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## Detailing Toward Zero-Energy Buildings Part 2

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Building America  
 U.S. Department of Energy  
 Research Toward Zero Energy Homes

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Design Towards Zero Energy

## ENCLOSURE DESIGN WALLS and Windows


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### Heat Flow

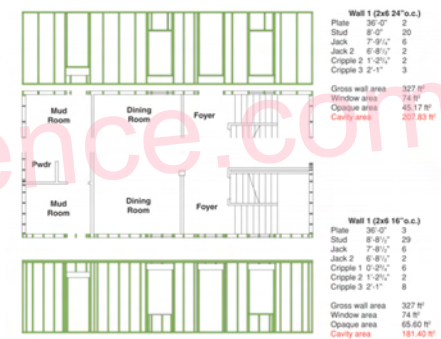
**Thermally Efficient Assemblies**

- Structure only where needed
- Insulating sheathing
- Blown insulations that fill the entire void



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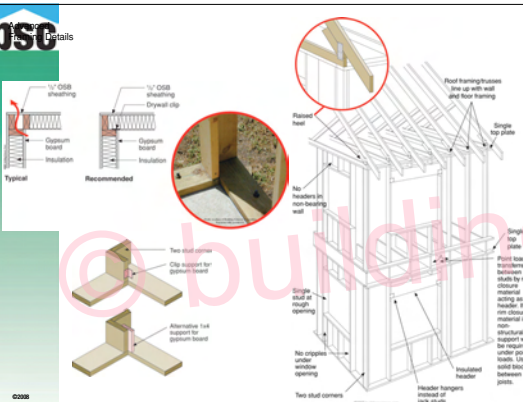
Wall 1 (2x6 24" o.c.)		
Plate	3/4"	2
Stud	6-8"	20
Jack	7-9"	6
Jack 2	6-8"	2
Cripple 2	1-2"	3
Cripple 3	2-1"	3
Gross wall area	327 sq'	
Window area	74 sq'	
Opaque area	45.17 sq'	
Cavity area	207.83 sq'	

Wall 2 (2x6 16" o.c.)		
Plate	3/4"	3
Stud	6-8"	29
Jack	7-9"	6
Jack 2	6-8"	2
Cripple 1	1-2"	6
Cripple 2	1-2"	2
Cripple 3	2-1"	8
Gross wall area	327 sq'	
Window area	74 sq'	
Opaque area	65.80 sq'	
Cavity area	181.40 sq'	

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Details



Typical  
 Recommended

1/2" OSB sheathing  
 Gypsum board  
 Insulation

1/2" OSB sheathing  
 Drywall clip  
 Gypsum board  
 Insulation

Roof framing/brusses  
 (level with sole and four framing)

Single top plate

Plat (stud) mechanical  
 studs by one  
 header &  
 one course  
 material in  
 structural  
 support wall  
 be required  
 under point  
 loads. Use  
 wall blocking  
 between  
 joints.

Header hangers  
 instead of  
 jack studs

Plat head

The headers in  
 non-bearing  
 wall

Single stud at  
 each  
 opening

No cripples  
 under  
 window  
 opening

Two stud corners

Two stud corners  
 support for  
 gypsum board

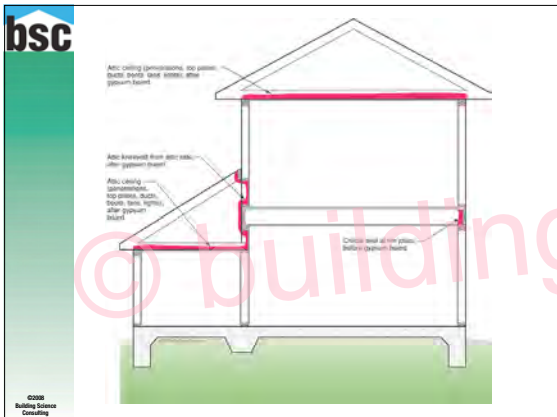
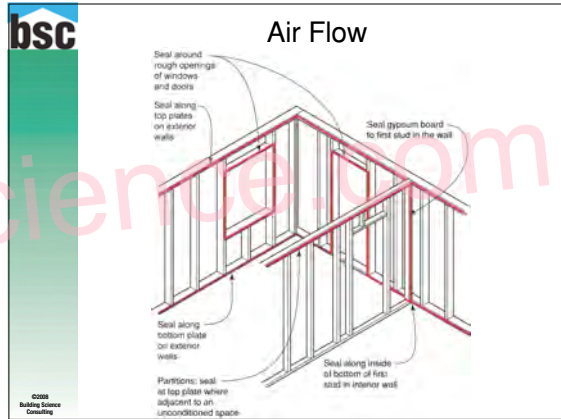
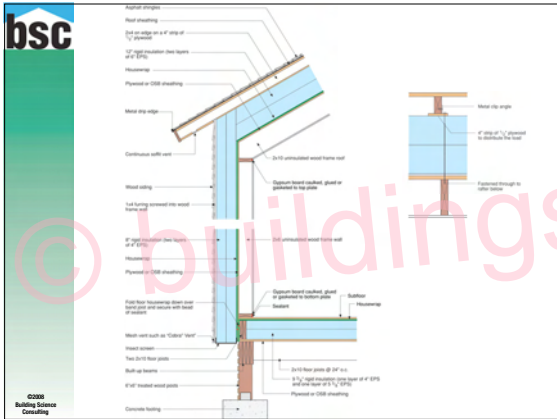
Alternative fast  
 support for  
 gypsum board

