Provider: AIA Fort Lauderdale
A138

Course Title: Design to Control Moisture Intrusion in Building Envelopes
AIAFLLOCT8-09

Speaker Name: Mark L. Smith, AIA

10/08/2018

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

This presentation will discuss and outline the science of moisture intrusion in building envelopes and the importance of understanding this science as we evaluate existing building envelopes that may be failing and as we design new building envelopes that will prohibit inappropriate moisture intrusion.

The presentation will cover four main areas of discussion as follows:

1. The science of moisture and air movement through various building materials and building envelope systems.
2. Evaluation of existing building envelope systems that may be failing, causes and potential fixes for existing failures.
3. Design and verification of new Building Envelopes to prohibit inappropriate moisture intrusion.
4. Building Envelope Commissioning and verification of quality construction during the implementation phase of the project.

Learning Objectives

At the end of the this course, participants will be able to:

1. Understand the science of moisture and air movement through various building materials and building envelope systems.
2. Learn evaluation techniques of existing building envelope systems that may be failing, causes and potential fixes for existing failures.
3. Design and verification of new Building Envelopes to prohibit inappropriate moisture intrusion.
4. Learn Building Envelope Commissioning and verification of quality construction during the implementation phase of the project.

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Is rain in the forecast for your building systems?

Design to Control Moisture Intrusion in Building Envelopes

Presented by:
Mark L. Smith, AIA, LEED AP
Vice President, Florida Operations
msmith@ghp1.com

Presented to:
34th Annual ACHA Seminar
Rosen Shingle Creek Hotel
9939 Universal Blvd.
Orlando, FL 32819

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Introduction

"In the 21st century, architecture isn't truly excellent unless it deeply engages the natural world and promotes health and resilience."

William Leddy, FAIA; quoted from an **Opinion Piece**
Repositioning the AIA Institute Honor Awards: There Is No Separation Between Sustainability and Design Excellence

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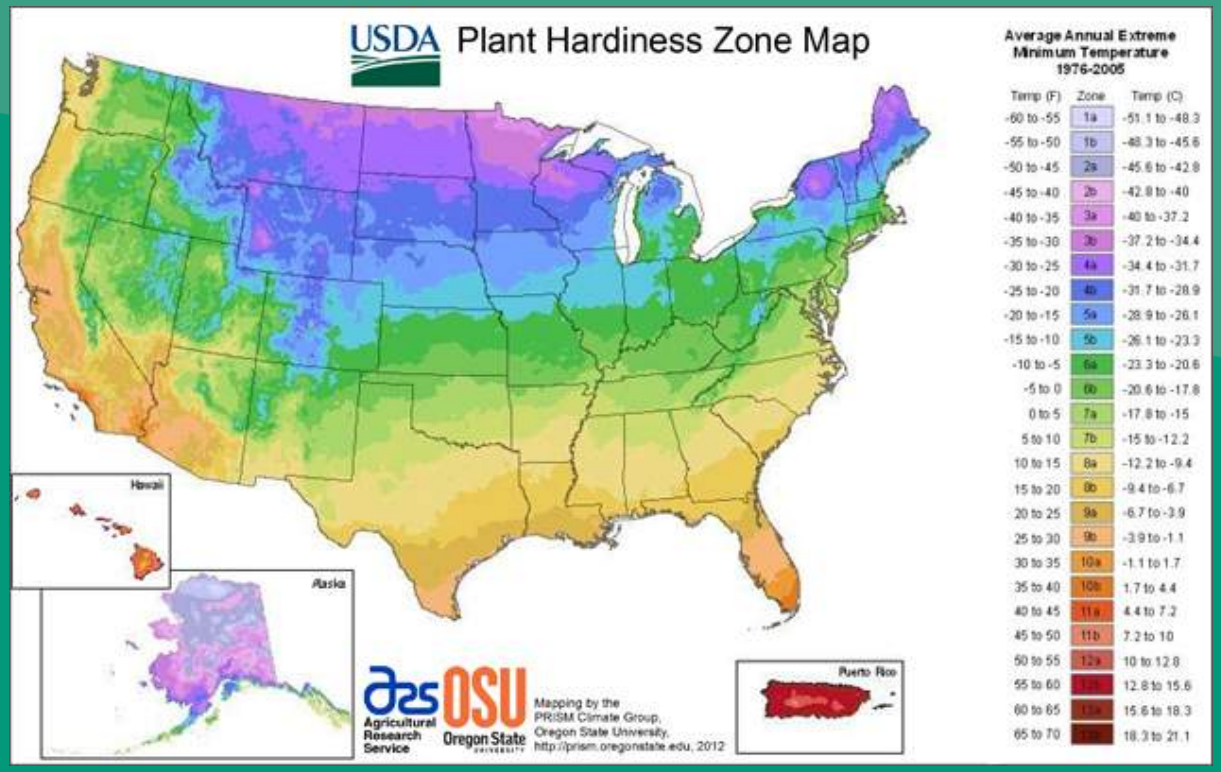
Introduction



