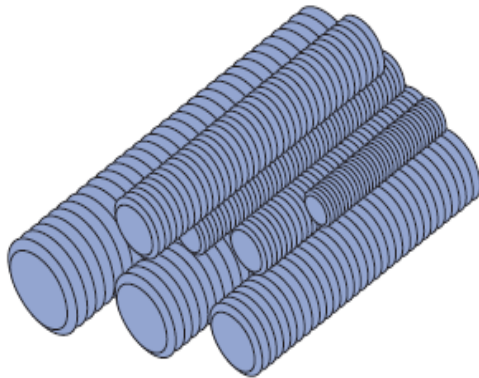
HARDWARE – FAQs



Screws

Screws conform to SAE J429 GR 2 (exceeds ASTM A307).
Proof Load 55KSI, Tensile Load 74 KSI

- SAE J429 exceed ASTM A307



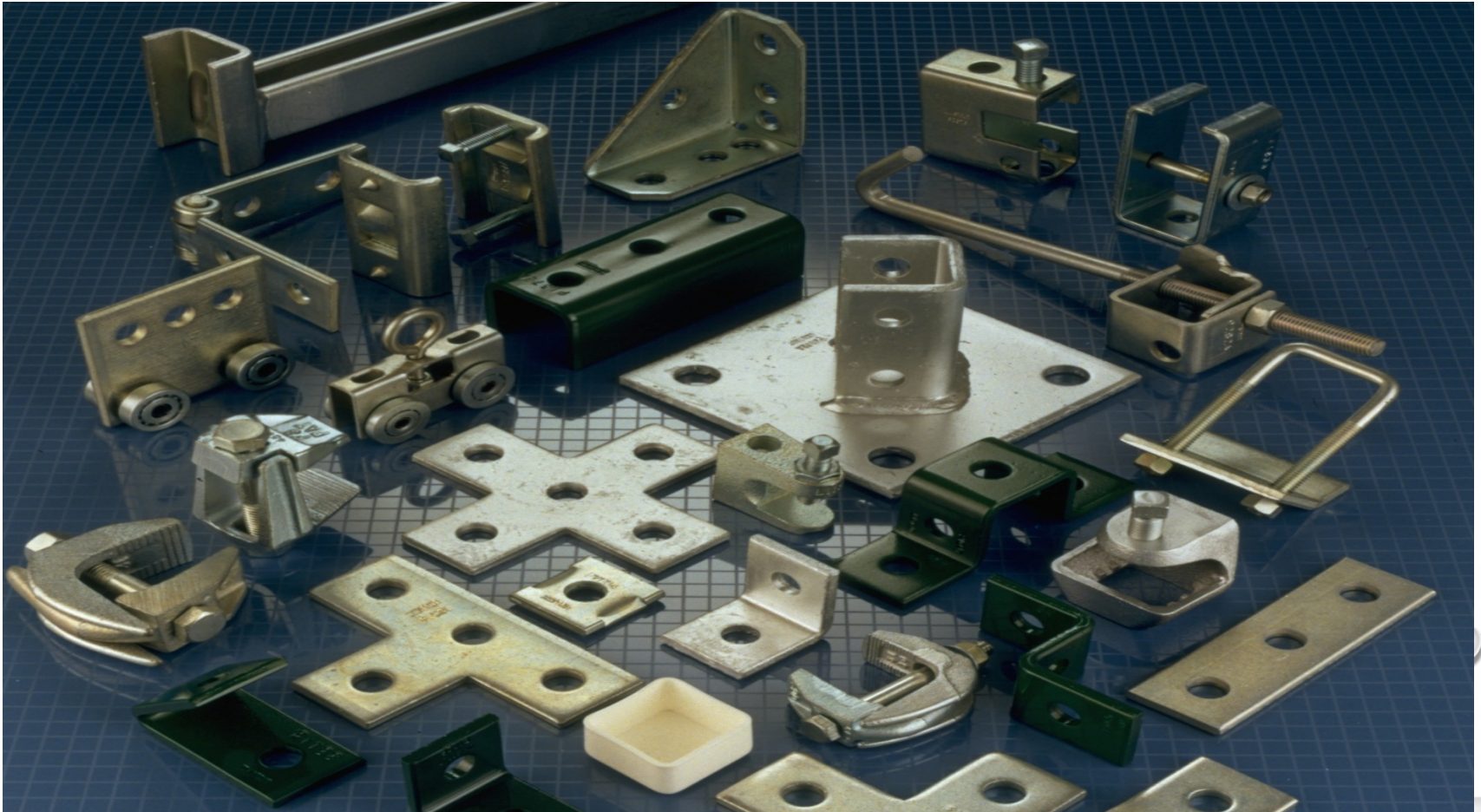
Threaded Rod

Threaded Rod Loads for Piping Applications (based on MSS SP-58)		
Nominal Dia.	Root Area In ² (mm ²)	Max. Safe Load at 650°F (343°C) Lbs (kN)
3/8	0.068 (43.9)	730 (3.25)
1/2	0.126 (81.3)	1,350 (6.01)
5/8	0.202 (130.3)	2,160 (9.61)
3/4	0.302 (194.8)	3,230 (14.37)
7/8	0.419 (270.3)	4,480 (19.93)
1	0.552 (356.1)	5,900 (26.24)

Threaded Rod Loads for Structural Applications (Based on AISC, Steel Construction Manual, ASD, 14th Edition. Per AISC, Allowed Tensile Stress = 0.33 * Fu)		
Nominal Dia.	Nominal Area In ² (mm ²)	Allowed Tension Load Lbs (kN)
1/4	0.049 (31.6)	930 (4.14)
3/8	0.110 (71.0)	2,110 (9.39)
1/2	0.196 (126.5)	3,750 (16.68)
5/8	0.307 (198.2)	5,870 (26.11)

- Threaded Rod capacities based on industry standards

STANDARD FITTINGS



FITTINGS – DESIGN STANDARDS

Design Standards

Thickness: 0.250" (ASTM A1011 SS GR 33)
0.220" (ASTM A1011 HSLAS GR 45)

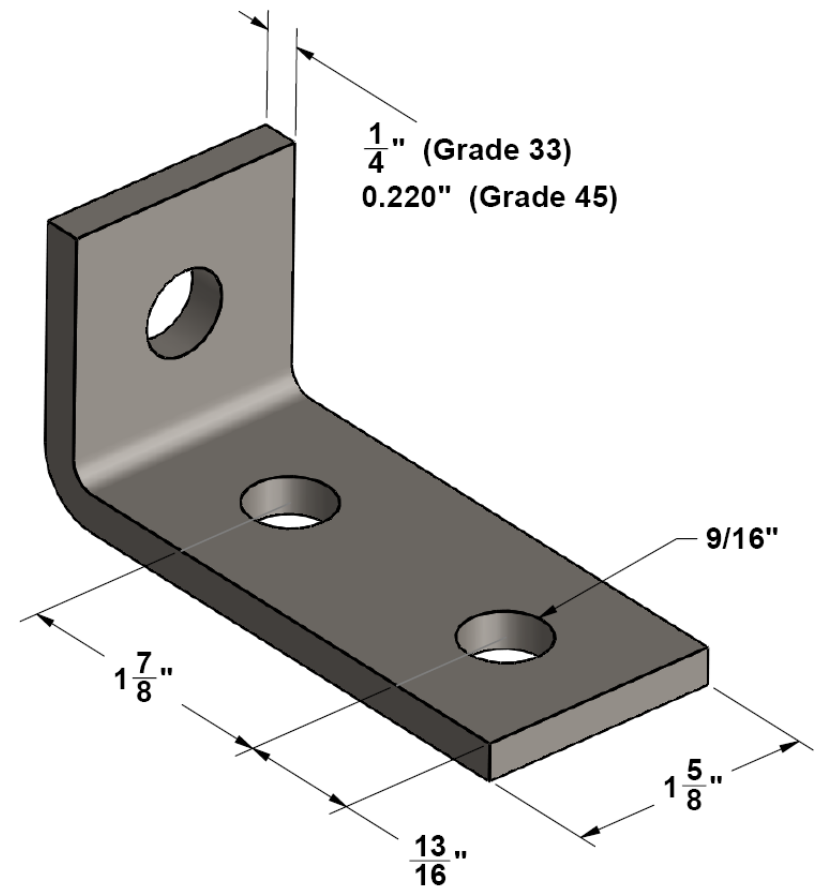
Width: 1 5/8"

Hole Diameter: 9/16"
(sized for a 1/2" fastener)

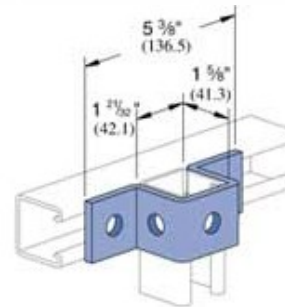
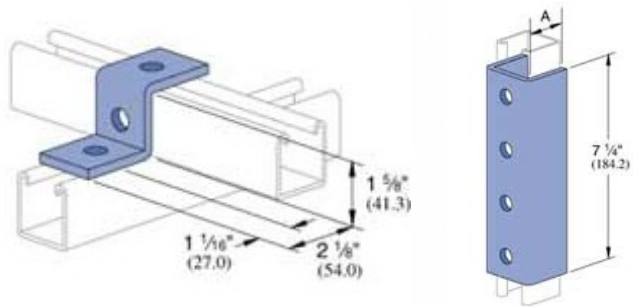
Hole Spacing (Center-to-Center): 1 7/8"

Hole Spacing (Center-to-End): 13/16"

