

M A R K F R E D R I C K R E I S S

A N A B S T R A C T S T U D Y O F
L I G H T
I N A R C H I T E C T U R A L D E S I G N

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T H E S I S

I understand architecture through its manifestation by light. As light pursues the dark, the unveiled evolves into spatial light, shadow, diffused light, form and texture. These five architectural conditions exist separately and entirely, for “without shadow, space has no perceptible reality.” Diffused light, form and texture are the materiality of light and shadow at differing architectonic scales.



I studied the interplay of light, form and space in architectural design. I focused my attention on an abstract study; I examined conditions that exist, proposed a finite set of universals, and explored the application of these universals in architectural design. This abstract study enriched my design ethic by providing a foundation for continuous study and development.

It empowered my thesis to differentiate among the experienced qualities of light. Divisional analysis does not undermine nor trivialize an experience or existence. Rather, it dissects, explores and reconstructs. Categorization in itself is not truth, but it does enable a discourse for enlightenment.

“An experience has its constituent elements, but the total experience has a reality which is in itself individual (and not simply the sum of its members). Hence the division of the visual environment into categories is somewhat artificial. However, it is a useful device for gaining insight into the situation. Although it must be remembered constantly that while each element has its own reality, it is linked in many indefinable ways with all other elements in producing the total experience.”

Leslie Larson

L I G H T S T U D Y



S P A T I A L L I G H T



Light gives us the ability to see and shadow gives us the ability to see in perspective. Without shadow, objects are flattened and space is condensed. Shadow is a visual message of space, but there are other cognitive readings which articulate spatial realization. The size, position and familiarity of objects also aid in determining spatial relationship and perspective.

Rene Magritte juxtaposes and contradicts visual information to heighten spatial awareness. In a documentary by Luc de Heusch, Magritte comments that "...there is no necessary connection between a thing, an object, or even its name." His perspectives succeed through shadow and object relationship, and question preconceived notions of space from the size, position and familiarity of objects. [Page 5]

Since space itself cannot be illuminated, its immediate existence is sensed through the illumination of objects, and the perspective of these objects is enhanced through shadow. The objects are visible as they reflect differing degrees of light, revealing their form and texture. As objects decrease in size and light becomes more intense, the objects lose their individuality and light exists spatially, as a three dimensional object.

The materialization of light evokes awe, it is at once intimate and distant. Even if defined as illuminated dust or moisture, light as object is still air we breath, air we walk through, air we see. A beam, a wedge, a wall, a sliver: descriptions of light in three dimensional form, light that has absolute existence. Although light has no perceptible weight, it has sensory mass that has architectural significance.

As a natural agent that bonds architectural elements, light captivates and enlightens. The visible light leads the eye to the aperture, the design intervention that sculpts the light. The aperture translates the light into human scale, an understandable and tangible piece of an incomprehensible and indistinguishable whole. The light takes on the form of the aperture in section and is extruded as it pursues its natural course. Through this extrusion, the light form connects the aperture to the column and to the floor. It connects the outside to the inside, the infinite to a flirtation with the finite. It is separator, link and unifier. It defines the extent of the interior and its relationship to the exterior. [Page 6]

Light displaces space and becomes an architectural element. It may be a beam, a column, a wall. It is possible to walk under light, around light and through light, a penetrable obstacle sensed by vision and sensory touch. It is also possible to enter it, linger in it and leave it, in the architectural aspect of a space. Le Corbusier designed wedges of light from which the Monks give forth prayer and song in the Monk's church at La Tourette. Light as absolute light defines the dimensions of a space and provides a space within a space, definition within definition.

The captivating aspect of light is its elusive ability to structure a space without being structural. Its refined existence is created through architecture, but architecture cannot retain it. Light arrives, brightens, fades, and departs; a beacon embodying Foucault's pendulum, gliding along while touching, painting, scorching. Light signifies time and timelessness, rejuvenating a space whilst reminding us of our mortality.





S H A D O W



Shadows are a visual metaphor of the time and timelessness of light. The morning shadow is veiled in dew and fog, the midday shadow is well defined and close to its object, and the evening shadow is outstretched, extending toward the eastern horizon yearning for rebirth, the remaining sign of life before darkness. And as the season moves from birth to sustenance to death to rejuvenation, shadows shorten and then lengthen as light recedes. Shadows are the hands of time.

From infancy to old age, shadows live for their day in the sun. That glory comes when time is maintained by the sun and earth is most apparent, when days are short and shadows are long. The sun hovers above the horizon, its light skimming the earth's surface. Rocks, trees, water, any reveal or elevation, are exaggerated, their shadows reaching for individual existence. Texture of and by the earth. The shadows are stretched from the object to the point of maximum strain. They seem to long to envelop the earth, hands trying to secure a stronghold, fingers grasping for one blade more. At the end of the day, the shadows stretch eastward as if to cage the sun when it rises the next day.

The winter solstice is the culmination of the sun and earth becoming one, when light, shadow and object are experientially unified. A latticework of death, hope and birth. The sun's nature

to initiate light and life is waning, but it remains above the horizon, awaiting its reemergence into dominance. And the earth, whose essence and life is memorialized in the shadows of its skeletal trees and sparse landscape, is a ghost of what was and the soul for what will be again.

