Combining the art of building design, the craft of building construction, the science of building performance, the rigor of consensus-based standards and the best practices of total quality management can get overwhelming. But that is what it takes to operate in the complex world of the building business today. We will orient the attendees to the complicated world of *Building Wall Design and Construction* and introduce some reliable standards of good practice.

Through case studies, horror stories, historical review and open discussion we will review the fundamentals of good design, applicable codes and standards, and a framework for executing the construction to ensure conformance with the design. The foundation of the presentation is the principles from two consensus standards from the American Society of Testing and Materials (ASTM): E2266 Standard Guide for Design and Construction of Low-Rise Frame Building Wall Systems to Resist Water Intrusion and E241 Standard Guide for Limiting Water-Induced Damage to Buildings. We will also touch on important topics from other documents including the "Building Envelope Design Guide - Wall Systems" from the Whole Building Design Guide (www.wbdg.org) and a PFCS whitepaper called Managing Construction Quality.

This presentation is for attorneys, adjusters, property managers, real estate agents, design and construction professionals, general contractors, building officials, and anyone involved or interested in the construction or real estate business.

Summary Outline

1. *Introduction*
2. *History of Building Walls*
3. *Components of Exterior Building Walls*
4. *Codes & Standards*
5. *Construction*
6. *Managing Construction Quality*
7. *Conclusion*

Agenda

1. Introduction
- A. Case Study: Door Installation
- B. Learning Objectives
- C. Who We Are
- D. Social & Economic Realities Make This Important
- E. The Building Envelope
- F. Building Wall Types
- G. Terminology
- H. Consequences of Poor Performance

2. History of Building Walls
- A. Mass Wall: The Beginning of the Building Envelope
- B. A Journey Through Time
- C. New Technologies

3. Components of Exterior Building Walls
- A. Case Study: Window Installation
- B. Common Elements of an Exterior Wall
- C. Components & Interface Conditions
- D. Flashing

4. Codes & Standards
- A. Case Study: Siding Installation
- B. Houses that Work
- C. ASTM E2266 Design Low-Rise Building Wall to Resist Water Intrusion
- D. ASTM E241 Limiting Water-Induced Damage to Buildings
- E. Building Codes
- F. Manufacturers Instructions
- G. Communicating Design Intent
- H. Other Resources

5. Construction
- A. Case Study: Stucco Installation
- B. Contracting 101
- C. DBSKCV Construction Management Method

6. Managing Construction Quality
- A. Case Study: JLC Flashing Flanged Window
- B. The Good Old Days
- C. The New World
- D. The DBSKCV Construction Management Method
- E. Construction Risk Management
- F. Project Definition
- G. Construction Document Literacy
- H. Managing Construction Quality
- I. Quality Management Plan
- J. Independent Quality Review

7. Conclusion
- A. Case Study: Detailing Rain Screen Siding / Recessed Window
- B. Learning Objectives
- C. Attachments

Building Wall Design & Const.

Pete Fowler
CONSTRUCTION
Services, Inc.

San Clemente, CA
T: (949) 240-9971 F: (949) 240-9972

Portland, OR
T: (503) 246-3744 F: (949) 240-9972

Building Wall Design & Const.

Building Wall Design and Construction

Pete Fowler Construction Services, Inc.
May 2008

Outline

1. Introduction
2. History
3. Components
4. Codes & Standards
5. Construction
6. Managing Construction Quality
7. Conclusion

1. Introduction to Building Walls

Introduction (1 of 3)

Combining the art of building design, the craft of building construction, the science of building performance, the rigor of consensus-based standards and the best practices of total quality management can get overwhelming.

But that is what it takes to operate in the complex world of the building business today. We will orient the attendees to the complicated world of Building Wall Design and Construction and introduce some reliable standards of good practice.

1. Introduction to Building Walls

Introduction (2 of 3)

Through case studies, horror stories, historical review and open discussion we will review the fundamentals of good design, applicable codes and standards, and a framework for executing the construction to ensure conformance with the design.

The foundation of the presentation is the principles from two consensus standards from the American Society of Testing and Materials (ASTM): E2266 Standard Guide for Design and Construction of Low-Rise Frame Building Wall Systems to Resist Water Intrusion and E241 Standard Guide for Limiting Water-Induced Damage to Buildings.

1. Introduction to Building Walls

Introduction (3 of 3)

We will also touch on important topics from other documents including the "Building Envelope Design Guide - Wall Systems" from the Whole Building Design Guide (www.wbdg.org) and a PFCS whitepaper called Managing Construction Quality.

