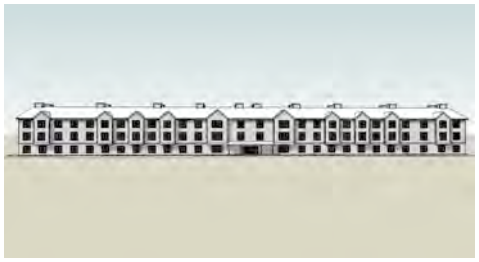
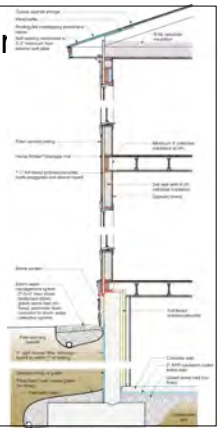
6: MULTI-FAMILY - UXBRIDGE, MA

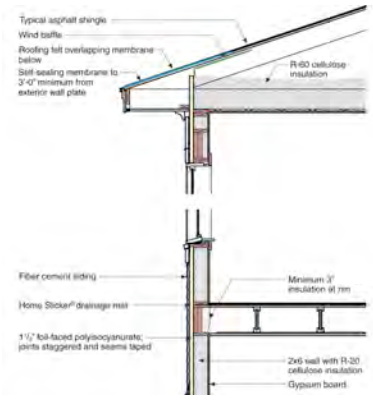
North-East Elevation Study
Taft Hill Manor, Uxbridge, MA

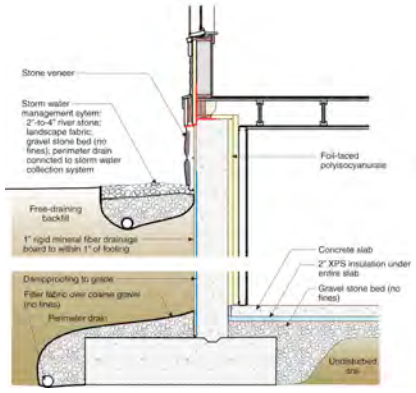


North Elevation
Taft Hill Manor, Uxbridge, MA

Enclosure Desig







Important differences

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

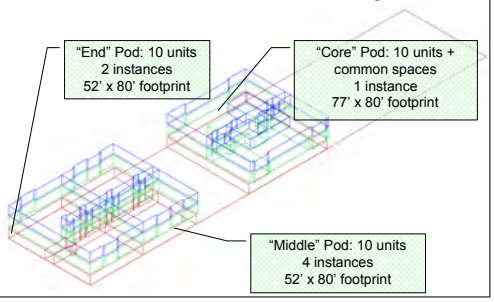
Increased energy “density”

- Per unit living space smaller (average 950 sq ft)
- Per unit basic energy needs the same

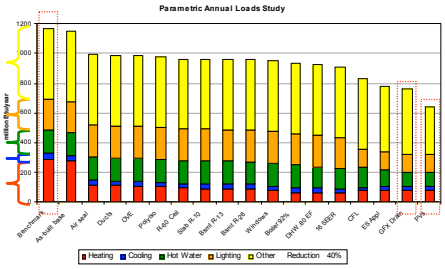
= Whole building energy density greater

“Lump” Model Analysis

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

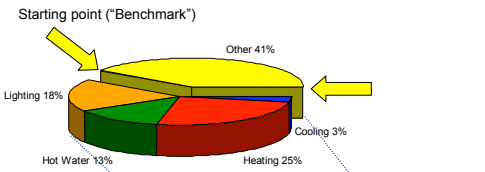


Parametric Simulations



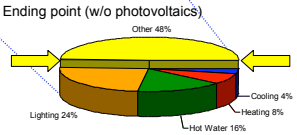
Relative Loads

Starting point (“Benchmark”)



~33% Reduction in overall source energy use

Ending point (w/o photovoltaics)



