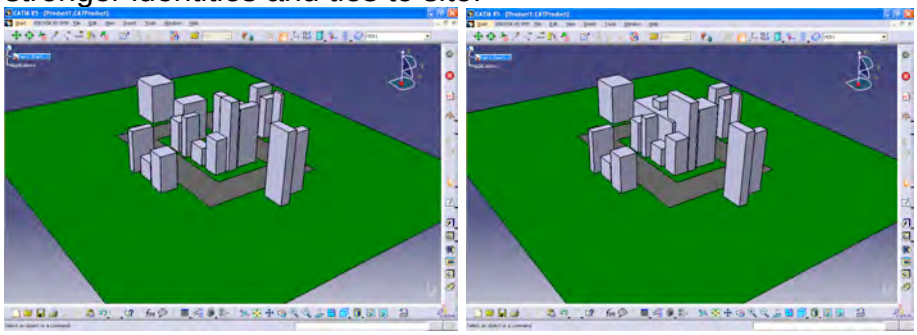
BETÜL TUNCER

Paper : **Urban Block in Terms of Generative Systems**

Abstract:
The purpose of the study is to create a computational tool that generates unique urban block alternatives by mimicking the site's built environment. The necessity to create such a tool has stemmed from observations of physically un-harmonious neighbourhoods. This tool is claimed as the initial phase of a new urban tool that generates urban blocks that respond to their built environment and help establish harmonious neighbourhoods.
The plug-in refers to built environment of the site in terms of facades. It mirrors neighbour building façade forms vertically onto four sides of the site border. Then a "for loop" in the script starts generating new depth values for the façade forms therefore it creates new plan combinations while referring to neighbour buildings in terms of façade.
Although it establishes symmetric streets, the plug in helps creation of unique plan alternatives which can be customized by the user to become a whole building or a building complex with inner gardens and outside spaces.
With the establishment of symmetric streets, the attention of the audience is aimed to be dragged on how architects should elaborate on creation of new buildings that reflect qualities of their built environment therefore create buildings that respond to their environment.
This study is only a first step for an urban generative system and continues to ask how other layers –especially context- can be integrated and coded into the system so that the products have stronger identities and ties to site.



Two alternatives generated with Catia.

Topic: Architecture

Author:
Betül Tuncer
Research Assistant
Doğuş University
Sinan Mert Sener
Assoc. Prof. Dr.
Istanbul Technical University

References:
[1] D. Cardoso & T. Nagakura, "The Melinkov Grammar", Formal Design Knowledge and Programmed Constrstructs, MIT, 2007,
[2] P. Müller, & Y. Parish, "Procedural Modeling of Cities", Procedings of International Conference on Computer Graphics and Interactive Techniques ACM Siggraph, Los Angeles USA, 2001.

Contact:
betultuncer@alumni.virginia.edu

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Computational design, Urban design, Responisive design, Symmetry

Urban Block in Terms of Generative Systems

Research Assistant Betül Orbey
[1] *Doğuş University, İstanbul, Turkey.*
borbey@dogus.edu.tr

Assoc. Prof. Dr. Sinan Mert Şener [2]
Istanbul Technical University, Istanbul, Turkey

General

This paper will present a study in which a plug-in is developed for an early phase of site planning process and discuss elements necessary for urban generative systems. An urban block is chosen as a reference point and the plug-in is designed to generate design alternatives referring to its built environment aiming at establishing a coherent city image as a result. A coherent city image has been taken as the first step for an urban generative system.

Today, matter of designing responsive environments is being discussed. Many design projects consist of a set of sensors either responding to humanly actions such as movement or climatic conditions such as heat or humidity. However, there are not enough design projects that respond to their built environment even at the most basic level, which in this study is considered as the visual level. Taking the environment into consideration has almost been forgotten among mechanically responsive devices, robotized and iconized buildings so that today, it is harder to give a neighbourhood a character because every building block in a neighborhood is disconnected. Therefore, an alternative generation system that generates an urban block in response to its built environment would help initiate neighbourhoods that are visually in harmony.

The aim of this study is to draw attention to ways in which urban blocks can respond to built environment. This study claims that the face of the city is important and the built environment should be valuable enough to look upon, mimic and even to learn from.

On the other hand, this study prepares a platform to discuss layers of an urban generative system. Although a coherent city image has been taken as the first step to an urban generative system, what are other layers to such a system? How can harmony be further established through other layers? How can identity of the urban entity come forward in such a study?

1. Generation of an Urban Block

Many efforts to design beautiful and healthy cities had been spent throughout the history. However, all of them had imposed a grand plan to be applied on a city. This study is related to city design at a scale of urban block. The urban block is perceived

as the building block of a city. If the building block is well developed, it consists of a very high potential to become a well-developed city as well. The method applied in the study offers a bottom-up approach to urban design allowing the method and the design of future cities to be unexpected and surprising.