There is a complementary balance of light and shadow that is maintained throughout the year, a crescendo that reaches its zenith during the winter. In the spring and fall, the crisp air and light and shadow present an austere canvas for birth and death. During the summer, when life is sustained, light and shadow is nondescript and may even take on a pragmatic dimension: the need to escape from the one to the refuge of the other.

At any time of the year, shadow defines a space in much the same way as light does. When used as a refuge, this spatial shadow even has a name: shade. The three dimensionality of a shadow is identified by its boundaries, from the object to the elements its shadow is cast upon.

For example, the photograph of Mies Van Der Rohe's German Pavilion in Barcelona, a place of surfaces, planes and volumes, reveals shadow as space. The photograph is divided diagonally by a wedge of shadow and by a wedge of light. The two walls and the floor of the reflecting pool clearly show three sides of the wedge. The camera is within a fourth side, and the diagonal that traverses the back wall and across George Kolb's sculpture is not a line but the top and fifth side of the wedge. The perceptible spaces between the camera, statue and wall, reveal the depth of the wedge. These dimensions illustrate the spatial existence of a shadow. [Page 9]

Spatial shadow, as with spatial light, is a space within a space. There are walls and a roof in a shadow, all penetrable thresholds between dark and light; a transparent structure that gives a sense of enclosure and shelter, a room to look out from and to peer in to. In addition to the sensory experiences of crossing a threshold, feeling enclosure and looking out from within, the shadows harbor physical differences such as cooler temperatures and reduced glare.

In addition to temperature and glare, color and form are transformed in the shadows, flattened and subdued by their entrapment. The skeletal color and form a glimpse into the object's soul. This is the filter through which black and white photography deciphers and orders a world of color.

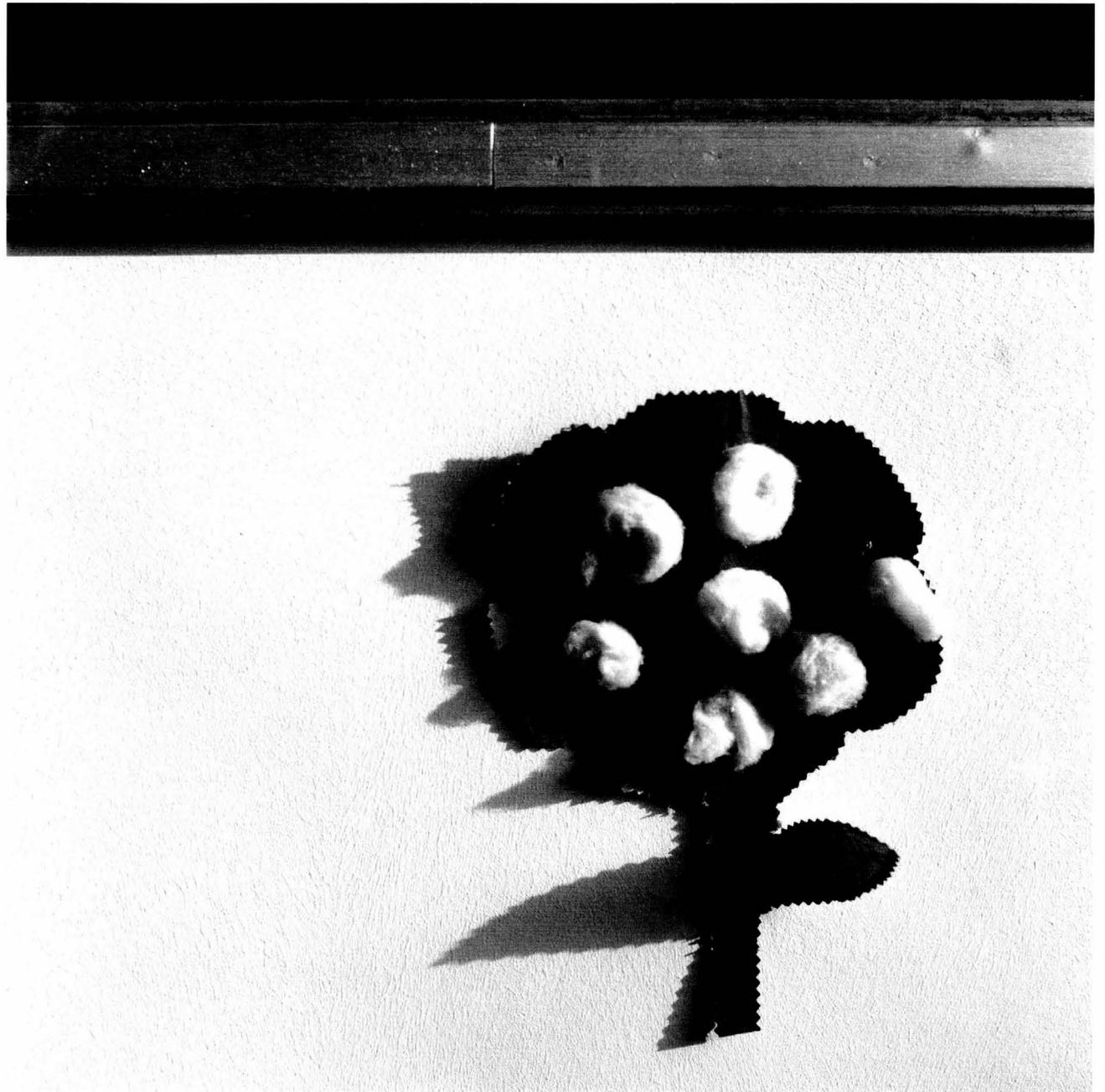
The shadow of an object is an inherent aspect of that object's form. When a shadow is not visually separated from its object, the object and shadow create an integrated form in which the shadow has as much object-ness about it as the object does. Together, the object and its shadow are transformed into a new entity, an existence which the object alone could not have obtained.

