Energy Efficiency Upgrades
Bolling Federal Building

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Presentation Outline

• **Introduction**
  - Energy Efficiency
  - Richard Bolling Federal Building project scope/objectives

• **Basic considerations for energy efficiency**

• **Challenges in design and implementation**

• **Thermal and hygrothermal models and on site validation methods**

• **Case Study - Bolling Building Curtain Wall System Upgrades**

• **Questions**
Energy Efficiency

• Means different things to different constituents
  – Alternative energy
  – Super insulating
  – Heating and cooling
  – Lighting considerations
  – Daylighting to offset loads
  – Passive solar
  – ........

• Important to accomplish, but complex
Richard Bolling Federal Building
Richard Bolling Federal Building

PROJECT SCOPE

• Design and built in the early 1960’s
• 18 Story office tower with 3 story annex
• 1.2 Million square feet over two city blocks
  Typical office tower floors are 50,000sf
  Tower and annex floors are 70,000sf
• Complete modernization while occupied
• Total construction cost of $260M
  Four Phases over 14 years
  Abatement | Mechanical | Interior Finishes
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PROJECT OBJECTIVES

• Abate Hazardous Containing Materials
• Energy Efficiency
• Invisible Construction
• Design Excellence
• LEED Silver
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Consideration for Thermal Efficiency

- Exterior glazing
- Reduce thermal bridges
- Air tighten the enclosure
- Enhance insulation with consideration for effect on existing building fabric
- Consideration for placement of fenestration within enclosure - interface with the wall systems thermal barrier
- Interaction between the mechanical system and the building enclosure
Design and Implementation - Challenges

- Integration with new systems with original structure
- Trades skills
- Understanding how the previous design worked
- How to alter to improve
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Thermal and Hygrothermal Models

Location: Kansas City; cold year

North Elevation

WUFIM®

10/1/2008

[W/m²]

Temperature [°C]

[mm/h]

Water Content [kg/m²]

Rel. Humidity [%]

PVC Roof Membrane

Icynene

Air Layer 50 mm

Gypsum Board

Cross Section [cm]

1. Max amount of water at surface of metal - 280 kg/m²
Thermal and Hygrothermal Models

Location: Kansas City; cold year

North Elevation

- Temperature [°C]
  - 0 to -20
  - 20 to 40

- Water Content [kg/m²]
  - 0.001 to 1

- Relative Humidity [%]
  - 0 to 100

Cross Section [cm]

- PVC Roof Membrane
- Icynene
- Air Layer 50 mm
- PE-Membrane
- Gypsum Board

Legend:
- Temp. Trace
- RH Trace
- Water Trace
Thermal and Hygrothermal Models

Winter Analysis Results - Kansas City

Indoor Temperature - 72 F
Outdoor ASHRAE Design Temp. - (-1) F

Dew Point at 40 % RH (Int.) - 46.4 F
Dew Point at 35 % RH (Int.) - 42.8 F
Dew Point at 30 % RH (Int.) - 38.9 F
Thermal and Hygrothermal Models
Thermal and Hygrothermal Models

Winter Analysis Results - Kansas City

Indoor Temperature - 72 F
Outdoor ASHRAE Design Temp. - (-1) F

Dew Point at 40 % RH (Int.) - 46.4 F
Dew Point at 35 % RH (Int.) - 42.6 F
Dew Point at 30 % RH (Int.) - 38.9 F
Thermal and Hygrothermal Models

Winter Analysis Results - Kansas City

Indoor Temperature - 72 F
Outdoor ASHRAE Design Temp. - (-1) F

Dew Point at 40% RH (Int.) - 46.4 F
Dew Point at 35% RH (Int.) - 42.5 F
Dew Point at 30% RH (Int.) - 38.8 F
Thermal and Hygrothermal Models

Winter Analysis Results - Kansas City

Indoor Temperature - 72°F
Outdoor Air HVAE Design Temp. - (-1)°F

Dew Point at 40% RH (Int.) - 48.4°F
Dew Point at 35% RH (Int.) - 42.0°F
Dew Point at 30% RH (Int.) - 38.9°F
Field Validation

- Thermography
- Instrumentation – measure and verify
Field Validation
Field Validation
Field Validation
Questions