



34th Annual State Construction Conference

March 26th, 2015

WELCOME





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Roofing Criteria & Problems

Low Slope Membrane Roofs

Farouk Zaman, RA



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Roofing Criteria & Problems

Low Slope Membrane Roofs

Purpose - Establish a minimum design standard for North Carolina State Facilities.

It is **Not** a North Carolina State roofing specification or Building Code summary.

~~State Construction Office have a “preferred roofing type”.~~

FALSE ! FALSE ! FALSE ! FALSE ! FALSE !

Information - Numerous publications are available for reference, such as **NRCA** National Roofing Contractors Association, **SMACNA** Metal & Air Conditioning Contractors National Association, manufacturer’s literatures and the Internet.

Roofing Criteria & Problems Of Low Slope Membrane Roofs

- GENERAL DESIGN**
- BASIC CRITERIA**
- GREEN ROOF OR VEGETATED ROOF**
- ROOF INSPECTION**

Roofing Criteria & Problems

Low Slope Membrane Roofs

GENERAL DESIGN

GENERAL DESIGN

A. Responsibility, Energy and Safety

Designer, Roofer & Owner

B. Standards

Compliance: North Carolina State Building Code,
North Carolina State Energy Code, ASHRAE

C. Sustainability/Recycle

Designer, Roofer & Owner

GENERAL DESIGN – Sustainability/Recycle

1. Built-Up Roof

Asphalt is 100% Recyclable. A petroleum byproduct.
Asphalt curbing, walkways etc.



GENERAL DESIGN – Sustainability/Recycle

2. EPDM - Ethylene Propylene Diene Monomer

A rubber base product.

Walkpads, Children's playground cover, athletic track



GENERAL DESIGN – Sustainability/Recycle

3. TPO – Thermoplastic Polyolefin Olefin

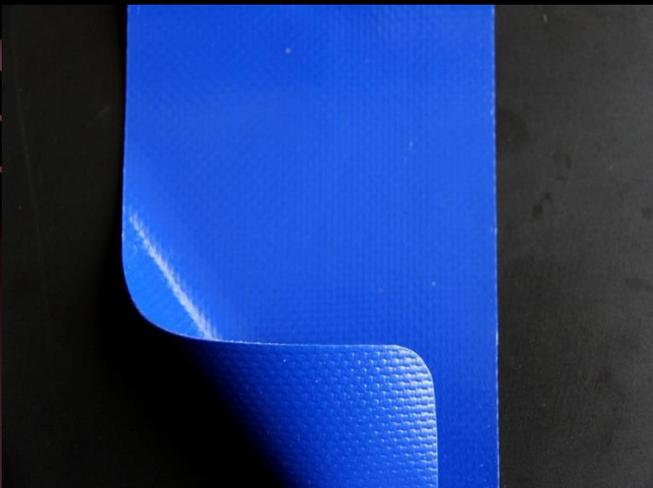
A thermoplastic that can be melted, purified and re-extruded into new roofing. Trunk tray...



GENERAL DESIGN – Sustainability/Recycle

4. PVC – Polyvinyl Chloride

There are 2 PVC types, rigid and flexible. Rigid one is recycle as vinyl fence, decks. Flexible are recycle as roofing and waterproofing



GENERAL DESIGN – Sustainability/Recycle

5. Bitumen

Fossil origin. A thick gooey black stuff, a petroleum byproduct of gasoline, diesel etc.

The process require heating the gooey stuff to a specific temperature to sieve out all contaminants like glass fibres, stones etc. If temperature is too high the bitumen breaks down into other chemicals. If too low the gooey stuff will not sieve out the contaminants.

Only ONE plant in the world located in Netherlands that does recycle bitumen.
Not economical at the moment.

Roofing Criteria & Problems

Low Slope Membrane Roofs

BASIC CRITERIA

BASIC CRITERIA

- Slope
- Equipment Curb
- Access
- Vapor Retarder
- Wood Blocking and Nailer
- Expansion Joint
- Area Divider

BASIC CRITERIA

- Building Code**
 - Uplift**
 - Fire**

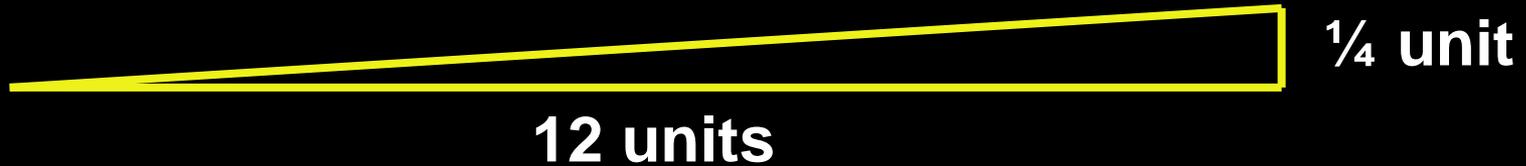
- Construction Details**
 - Metal Coping**
 - Wall/Roof Flashing**
 - Roof Penetrations**
 - Equipment Separation**

- Drainage**

- Add-Ons**

BASIC CRITERIA - Slope

Low slope roof shall have a design slope of a minimum $\frac{1}{4}$ unit vertical in 12 units horizontal or $\frac{1}{4}$ inch per 12 inches.



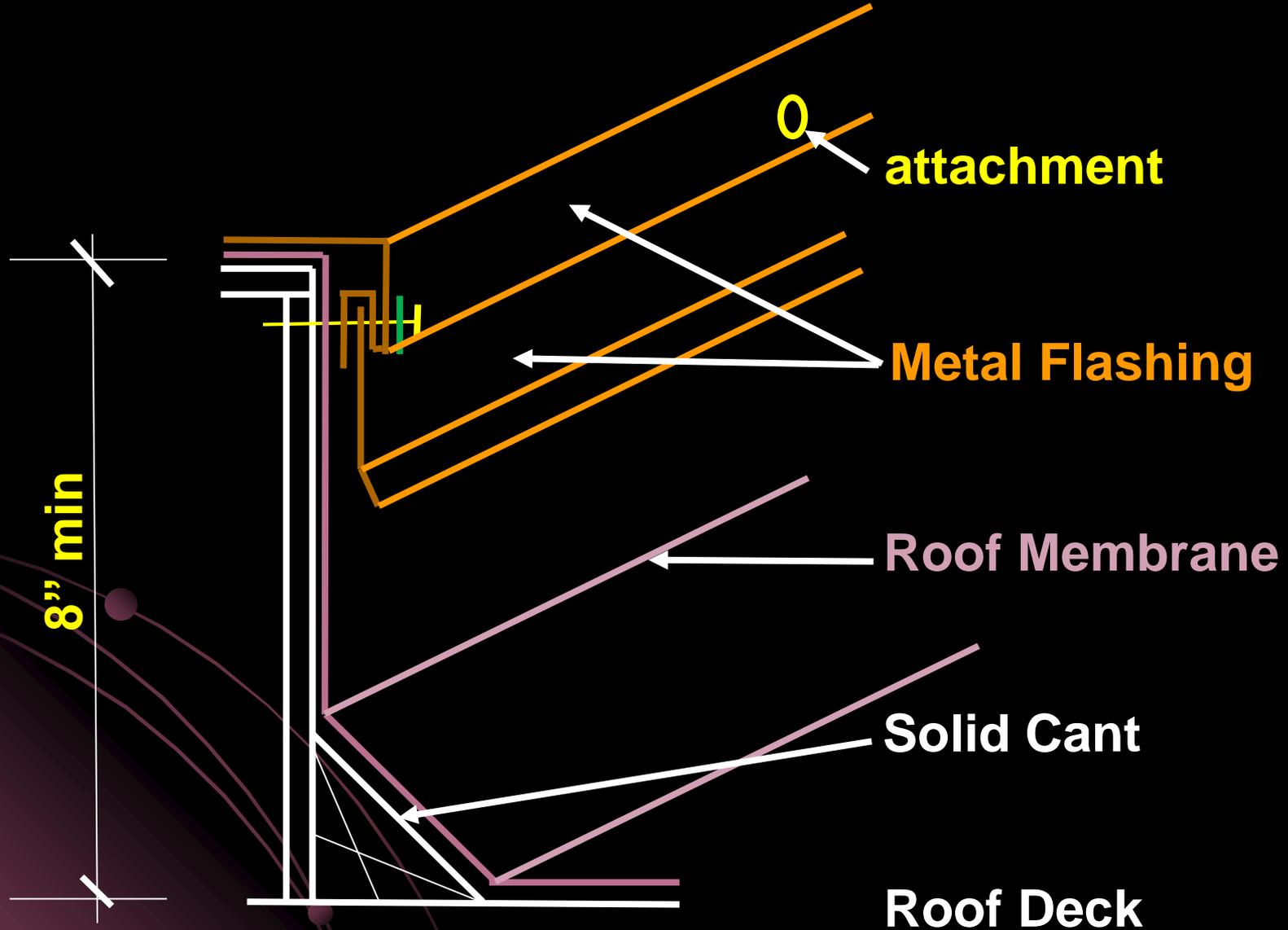
There is **NO** exception to the above for new construction.

New roof slope shall be designed into the roof framing to provide uniform insulation thickness.

Re-roofing not required to meet minimum design slope.

But the roof shall drain.

BASIC CRITERIA – Equipment Curb



BASIC CRITERIA – Equipment Curb



BASIC CRITERIA – Roof Access

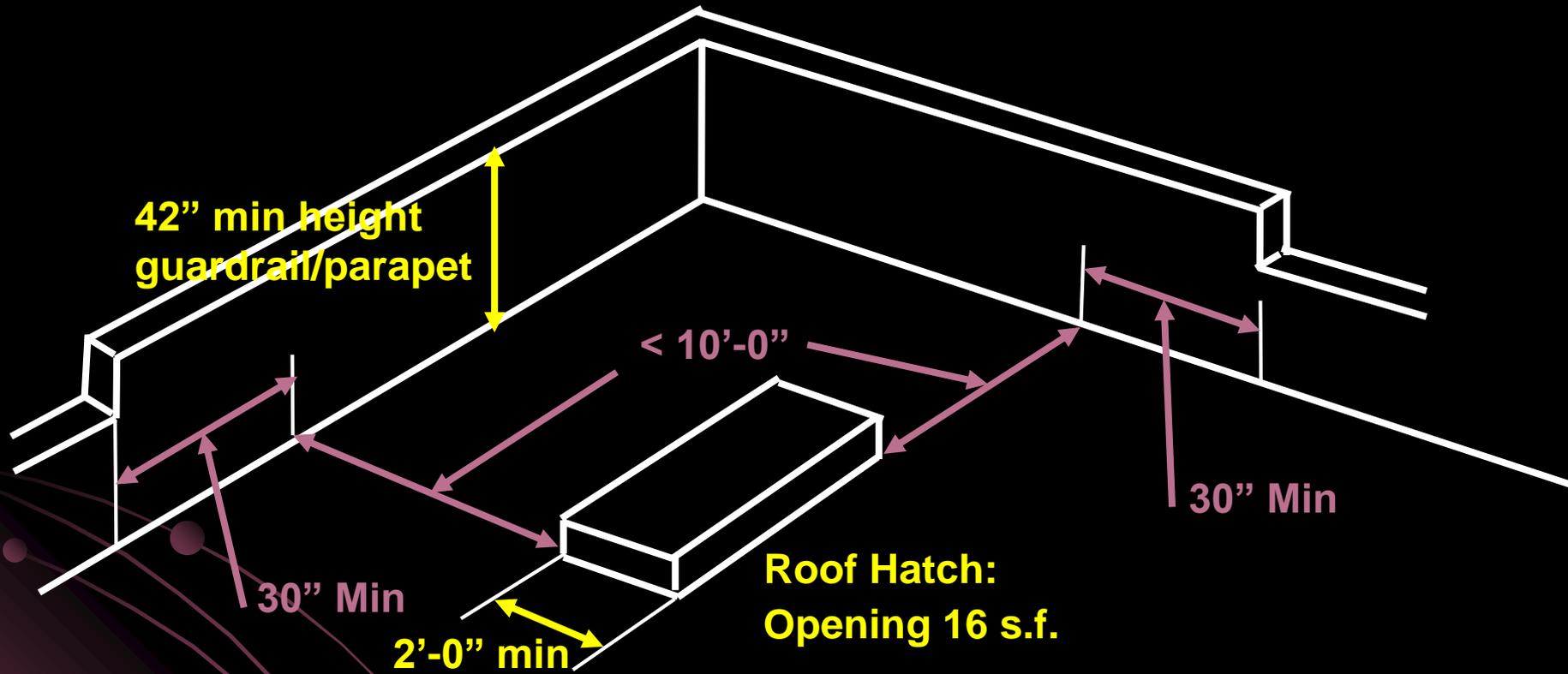
Buildings 4 stories and higher require 1 stairway to roof.

In building without an occupied roof, access by alternating tread device is allowed with a roof hatch.

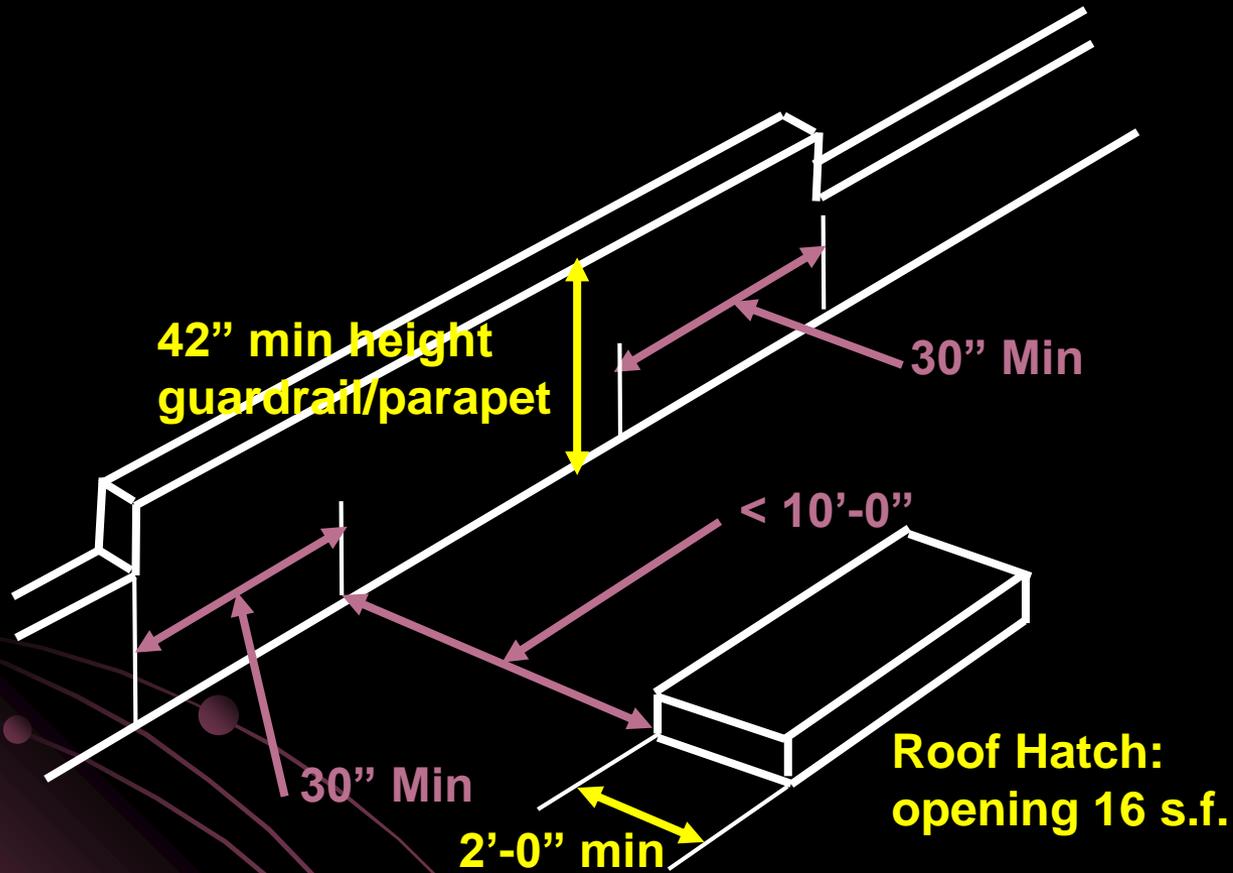
Roof hatch shall have an opening area of **16 sf. min** and a minimum dimension of **2 feet**.

Roof hatch opening a minimum of **10 feet** from the roof edge. If less than that guardrail or parapet **42 inches** high is required.

