Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Konstantina Chouliara

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Konstantina Chouliara
Student number	4744292
Telephone number	
Private e-mail address	

Studio		
Name / Theme	Building Technology	
Main mentor	Pirouz Nourian	Design Informatics
Second mentor	Willem van der Spoel	Climate Design
Argumentation of choice of the studio	My goal is to contribute in renovating the existing building stock in order to restrict the magnitude of the housing problem. The topic I want to research is a combination between architectural, computational and climate design with an emphasis on the architectural part.	

Graduation project	
Title of the graduation project	Cochleas: a methodology to convert an existing layout into a residential one
Goal	
Location:	The Netherlands
The posed problem,	Renovation of buildings is a topic that concerns many architects all over the world. Generative design seems a promising field to apply computational methods in the primary design renovation process. To do so the design task has to be translated in mathematical terms. The formulation of the part of the design process in a mathematical way constitutes the part that will be attempted to be automated. The approach constitutes basically the development of an algorithm whose parts are a combination of manual and automated subtasks. In some cases the manual work is legitimate as for example the inputs (building, program of requirements, desired proximity between rooms) and in others it is a limitation due to computational power or lack of advanced programming skills.
research questions and	The main research question of the graduation project can be formulated as: "To what extent is it possible to convert an existing

	layout into a residential one regarding proximity relationships and illuminance requirements using computational tools during primary design stages?". Subquestions: 1. What method can be used to find the optimal position of the rooms in respect to their proximity relationships in primary stage of a renovation design process? 2. What method can be used to find the optimal position of the rooms with respect to their illuminance requirements in primary stage of a renovation design process? 3. How to combine daylight and proximity preferences in one layout design configuration? 4. Are existing plugins for Grasshopper useful for the thesis' purposes?
design assignment in which these result.	The purpose of this project is to propose a methodology to wave proximity relationships with illuminance requirements. The designer inserts existing geometry of the building in the software. An illuminance analysis of the room is performed so as to determine the ideal light locations for each room according to regulations. The user inserts the desired proximity and illuminance requirements of the rooms in the form of points and lines and prioritizes them. Given these inputs the goal is to place the rooms in positions that the objective function (potential energy) is minimized. The tool finds the optimal position of the rooms regarding proximity and illuminance requirements in the given boundaries without overlapping themselves by simulating it as a spring network and produces the bubble diagram. The diagram produced serves as the starting point for the designer to further develop the layout into a proper floorplan manually.

Process

Method description

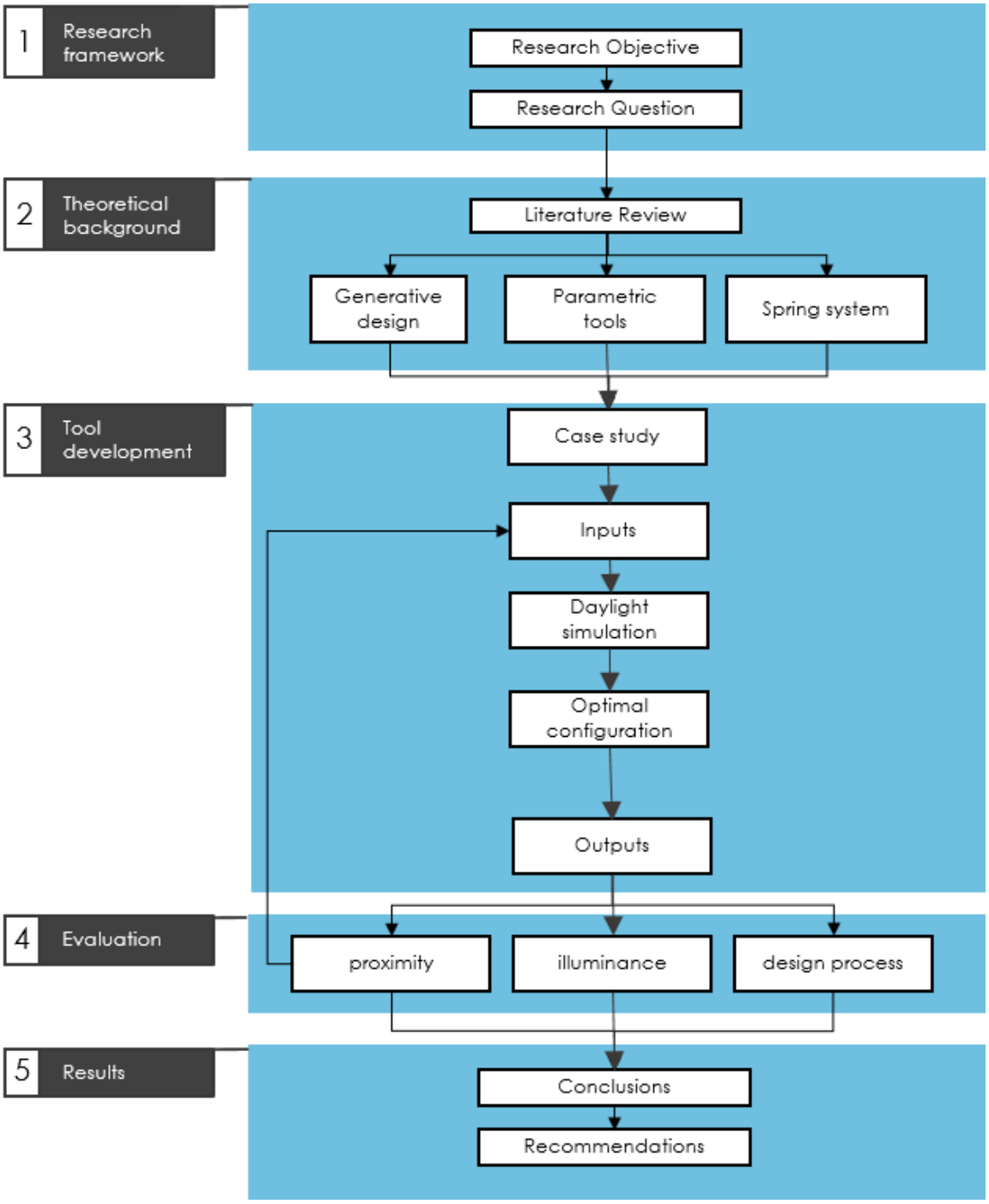
The first step in the graduation research is to formulate the research framework. In order to define the research objective a research of the relative background and the conventional methods of renovation design processes was conducted to spot the knowledge gap. After having set the research objective the research question and subquestions has to be defined in a more clear way.

