DEEP ENERGY RETROFITS
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AIR TIGHTNESS OF EXISTING BUILDINGS
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Retrofit Air Barriers in Existing Buildings
Deep Energy Retrofits

- Exterior assessment
- Condition of exterior materials
  - Masonry
  - Concrete
  - Precast
  - Wood
- Insulation
  - Interior
  - Exterior
- Air barrier
  - Interior
  - Exterior
Investigate Existing Conditions

- Condition Survey
- Material Properties
- Wetting / Drying Mechanisms
- Exposure History
Deep Energy Retrofits

- Look at parapets, chimneys
- Masonry in attics
- Rebar and lintel corrosion
- Condition of granite, limestone, marble and brownstone
- Airtightness
  - Inside
  - Outside
Condition Survey

- Close up vs. binocular survey.
- Typical vs. survey observations
- Sounding, tactile or other non-destructive assessments.
- Inspection openings.
- Interview building owner/maintenance
Types of Damage and Deterioration

- Eroded mortar
- Spalling
- Damaged/Missing Flashings
- Sealant Failure
- Efflorescence
- Corrosion of metal elements
- Coating or paint failure
- Differential movement
- Freeze-thaw damage
- Indicators of material performance - parapet walls, chimneys
Document Existing Conditions
Air Barrier Continuity

- ASTM E1186, Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
- Depressurization testing
- Locating air leakage
  - Infrared thermography
  - Tracer gas testing or theatrical smoke
Depressurization testing
Theatrical fog testing
Look at Building Holistically

Air Barrier Boundaries

- Green Area: Conditioned Space Air Barrier
- Yellow Area: Conditioned Space Under Negative Pressure (Interior and Exterior Air Barrier)
- Red Area = Unconditioned Space with Interior Air Barrier
Air Barrier Continuity
Interior or exterior air barrier?
Exterior air barrier and recladding
Air barrier applied to existing wall
AIR & VAPOR BARRIER MEMBRANE

R-7 MIN. RIGID INSULATION

CAVITY DRAINAGE MESH

6" STRIP OF COUNTER FLASHING MEMBRANE
FORMED METAL FLASHING SET SEALANT

OPEN HEAD WEEPS AT 2'-0" OC

SEALANT

SHELF ANGLE TAPE JOINTS
VENT 4'-0" O.C.

VENEER ANCHOR

AIR & VAPOR BARRIER MEMBRANE WRAPPED UP AND AROUND STEEL RELIEVING ANGLE

3 5/8" VARIES 4 TO 8"

GYPSUM BOARD

STEEL STUD

SPRAY URETHANE FOAM

CONCRETE SLAB

METAL DECK

METAL CLOSURE ANGLE

DEFLECTION TRACK

SHEATHING

2" AIR CAVITY

FACE BRICK
2" AIR CAVITY
CAVITY DRAINAGE MESH
VENEER ANCHOR
THRU-WALL FLASHING
WEEN AT 2'-0" O.C. HORIZONTALLY
AIR & VAPOR BARRIER MEMBRANE CONNECT TO CONCRETE FOUNDATION
GROUT SOLID
MIN. R-7 RIGID INSULATION
FACE BRICK
GRADE
MIN. R-5 EXTRUDED POLYSTYRENE RIGID INSULATION
FOUNDATION WALL
DAMP PROOFING OR WATERPROOFING

GYPSUM BOARD
SHEATHING
STEEL STUD
METAL RUNNER TRACK
CAPILLARY BREAK MEMBRANE
COMPRESSIBLE FILLER
CONCRETE SLAB
VAPOR BARRIER

EXTRUDED POLYSTYRENE INSULATION CONTINUOUS UNDER CONCRETE SLAB. STATE CODE MINIMUM IS R-5 FOR CERTAIN BLDG TYPES
LBJ Apartments, Cambridge, Massachusetts

- Existing Construction.
- Cambridge Housing Authority.
- 178 Units.
- Elderly/Disabled.
- Post tensioned concrete structure with precast spandrels and floors.
- Chronically Underfunded.
LBJ Apartments: EIFS
LBJ Apartments: EIFS
Gut Renovation
Facade restoration
Interior air barrier
How much is too much?
Embedded Structure

CONTINUOUS AIR SEAL AROUND BEAM

REDUCE INSULATION DEPTH TO 1” AT BEAM LOCATIONS
Material Properties

- Material physical properties
  - Dry density
  - Liquid water uptake (A-value)
  - Saturation moisture content
  - Frost dilatometry, $S_{\text{crit}}$

- Hazardous materials
Field Testing and In-situ Monitoring

- Local climate and rain water conditions.
- Absorption (Rilem tube, ASTM C1601)
- Water penetration
- Air leakage
Vapor Control

WUFI Pro
Delphin

8760 Hour Calculations

Transient Hygrothermal Analysis
Gallatin Hall – HBS – McKim, Mead & White
Gut renovations
Gallatin Hall HBS – LEED Gold
Flashing transitions at windows
Window flashing transitions
Insulate and air seal wall and roof
Gut renovations - Deerfield Arts
Window flashings
Air barrier seal at Window to flashing
Roofs – A huge opportunity
Sealing existing buildings (most difficult)
I. Seal Top of Building
Seal top of building

- Reroofing AVB
- Attics
- Roof/wall intersections and plenum spaces
- Mechanical penthouse doors and walls
- HVAC equipment penetrations through the roof
- Other roof penetrations, such as plumbing vent stacks
Air Barrier Continuity

- The plenum
- Air can infiltrate through many different assemblies if air barrier systems are not in place

exterior sheathing
Air Barrier Continuity

Seal top of building
Air Barrier Continuity

Seal top of building
Weatherstrip existing doors
II. Bottom of Building
Bottom of Building

- Exterior soffits, canopies and ground floor access doors
- Underground parking access doors and elevators
- Exhaust and air intake louvers and vents
- Pipe, duct, cable and other service penetrations into core and shafts of building
- Sprinkler head penetrations, inspection access doors and hatches.
- Seal core wall to floor slab
- Residential crawl spaces and penetrations, vented or unvented.
- Loading docks
III. Seal the Vertical Shafts
Seal the shafts

- Stairwell fire doors
- Fire hose cabinets
- Plumbing, electrical, cable and other penetrations within service rooms
- Elevator rooms - cable holes, door controller cable holes, bus bar openings
- Garbage chute perimeter and access hatches
- Hallway pressurization grille perimeters
- Smoke shaft access doors
- Elevator shaft smoke control grilles
- Mechanical & electrical shafts
IV. Seal the exterior walls
Seal exterior walls

- Seal individual leakage pathways
- Windows
- Sealants
- Radiation piping penetrations
- Floor and ceiling intersections with exterior wall
- Plenums
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