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Hygrothermal Behavior of Exterior Walls and Roofs & Energy

WHAT WILL I LEARN TODAY?

1. Basic Hygrothermal conditions at play inside a building.
2. How the amount of insulation and its placement can make a big difference on a roof or wall.
3. Major considerations to consider when replacing a roof or wall cladding.
4. How recent changes in the building code affects the roof or wall assemblies.

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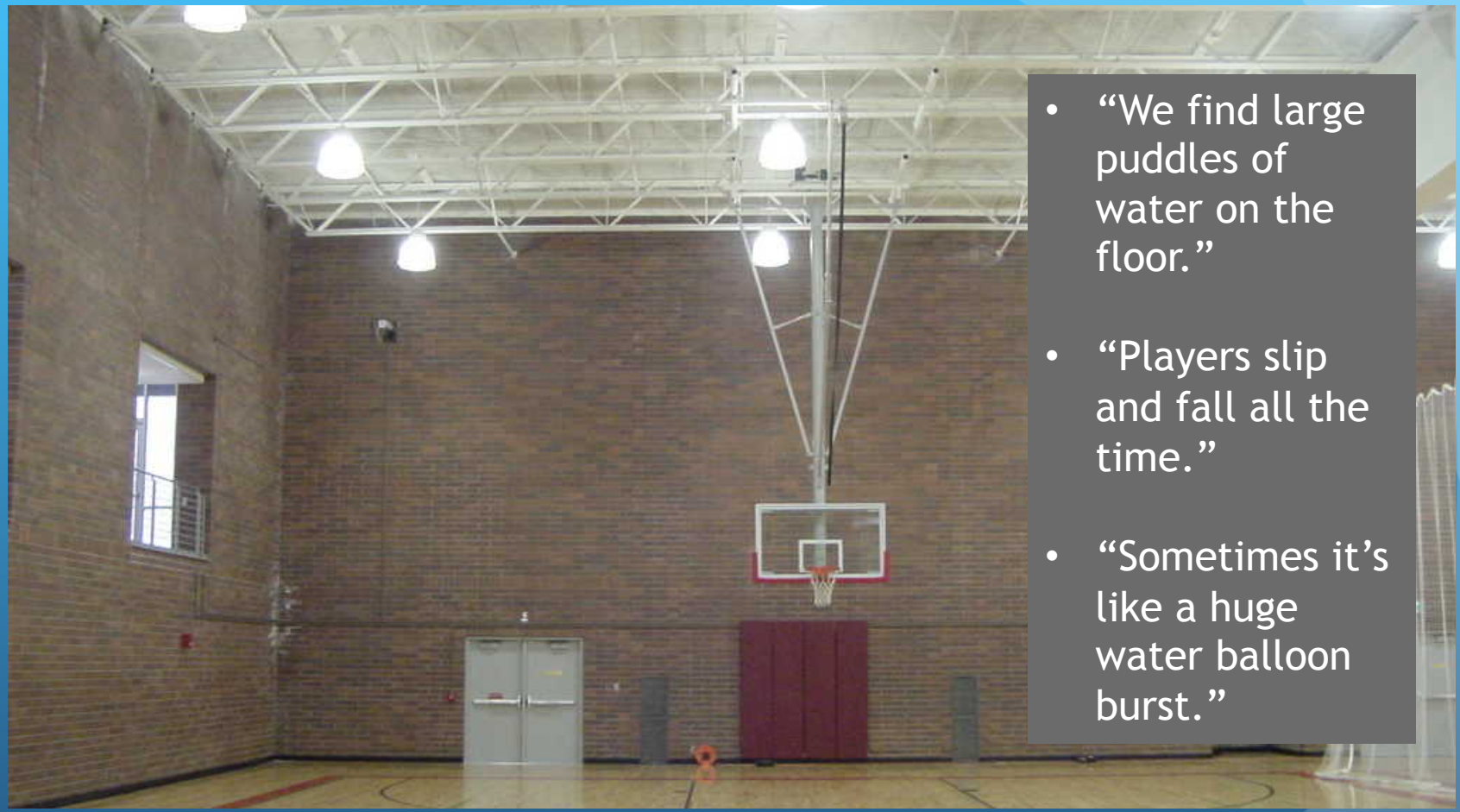
THE PROBLEM



- “We find large puddles of water on the floor.”
- “Players slip and fall all the time.”
- “Sometimes it’s like a huge water balloon burst.”

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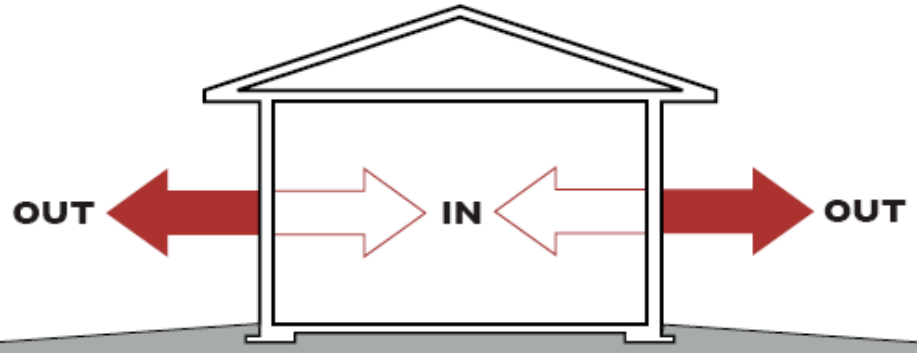
HEAT, WATER (GASEOUS FORM), TIME

Buildings Are Subject to Differences in Temperature

Temperature of air and water vapor inside the building envelope wants to equalize with temperature of air and water outside the building envelope. In winter, warm air and vapor inside the building are pushed toward cool temperatures outside.



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CONDENSATION? WHAT'S THAT?

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WHEN WILL IT OCCUR?

1. The warmer the air is, the more water vapor it can hold
2. Definition: Relative Humidity (RH)
   - The amount of water vapor in the air expressed as a maximum that the air can hold at the given temperature.
3. Definition: Dew Point
   - The temperature at which the air is completely saturated with water vapor. i.e. the RH reaches 100%.

4.2 Determining the Design Dew-point Temperature

4.2.1 Fundamental Concepts

Dew-point temperature is determined by knowing dry bulb (interior) temperature and relative humidity using the following simplified table from the psychrometric chart.

Relative Humidity	Dew-Point Temperature (°F) — Design Dry Bulb (Interior) Temperature (°F)														
	32°F	35°F	40°F	45°F	50°F	55°F	60°F	65°F	70°F	75°F	80°F	85°F	90°F	95°F	100°F
100%	32	35	40	45	50	55	60	65	70	75	80	85	90	95	100
95%	30	33	37	42	47	52	57	62	67	72	77	82	87	92	97
90%	27	30	34	39	44	49	54	59	64	69	73	78	83	88	93
85%	24	27	31	36	40	45	50	55	60	64	69	74	79	84	89
80%	20	24	28	32	36	41	46	51	55	60	65	69	74	79	83
75%	16	20	24	28	33	36	41	46	50	55	60	64	69	73	78
70%	12	15	18	23	27	31	35	40	45	49	53	58	62	67	71
65%	8	10	14	18	21	25	29	33	37	42	46	50	54	59	62
60%	6	7	8	9	13	16	20	24	28	31	35	40	43	46	52
55%	4	4	5	5	6	6	9	10	13	17	20	24	27	30	34

Adapted from ASHRAE Psychrometric Chart, *1993 ASHRAE Fundamentals Handbook*.

Table version of Psychrometric Chart

The following procedure is used to obtain the dew-point temperature from the table:

1. Along the top horizontal row of the table, locate the dry bulb temperature.
2. Along the vertical row at the left side of the table, locate the relative humidity.
3. The dew-point temperature is determined at the intersection of the appropriate dry bulb temperature column and relative humidity row. The unit value for dew point temperature determined from this table is expressed in degrees Fahrenheit (°F).

4.2.2 Example Calculation

Situation: Determine the dew-point temperature if the anticipated dry bulb temperature is 75° F and the relative humidity is 50%.

Solution: Using the psychrometric table, the dew point temperature is determined as 55° F.

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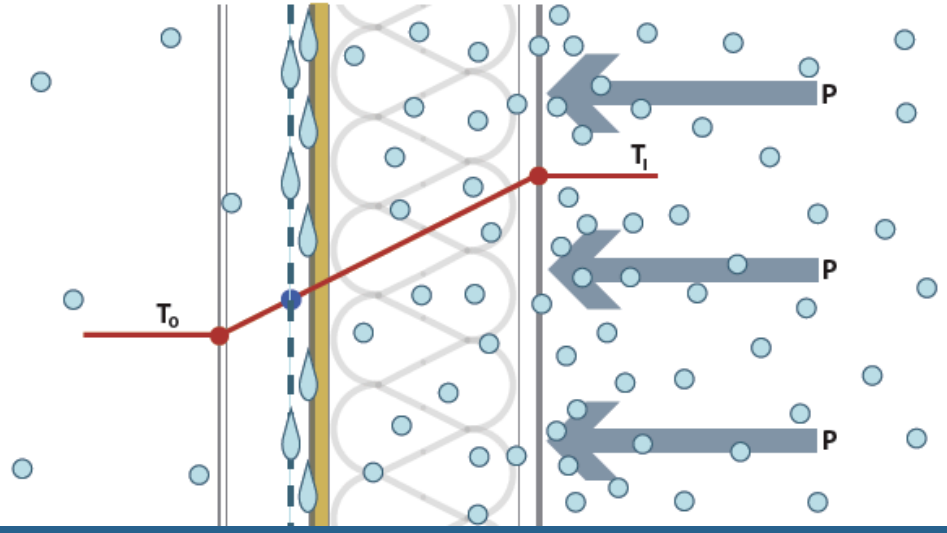
HOW DOES CONDENSATION OCCUR?

