Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

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

Personal information	
Name	Arwin Hidding
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Studio	
Name / Theme	Hyperbody studio: Non-standard and Interactive Architecture
Teachers / tutors	Henriette Bier, Nimish Biloria, Sina Mostafavi, Gary Chang, Ana Anton, Serban Bodea
Argumentation of choice of the studio	One of the main reasons I chose to pursue my graduation project in the Hyperbody studio is because this studio is teaching how to use parametric tools in the design process.

Graduation project	
Title of the graduation project	Networking form (subject to change)

Goal	
Location:	Ons Park, Noordereiland, Rotterdam
The posed problem,	[Problem Statement]
research questions and	[Research Question]
design assignment in which these result.	[Design Assignment]

Problem statement

The goal of the design studio is to formulate a design proposal for a 7000 m2 pavilion for the World Expo in 2025 in Rotterdam. The theme of the world expo is: where ambition turns environmental challenges into economic opportunities. The building industry is a large polluter, since manufacturing processes cause a lot of waste and has a high energy consumption.

The paradigm shift from mass standardization to mass customization is made possible by the third industrial revolution, namely the robotization of the manufacturing industry. When the manufacturing processes in the building industry is robotized this could reduce energy consumption, reduce waste, increase efficiency and use less materials while allowing humans to specialize.

Robotic devices are already being used in the manufacturing industry, but they are not being used to their full potential. The tasks they are most commonly given are repetitive, because of limitations in the software and willingness/knowledge of manufactures.

During the World Expo in Rotterdam 50 million visitors are expected to visit during its 6 months duration. In Shanghai during the World Expo this caused a lot of problems (waiting lines, insufficient public transport, etc).

Goal
The pavilion should showcase the development of the robotic devices that will allow for mass customization in the building industry.

ROS industrial consortium is a developer of open source robotic software and apply the software to the manufacturing industry. During the World Expo, the ROS industrial consortium will exhibit the newest technologies and showcase the major developments. After the World Expo the pavilion will be used as a research, education and conference centre by ROS.

Research questions
- In what way can the pavilion be shaped so the visitor will be stimulated to explore the pavilion and its exhibitions?
- In what way can the paths to the pavilion and inside the pavilion be shaped to account for these people flows?
- The inhabitants of the Noordereiland in Rotterdam appreciate the park space on the chosen site. In what way can the pavilion be placed to maintain or improve the qualities that are present on the site?

Design assignment
- Create a pavilion that will stimulate the visitor to become curious and explore the pavilion and its content.
- Shape the paths to and inside the pavilion in a way that takes into account the number of expected visitors.
- Place the pavilion in a way that either maintains or improves the qualities that are present on the site.

Process

Method description

The assignment for the design studio is to make a design proposal for the 2025 World Expo in Rotterdam.
- Curiosity and exploratory behavior research
- Agent based generative design system for function placement
- Agent based generative design system for path generation
- Prototype porosity research (micro and meso scale)

Curiosity and exploratory behavior research
The concept that has been developed for the studio project states that the visitors in the pavilion need to become curious as they wander through the building. Case studies will be analyzed and research will be done in the field of environmental psychology and phenomenology in architectural theory in order to deduct a set of parametric design principles that will shape the geometry in a way that will arouse curiosity and exploratory behavior in the visitor. These principles will determine the functional layout by defining the sequence of spaces, the sizes, the relationship between visitors and the different activities in the spaces, lightness or darkness, acoustic requirements and other aspects that will influence the experience in the pavilion.

Agent based generative design system for function placement
The analysis of the site will inform where the spaces will be placed, in accordance with the curiosity principles. These analysis includes wind conditions, acoustic conditions, view lines, access, solar radiation analysis and existing infrastructure. The curiosity principles and site analysis will ensure that the functions are placed in a way that fulfill all the different requirements. The self organizing system will generate multiple iterations that might differ slightly or significantly. All iterations however should meet the requirements, because they have been incorporated in the rules of the system. From these iterations a solution will be chosen, based on certain criteria.

Agent based generative design system for path generation
The next system will look into the people flows towards and inside the pavilion during the World Expo and will find solutions for the paths towards the building. It will also create the paths between the spaces that have been placed on the site. This process of generating paths will also be guided by the curiosity principles.