An example of this transformation is how an ominous character is typically revealed in film noire. The lighting is high contrast and from a low vantage, and the actor's shadow is given an element, such as a wall, to be cast upon. The shadow becomes an exaggeration of the character, larger than life and projecting intimidation and pending doom. Instead of giving existence to the wall, the shadow is perceptually separate from the wall and incarnates the character. The actor and shadow give form to the character, a form that is multi-dimensional: dimensions from the actor and a dimension through the shadow.

A shadow is a cross section of its physical dimension. Not only does this footprint reveal a relationship between light and object, but it may also give form to another element in the space. When a shadow is visually attached to its object, it transforms the object, but when it is visually detached, the shadow reveals the object and unifies the space. The detached shadow, object, architectural element and space remain autonomous and in unison. In contrast to light that links outside to inside and aperture to floor, shadow links object to floor, object to wall, and the space about these elements.

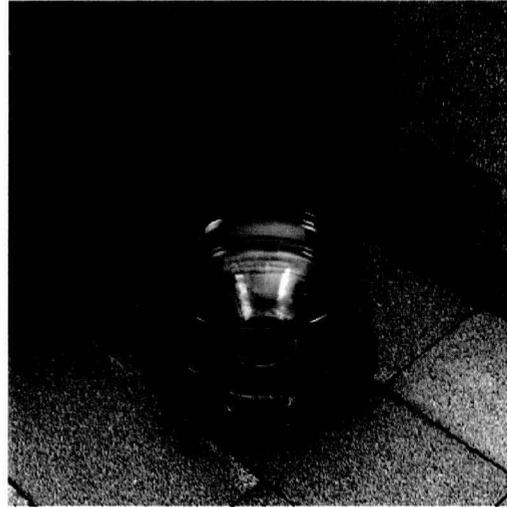
The shadow reveals and unifies the dynamics of a space as it exists between beginning and end. The object's materiality is expanded to include the projection and reception of its shadow; the object exists in and of itself, beyond itself through space, and as part of the architectural element its shadow is cast upon. The element receiving the shadow becomes a terminus for the spatial extension of the object, and for at least that moment, its hierarchical existence is advanced as it becomes a painted canvas for transient realities. Shadow reveals form: the material form of an object, the hierarchical form of an architectural element, and the structured form of a space. Light, object, architectural element and space are necessarily connected through the shadow on the canvas. [Pages 5, 10 and 11]







D I F F U S E D L I G H T



The dimensional and structuring properties of light do not only exist through autonomous light and autonomous shadow, but also through diffused light. Diffused light is the fusion of light and shadow into an ambient whole, where elemental form absorbs strong light and returns it as soft shadow. It is a space of gradual tones where light and material flow into a spatial unity, where form is of the whole and of the individual, where boundaries are not definitive, and yet thresholds are conclusive.

Diffused light unifies a space, not in the visually structural sense as with dimensional light and dimensional shadow, but rather in the experiential sense. In diffused light, the elements, including space and light, are so intertwined that any introduction is a momentary intrusion. A person first experiences this space as being separable from it, an outsider looking in. But then the diffused light permeates and envelops the new order, and its contents are once again inseparably fused. The space, light and form are experienced from within. Questions of materiality are answered with respect to the whole and not elementally. The entire space has a coherent dimension that exists between the walls, which creates a significant threshold to what exists beyond them, a threshold between timelessness within and dynamic time without.

Light and shadow, in relative isolation, each have time specific qualities, yet fused together they produce a quality that is devoid of demarcation. This timelessness quality of diffused light may be likened to the light during dawn and dusk, when the pervasiveness of the light veils its constant change, a change in hues and tones, not a change in the length of shadows. This pervasiveness envelops everything, and from within the change is imperceptible, perceived only when the threshold is crossed, when dawn gives way to the day and dusk to the night. Diffused light within architecture eternally encapsulates the dawn and the dusk and timelessness.

The threshold of time awareness stands between a space that is sheltered from light, shadow and time, and a space that is exposed to it. The architecture of diffused light shelters structurally and experientially, integrating everything between its walls into the architecture of the whole. An occupant is not an observer but a participant. Crossing the threshold from the spatial dimension of diffused light to the unbridled light beyond is disconnected, and not because of the height of the ceiling, or the distance between the walls, or the change in the floor. It is disconnected because the architecture of diffused light comes as close to creating space, as opposed to defining it, as is humanly possible. So this threshold exists between two nearly autonomous spaces, the inside and the outside.

The experience of cohesion through fusion of light, shadow, space, form and person does create a world seemingly independent of the outside world. This fusion is self-perpetuating, and once established, does not need external interaction for sustenance. The world within the architecture appears as such because it is complete and independent, crossing the threshold to the outside is a humble reminder that the autonomy within exists within a larger autonomy. And the larger autonomy, the outside, now appears as incomplete, the experienced is a section in time in comparison to the experience of timelessness inside the architecture.