1. Introduction to Building Walls

A. Case Study: Door Installation
B. Learning Objectives
C. Who We Are
D. Social & Economic Realities Make This Important
E. The Building Envelope
F. Building Wall Types
G. Terminology
H. Consequences of Poor Performance

A. Case Study: Door Installation *(1 of 3)*

Installation in a Perfect World

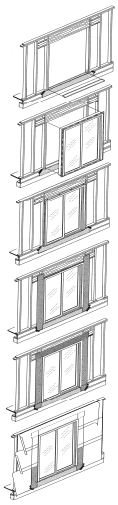
Disclaimer

Page one of the AAMA Training Manual it states -"Important Note: Different types of windows and doors require specific installation techniques. The information provided in this manual does not supercede installation instructions provided by the manufacturer. Always consult the manufacturer's instructions."

A. Case Study: Door Installation *(2 of 3)*

Step by Step

A. Case Study: Door Installation *(3 of 3)*



Step by Step

B. Learning Objectives

- Introduction to building wall types and components.
- Overview of how various wall types work.
- Overview of the historic evolution of building wall technology.
- Review case studies in building wall construction.
- Introduction to important industry standards of practice
- Introduction to a system for managing quality compared to standards and the project design

C. Who We Are

Pete Fowler Construction Services, Inc. is a team of consultants with expertise in all phases of building construction including design, estimating, construction management, inspection, testing, repair, construction defect forensics, and training. We specialize in delivering professional solutions for building projects in distress, dispute, or litigation, and in expert witness testimony. We listen to our client's individual needs, evaluate their situation, and use our unique systems to deliver comprehensive solutions with excellence, value, and integrity. Our methods are designed to guide clients through their situation in the fastest, most cost effective way, creating actionable information everyone can use to make informed decisions.

D. Social & Economic Realities Make This Important *(1 of 2)*

- Building construction will always be a fundamental component of human society.
- Construction constitutes nearly 10% of Gross Domestic Product (GDP).
- Consumers are expecting quality increases and price decreases in all products.
- The building industry, in general, is not keeping pace with the quality / price improvements that many industries are making.
- The building industry is not attracting the brightest young people into the industry.
- Consumers are more litigious than ever before and are becoming more and more so.

D. Social & Economic Realities Make This Important *(2 of 2)*

- There is a proliferation of attorneys.
- The built-environment has been altered dramatically in the last 20 years.
- Consumers are more conscious of building related health issues than ever before
- The marketplace is starved for skilled construction professionals who operate with integrity and in the client's best interest.
- We are in one of the largest economic booms in history.

E. The Building Envelope *(1 of 13)*

The Building envelope or "skin" consist of the structural materials & finishes that enclose space, in the forms of a building or structure, from the outside.

This includes the fountains, walls and fenestration system (doors & windows) roof and floor surfaces.

The skin must balance the requirements for ventilation and daylight while providing thermal and moisture protection that responds to the climatic conditions of each and every site.

Envelope design is a major factor in determining the energy requirements for the operation of a building.

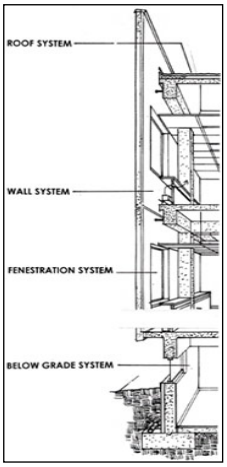
E. The Building Envelope *(2 of 13)*

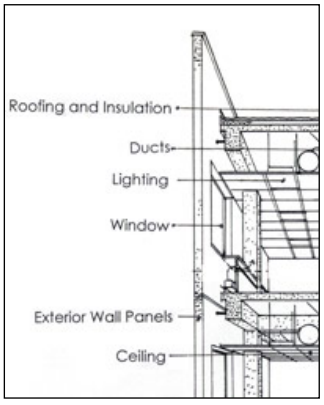
The basic function of the envelope or enclosure of a building or structure is to protect the covered or otherwise conditioned interior spaces from the surrounding environment.

However, as our needs have evolved and technologies have advanced, the demand placed on designers to both understand, *and integrate* an even wider range of increasingly complex materials, components, and systems into the building enclosure has grown in equal proportion.

Uncontrolled rainwater penetration and moisture ingress remain two of the most common threats to the structural integrity and performance of the building enclosure.

E. The Building Envelope





Left: A section including the 4 main building systems;

Right: A portion of the envelope showing some of the other systems that integrate with the envelope.

E. The Building Envelope *(4 of 13)*

The first building envelope that protected humans from the elements was probably a cave that provided a degree of privacy and security. The earliest building envelopes were dome shaped structures that combined wall and roof.

At an early stage, however, the two dominant forms of envelope evolved, depending on climate and available materials: the timber frame and the masonry wall.

To take one element of the envelope, the wall, its basic performance requirements have remained the same from medieval times to this day: protection of the interior from the elements and security for its occupants.

However, our expectations have vastly increased, both in terms of absolute performance & the ability to control the impact of exterior water, sunlight and the ambient outside temperature on our interior environment.

