SYMMETRY: PERCEPTION, REPRESENTATION AND COGNITION IN DESIGN

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"The first thing that emerged from chaos was the stars."
Ernst Cassirer

I.

Geometry was one of the first elements of order that man could come up with. Unlike other problems related to survival such as hunting, fishing, and building a protective habitat, that had to be organized and improved under daylight; Geometry was born in the dark, under night's shelter.

Night, stars, time, geometry, order, control, design. Although this sequence implies a lineal and simplified description, it allows us to entertain the hypothesis that Architecture emerged when man was able to submit the formal determination of constructions to a normative system of design.

Night -only with stars- sharpens the abstract function of intellect, generally confused by daytime, light, and the visualization of a chaos which is and will be slowly organized or misunderstood, usually misinterpreted for millenniums. Night, and darkness hard to imagine today, allowed man to translate the order of the sky to geometric thinking.

Although there is no certainty, sedentarism, durability of constructions and *geometric thinking* emerged at the same time. In his famous *History of Architecture,* Fletcher (1896 [1956]: 1) claimed that *Architecture, with all its varying phases and complex developments, must have had a simple origin in the primitive efforts of mankind to provide protection against inclement weather, wild beasts, and human enemies.* This explanation about the origin and most writings about architecture stress function, highlighting construction as an inhabiting-protective device. The time has come to change the discourse and analyze "art," "the artistic side," "the esthetic concern," from an angle of prefiguring possibilities that enable design operations through available graphic languages in the framework of an incipient *grammar* or *Theory of Design.*

"Order results from a preconceived plan."
Ilya Prigogine (1983)

II.

At this crossroads, Architecture is born. *Architecture results from the application of design to the formal elaboration of constructions mankind builds to inhabit the world.* Architecture is both the use of built space and the delimitation of inhabited space. Design is delimitation, creation, and articulation of form. *As autonomous* knowledge -about construction and habitat's social needs- *it enables, through a design project, modifying the first anthropoid's monotonous and utilitarian constructions.* (Jannello 1983: unpublished).

Geometry was probably the first development in human thinking about the world that had not emerged directly from sensory experience. Geometry belongs to the world of forms and its application to inhabitable constructions allowed for its exact formal determination. The history of architecture, as combined design, has produced in five thousand millenniums a vast typological repertoire of elements with their own combined syntax. Not much has been said about this syntax or combination.

One of the first problems is to understand that Geometry was not conceived for purposes of Design, although since ancient times some of its intuitive and non-systematic properties and techniques have been used, such as geometrical *tracings* (Ghyka 1927: 221-322; Lawlor 1982 [1992]: 23-64). These still are and have always been the

quintessence for appreciating the value of symmetry operations, generally hidden in constructions but present in *tracings*.

Even though Geometry deals with forms only from an entitative viewpoint, geometrical *tracings* were generally used to explain the structure of symmetry. Designers, however, have conceptual and practical needs: to compare and establish relationships between forms, and to select and combine them.

Graphic languages, such as *Monge System* and *Perspective*, traditionally used for designing, 'only' account for quantifying or qualifying space. They do not allow for conceptualizing or specifically working on *pure design*[1] operations, i.e., on form-related decisions such as selection and combination that will enable an architectural or graphic space which will acquire analogic consistency through traditional graphic systems of representation.

In turn, going back to the Geometry-Symmetry relationship, we must acknowledge that a *geometric figure* as a whole, as an entity, as a problem of selection, of differentiating recognition, lacks symmetry. Symmetry implies parts, which are in symmetry. It could be the parts of a figure or several figures. When there is symmetry, there must be a combination of parts. According to Nicolle (1950: 16), *ce qui nous frappe, c'est donc une certaine répétition, soit d'un objet, soit d'éléments qui le constituent.* A geometric figure considered as a whole has no parts, its general entitative viewpoint would not allow for a symmetrical approach. The only way of finding symmetry in a figure is to consider partial, syntactic, or combining aspects based on subdivision criteria. But Geometry does not refer to combinations, to comparisons among figures –either flat or volumetric- in relation to constant *dimensions* (Jannello 1984; Guerri 1988: 399).

"The categories suggest a way of thinking."
Charles S. Peirce (CP 1.351)

III.

On the other hand, the best known traditional graphic systems, such as *orthogonal* and *conic projections*, were developed as methods of execution. They were never conceived as *ideological systems* implicit in any language, either graphic or verbal.

The first graphic system explicitly defined as such is the graphic language known as TSD[2]. This graphic language resulting from the Theory of Spatial Delimitation systematizes all possibilities of selection and combination of flat and volumetric forms. It establishes necessary and sufficient *morphic*[3] and *tactic*[4] *dimensions* to account for all possible relationships of selection and combination, the *pure design* operations. TSD systematizes the execution of *tracings* and subsequent description in *tree-hierarchical structures* of corresponding *complex configurations* of pure design.[5]

Insofar as each graphic language supposes different types of analogies, each of them has its specificity: Perspective to *speak about* quality of space, Monge System to state the

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[1] For a reference on the *pure design* concept, see Jannello (1980) and Guerri (1988: 394).

[2] *TSD* is the acronym for *Theory of Spatial Delimitation*, a problematic name but used in honor of its first propounent César Jannello (1918-1985).

