FROM THE FOUNDATION

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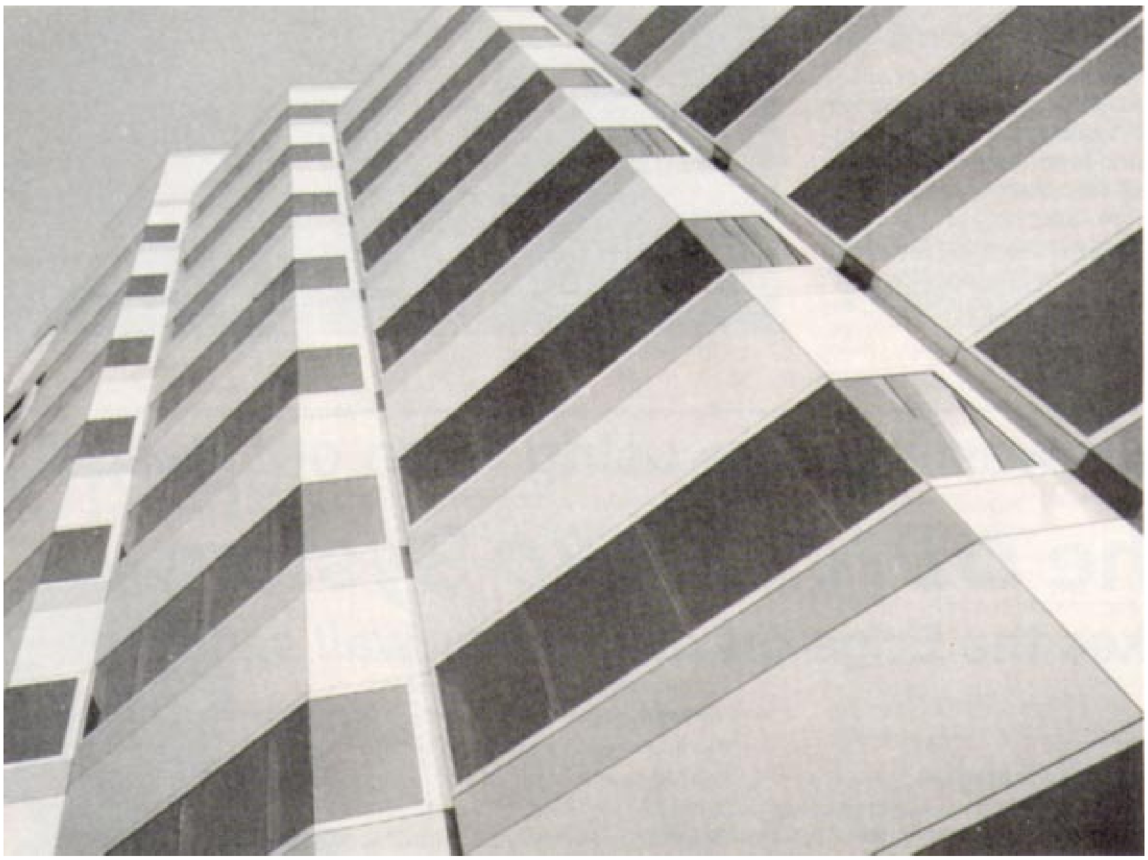
By Jeffrey L. Beard

Where the Building Meets the Eye



Honeycomb core metal panels and glass by H.H. Robertson Co. at Willow Oaks Corporate Center, Fairfax, Virginia. Architect: Hellmuth, Obata & Kassabaum. Contractor: Gilbane Building Co. (AGC).

Curtainwall/Cladding Systems Combine Beauty and Strength

Consider some of the world's great walls: Wailing, Berlin, China, Kremlin, Windsor Castle . . . all were built to keep something out (invaders, storms) or something in (workers, heads of state). Whether famous or obscure, the universal function of walls is to divide the desirable from the undesirable, the controlled environment from the uncontrolled.

Today's building contractors look upon walls in the same practical way. Cladding of exterior walls, commonly called the "closing in" of the structure, allows the job to progress into the interior finishes stage without the interference of trespassers or inclement weather.

Building designers, on the other hand, are more concerned with creating walls that are aesthetically pleasing. Architects probably spend more time analyzing and detailing building elevations than any other visual amenity. This focus is perfectly understandable. After all, buildings are recognized by their exterior appearance, not by their floor plans.

