Dorset Street MURB Case Study

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Overview

- A case study project incorporating a range of energy efficient, durability and environmental features
- Raised theoretical and practical issues
- Commercial / MURB lessons

Background

- Urban in-fill site in Waterloo, Ontario
  - Former site of a single-family house
- Owners desire an apartment building with office
- City offers tax holiday for mixed use projects

Objectives

- Financially sound investment
  - Retain ownership and control
  - A place for owners to live/retire
  - Polled contractors: $117-140/sf range (C$2004)
- Objectives:
  - Low maintenance & Durable
  - As energy efficient as practical
  - Healthy and pleasant

Concept and Constraints

- Parking and parking access limited site design, and building size
- Result: 5 storey building with 11 residential units and 2400 sf ground floor office space
- Severely constrained financing due to size of building
  - Fixed costs
    - Elevator, 2 stairwells
    - Fire safety systems

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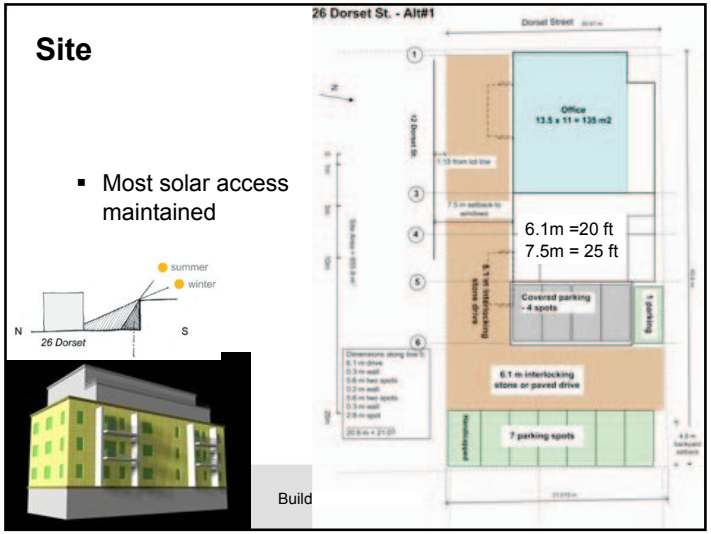
Site

- Most solar access maintained



Build

Existing Site

Final Stats

- 21 250 sf conditioned (1950 m^2)
- $125 / sf hard construction costs (Y2005)
- $12.50 / sf hard costs
- 11 Apartments (19 bedrooms)
- 2500 sf (230 m^2) office

- Substantial completion March 2006
- Full Occupancy July 2006

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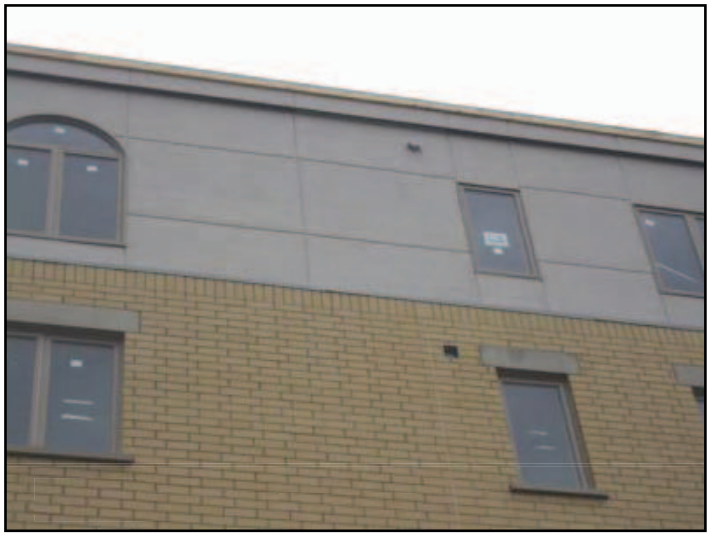
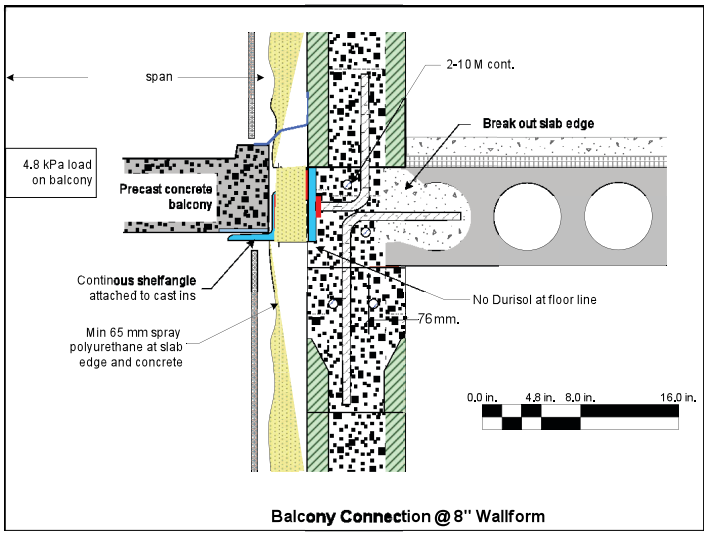
Enclosure

