



This presentation

- Roofing
 - Low-slope
 - Pitched
 - Membrane, metal, etc.

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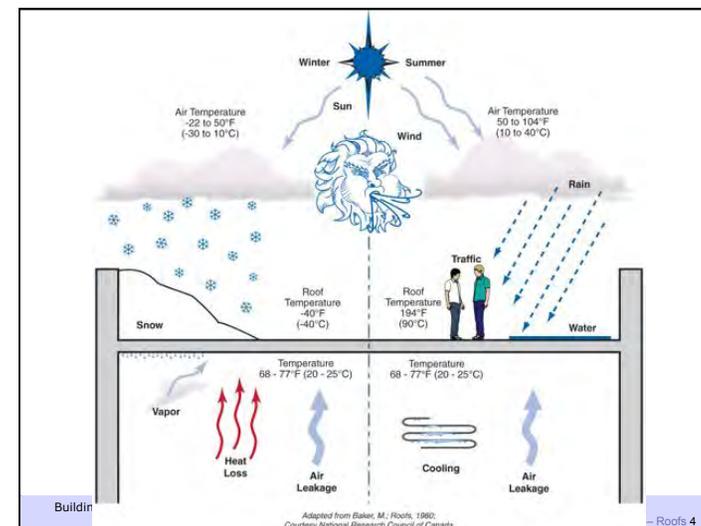
–Roofs 2

Roofs

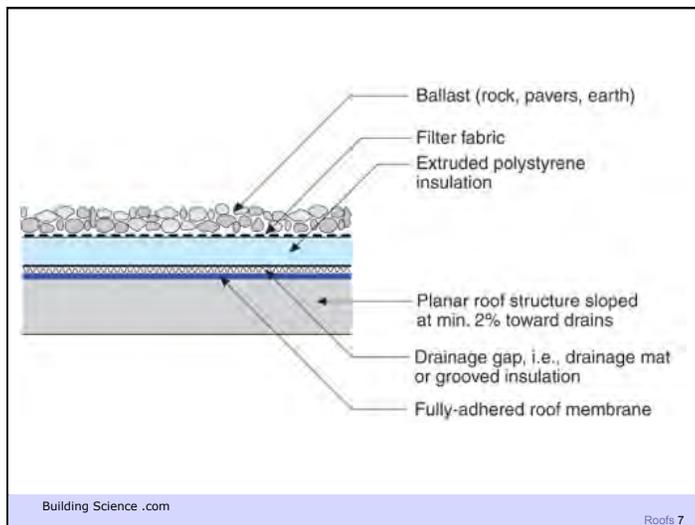
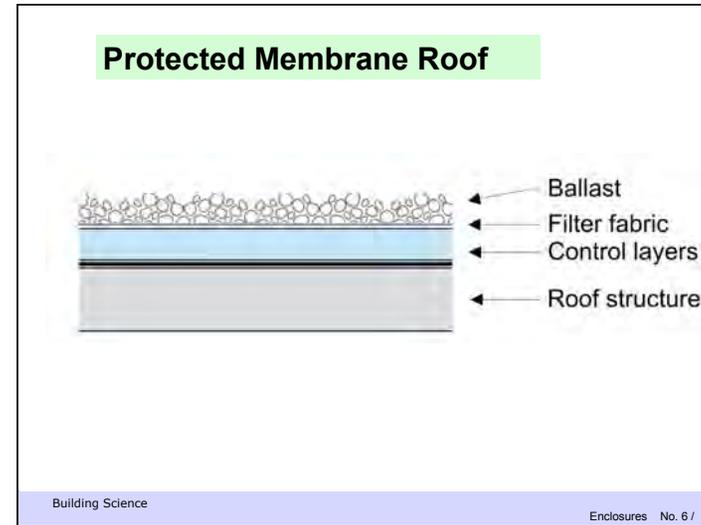
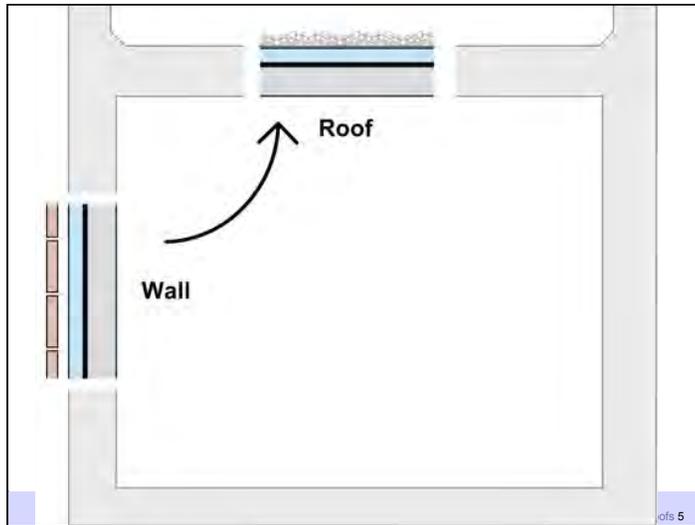
- Roofs are significant proportion of the area of *low-rise* buildings
 - Significant to total cost
 - Major area for heat loss / gain
 - Low-slope membranes usually need replacement every 15-25 yrs.
- Wide range of membrane choices
- Insulation on top *or* bottom of membrane
- Green roofs = organic ballast

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Enclosures No. 3 /



–Roofs 4



Inverted Roof

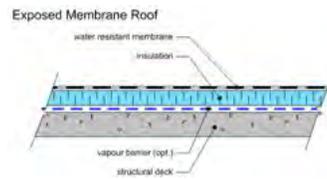
- Pros:
 - Preferred approach
 - Exterior insulation eliminates thermal bridges
 - Protects membrane
- Cons:
 - Added weight of ballast
 - Can only use XPS

