

Handbooks for the design, installation and verification of seismic protection for fire sprinkler systems

nVent CADDY
We Make Seismic Simple

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Thursday 9 May 2024



Seismic damage to/from a fire sprinkler system without seismic sway bracing



Seismic damage to a piping system



No clearance

Seismic damage to not anchored equipment



Tip over

Seismic damage to not anchored equipment



4 cm



10 cm



5 cm



20 cm



Glissement

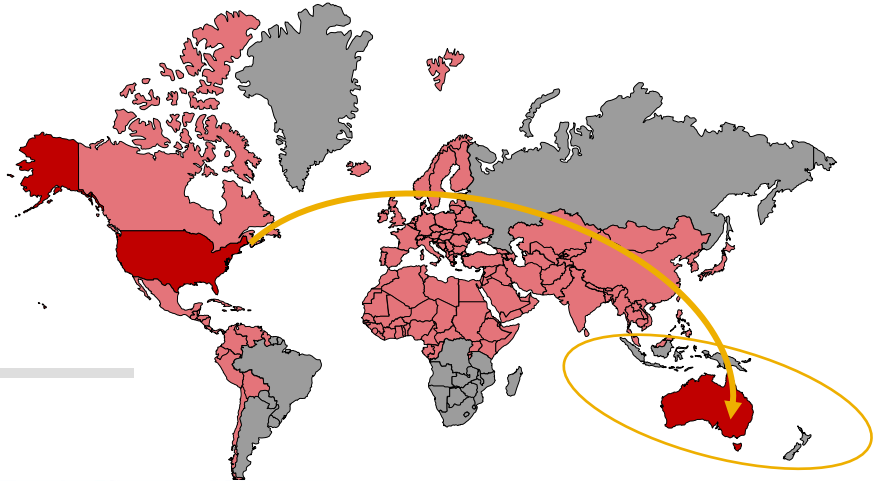
A changing world



The world and what to protect against fires are changing

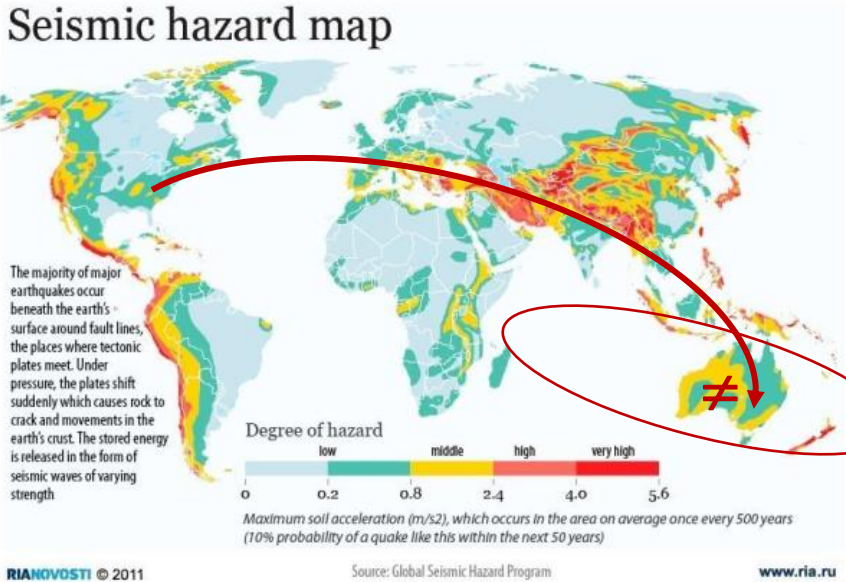
Fire protection systems and seismic protection

1 Fire Protection
 Fire Sprinkler Standards
 (from USA)
NFPA 13
FM Global



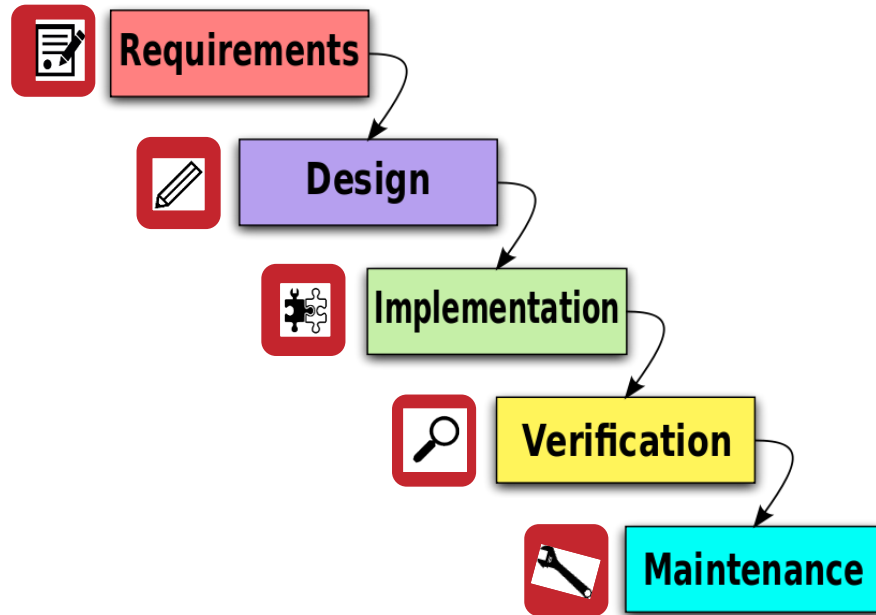
2 Seismic protection
 Seismic standard
AS 1170.4
 Performance based

- Operability of strategic infrastructures
 Immediately after and earthquake
- Operability of life-safety systems
 (fire protection systems)
- Seismic protection of life-safety systems
 (seismic protection of sprinkler systems)

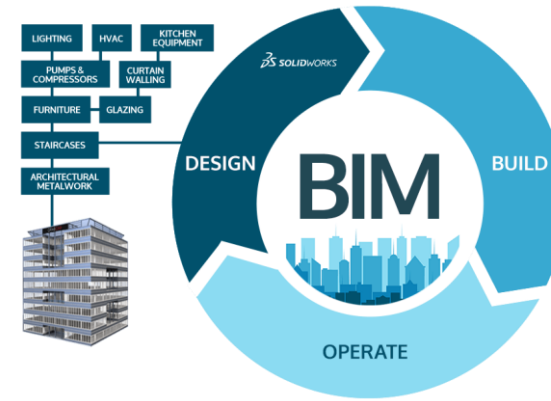


“Extension” of the use of fire sprinkler standards but different seismic standards contexts

The system realization process



Advanced approach



Protection

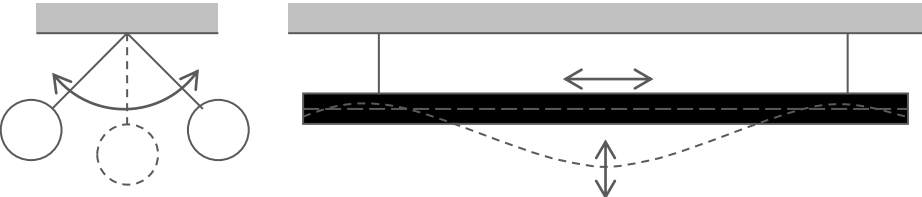


Multiple players

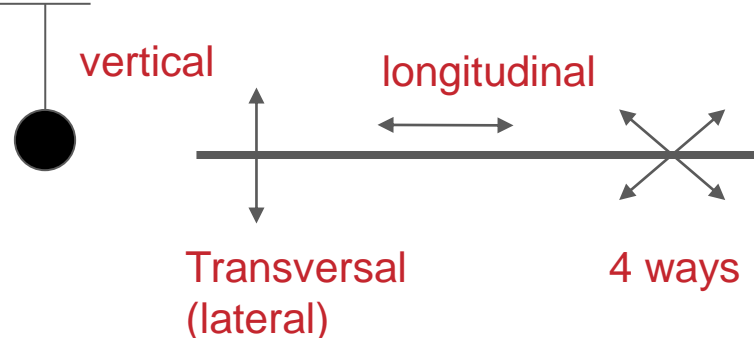
Piping systems seismic challenges

System seismic response

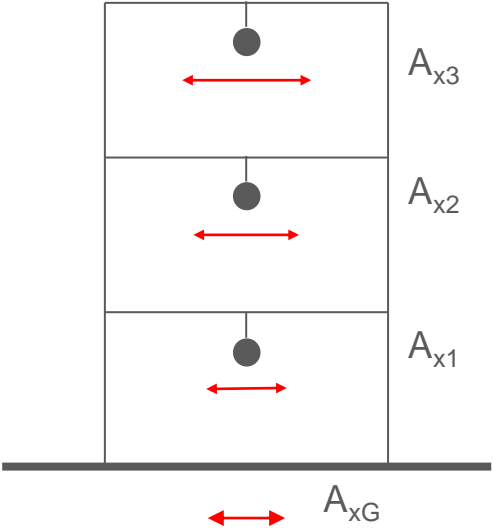
Potential problems: Lateral and Longitudinal sway



Seismic protection



Seismic force

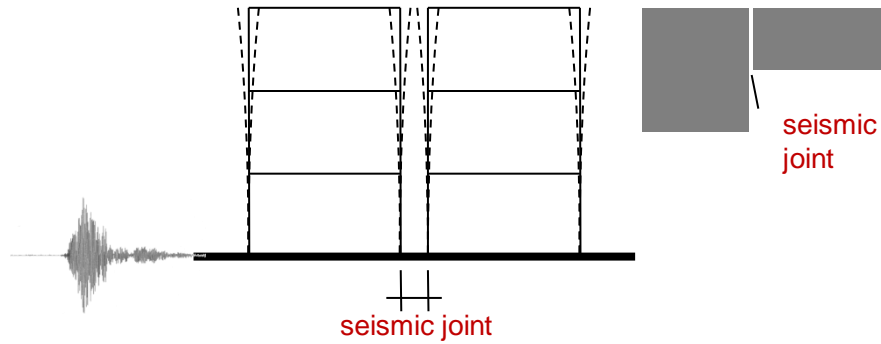


Layout and sizing of seismic protection systems



Motion and rupture, worsened by height of installation

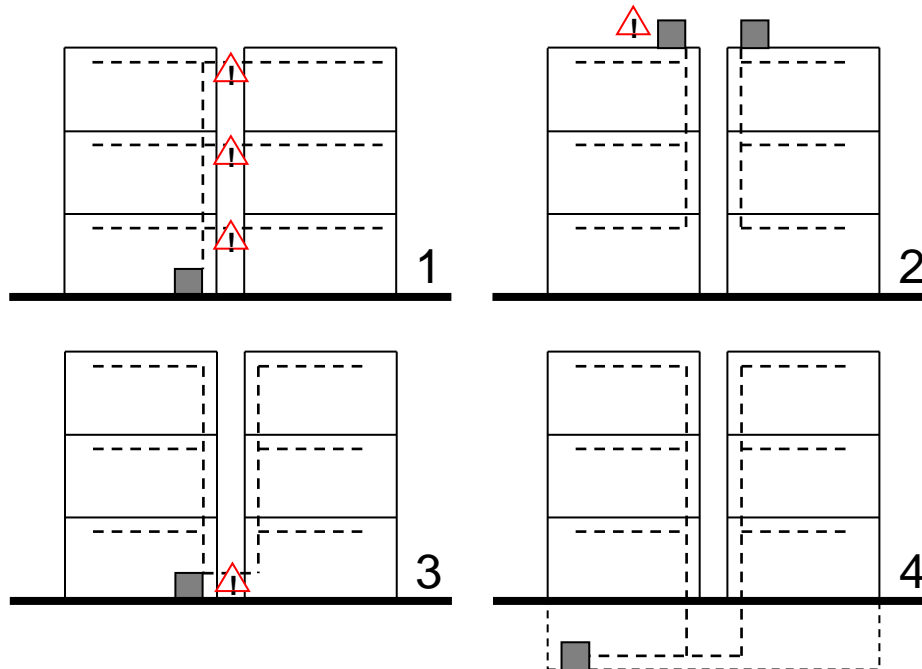
Integrated seismic design



Structural Design

To eliminate or reduce the configuration-related problems/weaknesses

- **Regularization**
- **Introduction of seismic joints**



Systems Design

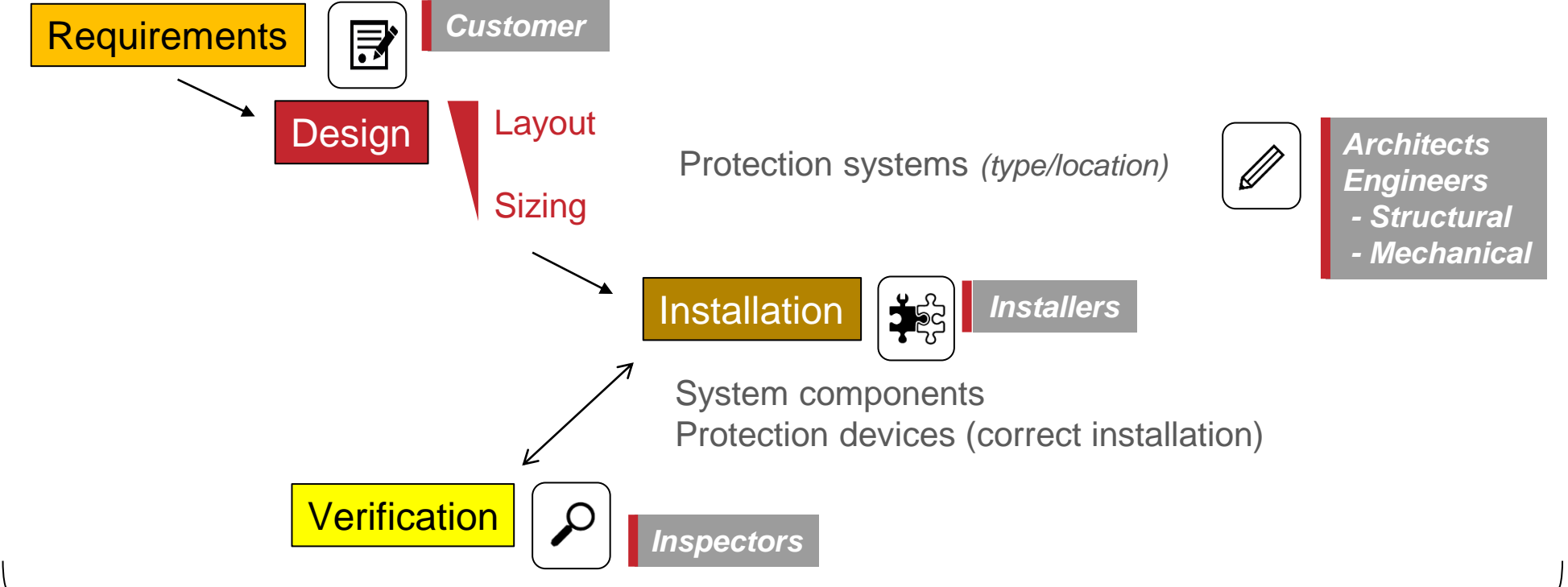
To eliminate or reduce the configuration-related problems/weaknesses

- **Reduce the number of joint crossings (1 → 2, 3 or 4)**
- **Cross at lower/est level (1 and 2 → 3 or 4)**