- Continuous air barrier, insulation, and drainage plane behind ventilated cladding
- Impact resistant, non-combustible finish
- Avoid thermal bridges!

Enclosure: Simple Layers

- Structure
- Air Barrier
- Insulation
- Rain Control
- Finish




span
2-10 M cont.
Break out slab edge
4.8 kPa load on balcony
Precast concrete balcony
Continous shelfangle attached to cast ins
No Durisol at floor line
76mm.
Min 65 mm spray polyurethane at slab edge and concrete
0.0 in.
4.8 in.
8.0 in.
16.0 in.
Balcony Connection @ 8" Wallform


Bathtub Balcony

Enclosure

- Opaque walls
  - True R20+ above grade (ccSPF+Durisol)
  - R15 below grade basement wall (XPS)
  - R8 below slab (EPS)
- Roof
  - True R22
  - Green roof or light colored stones
- Windows
  - U0.30 fiberglass, SHGC=0.42
  - Kawneer 451T entrance. PU balcony doors

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Air Leakage

- Blower door test Feb 24, 2006
- Not complete all window sealing
- Identified some leaks, lack of foam, etc
- 1.1 ACH@50
- 0.15 cfm/sf @ 50 Pa

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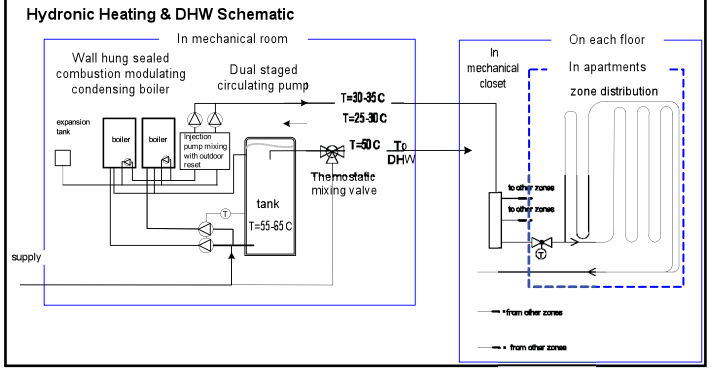
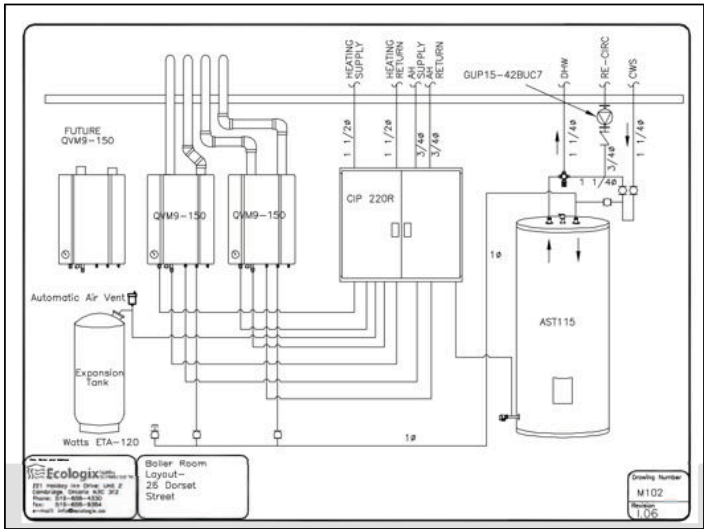
Mechanical System