Crossing the threshold to the inside is entering spatial equilibrium and spatial silence, a balance among light, shadow and form, any sounds are born of the architecture. Only the threshold contains the tension that exists between inside and outside. The dimensional space is disrupted by entering it, but the architecture absorbs the disruption and the displaced becomes the new order, the complete becomes more complete. It is like a pebble thrown into a pond, even though stillness returns, the pebble exists below the higher surface.

The cohesion that creates the autonomy within the whole results from the interaction and transformation of the primal light elements. The fusion of light and shadow dematerializes texture and enhances form. As texture and materiality is de-emphasized the essence of the architectural elements, and hence the space, exists and persists. Form is in the mass and form is in the absence of mass; the form of space is fused with the form of the elements. Dimensional light and dimensional shadow may saturate, but diffused light inhabits, penetrating the texture and bonding space and form. [Page 14]





Light materializes the volumes, voids, planes, curves, lines and mass of form. As the light changes, so changes the form; the type of light may intensify, subdue or transform the form's quality. Take for example, the form of the courtyard at La Tourette. It exists. It exists in strong light and it exists in diffused light, but it seems to revel in strong light. The courtyard is like a stage on which the forms of light, shadow, volumes and voids perform a seemingly serendipitous play as the sun moves across the sky. Under the auspices of diffused light, the volumes and voids have taken their place on the stage, their form unquestionably present, but they seem to anxiously await the raising of the curtain.

Form is generated through constructive light, material and thought, and its materialization distinguishes it from shape. Shapes readily exist and light is one of the design tools to enable shape to take form. Primarily through shadow hues, the dynamics of dimensional light and shadow, and the hierarchical emphasis on material as form and corresponding de-emphasis on light and shadow as object, light responds to transforming shape into form.

The use of light in architectural design may express form at any scale. Diffused light defines the entirety, bonding space and form; the rhythm of light and shadow gives form to architectural

conditions structured by individual elements; the smaller scale design of light and shadow is ingrained as surface form; and from chance light to precision light, otherwise non-dimensional existence is given metaphysical form. Viewed from afar or intimately (the two extremes where form may be esoterically discussed as texture) and in between, form through light has relevance to its architecture beyond its scale.

The definition of space and mass as form through diffused light is an engrossing, large scale design. Form is cognizable amidst diffused light because design considerations not necessarily critical to the essence of form, such as color, texture, and dimensional light and shadow, are visually subordinate to the formal structure, engendering visual form. In addition to the visual, the form exists personally and physically. This is an encompassing range of perceptions because there is a strong sense of inside versus outside, and because the forms are evoked by toned masses and a definitive line between space and material. It is this line, the joint between light as form and material as form, that makes the architecture of diffused light captivating.

A mix of light and shadow defines form at scales smaller than that which a fusion of light and shadow, or diffused light, defines form. A rhythmic structuring of light and shadow may define and clarify architectural events composed of architectural elements. The congregated shapes of columns, walls, floors and ceilings may take on form through light under otherwise benign conditions. Form readily exists in a living state, so its cognition is experiential as well as visual and physical, whereas shape primarily has a visual and physical existence.

For example, the corner of the west portico of the Pantheon in Paris is transformed from a grouping of architectural elements into an architectural condition as the sun settles in the western sky. The plan of the portico garners dimension as the columns and steps are awash in light and shadow; it is transformed into a corner pulsating with elements, space relationship and form. The elements exist in plan and in space, but only through light do they reveal their relationship as a corner. Individually, and in necessary light, the elements may have form, such as the tonal expression of light wrapping around a fluted column, but through designed light they import their relevance and contribute to a larger order, giving form to the corner. This corner gives to the street as it gives of the architecture, displaying its form as light is shed on an otherwise extruded plan. [Page 17]

Another example of an architectural condition realized through light is the entrance to a Gothic cathedral. The ribbed threshold functions like a series of speed bumps, slowing down the light and controlling its entry into the hallowed space. In part, the form of the threshold is in its physical dimensions, but more so, its form is born of the articulated surface that harnesses the light and the act of doing so: the material, the light and the shadow. Individually the ribs have shape, collectively and in the context of the whole, the ribs become a threshold that has form. [Page 18]

An attribute of form is that it is inherent in the architectonic relationship of the part to the whole. And it is the use of light in architectural design that articulates this consistency. This is most apparent at the small scale design of surface form. Surface form is distinguished from texture in that it is integral to the architectonic form of the whole. [Page 19]

Scarpa's cemetery at Brion is an example of this design in modern architecture. The sculpted surfaces at Brion design the light as it falls upon them, transforming the skin into saturated material, light, shadow and form. The light constructs the material into form while breaking down the architecture to its most intimate scale, making it visually and physically tactile. The integration of the surface into the progressively larger scales of the design gives it intellectual form through its critical being, like the smallest of cogs in a precision timepiece. Scarpa's architecture may be entered through many different scales, and one of these scales is the form of the surface. It is this relevance that elevates this small scale design to form. [Page 20]

