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Building Science

Roofs

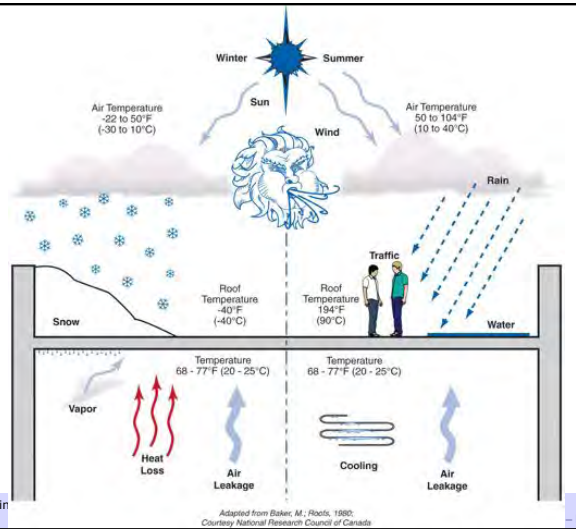
presented by www.buildingscience.com

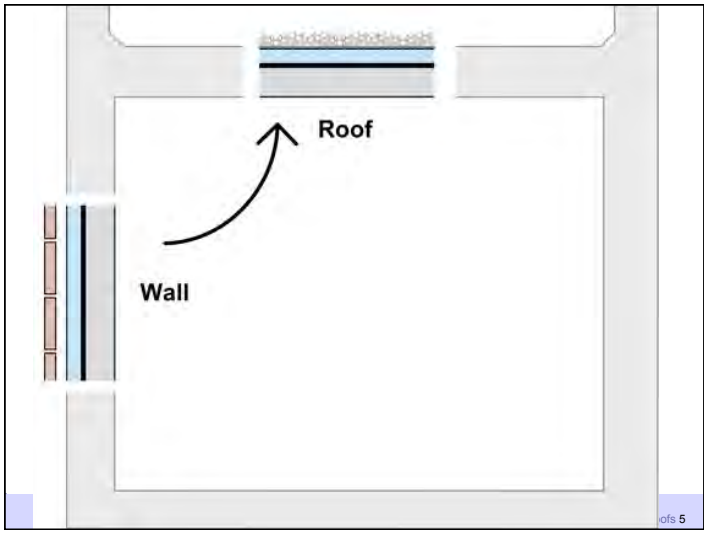
This presentation

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

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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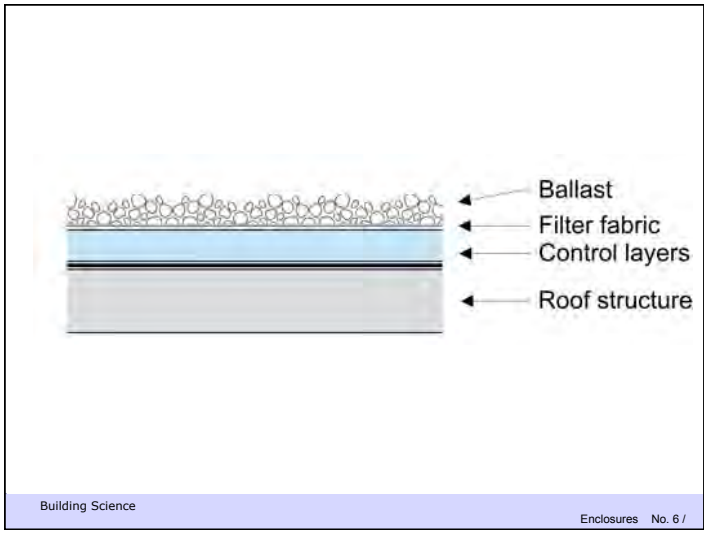