Typical Inverted Roof System

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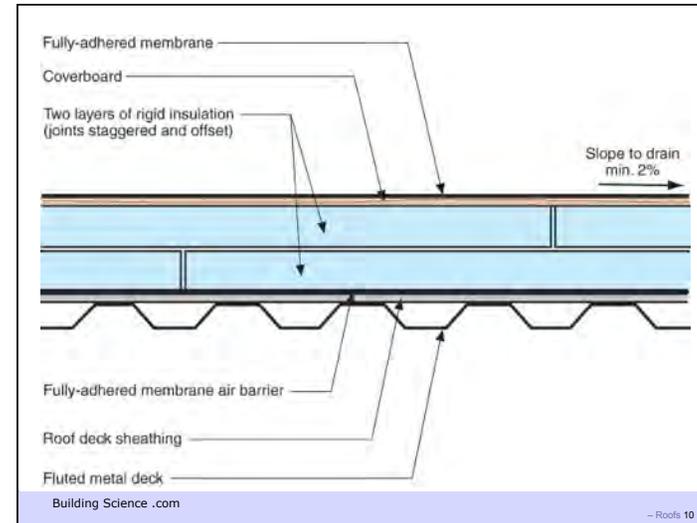
Exposed membranes

- Pros:
 - Lightest weight
 - Wide variety of insulation and membranes
- Cons:
 - Exposed membrane!



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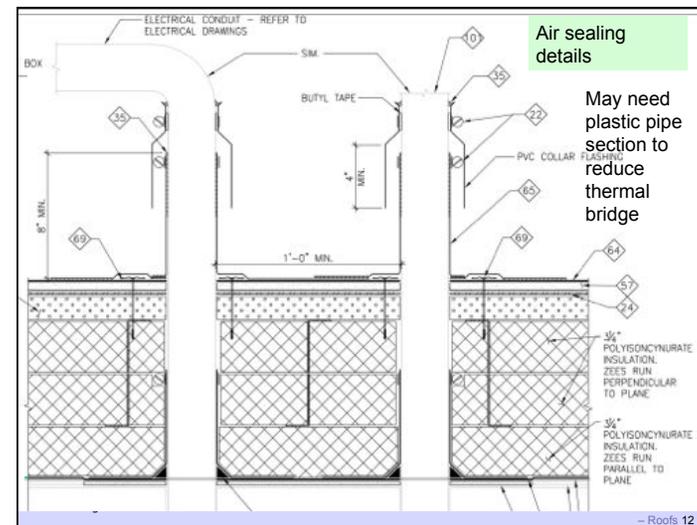


Special Applications

- Swimming pools
 - Esp in cold climates
- Freezer buildings
 - Esp in hot humid climates
- **MUST** have a deck level air barrier
 - Sealed at all edges, penetrations!

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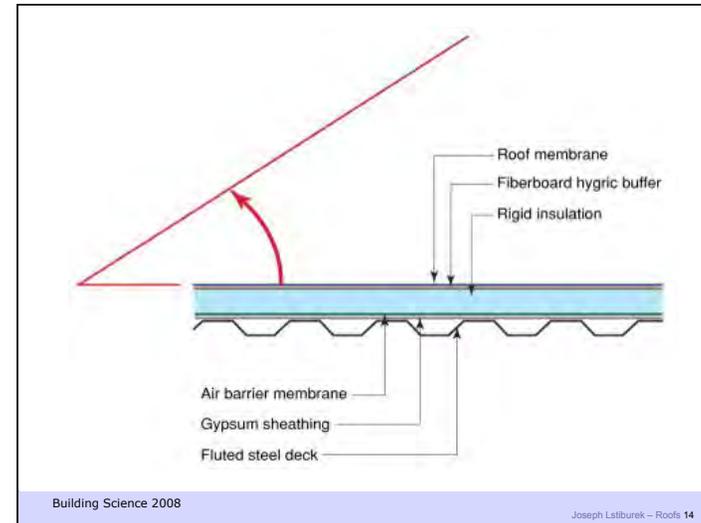
– Roofs 12

Sloped roofs

- Basic Physics are the same
- Slopes allows non-waterproof materials to be lapped “shingle fashion”
- Air leaky roofs require more ventilation

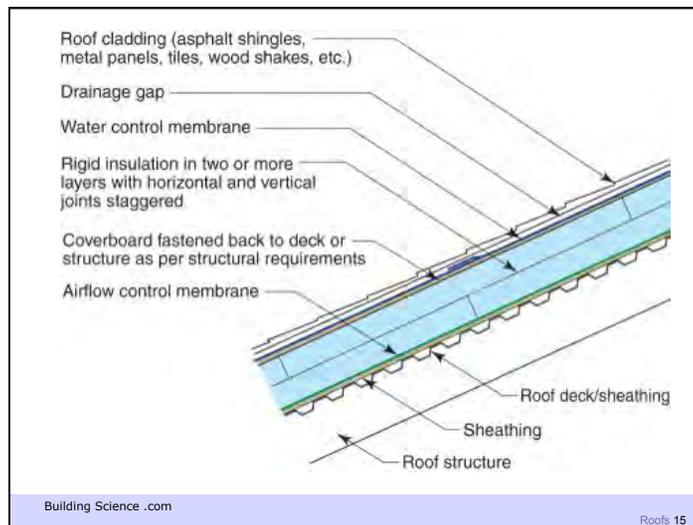
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– Roofs 13