Walls are the medium by which corporations can make a visual statement about their business. It is through manipulating the building's form, color and texture that part of a firm's self-image is expressed. For example, hi-tech headquarters often use sleek metal cladding in horizontal patterns; low-rise offices favor precast concrete panels; downtown retail centers tend toward more conservative brick facings or stucco veneer; and multi-tenant skyscrapers are invariably enveloped in reflective glass.

But beyond the stylistic preferences of corporations are the practical functions of cladding or curtainwall. Curtainwall is the name given to aesthetic and protective non-load-bearing walls, while cladding is also non-load-bearing, but may be attached either to a building frame or to a load-bearing wall directly behind it. Curtainwall is barely a century old, having been introduced in Chicago for early steel-framed office buildings in 1883. In that year, Burnham and Root, in designing the Home Insurance Building, decided to do away with heavy masonry-bearing walls by hanging a tile and glass curtainwall from the steel frame.

For today's super-tall skyscrapers, the basic principles of curtainwall design remain essentially the same. Protection against the weather, rather than appearance, is the prime concern of the construction contractor and the building occupant. Typical curtainwall specifications require the materials to pass a series of tests including water penetration, air infiltration, structural performance and fire resistance.

Curtainwall cladding can be divided into four basic categories—glass, metal, masonry (brick/concrete/stone) and composite materials. These different types of cladding react somewhat differently to structural changes in buildings. On concrete-framed buildings, for instance, it is natural for columns to shorten and beams to sag slightly during the first few years of the building's life. Steel beams and girders also deflect, due to foundation settlement and stress. These structural changes place the wall into tension or compression. Weather is another key factor, concentrating wind loads on the building's outer skin and causing warping of the wall due to thermal change. In extreme cases, the curtainwall material, subjected to forces for which it was not designed, may result in unsafe, broken attachments and flying glass. Such was the case in downtown

Boston, where scores of windows fell out of the 60-story John Hancock Building.

Walls of Glass

Large expanses of glass held in place by metal framework were first seen on European railway stations and covered markets in the 19th century. Later, in the 1930s and '40s, continuous glass facades on skyscrapers became commonplace. Glass curtainwalls on contemporary multi-story structures usually consist of tinted or reflective glass set into aluminum extrusions. Tinted glass is available in colors ranging from dark gray (15 percent light transmission) to blues, greens and golds (up to 75 percent light transmission). Clear glass transmits, by comparison, about 85 percent of visible light.

Another contemporary glazing approach for buildings incorporates reflective glass to reduce heat gain and lower solar glare. The shading coefficient of reflective glass varies from 0.30 to 0.70, depending on the thin film of

Glass curtainwall by Kawneer on Tower 49, New York, New York. Architect: Skidmore, Owens & Merrill. Contractor: Tishman Construction Corporation.

metal or metal oxide applied to the surface. Reflective glass can occasionally be too effective. During a recent summer day in Atlantic City, New Jersey, a mirrorlike wall of reflective glass on one of the new casinos caused the wooden boardwalk to catch fire.

Recent developments in curtainwall glazing include mullionless butt joint glazing and suspended glazing. The butt-joint system does away with vertical mullions, relying instead upon the "bite" of the extrusion or glass stop at the head and sill of each sheet. To seal the joint where the sheets are juxtaposed, polysulfide, polyurethane or silicone sealants are injected. An alternative is to mechanically stabilize the joint with a synthetic rubber compression gasket.

Suspended glazing has been used to enclose large interior spaces such as airport terminals, racetrack grandstands and commercial building lobbies. The suspended tempered glass panels, held by special clamps and reinforced by perpendicular tempered glass stiffness, create dramatic see-through walls which appear to defy gravity and the elements.

Aluminum and Steel Curtainwall

Metal curtainwall has been the high-rise building designer's material of choice during the past decade or so. Appearance and performance are the reasons. Architects have sought the smooth, flush finish of metal panels in natural aluminum, or in metallic coatings on steel. The actual skin material, whether cold-formed gauge metal or plate, is characterized by high strength and relatively low weight.

Modern presses and rolls form aluminum plate or steel coils into flat or curved panels. These custom-made panels allow the building to be "sculptured" with sharp angles, or softened with radiussed parapets and rounded corners. Due to the sophistication of some curved designs, both the manufacturing phase and field installation phase require additional man-hours.

