


bsc

6: MULTI-FAMILY - UXBRIDGE, MA

©2008 Building Science Consulting


bsc



North-East Elevation Study
Taft Hill Manor, Uxbridge, MA

©2008 Building Science Consulting

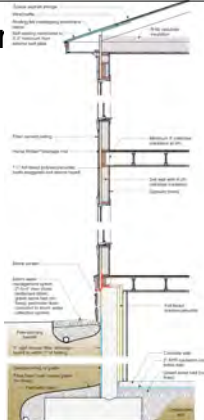
bsc



North Elevation
Taft Hill Manor, Uxbridge, MA

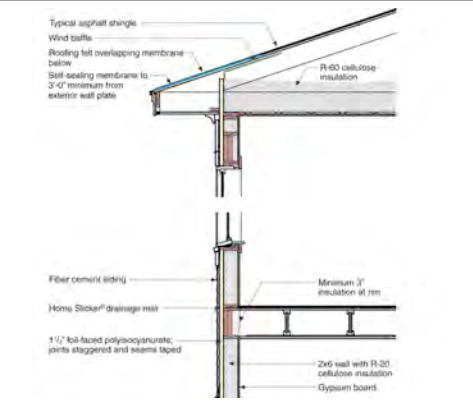
©2008 Building Science Consulting

bsc Enclosure Design



©2008 Building Science Consulting

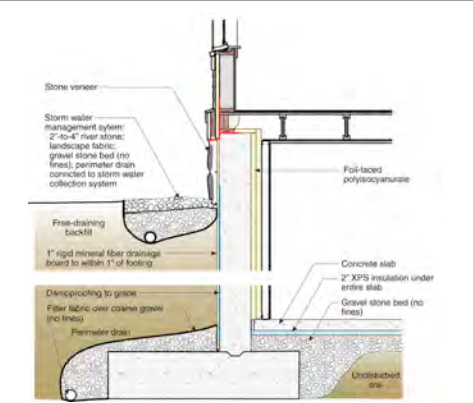
bsc



Typical asphalt shingles
Wind baffle
Roofing felt overlapping membrane below
Self-sealing membrane to 3" (2" minimum from exterior wall plate)
R-40 cellulose insulation
Fiber cement siding
Home Slicker® drainage mat
1 1/2" foil-faced polyisocyanurate; joints staggered and seams taped
Minimum 3" insulation @ rim
2x6 wall with R-20 cellulose insulation
Gypsum board

©2008 Building Science Consulting

bsc



Stone veneer
Storm water management system: 2" to 4" river stone; landscape fabric; gravel stone bed (no fines); perimeter drain connected to storm water collection system
Foil-faced polyisocyanurate
Free-draining backfill
1" rigid mineral fiber drainage board to within 1" of footing
Concrete slab
2" XPS insulation under entire slab
Gravel stone bed (no fines)
Perimeter drain
Underslab air

©2008 Building Science Consulting

bsc Important differences

- Increased energy “density”
- Whole building energy use profile
- Big building approach to airtightness
- Mechanical system integration

©2008 Building Science Consulting

bsc Increased energy “density”