In this study visual harmony, a consistency in physical form of architecture is sought after. This method is applied to establish consistency of visual form and act as a manifesto, when applied to most sites in a given city, which underlines the fact that appreciation of aesthetic values is degrading.

The method used in this study has been to develop a plug-in suggesting a way to design an urban block that responds to its built environment. A literal approach has been followed in responding to the environment. Simply, the plug-in mimics its environment to generate forms in elevation by taking mirror images of its neighbour building contours across the street and placing the 2D image on the side border of the site. The plug-in computes new site design alternatives by converting the 2D image into 3D by giving it depth values. This process is applied on all four sides of the site generating new plan alternatives with elements merging inwards from all sides while the elevations are filtered down to their contour lines and are represented abstractly as solids that establish harmony with the neighbourhood.

The application has been accomplished through using Microsoft Excel to generate and store values necessary to be able to draw the mass models; and Catia has been used to visualize the model by linking the Excel Design Table. In the Excel file, the user can create an imaginary environment by using randomly generated values, adjust the proportions of the buildings, how they are distributed on the edge or enter real dimensions of a measured environment manually; the user can also generate all the possible depth values that the recently created urban block elements can take as well as the minimum and the maximum value range between which the depth values are picked. This approach yields the designer to be more in charge of the restrictions through changes made in Excel Table.

First, the user either generates the environment randomly or by putting in values manually, saves the Excel file and updates the Catia file. After Catia generates the environment, the user has to go back to the Excel file to stabilize the environment building values if he has created it randomly by typing in 0 in the related rows of the 3rd column and copying the values in the 5th column which are resulting values for randomly generated environment and paste it into column 2 from where Catia will read the values. The user also needs to type in 1 for depth values of generated building rows in the 3rd column so that they can generate new values within the specified limits. Then the user saves the file and goes back to the Catia file and updates it and Catia generates a new alternative.