- Heating
  - Radiant heated floor system
- Cooling
  - Ductless mini-splits for cooling
- Ventilation
  - Single point power exhaust w/ passive distributed make-up

Heating schematic

- Modest performance (86-88%) from DHW
- Should be 92% from space heat

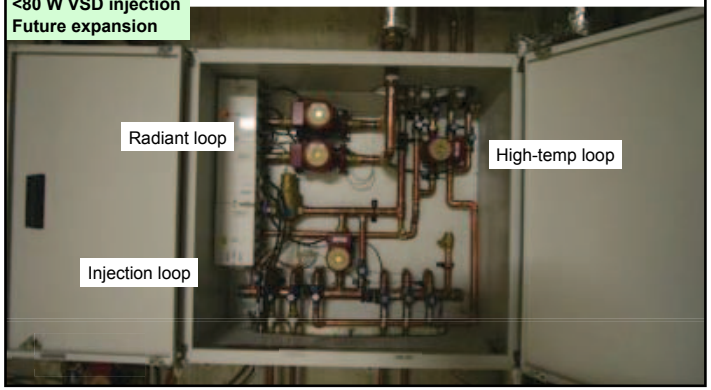




Dual boilers and pumps, quick change out possible, battery operation possible

Mixing / Control Box

Lead lag controls
245 W radiant
<80 W VSD injection
Future expansion

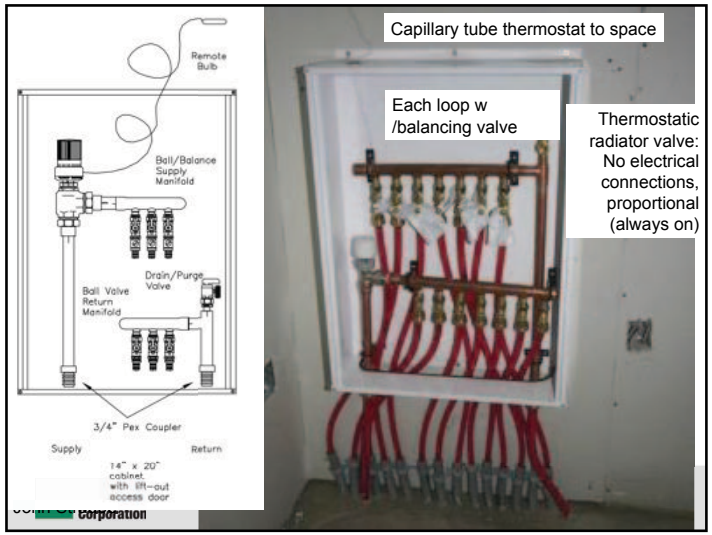


Mechanical Specs

- 2- 135 kBtu/hr combined DHW and space heat
- 1- 2.5 ton AC unit for office
- 4 – 3 ton Samsung mini-split

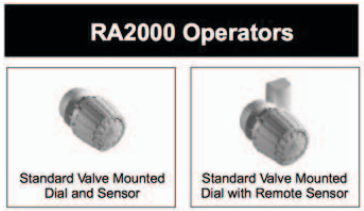
Radiant flooring design

- Tube spacing on floor topping
  - What is needed for comfort? Heat output?
- Design to keep water flowing most of the time and temperature low to distribute hot spots (solar gain, appliances)



Space heat control

- Thermostatic Radiator Valve (Danfoss)
  - Remote air sensor
- Controls flow of water into each zone



