SPRI Wind Design Seminar
ANSI/SPRI WD-1

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ANSI
American National Standards Institute

ANSI/SPRI Standards

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ANSI/SPRI Standards

- ANSI/SPRI WD-1 Design Standard Practices for Roofing Assemblies
- ANSI/SPRI RP-4*
- ANSI/SPRI RP-14
- ANSI/SPRI IA-1
- ANSI/SPRI FX-1

*referenced in the International Building Code

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ANSI/SPRI WD-1 - Wind Design Standard Practice for Roofing Assemblies

Document assists in verifying the process to meet the building code associated to uplift pressures for roofing:

ASCE 7 Design Load (PSF) ≤ Tested Load (PSF)

Includes rational analysis methods for determining enhancement of perimeter and corner fastening (if necessary)

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Rationale Analysis Method for Perimeters and Corners of Adhered Assemblies

Rationale analysis method is not necessary, when tested load capacity (not factored) is greater than the design load

Example:

Tested Load pressures is 90-psf. Zone 3 Design Load pressures have been calculated to -64.6-psf.

Since 90-psf > -64.6-psf, no enhancements would be necessary.

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Select an appropriate roofing system

Chapter 15, Section 1504.4.1 IBC

Assemblies are tested by following one of the following:

- ANSI/FM 4474 (12'x24' or 5'x9' size tables)
- UL 580 (10'x10' size table)
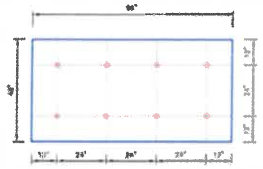- UL 1897 (10'x10' or 12'x24')

Results are Tested Loaded Assemblies in lbs/sqft.

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Rationale Analysis Method for Perimeters and Corners of Adhered Assemblies

Rationale analysis method can be used when:

- Insulation secured with fasteners or adhesive ribbons
- Securement pattern can be converted to a sqft area.

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Adhered Membrane Assemblies with Insulation Secured with Insulation Fasteners and Plates

Fastened Insulation

Increase fasteners per the following formula:

$$Fn = (Ft \times Ld)/Lt$$

Where:
- Fn = # of fasteners to meet design load
- Ft = # of fasteners used to achieve tested load
- Ld = Design load for perimeter or corner
- Lt = Tested load

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Adhered assembly with mechanically attached insulation

Roof Assembly Tested Load is 90-psf

Assembly uses 2-inch foam plastic insulation secured to the deck using 1 fastener every 4 ft² [8 fasteners per 4'x8' size board]

Design Loads in lbs/sqft			
Bldg. Ht., ft.	Zone 1'	Zone 1	Zone 2	Zone 3
60	-40.8	-71.0	-93.7	-127.7

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Adhered Membrane Assembly with fastened insulation
$Fn = (Ft \times Ld)/Lt$

Zone 2
- $F_n = (F_t \times L_d)/L_t$
- $F_n = (8 \text{ fasteners} \times 93.7\text{-psf}) \div 90\text{-psf}$
- = 9 fasteners per board (rounded up)

Zone 3
- $F_n = (F_t \times L_d)/L_t$
- $F_n = (8 \text{ fasteners} \times 127.7\text{-psf}) \div 90\text{-psf}$
- = 12 fasteners per board (rounded up)

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Rational Analysis Method
Adhered assembly with Ribbon/Bead Adhesive Attached Insulation

Ribbons/beads of an adhesive spacing equation:
$$Rn = Rt/(Ld/Lt):$$

Where:
- Rn = Adhesive spacing to meet the design load
- Rt = Adhesive spacing to achieve the tested load
- Ld = Design Load for the perimeter or corner
- Lt = Tested Load

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Adhered assembly with ribbon/bead adhesive attached insulation

Roof Assembly Tested Load is 90-psf

System uses 2-inch foam plastic insulation adhered using ribbon/bead adhesive spaced 12-inches

Design Loads in lbs/sqft				
Bldg. Ht., ft.	Zone 1'	Zone 1	Zone 2	Zone 3
60	-40.8	-71.0	-93.7	-127.7

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**Adhered assembly with
ribbon/bead adhesive attached insulation**

Rn = Rt / (Ld/Lt)

Zone 2:
- $R_n = R_t /(L_d / L_t)$
- $R_n = 12\text{-inches}/(93.7 \text{ psf} \div 90 \text{ psf})$
- = 11-inches (rounded down)

