The modern era is not the first time that architectural design philosophies have been concerned with the process of building; however, most architectural periods have been characterized by concern for better ways to build and their appropriate visual expression. The design philosophies of the modern school have tended to celebrate the construction aspects of building. The most sought-after expression has attempted to establish the reality of a building by honestly and directly showing the nature of the structure, materials, and methods of assembly. Concerned with both the means of construction and its expression, this design philosophy has set high ideals; through the years, outstanding prototypes have established the validity of this philosophy and illustrated that architecture can reach a high level of technical and aesthetic elegance following these principles. But often the visual expression has been more powerful than the underlying philosophy. Many stylistically modern buildings have been built which emulate or exaggerate an assembled appearance, but do not derive their expression from logical construction processes. Other supposedly modern buildings have deviated even further from the basic design philosophy, seeking visual effects regardless of how ill-conceived the building may be as a constructed object. In these cases, the design principles relating to expression have become hollow and meaningless as they have been separated from the more basic philosophic principles relating to the advance of the construction aspects of building.

Expression of Construction in Architecture

Currently the intentions of the modern movement are being questioned and the design principles relating to expression are being challenged. Certainly one must concede that a large number of buildings styled in the modern manner do not express the integrity or the logic of construction which the design principles intended. To further the discussion, I will explore two themes here: why constructive expression is relevant and that the lack of appropriate conceptual models for linking the objectives for construction with the objectives for expression is one cause for misuse of the design principles. Our concern for construction and the expression of that concern in the fabric of our buildings is only one of the many objectives of our design efforts. Often it is not the most important concern, but in varying degrees it always contributes to the overall expression. Our purpose here is to show that adherence to the basic philosophic intentions results in buildings with different architectural expressions for different situations, while the seeking of expression regardless of the situation results in stylistic mannerism.

It is useful to note that regardless of the designer's intentions buildings by their very nature are material constructs. Therefore, regardless of the relative emphasis one wishes to give to the means of construction, to some degree built form does impart the characteristics of what and how it is made. The issue for the designer is not whether this relationship exists, but given the relationship, at what level of expression do purpose, form, and constructive expression interact.

The levels at which we perceive and react to environmental settings provide an indication of the importance of how things are made. Normally, one comprehends the social setting, its symbolic content, the space and form, and the material expression in approximately that hierarchical order. But to some degree, each embodies the other; they are symbiotic. Materials, and the way they are expressed, have both formal and symbolic content; they are important to our perception and to our understanding of the environment and are capable of imparting an added level of meaning to both form and setting.

Dada and other movements in art have illustrated the strength of our expectations and associations among symbol, material, and purpose. Works of art and architecture have both congruence and conflict between expectation and reality. In spite of the occasional shock value of conflicting associations, significant architecture normally embodies a high correspondence between the spatial and formal attributes and the material systems by which it is made. This belief should not be interpreted as support for constructivist exhibitionism in form or material. Rather, I believe that there is an appropriate material, construction, and expression which provides meaning to form in a particular setting. In this respect, the level of appropriateness is determined by the nature of the form-making task to be accomplished as well as its relation to functional and symbolic intent. Thus, for buildings where merely achieving the enclosure is a technological feat, the dominance of structural forms may enhance the meaning of the form and its expression. In contrast, the same level of structural dominance for achieving a relatively simple space or form may be inappropriate and actually destructive to either the form or the social setting. Both formal condition and social conditions as well as formal context should therefore influence the overall material and construction vocabulary.

Architecture reaches greatness when there is strong interaction with—but not necessarily formal congruence between—activity systems and space-form and where there is a high degree of correspondence among—but not necessarily slavish consistency among—form, material, and means of construction. Many architects have demonstrated these principles as part of their concern for what might be called building well. Directness of form and expression in relation to construction often flows naturally from an understanding of how to build.

A Homogeneous Model

Conceptual models play an essential part in applying more abstract values in design. It is useful to digress for a moment and explore what appear to be deficiencies in the prevalent conceptual models. Early in the modern movement it became apparent that there were two relatively new material systems which could satisfy the objective for advanced technology and enhance a directness of expression: concrete frames and exposed steel frames. Masonry bearing walls would have met the criteria for expression, but they were antithetical to the technological pretensions of the movement. As a result, the concrete of Le Corbusier and the steel of Mies proved most legitimate and provided the prototypical examples which were to be the primary influences on design philosophy.

