

# Architectural Technology V

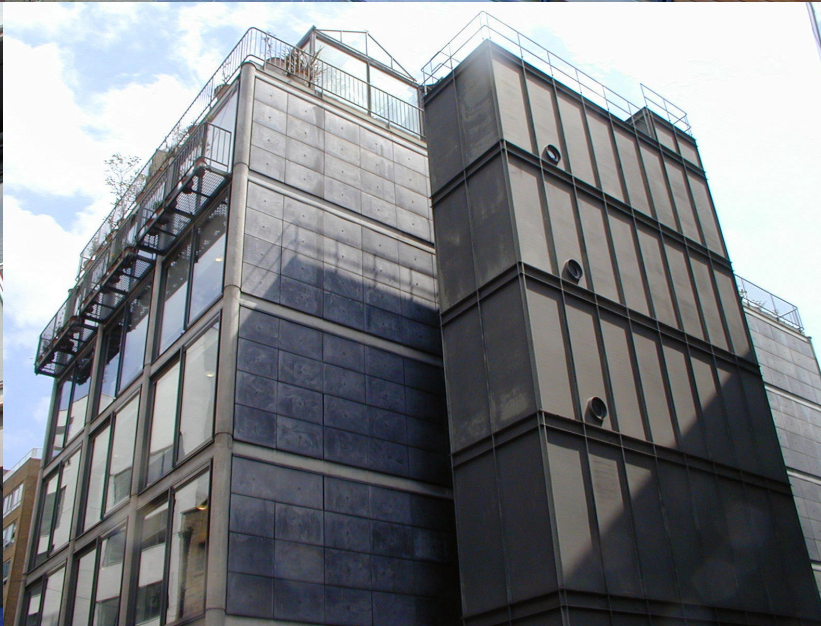
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**What is Cladding?**



*The non-bearing exterior wall enclosure; also called “building envelope.”*

## Examples of Cladding Systems



## Design Requirements of Cladding

### *Primary Functions*

Keeping Water Out

Preventing Air Leakage

Controlling Light

Controlling the Radiation of Heat

Controlling the Conduction of Heat

Controlling Sound

### *Secondary Functions*

Resisting Wind Forces

Controlling Water Vapor

Adjusting to Movement

Thermal Expansion and Contraction

Moisture Expansion and Contraction

Structural Movements

Resisting Fire

Weathering Gracefully

Ease-of-Installation

## Some Issues of Sustainability Regarding Cladding

Greatest impact upon lifetime energy consumption of all non-mechanical building systems.

Uniform cladding design for all orientations results in conflicting thermal behavior depending upon weather, season, and hour.



Lever House:  
*Le Glass Box par excellence*



Chesapeake Bay Foundation  
North Facade



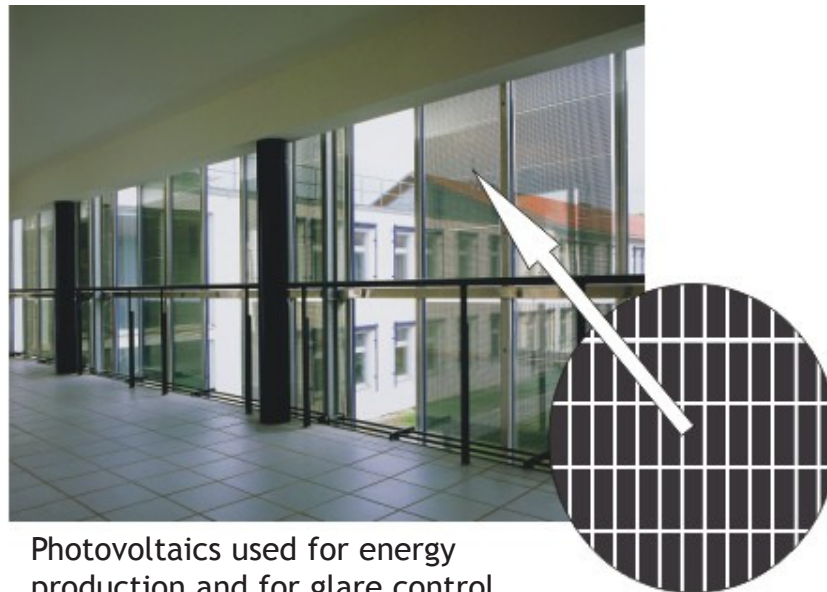
Chesapeake Bay Foundation  
Southwest Facade

Suggestions for the proper use of cladding in light of concerns about sustainability:

