Comfort Plus Homes™

Building & Design Ideas

Comfort Plus Homes™

Comfort Plus Homes Goals

- Energy Efficiency
- Occupant Safety
- Occupant Health
- Durability
- Occupant Comfort
- Environmental Impact
- Affordability

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Comfort Plus Homes Advantages

- Comfortable and Quiet
- Plenty of Natural Light
- Healthier Indoor Environment
- Higher Winter Humidity Levels
- Suitable for Any Lot
- Conventional Construction Techniques
- Heats for $100-$300 per Year
- Less Expensive to Own

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Could It Be Less Expensive?

- A Comfort Plus Home is durable, requiring less maintenance
- Lower energy costs offset additional mortgage costs
- Energy Efficient Mortgages (eems) are available to allow people to borrow more money for a Comfort Plus Home

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What'S an EEM?

- An Energy Efficient Mortgage (EEM) allows the lender to stretch the debt-to-income ratio 1-2%, allowing the borrower to borrow more money to cover the additional costs of a Comfort Plus Home
- The lower energy costs offset this additional mortgage payment
- Check out this example . . .

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EEM Example

Typical Home	Component	Energy Eff Home
$100,000	Home Price	$105,000
$10,000	Downpayment	$10,500
$90,000	Mortgage Amount	$94,500
8%	Interest Rate	8%
30	Term (Years)	30
$660	Monthly Payment	$693
$844	PITI	$877
$109	Monthly Energy Bills	$72
$953	Total Monthly Housing	$949
$3,013	Monthly Income Required	$2,922
$36,159	Annual Income Required	$35,070

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Who Benefits When a Comfort Plus Home Is Built?

- State/Region/Nation/Earth
- Utility Company
- Building Material Supplier
- Builder
- Real Estate Agent
- Lending Institution
- Homeowner/Buyer

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Comfort Plus Home Keys

- Airtight Construction
- Adequate and Properly Installed Insulation
- Properly Selected and Installed Heating, Air Conditioning & Water Heating Systems
- Controlled Ventilation
- Proper Commissioning

Site Selection

There goes the neighborhood

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Key Points - Site Selection

- If you have a choice, select a south sloping site where the back of the home faces south
- Select a site that is sheltered from NW winter winds and open to S/SW summer breezes
- Select a site that has trees that will shade the east and west sides of the home
- . . . Nice, but not always possible!
- Doesn't have to be . . .

House Layout

It does make a difference. . .

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Key Points - House Layout

- Any architectural style is suitable
- Minimize corners to increase efficiency
- Locate the most actively used areas (family room and kitchen/eating area) on south to benefit from daylighting and solar heat in winter
- Locate bathrooms, laundry, closets and mechanical rooms which don't need large windows on the north wall to act as a buffer
- Locate the garage on the NW corner of the house to buffer against the winter winds
- Locate baths close to kitchens and laundry areas to minimize plumbing runs

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Key Points - House Layout

- Concentrate windows on the south to capture solar gains in the winter
- Minimize east and west windows to lower cooling costs
- Use light colored walls, floors, and ceilings to maximize the daylighting effect
- Locate fireplaces on interior walls, not exterior

Building Envelope

Foundations, Floors, Walls, Windows, Doors, Ceiling/Roofs, and Insulation

Foundations/Floors

Build it right from the bottom up

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Key Points - Foundations

- Design for concrete cracks
- Design for water management
- Design to prevent frost damage
- Design to control moisture vapor
- Design to limit soil gas penetration

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Key Points - Foundation Cracks

- Concrete cracks
- Concrete has always cracked
- Concrete will always crack
- Reinforcing concrete will not keep it from cracking
- It is not possible to build a crack-free concrete slab or foundation wall
- However, it is possible to control where the concrete cracks . . .

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Control Joints

- Cracks are bad . . . Control joints are good
- Install control joints at:
  - Corners
  - Window openings
  - Steps in the foundation
- Control joints can be sawed or created with diagonally cut 2x2s
- Seal control joints with flexible sealant at the exterior prior to backfilling

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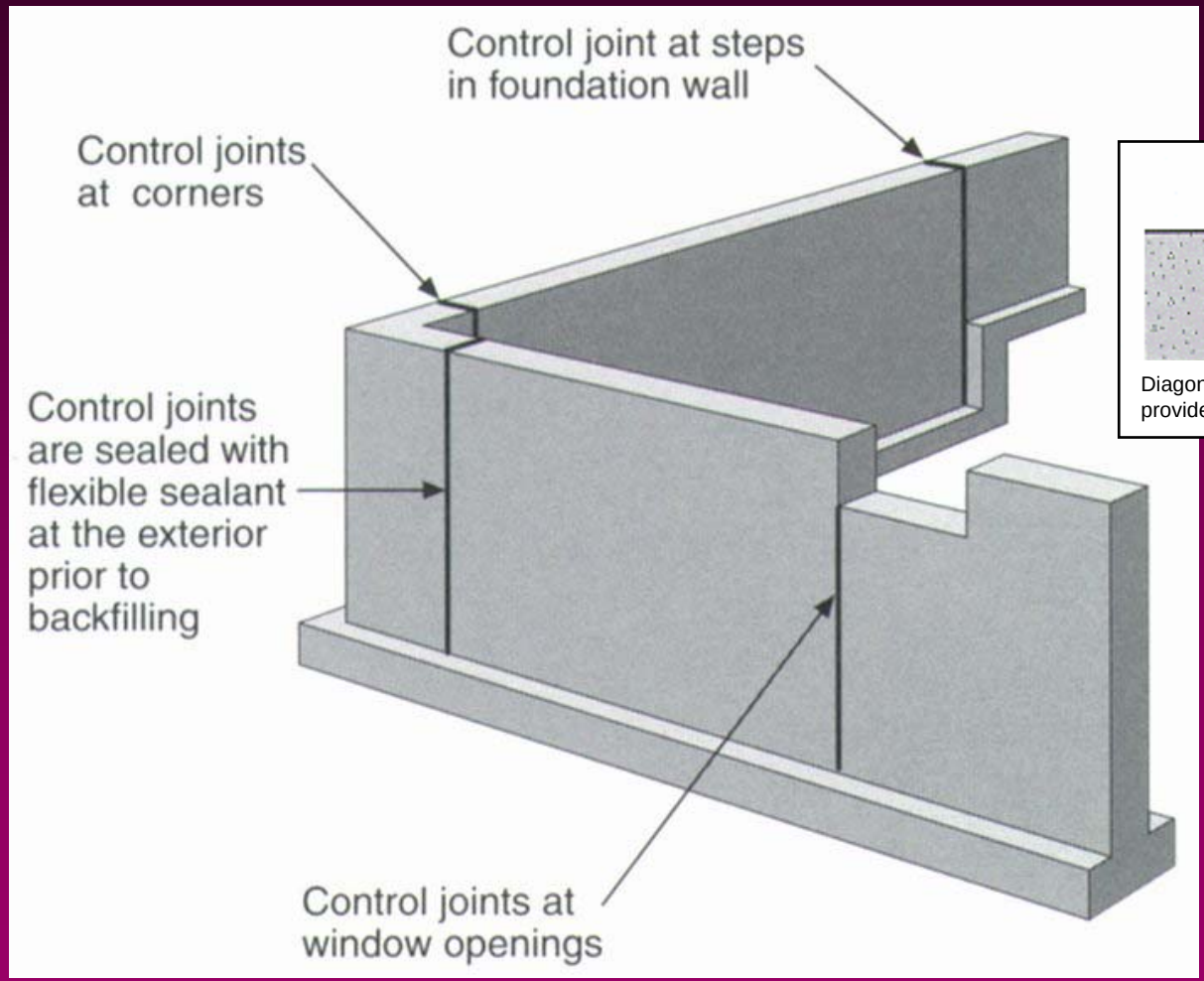
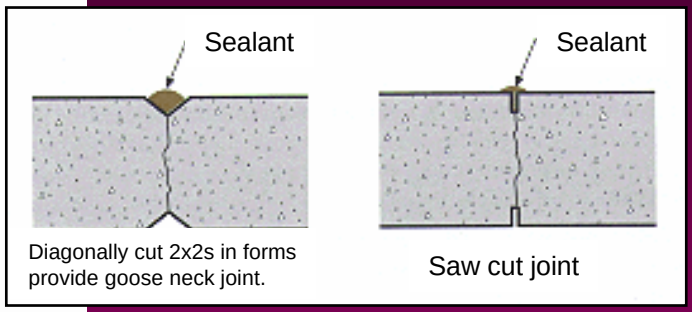
Control Joints





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Key Points - Water Managed Foundations

- Install granular drainage pad (no fines) under slab
- Install perimeter tile around foundation below slab level, connect to sub slab drainage pad and drain to sump or daylight
- Cover perimeter tile above and below with coarse gravel (no fines) and a filter cloth
- Install free-draining backfill or drainage board against dampproofed foundation wall
- Install impermeable clay cap around foundation
- Slope grade away from foundation
- Design overhangs to keep ground around foundation from getting saturated
- Install gutters to collect rainwater and downspouts to route water away from foundation

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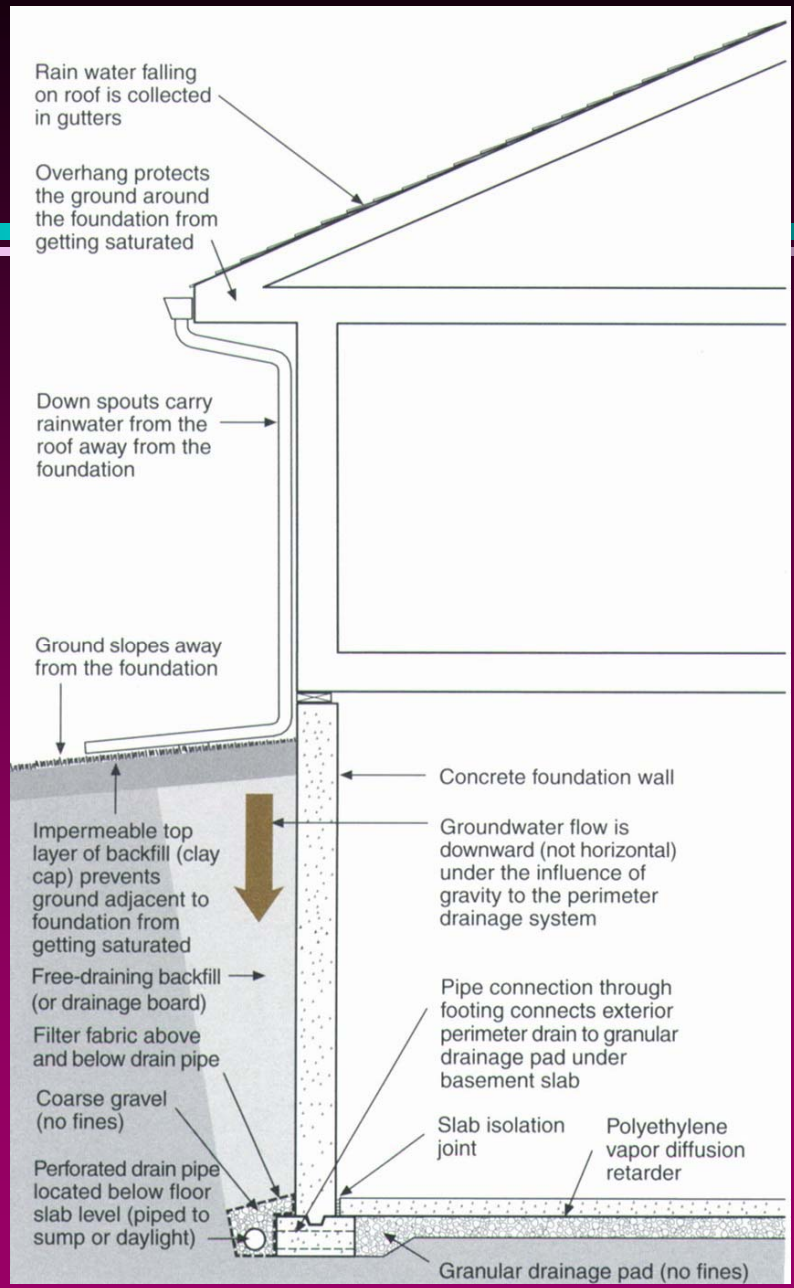
Water Managed Foundation



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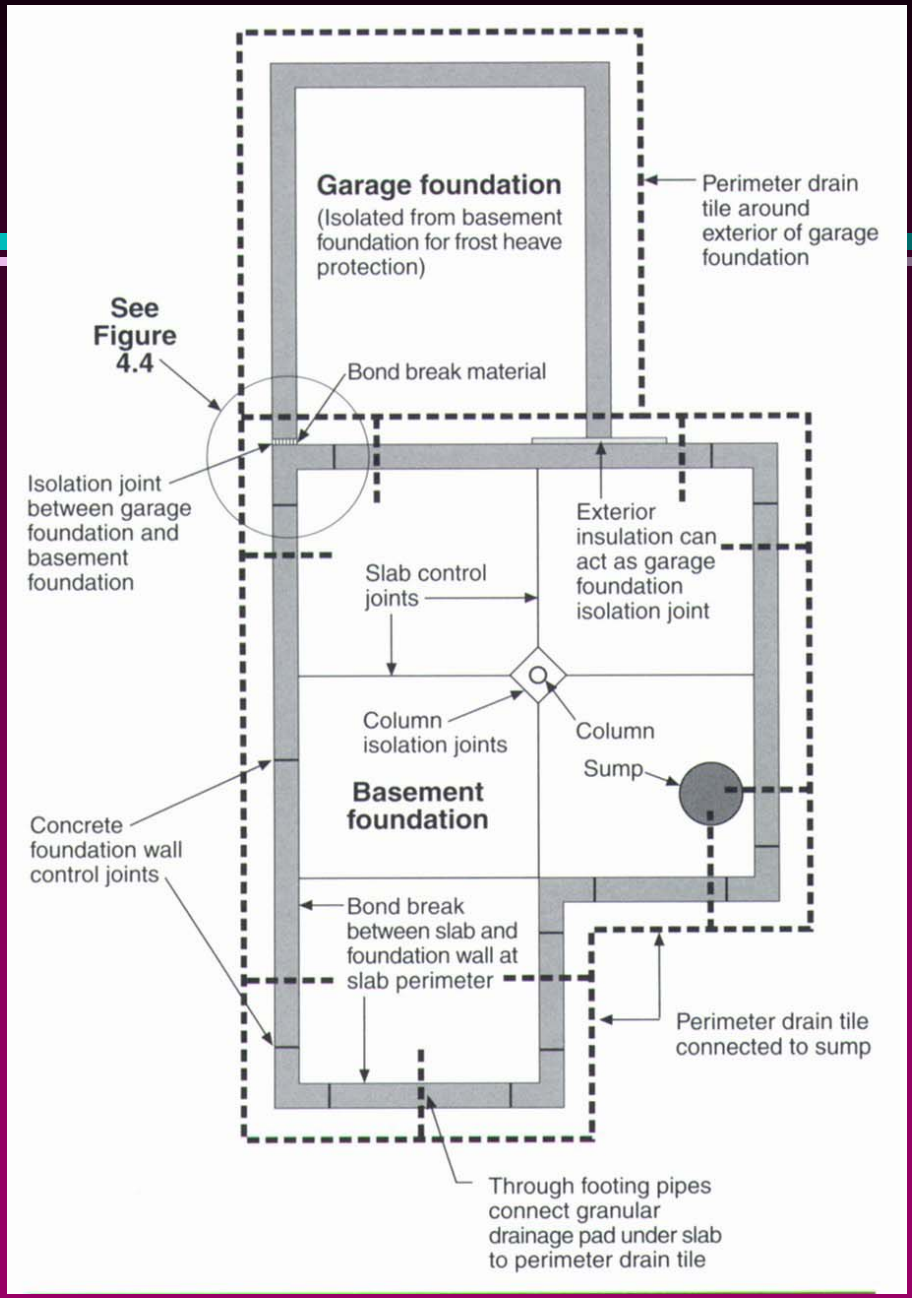
Sub Slab Drainage



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Key Points - Frost Movement

- The key to frost management is the same as water management . . .
- Keep water away from the foundation
- Garages are most susceptible because they are not heated
- Make sure garage foundation can move in a manner that won't destroy the house foundation

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Key Points - Controlling Moisture Vapor

- Dampproof top of footing to stop ground water capillary action
- Dampproof the foundation wall exterior
- Install coarse gravel (no fines) drainage pad under slab
- Install either a polyethylene vapor diffusion retarder or high density expanded polystyrene under slab
- Do not install sand over a layer of polyethylene

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Key Points - Controlling Soil Gas

- Radon, herbicides, termiticides, etc.
- Soil gas moves through holes due to a pressure difference and since we can't eliminate holes, we must address the pressure differences
- Solution: Install a passive sub slab ventilation system at time of construction
- A fan can be added later, if needed
- Also, seal all joints in concrete floor
- Seal the sump pump hole

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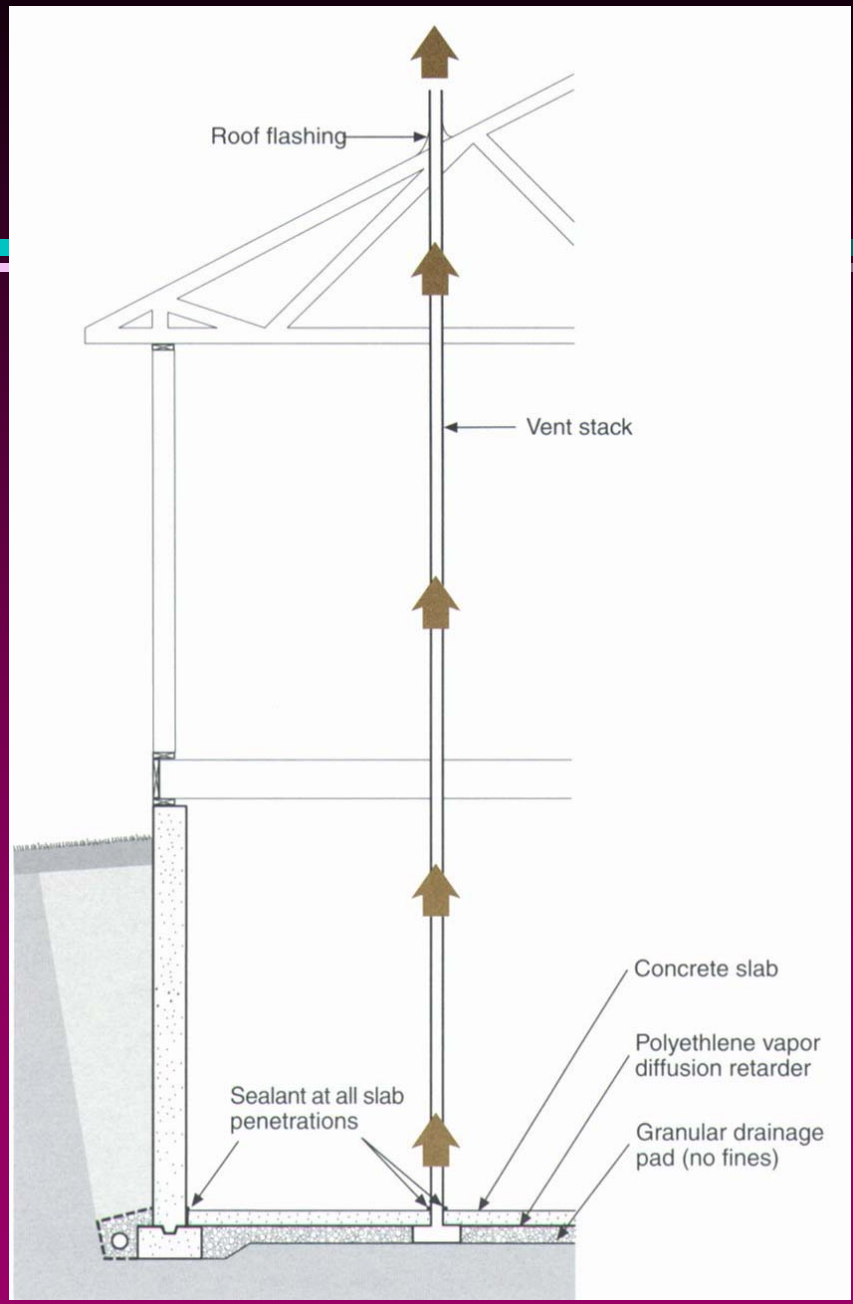
Soil Gas Ventilation System



Foundation and Floor Details

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Key Points - Basements

- Install subslab drainage pad connected to exterior perimeter tile
- Pour slab over polyethylene vapor diffusion retarder or high density expanded polystyrene
- Dampproof top of footing and foundation exterior
- Install control joints in slab and foundation wall
- Seal slab joint at foundation wall
- Seal around other slab penetrations
- Install exterior or interior insulation
- Slope grade away from foundation

