Chapter 29

Folds and Refolds: Space Generation, Shapes, and Complex Components

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ABSTRACT

Geometry and architecture both have a long trajectory in the history of western thought. Geometry offers the possibility to interpret the physical structure of the world and to develop rational thinking, while architecture provides the capacity to transform the physical substance and meaning of our surroundings. Diverse developments in the field of geometric representation have determined the characteristics of architectural space: from the modulated rigour of Classicism and the birth of Euclidean geometry, to contemporary informalism with the incorporation of digital mathematical calculation and intense questioning and reconsideration of traditional Cartesian space. The two-dimensional constant and dynamic projection of a three-dimensional spatial situation has been upheld since the time of simple spatial-temporal allegories of the architectural project up until the new developments with unconventional instrumental resources, generating innovative structural, formal, spatial and technological solutions.

GEOMETRY AND ARCHITECTURE: FROM MODULATED RIGOUR TO INFORMALISM

Since antiquity, geometry has become established as the most powerful tool with which to conceive and design architecture. Functional, technological, symbolic and cultural aspects are upheld by geometric logic, modified in accordance with changes and ruptures in our ways of thinking, doing and designing, in line with cultural and temporal parameters. The Greeks gave us a completely original way of designing architecture based on a modular system: the classical orders are a synthesis of connected geometric forms and relationships that enable a work of architecture to be described as an interconnected system of measurements. This form of regulated design remained decisive for architecture up until the Industrial Revolution. Although the system of proportions used in antiquity was brought back into use during the Renaissance and then lost force in modern times, the modular concept as a basis for the rationalisation of form prevailed through the centuries. The work of nineteenth century engineers marked the formal and

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conceptual break with architectural building traditions, rejecting the system of geometrical proportion passed down from antiquity. Instead, they imposed a strong practical line of thought to resolve problems, wherein the new geometric modularity is adapted in response to the results of graphic calculation, scientific analysis and the demands of other construction materials and systems. Descriptive geometry, with its orthogonal projections, provided another mechanism with which to understand and analyse determined forms and spaces, and is still the most frequently used geometric construction today in most architecture and design work. Modern rationalism established the functional principles and incorporated the three-dimensional reticulated structure now possible with reinforced concrete in order to organise the spatial volumetric syntax. All parts of the architectural whole were now subject to the three-dimensional repetition of measurements, in the form of a prismatic cage. This is the fullness of Cartesian space: a homogeneous one-directional continuity within the field of geometrical rigour; the realization of an isomorphism within a measureable and unlimited space. (Chiarella, 2009)

Through the use of computer graphics, the new (non-linear, dynamic and unpredictable) digital processes of mathematical calculation modify existing notions of spatiality by distancing certain geometric qualities that we historically identify with architecture; more precisely, by moving away from the three-dimensional stability and modular rigour inherent in the Cartesian space of predominately Euclidean geometries. Luis Fernandez-Galiano in “Form of the Formless” (Fernandez-Galiano, 1996) describes these trends characterized by the use of complex geometries such as: “Formless architecture is very formal, ..., If architecture is above all about construction and form, stripping it of any of these attributes can only be interpreted as polemic intention and literary provocation.”; “and following the deep currents of a sordid and sublime romanticism, we can imagine a drift that takes us from the fractures of constructivism to the tensions of expressionism, and from there to the tensions of expressionism, and from there to the foreshortened warings of informal organicism; from folded and geometrical skins to bones, trees and clouds, and from there also to a universe of inners a caves. These are shifts which, within the general framework of a shattered abstraction, lead through the path of the romantic repertory from crystals and the broken geology of mountain peaks to opaque and secret woods, crowned with foliage, and labyrinthine caverns: an entire panoply of expressive resources to endow the formless with form.”

Computer software opens the possibility for new complexities of form, more derived from indeterminacy and randomness than those forms traditionally arising from simple patterns obeying clear mathematical laws of generation. The complexity of form based on the topographical definition of curved or broken surfaces is placed opposite the geometric definition of the orthogonal network or the repetition of uniform structural frames. Concepts such as genetic architecture, digital-botanical architecture, bio-mimetic architecture, liquid architecture and trans-architecture move away from the classical orthogonal projection definitions in order to work on the folded forms of modern space, where floors, walls and roofs are curved into a single continuous surface. In geometrical syntax, the right angle no longer rules. Structural typologies take on new importance in the design, seeking expression through strong oblique lines and curved directrixes in the building envelope. Traditional composition solutions give way to continuous facades, floors and roofs with no apparent difference in quality and materiality. Images associated with non-Euclidean geometry seem to offer a way to apprehend and incorporate complexity, thus broadening understanding of the processes of morphogenesis and systemic culture of the designer. In this way, the understanding of new geometries or geometric actions brings about another way of observing reality, thus providing new resources for the architectural design project.

Aspects of these spatial realms were explored in architecture prior to the so-called “digital decade” (of the 1990s), but these were only isolated expressionist experiences within the general context of the