

DESIGNING BUILDING SKINS

by
Arjun Desai
Bachelor of Arts, Bennington College
Bennington, Vermont
June 1988

Submitted to the Department of Architecture in partial
fulfillment of the requirements of the degree
Master of Architecture
at the
Massachusetts Institute of Technology
June 1992

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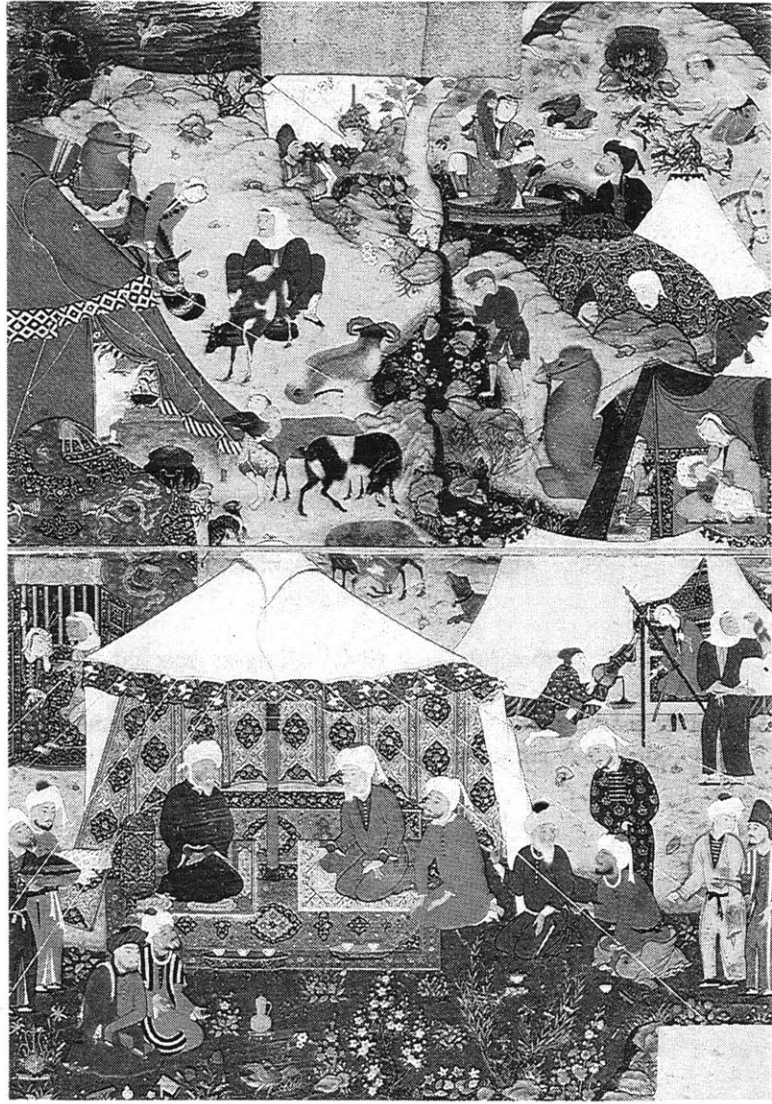
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Abstract

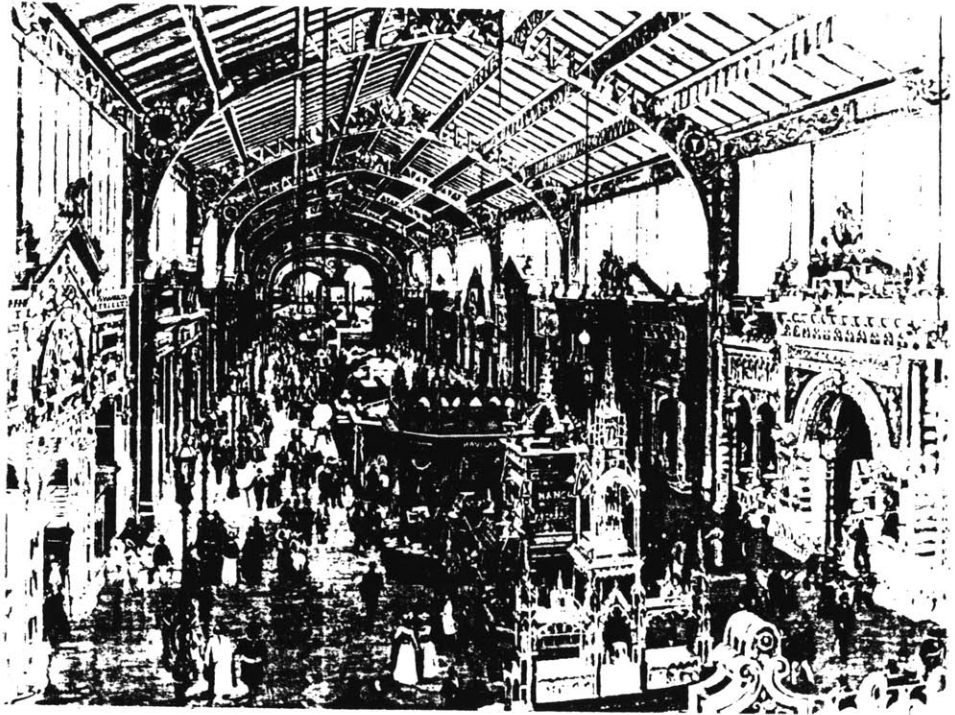
This thesis involves framing criteria and discerning issues to be considered in the design of building skins in an urban environment. The 'information age' has paradoxically seen the demise of the facade as an important signifier of cultural meaning. Homogeneous and minimally articulated skins have become silent and passive masks, creating anonymous and unresponsive urban environments. In contrast, the decorated facades of post-modern architecture have failed to address questions of meaning and representation in a serious and satisfactory way. Perhaps the problem is not solely one of economic constraints and misguided construction practices, but a lack of understanding and evaluation of the role of the skin, both as an architectural element, and as a social and cultural phenomenon.

This thesis will use the ethnographic theories of Gottfried Semper as a basis for establishing themes that have persisted in the understanding and construction of closure elements since the earliest shelters of man. The issue of transparency and spatial depth will then be addressed as a modern social and architectural dilemma, inseparable from the problem of designing building facades. Thirdly, this thesis will be concerned with skins that have a high degree of operability, allowing them to adapt to a dynamic and ever changing environment. The vehicle for exploring the problem of building skins will be the design of a market building in the Haymarket area of Boston.

Thesis Supervisor: Fernando Domeyko
Title: Lecturer in Architecture

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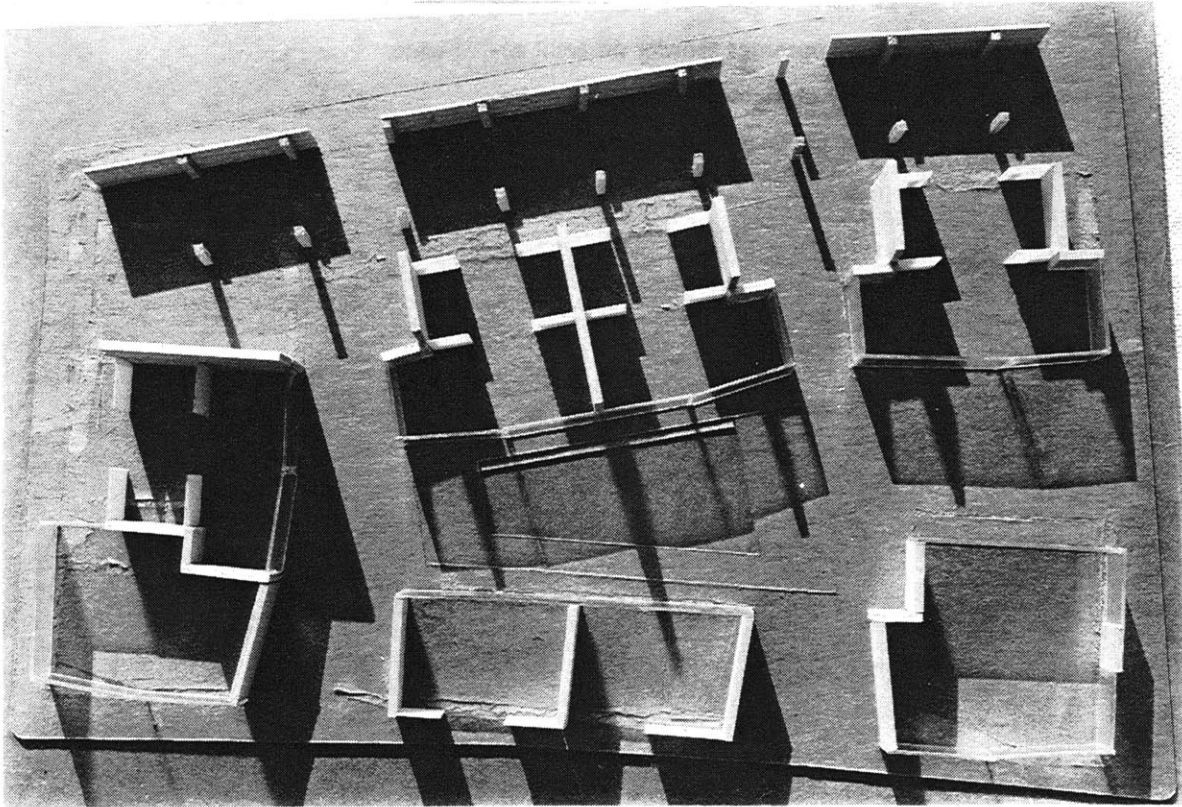
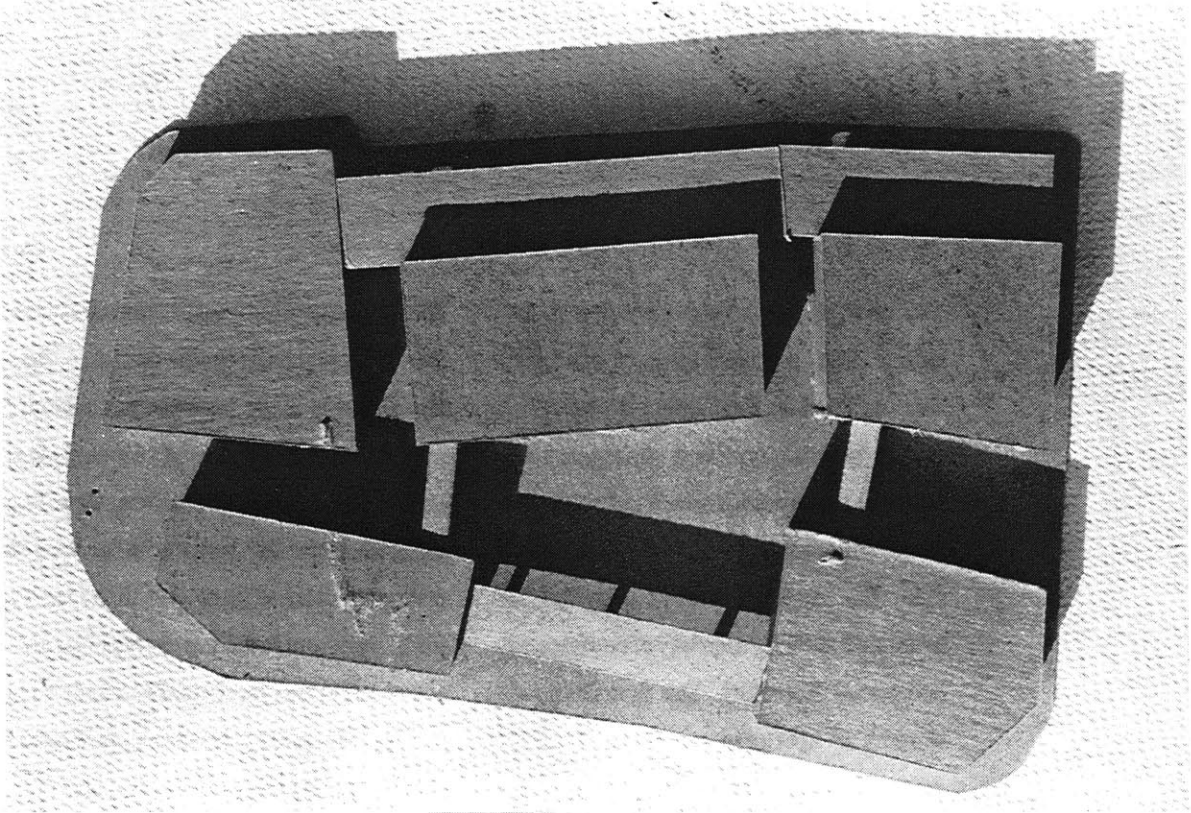
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The Design Project

The issue of a contemporary Semperian skin that has a great degree of flexibility was explored in this design project. The market building type was chosen as a vehicle for the investigation. Traditionally a frame structure covered with a protective skin, the market building provides an adaptable shell for a variety of commercial and social functions. The operability of shutters or apertures creates a dynamic urban condition, one that is dependent on the nature of the elements that wrap the frame. Various configurations of aperture or shutter openings sponsor different activities by changing the relationship between the public and private realms.

The theories of Gottfried Semper constitute the conceptual basis for the design. A clear distinction is made between the masonry work, the tectonic frame and the enclosing walls. The actual articulation, detailing and form of the skin reflects its function as a dressing that has its origins in the textile arts. Apart from fulfilling its role of protection, the skin also plays a more metaphorical one: that of masking or veiling, making the building presentable within its urban context, similar in manner in which individuals surround themselves with a defensive facade.

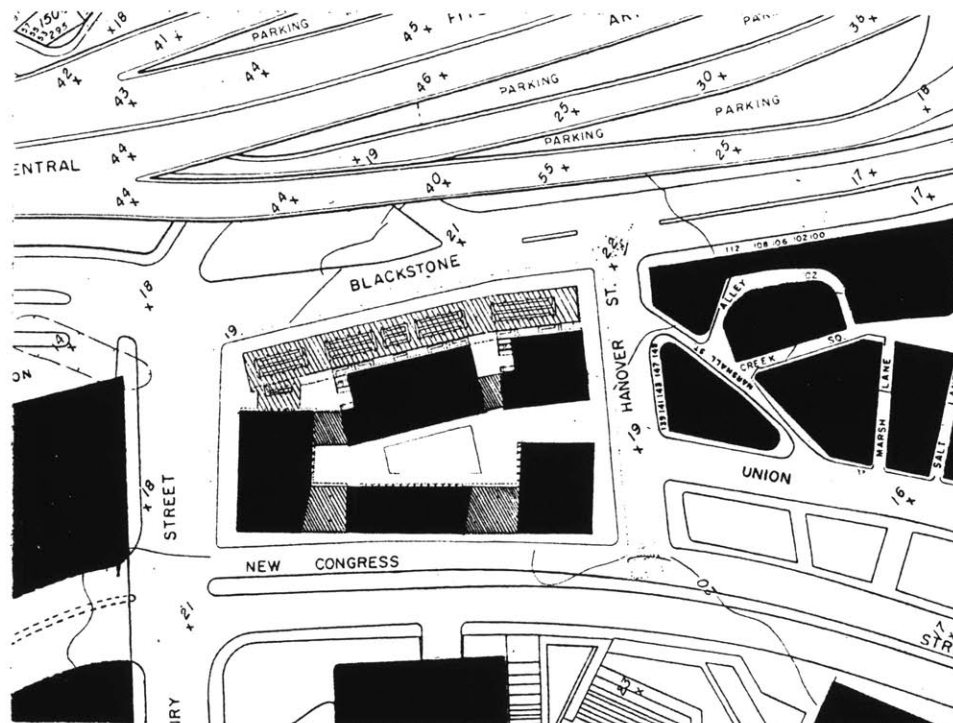


The Urban Scheme

The Haymarket area of Boston offered an appropriate site as it is the home of an informal open-air market which will be relocated when the Central Artery project is realized. The choice of market adopted in the design is that of the street market house, historically placed at the center of a busy thoroughfare. This type is essentially a shed which can range from twenty-five to thirty feet in width and as much as three hundred feet in length.¹ The selected site is an entire block adjacent to the historic Blackstone Block and Government Cen-

ter. In this project, the market house runs along one edge of the block, facing the same street on which the current market exists. The design for the block includes a range of activities, some permanent and requiring a substantial amount of infrastructure, and others more temporary and periodic. The lower level of the structure is used for retail purposes and the upper level as office space. The design of the block includes two adaptable spaces: one at the center of the site which functions as a small courtyard or plaza, used by cafés and

The layout includes an open and adaptable court space in the center, an inversion of the outward looking Boston block type. The covered market house is placed along Blackstone Street, the current location of the farmers market. The plan sought to continue the building edge of Union street, a busy pedestrian area, into the block. The edge along New Congress street is maintained as a barrier to traffic and noise.