Exterior Insulation and Moving the Dew Point

- Installing insulation outside sheathing can move the point at which moisture condenses further toward the exterior. If the dew point moves outside the WRB, it removes the risk of moisture condensing in the sheathing or framing.



1. Uncontrolled air leakage transports water vapor through deficiencies in the wall assembly.
2. Water condenses on surfaces that are equal or less than the Dew Point.

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THE PROBLEM

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BOTTOM OF THE ACOUSTICAL PANELS

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METAL ROOF WELL CONSTRUCTED

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NO OBVIOUS LIQUID WATER SOURCE

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THERMAL BARRIER INCOMPLETE

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THERMAL BARRIER INCOMPLETE

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UNCONTROLLED AIR LEAKAGE

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ACOUSTICAL PANEL

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① Standing seam metal roof

② Fiberglass batt insulation

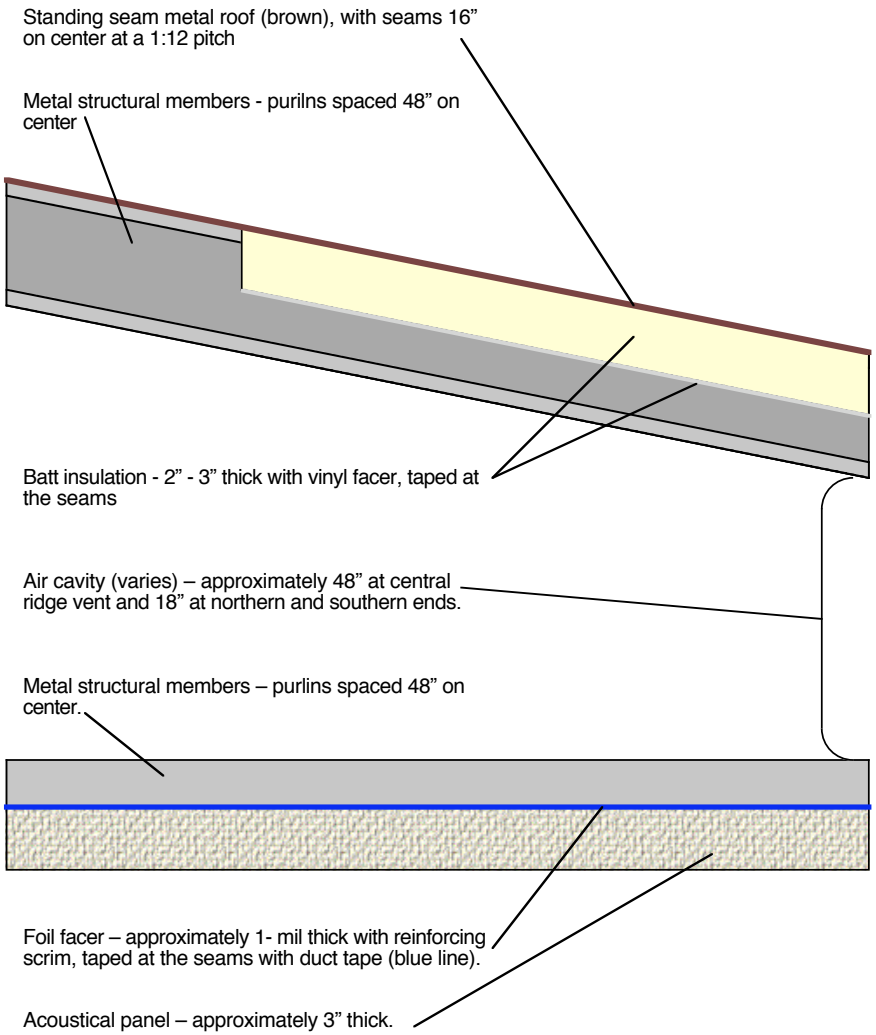
③ Vinyl facer on the insulation equal to 1-perm

④ Air cavity

⑤ Foil facer approximately 1-mil thick equal to 1-perm

⑥ Acoustical panel

⑦ Sweaty athletes



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RECORD THE DATA

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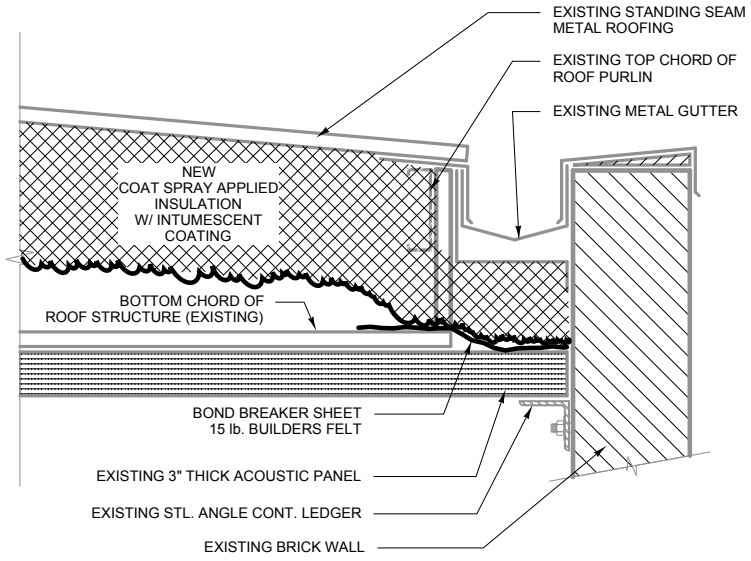

3
WP1

Gutter Detail

Scale: 1 1/2"=1'-0" (Do not scale drawing. For referance only)
NOTE: Verify all Dimensions, Distances & Existing Conditions

Project: 06-042
Dixon Rec. Center

Date: 02.09.07

Forensic Waterproofing Consultants, LLC 105 SE Taylor Street, Suite 307 - Portland OR 97214 Office: 503.772.1114 - Fax: 503.772.4039
Visit us at www.forensicwp.net or email us at info@forensicwp.net CCB# 155496

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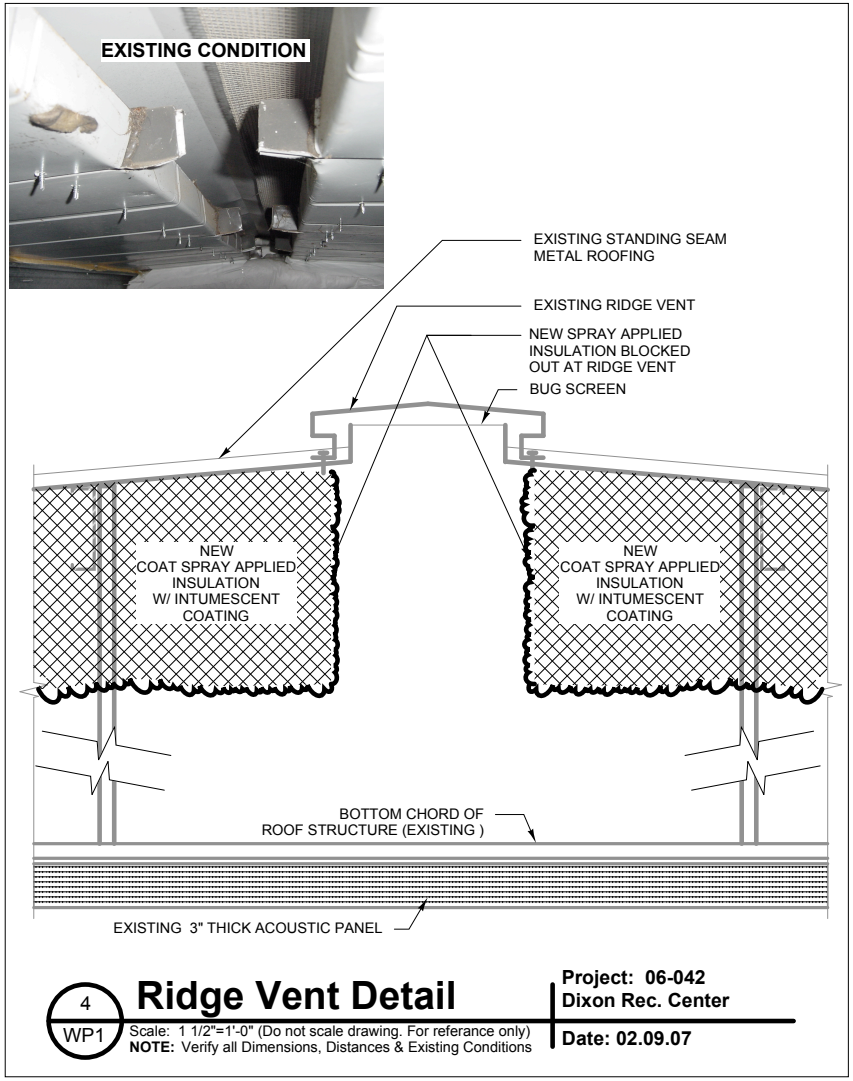

4
WP1

Ridge Vent Detail

Scale: 1 1/2"=1'-0" (Do not scale drawing. For referance only)
NOTE: Verify all Dimensions, Distances & Existing Conditions

