

Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences



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	Alessio Vigorito
Student number	4946219
Telephone number	
Private e-mail address	

Studio		
Name / Theme	Building Technology / Sustainable Design Graduation	
Main mentor	Ir. Joris Smits	Structural Design
Second mentor	Dr. Michela Turrin	Design Informatics
Argumentation of choice of the studio	I am fascinated by the strong coexistence of the architectural and engineering discipline in bridge design.	

Graduation project	
Title of the graduation project	Towards a Sustainable Bridge Design with the support of optimisation processes and decision making systems.
Goal	
Location:	EUR/Magliana, Rome. (Ponte dei Congressi)
Problem statement	<p>In 2000, the municipality of Rome solicited a design competition for a new bridge located in the southwest quadrant of the city expressing the desire to build it for the year 2025. The new connection designed for both vehicular and pedestrian traffic will have to cross the Tiber river and serve as a new entrance to the city of Rome. The design of the bridge must be able to satisfy the functional requirements keeping in mind the strong relationship it will have with the nearby E.U.R. district, dominated by a monumental and rationalist architecture.</p> <p>The bridge will have to be durable, functional, and architecturally beautiful while considering the impact that it will have on the environment since the construction industry has to face the need for sensitivity concerning global sustainability.</p> <p>With the consequent rising demand for sustainable and resilient infrastructures, an approach which considers the optimisation of a structure to the best of its efficiency is nowadays stronger than ever.</p>

Research questions	<p>The hypothesis behind this research is that by using computational optimisation methods, the choice between alternatives that have as objective to achieve a sustainable design can be facilitated. The use of such methods can minimize the environmental impacts of the building while aiming at having economic sustainability without overshadowing its performance and architectural quality. In the context of an optimisation of the bridge design process, the following research question is formulated:</p> <ul style="list-style-type: none"> • In what ways does the optimisation method impact the design process workflow and to what degree do these add value in respect to the project's sustainability? <p>The research will also address the following sub-questions:</p> <ul style="list-style-type: none"> • What are the main parameters to consider in order to make a parametric model suitable for this research? • How can be implemented a system to support the decision making from the output of the optimisation process? • To what extent can a designer influence the final result of the optimisation process in order to remain in control of the outcome of the original design? • Can the optimisation method used provide the designer directly with an optimal solution?
Design Assignment	<p>The research will be applied to the design of a bridge located in Rome, in the south-east of the city between the EUR and Magliana districts. The design must represent an effective application of the proposed method as well as be well integrated at the urban level, considering also the relationship it will have with the architecture of the neighboring districts.</p>

Process

Method description

This research has the aim of experimenting with a new method of evaluation and aid for the choice between different alternatives within the design process. The outcome will be the realization of a design as finite as possible, defined from its urban scale to the most important details. The study will go through three main phases introduced below.

Research Phase: it will be vital to understand what are the main factors to consider in the design of a bridge, as well as for the evaluation of what are the main criteria to be implemented in a MOO process and eventually a MCDM method. As far as the practice of bridge design is concerned, the main structural typologies, construction methods and design guidelines will be analyzed. As regards the computational part, the various optimisation methods will be examined, identifying the ones that uses a methodology best suited to the purpose of the research. The available tools to assess the sustainability of a project and the indicators needed for the research will be investigated. Consequently, case studies where optimisation processes have been used in the practice of bridge design will be analyzed.

Design Phase: the first step will be to carry out an analysis of the context, necessity and criticality of the chosen case study as well as a first urban-scale design to define the first restraints useful for the architectural concept design. Once the architectural design will be defined, the variables and criteria to be considered for the optimisation together with the best way to assign them a weight will then be assessed. The design will then be refined to obtain a quality and safe architecture where structural optimizations will then be taken into consideration. Finally, attention will be paid to crucial details of the project.

Evaluation Phase: Finally this research will evaluate the results obtained by taking a look both at the enhancement of the project's sustainability and at the role of the optimization methods within the work-flow of the design process. The final design will be critically evaluated to identify its strengths and eventual flaws, suggesting in case possible changes to the design workflow embraced.

Literature and general practical preference

The literature used for this research will be based on codes, books, research, and conference papers regarding the practice of bridge design and optimization processes. Documentation obtained by the municipality of Rome regarding the urban context and the characteristics required in the new project will be consulted too.

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 graduation topic "Sustainable Bridge Design through the use of optimisation processes and decision making systems" relates to the studio topic "Bridge Design" as the main objective will be to apply the outcomes of the research in the design of a bridge. The research focuses on the aspects to be taken into consideration for the construction of a bridge that is sustainable according to different indicators, the use of optimization processes will serve as an aid in the realization of the design.

The topic relates to the master track of Building Technology as its aim is to enhance the application of innovative engineering and architectural design knowledge in obtaining a sustainable design that can be integrated in the built environment.

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

From a social point of view, the design of a bridge in the chosen location requires solving various problems related to the architectural and historical context of the area. Furthermore, the functionalities needed for the bridge that will serve as a new landmark and access to the city must be satisfied in compliance with the needs of the community. The research, therefore, wants to propose a solution that can be realized from a sustainable perspective.

The scientific relevance of the research is firmly based on the use of new computational design strategies, in particular, in the field of optimization. the study, therefore, wants to explore the potential of these tools by applying them in the practice of bridge design.

TIME PLANNING																																								
PROGRESS		P1										P2					P3					P4					P5													
WEEK		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35				
DATE		12/11/2019	19/11/2019	26/11/2019	03/12/2019	10/12/2019	17/12/2019	24/12/2019	31/12/2019	07/01/2020	14/01/2020	21/01/2020	28/01/2020	04/02/2020	13/02/2020	18/02/2020	25/02/2020	03/03/2020	10/03/2020	17/03/2020	24/03/2020	31/03/2020	07/04/2020	14/04/2020	21/04/2020	28/04/2020	05/05/2020	12/05/2020	19/05/2020	26/05/2020	02/06/2020	09/06/2020	16/06/2020	23/06/2020	30/06/2020	07/07/2020				
RESEARCH PHASE																																								
BRIDGE DESIGN	Structural Typologies																																							
	Construction Methods																																							
	Program Requirements																																							
DESIGN OPTIMISATION	Optimisation Processes																																							
	MCDM Methods																																							
	Examples in Practice/Research																																							
LOCATION	Sustainability Assessment																																							
	Context Analysis																																							
	Project Requirements																																							
DESIGN PHASE																																								
	Urban/Architectural Draft Design																																							
	Parametric Model setup																																							
	Design Optimisation																																							
	Detailing																																							
	Final Design																																							
EVALUATION PHASE																																								
	Outcome Analysis/Reflection																																							
	Evaluation and Remarks																																							
DOCUMENTATION																																								
	Report																																							
PRESENTATION																																								
	Presentation																																							
	Model																																							
RETAKES																																								
	Building Physics																																							