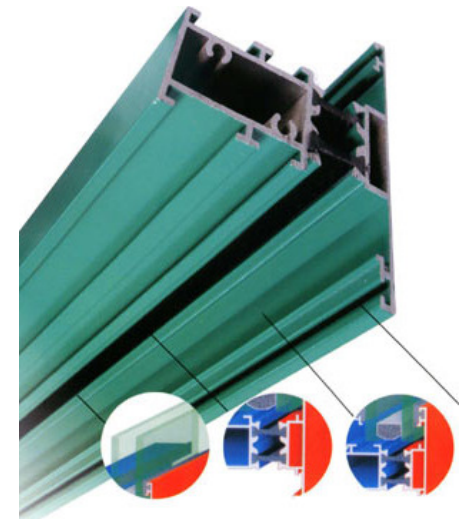
- Use glass in moderation, to promote daylight and views;
- Minimize glazed areas in orientations subject to summertime overheating;
- Operable windows may contribute both to well-being and energy savings;
- Insulate fully opaque areas of cladding;
- Eliminate thermal bridging from cladding;
- Building cladding should be air-tight; fresh air to be introduced by ventilation;
- South-facing facades provide opportunity for photovoltaic technologies.



Judicious use of openings in South-Facing Facade



Photovoltaics used for energy production and for glare control.



Thermal Break at Curtain Wall Mullion

## Conceptual Approach to Watertightness in Cladding [p.721]

Keep water completely away from wall; or,

Eliminate all openings in wall; or,

Eliminate all *forces* which move water through a wall:

Gravity, Momentum, Surface Tension, Capillary Action, Pressure Differential.

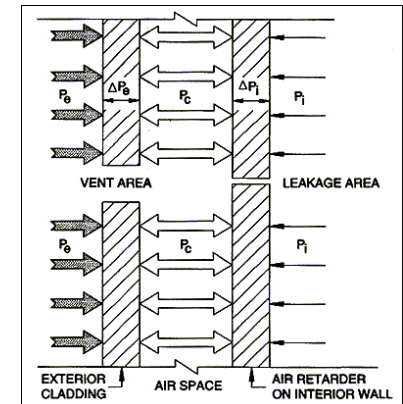
## Contemporary Solution which Eliminates all such forces:

### *The Rainscreen Principle.*

Two-stage system, like “cavity wall” to  
assure Pressure Equalization between stages;

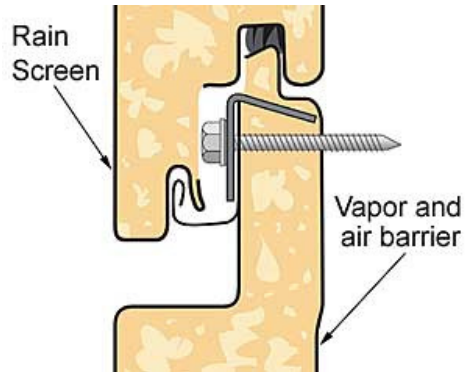
All membranes lapped vertically;

“Labyrinth” assemblies.

