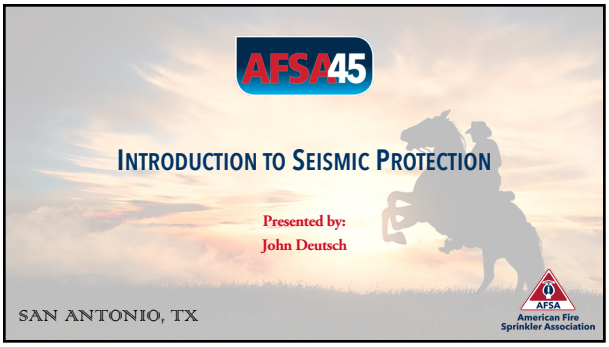
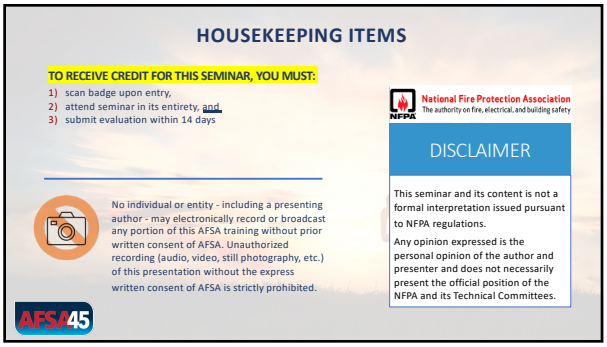
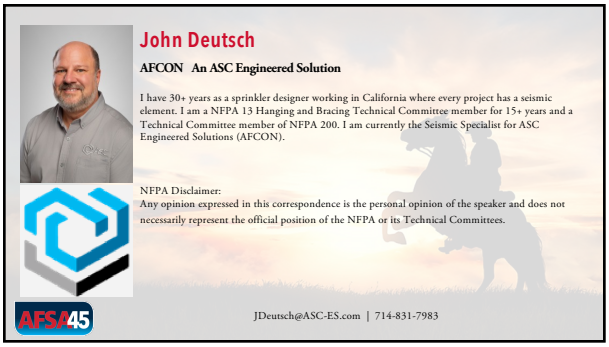

AFSA45
INTRODUCTION TO SEISMIC PROTECTION
Presented by:
John Deutsch
SAN ANTONIO, TX
AFSA
American Fire Sprinkler Association

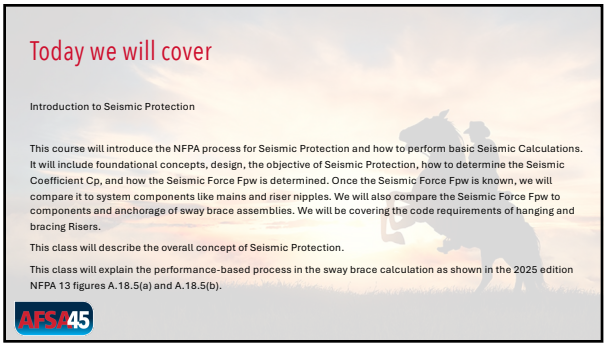
1


HOUSEKEEPING ITEMS
TO RECEIVE CREDIT FOR THIS SEMINAR, YOU MUST:
1) scan badge upon entry,
2) attend seminar in its entirety, and,
3) submit evaluation within 14 days
No individual or entity - including a presenting author - may electronically record or broadcast any portion of this AFSA training without prior written consent of AFSA. Unauthorized recording (audio, video, still photography, etc.) of this presentation without the express written consent of AFSA is strictly prohibited.
National Fire Protection Association
The authority on fire, electrical, and building safety
DISCLAIMER
This seminar and its content is not a formal interpretation issued pursuant to NFPA regulations.
Any opinion expressed is the personal opinion of the author and presenter and does not necessarily present the official position of the NFPA and its Technical Committees.
AFSA45

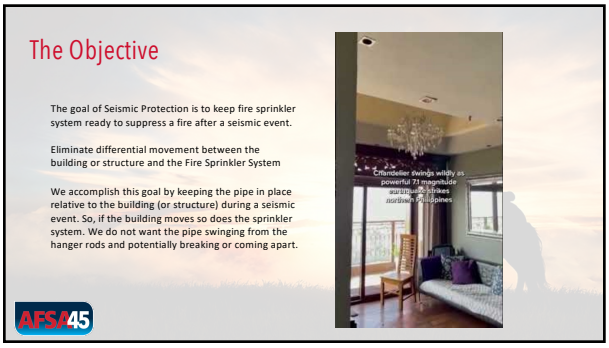
2


John Deutsch
AFCON An ASC Engineered Solution
I have 30+ years as a sprinkler designer working in California where every project has a seismic element. I am a NFPA 13 Hanging and Bracing Technical Committee member for 15+ years and a Technical Committee member of NFPA 200. I am currently the Seismic Specialist for ASC Engineered Solutions (AFCON).
NFPA Disclaimer:
Any opinion expressed in this correspondence is the personal opinion of the speaker and does not necessarily represent the official position of the NFPA or its Technical Committees.
AFSA45
JDeutsch@ASC-ES.com | 714-831-7983