Unfortunately, the design philosophy has not provided coherent conceptual models of how to build, permitting what would have the more abstract objectives to be achieved in situations where the prototypes did not fit. Rather than a philosophy of construction which serves the designer, there have been only type solutions, which are not applicable in many real situations.

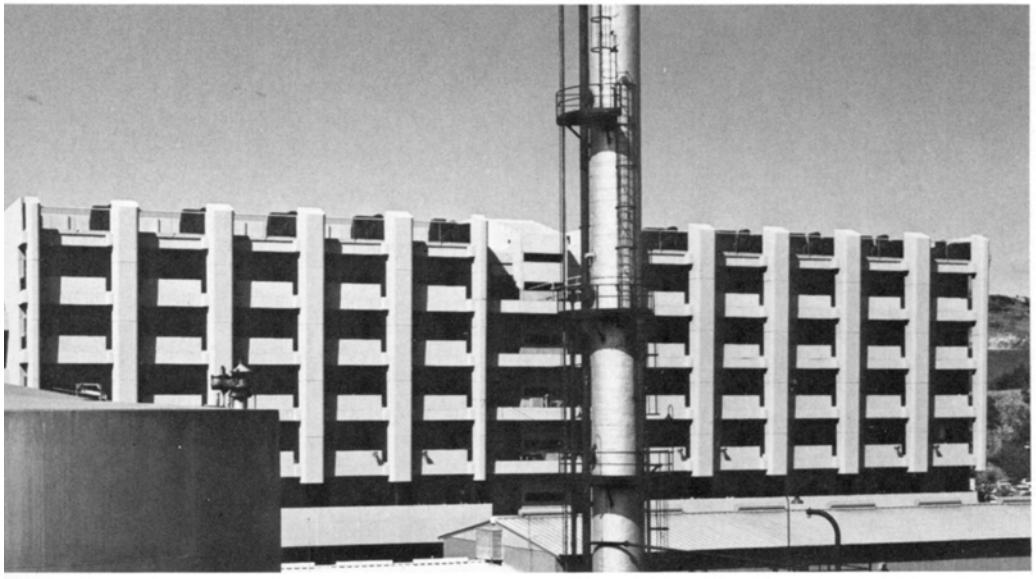
One may validly criticize modern architecture for becoming obsessed with superficial visual effects which become mannerisms, rather than being concerned with a deeper philosophy which permits evolution. This has often led to a decadence of architectural expression, as the superficial visual characteristics of the prototypes have been copied and recopied so that they are often perverted in both material and form. Just as in the neoclassical buildings that the modern movement was to replace, there is often little correlation currently between what buildings appear to be and how they are made. For instance, Miesian frames and walls move from inside to outside, changing materials as they penetrate the environmental skin; or similarly, Corbusian concrete-derived forms are fabricated from other materials, including masonry, wire-mesh, and plaster.