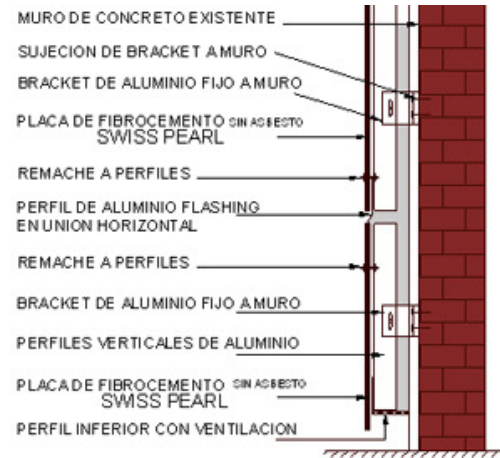


## Physical Manifestations of the Rainscreen Principle

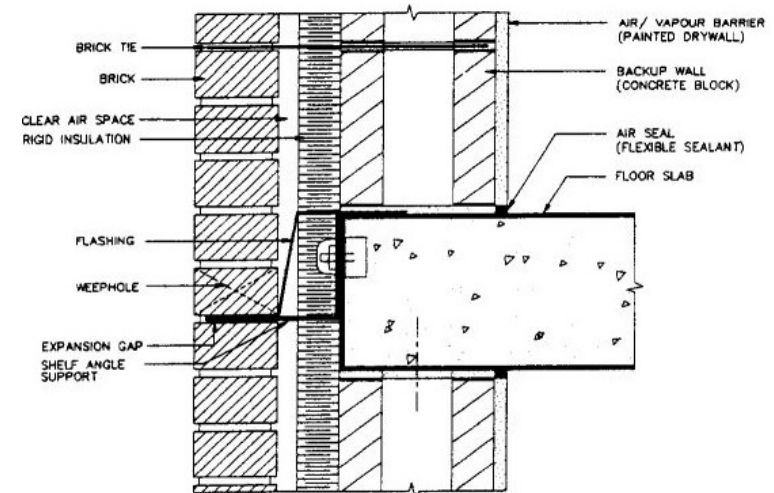
Metal Panel



Cementitious Panel

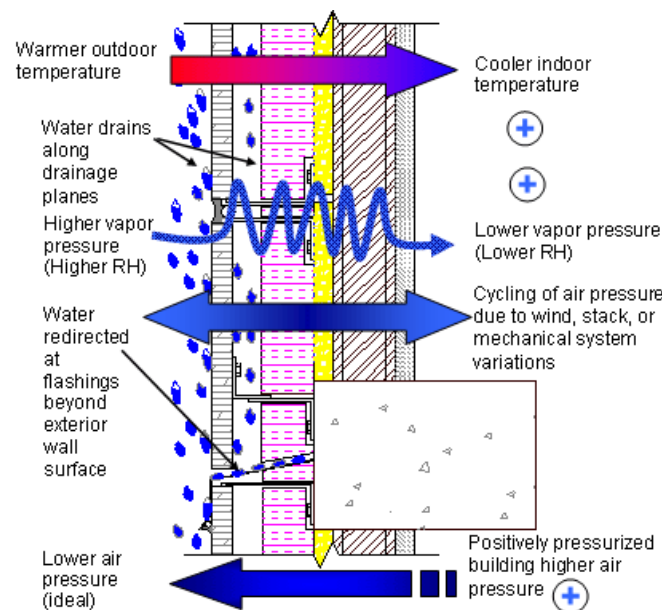


Masonry Cavity Wall



## Moisture Transfer Diagram

Warm/Humid Environment



## Rainscreen Detail Strategies

### Gravity

Moves rainwater down the face of the cladding and into sloped openings (e.g., holes, cracks, and flashing) encountered on the way down

Manage gravity-driven flow at open horizontal joints with a minimum overlap of 10 mm. Overlap in shingle fashion. Avoid reverse laps (where lower element overlaps upper element), as they channel water into the wall.

Provide drainage holes for all horizontal surfaces that can act as troughs.

Provide a minimum slope of 2% on 'horizontal' surfaces to prevent flow to the interior. [Require a slope of 8° (14%) for wood windowsills.]

Provide gaskets or sealants for closed vertical joints within a two-stage joint.

### Kinetic energy of raindrops

Propels raindrops into unprotected holes

Shield openings from direct rain entry with overlapping materials, sealant, or preformed gaskets or deflectors.

### Surface tension

Causes water to cling to the underside of horizontal, or nearly horizontal, surfaces

Incorporate a drip in the underside of projecting horizontal surfaces such as windowsills, balcony floors or soffits.

Put a drip edge on flashing.

### Capillarity (capillary suction)

Draws water into permeable materials and small openings (e.g., cracks, joints and junctions)

Shingle lap horizontal joints by at least 25 mm to eliminate water passage, since joints that are less than 5 mm wide support capillarity (Figure 3).

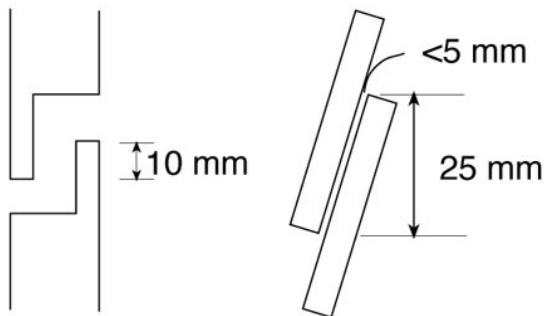
Ensure that drainage and venting holes are at least 10 mm wide to avoid bridging by water.

Choose materials with properties that minimize water absorption or that have greater thickness in order to delay water transport. For example, 20-mm-thick stucco that is subject to continuous wetting will saturate in two days. Therefore, if the building location often experiences rain for this long, change the material or shield the wall with an overhang or other such device.

### Air pressure difference

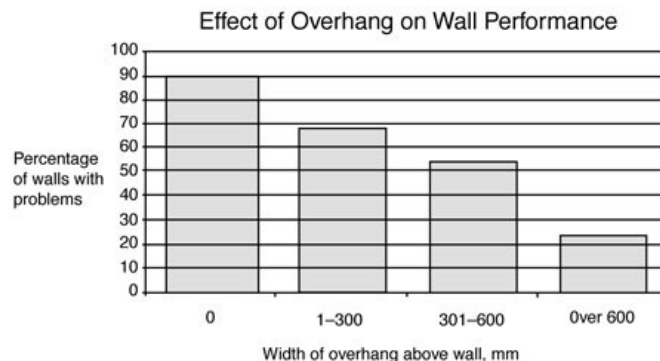
Drives rainwater in the direction of lower air pressure

Achieve some degree of pressure equalization across the cladding, its joints and junctions. (Air pressure difference across the cladding is a function of the effectiveness of the air barrier system, the size of the venting in the cladding, the volume of the air chamber between the cladding and the air barrier, and the stiffness of the chamber.)