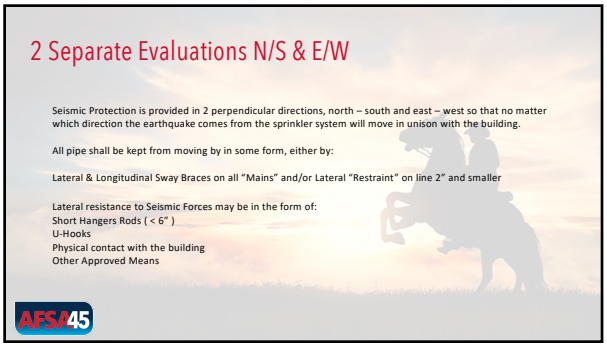
3


Today we will cover
Introduction to Seismic Protection
This course will introduce the NFPA process for Seismic Protection and how to perform basic Seismic Calculations. It will include foundational concepts, design, the objective of Seismic Protection, how to determine the Seismic Coefficient Cp, and how the Seismic Force Fpw is determined. Once the Seismic Force Fpw is known, we will compare it to system components like mains and riser nipples. We will also compare the Seismic Force Fpw to components and anchorage of sway brace assemblies. We will be covering the code requirements of hanging and bracing Risers.
This class will describe the overall concept of Seismic Protection.
This class will explain the performance-based process in the sway brace calculation as shown in the 2025 edition NFPA 13 figures A.18.5(a) and A.18.5(b).
AFSA45

4


The Objective
The goal of Seismic Protection is to keep fire sprinkler system ready to suppress a fire after a seismic event.
Eliminate differential movement between the building or structure and the Fire Sprinkler System
We accomplish this goal by keeping the pipe in place relative to the building (or structure) during a seismic event. So, if the building moves so does the sprinkler system. We do not want the pipe swinging from the hanger rods and potentially breaking or coming apart.
Chandelier swings wildly as powerful 7.1 magnitude earthquake strikes northern Philippines
AFSA45

5


2 Separate Evaluations N/S & E/W
Seismic Protection is provided in 2 perpendicular directions, north – south and east – west so that no matter which direction the earthquake comes from the sprinkler system will move in unison with the building.
All pipe shall be kept from moving by in some form, either by:
Lateral & Longitudinal Sway Braces on all "Mains" and/or Lateral "Restraint" on line 2" and smaller
Lateral resistance to Seismic Forces may be in the form of:
Short Hangers Rods (< 6")
U-Hooks
Physical contact with the building
Other Approved Means
AFSA45

6

Lateral Line Restraint – From 2025 NFPA 13

18.5.5.1.1

18.6.1*

(1)
(2)
(3)
(4)
(5)*
(6)

7

Examples of Line Restraint from 2025 NFPA 13

FIGURE A.18.6.1(5)(a) Hangers, with Surge Clips, Used in Combination for Restraint of Branch Lines.

8

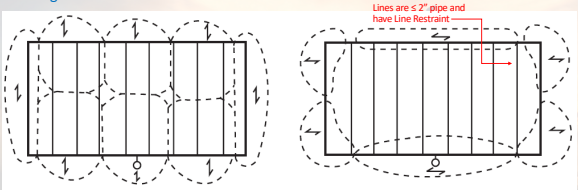
Short Hanger Rods = **Lateral** Restraint

2025 NFPA 13 Section 18.6.5

9

Zone of Influence (ZOI) = W_p

The "Zone of Influence" represents the portion of the sprinkler system that a individual sway brace is designed to resist seismic forces and prohibit differential movement from the building or structure.



North-South direction

East-West direction

10

Calculate the Force F_{pw}

We make sure that the SWAY BRACE assembly including anchorage is stronger than the SEISMIC Force (Fpw) being applied to it

Sway Brace > Seismic Force
And
Seismic Force (Fpw) = Seismic Coefficient (Cp) * Weight of Pipe (water filled + 15%)

$F_{pw} = C_p W_p$

From 2025 NFPA 13

3.3.202 Seismic Coefficient, C_p. The seismic coefficient that

18.5.9.2 The weight of the system being braced (W_p) shall be

11

How Strong Will the Earthquake Be?