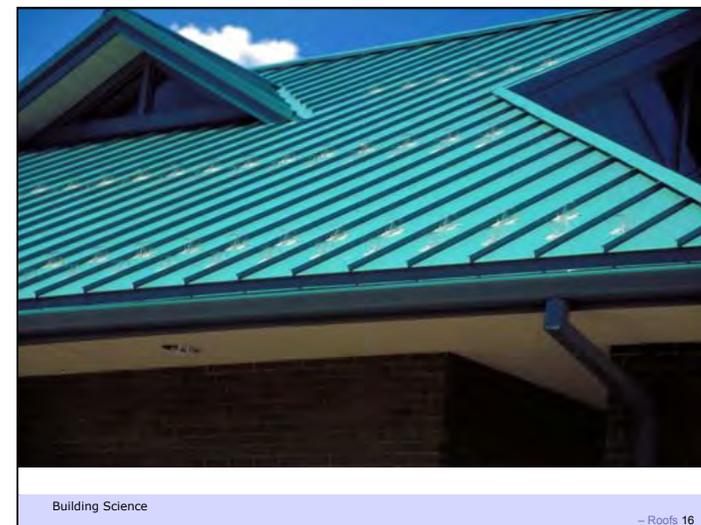
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Joseph Lstiburek – Roofs 14



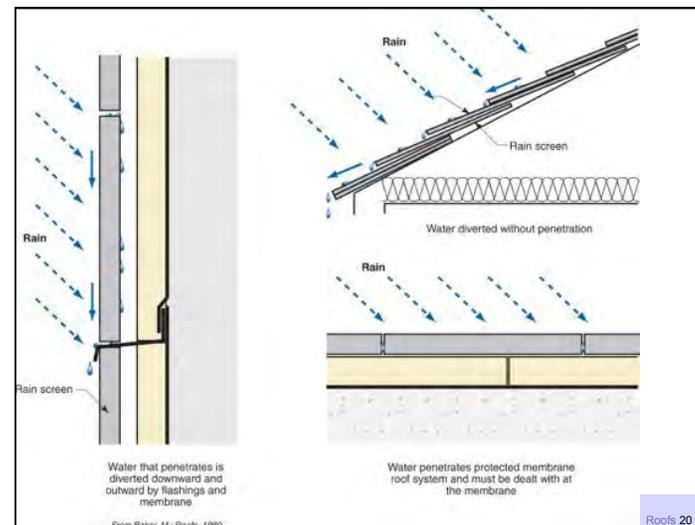
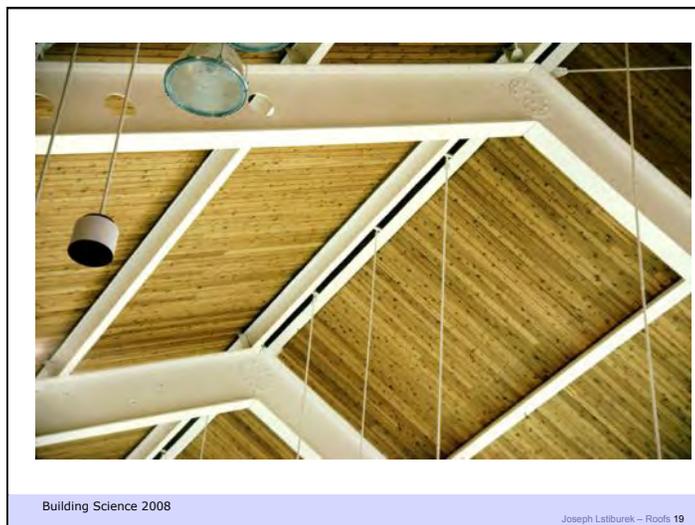
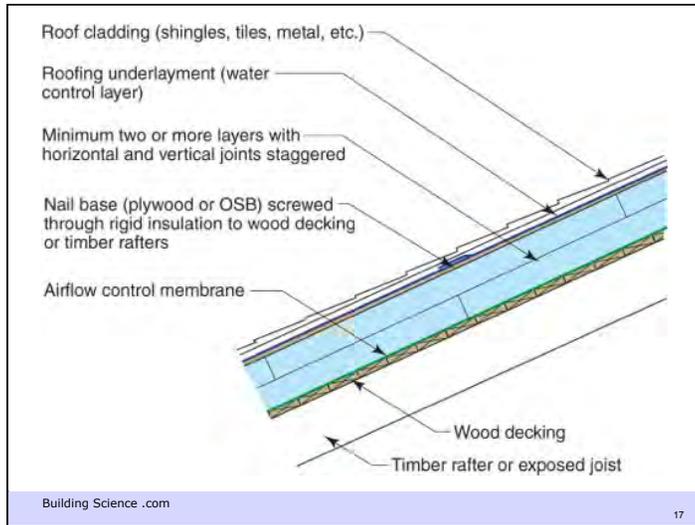
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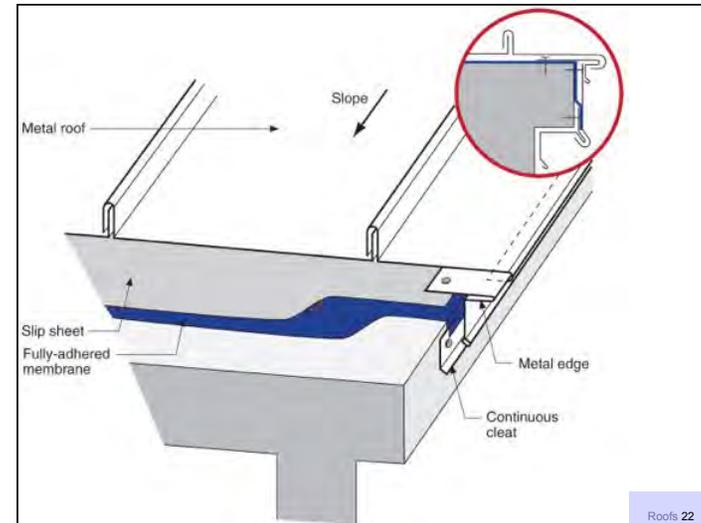
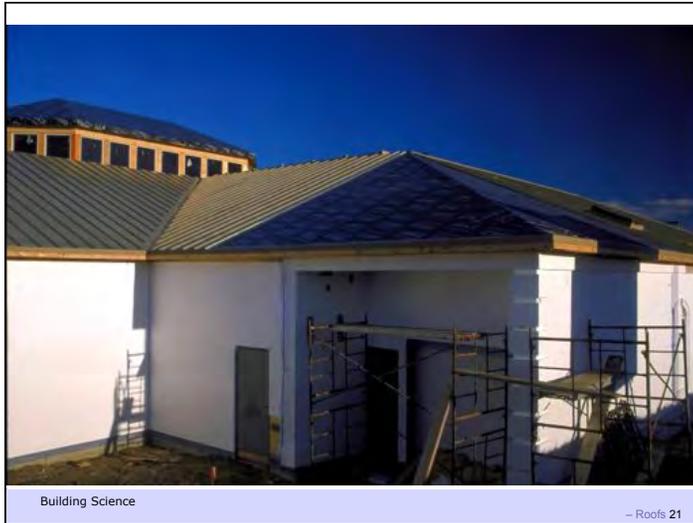
Roofs 15