Smart seismic structural design and seismic system design choices reduce the seismic risk

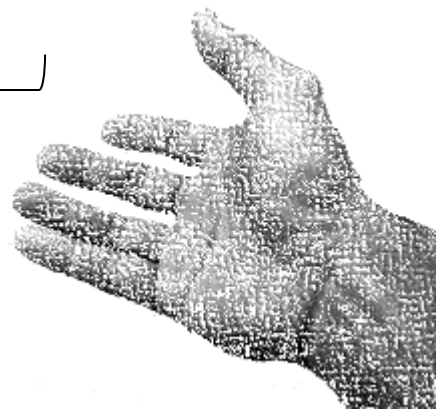
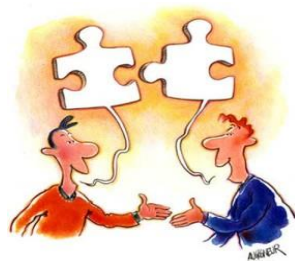
Many players



Plurality of players with different languages and different approaches



Interface support and common reference tools could play an important role





The 4 aspects of an effective seismic protection

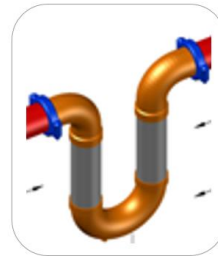
SWAY BRACING



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FLEXIBILITY



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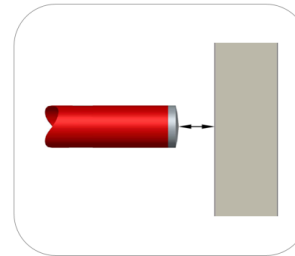
EQUIPMENT ANCHORING



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CLEARANCE

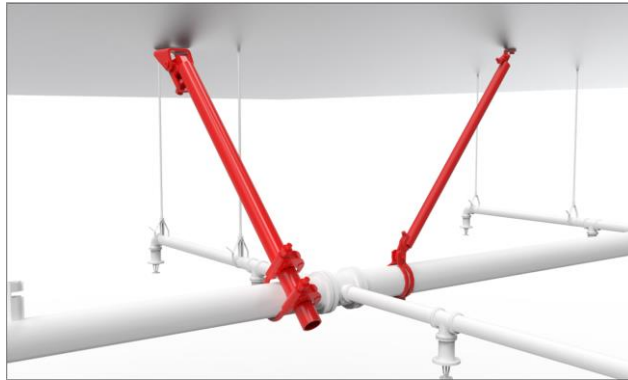


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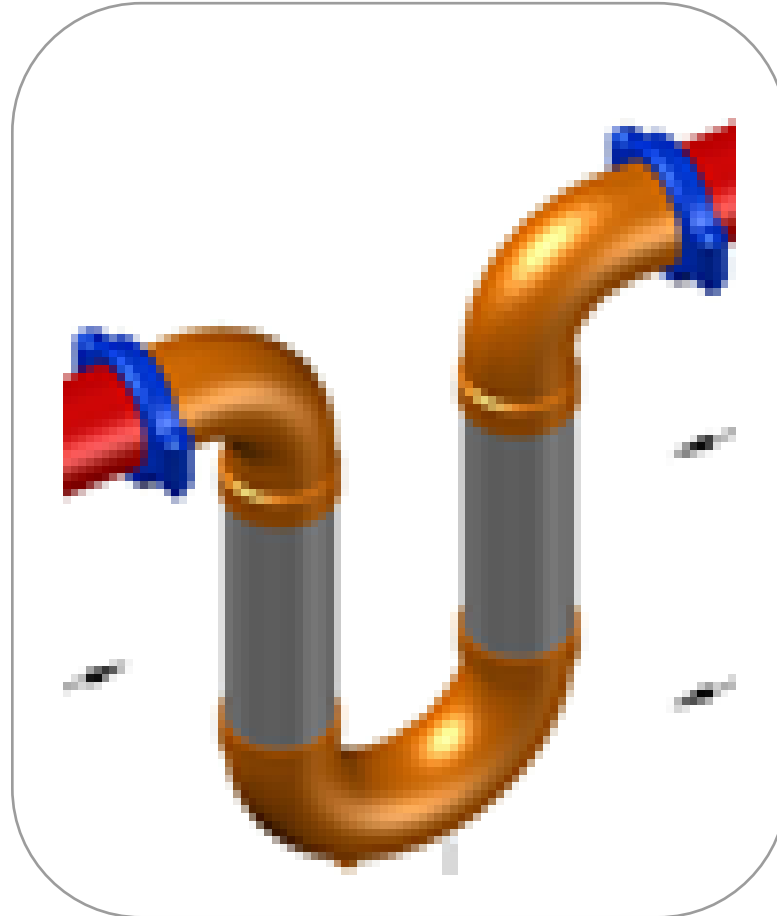
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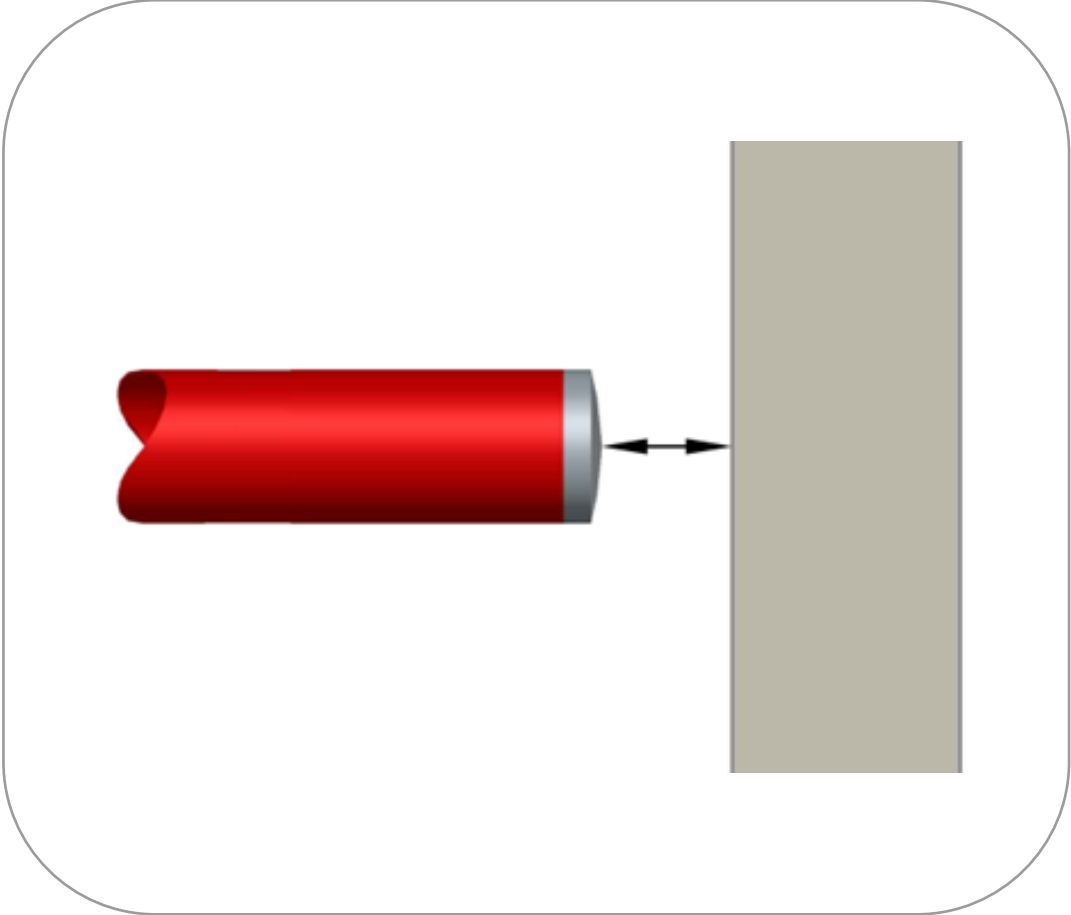
SWAY BRACING



FLEXIBILITY



CLEARANCE

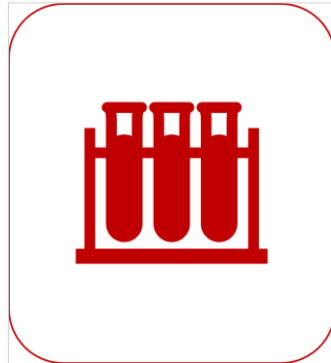


EQUIPMENT ANCHORING





The 4 pillars of a sound seismic protection





The 4 pillars of a sound seismic protection



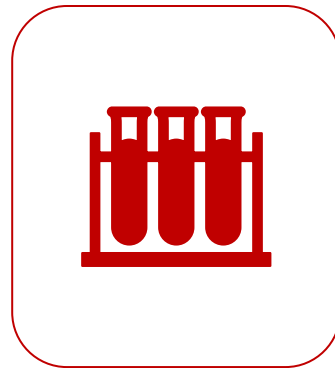


The 4 pillars of a sound seismic protection





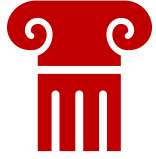
The 4 pillars of a sound seismic protection



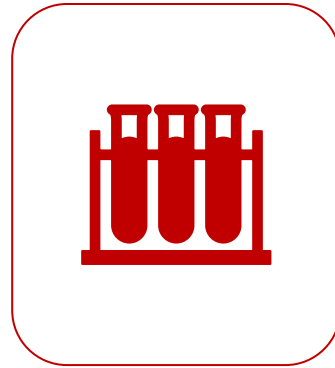


The 4 pillars of a sound seismic protection





The 4 pillars of a sound seismic protection



1. Agreed upon requirements –
2. Load path calculation –
3. Use products tested for seismic protection application –
4. Independent verification of the installation

Seismic protection for fire sprinkler: an example

Manifolded Risers



Seismic protection for fire sprinkler: an example

Manifolded Risers



1

Start from «Sway bracing» section



2.2.1.1 Sway Bracing Locations for Steel Piping

Guidance in this section applies to steel pipe. See 2.2.1.9 for other pipe materials.

2.2.1.1.1 At a minimum, locate and space sway bracing for sprinkler system (ceiling and in-rack) and hose system steel piping per this section. Braces and their attachments must also be sized to resist design forces per 2.2.1.2 and configured per 2.2.1.3. Provide additional sway braces when necessary to reduce the tributary load so the brace capacity is not exceeded or so sway bracing locations will coincide with adequate structural members to which the sway braces will be attached. Also see further commentary in Section 3.1.2.

2.2.1.1.2 Provide adequately sized and configured bracing on sprinkler system risers, whether they are single or manifolded type and regardless of size, in accordance with the following guidelines. Also see further commentary in Section 3.1.3.

2.2.1.1.2.1 Provide a four-way sway brace within 2 ft (0.6 m) of the top of each riser. When possible, avoid the use of a single manifolded sway bracing assembly at the top of multiple adjacent risers. If used, limit the manifolded arrangement to two risers.

2.2.1.1.2.2 In multistory buildings, provide a four-way brace on the riser within 2 ft (0.6 m) of each building floor level. A four-way brace can be considered to exist when the riser passes through a structural floor and clearances do not allow more than ½ in. (13 mm) movement in any horizontal direction (note: this arrangement will require additional flexible couplings on the riser; see 2.2.1.4.3.3).

2.2.1.1.2.3 Provide additional intermediate four-way sway bracing on risers at an interval not to exceed 40 ft (12.2 m). Where flexible couplings are used, arrange this intermediate four-way sway bracing so a brace is provided within 2 ft (0.6 m) of **every other** flexible coupling (adding four-way braces if necessary). For risers in multistory buildings or towers that have attached feed or cross mains not located at floor levels, add four-way braces if necessary such that a brace is provided within 2 ft (0.6 m) of these mains.


2.2.1.1.2.4 For risers fed from horizontal manifold piping, provide a two-way lateral sway brace within 2 ft (0.6 m) of the end of any horizontal manifold piping longer than 6 ft (1.8 m), or when any flexible couplings are used on either the horizontal manifold piping or on the riser stub between the floor and the connection to the horizontal manifold piping. See Fig. 2.2.1.1.2.




Seismic protection for fire sprinkler: an example

Manifolded Risers



1 | Start from «Sway bracing» section 

2 | Continue with the «Flexibility» section 

2.2.1.1 Sway Bracing Locations for Steel Piping

Guidance in this section applies to steel pipe. See 2.2.1.9 for other pipe materials.

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2.2.1.1.2 Provide adequately sized and configured bracing on sprinkler system risers, whether they are single or manifolded type and regardless of size, in accordance with the following guidelines. Also see further commentary in 2.2.1.4 Flexibility Needed to Allow Differential Movement

2.2.1.1.2.1 Provide the use of a single manifolded

2.2.1.1.2.2 In a floor level. A foot clearances do not require additional

2.2.1.1.2.3 Provide within 12 ft (3.7 m) when provided within in multistory buildings by four-way braces

2.2.1.1.2.4 For (0.6 m) of the riser are used on either side of the horizontal

2.2.1.4.1 Provide adequate flexibility between portions of properly braced, welded and non-welded sprinkler systems, regardless of pipe size, that are expected to move differentially with respect to each other using the following guidelines and techniques.

Guidance in this section applies to steel pipe. See 2.2.1.9 for other pipe materials.

2.2.1.4.2 If more flexible couplings are installed than recommended in this section, provide additional lateral sway bracing to prevent excessive movement of piping per 2.2.1.1.2.3, 2.2.1.1.4.3 and 2.2.1.1.5.1.E.

2.2.1.4.3 Provide flexibility for sprinkler risers per the following recommendations.

2.2.1.4.3.1 Provide a flexible coupling within 2 ft (0.6 m) of the top and bottom of each individual riser that is connected directly to underground piping (see Fig. 3.1.3 in the Section 3.1.3 commentary for details). This applies to risers located outside and inside buildings. Where welded piping systems exist from the riser through the cross mains, the flexible coupling at the top of the riser may be omitted.

2.2.1.4.3.2 When multiple risers are supplied by a single manifold connection to an underground main, provide each riser with a flexible coupling within 2 ft (0.6 m) of the top, and a flexible coupling within 2 ft (0.6 m) of the bottom where connected to the manifold. Locate the horizontal manifold piping 3 ft (0.9 m) or less above floor level and brace manifold piping when needed (see 2.2.1.1.2.4). Connect the horizontal manifold to the main riser and the main riser to the riser stub at floor level with flanged or other rigid connections (see Fig. 2.2.1.1.2). Where welded piping systems exist from the riser through the cross mains, the flexible coupling at the top of the riser may be omitted.

2.2.1.4.3.3 For multistory building risers, additional flexible coupling(s) are needed at each floor level. When the pipe doesn't penetrate a floor slab, steel plate, etc. (e.g., is in an open tower), or when it does penetrate one of these elements and clearances meet the recommendations of 2.2.1.5.1, locate the flexible coupling within 1 ft (0.3 m) of the floor (either above or below the floor; see Fig. 2.2.1.4.3). Where clearances per 2.2.1.5.1 are not provided, install flexible couplings within 1 ft (0.3 m) both above and below the floor. (Exception: the flexible coupling below the floor should be located below any main supplying that floor.)

