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Lightweight Insulating Concrete Roof Decks:

Florida Applications and The Florida Building Code

FRDA Speakers

- **Frank Peydro** – Vice President, Cellucrete, 26 years experience in the Lightweight Insulating Concrete Roof Deck Industry, current President FRDA.
  - Instructor for Palm Beach, Orlando, and Virtual Locations
- **Mike Fogel** – Operations Director, Estimator, Project Manager for iCrete LLC, 38+ years experience in the LWIC business. Past President & Current Director, FRDA.
  - Instructor for the Tampa Location
- **Jeff Sommer** – VP of Business Development, The Scarlette Group, 20+ years of experience in the residential and commercial building material industry
  - Instructor for Pensacola and Tallahassee Locations
- **Agan Prameshuber** – CEO, Agantic Group, 18 years experience specializing in LWIC and overall construction industry.
  - Instructor for the Jacksonville Location

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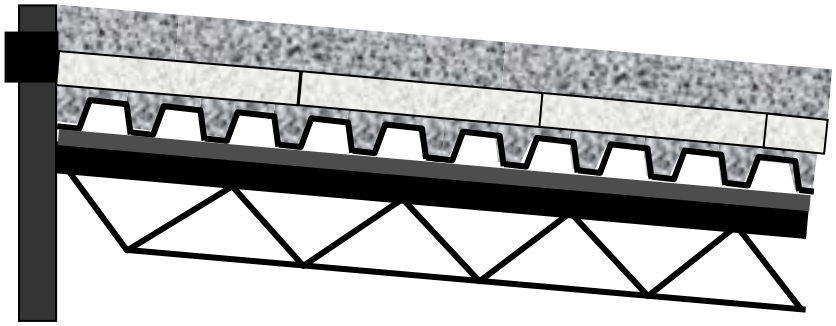
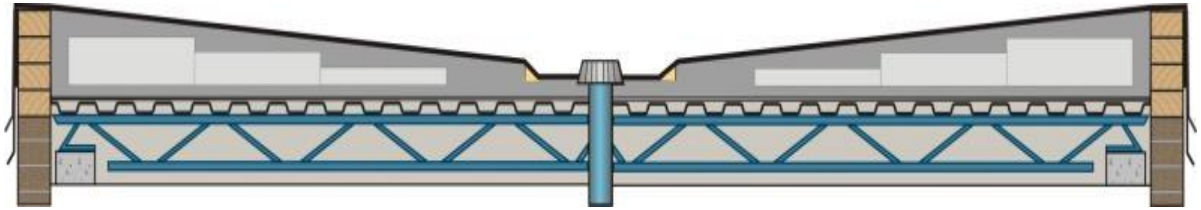
LWIC for Roof Deck Systems





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LWIC for Roof Deck Systems

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GOALS

- For FRDA and its members to become your trusted resource for LWIC related issues, concerns and/or recommendations. “Go To Guy”
- Provide help with spec. writing, FBC and to mitigate RFIs, change orders and substitution requests…
- **Earn a valued and long-lasting position within your master specification**

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- The Florida Roof Deck Association （FRDA） has represented and supported Florida‘s lightweight insulating concrete （LWIC） industry and it‘s manufacturers, applicators and suppliers for over 20 years.

- Our purpose is to ensure high quality LWIC concrete roof deck installations throughout the state of Florida and to provide resources and assistance to design and construction professionals.

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OVERVIEW

1. Florida Building Code
2. Types of LWIC
3. Insulation Board
4. Substrates
5. Installation of LWIC
6. Recovering
7. Roof Coverings
8. Fire Rating
9. Uplift
10. Benefits of LWIC

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Florida Building Code

- The Florida Building Code is unique from the International Code and codes in other states.
- It includes Florida-specific provisions in **Section 1917 addressing lightweight insulating concrete (LWIC) roof decks.**
- The Florida Building Code also includes provisions relating to LWIC in Chapter 15, the roofing chapter **and** in the High Velocity Hurricane Zones provisions.
- Many other states look to Florida's code for help with LWIC permitting, installation and field testing.
- The FRDA takes an active role in the development and amendment of Florida Building Code as well as legislative issues affecting the code.

Florida Building Code

- NEW 2020 Code revision regarding electrical conduit

1510.11 Metal conduit and electrical wiring.

If metal conduit or electrical wiring needs to be placed near a roof assembly, where possible, the conduit shall be positioned and supported a minimum of 1-1/2 inches from the bottom side of the roof deck or substrate to which the roof system is applied. In no instances shall conduit of any type be run horizontally through any type of roofing insulation to include lightweight insulating concrete or polyisocyanurate.

Hangers or other supports used to attach and support metal or pvc conduit and electrical wiring should be attached to framing or roof deck supports and not the roof deck or substrate. Where it is not possible to place metal or pvc conduit or electrical wiring on the bottom side of a roof deck or substrate, the metal or pvc conduit or electrical wiring may not be hidden or encapsulated within the roofing system and must be visible, easily locatable and properly supported above the roofing system.

CODE MOD 7600
Proposed by the FRDA for 2020 Edition of the Florida Building Code
Projected effective date: December 31, 2020

Florida Building Code Definition of LWIC

Material produced with or without aggregate additions to Portland cement, water and air to form a hardened material possessing insulating qualities, which, when oven dried shall have a unit weight no greater than 50 pcf (801 kg/m). (1917.1)

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Types of Lightweight Insulating Concrete (LWIC)

Cellular

Preformed foam

Site batched process

Placement

Properties

Aggregate Based

Production Process

Properties

Florida Building Code Sections 1917.1.1, 1917.1.2 and 1917.1.3 provide the Physical properties for these Lightweight Insulating Concretes

Cellular Preformed Foam

Diluted in water and expanded under pressure producing a preformed foam.

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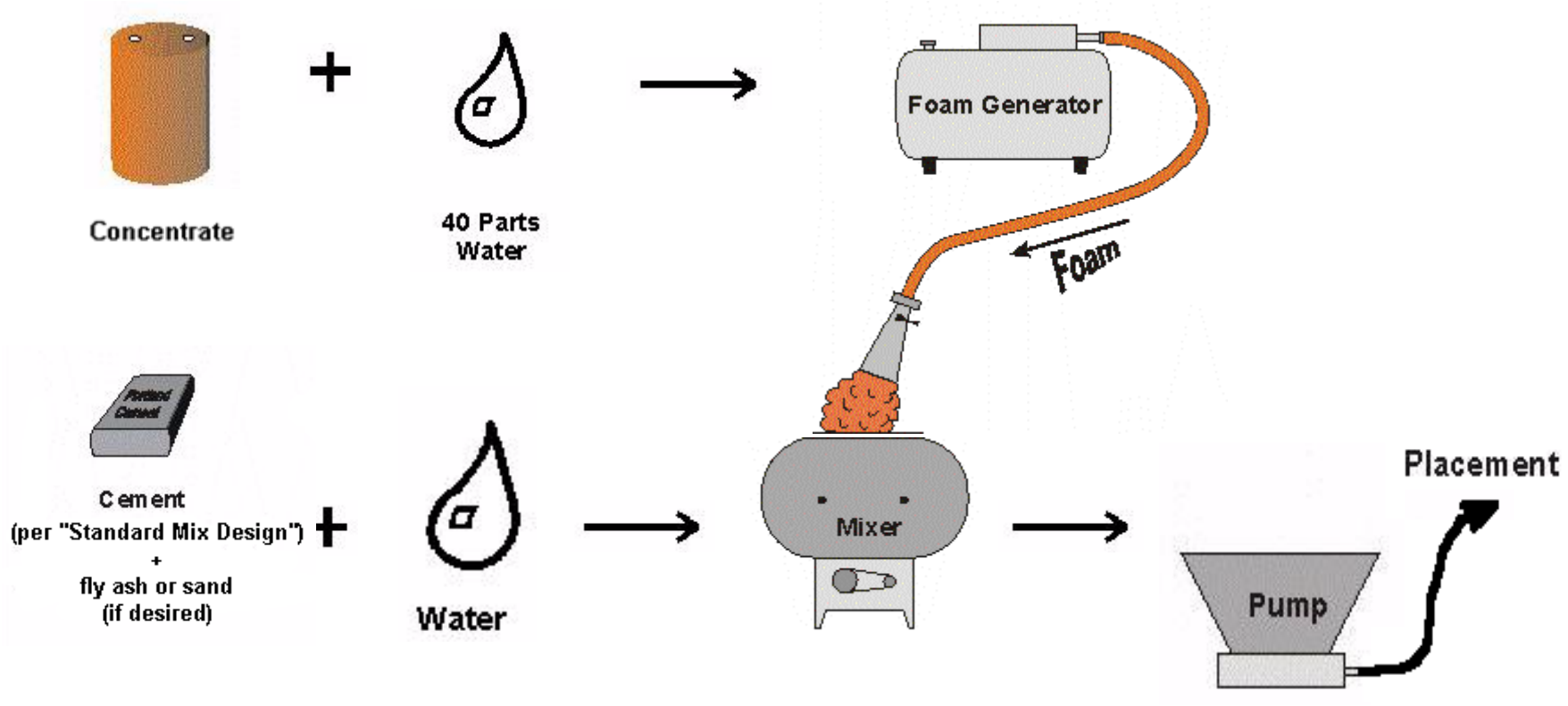
Cellular Site-Batched Process



Minimum 160 psi when tested in compliance with ASTM C 495 and C 796 per Florida Building Code Section 1917.1.2

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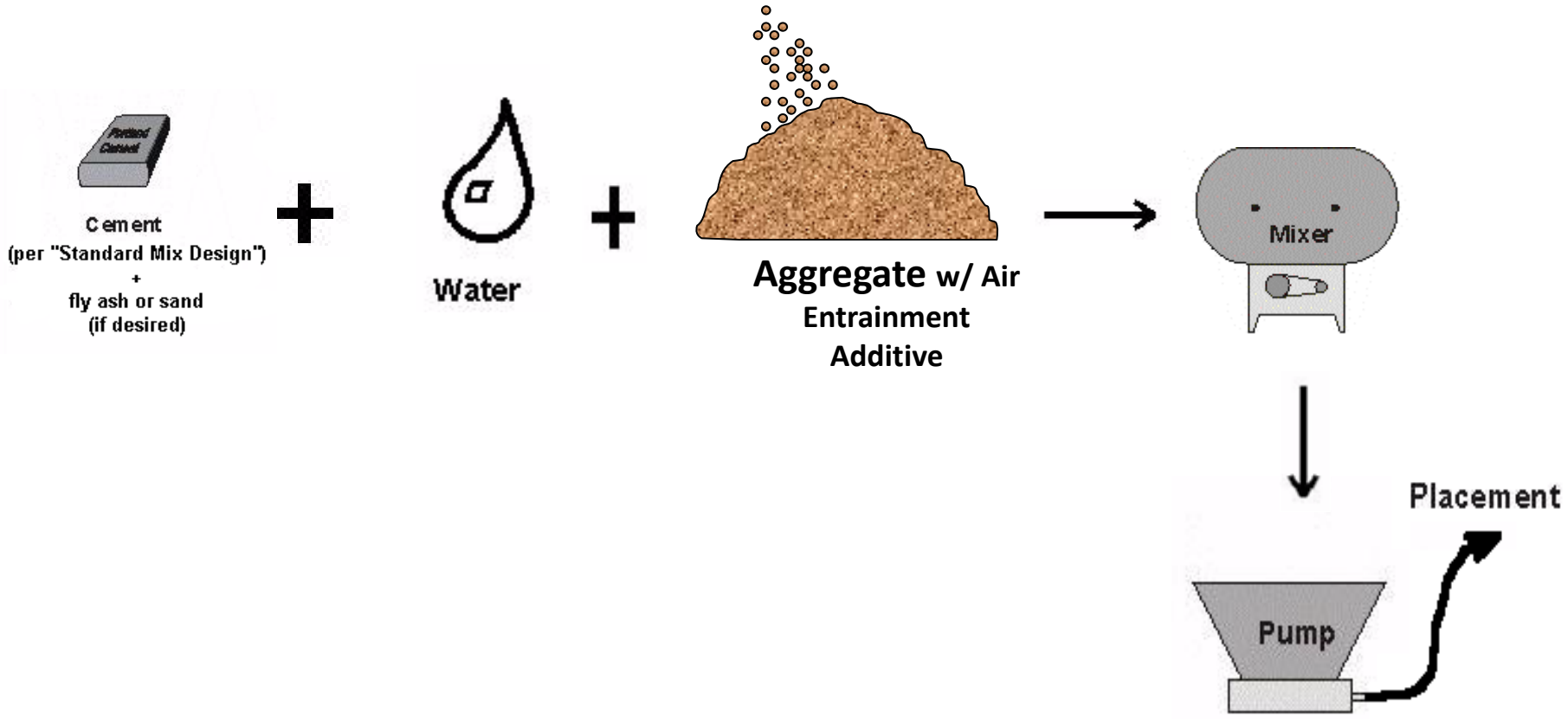
Aggregate Based LWIC

Admixtures (like vermiculite) are mixed in specific ratios for use in lightweight insulating concrete.