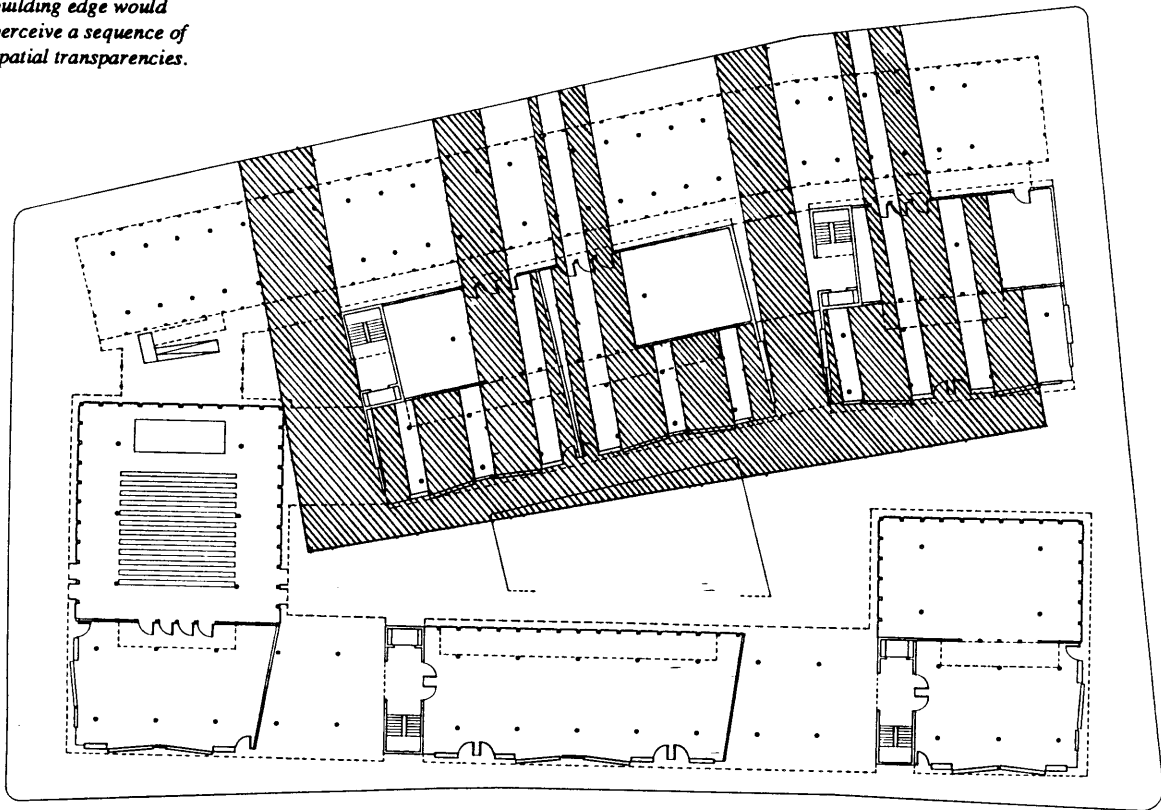


market stalls, or even for open air performances, and the other is a covered section of the market building which serves as a community meeting hall.

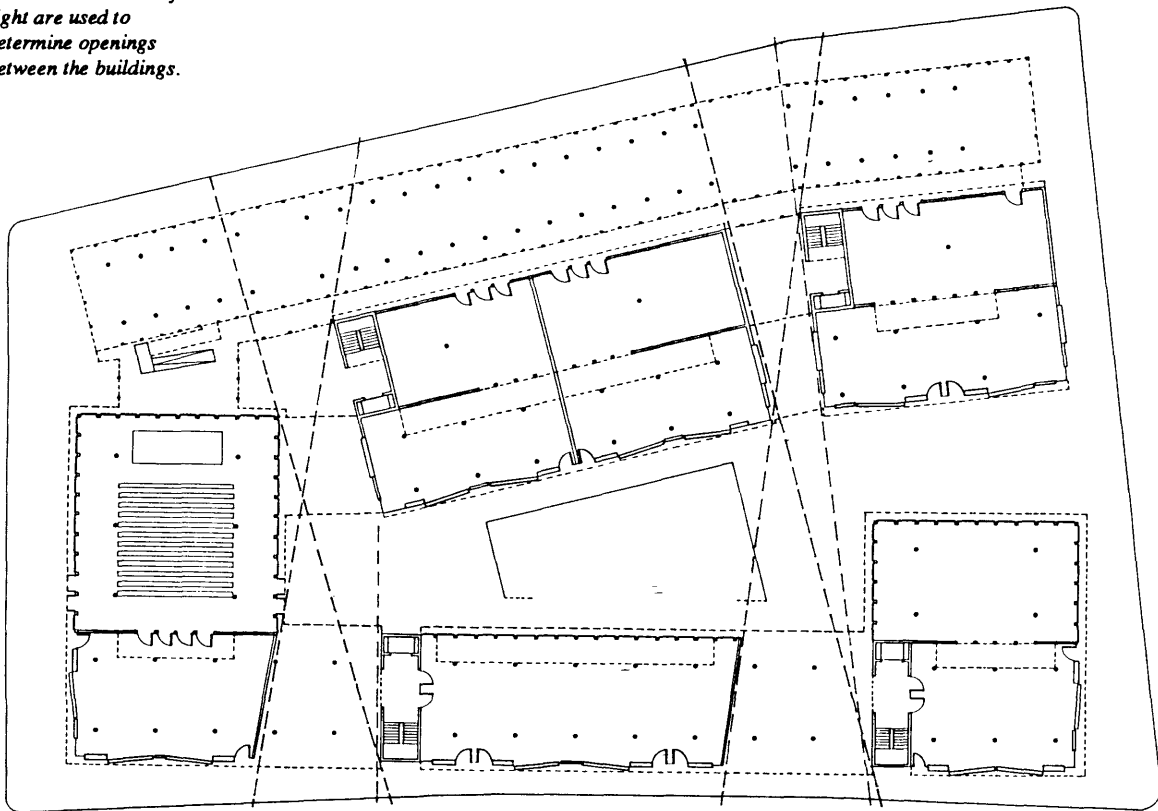
The site is part of an active pedestrian zone which connects Quincy Market and the downtown area to the Bullfinch Triangle, the North End and the Haymarket T-stop. The Central Artery, which currently runs along one side of the site, will be replaced by a park after it is sunk underground. The Artery project is expected to revitalize the area around the site and serve as a link between the North End and the rest of

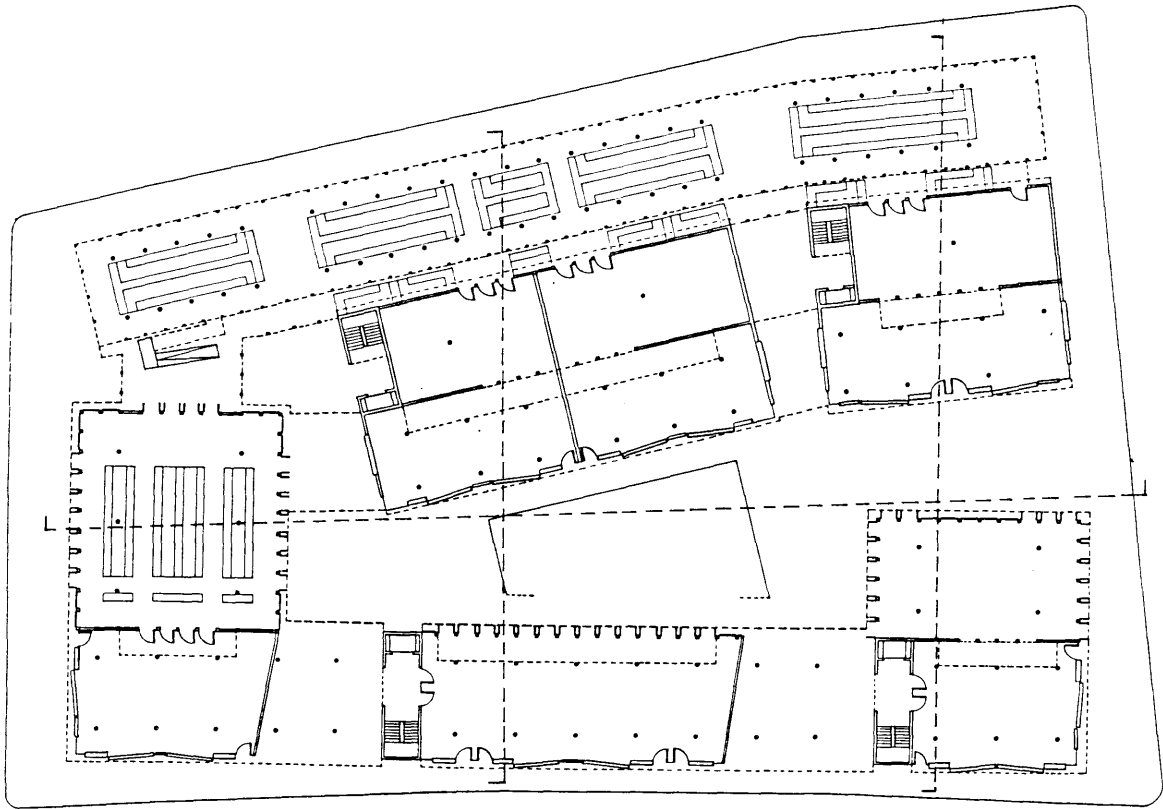
Boston. The attitude of the design was, therefore, to allow for a substantial amount of pedestrian penetration while maintaining the integrity and coherence of the Boston block. This was achieved by studying the quality of depth and visibility through the buildings and the site. A pedestrian moving through would experience a rhythmic variation in spatial depth, in part a result of the layout of the buildings, and primarily due to the articulation of the building skin. As an urban proposal, the skin opens up the center of the site, undermining the very strong hierarchy that the block type suggests.

The skin itself was articulated to facilitate a rhythmic experience of depth. A pedestrian moving along the building edge would perceive a sequence of spatial transparencies.

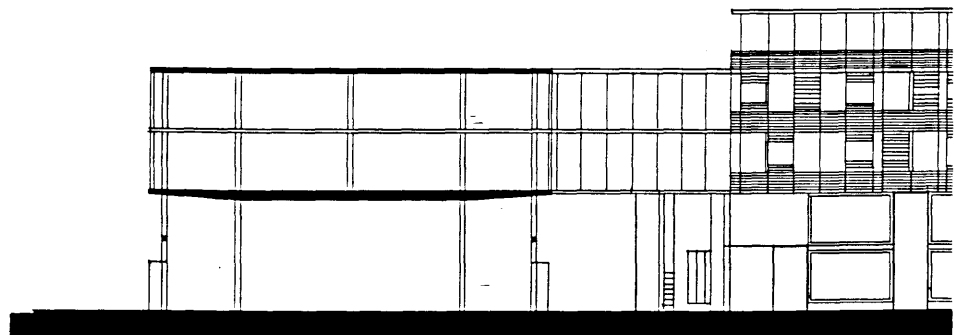


Buildings are placed on the site to allow for a perception of depth through the dimension of the block. The intention was to make the market visually, if not physically, present on all streets. Lines of sight are used to determine openings between the buildings.

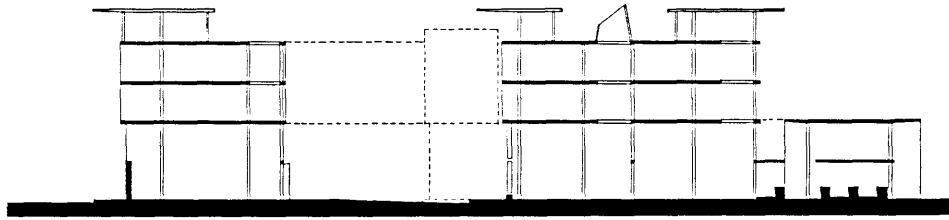




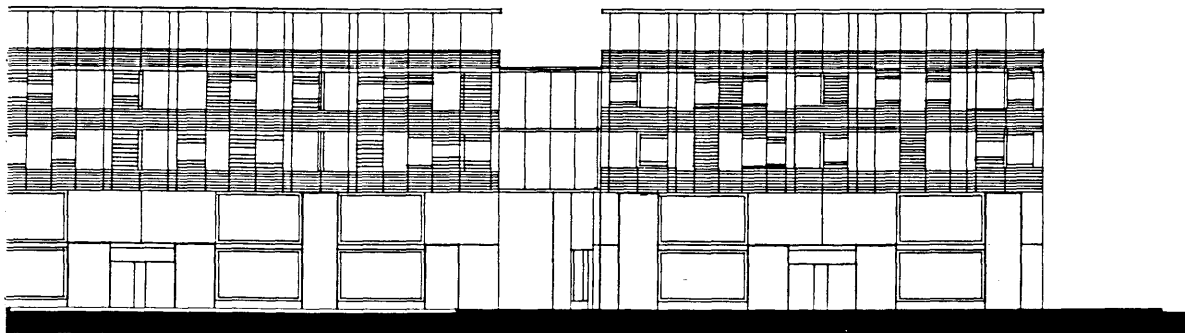
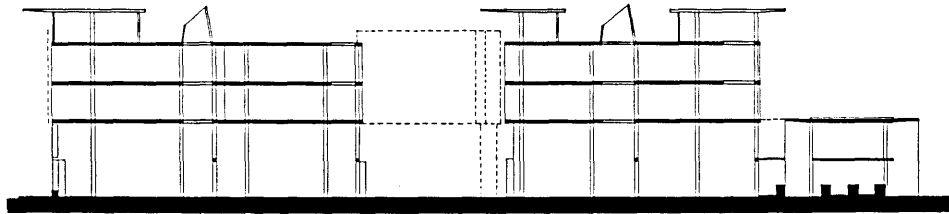
The plan of the project shows the market house along the upper edge of the block. The large hall to the left is used either as part of the market place or as a community meeting hall. Shops, cafés and restaurants occupy the ground plane of the scheme with office spaces above.

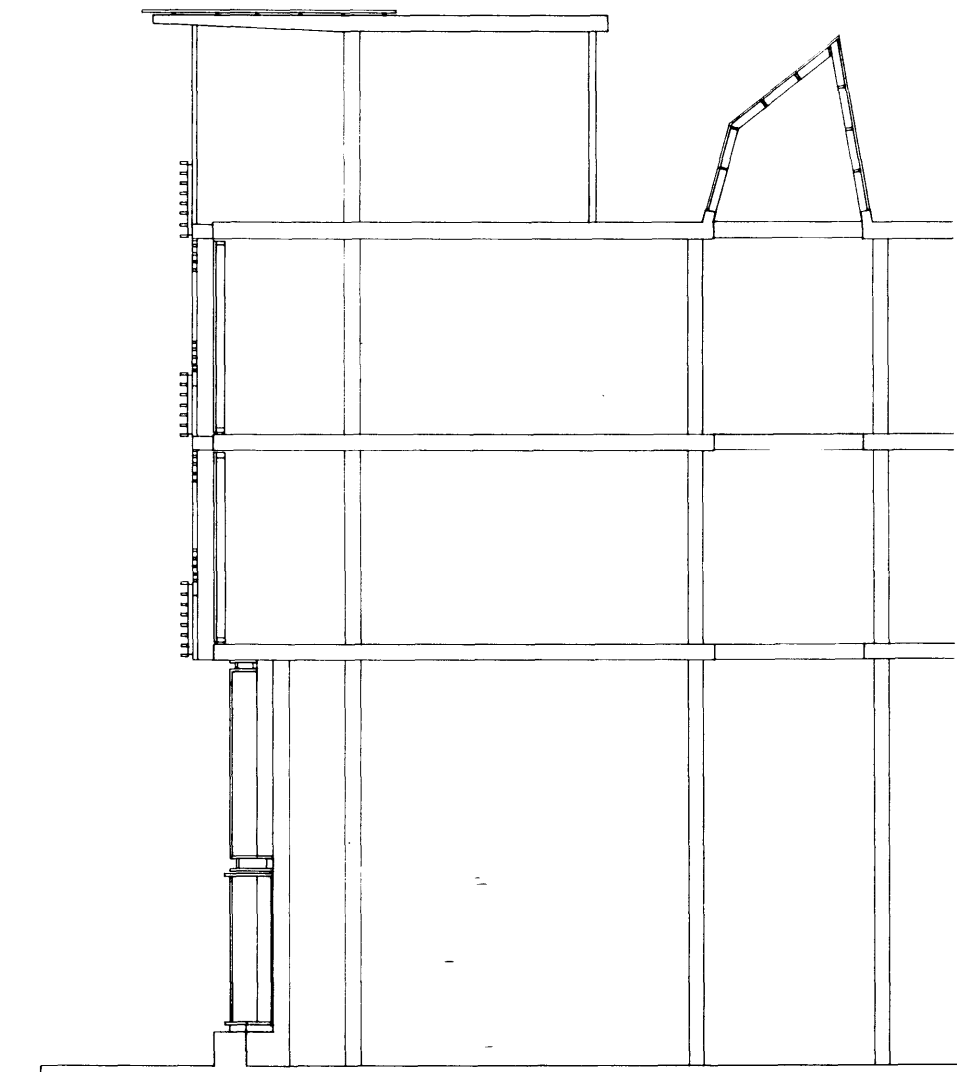


Longitudinal section through the block and court showing the operable skin which mediates the relationship between the private and public domains.