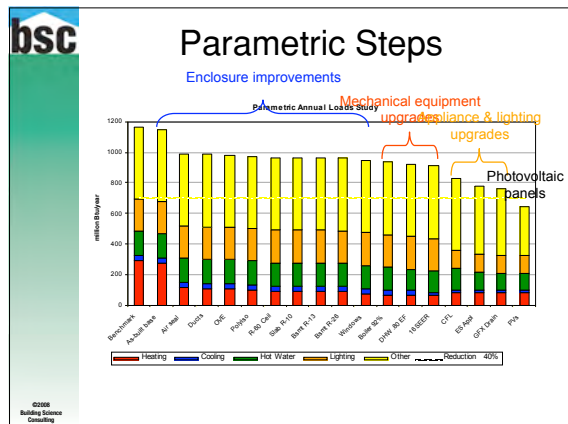
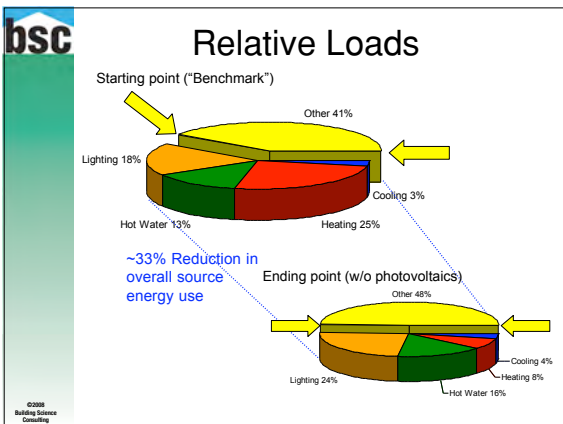
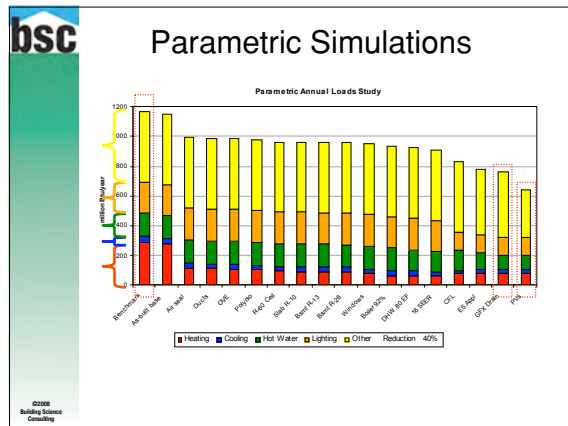
- Per unit living space smaller (average 950 sq ft)
- Per unit basic energy needs the same = Whole building energy density greater

©2008 Building Science Consulting

bsc “Lump” Model Analysis

- Analyze as “pods” of 10 units
- Individual unit variations averaged out

©2008 Building Science Consulting





Uxbridge Energy Use Profile

- Visible meter for occupants (ventilation, cooling, electricity, not DHW or boiler)
- Add PV to deal with electrical
- 30% enclosure, 70% on-site renewables