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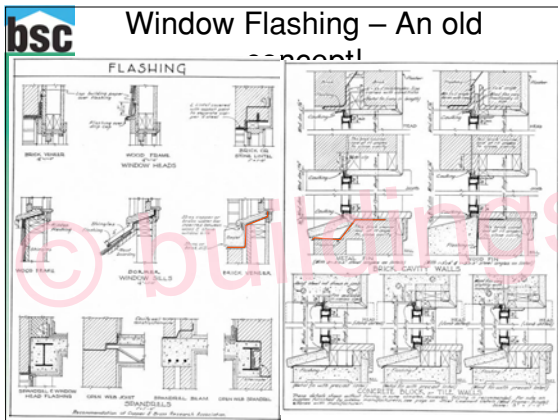




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Exterior Covering Ventilated?	Sheathing	Allowable Interior Vapor Resistance Requirements by Class			
		Climate Zone			
		4	5	6	7
Yes	OSB	Class I, II, III	Class I, II, III	Class I, II	Class I, II
	Plywood	Class I, II, III	Class I, II, III	Class I, II	Class I, II
	Gypsum <sup>1</sup>	Class I, II	Class I, II, III	Class I, II, III	Class I, II
	Fiberglass Sheathing <sup>2</sup>	(R-5 or greater) <sup>3</sup>	(R-5 or greater) <sup>3</sup>	(R-7.5 or greater) <sup>3</sup>	(R-10 or greater) <sup>3</sup>
	Fiberboard	Class I, II, III	Class I, II, III	Class I, II, III	Class I, II
	Other	Class I, II	Class I, II	Class I, II	Class I, II
	Notes:				
	(1) When insulating sheathing is installed over other sheathing, requirements for insulating sheathing shall govern.				
(2) Insulating sheathing R-values shown in parentheses are for 2x4 wall construction. 2x6 walls require insulating sheathing R-values to be increased 50%.					
(3) When insulating sheathing has a vapor permeance of greater than Class III, requirements for gypsum sheathing shall govern. When insulating sheathing having a vapor permeance of greater than Class III is installed over other sheathing, requirements for insulating sheathing shall govern.					
(4) Sillco (3/8 inch clear airspace with 3/8 inch continuous slot vent openings at the top and bottom of each wall).					
Brick (2 inch clear airspace with 3/8 inch x 2.5 inch openings (or equivalent net free area per opening) every 3" brick at the bottom and top course of each wall).					
Stone/Masonry Veneer (2 inch clear airspace with 1 square inch of vent opening every 24 inches of wall length at the bottom and top of each wall).					
Wood/Wood Based/Fiber Cement Siding (1/4 inch clear airspace or alternatively 1/4 inch gap between horizontal siding laps).					
Panel Siding (3/8 inch clear airspace with 3/8 inch continuous slot vent openings at the top and bottom of each wall).					

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Unvented Roof Design:  
Rigid insulation on Top of Deck /  
Air Permeable Insulation under Deck

The colder the climate,  
the more R-value is needed

- Zone 2B, 3B Tile Roof : none required
- Zone 1 - 3 : R-5
- Zone 4 : R-10 to 15
- Zone 5 : R-20
- Zone 6 : R-25
- Zone 7 : R-30
- Zone 8 : R-35

**Note:** 1. Air impermeable insulation must be installed in direct contact with the underside of the roof deck  
2. Massachusetts is in Zone 5

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**bsc** Controlling Condensing Surface Temperature : Zone 5 - 8

Shingles  
Roofing paper  
R-40 rigid insulation (6 inches of R-6.5 inch rigid insulation in two or three 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 (sheet polyethylene, membrane roofing in very cold and cold climates; housewraps, building paper in all other climates)  
Wood decking  
Timber rafter or exposed joist

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**bsc** This is the way we did our office/barn renovation

METAL DRIP EDGE  
ICE / WATER SHIELD 36" WIDTH AT ALL EAVES  
12" SCREWS  
8" O.C.

ORGANIC ASPHALT SHINGLES  
15# BUILDING PAPER  
1/2" PLYWOOD SHEATHING  
10" EPS INSULATION (4'x8' SHEETS)  
6 MIL POLY LAPPED SHINGLE STYLE MIN. 6" TYPICAL  
2"x10"x4" LONG RAFTER W 3/4" PLYWOOD STRIP BENEATH  
EXISTING RAFTERS / STRUCTURE TO REMAIN  
EXISTING SHEATHING TO REMAIN  
2x6 SUB-FASCIA  
2x4 BLOCKING  
1x6 FASCIA PRIMED ALL SIX SIDES  
PLYWOOD SOFFIT PRIMED ALL SIX SIDES  
1x8 FREEZE BOARD PRIMED ALL SIX SIDES  
1x4 FT FLOORING STRIP @ 24" O.C.  
4" CLAPBOARD 4-1/2" T.I.W. PRIMED ALL SIX SIDES  
8" EPS FOAM INSULATION (4'x8' SHEETS)

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Unvented Roof Design:  
Requirements for Vapor Diffusion

**Low Density (open cell) Foam**

- zone 1 - 4 (no minimum perm rating required)

**Low Density Foam (open cell)**

- zone 5 - 7 require 1 perm or less (ie foam sheathing or some other strategy to reduce permeability) in direct contact with the underside of the foam

**High Density Foam (closed cell)**

- meets min. perm requirements in all zones

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**bsc** Low Density Foam - Zones (5) 6, 7

Low density spray foam insulation  
Standing seam metal roof  
Fluoropolymer waterproofing (i.e. Ice & Water Shield®)  
1" EPS rigid insulation (Class II vapor retarder)  
Roof sheathing  
Rigid foam, or comparable insulation  
Floor joist (siding wall)  
Vapor barrier required for knee wall  
Knee wall  
Space behind knee wall for mechanical duct runs and air handling equipment in conditioned space  
Low density spray foam insulation

This works in Massachusetts and is the way our Somerville office is designed

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