When metal building panels are used, building tolerances are critical. Panels join or interlock in fixed modules, hence there is little or no adjustment for the wall to grow or shrink in sympathy with the steel or concrete columns and beams. Finishes are another crucial aspect of metal walls: Aluminum anodizing gives the panel a directional grain which can be detected by the naked eye. Each ingot or billet of aluminum has a slight color varia-

Metal panels by Consolidated Aluminum on 1st Nationwide Savings, Daly City, California. Architect: Hagman Assoc. Contractor: Dinwiddie Constr. Co. (AGC).

tion which may show up on the wall of a large building. To remedy the problem, newer anodizing processes (whereby colored oxide coatings are applied electrolytically) have produced extremely durable and weather-resistant curtainwall panels.

Stainless steel curtainwall panels, while virtually corrosion-free and fade-free, present problems of "flatness." When stainless panels are out of place, the variations and shadows, which distort reflections like mirrors in a funhouse, are easily noticed. New types of stainless panels, in which the metal is laminated to thermoplastic, eliminate excessive "oil canning." Consolidated Aluminum's Steel-O-Bond panels, for example, consist of two sheets of #4 finish, 304 stainless steel with a polyethylene core. Steel-O-Bond panels are available in sizes up to 4 feet by 20 feet.

Foam core steel wall panels are perhaps the most popular cladding for buildings with metal curtainwall. The foamed-in-place or laminated panels have good thermal values, are coated with longlife paint or porcelain finishes and exhibit long span capability. Joints with adjacent panels are tongue-in-groove with internal sealants. Where panels meet fenestration, extrusions wrap over the edge both for weatherability and for handling the transition to other building materials.

Widths of foam panels usually do not exceed 2 feet, 6 inches. For wider panels, manufacturers have gone to laminated paper honeycomb or aluminum core for extreme flatness in a relatively light panel. Naturally, the paper core panel is less expensive; but care must be taken to protect cut edges because the paper, when wet, can turn into papier mache.

Masonry, Stone and Pre-Cast Concrete

The greatest variety of wall finishes and texture is available through the use of concrete and masonry products. The look and cost of wall cladding covers a broad spectrum, from imitation travertine to real travertine, from site-installed brick wythe to pre-laid brick panels, and from exposed aggregate concrete units to polished granite.

Use of architectural precast concrete has increased because of its economy, design freedom and almost universal availability. For the site installer, concrete panels are somewhat forgiving, due to threaded anchor or welded attachments to framing. Joints in side-by-side units are normally weather proofed by backer rod and caulk.

With welded wire mesh or steel reinforcing, precast units weigh up to 100 pounds per square foot. Because it is expensive to transport heavy precast panels over long distances, the precast industry is typified by regional companies manufacturing panels for distribution within a few neighboring states. The brittle (5000 psi) panels can be damaged in shipping and handling, but are easily patched with color-

Precast concrete panel by Bluegrass Art Cast on Atrium Two, Cincinnati, Ohio Architect: Skidmore, Owings & Merril. Contractor: Huber, Hunt & Nichols (AGC).

matched bonding material after installation.

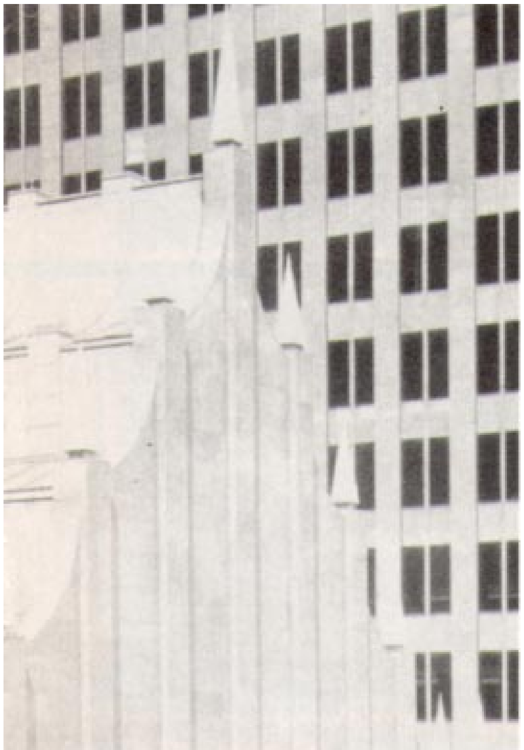
For stone curtainwall, blocks of cut stone can be supported on a building's wall in the same manner as brick masonry-by shelf angles. The ashlar walls are then backed up by block or steel studs. The ultimate stone curtainwall, however, consists of thin sheets of natural stone fastened to metal angles and bolted directly to the building frame. Some manufacturers simply mount stone panels in aluminum extrusions like sheets of spandrel glass. Polished stone curtainwall can be described by three superlatives: beautiful, durable, expensive. An owner's selection of limestone, marble or granite for a building's cladding is kind of an own-a-pieceof-the-rock syndrome, whereby corporate officials use stone in order to project an image of stability and permanence to current and potential stockholders.