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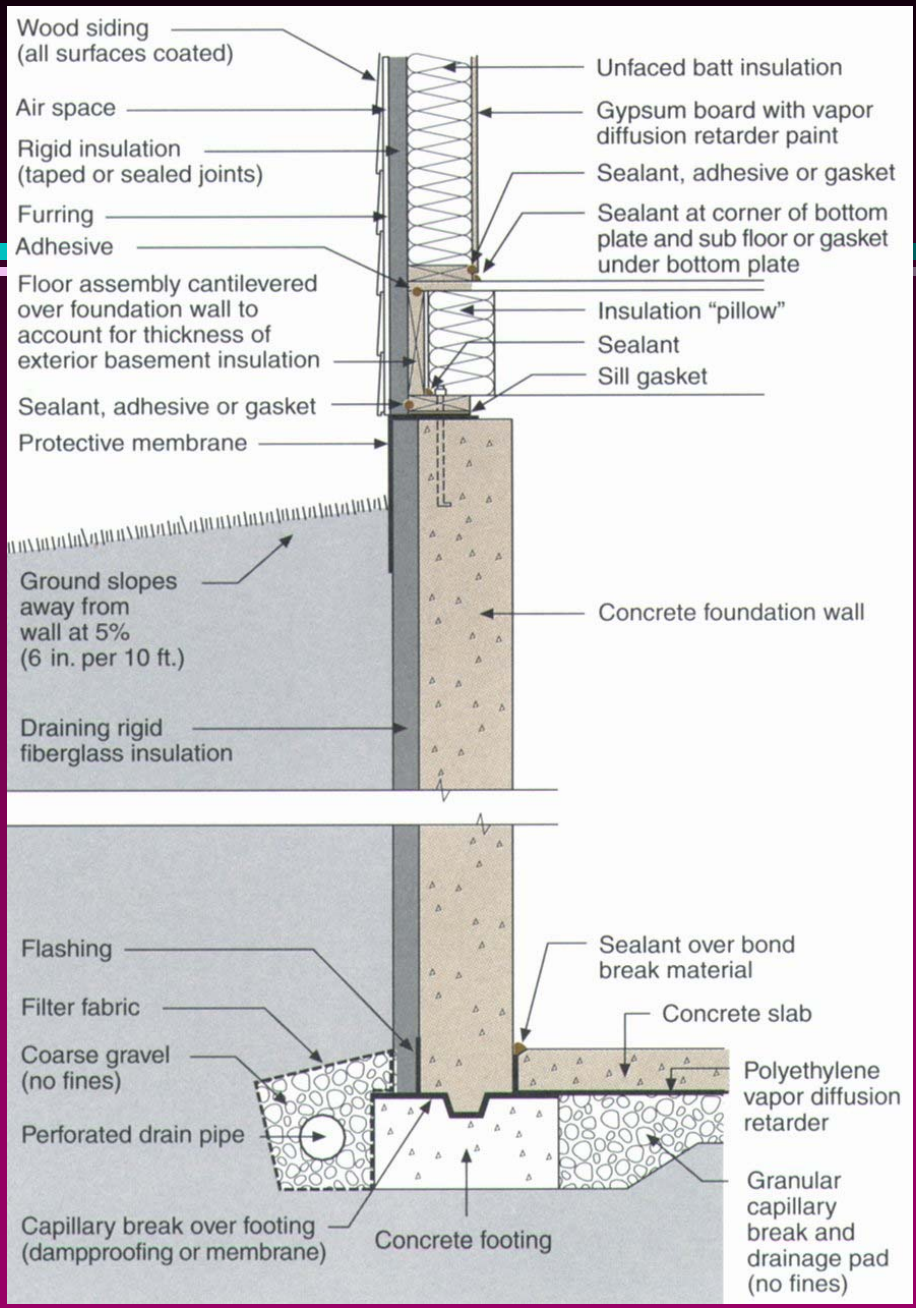
Basement - Exterior Insulation



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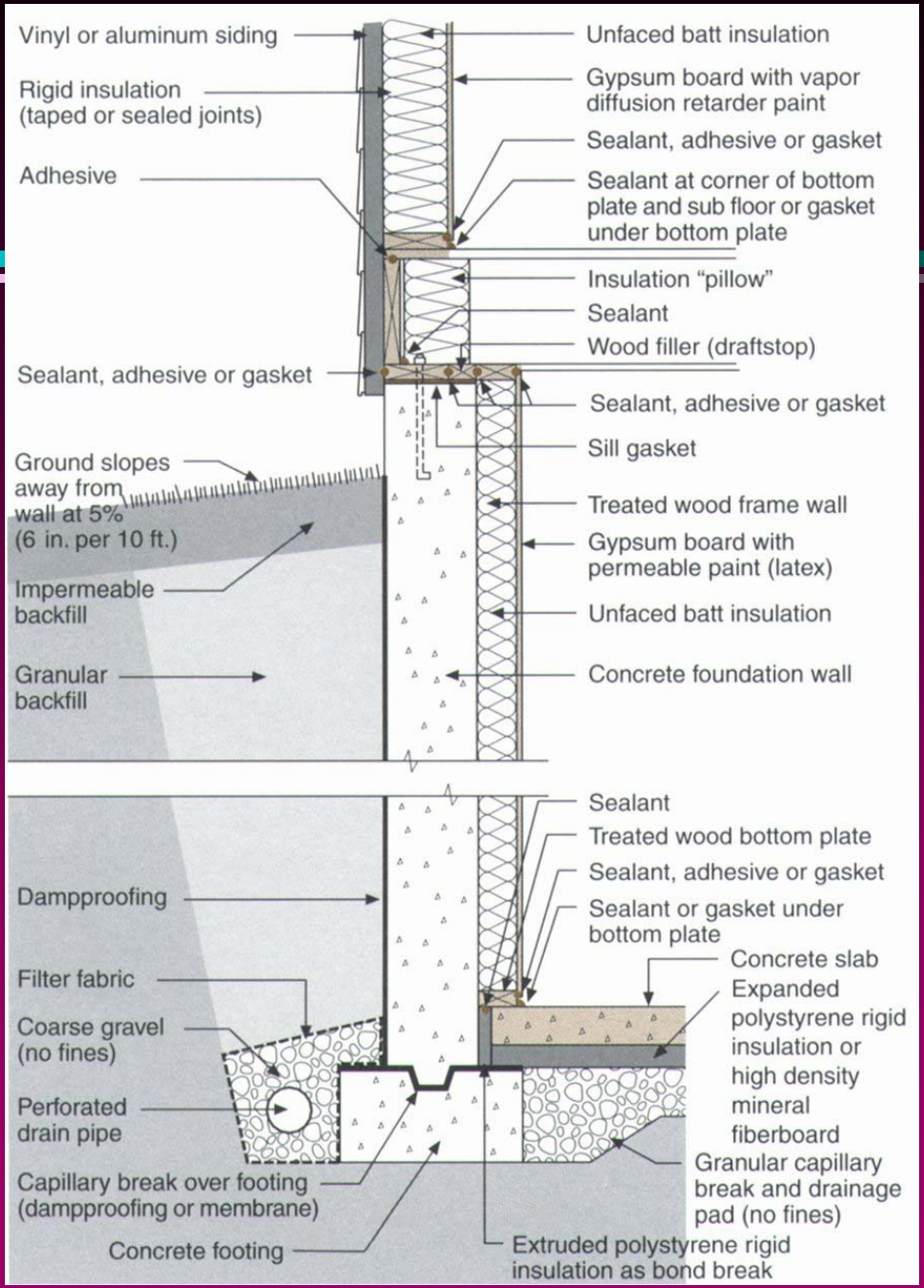
Basement - Interior Insulation



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Key Points - Rim Joist Area

- Install adequate sill sealer below sill plate and/or foam seal that joint
- Set rim joist back 1 1/2” to allow for extra exterior rigid insulation
- Use caulk or gasket at bottom of rim joist
- Use construction adhesive to seal flooring to rim joist
- Use caulk or gasket to seal wall plate to floor

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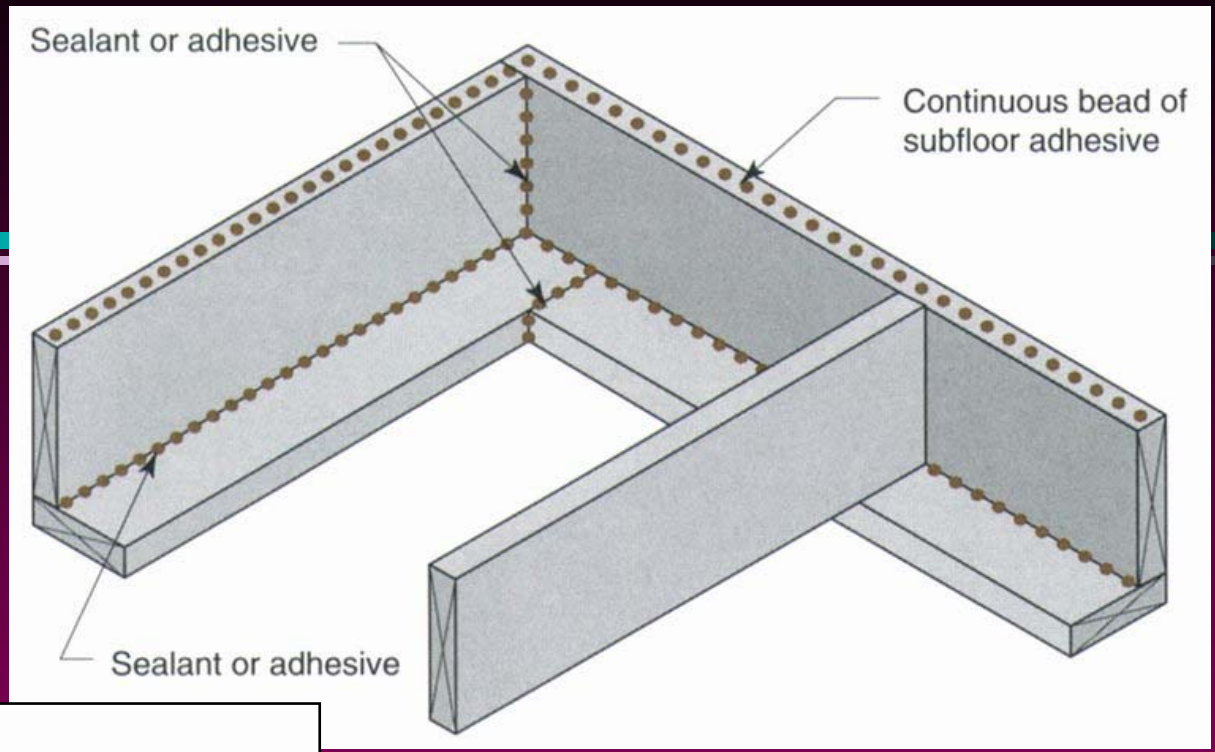
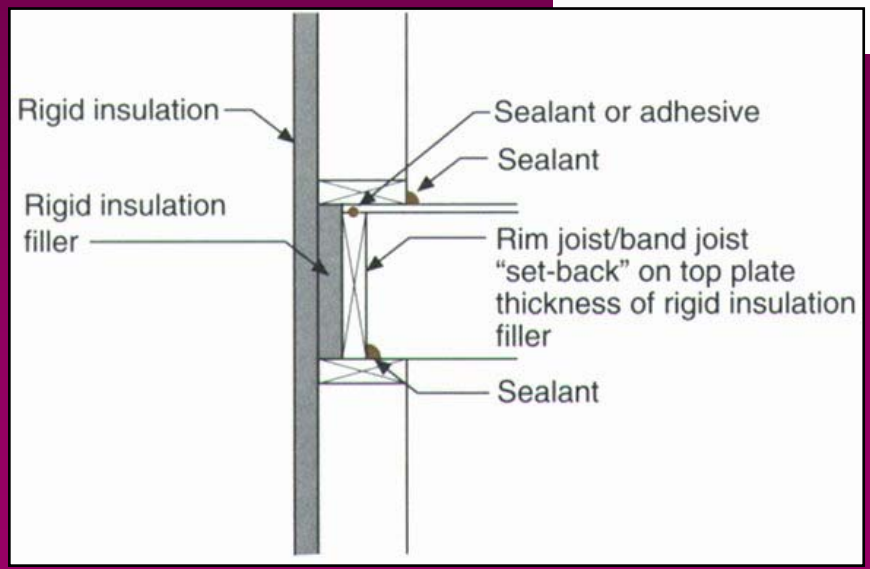
Rim Joist Details





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Key Points - Crawl Spaces

- Vented crawl spaces are a bad idea
- Ventilating a crawl space with exterior, humid air during the summer leads to condensation and wetting of cool crawl space assemblies
- Construct crawl spaces like mini basements that are heated in the winter and cooled in the summer

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Key Points - Crawl Spaces

- Dampproof top of footing and exterior of foundation wall
- Insulate the exterior or interior of the crawl space wall
- Install a continuous polyethylene vapor diffusion retarder on floor of crawl space that is sealed to the foundation walls and internal supports

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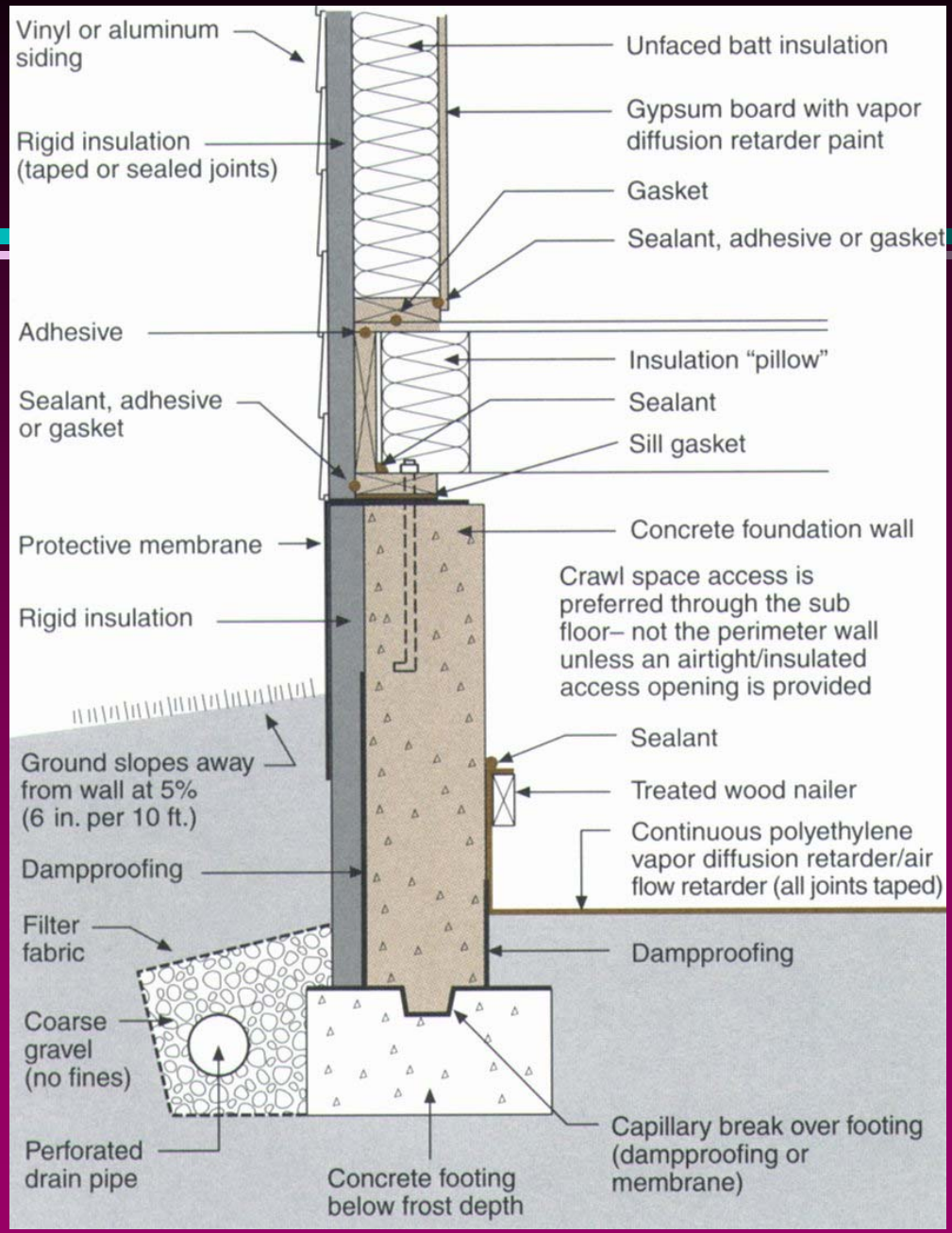
Crawl Space Exterior Insulation



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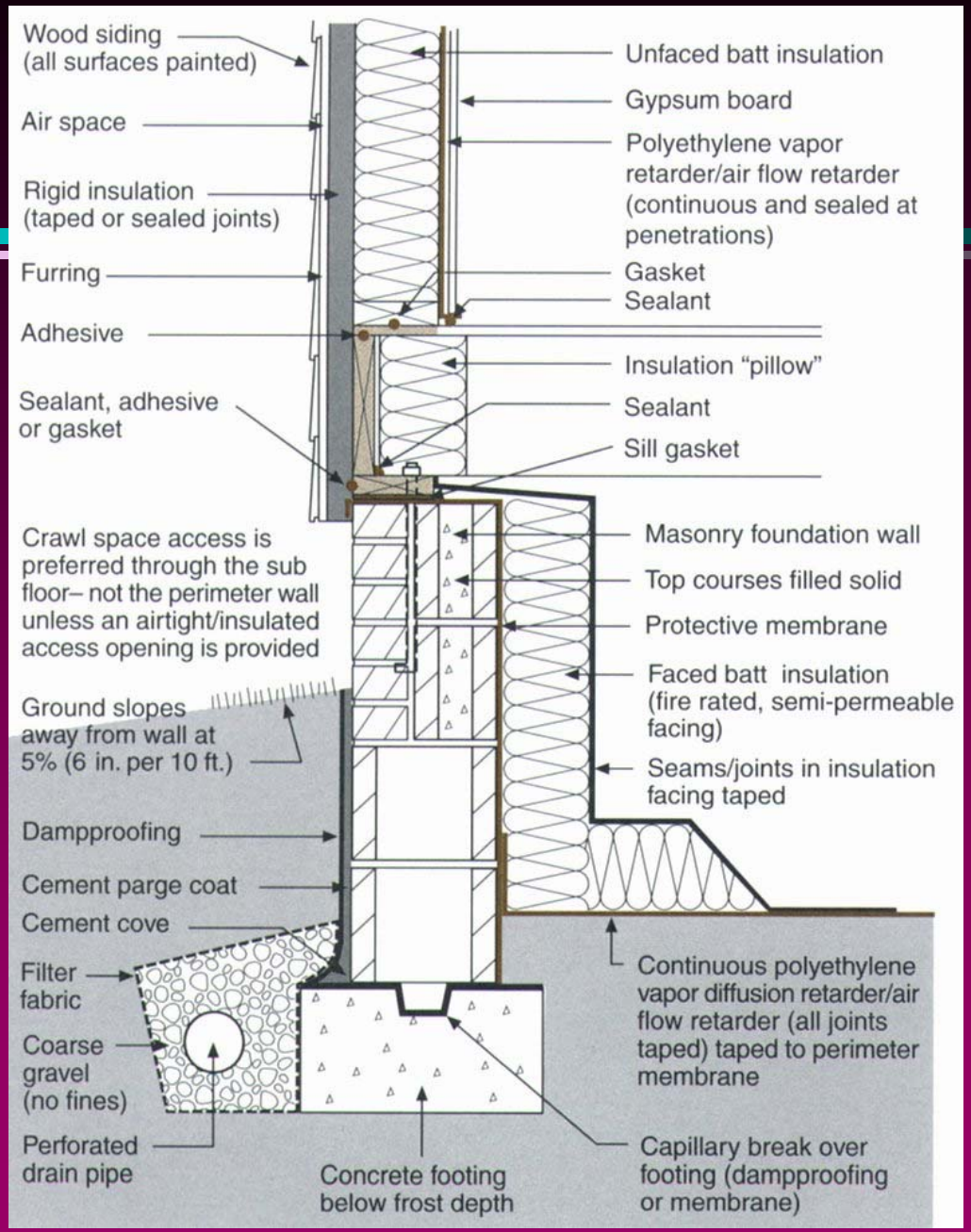
Crawl Space Interior Insulation



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Key Points - Slabs-on-Grade

- Isolate perimeter of slab with exterior or interior insulation
- Install granular drainage pad under slab
- Install high density expanded polystyrene under entire slab
- If you want to install carpet on the slab, it must be insulated or it could lead to serious health problems

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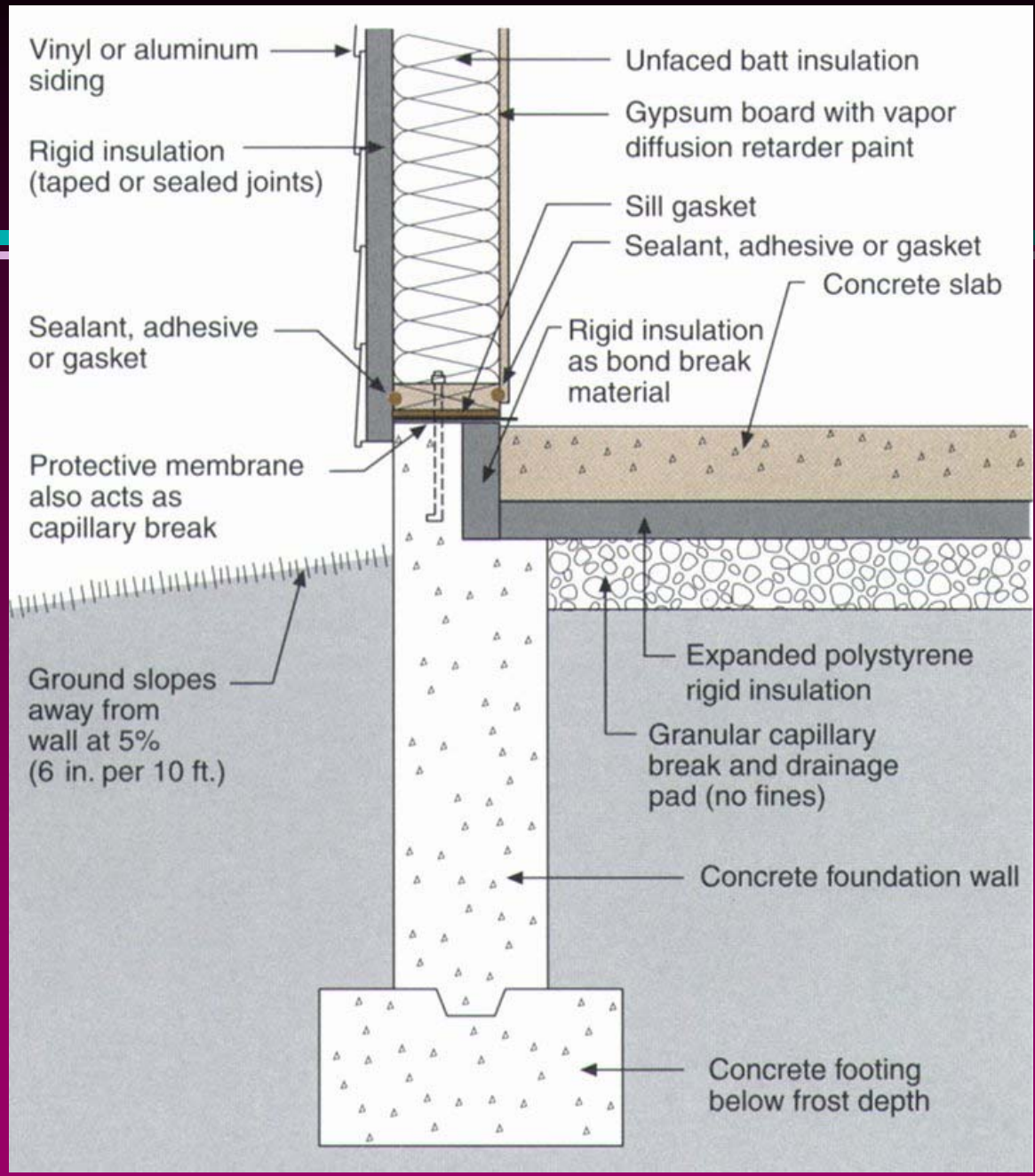
Slab Detail