Aggregate Based Site-Batched Process



Minimum 125 psi when tested in compliance with ASTM C 495 per Florida Building Code Section 1917.1.1

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Properties

Material Type	Cast Density (pcf)	Air Dry Density (pcf)	Weight per Inch (psf)	R Value per Inch (BTU Units)	Compressive Strength (psi)
Aggregate	44-60 pcf	22-28 pcf	1.9 psf/in	1.49	125+ psi
Aggregate	60-68 pcf	35-41 pcf	1.9 psf/in	0.90	300+ psi
Cellular	34-42 pcf	28-36 pcf	2.5 psf/in	1.20	200 psi
Cellular	42-50 pcf	38-46 pcf	3.0 psf/in	1.00	250+ psi

Minimum compressive strength requirements are listed in Florida Building Code Section 1917.1

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Concrete Density Comparisons

Lightweight Insulating Concrete

~ up to 50 pcf

Structural Lightweight Concrete

~ 80 to 115 pcf

Regular Structural Concrete

~ 129 to 139 pcf

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Average Square Foot Weights

Lightweight Insulating Concrete

+/- 11 pounds per square foot

Structural Lightweight Concrete

+/- 40 psf

Regular Structural Concrete

+/-56 psf

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Insulation Board
Expanded Polystyrene (EPS)

Definition

Properties

Providing Taper

Diagram of Complete System

Insulation board with Lightweight Insulating Concrete shall conform to Type 1 Expanded Polystyrene as defined in ASTM C 578 (per Florida Building Code section 1917.4.10

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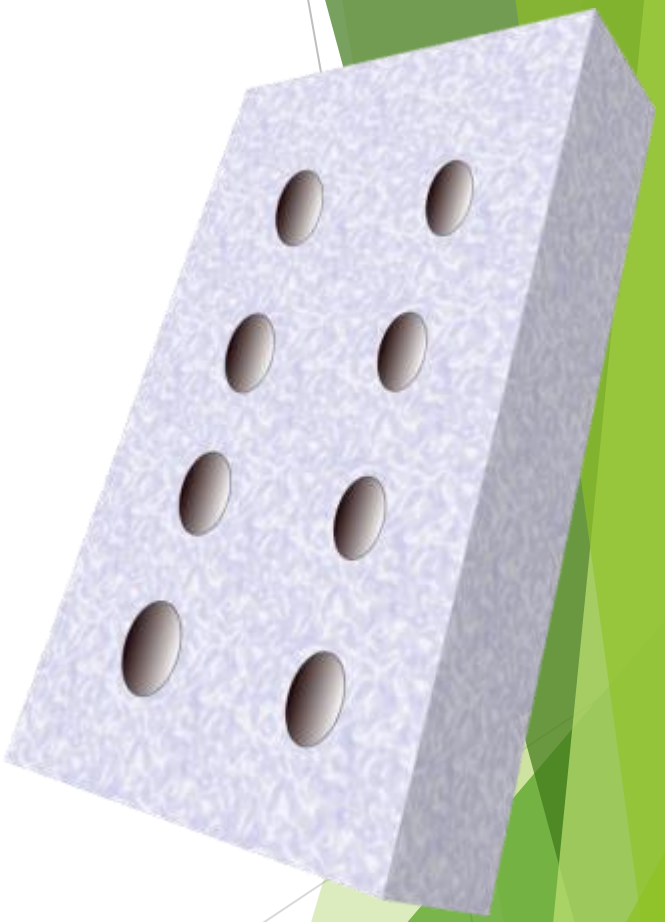
Insulation Board Definition

Expanded polystyrene (EPS) is an insulating component in lightweight insulating concrete roof deck assemblies.

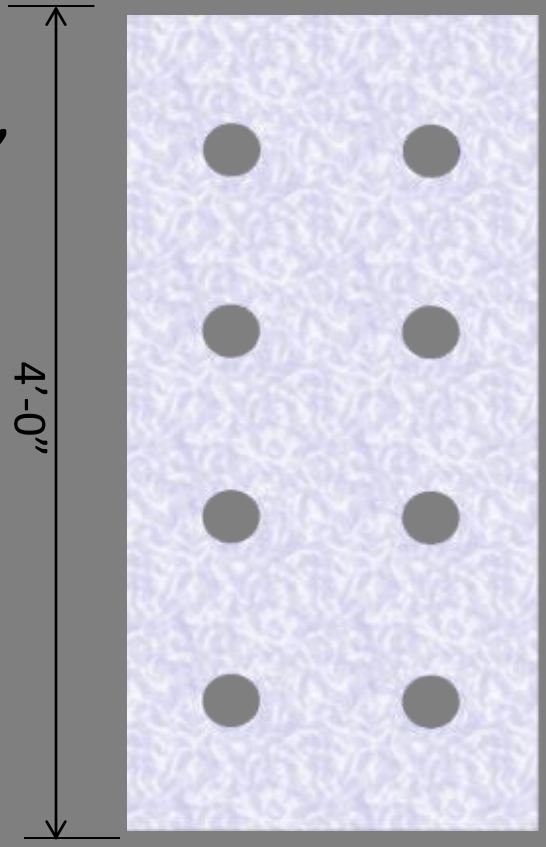
EPS is extremely lightweight and specially designed to give these roof deck systems great composite strength while allowing the release of moisture vapor.

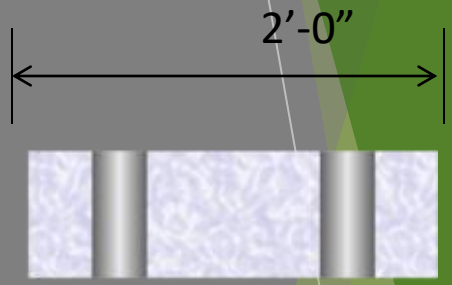
Factory Mutual and Underwriters Laboratories both approve EPS board for use in fire and wind rated assemblies.



Insulation Board Properties

- 2’ x 4’ boards
- Thicknesses from 1” to 16”
- 1 pcf density
- Key holes in board to enable topcoat bonding to the slurry coat, therefore commonly referred to as “holey board”.





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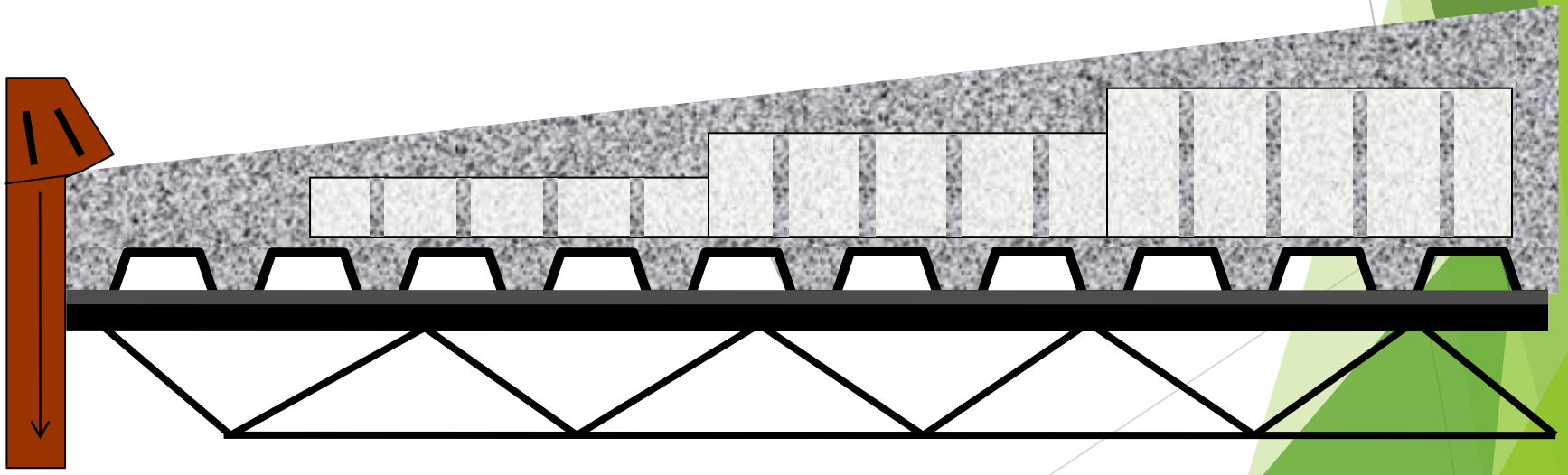
Insulation Board Providing Taper

EPS board is placed in the slurry coat in "stair-stepped" fashion, providing taper in the system. The insulation is then encapsulated in lightweight insulating concrete as the top coat pours over and through the key holes.



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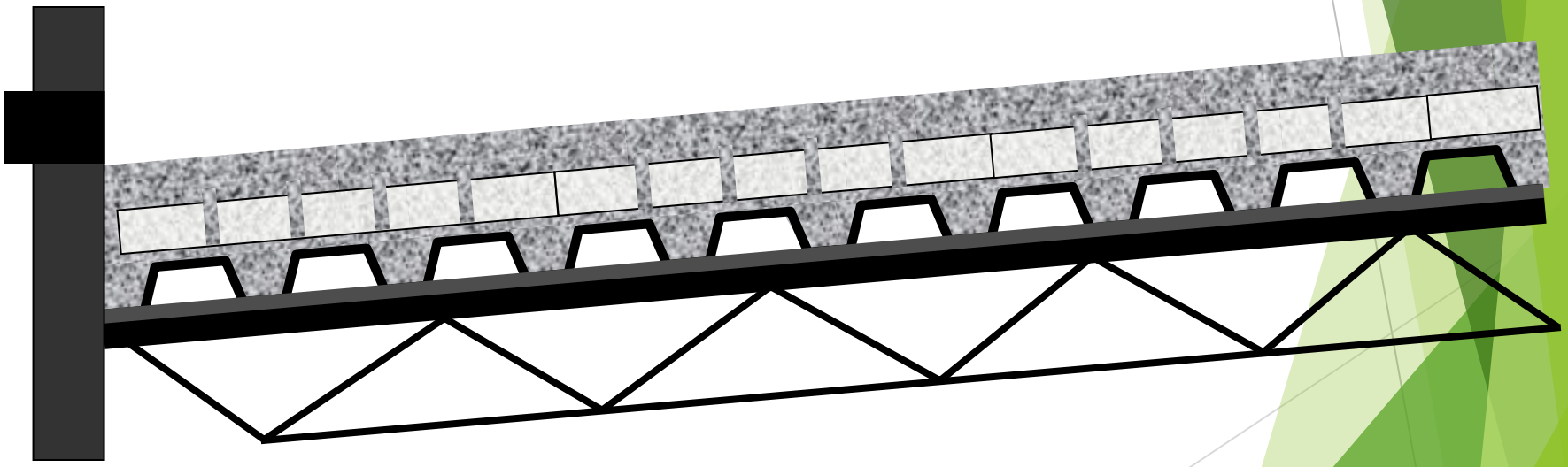
Insulation Board Structure is Providing Taper