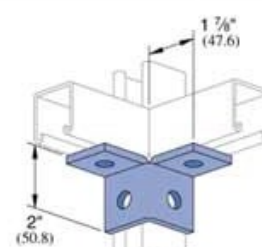
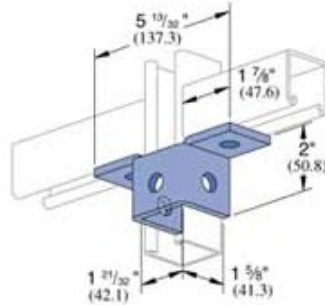
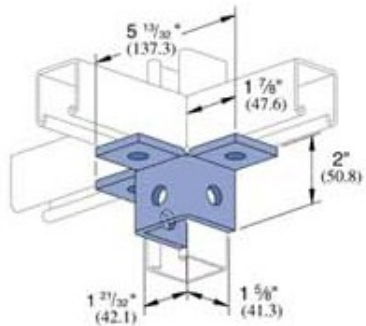
SF = 2.5 Ultimate Strength



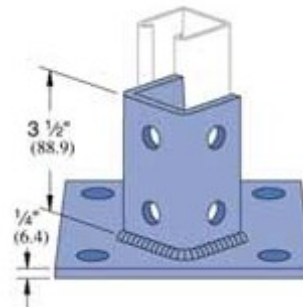
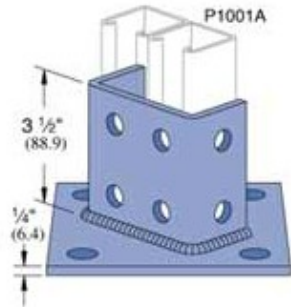
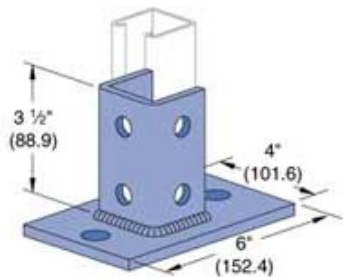
GENERAL FITTINGS



Z, U, Hat

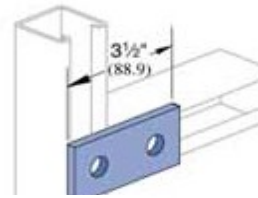
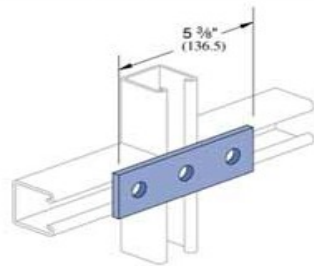
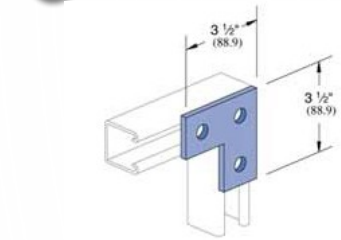


Wing

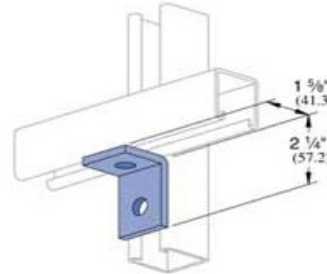
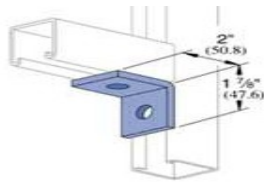
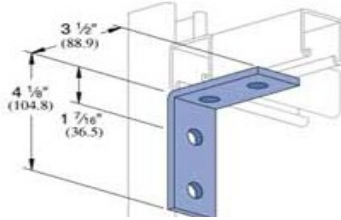


Post Bases

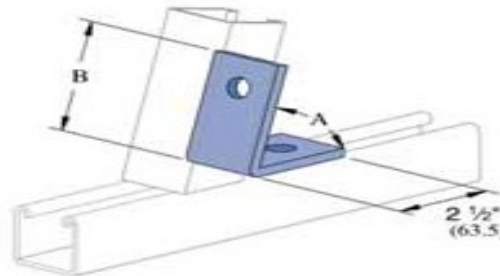
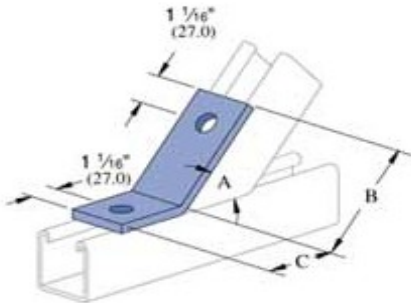
GENERAL FITTINGS



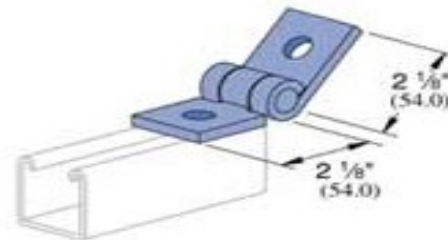
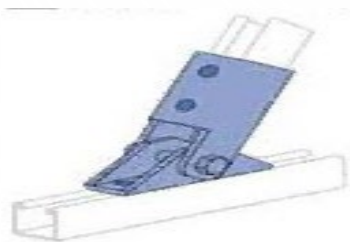
Flat



Angle (90°)

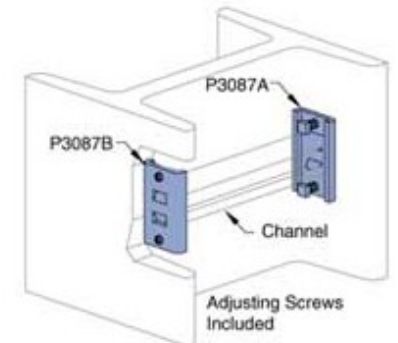
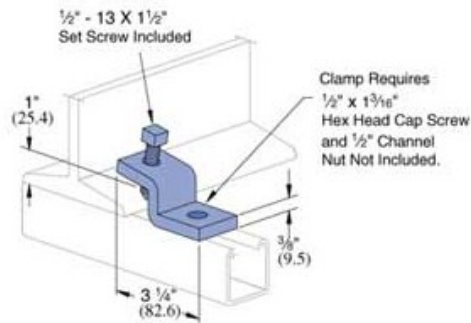
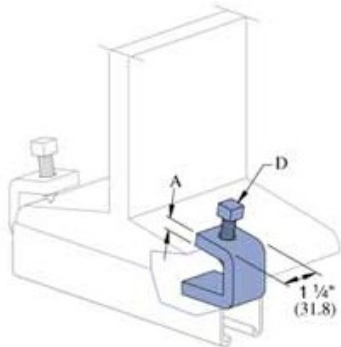
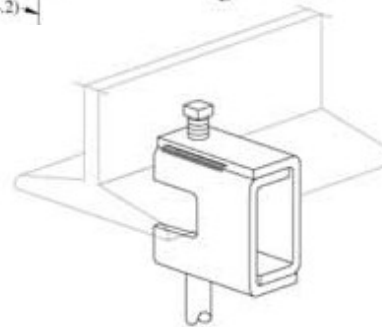
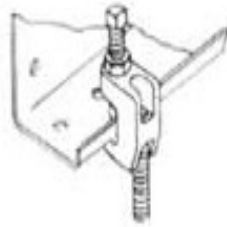
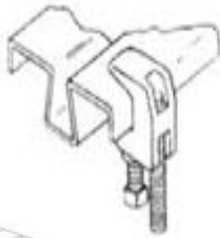
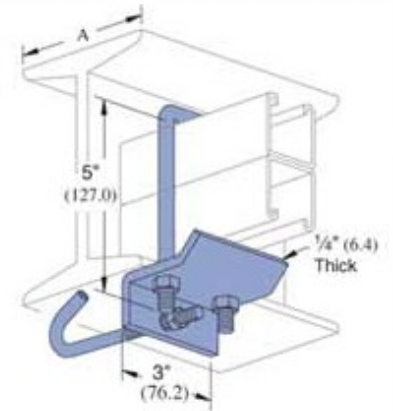
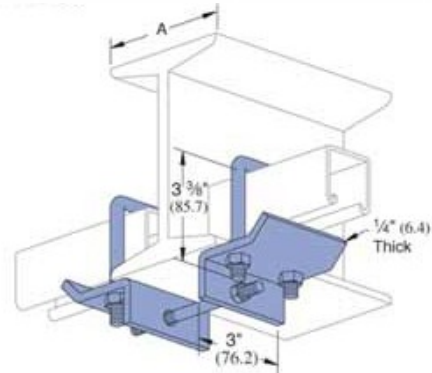
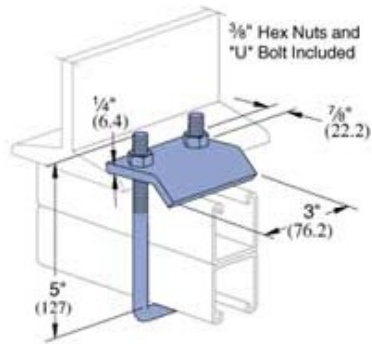


Fixed Angle ($7.5^\circ - 82.5^\circ$)