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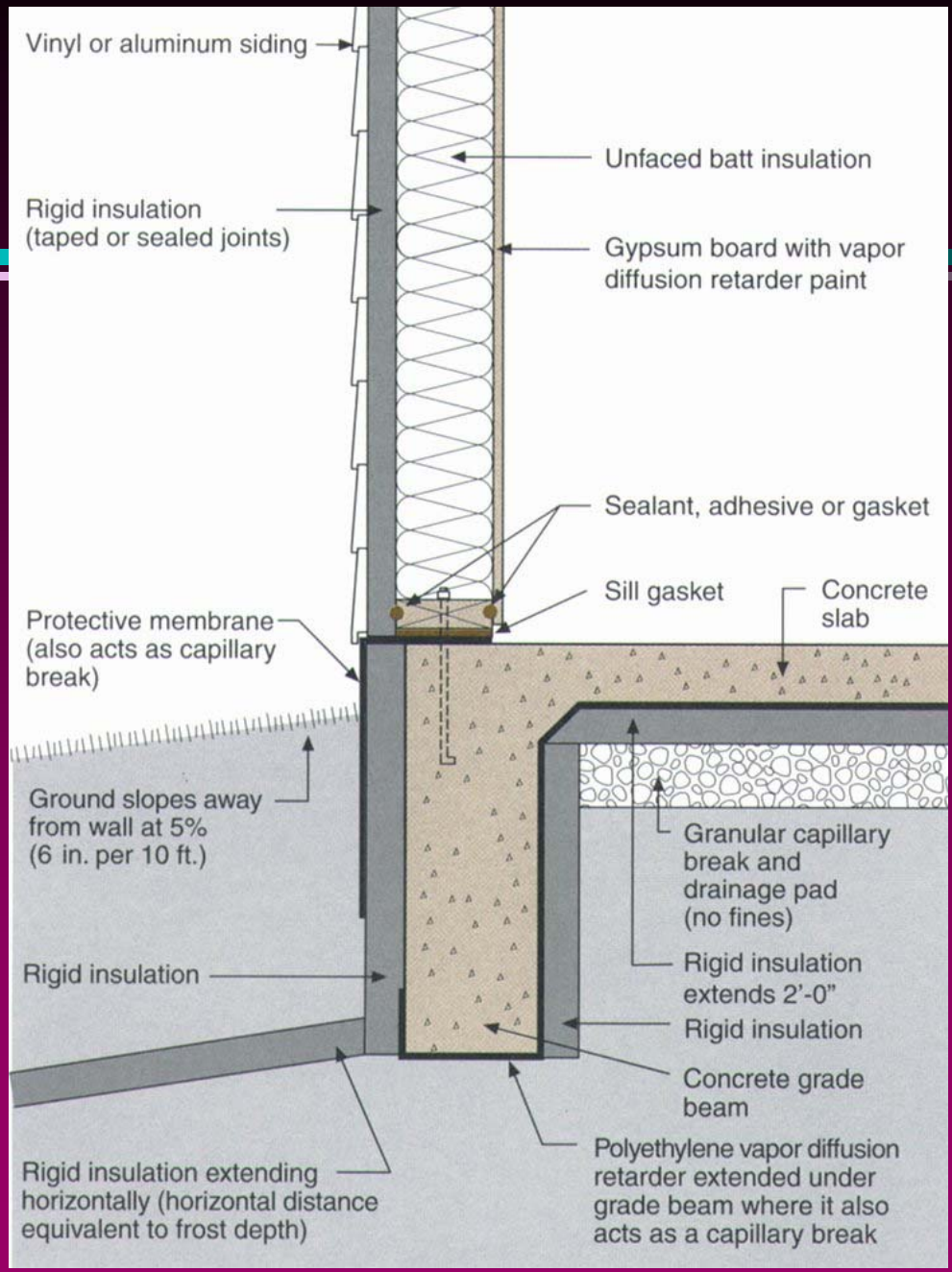
Frost-Free Shallow Foundation



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Key Points - Floors Over Unheated Spaces

- Treat like wall turned on side
- Seal all joints at rim joist and between heated and unheated spaces
- Insulate floor cavity and install rigid insulated sheathing on cold side

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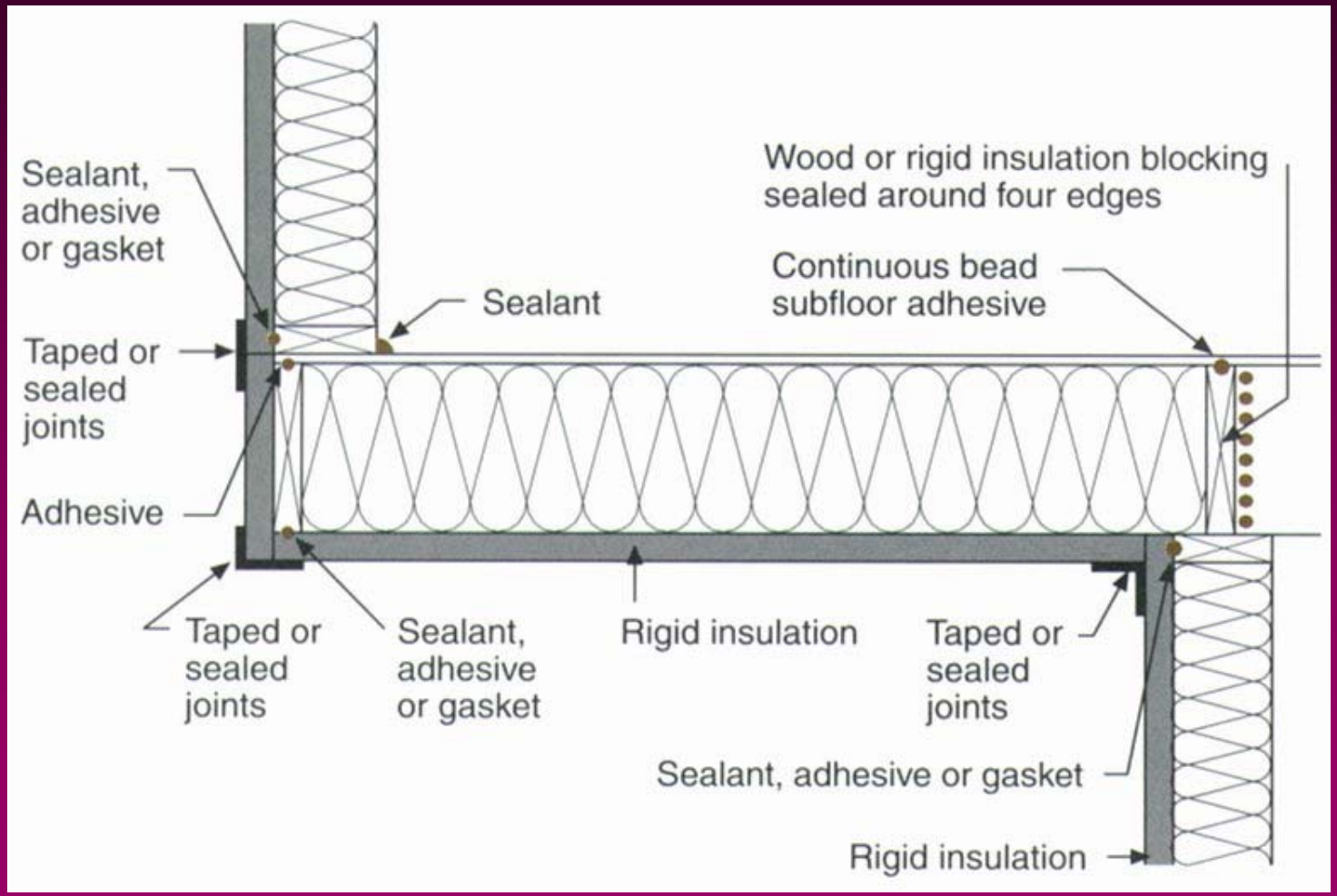
Cantilevered Floor Detail



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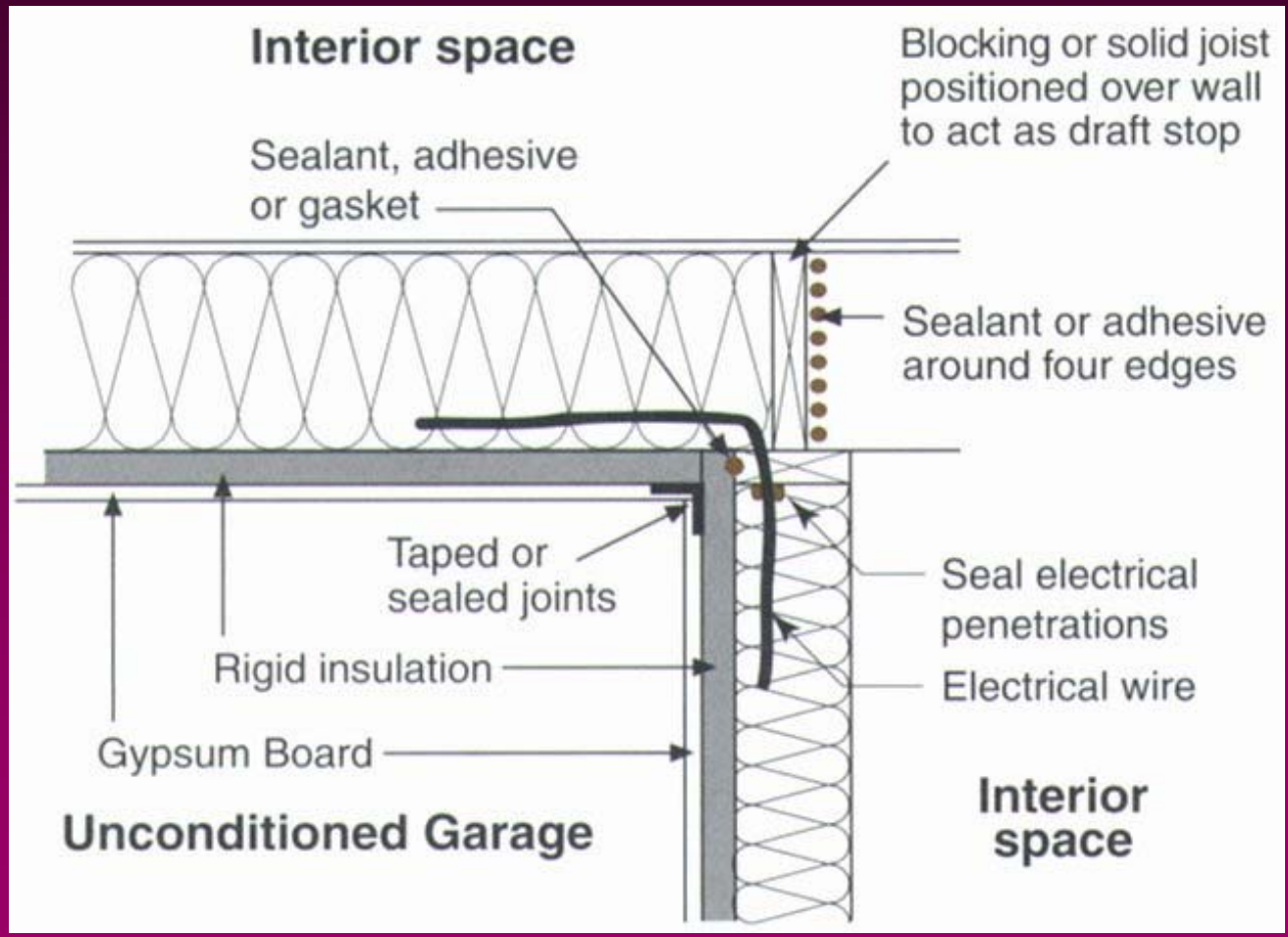
Floor Over Garage Detail



Walls

Build Them Right....Solve Many Callbacks

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Key Points - Walls

- Minimize unnecessary use of structure

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We Use Too Much Wood . . .

- Three stud corners
- Three stud interior/exterior wall connections
- Headers in non-load bearing walls
- Double top plates, because we haven't learned to line up roof framing with wall and floor framing
- Studs at 16" o.c. instead of 24"

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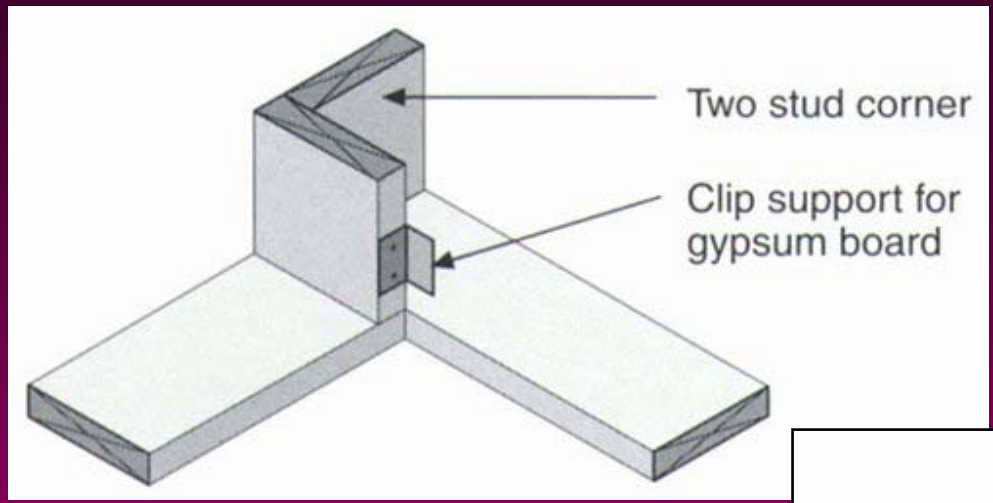
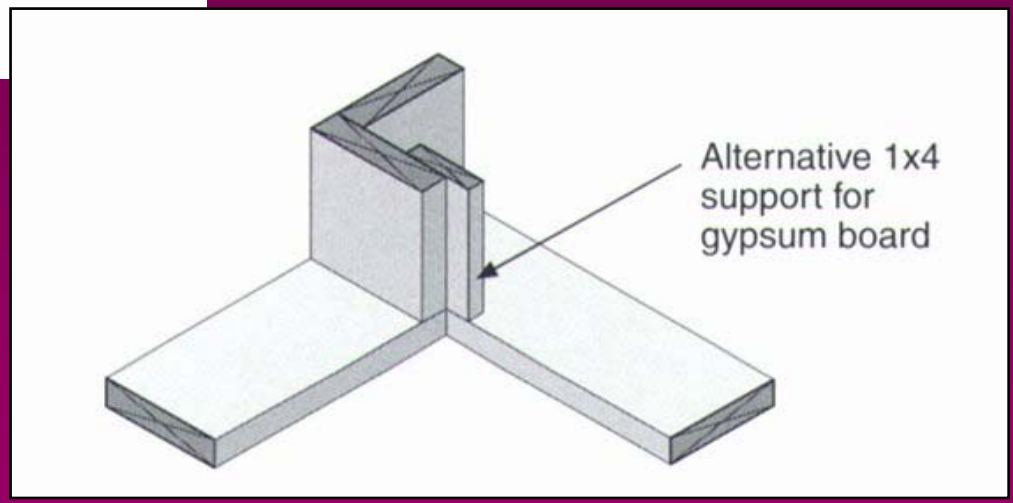
Alternative Corners





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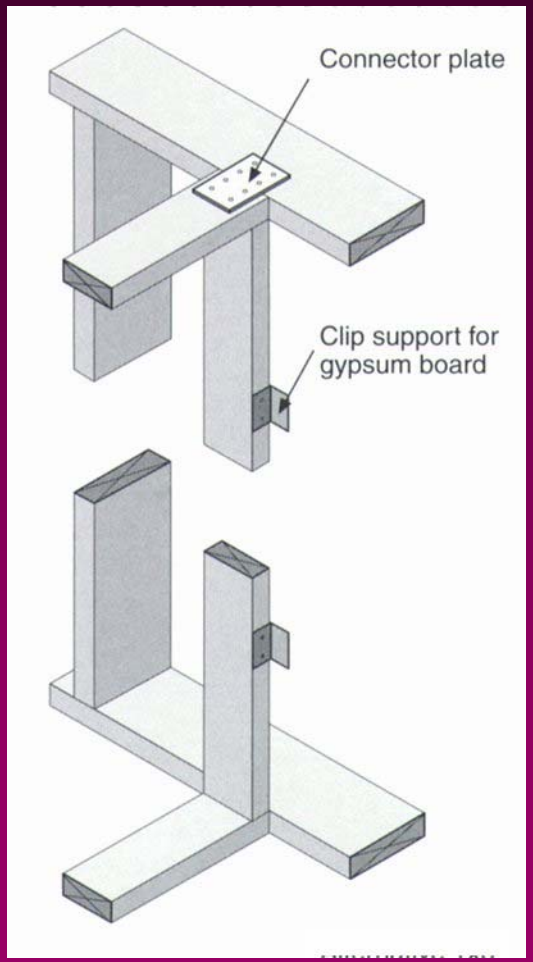
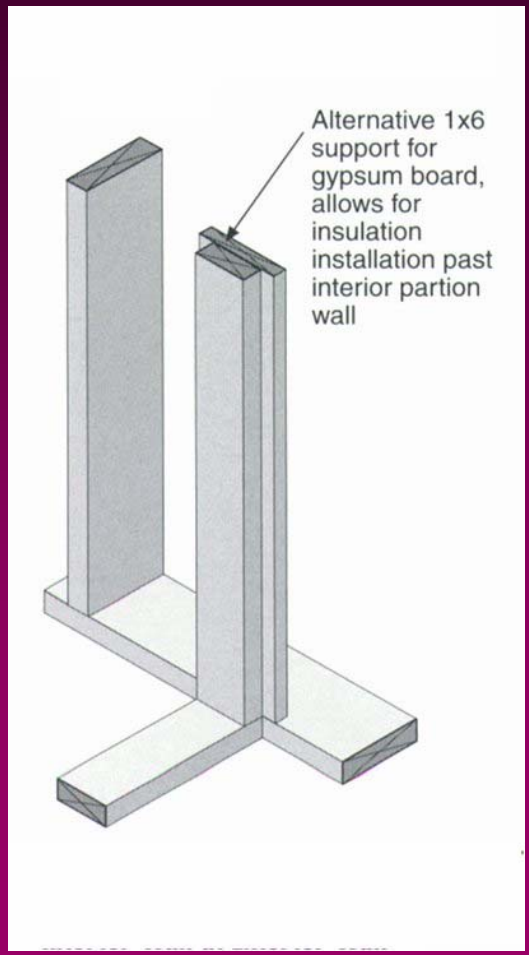
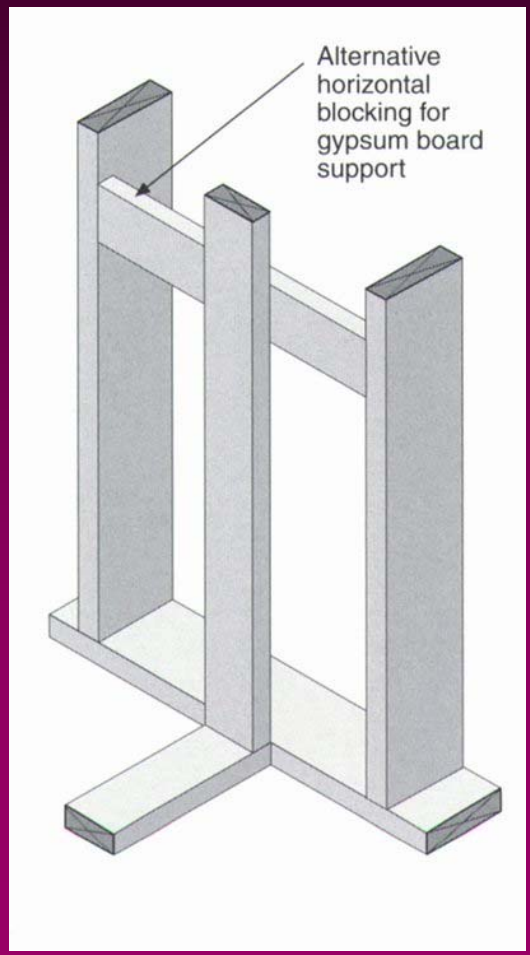
Alternative Interior Wall at Exterior Wall Connection







