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Revelations of *Folies* through Geometric Transformations

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Abstract
This article presents an activity carried out in a course on representation in a master's degree in architecture, which aims to train students in the practice and theory of geometric transformation for the production of shapes, using a case study from contemporary architectural design: the *folies* of the Parc de la Villette.

Keywords Geometric analysis · Design analysis · Didactics · Bernard Tschumi · Parc de la Villette

Introduction

The theory of geometric transformation lends itself to didactic experimentation during the teaching in architecture degree courses. This article presents an activity carried out in a course on representation, which aims to train students pursuing a master's degree in architecture at the University of Genoa (Italy) in the practice and scientific theory of the production of drawings and images for contemporary architectural design.

Students of the course completed an exercise that consisted of the analysis and reconstruction of the volumes of the *folies* of the Parc de la Villette in Paris, designed by Bernard Tschumi from 1982 onward. Well-known but understudied, Tschumi's project is useful for students in terms of its complex geometric implications. The articulated yet ambiguous combinatorial system used at Parc de la Villette was thus studied through the examination of two particular cases that reveal both its global conception and its singularities.

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Reading Geometric Transformation Through the *folies* of the Parc de la Villette

Studying the treatment of different geometries, which is not limited to theoretical explanations, is necessary during the training of architects. A part of the course of Representation methodologies for design in the master's degree in architecture at the University of Genoa (Italy) provides students the opportunity to apply the composition of forms in the design process. Dedicated to geometry and parametric models for architecture, the course requires that students engage with the theoretical aspects of modelling, applying them to the conception of curved surfaces and to the transformations and invariants of Euclidean, affine, projective and topological geometry.

In line with the course syllabus, students virtually reconstruct existing architectures to enhance their understanding of the conversion of ideal geometric forms into real architectural examples. In the last academic year, we chose the *folies* of the Parc de la Villette in Paris, designed by Bernard Tschumi with the cooperation of the philosopher Jacques Derrida from 1982 onwards, as an example.

The well-known planimetric layout of Parc de la Villette (Fig. 1) is based on independent layers (Tschumi 1988: 7) and explicitly refers to the fundamental entities of Euclidean geometry; the points are made up of small pavilions (*folies*), the lines coincide with the paths, and the surfaces correspond to the areas of the gardens.

The *folies*, unified through their metallic material and red colour, appear to be generated by a few repetitive geometric shapes (Tschumi 1985: 5): a grid made up of 27 cubes (3 for each Cartesian direction), each of which can be full, gridded, or absent; cylinders -variously scaled and sectioned; and prismatic elements (Fig. 2). A deliberately ambiguous combinatorial system is formed using these shapes, but

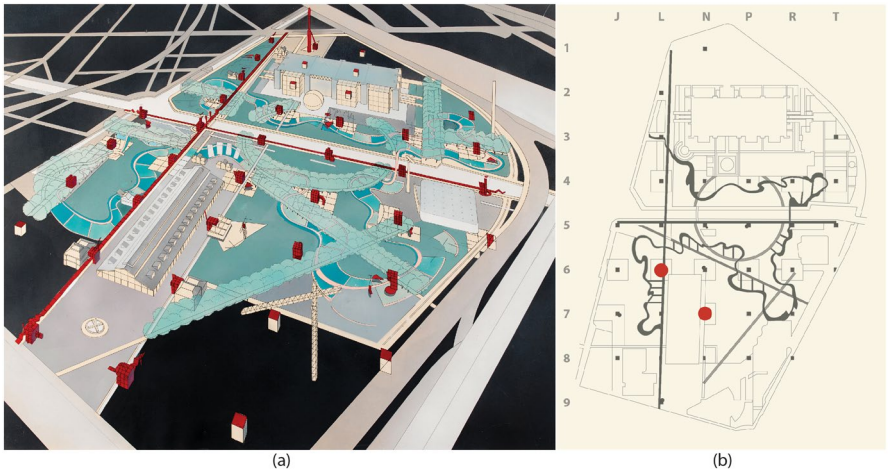

Fig. 1 Global layout of the Parc de la Villette, Paris. (**a**) Aerial Perspective (© Bernard Tschumi Architects; authorized for publication). (**b**) Plan (Drawing by Author)