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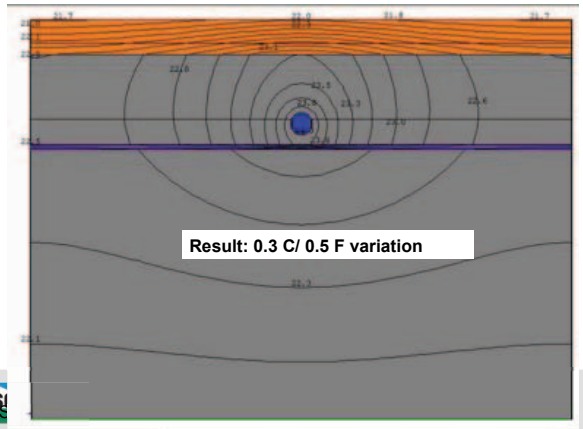
300 mm/12" w/wood



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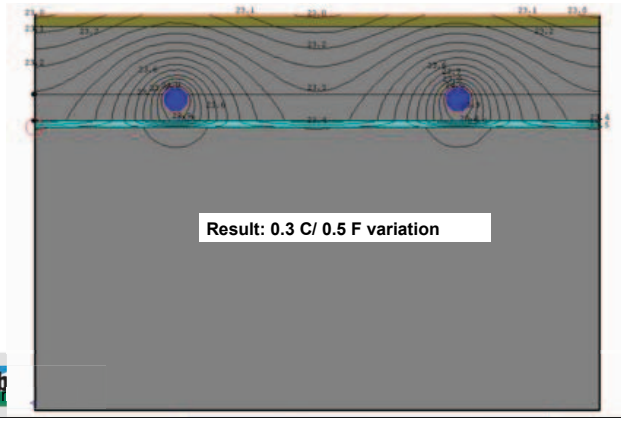
150 mm / 6" w/tile



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Ventilation

- Isolation of suites was priority one
  - Better IAQ, better known ventilation rates
  - Sound control, no smoke/fire/odor issues
- Continuous exhaust from bathroom
  - Boost for showers, cooking, drier
- Heat recovery difficult/$ for small flows
- Passive air inlet
  - Will incoming air be cold?

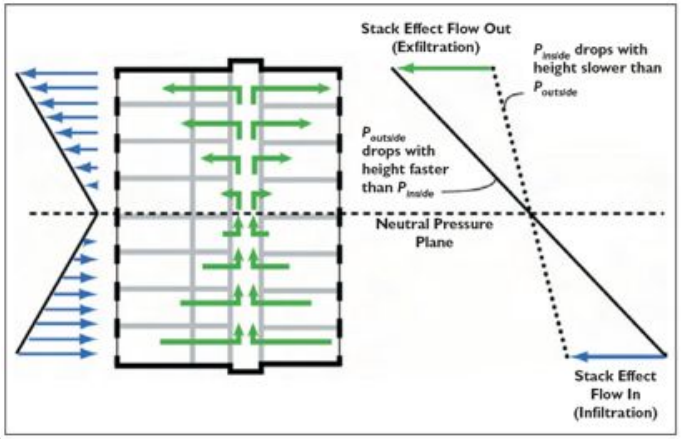
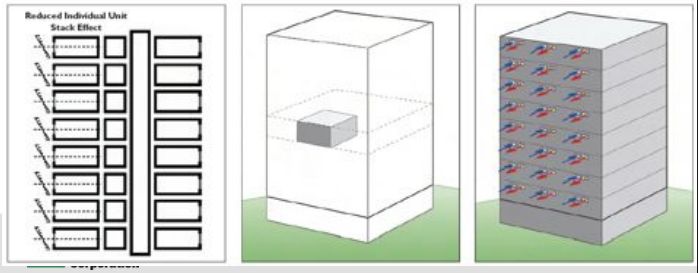


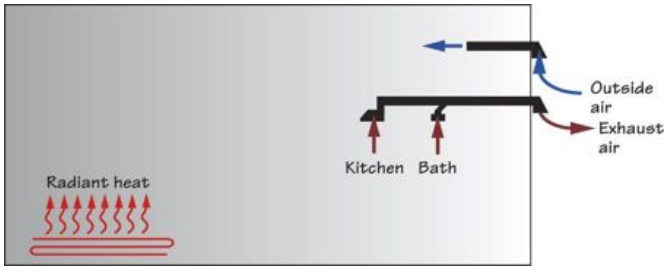
Figure 1: Stack effect. Interior airflows in tall buildings compromise smoke control, fire safety, indoor air quality, comfort and energy use.