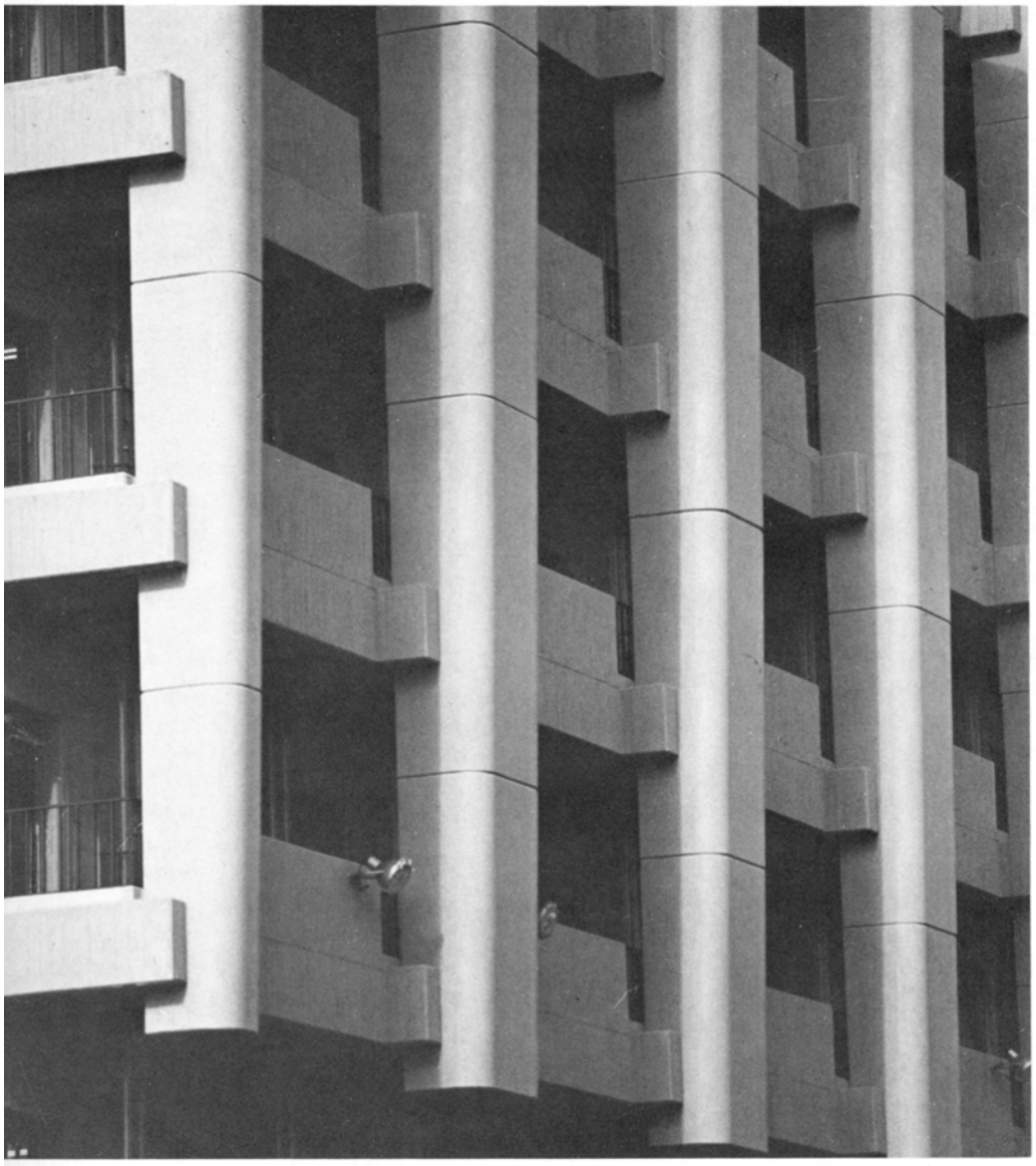
Most conceptual models used for the design are essentially structural rather than environmental. As a result they do not adequately fit the complexity of the modern building task and, therefore, fail to provide the proper theoretical framework for achieving appropriate levels of correspondence between form and means. The conceptual model represented by Le Corbusier's domino formed an important tenet of the modern movement; the introduction of bending through slab and columns and later through frames liberated modern architecture from the formal restrictions imposed by earlier compression-only load-bearing systems. As prototypes emerged in concrete and steel, this model presented a conceptual basis for relating structure and form, but did not adequately address environment and form. It is a "homogeneous model" where an ideal building is one in which the structure and finish are materials which are ideally homogeneous; at the very minimum, the materials must be suitable for exposure both inside and outside the building. In this conceptual model, glass is not a form-defining material, but a nonmaterial which can be located anywhere within the structure without affecting the essential characteristics. In this concept there is no real distinction between interior and exterior space; materials define form in a similar manner whether inside or outside.

This concept borrows from what we admire about earlier architectural periods: the brick forms of Roman baths and basilicas or the forms of the Gothic cathedrals. It also draws from the more primitive vernacular buildings where space was often formed with the same materials inside and out. Considered environmentally, this model derives most of its characteristics from buildings in warm moderate climates where there is little significant environmental difference between interior and exterior spaces in terms of either social separation of activities or climatic separation for environmental control. One of the important features of this conceptual model is that by moving doors and glass in and out within this homogeneous structure, one may retain a consistency of both formal and material expression.

There is a natural expressive appeal to this model. It is understandable, it permits powerful and free sculptural forms, and it provides legitimate deep modeling of space. Its prototypical examples provide powerful visual images, but they have often been perverted when built in social settings or with material systems inconsistent with the imperatives of this concept.

From among our work the Chevron industrial process research laboratory designed in 1966 for





Opposite page: Located adjacent to the oil refinery, the Chevron Laboratory is constructed out of concrete to avoid unnecessary fireproofing and finishes as well as to keep the structure and servicing clean and exposed as part of the organizational concept. Because the requirements are so huge, the primary air supply system is located in the horizontal manifolds in the front of the building.

Top: On the other side, the main facade is expressed by the precast concrete vertical exhaust ducts.

Bottom: Detail of the exhaust ducts shows the change in texture between the precast ducts and the rest of the cast-in-place concrete.