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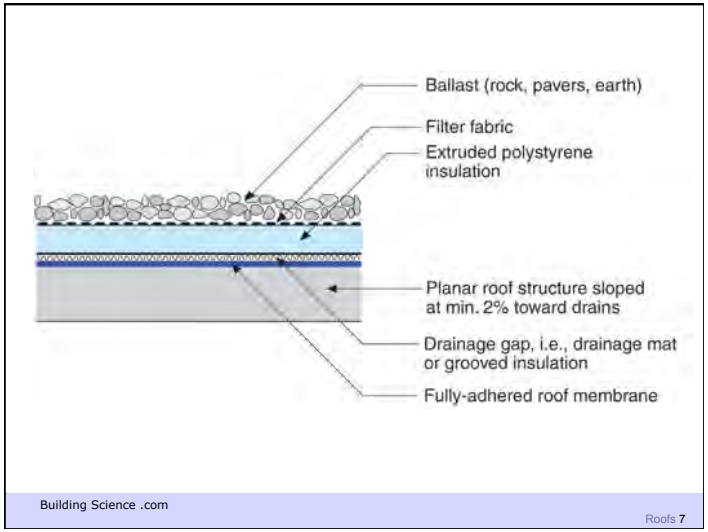
Enclosures No. 6 /



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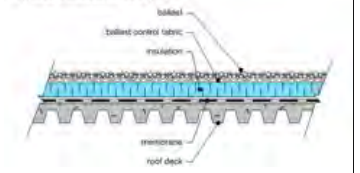
Inverted Roof

- 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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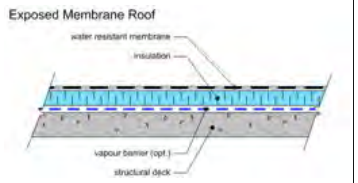
Enclosures No. 8 /

Exposed membranes

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



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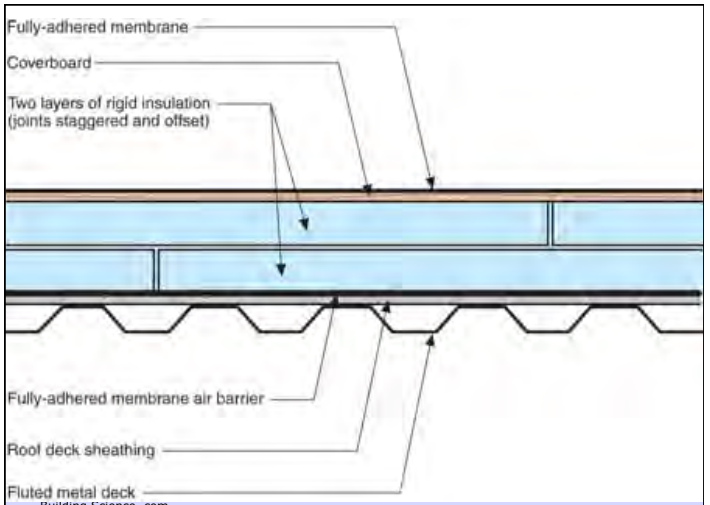

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Sloped roofs

- Basic Physics are the same
- Slopes allows non-waterproof materials to be lapped “shingle fashion”
- Air – vapor impermeable insulation needed OR
  ventilation of the sheathing
- Air leaky roofs require more ventilation

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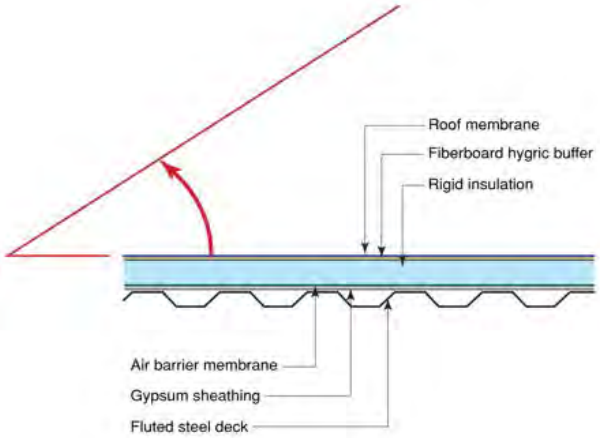
Roofs 12