2.2.1.4.3.4 Flexible couplings are not needed on riser piping beneath floors that rest directly on the ground; however, a flexible coupling is needed above the ground floor as recommended in 2.2.1.4.3.1 and 2.2.1.4.3.2.




2.2.1.4.3.5 Provide a flexible coupling within 2 ft (0.6 m) above or below any intermediate points of bracing for risers. Where welded piping systems exist from the riser through the cross mains, these flexible couplings may be omitted.



Seismic protection for fire sprinkler: an example

Manifolded Risers



- 1 | Start from **sway bracing** section 
- 2 | Continue with the **flexibility** section 
- 3 | Then, look at the **clearance** section 

2.2.1.1 Sway Bracing Locations for Steel Piping
Guidance in this section applies to steel pipe. See 2.2.1.9 for other pipe materials.

2.2.1.4 Flexibility Needed to Allow Differential Movement
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2.2.1.4.3 Provide flexibility for sprinkler risers per the following recommendations:




2.2.1.5 Clearance
2.2.1.5.1 Provide clearance around piping through walls or floors per the following guidelines.
2.2.1.5.1.1 Except as allowed in 2.2.1.5.1.2, where piping passes through walls, platforms, mezzanines, roofs, or floors, provide a hole or sleeve with a nominal diameter 2 in. (50 mm) larger than the pipe for pipes 1 in. (25 mm) diameter through 3 1/2 in. (90 mm), and 4 in. (100 mm) larger than the pipe for pipe sizes 4 in. (100 mm) and larger. Openings may be sealed with mastic or a weak, frangible mortar. If the pipe passes through a fire separation, the space can be filled with mineral wool held in place with a pipe collar.
2.2.1.5.1.2 Clearance is not needed when wall material is frangible, such as gypsum board, and the wall is not required to have a fire rating, or when flexible couplings are provided on both sides of the penetration per 2.2.1.4.3.3 or 2.2.1.4.4.4.
2.2.1.5.2 Provide at least 2 in. (50 mm) clearance between piping and walls/structural members in the following locations:
A. Between ends of piping and walls/structural members
B. When piping passes through walls/structural members, then turns 90 degrees to run parallel to the wall, between the parallel pipe run and the wall/member
C. When piping passes through walls/structural members, between any flanges, fittings, or other devices on the piping and the wall
2.2.1.5.3 Provide clearance to sprinklers per the following guidelines.
2.2.1.5.3.1 For sprinklers installed in suspended ceilings, provide an oversize adapter through the ceiling tile to allow for free movement, in all horizontal directions, of not less than 1/2 in. (13 mm), and preferably not less than 1 in. (25 mm) (i.e., a hole diameter that is 1 in. [25 mm] to 2 in. [50 mm] larger than the diameter of the sprinkler or pipe through the ceiling). Alternatively, accommodate differential movement by connecting to overhead pipe using FM Approved flexible sprinkler hose (for this alternative, the suspended ceiling must meet the requirements of the FM Approval and must be seismically designed per 2.2.1.6.2).
2.2.1.5.3.2 For other sprinklers, provide vertical and horizontal clearance of at least 2 in. (50 mm) to structural or nonstructural elements. A smaller clearance is acceptable where the system is arranged so that less relative movement between the sprinkler and the object is expected (e.g., by providing hangers that limit upward vertical movement per 2.2.1.8.1 or by accommodating the movement with FM Approved flexible sprinkler hose) or where the sprinkler is protected from impact. Provide greater horizontal clearance (4-6 in. [100-150 mm]) to sprinklers when possible.



Seismic protection for fire sprinkler: an example

Manifolded Risers



- 1 | Start from **sway bracing** section 
- 2 | Continue with the **flexibility** section 
- 3 | Then, look at the **clearance** section 

2.2.1.1 Sway Bracing Locations for Steel Piping
 Guidance in this section applies to steel pipe. See 2.2.1.9 for other pipe materials.

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2.2.1.4.2 If more flexible couplings are installed than recommended in this section, provide additional lateral sway bracing to prevent excessive movement of piping per 2.2.1.1.2.3, 2.2.1.1.4.3 and 2.2.1.1.5.1.E.

2.2.1.4.3 Provide flexibility for sprinkler risers per the following recommendations:

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2.2.1.5.1.2 Clearance is not needed when wall material is frangible, such as gypsum board, and the wall is not required to have a fire rating, or when flexible couplings are provided on both sides of the penetration per 2.2.1.4.3.3 or 2.2.1.4.4.4.

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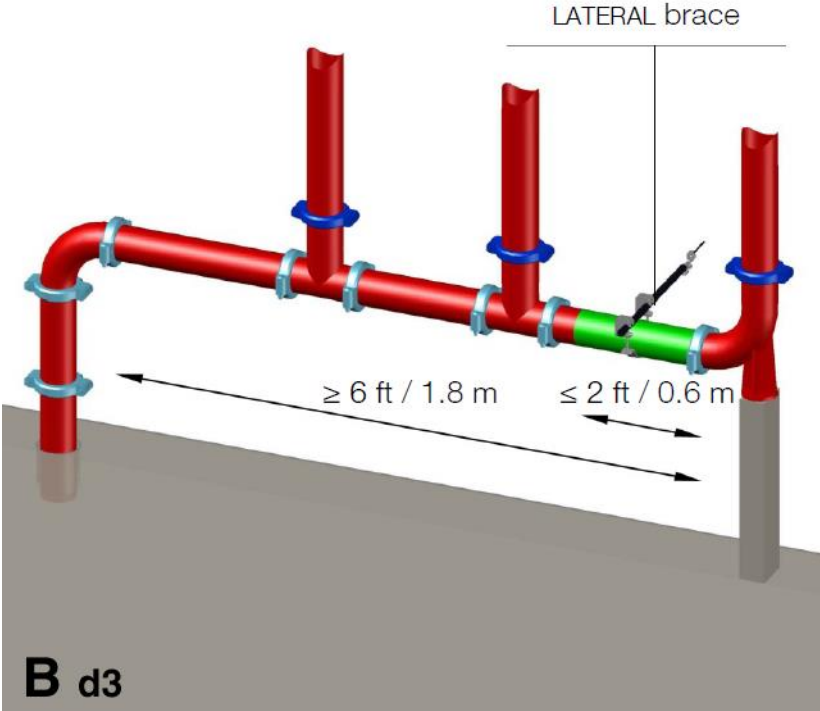
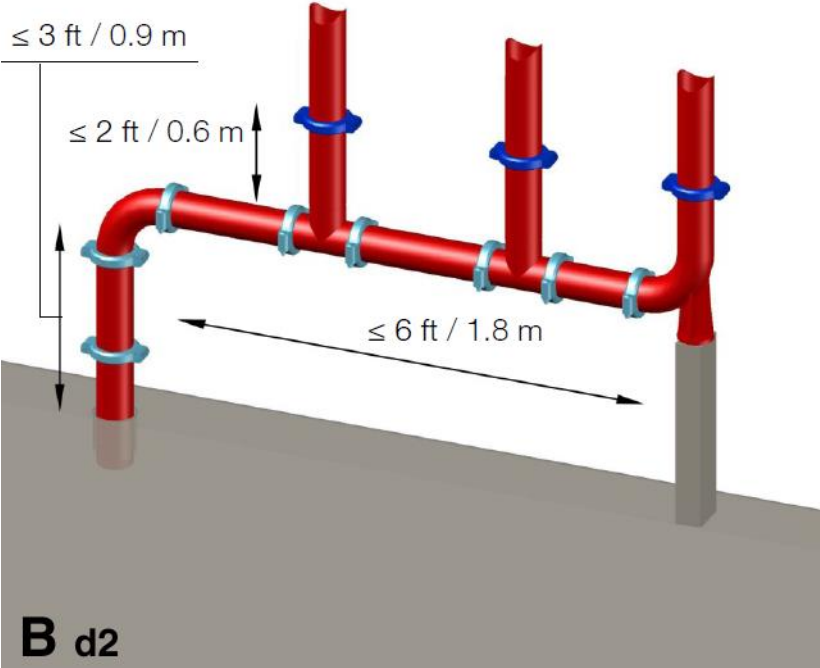
2.2.1.5.3.2 For other sprinklers, provide vertical and horizontal clearance of at least 2 in. (50 mm) to structural or nonstructural elements. A smaller clearance is acceptable where the system is arranged so that less relative movement between the sprinkler and the object is expected (e.g., by providing hangers that limit upward vertical movement per 2.2.1.8.1 or by accommodating the movement with FM Approved flexible sprinkler hose) or where the sprinkler is protected from impact. Provide greater horizontal clearance (4-6 in. [100-150 mm]) to sprinklers when possible.



How to explain to a non-expert? How do the multiple players get on the same page?

Seismic protection for fire sprinkler: an example

Manifolded Risers



Illustrations is the answer

“Translation” into a visual language

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October 2017
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EARTHQUAKE PROTECTION FOR WATER-BASED FIRE PROTECTION SYSTEMS

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2.2.1.1.4.2 At ends of horizontal feed mains and cross mains, provide lateral bracing within 6 ft (1.8 m) of the end, and provide longitudinal bracing within 40 ft (12.2 m) of the end. Consider seismic separation assemblies and flexible pipe loops in feed mains and cross mains per 2.2.1.4.8 as the end of the piping on both sides of the assembly or loop.

2.2.1.1.4.3 When unnecessary flexible couplings (i.e., more flexible couplings than recommended in 2.2.1.4) are installed on horizontal feed mains or cross mains, provide additional lateral sway bracing as follows:

A. Within 2 ft (0.6 m) of every other flexible coupling on straight pipe runs, and

B. Within 2 ft (0.6 m) of any horizontal change of pipe direction having flexible couplings but not braced per 2.2.1.1.4.1.

2.2.1.1.4.4 For straight pipe runs, after giving credit to any sway bracing installed per Sections 2.2.1.1.2 to 2.2.1.1.4.3, provide sway bracing on horizontal feed mains and cross mains at a maximum spacing of 40 ft (12.2 m) for lateral sway bracing and 80 ft (24.4 m) for longitudinal sway bracing using the following guidelines:

A. A four-way brace on a vertical pipe (e.g., at the top of the riser) may be counted as the initial lateral and longitudinal brace for the attached horizontal pipe (i.e., feed main or cross main) of the same or smaller diameter when the brace is located within 2 ft (0.6 m) of the horizontal pipe.

B. A lateral brace within 2 ft (0.6 m) of a feed main or cross main piping connection to another main that is perpendicular and of the same or lesser diameter may be used to also act as a longitudinal brace for the perpendicular main.

C. A longitudinal brace within 2 ft (0.6 m) of the end of a feed main or cross main piping connection to another main that is perpendicular and of the same or lesser diameter may be used to also act as a lateral brace for the perpendicular main.

2.2.1.1.4.8 The following terms or configurations may not be used to provide, or allow the omission of, lateral or longitudinal sway bracing on any horizontal feed main or cross main:

A. U-hangers, including wraparound types (however, U-bolts configured per 2.2.1.3.2 may be used as lateral bracing).

B. Feed mains and cross mains supported by hangers having short rods.

C. Sway bracing on branch lines.

2.2.1.1.8 Provide adequately sized and configured bracing on sprinkler system branch lines as described below. See also 2.2.1.1.6 for additional lateral restraint requirements at ends of branch lines.

2.2.1.1.8.1 Provide lateral sway bracing on 2½ in. (65 mm) diameter and larger branch lines and portions of branch lines that are greater than 20 ft (6.1 m) in length in accordance with the following guidelines:

A. For branch lines less than 4 ft (1200 mm) in diameter, lateral sway bracing is not needed on pipes individually supported by rods that meet the following criteria:

1. All rods have a length less than 6 in. (150 mm) from the supporting member attachment to the top of the branch line, and
2. there is no more than 12 in. (315 mm) of space between the top of the branch line piping and the bottom of the support rod.

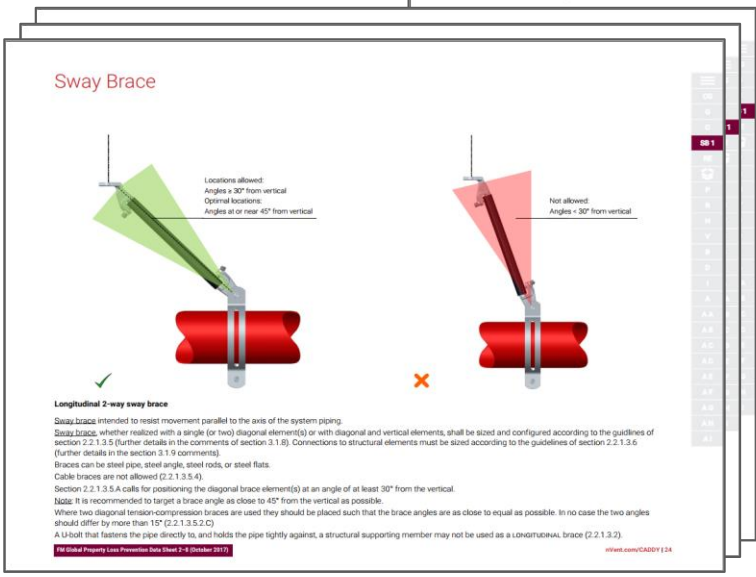
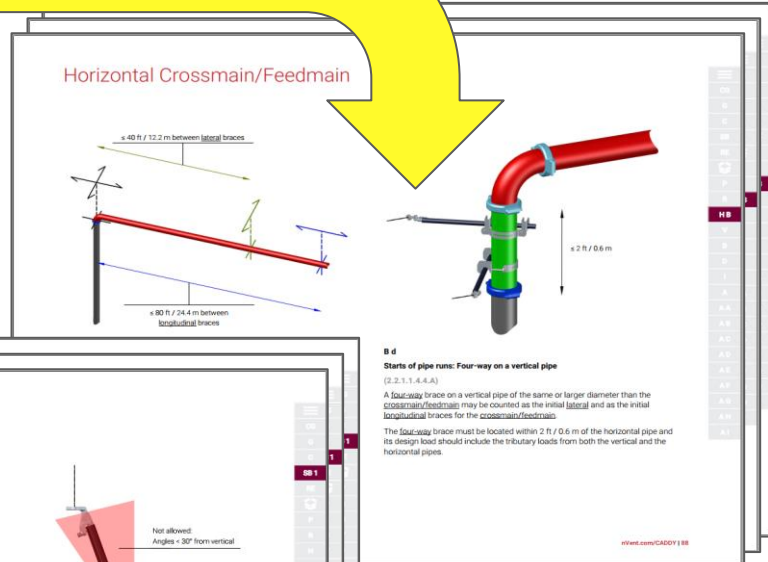
B. A four-way brace on a vertical pipe (e.g., at the bottom of a drop) may be counted as the initial lateral brace for the attached horizontal branch line of the same or smaller diameter when the brace is located within 2 ft (0.6 m) of the horizontal pipe.

C. A longitudinal brace within 2 ft (0.6 m) of the end of a branch line connection to another branch line that is perpendicular and of the same or lesser diameter may be used to also act as a lateral brace for the perpendicular branch line.

D. U-bolts configured per 2.2.1.3.2 and wraparound U-hangers (but not other types of U-hangers) meeting the criteria per 2.2.1.3.4 may be used as lateral sway bracing for branch lines.