Structural Slope Application



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Substrates

- **Metal Roof Deck**
- **Concrete**
  - **Poured in place slabs**
  - **Hollow core slabs**
  - **Double tee slabs**
- **Recover**
  - **Over existing membranes**
  - **Over new temporary membranes**

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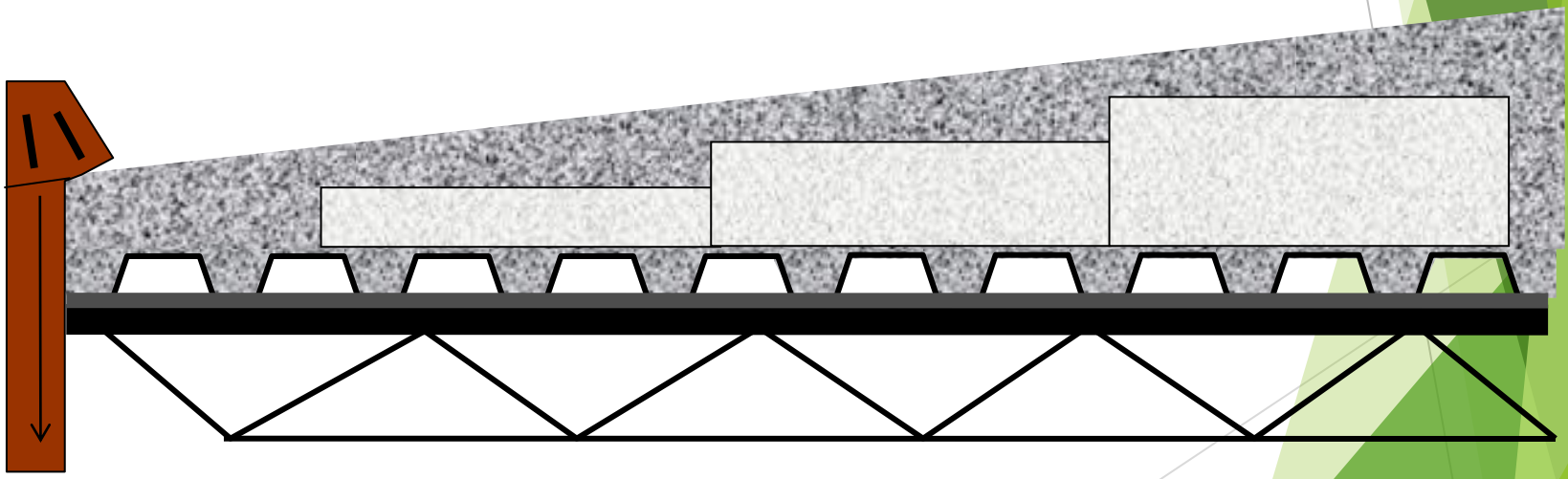
Substrates

Metal Roof Deck

- Types
- Gauges
- Finishes
- Attachment



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Metal Roof Deck Types

"BV"

Wide Rib - Vented

"NV"

3" Deep - Vented

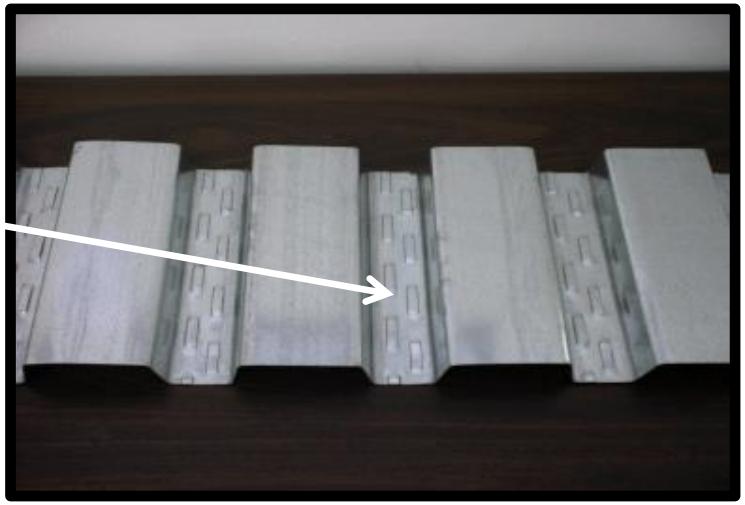
(rib widths @ 8" o.c.)

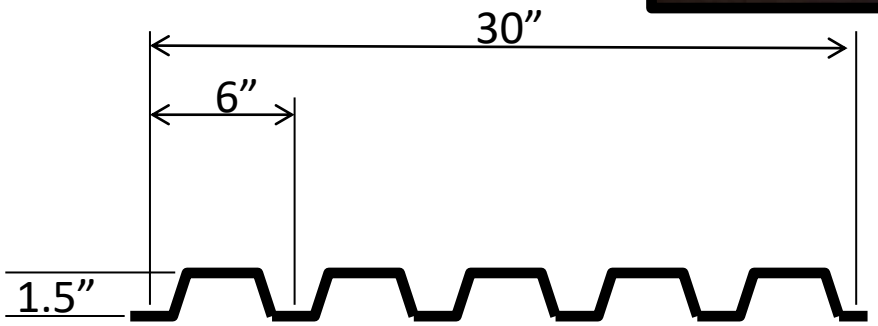
Base steel shall conform to ASTM A 446 Grade A, B, C, D or greater and ASTM A 611 C, D or E, per Florida Building Code 1917.4.3

Metal Roof Deck Type BV

“BV”

Wide Rib - Vented





Lightweight Insulating Concrete shall be poured over bottom slotted Galvanized (G-90) Steel deck as follows: cellular, 0.5% open, hybrid, 0.75% open, aggregate, 1.5% open. No Lightweight Insulating Concrete shall be poured over a painted or non-galvanized steel deck – per Florida Building Code 1917.4.1

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Metal Roof Deck Gauges

Normally 22 gauge and heavier

(i.e. – 20ga., 18ga., etc.)

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Metal Roof Deck Finishes

Galvanized – G-90 coatings

Galvanized coatings of formed steel sheets shall be in accordance with ASTM A 525 with a minimum coating designation of G-90 per Florida Building Code Section 1917.4.3

Metal Roof Deck Attachment

Puddle Welds
(22 gauge & heavier)

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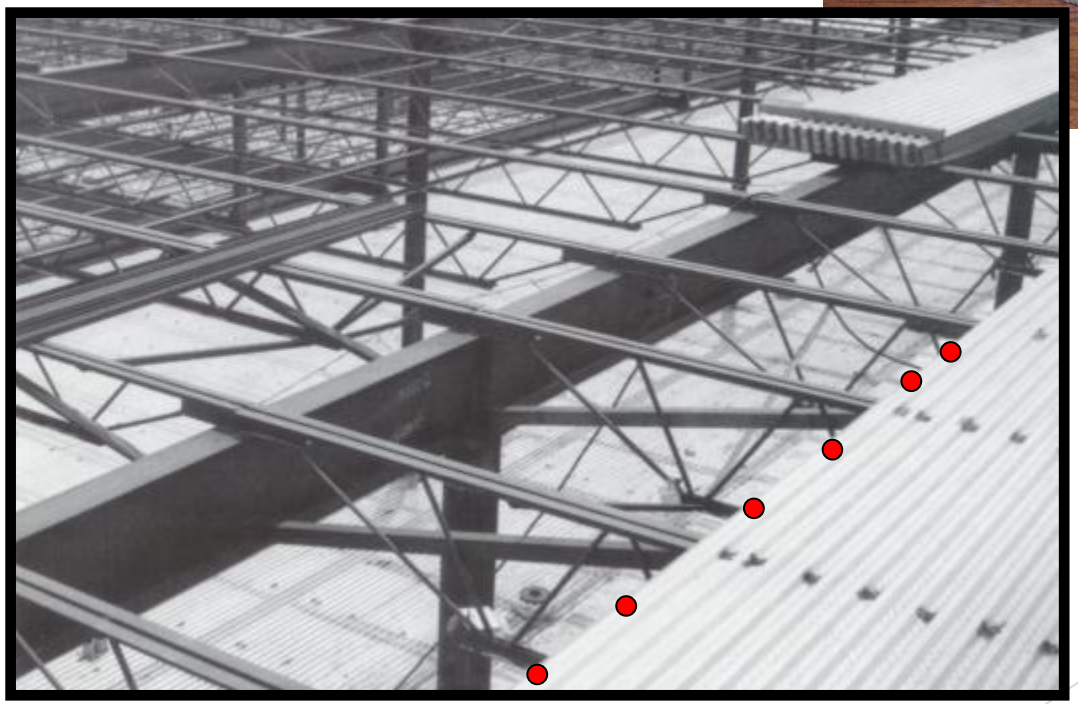
Metal Roof Deck Attachment

“Stitch Screws”

Used for side lap connection



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Metal Deck

Substructure	Admixtures (Top Coat)	Substrate Treatment	Min. Compressive Strength	Polystyrene Insulation Board	Maximum Design Pressure
NEW CONSTRUCTION					
Min. 22 ga., 1.5" type BV, G-90 steel deck welded to supports spaced max. 6' o.c. with 5/8" puddle welds every flute. Deck side laps are fastened with #10 TEK screws at 18" o.c.	(Optional) Zell-Crete Fibers	none	min. 200 psi 2" thick Range II	Minimum 2" thick & 1.0 pcf flat corrugated or grooved board.	82.5 psf
Min. 22 ga., 1.5" type B, Grade 33 steel deck welded to supports spaced max. 6' o.c. with 5/8" puddle welds or Traxx/5 fasteners every flute. Deck side laps are fastened with four self-tapping #10 TEK screws evenly divided within the 6 ft. spacing.	Zell-Crete Fibers	none	min. 250 psi	Minimum 1" thick & 1.0 pcf flat corrugated or grooved board.	90 psf* *(Deck Only no roof cover)*
Min. 22 ga., Type B, Grade 33 vented steel deck attached to supports spaced max. 4' o.c. with Traxx/5 fasteners spaced 6" o.c. Deck side laps are fastened with Traxx/1 fasteners spaced 18" o.c.	Zell-Crete Fibers	none	min. 550 psi	none	90 psf
Min. 22 ga., 1.5" type BV, G-90 steel deck welded to supports spaced max. 5' o.c. with 5/8" puddle welds every flute. Deck side laps are fastened with #10 TEK screws at 15" o.c.	(Optional) Zell-Crete Fibers	none	min. 250 psi 2" thick Range II	Minimum 1" thick & 1.0 pcf flat corrugated or grooved board.	97.5 psf
Min. 22 ga., 1.5" type BV, G-90 steel deck welded to supports spaced max. 6' o.c. with 5/8" puddle welds every flute. Deck side laps are fastened with #14 TEK screws at 6" o.c.	Zell-Crete Fibers	none	min. 200 psi 2" thick Range II	(Optional) Minimum 2" " thick & 1.0 pcf.	105 psf
Min. 22 ga., Type B, Grade 33 vented steel deck attached to supports spaced max. 6' o.c. with Traxx/5 fasteners spaced 6" o.c. Deck side laps are fastened with Traxx/1 fasteners spaced 18" o.c.	Zell-Crete Fibers	none	min. 700 psi	Minimum 1" thick EPS Holey Board	105 psf
Min. 22 ga., 1.5" type BV, G-90	(Optional)	none	min. 250 psi 3"	Minimum 2" " thick	112.5 psf

Substructure	Admixtures (Top Coat)	Substrate Treatment	Min. Compressive Strength	Polystyrene Insulation Board	Maximum Design Pressure
NEW CONSTRUCTION					
Min. 22 ga., 1.5" type BV, G-90 steel deck welded to supports spaced max. 6' o.c. with 5/8" puddle welds every flute. Deck side laps are fastened with #10 TEK screws at 18" o.c.	(Optional) Zell-Crete Fibers	none	min. 200 psi 2" thick Range II	Minimum 2" thick & 1.0 pcf flat corrugated or grooved board.	82.5 psf

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Product Control Approvals

MIAMI-DADE COUNTY
DEPARTMENT OF REGULATORY AND ECONOMIC RESOURCES (RER)

