

Architecture Dynamics

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Abstract

One must not treat buildings as pure shapes, without regard to their practical and social functions. All human needs are matters of the mind. It makes little sense to distinguish between body and mind. Hunger and Fear are on equal footing with the need for peace, privacy, harmony, order or color. Since they are requirements of the mind, they are satisfied not only by ventilation and heating but equally by light, colors, and by visual harmony and proportioned spaces. What counts is the interrelation between functions and the visual expressions derived from them.

Psychologists may point out that the difference between physical and mental needs is less self-evident than it might appear. All physical requirements of man express themselves as mental needs. These needs served by the architects are exclusively mental. The occupants of a building would be hard put to make a reasonable distinction between protection from the element environment, enough light to read, enough verticals and horizontals to satisfy the sense of balance, and walls and floors covered with the colors and shapes necessary to convey, through the eyes, the pleasure of a full life.

Introduction

As we walk in the streets we look to the arrangement of buildings in space and wonder how they are understandable to the human eye. Does their appearance display the spirit of the community? Do they transmit the best of human imagination? Do they have influences upon the psychology of man? Sometimes one feels inspired by the shape of Mohamed Ali's Citadel while driving to Mokattam city in Cairo with its two minarets and cupolas, the inherent poetry of its stone, and its setting amid the crystalline mountains. Inspiring as well are the Giza Pyramids which are surrounded by such generous spaces and sweep up the ramp to the arid desert. These monuments add a dimension of interaction to the relations between man and man-made forms. Such perceptual forces organize visual shapes and the expression embodied in the geometry of architecture with a purity found in the Nile River, so melodiously composed that it is found only in music. One may neglect the shapes of such features, but cannot do without them.

Absence of matter in space can be pervaded by perceptual forces and filled with density which is a visual substance. The effect of emptiness comes about when the contours of the shape do not impose a structural organization upon the surface in question. The observer's glance finds itself in the same place and feels the lack of spatial coordinates, of a framework for determining distances. In consequence, the viewer experiences a sense of forlornness. This occurs when placement of the object has no recognizable relation to its surroundings. For instance, a sculpture placed in an empty hall may seem lost and display a tendency to move to a different place, where it can be anticipated to

find spatial definition and therefore rest; and, in turn, modifies the structure of the setting. Emptiness, however, does not come about only when the visual objects needed to determine the fields of forces in an open expanse are missing. A building is not a solid object sitting on land, it actively displaces space. This displacement remains a permanent feature of the building appearance. It is a dynamic phenomenon that shows up to different degrees depending on the building's shape.

The dynamic effect of Concavity and Convexity

Circular buildings expand into the environment, whereas concave walls open the building toward the urban space. In the latter case the center of the generating field lies outside the architectural structure, which acknowledges the field's presence by yielding to its expansion. These observations go well with what is known about the dynamic effect of concavity and convexity in other perceptual situations. This is an indication that buildings of any shape create fields of forces around themselves, and these fields depend of the form of the generating structures. This means that the masses of buildings as well as their shapes and the distances between them organize the dwelling places of man, both outside and inside; added to these are the effects of the sun, the moon and weather conditions, besides the influence of the force of gravity.

The more circular a square shape is, the more self-contained it is. The round shape has to be accepted as the dominant focus. An interior reveals its typical character, when its walls or ceilings, or both, are concavely rounded. Since convexity enhances figure character, concave boundaries define the hollow of the room as the dominant volume.

Steen Eiler Rasmussen writes that the transition from the Gothic to the Renaissance involves a transformation from an architecture of sharp and pointed structures to one of well-shaped cavities, and that just as the Gothic pillar was enlarged by the addition of niches; and he points to Bramante's plan for St. Peter's, which forms the loveliest ornament of round, domed cavities joined together and expanded on all sides by semicircular niches.

