



**BEST 4 Conference:**

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# Performance Testing for Quality Assurance and Commissioning

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Principal

**WJE** | ENGINEERS  
ARCHITECTS  
MATERIALS SCIENTISTS

Wiss, Janney, Elstner Associates, Inc.

# **The most benefit to a project is obtained during the Design Phase**

- architectural program
- Owner's Project Requirements
  - design meet expectations
  - details that perform
- details that are constructible
  - cost vs. performance

**ENVELOPE.** Most insurance claims have to do with the integrity of the building envelope—wall and roof leaks, says David R. Reid, senior vice president and construction industry practice leader in the Phoenix office of insurer Marsh USA Inc.

**THE CONSTRUCTION WEEKLY**

**ENR**  
Engineering News-Record

enr.com

A Publication of The McGraw-Hill Companies

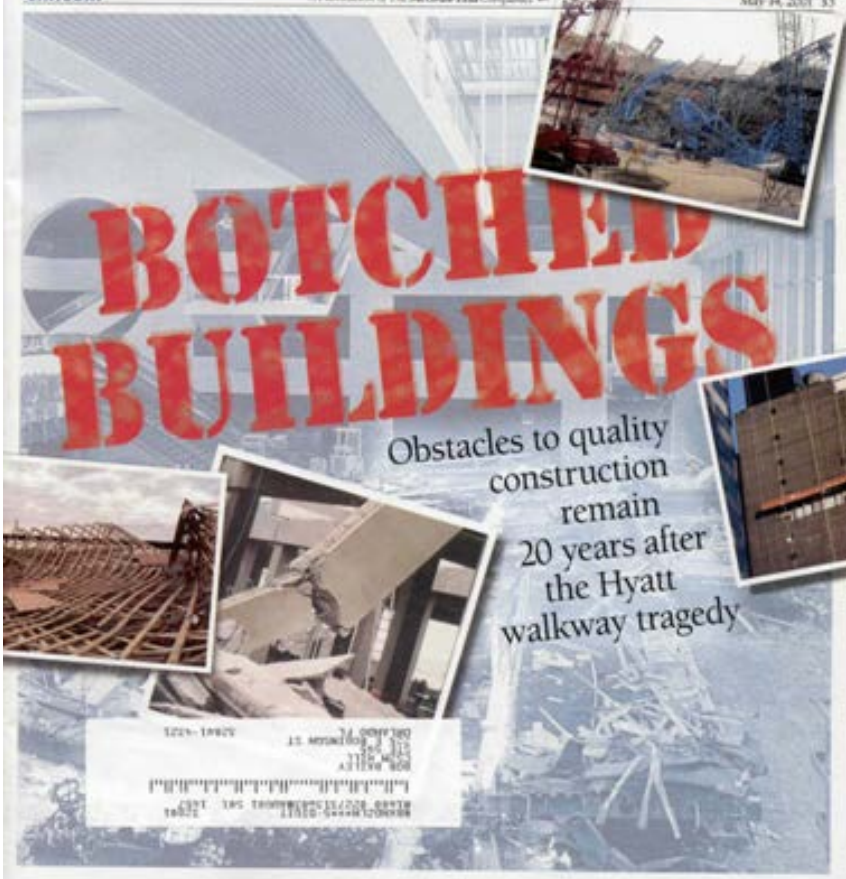
May 14, 2001 \$5

► **UNIONS:** Building trades president wants to mend fences and bring the carpenters union back into AFL-CIO

► **HIGHWAYS:** Utah's \$1.6-billion design-build test rolls in five months early

**BOTCHED BUILDINGS**

Obstacles to quality construction remain 20 years after the Hyatt walkway tragedy



# Consequences

- Cost to repair
- Time to repair
- Loss of use
- Lost reputation



“Architecture should  
speak of its time  
and place, but  
**yearn** for  
timelessness”

Frank Gehry

Pritzker Architecture Prize , 1989



*Stata Center, MIT Campus,  
Cambridge, MA 2004*

# Risk Factors

- ☐ Cost of Loss / square meter (square foot)
  - ☐ Building Use or Function
  - ☐ Area - square meter (square foot)
  - ☐ Building Enclosure Design Complexity
  - ☐ Environment / Climate
  - ☐ Level of Innovation and/or Performance
  - ☐ Level of owner's experience
  - ☐ Level of Contractor experience
- = Owner Risk Tolerance

**Tolerance of risk,  
influences  
approach to QA  
& verification**

# Verifying performance?

Quality Process, such as:

Building Enclosure Commissioning (BECx)

or a

**BUILDING ENCLOSURE**

**PERFORMANCE & QUALITY ASSURANCE**

**(COMMISSIONING PROGRAM)**

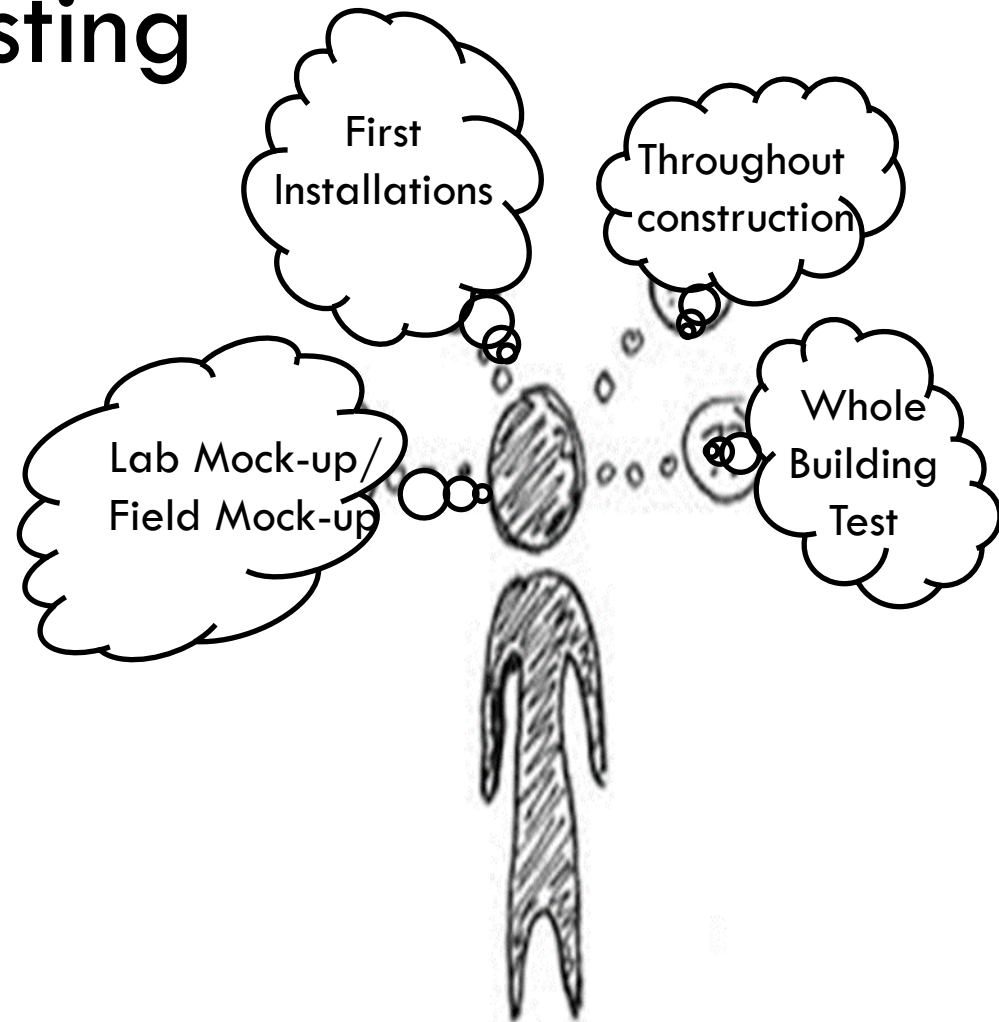
**Specified Performance Testing in  
Part 3 of enclosure related  
sections**

**Code Minimum or GC  
initiated QC Program**



# Testing

- When
- Where
- What
- How
- Cost / budget



# Testing

- Types of tests
  - Test per standard?
    - Water
    - Air
    - Thermal (CI)
    - Structural
    - Sound
    - Infra-Red
    - Pull testing for anchors
    - Peel Adhesion
    - Seismic/Inter-story drift
    - Test Pressures?
- Are there tests not defined by standards?
- Project specific tests



**Relevant  
testing is  
the best  
testing!**



# Field Air Tests – Glazed assemblies & Interfaces



**ASTM E783** *Standard Test Method  
for Field Measurement of Air  
Leakage Through Installed Exterior  
Windows and Doors*



# Field Water Tests – Glazed assemblies & Interfaces

**ASTM E-1105-00(2008)** Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Differential.



# Field Water Tests – Glazed assemblies & Interfaces

**AAMA 501.02** Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Differential.





# Field Water Tests – Glazed assemblies & Interfaces

**AAMA 501.1-05** Standard Test Method for Exterior Windows, Curtain Walls, and Doors for Water Penetration Using Dynamic Pressure – Modified for Field Use