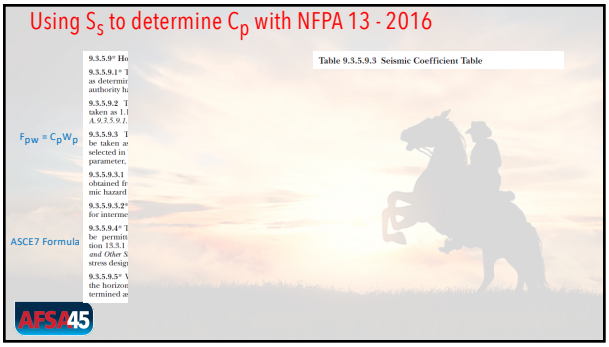
S_S = mapped MCE_R, 5% damped, spectral response acceleration parameter at short periods as defined in Sections 11.4.2, 11.4.4

11.4.2 Mapped Acceleration Parameters. The parameters S_S

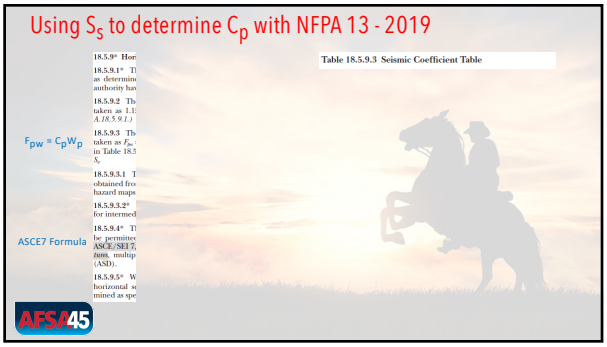
The value of S_s represents how strong the earthquake will be at bed rock for a specific site.