©2008 Building Science Consulting



South Roof with Photovoltaic Array
Taft Hill Manor, Uxbridge, MA

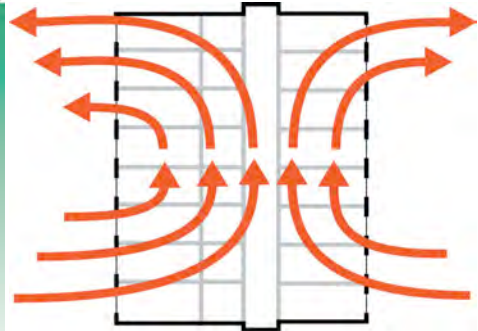
©2008 Building Science Consulting



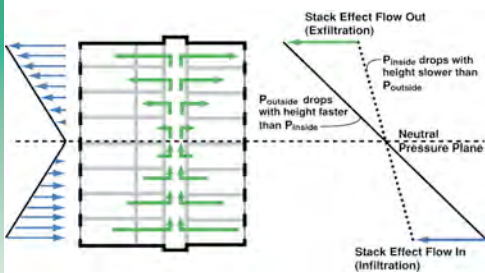
Big Building Airtightness

- Enclosure airtightness measures
- Compartmentalization

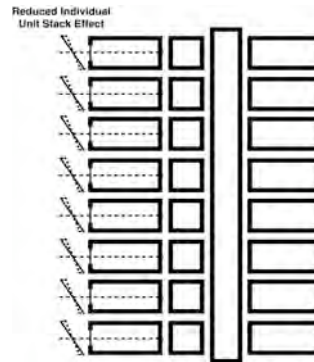
©2008 Building Science Consulting



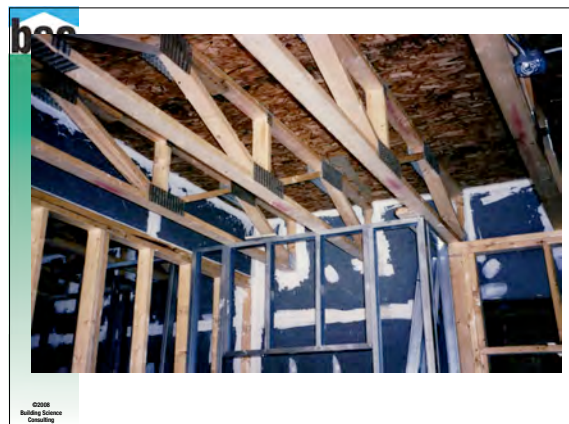
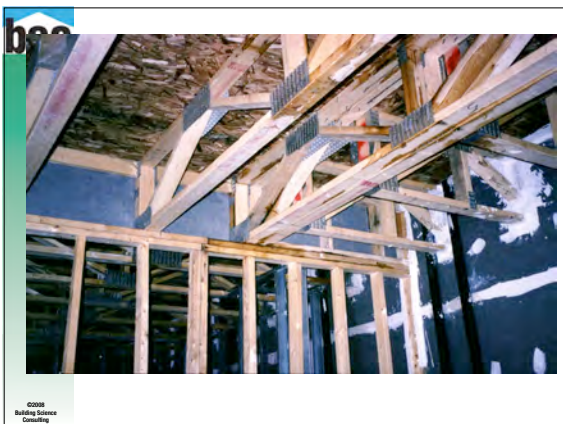
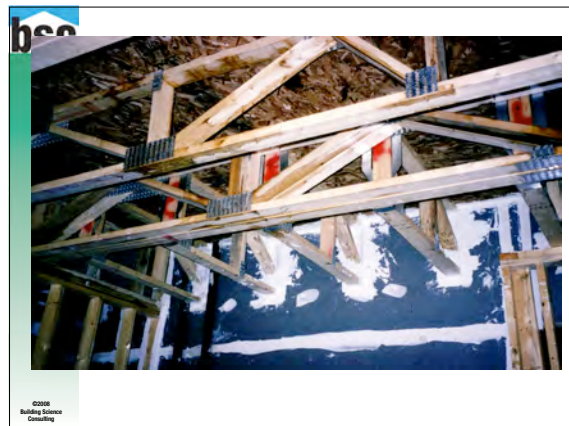
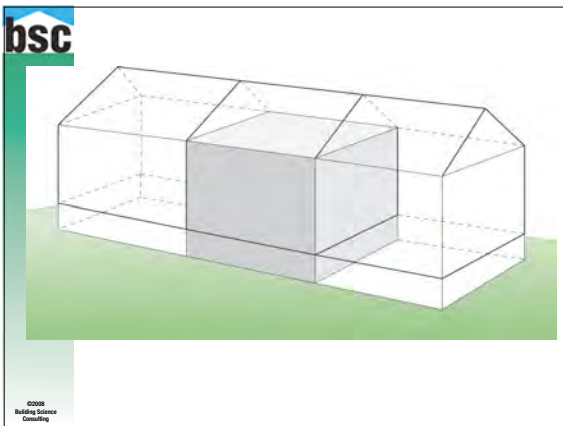
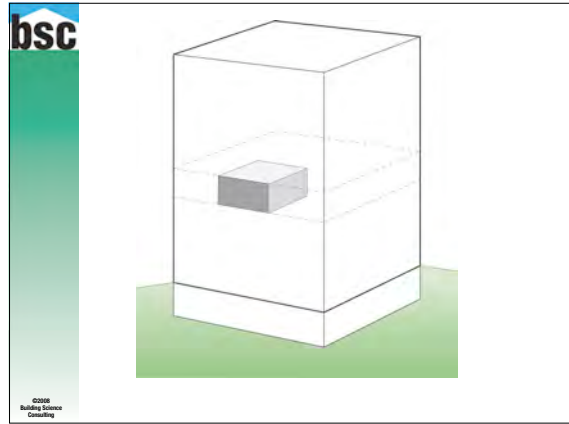
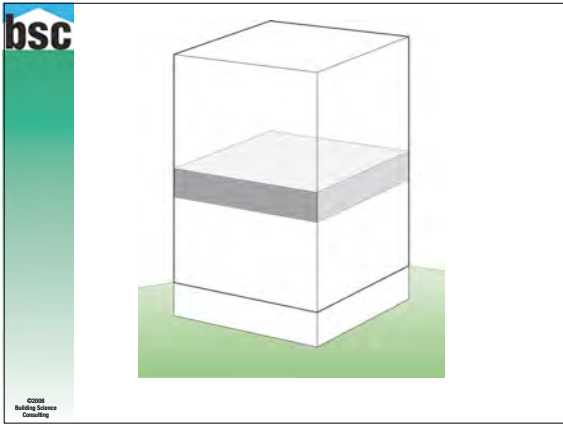
©2008 Building Science Consulting