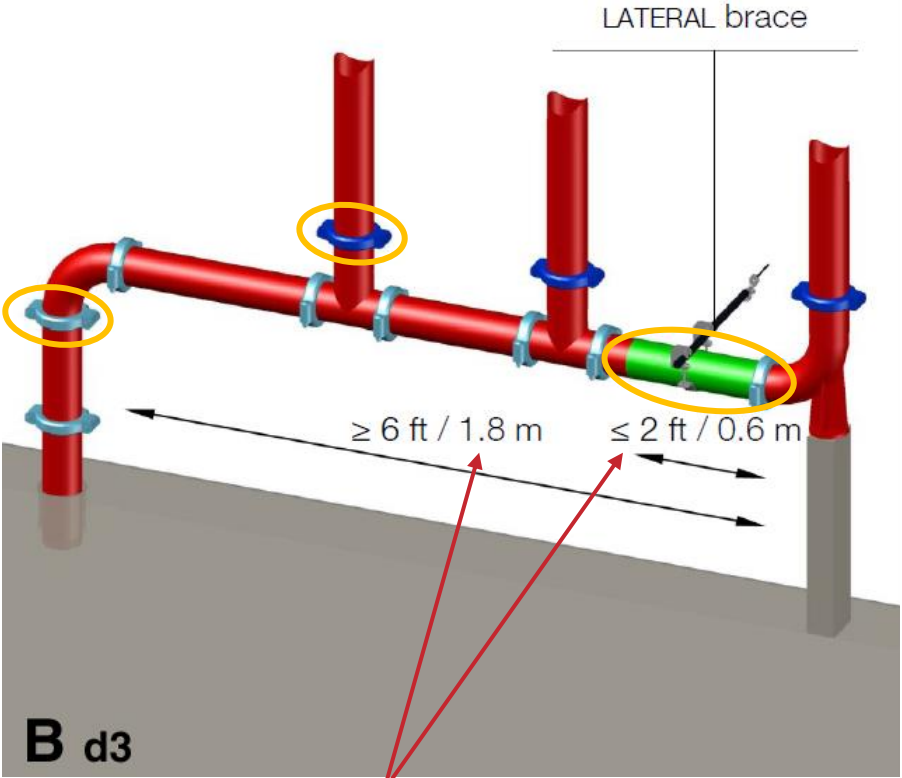
E. When more flexible couplings than recommended in 2.2.1.4 are installed on branch lines, provide additional lateral sway bracing.

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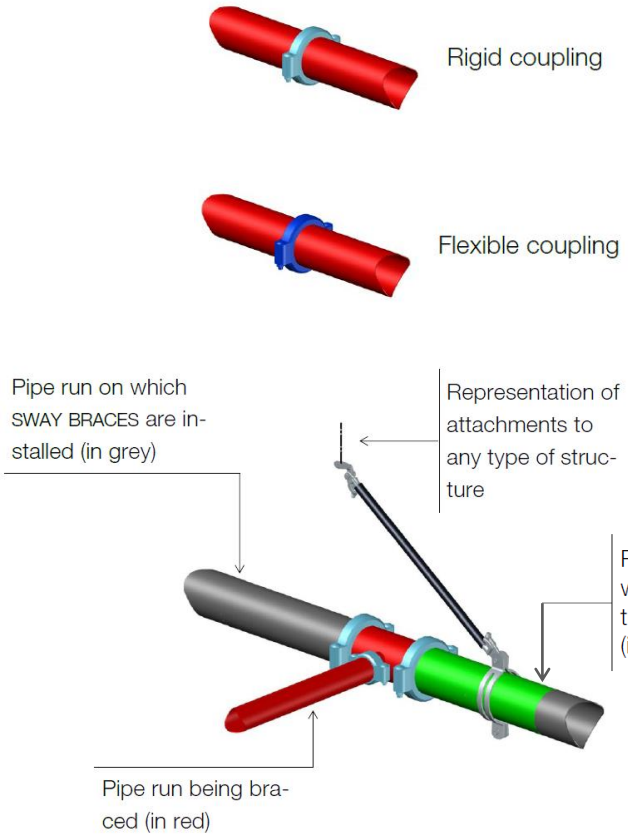


A picture is worth 1000 words

Color coding

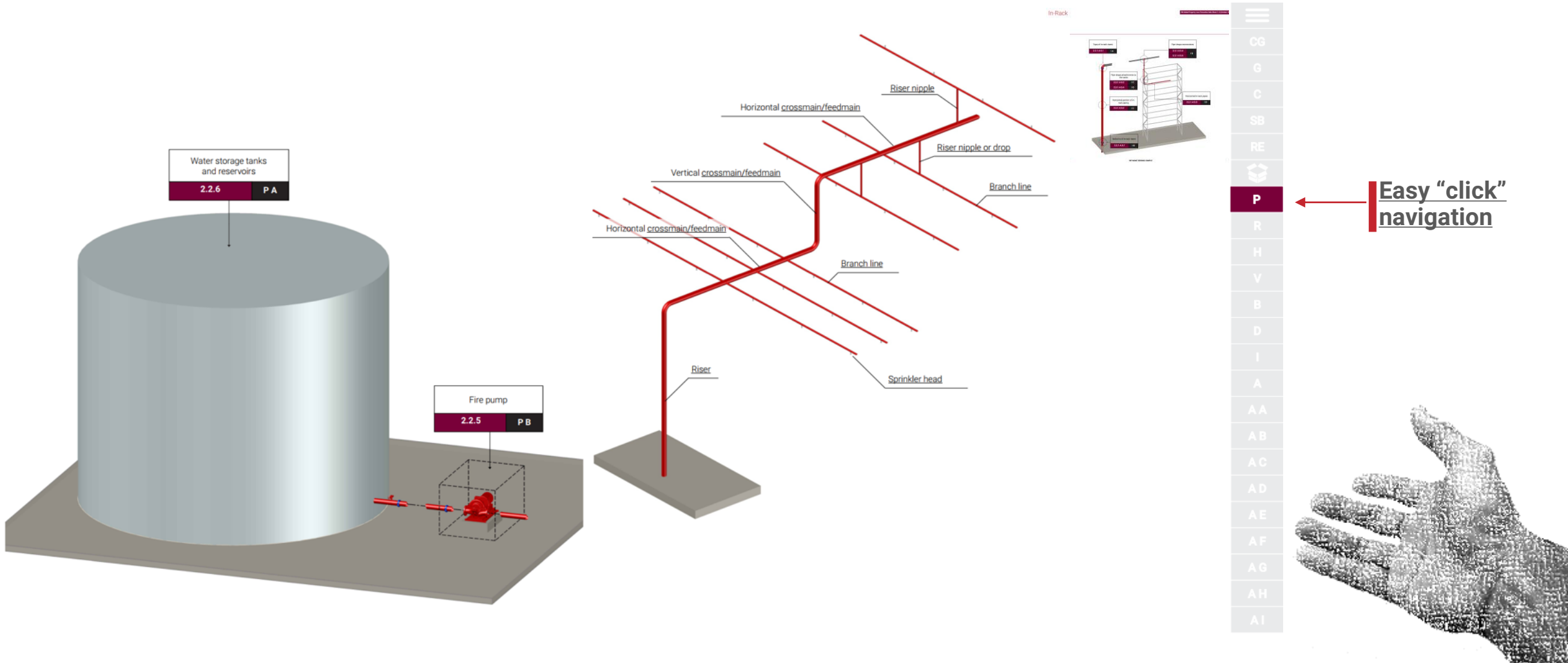


Measurements that drive requirements for seismic protection components



- Color codes** that identify:
- The seismic protection **components**
 - Proper **area of installation**

Logically ordered



Easy to Navigate

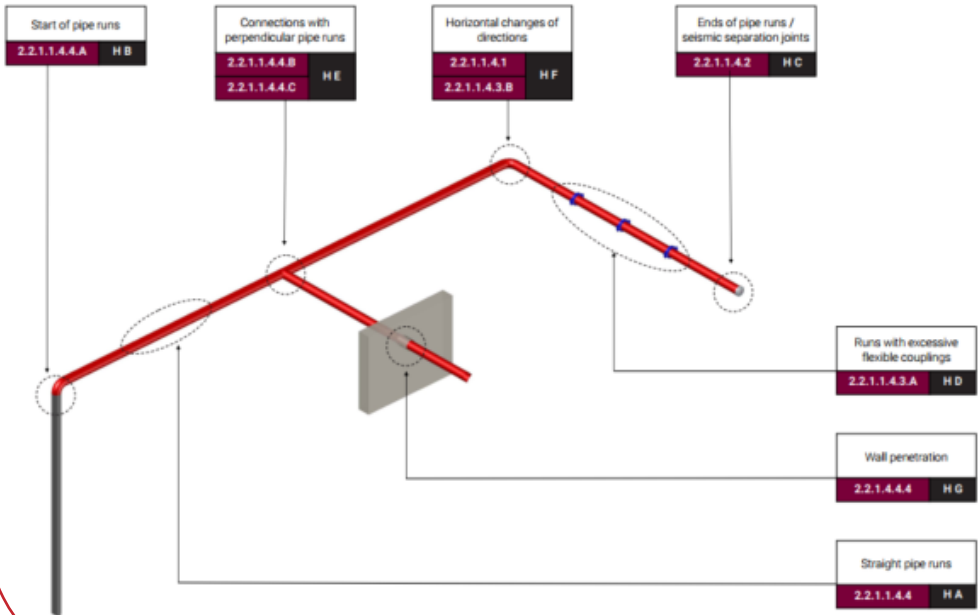
Layout of seismic protection components

FM Global 2-8

Horizontal Crossmain/Feedmain

Graphic interpretation of seismic protection requirements for fire sprinkler systems

OVERVIEW

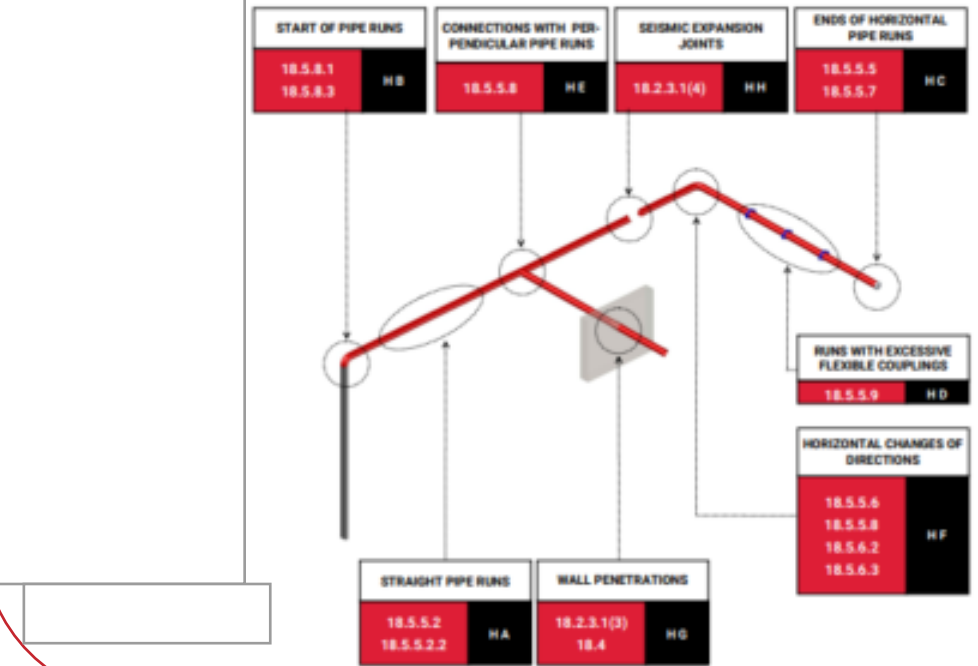


NFPA 13

Horizontal Crossmain/Feedmain

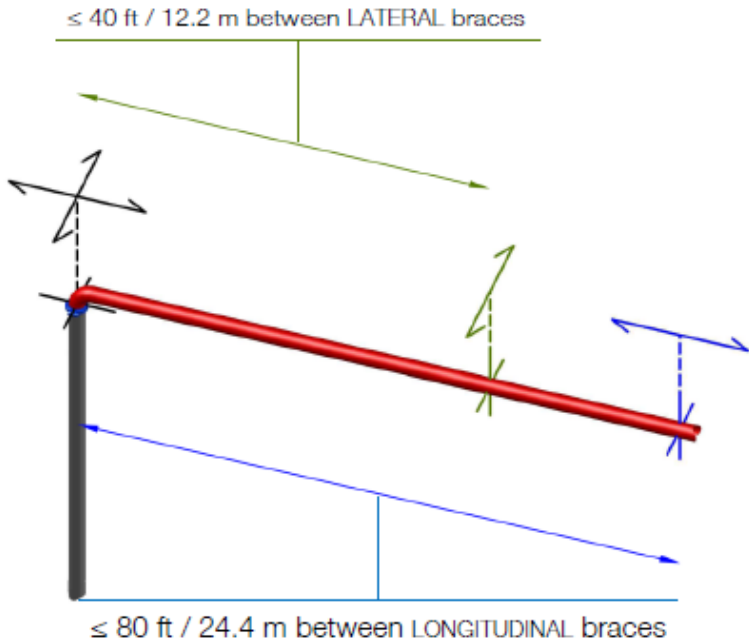
NFPA® 13 Standard for the Installation of Sprinkler Systems (2019 Edition)

OVERVIEW



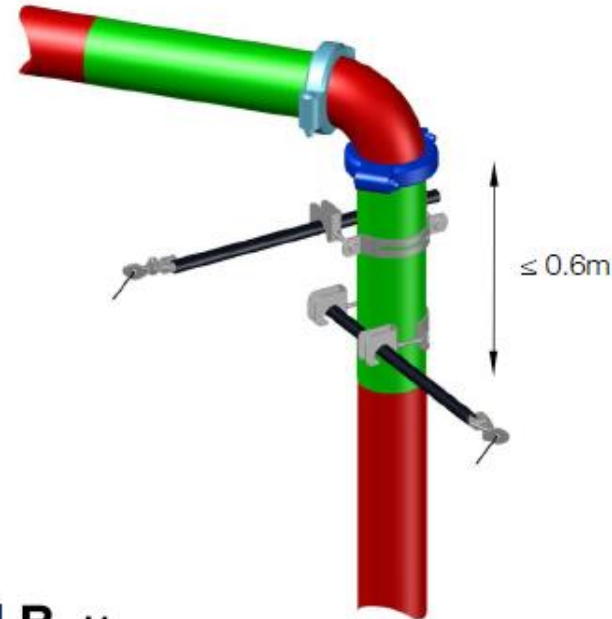
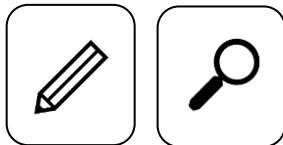
The prescription location is visibly made simple