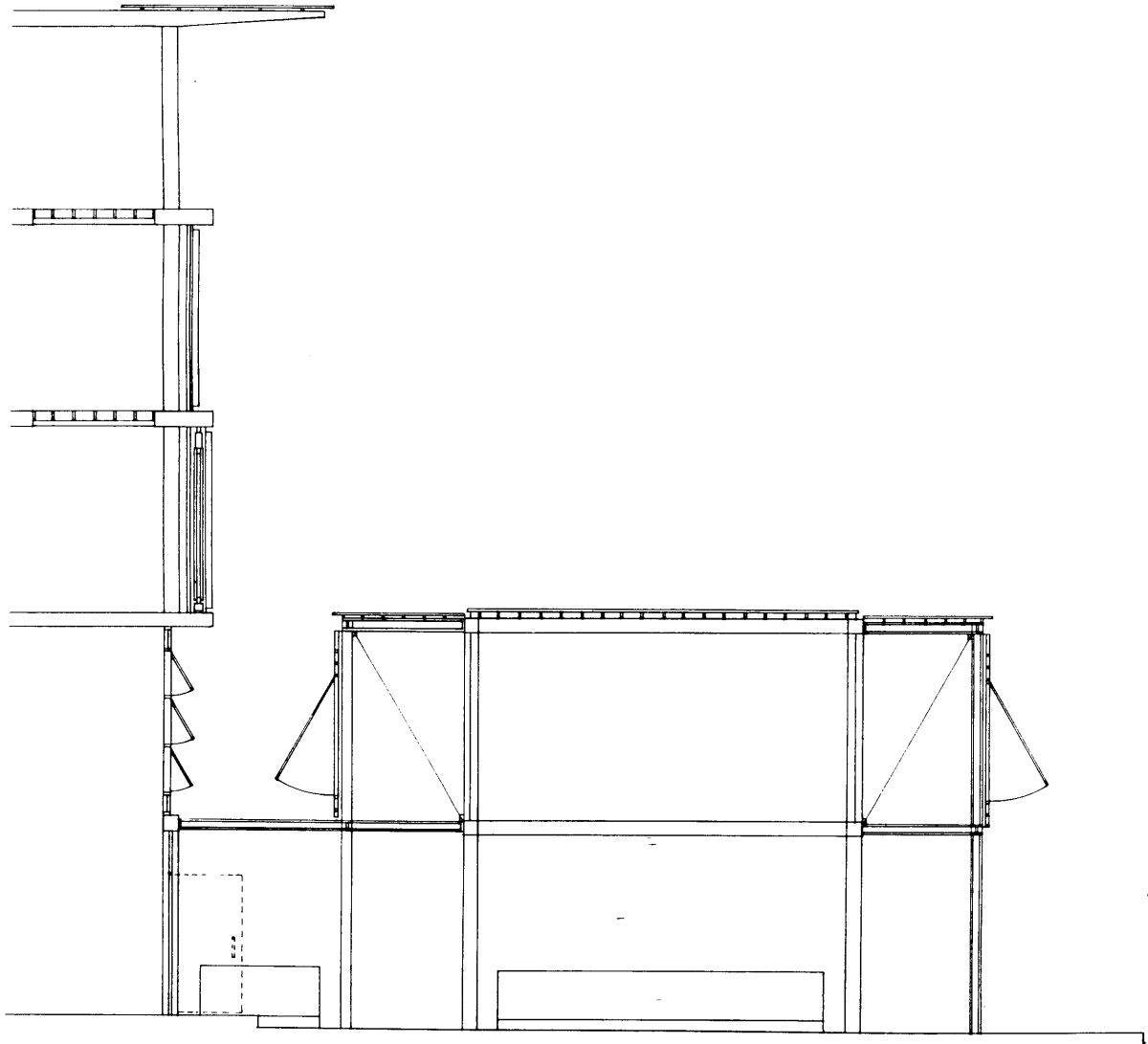


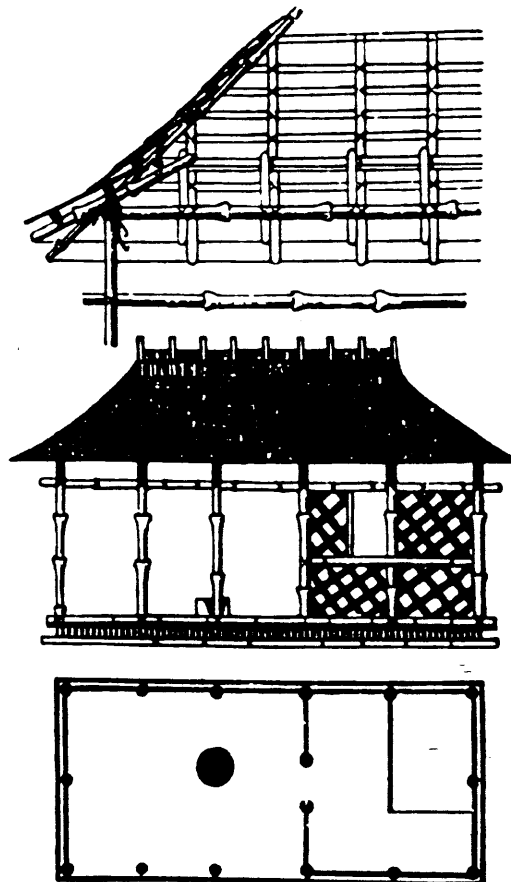
*Transverse sections
through the block
showing the court in
between buildings.*





Section through the building and market house. Skylights control the entrance of light into the building and, subsequently, the transparent quality of the glass skin.





*The Caribbean hut
that was displayed at
the Great Exhibition
in London in 1851.*

Semper's Four Elements

In 1851, Gottfried Semper published *The Four Elements of Architecture* in which he claimed that the wall of the primitive hut was not constructed of stone, but of woven mats. The other three elements that made up the hut were the hearth, the earthen platform and the frame structure supporting the roof. These elements were to be thought of, not as 'material elements or forms, but as motives or ideas, as technical operations based in the applied arts.'² The idea of roofing was connected with a number of frame-making activities that

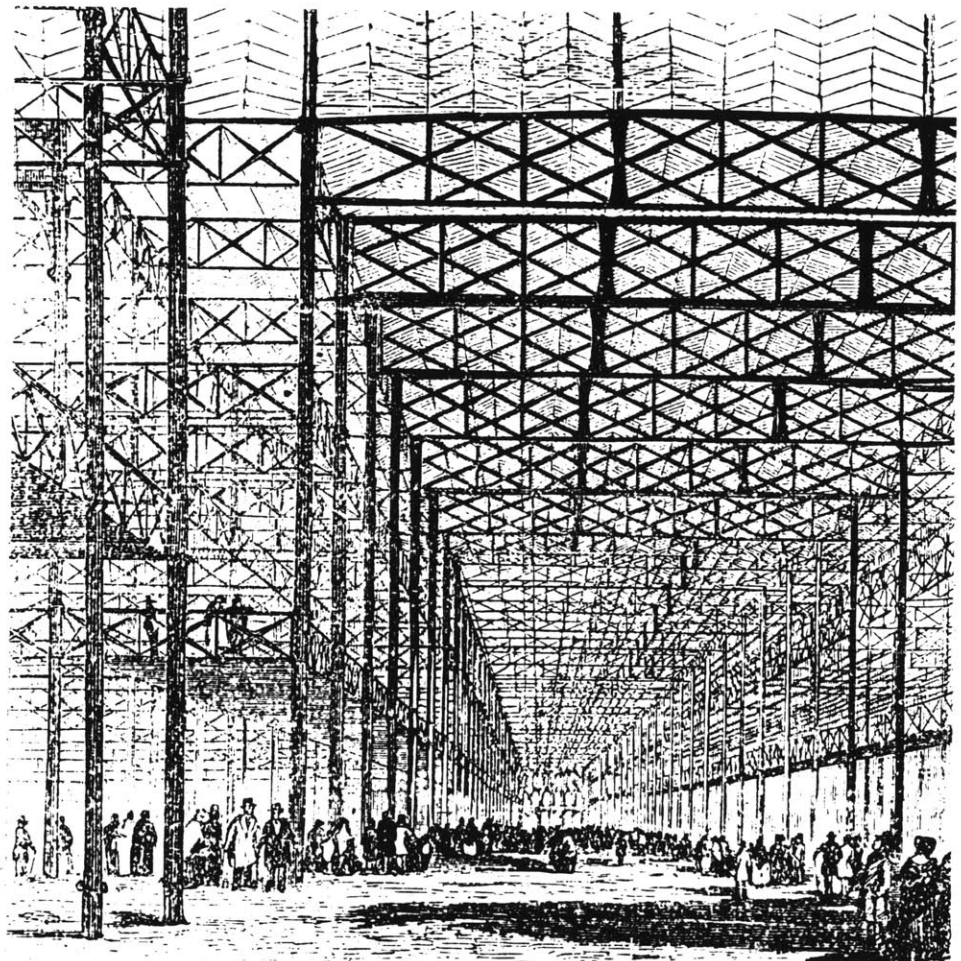
also included the making of tables and chairs. The idea of mounding was connected with terracing and even the masonry wall. The creation of the spatial enclosure was connected to actions of weaving, stitching, knotting and knitting which were also used to produce items such as clothing and baskets. Semper thus assigned a technical skill to each of the four elements, the hearth involved the ceramic arts, the earthen platform those of masonry, the frame involved joinery, and the walls were in the realm of the textile arts.

The wrapping of a frame with a skin to create a primitive but flexible structure.



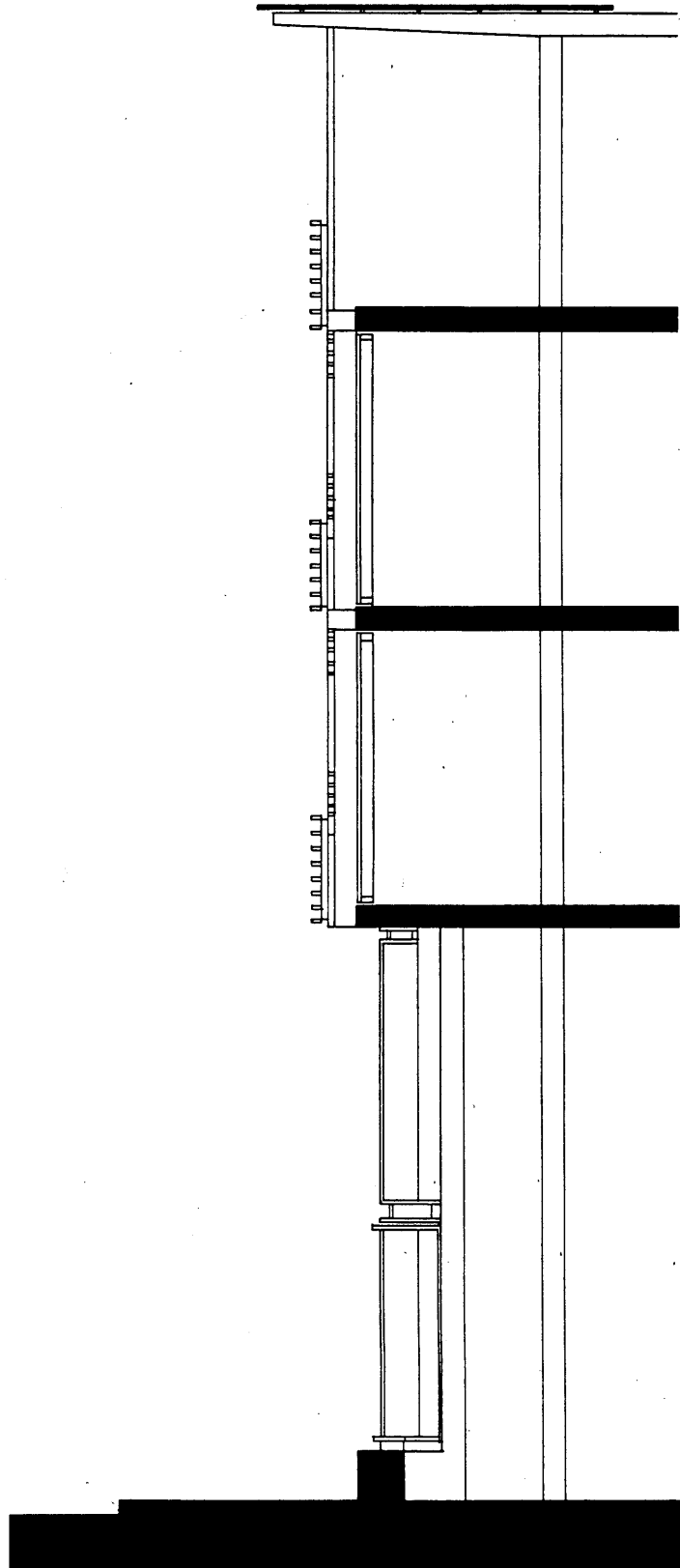
Semper had been in London at the time of the Great Exhibition of 1851, held in Joseph Paxton's Crystal Palace. Paxton himself had described the structure and glass skin of his exhibition hall as 'table and tablecloth,' the flexibility of the glass skin allowing the structure exceptional freedom to adapt and conform to different conditions and uses. Inside the exhibition was a display of a primitive Caribbean hut, the four elements readable in a simple and

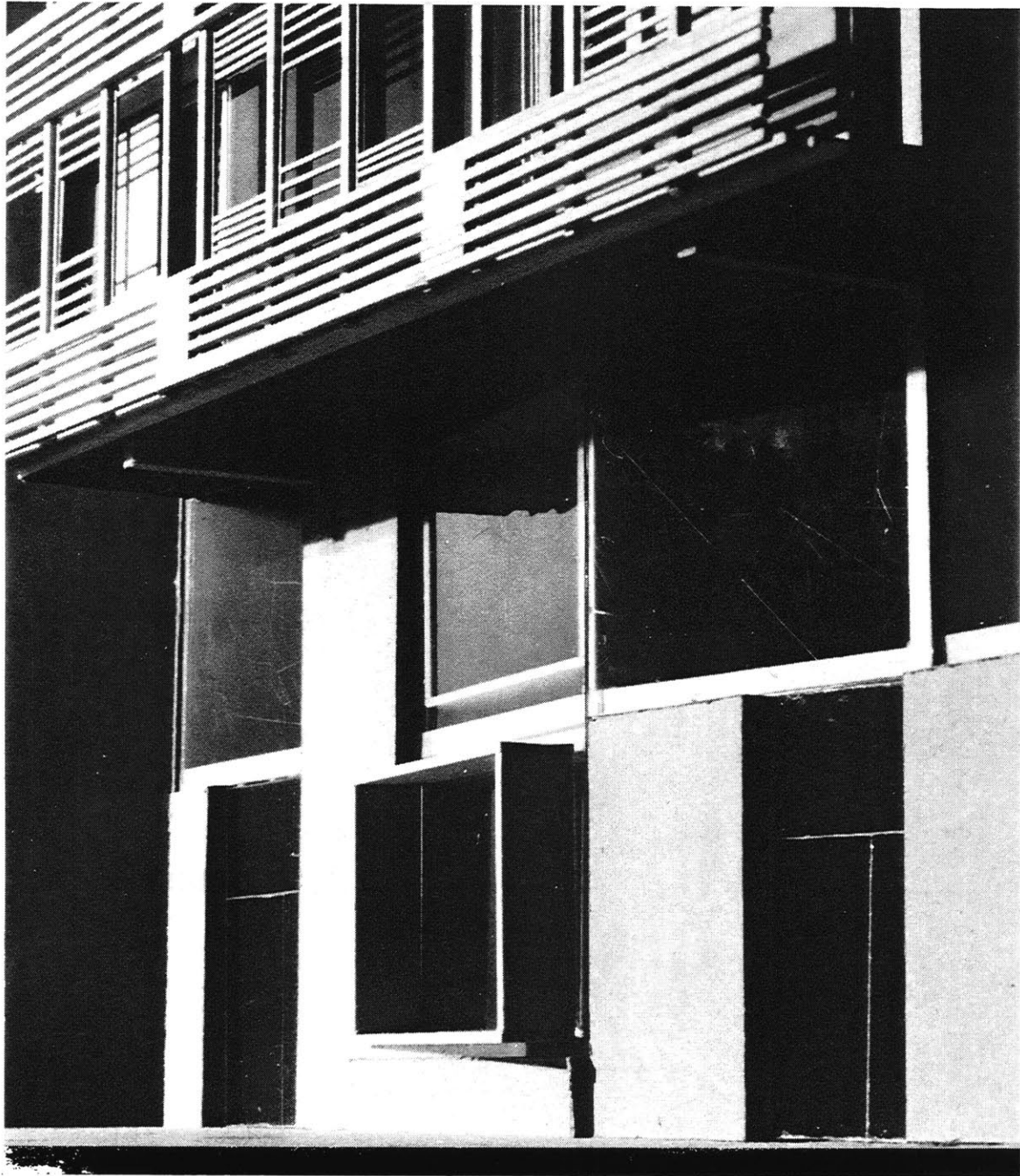
distilled form, offering a confirmation to Semper of the ethnographic roots of his theory. The crystal palace itself was evidence for the intransigence of the four ideas or motives despite the use of new materials and technologies. Paxton's use of the words 'tablecloth' and 'table' to describe the glass enclosure and the structural frame could not have been more appropriate in lieu of Semper's argument.