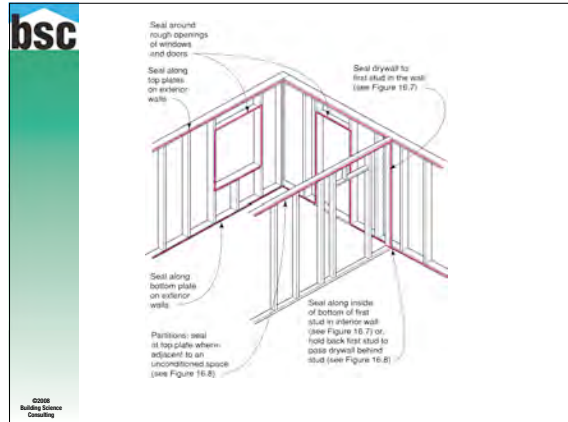


©2008 Building Science Consulting



©2008 Building Science Consulting





bsc

Mechanical Systems

- Typical system: central boiler and chiller
 - Some benefits
 - Distribution losses
 - Distribution piping first costs
 - Individual metering difficult

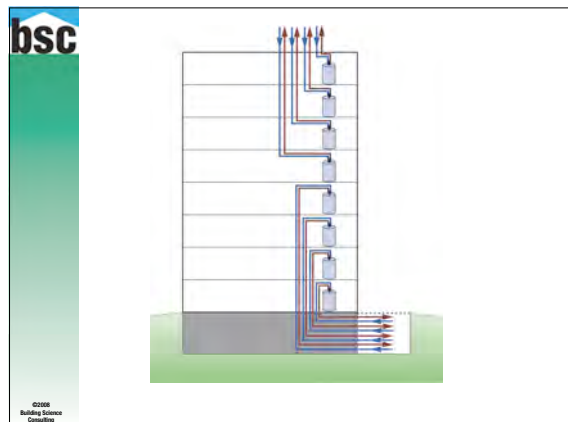
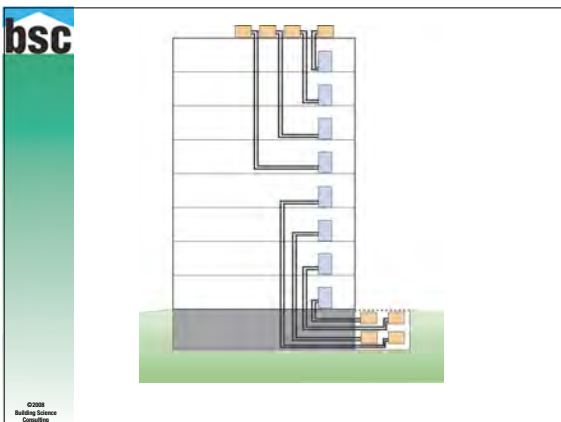
©2008 Building Science Consulting