At the lobby level of the Chevron Laboratory, the homogeneous concrete structure penetrates through the facade, which is only a glazed surface, as do the mechanical ducting and paving materials.

the Standard Oil Company of California in Richmond, California, comes closest to the homogeneous model. The cast-in-place concrete frame and precast exterior infill walls maintain the same form, material, and finish inside and out. Supported on clusters of deep driven wooden piles, the vertical structure consists of concrete piers supporting longitudinal girders with transverse beam and slab floors. The typical section consists of long span floor beams with cantilevers on each side. A little unusual in concrete construction, the floor girders and beams are in different horizontal planes like conventional wood construction, to permit through access for utilities in each axis. While the structure was cast-in-place, nonstructural elements of the exterior including both infill walls and the air ducts are of precast concrete.

The frame as a whole has its own visual integrity; definition of interior and exterior space is achieved by moving glass or infill panels into different positions within the frame. Exposed utilities were a programmatic necessity and maintained a consistent expression of this model. The utilities, like the structure, move inside and outside, exposed in both locations. The few interior finishes are carefully set off by reveals or by the concrete systems of the frame, never penetrating to the exterior. Consistent with this model, the ground floor was paved inside and out.

At a detail level of expression, both concrete systems of the Chevron Laboratory express how they were made: the cast-in-place concrete was formed with rough sawn boards, the precast in reusable forms. In retrospect, the offset in plane between the two systems seems unnecessary as the change in surface texture and articulation of joints provide sufficient distinction between the two processes. The overstatement of the assembly aspects of construction was destructive to the more basic formal definition; an articulated joint would have sufficed to define the material systems and yet maintain continuity of form.

After ten years, the techtonic expression of the Chevron Laboratory still seems reasonable for its use, its setting and its form. Since the mechanical

systems are a meaningful part of the activities conducted there, their strong influence on the overall expression seems logical and appropriate. In some respects this building is environmentally simplistic, as befits the homogeneous model. The exposed structure penetrating from inside to outside without either moisture barrier or thermal isolation is only possible where there is no problem of a freezing line within members, where heat loss is not considered severe, and where interior and exterior fireproofing requirements are similar. The exterior concrete walls have neither insulation nor vapor barriers, but even in this particular climatic location, the lack of vapor barriers has created problems. In this mild climate the building was considered a reasonable solution, but where it has deficiencies they are due to its adherence to a structural, rather than an environmental, conceptual model.

A Heterogeneous Model

Other building purposes, other environmental settings, or other construction techniques may make the homogeneous model an inappropriate design. Considered only from an environmental point of view, one might take an entirely opposite approach where there is absolute differentiation between the interior and exterior environment—a "heterogeneous model." In this concept the building is considered to be bounded by layers which form the definition between interior and exterior spaces. Interior spaces, forms, and material systems have an integrity of their own and interact, but are not necessarily congruent, with the form and material systems of the boundary layer. Here, glass creates part of the boundary; it may be treated as an interruption in the primary material or as an integral part of a boundary surface of the skin. Followed consistently, the heterogeneous model leads to a totally different vocabulary of sculptural forms and establishes different disciplines of material use than the homogeneous model.

Historic and vernacular antecedents for the heterogeneous model are many, ranging from the Baroque churches with their severe granite facades revealing interiors of white and gold plaster to the layered walls of the so-called postmodernists. Buildings in northern regions with severe climates tend to support sharply different interior and exterior environments. Strong separations between interior and exterior social settings also tend to support this conceptual model as does construction where the materials of the fabric of the building are not suitable for exterior exposure.

IBM's Santa Teresa computer programming center near San Jose, California, designed in 1977, is one of the several projects we have completed which are variations of the heterogeneous model. Projects that adhere to this concept range from wood and shingle-covered houses to concrete and metal-clad institution buildings. They may look superficially different due to their forms and the particular material used for the boundary layer, but they are all essentially of the heterogeneous type and, therefore, belong to the same conceptual model. In many respects, these buildings result from pragmatic necessity, where dictates of either program or budget make it logical or essential to have structural or finish systems on the interior which are not suitable for exposure on the exterior. To follow this logic, the exterior boundary materials should not extend into the interior.