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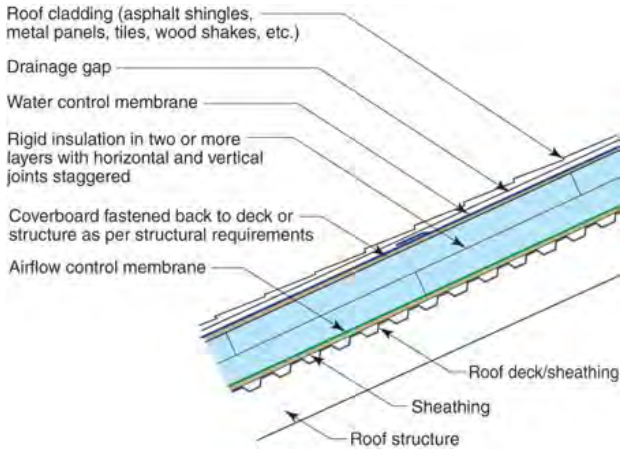

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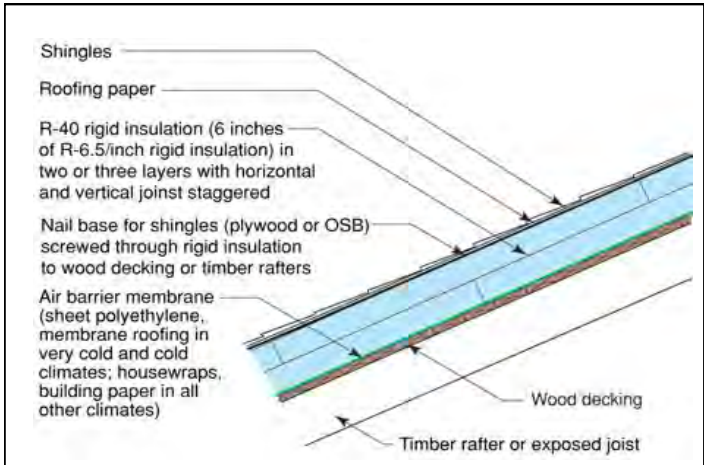
– Roofs 15



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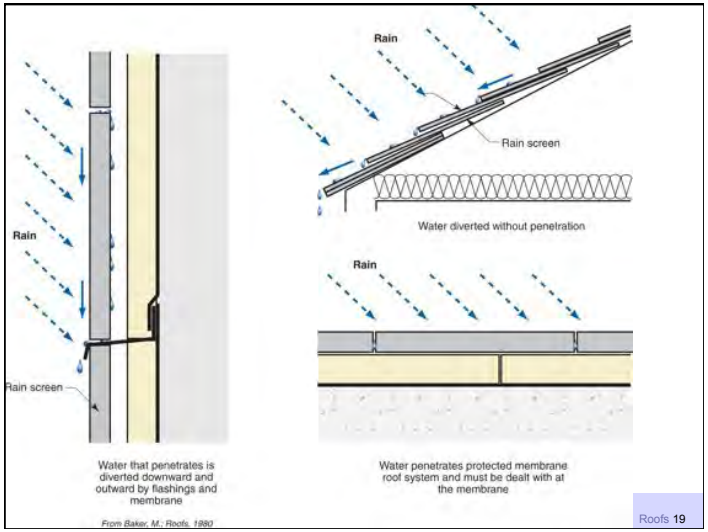

