Vertical and Horizontal Skins: The Phoenix Central Library and the Beyeler Museum

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INTRODUCTION

In many recent architectural designs throughout the world, building skins have been developed as a multi-layered "organ" that mediates between the interior and the exterior while playing a significant role in the overall architectural expression. Such skin treatments are often the result of architectural preoccupations concerning light, lightness, and transparency as well as environmental issues. Two recent buildings, the Phoenix Central Library in Phoenix, Arizona by Bruder DWL Architects (1995) and the Beyeler Foundation Museum in Basel, Switzerland by Renzo Piano Building Workshop (1997), exemplify a multi-layered approach for treating the envelope. Both buildings are characterized by their simple form and orthogonal geometry, and they exploit vertical or horizontal layered skins to explore various architectural preoccupations that include the use of current building technologies, structure, context, etc. as well as light, lightness, and transparency as mentioned above. In both examples the skin plays an important role in the architectural expression.

Comparisons are often made between current architecture in the United States and in Europe. In an article in the May 2000 issue of the magazine *L'ARCA* entitled *Connections Between European and American Architecture*, Bruce Fowle laments a lack of innovation in American architecture. He feels the problem is the result of political leadership that does not place a high value on architecture, a conservative construction industry, and the litigious nature of American culture. Fowle suggests that "the most telling difference between European and American architecture is in the use of glass" and that "it is high-tech glass detailing that most consistently distinguishes European architecture" (p. 3). Many of the most sophisticated façade systems are of a layered type in order to reconcile a quest for transparency and a need to reduce energy consumption.

In his book *The Architecture of the Well-tempered Environment,* Reyner Banham spoke of Le Corbusier's use of the brise-soleil as a "masterly invention" that allows transparency and view, while limiting heat gain. The brise-soleil, however, also deals with an architectural research of enclosure when "transparent glass membranes" replace massive walls. Banham also described a double wall scheme called the mur neutralisant (neutralizing wall) that Le Corbusier proposed and later tested with the French glass manufacturer Saint Gobain. His goal was to control a building's climate regardless of its geographical location. This was to be achieved by the creation of a "neutralizing" double membrane surrounding the building into which would be blown "scorching" air in cold climates and cold air in hot climates. Banham briefly relates Saint Gobain's seemingly skeptical conclusion at that time "that the use of hot air between double glazing needed a third layer of glass, trapping a second layer of (still) air, to make it a workable proposition!" (p. 162). Nevertheless, architects have continued to successfully explore double and multiple-layered skins and many buildings, including the Phoenix Library, which may be somewhat atypical in the American context, and the Beyeler Museum employ variations of the brise-soleil and the mur neutralisant for architectural and climatic purposes. While neither building is completely surrounded by a double skin, both projects employ significant areas of layered skins that temper the passage from interior to exterior architecturally and climatically. Both buildings are for cultural institutions and respect conservation requirements for the objects that they house.

The general plan organization of the two projects is surprisingly similar. Both are generally rectangular buildings elongated along the north / south axis. Walls at the north and south ends are transparent and establish a relationship with the exterior. Longitudinal walls are opaque and contain mechanical services. The roofs are major architectural components and allow for top lighting. Both designs situate major programmatic and ceremonial spaces at the heart of the building and envelop them with subordinate spaces. In itself, the organizational principle of each building suggests an outer envelope that is resolutely related to the overall scheme rather than an applied veil.

THE PHOENIX CENTRAL LIBRARY

The Central Library is situated just north of downtown Phoenix adjacent to Central Avenue, an important north / south artery. Though the overall building geometry is simple, there is considerable articulation of parts and the notion of frame and in-fill, or frame and skin is present at many different levels of the design.