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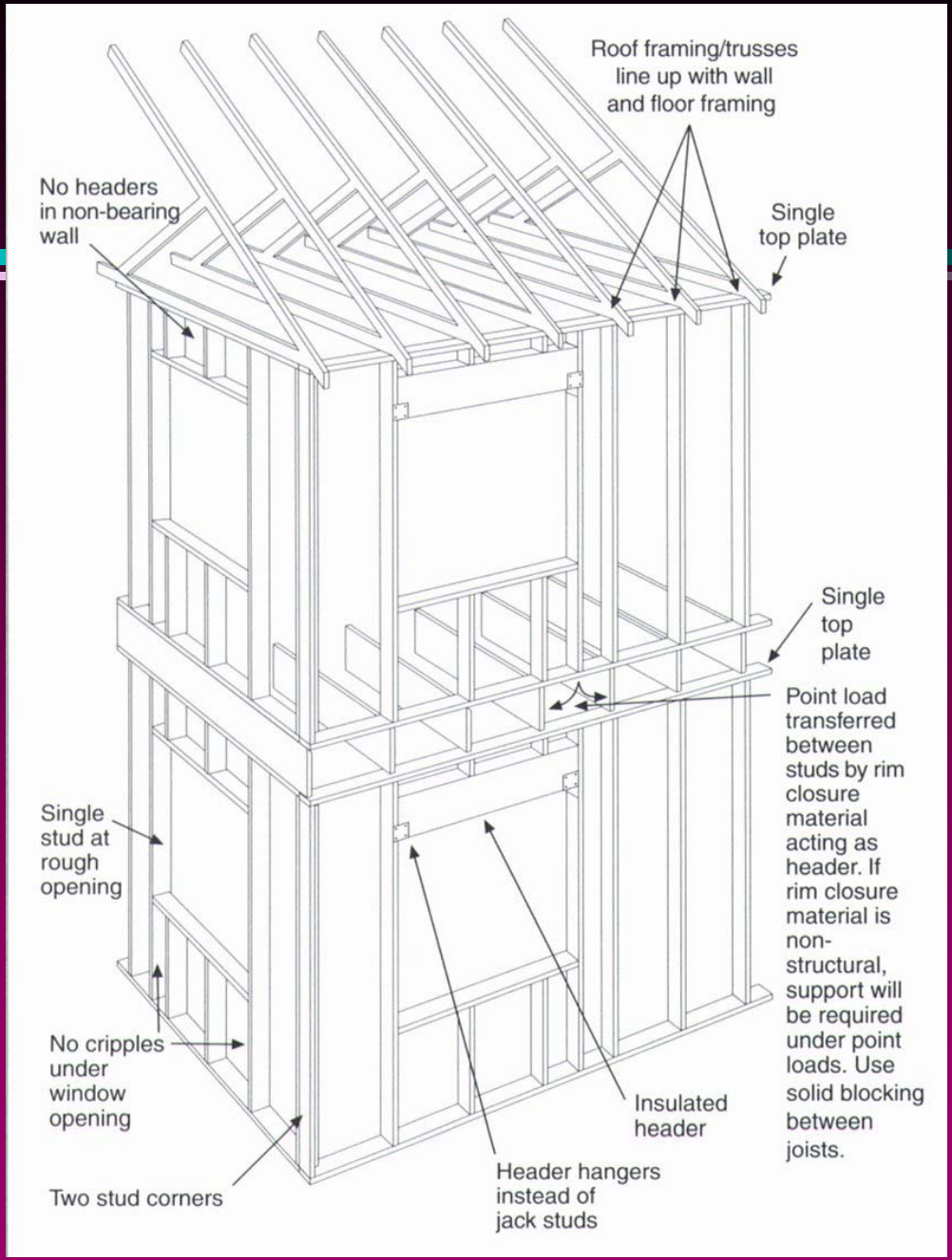
Stack Framing Detail



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Key Points - Walls

- Minimize unnecessary use of structure
- Seal joint where wall plate sits on floor
- Use some type of vapor diffusion retarder
- Insure that interior surface is as airtight as possible -- especially electric boxes
- Install a minimum of 1” rigid insulation as exterior sheathing and tape seams
- Coat all six sides of wood siding and install it over spacers to promote drainage and drying

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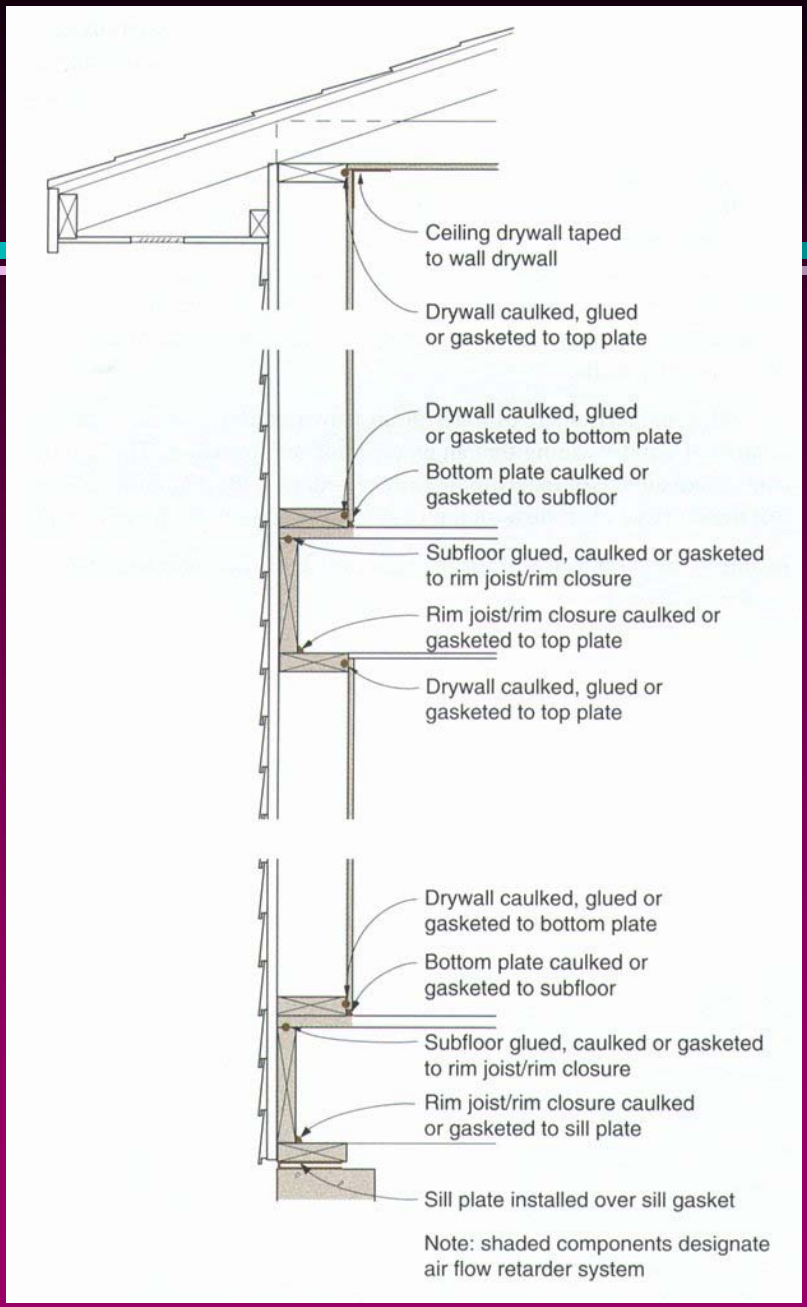
Wall Detail



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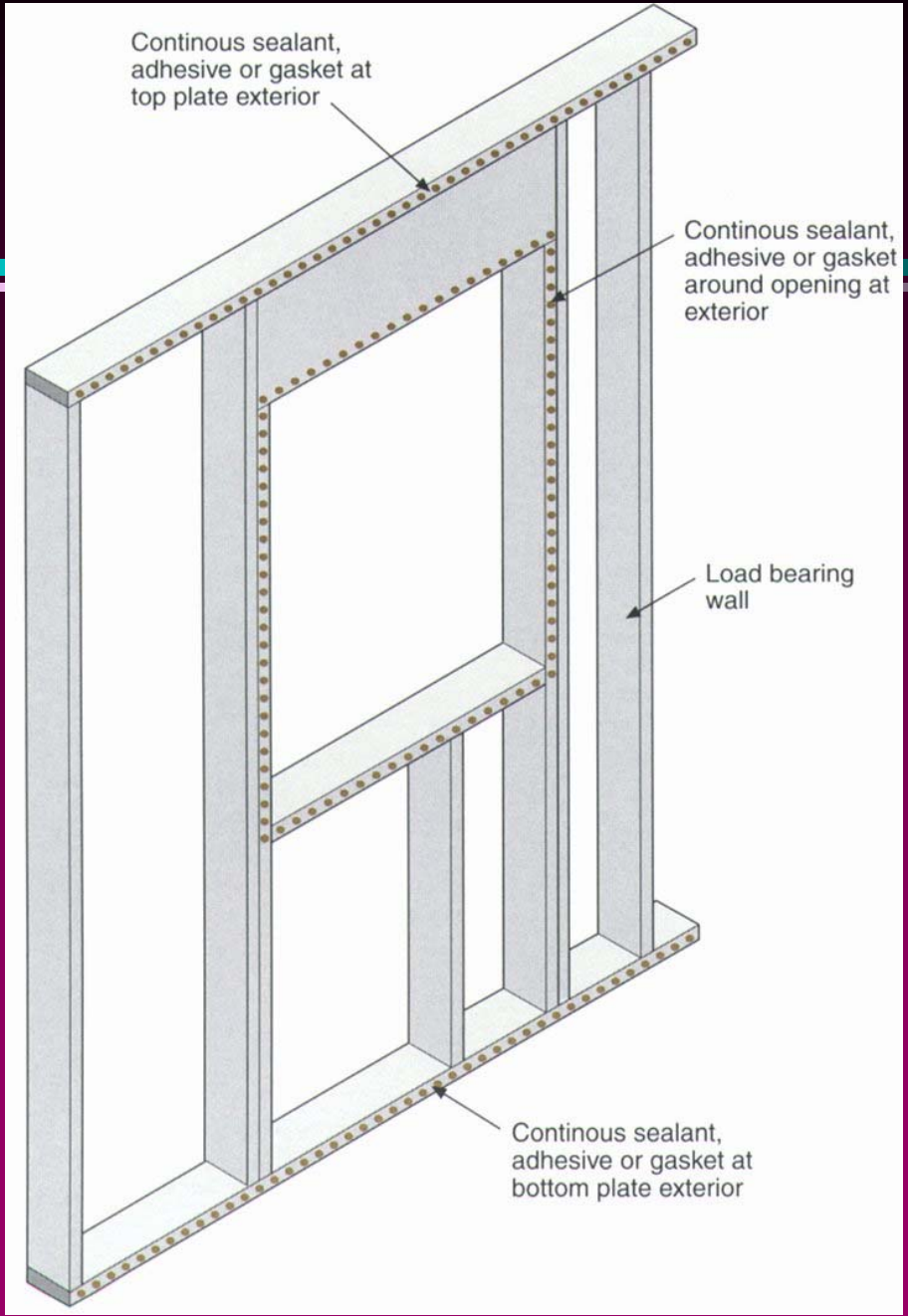
Sealing Rigid Insulation



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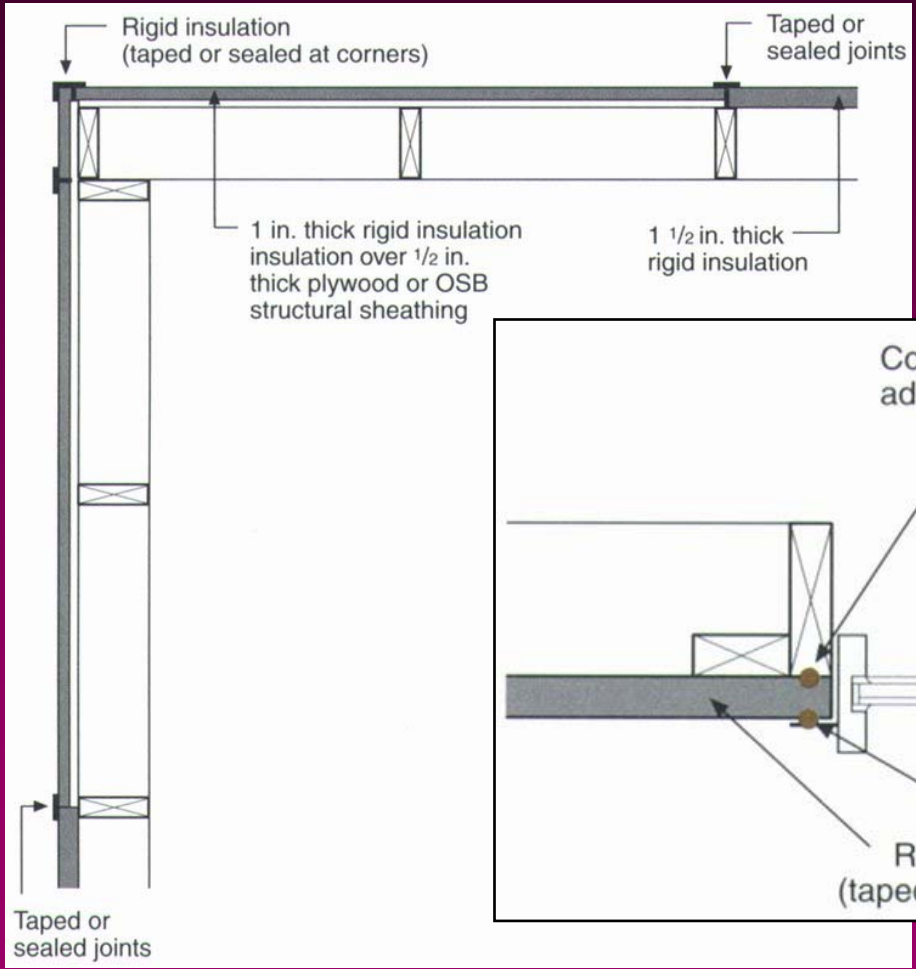
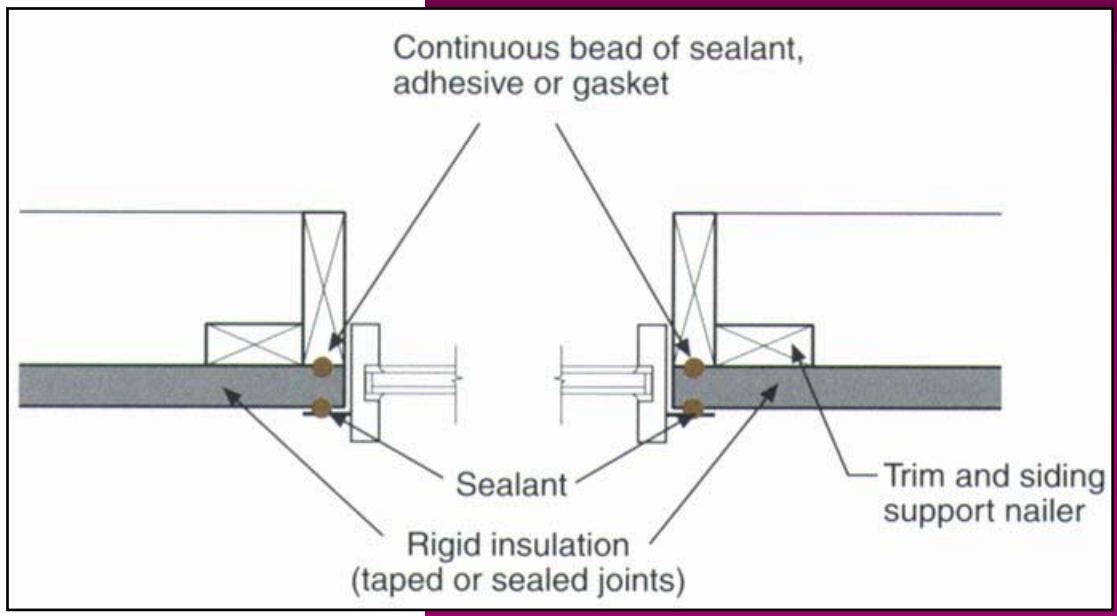
Rigid Insulation





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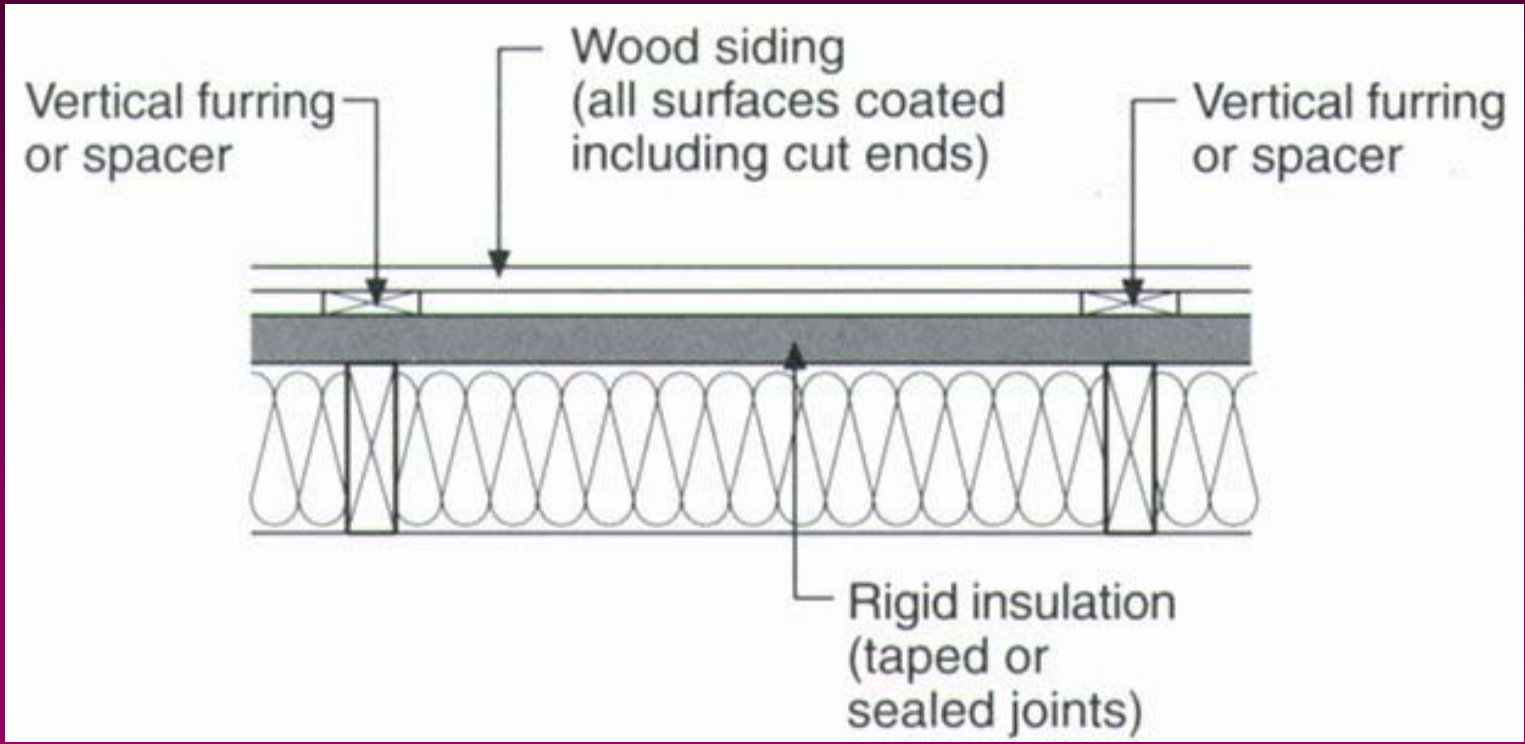
Wood Siding Installation



Windows & Doors

Let the sunshine in...and your neighbors

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Windows

- Casement/Awning windows are naturally tighter than double hung or sliders
- Avoid aluminum windows unless they have an adequate thermal break
- Use a minimum of double-glazed low-E
- Window placement: 40% on south, 30% on East, 20% on west, 10% on north
- 100 Square feet of west glass will require an additional ton of air conditioning
- Provide adequate overhangs for south windows

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Doors

- Install a high R-value door. Doors with R-15 are available
- Install French doors as instead of sliding glass doors because they seal tighter
- Vestibule entries are not cost-effective for our climate

Handling Wall Penetrations

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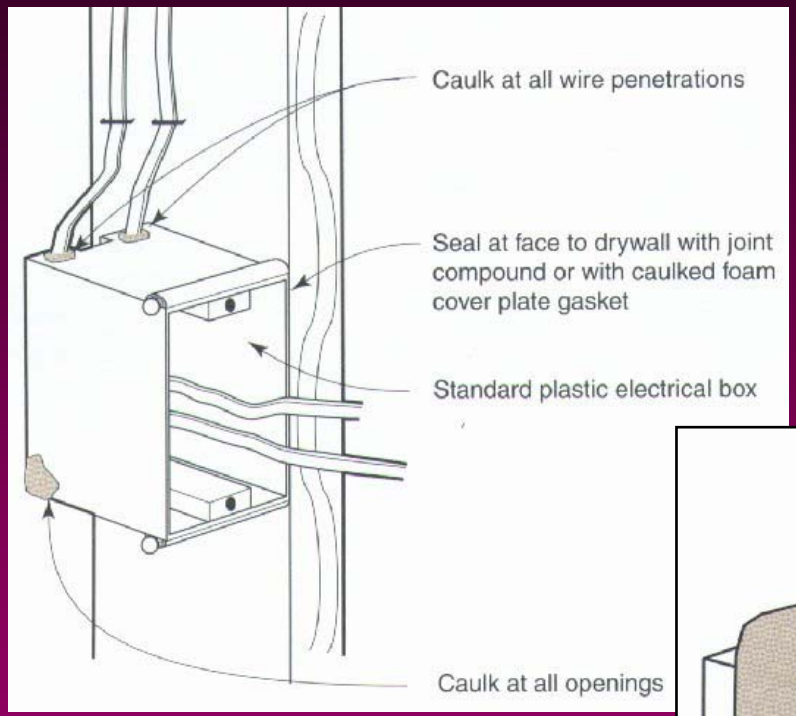
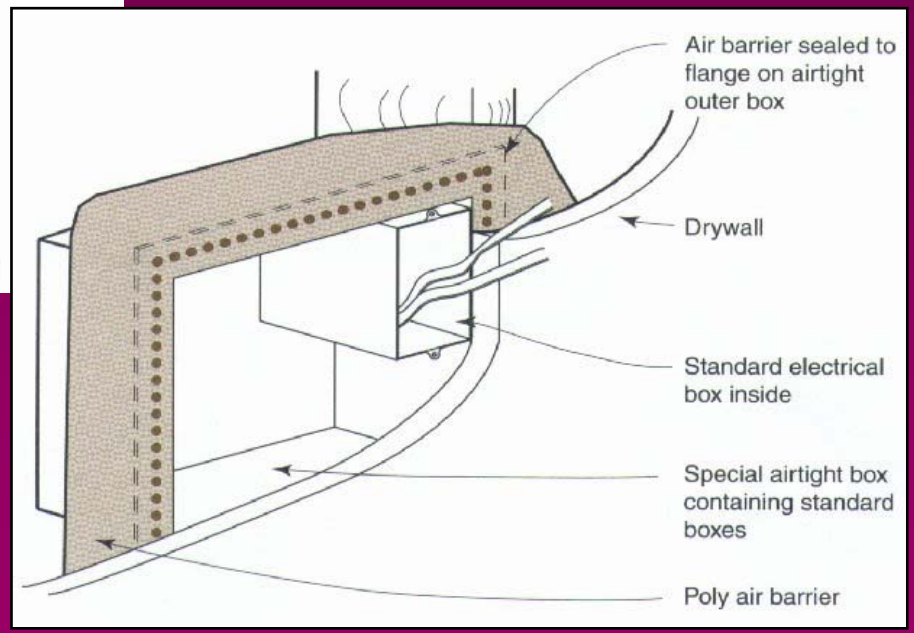
Electrical Boxes