MIAMI-DADE COUNTY
PRODUCT CONTROL SECTION
11805 SW 26 Street, Room 208
Miami, Florida 33175-2474

Substructure	Admixtures (Top Coat)	Substrate Treatment	Min. Compressive Strength	Polystyrene Insulation Board	Maximum Design Pressure
NEW CONSTRUCTION					
Min. 22 ga., 1.5" type BV, G-90 steel deck welded to supports spaced max. 6' o.c. with 5/8" puddle welds every flute. Deck side laps are fastened with #10 TEK screws at 18" o.c.	(Optional) Zell-Crete Fibers	none	min. 200 psi 2" thick Range II	Minimum 2" thick & 1.0 pcf flat corrugated or grooved board.	82.5 psf
Min. 22 ga., 1.5" type B, Grade 33 steel deck welded to supports spaced max. 6' o.c. with 5/8" puddle welds or Traxx/5 fasteners every flute. Deck side laps are fastened with four self-tapping #10 TEK screws evenly divided within the 6 ft. spacing.	Zell-Crete Fibers	none	min. 250 psi	Minimum 1" thick & 1.0 pcf flat corrugated or grooved board.	90 psf* *(Deck Only no roof cover)*
Min. 22 ga., Type B, Grade 33 vented steel deck attached to supports spaced max. 4' o.c. with Traxx/5 fasteners spaced 6" o.c. Deck side laps are fastened with Traxx/1 fasteners spaced 18" o.c.	Zell-Crete Fibers	none	min. 550 psi	none	90 psf
Min. 22 ga., 1.5" type BV, G-90 steel deck welded to supports spaced max. 5' o.c. with 5/8" puddle welds every flute. Deck	(Optional) Zell-Crete Fibers	none	min. 250 psi 2" thick Range II	Minimum 1" thick & 1.0 pcf flat corrugated or grooved board.	97.5 psf

Substructure	Admixtures (Top Coat)	Substrate Treatment	Min. Compressive Strength	Polystyrene Insulation Board	Maximum Design Pressure
NEW CONSTRUCTION					
Min. 22 ga., 1.5" type BV, G-90 steel deck welded to supports spaced max. 6' o.c. with 5/8" puddle welds every flute. Deck side laps are fastened with #10 TEK screws at 18" o.c.	(Optional) Zell-Crete Fibers	none	min. 200 psi 2" thick Range II	Minimum 2" thick & 1.0 pcf flat corrugated or grooved board.	82.5 psf

TEK screws at 15" o.c.

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NOA No.: 13-0617.20
Expiration Date: 08/28/18
Approval Date: 09/05/13
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MIAMI-DADE COUNTY
DEPARTMENT OF REGULATORY AND ECONOMIC RESOURCES (RER)

MIAMI-DADE COUNTY
PRODUCT CONTROL SECTION
11805 SW 26 Street, Room 208
Miami, Florida 33175-2474

NEW CONSTRUCTION (continued)

NEW CONSTRUCTION (continued)

Substrate	Substrate Treatment	Min. Compressive Strength	Apache Holey Board	Maximum Design Pressure
18-22 ga. vented steel	Steel deck shall be secured to ¼" thick structural supports spaced a maximum of **6** ft. on centers with ITW Buildex Traxx/5 at the bottom of each rib (6" o/c.)	200 psi	min. 1" thick min. 1.0 pcf	-60 psf
18-22 ga. vented steel	Steel deck shall be secured to supports spaced a maximum of **6** ft. on centers with ½" puddle welds at every corrugation (6" o.c.). Deck side laps fastened with ITW Buildex Traxx/1 at midspan.	200 psi	min. 1" thick min. 1.0 pcf	-60 psf
	Steel deck shall be secured to supports spaced a maximum of **5** ft. on centers with ½" puddle welds and washers at every other corrugation. Deck side laps fastened with ITW Buildex Traxx/1 at midspan.	200 psi	min. 1" thick min. 1.0 pcf	-52.5 psf

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Approval Date: 09/26/13
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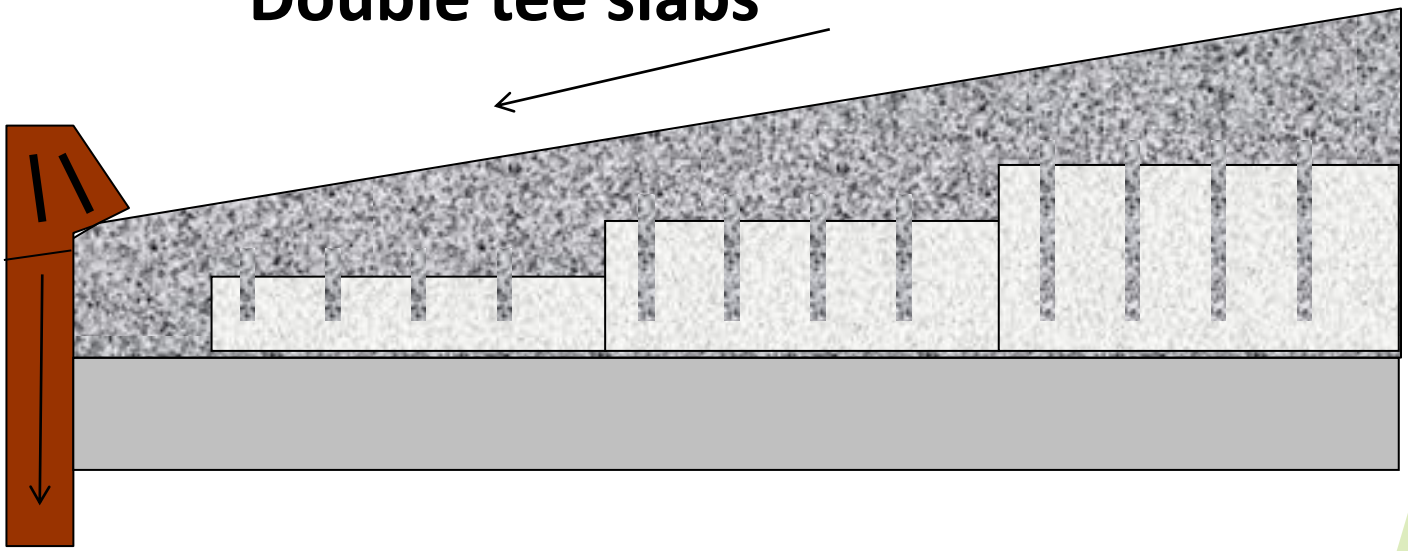
Concrete Substrate

Poured in place slabs } **Typically flat**

Hollow core slabs

Double tee slabs



Lightweight Insulating Concrete over structural concrete slabs, twin tees, Precast units or other non-venting substrates shall be vented to allow the Escape of excess moisture per Florida Building Code Section 1917.4.1

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Concrete Deck

Poured in place slabs
- *** Hollow core slabs**
- *** Double tee slabs**

Typicall

Substructure	Admixtures (Top Coat)	Substrate Treatment	Min. Compressive Strength	Polystyrene Insulation Board	Maximum Design Pressure
NEW CONSTRUCTION					
Min. 26 ga., 1.5" type BV, G-90 steel deck welded to supports spaced max. 5' o.c. with 5/8" puddle welds or Traxx/5 fasteners every flute. Deck side laps are fastened with 3 #10 TEK screws evenly divided within the 5 ft. purlin spacing.	Zell-Crete Fibers	none	min. 350 psi 2" thick Cellular/ Hybrid	Minimum 1" thick & 1.0 pcf flat corrugated or grooved board.	112.5 psf

Substructure	Admixtures (Top Coat)	Substrate Treatment	Min. Compressive Strength	Polystyrene Insulation Board	Maximum Design Pressure
NEW CONSTRUCTION OR REROOF (TEAR-OFF)					
Structural concrete deck	none	none	min. 450 psi	(Optional) Minimum 1" thick EPS Holey Board	145 psf
Structural concrete deck	none	none	min. 250 psi	(Optional) Minimum 1" thick & 1.0 pcf flat corrugated or grooved board.	205 psf
Structural concrete deck	none	none	min. 200 psi	(Optional) Minimum 1" thick & 1.0 pcf flat corrugated or grooved board.	240 psf
Structural concrete deck	none	none	min. 450 psi	(Optional) Minimum 1" thick & 1.0 pcf flat corrugated or grooved board.	240 psf
Structural concrete deck	none	ASTM D41 primed followed by torch applied ASTM D6163; Grade G	min. 450 psi	(Optional) Minimum 1" thick & 1.0 pcf flat	240 psf

Structural concrete deck	none	none	min. 200 psi	(Optional) Minimum 1" thick & 1.0 pcf flat corrugated or grooved board.	240 psf

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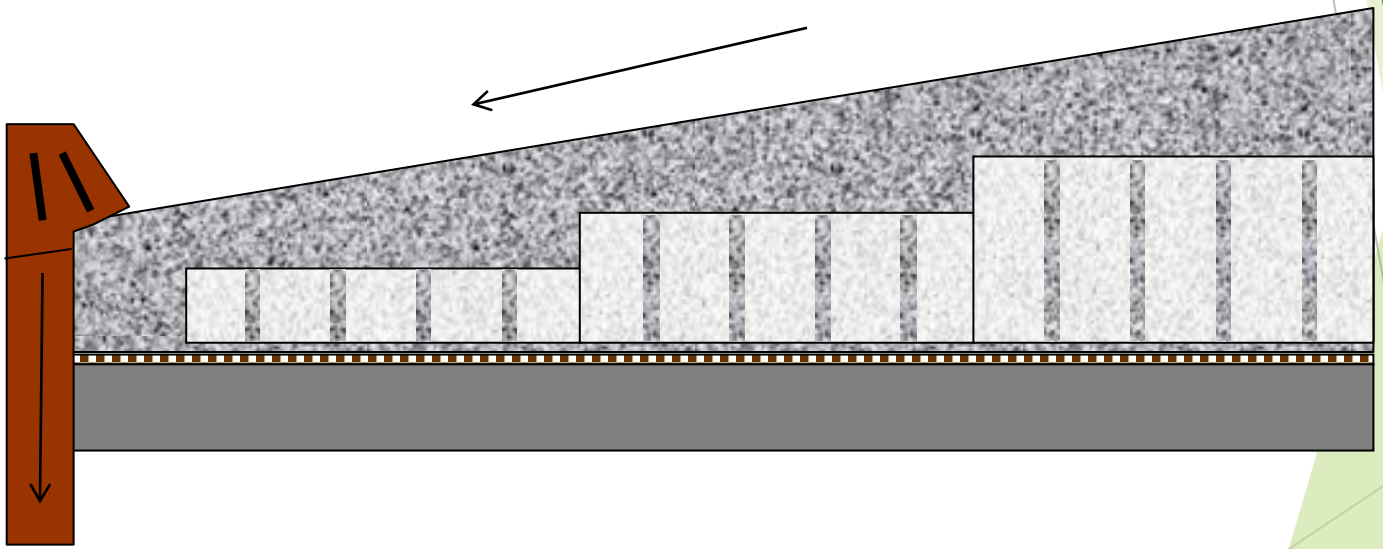
Recover Substrate

Over existing membranes

Over new temporary membranes



Existing Roof Assemblies to receive Lightweight Insulating Concrete…shall be tested for uplift for adhesion to the substrate to confirm compliance with design pressure per Florida Building Code Section 1917.3.1

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Reroof (Recover)

Over existing membrane

Over new temporary membranes

Substructure	Admixtures (Top Coat)	Substrate Treatment	Min. Compressive Strength	Polystyrene Insulation Board	Maximum Design Pressure
NEW CONSTRUCTION OR REROOF (TEAR-OFF)					
RECOVER					
Existing structural concrete deck with existing asphaltic BUR roof cover	none	none	min. 200 psi	(Optional) Minimum 1" thick & 1.0 pcf flat corrugated or	112 psf
Existing structural concrete deck with existing asphaltic BUR roof cover	none	none	min. 250 psi	(Optional) Minimum 1" thick & 1.0 pcf flat corrugated or grooved board.	342 psf
with existing asphaltic smooth BUR roof cover				Minimum 1" thick & 1.0 pcf flat corrugated or grooved board.	