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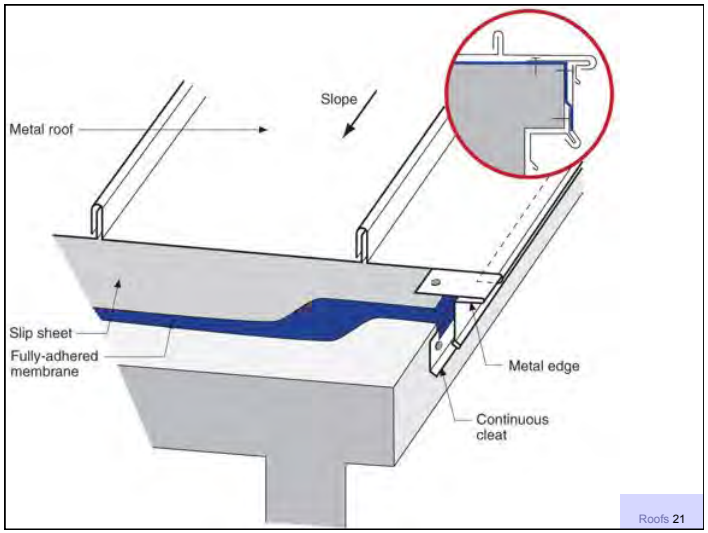
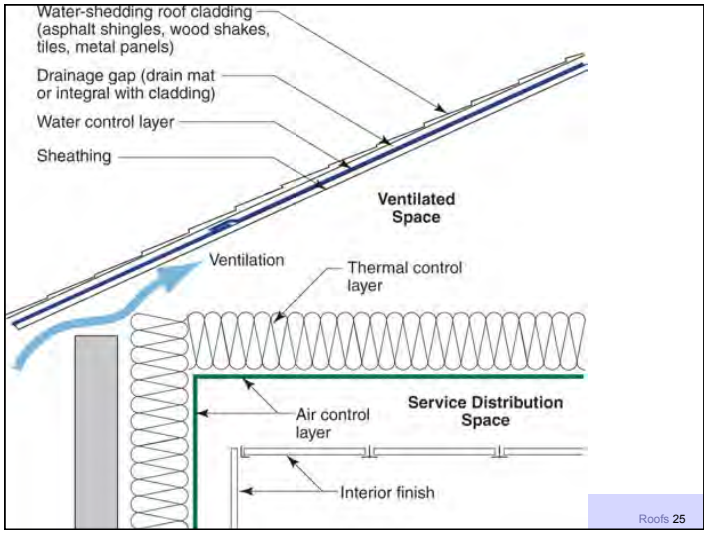
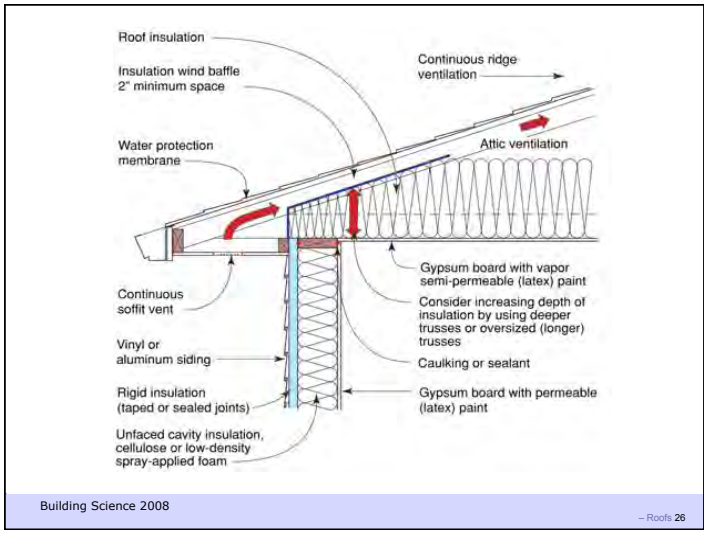

Slope
Metal roof
Slip sheet
Fully-adhered membrane
Metal edge
Continuous cleat
Roofs 21


LES JONES ROOFING


Water-shedding roof cladding (asphalt shingles, wood shakes, tiles, metal panels)
Drainage gap (drain mat or integral with cladding)
Water control layer
Sheathing
Ventilated Space
Ventilation
Thermal control layer
Air control layer
Service Distribution Space
Interior finish
Roofs 25