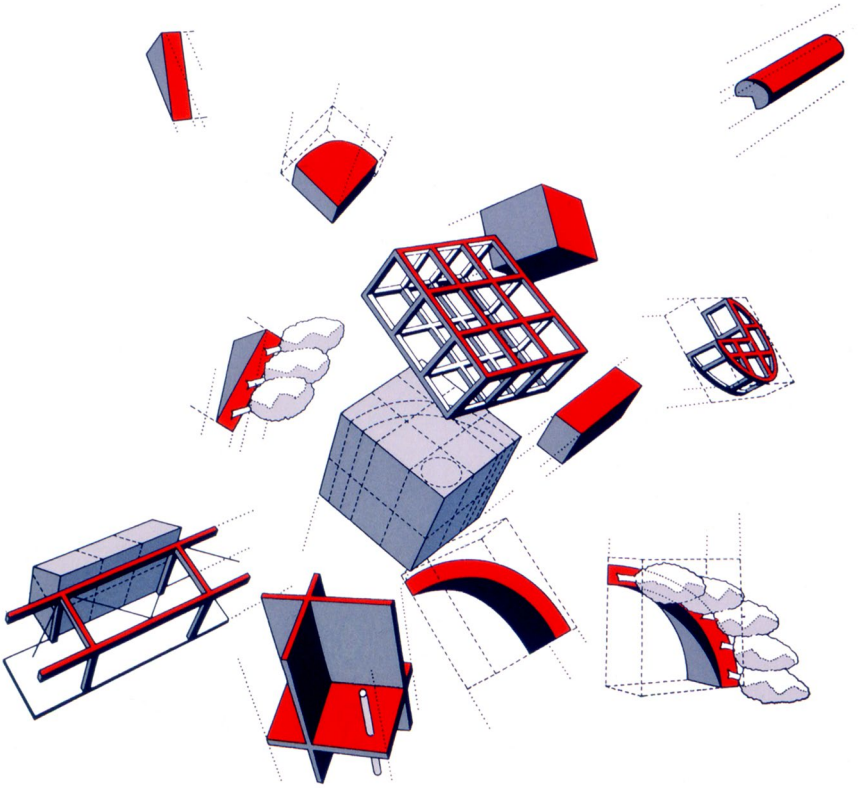

Fig. 2 Exploded folie (© Bernard Tschumi Architects, authorized for publication)

reality is further complicated with the intervention of form-generating procedures. These procedures, which we examined in Folies L6 and N7, were explored as different typologies of *déviance* originating from the *normalité* of the scheme (Barzilay et al. 1984: 32), a true testament to the non-prescriptive and flexible attitude of Tschumi's design method.

Planimetry Rules and Singularity

The Parc de la Villette has a planimetry arrangement based on an orthogonal grid which sees the *folies* set in correspondence with its intersections (Fig. 1b). The abscissas of the system are named alphabetically, while the ordinates are numbered (Tschumi 1988: 8–9). The combination of these two Cartesian coordinates determines the name of each *folie*.

From the perspective (Fig. 1a), two straight red elements emerge which connect the ends of the project lot and correspond to the main movement axes: the *Galerie*

Nord-Sud, developed at ground level and with an undulating roof, and the *Galerie Est-Ouest* which is located at an elevated level.

The main axes interact with the *folies* in different ways, modifying the geometric conformation of the pavilions, even in the most distant areas. These factors have prompted us to present here two *folies*, *N7* and *L6* (Fig. 1b), as effective examples for describing possible geometric developments, transformations and contaminations between the different elements of the park. Tschumi states that "*Designing La Villette was not unlike going from pure to applied mathematics* (Tschumi, Walker 2006: 50). However, we do not intend to attribute a procedure to the designer. Rather, we want to propose a geometric approach capable of developing the interpretative skills of the students.

The Interpretation of the Rule

Next to the imposing *Grand Halle*, a late 19th-century building, we find *folie N7*. The pavilion is located in the centre-south of the park along the longer side of the triangular-shaped green area called *Prairie du Triangle*.

The first design proposal for the *folie N7* was different from the structure that was realised: the initial solution occupied the entire available space of the modular grid (Barzilay et al. 1984: 23). The original name was *folie du spectacle* (Barzilay et al. 1984: 37) and was intended to host events, as appears from in a perspective of the pavilion intersected by an inclined plane which provides the coverage of a stage (Tschumi 1988: 15). The completed building has undergone a formal and functional modification and is presented as a water mill, a space for first aid, and—partially maintaining the initial idea—a raised theatre stage (Tschumi et al. 2014: 103).

