Putting it All Together

Design Specifications for High Performance Homes
High Performance Homes are . . .

• Green
• Sustainable
• Environmentally responsible
What Makes a Home High Performance? ...

It DOES NO HARM
– To People
– To Buildings
– To the Environment
Goals

- Create buildings that ensure a healthy environment for its occupants
- Deliver building that are durable (life expectancy of 100 years with only minimal replacement of parts needed) thereby reducing future waste and depletion of natural resources
- Deliver buildings that have low total energy consumption during their lifetime. They must have low operating energy since operating energy accounts for 70-to-90% of the total energy consumption

+ Operating Energy
+ Embodied Energy
+ Decommissioning Energy

Total Energy
Sustainability is really about Durability …

• Of People
• Of Buildings
• Of the Planet
How Do We Achieve High Performance Homes? ...

• Design, Construct and Operate the Homes so they are healthy to live in

• Design, Construct and Operate Homes so that they last a long time

• Do no Harm to the Earth in the Process by using its resources in a conservative manner
Durability for People = Indoor Air Quality

• Houses are for Humans; Humans want and need safe and healthy homes that are comfortable

• We can provide the above in an energy efficient manner
Durability for Buildings = Building to Last . . .

• Design the Homes so that They Use all of Their Materials and Equipment in their Highest and Best Use
  – Understand the Building System
  – Understand the Damage Functions
Durability for the Planet = How is it Made?...

- Evaluate and Understand the Extraction, Manufacture, and Transportation Costs
- This is the Cradle to Gate Process
  - Scar the Landscape
  - Create Chemical Soups
    - Suspected carcinogens
    - Endocrine disruptors
    - Toxic Waste
Durability for the Planet = Conserve Energy . . .

- Embodied energy
- The combustion of fuels to make energy creates byproducts that change our planet
  - Ozone Depletion
  - Greenhouse Gases
The Energy Equation
Embodied Energy . . .

• Energy of extraction
• Energy of manufacturing
• Energy of transport
• Energy of assembly
The Energy Equation =.

(Embodied Energy + Operation Energy) x

Useful service Life =

TOTAL ENERGY
What is a High Performance Home? ...

- An environmental separator....
  - Recognizes that humans need comfort and nurture
- That reduces heat flow and air flow....
  - No unintentional air change
  - Conserves operational energy use
- That does not trap moisture.......
  - Has liquid water shedding properties by design
  - Has a PLAN to control water in the vapor form
Make the Highest and Best Use of the Materials You Select …..

• Assess Risks
  – Manage them

• Quality Assurance
  – Design

• Quality Control
  – Workmanship
Understand Building Science Damage Functions

- Systems thinking to design the Building Enclosure

- DO NO HARM
• DO NOT HARM

  – (H) Heat Flow - Thermal Resistance Profile
  – (A) Air Flow - Air Leakeage Resistance
  – (R) Radiation - Radiation Resistance Profile
  – (M) Moisture
    • Liquid Form - Drainage Planes Profile
    • Vapor Form - Vapor Resistance Profile
Thermal barrier

Cavity insulation; see Material Compatibility and Substitutions

Raised heel roof truss provides increased depth of roof insulation at perimeter

Insulation baffle prevents wind blowing through insulation and maintains 2" clearance under roof sheathing

Rigid insulation; see Field Experience Notes

Cavity insulation; see Material Compatibility and Substitutions

Cavity insulation; see Material Compatibility and Substitutions

Cavity insulation; see Material Compatibility and Substitutions

Plastic L-bracket for insect/rodent protection of rigid insulation

Unfaced extruded or expanded polystyrene rigid insulation (vapor semi-permeable with taped or sealed joints)

Gypsum board thermal barrier necessary when rigid insulation is not rated for exposed application

Extruded polystyrene (XPS), expanded polystyrene (EPS) or high density mineral wool

Chicago
Wall section

- Vinyl siding
- Vertical joints shiplapped if available; otherwise use mastic or adhesive sealant
- Rigid insulation
- Flexible flashing (polyethylene) at horizontal joints in insulating sheathing
- Gypsum board caulked, glued or gasketed to top plate
- Bottom plate caulked or gasketed to subfloor
- Subfloor glued, caulked or gasketed to rim joist/rim closure
- Rim joist/rim closure caulked or gasketed to top plate
- Gypsum board caulked, glued or gasketed to top plate
- Cavity insulation
Air flow retarder
Drainage plane