E. The Building Envelope *(5 of 13)*

In creating the building envelope the entire design team (architects, structural engineers, mechanical, plumbing engineers, interior designers, acoustical & glazing consultants) must integrate the design of the envelope with other design elements including material selections, solar passive design, heating and air conditioning (HVAC), and electrical strategies and project performance goals.

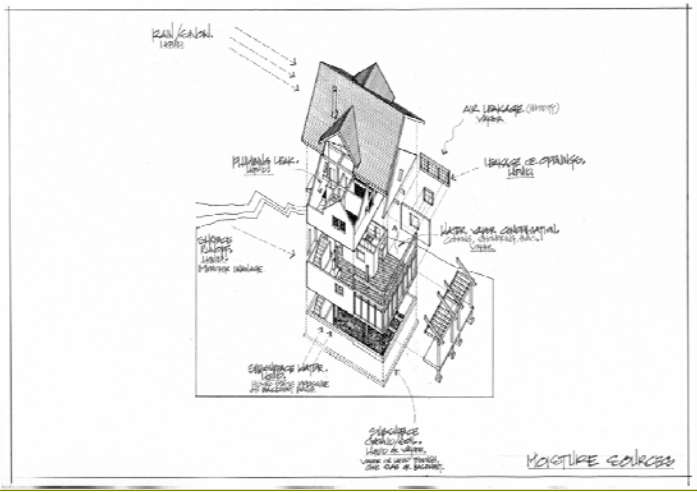
E. The Building Envelope *(6 of 13)*

The Building Envelope Systems can be divided into the following categories:

1. Below Grade, construction
2. Exterior Walls, both structural (providing support for the building) and nonstructural (supported by the building structure)
3. Fenestration, both windows and metal/ glass curtain walls
4. Roofs, both low- and steep-slope
5. Atria.

E. The Building Envelope *(7 of 13)*

Moisture Sources



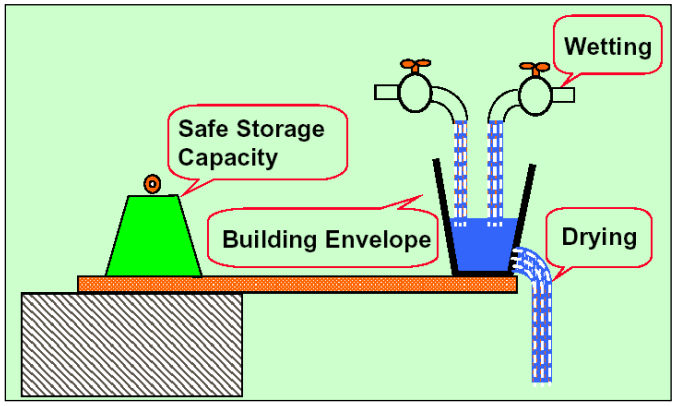
E. The Building Envelope *(8 of 13)*

Building Science

Building science is the collection of scientific knowledge that focuses on the analysis and control of the physical phenomena affecting the performance of building materials and building envelope systems

E. The Building Envelope *(9 of 13)*

Hygrothermal Balance



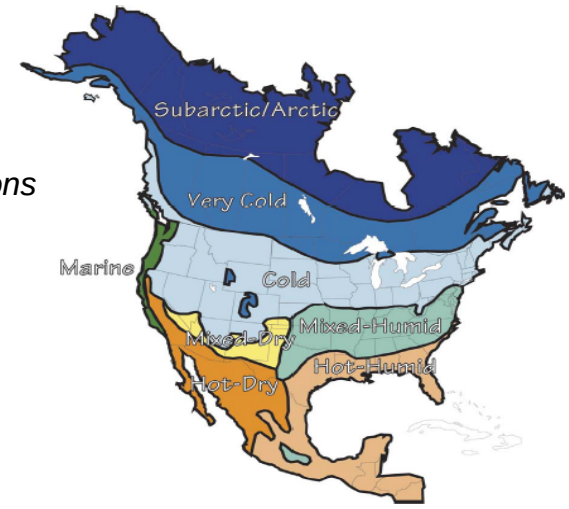
E. The Building Envelope *(10 of 13)*

Hygrothermal Balance

- Hygrothermal: Pertaining to heat and humidity.
- Hygrothermograph: Instrument recording humidity and temperature.
- Hygrothermal Effect: The change in properties due to moisture absorption and temperature change.