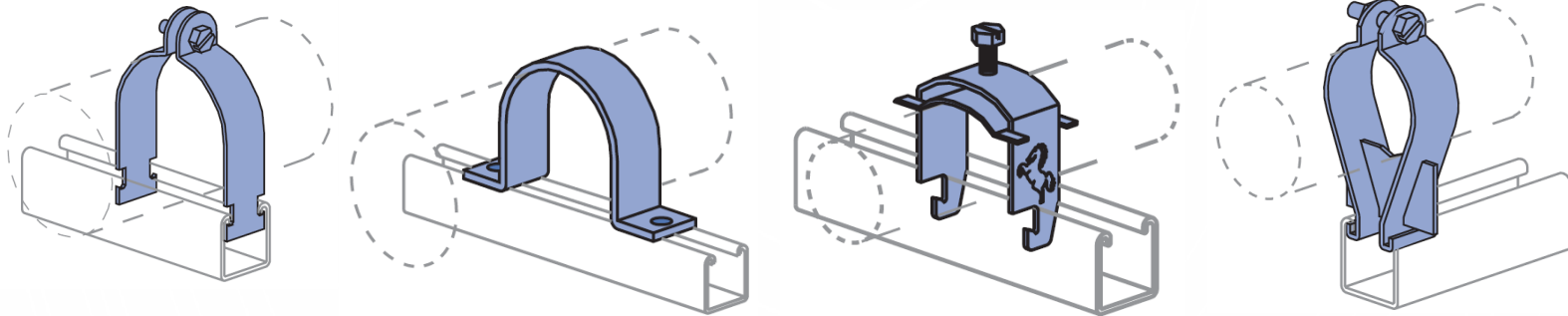
Hinged Angle

BEAM CLAMPS

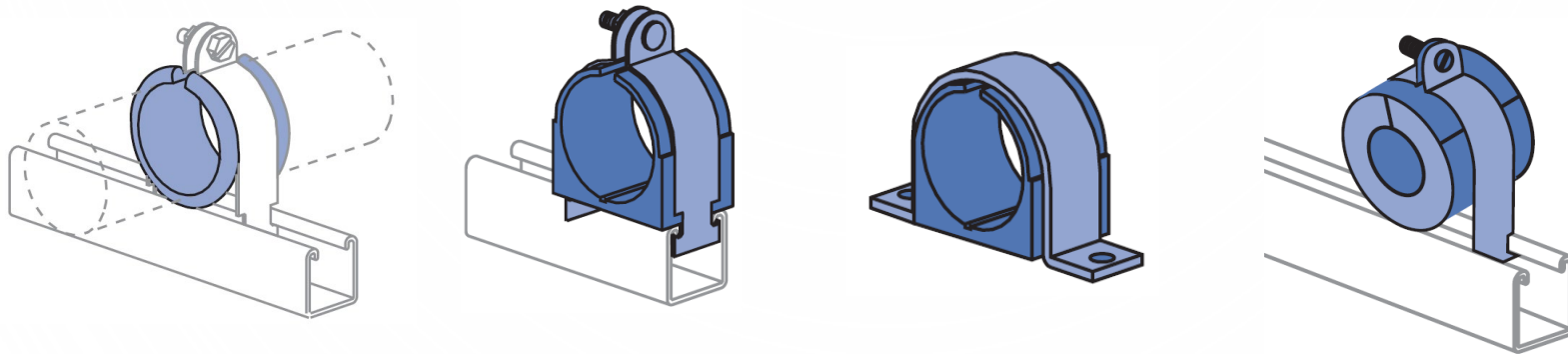


PIPE & CONDUIT CLAMPS

Standard



Insulated





MATERIAL & FINISH OPTIONS



MATERIAL CORROSION TABLE

FINISHES

There are six types of protective coatings available. Electro-galvanized, Pre-galvanized, Hot-dipped galvanized, Yellow Zinc Dichromate, Perma-Green III and Unistrut Defender.

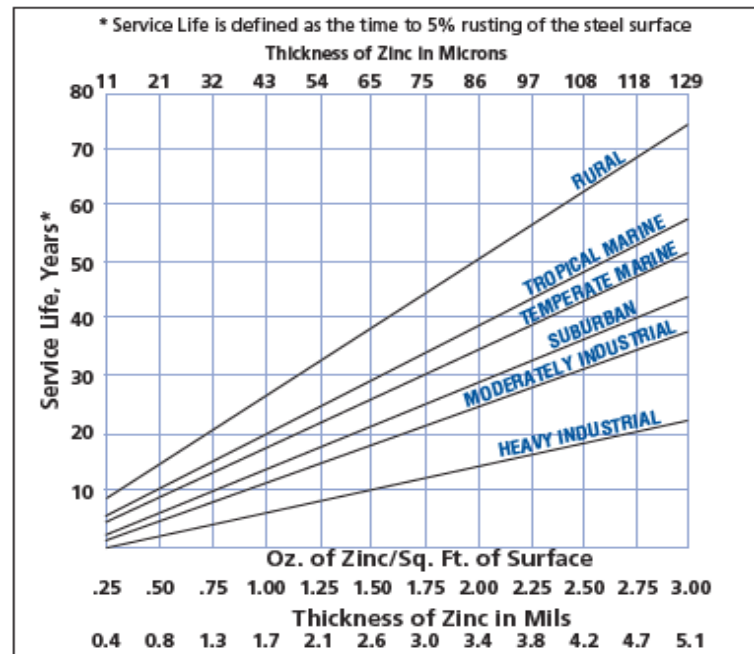
Zinc Coating

A zinc coating offers a sacrificial barrier to protect the base metal from direct contact with the environment. The service life of secondary zinc coating is related directly to the thickness as show below.

Comparison of Zinc Galvanized Finishes

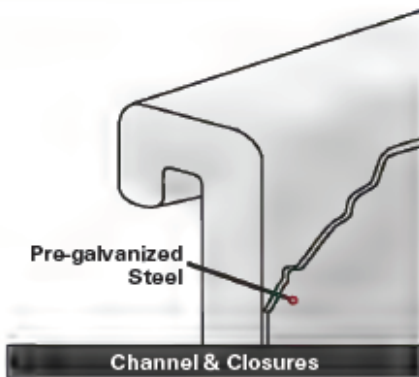
Finish	Zinc Thickness
Hot-Dip Galvanized	2.6 MIL
Pre-galvanized	0.75 MIL
Electro-Galvanized (SC1)	0.2 MIL
Electro-Galvanized (SC3)	0.5 MIL
Perma-Gold (SC3)	0.5 MIL

Life of Protection vs. Thickness of Zinc and Type of Atmosphere



CHANNEL AND FITTINGS FINISHES

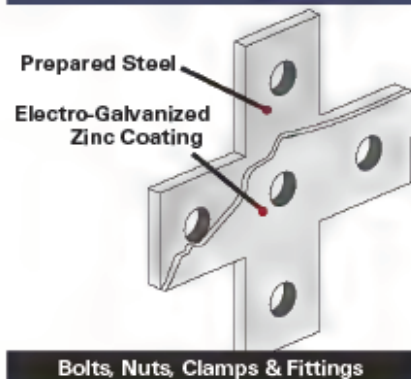
Pre-galvanized Zinc (PG)



ASTM A653

Pre-galvanized steel is zinc coated by a hot dip process. Steel strip from a coil is fed through a continuous zinc coater which cleans, fluxes and coats the steel with molten zinc. After cooling, the steel is recoiled. The pre-galvanized zinc coating conforms to a G-90 thickness designation per ASTM A653. The zinc thickness is .75 MIL or .45 oz./sq. ft. of surface area. This coating is offered on Unistrut channel and tubing and is a well-proven, time-tested performer for indoor and outdoor applications. For severe corrosion applications, hot dip galvanizing, as described below, is a good alternative.

Electroplated Zinc (EG)



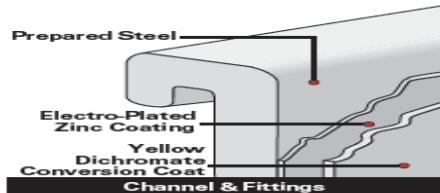
ASTM B633, Type III SC1 or SC3

In the electroplating process, the part to be zinc coated is immersed in a solution of zinc ions. An electric current causes the zinc to be deposited on the part. SC1 (Mild) has a Zinc coating of 0.2 and is recommended for dry indoor use. SC1 is the standard finish thickness. SC3 (Severe) has a Zinc coating of 0.5 mill and is the standard finish thickness only.

CHANNEL AND FITTINGS FINISHES

FINISHES (continued)

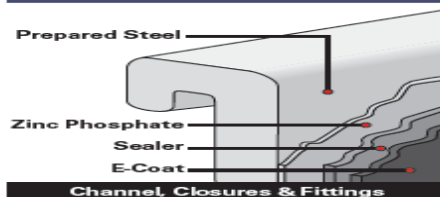
Yellow Zinc Dichromate (ZD)



ASTM B633, Type II SC3

An Electro-galvanized zinc plate is applied with a cohesive molecular bond to the steel base metal, in compliance with the ASTM B633 standard. Yellow Dichromate is applied over the zinc and results in a gold appearance which acts as a nonporous barrier sealant. SC1 (mild), recommended for dry indoor use. The zinc coating of 0.2 is the standard finish thickness SC3 (Severe) and zinc coating of 0.5 mill is the standard finish thickness only on UL Listed raceway products.

Perma-Green III® (GR)

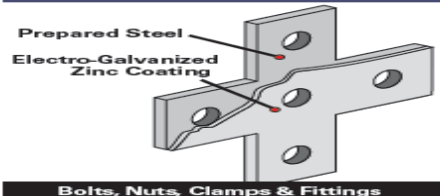


Perma-Green III is an epoxy coating with superior rust protection and fade resistance. The epoxy coating is a proprietary formulation that provides a smooth, hard, durable surface that exceeds the corrosion protection of conventional finishes. Channel and parts are cleaned and phosphated. Immediately afterward, a uniform coat of rust-inhibiting thermoset epoxy paint is applied by cathodic electro-deposition and thoroughly baked.

Additional Technical Information:

- **Steel Substrate Preparation** - Eight stage continuous cleaning, rinse, zinc phosphate conversion coating and sealer
- **Color:** Federal Highway Green (Color Tolerance Chart PR Color No. 4).
- **Hardness:** 2H+
- **Salt Spray Performance:**
 - o Scribed: exceeds 400 hrs. per ASTM B117. (1/8 Creep)
 - o Unscribed: exceeds 600 hours per ASTM B117. (6% Red Rust)
- **Environmental Issues** - Formulated as a "heavy metal"- free coating (trace elements only).
- **Outgassing in service:** Essentially none at 350°F for 24 hr

Hot-Dip Galvanized (HG)



ASTM A123 OR A153

In hot dip galvanizing, the finished part is immersed in a bath of molten zinc. This method results in complete zinc coverage and a thicker coating than pre-galvanized or plated zinc. The zinc coating is typically 2.6 MIL or 1.5 oz. /sq. ft. of surface area. This is the coating of choice for applications where severe corrosion is a design factor.

