Graduation Plan

of Science Architecture, Urbanism & Building Sciences

Lars Hammer
15-01-2016
Graduation Plan, P2

Graduation Plan

Personal information	
Name	Lars Hammer
Student number	4024834
Telephone number	00316-29197958
Private e-mail address	LarsHammerNL@gmail.com
Studio	
Name / Theme	Building Technology
Teachers / tutors	Prof. Dr. Ing U. Knaack (Main Mentor), Dr. Ir. W. van der Spoel (Second Mentor), Dr. Ir. M. Otheguy (External Mentor)
Argumentation of choice of the studio	The focus in the building technology studio is more in depth into different strategies and technologies, and how to implement these into a design. This studio was chosen because of the interesting integration of sustainable design in building technology. This knowledge will become more and more important the coming years and this studio provides the opportunity to be more specialized in these important areas.

Graduation project	
Title of the graduation project	Passive Offshore Accommodation *Energy-Efficient Retrofit of Offshore Accommodation Façades*
Goal	
Location:	Rotterdam / Delft
The posed problem,	[Problem Statement, See Below]
research questions and	[Research Question, See Below]
design assignment in which these result.	[Design Assignment, See Below]

Problem Statement

Research showed that currently the accommodation units aboard drilling rigs use diesel generators to get their demand of energy. Next to environmental costs, the energy costs could be greatly reduced, however this doesn't happen due to current design & costs. *(Otheguy, 2014)*

However since the sustainable technologies are widely used in onshore buildings, these are not used a lot in the offshore accommodation, even though offshore companies like ProSafe claim that sustainability is one of their core values. *(ProSafe, 2015)* The financial aspect is the primary design factor in current designing process. This results in designs where the sustainable innovation is of secondary factor. Fortunately, as mentioned, this is an area the *onshore* industry has made a lot of advancements, especially in the last decades. Estimated is that in 2015, around 48 % of new built architecture can be considered 'green'. From 2005 to 2012, the number of new green building designs jumped by 39% in the US. *(Peters, 2016)*

Previous research into this topic by Keppel Verolme shows that a huge difference in energy-use could be made by applying more insulation. *(Sneep, 2014)* However, applying a thicker insulation when retrofitting or designing a new built offshore accommodation is also not done because of the increased invested capital. Other problems posed are:

- There is not much information on the influences of new sustainable strategies in the offshore industry.
- The extreme environment on sea, together with the salty water, hard wind and fire-danger, make it more difficult to design innovative solutions.
- This could bring higher costs and would make it harder to convince investors. This directly relates to the ratio of OPEX to CAPEX. *(Otheguy, 2014)*
- The reliability of the onshore strategies is harder to guarantee offshore because it is not implemented often. *(P. Morgan, personal communication, January 6, 2016)*
- There is a high cooling load in the summer, or in arctic climates. This asks for solar blocking or reflection solutions.

Research Questions

The main research question to be addressed in this research project is:

What design is *technically* and *financially* feasible for retrofitting the façade of an existing accommodation based on *onshore strategies, in order to make the accommodation more energy-efficient*?

Next to the main question, the following sub-questions should be asked:

1. *What different sustainable façade strategies are available? In offshore and at onshore?*
2. *What effect do the implementation of specific strategies have on an already determined case study?*
3. *What rules and standardization will affect the design?*
4. *What does a conventional offshore accommodation look like?*
5. *What sustainable strategies are the best solution?*

During the research also other questions, which do not fit the topic of the research report but will have to be answered in order to deliver a good conclusion, these are the background questions:

How does DesignBuilder work?
How to do an assessment of sustainable strategies?
What kind of literature will be used?
Who will I have to contact in order to answer my questions?
What are the constraints - assumptions - starting points of the design?

Design Assignment

A façade retrofit will be designed, which can be tailored to specific wants of the company or client.
Plans and other related drawings will be included as well as steps of assembling.
The façade retrofit will be simulated with DesignBuilder in order to give insight into its effectiveness.