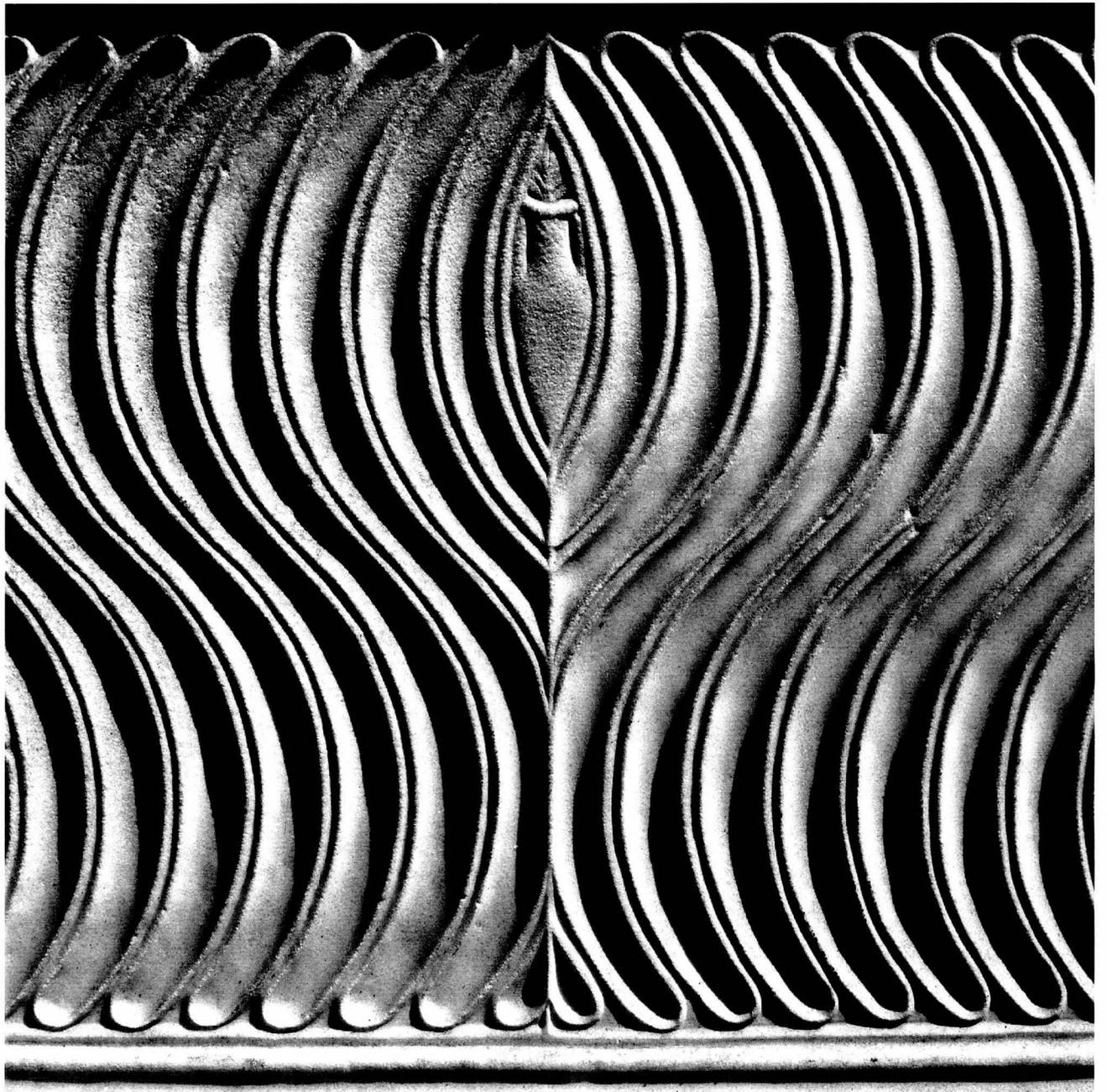
In addition to revealing the visual, physical, tactile and philosophical properties of form, light may also unveil a metaphysical facet of form. While working the material and the space, light may unlock the essence of a coming together of dimensions. It is the adage, the whole is greater than the sum of its parts, where light transforms the sum into a whole and we perceive it metaphysically.