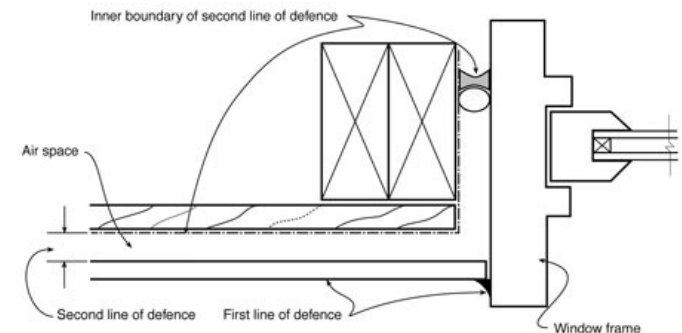


Open joint

Closed joint



Design Features Can Aid Rainscreen Performance



First and Second Lines of Defence



## Sealant Joints in Cladding

### Sealant Materials

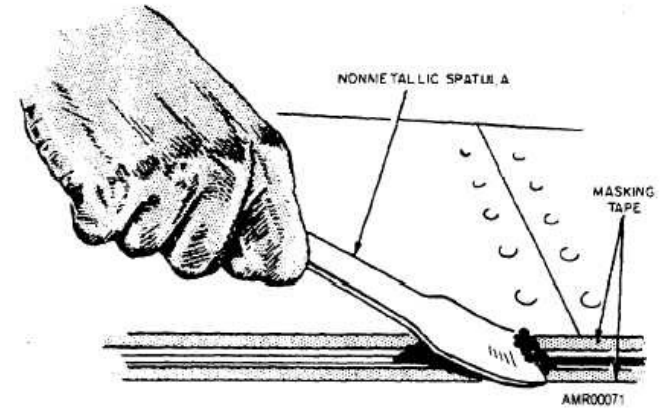
Gunnable Sealant Materials

Solid Sealant Materials

Gaskets

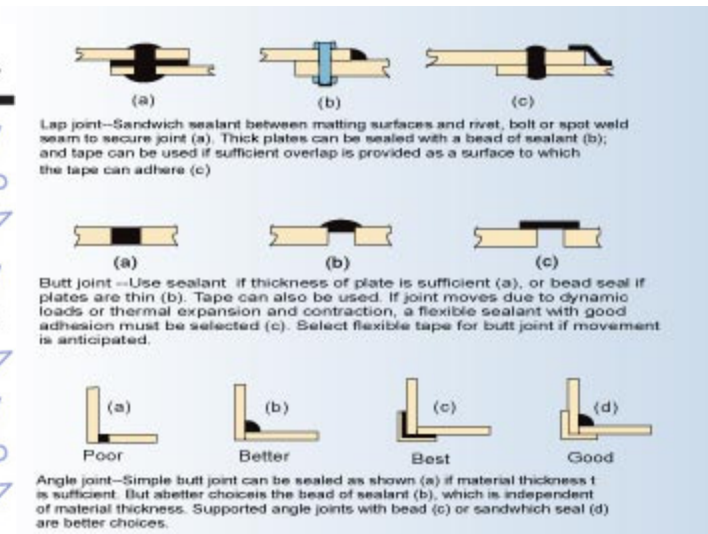
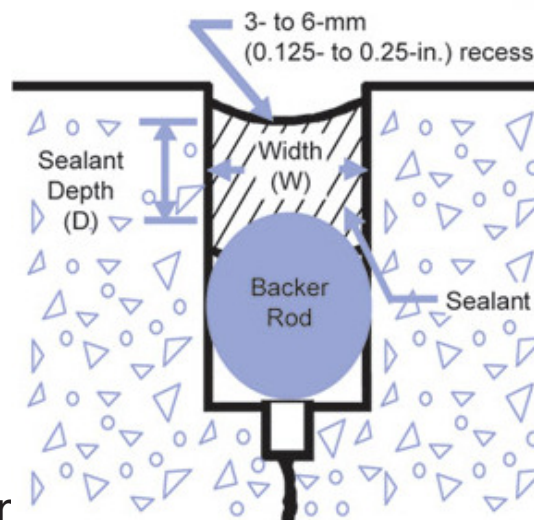
Cellular Tape Sealant

Preformed Solid Tape



### Sealant Joint Design

Avoid three-side applications; apply bond-break where required



## Concepts for the Construction of Cladding

Loadbearing Wall



Curtain Wall



## Testing Cladding Systems

Static Test for Water Penetration

Structural Performance

Thermal Performance

Sound Transmission

**IMPACT!**

\*\*\* Inspection during fabrication

Mock-up testing...