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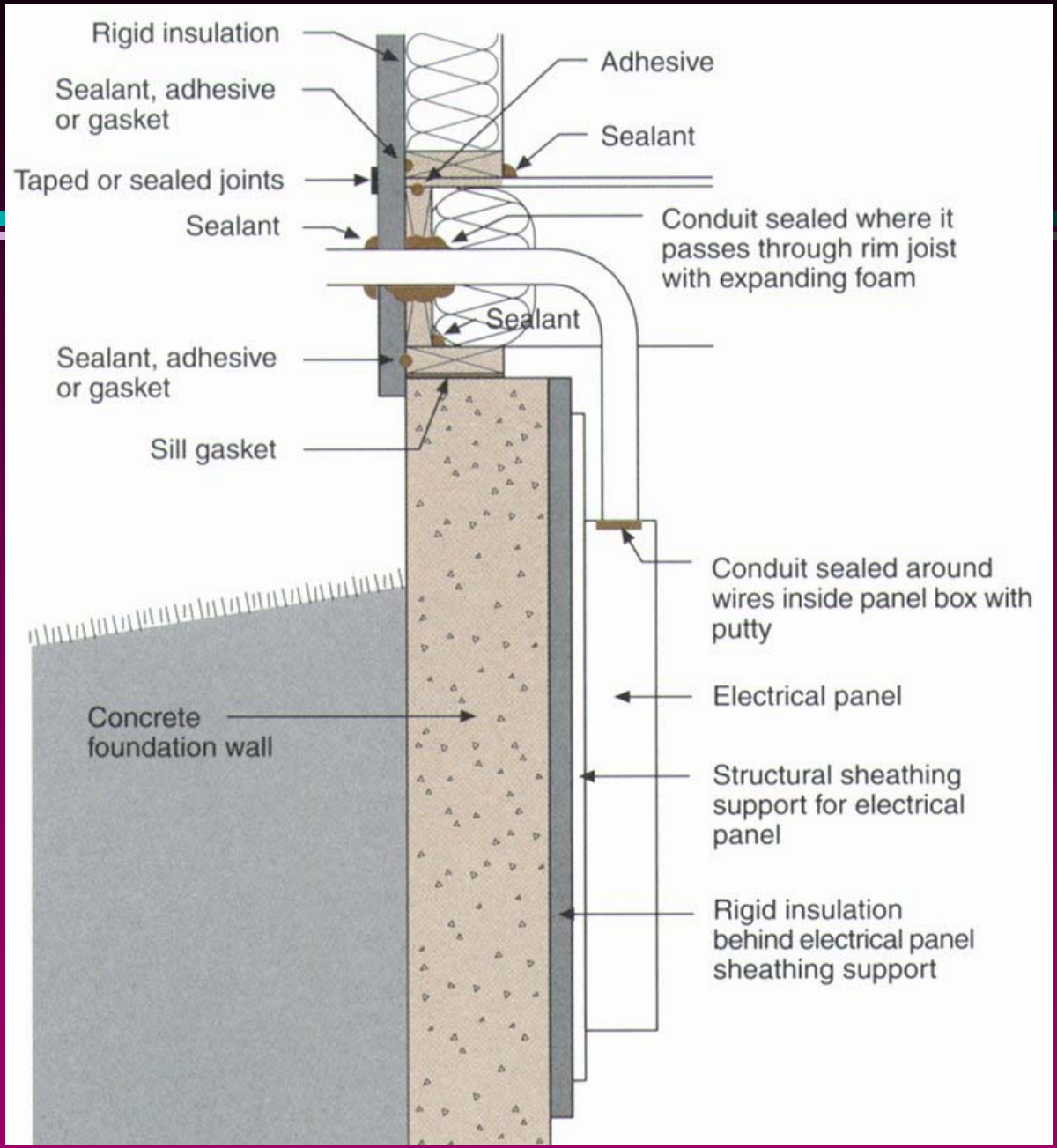
Electrical Service Sealing



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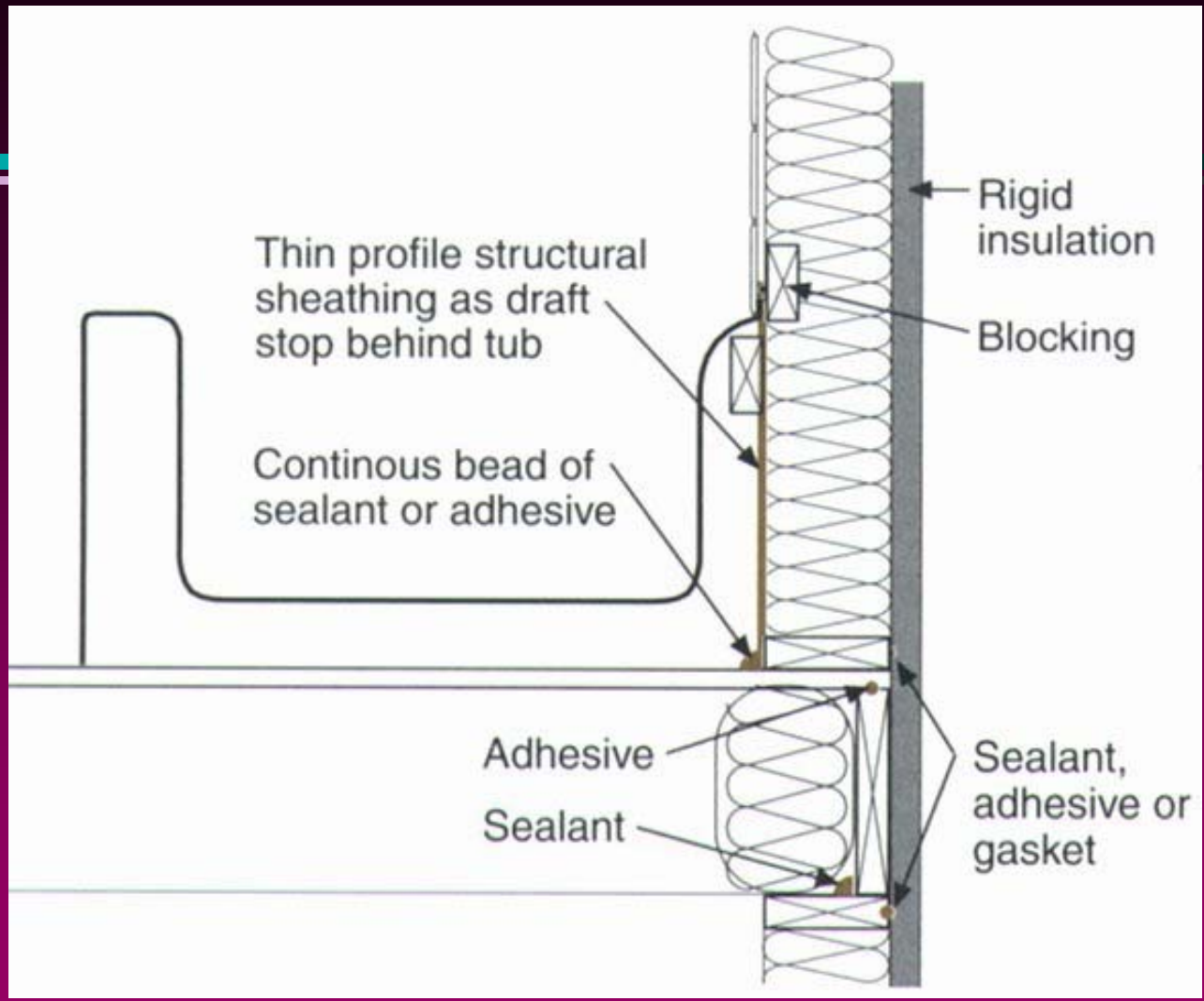
Bath Tub Installation



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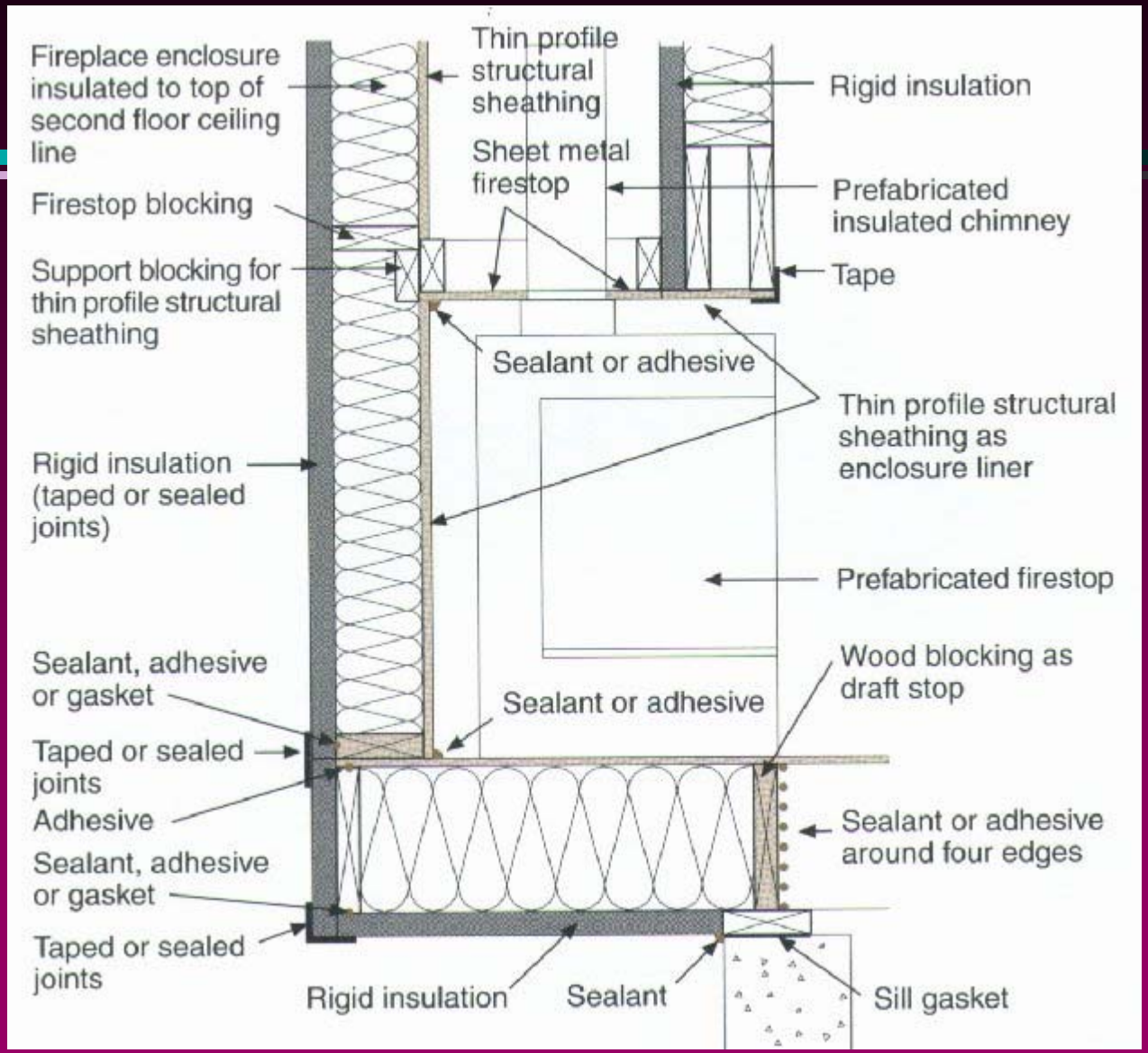
Fireplace Detail



Ceilings/Roofs

Need Special Attention to Stop Air Leaks

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Key Points
Ceilings and Roofs

- Select a roof truss that allows for adequate insulation/ventilation at top of exterior wall
- Install baffles at roof edge to allow ventilation and prevent windwashing of insulation
- Install a combination of continuous soffit and ridge vents -- never use powered ventilators
- Avoid unnecessary ceiling penetrations such as recessed lights
- Seal all penetrations into the ceiling/attic

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Roof Truss Options

- Raised Heal Truss
- Cantilevered Truss

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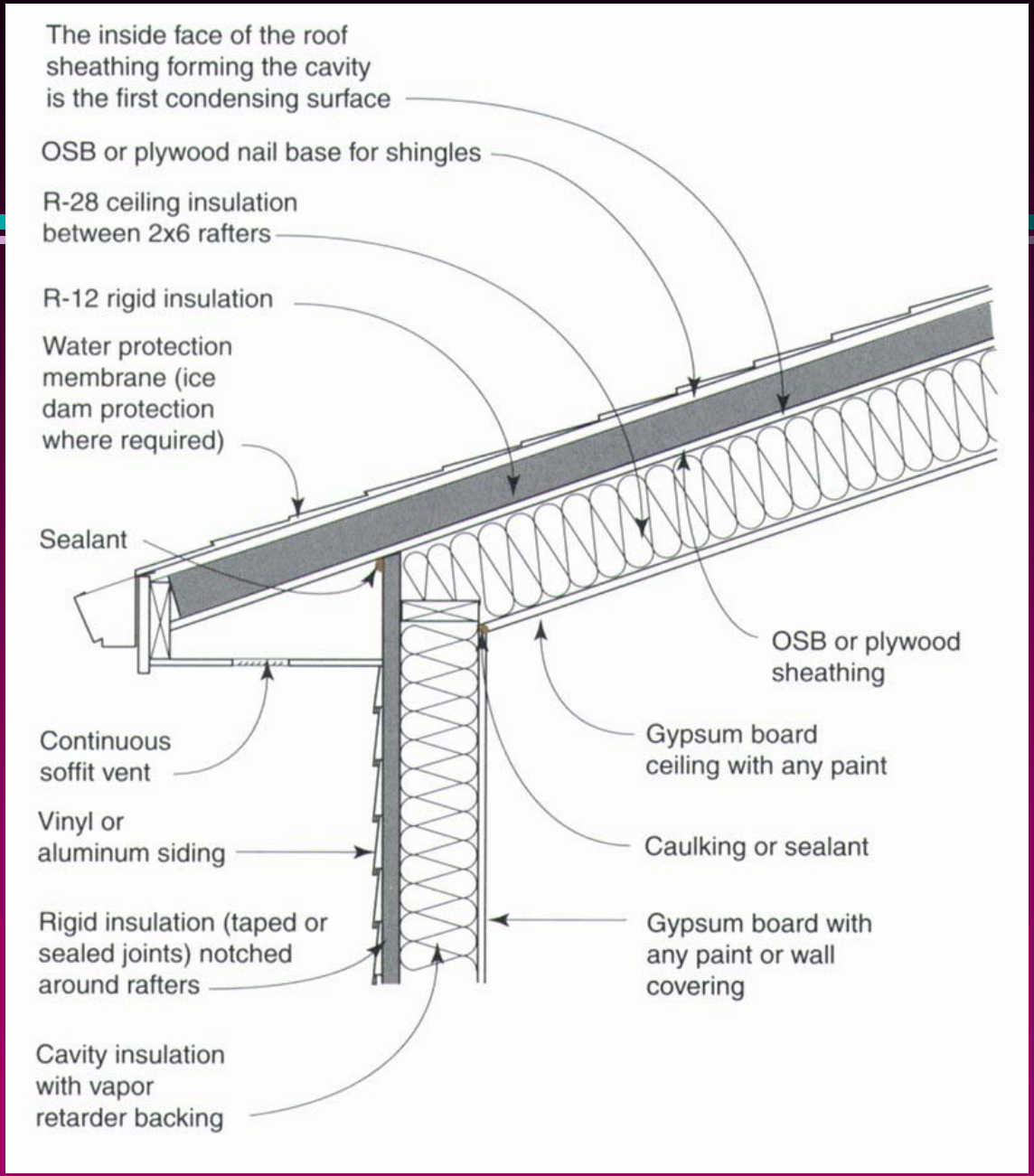
Hot Roof Detail



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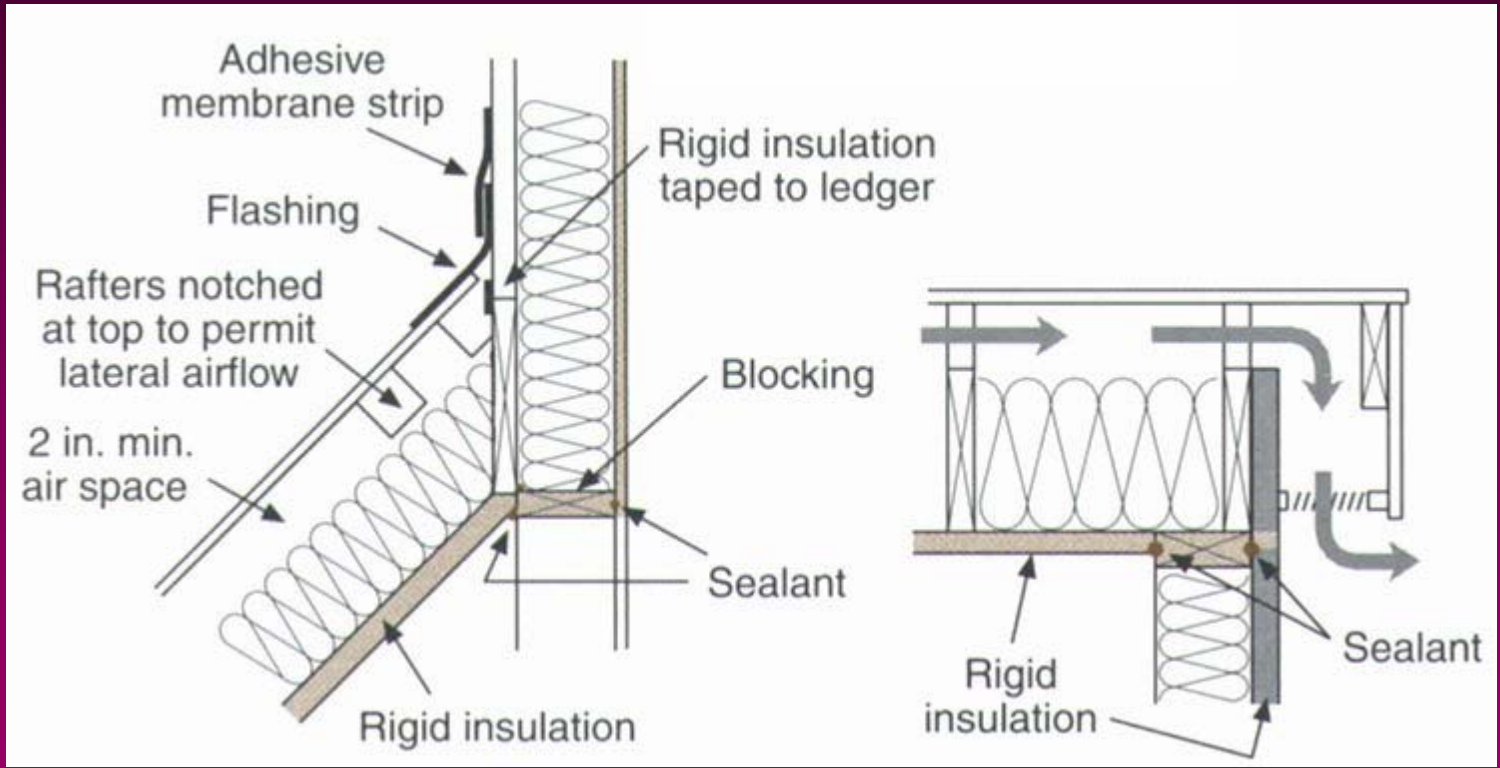
Vented Shed Roofs



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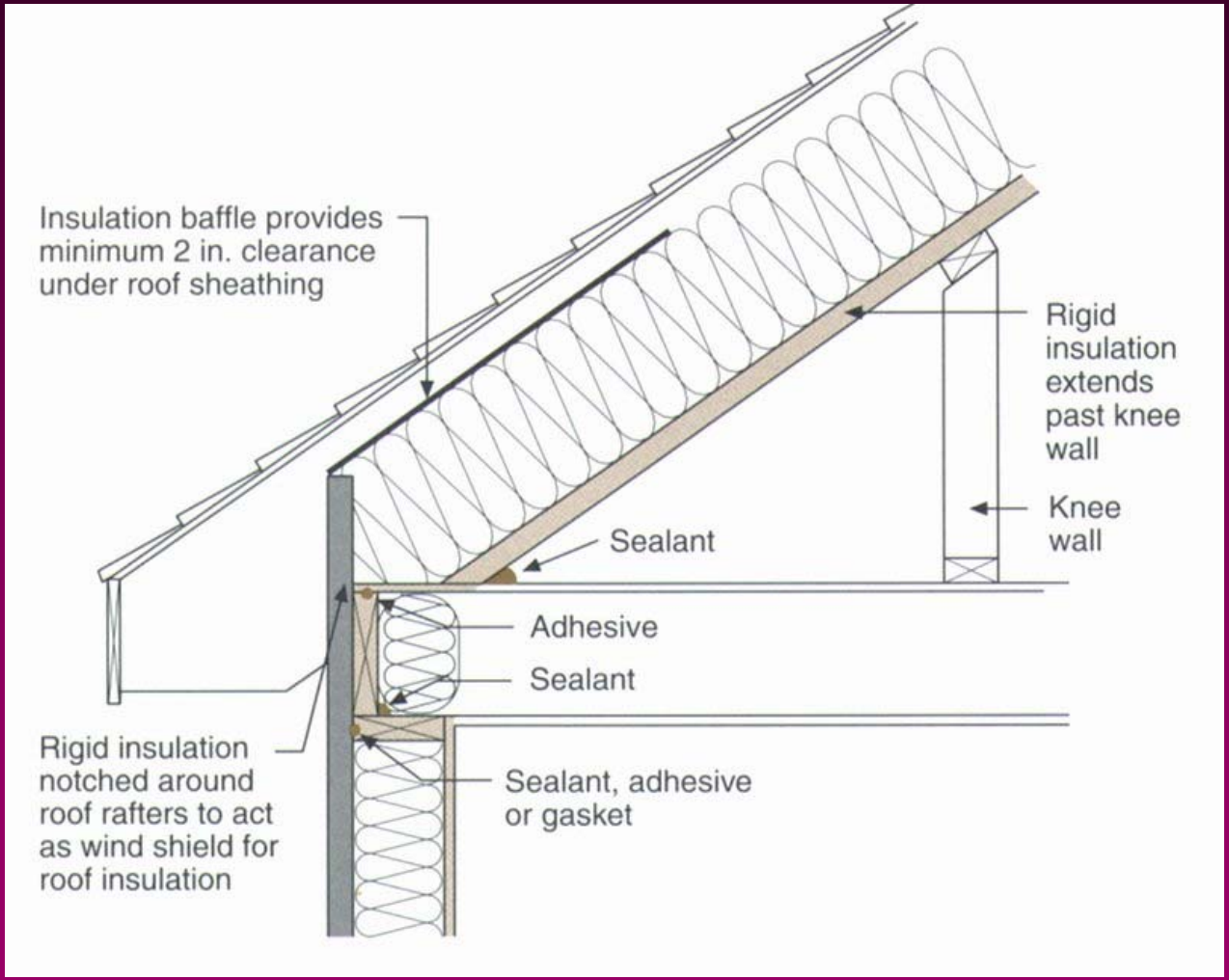
Knee Walls