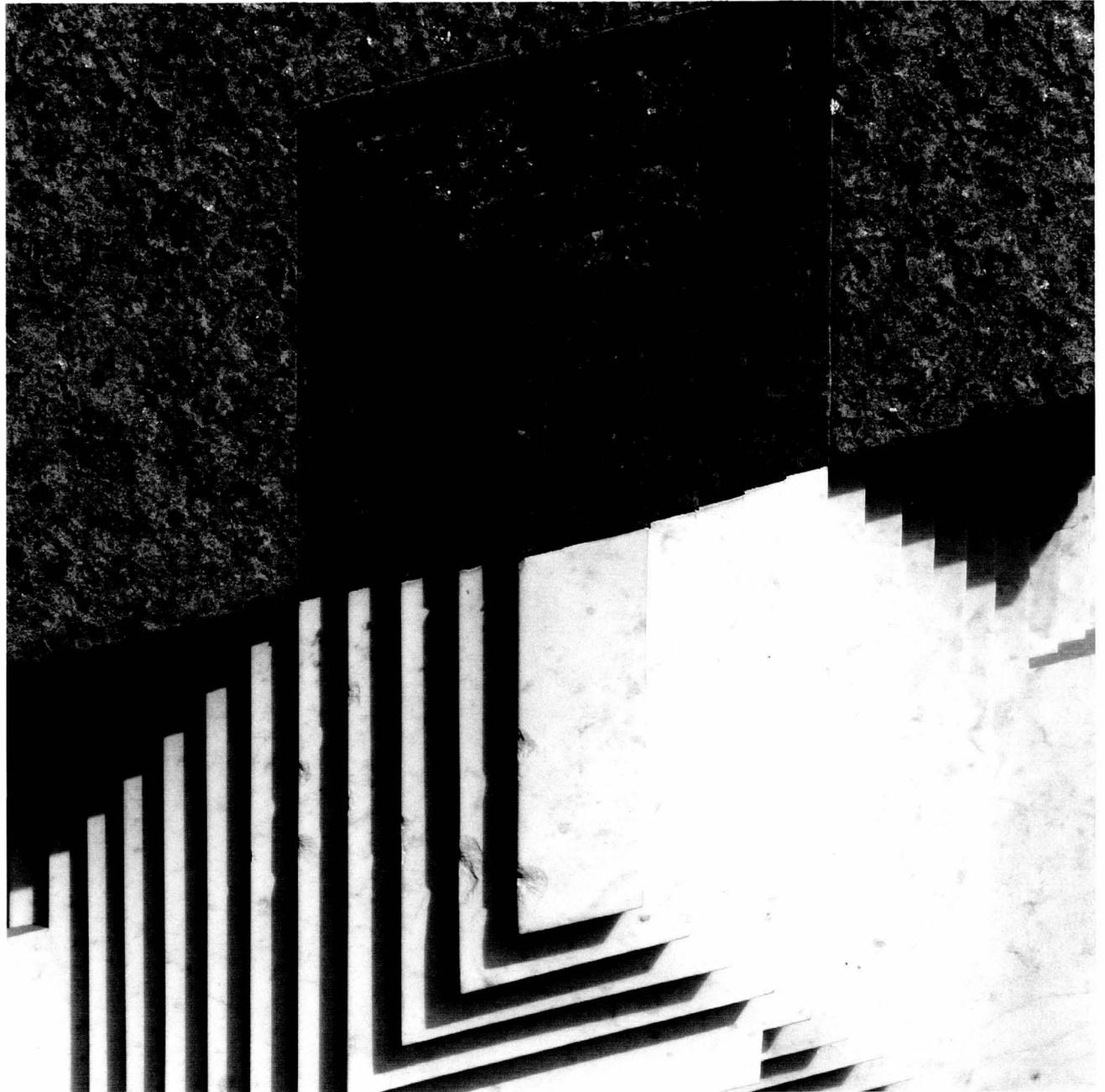
For example, photojournalism approaches art when an elusive, non-dimensional personality, emotion or event of a three dimensional reality is captured, not only recorded, in the two dimensional medium. That image is metaphysically structured through form; its visual structure and historical reference do not rationally explain its synergism. [Page 21]

Like the medium of photography, light reveals the non-dimensional by capturing its form at a point in time. A benign existence is transformed into a dynamic essence. The control of light in architectural design presents form at many scales and through many sensations, offering insight into our own existence. Form cannot be devoid of light, not only does light give us the ability to see but also to understand.











T E X T U R E



Texture is the layer of design between space and form. Esoterically, just as the micro and macro scales of form are textural, the converse holds true, the micro and macro scales of texture are formal. In between these extremes, texture may be differentiated from form, primarily surface form in three ways. Firstly, texture has a different set of scale issues as it relates to the architecture; secondly, it is not critical to the form of the whole; and thirdly, its cognition is tactile and visual.

The scale relationship of texture to the architecture pertains to the visual massing of the texture surface in the context of the whole, the form of the texture in the context of its individual scale, and the surface of the texture in the context of its repetition.

The visual massing of the texture and the vantage from which and the context in which it is viewed determines whether an element is textural or formal to the architecture. In order to clarify what may otherwise sound like an exercise in semantics, take for example a brick wall. At the scale of the wall, its texture comes from the form of the brick, not the texture of the brick. At the scale of the brick, its porous exterior is surface form and not texture, because the surface is a direct object of the making and is formal to the brick. Brick-like texture would exist as a surface at

a scale larger than that of a conventional brick. The semantics are governed by the human scale perception of light's effect on surfaces and a perception of the material.

Texture takes on form at its smallest scale where it should be designed. At the scale of the individual textural component, light, shadow and form define the texture. Through the formal arrangement of concavities, convexities, cantilevers and evenness in micro form, light partially becomes shadow and hence texture. It is this projection, entrapment or elimination of shadows that we perceive as texture and its materiality we recognize as texture.

The perception and recognition of texture occurs as the formal texture is repeated and its scale is increased. At this larger scale and through its repetition, the texture makes a surface. It may be smooth or rough, subtle or abrupt, consistent or dynamic, free flowing or patterned. Figuratively speaking, the surface may be skin deep or it may have sectional significance through the architecture. Texture complements the walls, floors and ceilings of a building as its skin. There is a necessary layer or surface to every architectural element and the recognition of the opportunity to design this layer through light, shadow and perhaps another material is texture. Since texture is either an obstacle to light or a clear path for it, its design is relevant to the architecture and its perception.

Matter gives light human scale. On the exterior of a building texture is the initial design intervention to break down the scale, to make light appear as a precious necessity as opposed to a natural excess. On the interior of a building texture further controls the course of light and its enhancement of space and material. From exterior to interior, texture is representative of the architecture and should be elevated from a passing experience to an architectural condition. At Ronchamp, Le Corbusier engaged texture to give form to light making the light comprehensible, intimate and divine.