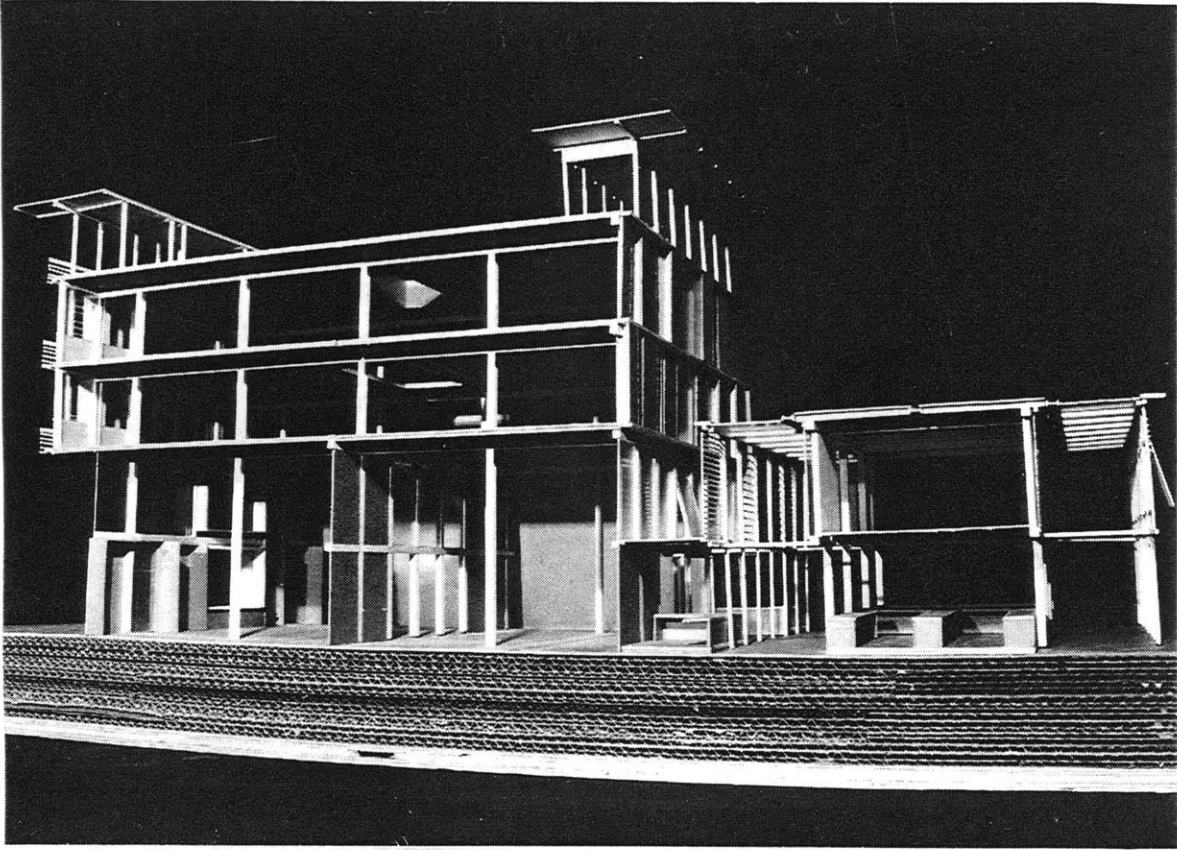
Joseph Paxton's design for the Crystal Palace which housed the Great Exhibition in 1851. It was essentially a tent-like construction of iron and glass.

Section through the facade overlooking the court, illustrating the relationship between three of the four Semperian elements: the tectonic frame, the earth-work or stereometry and the textile skin.

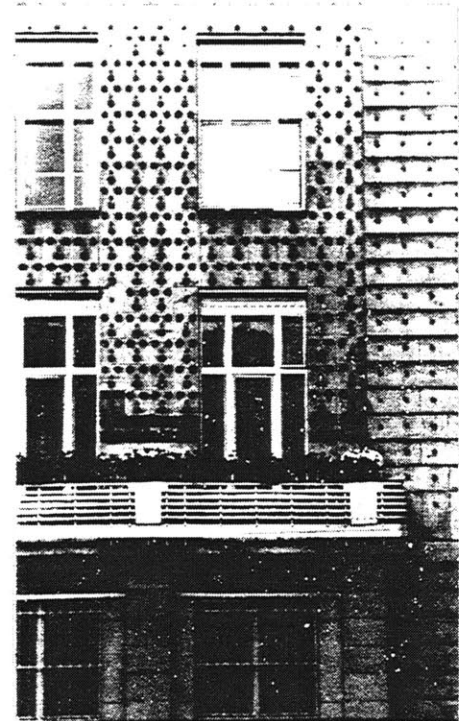
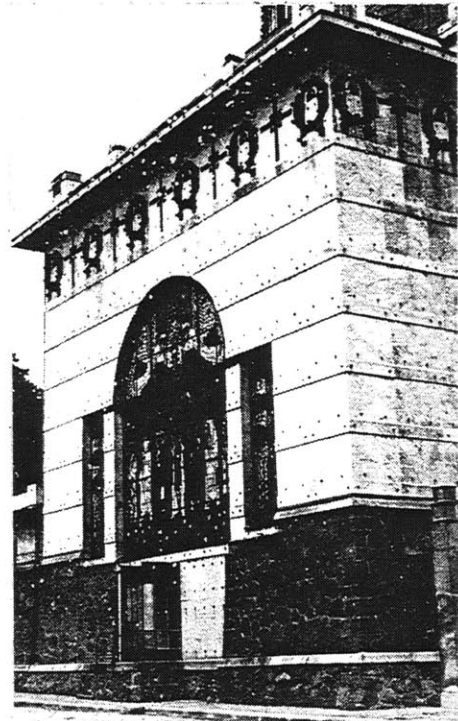
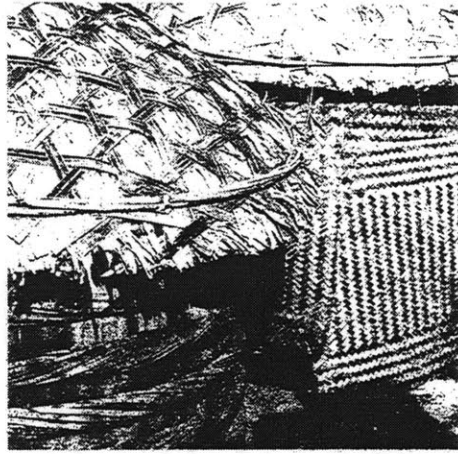




The stereometry is evident at the base of the facade. Massive concrete walls are juxtaposed against the fragile glazing which is bolted to a frame structure. Wooden box windows are inserted between the concrete walls, framing views into the shops.



A concrete column and slab structure, punctuated by light wells, constitutes the tectonic element. The column grid is dense and screen-like to emphasize the presence of the frame. Interior partition walls are articulated as panels between the columns, similar in intention to hanging carpets. The overhang of the roof is pronounced in order to accentuate the hanging or draping of the skin.



Examples of woven walls from African huts.

Textile motifs in the work of Otto Wagner.

The Theory of Cladding

Semper was particularly interested in the fourth element, the textile wall, connected to the motive of 'dressing' a building. In fact, some ethnographic theories of the time suggested that woven walls and spatial enclosures of branches, twigs or grass preceded the invention of clothes. Later on, more solid masonry walls were constructed from which the textiles were hung. Semper insisted that the 'hanging carpets remained the true walls, the visible boundaries of space.' He saw the solid masonry walls behind the hangings as 'necessary for reasons that had nothing to do with the creation of space,'³ the wall covering being the element of architectural significance and the wall itself having only a secondary role. This distinction was also made by the archaeologist Karl Botticher who saw every detail or element as being comprised of two components:

the *kern*-form and *kunst*-form or core-form and the art-form. The *kern*-form is the 'mechanically necessary and statically functional structure; the *kunst*-form, on the other hand is only the characterization by which the mechanical-statical function is made apparent.'⁴ Semper saw the bare form of the wall as being enveloped with a symbolic application, a result of the 'analogies of binding,' giving it 'greater significance, artistic expression and beauty.'⁵ The distinctions made by Semper are important in understanding the role of the building skin within a larger ensemble of elements. The skin is not a substitute for a wall but plays a very different role, that of signification and embellishment. It therefore takes on an additional function to space-making: that of dressing the architectural work.



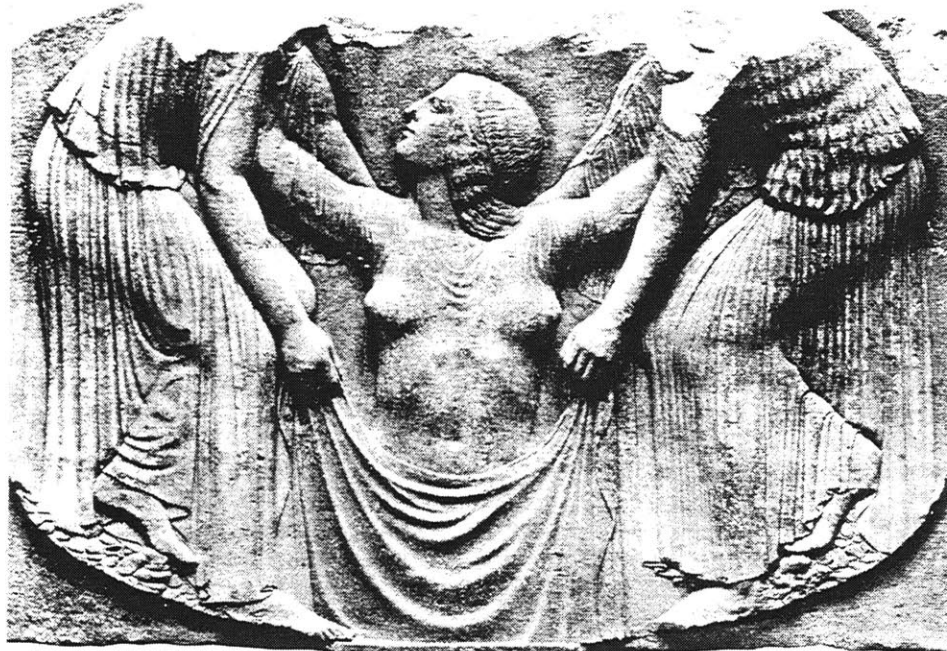
The idea of an art- or kunst-form wrapping the core- or kern-form is employed in the skin facing the court. The operable window panels are clad with a mechanical veil emphasizing the role of the elements that lie behind them.

The Facade as Mask or Veil

Semper considered the act of masking the *kern* or core-form a denial of materiality and a means for raising the architectural work to the realm of art and the spiritual. The mask or the veil was an essential element to the art-work, allowing 'form to emerge as a meaningful symbol' and as an 'autonomous creation of man'⁶. Covering or clothing involved a denial of reality which allowed the art-object to paradoxically reveal its true nature in the form of symbols and essences. This is similar to

the use of mask in Greek drama where the mask becomes an expression of the inner thoughts and emotions of the character behind it, achieved through covering the actor's face. Semper was insistent, however, that the mask should not act as a deceit and the object behind the mask should not be false.

The notion of an art work being surrounded by a veil was also echoed by Walter Benjamin who, commenting on Goethe's

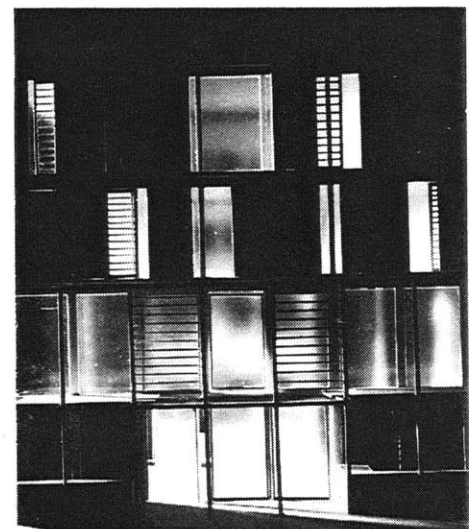
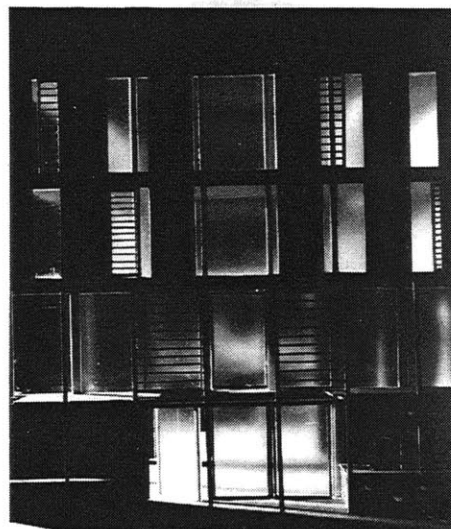
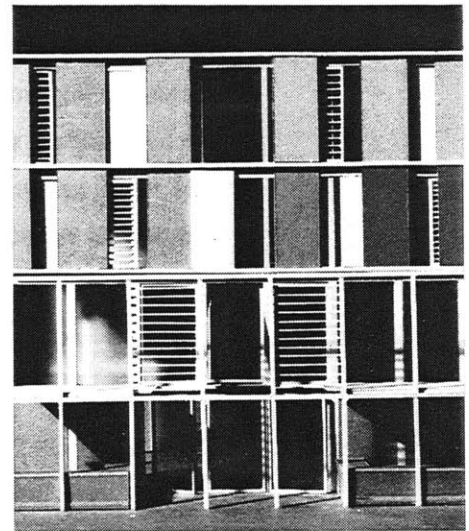
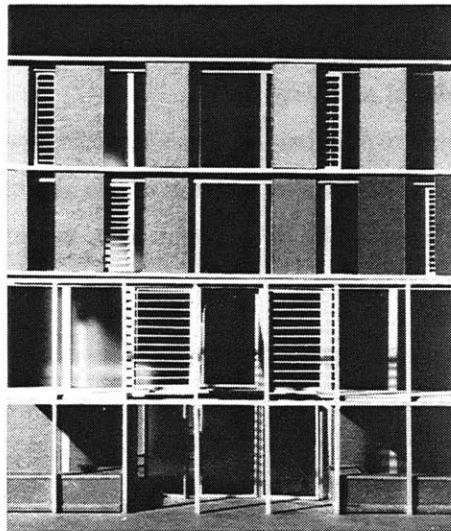