Compartmentalization

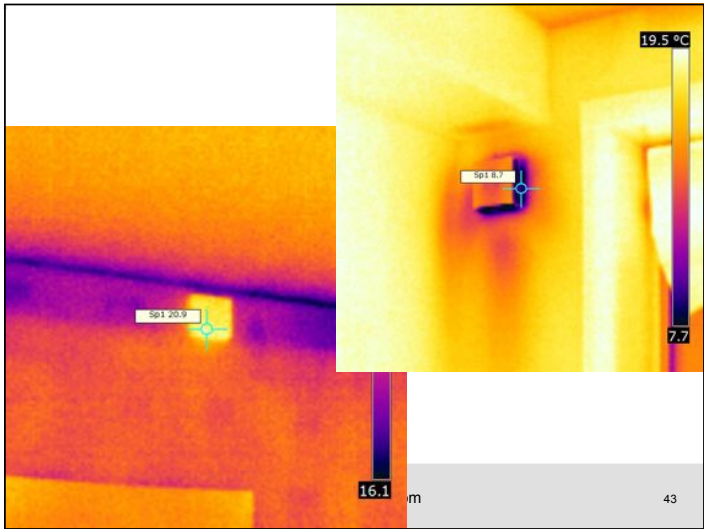
- Each suite is air sealed
- Suites at <1.5 ACH@50 tightness



- **Distributed supply per room, trickle vent**
  - **ONLY works for very tight suites!**
- **Point exhaust, intermittently operated**

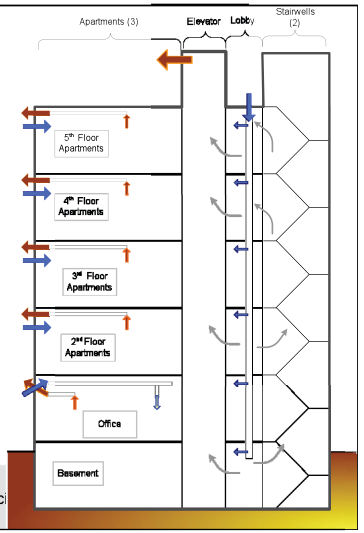


Cooling: Ductless mini-split



Dorset

- Lowest cost
- Low energy
- HRV's would reduce energy *cost* very little
- Fan electric energy costs 3x as much as gas heat



Elevator exhaust

- Rheostat control
- Low flow required (approx. 75 cfm)

Electrical

- CFL everywhere
- Efficient fans and few of them
- Motion sensors in stairwells
  - 95% saving over CFL
- Outdoor motion sensors for parking / front door
  - Security advantages

Energy Consumption

- Current MURB/office in Ontario
  - 250 kWh/m2/yr = 82 kBtu/sf
  - 320 kWh/m2/yr = 106 kBtu/sf
- Projected 105 kWh/m2/yr= 35 kBtu/ft2/yr
- 80% is heating and cooling, 20% electric

- Substantial completion Dec 05
- Occupany Jan 06

Measured Energy Consumption

- Two years: Jan 18/06 to Jan 17/08
- Gas: 66.5 ekWh/m^2/yr 21.1 kBtu/sf/yr
- Elec: 25.0 kWh/m^2/yr 21.1 kBtu/sf/yr
- Total: 91.5 ekWh/m^2/yr 29.0 kBtu/sf/yr