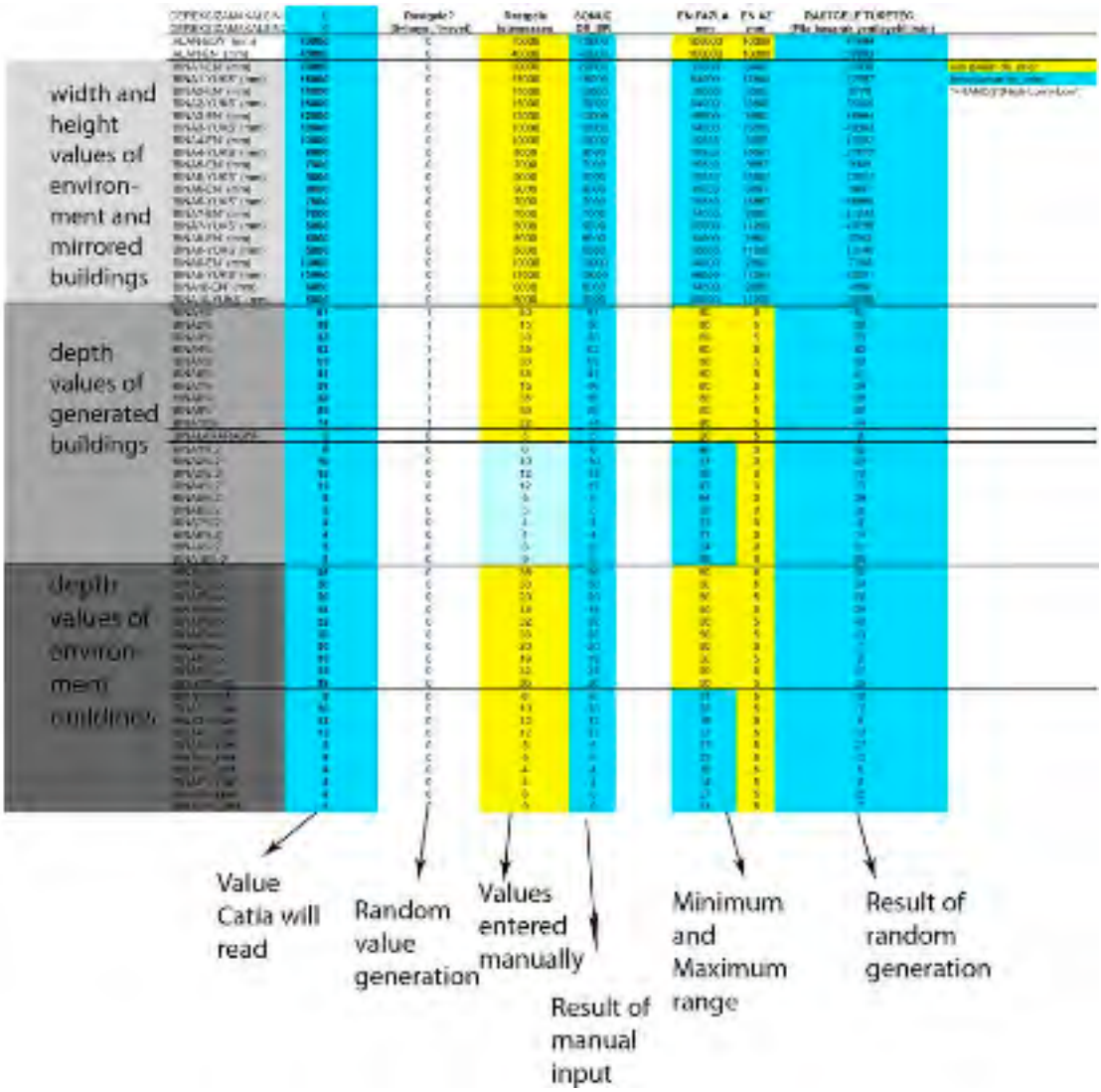

Figure 1: *Excel Table*

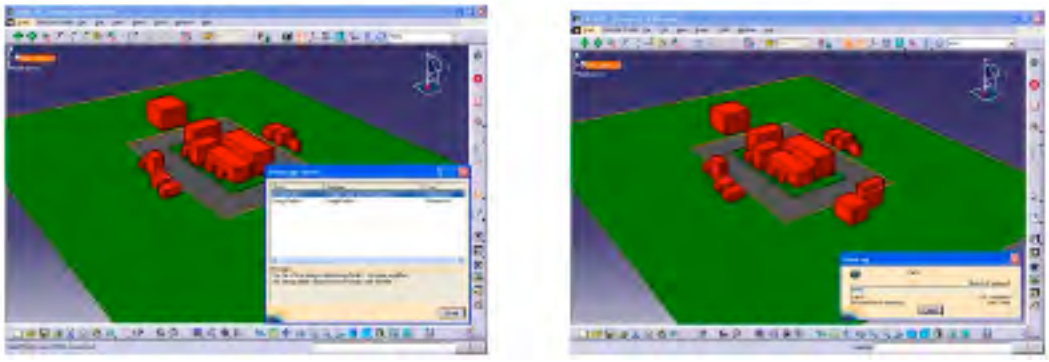

Figure 2 : *Linking Excel Design Table to Catia and Scene Update.*

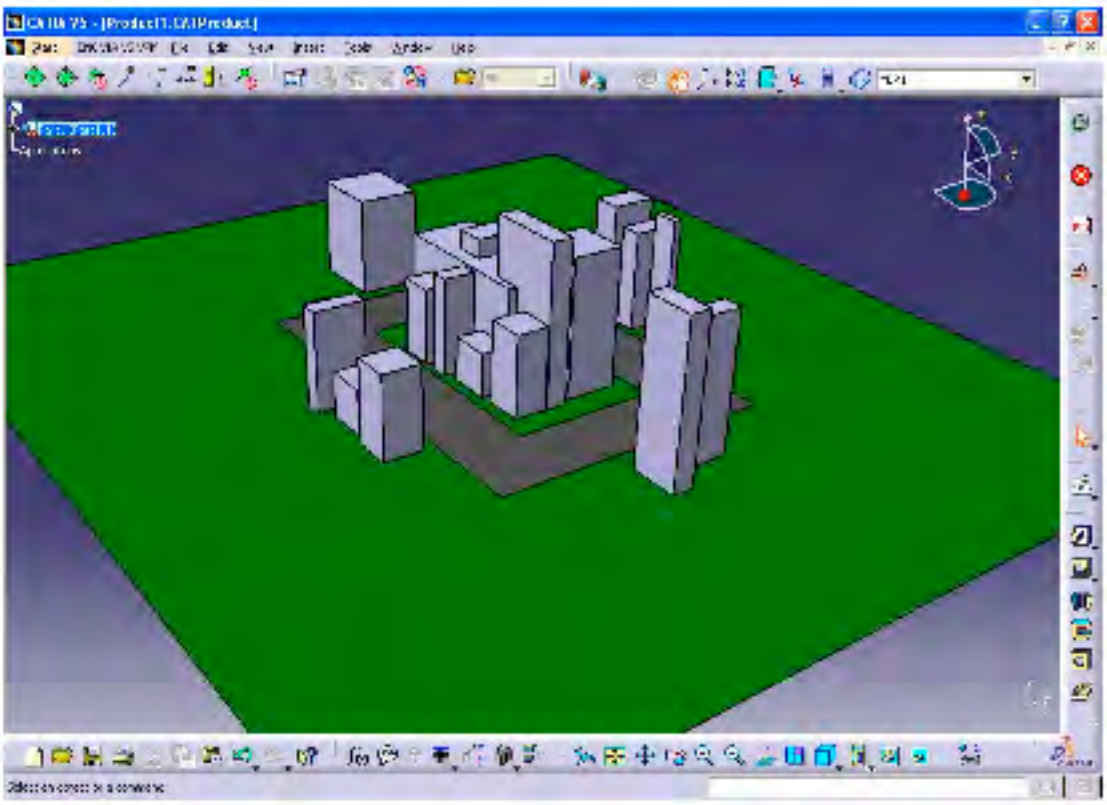

Figure 3: *Example of a generated alternative.*

2. Further Steps for an Urban Generative System

This study takes a concrete step towards an urban generative system with a concrete approach regarding the visual coherence of a city. This brings up questions about how to proceed to further steps of the system and other layers of such a generative system.

Harmony is a key issue when dealing with any architectural element. So far harmony is considered in terms of visual coherence. However, there is more to an urban organization than visual harmony. Identity of each city is unique to itself. History, social and economic considerations, geographic properties and many more programmable and un-programmable issues affect an urban development. This point is important and brings subjectivity on the table. The question of how context can be integrated into urban generative system may come up with answers that are subjective and may be hard to code. It is important to find answers to integrating context issue since only then generated urban entity will have a strong identity.

3. The Bottom-Up Approach and Others

Attempts to improve quality of life have been made at city scale by numerous planners. In this study, it is advocated that the character of a city should not be imposed with a grand plan but rather, should be adopted starting with the simplest urban unit, a block, which is referred to as the building site. The new urban block in itself embeds a bottom-up approach. Addition to that, it allows for further studies on clustering strategies for growing future cities.

Fieldwork regarding urban morphology generation is explained in the study are selected depending on different aspects that links the project with this study and the plug-in that is developed. The projects analyzed in this study include CityEngine (Müller and Parish, 2001), The Melinkov Grammar (Cardoso and Nagakura, 2007), CityZoom (Turkienicz and Golçalves and Grazziotin, 2008), Urban Design with Patterns and Shape Grammars (Duarte, Beirao, 2009) and Smart Solutions for Spatial Planning (SSSP) [2].

It has been observed that most of the efforts combine Shape Grammars and all of them are composed of Rule Based Systems, similar to this thesis. However, this thesis is unique and differentiates by focusing only on block generation, which is rarely seen in the approaches explained.

CityEngine has presented a different method in defining an urban block by applying a recursive algorithm on the site boundary defined by roads established by applying various steps provided by the software. CityEngine also differs the way in which it approaches to design of a city : top-down. This thesis follows a bottom-up approach, which makes the result unpredictable, unlike CityEngine.