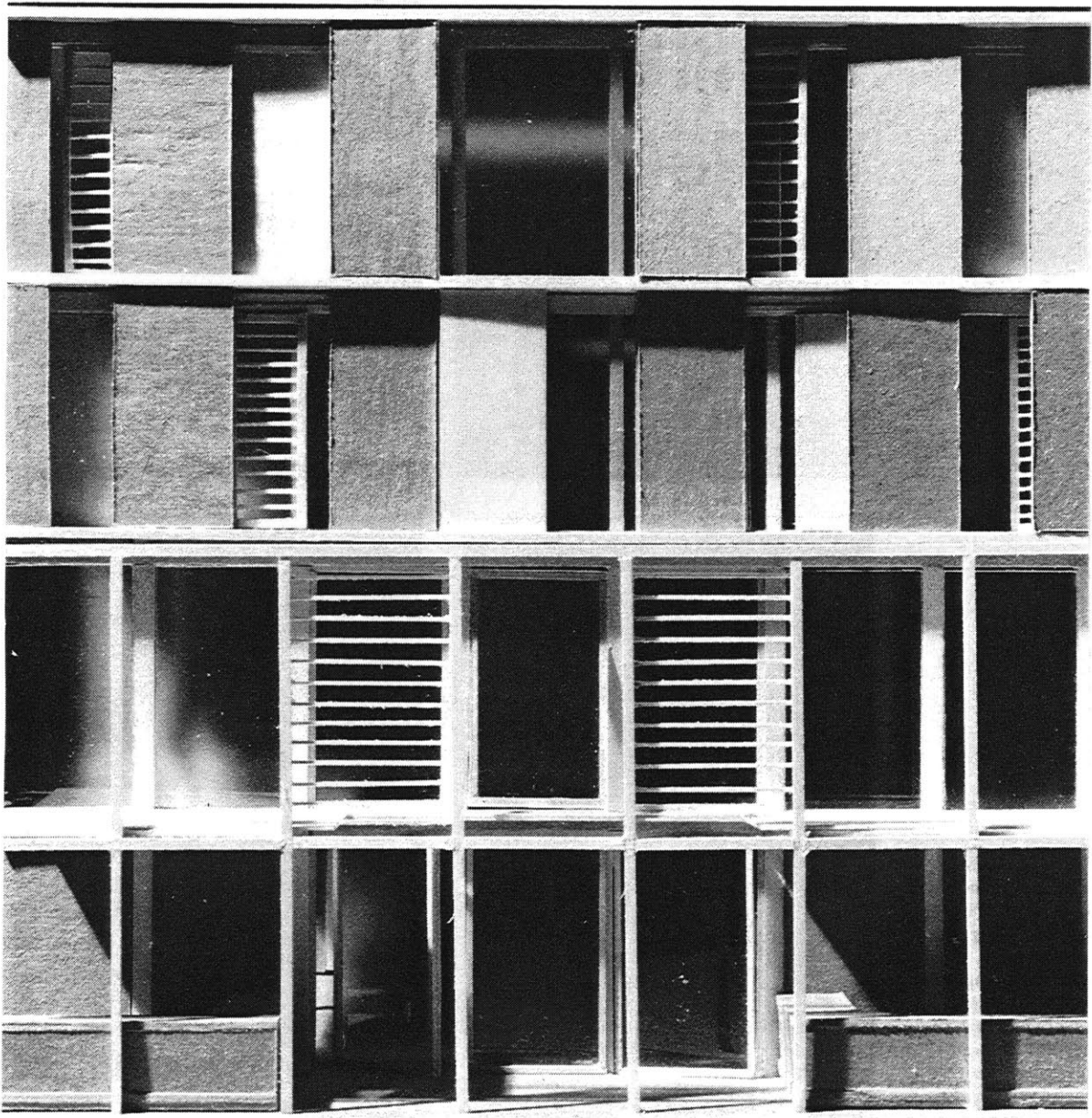
Wahlverwandtschaften , wrote that “beauty itself is not appearance, but most certainly essence, admittedly one which essentially only remains true to itself beneath the veil.’ The veil and the object it conceals together form a unity that constitutes beauty. The naked object, that which has been unveiled, is somehow transformed and not ‘true to itself.’ The skin of a build-

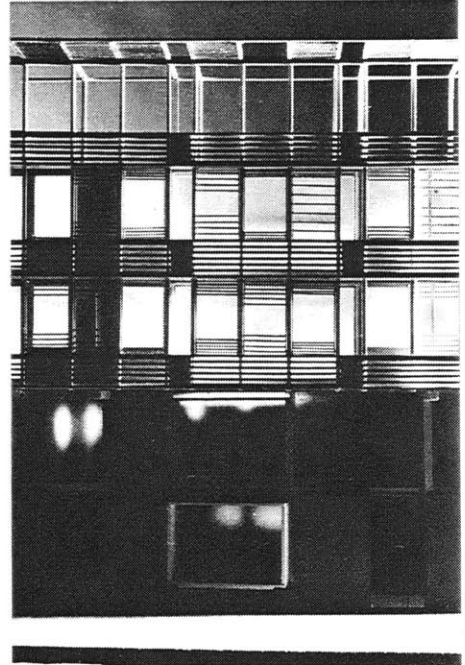
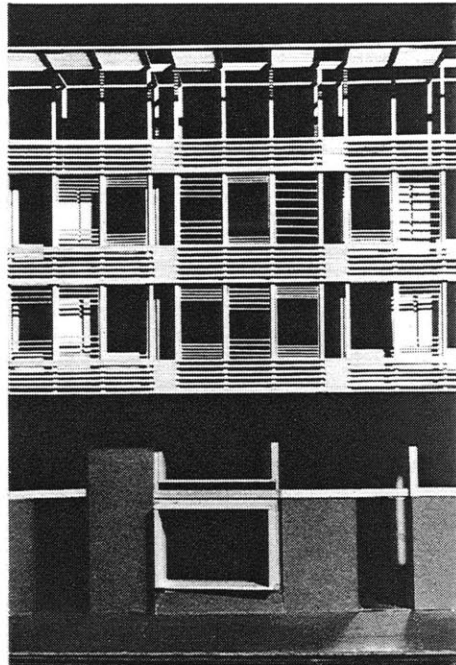
ing is a tangible and physical device to conceal an object or an inner order. It becomes analogous to a veil over an inner set of values or truths, not completely obscuring or revealing them, but allows fragmentary glimpses to penetrate through, making possible an understanding of the whole.

The facade facing the market building. The skin changes in thickness rhythmically, creating the impression of curvature which is perceivable when strong shadows are cast on it. The result is a variation in depth of the surface which corresponds to changes in spatial depth through the building. Wooden shutters are embedded behind the opaque concrete panels, to assist in the function of veiling the interior.

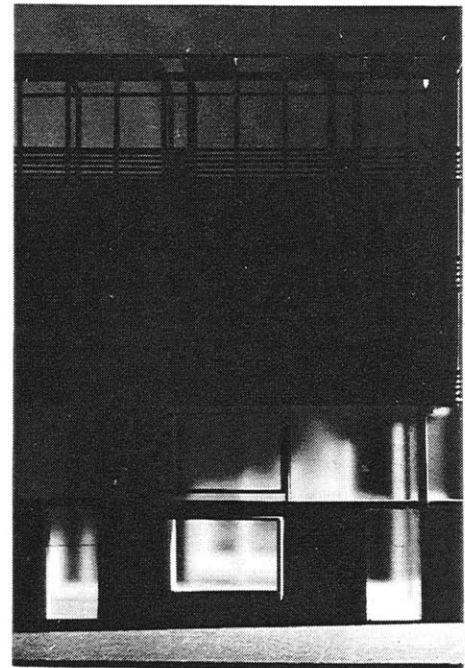
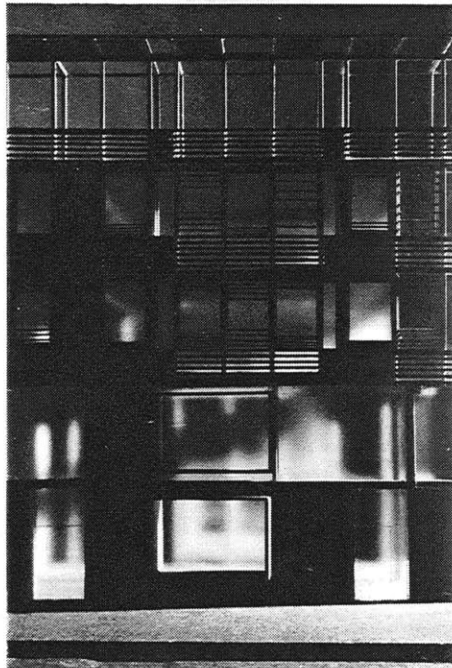
Studies of the facade under different conditions of light and shutter configurations illustrate the changes in transparency and concealment, essential to the act of veiling.

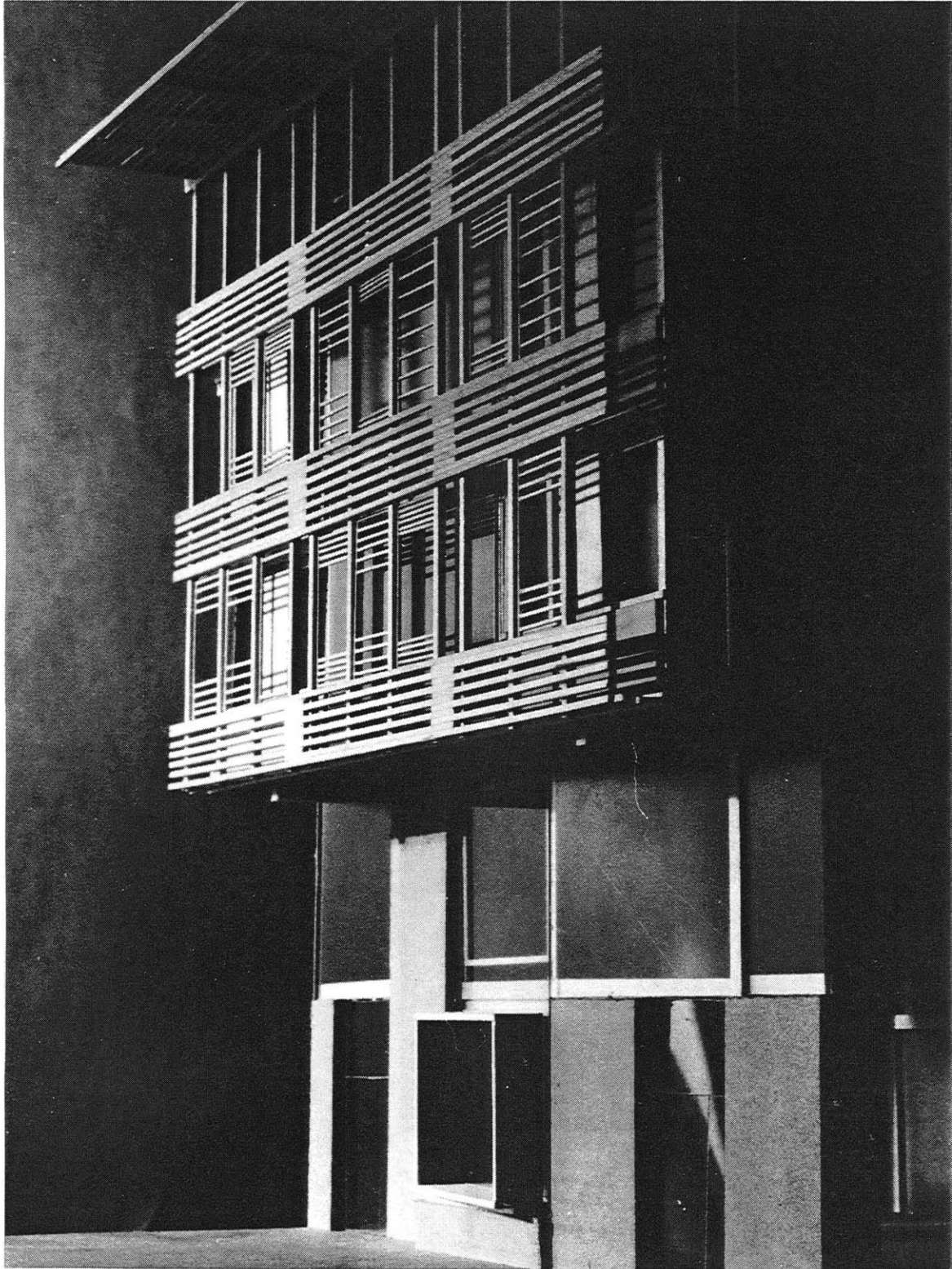


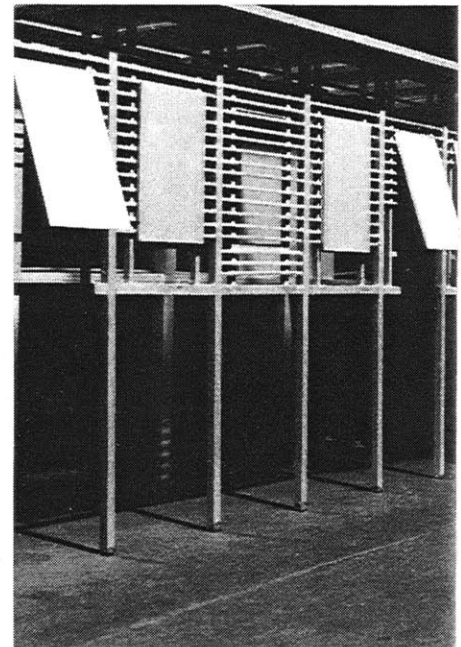
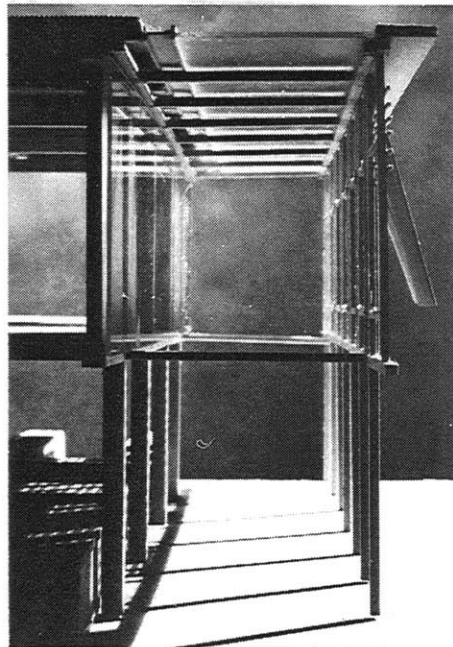
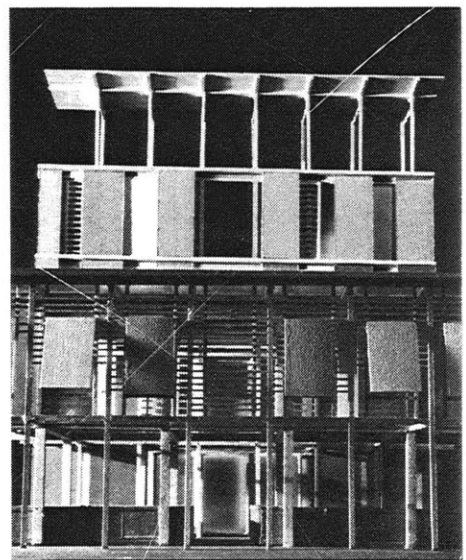
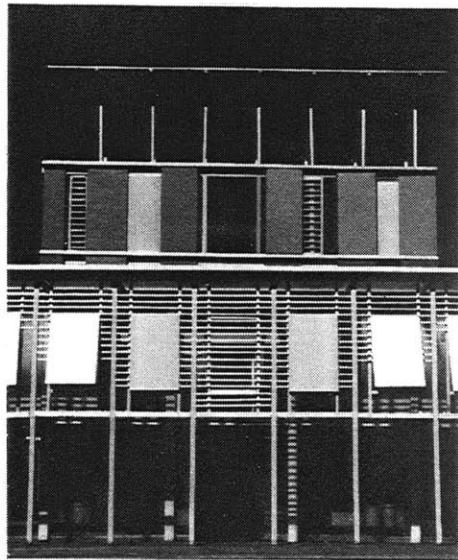




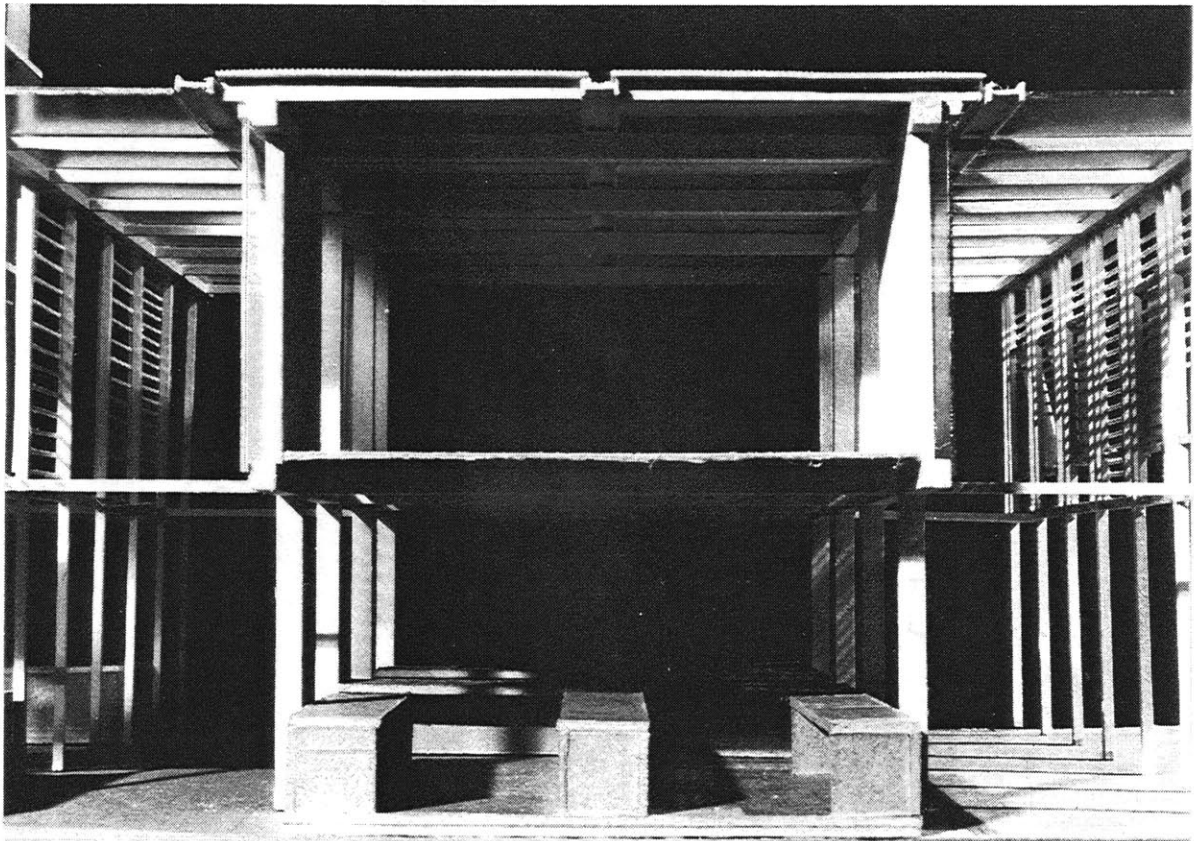
The facade facing the court. Studies under different conditions of lighting. During the day, the skin is opaque, masking the interior. At night, when lit from behind, the skin becomes transparent and fragile, revealing the depth of the building.

