Integrated Design: The Renewal of Ketchum Arts and Sciences Bldg.
Presenters

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Agenda

- Historic Buildings
- Ketchum project overview
- Preservation treatment
- Envelope – hygrothermal analysis
- Mechanical – eQuest and CFD
Secretary of the Interior’s Standards

Some features of a historic building or site such as cupolas, shutters, transoms, skylights, sun rooms, porches, and plantings can play an energy-conserving role. Therefore, prior to retrofitting historic buildings to make them more energy efficient, the first step should always be to identify and evaluate existing historic features to assess their inherent energy-conserving potential. If it is determined that retrofitting measures are appropriate, then such work needs to be carried out with particular care to ensure that the building's historic character is retained.
Pocantico Principles

1. Promote a Culture of Reuse
2. Reinvest at a Community Scale
3. Value the Lessons of Heritage Buildings and Communities
4. Make Use of the Economic Advantages of Reuse, Reinvestment and Retrofits
5. Re-imagine Historic Preservation Policies and Practices as They Relate to Sustainability
6. Take Immediate and Decisive Action
Historic Preservation

Sustainable Design

Opportunities

Programming and Functionality
Ketchum Original Goals

- CU Design Review Board – building exterior concerns
- LEED Gold + campus standard
- Given scope of work for pilot project to upgrade the entire building at once – a “Capital Renewal Project”
History of Ketchum

- Charles Z. Klauder, Architect
- Constructed 1938
History of Ketchum

Not listed on register, adjacent to National Historic District and in the same style.

“Italian Vernacular Revival style” or “University of Colorado style” per Klauder

Originally Ketchum Engineering Building
Ketchum LEED Design Opportunities

- Displacement Ventilation
- R-40 Roof Insulation
- Daylighting and Controls
- Reuse of Building
Opportunity and Compromise

- R-20 Walls – 1 to 2” Polyiso insulation on interior surface – character impacts?
- Insulated glazing units
- Thermally broken aluminum frames
- LowE film; changes on various elevations
Decisions, Decisions

- Window Replacement
  - Poor condition of windows
  - Structural concerns – large size and sagging
  - Operability – storm windows undesirable
- Lead abatement
- Replacement “in-kind”
Insulating Exterior Masonry walls

Pros
- Increasing R value of assembly
- Potential personal comfort benefits
- Potential to minimize mechanical system size

Cons
- Dewpoint analysis critical
- Loss of interior historic fabric and trim
- Loss of relationship between window and wall
- Loss of plaster finishes and inconsistent interior
Building Performance Goals

- Energy efficiency
- Mechanical system selection
- Another hundred years
- LEED Gold Rating

![Diagram showing Building Performance Goals]

- Sustainable Sites, 26% (20%)
- Water Efficiency, 10% (7%)
- Energy & Atmosphere, 35% (25%)
- Materials & Resources, 14% (19%)
- Indoor Environmental Quality, 15% (22%)
- Innovation in Design, 6% (7%)
- Regional Priority, 4%
Hygrothermal Analysis
Existing Walls

- Masonry wall R-3
- Warm and dry

Calculation Conditions:
-3°F outdoor temp
60% outdoor RH
70°F indoor temp
30% indoor RH
Insulation Only – 1” Polyiso

- R-9.80, no vapor barrier
- Cold and wet

Proposed Wall -- 1" Foil Face Polyiso Insulation
Dry-Bulb and Dewpoint Temperature
(not to scale)

 Calculation Conditions:
-3°F outdoor temp
60% outdoor RH
70°F indoor temp
30% indoor RH
Insulation + Vapor Barrier Systems

- R-9.8+ reinforced-polyethylene 0.05 perm
- Paint on gypsum board and plaster
- Foil faced polyiso with tape

Proposed Wall -- 1" Polyiso plus Vapor Barrier on Interior
Dry-Bulb and Dewpoint Temperature
(not to scale)

Calculation Conditions:
-3 F outdoor temp
60% outdoor RH
70 F indoor temp
30% indoor RH
Final Design

- Vapor barriers:
  - Paint, foil-faced polyiso, polyethylene

- Penetrations:
  - Seal electrical and data
  - No mechanical penetrations

- Re-evaluate closed cell spray foam
  - Flammability, masking, reversible

- Operate at a negative pressure
- Regularly re-point
Window Selection

A2 TYP OPERABLE SILL DTL
SCALE: 1-1/2" = 1'-0"
# Architectural Options

## SUMMARY

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<th>Energy Cost</th>
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HVAC System Selection

- VAV air handling units -- overhead distribution
- VAV air handling units -- displacement ventilation
- Dedicated outside air units with fan coil units -- overhead distribution
Displacement Ventilation

- Computational fluid dynamics of small offices
Displacement Ventilation

- 1.3 feet from wall
Displacement Ventilation

- 2.4 feet from wall
Displacement Ventilation

- 8 feet from wall
Displacement Ventilation

- 8 feet from wall
Displacement Ventilation

- 0.3 feet from floor
Displacement Ventilation

- 2.5 feet from floor
Displacement Ventilation

- 5.6 feet from floor
Displacement Ventilation

- Computational fluid dynamics of small offices
HVAC Energy Comparison

Energy for HVAC End Use
(MMBTU/yr)

- Space Cool
- Space Heat
- Fans
- Pumps

- VAV
- DV
- DOAS + FC
Displacement Ventilation

- Increased indoor air quality (IAQ) due to minimal disturbance of room contaminants;
- Reduction of total building air flow (CFM)
- Smaller air handling units compared to overhead distribution
- Additional hours of free cooling
- Noise at diffuser termination NC<25.
HVAC System Footprint

MECHANICAL ROOM SECTION LOOKING WEST

SCALE: 1/4" = 1'-0"

CLASSROOM

STORAGE

HWS/R MAINS

30x50 RETURN DUCT

62x24 SUPPLY DUCT

HWS/R RISER DOWN TO CONVECTORS
Outcome Compared to Goals

- New windows preserve look with performance
- Existing masonry walls protected by vapor barrier(s)
- Insulation saves over $8,000 per year
- Compact HVAC system retrofit
- Displacement ventilation system
- LEED Gold plus
Thank You!

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