Roof insulation
Insulation wind baffle 2" minimum space
Continuous ridge ventilation
Water protection membrane
Attic ventilation
Gypsum board with vapor semi-permeable (latex) paint
Continuous soffit vent
Consider increasing depth of insulation by using deeper trusses or oversized (longer) trusses
Vinyl or aluminum siding
Caulking or sealant
Rigid insulation (taped or sealed joints)
Gypsum board with permeable (latex) paint
Unfaced cavity insulation, cellulose or low-density spray-applied foam
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Waterloo Bowling Lanes


"Money spent on roof slope is one of the best bargains in the construction business"
Wayne Tobiasson, CRRL
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Combine multiple penetration at doghouses
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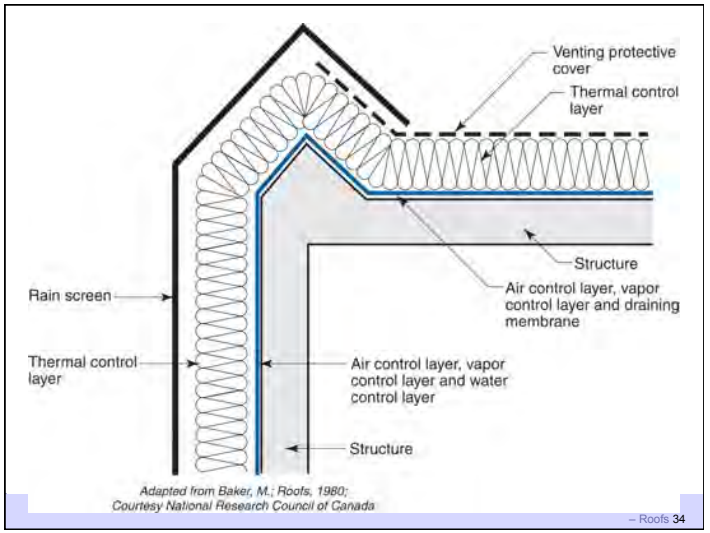
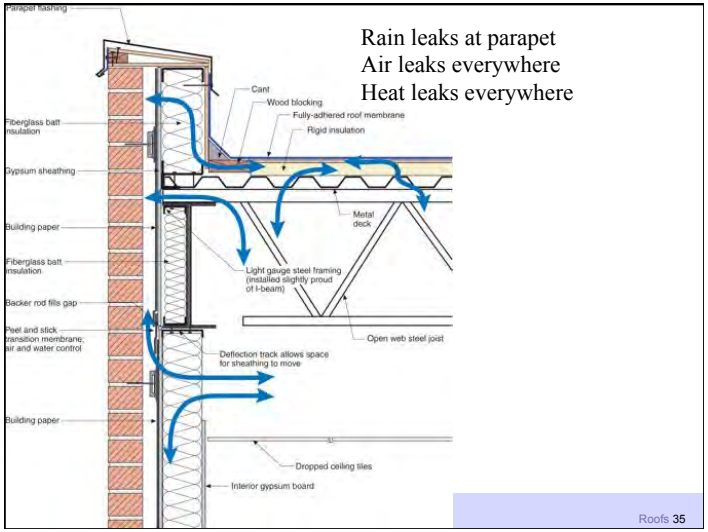
Avoiding penetrations is always best

Parapets



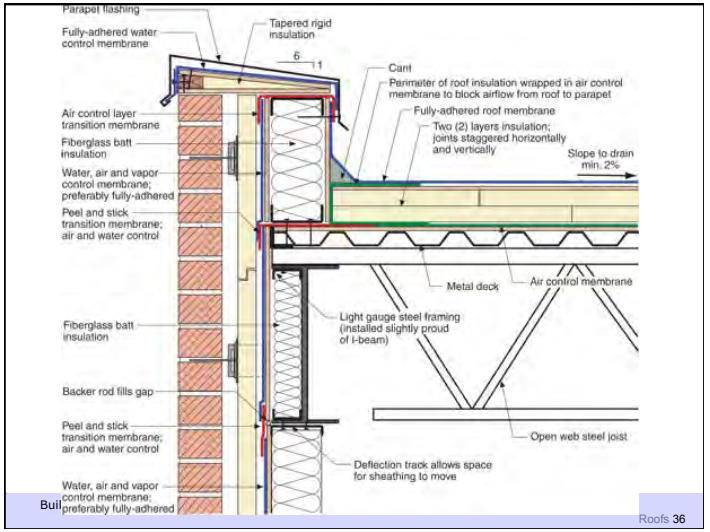
Adapted from Baker, M.; Roofs, 1980; Courtesy National Research Council of Canada