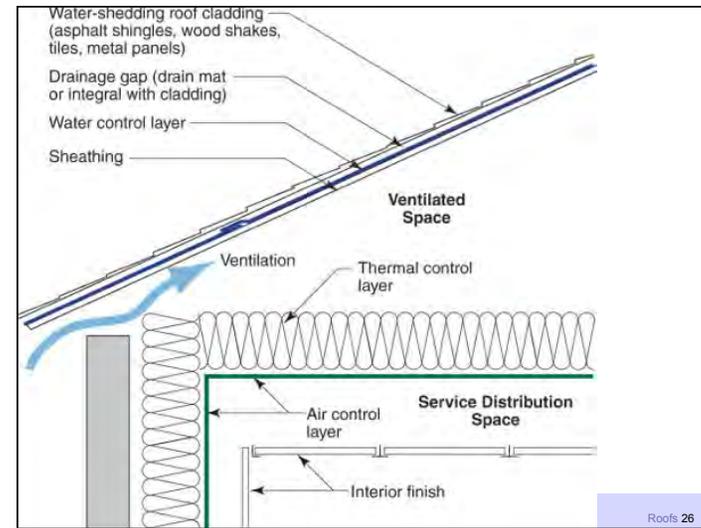


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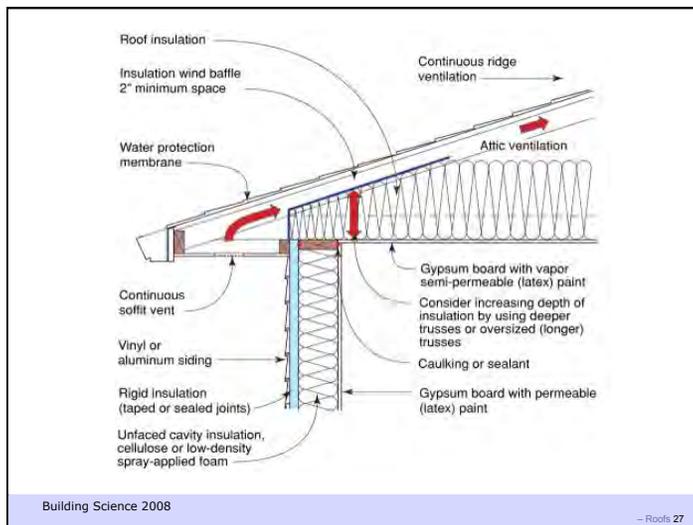
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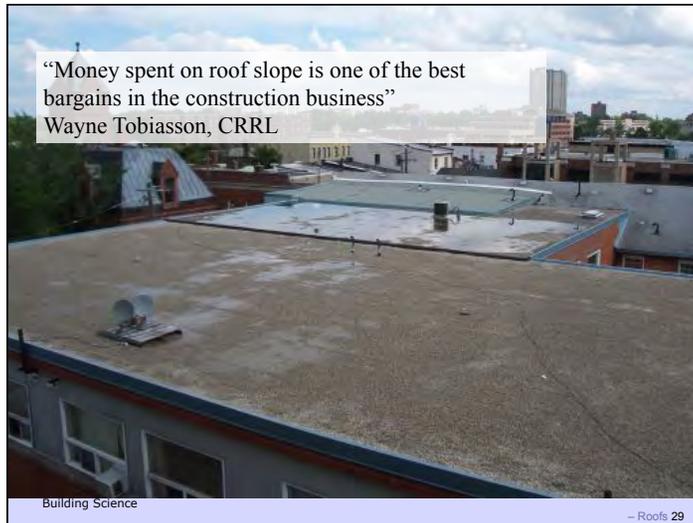
Roofs 26



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- Roofs 27





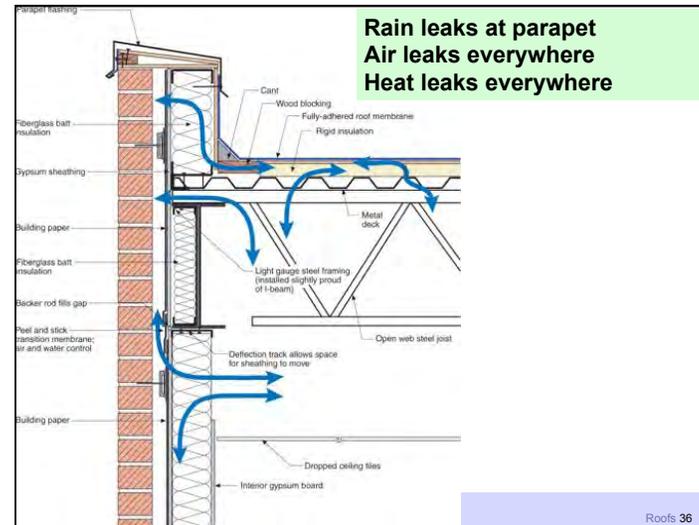
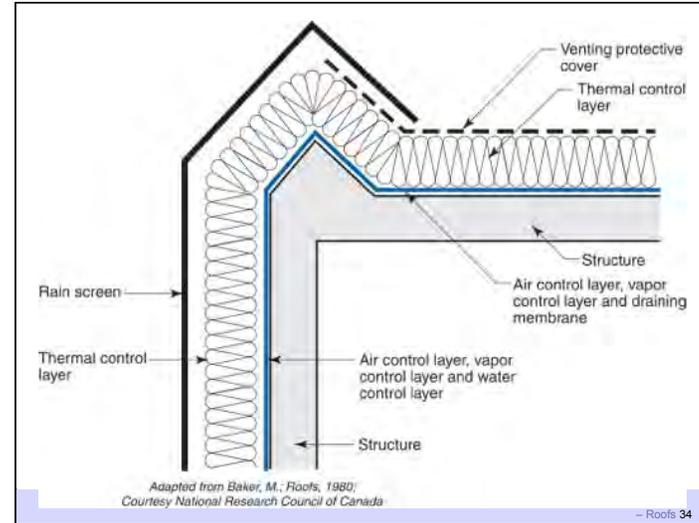
Slope