BASIC CRITERIA – Roof Access



BASIC CRITERIA – Roof Access



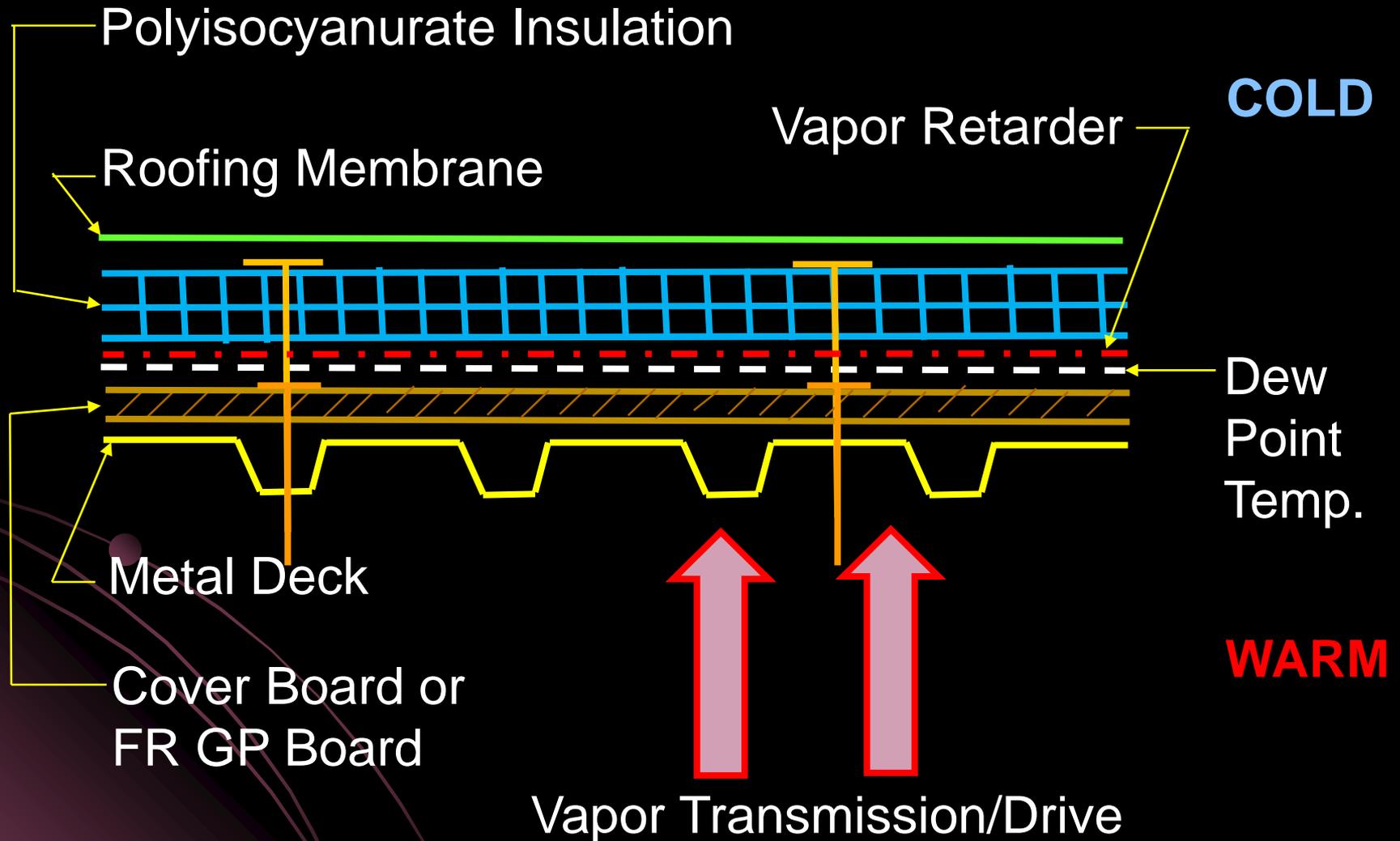
BASIC CRITERIA – Equipment Curb



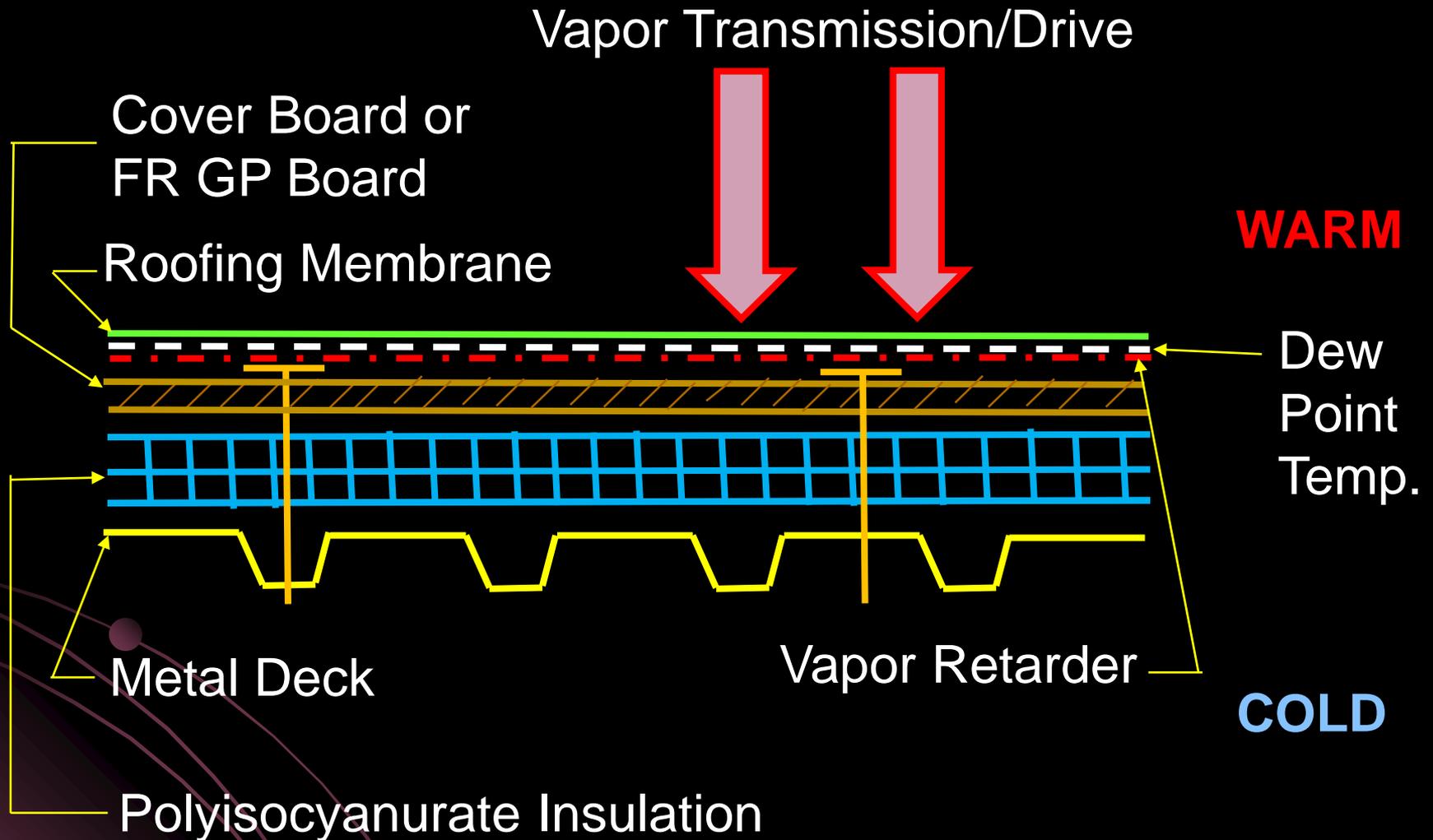
BASIC CRITERIA – Vapor Retarder

- To stop condensation from occurring in roof.
- Separate warm humid air from surface at dew point temperature.
- Prevent warm humid air from condensing.

BASIC CRITERIA – Vapor Retarder



BASIC CRITERIA – Vapor Retarder

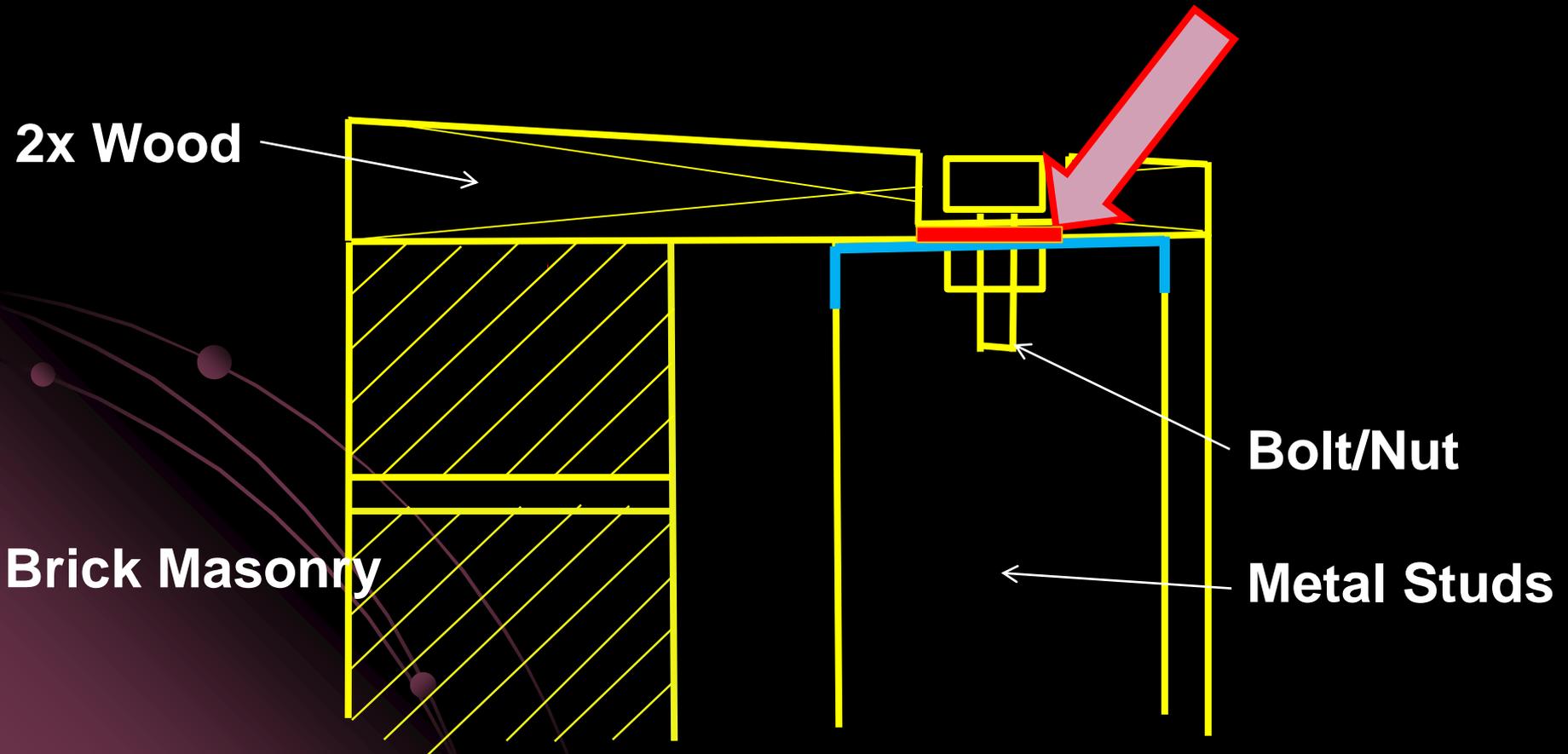


BASIC CRITERIA – Vapor Retarder

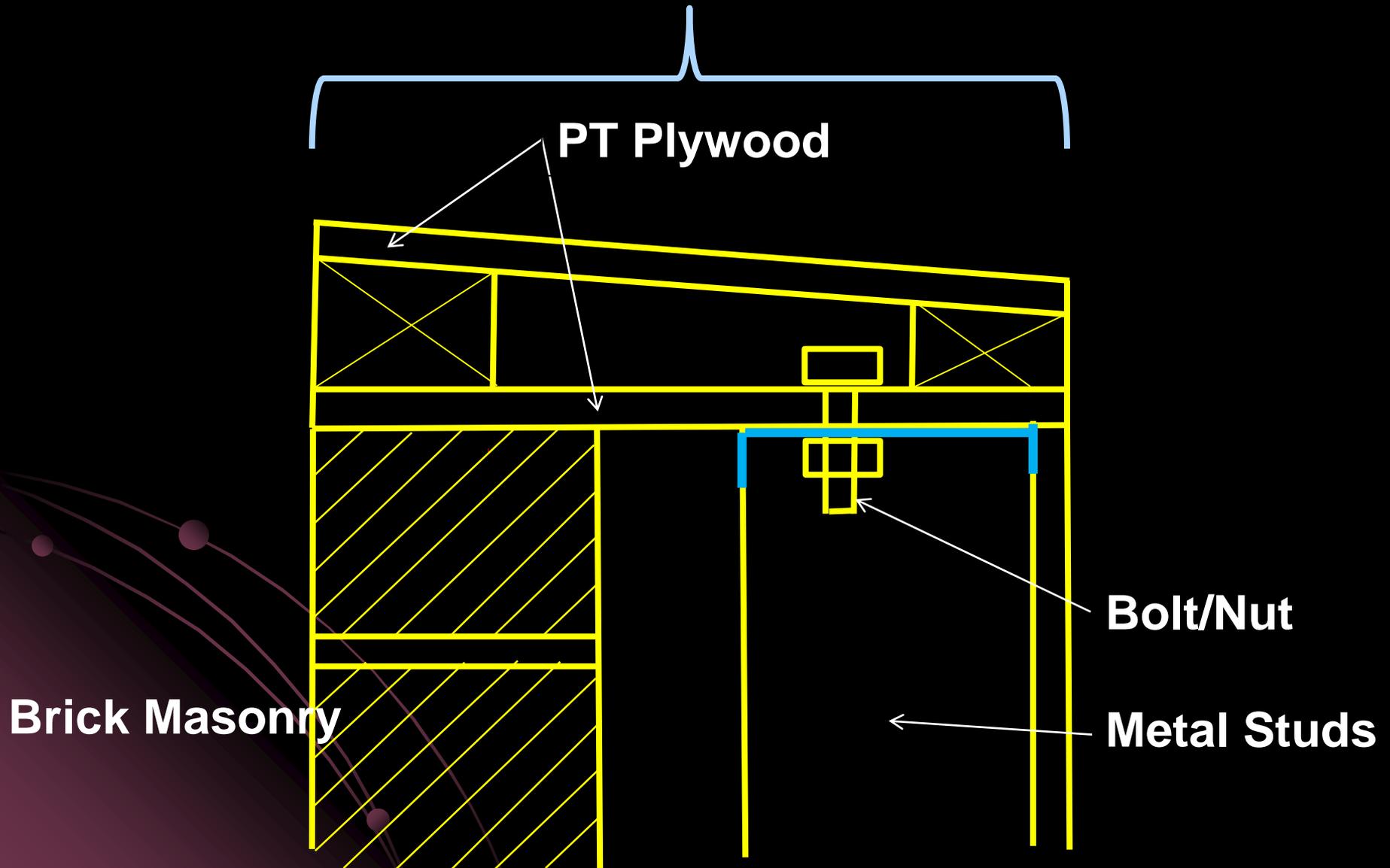
- Note the geographic location of the building**
- Who are the building used?**
- How is the building used?**
- Discuss the inclusion or exclusion of Vapor Retarder with Owner and Roofing Consultant**

BASIC CRITERIA – Wood Blocking/Nailer

Preservative Treated Nailer/Lumber/Plywood.
Kiln dry.
19% moisture or less.



BASIC CRITERIA – Wood Blocking/Nailer



BASIC CRITERIA – Expansion Joints

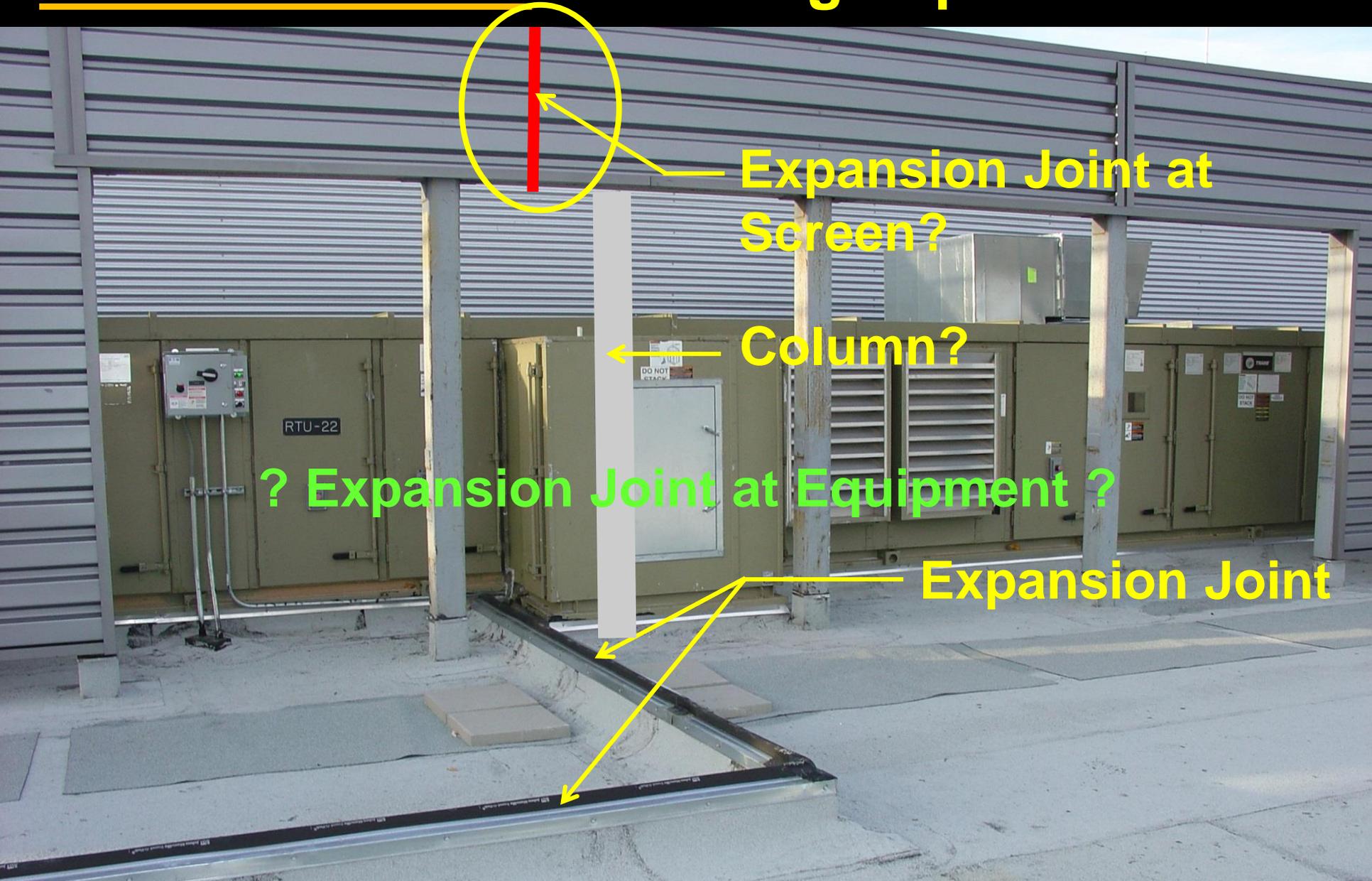
Building Expansion:

The building is structurally separated and all gaps between decks are protected by a Building Expansion Joint Cover that starts at the base of the wall, extend up the exterior building wall, over and down the parapet, across the roof, up and over the parapet and finally down to the wall base on the other side of the building. The joint continues on the interior walls, floors and ceilings.