Note: Maximum Design Pressures noted herein shall be used in conjunction with those maximum design pressures published in the Roof System Assembly Notice of Acceptance for Approved Systems over lightweight concrete decks.

Existing structural concrete deck with existing asphaltic BUR roof cover	none	none	min. 250 psi	(Optional) Minimum 1" thick & 1.0 pcf flat corrugated or grooved board.	342 psf

MIAMI-DADE COUNTY APPROVED

NOA No.: 13-0617.20
Expiration Date: 08/28/18
Approval Date: 09/05/13
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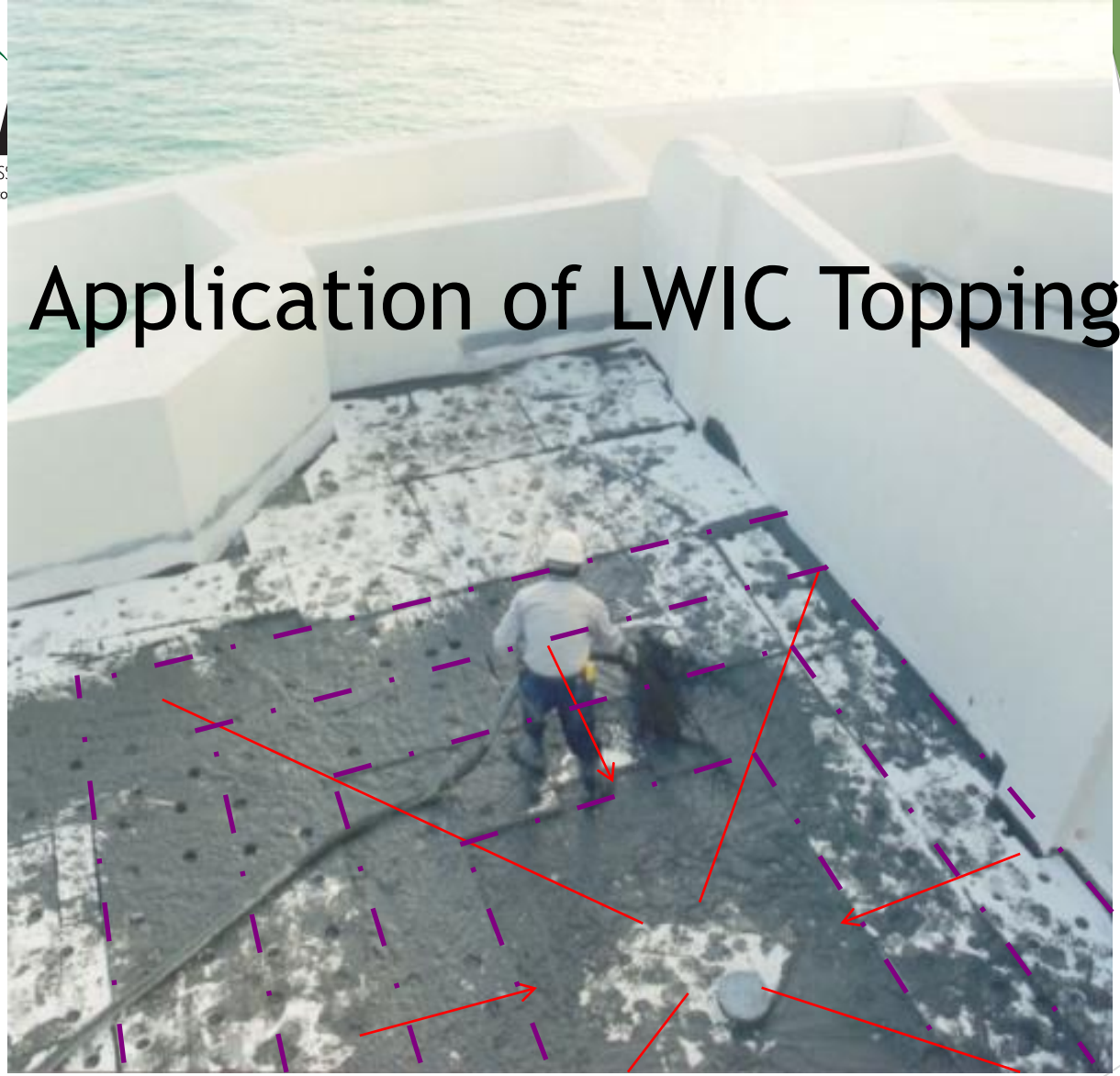
Placing EPS Board into Bond Coat

Insulation panels must be placed in a minimum 1/8" slurry of insulating concrete while the material is still in the plastic state per Florida Building Code Section 1917.4.10.2

Application of LWIC Topping



Minimum thickness of lightweight insulating concrete shall be 2" from the top plane of the substrate unless otherwise specified in the product approval per Florida Building Code Section 1917.4.2

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Quality Control

Mixing, placing and finishing shall be in compliance with roof deck system product approval per Florida Building Code Section 1917.4.6

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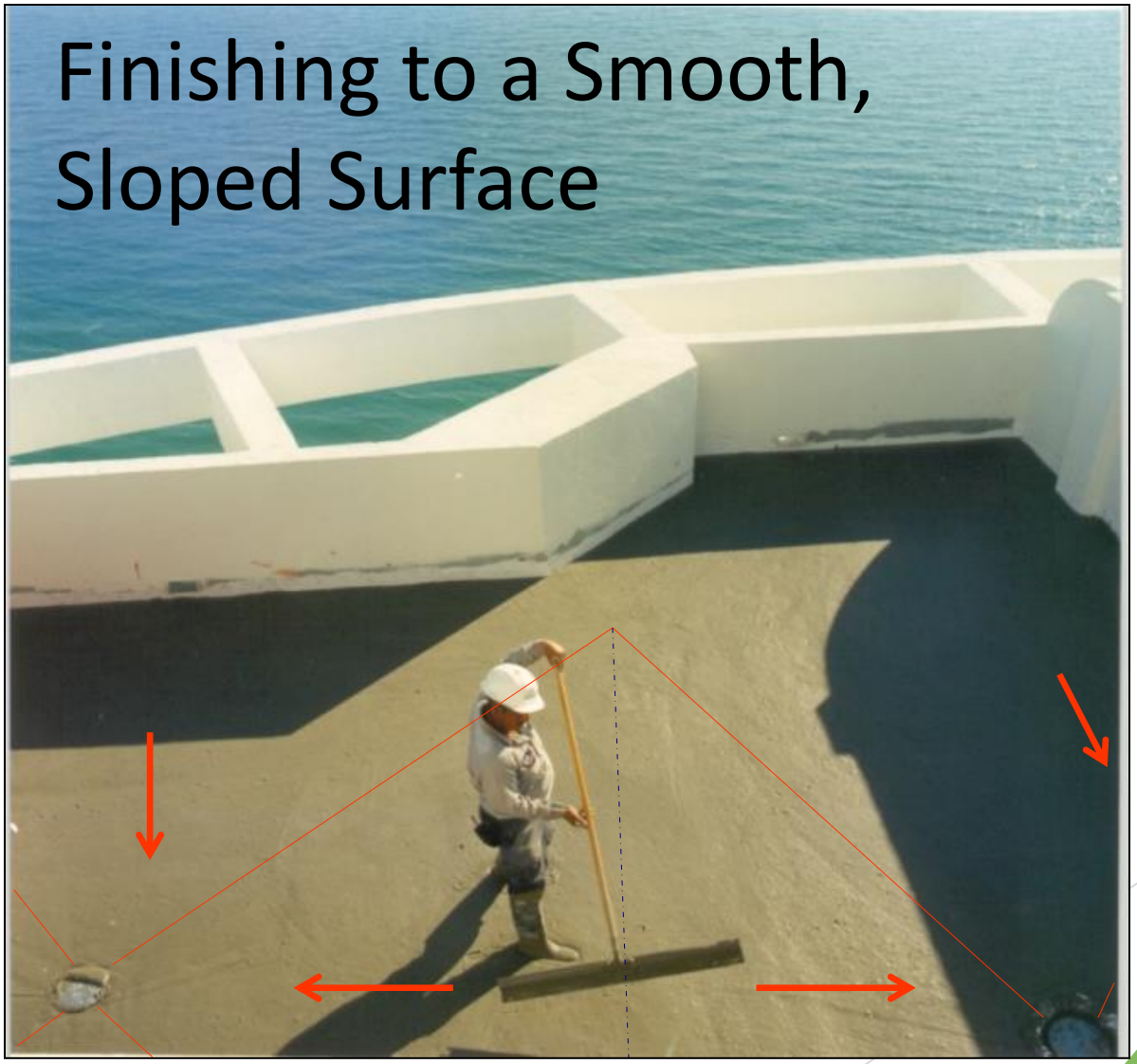
Finishing to a Smooth, Sloped Surface



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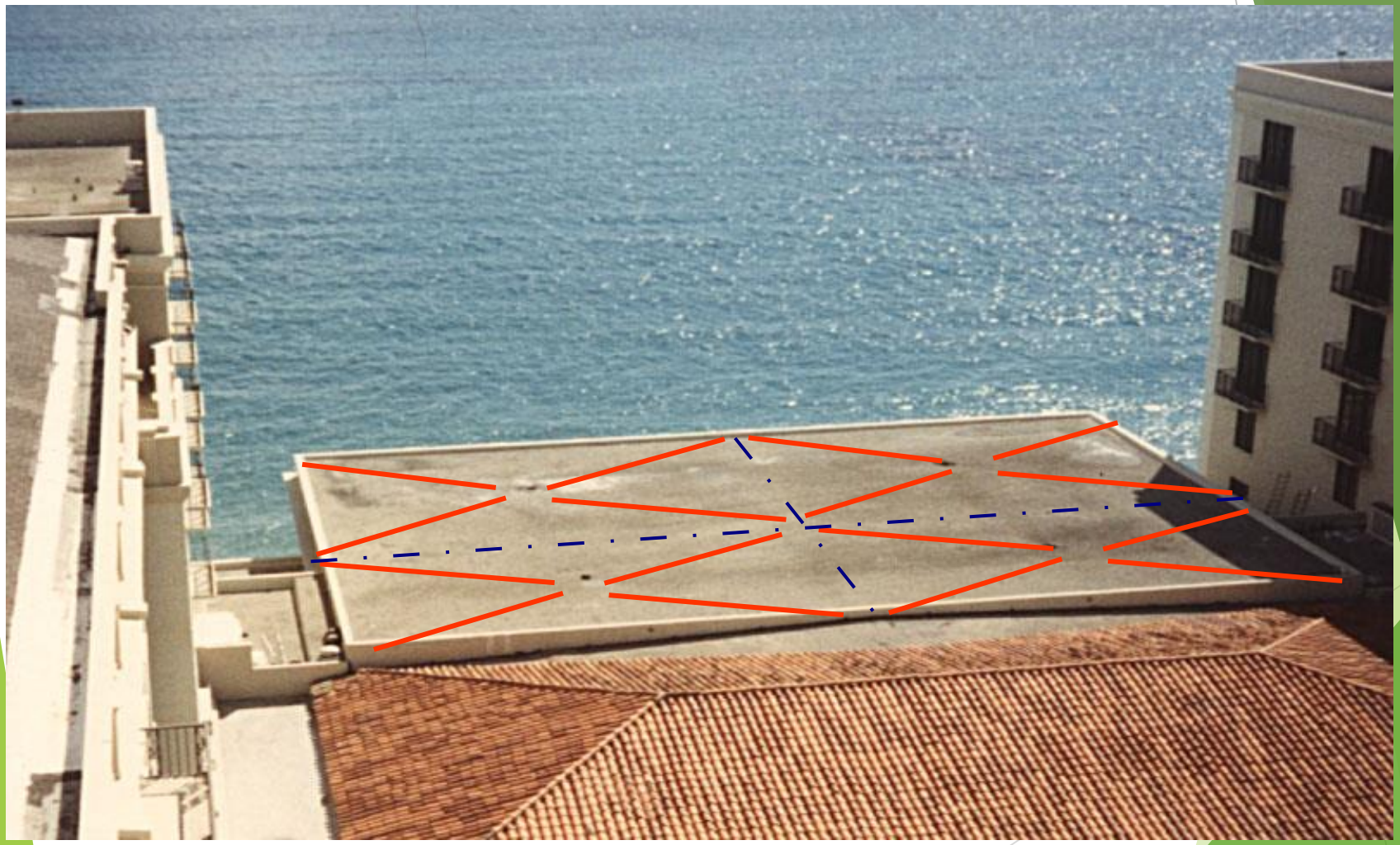
Finished LWIC Roof Deck Ready for Membrane