From ASCE 7-16

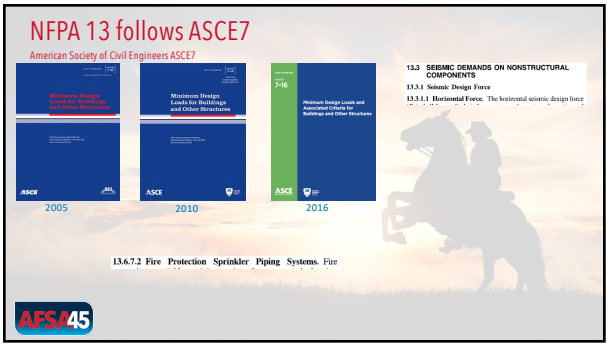
12



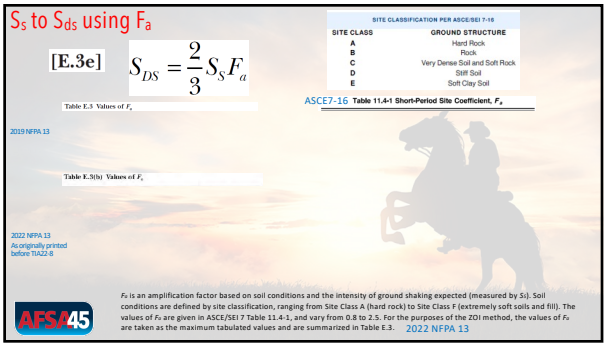
13



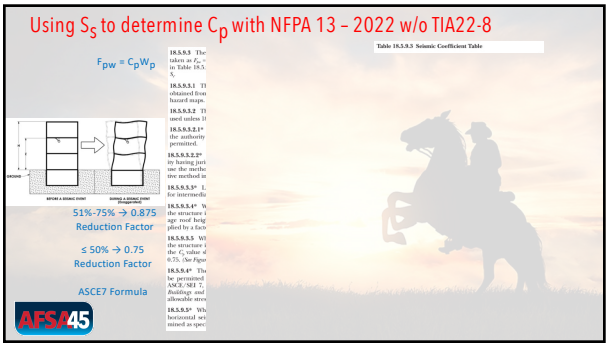
14



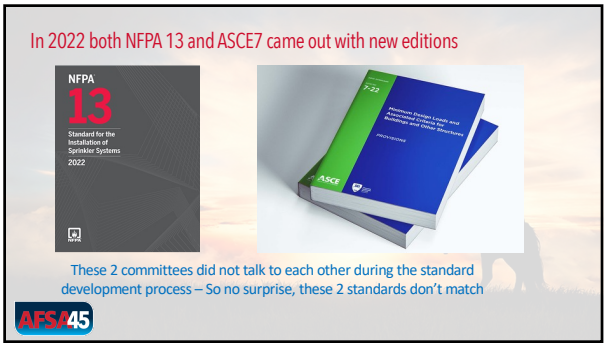
15



16

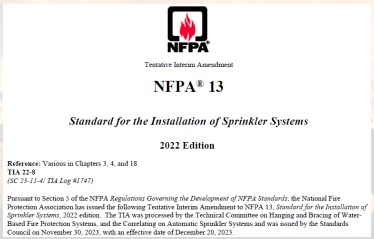


17



18

ASCE7-22 forced NFPA to issue TIA 22-8



Tentative Interim Amendment

NFPA® 13

Standard for the Installation of Sprinkler Systems

2022 Edition

Reference: Various in Chapters 3, 4, and 18
TIA 22-8
(SC 23-11-4/ TIA Log #1747)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2022 edition. The TIA was processed by the Technical Committee on Hanging and Bracing of Water-Based Fire Protection Systems, and the Correlating on Automatic Sprinkler Systems and was issued by the Standards Council on November 30, 2023, with an effective date of December 20, 2023.

19

Using S_{DS} to determine C_p with NFPA 13 – 2022 with TIA 22-8 & 2025

$F_{pw} = C_p W_p$

$C_p = 0.754 * S_{DS}$

S_{DS}

S_{DS}

S_{DS}

51% to 75%

Less Than 50%

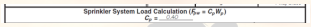
ASCE7 Formula

$C_p = 0.5$

20

The potential force on the brace (F_{pw})

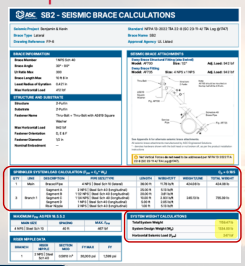
From 2025 NFPA 13
Sprinkler System Load Calculation
or
Zone of Influence (ZOI)



ZOI times C_P = F_{PW}
959.6 * 0.40 = 383
Example = 383 lbs

21

The potential force on the brace (F_{pw})



SB2 - SEISMIC BRACE CALCULATIONS

ASC Example

Water filled pipe weight = 1159.47 lbs

Add 15% to get 1334.0 lbs

Multiply 1334 time the Seismic Coefficient (Cp) of 0.185 to get a Seismic Force of 247 lbs.

22

The Force F_{pw} must not exceed the Sway Brace capacity to resist a force.

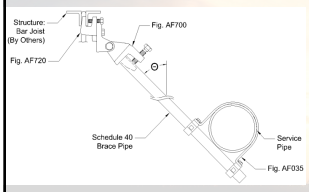
The Sway Brace capacity shall be based on the weakest element of the assembly.
(A chain is only as strong as its weakest link)

1) The maximum allowed Main Stress including the pipe joining method (Threaded or Grooved)
2) The Riser Nipple strength
3) The Sway Brace Fitting
4) The Sway Brace pipe element
5) The Sway Brace Structural Fitting (Swivel)
6) The Sway Brace Structural Adapter (if used)
7) The load capacity limit of the fastener
   a) Lag bolt to wood
   b) Thru bolt to wood
   c) Concrete anchor or embed including Sway Brace Structural Fitting Prying Factor reduction

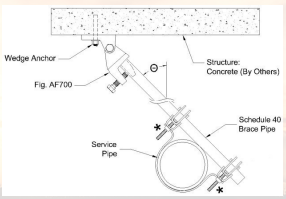
23

A Sway Brace Assembly is only as strong as its weakest link

Usually Limited by Steel Adapter

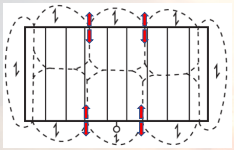


Usually Limited by Fastener



24

Main Stress Limits



25

Main Stress Limits

18.5.5.2* accordanc 18.5.5.2(n sprinkler s

18.5.5.2.1 using the with values

18.5.5.2.2 40 ft (12 m

18.5.5.2.3 influence Table 18.5 lated in ac

18.5.5.2.4 with 18.5 allowable the zone o

18.5.5.3 specially li

A.18.5.5.2 sway brac 18.5.5.2(n mic forces to allow de zone of in ensuring c spacing of ASCE/SEI *Buildings a* or groove 18.5.5.2(f) simplifying into accou provide gr tions, in n 40 ft (12.2

26

Main Stress Limits

Table 18.5.5.2(a) Maximum Load (F_{pw}) in Zone of Influence (lb), (F_p = 30 ksi) Schedule 10 Steel Pipe

Table 18.5.5.2(a) Maximum Load (F_{pw}) in Zone of Influence (lb), (F_p = 30 ksi) Schedule 10 Steel Pipe

