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Building Science

Adventures In Building Science

www.buildingscience.com
Roof insulation

Insulation wind baffle
2” minimum space

Water protection membrane

Continuous soffit vent

Vinyl or aluminum siding

Rigid insulation
(taped or sealed joints)

Unfaced cavity insulation, cellulose or low-density spray-applied foam

Continuous ridge ventilation

Attic ventilation

Gypsum board with vapor semi-permeable (latex) paint

Consider increasing depth of insulation by using deeper trusses or oversized (longer) trusses

Caulking or sealant

Gypsum board with permeable (latex) paint
Leaky air handling unit and supply ducts

Air handling unit

Supply
Return
Supply

Depressurized conditioned space inducing infiltration

Note: Colored shading depicts the building’s thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.
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Solar radiation warms cladding

Cladding warms air

Warm air is trapped by overhang
- Air barrier membrane
- Gypsum sheathing
- Fluted steel deck
- Rigid insulation
- Fiberboard hygric buffer
- Roof membrane
Shingles

Roofing paper

Minimum R-50 rigid insulation in two or more layers with horizontal and vertical joints staggered

Nail base for shingles (plywood or OSB) screwed through rigid insulation to wood decking or timber rafters

Air barrier membrane

Wood decking

Timber rafter or exposed joist
Minimum R-50 rigid insulation in two or more layers with horizontal and vertical joints staggered

Roof sheathing

Roofing membrane

Vented space

Roof sheathing

Roofing paper

Shingles

Air barrier membrane

Wood decking

Timber rafter or exposed joist
Vented roof

All structure inside; okay, not the trusses but you know what I mean

Ventilated cladding

Thermal control layer outside of air and vapor control layers

Continuous air control and vapor control layer outside of structure

Ventilated cladding

All services inside; all, not some, all and I really mean it
Fully-adhered roofing membrane

Coverboard and hygric buffer

Rigid insulation (min. two layers; joints offset)

Gypsum sheathing (paperless)

Fully-adhered air control layer/vapor control layer

Screw attachment

Metal deck
Fully-adhered roofing membrane

Coverboard and hygric buffer

Screw attachment to intermediate plywood layer

Intermediate plywood layer; joints sealed

Screw attachment to structural deck

Rigid insulation

Gypsum sheathing (paperless)

Fully-adhered air control layer/vapor control layer

Metal deck

Screw attachment
Cold air falls toward bottom of joint

Rising air cools and vapor condenses on underside of top layer

Warm air rises toward cold side of SIP

Air returns to interior through accidental opening

Accidental opening on inside of joint allows warm moist air to enter
Sealant at this location would not have prevented failure.

Continuous sealant at this location, or at a location closer to the interior, would have prevented failure.

Continuous sealant at this location would have prevented failure.
0.019\* ALUMINUM - CONTINUOUS
SECURE WITH PANEL SCREWS AND
8D NAILS, LAP ENDS 6\* AND SEAL
WITH CAULK

#14 PANEL SCREW -
(MAY BE UNDER OR OVER
ALUMINUM FLASHING)

FILL ALL GAPS WITH FOAM
SEALANT; CONTINUOUS BEAD
RIDGE SEAL

GENEROUS BEADS
OF CAULK SEALANT

SEAL ROOF RIDGE WITH
ROOF MEMBRANE OR 0.19\*
ALUMINUM SHEET EXTENDING
6\* EACH SIDE OF APEX

INTERIOR DRYWALL

CONTINUOUS SEALANT AT
LOWER PANEL JOINT

SECTION

SEALANT IN GAP

 GAP PROVIDED BETWEEN
PANEL EDGES
Legend

- **Green arrows**: Upper level air flows
- **Blue arrows**: Lower level air flows
- **Red arrows**: Air flow at panel joints
Legend
- Green arrows: Upper level air flows
- Blue arrows: Lower level air flows
- Red arrows: Air flow at panel joints connecting upper and lower air flows
New roofing system

Fully adhered membrane

Roof sheathing

Two layers of rigid insulation (joints staggered and offset)

Fully adhered membrane air barrier

Gypsum sheathing

Fluted metal deck
Shingles

Roofing paper

R-19 batt insulation installed with wire stays or twine or netted cellulose

R-5 rigid insulation (vertical and horizontal joints offset from roof sheathing)

3/8" sheathing over rigid insulation

Roof sheathing

Sealant

Rigid insulation notched around roof trusses and sealed

Underside of roof sheathing is typically the “first” condensing surface

Unfaced batt insulation

Gypsum board with vapor semi-permeable (latex) paint

Vinyl or aluminum siding

Rigid insulation

Building paper drainage plane
Mean monthly outdoor temperature

First condensing surface temperature (underside of roof sheathing) if R-5 rigid insulation is installed over roof deck

Dew point temperature at 50% R.H., 70°F

Dew point temperature at 40% R.H., 70°F

Temperature (°F)

Month

APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC  JAN  FEB  MAR  APR  MAY
The inside face of the roof sheathing forming the cavity is the first condensing surface.

OSB or plywood nail base for shingles

R-30 unfaced batt ceiling insulation compressed to fit within 2x8 rafters or damp spray cellulose or "netted" dry blown cellulose or fiberglass

R-5 rigid insulation (vertical and horizontal joints offset from roof sheathing)

Sealant

Rigid insulation notched around roof rafters and sealed

Vinyl or aluminum siding

Rigid insulation (taped, shiplapped or sealed joints)

Unfaced batt insulation

OSB or plywood roof sheathing

Gypsum board ceiling with semi-vapor permeable (latex) paint

Caulking or sealant

Gypsum board with semi-vapor permeable (latex) paint
Building Science Corporation

Roof insulation

Insulation wind baffle
2” minimum space

Water protection membrane (ice-dam protection where required)

Continuous ridge ventilation

Rigid insulation
(taped or sealed joints)

Gypsum board

Caulking or sealant

Gypsum board with semi-vapor permeable (latex) paint

Continuous soffit vent

Vinyl or aluminum siding

Rigid insulation
(taped or sealed joints)

Cavity insulation with vapor retarder backing
Roofing tile

Roofing paper

Netted cellulose insulation or batt insulation installed with wire stays or twine

Roof sheathing

Underside of roof sheathing is typically the “first” condensing surface

Stucco

Unfaced batt insulation

Rigid insulation

Gypsum board with vapor semi-permeable (latex) paint

Building paper drainage plane
Map of DOE’s Proposed Climate Zones

March 24, 2003
Low density spray foam insulation

Asphalt shingles

Roofing paper

Roof sheathing

Raised heel truss

Rigid foam, or comparable, as backdam

Soffit

Roof underlayment sealed to drip edge

Gypsum board with latex paint (acts as thermal barrier separating occupiable space from non-occupiable space)

Non-occupiable space