Process

Method description

The literature study will contain the next parts:

1. Introduction and Research Framework
2. Relevant topics of offshore Industry
3. Relevant topics of Energy Efficient Solutions and Analysis
4. Boundary conditions and first schematic concept development

The research methodology used is derived from a ten-step process for designing and constructing low energy buildings. The methodology is the result of a technical analysis of the design process of 6 zero-energy projects. This analysis is laid out in the technical report of the National Renewable Energy Laboratory (NREL).
(P. Torcellini, 2006, p. 27) According to the NREL, the process should look like this:

1 First phase is the '**Predesign**'. At the start of this phase the team will set specific and measurable energy performance goals, which may include percent energy-saving, percent energy cost saving, and emission reduction. Also an understanding of the building environment, local weather patterns, and building functional requirements are important. Next to these functional requirements we will also do a study into the Standardization and Rules of designing an offshore accommodation. During this period, we will also brainstorm energy-saving solutions, with help of previous projects of the Extreme-course, and available literature, which are provided by the internet, the TU Delft and Keppel Verolme. We will also look more in detail to previous generated simulations of energy use aboard the GlobalTech 1.

2 The second step is the start of creating a benchmark building model to quantify Base-Case energy use and costs. Primarily we will use a test model, the GlobalTech 1, since a more current case study is unfortunately not yet available. However, when available, we can change the settings and parameters to conform to the new study case. This new study case could be a floating accommodation ready for retrofit at the yard of Keppel Verolme. This model will then also provide us with known figures about the use of energy.

3 Based on this benchmark model study a parametric analysis will be made to determine possible sensitivities to specific load components. Sequentially eliminate loads such as conductive losses, lighting loads, solar gains, and plug loads from the benchmark building, these will be the boundaries and constraints for possible concepts.

4 At this step several concepts will be developed. These preliminary design solutions will then be assessed on their potential in costs, savings, workload and other topics discussed in the literature.

5 The fifth step is the beginning of the **'Schematic Design'.** Basically this will be based upon the developing of several concepts of the step before. The energy impact and cost effectiveness of each concept/variant are determined by comparing several simulations where the variant is applied on the Base Case or the new study case. After this the best solution(s) will be chosen to develop further.

6 At this step several construction drawings will be prepared. These drawings will show the essence of the chosen variant.

7 At the seventh step the **'Design Development'** begins**.** In this stage the previous simulations will be combined with an identified HVAC system. This HVAC system should complement the building architecture and exploit the specific climatic characteristics of the site for maximum efficiency. This is when we will update the simulations, and analyze the new results. These results will be presented at the third presentation, the P3.