Handling Ceiling Penetrations

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Ceiling Penetrations

- Wires at top of interior walls
- Ceiling light fixtures
- Recessed lights
- Utility Chases
- Plumbing stacks
- Flue pipes
- Attic hatches
- Dropped soffits

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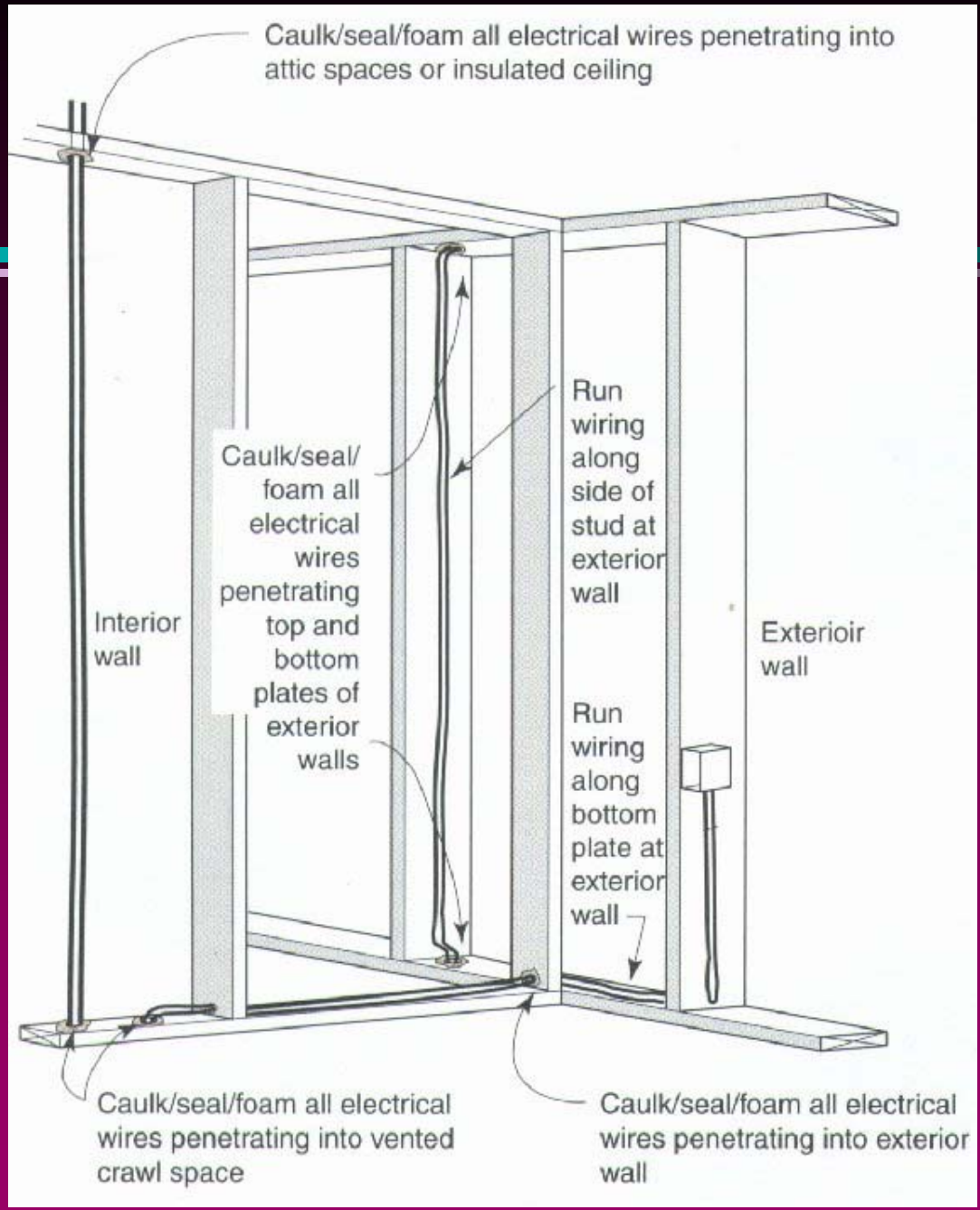
Electrical Wiring



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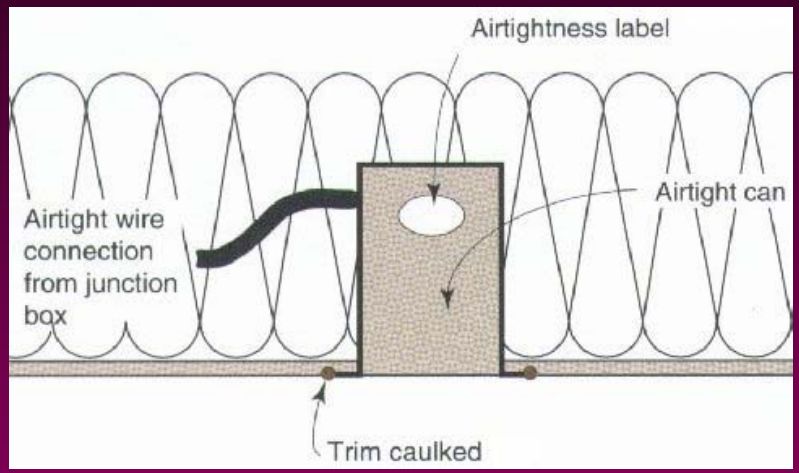
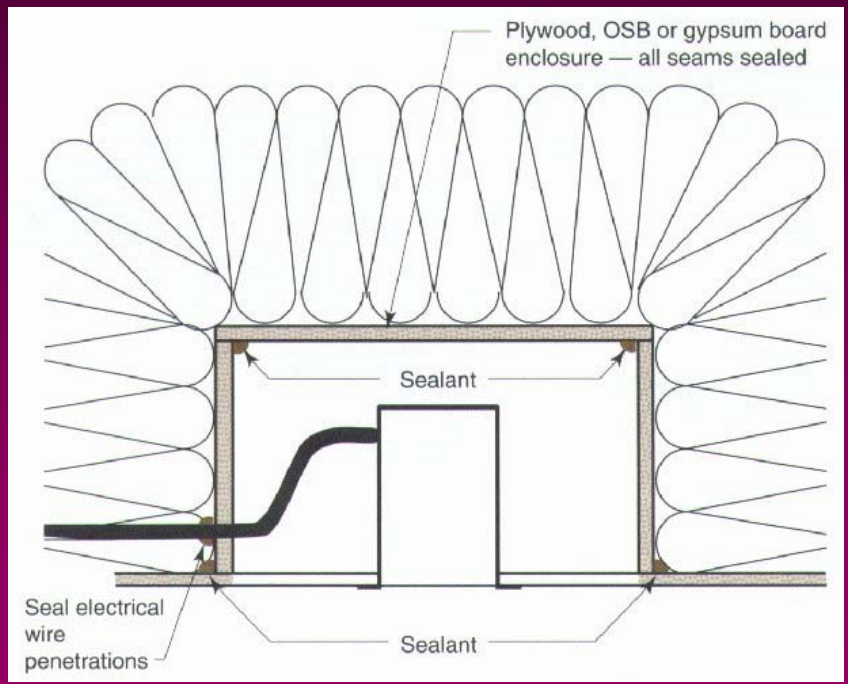
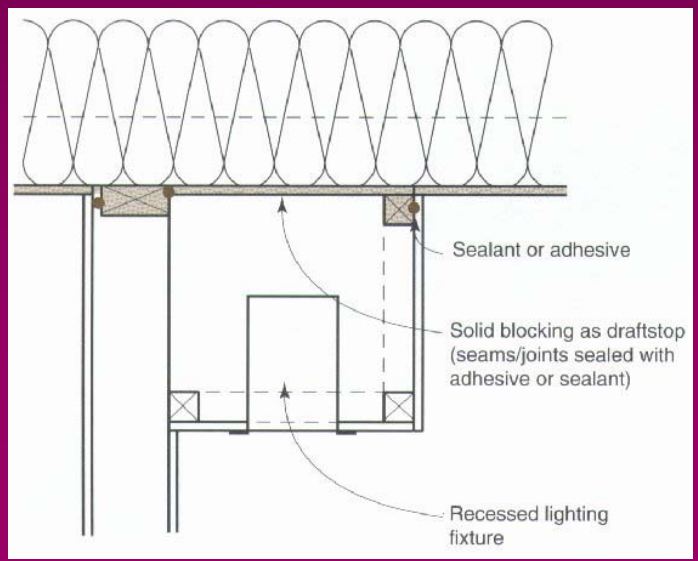
Recessed Light Options







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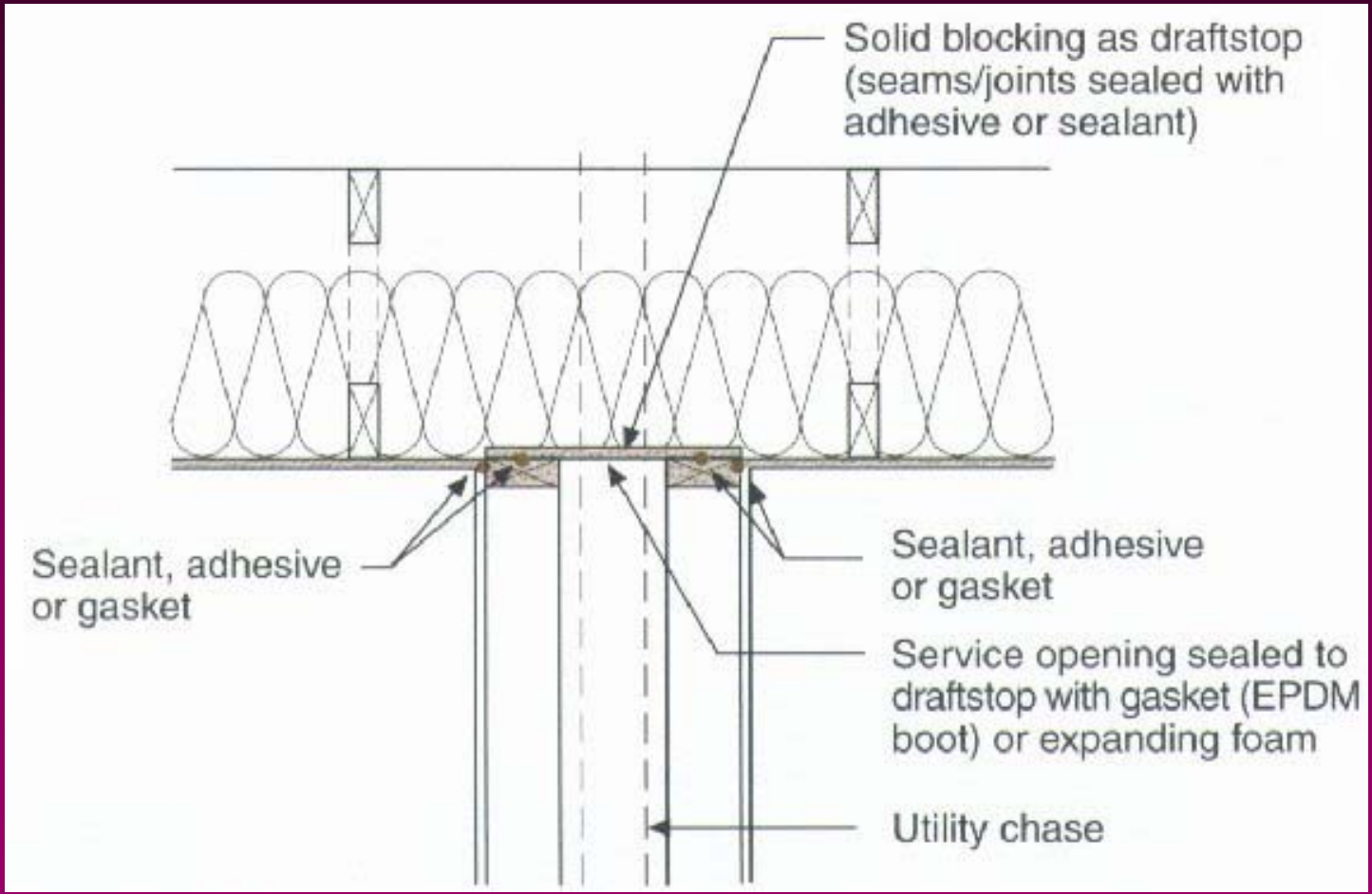
Utility Chase



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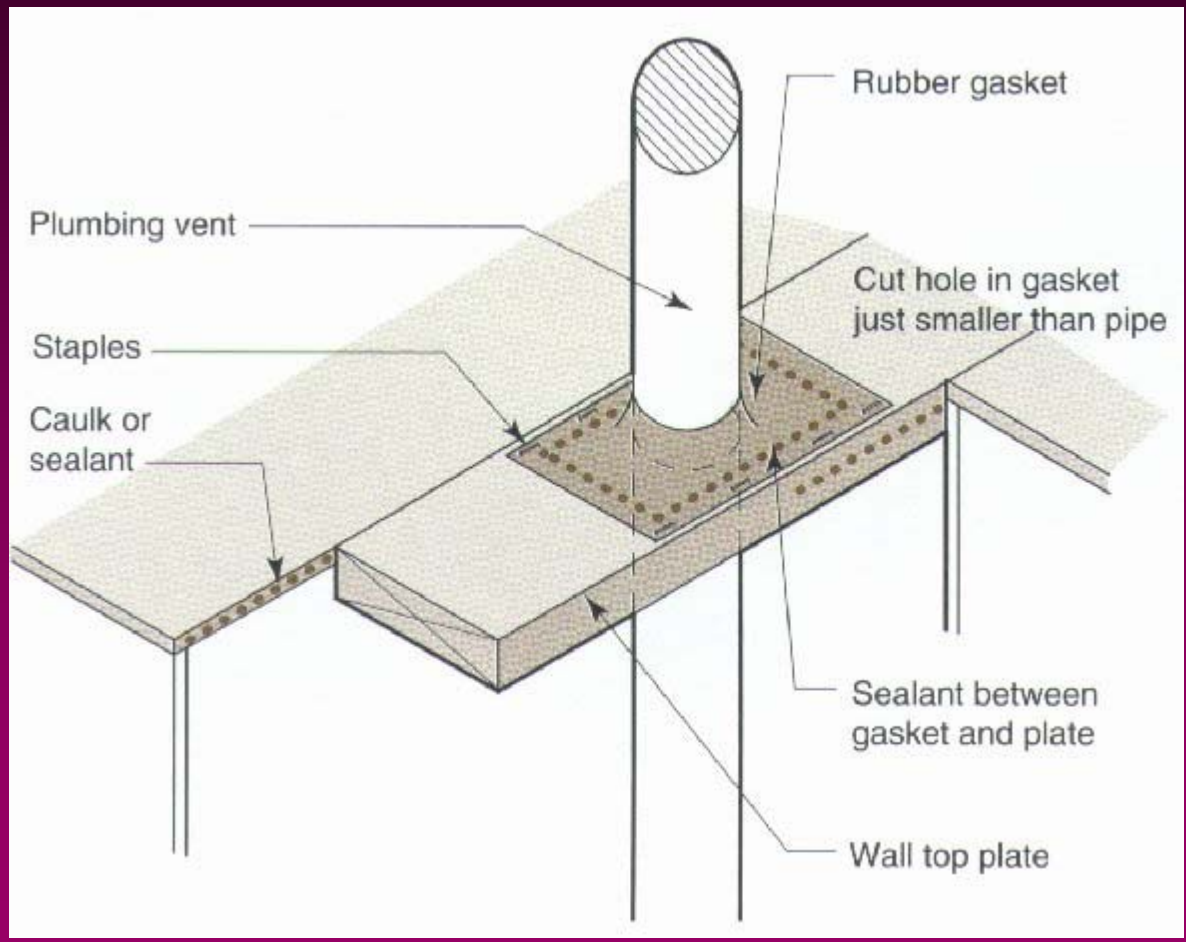
Plumbing Stack



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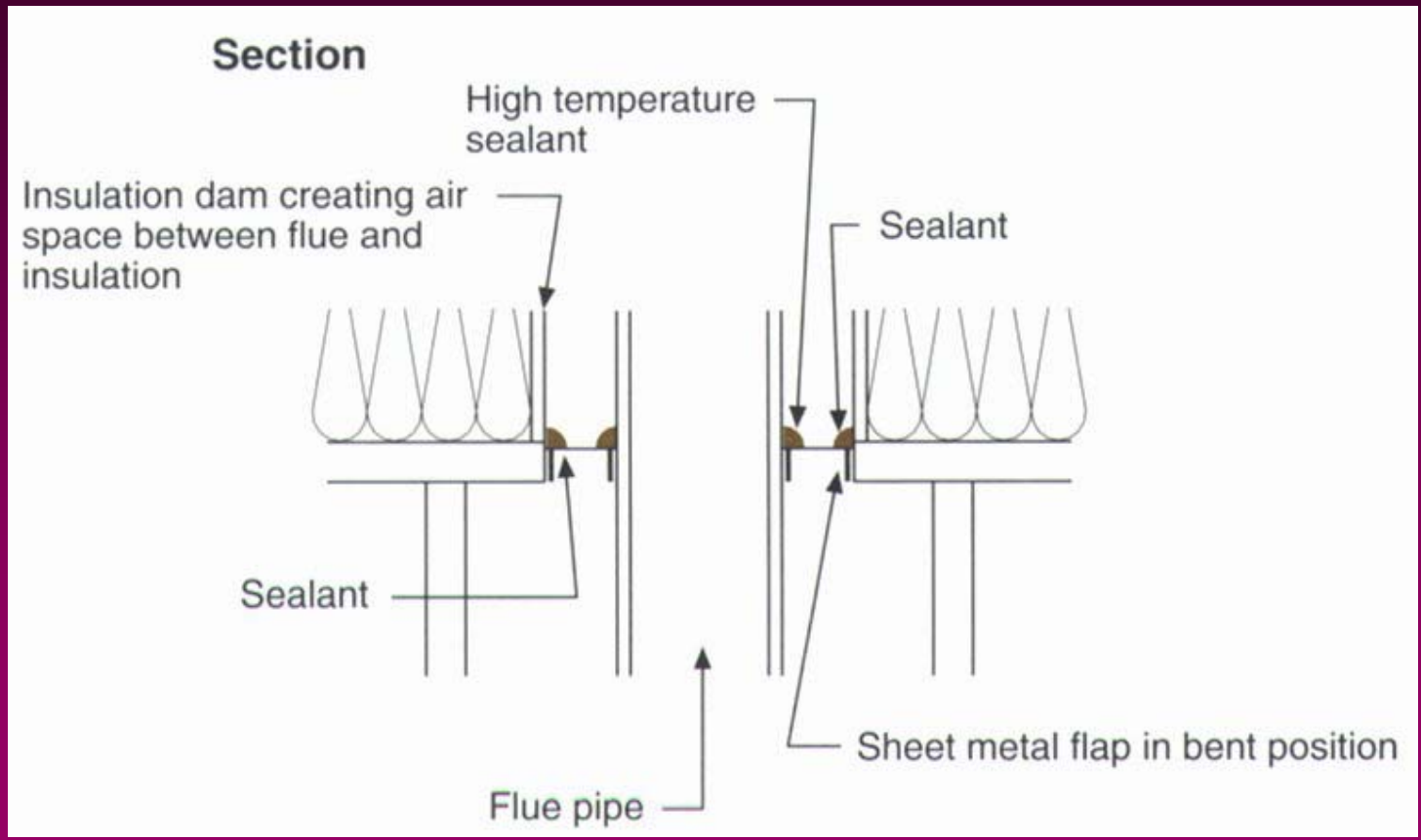
Flue Stack