- Roofing paper
- Roof sheathing
- Water protection membrane (ice-dam protection where required)
- Vertical joints shiplapped if available; otherwise use mastic or adhesive sealant
- Rigid insulation; see Field Experience Notes
- Flexible flashing (polyethylene) at horizontal joints in insulating sheathing
- Vinyl siding
- Ground slopes away from wall at 5% (6 in./per 10 ft.)
- Dampproofing
- Filter fabric
- Stone drainage bed
- Perforated drain pipe
- Capillary break over footing (dampproofing or membrane)
- Drain pipe through footing
- Sub-slab stone layer (no fines); see Building Science Details

Chicago
Vapor profile

Rigid insulation; see Field Experience Notes

Unfaced extruded or expanded polystyrene rigid insulation (vapor semi-permeable with taped or sealed joints)

Extruded polystyrene (XPS), expanded polystyrene (EPS) or high density mineral wool

Chicago
Thermal barrier

Low density spray foam insulation (approx. 3"

Raised heel truss
Rigid foam, or comparable, as backer

Rigid insulation

OSB sheathing

Cavity insulation

Sill gasket
Rigid insulation (fire-rated)
taped or sealed joints

Boston
Attic section

Low density spray foam insulation (approx. 10 perms); see Material Compatibility and Substitutions

Asphalt shingles
Roofing paper
Roof sheathing
Raised heel truss
Rigid foam, or comparable, as backdamp
Fiber cement siding soffit
Roof underlayment sealed to drip edge
Shadow board hides siding held down from soffit for flow-through ventilation

Gypsum board caulked, glued or gasketed to top plate
2X6 24" o.c. advanced framing

Soil gas stack vented through flashed roof penetration
Roof flashing

Boston
Foundation section

- Fibercement panels and battens
- Vented mesh or corrugated housewrap
- Sealant, adhesive or gasket
- Adhesive
- Plastic L-bracket for insect/rat protection of rigid insulation
- For insect protection provide 3'-6" of mulch and then climate-specific plants
- Ground slopes away from wall at 5% (6 in. per 10 ft.)
- Damproofing
- Filter fabric
- Stone drainage bed
- Perforated drain pipe
- Capillary break over footing (drumproofing or membrane)
- Gypsum board with semi-permeable (latex) paint
- Sealant, adhesive or gasket
- Sealant at corner of bottom plate and subfloor or gasket under bottom plate
- Cavity insulation
- Sealant
- Sill gasket
- Rigid insulation (fire-rated) (taped or sealed joints)
- Tape
- Stone layer (no fines)
- Continuous polyethylene vapor diffusion retarder/air flow retarder (all joints taped) mechanically attached to perimeter rigid insulation
- Perforated drain pipe added to "T" in order to couple sub-crawl pressure field to vent stack

Boston
Air flow retarder

Low density spray foam insulation (approx. 10 perms)

Gypsum board caulked, glued or gasketed to top plate
Bottom plate caulked or gasketed to subfloor

Subfloor gasket: caulked or gasketed to rim joistrim closure
Rim joist/rim closure caulked or gasketed to top plate

Gypsum board caulked, glued or gasketed to top plate
Cavity insulation

Sealant, adhesive or gasket
Sealant at corner of bottom plate and subfloor or gasket under bottom plate

Cavity insulation: see Material Compatibility and Substitutions
Sealant

Sill gasket
Rigid insulation (fire-rated) (taped or sealed joints)
Tape

Continuous polyethylene vapor diffusion retarder/air flow retarder (all joints taped) mechanically attached to perimeter rigid insulation

Boston
Drainage plane

Asphalt shingles
Roofing paper
Roof sheathing
Roof underlayment sealed to drip edge
Rigid insulation
Vertical joints shiplapped if available; otherwise use mastic or adhesive sealant
Flexible flashing (polyethylene) at horizontal joints in insulating sheathing
OSB sheathing
Fiber cement panels and battens
Vented mesh or corrugated housewrap

Ground slopes away from wall at 5% (6 in. per 10 ft.)
Damp proofing
Filter fabric
Stone drainage bed
Perforated drain pipe
Capillary break over footing (damp proofing or membrane)

Boston
Vapor profile

Low density spray foam insulation (approx. 10 perms)
Asphalt shingles
Roofing paper
Roof sheathing
Rigid insulation
Flexible flashing (polyethylene) at horizontal joints in insulating sheathing
OSB sheathing
Rigid insulation (fire-rated) (taped or sealed joints)

Boston