2022 before TIA22-8 and earlier

2025 NFPA 13

27

Main Stress Limits on "Flow" pipes

Bull Moose Tube EDDY FLOW Steel Pipe Joined by Threading, Bonding or Compression/Grooved Couplings

Max Zone of Influence Load (F_{pw}) lbs. | Max. Transverse and 4-way Brace Spacing (ft) *** According to HLF for the 2006 & 2009 IBC (ASCE 7-05) & C_p for NFPA-13 shown in BOLD TYPE

Pipe Size	Transverse Brace Spacing* 20 ft	25 ft	30 ft	35 ft	40 ft	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
1 1/4	136	109	89	76	64	40	40	37	32	29	26	24	23	21	20	19	18
1 1/2	232	185	152	130	109	40	40	40	35	31	29	27	25	23	22	21	20
2	372	297	244	209	175	40	40	40	38	34	31	28	27	25	24	23	22
2 1/2	549	440	360	309	258	40	40	40	40	36	32	30	28	26	25	24	23
3	809	648	531	455	381	40	40	40	40	37	34	31	29	28	26	25	24
4	1544	1235	1012	867	726	40	40	40	40	40	37	34	32	30	29	28	26

Bull Moose Tube EDDYTHREAD 40 Steel Pipe Joined by Threading, Bonding or Compression/Grooved Couplings

Max Zone of Influence Load (F_{pw}) lbs. | Max. Transverse and 4-way Brace Spacing (ft) *** According to HLF for the 2006 & 2009 IBC (ASCE 7-05) & C_p for NFPA-13 shown in BOLD TYPE

Pipe Size	Transverse Brace Spacing* 20 ft	25 ft	30 ft	35 ft	40 ft	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
1	119	95	78	67	56	40	40	36	31	28	25	24	22	21	20	19	18
1 1/4	218	175	143	123	103	40	40	40	35	31	28	26	25	23	22	21	20
1 1/2	312	250	205	175	147	40	40	40	37	33	30	28	26	25	23	22	21
2	518	414	339	291	243	40	40	40	40	36	33	30	29	27	26	24	23

All these numbers are based on pre-TIA22-8 allowances and must be reduced by about 40% to meet the new requirements

28

Main Stress Limits

Sprinkler System Load Calculation ($F_{pw} = C_p W_p$)

C_p = 0.40

Table 18.5.5.2(a) Maximum Load (F_{pw}) in Zone of Influence (lb), (F_p = 30 ksi) Schedule 10 Steel Pipe

29

Main Stress Limits

S82 - SEISMIC BRACE CALCULATIONS

SPRINKLER SYSTEM LOAD CALCULATION ($F_{pw} = C_p * W_p$)

QTY	LINE	DESCRIPTION	PIPE SIZE/TYPE	LENGTH	WEIGHT/FT	WEIGHT/LINE	TOTAL WEIGHT
1	Main	Braced Pipe	4 NPS (Steel Sch 10 Seismic)	36.00 ft	11.76 lb/ft	424.08 lb	424.08 lb
3	Branch 1	Segment A	2 NPS (Steel Sch 40 Eong/cutnipl)	33.00 ft	5.13 lb/ft	245.13 lb	735.39 lb
		Segment B	1 1/2 NPS (Steel Sch 40 Eong/cutnipl)	33.00 ft	3.61 lb/ft		
		Segment C	1 NPS (Steel Sch 40 Eong/cutnipl)	5.00 ft	2.05 lb/ft		
		Segment D	1 NPS (Steel Sch 40 Eong/cutnipl)	5.00 ft	2.05 lb/ft		
		Riser Nipple	2 NPS (Steel Sch 40 Eong/cutnipl)	1.00 ft	5.13 lb/ft		

MAXIMUM F_{PW} AS PER 18.5.5.2

MAIN SIZE	SPACING	MAX. F_{PW}
4 NPS (Steel Sch 10	40 ft	467 lbf

RISER NIPPLE DATA

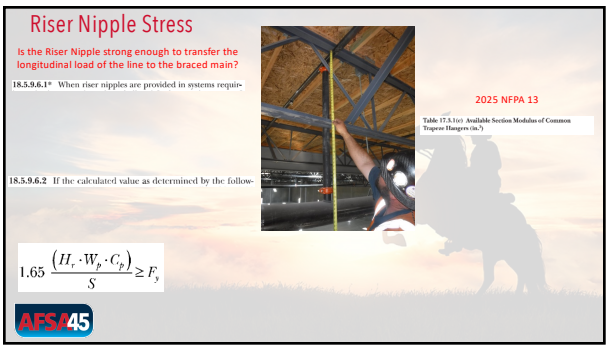
BRANCH	RISER NIPPLE	SECTION MOD	FY MAX	FY
1	2 NPS (Steel Sch 40	0.6810 in³	30,000 psi	1,588 psi