Membrane expansion (Area Divider):

Joint is to permit expansion and contraction of the membrane. It can be located anywhere on the roof. Ensure all divided areas have proper drainage.

BASIC CRITERIA – Building Expansion Jt



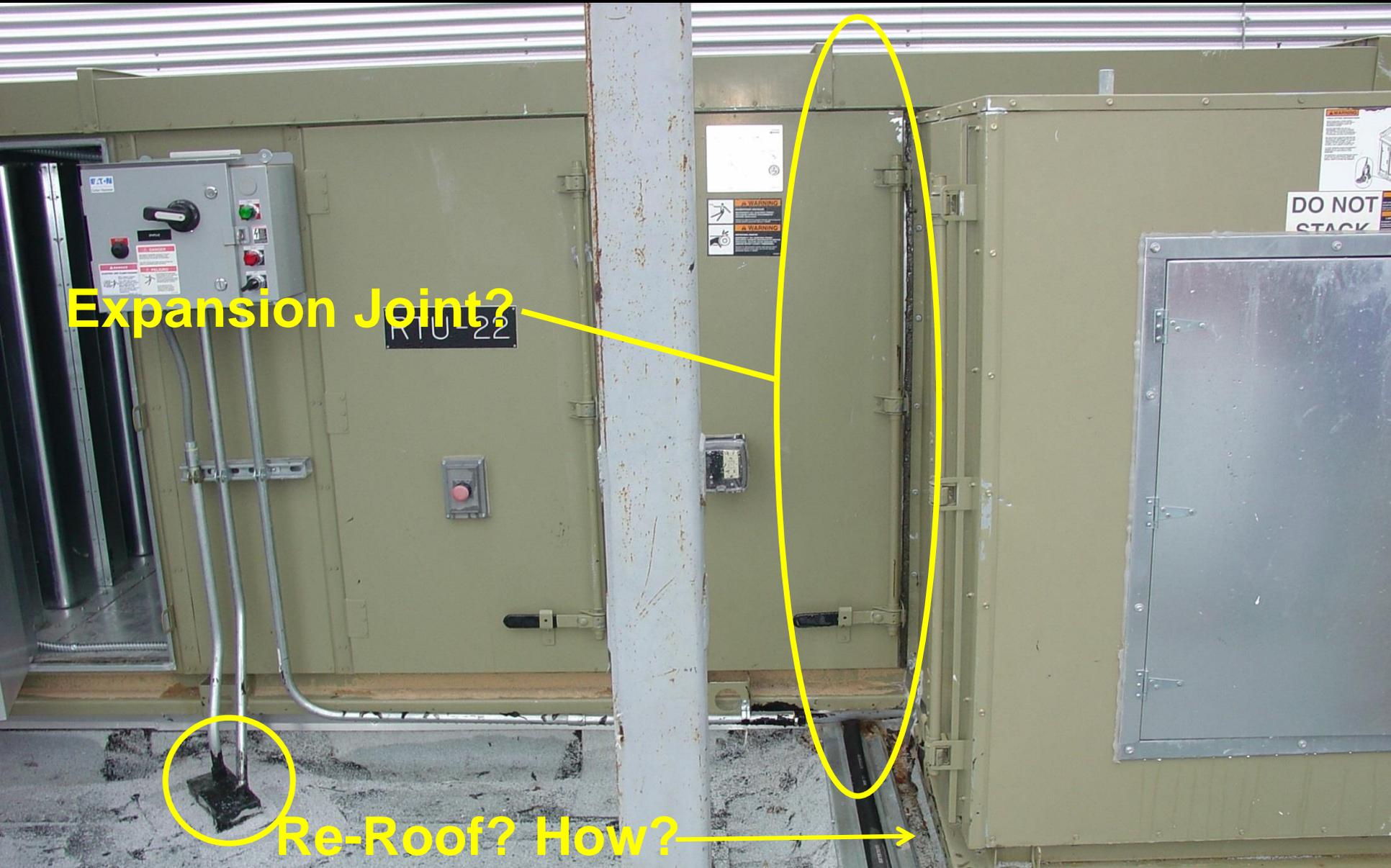
Expansion Joint at Screen?

Column?

? Expansion Joint at Equipment ?

Expansion Joint

BASIC CRITERIA – Building Expansion Jt



Expansion Joint?

Re-Roof? How?

DO NOT STACK

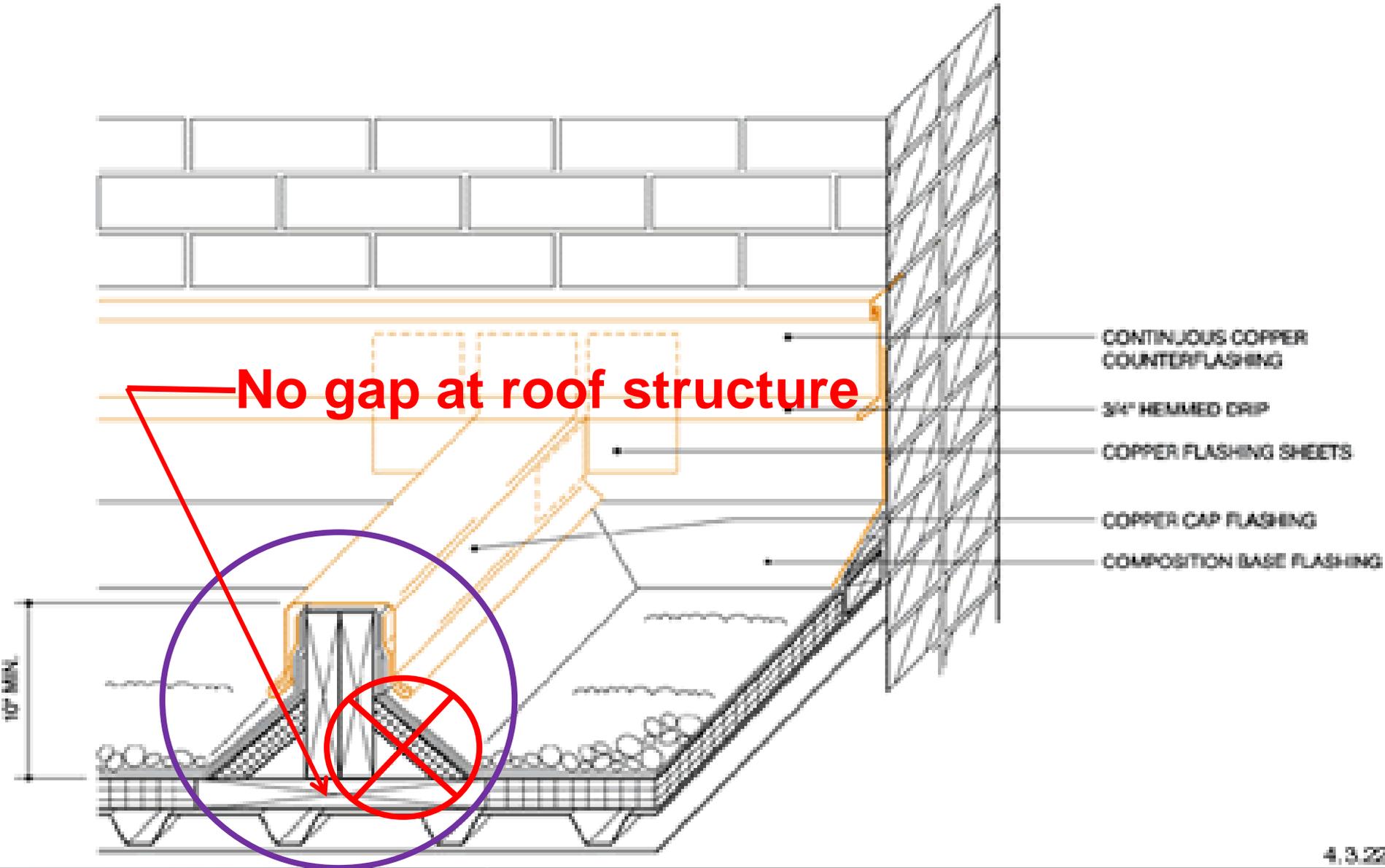
BASIC CRITERIA – Area Divider

Material expanded in the heat of the day.

Poor installation:

- Membrane not “relaxed” before installation.**
- Not fully adhered.**
- Workmanship.**
- Moisture.**
- Too large an area?**

BASIC CRITERIA – Area Divider



4.3.22

BASIC CRITERIA – Building Code - Uplift

WIND UPLIFT TESTING

UNDERWRITERS LABORATORIES UL580

CLASS 30, CLASS 60, CLASS 90

FACTORY MUTUAL 4470

FM I-30, FM I-60, FM I-90

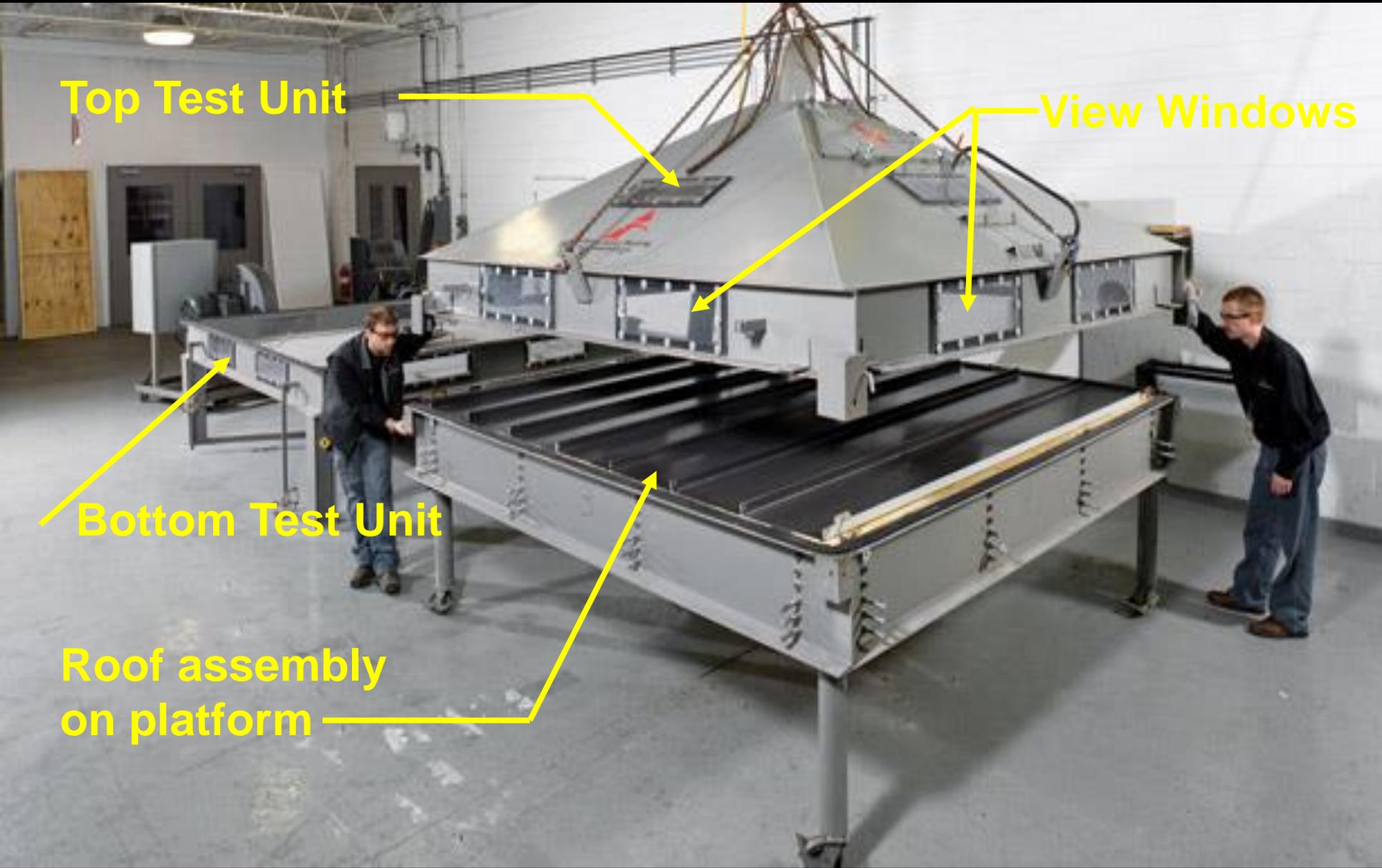
BASIC CRITERIA - TEST EQPT – Uplift Test

Top Test Unit

View Windows

Bottom Test Unit

Roof assembly
on platform



BASIC CRITERIA - TEST EQPT – Uplift Test



View of Metal Roof test through window

BASIC CRITERIA – Building Code - Uplift

WIND UPLIFT TESTING

FM 4470 TEST

Negative Pressures. Starting at **30 psf**.
Increase by **15 psf** each additional minute

Three Stages Test.
Pass or Fail at Each Stage

UPLIFT TEST – FM4470



FM I-90

90 Psf (15 psf/min)

FM I-60

60 psf (15 psf/min)

FM I-30

30 psf for one minute

15 psf increment each minute

BASIC CRITERIA – Building Code - Uplift

WIND UPLIFT TESTING

FM 4470 TEST

FM has a safety factor of 2.

FM I-60 is for a wind uplift of 30 psf

FM I-90 is for a wind uplift of 45 psf

BASIC CRITERIA – Building Code - Uplift

WIND UPLIFT TESTING

UNDERWRITERS LABORATORIES UL580

**Positive pressure exerted on the underside of
test sample for 80 min.**

**Oscillating Negative Pressure on the top side
10 minutes into the test for 60 min.**

**Three Stages Test.
Pass or Fail at Each Stage**

UPLIFT TESTING – UL 580



Class 90
240 Minutes test

Class 60
160 Minutes test

Class 30
80 Minutes test

BASIC CRITERIA – Building Code - Uplift

- ❑ FM4470 and UL580 are **UPLIFT** test. It does **NOT** have direct correlation with Wind Speed.
- ❑ i.e. FM I-90 does **NOT** mean Wind Speed of 90 mph !
But an Uplift of 45 psf.
- ❑ Designer shall utilize Wind Speed to determine Uplift of the roof.
- ❑ Uplift depends on location, height above grade, top of a hill, slope, surrounding environment and with or without parapet.
- ❑ Designer should call for shop drawings and calculation on wind uplift in the specification.

BASIC CRITERIA – Bldg Code - Fire Test

STANDARD TEST METHODS for FIRE TEST of **ROOF COVERING**

AMERICAN SOCIETY for
TESTING and MATERIALS
ASTM E 108

CLASS A, CLASS B, CLASS C

**UNDERWRITERS
LABORATORIES
UL 790**

BASIC CRITERIA – Building Code - Fire Test

ASTM E108

THERE ARE 5 TESTS

Class A, Class B, Class C

INTERMITTENT FLAME TEST

SPREAD OF FLAME TEST

BURNING BRAND TEST

FLYING BRAND TEST

RAIN TEST

FIRE TEST – ASTM E108



FIRE TEST – ASTM E108



BASIC CRITERIA – Bldg Code Fire Test

ASTM E 108

CLASS A, **CLASS B**, **CLASS C**

They are not readily flammable, do not carry or spread fire, and afford some degree of fire protection to the roof deck

CLASS A - effective against **severe** fire exposure

CLASS B - effective against **moderate** fire exposure

CLASS C - effective against **light** fire exposure

This test and its results has NO bearing on the Roof Assembly as in the Building Code !!