– Roofs 34

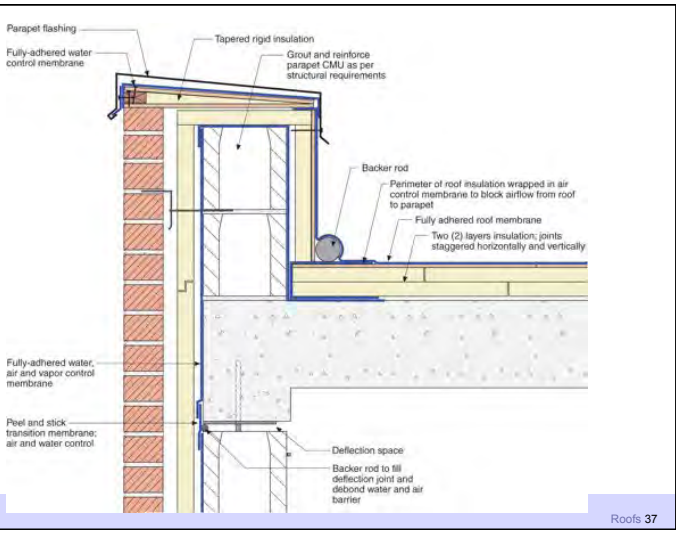


Rain leaks at parapet
Air leaks everywhere
Heat leaks everywhere

Roofs 35



Roofs 36


Parapet flashing
Fully-adhered water control membrane
Tapered rigid insulation
Grout and reinforce parapet CMU as per structural requirements
Backer rod
Perimeter of roof insulation wrapped in air control membrane to block airflow from roof to parapet
Fully adhered roof membrane
Two (2) layers insulation; joints staggered horizontally and vertically
Fully-adhered water, air and vapor control membrane
Peel and stick transition membrane; air and water control
Deflection space
Backer rod to fill deflection joint and debond water and air barrier
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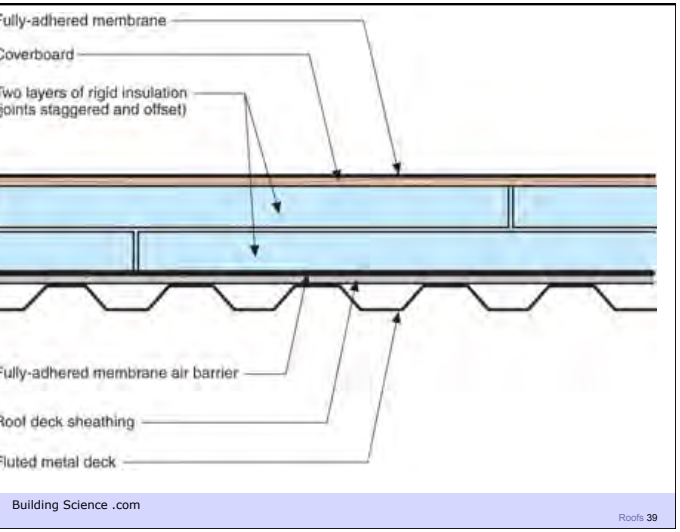
– Roofs 38