Project: 06-042
Dixon Rec. Center

Date: 02.09.07

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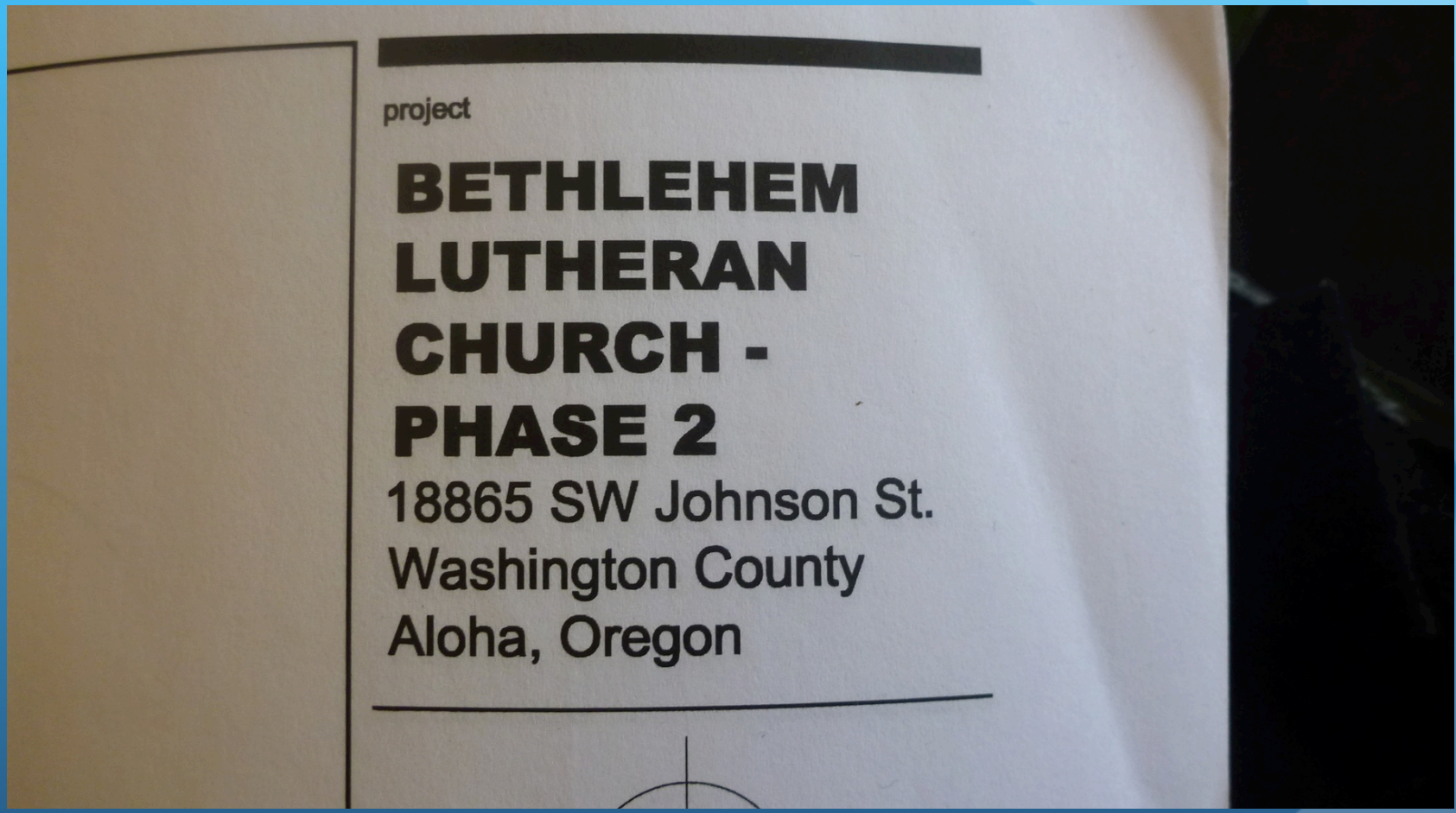
WATER LEAKS ON A BRAND NEW ROOF?



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“…but, the roof is only two years old…”

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INSIDE THE BUILDING

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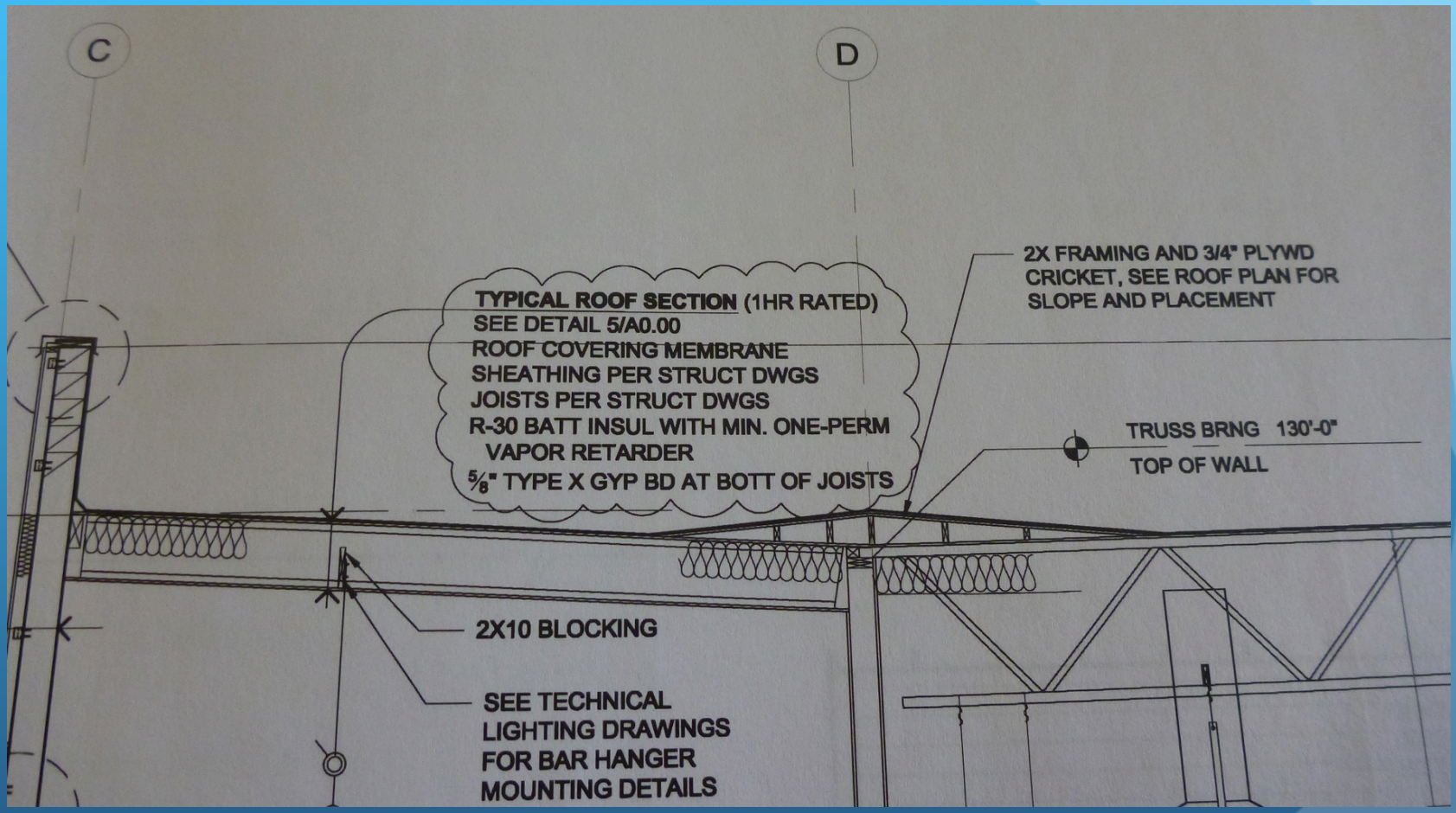
DESIGN DEFECTS



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DESIGN WEAKNESSES

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ROOF FRAMING SHOP DRAWINGS

OPEN–WEB TRUSS INSTALLATION INFORMATION

PERSONAL INJURY OR DEATH MAY RESULT FROM FAILURE TO READ AND FOLLOW THIS INFORMATION

iLevel TRUS JOIST commercial — Weyerhaeuser

ATTENTION BUILDER
Enclosed is IMPORTANT information on how to safely and properly install Open–Web Trusses

1 JOBSITE HANDLING OF TRUSSES

THIS — NOT THIS

WARNING
Do not hit webs with forklift forks. Bent or dented webs must be replaced.

WARNING
Workers should stay clear when cutting the banding to avoid possible injury from flying banding or toppling trusses.

- Trusses will be delivered to the jobsite in bundles of twenty or fewer, banded together for handling and shipment. To avoid damage they should be left in these bundles until they are ready to be installed in the structure.
- Miscellaneous hardware such as bearing angles, lag screws, bolts and nails as required for each specific job will be shipped in bags or boxes with the trusses.
- Bridging material and pre-cut blocking items, if furnished by Trus Joist, will be bundled and banded.

2 JOBSITE STORAGE OF TRUSSES

THIS — NOT THIS

- ALWAYS set truss bundles on stickers placed at the truss pin locations. NEVER store trusses flat or set trusses directly on the ground or in contact with standing water.
- Cover truss bundles with paper wrap or canvas tarps to protect them from the weather. DO NOT use plastic covers as they will cause moisture to accumulate on the trusses.

PROLONGED EXPOSURE TO THE ELEMENTS HARMS THE APPEARANCE AND STRENGTH OF THE TRUSSES.