- DHW estimated 11.7 ekWh/m^2/yr =3.7 kBtu/sf/yr
- 21 bathrooms in building
- Most recent year (to mid 08 to mid 09) 67.6 / 21.5 gas
- $9200 total energy cost (2007)

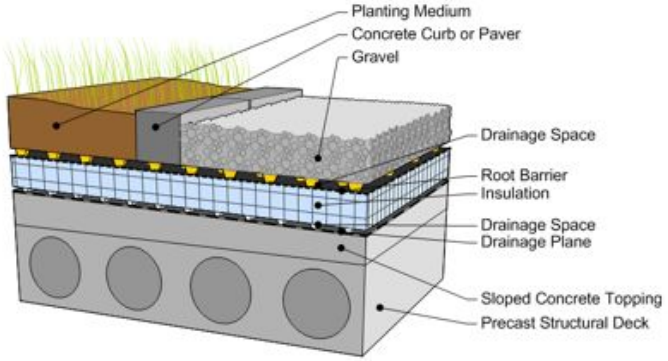
Sound control

- Floating floors of gypcrete on foam
- Airtight suite doors
- Durisol suite demising walls
- Only low sone (0.3) fans
- Airtight windows

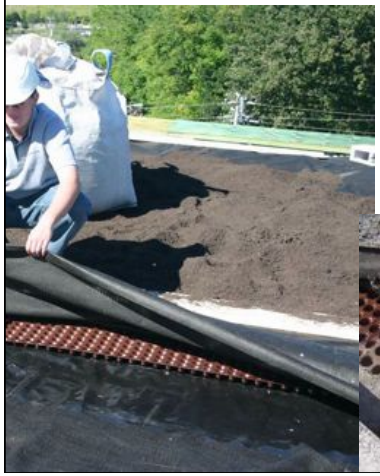
Green roof

- Occupant amentity, heat island reduction, neighborhood contribution
  - Not “reduction in heat loss/gain”
- Low cost and simple
  - Inverted roof fully adhered (expensive)
  - Drainage mat
  - 4” Extruded foam
  - Water retention membrane (MS20)
  - Landscape cloth
  - Soil or pavers or gravel

Roof Design



Cosella-Doerken MS20



Green Roof

- Add'l =$5/sf
- PLUS plants

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Lessons Learned

- Can build durable, energy efficient for same or less than typical
- Achieving this requires many things
  - directed choices/trade-offs at concept stage
  - Committed owner / design team
  - Involvement in quality control and compromises throughout process
  - Do mockups, even for small jobs
  - There are many reasons why not, find the reason why.

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Doing again

- Triple-glazed windows
- Overhangs to protect top floor doors
- HRV on elevator/hallway (100 cfm)

Meeting Passiv Haus

- 120 kWh/m^2/yr primary energy
- Current :
  - North American values
    66.5 * 1.09 + 25*3.365 = 157 kWh/m^2/yr
  - German Values
  - 66.5 * 1.0 + 25*2.70 = 134 kWh/m^2/yr
  - But building area different in PH
- Should be easy to meet primary target with modest efficiency measures
- Hard to meet 15 kWh/m2/yr site heating target