Fully-adhered membrane
Coverboard
Two layers of rigid insulation (joints staggered and offset)
Fully-adhered membrane air barrier
Roof deck sheathing
Fluted metal deck
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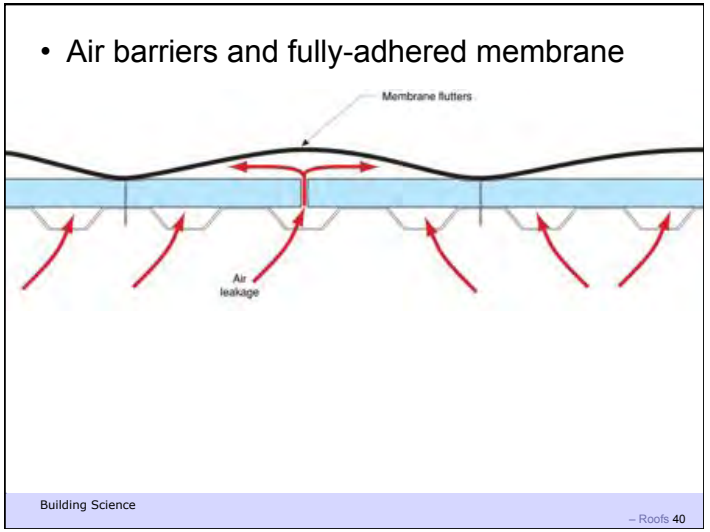
• Air barriers and fully-adhered membrane
Membrane flutters
Air leakage
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Low-level air barriers

- Roof membranes can be air barriers
- In practise, a deck level air barrier is more reliable, easier to control
  - Other benefits include secondary roof during construction and re-roofing

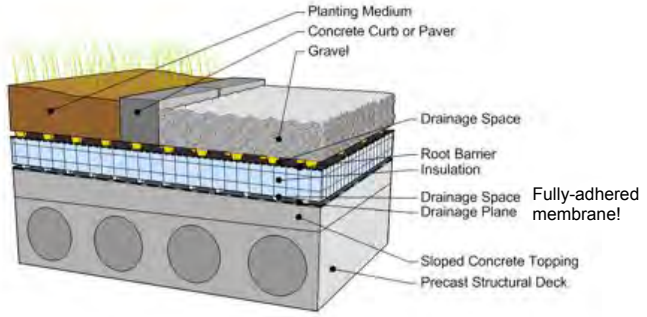
White roofs

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

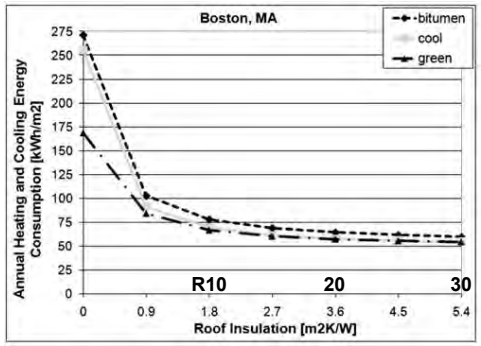
Green Roofs

- Green roof acts as thermally massive, low solar absorption surface
  - Not insulation
- Save energy compared to black roof of same R-value
- White roof with more insulation is less expensive alternate
  - Don't feel good

"Perfect" Green Roof

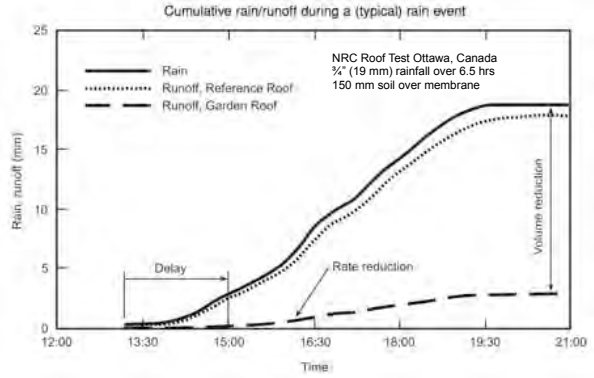


Energy: Dirt is not insulation



Source: Ray, S., Glicksman, ASHRAE Buildings XI 2010

Stormwater Management



Green Roofs

- To save energy, use white roofs with lots of insulation
- Soil does store lots of stormwater
  - Retention mats can do the same
- Likely cleans water somewhat
- Likely absorbs particulates