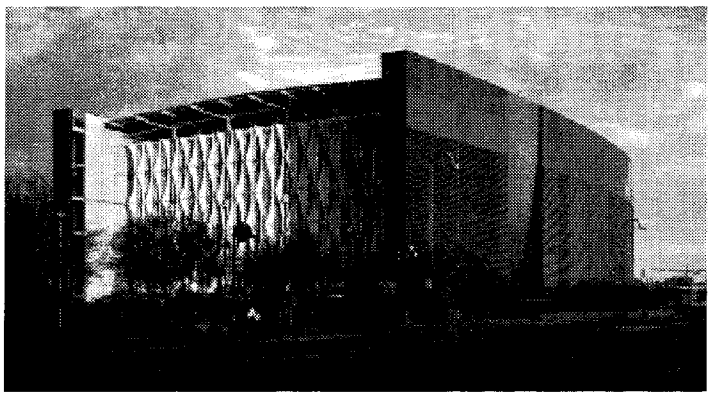

Fig.1. The Phoenix Central Library: view from the north/west.

The main body of the building is composed of superimposed concrete floor plates and is flanked on the east and west sides by service and mechanical elements that the architects called "saddlebags." The saddlebags function as vital organs that nourish the 5 levels of the main body of the building and allow the space to be open and unencumbered. As a "thick skin" these slightly curved copper clad elements are derived from programmatic, structural and mechanical necessities. While they play an essential role in the architectural expression of the building, the saddlebags are not conceived of as simply a formal or esthetic element but act as an interface between a protected interior and the exterior.

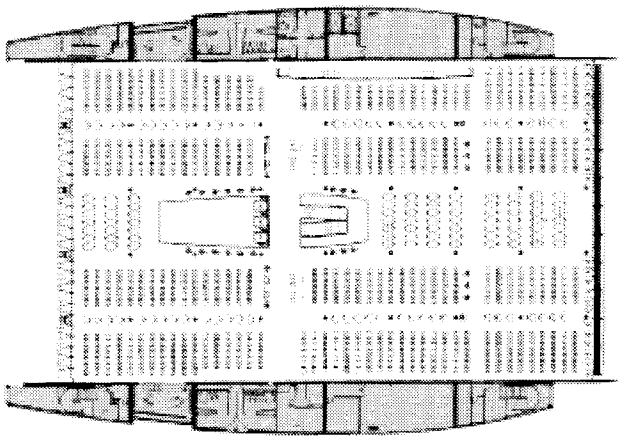

Fig. 2. The Phoenix Central Library: 5th floor plan with flanking saddlebags on the east and west sides of the main reading room.

A textured, 12-inch thick pre-cast concrete wall separates the main body of the building from the saddlebags. This concrete wall acts as a filter of sorts delaying the radiation of heat absorbed during the day until the evening and night. The ensemble of the saddlebags shades the east and west facades of the building. Though they are not hermetic environmental controlling elements, the saddlebags offer a "neutralizing" effect. Uninhabited spaces such as fire escapes, mechanical rooms and storage, as well as service elevators and restrooms, are sandwiched between the concrete wall and the outer perforated copper layer. Where possible the spaces remain outdoors thereby reducing more costly enclosed space and air conditioning loads while also providing greater visual depth and complexity to the skin. Mechanical systems and architectural design are intertwined. Mechanical systems located within the saddlebags enter into the building via the "powerbellies." These mechanical lifelines contain HVAC ducts, sprinklers, electrical conduit, etc that are housed within aluminum clad soffits and are located just inside and parallel to the pre-cast concrete walls.

In contrast to the concrete structure of the main body of the building, the saddlebags are framed in a steel structure. Between the concrete wall and the copper cladding, lateral bracing for the building and support for the tensegrity roof are also provided. The richness and complexity of the saddlebags remain visible and understandable due to the transparency offered by the filigree of the outer perforated copper skin. At the same time the copper cladding is for Bruder a tough skin that can resist the harsh desert climate.

The overall impression of the building remains solid and massif, especially in the daytime, and it appears as a monolith from a distance. The geographical metaphor of the mesa was more important for the design than any single architectural allusion. The copper skinned saddlebags play an important role in this metaphor in their color and form.