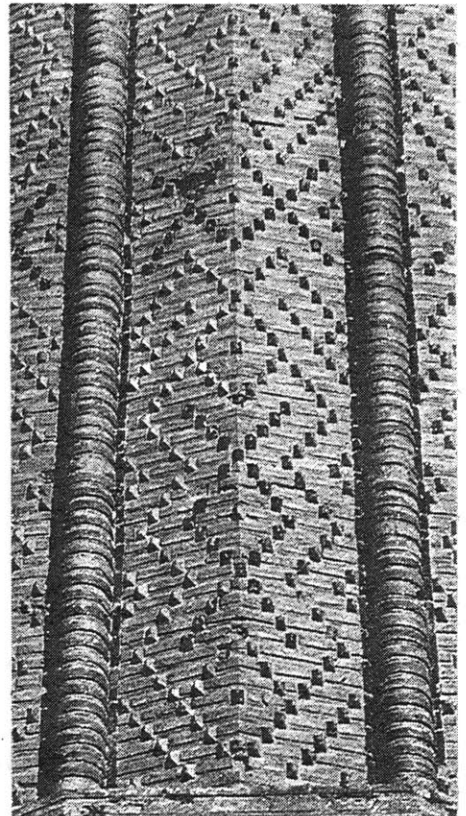
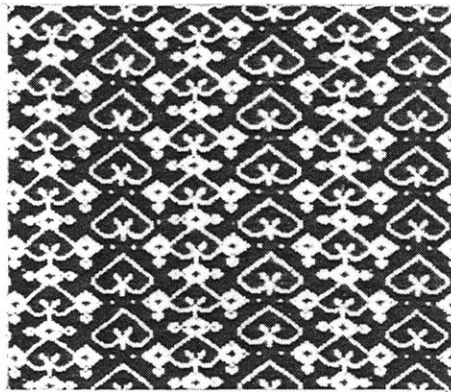
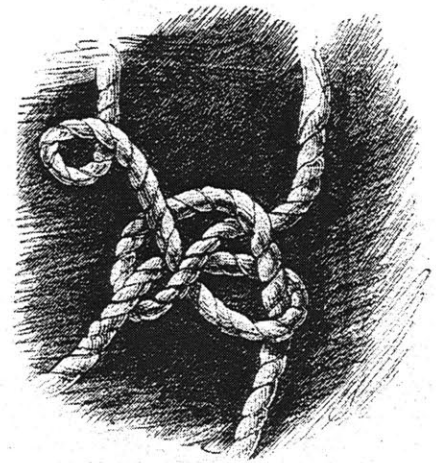
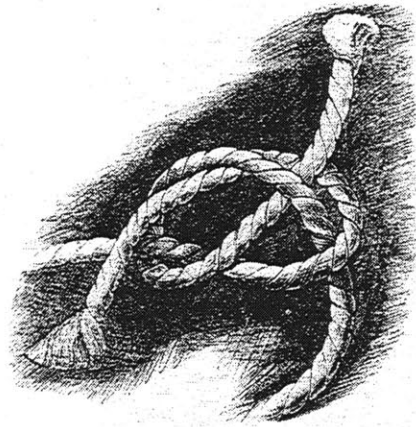






The facade of the market building. The textile-like screen with operable shutters acts as a sun and rain baffle. The second floor is enclosed allowing for storage and will be used as a pavilions overlooking the planned park.

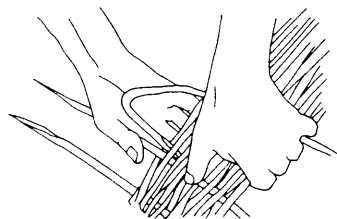
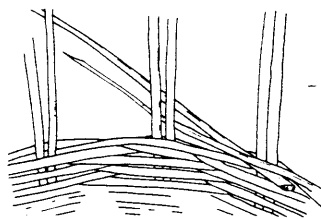
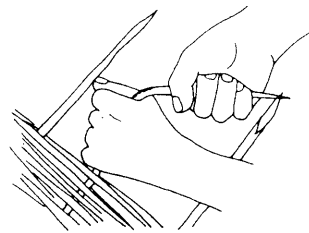
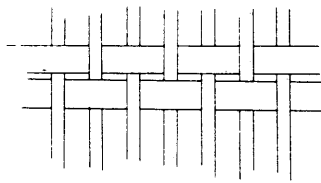




Treatment of Materials and Modes of Production

Semper placed the four elements of architecture within the realm of the technical arts, adding a materialistic and utilitarian aspect to his theory. The forms of architecture, as well as the laws of beauty and style, originated from the production of industrial artifacts. In the textile arts, the actions of the hand in knotting, stitching and weaving formed the basis for the production of clothing as well as the walls of the primitive hut. The human hand possessed a certain language in transforming raw

materials which were listed as elastic, soft, ductile and hard, corresponding to the textile, ceramic, tectonic and stereometric arts respectively. Semper attempted to classify the rules of production in the textile arts in an emulation of the taxonomical work carried out by the biologist Georges Cuvier who established a classificatory system for the physical forms found in the animal kingdom. Starting with a discussion of bands and threads as the raw material, Semper discusses the knot as the



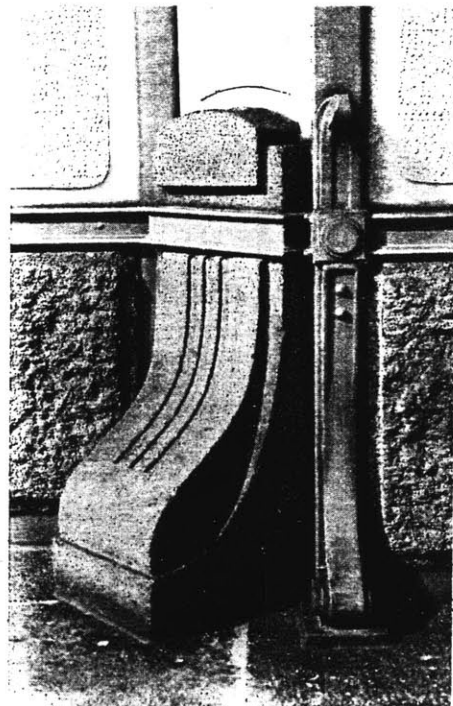
'oldest technical symbol' and its different forms . He then gives an account of different types of stitching, plaiting and weaving, where the band or linear element is transformed into a surface capable of dressing or clothing.

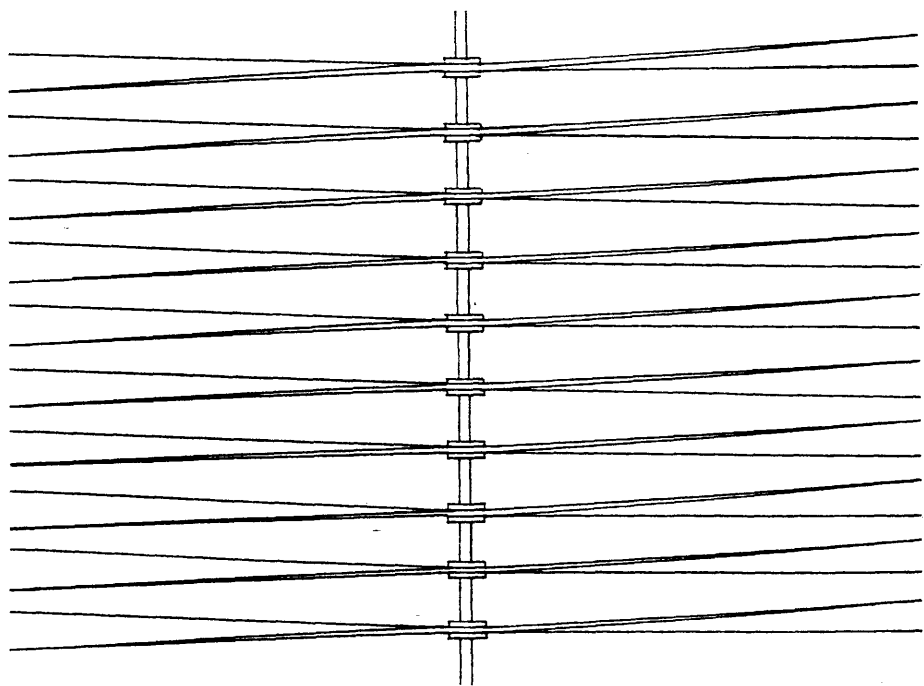
Semper also outlined ideas on material transformation: when a new material was used to produce one of the four elements or motives, forms and motifs arising from the manipulation of the old material were

transferred to the new one. The details of joinery of the Greek temples built in stone were derived from the rules and logic of constructing with timber. The theory indicates that there are certain vestigial forms which grew out of the characteristics of one material but would inevitably be transferred and adapted to a new one. Thus forms could become detached from their technical origins and possibly disappear, allowing an evolution of styles.

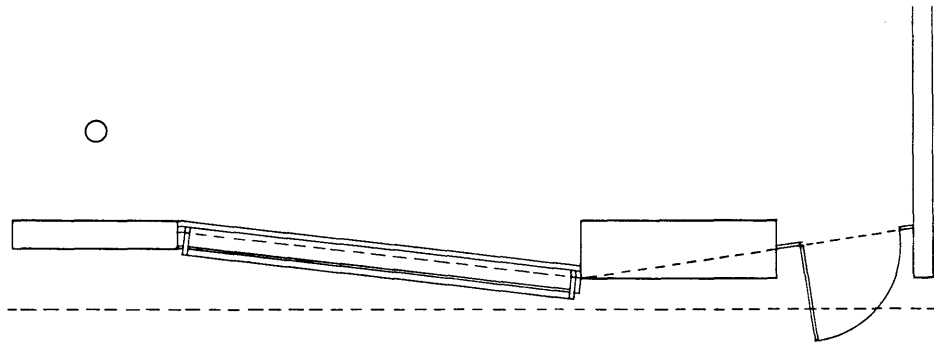


Details from Otto Wagner, emphasizing the textile origins of cladding through the manipulation of materials.

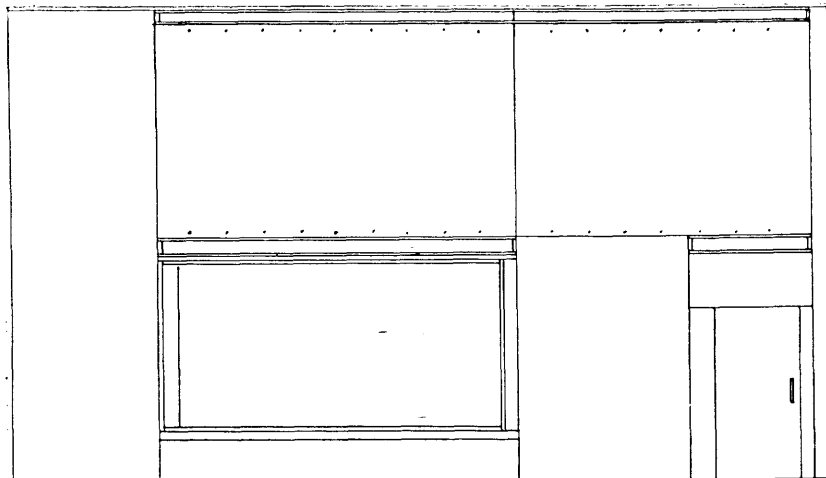


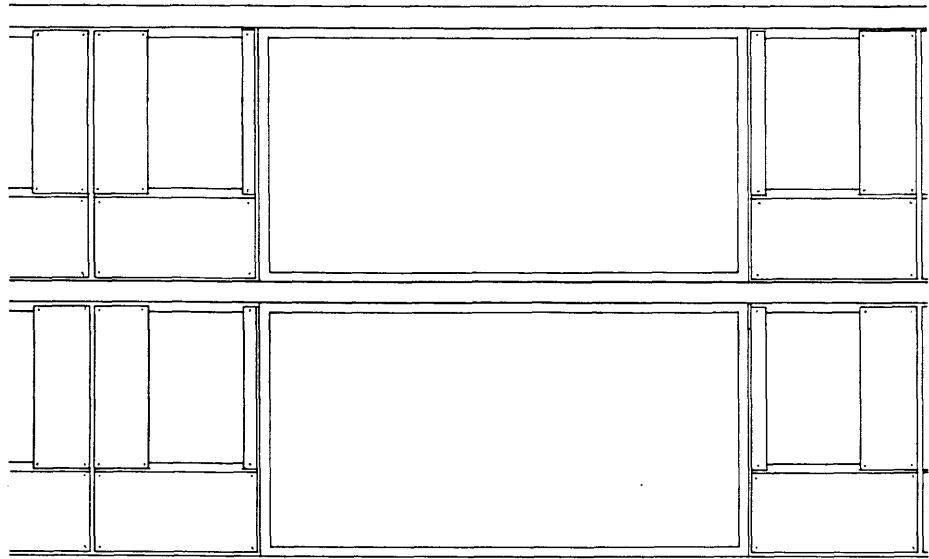


Detail of woven steel elements.