January 25, 2012

http://www.ars.usda.gov/is/pr/2012/120125.htm

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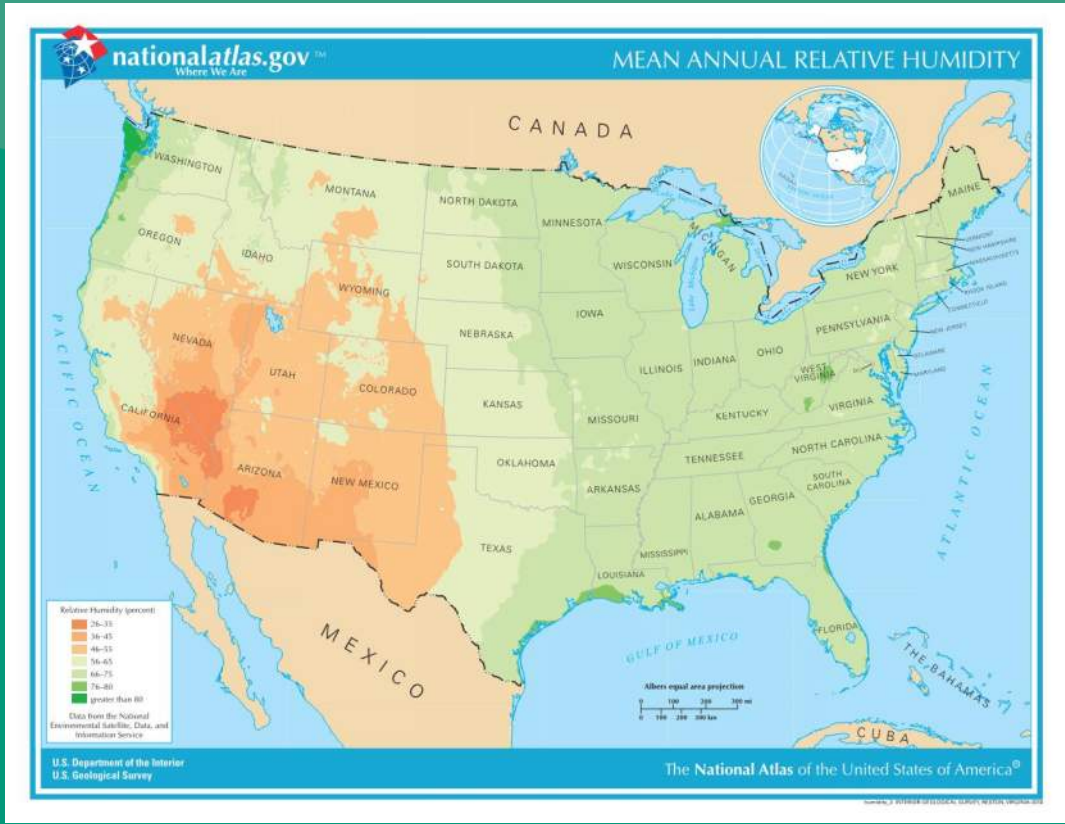
Introduction



September 15, 2018

https://nationalmap.gov/small_scale/printable/climatemap.html#list

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PART I

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Part I

Building Envelope Science

Material Properties related to Moisture Transfer

Design and Construction Issues

Means and Methods for Controlling Moisture Intrusion

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Capillary Properties of Building Materials

Moisture Capacity of Materials is directly related to Capillary Properties of Materials

- Small Capillary Materials: Absorb moisture more slowly with higher pressure, but also dry more slowly
- Large Capillary Materials: Absorb moisture more quickly with lower pressure, but dry more quickly

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Capillary Properties of Materials and Permeability of Building Materials

Permeability of Materials is directly related to the Capillary Properties of Material

- Capillary Properties establish Porosity of Materials
- Porosity allows for movement of moisture through the Materials

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Capillary Properties of Materials and Permeability of Building Materials

- Moisture movement through Materials is directly related to Moisture Capacity of the Capillaries

- High Volume of Moisture movement causes High Capillary Pressure, which tends to begin the breakdown of Materials over time

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Permeability of Building Materials

What is the Permeance of Some Standard Building Materials?