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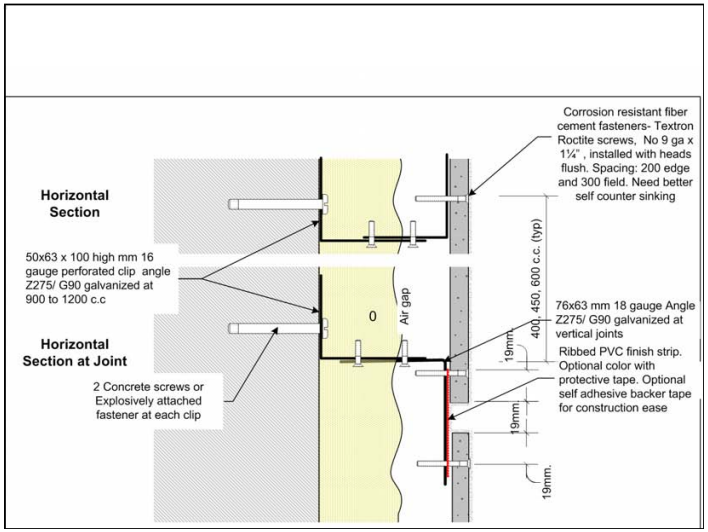
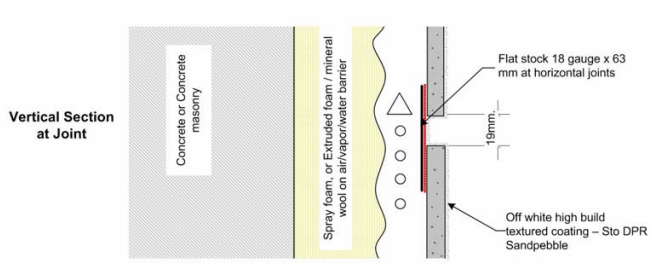
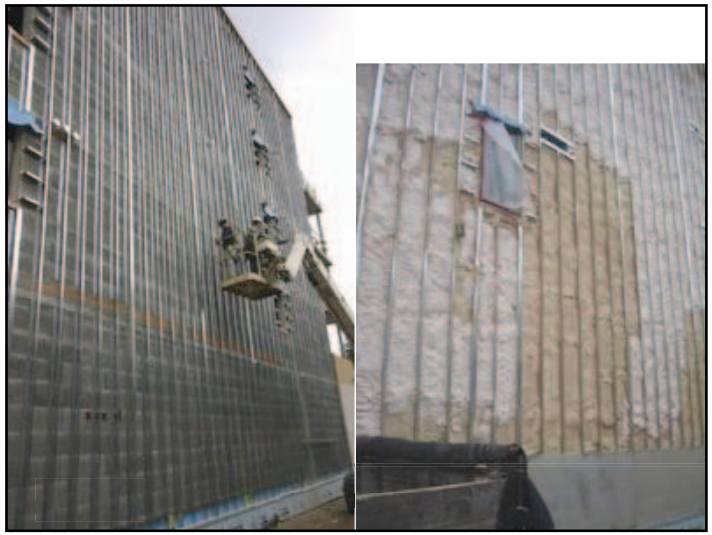
Cladding

- Desired light weight, impact resistant, non-combustible low cost cladding
- EIFS has does not meet these requirements
  - Transitions to spray foam? Draining?
- Developed fiber-cement panel system
- Elastomeric textured coating used to cover screws
- Special joint details



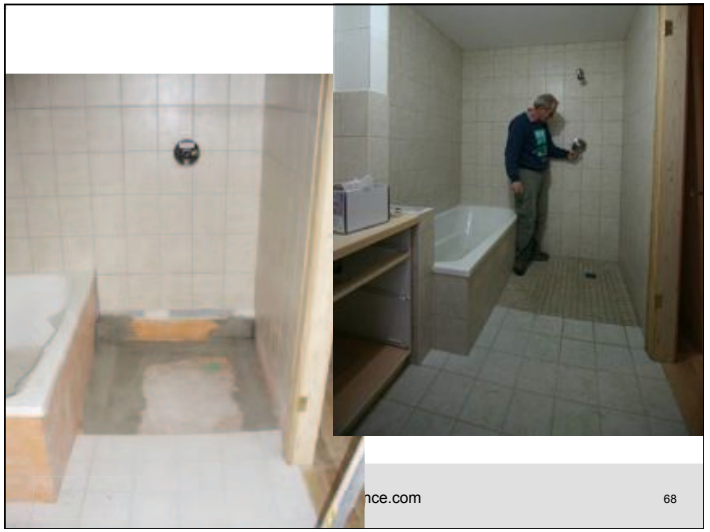


Stucco-textured Ventilated and Drained Expressed Joint Cladding System on Thermally Broken Framing System Over 2-6" Exterior Insulation



Internal moisture control

- Each wet room has a floor drain for plumbing bursts
- Waterproof membrane under tiles used in standing water areas / sprayed walls

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