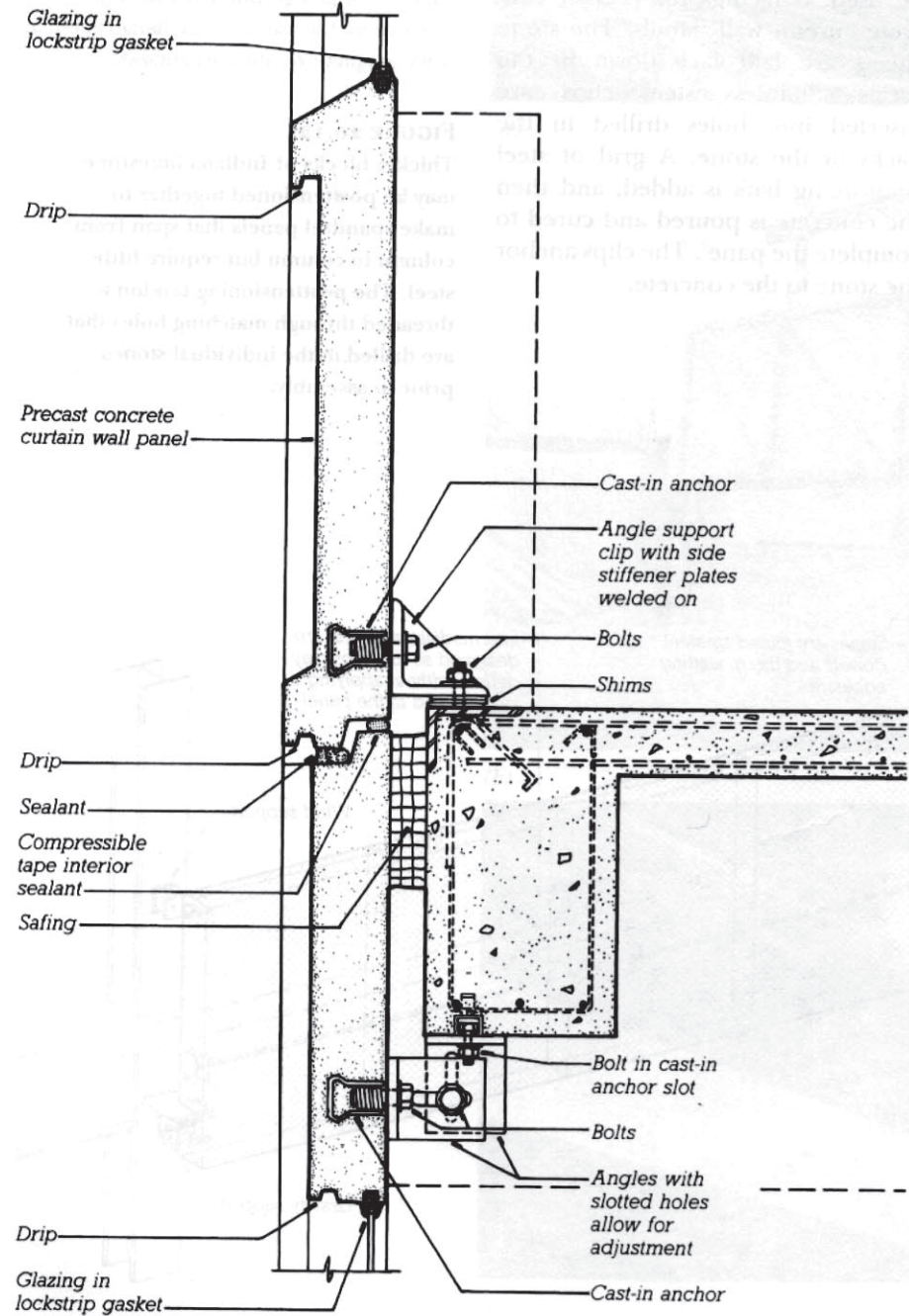
## Building Code Issues

Fire Safety

Firestopping/Firesafing