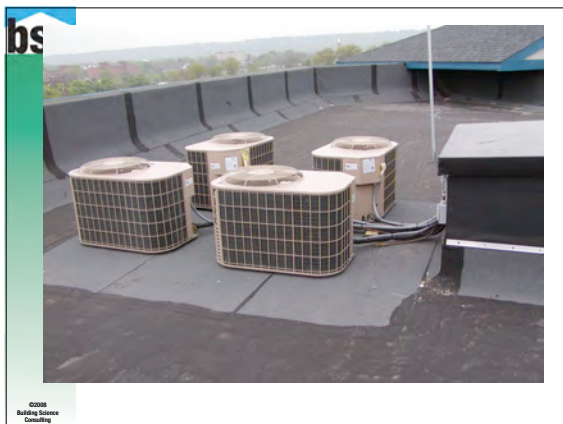
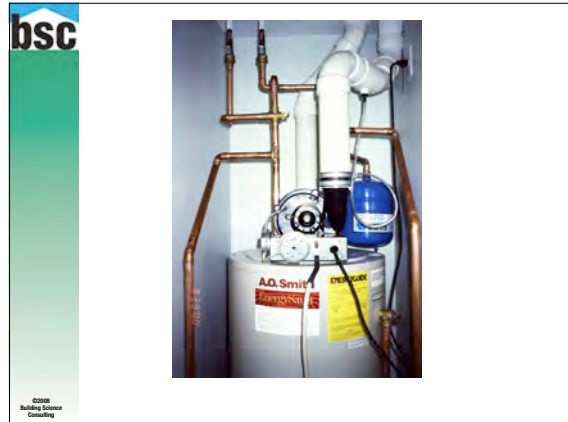
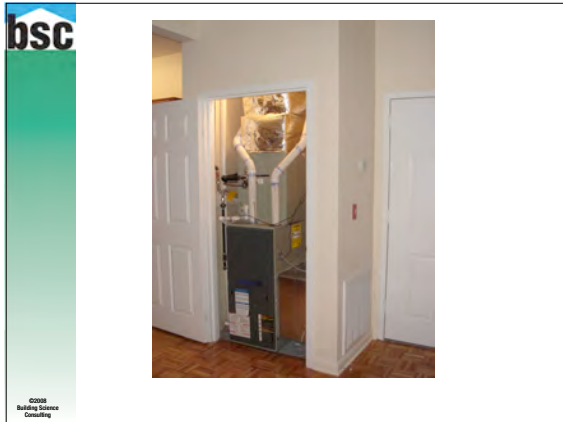
bsc

Mechanical Systems

- Recommended system: Compartmentalized HVAC
 - Supports rational behavior
 - Oversized equipment:
 - Smallest furnace ~40 kBtu/hr
 - Apartment load ~4-12 kBtu/hr (typical ~7)
 - Space requirements for equipment (e.g., DHW tank in apartment, full-size furnace)

©2008 Building Science Consulting






bsc

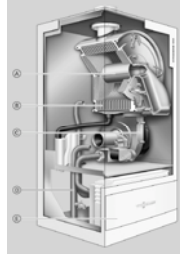
Mechanical Systems - Uxbridge

- Hybrid system: "Pod" space conditioning and DHW
 - Combine equipment for 10 units (2 rows)
 - Greatly reduced distribution losses (Important for DHW, less so for heating)
 - Condensing boiler (space heat & DHW) in basement, with sidearm tank
 - Single variable refrigerant volume (VRV) condenser (cooling) on roof
 - Heating/cooling by fan coils in apartment

©2008 Building Science Consulting

bsc Heating/DHW System

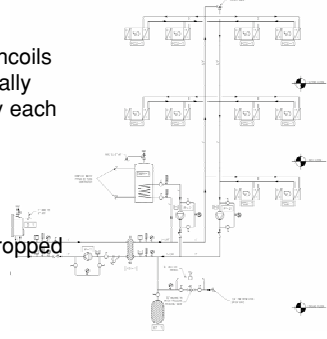
- Wall-hung modulating condensing boiler (95.1% AFUE, 29-100 kBtu output)
- 



©2008 Building Science Consulting

bsc Heating/DHW System



- Individual fancoils thermostatically controlled by each occupant (heat/cool)
- Horizontal "pancake" fancoils in dropped ceilings



©2008 Building Science Consulting

bsc Cooling System

- Variable refrigerant volume system: single condenser (6-8 tons) connected to individual DX fancoil units



©2008 Building Science Consulting

bsc Review: Important differences

- Increased energy "density"
- Whole building energy use profile
- Big building approach to airtightness
- Mechanical system integration

©2008 Building Science Consulting

bsc

CONCLUSIONS

©2008 Building Science Consulting