SYSTEM WEIGHT CALCULATIONS

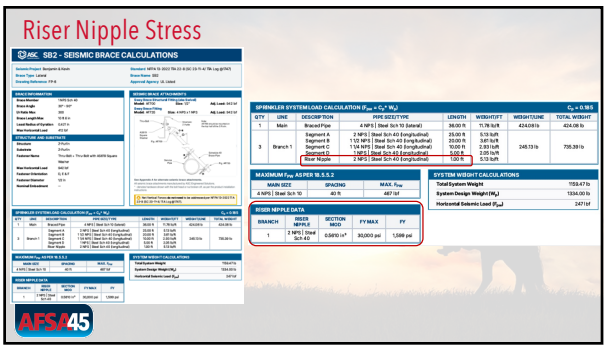
Total System Weight	1159.47 lb
System Design Weight (W_p)	1324.00 lb
Horizontal Seismic Load (F_{pw})	2471 lbf

Table 18.5.5.2(a) Maximum Load (F_{pw}) in Zone of Influence (lb), (F_p = 30 ksi) Schedule 10 Steel Pipe

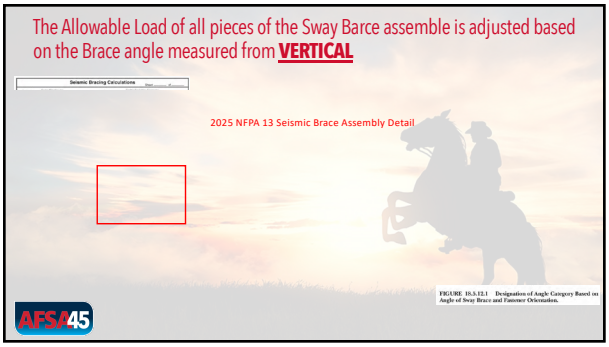
30



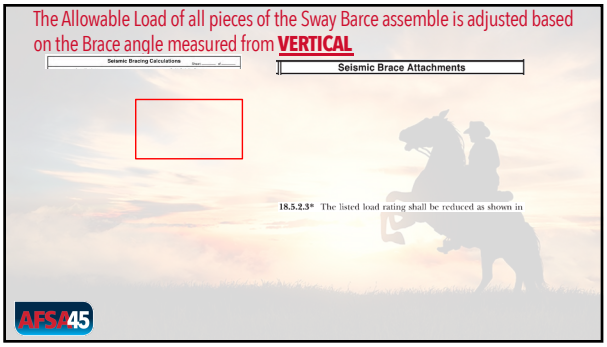
31



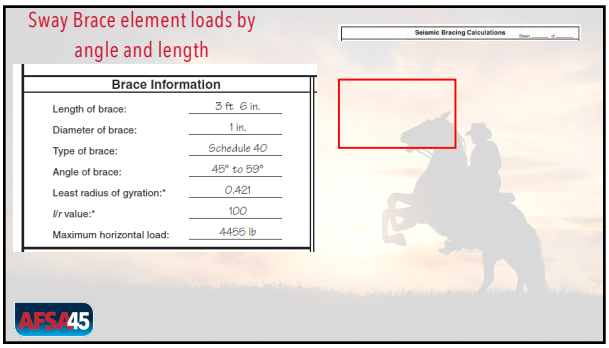
32



33



34



35

36

Fastener to Wood

Seismic Bracing Calculations

Table 18.5.12.2(f): Maximum Load for Through-Bolts in Sawn Lumber or Glue-Laminated Timbers

	¾							
	A	B	C	D	E	F	G	H	I
1½	155	220	270	180	310	530	170	300	450
2½	180	255	310	205	360	615	215	365	575
3½	220	310	380	255	440	755	260	455	730
5½	310	440	535	360	620	1065	360	610	925

620 lbs is greater than the ZOI = 383 lbs

37

Concrete & Prying Factors

FIG AF700 Horizontal Prying Factors (Pr) Per NFPA 13: Angles (Deg)

Fastener Orientation	A	B	C	D	E	F	G	H	I
Brace Angle	30°-44°	45°-59°	60°-90°	30°-44°	45°-59°	60°-90°	30°-44°	45°-59°	60°-90°
AF700	2.55	1.09	.091	1.41	1.45	2.00	1.83	1.29	1.06
AF700 w/ Metal Deck[1]	2.55	1.09	1.14	–	–	–	–	–	–
AF700 w/ Metal Deck[2]	2.75	1.11	1.14	–	–	–	–	–	–