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Finished Roof

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Recover Drain Prep and String Lines

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Insulating Concrete Roof Decks are Versatile Roofing Substrates

Waterproof Membrane Types

Multi Ply BUR

Multi Ply Modified Bitumen

Single Ply (Fleeced or Smooth backed)

Liquid Applied

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Insulating Concrete Roof Decks are Versatile Roofing Substrates

Methods of Membrane Attachment

Embedded Base Ply Fasteners

Asphalt Adhered (saturated or strip adhered)

Torched or Mopped

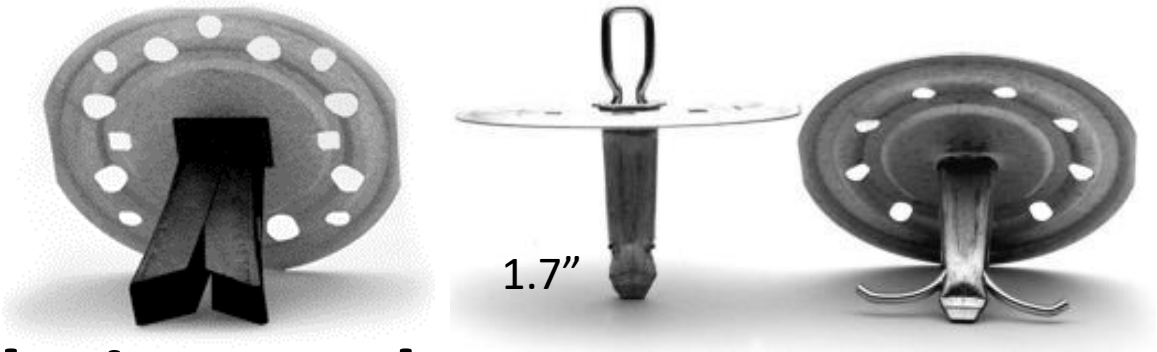
Adhesive (ribbon of fully adhered)

Contact, Water Based, Low-Rise

Mechanical (fastened to the structural deck)

TL Auger Fastener and Plate or Bars

Lightweight Concrete Base Ply Fasteners with FM Approved Disks



Installation Tool and Pull Test Equipment

Base ply fasteners must have a product approval, and meet Minimum withdrawal resistance values per Florida Building Code Sections 1917.4.9 and 1917.4.10.

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Properties
Fire Rated Systems

UL Fire Rated listings

FM – Class 1 Fire Classification

Non-combustible, even with EPS

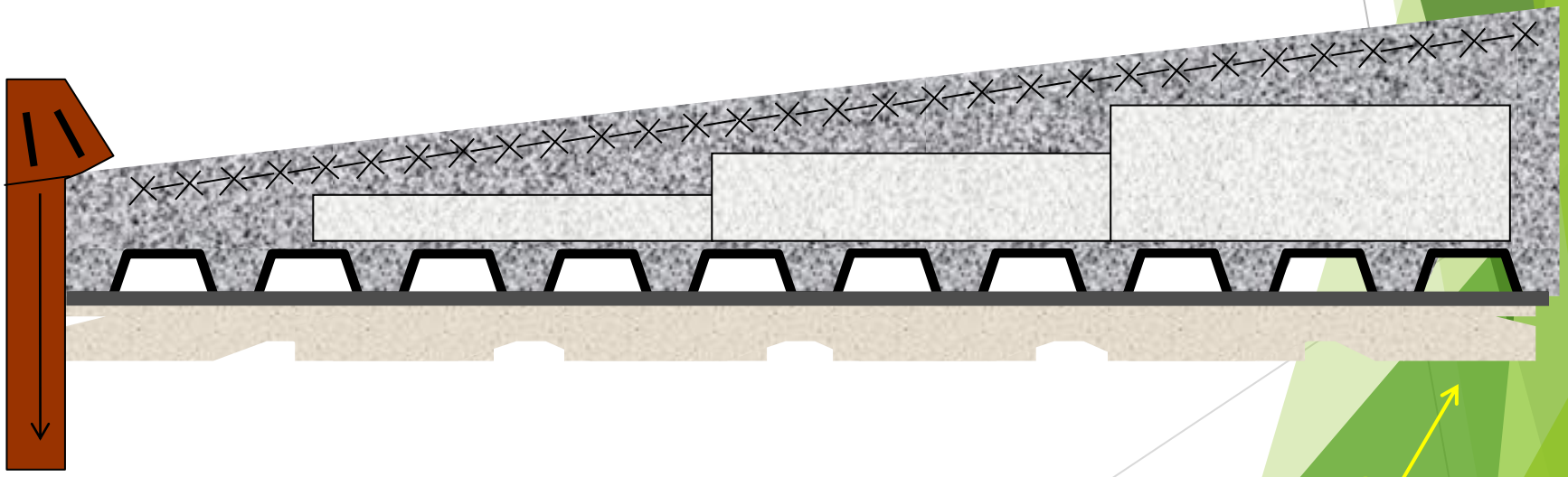
Filling flutes eliminates fire channel

Please see Florida Building Code Section 1505 (Fire Classification) regarding fire rating requirements and assembly details

Properties
Fireproofing

UL Designs

Use of LWIC eliminates the need for sprayed fireproofing on the underside of metal roof deck, in structural steel applications.



UL Ratings
Unprotected Steel Deck

P902, P903, P907, P908, P919, P920, P921, P922, P923, P924, P925, P926, P927, P928, P929, P930

Exposed:	***P905, P910, P913, P916***
Sprayed Fireproofing:	***P708, P737, P810, P812***
Protected Deck:	***D708, D750, D755, D759,***
Unprotected Deck:	***D768, D775, D832, D902*** ***D916, D919, D922, D923, D925, D927, D929***
Armstrong Ceiling:	***P215, P216, P231, P251***
Other Tile Ceiling:	***P214, P241, P246, P255, P261, P264***
Plaster Ceiling:	***P405, P406, P407, P410, P411***
Gypsum Ceiling:	***P501, P503, P509, P511, P513, P514, P520***

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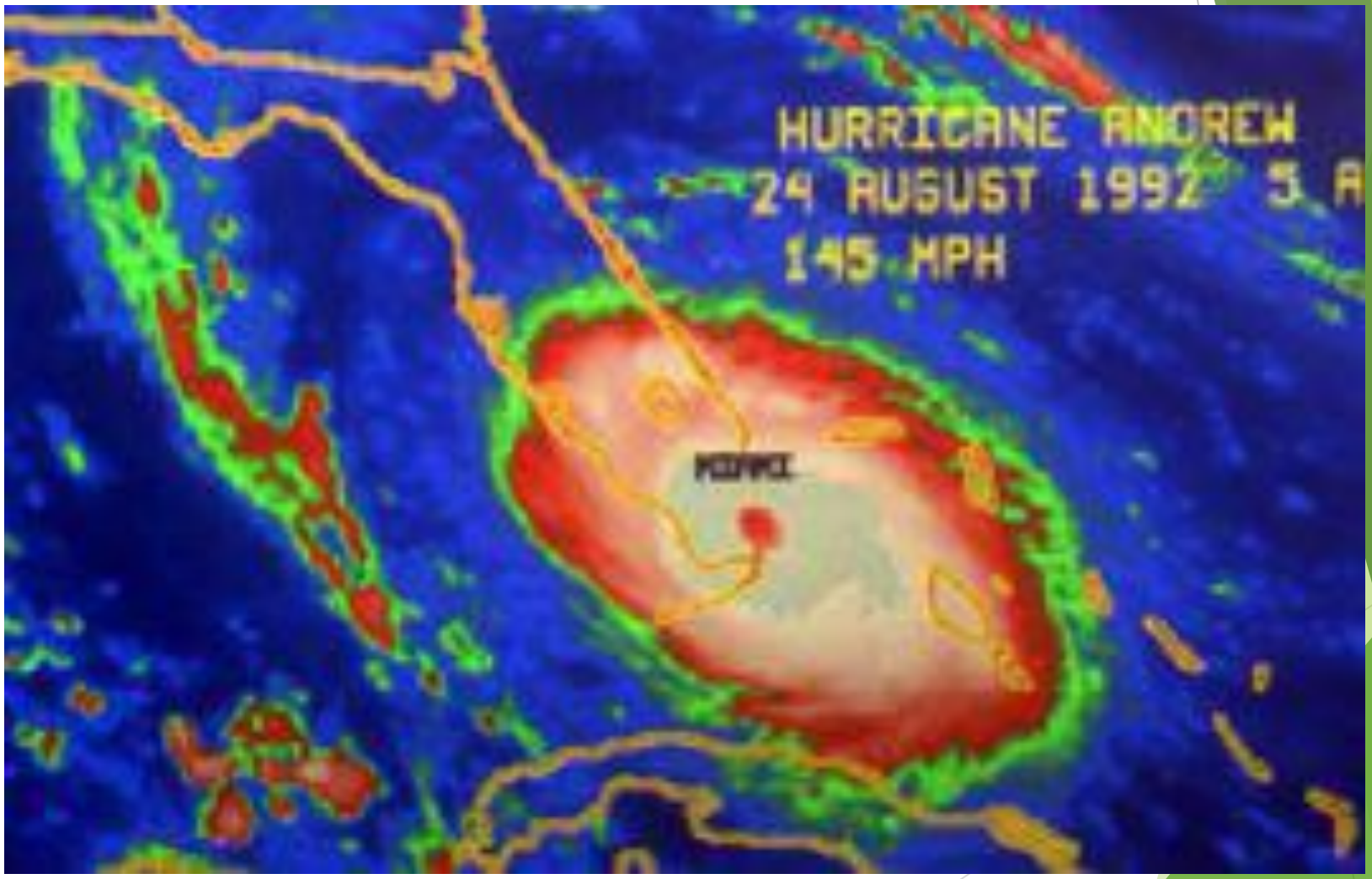
So Why LWIC ?



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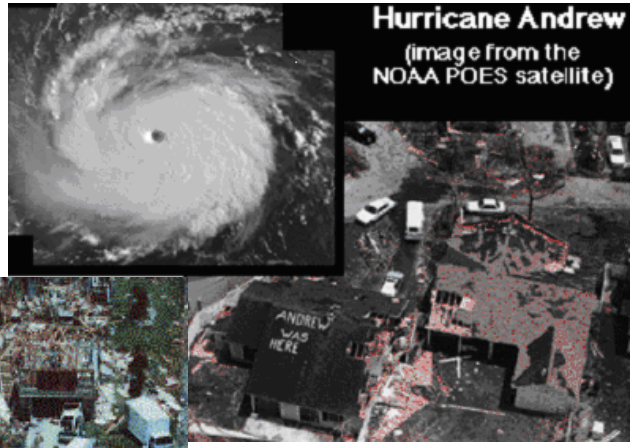
Hurricane Andrew Leaves Its Mark



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The Aftermath!!

These before and after pictures are from a facility in Louisiana, which encountered a greatly weakened Andrew!

Before Andrew

After Andrew

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Lightweight Insulating Concrete "Untouched"

This LWIC roof in Miami endured Andrew at its most destructive stage!