DAMAGED TRUSSES MUST BE REPAIRED OR REPLACED

3 OPEN–WEB TRUSS IDENTIFICATION

T.JI™ and T.JI.X™ Trusses 1½"x3½" — SINGLE–CHORD TRUSS

T.JW™ Trusses 1½"x4½" — SINGLE–CHORD TRUSS

TJS™ Trusses 1½"x2⅝" double — DOUBLE–CHORD TRUSS

TJM™ Trusses 1½"x3⅝" double; TJH™ Trusses 1½"x5⅛" double — DOUBLE–CHORD TRUSS

4 MATERIAL IDENTIFICATION

A. STRUT BRACING of tabular steel with flattened ends furnished with all open–web trusses. Strut bracing to be installed as each truss is set. See 5–A, 5–B, 5–D and 5–D

No tab for single–chord trusses

B. PLYWOOD EDGE BLOCKING is provided by Trus Joist on some projects and used for nailing sheathing edges.
Edge blocking will not prevent trusses from bowing.
Edge blocking should be installed after strut bracing (installation bracing) is in place and immediately prior to laying sheathing.

C. 2x4 STARTER STRUTS by contractor with one A35 framing anchor (UNO) each end (furnished by Trus Joist and shipped loose). Flatten upset prong and fold portion of vertical tab around end of 2x4. Attach with 6–8d nails each end. See 5–A and 5–D

D. CROSS BRACING is provided for most bottom–bearing locations. Cross bracing to be installed as each truss is set. Contractor to bend ends prior to installation. See 5–E

5 INSTALLATION BRACING

DO NOT allow workers on the trusses until all truss bearings and bracing have been permanently attached.

WARNING
WITHOUT CORRECTLY INSTALLED BRACING AS SHOWN BELOW, TRUSSES CAN BOW AND ROLL OVER CAUSING DEATH OR SERIOUS PERSONAL INJURY AND PROPERTY DAMAGE.

NOTICE
INSTALLATION BRACING AND PROCEDURES, AS WELL AS THE SAFETY OF WORKERS, ARE THE RESPONSIBILITY OF THE INSTALLER. THE INSTALLER SHOULD MAKE SURE THAT THIS INSTALLATION INFORMATION IS UNDERSTOOD BY ALL PERSONS INVOLVED IN THE TRUSS INSTALLATION.

DO NOT stock building materials on trusses before all truss bearings and bracing have been permanently attached. See 7

BRACE EACH TRUSS AS IT IS PLACED

GETTING STARTED PROPERLY

BEGIN AT LATERALLY BRACED END WALL OR BEAM

5–A: Laterally braced end wall, beam or ledger; 2x4 starter strut furnished by contractor, with framing anchors furnished by Trus Joist. See 4–C and 5–D; Strut bracing furnished by Trus Joist. See plan and 5–B for number of rows required. See 6 for truss alignment; Beam, wall or ledger support (typical); TJS™ truss shown (typical). Details for other open–web trusses similar.

OR

BEGIN LIKE THIS IF THERE IS NO LATERALLY BRACED END WALL OR BEAM

5–B: Sheathing and nailing to conform to minimum requirements as set forth by project architect, engineer or local building code. See 8 for allowable nailing.

STRUT BRACING BOW SPACING	
T.JI™	10' O.C.
T.JW™, T.JH™	12' O.C.
TJM™	14' O.C.

Strut bracing furnished by Trus Joist. See plan and table above for number of rows required. See 6 for truss alignment.

REMAINING TRUSSES– INSTALL STRUT BRACING AS EACH TRUSS IS PLACED

USE THIS WHEN INSTALLATION BEGINS IN MIDDLE OF BAY

5–C: Sheathing and nailing to conform to minimum requirements as set forth by project architect, engineer or local building code. See 8 for allowable nailing; Strut bracing furnished by Trus Joist. See plan and 5–B for number of rows required. See 6 for truss alignment.

TYPICAL STRUT BRACE CONDITIONS (roof, floor or odd space)

5–D: 2x4 starter strut furnished by contractor with framing anchors furnished by Trus Joist; Roof strut bracing; Floor strut bracing– attach to underside of truss top chord; 2x4 with two 10d (3") nails at each truss by contractor; 10d (3") nails furnished by Trus Joist

TYPICAL DETAIL AT END WALL — DETAIL AT ODD SPACING

BOTTOM CHORD BRACING INSTALLATION

BRACING BELOW IS FOR TYPICAL CONDITIONS. FOR BRACING SPECIAL CONDITIONS SEE DRAWINGS.

5–E

SINGLE–CHORD TRUSS: Cross bracing; Nailer and bracing if shown on the drawings; Bridging where shown on drawings; Cross bracing furnished by Trus Joist. Install as each truss is set.

DOUBLE–CHORD TRUSS: Cross bracing; 1x4 nailer required; attach with two 8d (2½") nails; Nailer required at spans beyond 40 feet; Bridging if shown on the drawings; Nailer and bracing if shown on the drawings

Expires: June 30, 2009

6 INSTALLATION TOLERANCES PERMITTED

TRUSS CHORD ALIGNMENT TOLERANCE

Maximum ½"

To provide proper performance, trusses should not vary more than ½" from a straight line

Bottom chord of truss should not be out of square with deck by more than ¾" per foot of truss depth (i.e. ½" for 24" depth truss)

VERTICAL ALIGNMENT TOLERANCE

BEARING CONDITIONS – OVERHANG TOLERANCE OF TYPICAL BEARING HARDWARE (TJS™ bearing shown)

Maximum overhang for all truss bearing hardware is ½"*

* Maximum overhang for TJM™ series trusses with "Z–Clip" or "Pedestal" bearing hardware is ¾"

7 STACKS OF MATERIAL ON TRUSSES

THIS — NOT THIS

CAUTION
Maximum of 3 sheets of sheathing per 10 feet of truss length.

WARNING
NO WORKERS OR MATERIALS ARE ALLOWED ON THE TRUSSES UNTIL ALL TRUSS BEARINGS AND BRACING HAVE BEEN PERMANENTLY ATTACHED. SEE 5

8 FASTENING OF SHEATHING TO TOP CHORD MEMBERS

MAXIMUM SPACING: 24" o.c. maximum in each chord member; Sheathing material; Chord members

WARNING
NAILING CLOSER THAN SPECIFIED MAY RESULT IN CHORD SPLITTING.

IMPORTANT
USE PROPER SIZE NAILS TO FILL ALL NAIL HOLES IN BEARING CLIPS, BRIDGING CLIPS, BRACING, ETC.

Nailing pattern to be per plans and specifications. In no case shall nail spacing be greater than 24" o.c. in either chord member. Nails shall not be less than 8d (2½") or greater than 16d (3½").

MINIMUM NAIL SPACING

NAIL TYPE	NAIL SIZE	TRUSS SERIES: T.JI™, T.JI.X™, T.JW™	T.JI–I™, T.JW–I™	TJS™	TJM™, T.JH™	Structural Composite Lumber[2] (Edge Nailing)
8d[1]	.113" x 2½" / .131" x 2½"	4" / 6"	1½" / 1½"	4" / 6"	2" / 2"	3" / 3"
10d	.128" x 3" / .148" x 3"	6" / 6"	1½" / 1½"	6" / 6"	2" / 2½"	3" / 4"
12d	.128" x 3¼" / .148" x 3¼"	6" / 6"	1½" / 1½"	6" / 6"	2" / 2½"	3" / 4"
16d	.135" x 3½" / .148" x 3½" / .162" x 3½"	6" / 6" / 8"	1½" / 1½" / 1½"	6" / 6" / 8"	2½" / 2½" / 4"	4" / 4" / 4" (8"@ LVL)

- If more than one row of nails is used, the rows must be offset at least ½" and staggered at 1" into the the flange is maintained.

(1) 14 gauge staples may be a direct substitute for 8d (2½") nails if a minimum penetration
(2) Denotes Timberstrand® LSL, Microllam® LVL and/or Parallam® PSL materials.

9 FIELD MODIFICATION OF TRUSSES NOT PERMITTED

- DO NOT PERMIT CUTTING, DRILLING OR DAMAGE OF THE CHORDS OR WEBS.
- DO NOT REMOVE STEEL PINS OR WEBS (EVEN TEMPORARILY).
- DO NOT MAKE FIELD REPAIRS TO DAMAGED TRUSSES WITHOUT WRITTEN APPROVAL OF TRUS JOIST.

Trus Joist Open Web Truss Product Sections
Refer to plan for series and depth

TJS: DOUBLE 1.5"x2.5" MICRO=LAM LVL CHORD
TJM: DOUBLE 2x4 NDS LUMBER CHORD
TJH: DOUBLE 2x6 NDS LUMBER CHORD
TJL: 2x4 WEB LUMBER CHORD
TJLX: 2x4 WEB LUMBER CHORD
TJW: 1½"x4½"WEB LUMBER CHORD

Manufacturer's engineering responsibility is only for the design of the Trus Joist products and not for any supporting structure or loads other than indicated herein. All materials shall be furnished by others, unless specifically noted by "TJ" or by "Trus Joist" herein.

IF THESE DRAWINGS ARE STAMPED AS "PRELIMINARY" –This Trus Joist Submittal Package must be provided to the contractor/installer and responsible design professional(s), to be verified and/or corrected for accuracy, before any fabrication is authorized. See separate "Trus Joist Package" cover sheet for required "Approval". – Any changes to building design after approval which affect Trus Joist Products, may affect the product delivery date.