In the main volume of the building and especially in the 5th floor reading room, exterior space seems to flow through the glass facades of the building and expand it towards the north and the south. These facades use applied skins similar to a somewhat more typical brise-soleil system. On the south side the glazed façade frames the Phoenix skyline. A layer of exterior horizontal metallic louvers was added to a conventional window system and allows a visual relationship with the outside while protecting the occupants and the books from harsh sunlight. To the north vertical fabric sails are again added to a conventional window system and function in a similar way to shade the façade primarily during the early morning and late afternoon.

In spirit the building obviously shares certain qualities with great libraries of the world, notably the French Bibliothèque Nationale (1875) in Paris by Henri Labrouste which Bruder acknowledges as an inspiration for his building. The Phoenix library design does not look to the Bibliothèque Nationale primarily as a typological reference. It benefits from an interpretation of space, the relationship between wall enclosures and roof covering, detail, structure, and lighting. In fact, the organization of both buildings, Bruder's library and Piano's museum can be compared to the architectural organization of the main reading room of Labrouste's library with its heavy perimeter wall and its "light" skin-like roof inserted within. The expression of structure and materials varies between Bruder's and Piano's projects but both derive much of their architectural qualities from a relationship or contrast of two major architectural compositional elements: the walls and the roof. In both projects masonry walls or thick wall elements define the limits of the project while the roof is used as an important means for admitting natural light into the interior spaces.

THE BEYELER FOUNDATION

Naturally top-lit spaces are found in many of Piano's projects but are essential in his museums in order to create exhibition spaces with the best light quality for viewing art in a calm and serene space. The building section of the Beyeler Museum reveals that the gallery spaces are protected on three sides. To the east, the entry and service zone acts as a buffer; to the west a glass enclosed "winter garden" acts as a buffer; and above a vast, horizontal, multi-layered glass roof offers protection. The glass roof was developed as a significant element of the design.

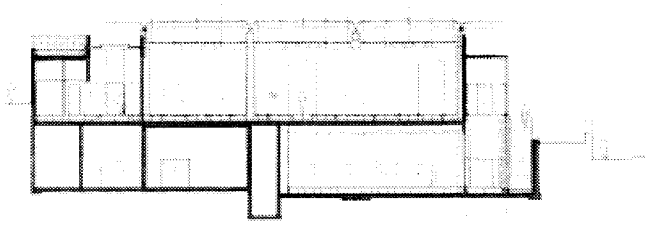

Fig. 3. Beyeler Museum: section looking south.

The Beyeler project is a three-aisle building with parallel walls approximately 350' long. The exterior walls seem to be carved from the earth. They are clad in stone similar to the local red colored sandstone. The building is oriented along a north/south axis and glazed facades at the north and south extremities allow the landscape to penetrate into the galleries. Light and sun are controlled on the south and west glazed facades of the building by simple, motorized, exterior fabric blinds. Inside, the thick longitudinal walls contain services such as electricity and return air ducts and are linked to the mechanical rooms that are situated in the basement. Supply air for the main gallery level arrives through plenums below the floor.

The horizontal glass roof was developed with the London engineering firm of Ove Arup. The goal was to provide enough natural lighting in the gallery spaces throughout the year. The design process included computer modeling and lighting calculations done in coordination with thermal calculations. Light transmission and thermal performance information was collected for proposed materials. Large scale models representing building materials were fabricated and tested outdoors using hand-held light meters. Finally, a full-scale prototype of one gallery space that accurately represented all interior and exterior materials was constructed on the site of the future building for final verifications.

Seen from the exterior, the glass covering of the Beyeler Foundation seems to be independent of the thick walls of the building. The ensemble of the roof is actually over five feet thick and it becomes an oversized double glazing or a "neutralizing roof" in order to meet thermal performance requirements in Switzerland. Repetitive white glass panels appear to hover in space. They create a system of north facing sheds and make-up the outermost layer of the five-layer roof structure or loft. These panels are made of 12mm tempered, extra white glass panels, silk-screened at 100%. They are bolted to cast steel pieces that connect to vertical steel tubes that are themselves connected to the primary, steel roof structure below. The second layer provides waterproofing and is composed of a double-glazing of tempered and laminated glass that is slightly sloped towards gutters situated above the thick walls. Within the loft is a third layer made of operable louvers that are controlled by a computer that is linked to light sensors on the roof. The loft is closed at the bottom by a fourth layer of the envelope: a 20mm thick horizontal laminated glass.