MATERIAL & FINISH OPTIONS

Superior Corrosion Protection
Generally Higher Cost

Stainless Steel – Type 316 (ST)
Stainless Steel – Type 304 (SS)

Aluminum (EA or AL)

Special materials

Fiberglass

3,000 Hrs.

Defender (DF)

1,000 Hrs.

Hot-Dipped Galvanized (HG)

200 - 600 Hrs.

Perma-Green (GR)

Pre-Galvanized (PG)

Electro-Galvanized (EG)

Perma-Gold (ZD)

Carbon Steel

Inferior Corrosion Protection
Generally Lower Cost

Plain (PL)

STAINLESS STEEL SYSTEM

PRODUCT OFFERING:

- TYPES 304 (SS) AND 316 (ST) AVAILABLE
- LIMITED PRODUCT OFFERINGS

PERFORMANCE:

- CHANNEL BEAM & COLUMN LOADS ARE SAME AS CARBON STEEL
- CHANNEL NUTS HAVE A REDUCED CAPACITY
 - PULLOUT = 100% OF CARBON STEEL
 - SLIP = **25%** OF CARBON STEEL

ADVANTAGES:

- EXCELLENT ENVIRONMENTAL CORROSION RESISTANCE
- ALSO A GREAT MATERIAL FOR MANY CHEMICAL ENVIRONMENTS

ALUMINUM SYSTEM

Product Offering:

- Limited product offering
- Channel: Extruded, type 6063-T6
- Fittings: Type 1100F or 5052-H32

Performance:

- Channel beam & column loads are **33%** of carbon steel
- Channel Nuts have a reduced capacity
 - Pullout = **50%** of Carbon Steel
 - Slip = **75%** of Carbon Steel
- Recommend using Stainless Steel Channel Nuts

Advantages:

- Excellent environmental corrosion resistance
- Also a great material for many chemical environments

FIBERGLASS SYSTEM CHANNEL PROFILES

PRODUCT OFFERING:

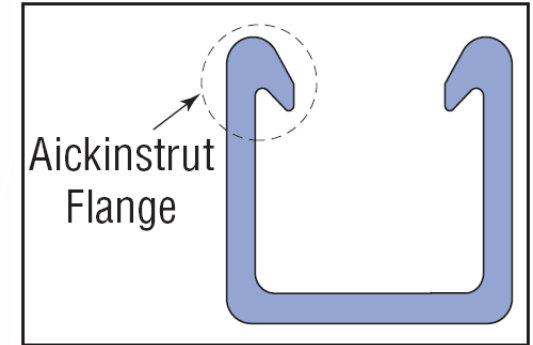
- LIMITED PRODUCT OFFERINGS
- UV RESISTANT MATERIALS
- SEVERAL MATERIAL OPTIONS

PERFORMANCE:

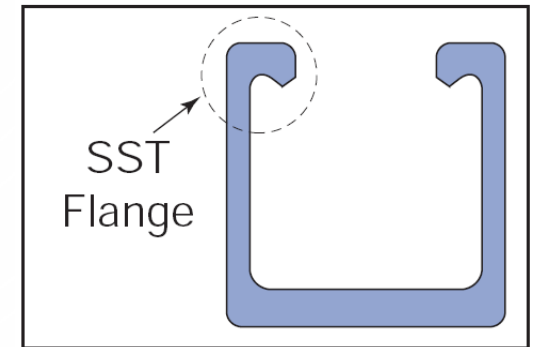
- CHANNEL BEAM & COLUMN LOADS – SEE CATALOG
- STOP-LOCK SLIP RESISTANCE: 200 – 250 LBS.

ADVANTAGES:

- EXCELLENT ENVIRONMENTAL CORROSION RESISTANCE
- ALSO A GREAT MATERIAL FOR MANY CHEMICAL ENVIRONMENTS



FOR USE WITH FIBERGLASS COMPONENTS



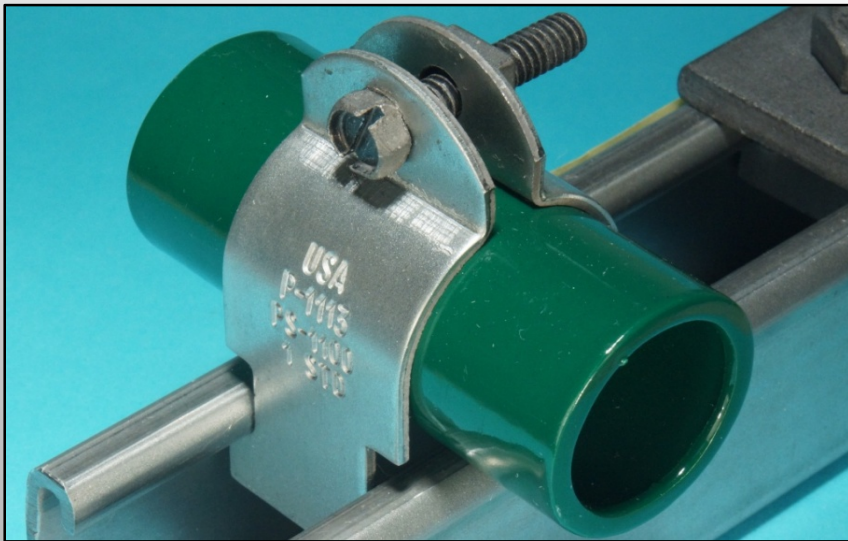
FOR USE WITH METALLIC COMPONENTS

UNISTRUT DEFENDER TESTING PROCESS

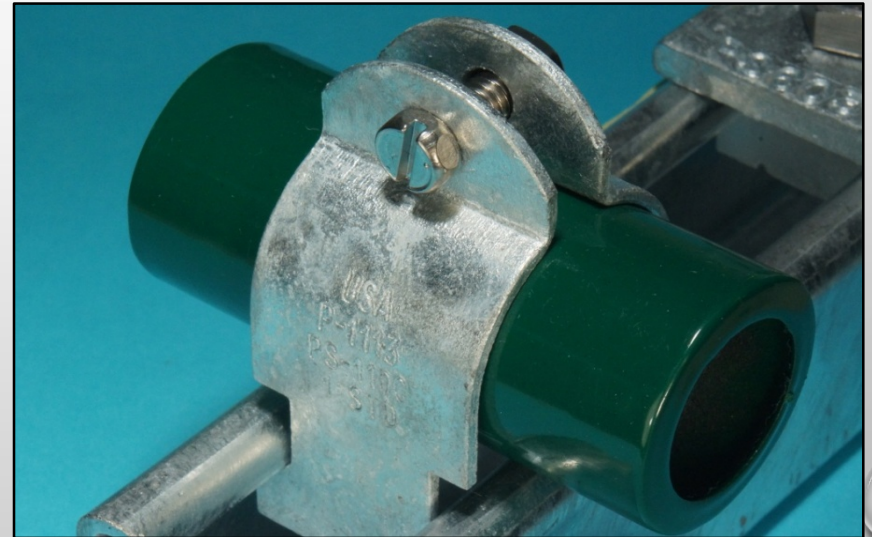
DEFENDER™ - NEW Corrosion Resistant Line

Defender™ is designed for outdoor corrosive applications utilizing two proprietary material coatings conforming to ASTM standards A1046 and A1059. Channel, Fittings and Pipe Clamps meet the physical requirements of ASTM A1011 SS GR 33, ASTM A1046 SS GR 33, or ASTM A1011 HSLAS GR 45 Class.

DEFENDER MATERIAL



HG MATERIAL



Start of testing '0' hours

3/8/2019

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DEFENDER 1 000 HOURS

Salt Spray Testing - to 1,000 hours continuous testing in chamber.

DEFENDER MATERIAL

HOT-DIP GALVANIZED

VS.

1,000 HOURS CONTINUOUS SALT SPRAY TEST RESULTS

3/8/2019

DEFENDER 3000 HOURS

- Salt Spray Testing - to 3,000 hours continuous testing in chamber.

Out performed hot dip galvanized! Defender provides a performance service life that is 3X greater than hot dip galvanized products.