IF YOU HAVE PROBLEMS
- Damaged Trus Joist products
- Improper fit
- Field modifications
- Questions about these drawings

Call your Trus Joist Representative
Craig McManus
Phone: (503) 520–7104
Or the Project Coordinator (Scheduling)
Jennie Newman
Phone: (503) 520–7405
Or our Design Center
Vicki Lundmark–Trujillo
Phone: (503) 520–7403

Bethlehem Lutheran Church–Phase 2
Aloha, OR
FLOOR and ROOF

DRAWN	DATE	CHECKED	DATE	ORDER NO.	SHEET
VLT	5/30/2008	RW	8/14/08	06–013765	1 OF 6

Job 06 revised

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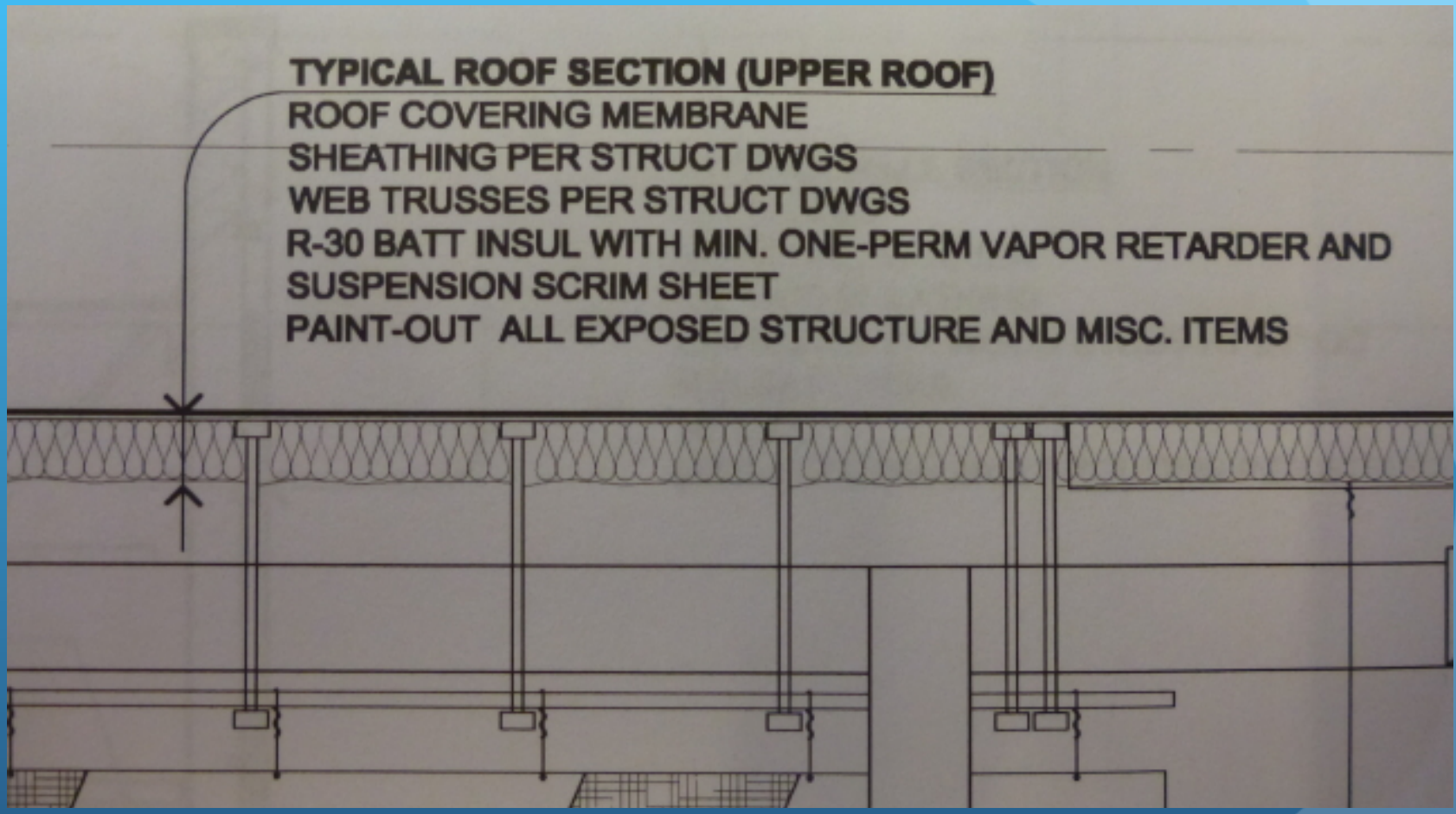
NOT CONTRUCTED PER PLANS



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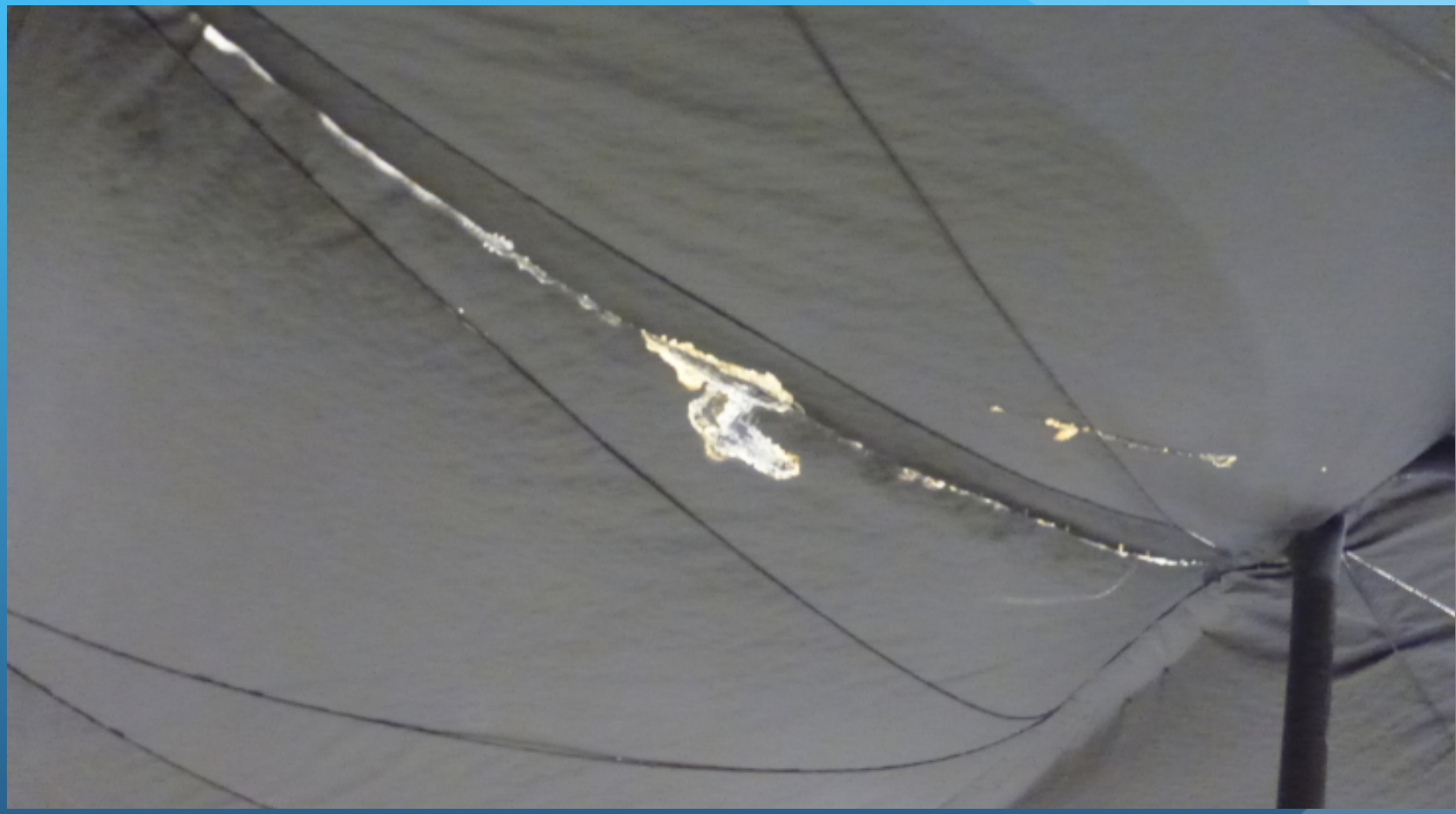
UNCONTROLLED AIR LEAKAGE