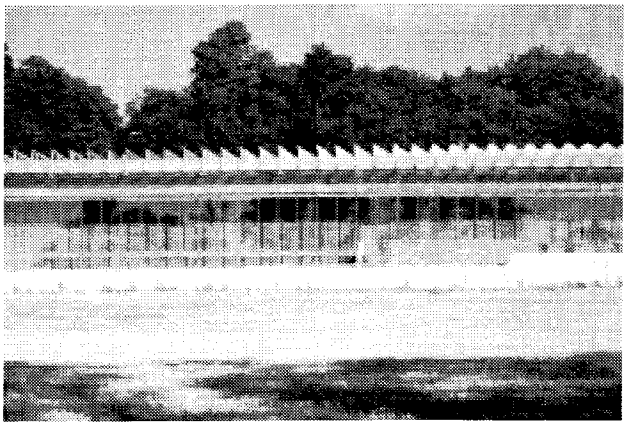

Fig. 4. Beyeler Museum: partial view of the west façade.

Fig. 5. Beyeler Museum: view of the loft during construction.

Inside the building, the fifth layer is a suspended ceiling made of 2'-6" x 5'-6" perforated aluminum panels. All panels can be opened to allow access above. The panels create a virtual ceiling plane with nothing suspended below; however, visitors perceive the structure and the layers above and glimpses out to the sky are sometimes possible. Fluorescent artificial lighting is situated above the ceiling and bathes the walls of the galleries. Another concealed fluorescent lighting system in the loft provides a general light for the space at night and lights the layers above the ceiling thereby expanding the gallery spaces upwards and through the envelope. It also lights the white glass panels that hover above, and makes them glow.

CONCLUSION

For the Phoenix Library as well as the Beyeler Museum, versions of the brise-soleil are used when transparency or view is desired and shading is necessary. For the library this is the case on the north and south elevations where fabric sails and louvers are attached to the glass facade. For the museum this is the case on the south and west elevations where motorized exterior fabric blinds, rather than a stationary brise-soleil, provide shading for the glass façades.

More complex skins that approach an idea of the "neutralizing wall" are developed in both buildings when design issues become more complex. Consideration of program, climate, mechanical systems, services, lighting, etc. lead to the development of the thick, vertical skins, or saddlebags, of Bruder's building as well as the horizontal multi-layered roof structure of Piano's building. Both solutions are synthetic responses to complex design considerations.

Layered skins that are commonly associated with certain contemporary European architecture are often double glass facades. They offer acoustical benefits as well as possibilities of shading and ventilation within the space between the glass. The layers of the Central Library saddlebags, though not in glass, offer these benefits as well. They are also conceived in a way to integrate structural, mechanical and programmatic considerations. The loft of the Beyeler Museum is essentially a double glass façade with an added layer above, below, and in between the two glass layers. The loft's primary function is the control of light and shading. It is not ventilated to the outdoors. The loft acts as a buffer and its climate control is different from that of the gallery spaces below it. Though neither very cold air nor scorching air is blown into it, the horizontal loft of the Beyeler Museum more closely approaches the idea of the "mur neutralisant" mentioned by Reyner Banham. Both projects successfully use a variety of layered skin types in order to maintain transparency, views and natural day lighting while maintaining environmental control. The layered skins also play a significant role in the architectural expression of each project.

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Concerning the Beyeler Foundation: I was a collaborator in the Paris office of Renzo Piano Building Workshop from 1986 to 1998 and participated in the Beyeler Foundation project. The Beyeler Foundation was published in *Renzo Piano Building Workshop Complete Works* by Peter Buchanan as well as Renzo Piano's *Logbook.*