A concave boundary yields to the forces it has itself generated. It provides the expansive hollow space with a maximum freedom, but at the same time this expansion derives its power from the resistance of the boundary. The tendency to expand "says Lipps depends on the size and narrowness of the delamination". While yielding to such an expansion, a cupola responds by closing in on the interior space and compressing it from all sides in a gripping pincer movement. The strength of this restraining force reflects the strength of the expansion it contains.

The dynamics of verticality

Anybody climbing a ladder, a staircase, feels he is striving to overcome a counter force, as weight. Thus the gratification in climbing consists in conquering of one's own inert heaviness. To rise in elevator, is to experience being liberated from weight. In addition, to rise from the earth is to approach the realm of light and overview. This shows the value attributed to the symbolic quality of visual height.

Verticals do not run parallel but converge toward a common center, the center of the earth. It is a matter of relative size and is due to man's sensory limitations. The vertical

direction in buildings defines the horizontal plane as the only one of which the vertical serves as an axis of symmetry. It is the one plane on which one can move freely in any direction without the sensation of climbing or descending. The horizontal style of living promotes interaction, free movement from place to place, whereas vertically oriented living stresses hierarchy, isolation, ambition and competition.

Columns

Classical columns have bases and a capital to block the further expands, upward downwards, of the columns. Such buffers fulfill their function only if they are perceived as belonging column not to the floor. The same is true at the other end; the capitals must be seen as parts of the columns, not of the architrave. Le Corbusier's pilotis are unmitigated cylinders and run visually right into the floors and ceilings, because they neither indicate completeness by their shape nor are supplied with buffers. This effect maybe the want of the supports to be seen as rising through the building, impeded by the floors they cross.

The human mind receives all its visual information about physical space from two dimensional projections on the retinae, and the flat images of plan and vertical section in architectural drawings conform nicely to that limitation of our sense of sight. Genuine three-dimensional conception is essential and that psychologically it is feasible within certain limits, not only in direct perception but also in mental images.

The dynamics of a street crossing

When two streets are unified in a cross pattern, which defines the area overlap as a symmetrical centerpiece. This structural recognizes the visual character of the four corner buildings, each of which was split into two essentially independent and two-dimensional facades, as long as they were conceived only in relation to the linear streets. The meeting of two flat fronts is now replaced by a three-dimensional conception, in which the corner buildings are seen as cubic solids, symmetrical to their protruding edges and to both streets. This spatial restructuring vastly increases the figure power of the corner buildings.

What is the dynamic character of the space created by a crossing? Certainly it is not simply empty. Each of the corner buildings generates a field of forces that advances along the building's axis of symmetry toward the center of the crossing. If these four fields were the only dynamic factors in the situation, checked by the impact of the others. The crossing would be a configuration of four centripetal vectors, formed by the buildings as figure and the center space as ground, the central area would have no boundaries and therefore no shape of its own.

The dynamics of inner and outer shape

There is a physical correspondence of outer and inner shape however not all duplications of an outer shape work well on the inside. The Hagia Sophia cast. In the one instance its outer shape does not work when used as interior, in the other, an inner shape used on the outside looks wrong. The internal hollows of the copulas of Hagia Sophia cannot be compared to one another with respect to size, shape and height.

Wherever a correspondence between outside and inside is desirable depends on stylistic preference. This is found in architectural styles that deviate from parallelism. Simple parallelism reflects little of the dramatic struggle by which the architect must plan the inside and from the outside at the same time two kinds of planning that typically involve different considerations accordingly different shapes.

Compare the roof found in Le Corbusier's chapel of Notre-Dame du Haut in Ronchamp with Soufflot's Pantheon. The chapel is covered by two thin curved shells, the one forming the roof, the other the ceiling of the interior. There is a hollow about two meters in diameter between them, but the two surfaces do not result in a contradictory duplication of function, as do the outer and inner dome of Soufflot's Pantheon. They add up to a sculpturally unified bi-vature.