E. The Building Envelope *(11 of 13)*

Hygrothermal Regions



E. The Building Envelope *(12 of 13)*

Rain Fall Exposure

San Clemente, CA = 13”-15”

Portland, OR = 35”-40”

E. The Building Envelope *(13 of 13)*

Moisture Assessment: In-Situ Examination

- Unique Situation; Generalization Not Usually Possible
- Wide Variation of Influences

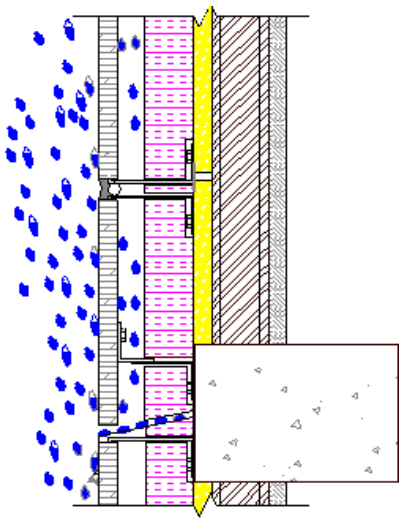
F. Building Wall Types *(1 of 20)*

- Cavity (Drainage) Wall
- Barrier Wall
- Mass Wall

F. Building Wall Types:

(2 of 20)

Cavity Wall



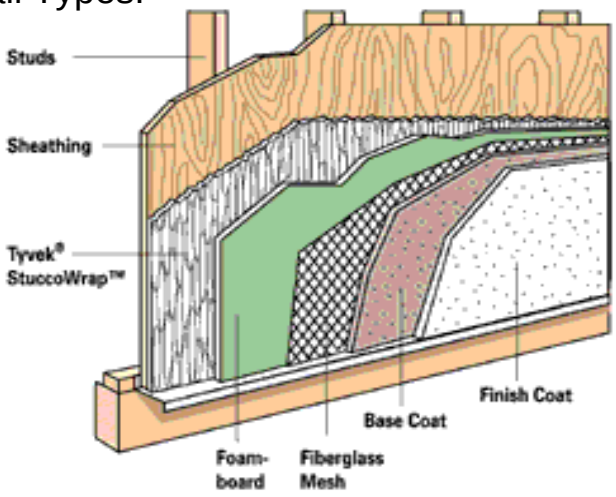
Cavity Wall Schematic illustrating that a bulk of the rainwater is deflected off the exterior finish.

Portions of precipitation that enters the air space is drained away to the exterior

F. Building Wall Types:

(3 of 20)

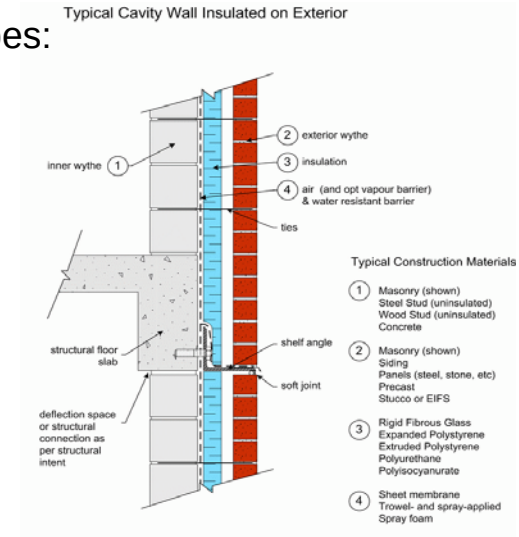
Cavity Wall



F. Building Wall Types:

(4 of 20)

Cavity Wall



F. Building Wall Types:

(5 of 20)

Cavity Wall

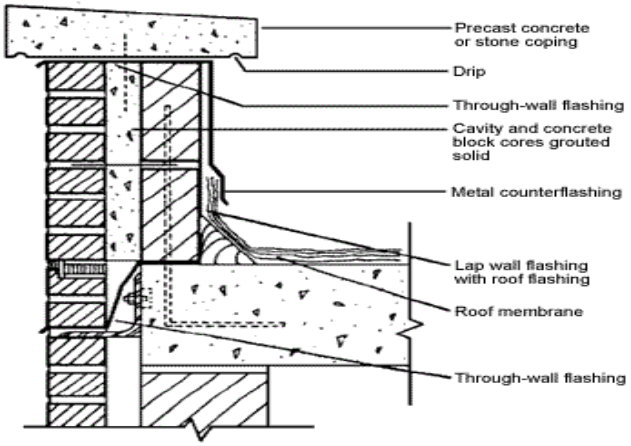


Figure 2

F. Building Wall Types: *(6 of 20)*

Cavity Wall

Also referred to as “screen” or “drained” wall systems.

Considered by many to be the preferred method of construction in most climatic and rainfall zones in the United States. This is due primarily to the pressure-equalization that can be achieved, and the redundancy offered by this type of wall assembly to resist uncontrolled, bulk rainwater penetration.

This term is now used more generically to define any wall system or assembly that relies upon a partially or fully concealed air space and drainage plane to resist bulk rainwater penetration and, depending upon the design, to improve the overall thermal performance at the building enclosure.