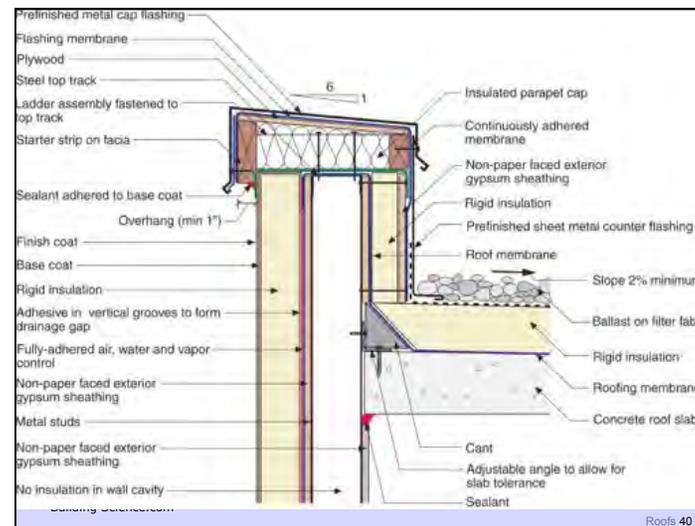
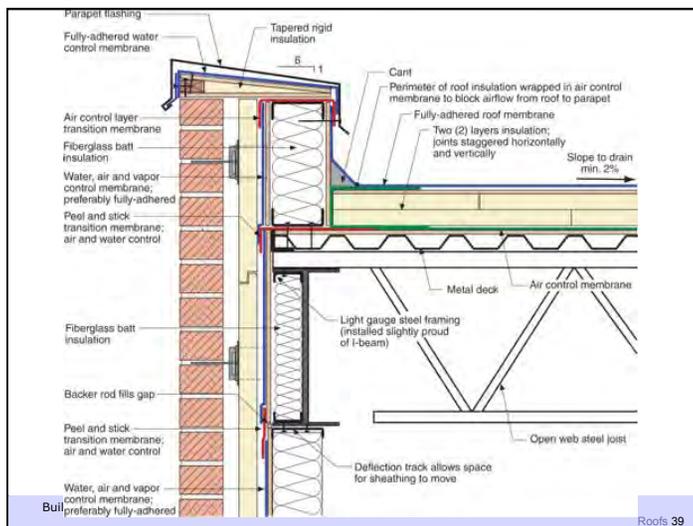
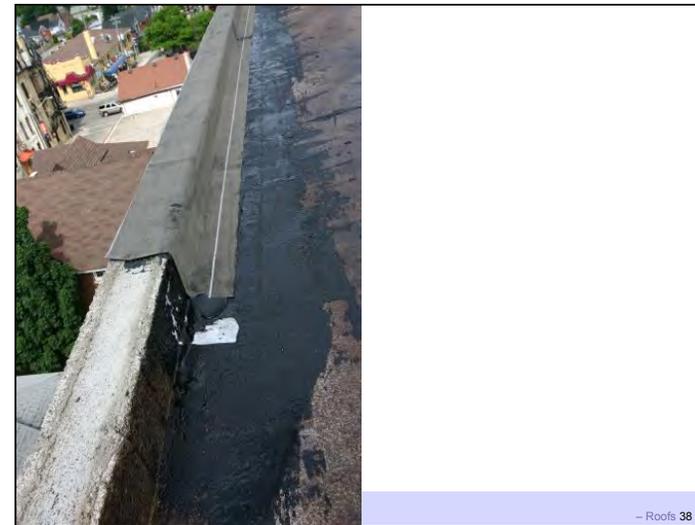
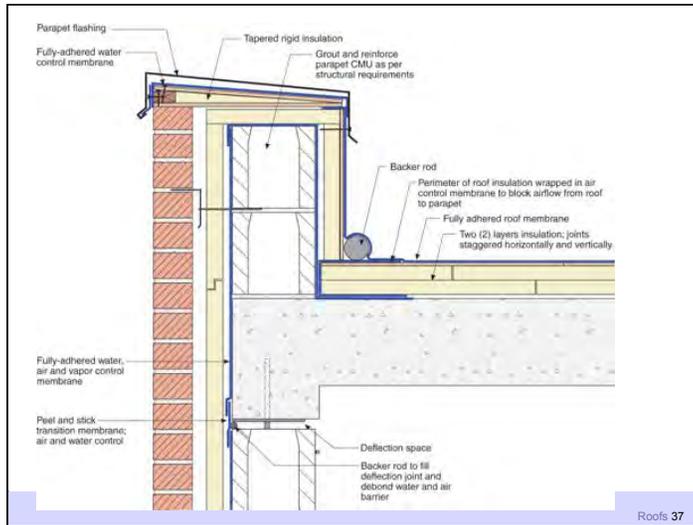
- 2% is a good design value for membrane
- Account for roof sags: long span steel often sags more than slope
- Roof drains at columns
- Metal panel slopes
 - Higher ribs, allow lower slopes
 - Beware laps