38

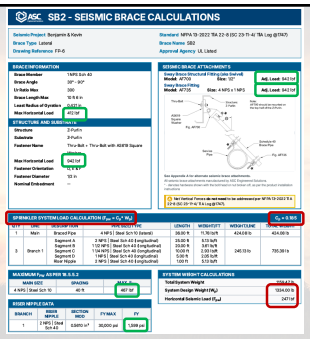
Concrete & Prying Factors

Table 9.3.3.12.2(c): Maximum Load for Wedge Anchors in 3000 psi (207 bar) Normal Weight Cracked Concrete

From 2025 NFPA 13

39

The system piping and Sway Brace's capacity to resist a seismic force must exceed the potential seismic force applied



40

Support, Bracing and Flexible Couplings of "Risers" as per 2025 NFPA 13

3.3.196 Risers.
(AUT-SSI)

17.4.5.5
25 ft (7.(

Δ 18.2.4.1

18.5.8.4
exceed 2

41

Intermediate Support of a Riser (Every 25' Vertically)

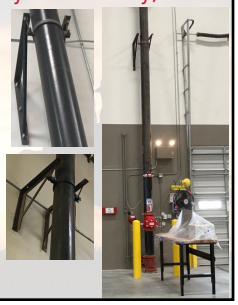
17.4.5 Su

17.4.5.1
ers locat
(600 mm

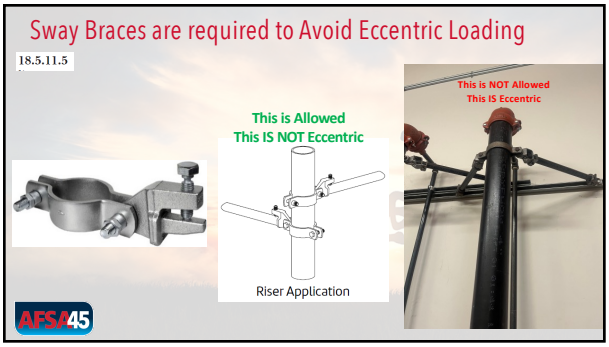
17.4.5.2
shall not

17.4.5.3*
the horiz
support r

A.17.4.5.3
secure the
vertical loa



42


Sway Braces are required to Avoid Eccentric Loading
18.5.11.5
This is Allowed
This IS NOT Eccentric
Riser Application
This is NOT Allowed
This IS Eccentric
AFSA45

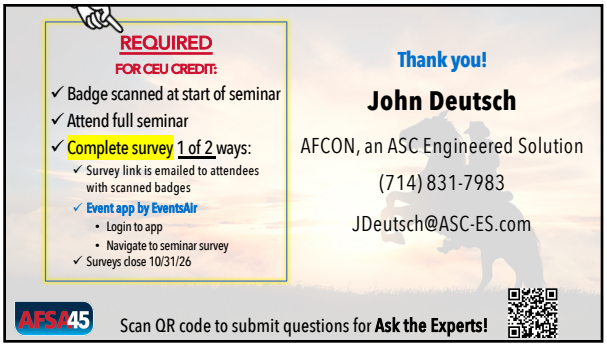
43

What we covered today
What is a Zone of Influence (aka W_p)
What the structural variables S_s and Sos represent
A simple and conservative way to determine the Seismic Coefficient C_p
How the force on a sway brace F_{pw} is determined
How to make sure the Sprinkler System Mains are not damaged during a seismic event
How to make sure the Sprinkler System Riser Nipples are not damaged during a seismic event
A Sway brace is only as strong as its weakest component
How the Horizontal Rated loads of sway brace components are reduced based on sway brace angle from vertical
How the Prying Factor of a Sway Brace Structural Fitting reduces concrete fastener capacity
What required to support and brace tall Risers
AFSA45

44

What we did not cover today
Net Vertical forces per 2025 NFPA 13 section 18.5.10
The ASCE7 formula which can be used to establish lower Seismic Coefficients
How the precise elevation of a sway brace can be used to establish lower Seismic Coefficients
How the building use category can be used to establish lower Seismic Coefficients
How the building construction and resistance to seismic forces can be used to establish lower Seismic Coefficients
How a lower Seismic Coefficient can reduce the required number of sway braces and line restraints
How to use free software provided by sway brace component manufactures to do your seismic calculations
Any Questions
AFSA45
Email: JDeutsch@ASC-ES.com | phone 714-831-7983

45


REQUIRED
FOR CEU CREDIT:
✓ Badge scanned at start of seminar
✓ Attend full seminar
✓ Complete survey 1 of 2 ways:
✓ Survey link is emailed to attendees with scanned badges
✓ Event app by EventsAir
• Login to app
• Navigate to seminar survey
✓ Surveys close 10/31/26
Thank you!
John Deutsch
AFCON, an ASC Engineered Solution
(714) 831-7983
JDeutsch@ASC-ES.com
AFSA45
Scan QR code to submit questions for Ask the Experts!