[3] The *morphic dimensions* are *Formatrix*, *Size* and *Saturation* (Jannello 1984; Guerri 1988: 406-408). These three dimensions can be justified to be necessary and sufficient conditions from a geometrical point of view: they determine a point in space, in the infinitely high semi-cone of morphic selection possibilities (Guerri 1988: 398), or else from a logical-semiotic, Peircean point of view, because they are *firstness*, *secondness*, and *thirdness* respectively (Peirce CP 2.235-2.241).

[4] The *tactic dimensions* are *Tactrix*, *Separation* -in two or three directions-, and *Attitude* (Guerri 1988: 409).

[5] Although out-dated, for a more thorough historical-conceptual approach on TSD, see Guerri (1988: 389-419). Due to space limitations and for practical reasons, the concept and functioning of this graphic language will be shown during the presentation of this paper by means of the CA-TSD (Computer Aided TSD) specialized-graphic software.

quantity of matter present in that space, and TSD to account for the relationships in which matter and space abide.

Regarding Symmetry, a variety of conclusions may be drawn from the TSD proposal and its use through CA-TSD:

1. Although Geometry is taken as its foundation, given *morphic and tactic dimensions* considered necessary and sufficient for both flat and volumetric figures, what is considered a *figure*[6] and a *simple configuration*[7] for this graphic system is thus redefined.

2. The *morphic paradigm* generates the *figures*, as a continuous group of substitution possibilities. As to symmetry, figures should be considered on account of their lineal components and of the *dimensions* proposed by the graphic language TSD itself.[8]

3. The *tactic paradigm* generates *simple configuration*, as a continuous set of integration possibilities. The set of *morphic* and *tactic paradigms* constitutes theoretically exhaustive systems of all possible -flat and volumetric- *figures* and *configurations*. It demonstrates that symmetry operations are a specific convergence of *morphic* and *tactic dimensions*; and that given any two forms, any *simple* flat or volumetric *configuration*, all derived symmetry variables can be determined *a priori*.

4. For Design, Symmetry is an operation of higher isotopic synthesis and, as a result, it is one of the most widely used design operations. Since its origin, it has been known as a concept linked to regularity that has been used to keep order, a way to skirt chaos, monstrosity, and shapelessness. History has it that symmetry was patently used or hidden, denied or reconsidered, but has always been present in design processes.

"The relationship between chaos and order has been a dilemma raised and solved by each generation according to the vocabulary and interests of the times."
Ilya Prigogine (1983: 155)

IV.

In Western architecture, order is construed in an agitated dialectics between historical periods –taken as *concrete units*- and the *general structure* of architectural design since its origin up to current times. Since time is *unidirectional* and *irreversible*, different conceptual structures are applied to it, demonstrating that order in not static but the manifestation of *structured fluctuations*. In this history of fluctuations, of permanence and change, symmetry follows its own development, and will be considered by Western thought as a concept of regularity.

In architecture, symmetry has been one of the pillars for design, to the extent that all epochs have been ordered around it. Thus, symmetry anchors a formal practice, an abstract practice of design, in what is concrete, in a concrete design operation. As stated, it becomes the first design algorithm.

In Greece, symmetry is ostensible, generally, *bilateral* and with *rotation 2*, but given that pure symmetry bores through sameness, in their buildings, the Greeks removed it and hid it through foreshortening -e.g., the Parthenon. The Renaissance continued making it ostensible, but in a more complex way: there was a tendency towards *rotation 4* -e.g., Palladio's Villa

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[6] A rhomboid and a trapezium –for example- are not longer *figures* for the system and will be considered as design *configurations*.

[7] A *simple configuration* is the combination of at least two *figures*. The *tactrix* of a *simple configuration* is defined by a description of the *morphic relation* of the intervening *figures*.

[8] *Saturation*, insofar as it is a qualitative evaluation of *figures*, implies a problem of *constance-variation* which is usually known as proportion -but that, among other things, is a concept that can not be used to compare two irregular *figures*. *Saturation* also posits a problem of *presence-absence* as in *entitative-symmetry*. There will always be some kind of *saturation-proportion* in any figure, but there may or may not be *saturation-symmetry*.

Rotonda- and even towards *full rotation* -e.g., Bramante's San Pietro in Montorio. At the break of the century, Modernism meant a significant change in the application of symmetry, insofar as it was not built. This rupture in ostensible symmetry lead to the development of hidden symmetry in subjacent design operations, never shown on designs plans or in buildings. Post-modern architecture attempts to establish a new order completely different from the modern order: it counters functional and constructive principles that, in their discourse, backed the basic principles of Modernism, and once again welcomes symmetry, columns, and adornment. But this return takes place from a viewpoint in which the paradigms of reason coexist with those that question its almighty presence: symmetry becomes a reference and a parody of other symmetries. In post-modern architecture, there is a transposition, and designed or built symmetry is a reflex or reference of some historical symmetry.

The history of architecture reveals that, as in any human aspect, there is no order, but rather a series of different orders that have been diachronically occurring over time.

V. Conclusions

TSD is presented as a temporary improvement regarding control over *pure design* operations. Within *pure design* operations, the possibilities of symmetry in any configuration are predetermined *a priori* by the *tactic paradigm*.

As shown in the computerized and transparency examples, the use of TSD for analyzing architectural design -Palladio, Le Corbusier-, graphic design -El Lissitzky- or pictorial design -Velázquez, Malevich- allows for systematizing one's approach to aesthetic values, thus contributing to the understanding of both historical practices as well as new design possibilities.

Putting aside the problems of *perception* -not that important in this case- TSD implies a new code of graphically *representing* the problem of Symmetry and, thus, it is also a new *cognitive* approach.

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