On inside and outside Robert Venturi writes; Designing from the outside in as well as the inside out, creates necessary tensions, which help make architecture. Since the inside is different from the outside, the wall, the point of change, becomes an architectural event. Architecture occurs at the meeting of interior and exterior forces of use and space. Architecture as the wall between the inside and the outside becomes the spatial record of this resolution and its drama.

The dynamics of the visual field

Visual perception and imagination are not limited to the range of the optical images on which they rely. The sense of vision organizes, completes, and synthesizes the structure found in the particular optical images. In the medium of perceptual space, architecture presents embodiments of thoughts when they invent and compose shapes.

A work of architecture therefore is an object that never has and never will be seen in it's entirely by anybody. It is a mental image synthesized with greater or lesser success from partial views. That image depends on the shapes used by the architect. What can be seen in imagination tends to be less detailed and more generalized, but the mental image can visualize the final product as a huge structure to be seen and used small persons.

In the psychological world of perceptual awareness, the constant factor that makes for a similar difference is the disproportion in size between man and his dwelling place, and because he walks slowly, he builds for himself environments in which the local distances are small. The shorter the distance from a space, the greater the visual angle, which determines the size of the space. Therefore a relatively small part of a space between buildings fills a large area of the visual field.

A regularly shaped road or corridor is seen as converging in the distance ahead. This renders the path more dynamic visually because any wedge shape looks more dynamic than a pair of parallel edges. At the same time, a convergence offers the prospect of a gradual narrowing and ultimate blocking of the road, which inhibits forward progress.

It is only the displacement of the things around us that confirms for the eyes the kinesthetic information of locomotion.

Boredom

Boredom is relieved when a street or pedestrian is lined with shops or a highway with streets, gardens and bridges. In addition, passing targets change appearance as one comes closer. A store window, contracted and invisible from a distance, gradually broadens and unfolds its full display as one passes by it. This perspective unfolding is an essential part of the experience that transforms the simultaneity of space into a sequence in time. As we walk, the environment becomes a happening in which things follow one another and change shape while they change position. A building in which nothing is designed for sequence is a depressing experience. Even any passage from a corridor to the sudden expanse of a room quickens one's experience with a small visual surprise.

Identical housing units let the visitor find himself in the same place wherever he goes. Regularity is not acceptable when the mind for which the object is made thirsts for irregularity. Symmetry is contraindicated by dissimilarity of function. Complex structure can be housed but not expressed by simple shape. A building may be designed without regard to its neighbors, but almost always it shows its force of gravity, and it provides an entrance and an exit and has its windows for the intake of air and light.

Such modification of the building's order by its interaction with the environment is not only indispensable for its functioning, but also desirable for its form and appearance.

A building entirely covered with reflecting glass creates a painful contradiction by offering a visual denial of the fact that physically it is indeed present. Is there any merit to introducing the mystery of the Invisible man in architecture?

Degree of Unity

Tension derives from the reliance of spatial orientation on the framework of vertical and horizontal. As long as this framework is explicitly represented by discrete elements, orientation is easy. But when the two dimensions are integrated in continuous shapes, the mind must extricate them from their disguise. The disparity between observed unity and underlying separation creates tension, and increase in dynamics, which may be welcomed or rejected.

A designer composing a pattern of simple shapes uses a procedure comparable to that of a builder who constructs a wall from elements, such as stones. On the other hand, the fusion of functions and directions in complex wholes is analogous to organic growth, which builds by seamless continuity and treats even the joints as links rather than distinct parts. Poured concrete is most congenial to such biomorphic imagery, while there is always something awkward and almost dishonest in constructing indivisible shapes from separate components.

Here we come to the principle that the appropriate degree of unity among various components of an architectural whole is directly related to the functional relations between them. The various functions of a building or complex of building components devoted to different functions require more autonomy than can be permitted in a space or group of spaces serving a single function. The formal yoking of different functions may only mislead and confuse the building's users.

On the other hand, it would be dogmatic to insist that all functions should be different in appearance. The various functions of a building are related to one another by an intricate pattern of connections and separations to which the architect may provide different ratios of unity and diversity at different levels of the design.