The complete ideal shape of the *folies* is made up of 27 cubes ($3 \times 3 \times 3$), over a total extension of 10 m in each direction. *Folie N7* can be obtained by removing 14 modules and configuring the remaining 13 in two ways: 6 modules made of a closed surface to form the base, and 7 skeletal modules located on the upper levels (Fig. 3a). In other words, the upper part of empty cubes (Fig. 3b, green) can be achieved by rotating the base of full cubes (yellow) with the addition of a single protruding modular cube at the top level (Fig. 3a, blue).

The other basic geometric elements can also be observed: a triangular prism, which houses the staircase, and two cylindrical elements, which constitute the wheel and the gear of a mill. These two elements modify the modular system. The smaller cylinder is arranged at the top and the largest cylinder, placed at the bottom, generates the reduction of one of the six modules of the base. The two wheels are connected by an inclined water channel, thus drawing a path that ends in the collection tank at street level (Fig. 3c).

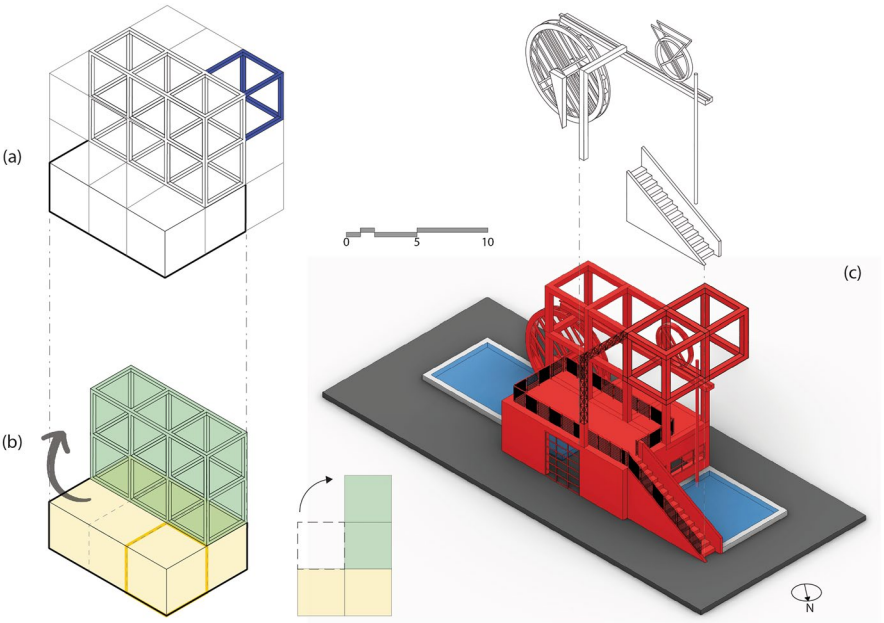

Fig. 3 *Folie N7*. (**a**) Ideal 3×3×3 mesh and real scheme. (**b**) Isometric view of full and empty cubic modules and their composition by rotation. (**c**) Exploded isometric view of the virtual model (Diagrams by the authors and model image by the students of the course; authorized for publication)

Interferences Between Layers

Folie L6 represents a characteristic example of the interaction between different layers. Currently, the pavilion bears the name *Folies des vents et des dunes* and assumes the role of entrance to the children's play area (Tschumi et al. 2014: 95). Originally referred to as *la Folie des thermes et des expositions* (Barzilay et al. 1984: 37), the architecture is understood as a theatre of real life with that programmatic fluidity anticipated by Tschumi in the *Manhattan Transcripts* (Tschumi 1981). It is precisely for this reason that it cannot be established a priori and is, instead, presented as a work in progress.

From a formal point of view, *folie L6* presents the typical modular geometry (Fig. 4a), interpreted in a Deconstructivist key. In this case, the 14 full cubes occupy a volume made up of 3×2×2 modules, surmounted by 2 modules on the last level (yellow). The skeletal cubes are represented by only 2 elements (green), which flank this last pair and extend with an empty canopy made up of two squares (blue), to overlap the passage alongside. We also note the presence of a suspended walkway on the second level (composed by an alignment of 10 half modules) and a triangular protruding terrace representing the prismatic component. The presence of cylindrical elements is not found, except in the semi-cylindrical technical service staircase positioned above the same terrace (Fig. 4c, d).