Illustrations for the layout & illustrations for the installation



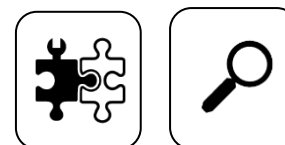
B

Drawings focusing on **layout**



B d1

Drawings focusing on **installation**

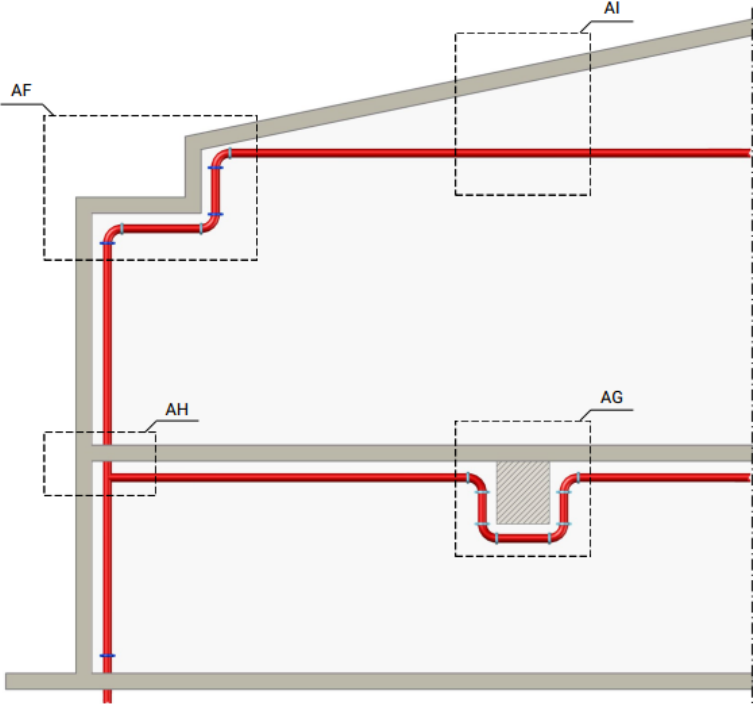


Jobsite complex situations

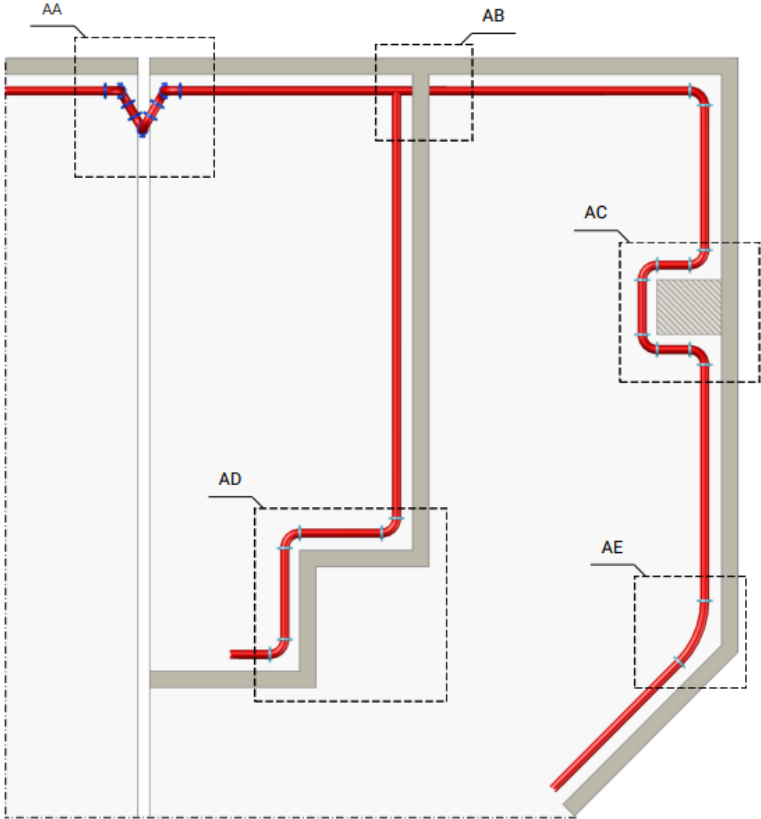


Not detailed in standards

Complex applications

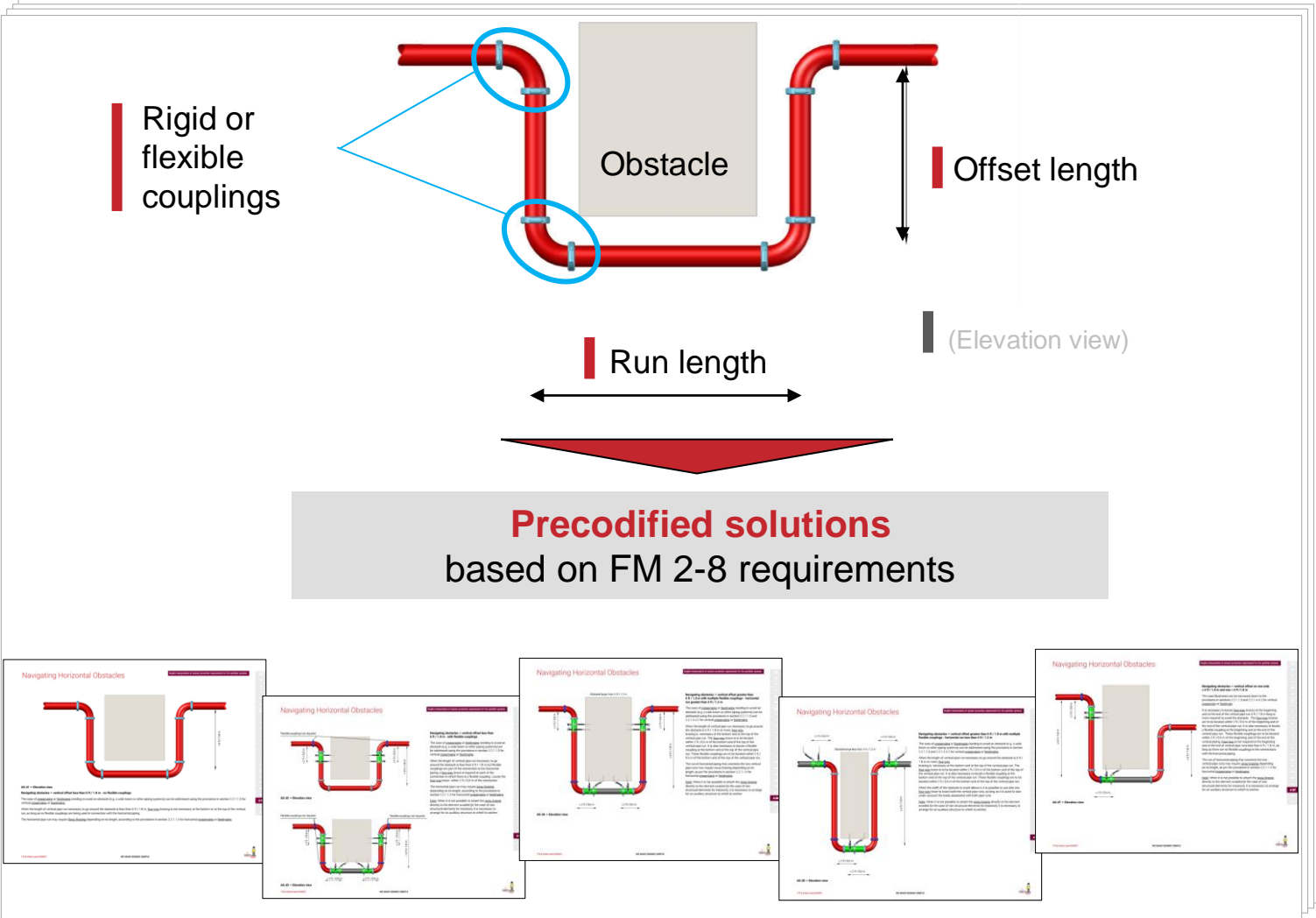


Section view
 AF) Riser with offsets, vertical changes of directions
 AG) Obstacles avoidance—Beams
 AH) Floor penetrations
 AI) Sloped ceilings



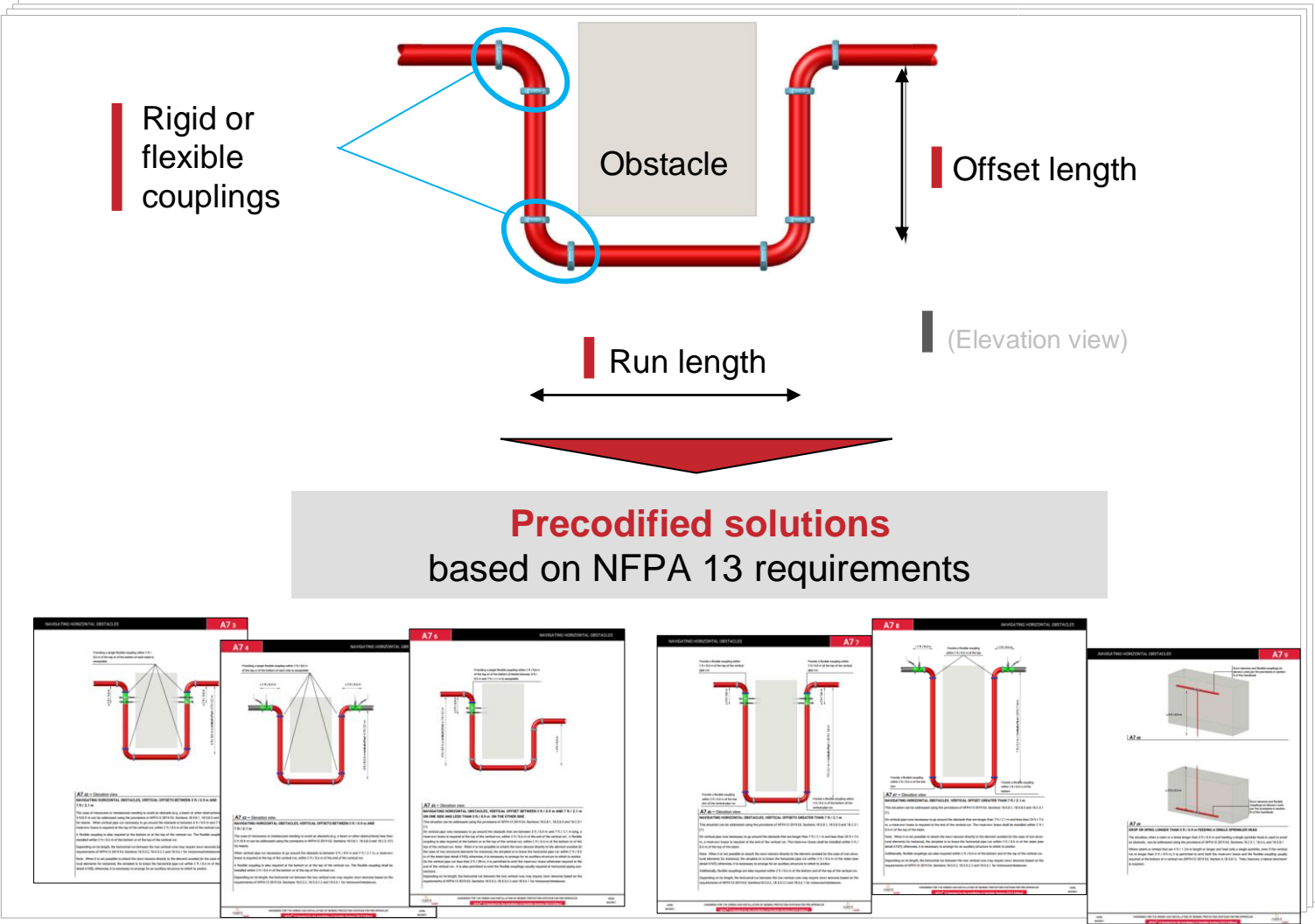
Plan view
 AA) Crossing of seismic expansion joints
 AB) Wall penetrations
 AC) Obstacles avoidance
 AD) Horizontal changes of directions: 90°
 AE) Horizontal changes of directions: not at 90°