The stucco-ed exterior walls and window wells of Ronchamp harness the unbridled light and give it form before it is allowed to pass into the chapel space. The exterior stucco acts as a light threshold, similar to the ribs of the threshold of the Gerona Cathedral; when the light encounters the walls it is confronted with the expansive and oversized stucco, each a micro mountain in the light's path. Altered but undaunted by the exterior stucco, the light then flows into the window wells where it is again confronted by the stucco on the inside walls of the deep windows.

This filters the light at its extremities, intensifying its core and its soul. When the light finally enters the space as a beam, it is at a scale relative to humans, with an essence relative to inspiration, and in a form relative to worship. That wall of architecture puts light through its own pilgrimage to Ronchamp. [Page 24]

Unlike the many faceted dimensioning capacity of form, texture is cognizable primarily visually and tactilely. And if the light does not reveal the texture, than it does not immediately exist visually and only memorially exists tactilely. Whereas the dynamics of light unveil texture one minute and conceal it the next, the dynamics of light may change a form's quality, but the form does not necessarily lose its form-ness.

During the time when the texture is unveiled, and through cognizant retention when it is concealed, the light and the memory of light make the material tactile. Light makes the soothing, rhythmic, tingling textures irresistible. The hand touches without the conscious thought of its movement. It is a natural experience, the coming together of two acquainted surfaces: the human skin and the skin of the material, light and shadow, made by the human hand. The light has etched its path in the material, and the mind, through the hand's fingers, follows the path up and down the hills, through the valleys, over the cliffs and across the plains. The light has made the material recognizable as texture, and the retouch of the human hand makes the texture tactile.

Aside from the visible aspect of texture that makes the tactile apparent, its visual dimension also expresses the nature of the architecture. Texture, the initial realization of light in a design, signifies the relevance of light in the manifestation of the idea. This is evident in the capacity of texture at Ronchamp. Frank Lloyd Wright manipulated the form of the reveals between bricks and brick courses in order to design horizontal shadows and accentuate the horizontality of the texture of the brick wall. At the German Pavilion in Barcelona, Mies Van Der Rohe used polished marble walls, allowing visual texture and subsurface tactile texture but disallowing the surface tactile texture that would impede the light as it flows through the open plan.

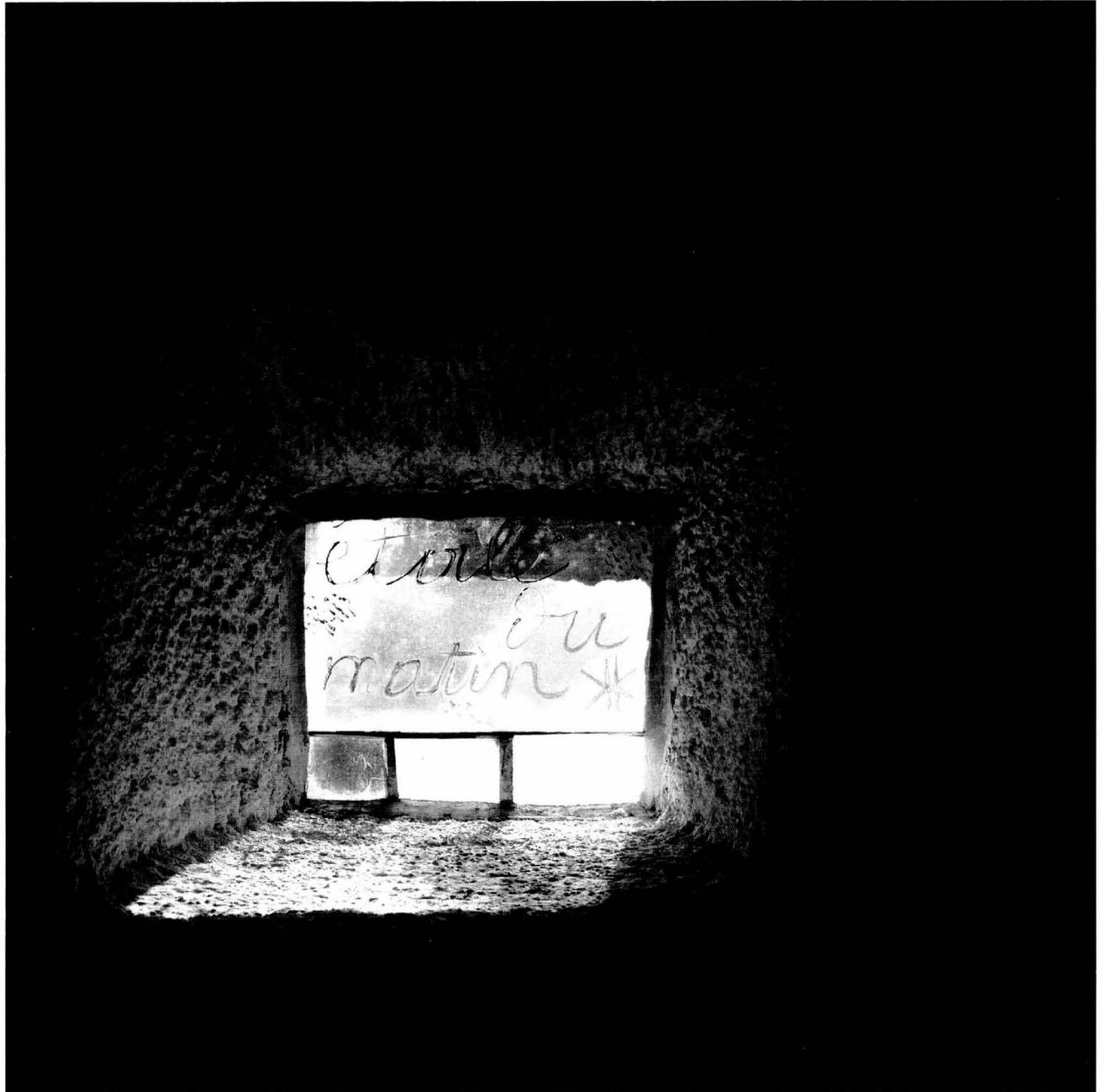
Visual texture is an element of time and of place. As light and shadow respond to the unfolding day, a building's texture is gradually constructed and dismantled, imparting visual references in perpetuation, Generally, in order for the reference