The result of these two systems will be a primitive geometry on the site, a three dimensional landscape where the pavilion, the paths and the park spaces overflow in each other.

Prototype research
The prototype investigates how multiple aspects can be embedded into one geometry on the micro and meso scale. This prototype acts as a blueprint for the design studio, its principles can be developed further and applied to the primitive geometry on the site.

Literature and general practical preference
Media studies

Hyperbody's MSc 3 course on Media Studies provides theoretical and historical background on the influence of industrial and digital technologies on society, culture, and architecture as well as practical knowledge with respect to the use of interactive media in architectural design and architecture. Lectures, seminars and workshops address issues such as (1) Industrial And Digital Production, (2) Modernity And Contemporaneity, and (3) Interactivity In Contemporary Art and Architecture emphasizing the paradigm shift towards Industrial (Mass) Customization through Parametric Design and Computer numerically Controlled Fabrication as well as a development towards incorporating sensor-actuator technologies in architecture.

Oosterhuis, K, Xin, K & Slootweg, O (2010) "iA#3 - Interactive Architecture" Jap Sam Books
Berlyne, D. E. (1960). Conflict, Arousal, and Curiosity. New York: McGraw Hill.
Berlyne, D. E. (1950). Novelty and curiosity as determinants of exploratory behavior. British Journal of Psychology, 41:68-80.
Berlyne, D. E. (1954). A theory of human curiosity. British Journal of Psychology, 45:180-191.
Fowler, H. (1965). Curiosity and Exploratory Behavior. New York: Macmillan.

Loewenstein, G. (1994). The Psychology of curiosity: A review and reinterpretation. Psychological Bulletin, 116(1):75-98.
Langevin, R. (1971). Is curiosity a unitary construct? Canadian Journal of Psychology, (25) 360-374.
Franken, R. E. (1994). Human Motivation, 3rd ed. California: Brooks/Cole.
Henriette Bier and Terry Knight "Dynamics of Data-driven Design" Footprint 15th issue ed. Henriette Bier and Terry Knight (Delft: TU Delft, Stichting Footprint, 2014)
Kas Oosterhuis and Henriette Bier, Robotic(s in) Architecture, (Heijningen: Jap Sam Books, 2013)
Henriette Bier and Terry Knight, "Digitally-driven Architecture", Footprint 6th issue Eds. Henriette Bier and Terry Knight, (Delft: TU Delft, Stichting Footprint, 2010).
Henriette Bier, "Robotic Environments", International Symposium Automation and Robotics in Construction, (ISARC, 2011)
Henriette Bier "Interactive Building", Advances in Internet of Things, Vol.2, No.4, (AIT, 2012)

Reflection

Relevance

I think that my project could have a life beyond pure academic work, and could eventually join the current debate about the way architecture is being designed and produced.

Time planning

31 Aug 2015- 7 Sept 2015	**Introduction to MSC3 and design assignment.**
7 Sept 2015- 14 Sept 2015	**Urban analysis in groups and Rotterdam site visit: Mapping, data collections, interviews and photographs.**
14 Sept 2015- 21 Sept 2015	**Further development of site analysis and data collections**
21 Sept 2015- 28 Sept 2015	**Agile-Fab workshop: agent based generative design systems introduction and development.**
28 Sept 2015- 5 Okt 2015	**Agile-Fab workshop: Development of Agent Based design systems**
5 Okt 2015- 12 Okt 2015	**Development of generative design system and initial concept formulation. Rotterdam Site Visit: Mapping, data collections, interviews and photographs.**
12 Okt 2015- 19 Okt 2015	**Development of generative design system and concept Development**
19 Okt 2015-	**Development of generative design systems: paths placement and function distribution. Concept Development.**