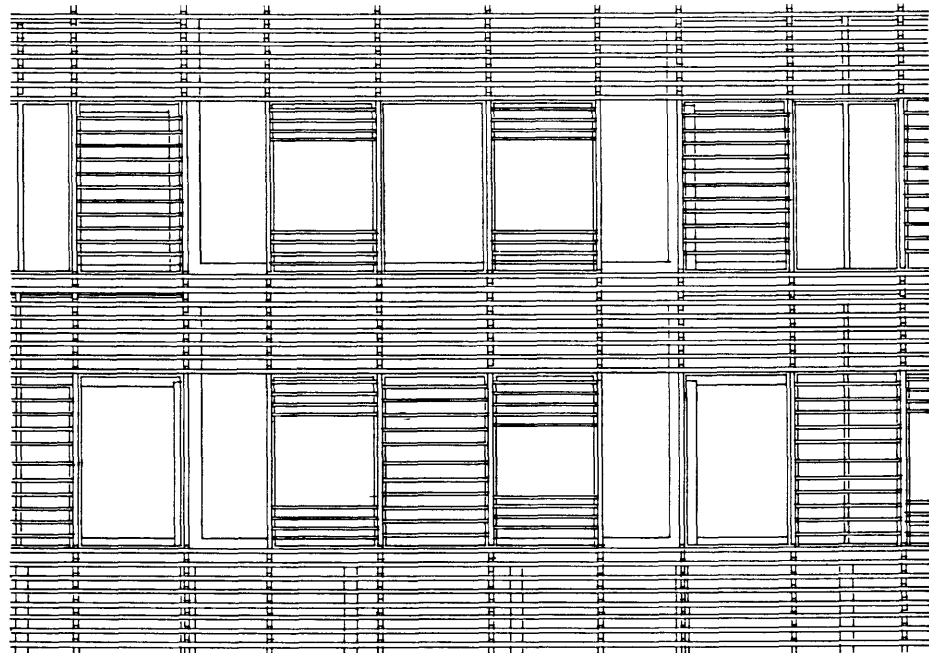


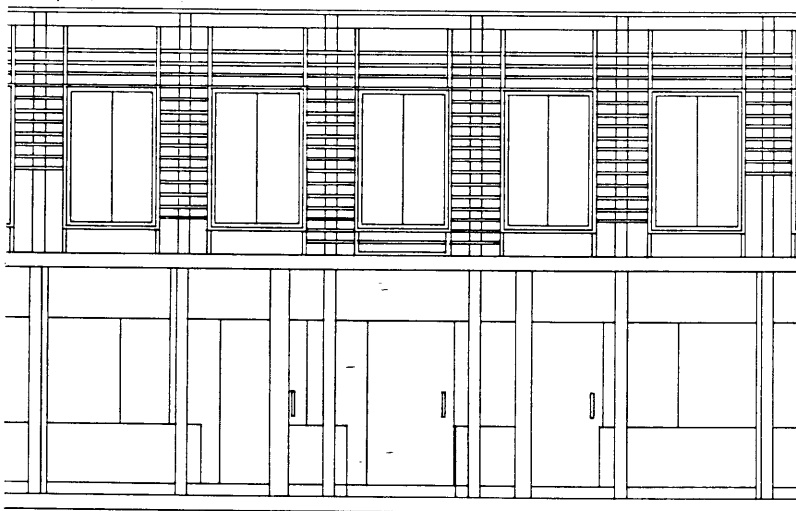
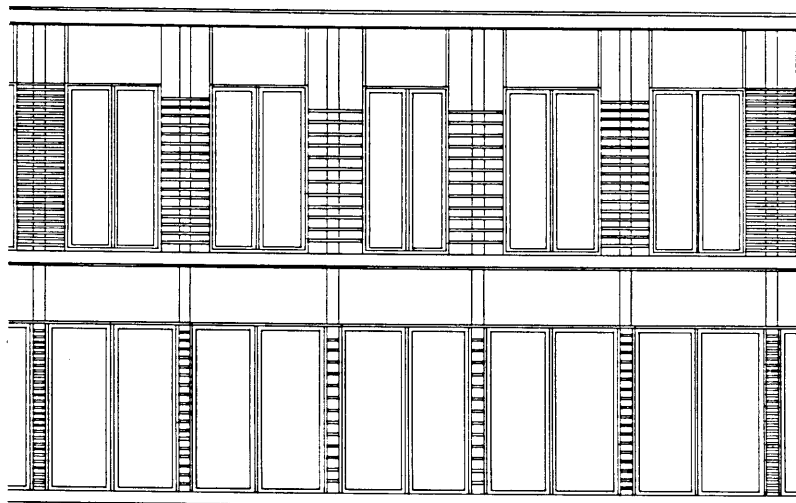
*In the facade below,
the glass acts as an
undulating skin,
creating a rhythm of
shadows similar to a
hung fabric. The bolts
in the glass are
evocative of knots
used to bind a textile
to a wall.*



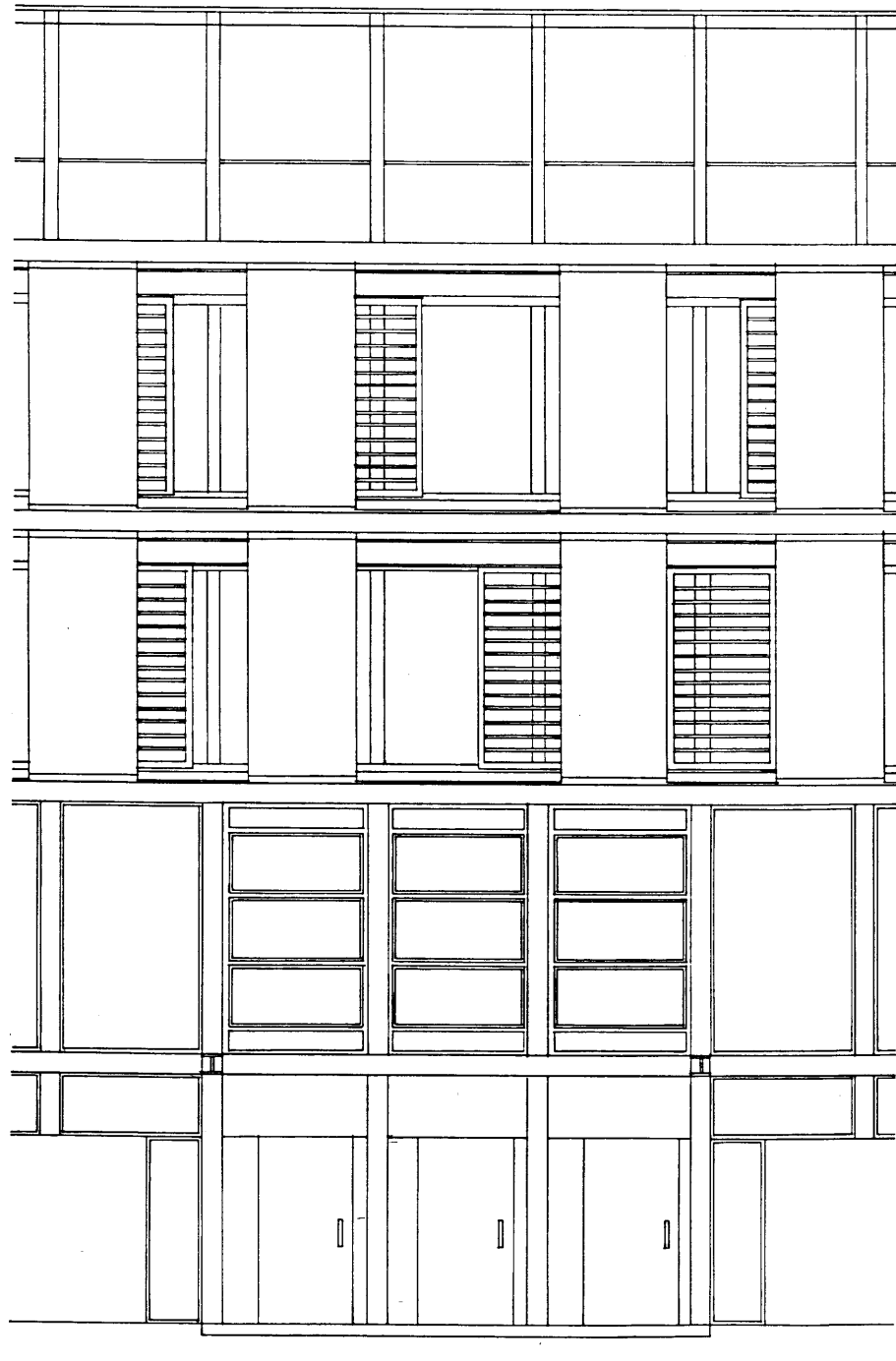
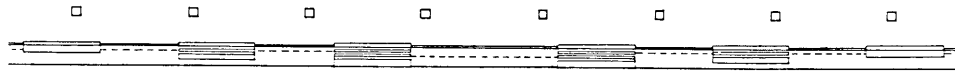


Wooden panel are bolted to a frame, making apparent their function as cladding. The mechanical veil covering them is articulated to resemble a woven screen or mat. The operable elements can be open or closed giving an impression of a fabric being pulled apart.





The skins on the market house are screens inset with operable shutters. The screens are analogous to stitches binding the shutters to the frame.



The skin on this facade is constructed of concrete panel and wooden shutters. The shutters give the impression of stitching the panels together. The panels are bolted to a frame behind them, appearing to float within a larger fabric medium.



*Facade details from
the work of Adolf
Loos.*

Loos and the 'Principle of Cladding'

The connection between enclosing a building and dressing the human body was also echoed by Adolf Loos in an article entitled 'The Principle of Cladding,' published in 1898. He traced the origins of building to the need for covering and shelter. Cladding was therefore the first architectural act, the first detail, and needed to be considered before the choice of structural elements of the building. The function of architecture was to instill sentiments in the user appropriate to the function of the space. A bank would evoke different feelings than a prison or a church, and this would be achieved by a mask of materials over the structural elements. Loos, however, protested imitation and surrogation in the application of the dressing. It was wrong to stain or paint wood to imitate the color of the wood itself or to paint stucco with an image of brickwork. The applied cladding should be called out as distinct from the material it covers.

In a later article entitled 'Ornament and

Crime,' published in 1908, Loos condemned the use of decorative motifs and symbols on a building facade, likening them to the body-painting of primitive man. The undeveloped mind of the savage required him to use color and decoration to distinguish himself, whereas modern man, possessing a more subtle and refined mind, uses clothing to conceal rather than reveal his individuality. This distinction in the primitive and modern use of dressing made by Loos was an important shift in understanding the role of the facade: it was no longer a 'neutral canvas free for every conceivable type of decoration,'⁷ but an element that mutes or masks a building's presence. In Loos's personal work, the exterior of the building is stripped bare of any ornamentation or rich cladding, leaving simple and abstract modern forms. The interiors, however, are richly covered with textured surfaces but without unnecessary ornamentation.



Transparency

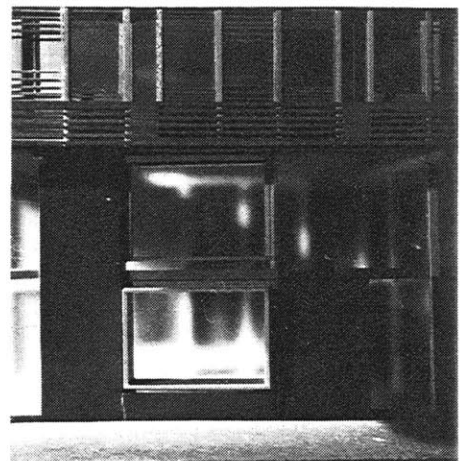
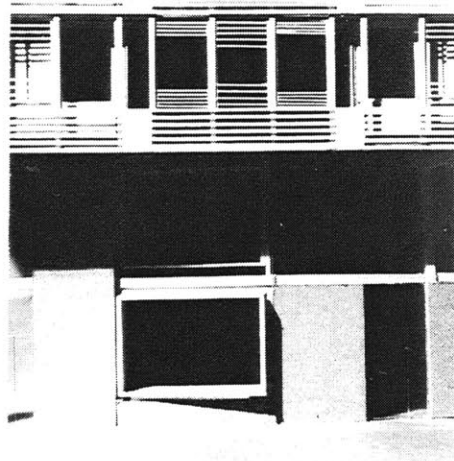
The modern technology of steel framing and plate glass allowed the exterior building wall to become transparent, leaving the private realm of the interior vulnerable and exposed. In addition, the tectonic element also became transparent, naked and open. This phenomenon was, in part, responsible for prompting the theories and work of such architects as Otto Wagner and his followers. With the advent of modernism, transparency became part of a social agenda to redefine the realms of the individual and

society. The phenomenon was interpreted by Siegfried Gideon as the 'simultaneity of inside and out.' Private life and the public sphere could become one and the same, with individuals carrying out their routines unmasked, vulnerable and bathed in light inside transparent boxes. Transparency also resulted in a different perception of space, one that Moholy-Nagy described as overcoming the fixations of space and time, allowing a simultaneous reading of superimposed orders and layers.

In an article entitled 'Plate Glass,' Richard Sennett discussed the ambiguous role of a glass skin resulting from its dual nature of being both transparent and reflective. It allows a visual violation of the interior space and yet encloses and protects. The glass skin, acting as a 'field on which the exchange between inner and outer occurs,'⁸ is both a mirror to the world and a mirror to the self. Unlike walls constructed of natural materials, the transparent facade becomes

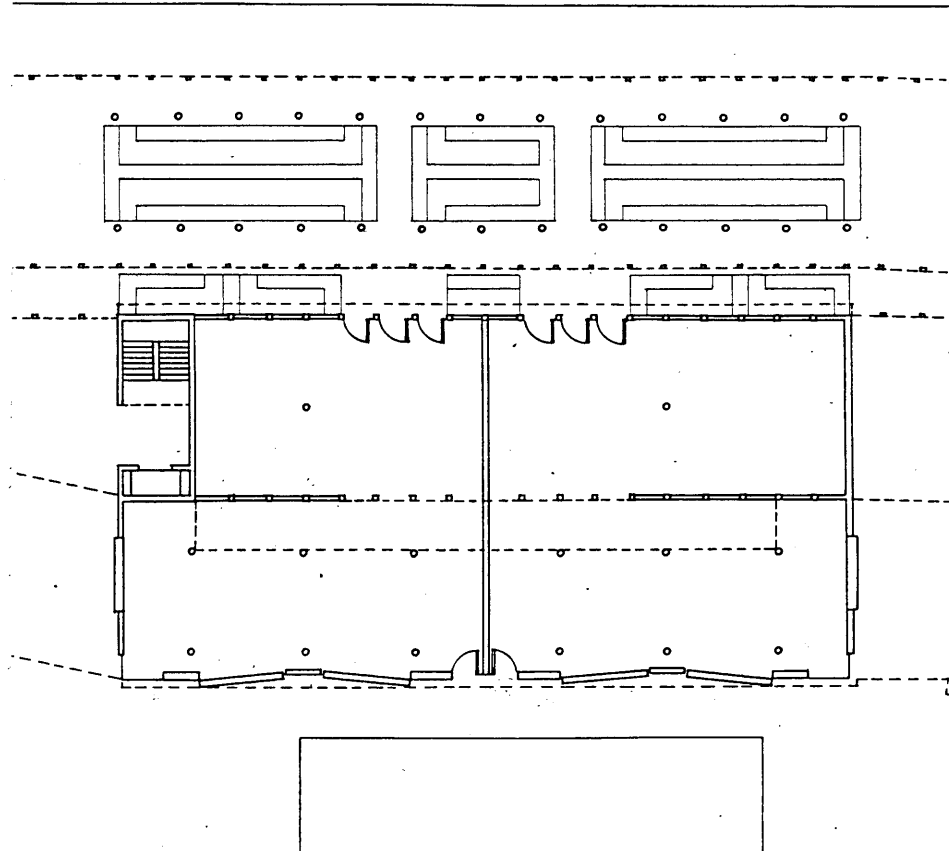
a metaphor of both emptiness and reflection. Complete transparency renders the interior naked, playing a role of revealing rather than concealing. By its mirror-like behavior, glass is no longer a mask or a veil to an object, but a device that holds and equalizes images of the inside and the outside on a common boundary. The act of looking becomes an act of self-reflection at the same time.

The qualities of glass were exploited in the construction of the building skin. Under different conditions of light, the mask would reveal or conceal the elements behind it.