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UNCONTROLLED AIR LEAKAGE

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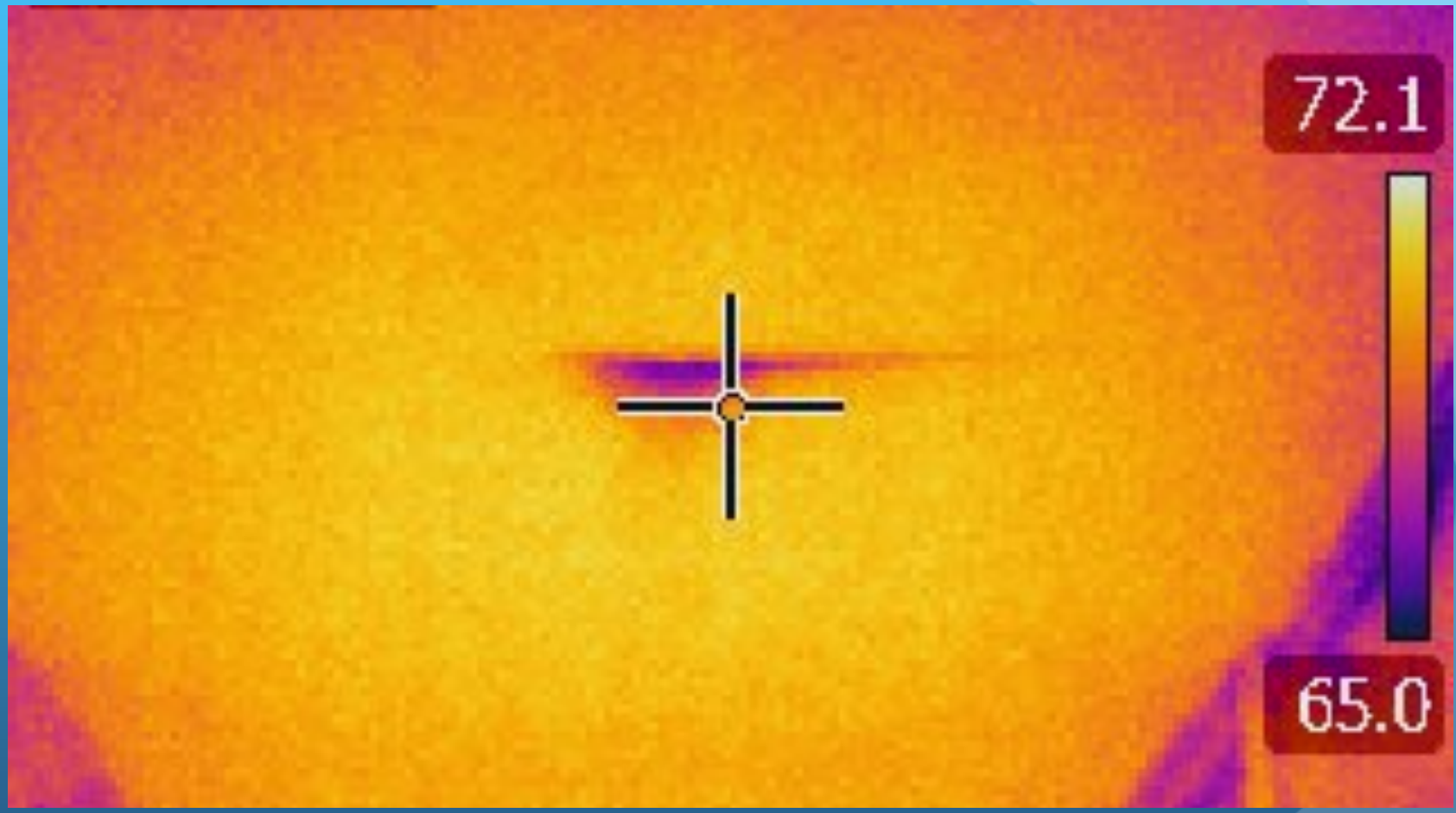
UNCONTROLLED AIR LEAKAGE



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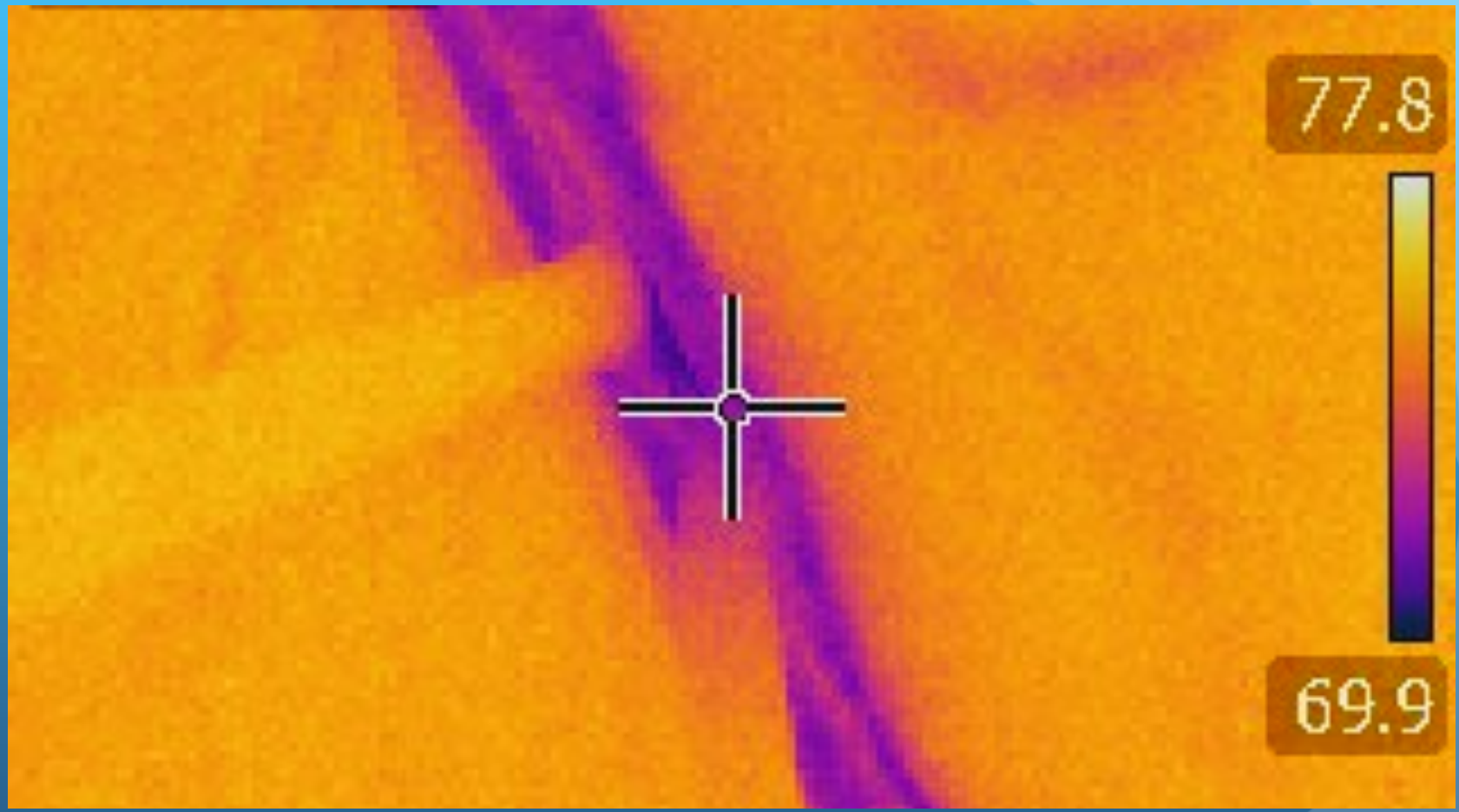
VIRTUALLY IMPOSSIBLE TO CONSTRUCT



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INSULATION INSTALLED IMPROPERLY

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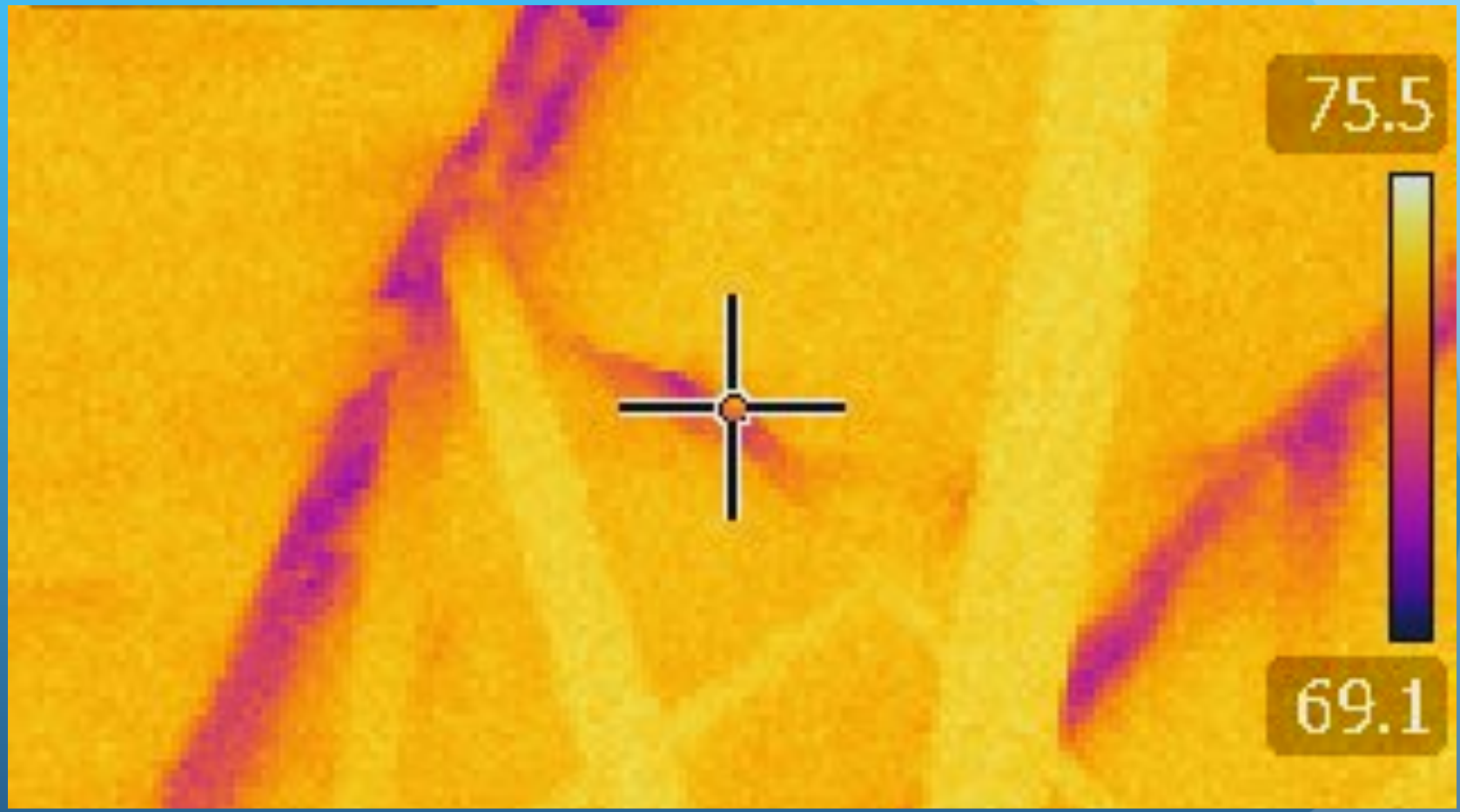
THERMAL BARRIER INCOMPLETE