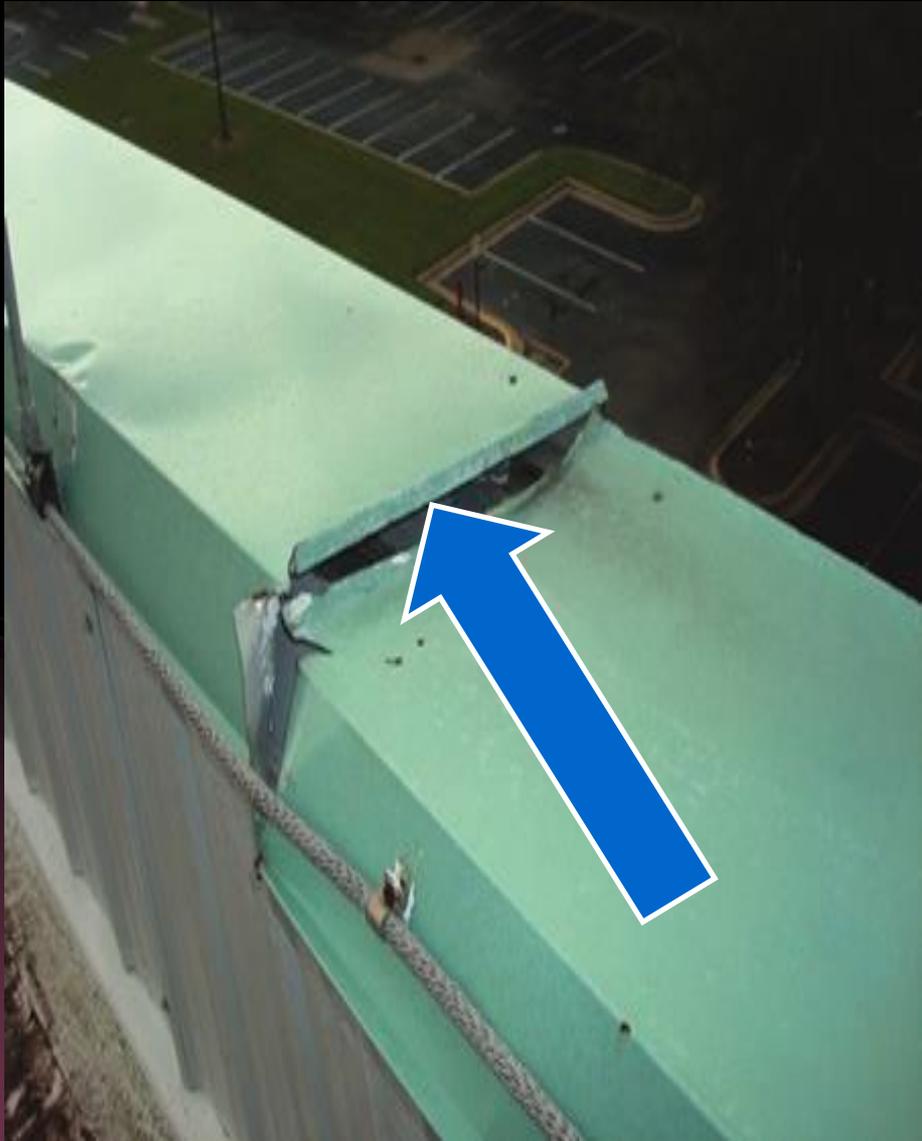
BASIC CRITERIA

Construction Detail - Metal Coping



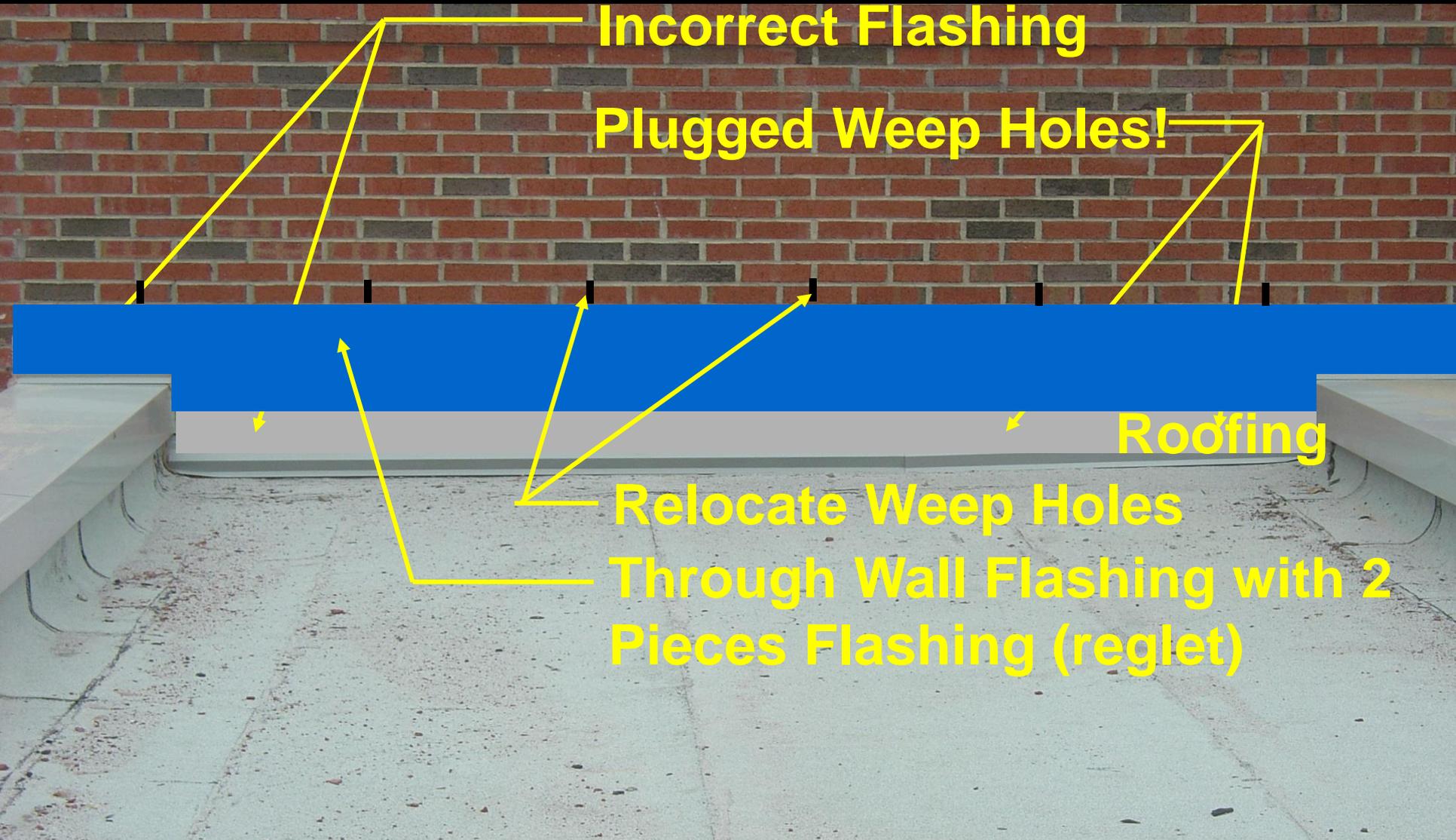
BASIC CRITERIA

Construction Detail - Metal Coping



BASIC CRITERIA

Construction Detail - Wall Flashing



Incorrect Flashing

Plugged Weep Holes!

Roofing

Relocate Weep Holes

Through Wall Flashing with 2 Pieces Flashing (reglet)