Composite Cladding

This final category of wall product includes glass fiber reinforced concrete (GFRC), crystalline silica composite, thermoset plastics and exterior rigid insulation with synthetic stucco.

Except for rigid insulation/stucco walls, all of the above products are cast into thin panels and set into metal curtainwall framing systems. With excellent dimensional characteristics and color control, opaque composite panels can be alternated with bands of transparent glass to define the multiple floors of a high-rise office building.

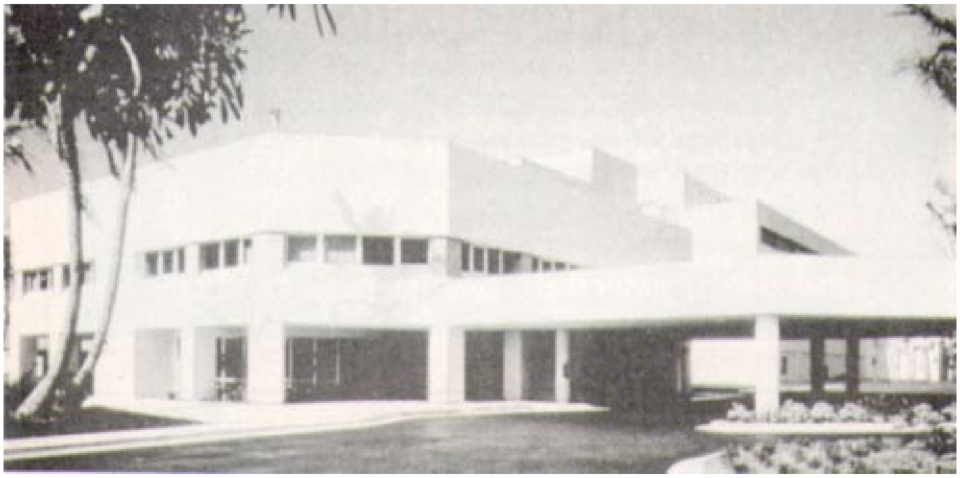
Polymer-modified stucco over rigid plastic foam insulation creates a cladding system with excellent thermal properties. The foam panel is attached to sheathing or studs by adhesive or mechanical fasteners. Reinforcing mesh is then laid atop the foam panel. A stucco finish is troweled over the mesh, providing a monolithic/monochromatic appearance for the total building wall. The rigid insulation (called "Outsulation" by one manufacturer) and stucco system is extremely versatile, and can cover a multitude of sins, making it ideal for renovation work. The thin stucco veneer is quite fragile, however, and although easily repaired, it is not recommended where it will be exposed to abrasion and impact.



Granite and glass curtainwall by Cupples Products on Republic Bank, Houston, Texas. Architect: Johnson/Burgee. Contractor: Turner Construction (AGC).

Cladding and Curtainwall—Technical Design and Construction Practice

Herman Sands, author of a new book entitled "Wall Systems Analysis by Detail" (McGraw-Hill 1986) explains the architect's reliance upon construction contractors to produce wall assemblies that work. Architects ask for details and design data from the contractors who are bidding for the job, Sands says. The material submitted, if accepted, becomes the basis for the construction contract for that element



Insulation/stucco wall by Insul-Crete/Dow Chemical on the Cape Coral Hospital, Cape Coral, Florida. Architect: Hanson, Lind, Meyer. Contractor: Mellon-Stuart (AGC).

of the work. "The assembly or system is fabricated in accordance with the architect's technical and design requirements, but (the wall) remains a reflection of the technical virtuosity and experience of the contractor," maintains sands.

The creation of a curtainwall is a microcosm within the increasingly sophisticated business of producing buildings. Better curtainwall, and by extension, better buildings, are the result of all three members of the building team—architects, engineers and constructors—combining their building development expertise.