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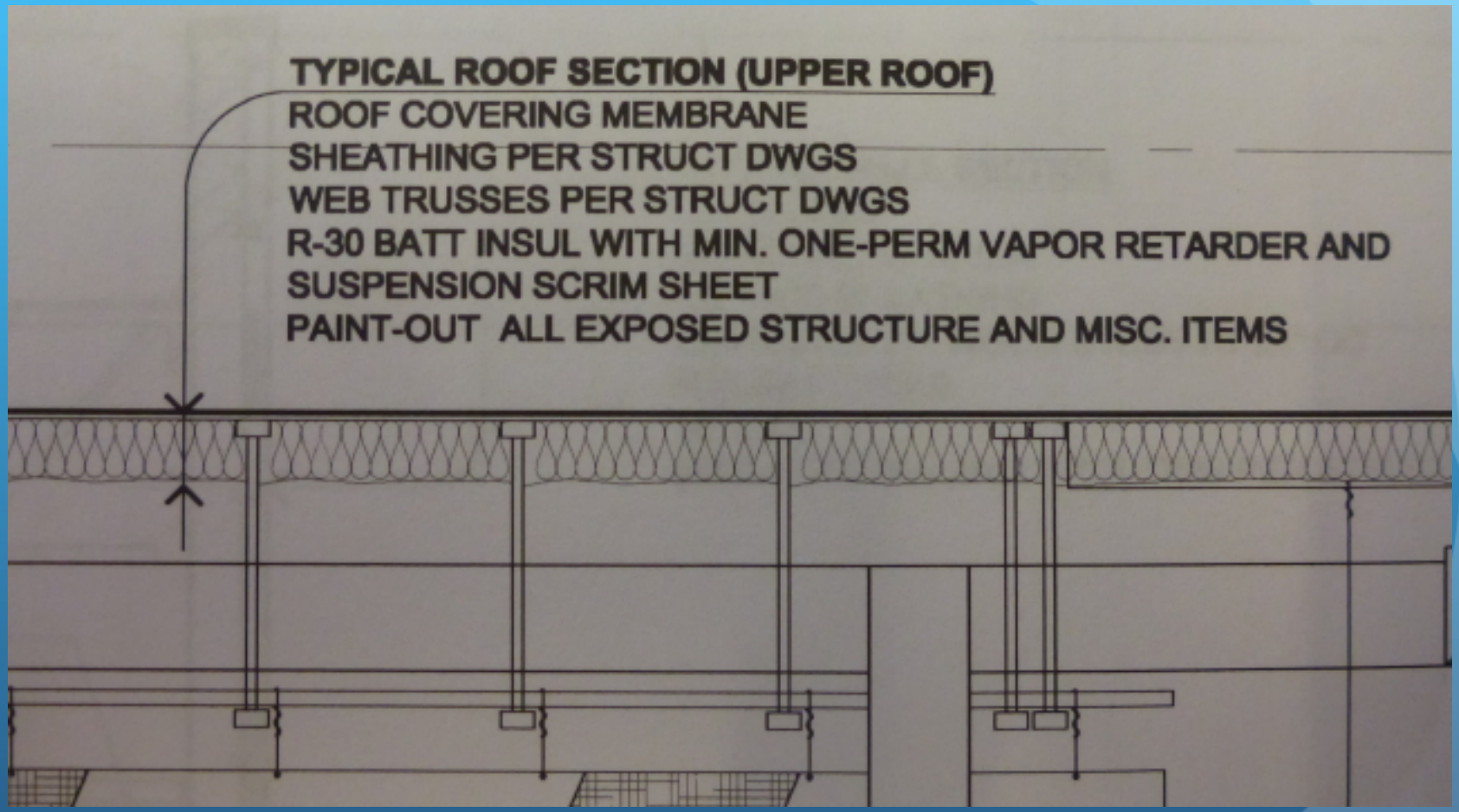
R-30 REQUIRED, +/- R-2 ACHEIVED



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COMPUTER MODELLING

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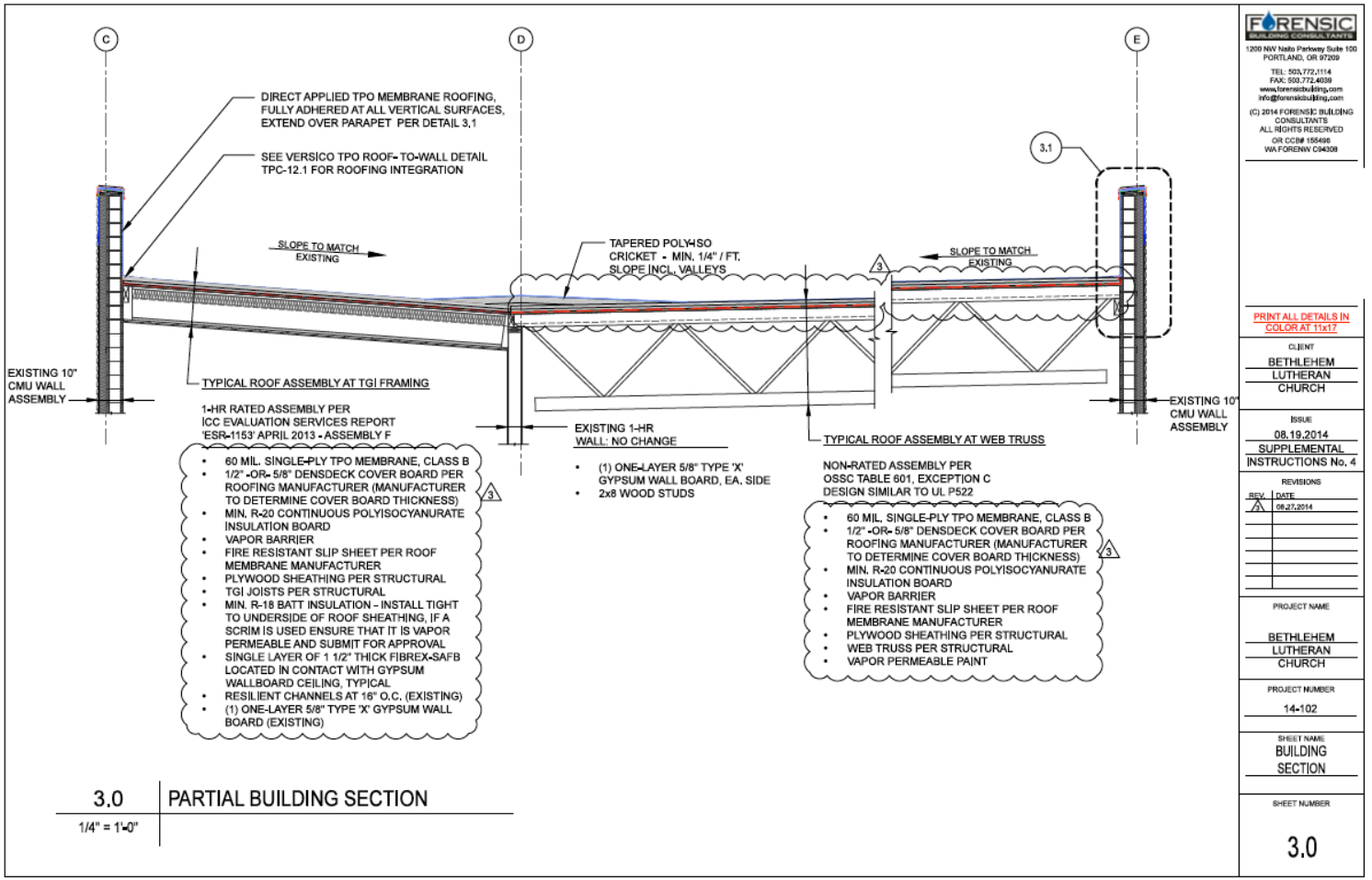
THE FIX



