

AUTO-GENERATIVE URBAN INTERVENTIONS: A STUDY OF THE RELATIONSHIP BETWEEN BUILDING FORM GENERATION AND URBAN CONTEXT MAPPING

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Abstract

This project documents the progress of research developed to explore the unique relationship between building **form** and urban **context** with the application of a novel auto-generative modeling process incorporated into a speculative design methodology. The techniques and parameters for the project are reviewed relative to key concepts of D'Arcy Thompson's dynamic "theory of transformation" and the development of the auto-generative modeling process. This is followed by a detailed discussion of the set of exchanges between the urban context (field of influence) and the formation of the building intervention that were subsequently mapped through a series of diagramming studies. Specific issues explored in the project focus on Thompson's descriptive analysis of form as a "**diagram of forces**" and his use of flexible, deformable topological Cartesian nets (Method of Coordinates) to subject the stasis of geometric types to dynamic transformation. Some preliminary interpretations of the project results are evaluated through studies of the generative schemes deployed in different urban situations. The initial results of the study are demonstrated with a resultant schematic building design for a modest scaled intervention in the city of Miami.

Introduction

In the discipline of architecture, context has typically been a critical element intrinsic to the generation of building form. However, emerging developments to computationally model this unique and *reciprocal* exchange have only recently

begun to be fully explored for their creative and operational potential. Fundamental to research in this spatial discourse is a position that seeks to elucidate an understanding that the interpretation of context, of our urban environment, is evolving from a static, **fixed model** of concrete relations to a more **dynamic model** of fluid and complex systems, constituted by an array of events, cultural constructions and spatial organizations. An exemplary paradigm for the study of a dynamic systems model and its inherent multiplicities of "forces at work" can be traced throughout D'Arcy Thompson's investigations in *On Growth and Form*. Of particular interest for the development of the speculative design methodology for the urban interventions was Thompson's intense and precise method of analysis and description of the *alliance* between **form** and **force**, "between the outward appearance of organic form and an understanding of the forces that gave rise to it." This *affiliation* for architecture is explored as a provisional organizational structure to facilitate the construction of the urban context as a numeric force field or "**diagram of forces**." Also important to the development of the case study project is an elaboration and expansion of the very processes that Thompson developed in order for his analysis to advance. Specifically, the flexible topological nets (Method of Coordinates) implemented by Thompson to subject particular species types to dynamic transformation were essential for developing the computational schemes for formation of the intervention studies. Finally, and perhaps most important for the project is the structure of *reciprocity* inherent within the model itself, "*where sometimes a knowledge of form leads us to the interpretation of forces, and at other times a knowledge of forces at work guides us towards a better insight into form.*" A reciprocal exchange of "*growth and form or structure*" is developed between the architectural intervention and the context in which it operates.

Urban Interventions - Miami

The Urban Intervention project serves as a vehicle to expand Thompson's dynamic model of "*growth and form or structure*" into the domain of architectural production. To test the design methodology, a strategy was developed to deploy a **topological seed** within a specified urban force field and to animate the auto-generative process of internal formational response to the external forces of events layered within the given context. The formation read-out diagrams emerge as the seed collapses into the field of influence and begins to fold: forming new, unanticipated, dynamic and fluid spatial "alliances" and "affiliations" with the urban context.

Urban Force Fields and Topological seeds

There are, of course, as many ways to map a context as there are ways to occupy its exigencies. The creative role in the development and structure of the urban force field study could only be arrived at after considerable experimentation. In preparing the construction of the urban force field, the project was initially studied on two different sites within the fabric of Miami and Charleston. Each of the potential territories was analyzed and mapped using the same criteria. Both cultural and contextual attributes of the site were considered as co-present forces active within the “*diagram of forces*.” Numeric values were assigned to the different attributes of the site in order to activate the field of influence. Careful consideration was given to “*forces and resistances other than the main one*.”

As the project developed, the importance of the topological seed type became obvious due to its inherent properties and its resultant behavior to the external forces constructed with the urban force field study. Many of the different types of topological conditions experimented with yielded unsatisfactory results, as the focus of the project was the formation of spatial phenomena, its structures and implied spatial organization. Simple or even complex conditions of a surface with only a single spatial cavity were rejected. In the study for example, it was discovered that a single continuous welded mesh type seed could only yield, at most, a single spatial cavity during the formation process. Spherical topologies and other blob like morphologies were also eliminated from the study as they already represent a worn path within this emerging spatial discourse. Having made those adjustments, it is interesting in retrospect that the most spatially productive of the topological seeds was a cube with detachable faces of which each is composed of a nine square mesh. The multiplicitous sets of internal and external exchanges, spatial cavities, tubes and spatial folds engendered rich architectural potential. The dynamic deformation of the pure mathematical model of the cubic seed is significant because it offers an alternative to a more conventional static model of the cube as it is so often used in architectural design. Not surprisingly, this seed type is more in alignment with Thompson's understanding “*If no chain hangs in a perfect catenary and no raindrop is a perfect sphere, this is for the reason that forces and resistances other than the main one are inevitably at work*.”

Diagrams and the Formation Read-Outs

Thompson's “*twofold concept of growth both as a force and as a process*” is significant relative to the computational modeling and its animation. Here it is also noted that the notion of the diagram and its formation in time is perhaps most important. As the formation diagram develops, it incorporates into its structure and form the events it encounters. Rather than being solid and standing against the forces of the urban condition, it is allowed to enter into new relationships with it. In Thompson's words again, “*...we rise to the conception of form to an understanding of the forces that give rise to it*.” The result is a condition of the diagram that is neither static nor an appropriated condition used to represent a formal idea.

Project Resolution and Conclusions

It should be understood that the auto-generative processes developed with the research project did not produce a building; rather the formation read-outs should be read as an integral component of a speculative design process. The formation diagrams themselves are operational, they can be understood as both mechanical and material topological fabrics in themselves and they can also be read as an inbetween condition suggestive of

possible spatial and organizational systems. They are pliable. To further test the study of the architectural potential of the formation read-out diagrams particular issues concerning scale, occupation, and materiality were layered into the project with both digital and physical modeling. The reading, translation and programming of the topological meshes were supplemented with the introduction of a simple program for a public pavilion.