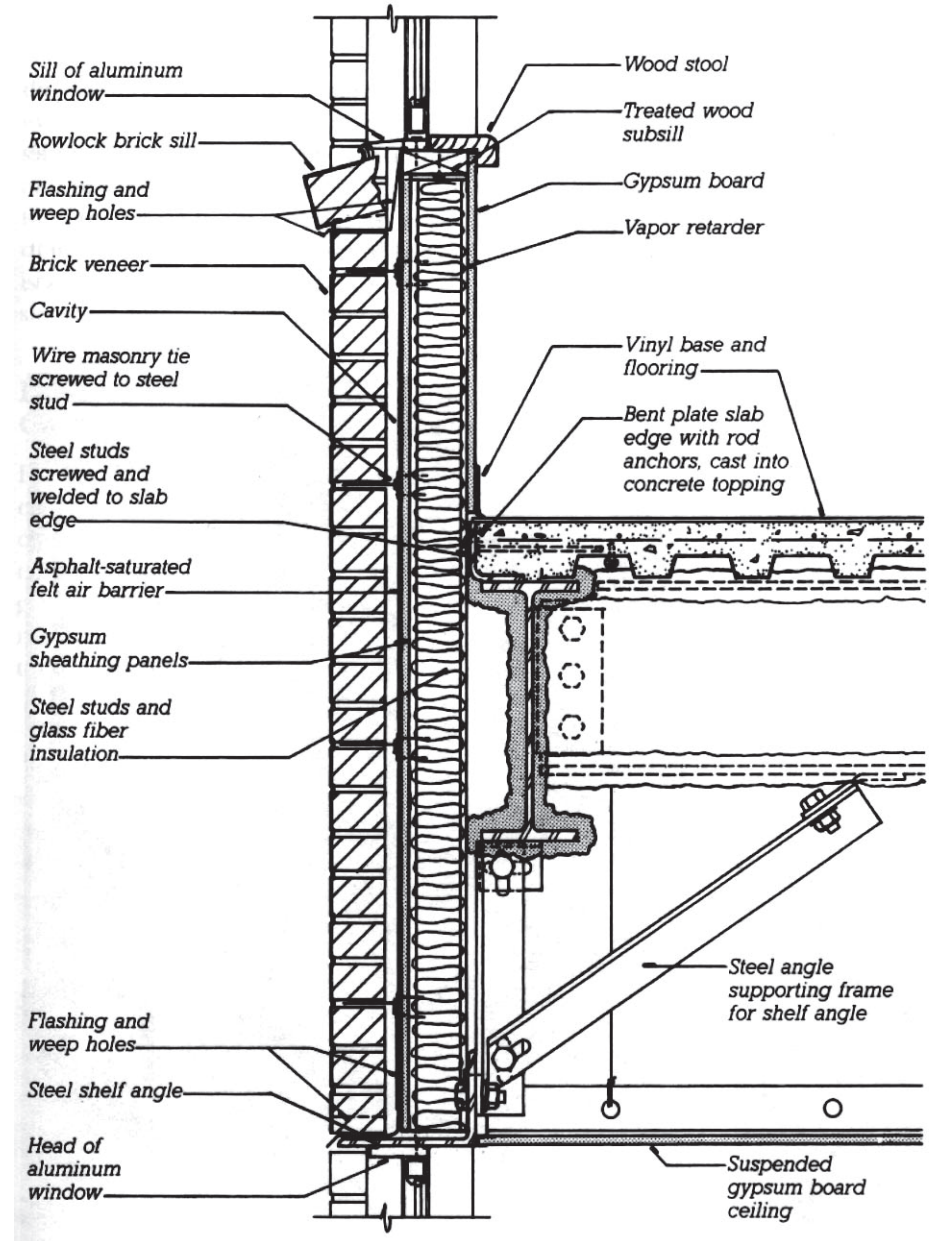
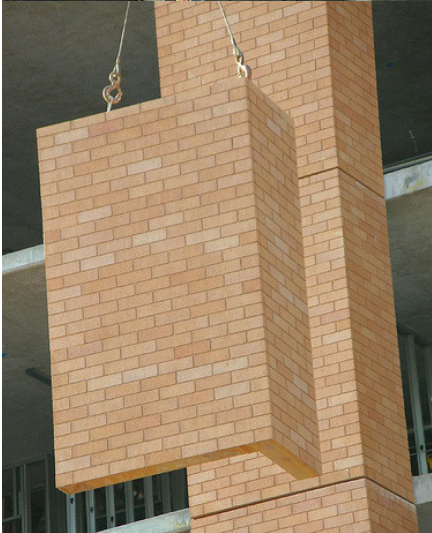
Impact!