Defender



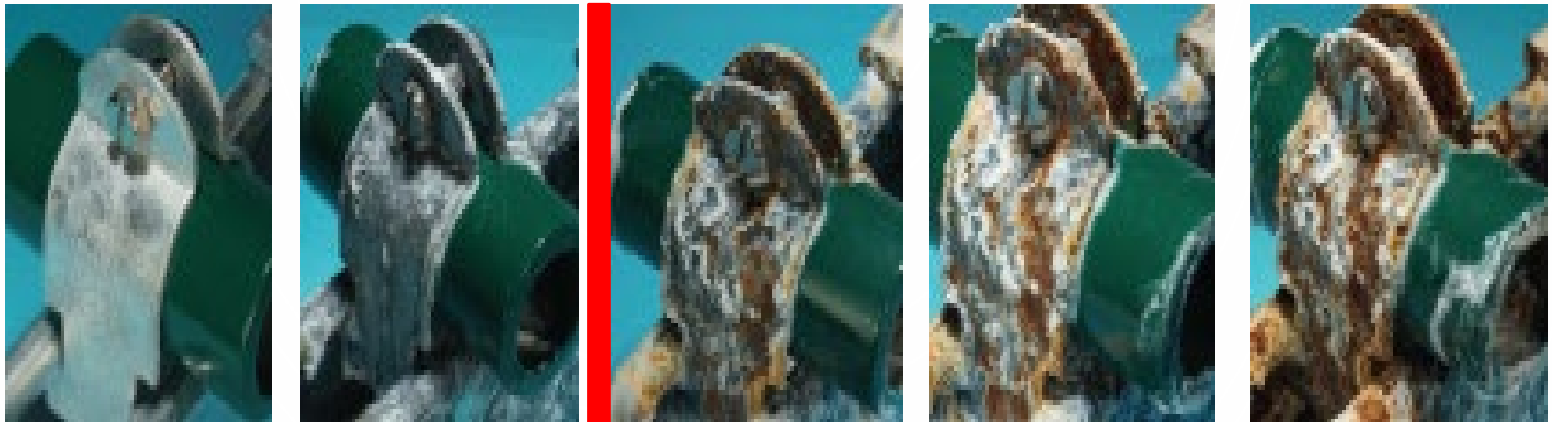
“HG” Hot Dipped Galvanized



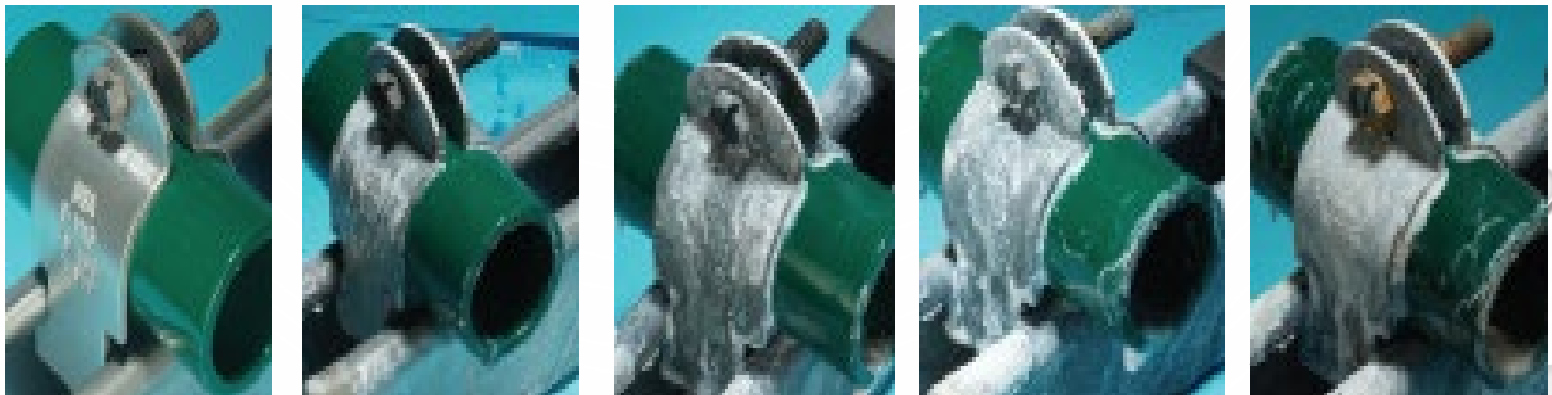
3,000 HOURS CONTINUOUS SALT SPRAY TEST RESULTS

DEFENDER CORROSION TEST

Hot-Dip Galvanized reached 5% red rust at an average of 898 hours.



Hot-Dip Galvanized per ASTM A123 and A153

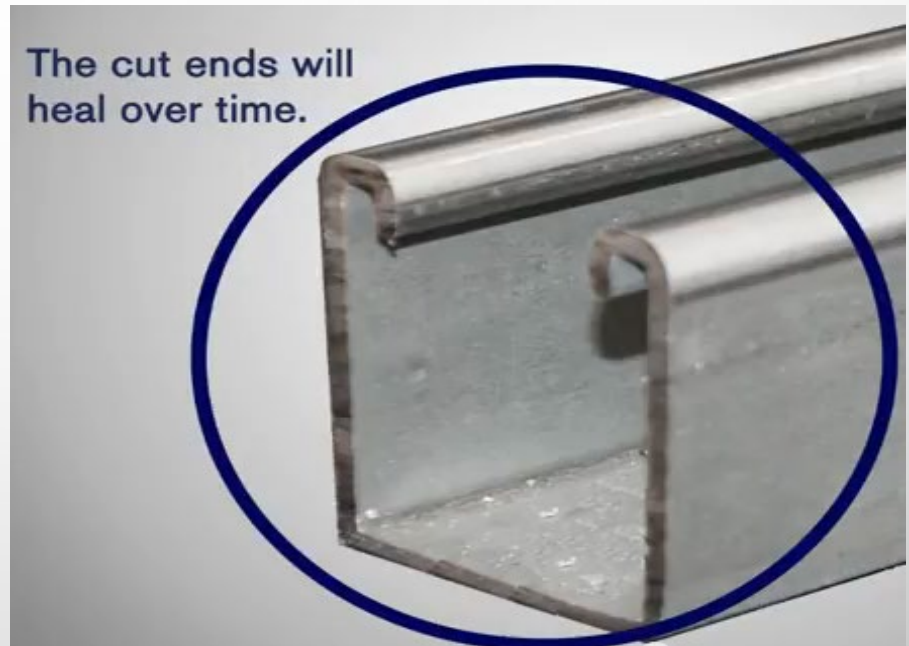
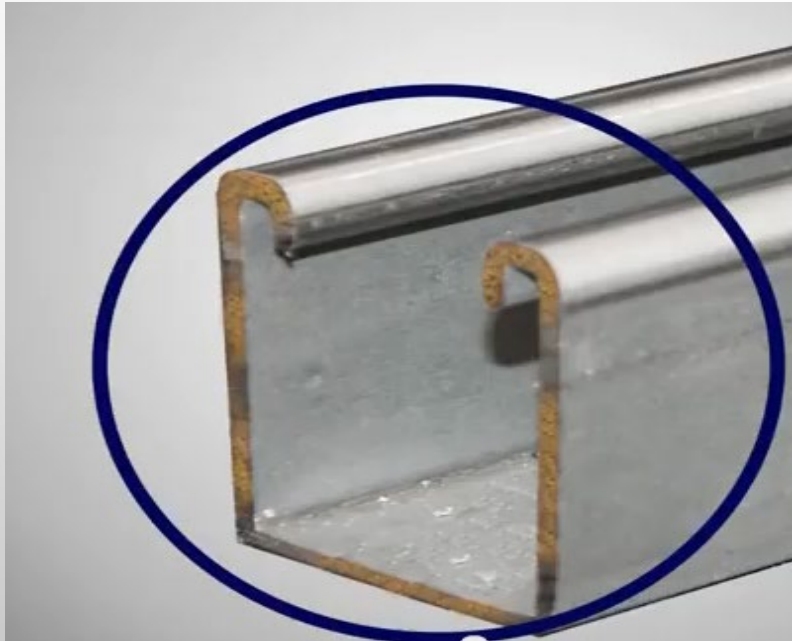


Defender

PHOTOS FROM ASTM B117 SALT SPRAY TEST:

DEFENDER CUT ENDS

Self Healing:



* The self-healing process generally takes 3 – 6 months

No need for touch-ups after cutting!

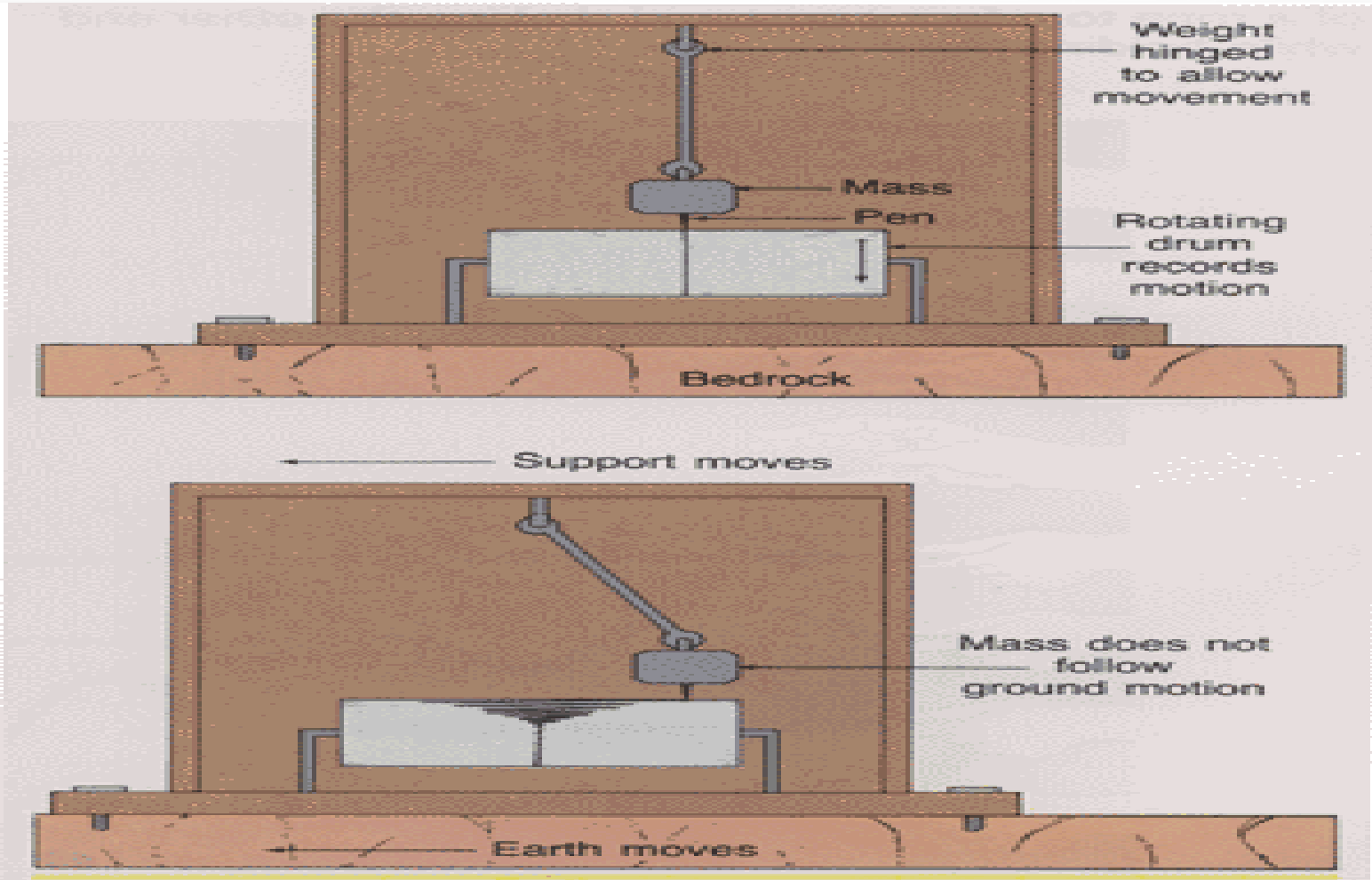
WHAT IS THIS?