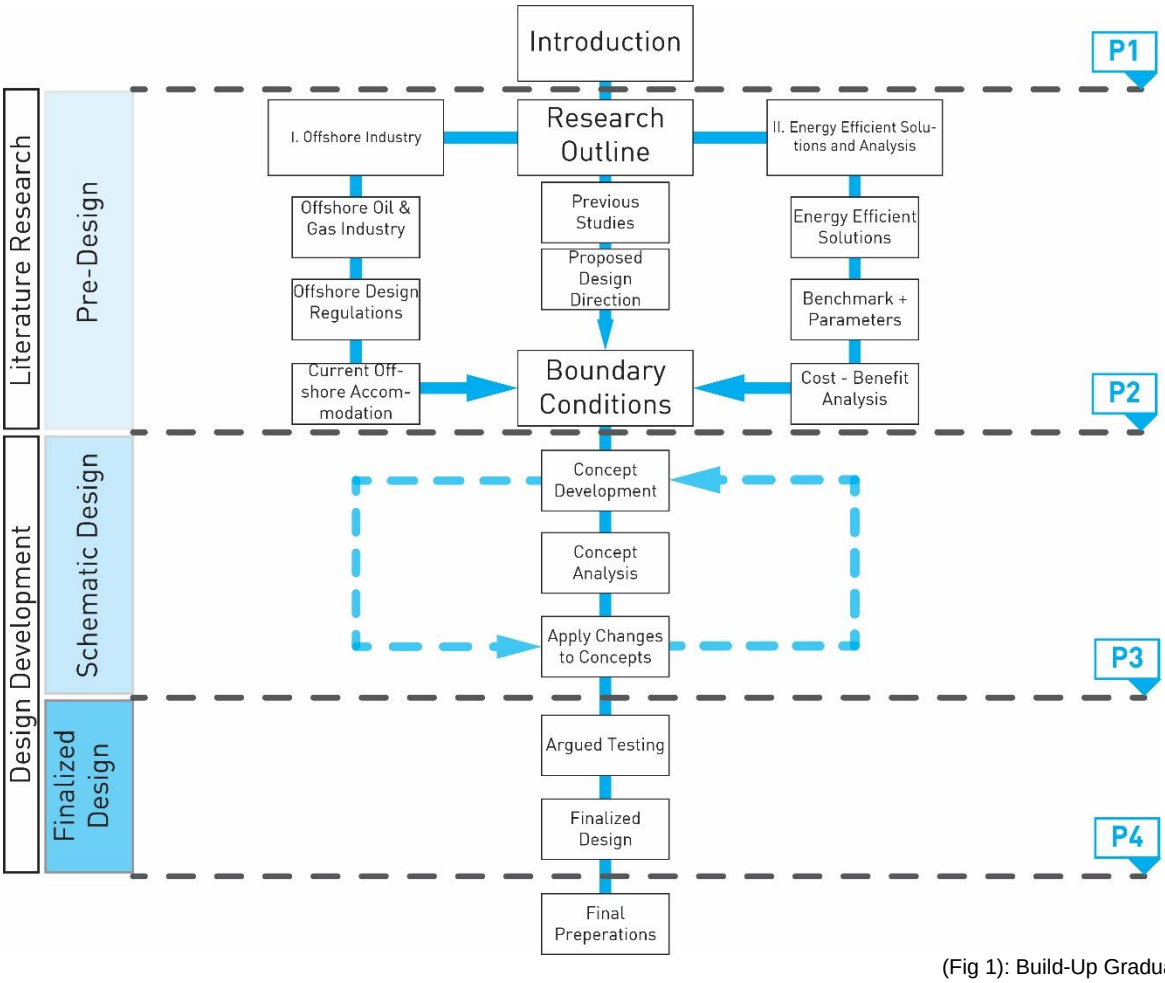
8 This step is the '**Construction Documents and Bid**'. Once we analyzed the new results from the third phase, the plans and specifications will be finalized. It should be ensured that the building plans are properly detailed and that the specifications are accurate. There should also be a final design simulation which incorporates all cost effective features. These drawings and simulations will then be presented at the fourth graduation presentation. This will be around the last graduation presentation, the P4. The last two steps are not included in the graduation, but are mentioned because of their relevance to the total process.

9 The ninth step is '**Construction**'. In a period after the graduation the designed solution could be implemented during the retrofit of an offshore drilling rig. During this implementation, the simulation should be ran again before changes are made in the design during construction. This is because these design changes should not negatively affect the energy performance.

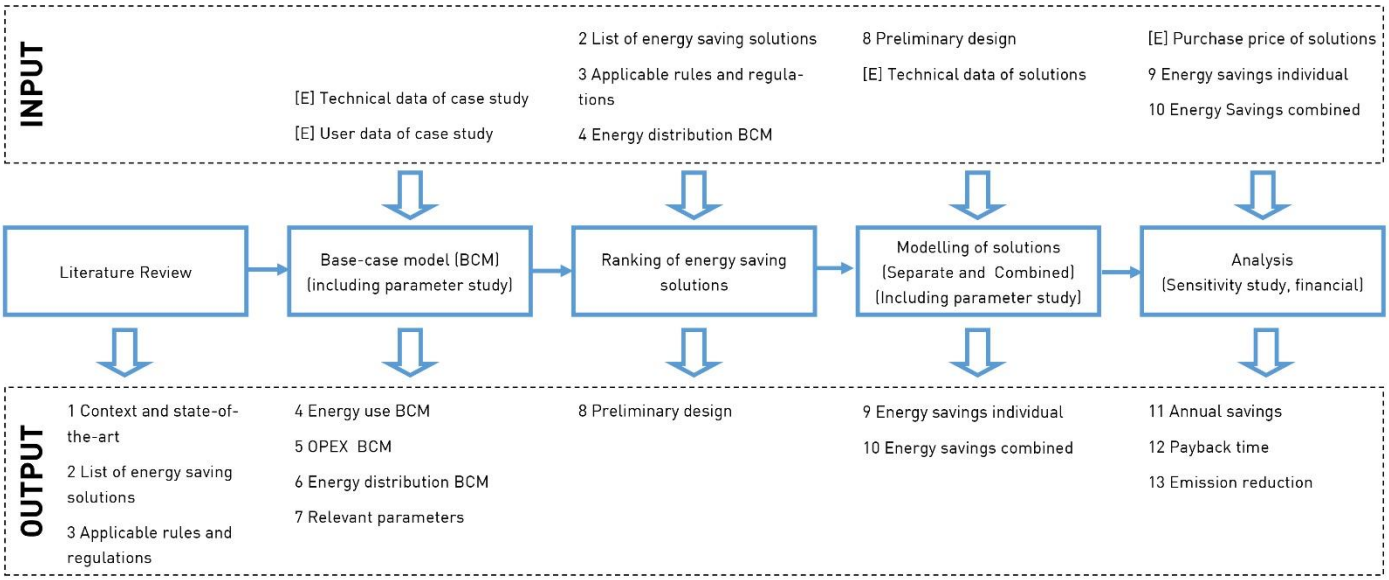
10 The final step is '**Post Occupancy Evaluation**'. Here we should measure and evaluate actual energy performance to verify if design goals are met.