The second step is to obtain the necessary theoretical background. This includes reading relative literature regarding generative design in layout applications, exploring existing commonly used parametric tools and finding a representative case study to apply the proposed methodology.

During the third step the specifications and assumptions are set so as to start the tool development. In the beginning the main skeleton of the tool is defined by relative research and it is fully developed when applied in the case study. By following the proposed methodology it is possible to produce and evaluate the outputs. If the result is not satisfactory the process has to be repeated but this time the chosen parameter should be shifted slightly to observe its impact. By repeating and improving the tool starts to take its final form.

In more detail, the tool is developed in five stages: the first stage starts with all necessary input set by the user, then an illuminance analysis is performed in order to obtain the lux values, afterwards the optimal configuration is found by performing dynamic relaxation. The configuration is later evaluated based on proximity and illuminance requirements set at the beginning. The output of the tool is a schematic layout (bubble diagram) indicating the ideal position of the rooms as well as their corresponding lux values.

The evaluation step is a test to check how the tool performs in larger and more complex cases. The last step includes the discussion upon the results, the conclusions drawn from the discussions and recommendations for improvement of the tool and further research.



Literature and general practical preference

The topic of this thesis is relatively new so the most relevant existing literature are academic projects by individuals. The first three projects use parametric tools as the design environment, while the last two make use of graph theory in their approach. Graph theory is not the approach for this thesis but was used as an inspiration only (graph, adjacency matrix). The project closes to the approach proposed is "Architectural space planning using parametric modeling" by M. Elsayed where he also

simulates the problem as a physical system. During the research some other projects developed by students were found but were not officially published and or well documented and therefore were not included in the review. The overall impression is that there are many gaps in relative literature and every attempt is beneficial.

The following software applications are related to the scope of this research in that they provide various methods of modeling and processing data. Some representative tools would be: Rhinoceros by Robert McNeel & Associates, Grasshopper by David Rutten & Robert McNeel & Associates and KangarooPhysics by Daniel Piker.

References

sites: TU Delft library, researchgate, Elsevier, academica, Scopus, Google scholar
books: TU Delft library, personal collection

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Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

The current graduation project is directly related to MSc Architecture, Urbanism and Building Sciences and the Building Technology track. Firstly, the computational methods proposed are intended to be applied in existing buildings, in real life scenarios, which is what architecture and building sciences is about. The case study selected empower the practicality and the usefulness of the tool and is itself a property of TU Delft (Faculty of electrical engineering, mathematics and computer science). The intention to contribute in the systemization of the renovation design process is an architectural intention interwoven with sustainability, that is one of the main aspects of Building Technology track. Building Technology is also the field where architects are more oriented towards engineering. Mathematics and physics are some of the fundamental subjects of an engineer. Engineering is also about improving existing methods as well as inventing new ones. In this dissertation the innovation lies in developing a methodology on how to systemize a renovation design project using principles of computer science, mathematics and physics.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

As far as society concerns, renovation was and still is an import design assignment, especially in countries where its available to build area is limited. Converting existing buildings into residences is a way to tackle the housing problem many people (locals

and expats) from all over the world face. In a professional point of view, finding a way to systemize the renovation design process could have a great impact on the way architects would approach a renovation project since the very beginning. As soon as they have an initial design idea by following the suggested methodology it would be possible to insert the necessary data and produce the schematic residential layout based on the two –most important according to the author- design criteria: proximity and daylight. One of the main advantages of computational applications is that they can handle a respectable amount of data simultaneously. This means that many levels of complexity can be added to the tool and in that way help the architect find the optimum layout. This could speed up the design process and also produce non-conventional but still functional layouts.