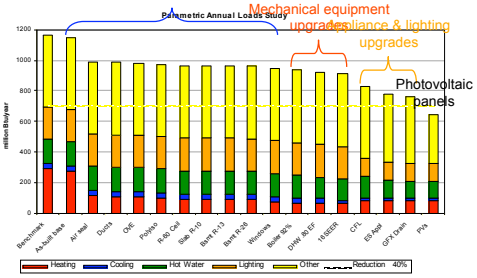
Parametric Steps

Enclosure improvements

Mechanical equipment upgrades

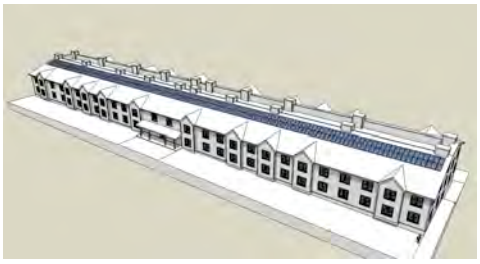
Appliance & lighting upgrades

Photovoltaic panels



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

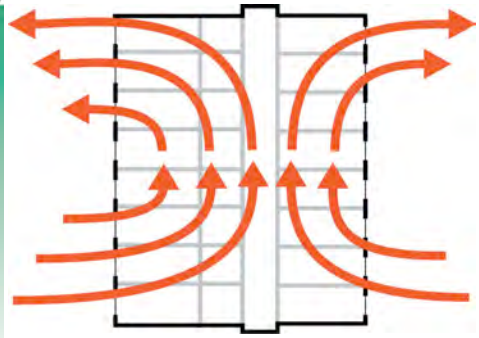


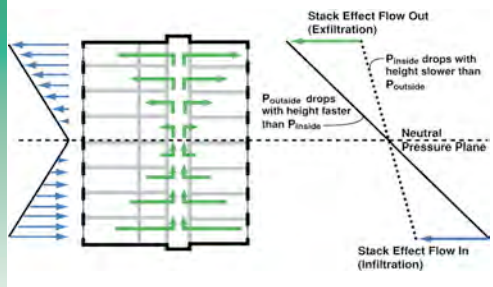
South Roof with Photovoltaic Array

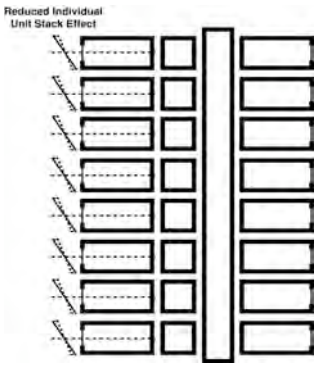
Taft Hill Manor, Uxbridge, MA

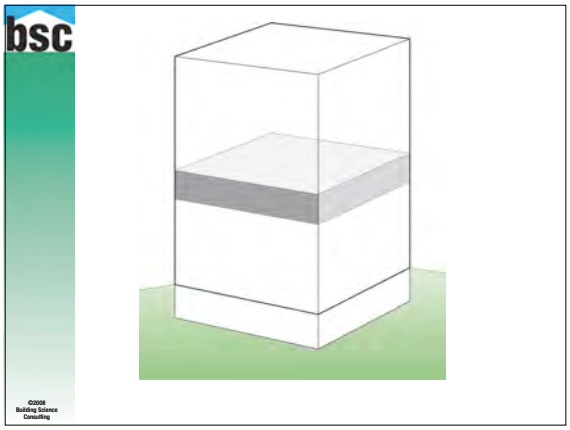
Big Building Airtightness

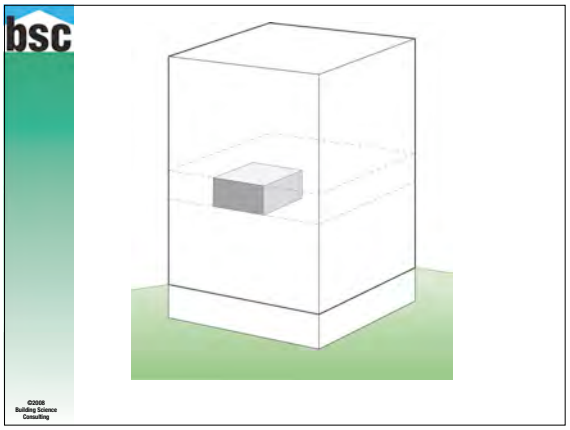
- Enclosure airtightness measures
- Compartmentalization