3/8/2017

Slide
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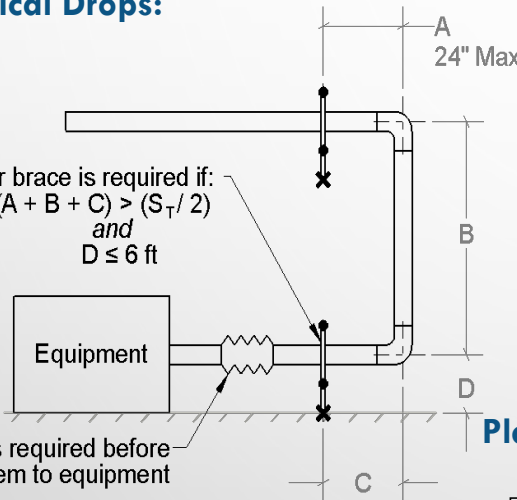
EARTHQUAKES & SEISMIC ACTIVITY



LAYOUT OF SEISMIC BRACING REQUIREMENTS

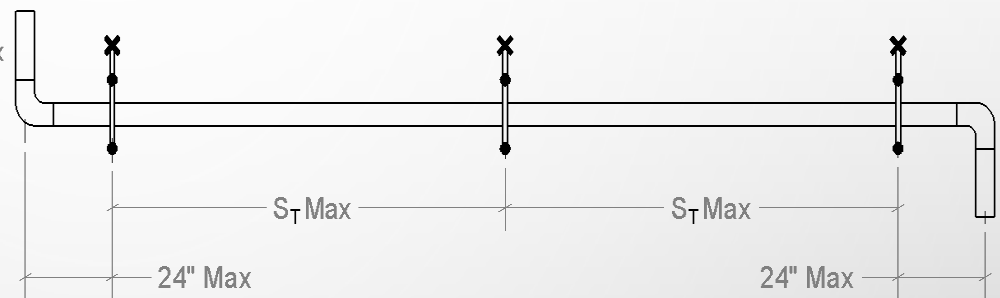
Bracing Vertical Drops:

A floor brace is required if:
 $(A + B + C) > (S_T / 2)$
 and
 $D \leq 6 \text{ ft}$

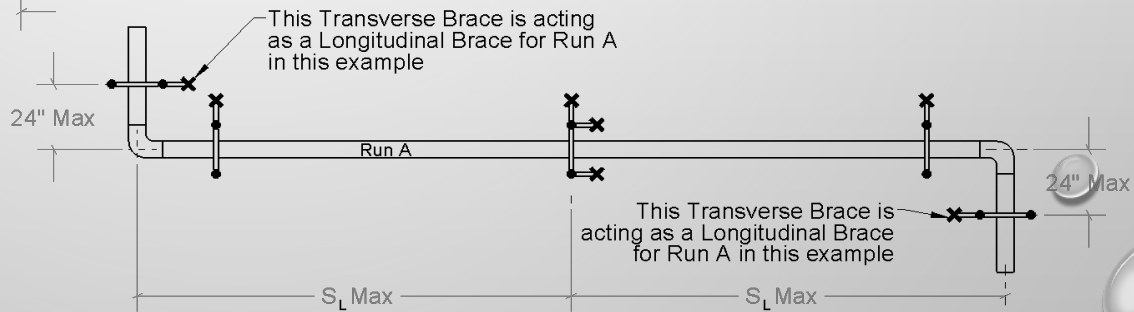


A flexible connector is required before connecting system to equipment

Placing Transverse Braces:



Placing Longitudinal Braces:



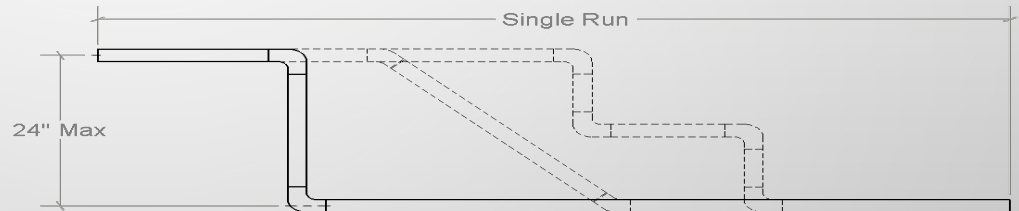
LAYOUT OF SEISMIC BRACING REQUIREMENTS

Overview:

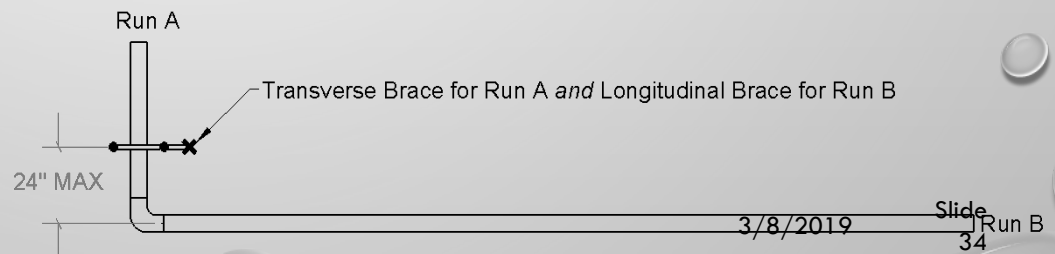
- I. There are two types of braces to restrain horizontal seismic loads.
 - Type 1: Transverse Brace – Braces against loads perpendicular to its run
 - Type 2: Longitudinal Brace – Braces against loads parallel to its run

Legend – Brace Details			
	Transverse Brace	Longitudinal Brace	Transverse & Longitudinal Brace
S_T = Maximum Transverse Brace Spacing S_L = Maximum Longitudinal Brace Spacing			

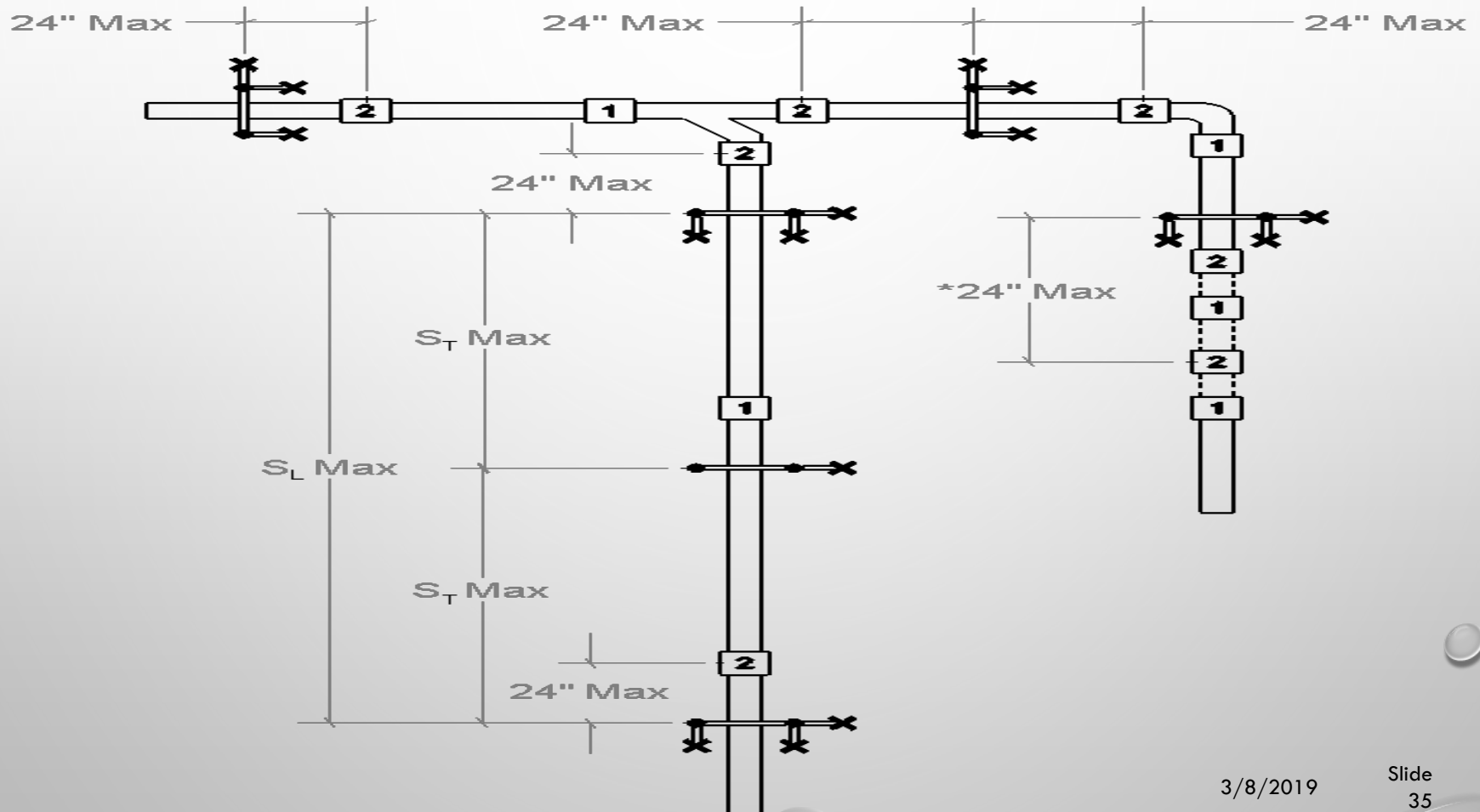
- II. Offsets of less than 24" can be treated as a single run