The IBM center houses offices for the programmers and their computer-support areas. All the interior space has been built as adaptable loft space and is currently subdivided into office cubicles finished with inexpensive interior finish materials; none of these materials penetrate the boundary to the exterior of the building. The steel moment-resisting structural frame was also fireproofed with interior finish materials. In this case, the boundary layer is a sheer surface skin; glass and aluminum panels are both treated as part of this skin, and these materials do not penetrate the boundary into the interior of the building. Consistent with this model, the boundary layer itself is heterogeneous; the outside aluminum surface is backed by vapor barriers and insulation and faced on the interior with the interior wall finish. It should be mentioned that development of the exterior curtain wall also represents a technological response to seismic design criteria.

At the ground level, the IBM project is also consistently heterogeneous. There are no sculptural penetrations which imply a deep wall boundary layer, but rather the expression is an admission of the thin surface skin. An illusion of modeling and penetration of space is accomplished, but through other means; the exterior walls and the interior walls of the core are layered pierced walls, defining a series of corridors which describe and link the workspace pavilions. Thus when moving through and around the project, a sculptural spatial feeling is achieved, which is entirely consistent with the heterogeneous model. The wall forms are made opaque through the use of mirror glass in the private office areas and transparent by clear glazing at the circulation corridors. The mirror glass is juxtaposed with intensive wall colors to cause the appearance of pene-

trations and spatial definition. Thus within the reflections, the design explores means for achieving space-form modeling which conveys deep volumes through means which are compatible with and which exploit the heterogeneous model.

A Composite Model

These two projects, the Chevron Laboratory and IBM's Programming Center, express literal translations of the polar extremes between the homogeneous and heterogeneous models. One model is not inherently better than the other, but each has its relevance and each may serve as a basis for developing an internally consistent logic for design development.

One of the deficiencies in the modern movement is the failure to identify legitimate conceptual models which meet real design conditions. The homogeneous model served as the ideal and gave many buildings built conditions which did not follow the underlying principle of the basic design philosophy. Consequently, architects often design buildings which have the essential characteristics of the heterogeneous model, yet attempt the aesthetic expression of the homogeneous form; the result is bastardization of form, material, aesthetic, and ethic.

A better understanding of these notions leads to conceptual models suitable for the particular purpose and environmental setting being addressed. An appropriate model will permit an approach to both overall formal issues and individual design details with a consistent theoretical frame of reference. Often conditions suggest a composite model which incorporates parts of both the homogeneous and heterogeneous models, where certain forms and material systems of the building fabric may serve inside and outside the environmental layer while others may not.

Designed in 1970, the Alza Corporation Building with pharmaceutical research space and headquarters offices in Palo Alto, California, is an example of the composite model. The requirements for long spans and the need for rapid erection led to selection of a steel frame for the structure. The ground floor is a concrete slab on grade; the second floor and roof are concrete fill on steel decking. The infill exterior walls are formed with precast concrete slabs welded by clips to the frame. The erection tolerances and procedures precluded a tight fit between slabs and steel; therefore, a waterproof membrane forming the actual environmental barrier was applied over the concrete and was flashed to the steel.

View on the garden level atop the IBM Programming Center looking at the office clusters. Each of the 2,000 offices in the complex is located along a private U-shaped corridor to maximize the number of perimeter offices. The exterior wall is one of the few walls ever specifically designed to be able to accommodate large lateral displacements during earthquakes. The aluminum panels are completely planar so that the plates of skin may rotate with respect to one another, while the corners will pop off in the event of a serious tremor.