BASIC CRITERIA

Construction Detail - Wall Flashing

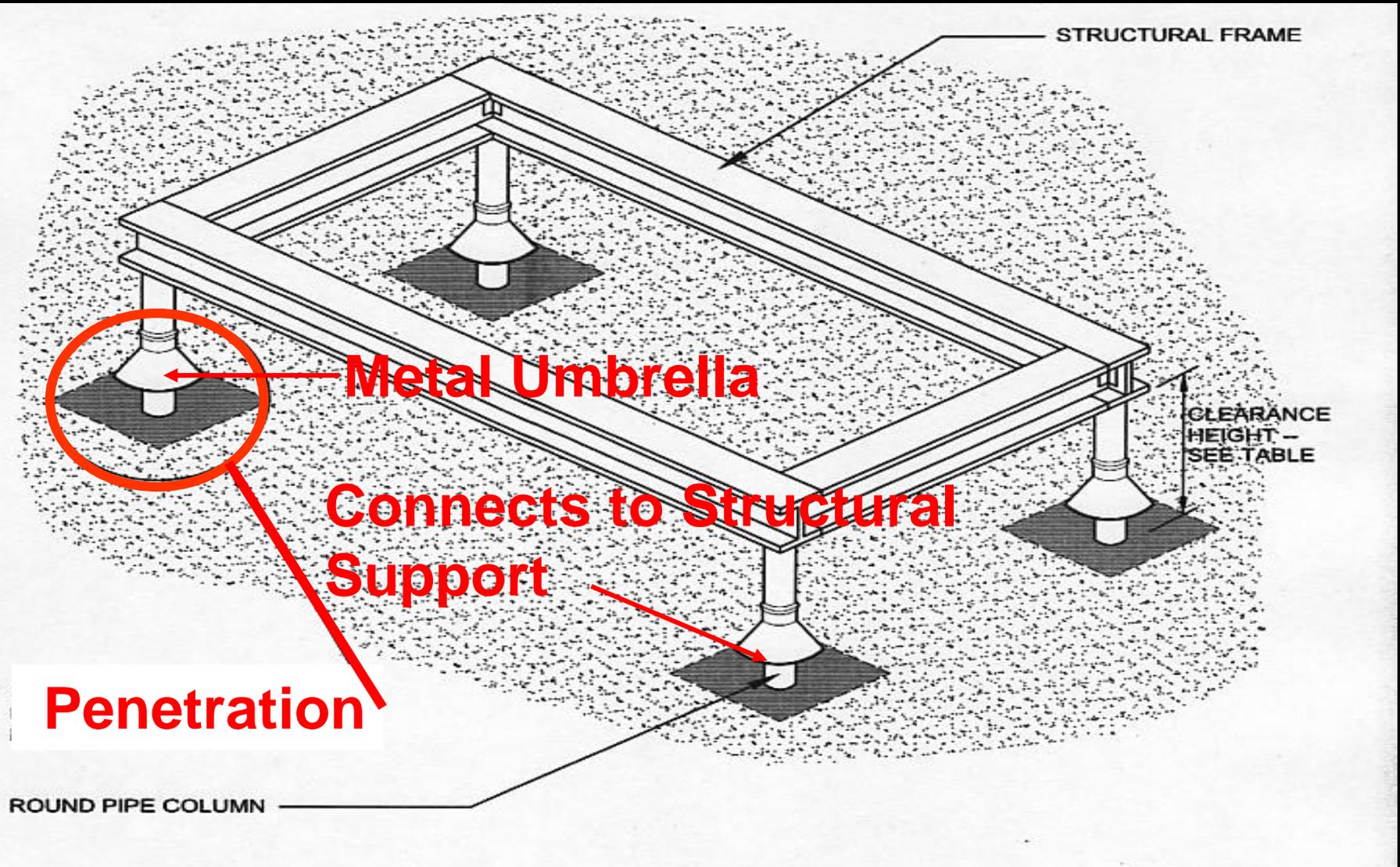
Wall Material

Wall Flashing at 18"
above roof surface



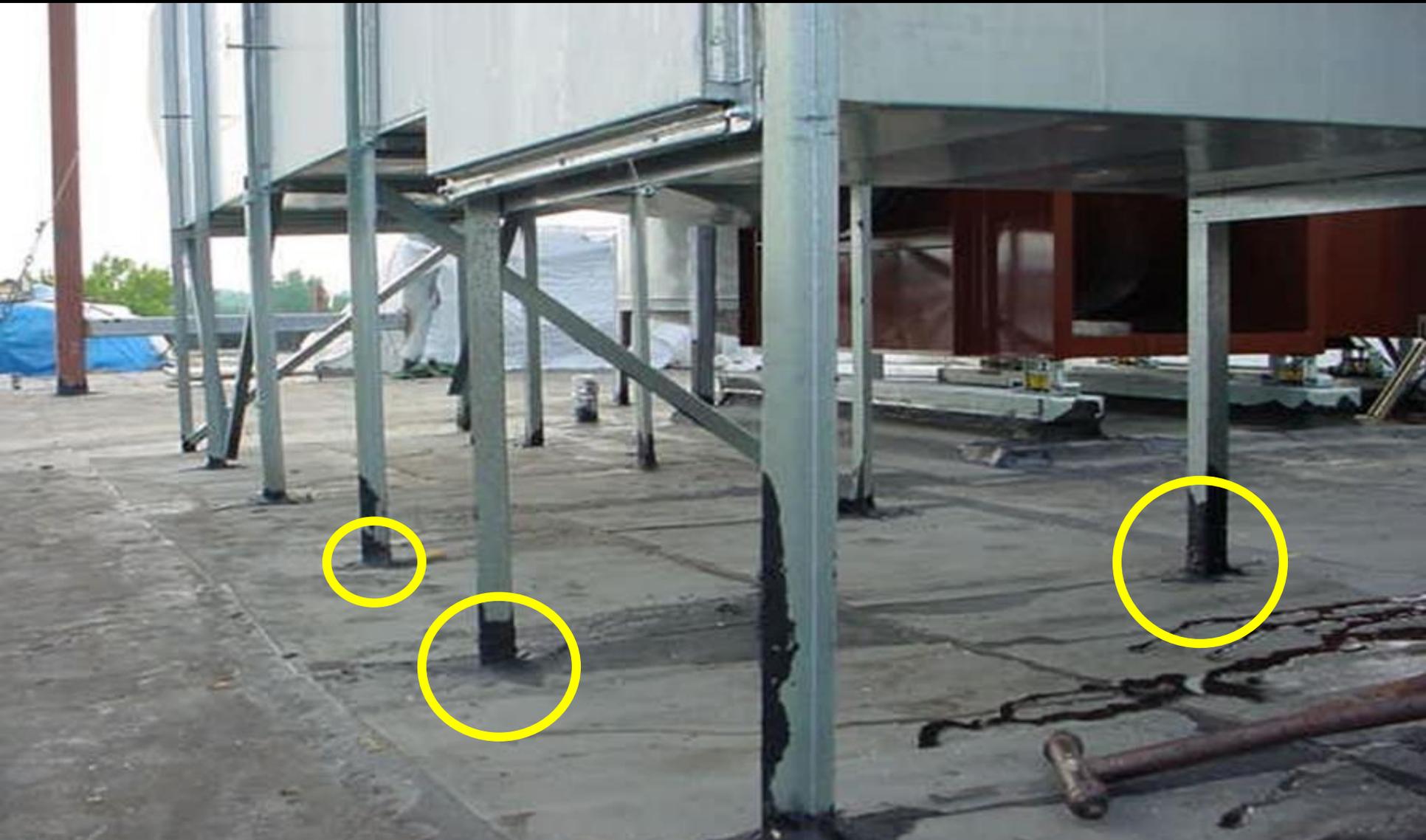
BASIC CRITERIA

Construction Detail - Penetration



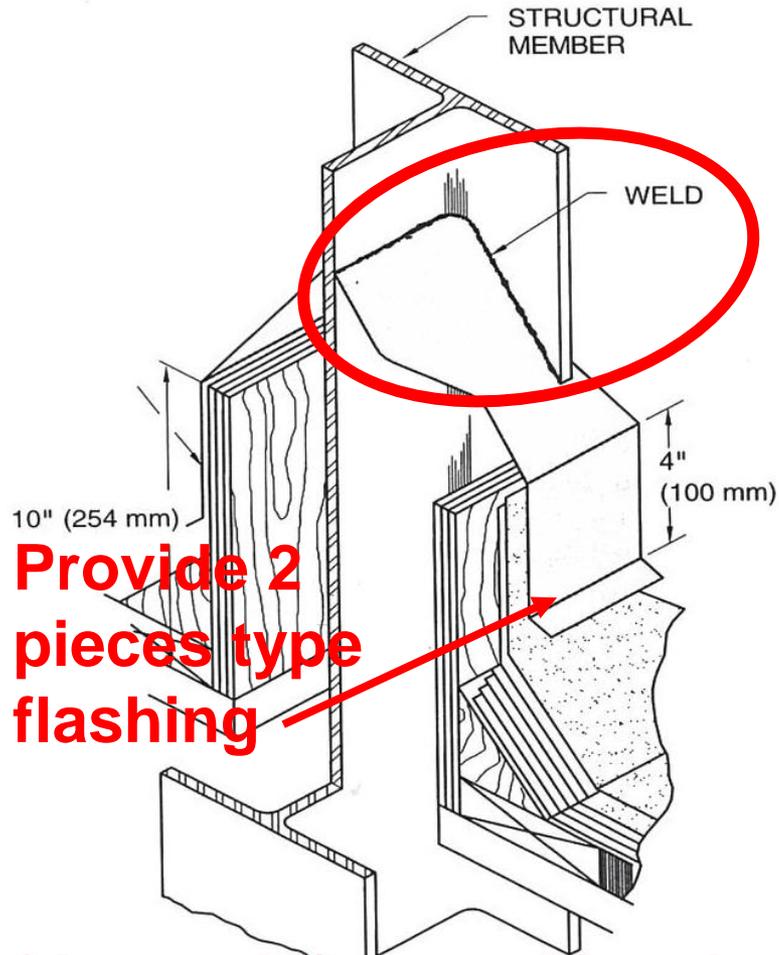
BASIC CRITERIA

Construction Detail - Penetration

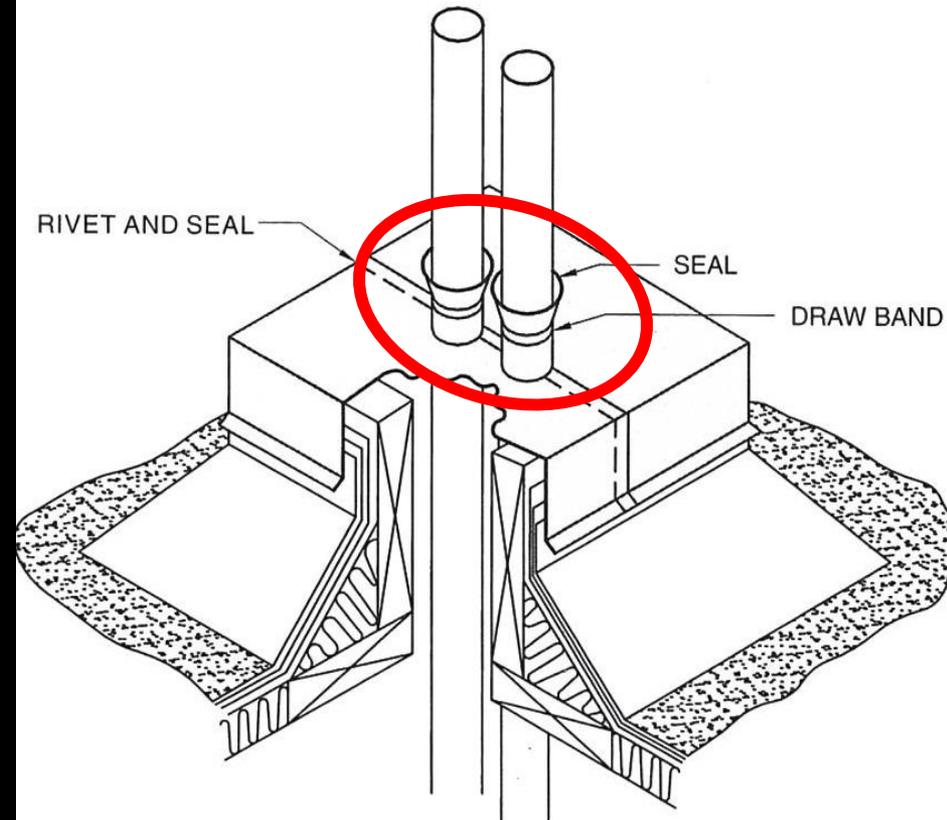


BASIC CRITERIA

Construction Detail - Penetration



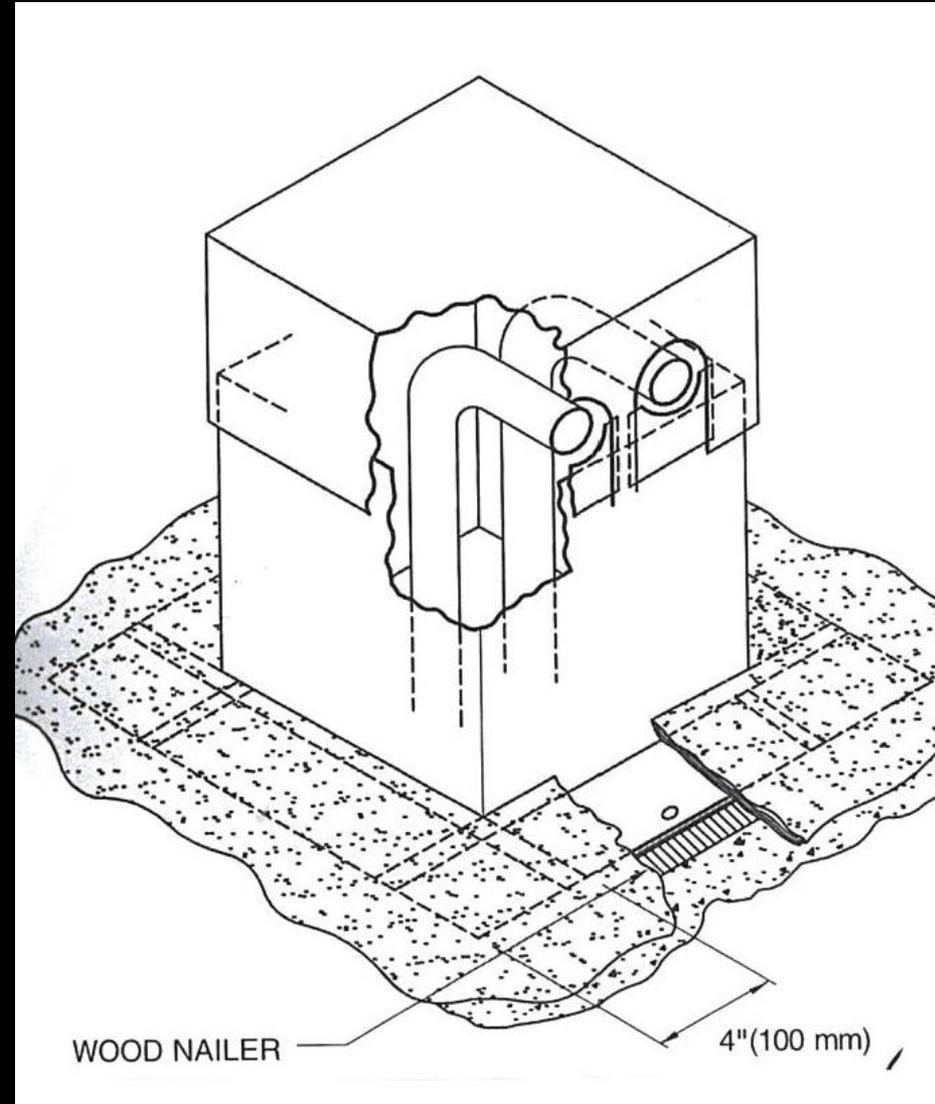
Shaped Struct Member



Multiple Pipes

BASIC CRITERIA

Construction Detail - Penetration



BASIC CRITERIA Construction Detail - Penetration

Re-roof ?

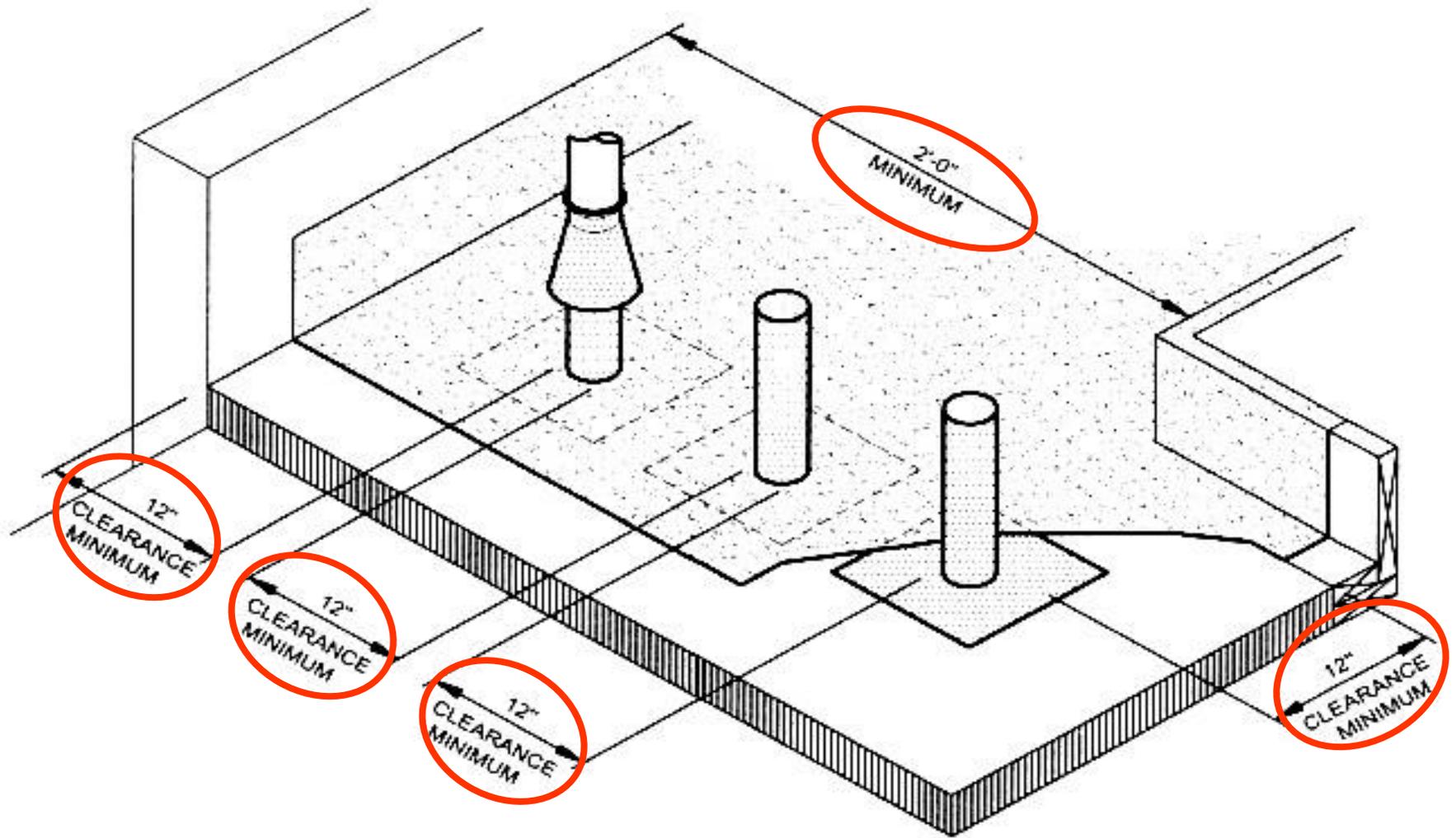
Disruptive to Users

Long construction time

Costly \$\$\$



BASIC CRITERIA Construction Detail - Separation



BASIC CRITERIA

Construction Detail - Separation

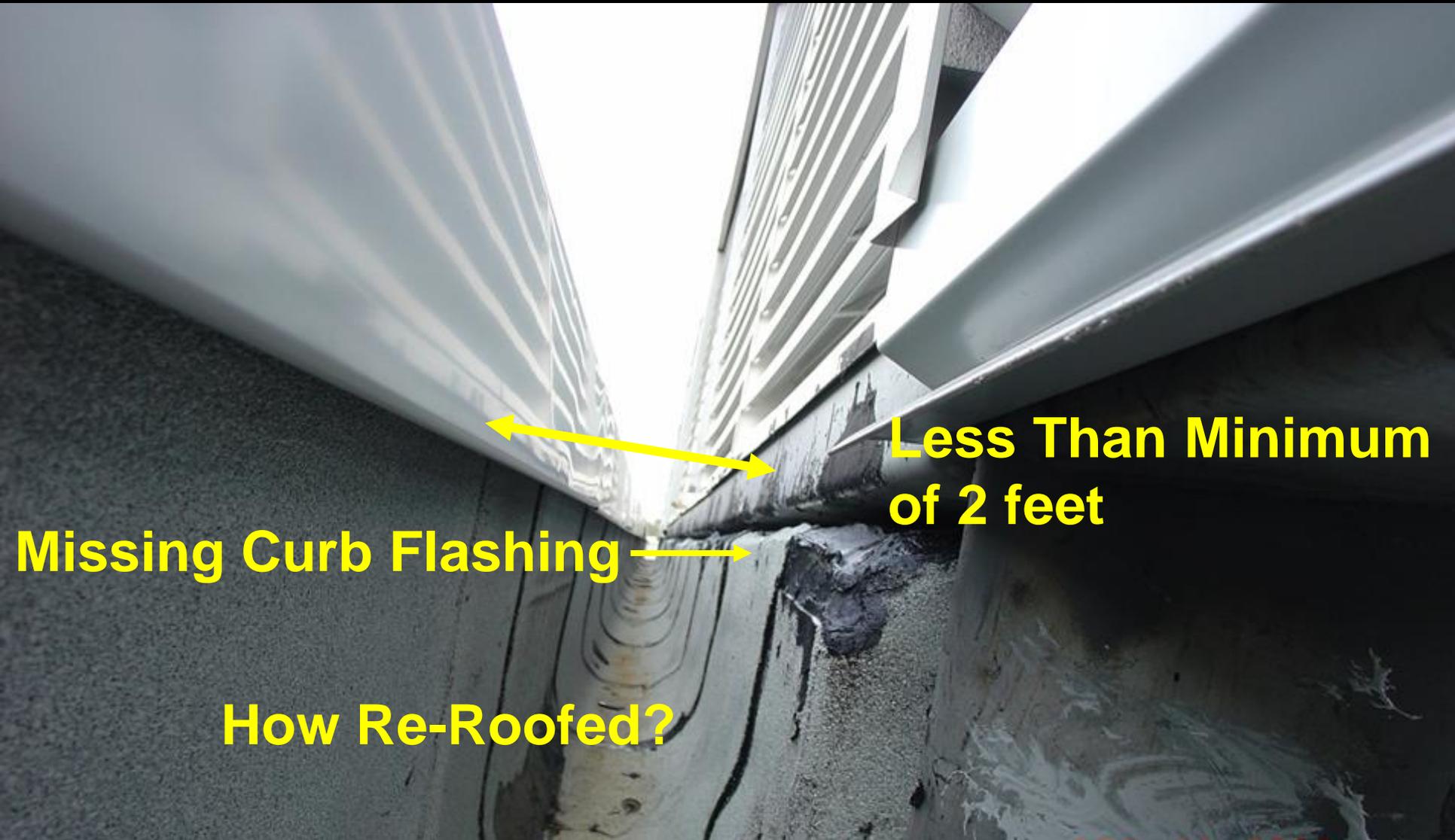


2 piece flashing?

Less than recommended minimum clearance?

BASIC CRITERIA

Construction Detail - Separation

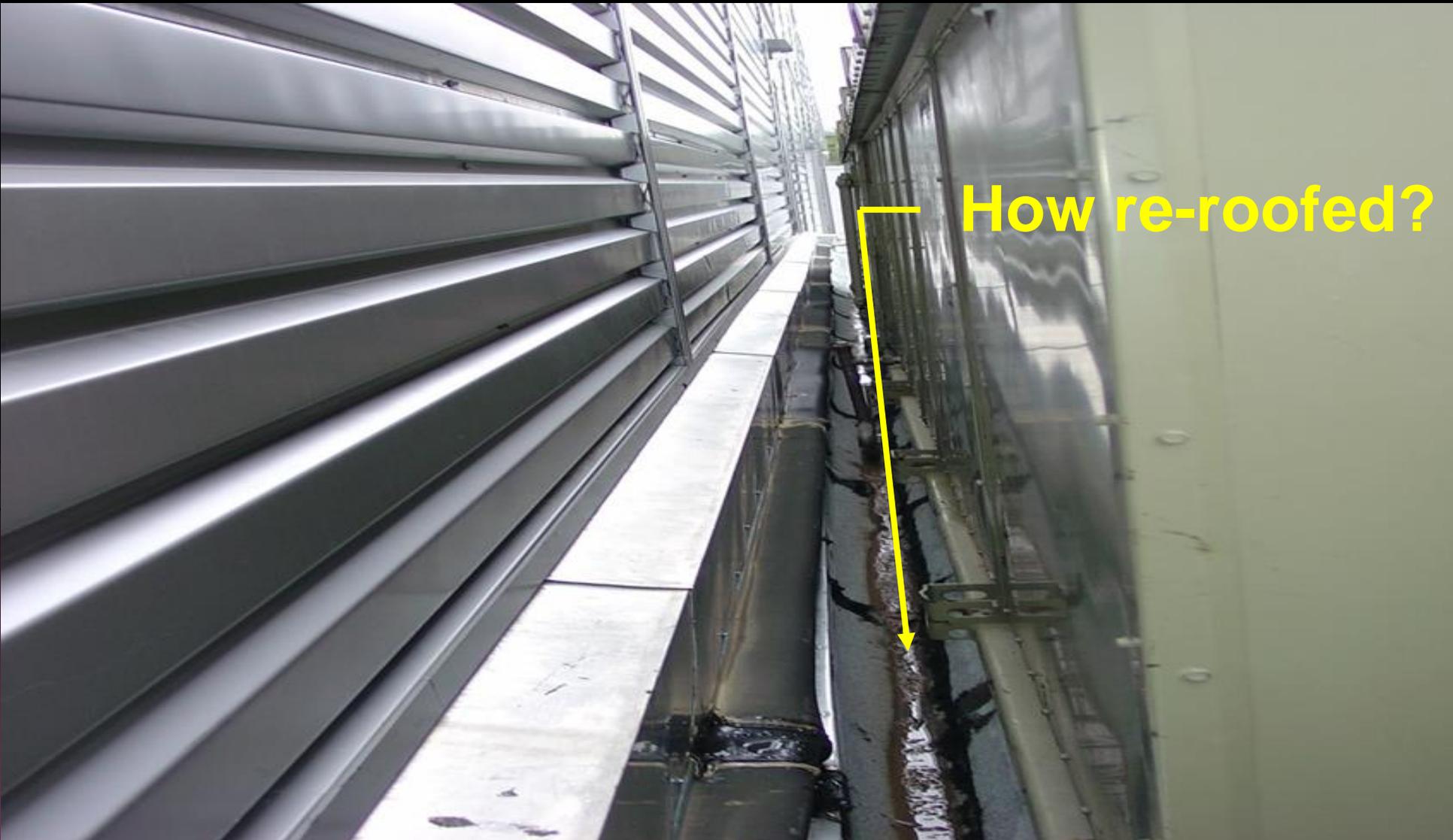


Less Than Minimum
of 2 feet

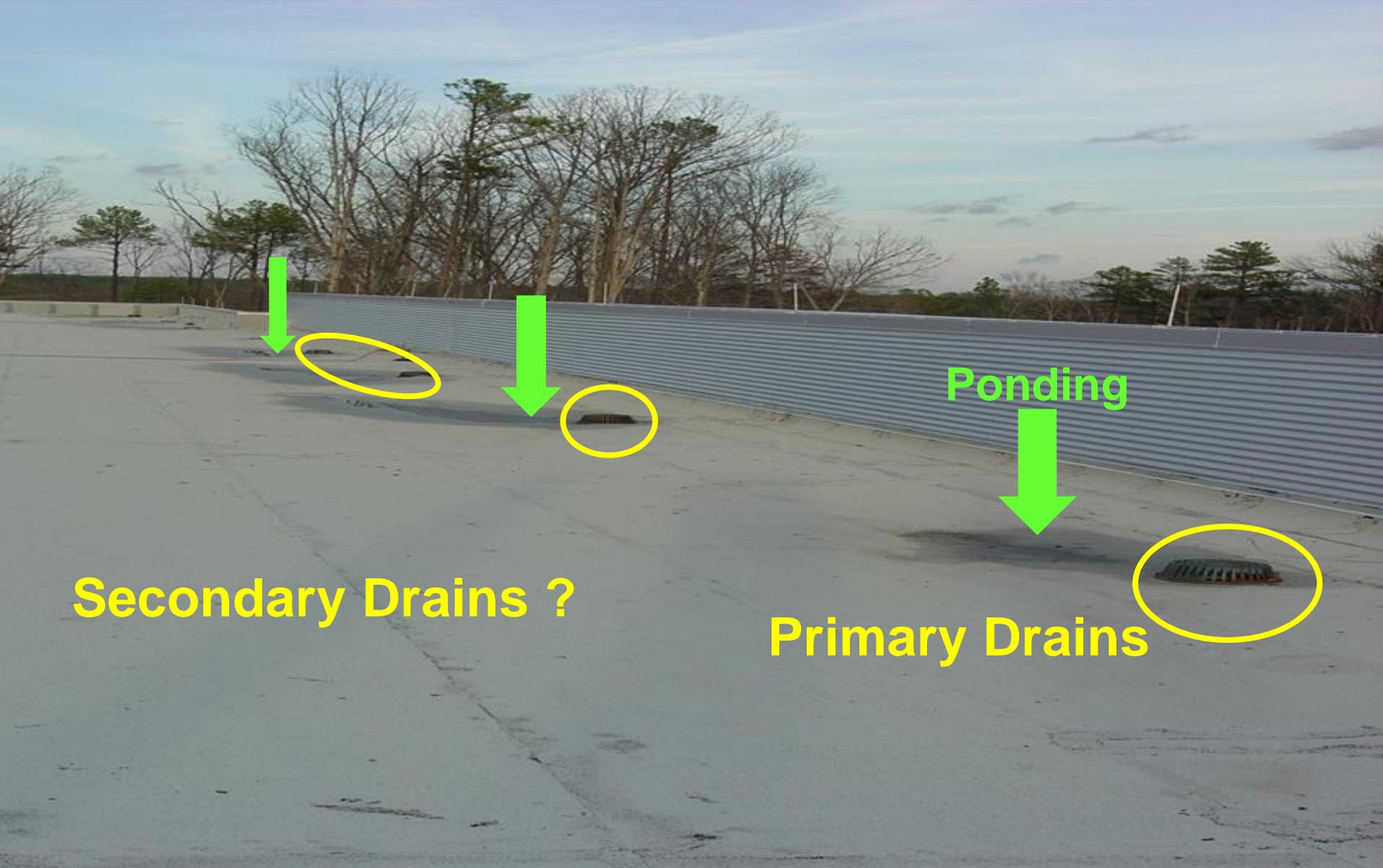
Missing Curb Flashing

How Re-Roofed?