Complex applications



Compliant solutions made simple

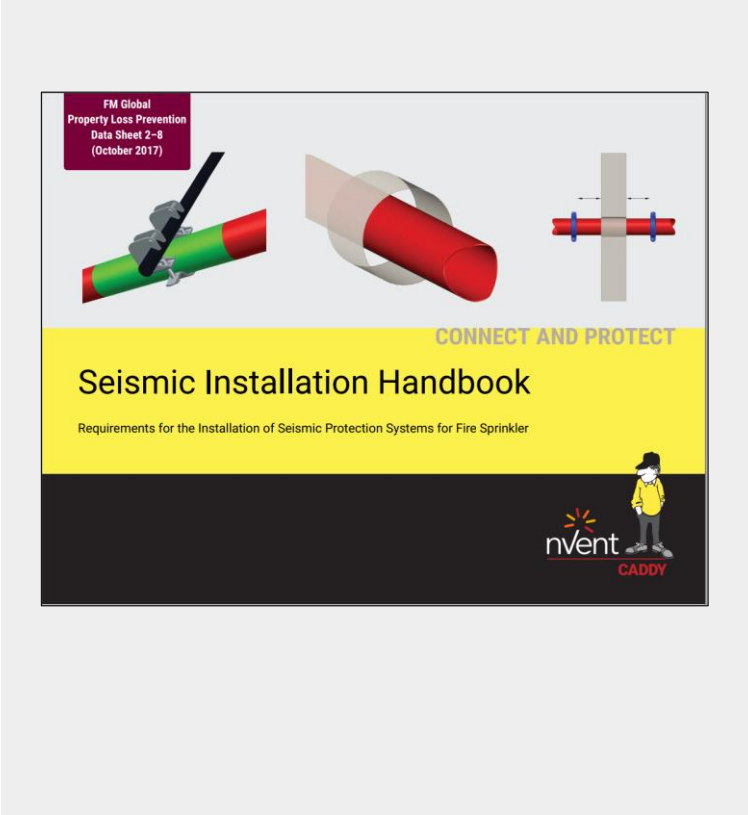
Complex applications



Compliant solutions made simple

Handbooks for different standards

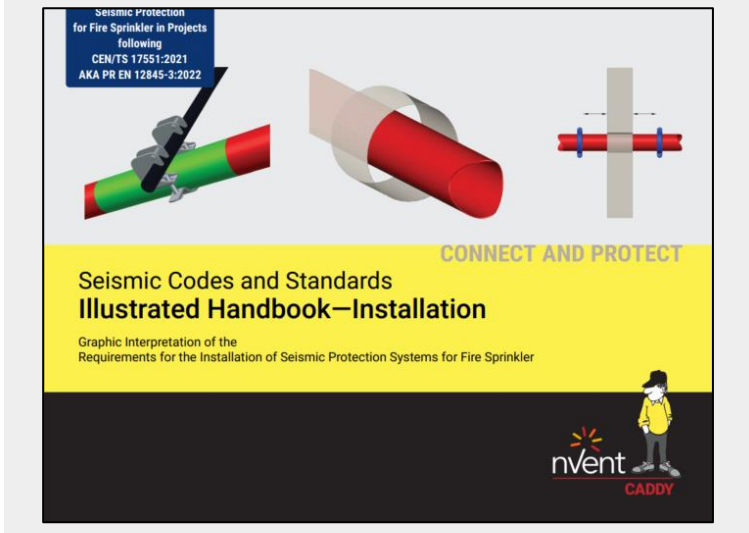
For projects insured by FM Global



For projects per NFPA 13



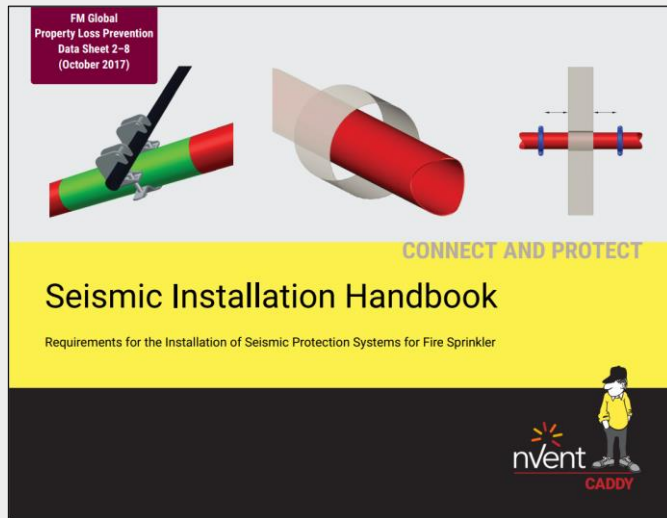
For projects per EN 12845



For recognized standards around the world

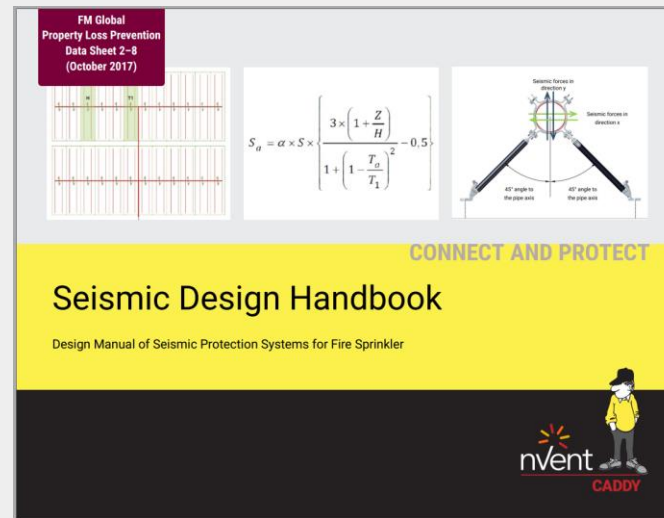
3-Contents per standard

nVent CADDY Seismic Installation Handbooks



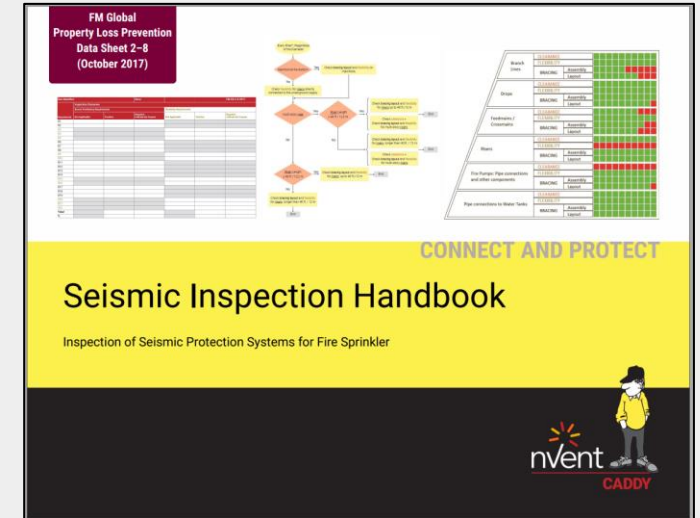
1 The focus is on the **layout and installation** of the seismic protection

nVent CADDY Seismic Design Handbooks



2 The focus is on the **load path calculation** and the **sizing** of the seismic protection

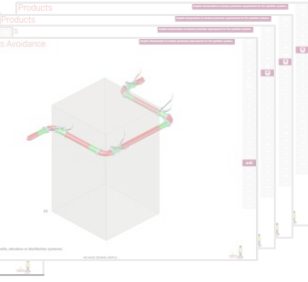
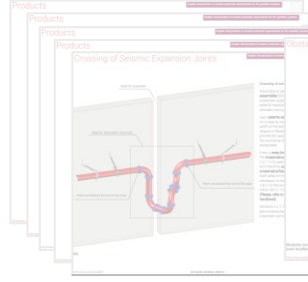
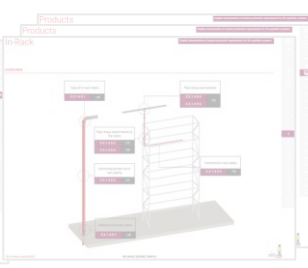
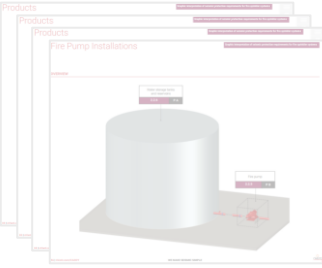
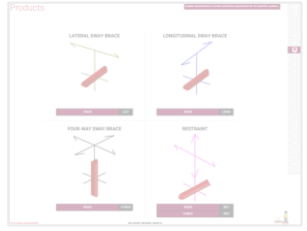
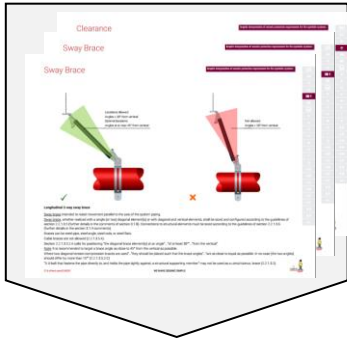
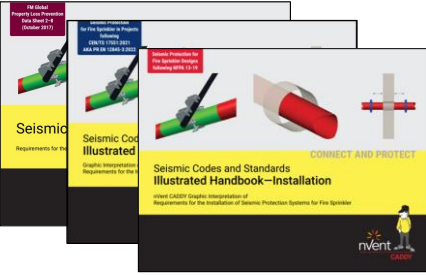
nVent CADDY Seismic Inspection Handbooks



3 The focus is on the **verification** and the **quality** of the seismic protection

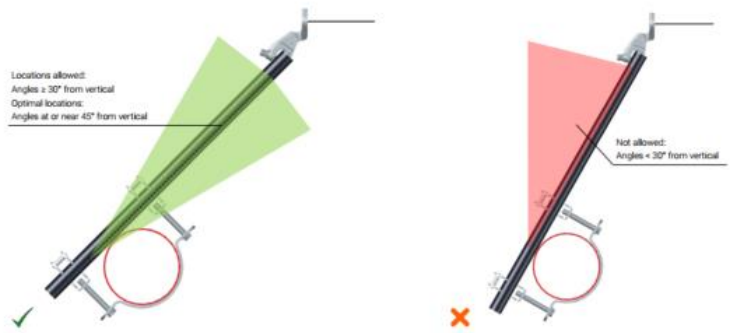
3 books per standard / multiple standard per content

Installation instructions



Sway Brace

Graphic interpretation of seismic protection requirements for fire sprinkler systems



Lateral 2-way sway brace

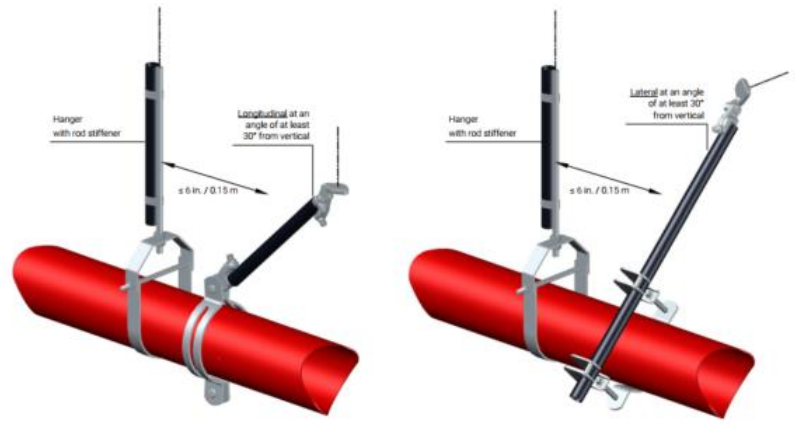
Sway brace intended to resist differential movements between pipe and structural element perpendicular to the axis of the system piping.

"For **sway bracing** that consists of individual diagonal element(s) or diagonal plus vertical elements, configure and size these elements per" 2.2.1.3.5 (further commentary in Section 3.1.8). "Select the proper method to attach the **sway bracing** to the structure and to the piping" per 2.2.1.3.6 (further commentary in Section 3.1.9). Braces can be steel pipe, steel angle, steel rods, or steel flats. "[C]able bracing would not qualify" (2.2.1.3.5.4).

Section 2.2.1.3.5.2.A calls for positioning the "diagonal element(s) at an angle...of at least 30°...from the vertical" as close to 45° from the vertical as possible. "Where two diagonal tension-compression braces are used"...they should be placed such that the brace angles"...are as close to equal as possible. In no case they should differ by more than 15°" (2.2.1.3.5.2.C).

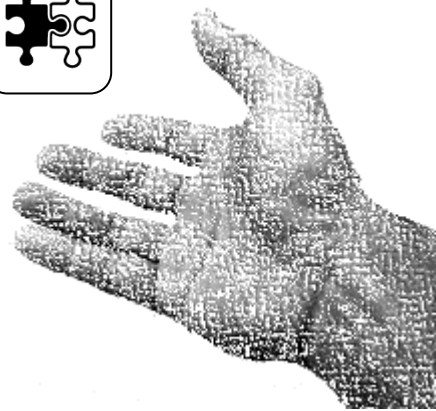
Sway Brace

Graphic interpretation of seismic protection requirements for fire sprinkler systems



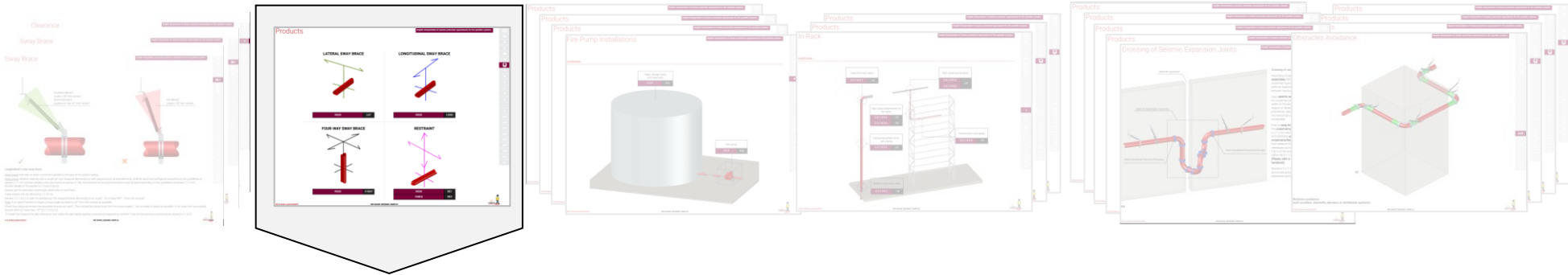
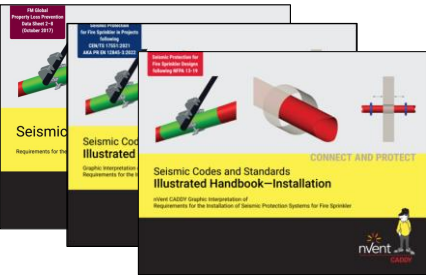
2-way sway brace with brace or reinforced hanger rod to resist vertical uplift force

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Clearance, sway bracing, restraints

Products and assemblies



Lateral Sway Braces

Graphic interpretation of seismic protection requirements for fire sprinkler systems

LATERAL ONLY BRACES—PIPE BRACE MEMBER



Quick Grip Jt. Lateral Sway Brace, up to 2" - DN 10 CSBG****EG
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Quick Grip Lateral Sway Brace, 2½" - DN 65 and up CSBG****EG
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Lateral Telescoping Sway Brace Assembly CSBT* (FM does not approve assemblies)
FM Tested
FBC HCAI

Restraints—Cable

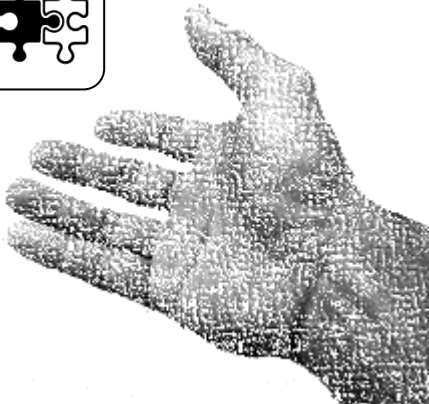
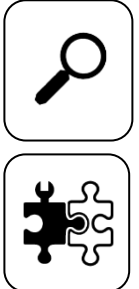
Graphic interpretation of seismic protection requirements for fire sprinkler systems

TENSION ONLY RESTRAINTS—CABLE RESTRAINT MEMBER

Universal Restraint Clip Attachment Kit
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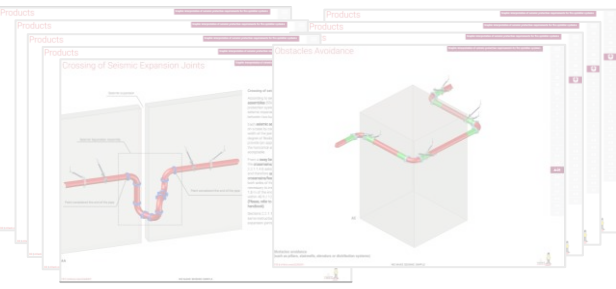
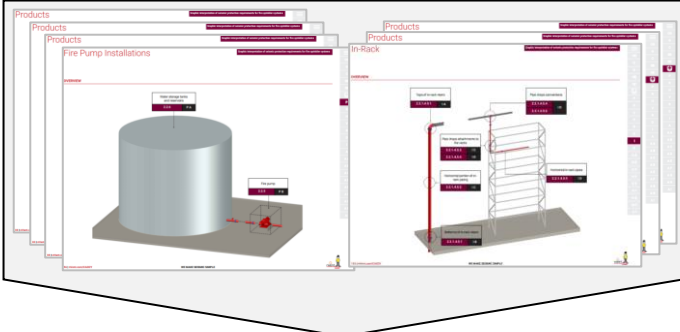
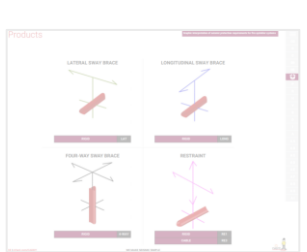
Dual Sleeve CSBSLV****

Note:
Installation of the cable requires:
• Cutter slvic or csac48
Installation of the sleeves requires:
• Power or manual swaging tool



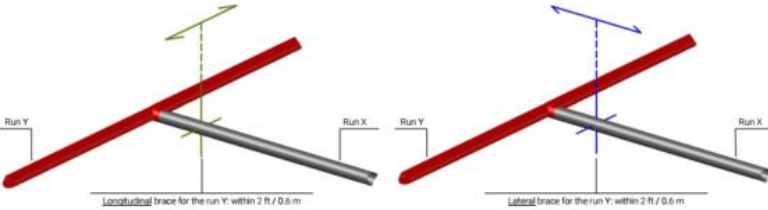
For sway bracing and for restraining

Requirements per major portions of the sprinkler system



Horizontal Crossmain/Feedmain

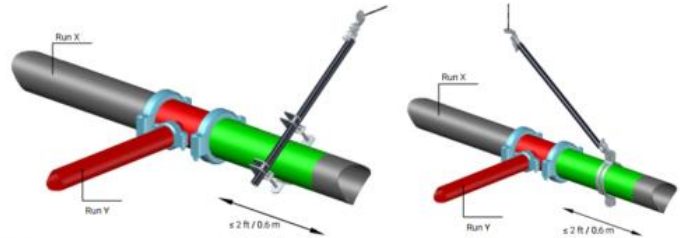
Graphic interpretation of seismic protection requirements for fire sprinkler systems



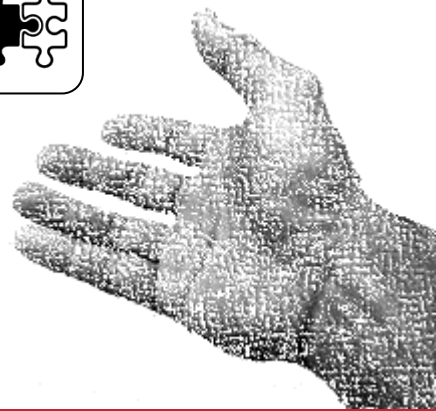
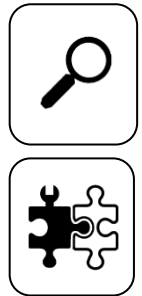
E1 Crossmain/Feedmain horizontal intersection
 2.2.1.1.4.4.B and 2.2.1.1.4.4.C state that:
 A lateral [longitudinal] brace within 2 ft / 0.6 m of the end of a feedmain or crossmain (run X) to another horizontal crossmain/feedmain that is perpendicular (run Y), may be used to also act as a longitudinal [lateral] brace for the perpendicular crossmain/feedmain, provided it's installed on the bigger diameter pipe and load contribution from the perpendicular pipe is considered too.