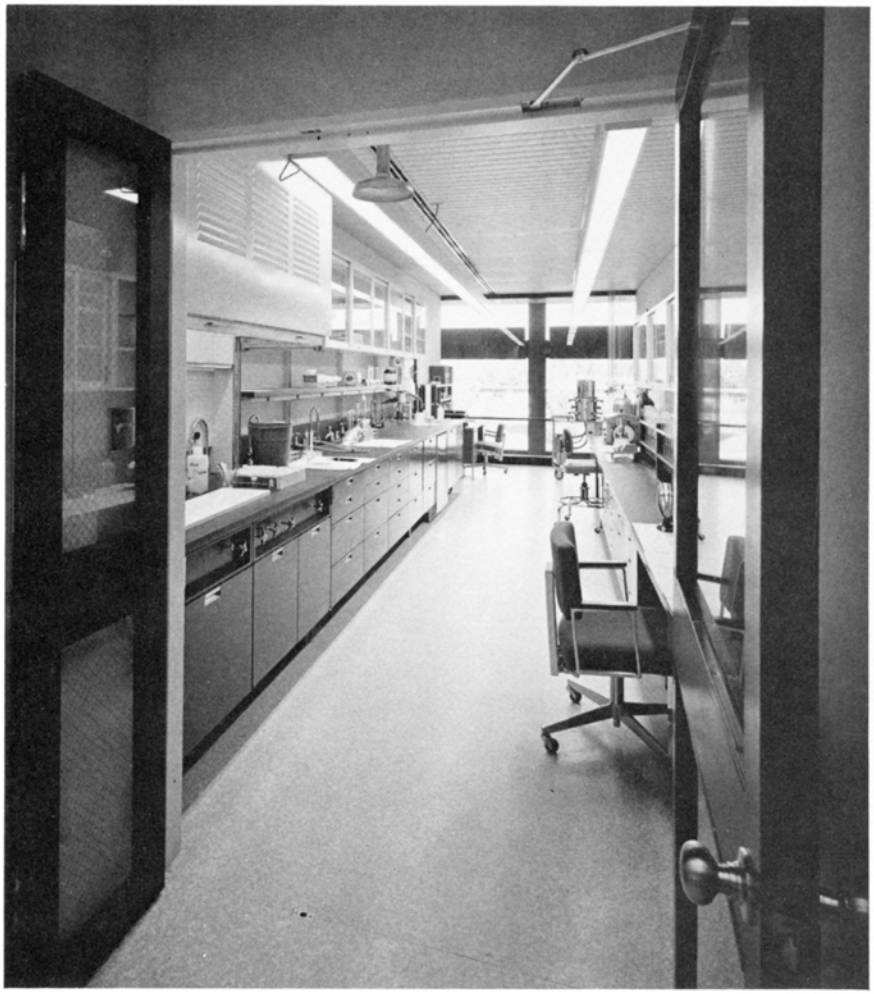
This membrane was veneered with brick, applied in a clearly nonstructural manner. The building's small size permitted the steel skeleton to be exposed on the exterior without fireproofing, allowing the infill walls to be set in and out of the frame. In this respect, the building is homogeneous. However, the panels are obviously nonstructural and are so expressed by creating a deep wall solution. Glass is used in two ways: as non-wall in the deep wall areas and as part of the surface skin where the wall panels are set flush with the frame. It was not reasonable, however, to expose the steel girders on the interior, and therefore, the frame and infill panels are utilized as a deep wall environmental boundary.

One could argue that the composite model is a compromise solution, but that is not the case. As the Alza Building illustrates, it is reasonable to develop a boundary layer which has the characteristics of the homogeneous model yet clearly differentiates this layer from the interior of the building as in the heterogeneous model. In this case the exterior conveys the reality of how the building is made, and yet it does not seem incongruous to find more refined levels of finish on the interior. Because of the programmatic necessity for cleanliness and the social atmosphere of the activities, the utility services in the Alza laboratory are concealed in the more finished interior. Credibility of the concept is maintained by never allowing columns, structure, or ducting to appear on the interior and always exposing them in the boundary layer. Placing the environmental membrane back and forth within the deep walls proved difficult and expensive to build, however, and may be criticized for its lack of conceptual purity. While it was technologically feasible and there have been no problems, this is a slightly forced logic of expression.

This line of reasoning does not suggest that the designer should not choose to create interior spaces with essentially the character of exterior space, or vice versa. Contrast and ambiguity may be powerful ways of achieving overall objectives. But it does suggest that the conceptual model should be compatible with the problem at hand and with the realities of environmental separation that will exist; a definitive conceptual model provides a theoretical integrity for individual solutions.

Architectural design is the act of bringing together the what and how to build. The highest forms of architecture historically and presently are those which bring the functional and symbolic purposes of building into meaningful interaction with both the space form and the constructive means of their achievement. If there is an inadequacy in modern architecture, it has been the superficial concern for expression rather than concern for broader principles. When visual and formal concerns become effects rather than an expression of both purpose and means, they lose the essential dimension of their meaning; buildings which are a collection of effects have little meaning.

Whether conscious to the designer or not, conceptual models of buildings as constructed objects are the basis for design decisions. One's design philosophy should not be wedded to the visual effect of a specific construction model, rather a model should be developed appropriate to the purpose, setting, and means of building. Consistent dedication to a philosophy which establishes conceptual models relevant to both the what and how to build provides the potential for new and creative expression with continued evolution and development, while architecture derived principally from expression often degenerates into mannerism.



Above: Despite the fact that the exterior wall zone is heterogeneous, the interior is very much a completely defined space.

Opposite page: The different environmental loads on the various faces of the Alza Corporation Building are reflected in the varying thicknesses of the walls: on the north facade, the structural and cladding elements are virtually flush, while on the west facade, they are split from each other.