BASIC CRITERIA Construction Detail - Separation



BASIC CRITERIA – Drainage



Secondary Drains ?

Primary Drains

Ponding

BASIC CRITERIA – Drainage



Roof Drain
Secondary Drains ?

BASIC CRITERIA – Drainage



BASIC CRITERIA – Drainage



BASIC CRITERIA – Addons - Turbine



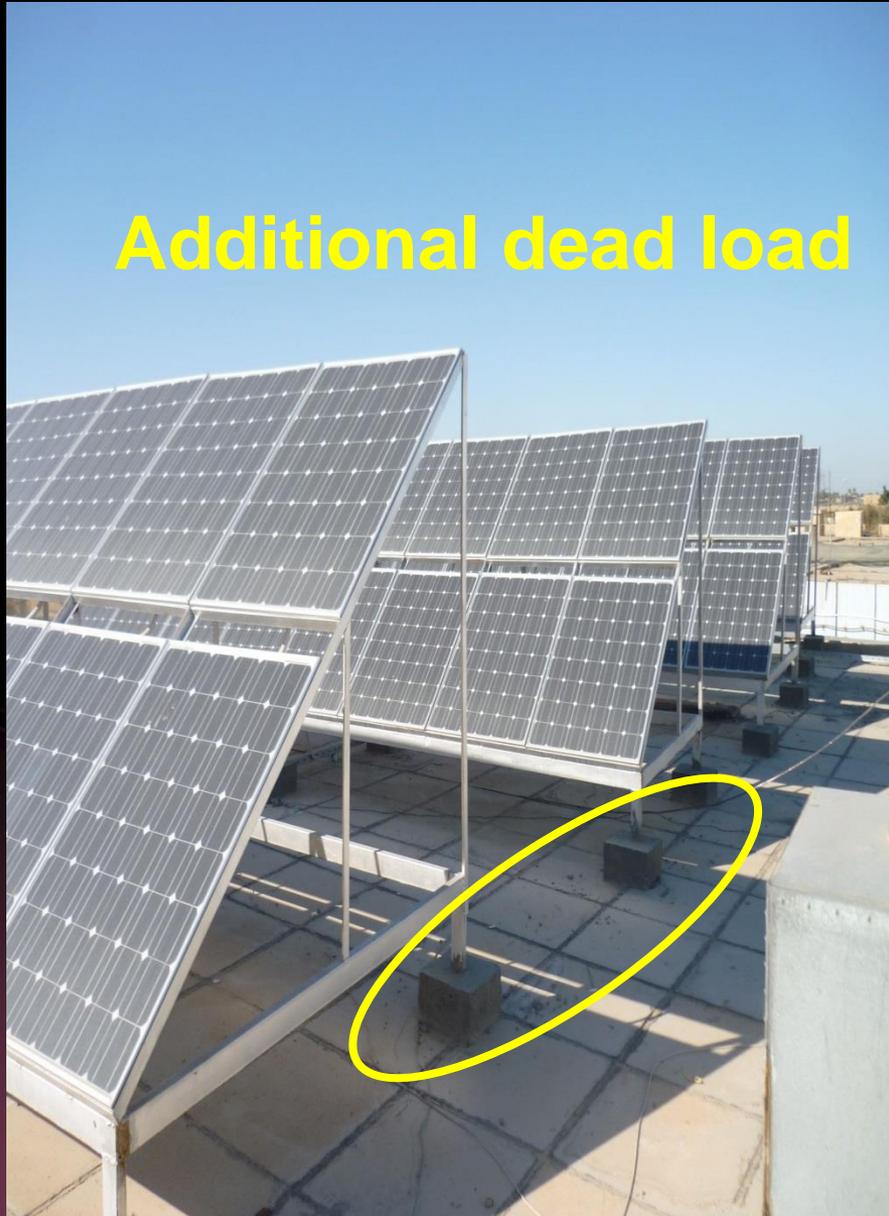
BASIC CRITERIA – Addons - Cell Phone



BASIC CRITERIA – Addons - Camera



BASIC CRITERIA – Addons - Solar/PV Penal



BASIC CRITERIA – Addons - Flag Pole



BASIC CRITERIA – Addons

Satellite Dish



Weather Station



BASIC CRITERIA – Addons - Lightning



BASIC CRITERIA – Addons - Heli-Pad



**Roofing Criteria
& Problems**
Low Slope Membrane Roofs

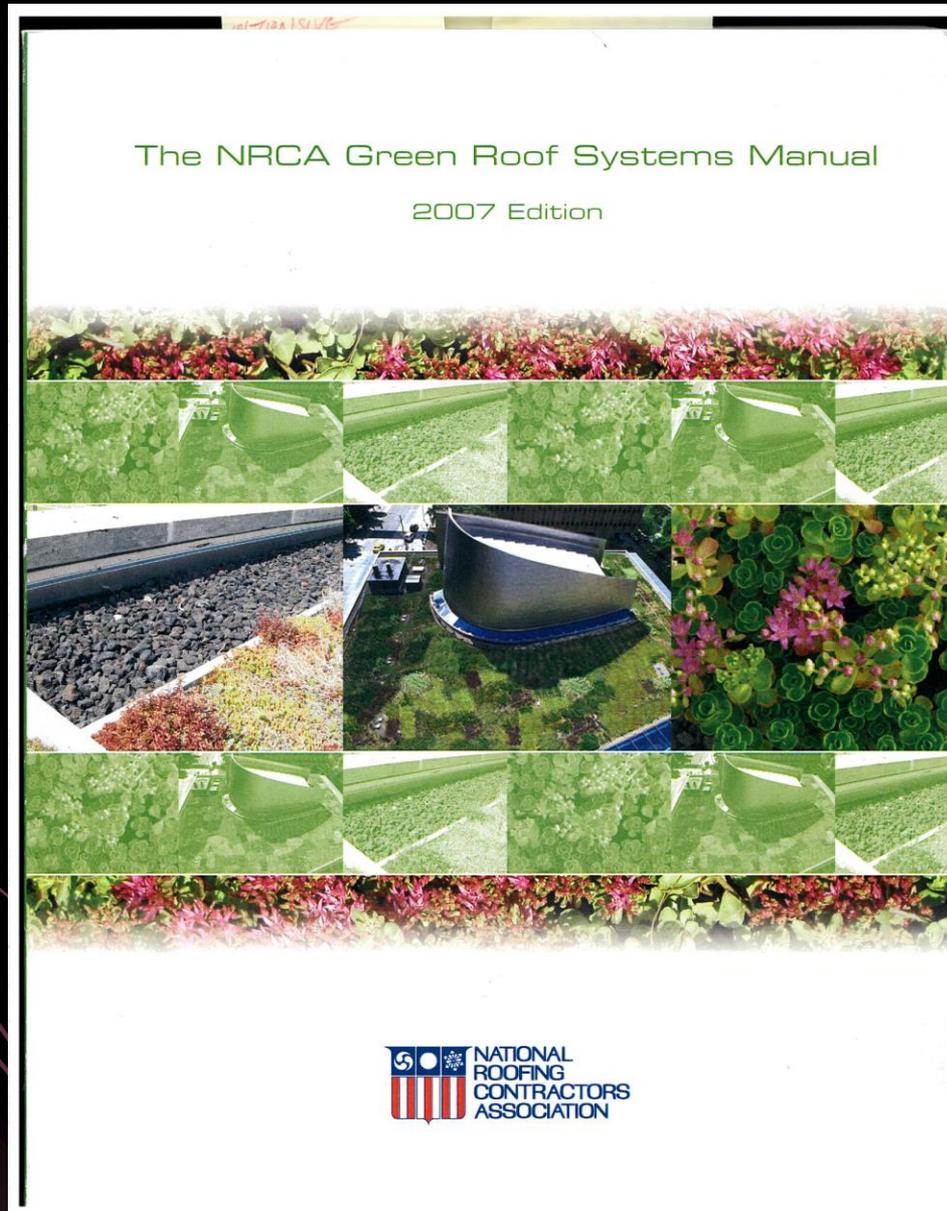
GREEN ROOF
or
VEGETATED ROOF

GREEN ROOF or VEGETATED ROOF



I'm not a lawn
mower !

GREEN ROOF or VEGETATED ROOF



GREEN ROOF or VEGETATED ROOF

Three (3) categories of Green Roof:

- ❑ **Extensive (shallow): 2 to 6 inches deep**
- ❑ **Semi-Intensive (moderate depth): 6 to 10 inches deep**
- ❑ **Intensive (deep): greater than 10 inches deep**

GREEN ROOF or VEGETATED ROOF

- ❑ Care in preventing damage to green roof from tools during installation and maintenance
- ❑ Fully adhered waterproof membrane and protected from UV light
- ❑ High density & compressive strength layer of insulation and moisture resistance
- ❑ Source of water supply
- ❑ Indigenous plant materials
- ❑ Root barrier
- ❑ Single Source for Green Roof

GREEN ROOF or VEGETATED ROOF

Flood test for 48 hours

**Alternate test method:
EFVM – Electric Field Vector Mapping**

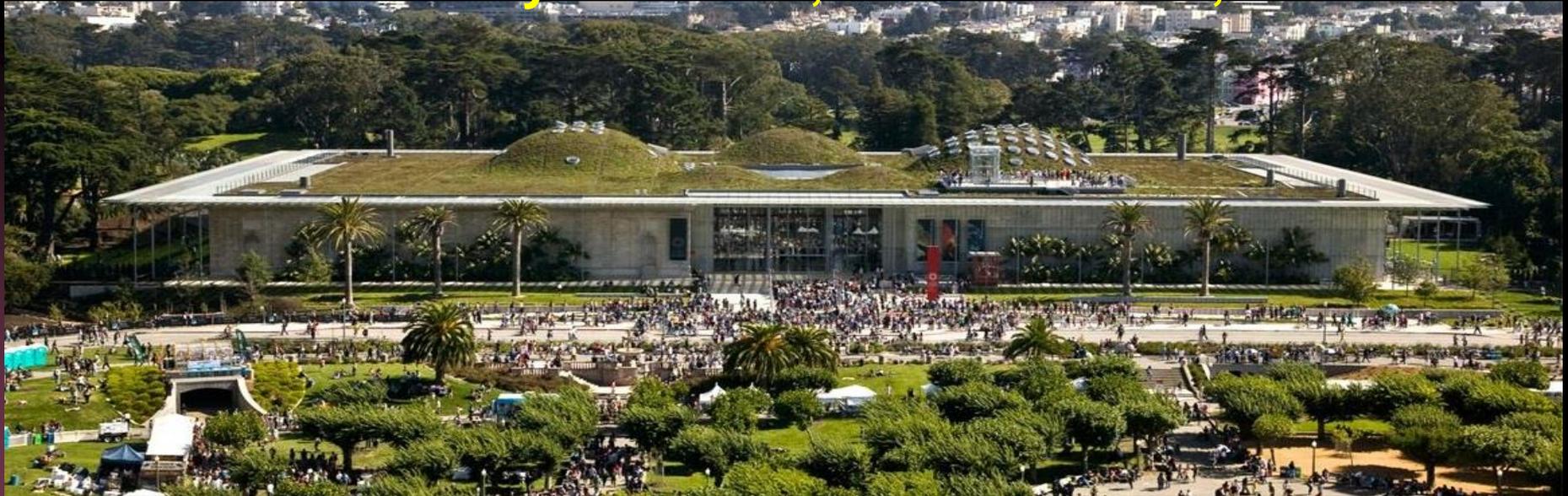
Slope



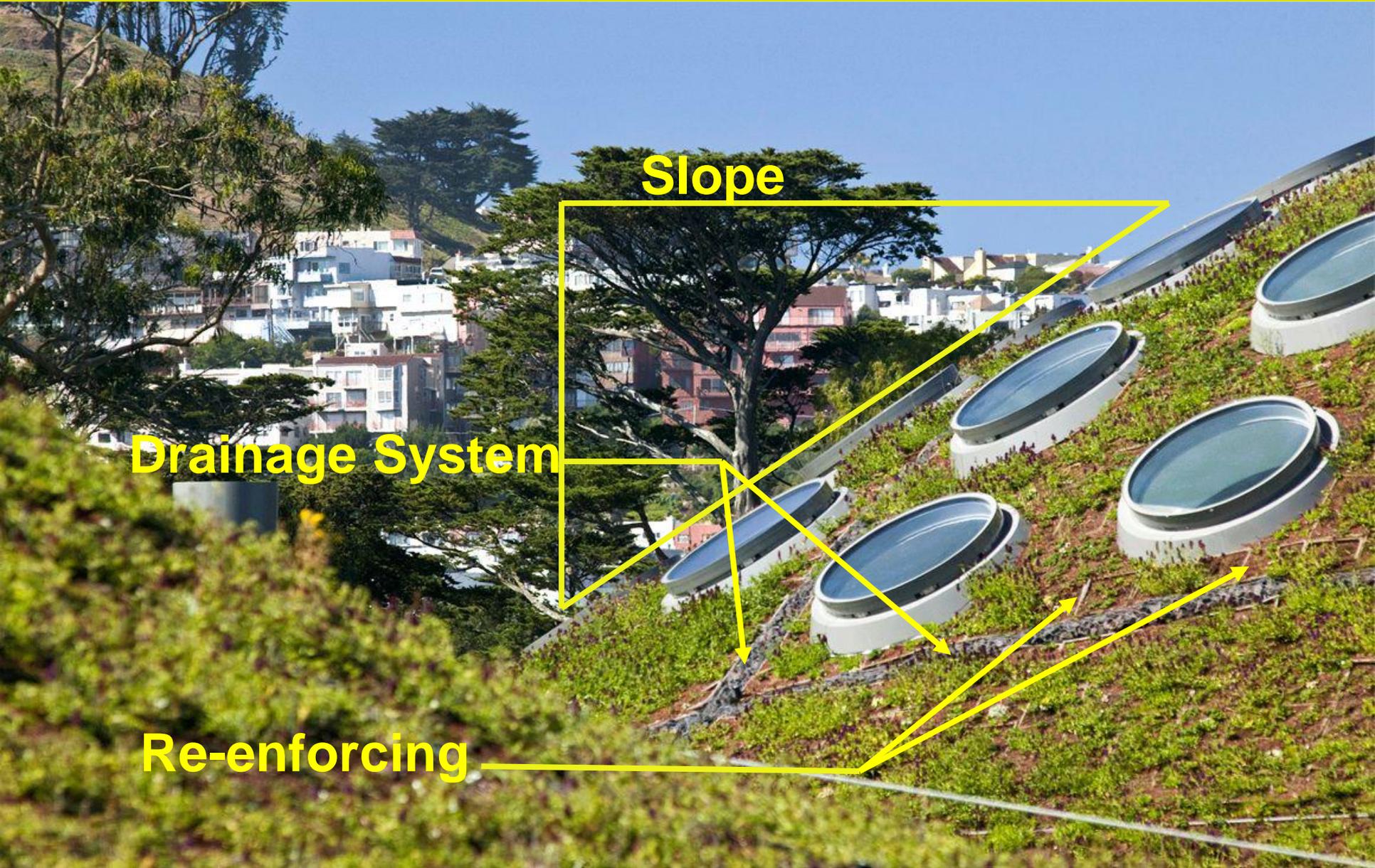
GREEN ROOF or VEGETATED ROOF Law Courts, Vancouver, BC.



Calif Academy of Scienc, San Francisco, Ca.