Horizontal Crossmain/Feedmain

Graphic interpretation of seismic protection requirements for fire sprinkler systems

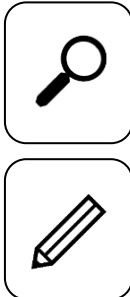
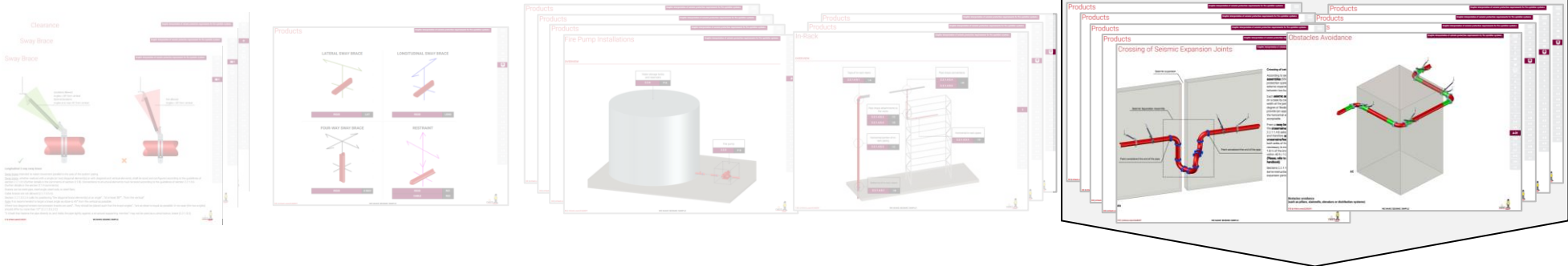


E1 d2 Bracing at intersecting crossmain/feedmain pipe connections
 2.2.1.1.4.4.B and 2.2.1.1.4.4.C state that:
 A lateral [longitudinal] brace within 2ft / 0.6 m of the end of a feedmain or crossmain (run X) to another horizontal crossmain that is perpendicular (run Y), may be used to also act as a longitudinal [lateral] brace for the perpendicular crossmain, provided it's installed on the bigger diameter pipe and load contribution from the perpendicular pipe is considered too.

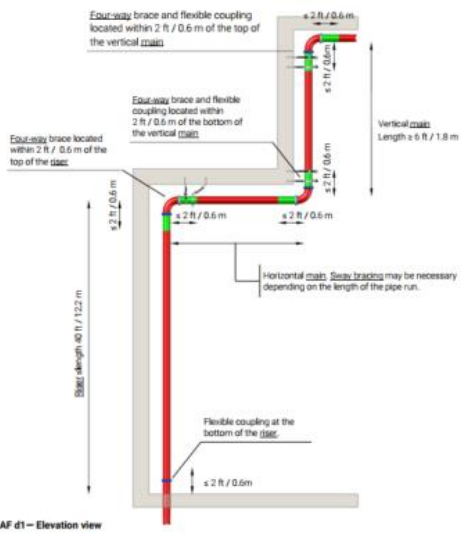


Water source, pump room, risers, mains, drops, branch lines, in-rack

“Turn-key” compliant solutions to complex applications



Risers with Offsets

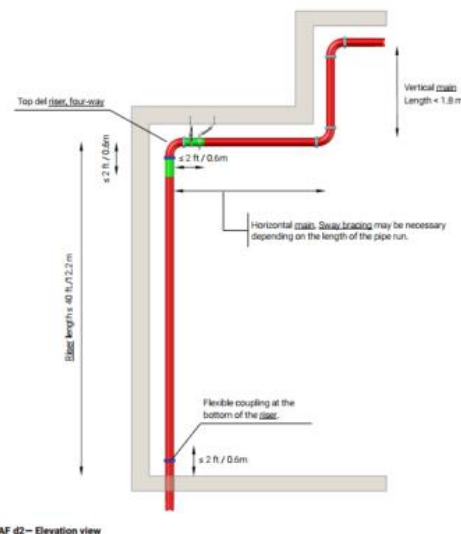


AF d1 – Elevation view
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Graphic interpretation of seismic protection requirements for fire sprinkler systems

Risers with offsets – vertical changes of directions
For the purpose of seismic bracing, the case in which risers need to overcome an obstacle may be divided into the succession of three elements: **Riser**–**horizontal main**–**vertical main**.
On **Risers**, a flexible coupling is required within 2 ft / 0.6 m of the bottom and another flexible coupling and a **four-way** brace are required within 2 ft / 0.6 m of the top. In the case presented the highest point of the vertical piping is considered the top of the **riser**. (Refer to chapter R of the handbook for other instructions regarding risers).
The **four-way** brace located at the top of the **riser** may be considered as the first **lateral** and the first **longitudinal** braces of the horizontal **main**, as long as it is located within 2 ft / 0.6 m of the horizontal pipe run and is sized taking the loads from the horizontal piping also under account.
Depending on the length of the horizontal run, additional **sway** braces may be necessary. (Refer to chapter H of the handbook for further details).
The next run of vertical piping is considered to be a vertical **main**. If the length of this run is 6 ft / 1.8 m or more, a **four-way** brace and a flexible coupling are required within 2 ft / 0.6 m of the top and the bottom of the pipe.

Risers with Offsets



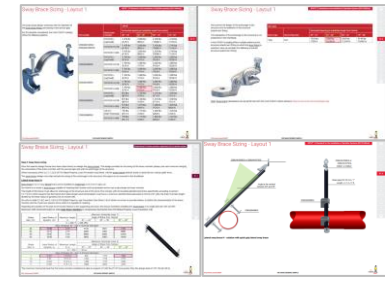
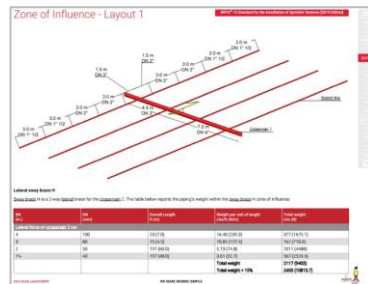
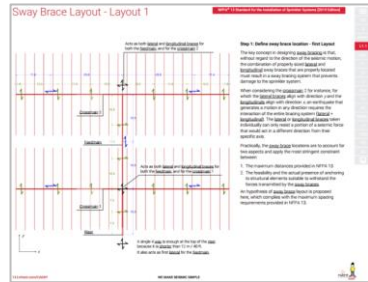
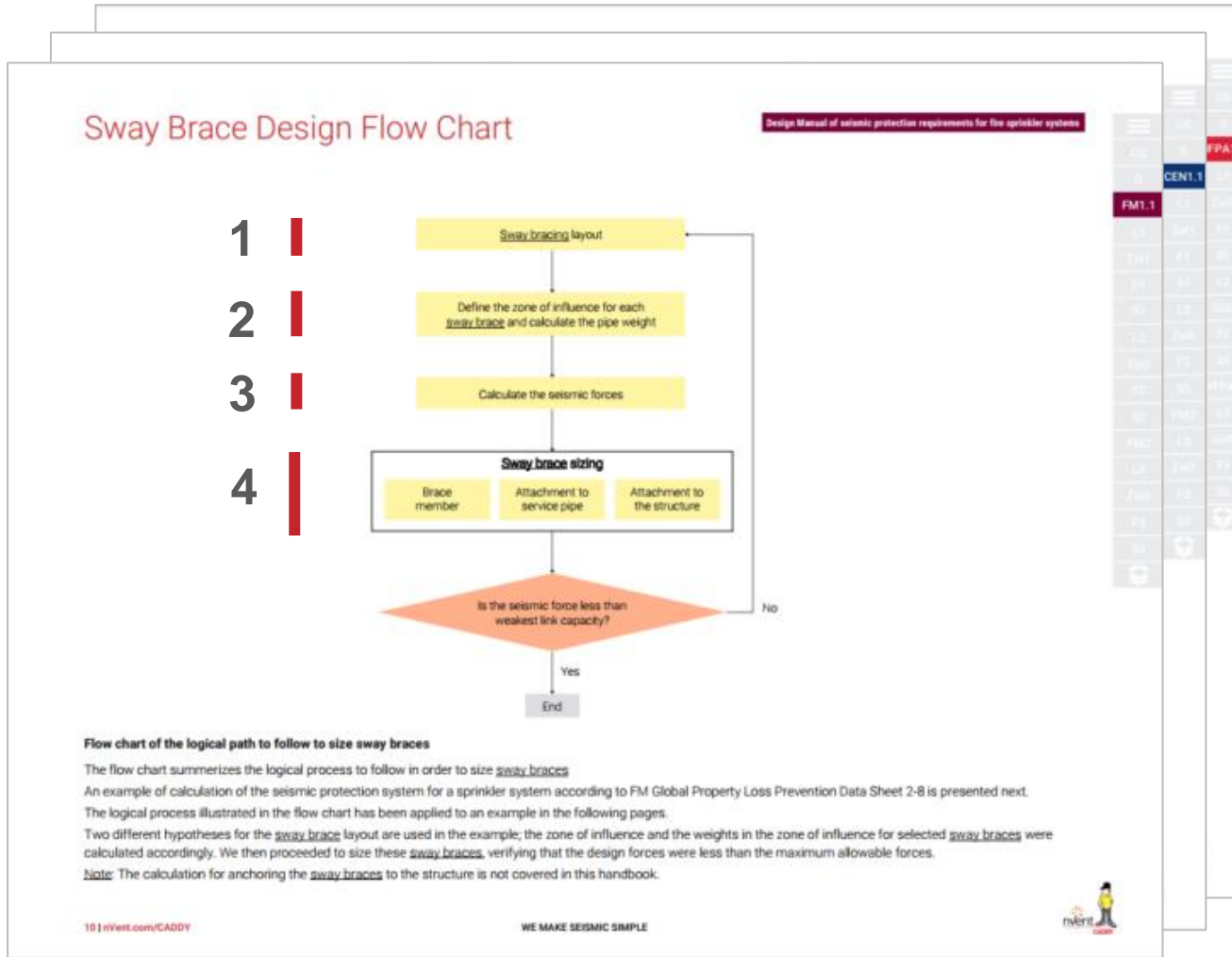
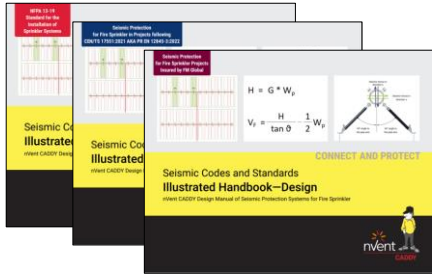
AF d2 – Elevation view
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Graphic interpretation of seismic protection requirements for fire sprinkler systems

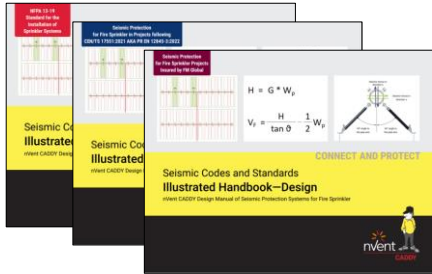
Risers with offsets – vertical changes of directions
For the purpose of seismic bracing, the case in which risers need to overcome an obstacle may be divided into the succession of three elements: **Riser**–**horizontal main**–**vertical main**.
On **Risers**, a flexible coupling is required within 2 ft / 0.6 m of the bottom and another flexible coupling and a **four-way** brace are required within 2 ft / 0.6 m of the top. In the case presented the highest point of the first run of vertical piping is considered the top of the **riser**. (Refer to chapter R of the handbook for other instructions regarding risers).
The **four-way** brace located at the top of the **riser** may be considered as the first **lateral** and the first **longitudinal** braces of the horizontal **main**, as long as it is located within 2 ft / 0.6 m of the horizontal pipe run and is sized taking the loads from the horizontal piping also under account.
Depending on the length of the horizontal run, additional **sway** braces may be necessary. (Refer to chapter H of the handbook for further details).

Obstacles, changes of direction, seismic expansion joints, floor & wall penetration, slopped ceilings...