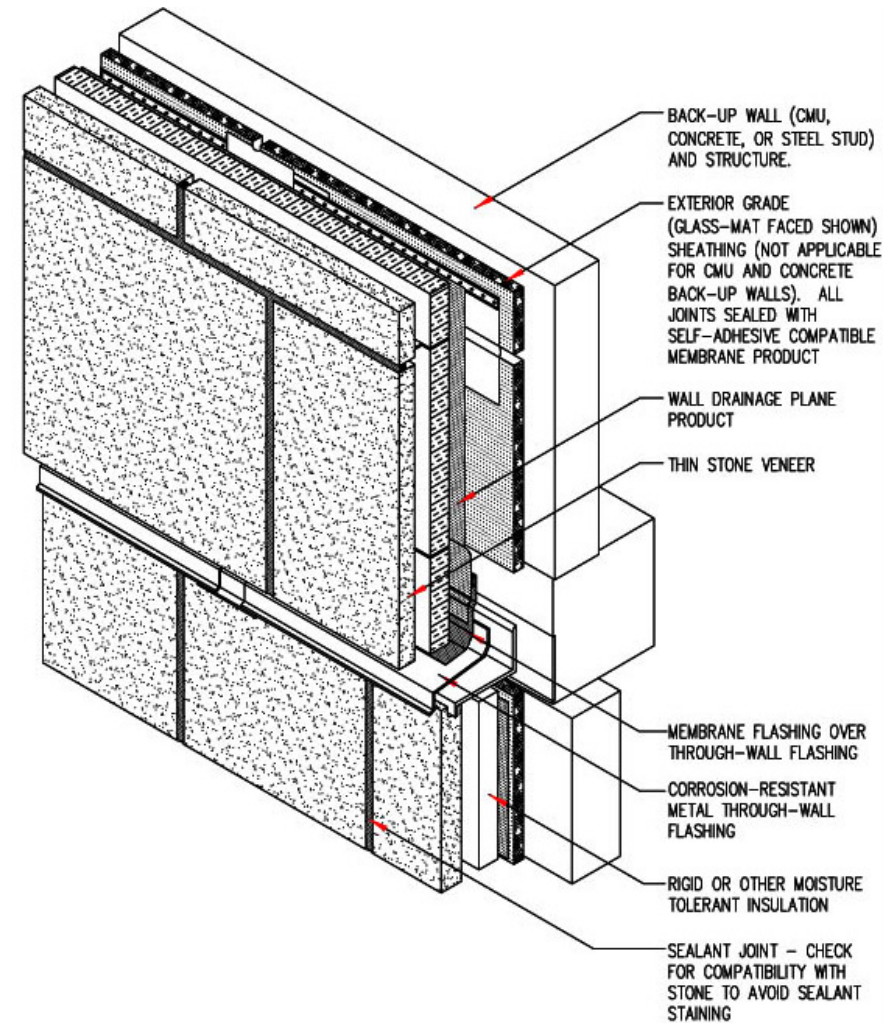
## Cladding with Masonry and Concrete

### Masonry Veneer Curtain Walls

### Prefabricated Brick Panel Curtain Walls



## Cladding with Masonry and Concrete Stone Curtain Walls



Stone Panels Mounted on a Steel Subframe;  
Monolithic Stone Cladding Panels;  
Stone Cladding on Steel Trusses;  
Posttensioned Limestone Spandrel Panels;  
Very Thin Stone Facing (on backing substrate);

## Cladding with Masonry and Concrete Precast Concrete Curtain Walls



## Cladding with Masonry and Concrete Glass Fiber Reinforced Concrete (GFRC)





# Architectural Technology V

Cladding Connection Failure



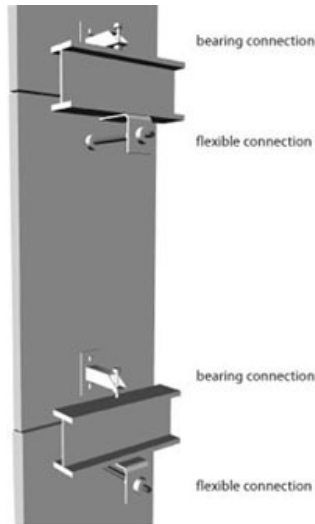
## Cladding Connections for Seismic Loads

[www.wbdg.org/design/env\\_seismicsafety.php](http://www.wbdg.org/design/env_seismicsafety.php)