GREEN ROOF or VEGETATED ROOF



Slope

Drainage System

Re-enforcing

Roofing Criteria & Problems

Low Slope Membrane Roofs

ROOF INSPECTION

ROOF INSPECTION

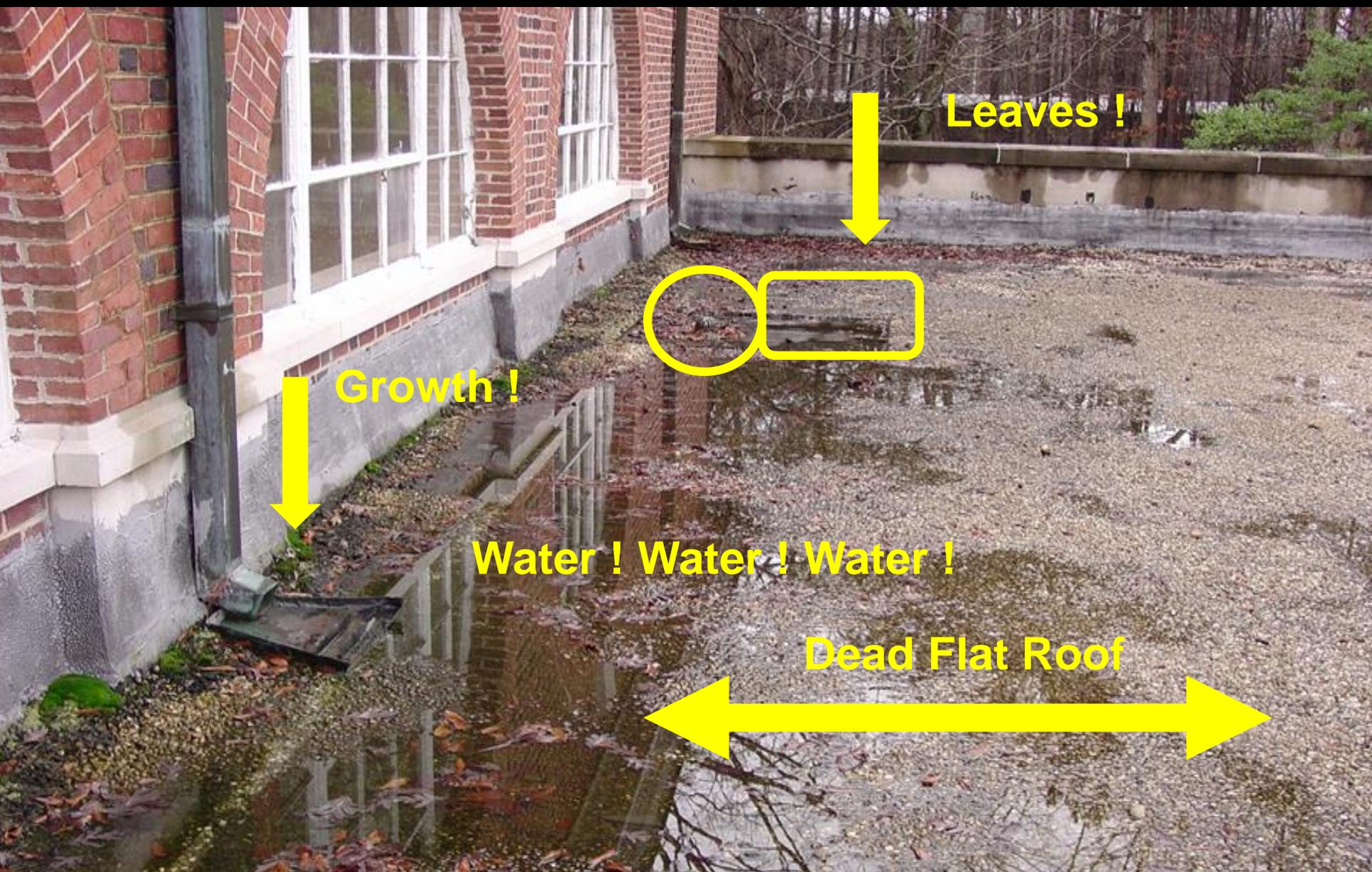
EVERY 6 MONTHS – Spring and Fall

ADVERSE WEATHER – Storm, rain, snow, hail

RECORD KEEPING– Inspection dates, maintenance schedule, note repairs and alterations and the party responsible

Candidate for a New Roof!

ROOF INSPECTION – Roof Slope



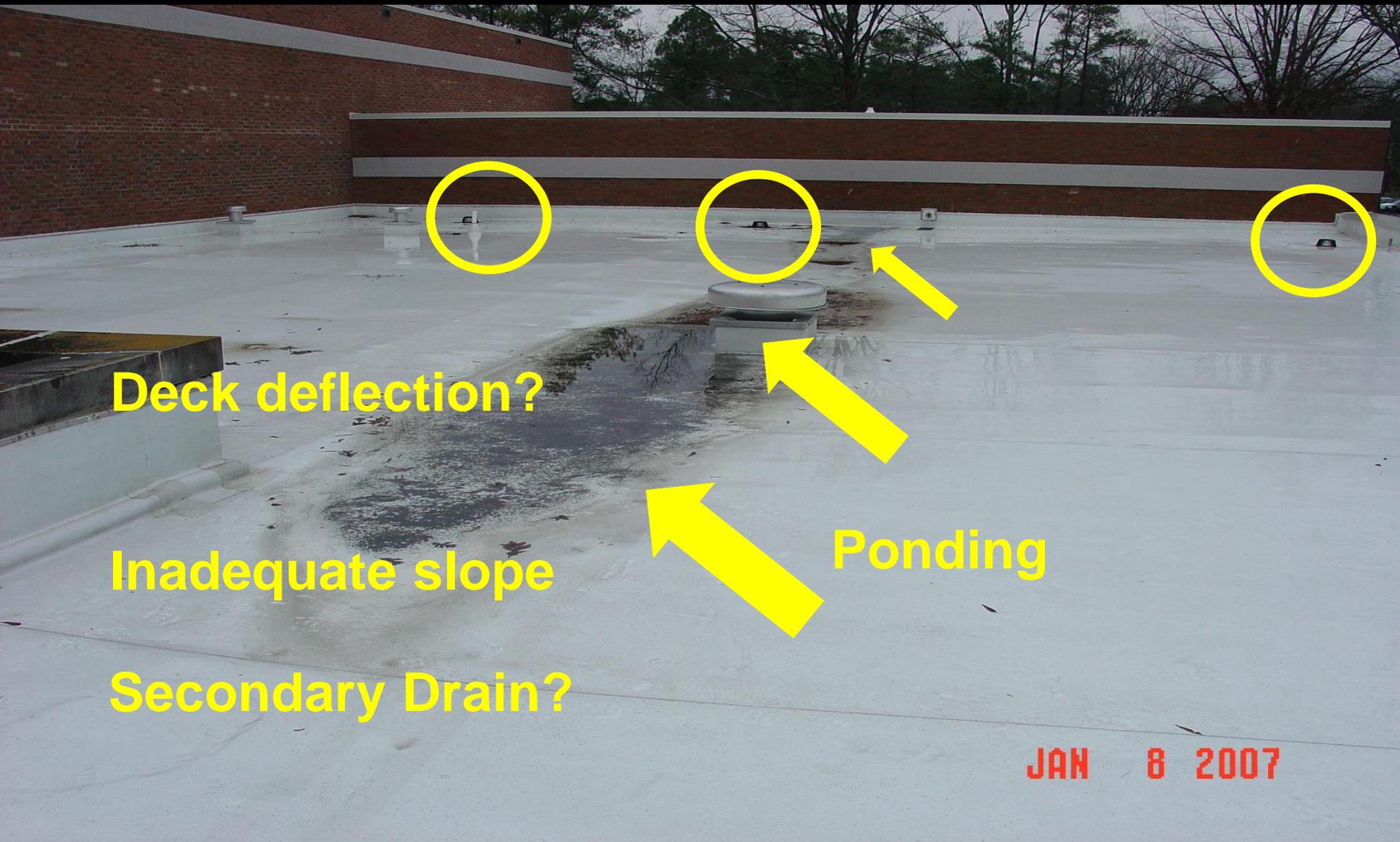
Leaves !

Growth !

Water ! Water ! Water !

Dead Flat Roof

ROOF INSPECTION – Roof Drain



Deck deflection?

Inadequate slope

Secondary Drain?

Ponding

JAN 8 2007

ROOF INSPECTION – Roof Drain

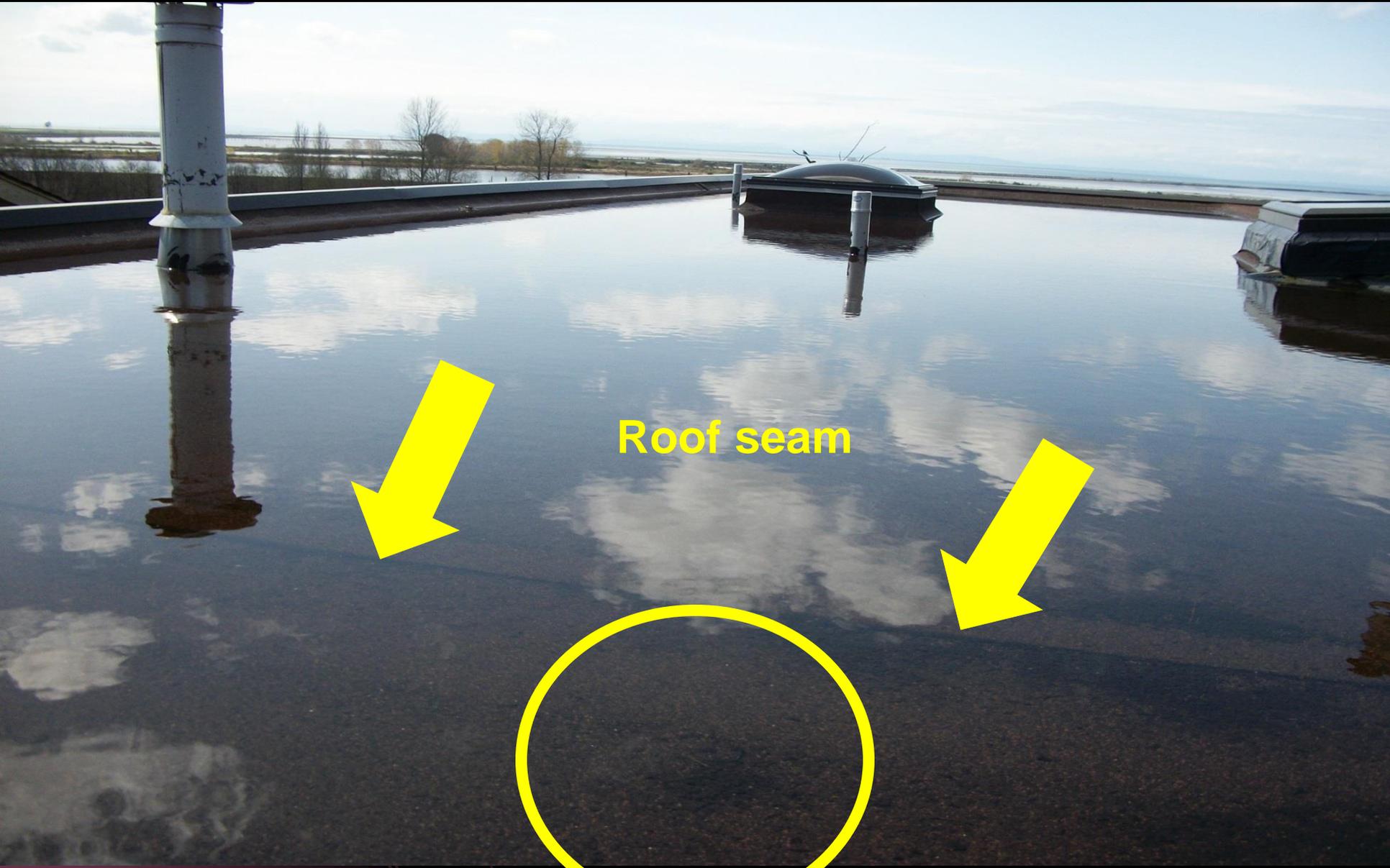


ROOF DRAINAGE - Scupper



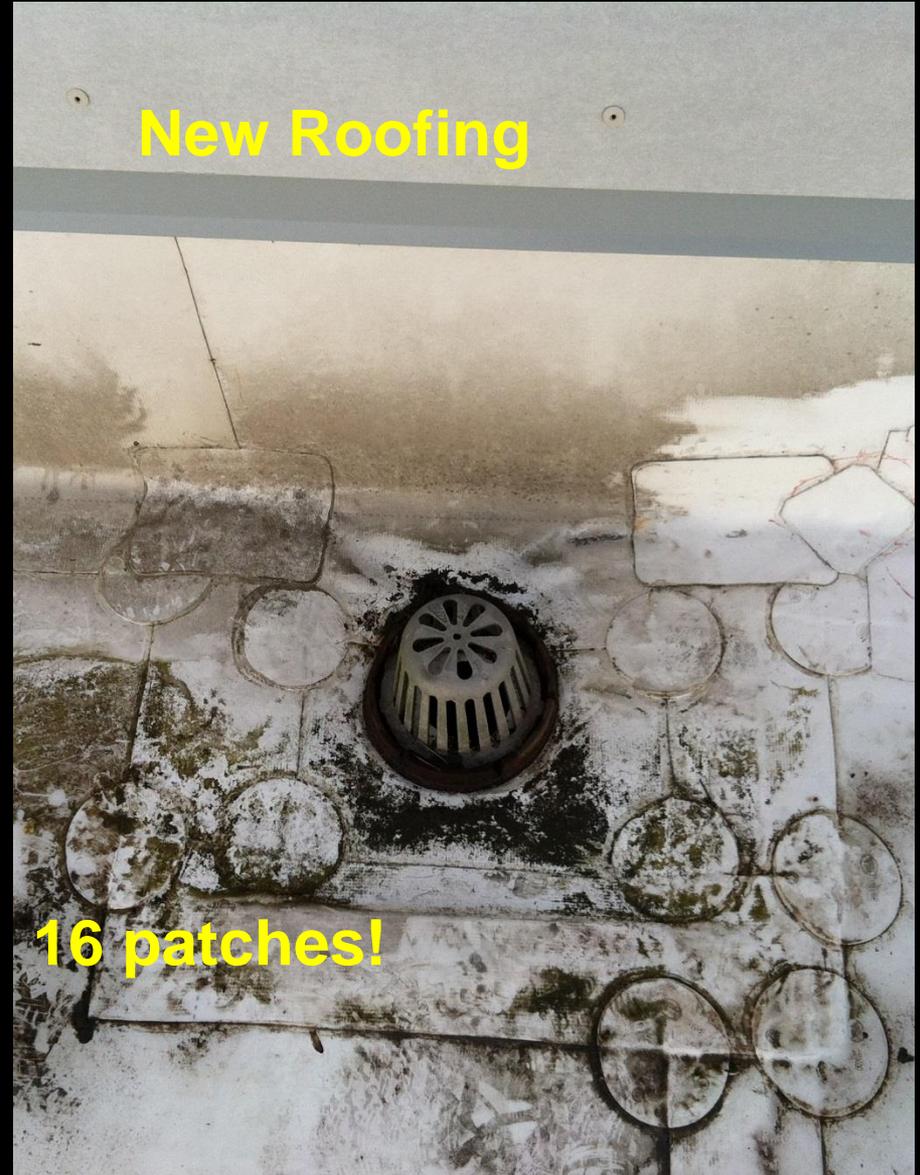
Leaves !

ROOF INSPECTION – Roof Drain? Plugged?



Roof seam

ROOF INSPECTION



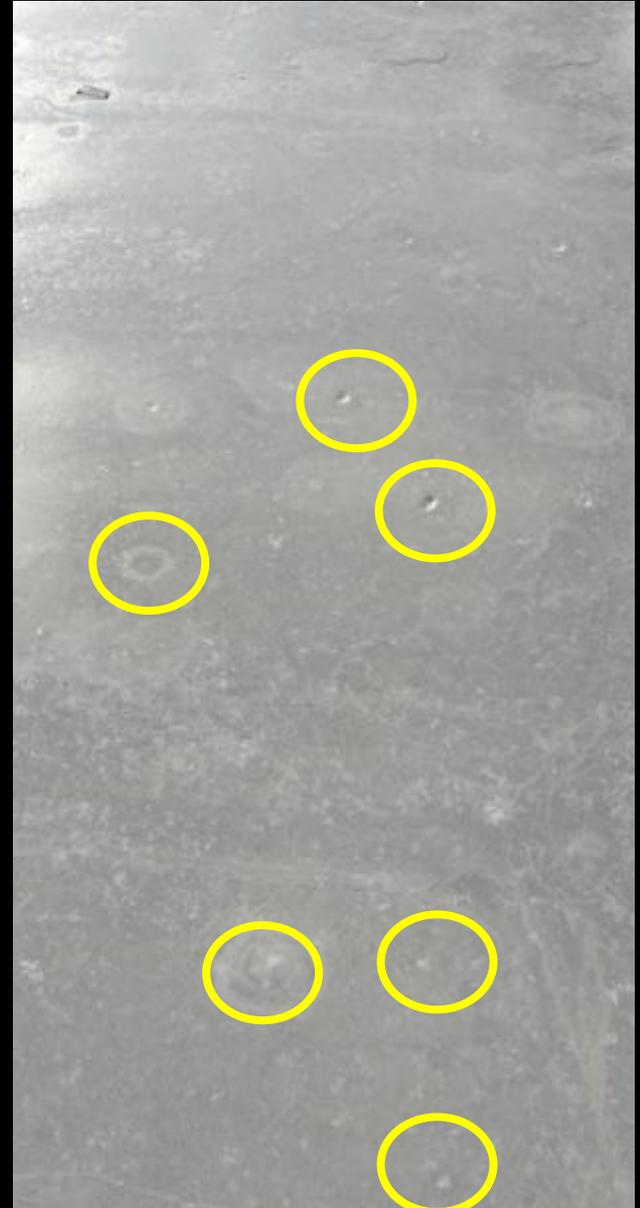
ROOF INSPECTION – Need New Roof?