- III. Transverse braces located within 24" of an elbow or tee can serve as both a transverse brace for the attached run and a longitudinal brace for the adjacent run

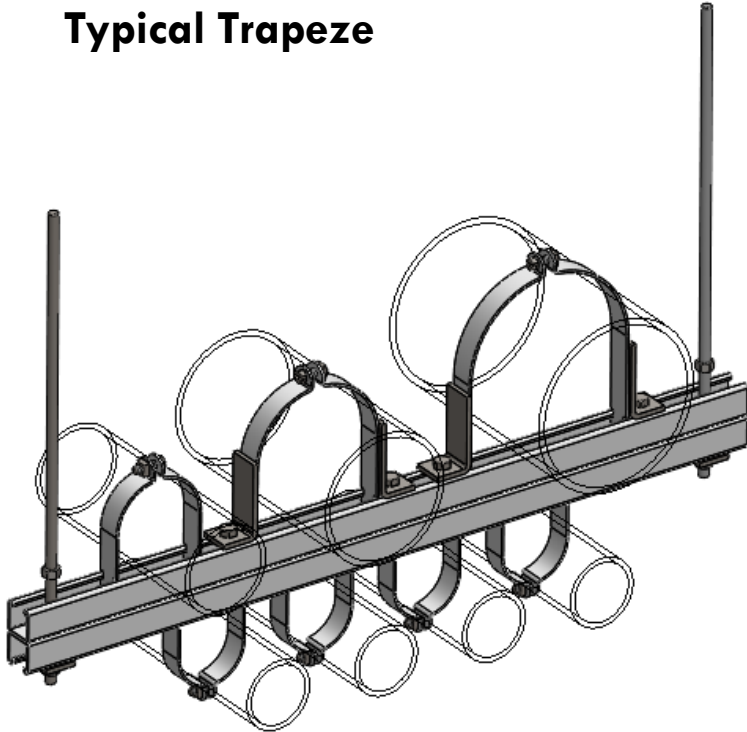


SPECIAL REQUIREMENTS FOR FIRE PROTECTION PIPING

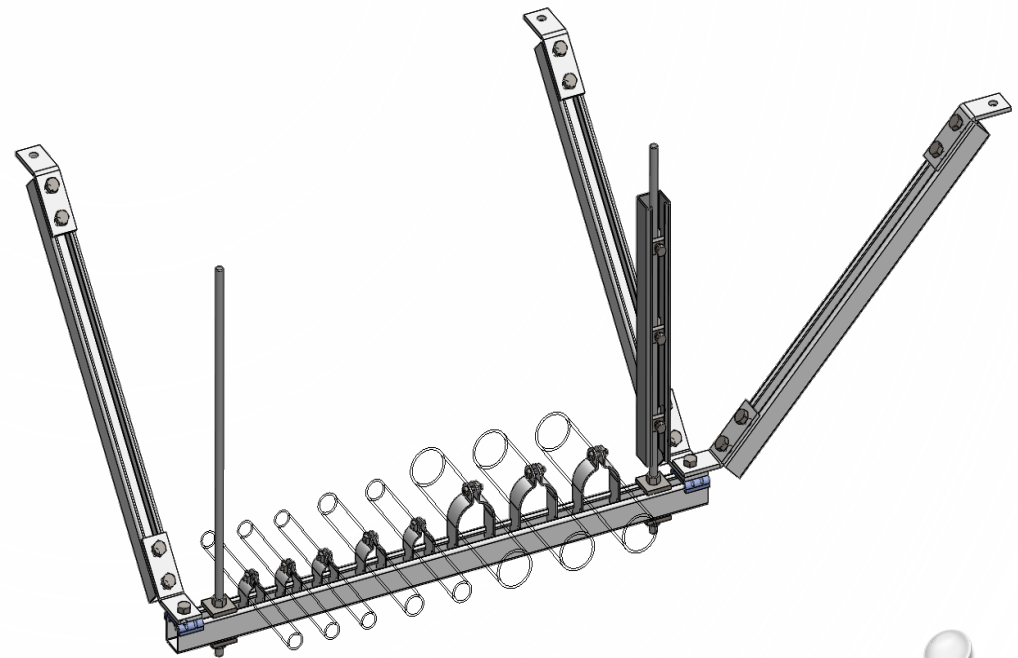


SEISMIC BRACING TYPICAL TRAPEZE

Typical Trapeze



Seismically Braced Trapeze

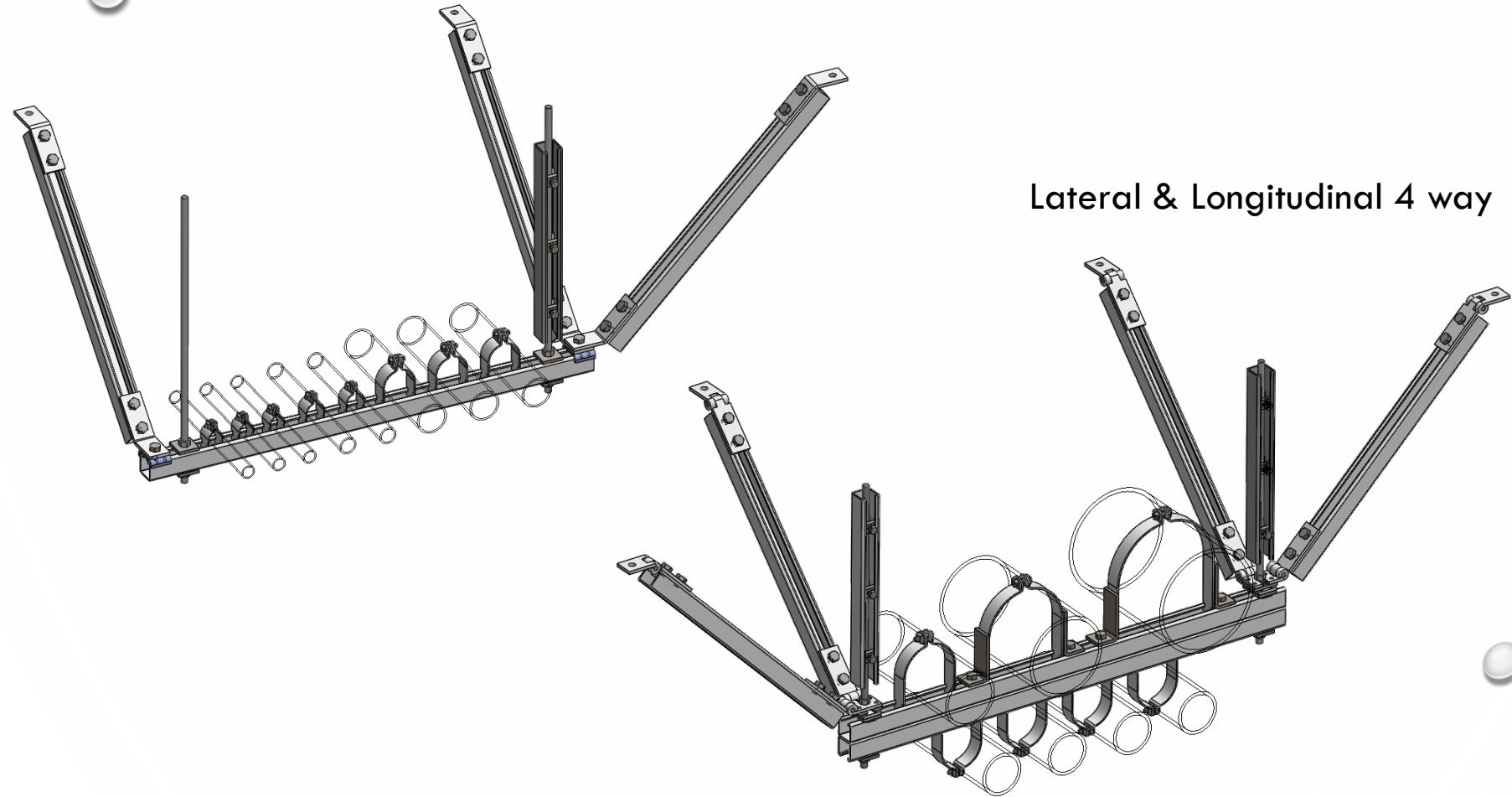


Adds:

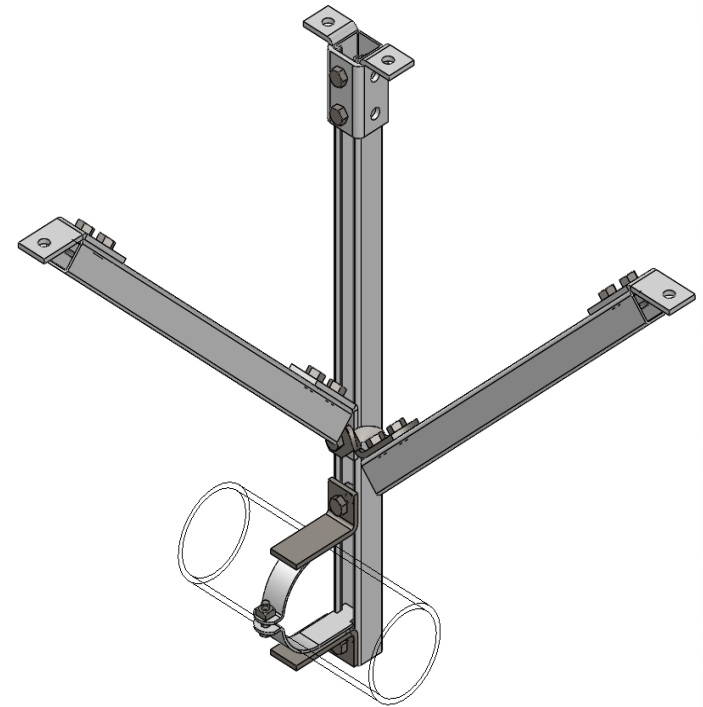
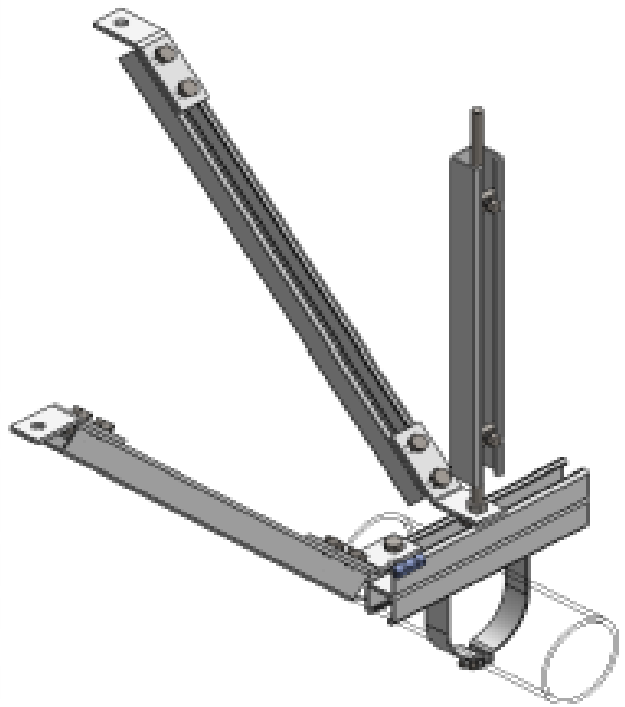
- Braces: Channel, Fittings, Hardware
- Rod Stiffeners: Channel, Rod Stiffeners

SEISMIC BRACE LATERAL & LONGITUDINAL

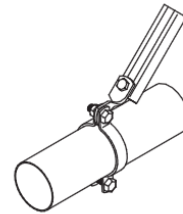
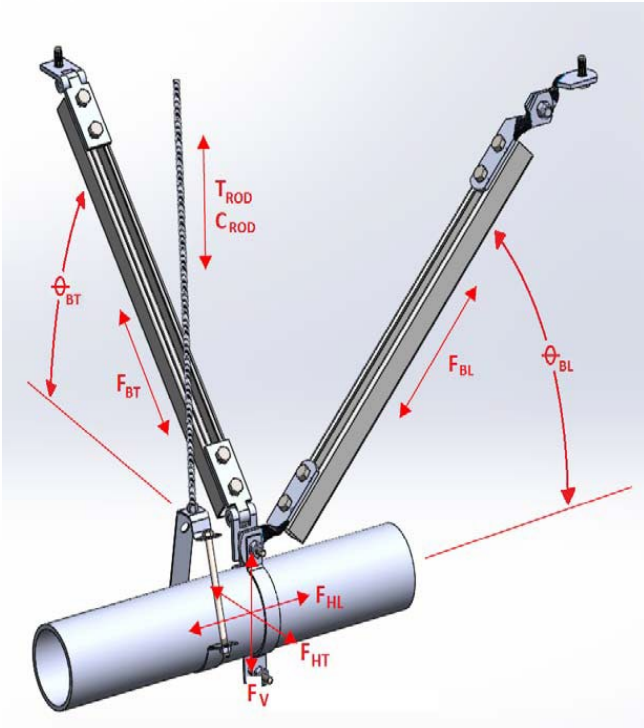
Lateral & Longitudinal 4 way



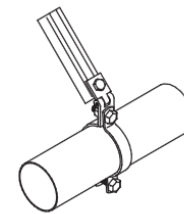
SEISMIC BRACE ON SINGLE PIPE



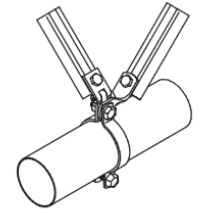
SEISMIC BRACE TYPICAL HANGERS



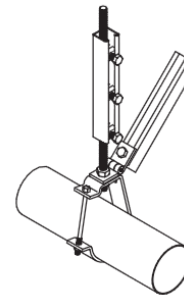
RSHP 1L
SINGLE TRANSVERSE
TO PIPE CLAMP



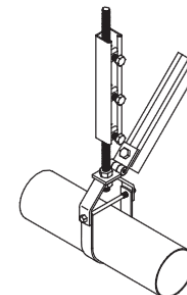
RSHP 1T
SINGLE LONGITUDINAL
TO PIPE CLAMP



RSHP 2TL
SINGLE TRANSVERSE
& LONGITUDINAL
TO PIPE CLAMP



RSHJ 1T
SINGLE TRANSVERSE
TO TOP OF HANGER



RSHC 1T
SINGLE TRANSVERSE
TO TOP OF CLEVIS

SEISMIC CABLE RESTRAINT SINGLE PIPE

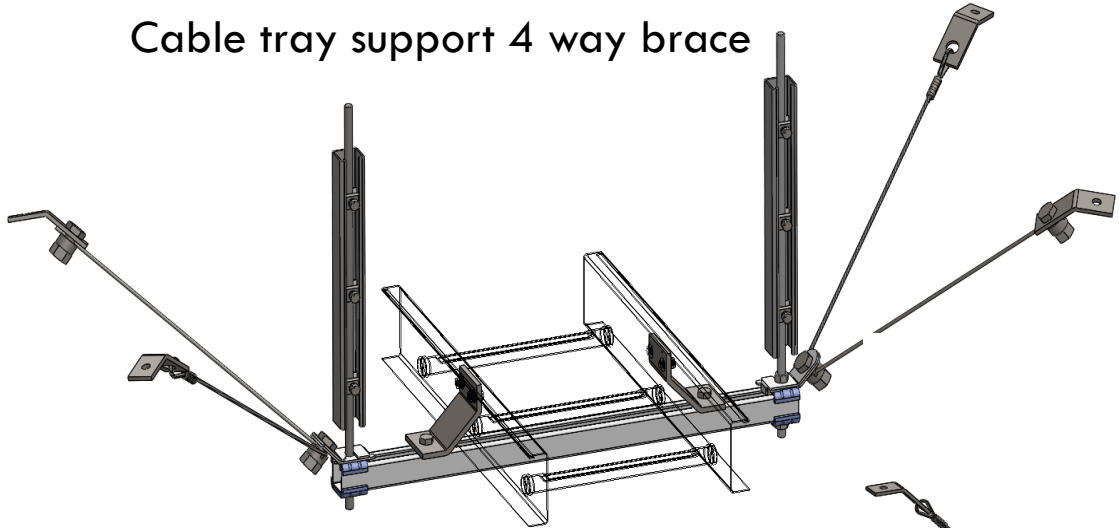


3/8/2019

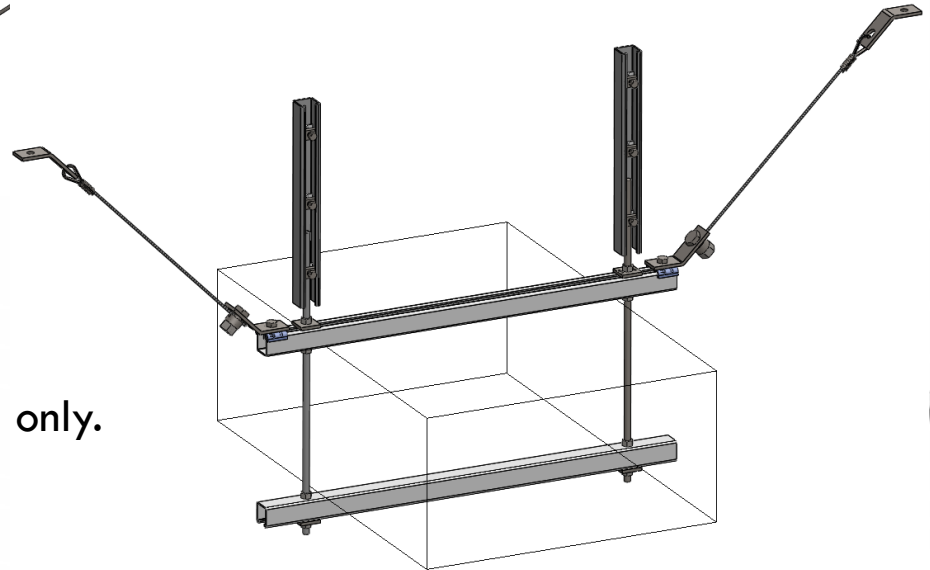
Slide
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TRAPEZE SEISMIC CABLE RESTRAINT

Cable tray support 4 way brace



Mechanical duct 2 way brace, lateral only.





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THANK YOU!