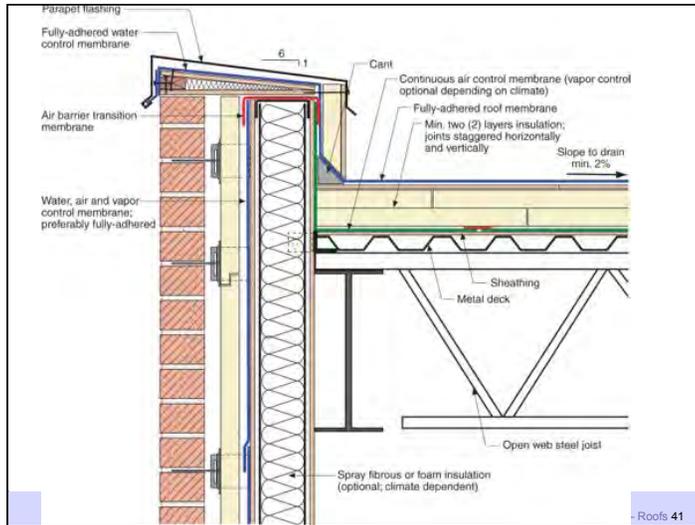
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Transitions / Penetrations

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Roofs 33







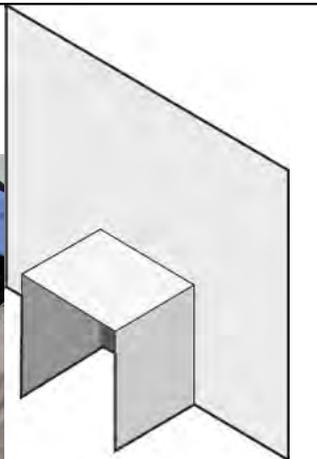
Wall Transitions

- Roof to wall is one of the most problematic “roof” details

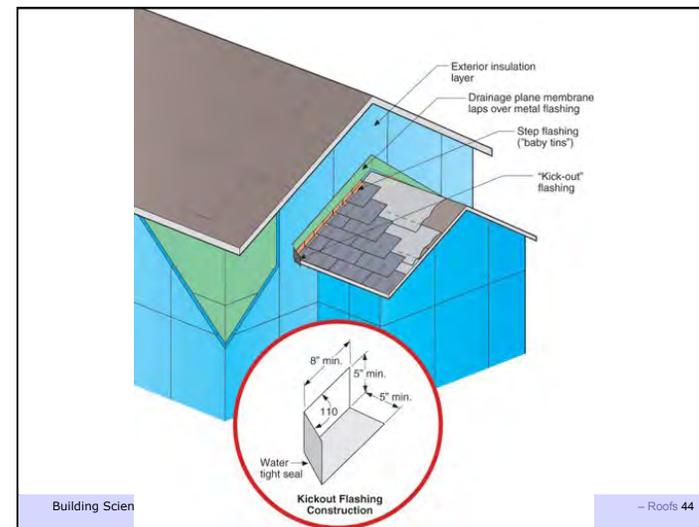
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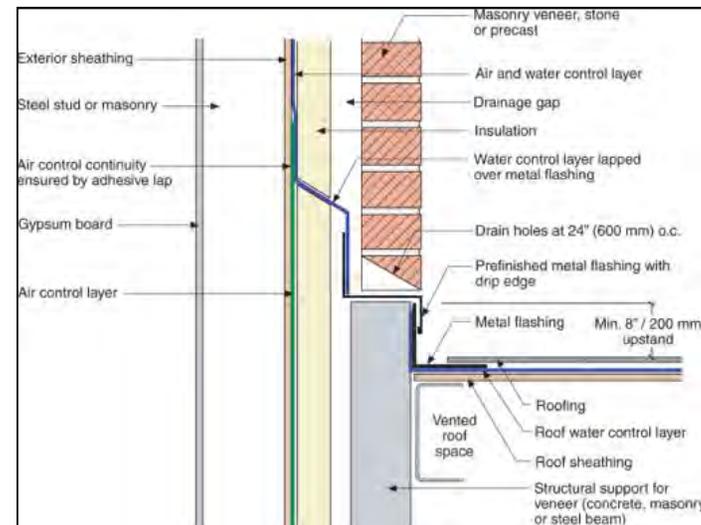
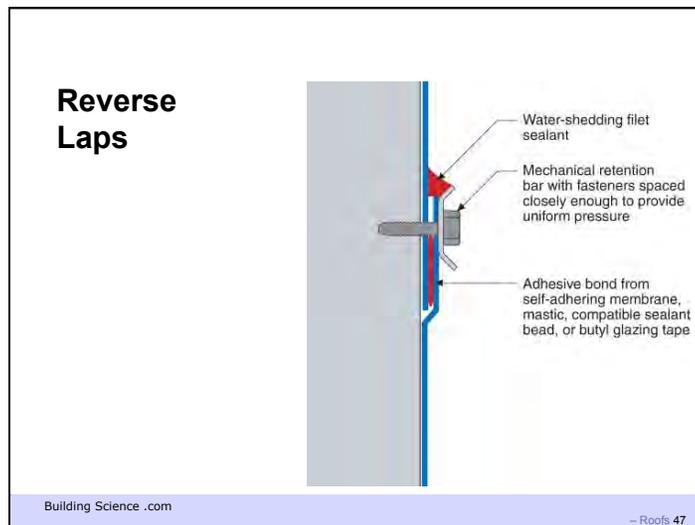
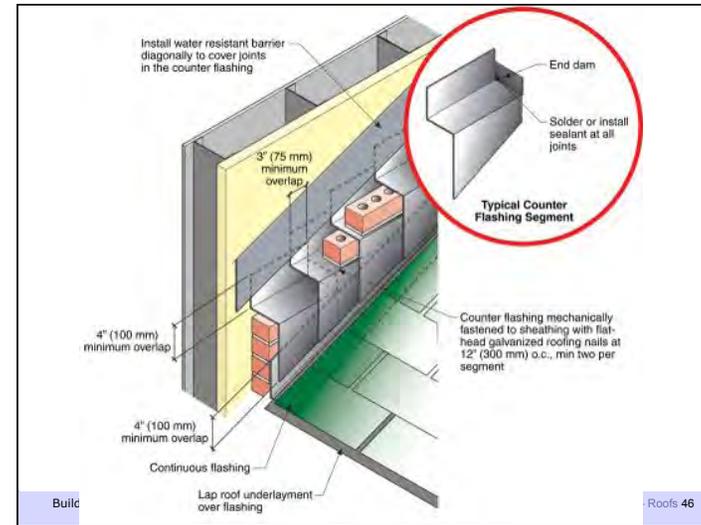
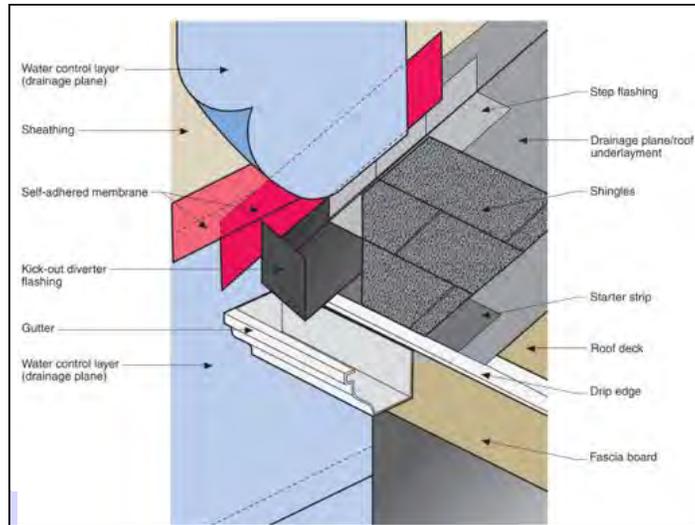
— Roofs 42