to exist, that is, to have made an impression, the light and material must have brought forth an insight for the person, the place or the architecture. It is the realization of the life a building does live and the realization of the dynamics of perceived constants: the static material exposed to cyclical light conceived by thought.

The Mashburn residence in Blacksburg, Virginia is one such architectural realization. One hundred fifty-six feet long, fourteen feet wide, clad in corrugated galvanized steel, and rooted in a valley in the Blue Ridge Mountains, it is a wedge of light from the sky and of the earth. The structure is nearly literal – light manifest, it evolves with the day's light reflecting the nuances that arise: sun angle, cloud density, air density, sky color. However, its relevance to architecture, light and texture is not as a barometer, it has a phenomenological, objective existence. At dusk, as the light leaves the valley, it does not leave the house. On the contrary, as the siding darkens the house radiates light from within, and the architecture becomes a dwelling in a place, inseparable from its materials, inhabitants, its valley.

It takes the day's light and life to reap this richness at twilight. It is as if the work and thought of each day is added to a foundation of the work and thought of previous days, and this is added to the foundation of the dwelling. That is the source of the light the architecture is emanating. At dawn, the house emerges from its valley, and a visual separation occurs between dwelling and place. That day's light and life ensure the radiant reunification at dusk. [Pages 25 and 26]

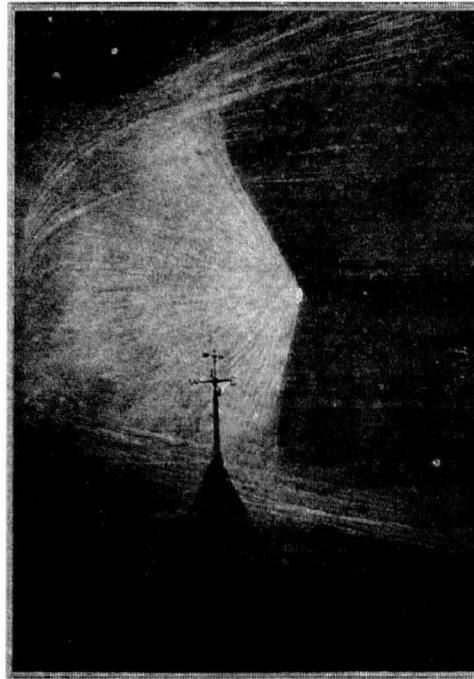
The skin of a building is formal in its entirety and textural within the scale of its design and realization. It is through its texture that it has a relationship with the light and through its form that it has a relationship with its context. At the scale of form, the materiality of texture is less relevant to the context than the tonality of texture, and the relationships within the context are governed by perspective with respect to the tonal components. With a change in light and the accompanying change in shadows within the texture, the form's position within the perspective changes. As tones brighten or darken, the planar shapes progress or recede and become prominent or concealed, coarse or softened, opaque or transparent. Consideration of texture and the use light in its realization has relevance to architecture at scales beyond the immediacy.







A B S T R A C T



When the metamorphic powers of light are consciously inherent in architectural design, the ordinary becomes the extraordinary, the temporal becomes the sublime, the brick of dirt becomes the brick of gold. Left to its own devices, light may transfigure or it may not, but a significant design opportunity has been left to chance. And it is likely that architecture empty of designed light will be more cerebral and less soulful; architecture that exists because of light not through light.

We perceive that which exists because of the sensory dependency of sight on light. Beyond physiology, space and materiality become architectural tools through light. Looking should be elevated to seeing, and seeing elevated to understanding.

“...We were born to light. The seasons are felt through light. We only know the world as it is evoked by light, and from this comes the thought that material is spent light...”

Louis Kahn

Light is as much a building material as are wood, stone and mortar. It is a free but discriminating material: available to all, elusive to many, controlled by few. And light is not captured, but impeded. Through its penetrating, permeating and perpetual nature, light reveals the relationships between form and space.

Light is, just as space is. Neither can be created. Both are omnipresent. Light and space need not be the heart of an architecture, but they are its soul.

Space exists, light exists. Light exists to penetrate space. Light sails through space effortlessly, indifferently illuminating its course and leaving generational light in its wake. Space offers no resistance, only to be discovered. Space cannot be illuminated.

A wedge of light traverses the concavity of darkness. The comet, ice and stone hurled through space; inorganic but alive in its syphilitic journey. This is the extreme contrast: light and dark, matter and void, existence and nonexistence. It is the sun's mass that gives the ice and stone its orbital existence, but it is the sun's rays that make this ice and stone a comet. The sun's rays reveal the comet's spirit, a spirit to which we have given cultural relevance rich in history, religion and art. Construction can be likened to the orbiting ice and stone, architecture to the comet.



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