In a well-designed building there is a structural correspondence between visual properties and functional characteristics. Similar functions should be reflected in similar shape; different functions in different shapes. Visual accents should occur in places of importance. The image of the building should lead, not mislead, in its overall arrangement as well as in detail. This principle of correspondence between function and appearance has a purely practical aspect. A motel or a hospital cannot look like a public library. One has to consider also the changes that types of buildings undergo over time. A building built forty years ago looks different from one built today.

Symbolism

Some architects draw attention to their work by making it spectacularly different from their fellow architects which has distorted the notion of originality to mean something divergent from its neighbors. Function has been neglected, and accordingly the word symbol has been flattened out to refer to mere signs. A work of architecture, as a whole and in its parts, acts as a symbolic statement, which conveys, through our senses, humanly relevant qualities and situations. Sensory symbolism reveals the general in the particular and thereby raises the latter to a higher level of relevance. Symbolism derives from the expression in perceived objects. The shape of an object must be seen as dynamic. Symbolism is found in all shapes, including architecture. Mies van der Rohe un-symbolic buildings come across more clearly than those of Eero Saarinen's TWA air terminal which looks like a pregnant bird.

The basic fact of architectural expression is that the building as a man-made of object placed in the natural environment for man's benefit while desecrating the landscape, even when the building was designed by a talented architecture. Adolf Loos on the other hand thought that architecture should serve as an extension of nature, not attempting to imitate nature nor being conceived as an outgrowth of nature. On the other hand, Frank Lloyd Wright said "buildings should grow out of the landscape, in the image of the tree", and he is inclined toward biomorphic shapes rather than geometrical ones. Such organic architecture favors curving deviations from the straight line or plane, and merges in the flow of a landscape. The identification of nature with biological growth is a romantic interpretation conveyed by the type of architecture.

However, architecture need not aspire to comprehensive symbolism because it is limited to its expression by its particular function as dwelling, and as a stable refuge for man's necessities and activities. Kaufmann House, "Falling Water", built by Frank Lloyd Wright would probably be misinterpreted if it were seen as a structure offering a birth to both human inhabitant and water. The water is not served by the building, but is engaged by the house as a component that extends the centrifugal dynamics of its concrete slabs into the actual motion of the water. Thus, falling water is liquid architecture, not a combination of human habitation and spring house.

The tower on the roof of the Unite d'habitation in Marseille, France built by Le Corbusier can be seen as a sculpture, at the same time this tower functions as a channel for the flowing of depleted air.

Streets are perceived as positive ducts of action, so the entrances and other functional spaces in the Wright house are filled with in and out motion. The open spaces must be kept from reducing the material slabs and cubes to mere scaffolding, thereby depriving the building of its virtue as a shelter.

The dynamics of surface and volume

In extreme cases the building is reduced to a skeleton, which traces the outlines of a delicate pattern against the sky. When open and closed spaces are given equal shares, the effect is of a screen which is dynamically neutral and simply provides the surface of the building with some transparency. In modern architecture, such screens may stand in front of the actual wall as a protection against too much openness. More often the walls themselves appear as semi-transparent screens, in which open and closed spaces alternate rhythmically. However, the mere puncturing of the walls by windows and doors tempers the solidity of the enclosure. Islamic architecture has solved this by lattice work or Mashrabias fitted in window openings to retain the solidity of the Mosque's walls' boundaries.

The curtain walls of the International style offer this quality of a permeable weave, as do the surfaces of Gothic buildings, the lacework of the Venetian palazzo on the Grand Canal. The effect of such screen depends on the ability of their open and closed spaces to act together as a partition, which is a flat plane or a surface layer of some depth. This effect is obtained in accord with a basic perceptual principle, that a line or plane need not to be spelled out entirely, but will complete itself in the observer's mind if its structure is sufficiently represented. A city square can be adequately staked out by four corner buildings. A surface may consist of openings will be perceived as a coherent wall.