This thesis takes urban block generation into consideration in a bottom-up approach similar to the Melinkov Grammar where the end result is complex although the process and the initial shapes are very simple. However, this thesis differentiates from the Melinkov Grammar approach in that the Melinkov Grammar is a 2D generation tool where this study generates solid urban blocks in 3D rather than a 2D city network.

CityZoom is highly oriented to enable the user visualize a city according to regualtions and modify it as a result of a set of performance models. It aims at finding a balance between design needs and regulation requirements. The software does not offer a system that creates a city from scratch as it is intended with this thesis.

Urban Design with Patterns and Shape Grammars Studio does not offer a computational product. This study has been explained within this thesis to present as an experiment that proves efficiency of Rule Based Systems as well as because it consists of approaches developed to generate an urban block at a level that is not present in other models explained.

Smart Solutions for Spatial Planning is another software developed which takes generation of a city into consideration from urban scale to building scale including a step to generate urban block alternatives. The software presents an approach on building block generation depending on generation of allotments with reasonable dimensions for development of buildings and open spaces following a recursive search method. Building masses are created taking climatic considerations into account and making a distinction between public and private realm. This step of the software relates to this thesis in terms of intention to create urban blocks with building masses but differentiates with its methods. SSSP uses a recursive search method in dividing the plot into allotments depending on optimization rules. However, this thesis simply mimics the environment to create a new design.

As seen in precedent works, systems are not as complex to integrate contextual information and they heavily depend on geometric associations, which is similar to this study's approach.

4. Conclusion

The proposed plug-in has been developed in order to help the architect or the city planner with creative design alternatives that are also in visual harmony with its built environment. The generated solutions are desired to force the user and the readers of this study to put emphasis on responding to environment when designing cities.

In the future, this study has the potential to be further developed to form clusters of urban block growing in accordance with other layers of urban generative system. This study will act as the first step of a future city generation engine with a bottom-up approach growing computationally from inside out and it is currently still assessing questions regarding mentioned layers and how to incorporate context within the system to establish a stronger identity of the product.

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[2] http://www.vimeo.com/2023898