# Field Air Tests – Air Barrier

**ASTM E1186 –03 (2009) Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems**



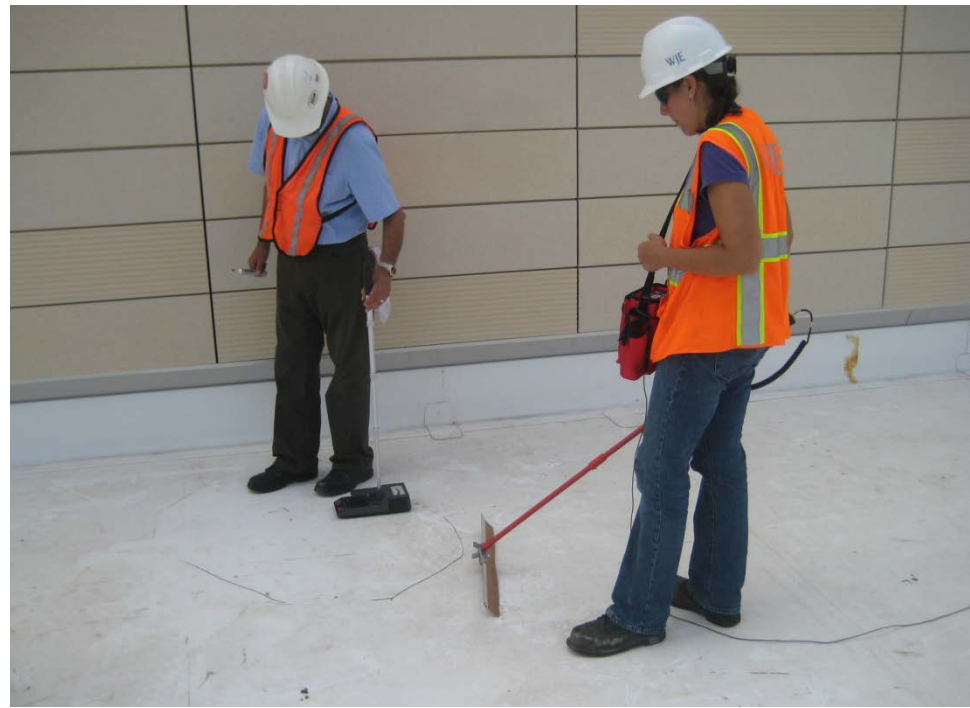


# Field Thermal Tests – Glazed Assemblies/Transition to Air barrier

**AAMA 1503-09** Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Assemblies.



# Field High Voltage Electronic Leak detection – Roofing and Planter waterproofing



- Approach to testing?

- What's the risk?

- watertightness
    - air tightness
    - thermal continuity



**DURABILITY**

- Be project specific

- Define a pass / fail

- Be prescriptive

- Isolate window from wall

- Be prepared

- What fails/leaks and why?
  - Is it systemic?
  - How much more to test in event of failure

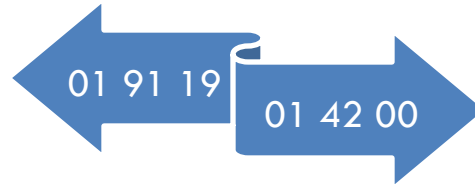
**discussion**



**SECTION 01 42 00**  
**EXTERIOR ENCLOSURE**  
**PERFORMANCE REQUIREMENTS**

The section, to be included in Division 1 of the project manual shall at minimum, include criteria for:

- Structural Performance Requirements
- Minimum design pressure
- Lateral loading
- Vertical deflection
- Horizontal deflection
- Inter-story Wind and seismic drift
- Structural serviceability
- Thermal Movement Requirements
- Hygrothermal Performance Requirements
- Air Leakage
- Water leakage
- Thermal Transmittance
- Thermal Resistance



**SECTION 01 91 19**  
**EXTERIOR ENCLOSURE**  
**COMMISSIONING**

The section, to be included in Division 1 of the project manual shall complement the Exterior Enclosure Performance Requirements section and address:

- Commissioning requirements common to all Exterior Enclosure-related sections.
- Validation of proper and thorough installation of Exterior Enclosure components.  
Building enclosure component performance testing schedule and verification.
- Documentation of tests, procedures, and installations.
- Coordination and requirements for mock-up, trial installation and testing events.
- Preparation and coordination of Commissioning Report content.
- Management of Record Construction Documentation
- Preparation and Coordination of Facility Building Enclosure Maintenance and Operation Manual
- In-situ training of Owner personnel

**The performance requirements shall be coordinated for the building enclosure as an integrated whole, inclusive of air barrier requirement for continuity between the various facade, roof and below grade assemblies.**

# Prevent Loss by Verifying Performance

## **Meeting the Owner Project Requirements (OPR) and the design intent through a quality oriented process**

“The Commissioning Process is a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria. The Commissioning Process assumes that owners, programmers, designers, contractors, and operations and maintenance entities are fully accountable for the quality of their work. The Commissioning Team uses methods and tools to verify that the project is achieving the Owner’s Project Requirements throughout the delivery of the project.

The Commissioning Process begins at project inception (during the Pre-Design Phase) and continues for the life of the facility (through the Occupancy and Operations Phase). The Commissioning Process includes specific tasks to be conducted during each phase in order to verify that design, construction, and training meet the Owner’s Project Requirements.”

The Guideline 3-2006 Exterior Enclosure Technical Requirements for the Commissioning Process (available at: [http://www.wbdg.org/ccb/NIBS/nibs\\_gl3.pdf](http://www.wbdg.org/ccb/NIBS/nibs_gl3.pdf))

**The building enclosure  
provides the layer by  
which the exterior  
environment is filtered  
from the interior.**