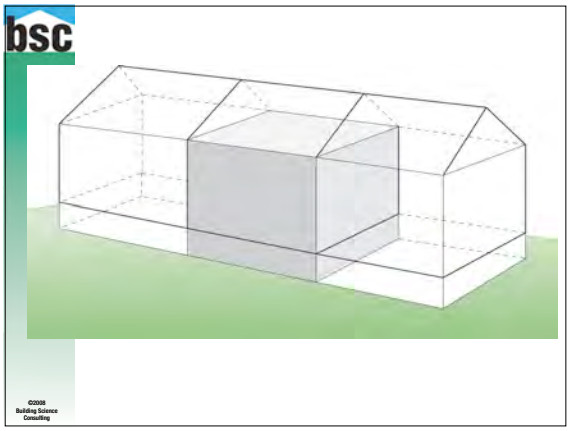


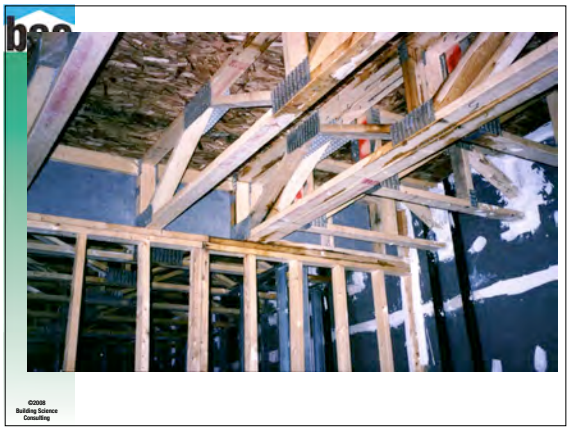


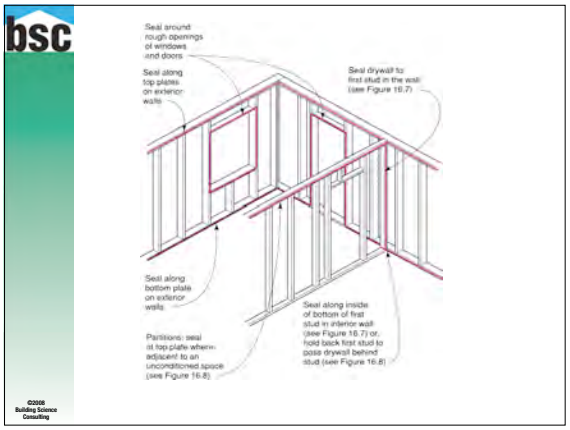










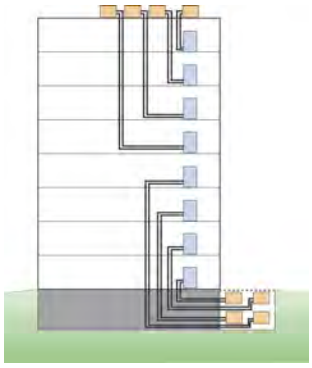


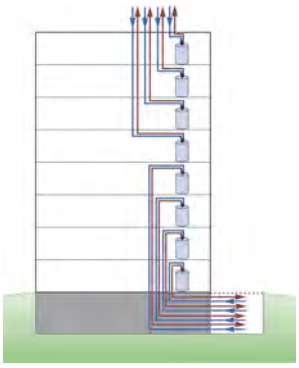
Mechanical Systems

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

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)





Mechanical Systems - Uxbridge

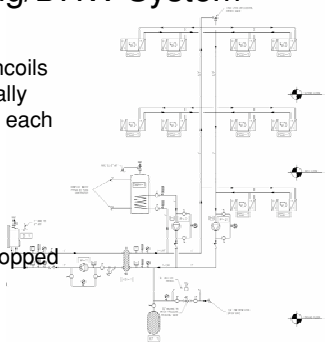
- Hybrid system: “Pod” space conditioning and DHW
  - Combine equipment for 10 units (2 rows)
  - Greatly reduced distribution losses (Important for DHW, less so for heating)
  - Condensing boiler (space heat & DHW) in basement, with sidearm tank
  - Single variable refrigerant volume (VRV) condenser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

Heating/DHW System

- Wall-hung modulating condensing boiler (95.1% AFUE, 29-100 kBtu output)
- S[illegible]k

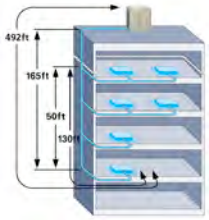
Heating/DHW System

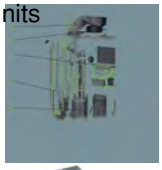
- Individual fancoils thermostatically controlled by each occupant (heat/cool)
- Horizontal "pancake" fancoils in dropped ceilings



Cooling System

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





Review: Important differences

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- Whole building energy use profile
- Big building approach to airtightness
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CONCLUSIONS