4” Brick	0.8 Perm
Stucco	1.6 Perm*
1” of Concrete	3.2 Perm
3/8” Gypsum Board	50.0 Perm
6 mil. Polyethylene	0.06 Perm
2 Coats of Exterior Paint	0.9 Perm

*Stucco Permeance Today – Old Stucco can be as high as 18.9 Perm

Excerpt from “Building Construction Illustrated,” Second Edition, by Francis D.K. Ching

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Permeability of Building Materials

The Permeance of Some Standard Building Sheathing and Building Wrap Materials

3/8" OSB	2.0 Perm
Fiberboard – Asphalt Impregnated	15.0 Perm
DensGlass	23.0 Perm
XPS Rigid Insulation	1.0 Perm
No. 15 Asphalt Impregnated Felt	6.0 Perm*
Tyvek	58.0 Perm*

*No. 15 asphalt impregnated felt has an Air Permeance of 0.4 Perm while Tyvek is 0.0045 Perm (@ wind pressure 30 mph)

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Design Issues to Control Moisture Infiltration

Air Barriers versus Vapor Barriers

- **Air Barrier** – An element that controls the movement of air and/or water across a building envelope system (horizontal and vertical), but may be permeable to moisture vapor.

- **Vapor Barrier** – Impermeable to moisture vapor movement.

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Design Issues to Control Moisture Infiltration

Air Retarders versus Vapor Retarders

- **Air Retarder** – An element that effectively resists or slows the rate of airflow across a building envelope system or assembly.

- **Vapor Retarder** – Limits the flow of moisture vapor across a building envelope system or assembly.

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Design Issues to Control Moisture Infiltration

Traditional Construction Techniques

- Most all Exterior Building Cladding Materials Allow for Moisture Infiltration!
- Design Exterior Envelopes to Drain the Moisture that is Allowed into the System.
- Eliminate potential for moisture collecting in the Building Envelope System.

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Design Issues to Control Moisture Infiltration

Historical Construction Techniques - Florida

- Cementitious Stucco on Masonry (CMU)
- Cementitious Stucco on sheathing – typical stud wall construction
- EIFS on either of the above substrates
- Single-wythe structural walls – CMU or Concrete
- Veneer construction on multiple substrates

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Design Issues to Control Moisture Infiltration

Primary Design Consideration for Moisture Control

- Create a Diaphragm

  "Drain Plane – A Plane for Rain to Drain"

  Thomas "Willie" Adams, Envirotest, Inc.

- Diaphragm Drained to Daylight

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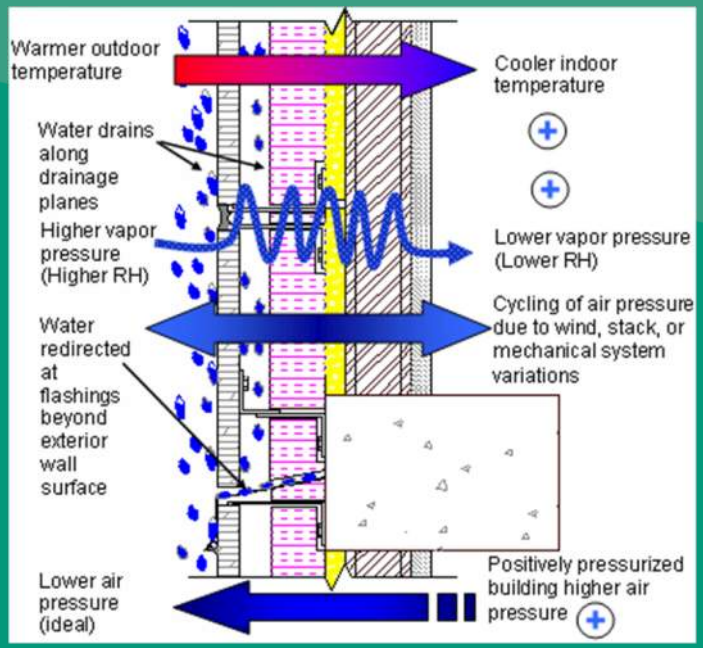
Design Issues to Control Moisture Infiltration

Moisture Management System



Building Envelope Design Guide - Wall Systems
by Daniel J. Lemieux, AIA and Paul E. Totten, PE
Wiss, Janney, Elstner Associates, Inc.
http://www.wbdg.org/design/env_wall.php

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Design Issues to Control Moisture Infiltration

Current Construction Techniques - Florida

- Cementitious Stucco on Masonry (CMU)
- Cementitious Stucco on water barrier sheathing – typical stud wall construction
- EIFS on either of the above substrates
- Single-wythe structural walls – Tilt-up Concrete
- Rainscreen construction on multiple substrates

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Design Issues to Control Moisture Infiltration

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Construction Means and Methods

- Appropriate Means, Methods, Techniques, Sequences, and Procedures to Eliminate Moisture Saturation of Building Materials During Construction and beyond.
- Standard Specifications are being written to define Limitations for Moisture Saturation of Materials
- Important to monitor construction process step-by-step, including third-party review.