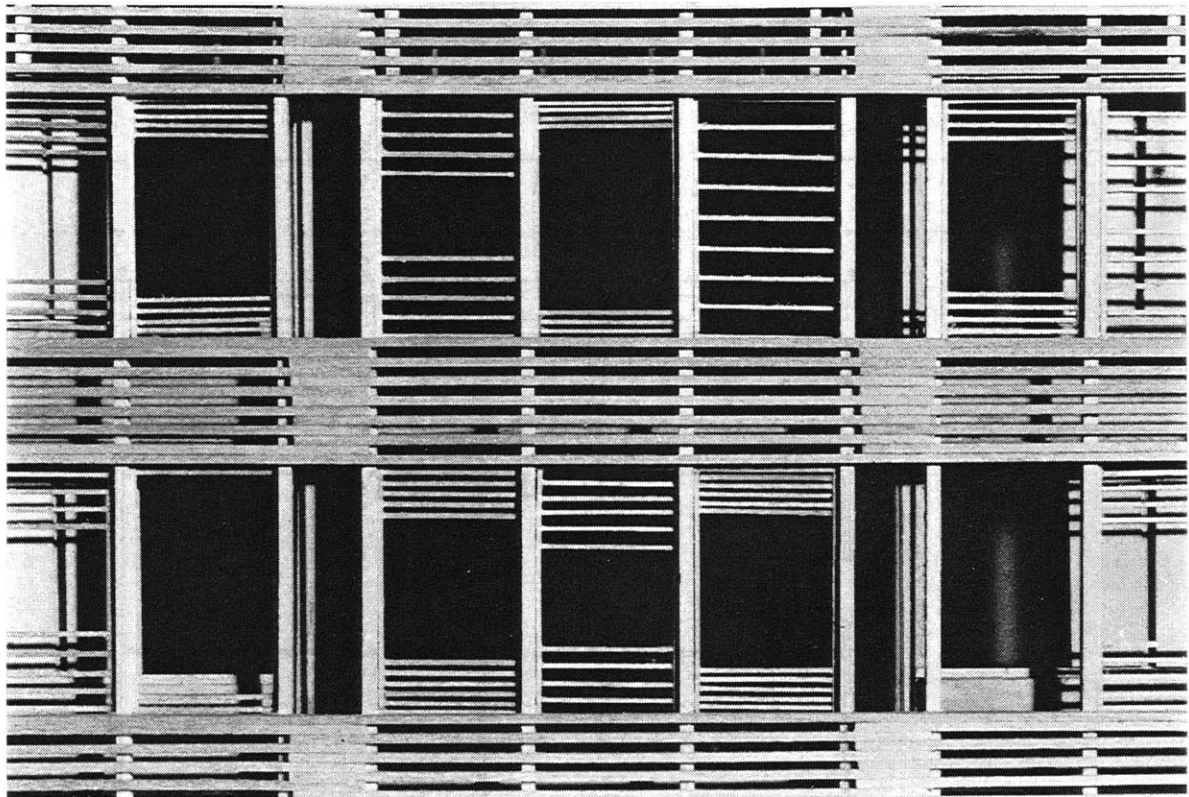
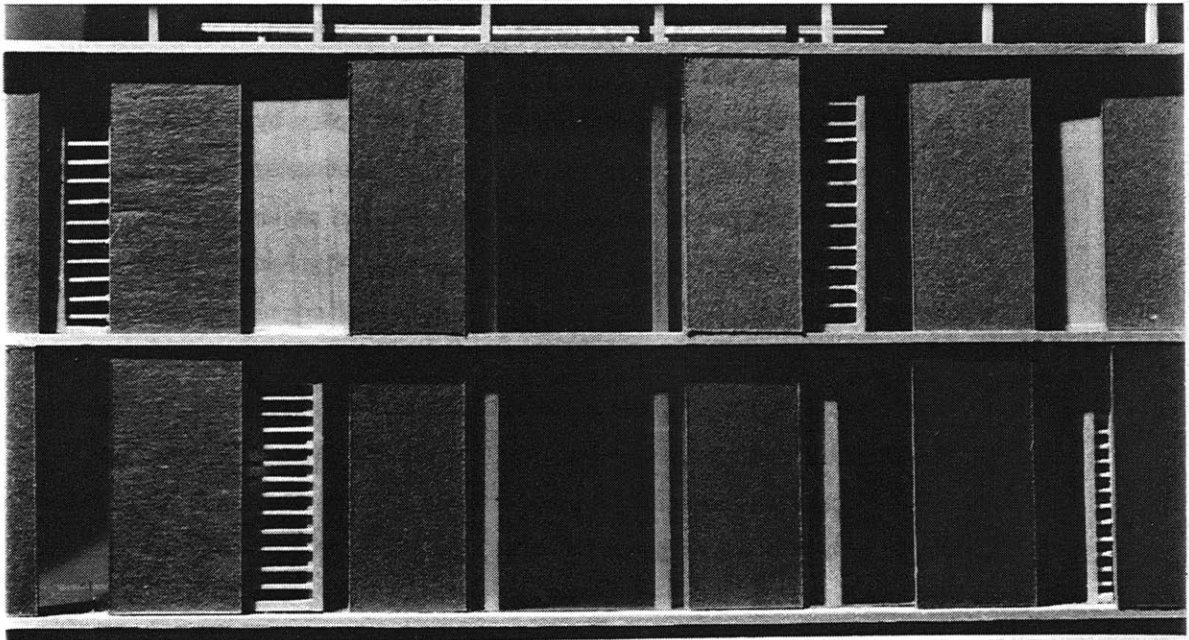


Interpreting the writings of Gyorgy Kepes, Colin Rowe and Robert Slutzky identified a distinction between a literal and phenomenal transparency, the former being a material property and the latter an organizational one. The overlapping of spatial orders and locations creates a transparency of relationships which, unlike a material transparency, 'ceases to be that which is perfectly clear and becomes instead, that which is clearly ambiguous.'⁹ Moholy-Nagy, echoing a similar understanding, discussed the effect of superimpositions,

'transposing insignificant singularities into meaningful complexities' and building up a 'completeness by an ingenious transparency of relationships.'¹⁰ The act of veiling or masking an inner set of values and principles also becomes a matter of composition and organization. Concealment is achieved by a dynamic layering of spatial elements which results in a fuzziness and a multiplicity of readings. Veiling is achieved not only with a two dimensional skin element but also a series of transparent and overlapping orders.



A phenomenal transparency was achieved by juxtaposing different orders of column grids behind the building skin.

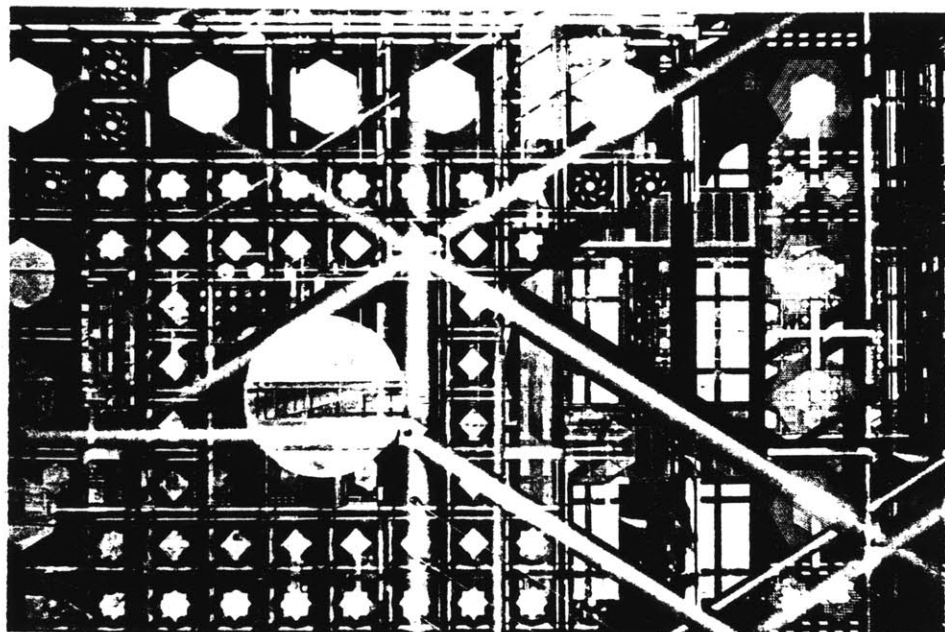


Operable devices such as shutters and blinds were used, allowing the skin to adapt dynamically to the changing environment.

Skins in the Information Age

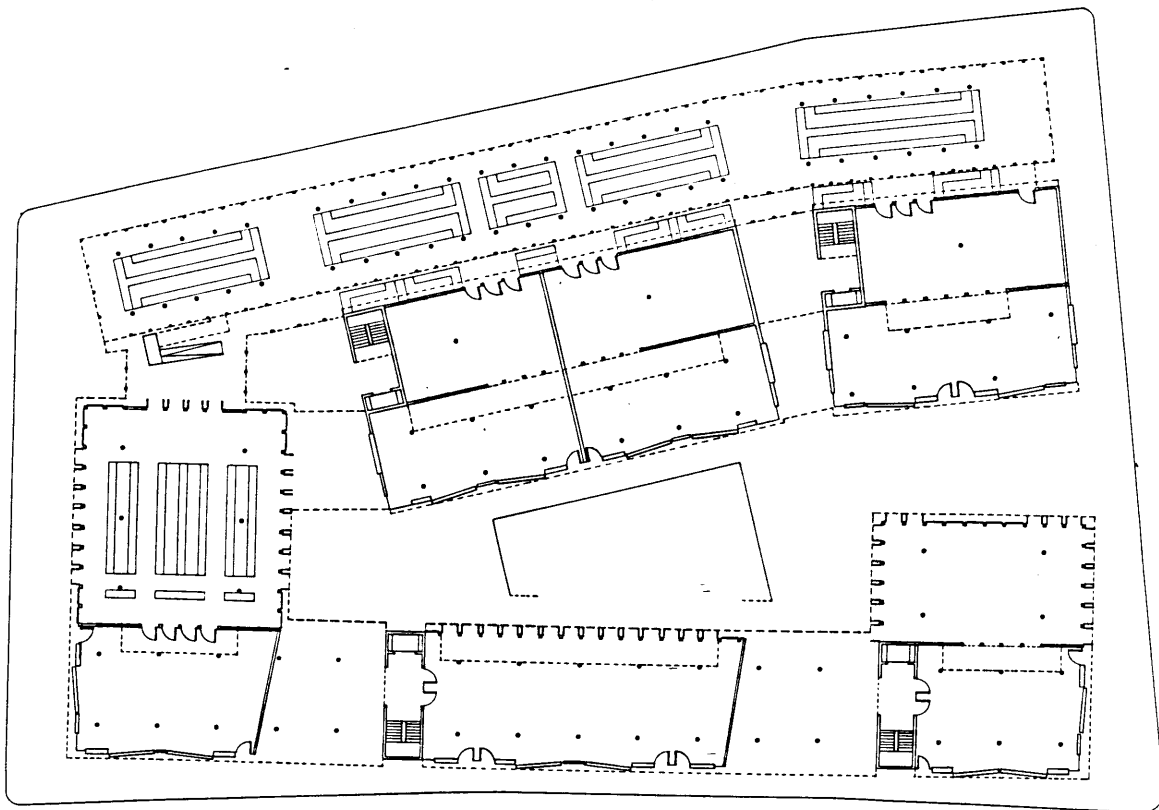
In an article entitled 'Objects and their Skins,' Ezio Manzini discusses the contemporary resurgence of interest in the nature of surface. The Modern Movement subjugated material qualities of the surface in the interest of pure form. Abstract white planar walls were deprived of any articulation and even windows and doors were made to disappear. Manzini argues that in the information age, the surface is once again taking on a dramatic role in our environment as a result of con-

temporary technological developments. There has been a revolution in the invention of new composite materials and a tendency to flatten and miniaturize. Objects today are 'entrusting a greater part of their expressive capacity and their performance to the surface area.'¹¹The surface can be thought of as a resistive barrier or an interface, playing the role of modulating the exchange of energy and information between the outside and the inside of an object.

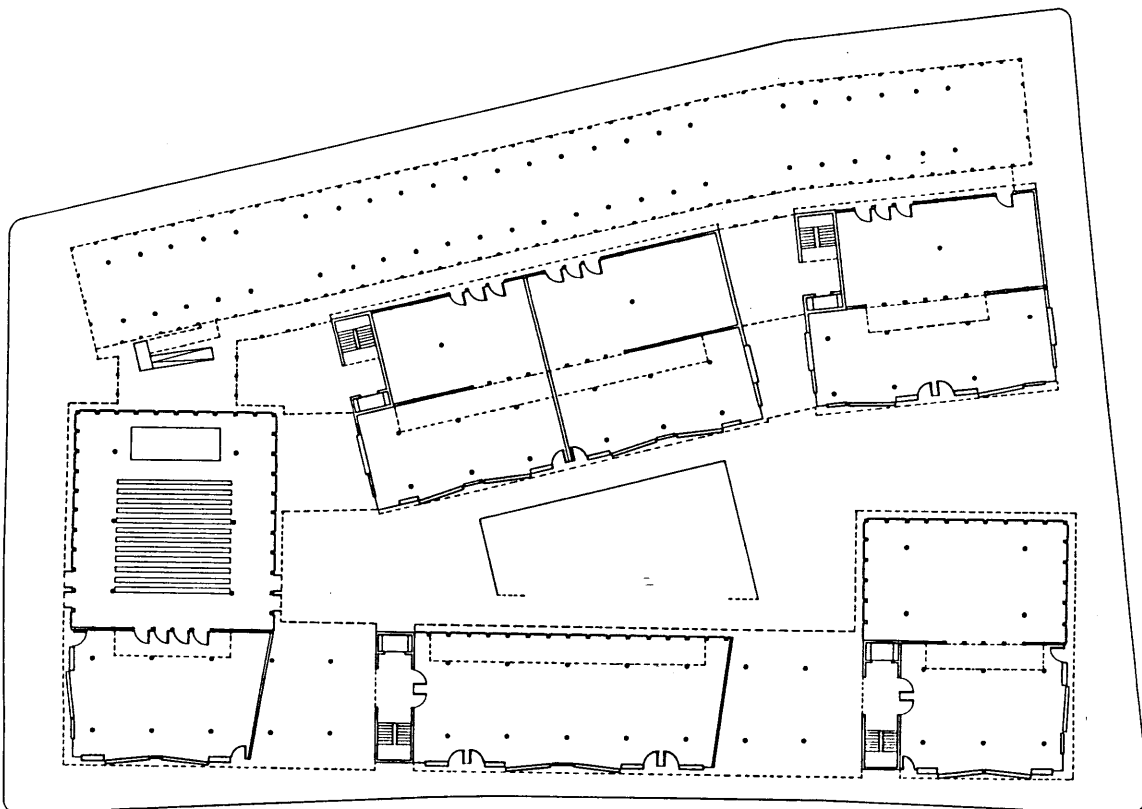


The original textile wall hangings were extremely versatile elements, capable of being folded, rolled-up and removed. Tents used by nomadic tribes were transportable and adaptable to different conditions of openness and privacy. This flexibility was lost when the textile wall was translated into more durable materials. Today, however, with the advent of new technologies and a revived interest in the surface as a reactive interface or membrane, the flexible qualities of the original fabric enclosures can be regained. Skins can be made which are sensitive to the ever changing environment, capable of controlling the

relationship between building and environment in a dynamic and almost organic way. Manzini writes that 'the evolution of reactive and expressive surfaces leads to a whole new generation of sensitive and communicative objects for which the central point of the design is no longer the physical shape but rather the form of the relationship set up with the environment. These are objects that are defined by their 'behavior' and their 'personality', and for this reason, exist on quite a different level from anything that has been produced by man hitherto.'¹²



At the scale of the block, shutters could be opened and closed to accommodate different activities and functions. Illustrated here are two examples: one is a daytime configuration and the other a nocturnal one. The perimeter of the building becomes like an organism which exhibits a behavior in adapting to the environment.



Epilogue

This thesis was an attempt to understand the role of a building skin as an architectural element. With the advent of Modernism, any interest in the closure element of a building was considered superficial and contrary to the tenets of the movement which stressed abstract and functional forms and spaces. The blank and silent modern facades eventually gave way to Post-Modernism and the attempt to re-invest symbolic meaning in the exterior of buildings. It appears that both these movements never successfully addressed the question of the social, cultural and architectural role of the building skin. The theories of Gottfried Semper provide an understanding of the historical and ethno-

graphic origins of the wrapping element and a rich conceptual basis for design.

In the design project, themes from textiles and clothing were used in the conception of the wrapping of the building. The structural elements and the interior spaces were veiled or masked in a literal sense but were always perceivable in fragments. The articulation of joints and elements was intended to reflect those of a hanging textile. The forms of a draped or folded cloth influenced the slightly curved or undulating nature of the skin, allowing a richness of shadows and depth in an otherwise two dimensional element. By investing a substantial amount of architectural interest in

the skin, the interior spaces of the building were allowed an openness and freedom suitable for retail purposes.

One of the lessons learnt in pursuing this thesis was that the skin, although essentially a mask to an inner set of orders, can clarify and strengthen the architectural intentions of a building. The mask is a device to conceal a certain reality or truth but, in doing so, can also reveal certain distilled essences of the object behind it.

This understanding of the exterior element is very different from that of Post-Modernism which sought to embellish facades with themes alien to what lay behind them. Another lesson of this thesis was that skins can take on modern architectural themes and ideas which are usually only invested in the spatial and formal nature of a building. Unlike the blank and silent facades of Modernism, the skin can become an element of architectural interest without being a lie or a deceit.

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- ¹⁰ L. Moholy-Nagy, *Vision in Motion*, Chicago, 1947.
- ¹¹ E. Manzini, *Objects and their Skin* in *The Plastics Age: From Modernity to Post-Modernity*, Victoria and Albert Museum, p.116.
- ¹² E. Manzini, *Ibid.*, p.127

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- p.2 Postcard of Persian Nomads, published by the Sackler Museum, Cambridge, Massachusetts.
- p.6 Daidalos, v.6, 1982, p.71.
- p.16 Gottfried Semper: *The Four Elements of Architecture*, Camb. U. Press, p.29.
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