Surfaces and volumes are presented as dematerialized dynamic systems as seen in the Crystal palace and Eiffel Tower. The parallel hatchings of the steel skeleton that spell out the transparent volumes of glass buildings or connect the catenary arches of suspension bridges with their base can be compared with the strings and wires which have created harp like surfaces. Le Corbusier gave a dynamic impetus to the deep window reveals of the chapel at Ron champ by splaying from a constricted outside to a broad inside. Cognitive fascinations are derived from the transparency of the structures.

The Egyptian Pyramid

The simple shape of the Egyptian pyramid is a heavy compact manifestation of an upward force resting on the ground, but at the same time is the wedge-shaped pointing upward forcible. The rising of the pyramid is counteracted by a downward pressure, which, starting at the top as a mere point grows into an ever-larger base as it proceeds toward the ground. This downward movement is clearly secondary because whenever a visual pattern is anchored in a solid base, the direction toward the free end dominates. To-way dynamics is more clearly active in the horizontal layers of the pyramid, as it contracts while rising from the ground or, conversely, expands from the top down.

Contraction and expansion in the horizontal dimension have no relation to the pyramid's base and therefore can alternate in perception.

The complementary relation between rising and descent, contraction and expansion, constitutes the internal dynamics of the pyramid. This internal behavior is embedded in the relation between the building and its surroundings. The pyramid displaces the air as it pushes upward. At the same time, the surrounding space can be seen as compressing the building fabric by progressively reducing its bulk until, at its greatest height, the pyramid comes to a mere point and vanishes entirely. The building's immobile shape is perceived dynamically as resulting from the equilibrium between the expansive forces generated from within and the compressive forces converging from without.

The pyramid performs as a compact, uninterrupted whole. A step pyramid of Sakkara falls in between. It may not be strong enough to bring about a real subdivision. Its steps may be seen as the ribbed surface of an otherwise polyhedron, but the steps can also transform the solid into a pile of slices. In that case, the task of contracting or expanding is seen as distributed among the members of a group of participants, which act concretely but at different levels of efficiency. The bottom slice, having the largest bulk, produces power of the layers diminishes.

The Citadel

What do we see when we approach the mosque of Mohamed Ali located in the Citadel in Cairo. We see the theme of vertical rising is entrusted to the two minarets. They fulfill this task more compellingly than the building of the mosque as a whole could, because they are slim in relation to the height they attain. Looking upward along the vertical axis of the minarets, one is stopped rather brusquely by the rims which come without warning, and in comparison with the vigor of the upward sweep they are weak. The rims serve as a retardant; they provide a first contraction of the minaret's bulk, before the pointed tops apply an ultimate squeeze, which sends the upward movement forth into the sky.

In comparison with these pointers, the central mass of the mosque, nearly square shaped looks heavy and inert. It thereby provides the building with a Solid core covered with a dome supported by semi domes which keep the building anchored to the ground. The solidity of this central core is modified, however, by the set back of the dome with its semi domes from the porch to the upper levels as an echo of the contraction acted out at the tops of the minarets. This set back is an acknowledgment of the vertical ascent. They make the eyes step upward.

The dynamic of Function, Form and Ornament

In this 21st Century, architects suggested the stripping of architectural form to the bare geometry of its bones. Now we realize that such abstinence is not the necessary corrective of the abuse but simply a stylistic alternative.

Decoration comes from decorum and indicates what is needed for a thing or person to perform its function properly. Cosmetic derive from cosmos and therefore designates what is needed for proper order. Ornament or decoration did not stand for gratuitous prettification but, on the contrary, referred to necessary attributes of an object or person, such as the ornament of an altar and to what is needed for effective communication.

Frank Lloyd Wright defined integral ornament as “the developed sense of the building as a whole, or the manifest abstract pattern of structure itself”.