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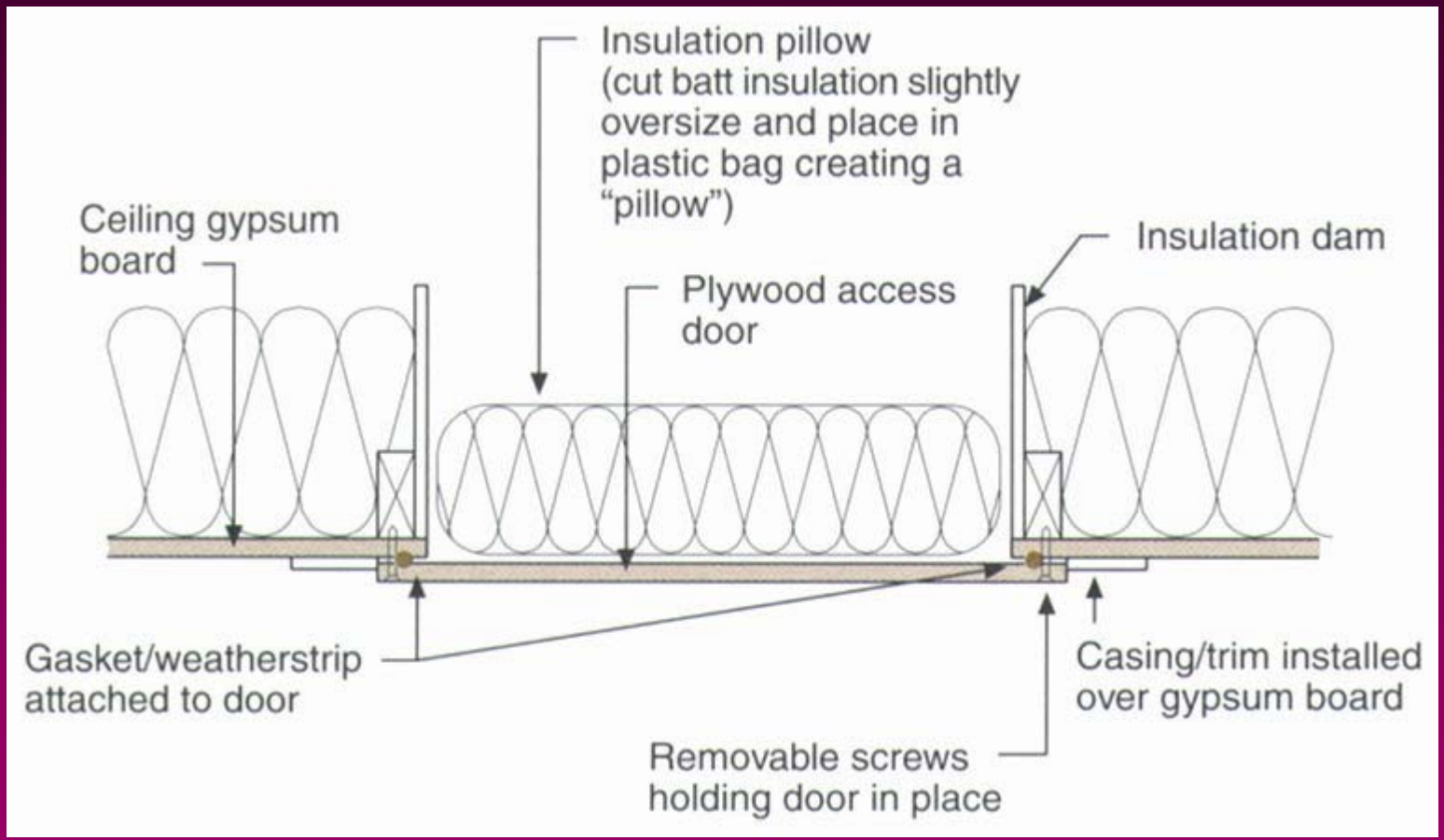
Attic Hatches



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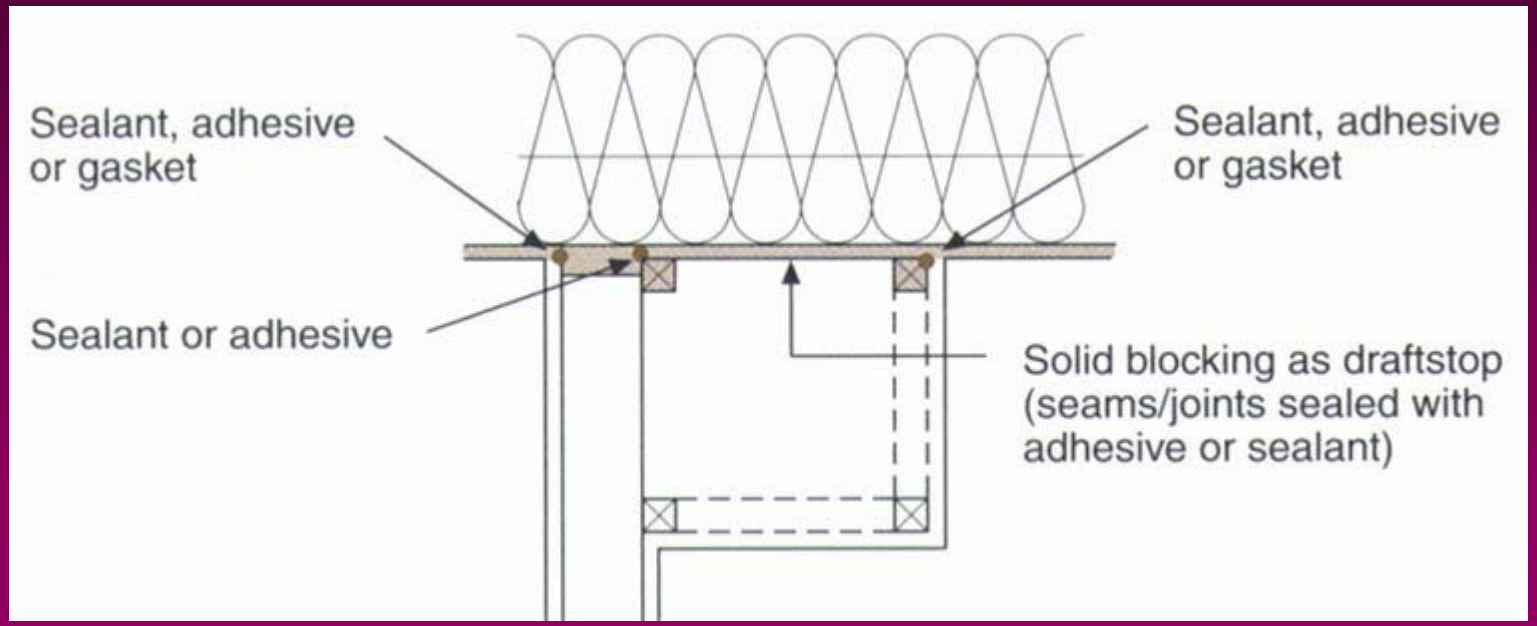
Dropped Soffits



Insulation

Stuff that keeps us warm

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Key Points - Insulation

- Any insulation will work if properly installed in a properly constructed building envelope
- All insulation is environmentally friendly, even the rigid foams because of the shear quantity of energy they save over their useful service lives
- All walls and ceilings need vapor diffusion retarders

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Key Points - Fiberglass

- Do not cut batts too short or too long
- Do not compress batts into small areas
- Fluff batts to full thickness
- Split batts around electrical wiring
- Run wires along the bottom of studs so batts don’t have to be split
- Either face staple batts or use unfaced batts, but don’t use inset stapling
- Using higher density batts will improve the quality of the installation

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Key Points - Cellulose

- Use damp sprayed cellulose only with permeable sheathings
- Dry spray cellulose can be used with any type of sheathing
- In a poorly constructed wall, cellulose will stop more air movement than fiberglass

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Other Insulation

- Icynene foam is available
- Expanded polystyrene is not a vapor barrier
- Extruded polystyrene is a vapor barrier

Mechanical Systems

Heating, Ventilating, Air Conditioning, and Water Heating

Ductwork

Key to an efficient system

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Key Points - Ductwork

- Locate air handler in a central location
- No ductwork in exterior walls or attic
- Install high return in hallway of upper floor
- Install low return in hallway of main level
- Do not install returns in basement
- Install only “hard” ducted returns when connected directly to air handler; no panned floor joist returns; no stud cavity returns
- Either return ducts in bedrooms or transfer grills
- Seal all duct work with mastic

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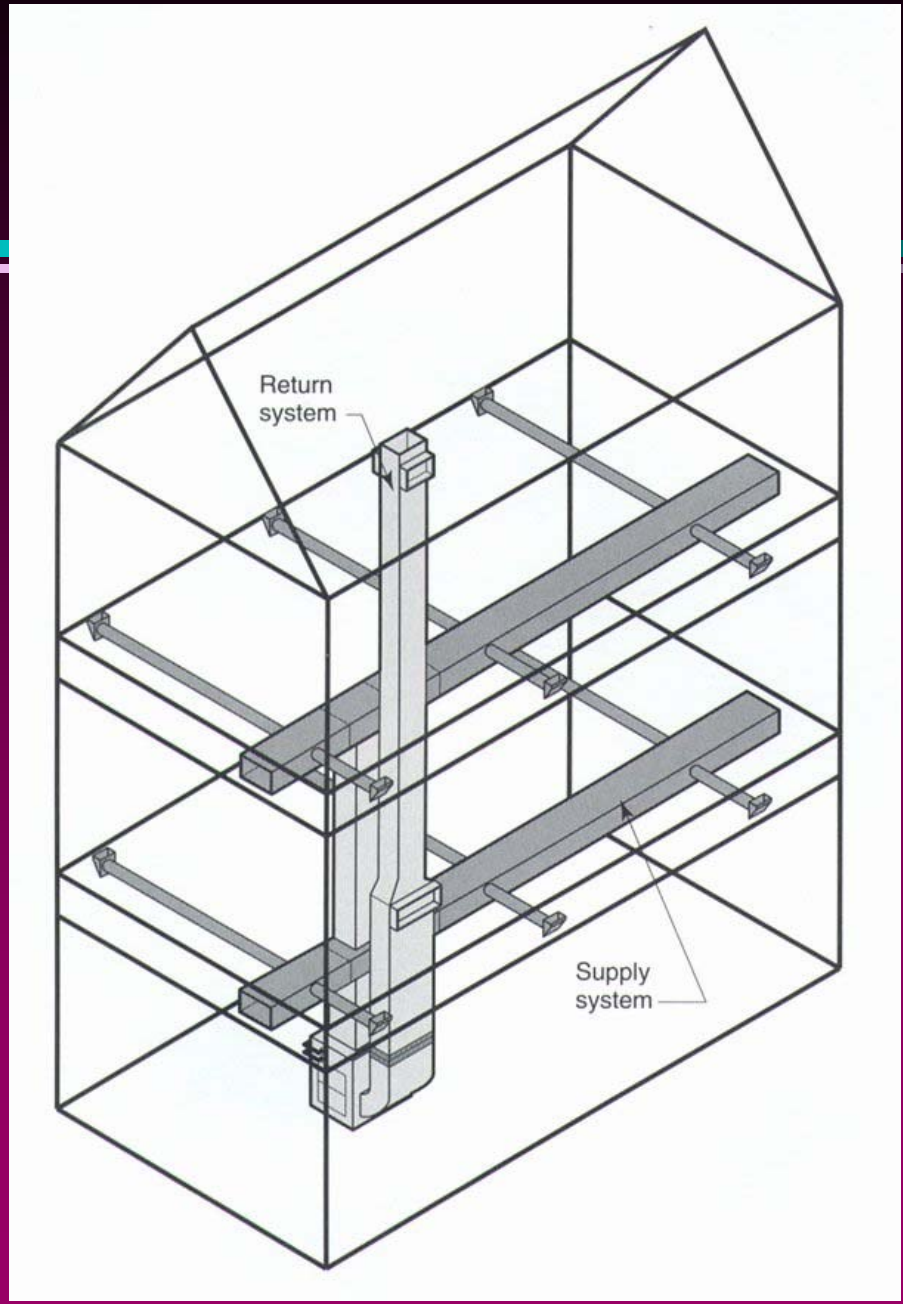
Air Handler and Duct Layout



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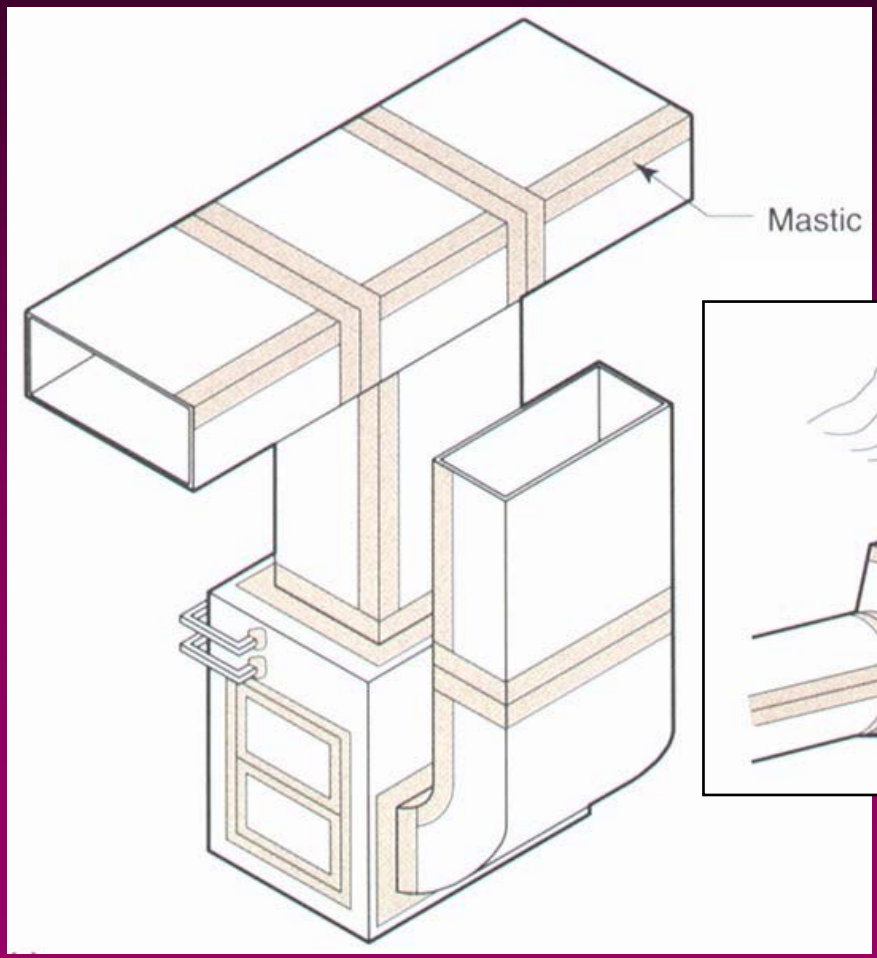
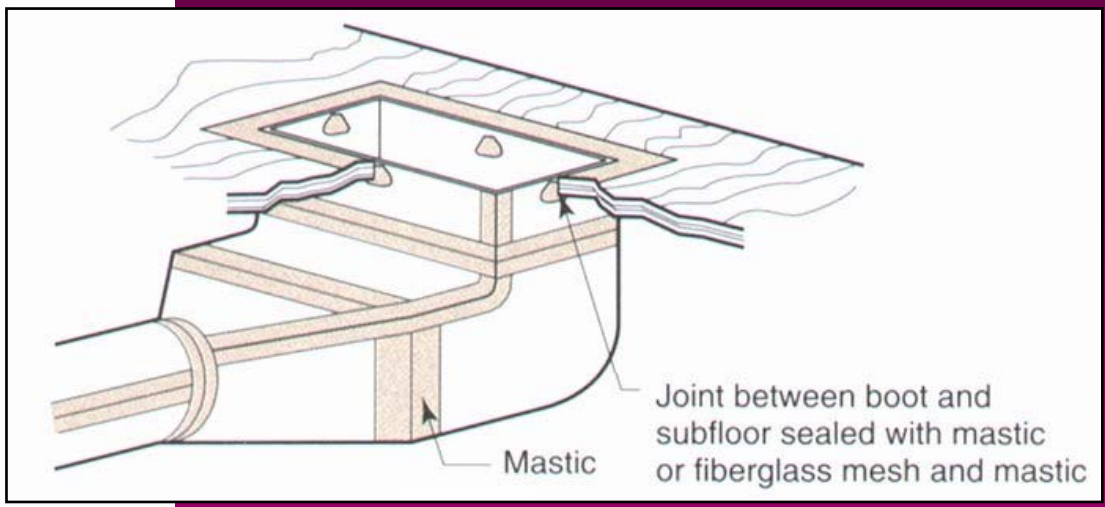
Duct Sealing





Heating Systems

Keeping clients warm in winter

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Best Heating System Options

- Air-to-air heat pump
- Ground water heat pump
- Induced draft gas furnace
- Sealed combustion gas furnace
- Sealed combustion or power vented water heater with fan coil

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Key Points - Heating Systems

- If gas is chosen, install only induced draft or sealed combustion
- Install an auto-setback thermostat for clients
- Don’t spend a lot of money on a heating system for a house that doesn’t need much heat

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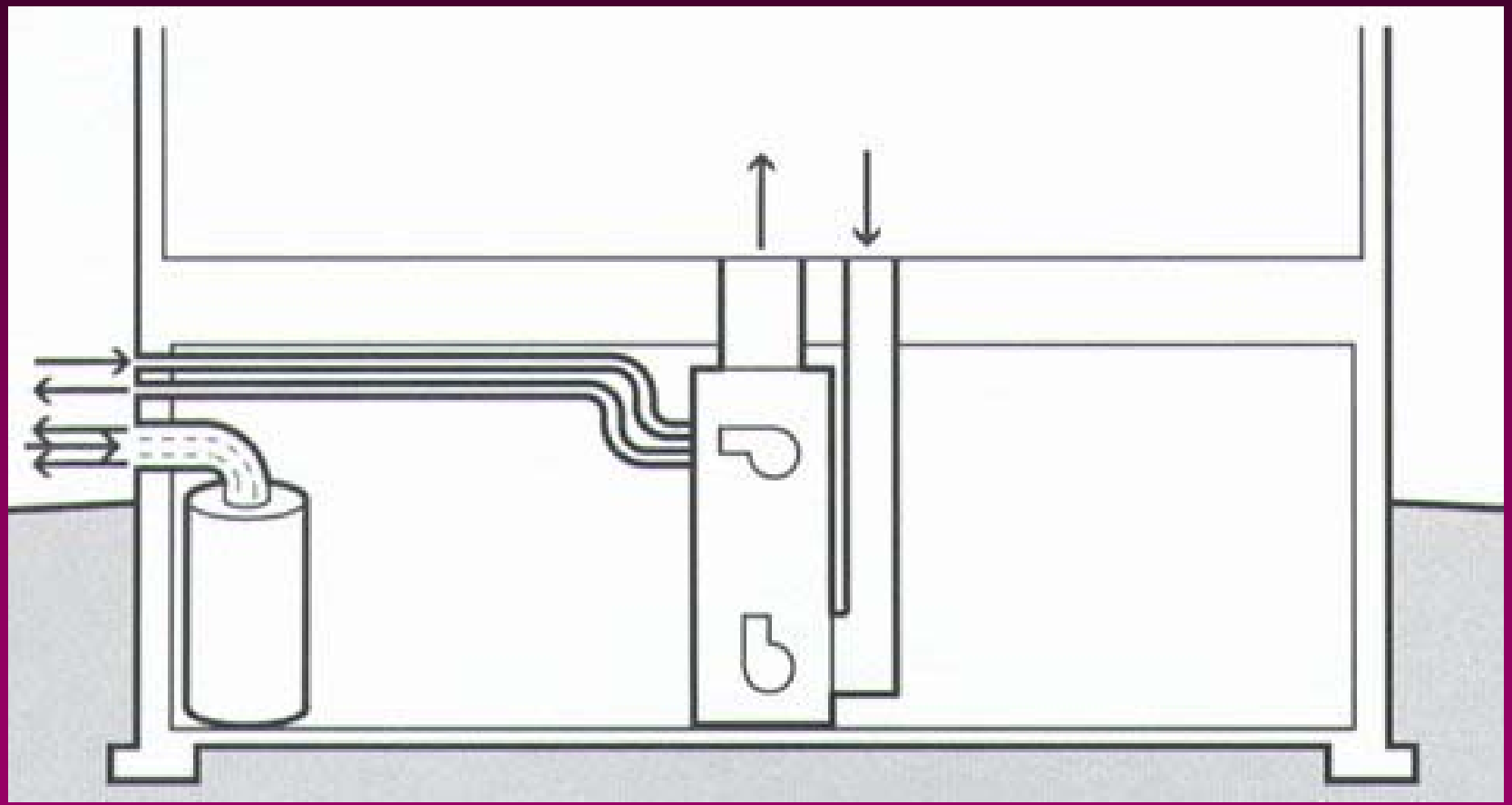
Sealed Combustion System



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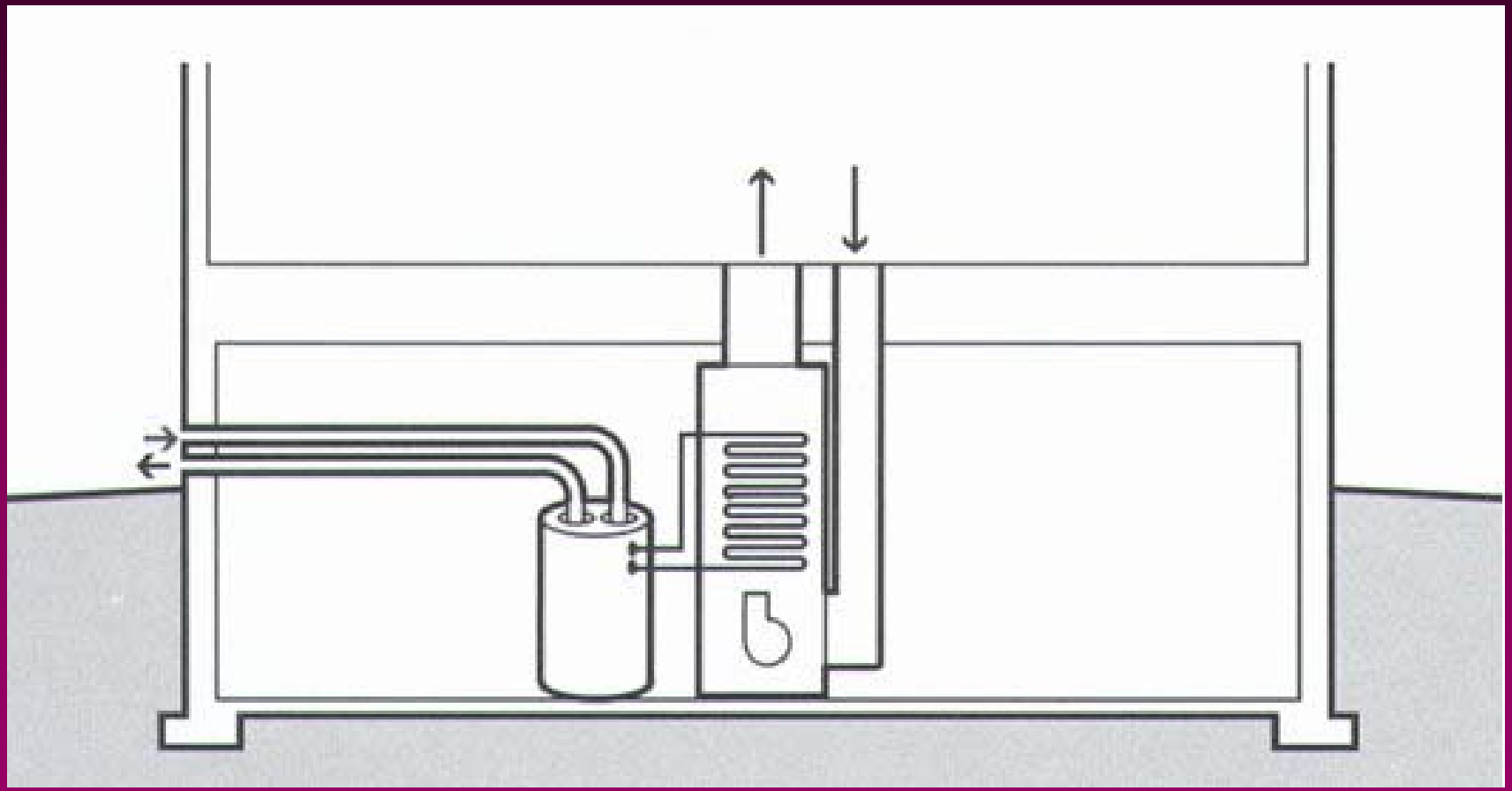
Water Heater - Fan Coil