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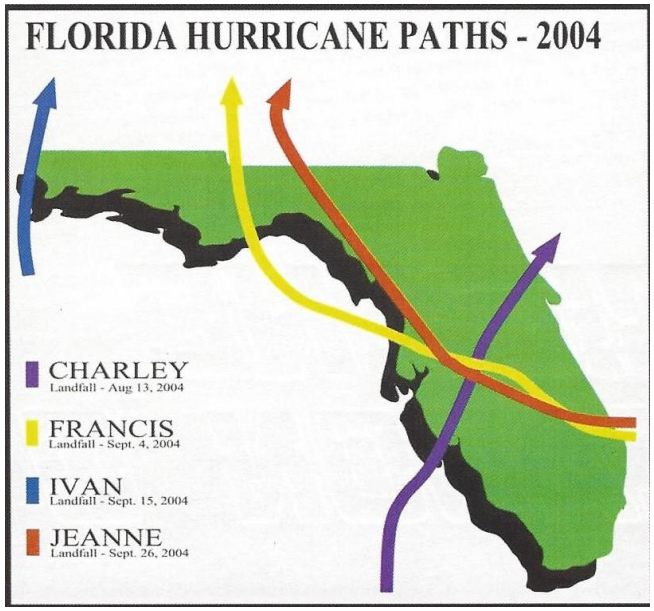
2004 Hurricane Season

- From August 13 through September 28, 2004, the state of Florida experienced the peak of its worst hurricane season to date.
- During this period four major storms, one category two (Frances), one category 3 (Jeanne) and two category four (Charley and Ivan) spawned damage in virtually every county in Florida!



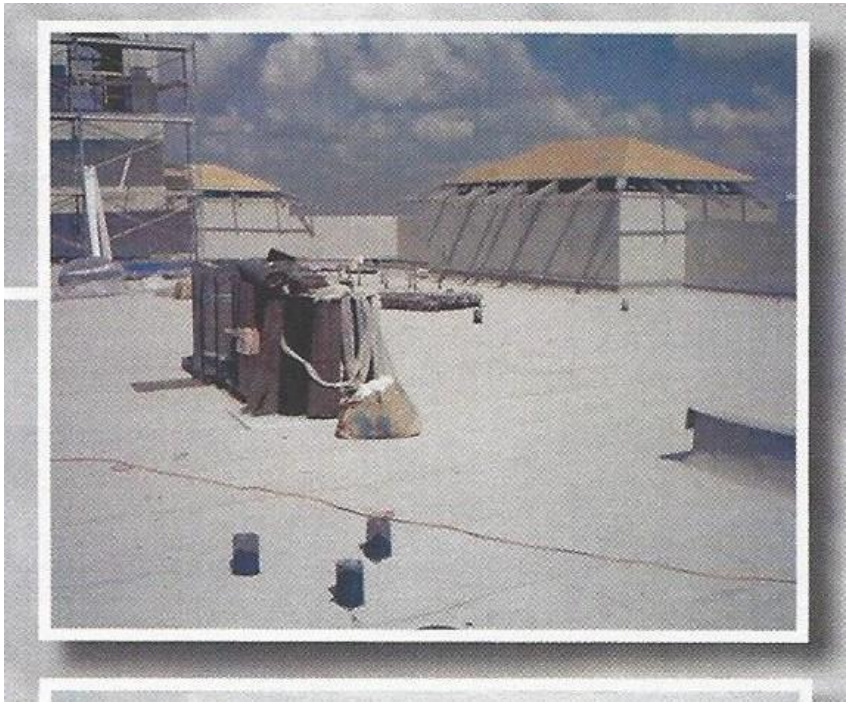
LWIC Performance

- In the months that followed Hurricane Season 2004 FRDA members performed site visits and gathered reports of damaged and devastated buildings.
- From this research remarkable evidence was found substantiating the industry's claim that:

  " …Lightweight insulating concrete is one of the best wind uplift performers available." - Factory Mutual Research

Alta Mar Condominiums
Fort Myers, Florida

- Insulation Product: Lightweight Insulating Concrete
- Design Class: FM I-90
- Roof: BUR
- Job Completion: 2004



Despite being only 50% complete during Hurricane Charley, the LWIC and partially finished roof membrane suffered no damage

Sand Dollar Condominiums Redington Beach, Florida

- Insulation Product: Sprayed Polyurethane Foam Insulation
- Design Class: Unknown

This building lays on the west coastline of Florida. After losing a small portion of the perimeter nailer, the hurricane winds forced their way under the insulation and over 50% of the roofing system was lost. Repairs were completed by removing the entire roof system and replacing with an LWIC deck and modified bitumen roof membrane.

Punta Gorda Post Office Hurricane Season ’04

- Insulation Product: Vermiculite Insulating Concrete
- ***The Central post office in Punta Gorda felt the force of Hurricane Charley. Despite the uplift of heavy rooftop equipment that damaged the roof membrane, LWIC and the metal deck substrate, the remaining roof deck remained in place and the entire building was expeditiously dried in and a new LWIC and roof membrane system installed, saving the building from demolition.***

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Lyman High School, Seminole County, Florida Hurricane Season '04

- Insulation Product: Cellular Lightweight Insulating Concrete
- Completed: New Construction & Reroof Prior to hurricane season
- ***Lyman High School was opened as a shelter during all three hurricanes that affected Seminole County. No damage was sustained!***

Indian River Community College - Hurricane Season ’04

- **Indian River Community College, Fort Pierce, Florida**
- Insulation Product: Cellular Lightweight Insulating Concrete
- Design: FM Class 1-150 – fully adhered
- Completed: 2004 prior to hurricane season
- ***Indian River Community College took the direct impact of a Category 3 hurricane and sustained no damage.***

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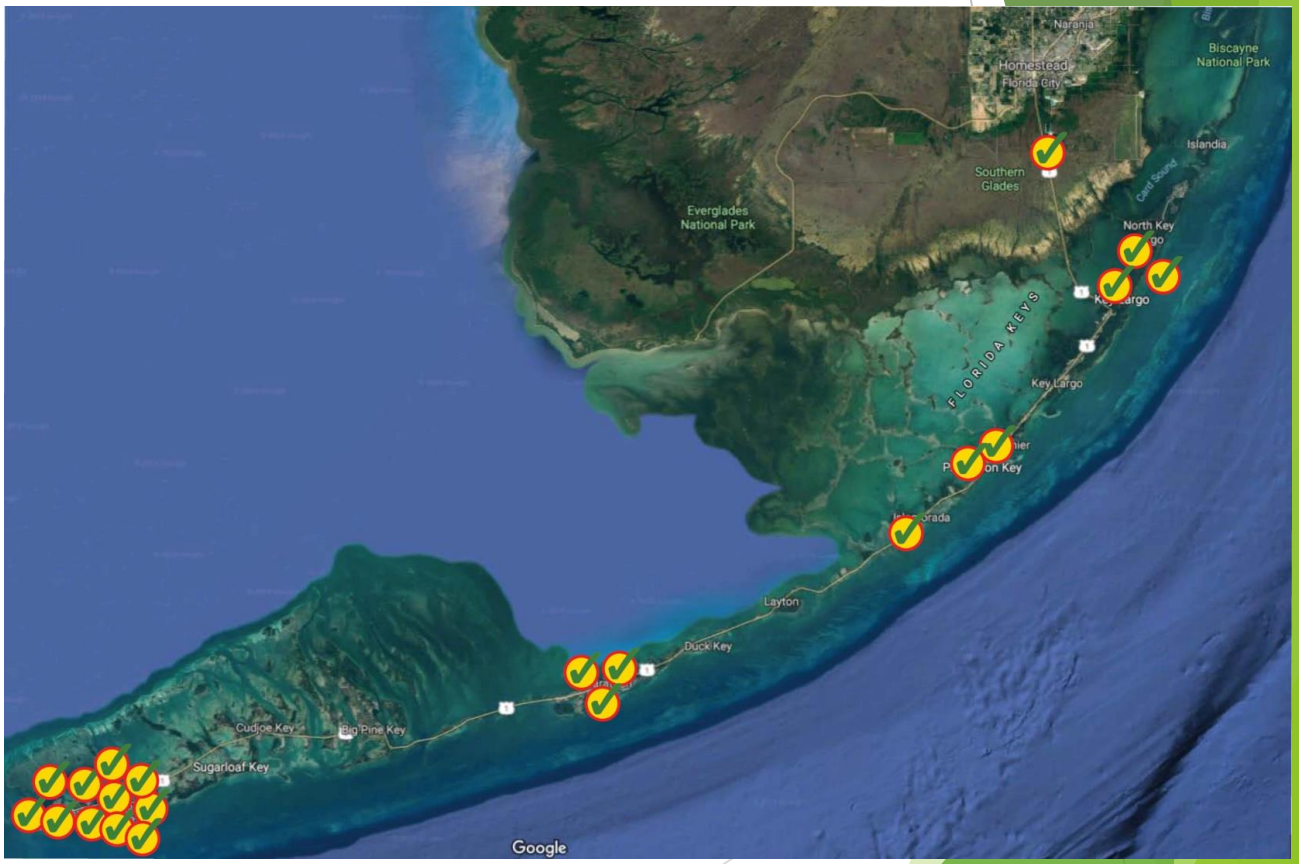
Hurricane Irma
September 10, 2017

- When Hurricane Irma made landfall in Florida, first at Cudjoe Key and then at Marco Island, it was a category 4 storm wreaking havoc on the Florida Keys and Southern Florida. This was a rigid insulation project in Homestead, FL which didn't feel the worst of Irma.

Lightweight Insulating Concrete Projects In The Path of Irma

No reported damages to the LWIC.

- **Home Depot**
- Key West
- **Lowes of Homestead**
- Blue Waters Hotel
- Boca Chica NAS Hanger
- Conch Harbor & Marina Development
- Courtyard Marriott Hotel
- **CVS** Stock Island
- Fishermen's Hospital
- **Florida Keys Electric**
- Irving Eyester Museum
- Keys Energy Steam Plant
- Marriott Autograph Hotel
- Ocean Reef Carysfort Center
- Ocean Reef Club, Inc.
- Ocean reef Town Hall
- P678 Aircraft Crash Rescue & Fire HDQT
- Saltpond Condominiums
- Tavernier main Post Office
- **Truman Waterfront Park**
- USCG Sector 48
- USMS Addition



Irma Hits Tampa/St. Pete and Clearwater Beach

- By the time IRMA made it to the West Coast of Florida the storm had weakened to category 2 and then a category 1 storm. It still sucked the water out of Tampa Bay and caused damage to the area.
- An assessment by FRDA members in the area revealed the following results:

Beach House on Clearwater Beach; Product: LWIC & Adhered Roof 2 years old – NO DAMAGE

Aqualea Hyatt Clearwater Beach; Product: LWIC & modified roof 9 years old – NO DAMAGE

Sandpearl Resort, Clearwater Beach; Product: LWIC & BUR – Inconsequential damage quickly repaired.

Belle Harbor, Clearwater Beach; Product: LWIC & BUR – NO DAMAGE

Damages From Irma

- **Pier House 60, Clearwater Beach:** One-fourth to one-third of roof removed by the storm – ISO and facers were removed with adhered membrane
- **Water's Edge Apartments, Seminole:** Northeast corner of the condo suffered damage. Spray urethane insulation and roof peeled back when perimeter failed. Project replaced with LWIC and BUR

Wind Uplift Approvals

FM – ratings from 1-60 to 1-540+

UL – Class 90

FM Class 1, Non-Combustible

Metro-Dade (FL) Approvals

Based upon standards established post Hurricane Andrew LWIC roof deck assemblies can be expected to perform even better than those built prior to that event.

Florida Building Code Section 1504.3.1 requires membrane roof covered Assemblies must be tested by standards FM 4474, UL 580 or UL 1897

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HURRICANE ANDREW: August 24, 1992
Structural Performance of Buildings in Dade County, Florida

Written and Edited
by
Ronald F. Zollo, Ph.D., P.E.
Professor
Department of Civil and Architectural Engineering

10.1.1 Metal Deck Over Bar Joists

Metal deck over bar joists were generally one of two types; metal deck with rigid insulation or metal deck with lightweight insulating concrete. In each of these systems the metal deck is attached to the bar joists by welding or by self tapping screws.