26 Okt 2015	
26 Okt 2015- 2 Nov 2015	**P1 Presentation: Presenting Agent based generative design strategies for placement paths and functions, conclusions and introduction to the site. Framing the Project Goal and Research Goals.**
2 Nov 2015- 9 Nov 2015	**Development of generative design system and concept development.**
9 Nov 2015- 16 Nov 2015	**Development of generative design system and concept development. Preparation of the D2RP workshop**
16 Nov 2015- 23 Nov 2015	**Design to Robotic Production workshop(D2RP): porosity research to the production of a prototype with an industrial robotic arm**
23 Nov 2015- 30 Nov 2015	**Design to Robotic Production workshop(D2RP): Development prototype**
30 Nov 2015- 7 Dec 2015	**Design to Robotic Production workshop(D2RP): Development prototype**
7 Dec 2015- 14 Dec 2015	**Design to Robotic Production workshop(D2RP): Development prototype. Development of generative design system and concept development. Case studies and curiosity research**
14 Dec 2015- 21 Dec 2015	**Design to Robotic Production workshop(D2RP): Development prototype. Development of generative design system and concept development. Case studies and curiosity research**
21 Dec 2015- 28 Dec 2015	**Holiday**
28 Dec 2015- 4 Jan 2016	**Holiday**
4 Jan 2016- 11 Jan 2016	**Development of generative design system and concept development. Case studies and curiosity research. Finishing Research Paper**
11 Jan 2016- 18 Jan 2016	**Design to Robotic Production workshop(D2RP): Development prototype. Development of generative design system and concept development. Preparation for the P2, refinement of the design systems and concept, production of a primitive geometry. Case studies and curiosity research**

18 Jan 2016- 25 Jan 2016	**P2 Presentation: Presenting concept, curiosity research, relation to generative design systems , the resulting primitive geometry on the site, initial materialization as shown in the prototype, and reflect on design system (aspects for improvements and potentials for further development)**
25 Jan 2016- 1 Feb 2016	**Design exploration and development of agent based generative design systems and primitive geometry.**
1 Feb 2016- 8 Feb 2016	**Design exploration, and refinement of agent based generative design systems and primitive geometry.**
8 Feb 2016- 15 Feb 2016	**Design exploration and refinement of agent based generative design, combining the macro, meso and micro scale, refine the primitive geometry**
15 Feb 2016- 22 Feb 2016	**Design exploration and refinement of agent based generative design, combining the macro, meso and micro scale, refine the primitive geometry**
22 Feb 2016- 29 Feb 2016	**Design exploration and refinement of agent based generative design, combining the macro, meso and micro scale, refine the primitive geometry**
29 Feb 2016- 7 Mar 2016	**Design exploration and refinement of agent based generative design, combining the macro, meso and micro scale, refine the primitive geometry**
7 Mar 2016- 14 Mar 2016	**Design exploration and combining the macro, meso and micro scale, focus on technical issues and details**
14 Mar 2016- 21 Mar 2016	**Design exploration and combining the macro, meso and micro scale, focus on technical issues and details**
21 Mar 2016- 28 Mar 2016	**Design exploration and combining the macro, meso and micro scale, focus on technical issues and details**
28 Mar 2016- 4 April 2016	**Design exploration and combining the macro, meso and micro scale, focus on technical issues and details**
4 April 2016- 11 April 2016	**P3 Presentation: Presenting concept, research, relation to generative design systems , the resulting geometry on the site, materialization, detailing in sections and plans, and reflect on design system (aspects for improvements and potentials for further development).**
11 April 2016-	**Design prototyping: producing physical models and tests**

18 April 2016	**with the robotic arm. Development of design. Detailing Overall scheme, along with detailed plans, and physical models.**
18 April 2016- 25 April 2016	**Design prototyping: physical models and tests produced with the robotic arm. Development of design. Detailing Overall scheme, along with detailed plans, and physical models.**
25 April 2016- 2 May 2016	**Development of design. Detailing Overall scheme, along with detailed plans, and physical models.**
2 May 2016- 9 May 2016	**Design detailing: Plans, sections, elevations, axonometrics, as well as physical models.**
9 May 2016- 16 May 2016	**P4 Presentation: Presentation of final scheme. Detailed Plans, sections, elevations and architectural details (material and construction).**
16 May 2016- 23 May 2016	**Finalizing material for final P5 presentation.**
23 May 2016- 30 May 2016	**Finalizing material for final P5 presentation.**
30 May 2016- 6 June 2016	**Finalizing material for final P5 presentation.**
6 June 2016- 13 June 2016	**Finalizing material for final P5 presentation.**
13 June 2016- 20 June 2016	**Finalizing material for final P5 presentation.**
20 June 2016- 27 June 2016	**Finalizing material for final P5 presentation.**
27 June 2016- 4 July 2016	**P5 Presentation: Preparation for final presentation.**