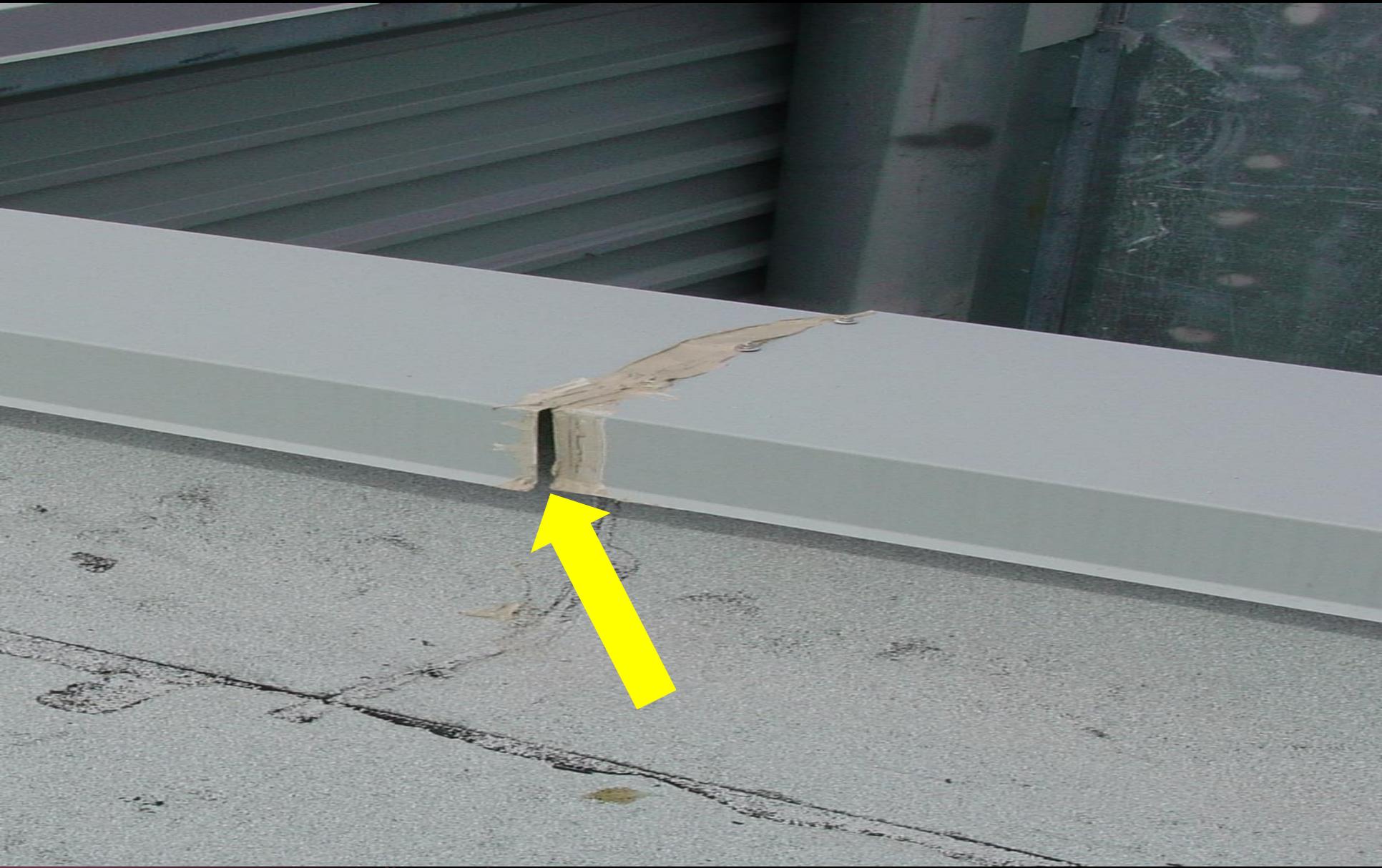
ROOF INSPECTION - Damage



ROOF INSPECTION – Hail



ROOF INSPECTION – Metal Coping



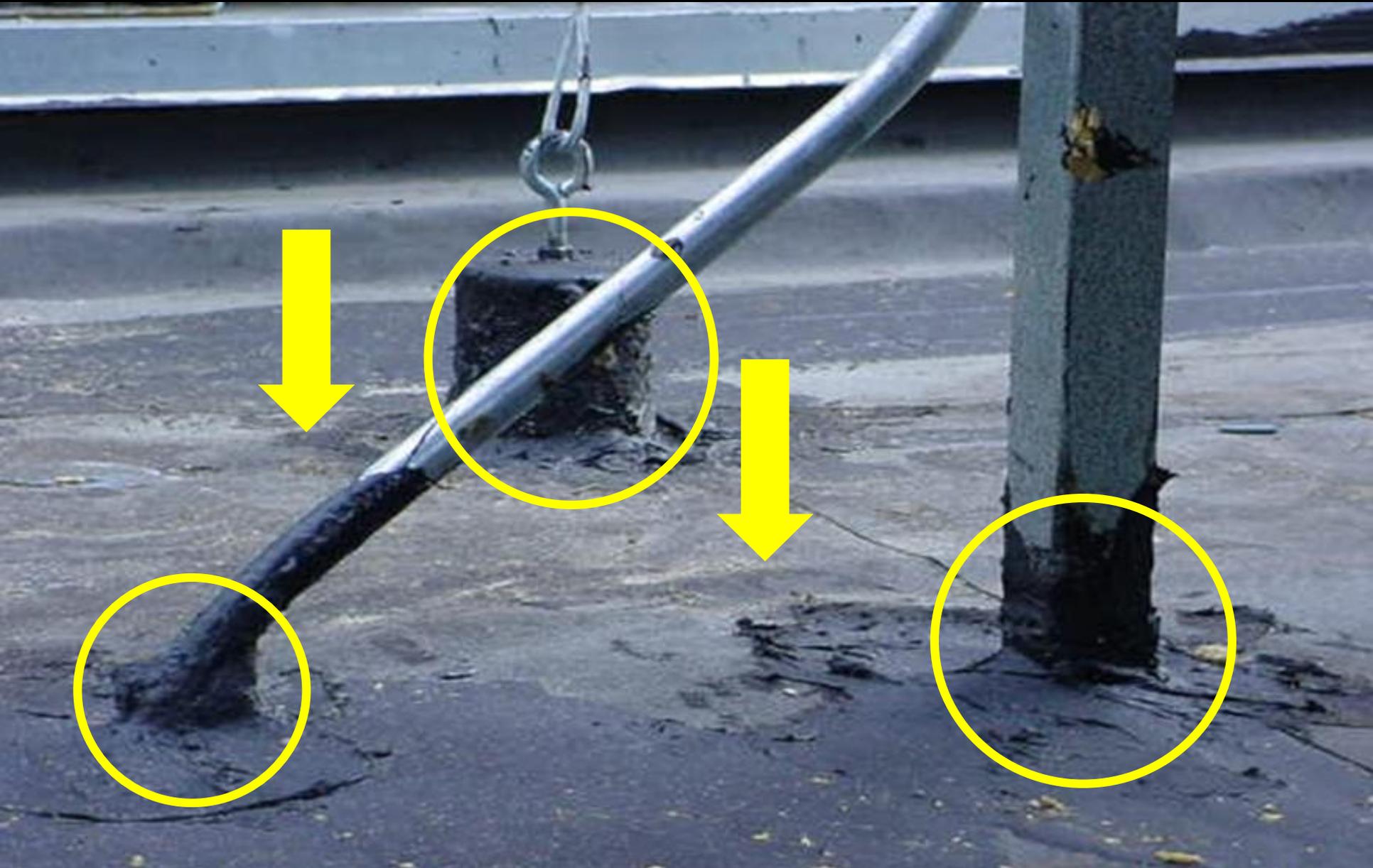
ROOF INSPECTION – Not a Green Roof !



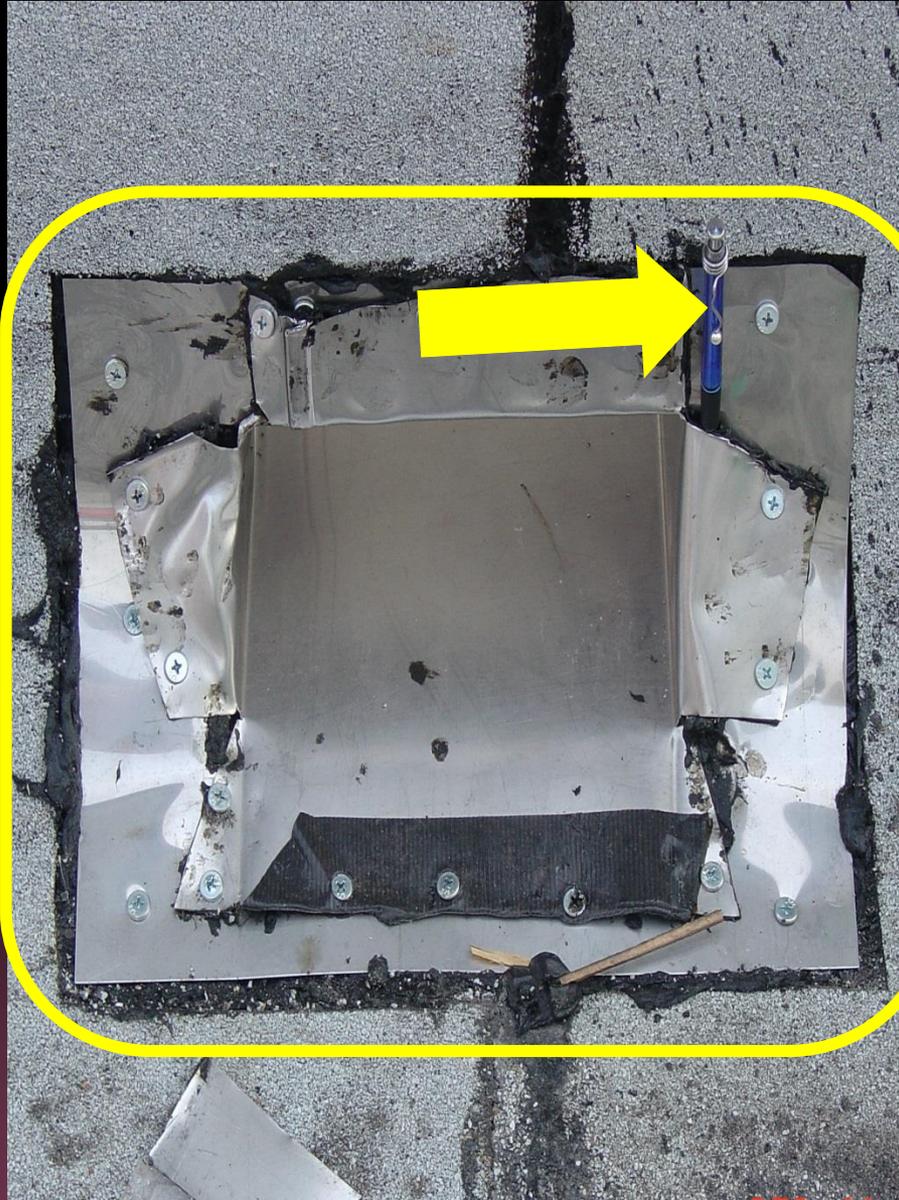
Unwanted growth



ROOF INSPECTION – Roof Penetrations



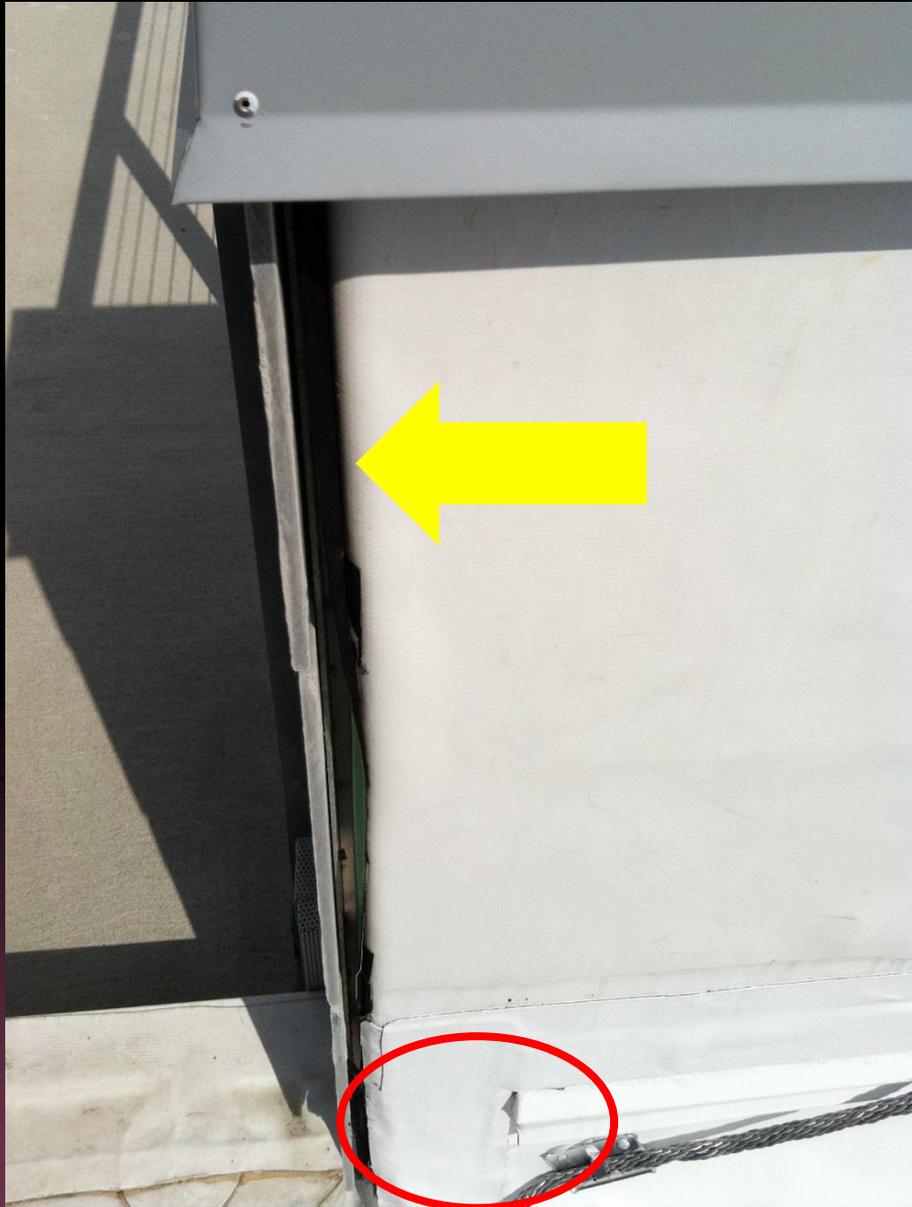
ROOF INSPECTION – Roof Scupper



ROOF INSPECTION – Flashing



ROOF INSPECTION – End Wall



ROOF INSPECTION – Ballasted Roof

**Ballast shifted!
Exposed membrane to UV Light**

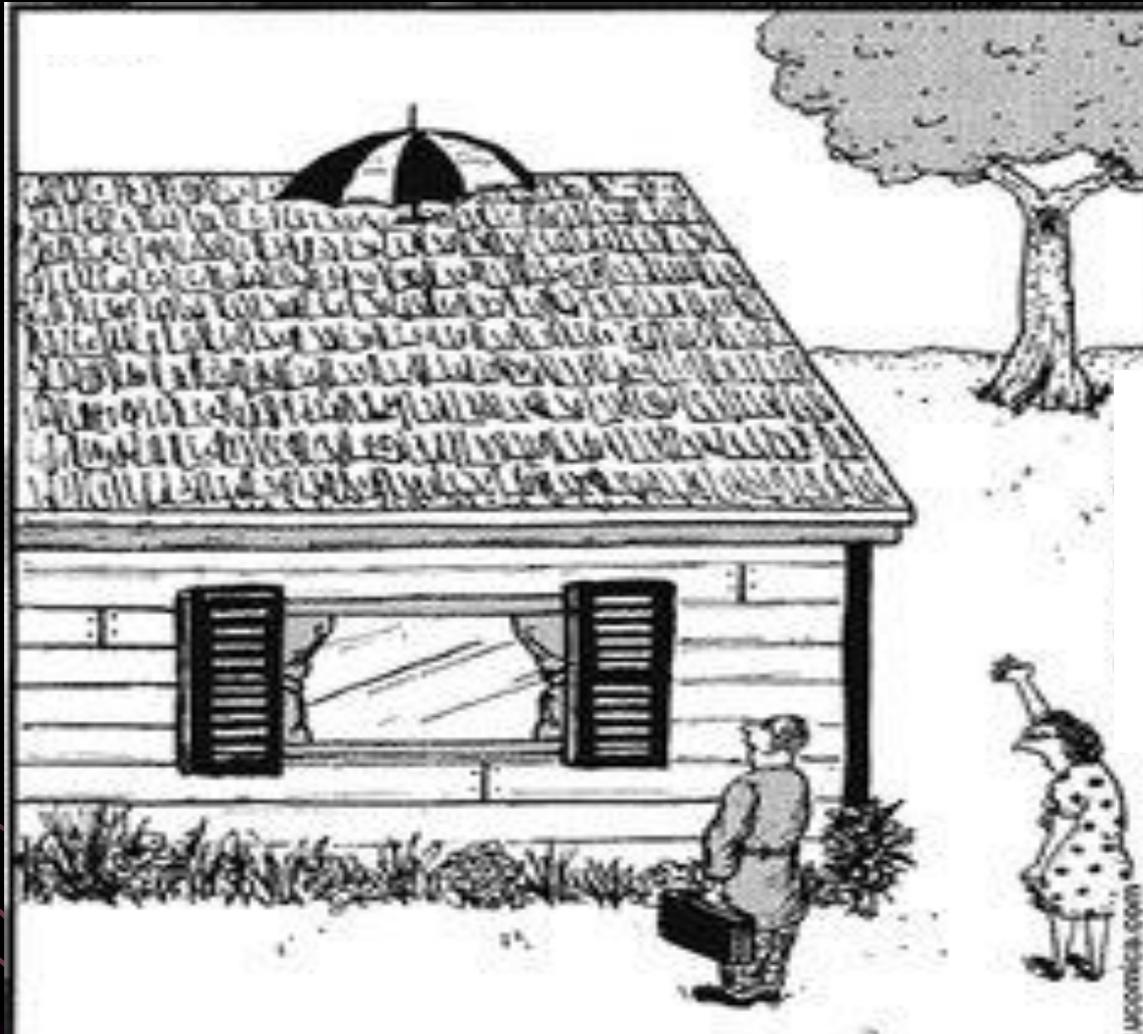


ROOF INSPECTION – Cleaning



Pigeon Droppings!

? Questions ?



"After hounding the contractor for three months to fix the leak in the roof, THIS is what we get?!"



Thank you!

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