Function is most familiar to architects, although there is no agreement on its meaning. Expression although equally fundamental, is all but absent from most systematic discussion of architecture and appears only in the narrow sense of traditional symbolism. When an architect decides that function should be limited to what satisfies needs, he is narrowing the meaning of the term to accord with his own attitude or style. Needs are only felt by our minds related to security and enjoyment. Function must refer to the totality of the needs the building is to meet.

Expression on the other hand relies on the dynamics of visual form of architecture. Dynamics is a property supplied by the mind to any form that is perceivable by the nervous system. Perceptible dynamics serves as the carrier of expression illustrating ways of being and behaving found in nature and in man-made things, in physical and mental processes. The capacity to perceive the expressive qualities of things inheres spontaneously in the human mind. It is hampered by a civilization that favors utility in a physical sense and do not acknowledge the existence of phenomena that cannot be measured. Full perception is beyond retrieval in the average person. It is favored by individuals that promote the sense of human experience.

Function cannot make form because expression is a quality inherent in the perceptual appearance of objects. Expression is not identical with building’s physical properties: a building maybe soundly built yet looks flimsy. The pure form of a building is the vehicle for its spirit. For example Vitruvius observes that the Doric order fits the “virile strength” of a Minerva, Mars, or Hercules. In such example there reverberates the intuitive realization of a visible between the look of things and their character, but essentially architectural thinkers have been occupied by the question of how form, whatever its meaning, relates to function.

David Pye has explained that function consists in abstract principles, not in shapes. For example, the function to be fulfilled by a wedge can be described verbally. The principle designates a range of shapes as suiting the purpose, but it declares no preference for any particular embodiments. In most cases this range of shapes, serving a particular function, is defined not only intellectually, but also perceptually. Perception, too, is not primarily concerned with particular shapes but with kind of shapes. David Pye realizes, that the more specific the functional requirements of the object, and the stronger the constraints imposed on it, the narrower the range of choices available to the designer.

Form should provide formal beauty. Leon Battista Alberti defining beauty as “a harmony of all the parts, in whatever subject it appears, fitted together with such proportion and connection that nothing could be added, diminished or altered, but for the worse”. Harmony of proportion is important as an aesthetic obligation and is unrelated to the requirements of practical function. Function, physically does not sufficiently determine form. The meaning of beauty emerges only if we understand beauty as a way of perfecting expression.

Conclusion: the art of systems

When talking about images offered to our senses when experiencing a building, Etienne-Louis Boullée said that they “should arouse sentiments analogous to the use to which these buildings are dedicated”. When Frank Lloyd Wright, in his Guggenheim Museum in New York, combined the horizontality of floor spaces with the gradual transition from one floor to the next, the resulting spiral kept both functions in sight and demonstrated their union in a striking intelligent solution. Eero Saarinen’s auditorium for the Massachusetts Institute of Technology (MIT) forces all functions into a single geometric shape because the problem of how to unite different activities in a common enterprise is a good and a pleasing environment to the beholders because these arrangements are immediately relatable to fundamental aspects of human social behavior, to qualities like generosity and exploitation for which the generic perceptual properties stand.

Referring to Kant, toward the end of his critique of Pure Reason, he writes a chapter on what he calls architectonics of pure reason. He means the art of systems. Kant’s principal paragraph is: “Under the rule of reason, our cognitions must not be rhapsodic but must form a system, which alone enables them to support and promote reason’s principal purposes. By a system I mean the unification of the manifold cognitions under one idea. This idea is the rational concept of the form of a whole, to the extent to which determines a priori the range of manifolds and the position of the parts in relation to one another. This is to say that the rational scientific concept contains the purpose and the form of the whole, which is congruent to it. Owing to the unity of the purpose to which all parts refer and in view of which they also relate among themselves, any one part can be missing as long as all the others are known; and no accidental addition can be made, nor can any dimension of the completed totality be undefined, that is, not determined a priori by definite boundaries. It follows that the whole is articulated and not aggregated; it can grow, but only by internal action, not externally, just as the body of animal does not grow by adding limbs but rather strengthens each of them and makes it better suited to its purpose without any change of proportion.