Of the two system types observed, the system using lightweight concrete performed best, all other factors considered equal. This was judged to be due to the superior overall system rigidity, significantly better diaphragm shear capabilities, the closer joist spacing provided, and the increased opportunity for composite action available with this system.

Nevertheless, failures of metal deck roof systems were widespread. In addition to unanticipated internal overpressures caused by breaching of the building envelope, there were numerous examples of inadequate connection of the bar joists to their supports and inadequate connection of metal deck to the joists especially with regard to uplift forces. This was equally true for decks attached by welding and for screw fastening. Also, many systems failed at the nonload bearing end wall where connections were not adequate to resist either the shear loads between the diaphragm and the shearwalls or the direct tension force resulting from the outward pull of the internal pressure and external suction on the walls. In many cases such failures were in older buildings, in which diaphragm design was not likely considered.

Failures associated with the screw on system were generally such that the deck was pulled over the screw heads. Failures at welds were by cracking, either within the weld or in the heat affected zone of the weld. Either of these failure modes are aggravated by the reversal and repeated loading (fatigue loading) that will occur in the presence of buffeting winds. An item

"Of the two [metal deck over bar joist] system types observed, the system using lightweight concrete performed best [during Hurricane Andrew], all other factors considered equal."

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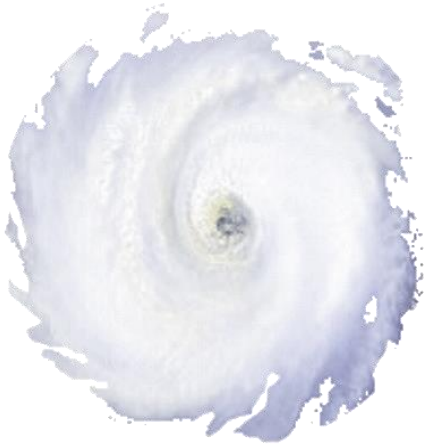
EHPA



ENHANCED HURRICANE PROTECTION AREAS

Interpretation of EHPA Requirements

EHPA-Rated Roof Systems must be able to:

Provide resistance against the **IMPACT** of a 9 pound object traveling at 50 ft/sec.

Withstand **WIND LOADS** in accordance with geographic location and ASCE 7.

Provide stability and **DIAPHRAGM ACTION** to effectively transfer loads to the foundation.

Prevent **WATER INTRUSION**.

Diaphragm Action

"In those areas of the country that are prone to high wind, tornado, and/or hurricane activity, lightweight insulating concrete and metal decking over bar joist construction is quickly becoming a cost effective and sound engineering alternative to diagonal bracing, drag struts, etc.

"In this roof deck system, the metal decking and bar joists act as the diaphragm. The metal panels are attached perpendicular to the joists and cause the roof construction to act like the web of an I-beam when subjected to lateral forces. This design helps to brace the walls and allows lateral load transfer from the roof through the walls to the foundation.

(2001), "Diaphragm Design".

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Moisture Absorbance & Transfer

Rigid Insulation Board

Absorbs and transfers moisture during roofing failures – must be replaced.

LWIC Roof Decks

No moisture absorbing components – typically does not require replacement.

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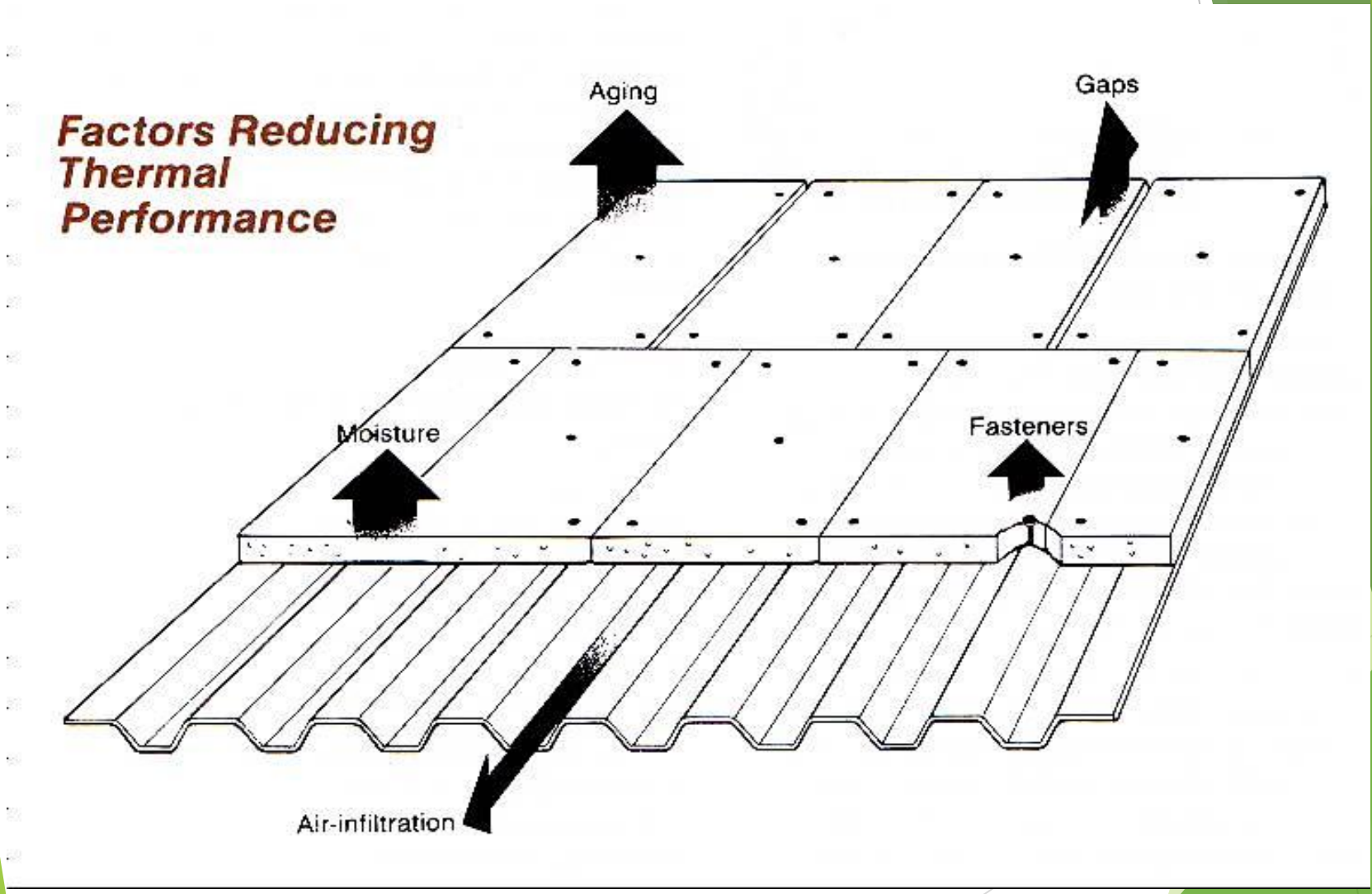

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NRCC Guarded Hot Box Testing (ASTM C1363-97) for Energy Efficiency of a Total Roof Assembly

Figure 23 below shows a 2001 Company roof where snow melt occurred over insulation joints from convection air currents and thermal transmission from mechanical fasteners on a totally adhered EPDM over a **single layer of 3" ISO** with six fasteners per board.

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2” Wide Application Gap

Do Gaps Occur?

ISO boards shrink 2 %

A 4 foot board can shrink 0.96 inches

An 8 foot board can shrink 1.92 inches

Shrinkage gaps of 1/4 to 3/4 inches are common

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Effect of R-Value on Gap Reduction

4’ x 4’ Board

Material	2” Iso Board	4” Iso Board
R- Value	12.1	25

Gap (Inches)	Percent R-Value Reduction	
1/8	-4.0	-7.9
1/4	-7.7	-14.7
3/8	-11.0	-20.4
1/2	-14.1	-25.4

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Thermal Reductions Due to Fasteners

	1 Fastener per 4sf			1 Fastener per 2sf			1 Fastener per 1sf		
Insulation	R-Value		Loss	R-Value		Loss	R-Value		Loss
Thickness	Assumed	Calculated	%	Assumed	Calculated	%	Assumed	Calculated	%
1.0 in	5.85	5.18	11.50	5.85	4.66	20.27	5.85	3.45	26.49
1.5 in	8.35	7.34	12.08	8.35	6.57	21.30	8.35	4.75	28.19
2.0 in	10.85	9.51	12.40	10.85	8.48	21.86	10.85	6.05	29.13
3.0 in	15.85	13.83	12.73	15.85	12.29	22.44	15.85	8.66	30.13
4.0 in	20.85	18.16	12.90	20.85	16.11	22.75	20.85	11.26	30.66
5.0 in	25.85	22.49	13.01	25.85	19.92	22.94	25.85	13.86	30.98
6.0 in	30.85	26.81	13.08	30.85	23.74	23.06	30.85	16.46	31.20
7.0 in	35.85	31.14	13.13	35.85	27.55	23.15	35.85	19.06	31.36
8.0 in	40.85	35.47	13.17	40.85	31.36	23.22	40.85	21.67	31.48

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"Thermal Conductivity in Mechanically Fastened Roof Systems"

By Mike Watts, CSI, CDT, RCI's Interface Magazine

This article reports the effect of board fasteners on system thermal value using the zonal heat flow concept.

Fasteners spaced at 1 per 4 $feet_2$, 1 per 2 $feet_2$, and 1 per 1 $foot_2$.

Conclusion: "The efficiency of the thermal medium diminishes in direct proportion to the fastening rate."

Roof Test Study
The 2001 Company
ISO Board on Metal Deck

R-Value of Roof Assembly by the Guarded Hotbox (ASTM C 1363) Published Results

Test No.	Measured System R	Design System R	% Reduction
1	2.43	18.5	-86.7
2	13.74	18.5	-25.7
3	12.60	18.0	-30.0
4	12.26	18.0	-31.9

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Lightweight Insulating Concrete Roof Decks Are…

Permanent
Insulative
Nailable
Approved
Economical
Moisture Resistant
Strong
Non-Combustible
Compatible with Roofing
Dimensionally Stable
Wind Uplift Resistant
Provide Heat Sink
Sloped to Drain

FRDA Member Projects

WALKER & COMPANY

Sumter Place In The Villages

11-19-11

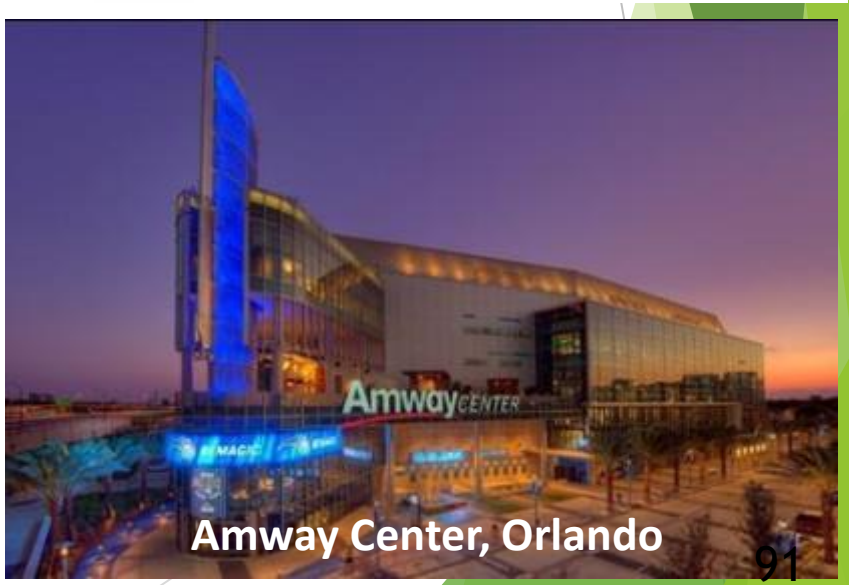
Moss Miller

NOVA

NSU Center of Excellence for Coral Reef Ecosystems Science Research Facility

01-09-12

Performing Arts Center of Miami



Amway Center, Orlando

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Q & A

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CARPENTER

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