Sway bracing design

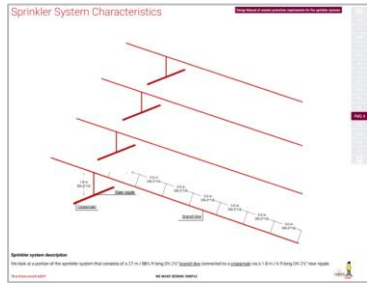


Layout – zone of influence – design seismic force calculation – assembly products selection

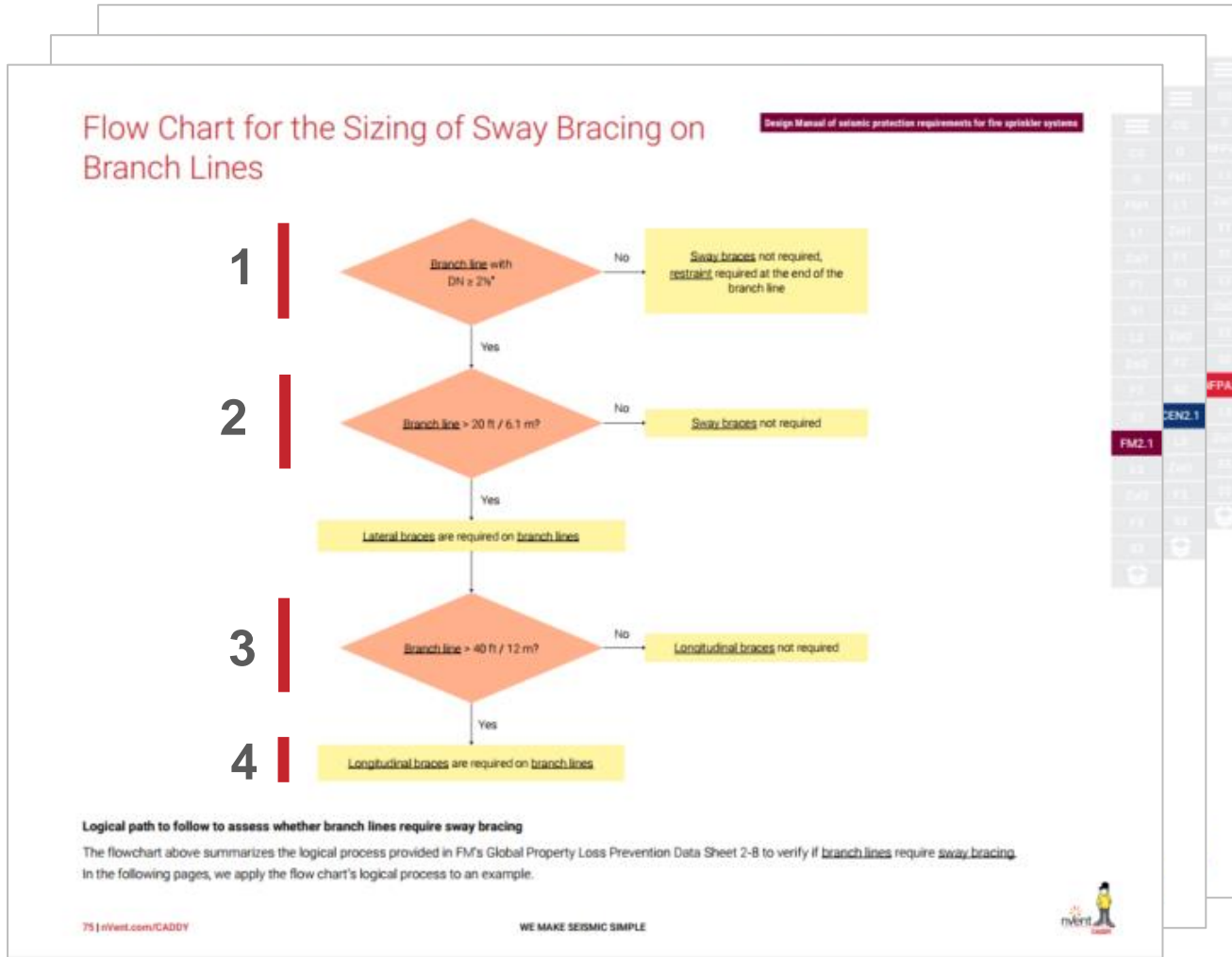
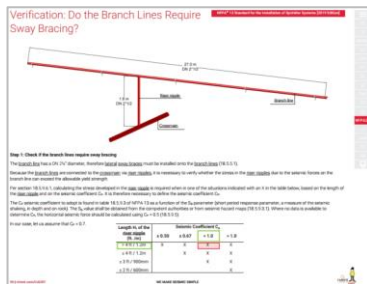


Verification: do the branch lines require sway bracing?

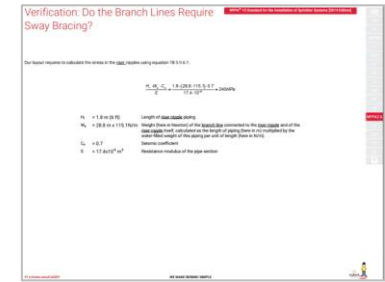
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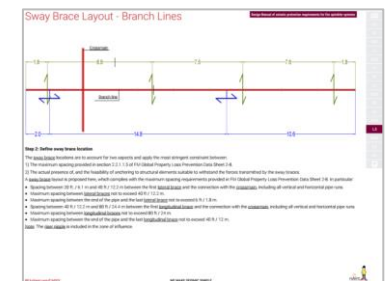
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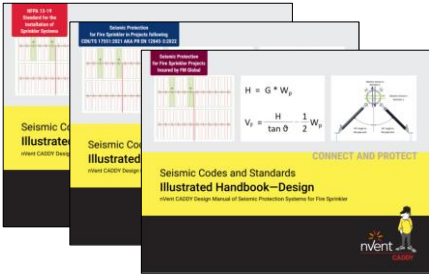
3



4



Flow chart, example



Visualization

Four-Way Sway Braces - Rigid

Design Manual of seismic protection requirements for fire sprinkler systems

RIGID BRACES—PIPE BRACE MEMBER



In the part number, **** refers to service pipe diameter in inches; e.g. CSBISTU for 4" pipe is the CSBISTU4000EG

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In part number **** refers to service pipe diameter; CSBQGD4000EG for 4" pipe

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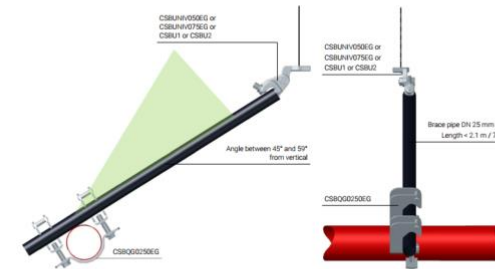


In the part number, * refers to the telescoping range of the assembly; CSBT1 extends from 1 ft / 30 cm to 1 1/2 ft / 46 cm; CSBT2 extends from 1 1/2 ft / 46 cm to 3 ft / 90 cm



Sway Brace Sizing

Design Manual of seismic protection requirements for fire sprinkler systems



Lateral sway brace A - solution with quick grip lateral sway brace

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Restraints - Rigid

Design Manual of seismic protection requirements for fire sprinkler systems

THREADED ROD RESTRAINT MEMBER



In the part number, **** refers to service pipe diameter in inches; e.g. the CSBR912EG is a restraint for 1 1/2" pipe



Branch Line Restraint Structure Attachment to Steel CSBR91EG



Branch Line Restraint Structure Attachment to Wood/Concrete CSBR92EG



Branch Line Restraint Structure Attachment to Threaded Hole CSBR93EG

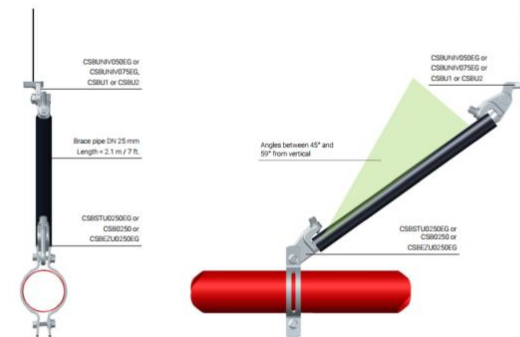
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110

Sway Brace Sizing

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Longitudinal sway brace B - solution with universal, standard universal or easy universal

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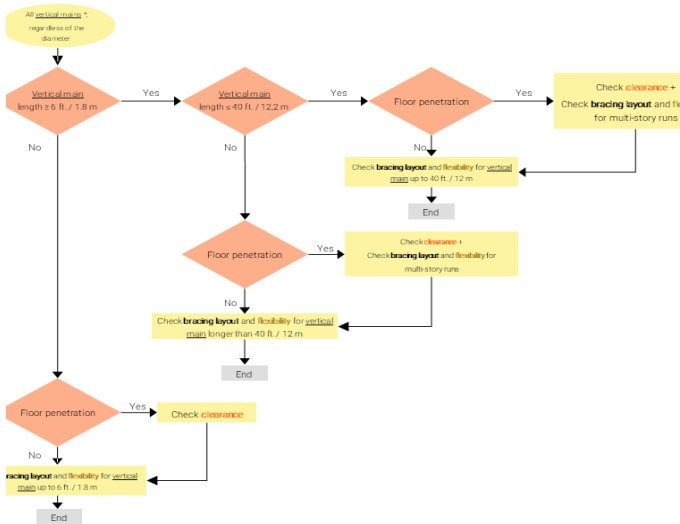
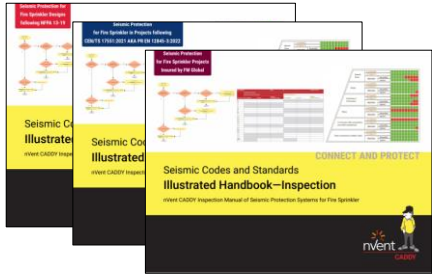
WE MAKE SEISMIC SIMPLE

108

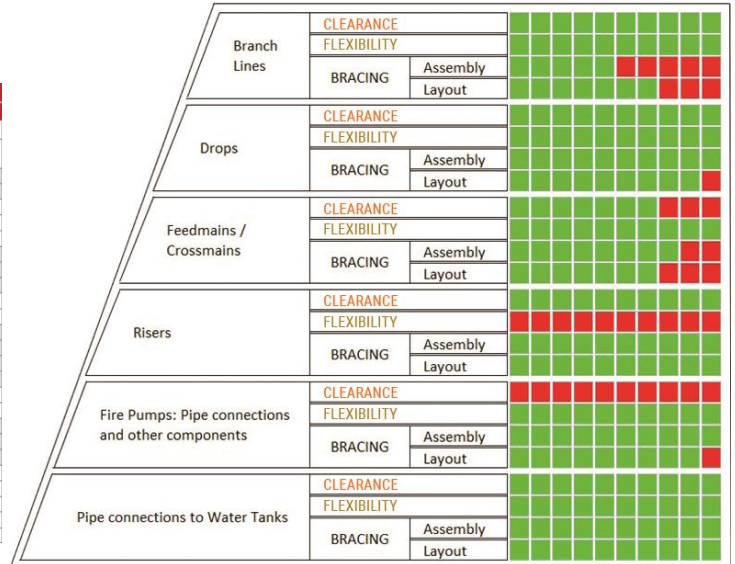


Four-way, lateral (transverse), longitudinal sway braces, and restraints

Verification

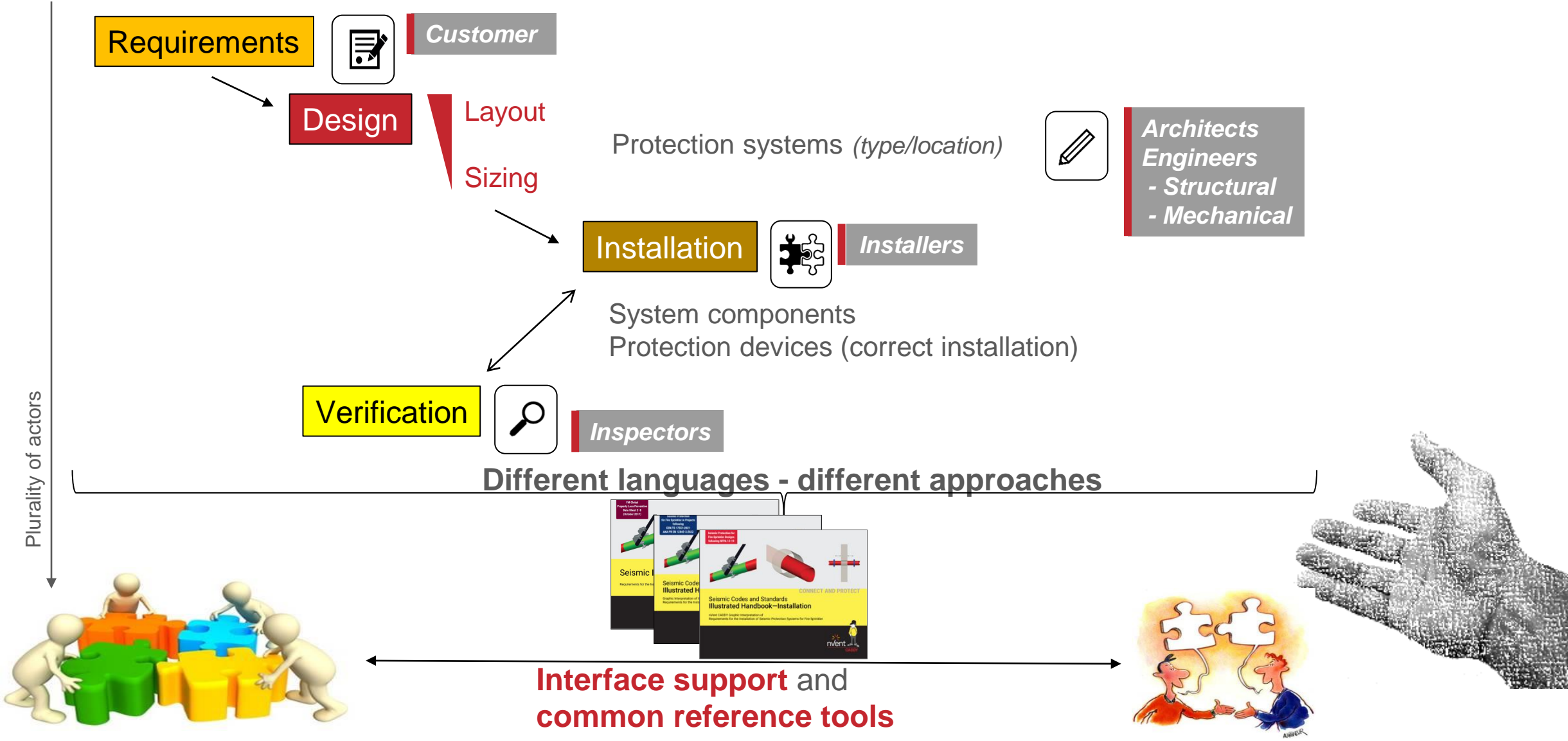


Run Identifier:		Riser			FM DS 2-8 2017	
Inspection Outcomes						
Braces Positioning Requirements			Flexibility Requirements			
Requirement	Not Applicable	Positive	Negative Indicate the Causes	Not Applicable	Positive	Negative Indicate the Causes
R1						
R2						
R3						
R4						
R5						
R6						
R7						
R8						
R9						
R10						
R11						
R12						
R13						
R14						
R15						
R16						
R17						
R18						
R19						
R20						
R21						
R22						
Total						
%						



Flow charts, collection charts, proprietary pyramid to evaluate compliance and quality

Final considerations



Final considerations

Handbook: a **facilitator** for the **dissemination** of a



culture of Integrated / Contextualized Protection

Requests for Handbooks can be submitted at <https://go.nvent.com/Seismic-Handbook-FM2017.html>

Facilitator of integrated and contextualized fire and seismic protection


Thank you for your attention

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UNIVERSITÀ DEGLI STUDI DI UDINE


- Founded in 1978
- Founded as part of the reconstruction plan from the Friuli earthquake in 1976





English integration of seismic protection requirements for fire sprinkler systems

ILLUSTRATED HANDBOOK

For the installation of Seismic Protection Systems for Fire Sprinkler in Projects Insured by FM Global
August 2023

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The authors all have a personal history with the consequences of earthquakes