Cooling Systems

Keeping clients cool in the summer

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Designing for Cooling Efficiency

- Minimize west windows
- Design overhangs for south windows
- Provide shading for east and west windows
- Install ceiling fans in bedrooms and other living areas of the home
- Install a whole-house fan as an alternative or supplement to air conditioning

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Key Points - Air Conditioning

- Sizing is critical to efficient operation - DO NOT OVERSIZE
- Oversizing leads to frequent cycling, inadequate dehumidification, higher costs to your clients, and lower equipment life.
- Seal all duct work with mastic
- Insulate ducts in unconditioned spaces
- Locate condenser unit where it will be in the shade

Controlled Ventilation

A must for a quality Comfort Plus Home

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Reasons for Controlled Ventilation

- Provides a healthy indoor environment
- Solves most moisture related callback problems
- Saves energy

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Key Points - Controlled Ventilation

- Buildings can never be built too tight - they can, however, be under ventilated
- A leaky building is over ventilated during the winter when the stack effect is strongest
- A leaky building is under ventilated during the summer when there is no stack effect
- Install a controlled ventilation system that operates when people are present
- Rule of thumb: Take number of bedrooms plus one and ventilate at 10 cfm per
- If there are strong interior pollutants (smokers, untrained house pets, etc.), Increase ventilation

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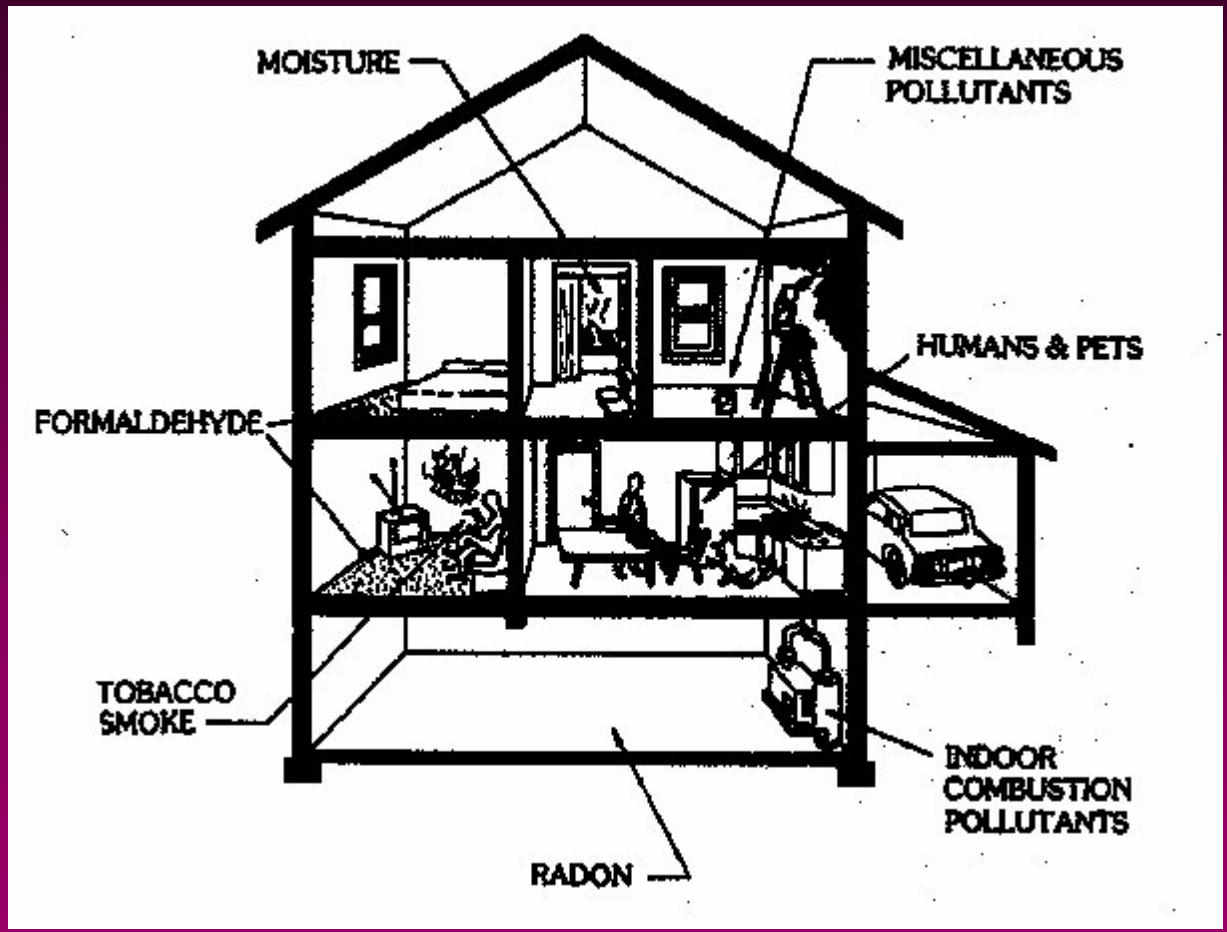
Indoor Air Quality Problems



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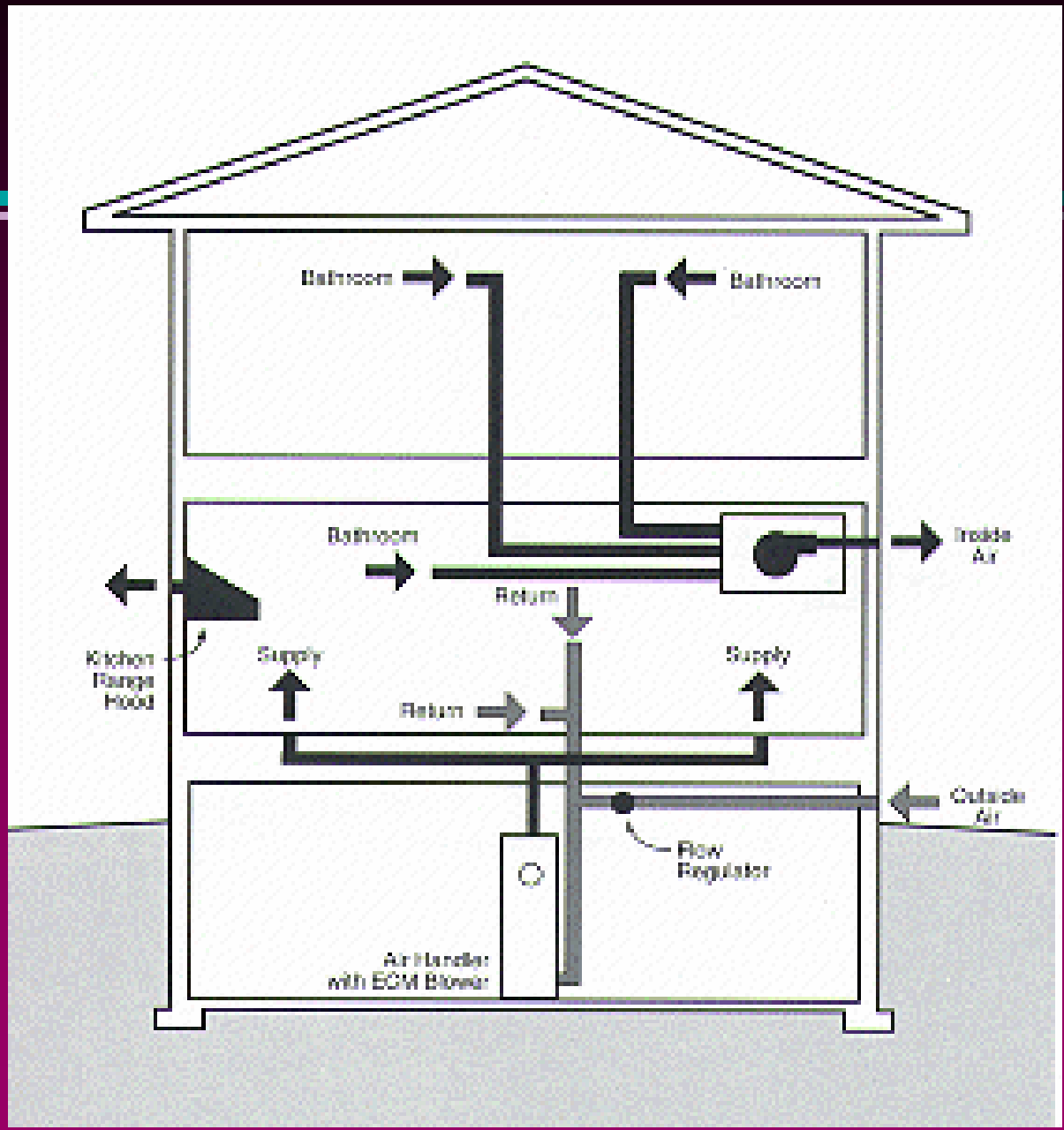
Central Exhaust System



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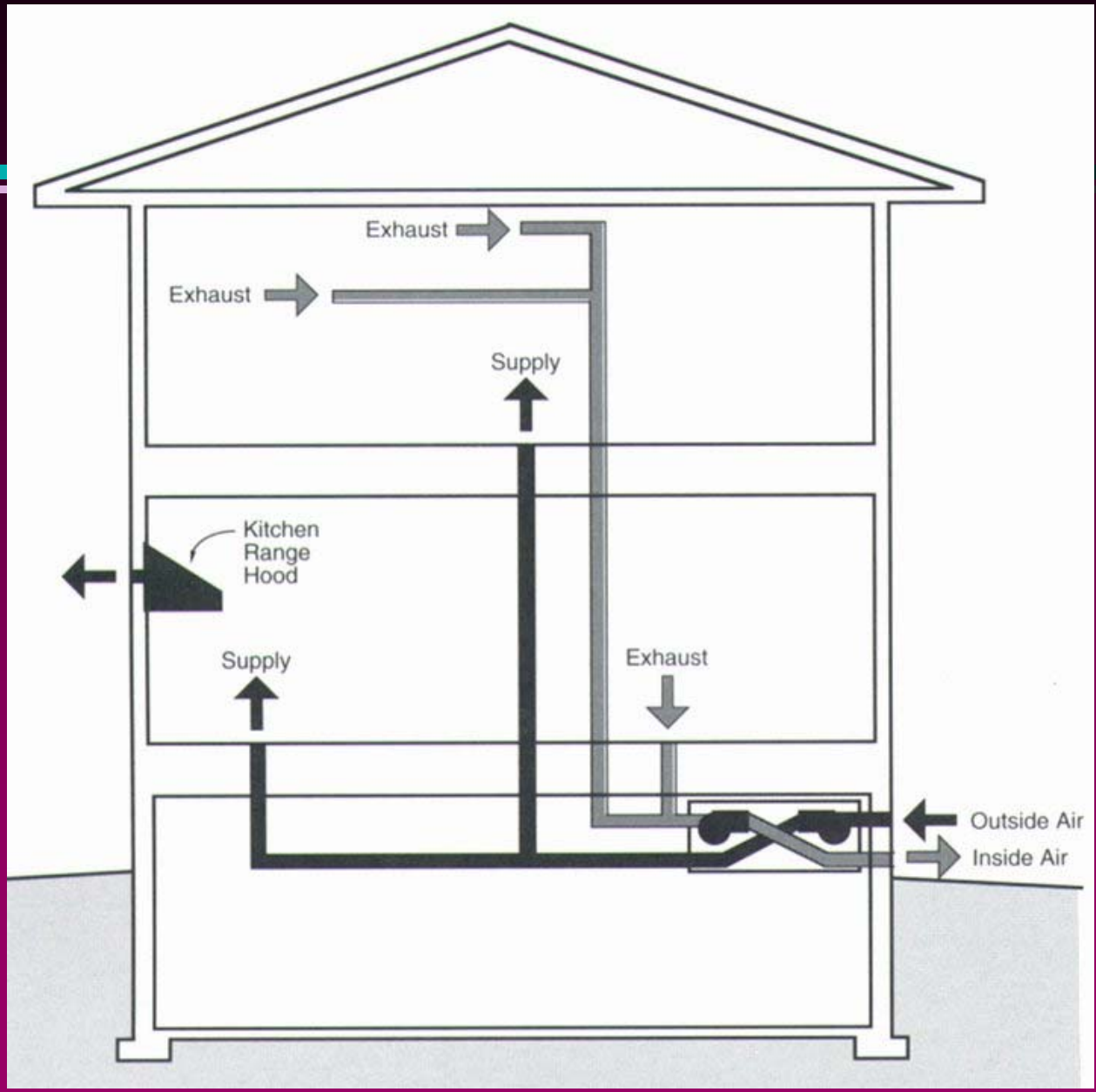
Air-to-Air Heat Exchangers



Water Heating Systems

Everyone wants a hot shower

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Keys Points - Water Heating

- Install a high efficiency water heater
- Locate water heater close to points of use
- Insulate first 10 feet of hot and cold pipe
- Install heat traps on top of water heater
- Install 2.0 Gal/min showerheads and kitchen faucets
- Install 1.5 Gal/min lav faucets

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Acceptable Water Heating Systems

- Sealed combustion, direct vent
- Power vented
- Combination systems

Lighting System

Nobody likes to sit in the dark

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Key Points - Efficient Lighting

- Plan window locations to provide adequate lighting during daylight hours
- Decorate with light colors to make the home seem brighter
- If installing ceiling fixtures, make sure fixtures are adequately sealed
- Provide low level general illumination with task lights for specific working/reading areas

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Keys Points - Efficient Lighting

- Use track lights instead of recessed lights
- Multi-bulb fixtures are a poor choice. Larger wattage bulbs are more efficient than several smaller wattage bulbs
- Use fluorescents or compact fluorescents where possible
- You can use indirect fluorescent lighting effectively

Appliances

Gotta have ‘em . . .

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Key Points - Appliances

- Don’t locate refrigerator next to the range
- A gas range is not recommended for an energy efficient home
- Indoor grills should only be installed with a provision for make-up air
- Never duct a clothes dryer into the house
- Select dishwasher with energy-saving cycle

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Key Points - Appliances

- Install central vac as it provides a much healthier indoor environment for you clients
- If appliances are not included, provide clients with a list of energy-efficient appliances

Landscaping

More than pretty flowers

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Key Points - Landscaping

- Protect existing trees
- Keep trees on the south at least twice as far from the house as the trees mature height
- Plant trees that will shade east and west windows which receive over 50% more solar gain than south windows in the summer
- Plant wind breaks on the north and west
- Minimize concrete and asphalt as it raises the temperature of the air around the house

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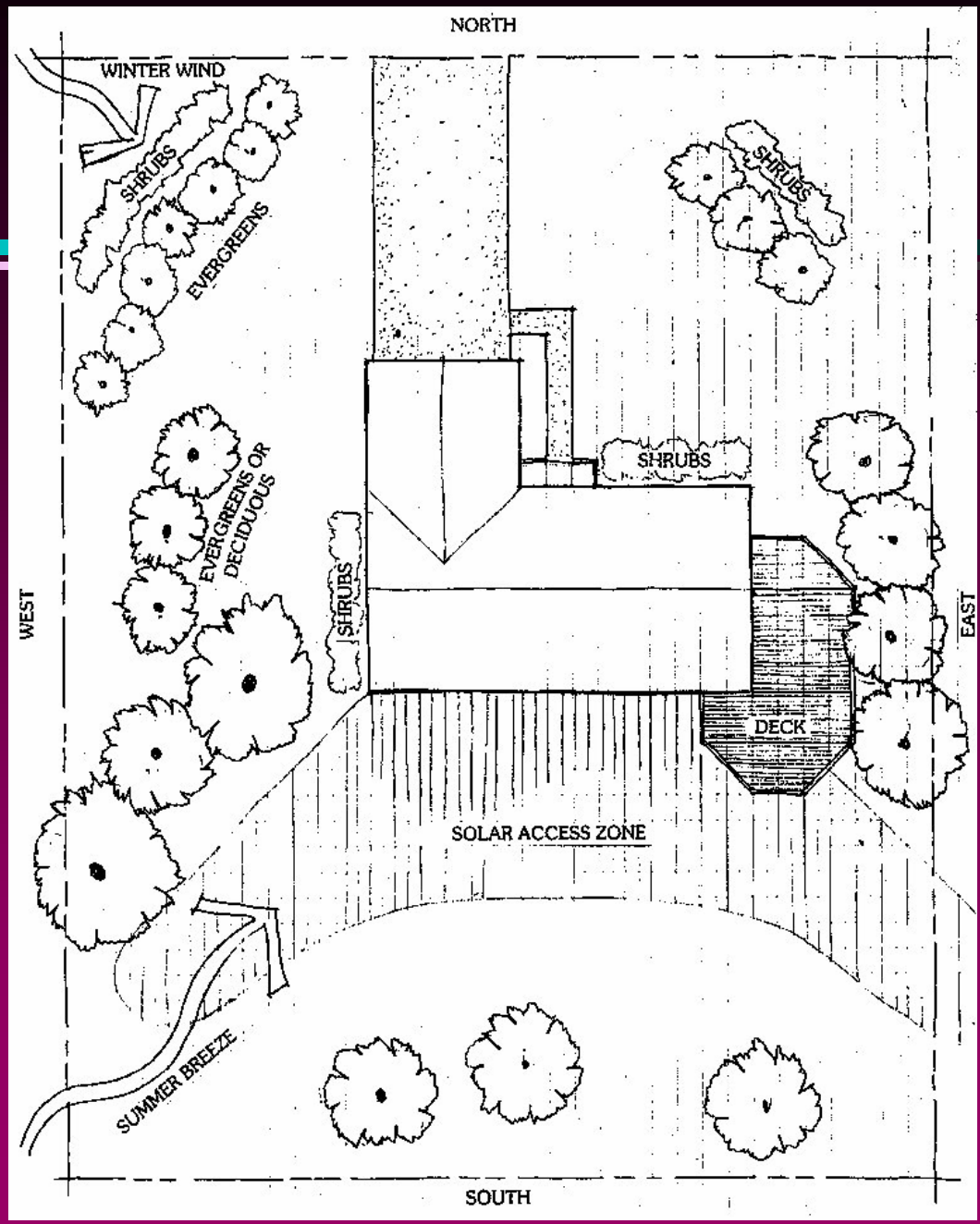
Ideal Landscaping



Green Building

For those interested in environmentally friendly housing

Comfort Plus Homes™

Green Building

- Protect trees and natural features on site during construction
- Save and reuse all site topsoil
- Locate home on lot so that long dimension faces within 30 degrees of south
- Save east and south areas for outdoor use
- Use permeable materials for walkways, patios, and driveways
- Use low-water grass such as blue gramma or fescue
- Xeriscape with native drought resistant plants
- Setup rainwater recovery from roof for watering

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Green Building

- Minimize job waste by using materials wisely and recycling
- Provide garage sorting bins for recycled materials
- Provide built-in kitchen recycling center
- Use non-asphalt damp proofing on foundation
- Use western coal fly ash concrete or regionally produced brick, rock, or block
- Use frost-protected shallow foundation where applicable

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Green Building

- Avoid large dimension solid lumber, instead use engineered “I” joists for floors
- Use trusses or “I” joists for roofs
- Use engineered lumber products for beams, joists, and headers
- Use optimum value engineered framing (24” o.C. Framing and other material reducing strategies)
- Use finger-jointed plate material
- Use engineered stud materials

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Green Building

- Construct outdoor structures from recycled materials, pressure-treated engineered lumber or certified sustainably harvested lumber
- Use urea formaldehyde-free subfloor and underlayment materials
- Use oriented strand board (OSB) for roof and floor sheathing from fast growth material
- Use fiberglass (class A), recycled-content, or 30-year roofing materials
- Use recycled-content facia, soffit and trim

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Green Building

- Don’t use Luan doors (tropical hardwood)
- Use recycled content doors
- Use finger-jointed wood or vinyl framed windows
- Paint all exposed particle board with water-based sealer (inside cabinets, underside of counter tops)
- Use finger-jointed trim
- Install cabinets made with formaldehyde-free particle board

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Green Building

- Uses paints and finishes with low VOC content (< 250 grams/liter)
- Use only low toxicity, solvent free adhesives
- Use water-based urethane and lacquer finishes on wood floors and woodwork
- Use recycled-content or natural material carpet
- Use tacks instead of gluing carpet
- Use natural linoleum with low toxic adhesives and backing
- Use recycled content ceramic tile

Commissioning

Testing how well you did

Comfort Plus Homes™

Commissioning

- To qualify for a Comfort Plus Homes incentive, you have to have a rating performed by a certified Energy Rated Homes of Iowa rater
- Conduct blower door test
- Conduct duct leakage test
- Equipment testing and cycling
- Radon and carbon monoxide tests

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Summary

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Comfort Plus Homes Summary

- Dedicate yourself to quality
- Pay attention to detail
- Make sure you communicate your expectations to your crew and your subs
- Use your dedication to quality and efficiency in your marketing
- Test your house upon completion and verify that you did indeed build a quality house
- Get your Energy Rated Homes of Iowa rating

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Building & Design Ideas