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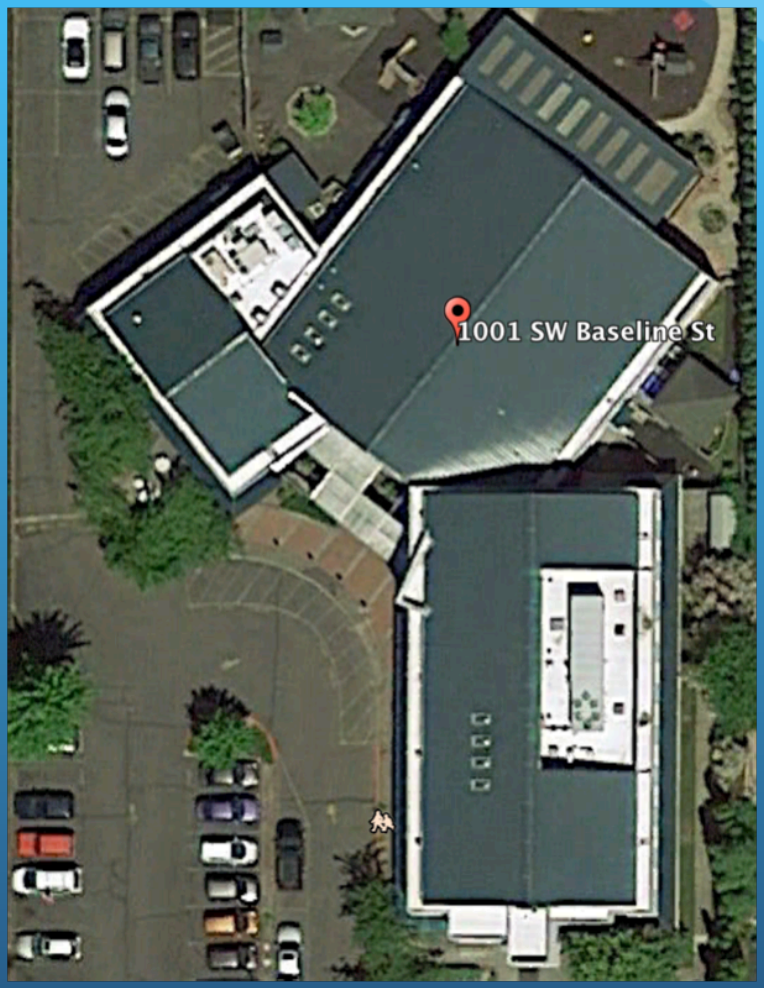
COMMUNITY ACTION ORGANIZATION BUILDING



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2014 IEEC: COMMERCIAL ROOFS

TABLE 502.1.1
BUILDING ENVELOPE REQUIREMENTS - OPAQUE ASSEMBLIES

CLIMATE ZONE	5 AND MARINE 4	
	All other	Group R
Roofs		
Insulation entirely above deck	R-20ci	R-20ci
Metal buildings (with R-3.5 thermal blocks[a, b])	R-13 + R-13	R-19
Attic and other	R-38	R-38

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THE DISCREPANCY IN THE CODES

SECTION R806
ROOF VENTILATION ES

R806.1 Ventilation required.

Enclosed attics and enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters shall have cross ventilation for each separate space by ventilating openings protected against the entrance of rain or snow. Ventilation openings shall have a least dimension of $^1/_{16}$ inch (1.6 mm) minimum and $^1/_4$ inch (6.4 mm) maximum. Ventilation openings having a least dimension larger than $^1/_4$ inch (6.4 mm) shall be provided with corrosion-resistant wire cloth screening, hardware cloth or similar material with openings having a least dimension of $^1/_{16}$ inch (1.6 mm) minimum and $^1/_4$ inch (6.4 mm) maximum. Openings in roof framing members shall conform to the requirements of Section R802.7. Required ventilation openings shall open directly to the outside air.

R806.2 Minimum vent area.

The minimum net free ventilating area shall be $^1/_{150}$ of the area of the vented space.

Exception: The minimum net free ventilation area shall be $^1/_{300}$ of the vented space provided one or more of the following conditions are met:

1. In Climate Zones 6, 7 and 8, a Class I or II vapor retarder is installed on the warm-in-winter side of the ceiling.
2. Not less than 40 percent and not more than 50 percent of the required ventilating area is provided by ventilators located in the upper portion of the attic or rafter space. Upper ventilators shall be located not more than 3 feet (914 mm) below the ridge or highest point of the space, measured vertically, with the balance of the required ventilation provided by eave or cornice vents. Where the location of wall or roof framing members conflicts with the installation of upper ventilators, installation more than 3 feet (914 mm) below the ridge or highest point of the space shall be permitted.

R806.3 Vent and insulation clearance.

Where eave or cornice vents are installed, insulation shall not block the free flow of air. Not less than a 1-inch (25 mm) space shall be provided between the insulation and the roof sheathing and at the location of the vent.

R806.4 Installation and weather protection.

Ventilators shall be installed in accordance with manufacturer's instructions. Installation of ventilators in roof systems shall be in accordance with the requirements of Section R903. Installation of ventilators in wall systems shall be in accordance with the requirements of Section R703.1.

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R806.5 Unvented attic and unvented enclosed rafter assemblies.

Unvented *attics* and unvented enclosed roof framing assemblies created by ceilings that are applied directly to the underside of the roof framing members and structural roof sheathing applied directly to the top of the roof framing members/rafters, shall be permitted where all the following conditions are met:

1. The unvented *attic* space is completely within the *building thermal envelope*.
2. No interior Class I vapor retarders are installed on the ceiling side (*attic* floor) of the unvented *attic* assembly or on the ceiling side of the unvented enclosed roof framing assembly.
3. Where wood shingles or shakes are used, a minimum $^{1}/_{4}$-inch (6.4 mm) vented airspace separates the shingles or shakes and the roofing underlayment above the structural sheathing.
4. In Climate Zones 5, 6, 7 and 8, any *air-impermeable insulation* shall be a Class II vapor retarder, or shall have a Class II vapor retarder coating or covering in direct contact with the underside of the insulation.
5. Insulation shall be located in accordance with the following:
   - 5.1. Item 5.1.1, 5.1.2, 5.1.3 or 5.1.4 shall be met, depending on the air permeability of the insulation directly under the structural roof sheathing.
     - 5.1.1. Where only *air-impermeable insulation* is provided, it shall be applied in direct contact with the underside of the structural roof sheathing.
     - 5.1.2. Where *air-permeable insulation* is provided inside the building thermal envelope, it shall be installed in accordance with Section 5.1. In addition to the *air-permeable insulation* installed directly below the structural sheathing, rigid board or sheet insulation shall be installed directly above the structural roof sheathing in accordance with the *R*-values in Table R806.5 for condensation control.
     - 5.1.3. Where both *air-impermeable* and *air-permeable insulation* are provided, the *air-impermeable insulation* shall be applied in direct contact with the underside of the structural roof sheathing in accordance with Item 5.1.1 and shall be in accordance with the *R*-values in Table R806.5 for condensation control. The *air-permeable insulation* shall be installed directly under the *air-impermeable insulation*.
     - 5.1.4. Alternatively, sufficient rigid board or sheet insulation shall be installed directly above the structural roof sheathing to maintain the monthly average temperature of the underside of the structural roof sheathing above 45°F (7°C). For calculation purposes, an interior air temperature of 68°F (20°C) is assumed and the exterior air temperature is assumed to be the monthly average outside air temperature of the three coldest months.
   - 5.2. Where preformed insulation board is used as the air-impermeable insulation layer, it shall be sealed at the perimeter of each individual sheet interior surface to form a continuous layer.

TABLE R806.5
INSULATION FOR CONDENSATION CONTROL

CLIMATE ZONE	MINIMUM RIGID BOARD ON AIR-IMPERMEABLE INSULATION *R*-VALUE[a, b]
2B and 3B tile roof only	0 (none required)
1, 2A, 2B, 3A, 3B, 3C	R-5
4C	R-10
4A, 4B	R-15
5	R-20
6	R-25
7	R-30
8	R-35

a. Contributes to but does not supersede the requirements in Section N1102.

b. Alternatively, sufficient continuous insulation shall be installed directly above the structural roof sheathing to maintain the monthly average temperature of the underside of the structural roof sheathing above 45°F (7°C). For calculation purposes, an interior air temperature of 68°F (20°C) is assumed and the exterior air temperature is assumed to be the monthly average outside air temperature of the three coldest months.

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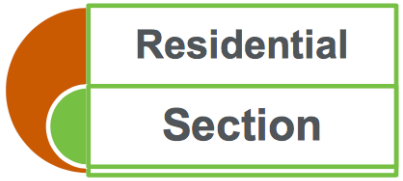
2015 IECC UPDATES

Ch. 1 Scope and Application / Administrative and Enforcement
Ch. 2 Definitions
Ch. 3 General Requirements
Ch. 4 Commercial Energy Efficiency
Ch. 5 Existing Buildings - NEW
Ch. 6 Referenced Standards



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AIR LEAKAGE ADDRESSED

502.4 Air leakage. The thermal envelope of buildings shall comply with Sections 502.4.1 through 502.4.7.

502.4.1 Air barriers. A continuous air barrier shall be provided throughout the building thermal envelope. The air barriers shall be permitted to be located on the inside or outside of the building envelope, located within the assemblies composing the envelope, or any combination thereof. The air barrier shall comply with Sections 502.4.1.1 and 502.4.1.2.

502.4.1.1 Air barrier construction. The continuous air barrier shall be constructed to comply with the following:

1. The air barrier shall be continuous for all assemblies that are the thermal envelope of the building and across the joints and assemblies.
2. Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. Air barrier penetrations shall be sealed in accordance with Section C502.4.2. The joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.
3. Recessed lighting fixtures shall comply with Section 504.2.8. Where similar objects are installed which penetrate the air barrier, provisions shall be made to maintain the integrity of the air barrier.

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ON THE HORIZON

502.4.1.2.3 Building test. The completed building shall be tested and the air leakage rate of the building envelope shall not exceed 0.40 cfm per square foot at a pressure differential of 0.3 inches water gauge (2.0 L/s · m^2 at 75 Pa) in accordance with ASTM E 779 or an equivalent method approved by the code official.

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