Saddles

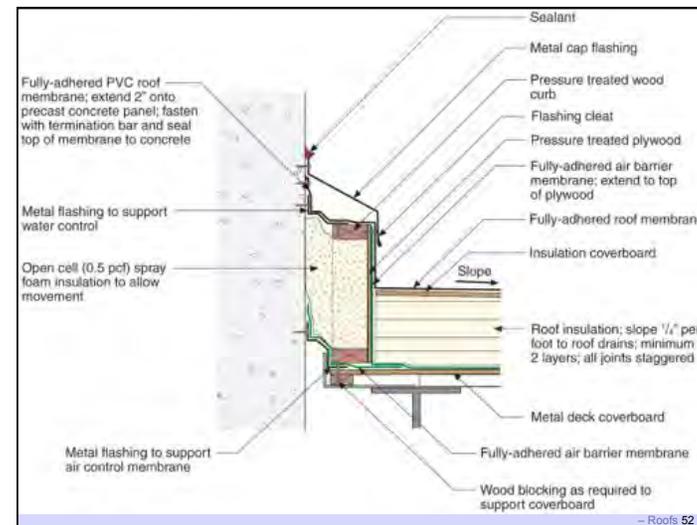
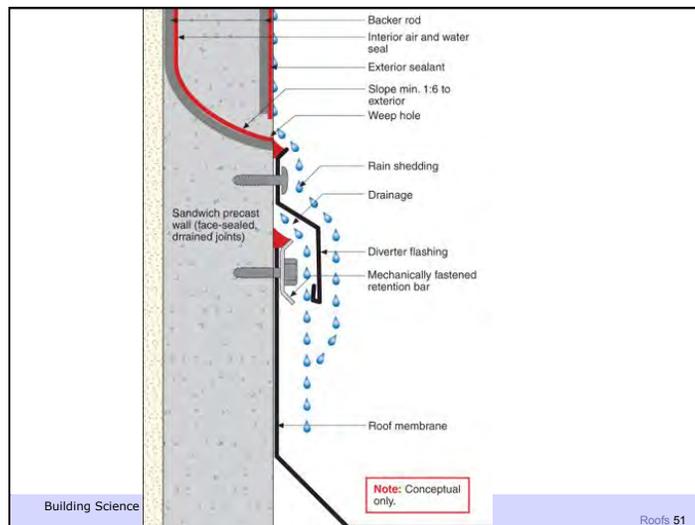
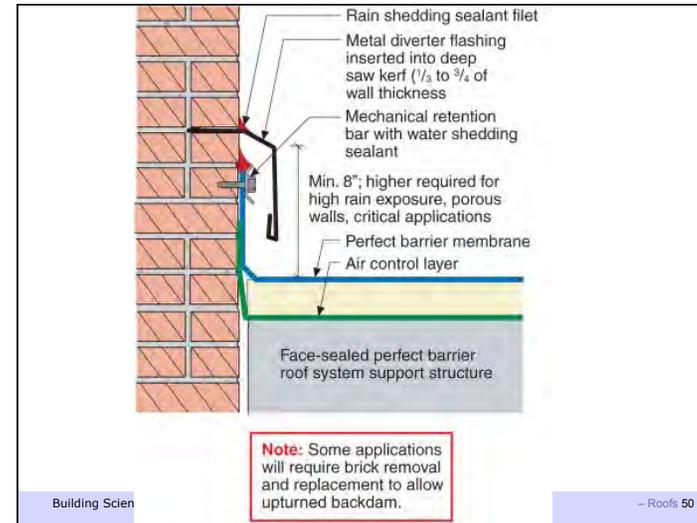
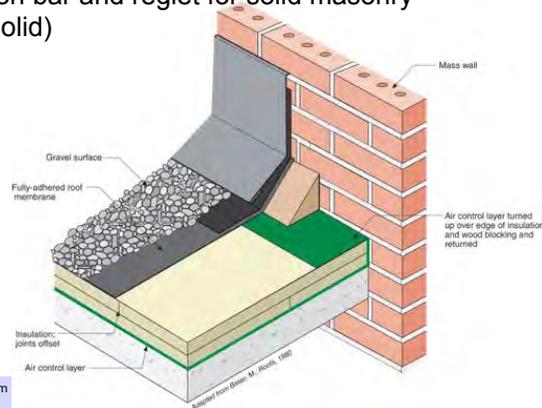