A particularity of *folie L6*'s design is its deviation in position and direction from the modular grid. Regarding the position, the cubic components appear to be

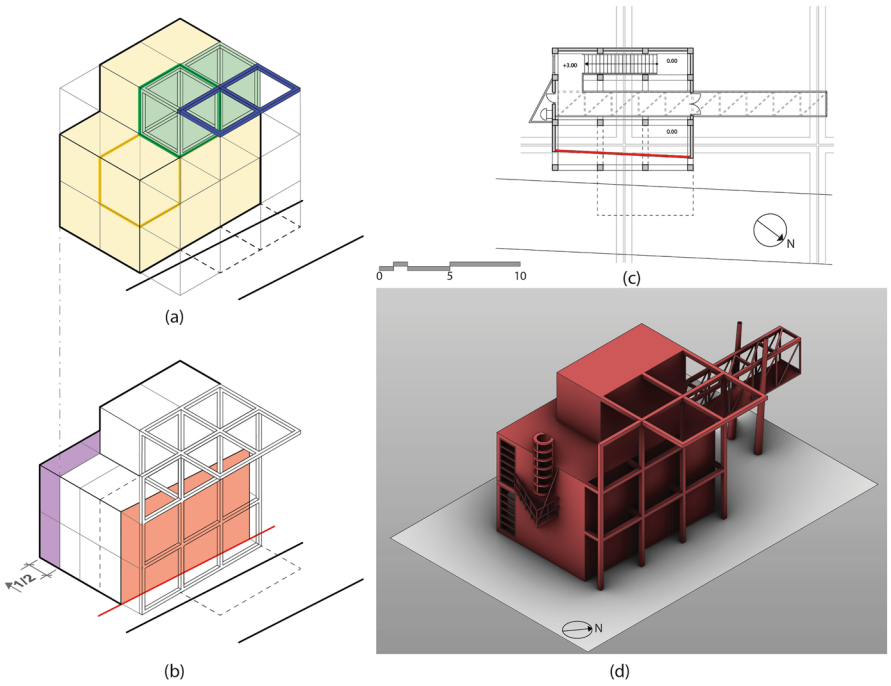

Fig. 4 *Folie L6*. (**a**) Ideal 3×3×3 mesh and real full, empty and partial cube scheme. (**b**) Deviations by position (translation) and direction with respect to the modular lattice. (**c**) Plant. (**d**) Isometric view of the virtual model (Diagrams by the authors and model image by the students of the course; authorized for publication)

translated by 1/2 module in depth with respect to the reticular mesh, including the staircase, thus making the mesh of the lattice emerge on the opposite side (Fig. 4b). Even more surprising is the direction of the anterior vertical surface of the block of filled cubes (Fig. 4b, red), which is inclined with respect to the grid of the *folie* in such a slight way as to reveal itself only upon careful observation. This inclination appears as an interference with the layer of tangent paths (*Galerie Nord-Sud*): a manifestation of strangeness, as proof of a will to articulate a geometric rule that is 'simple' only in appearance.

Conclusion

The *folies* of the Parc de la Villette in Paris are an appropriate starting point for reflecting on the meaning of geometry in architectural forms, which is indispensable during the formation of the contemporary architect. Folies constitute a sort of Deconstructivist manifesto through the absence of hierarchy between the layers of the park project (points/*folies*, lines/paths and surfaces/garden). A further level

of interest is the language of representation, deliberately original and ambiguous, which has not been studied here.

For students of the master's degree in architecture the exploration of Tschumi's folies provide the opportunity to identify essential types of Euclidean transformations. For instance, *folie N7* and *folie L6* can be generated through the isometric transformation of rotation and translation. The shape is originated from the $3\times3\times3$ cube, however in both cases we can observe distortion. Born of the philosophical theories of Jacques Derrida, for whom alteration and irregularity are placed inside the form (Derrida 1998: 566), the combinatorial system of the shapes apparently used in the *folies* is complicated through various transformations, applied in a non-homogeneous way to the positions, directions and dimensions of the *folies*: a poetics of the fragment that starts from pure geometry to articulate its rules.

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Data Availability The authors confirm that the data supporting the findings of this study are available in the article.

Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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