46

2027 Training Schedule

WEBINARS

1/6	Updates to NFPA 20
1/20	Calculating Pressure Reducing Hose Valves
2/3	Consumer Alert: Nitrogen in Sprinkler Systems
2/17	Reviewing Hydraulic Calculations
3/3	Updates to NFPA 13, 2028 Ed.
3/17	Updates to NFPA 13R & 13D, 2028 Eds.
4/7	Topic Coming Soon
4/21	NFPA 25: Roles & Responsibilities
5/5	Standpipe Flow Test Procedures
5/19	Storage 101
6/2	NFPA Technical Meeting - Voting Guide
6/16	Topic Coming Soon
6/30	Topic Coming Soon
7/7	Updates to NFPA 14, 2027 Edition
7/21	Adjacent Hazards & Design Methods
8/4	Acceptance Testing
8/18	Modifications to Existing Systems
9/22	Topic Coming Soon
10/6	Seismic 101
10/20	Proposed Updates to NFPA 25, 2029 Ed.
11/3	Evaluating Fire Pump Flow Tests
11/17	Top 10 Tech Reviews
12/1	Designing Water Storage Tanks
12/15	Pump Room Layout

PROGRAMS

Feb 9 - Mar 5 Apr 20 - May 14 Aug 3 - Aug 27** Oct 26 - Nov 19	Beginning Design School*
Apr 26 - May 7 Nov 1 - 12	Intermediate Design School*
Feb 8 - 10** Apr 12 - 14 Jul 12 - 14 Oct 11 - 13	Sprinkler Hydraulics Calculations Workshop
Apr 19 - 21 Oct 18 - 20	Advanced Hydraulics Calculations Workshop
Feb 11** Apr 30 Jul 23 Sep 24	Introduction to the Fire Sprinkler Industry
Mar 1 - 3 May 17 - 19 Aug 16 - 18 Oct 18 - 20**	NFPA 25 Essentials Workshop
Jun 7 - 10 Sep 20 - 23	Experienced Inspector Skills Lab
Mar 4 - 5 May 20 - 21 Aug 19 - 20 Oct 21 - 22**	NFPA 25 Fire Pump Workshop
Spring Summer Fall	ITM Inspector Development Program* *This program is 20 months.*

** Hybrid course **At General Air Products Lab, Exton, PA*

AFSA46

September 8-11	Manchester Grand Hyatt San Diego, CA

For More Details Visit:
firesprinkler.org

AFSA
American Fire Sprinkler Association

Dates subject to change. Programs subject to minimum registrations.

rev 9/14/2026

Virtual Instruction Path (VIP)

for Sprinkler Fitting Apprentices

Level 1 - Begins January 2027

Level 2 - Begins February 2027

Level 3 - Begins January 2027

Level 4 - Begins March 2027

www.firesprinkler.org/VIP

AFSA
American Fire Sprinkler Association

HANDS-ON WORKSHOPS FOR 2027

FEATURING AFSA'S TRAINING LAB

NFPA 25 Essentials Workshop

Mar | May | Aug | Oct

Description: Understand roles, responsibilities, and NFPA 25 ITM procedures through hands-on testing of wet systems, dry systems, and fire pumps.

NFPA 25 Fire Pump Workshop

Mar | May | Aug | Oct

Description: Develop practical NFPA 25 fire pump ITM skills, including no-flow and full-flow testing, water supply graphing, and performance evaluation.

Introduction to the Fire Sprinkler Industry

Feb | Apr | Jul | Sep

Description: This course is designed for those new to the industry. An introductory, wide-ranging 8-hour course that provides a broad overview of core fire sprinkler industry concepts for those new to the field.

Experienced Inspector Skills Lab NEW

Mar | Sep

Description: Take your ITM expertise beyond the basics. Designed for experienced technicians, this course combines focused classroom instruction with hands-on system lab training to strengthen your application of current NFPA 25 inspection, testing, and maintenance requirements. Refine fire sprinkler testing practices, improve documentation, deliver more consistent service, and help reduce liability while reinforcing knowledge commonly covered on certification exams.

Learn more about AFSA's fire sprinkler lab featuring functional risers, a spray room, fire pumps, and an interactive classroom.

firesprinkler.org/lab