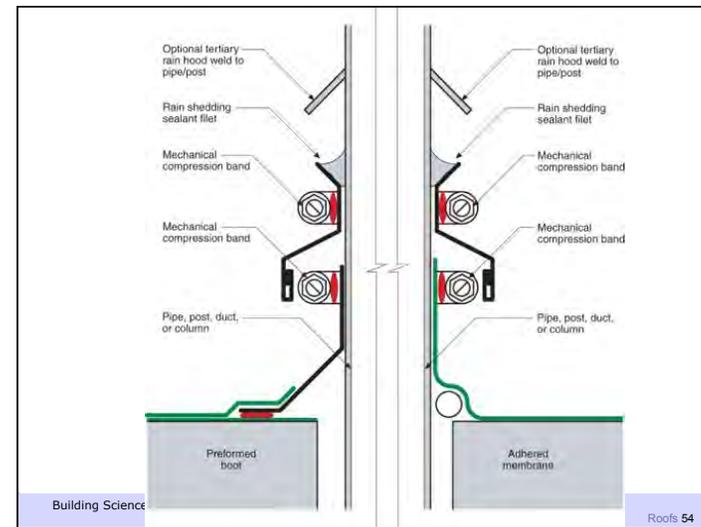
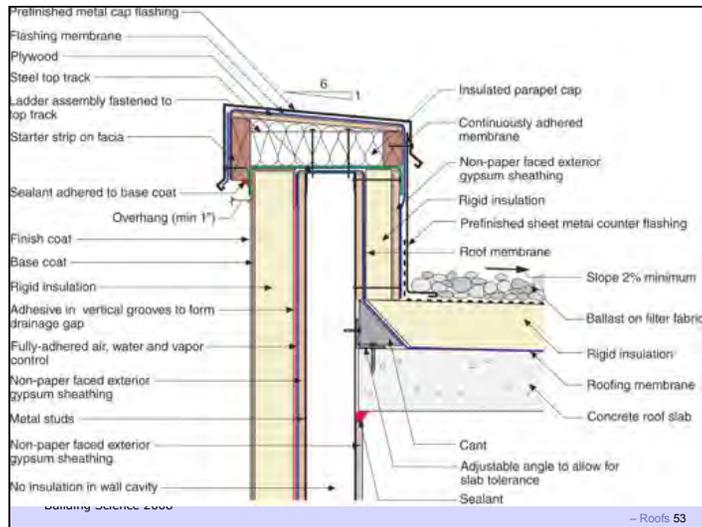
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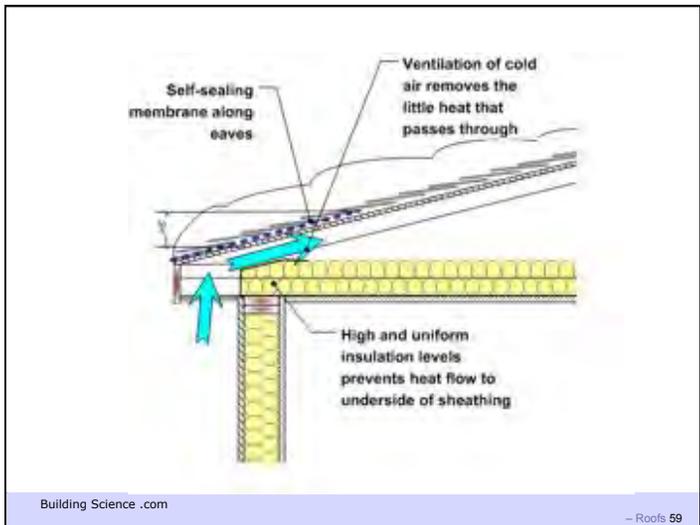
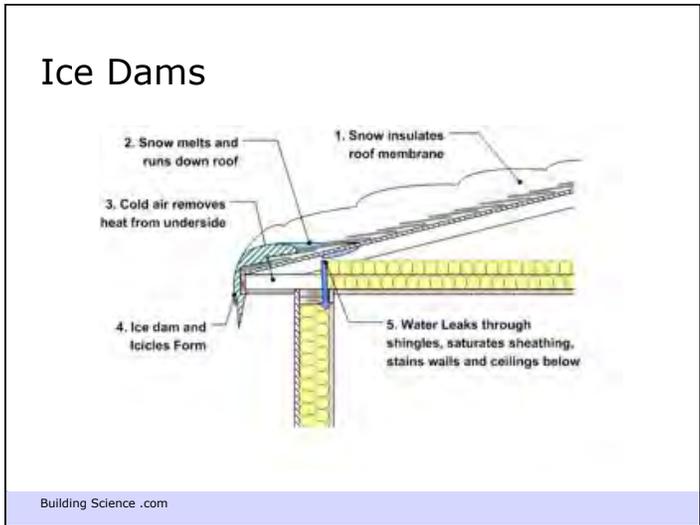




- Flashing must go THROUGH a brick veneer to drainage plane
- Retention bar and reglet for solid masonry (if it is solid)









Heat loss at Z-girts

- Thermally break Z-girts
- Steep slope to get water off the roof ASAP



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White roofs

- Lower heat gain
- Reduces drying out of roof
- Require better moisture control!
 - Air barrier
 - Construction moisture

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