Zone 3:
- $R_n = R_t /(L_d / L_t)$
- $R_n = 12\text{-inches}/(127.7 \text{ psf} \div 90 \text{ psf})$
- = 8-inches (rounded down)

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**Rationale Analysis Method Mechanically
Attached Membranes Linear Securement
(Rows Spacing)**

$$RS_n = (L_t / L_d) \times RS_t$$

Where Fastener Spacing stays the same:
- RS_n = Fastening Row Spacing (ft)
- L_t = Tested load capacity
- RS_t = Tested Row Spacing (ft)
- L_d = Design load for the Zone 1, 2 and 3

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**Mechanically Attached Membrane with
Linear Securement**

Roof Assembly "Tested Load Capacity" is 90-psf

Membrane mechanically attached with 9.5-ft* rows at a rate of 12-inches

Bldg. Ht., ft.	Design Loads in lbs/sqft			
	Zone 1'	Zone 1	Zone 2	Zone 3
60	-40.8	-71.0	-93.7	-127.7

*10-ft sheet – 0.5 seam = 9.5-ft

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Mechanically Attached Membrane (Linear)

$$RS_n = (L_t / L_d) \times RS_t$$

Zone 2
- $RS_n = (L_t / L_d) \times RS_t$
- $RS_n = (90\text{-psf} / 93.7\text{-psf}) \times 9.5\text{-ft}$
- = 9-ft rows (round down)

Zone 3
- $RS_n = (L_t / L_d) \times RS_t$
- $RS_n = (90\text{-psf} / 127.7\text{-psf}) \times 9.5\text{-ft}$
- = 6-ft rows (round down)

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Rationale Analysis Method Mechanically Attached Membranes Linear Securement (Fastening Spacing)

$$FS_n = ((L_t \times FS_t) / L_d) \times 12\text{-inches}$$

Where Fastener Spacing stays the same:
- FS_n = Fastening Spacing in seam (ft)
- L_t = Tested load capacity
- FS_t = Tested Fastening Spacing in seam (ft)
- L_d = Design load for the perimeter or corner

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Mechanically Attached Membrane with Linear Securement

Membrane mechanically attached with 9.5-ft* rows at a rate of 12-inches

Design Loads in lbs/sqft				
Bldg. Ht., ft.	Zone 1'	Zone 1	Zone 2	Zone 3
60	-40.8	-71.0	-93.7	-127.7

*10-ft sheet – 0.5 seam = 9.5-ft

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Mechanically Attached Membranes Linear Securement (Fastening Spacing)

$$FS_n = ((L_t \times FS_t)/ L_d) \times 12\text{-inches}$$

Zone 2:
- $FS_n = ((L_t \times FS_t) / L_d) \times 12$-inches
- $FS_n = ((90\text{-psf} \times 1\text{-ft}) / 93.7\text{-psf}) \times 12$-inches
- = 11-inches (round down)

Zone 3:
- $FS_n = ((L_t \times FS_t) / L_d) \times 12$-inches
- $FS_n = ((90\text{-psf} \times 1\text{-ft}) / 127.7\text{-psf}) \times 12$-inches
- = 8-inches (round down)

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Rationale Analysis Method for Induction Welded Membranes

Induction Plates and Fasteners:

Increase Induction Plates & fasteners per the following formula:

$$Fn = (Ft \times Ld)/Lt$$

Where:
- Fn = # of plates & fasteners to meet design load
- Ft = # of plates & fasteners used to achieve tested load
- Ld = Design load for perimeter or corner
- Lt = Tested load

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Induction Welded Membrane

Roof Assembly Tested Load is 90-psf

Membrane induction welded to 6 plates and fasteners per 4'x8' size board

Design Loads in lbs/sqft				
Bldg. Ht., ft.	Zone 1'	Zone 1	Zone 2	Zone 3
60	-40.8	-71.0	-93.7	-127.7

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Induction Welded Plates and Fasteners attaching insulation

$Fn = (Ft \times Ld)/Lt$

Zone 2

- $F_n = (F_t \times L_d)/L_t$
- $F_n = (6 \text{ fasteners} \times 93.7\text{-psf}) \div 90\text{-psf}$
- $= 7$ fasteners per board (rounded up)

Zone 3

- $F_n = (F_t \times L_d)/L_t$
- $F_n = (6 \text{ fasteners} \times 127.7\text{-psf}) \div 90\text{-psf}$
- $= 9$ fasteners per board (rounded up)

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