

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	Maria Valentini Sarakinioti
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Studio	
Name / Theme	Building Technology /Sustainable Design Graduation Studio
Teachers / tutors	Prof.dr.ing.Ulrich Knaack Dr. Michela Turrin
Argumentation of choice of the studio	The main reason for choosing this studio is because I am interested to research innovative solutions for existing problems in building construction and according to the future needs of the society. My aim is to research more in depth with a multidisciplinary approach problems and find innovative solutions for the building industry and the society.

Graduation project	
Title of the graduation project	Additive manufacturing and cellular structures for the production of a façade component.
Goal	
Location:	Delft
The posed problem,	During the last decades additive manufacturing methods became more feasible in the field of architecture and building construction. This new production method gives the opportunity to the architects and the engineers to give innovative solutions in designing, manufacturing and promoting new construction components in building industry. This production methods give the opportunity to achieve complex geometries in small tolerances (hierarchical, material and functional complexity) and be possible to apply geometries of the natural environment with great mechanical properties for solutions in building industry. Cellular structures that are produced with AM have good mechanical properties .Since it is an innovative production method there are still potentials that are not

	<p>explored yet and that can provide new additional functions for the cellular structures.</p>
<p>research questions and</p>	<p>How to create a cellular structure with good thermal properties with AM? How this cellular structure change its thickness? What is the geometry of this cellular structure? What is the relative density and the topology of the cell? Which is the suitable synthesis method to determine the appropriate connectivity and sizes of the cells? Which are the materials according with the functions that need to investigate? Which is the suitable additive manufacturing method in order to produce this cellular structure and what are the options that are offered?</p>
<p>Design assignment in which these result.</p>	<p>This research will give as a result, the performance of 3d printed cellular structures in thermal properties and possibility to change its thickness and how this is possible to apply it in a construction component. The final product of this research will be a façade component that is created with additive manufacturing methods.</p>
<p>[This should be formulated in such a way that the graduation project can answer these questions. The definition of the problem has to be significant to a clearly defined area of research and design.]</p>	
<p>Process</p>	
<p>Method description</p> <p>In order to define the problem statement and the graduation topic it has been preceded a research in the field of additive manufacturing methods and the innovative solutions and potentials that these production processes provide in the building industry. The research was focused in the properties of the final product and how this can be achieved with the geometry and the materials.</p> <p>The geometrical complexity that is offered with the AM and the fact that it is possible to study a component in multiple scales (micro-meso– macro), give the possibilities to produce a component with multiple functions. Similar geometrical shapes with multiple functions are</p>	

applied in natural world. It is the complex hierarchies of materials within natural structures from which their performance emerges. The research is focused in the cellular solids which both present man-made and natural materials with remarkable properties. The mechanical behavior of cellular structures was researched into literature and moreover some limited research in the thermal properties. The potential that 3d printing provides with the complex geometries gives the opportunity to create a component with similar geometry forms. Moreover in order to study and achieve the properties of this component there will be a research into the materials that can be provided from the printing industry and also possible solutions with already existing materials.

The following steps of the research include first the research for the suitable synthesis for the cellular structure, possible first options for the geometry and size of the cell, experiments with samples for thermal properties and possible solutions for changing the thickness of the component. After the analysis of the results of the experiments the design of the sample with the efficient performance will be developed in a façade component in size, shape and assembling method. The final details of the component ought to give a result that it is successful for the façade.

Literature and general practical preference

Ashby, M.F. 'The Properties Of Foams And Lattices'. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 364.1838 (2006): 15-30. Web.

Chu, Chen, Greg Graf, and David W. Rosen. 'Design For Additive Manufacturing Of Cellular Structures'. *Computer-Aided Design and Applications* 5.5 (2008): 686-696. Web.

Diegel, Olaf et al. 'Tools For Sustainable Product Design: Additive Manufacturing'. *Journal of Sustainable Development* 3.3 (2010): n. pag. Web.

Gao, Wei et al. 'The Status, Challenges, And Future Of Additive Manufacturing In Engineering'. *Computer-Aided Design* (2015): n. pag. Web.

Gibson, Lorna J. 'Biomechanics Of Cellular Solids'. *Journal of Biomechanics* 38.3 (2005): 377-399. Web.

Gibson, Lorna J. 'Biomechanics Of Cellular Solids'. *Journal of Biomechanics* 38.3 (2005): 377-399. Web.

Knaack, Ulrich. *Façades*. Basel: Birkhäuser, 2007. Print.

Meyers, M. A., J. McKittrick, and P.-Y. Chen. 'Structural Biological Materials: Critical Mechanics-Materials Connections'. *Science* 339.6121 (2013): 773-779. Web.

Strauss, Holger. *AM Envelope*. Print.

Yan, Chunze et al. 'Evaluations Of Cellular Lattice Structures Manufactured Using Selective Laser Melting'. International Journal of Machine Tools and Manufacture 62 (2012): 32-38. Web.

Yang, Li et al. 'Additive Manufacturing Of Metal Cellular Structures: Design And Fabrication'. JOM 67.3 (2015): 608-615. Web.

Yang, Sheng, and Yaoyao Fiona Zhao. 'Additive Manufacturing-Enabled Design Theory And Methodology: A Critical Review'. Int J Adv Manuf Technol (2015): n. pag. Web.

Yang, Sheng, and Yaoyao Fiona Zhao. 'Additive Manufacturing-Enabled Design Theory And Methodology: A Critical Review'. Int J Adv Manuf Technol (2015): n. pag. Web.

Michael Hensel, Achim Menges, and Michael Weinstoc. 'Emergent technologies and design ,Towards a biological paradigm for architecture'. Routledge (2010)

[The literature (theories or research data) and general practical experience/precedent you intend to consult.]

Reflection

Relevance

- Societal

The product aims to reduce the amount of material that it could be needed with an conventional production method therefore reduce the impact in the environment. Moreover the goal is to create an innovative component that meet the contemporary needs of the occupants but with a perspective of the future challenges.

- Scientific

The value of this research aims to investigate a new cellular material that it is possible to provide new functions with an innovative production method. The aim is to challenge the benefits that AM introduces such as complex geometries and new materials in order to give as a solution for a new product in the scientific community and the facade industry

[The value of the graduation project in the larger social and scientific framework.]

Time planning

GRADUATION PLAN_ MARIA VALENTINI SARKINIOTI_ 43228439