slotted hole lateral connection



ductile rod lateral connection

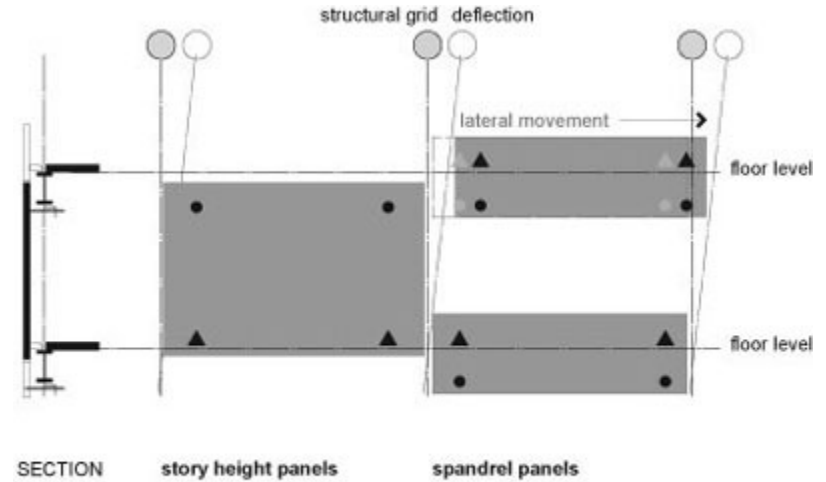


bearing connection

flexible connection

bearing connection

flexible connection

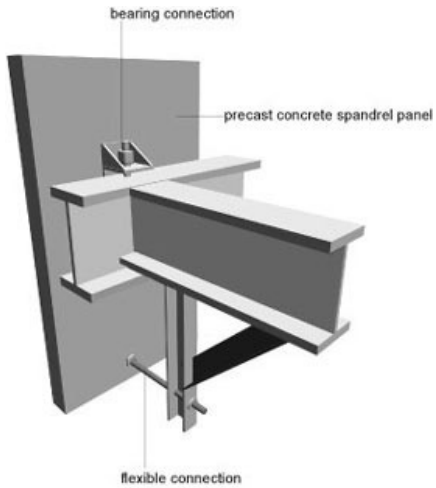


SECTION

story height panels

spandrel panels

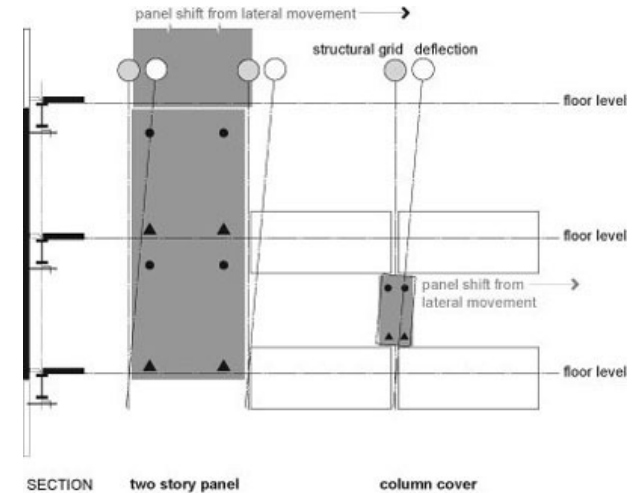
- tie-back connection
- ▲ bearing connection



bearing connection

precast concrete spandrel panel

flexible connection



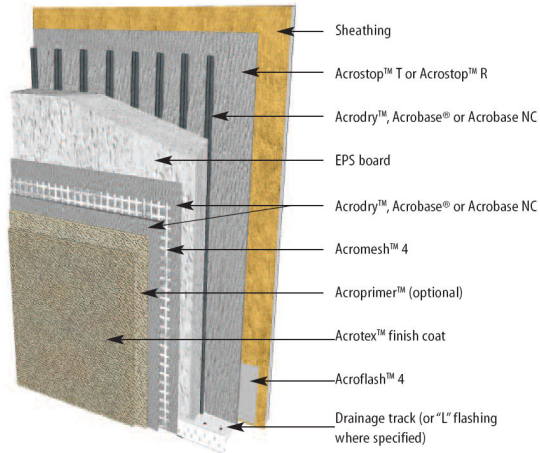
SECTION

two story panel

column cover

- tie-back connection
- ▲ bearing connection

## Cladding with Masonry and Concrete Exterior Insulation and Finish System (EIFS)



EIFS Lawsuits and Liability...

## Cladding with Masonry and Concrete Future Directions in Masonry and Stone



Extensive “Open-Joint”  
Rainscreen Systems:

Cast Materials;  
Sheet-formed materials;  
Prefabricated Panels.

Renzo Piano, Potsdamer Place, Berlin

## Cladding with Metal and Glass Aluminum Extrusions

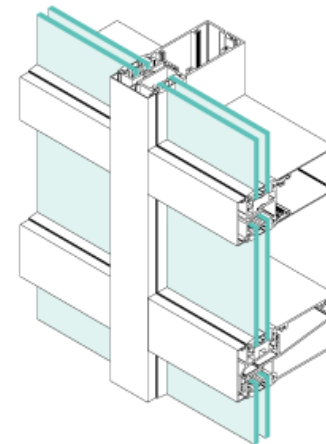
Considerations of Sustainability in Aluminum Cladding:

*Recyclability, lightweight, low maintenance; but -- energy intensive.*



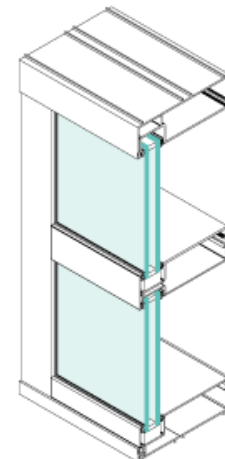
**Curtain Wall**  
High-performance  
infiltration-resistance

Multiple-story structural  
behavior (typical)



**vs. Store Front**  
Moderate-performance  
infiltration resistance

single-story structural  
behavior (typical)



Thermal Breaks: *Rubber or Plastic Gaskets*

Surface Finishes for Aluminium: *Anodized; Powder Coating; Polymer Coatings.*

Modes of Assembly: *Stick System; Unitized System; Unit-and-Mullion; Panel System; Column Cover and Spandrel*

Outside Glazing: *Low buildings, easy access for replacement; Inside Glazing: High Buildings, easy for both installation and repair.*

Structural Glazing Options

## Cladding with Metal and Glass

Expansion Joints;

Sloped Glazing;

Structural Glazing;

Dual-Wall Glazing;

Design and Detailing: The Process, Shopdrawings, and Architect's Review.