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Construction Means and Methods

Sequencing of Construction Issues to Avoid

- Installing Gypsum Materials Prior to having Building Envelope Dried-in
- Installing Water Based Materials Against Highly Permeable Materials
- Installing Materials over Substrates that are not Sufficiently Dry or Conditioned.

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Summary – Part I

Prevention of Inappropriate Water and Moisture Vapor Infiltration into Buildings and the Building Materials during Design and Construction is "Step One" to the Prevention of Mold Growth in Building Systems

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PART II

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Part II

Importance of Building Envelope Commissioning (BECx)

Standards and Tools for Moisture Control as a Part of BECx

- **ASHRAE** Standard 160-2009
- Modeling Moisture Transfer Through Building Envelopes Utilizing **WUFI**

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Basics of Building Enclosure Commissioning

LEED v.4 offers Two (2) Points for Building Enclosure Commissioning (**BECx**)

BECx begins at Project Inception and continues for the Life of the Facility

NIBS Guideline 3-2012 outlines BECx Process, including Owner Project Requirements (OPR) and Basis of Design (BOD) objectives

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Basics of Building Enclosure Commissioning

NIBS Guideline 3-2012 – BECx Performance Objectives – Require in addition to Sustainability…

- Light and Heat Transmittance
- Control of Moisture to Airflow
- Noise Control to Security
- Durability to Maintainability

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Basics of Building Enclosure Commissioning

Performance Testing Requirements during Construction

- Acoustic Performance
- Air Leakage
- Infrared Imaging of Roofing Systems
- Static and Dynamic Water Penetration

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ASHRAE Standard 160-2009

ASHRAE Standard 160 – Criteria for Moisture Control Design Analysis in Buildings

- Performance-based Design Methods
- Applies to New Buildings, or Retrofit and Renovation of Existing Buildings
- Prescribes Design Analysis – Utilizing Moisture, Temperature, and Relative Humidity Loading

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Moisture Transmission Modeling

Modeling is now possible through specialized software such as WUFI

(Warme und Feuchte Instationar) created by the Fraunhofer Institut and Oakridge National Laboratory (ORNL)

- WUFI facilitates Hygrothermal (moisture and heat) transfer through Building Envelope Systems
- WUFI utilizes historic weather data for any region in the world.
- WUFI demonstrates over time the performance characteristics of different parts of Building Envelope Systems

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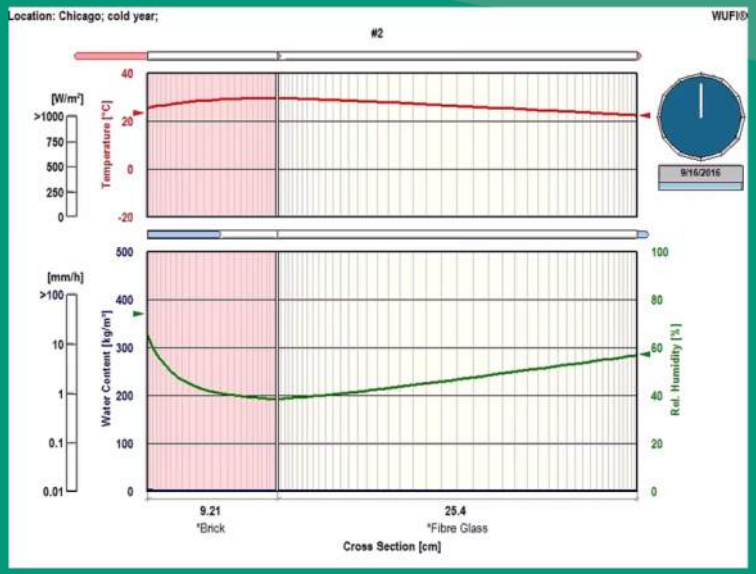
Moisture Transmission Modeling

Modeling is possible through specialized software such as WUFI



Summary – Part II

Integrity of Designed and Constructed Building Envelope Systems is verified through BECx

Standards and Tools to Facilitate BECx

- **NIBS** Guideline 3-2012 outlines BECx Process
- **ASHRAE** Standard 160-2009
- **WUFI** Provides Modeling of Moisture and Heat Transfer

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Questions?

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Office Locations

This concludes The American Institute of Architects
Continuing Education Systems Course

AIA Fort Lauderdale

Karen L. Warseck, AIA

director@aiafortlauderdale.org

954-299-9660