At the following page, the above mentioned methodology and design process are placed into two diagrams. The first image represents a box diagram which shows the phases and most relevant topics of the graduation for the thesis set-up, in reference to presentations.

The second image depicts the information flow in order to get the wanted results. Basically the graduation is set up in 5 points. The literature review, the Base Case model, Ranking of energy-saving solutions, Modeling of these solutions and analysis. Each of these require certain information and provide certain information. The information which follows an (E) depicts information which should be retrieved from external sources.



(Fig 1): Build-Up Graduation



(Fig 2): Information Flow (Taen, 2015)

These steps will be done within a research team which includes: Lars Hammer (Building Technology Graduate) and Jeroen Taen (Ship Design Graduate).

Outside of this team we will be supported from the Architecture Faculty by Ulrich Knaack (Façade Department), Willem van der Spoel (Climate Department) and from the Maritime Faculty; Robert Hekkenberg (Ship Design, Productions & Operations) and finally as external mentor, provided by the company Keppel Verolme, Mariano Otheguy, who is the initiator of this project and will supervise the project while on site.

Literature and general practical preference

(2015, december 16). Retrieved from ProSafe: http://www.prosafe.com/the-environment/category915.html

(2015, 12 29). Retrieved from Cepheus: http://www.cepheus.de/eng/index.html

About: GlobalTech One. (2015, 12 28). Retrieved from GlobalTech One: http://www.globaltechone.de/en/about/

Advantages of Underfloor Heating. (2015, 12 21). Retrieved from Ice Energy: http://www.iceenergy.co.uk/advantages-of-underfloor-heating/

ASHRAE. (2013). Thermal Environmental Conditions for Human Occupancy. *ANSI/ASHRAE Standard 55-2013*.

Capital Expenditure. (2015, 12 22). Retrieved from Investopedia: http://www.investopedia.com/terms/c/capitalexpenditure.asp

Department of Energy . (2015, 12 23). *insulation*. Retrieved from Ornl.gov: http://web.ornl.gov/sci/roofs+walls/insulation/ins_02.html

DesignBuilder. (2015, 12 28). Retrieved from DesignBuilder: http://www.designbuilder.co.uk/

DesignBuilder. (2015, 07 15). DesignBuilder Manual v4.5. *DesignBuilder EnergyPlus Simulation Documentation for DesignBuilder v4.5*. DesignBuilder.

Fire Protection Measures. (2015, December 22). Retrieved from Electrical Engineering Portal: http://electrical-engineering-portal.com/fire-protection-measures

Grondahl, M., & Gates, G. (2010, September 25). *The Secrets of a Passive House*. Retrieved from The New York Times: http://www.nytimes.com/interactive/2010/09/26/business/smart.html?_r=0

Hines, J. (2012, October). Offshore Regulatory Issues. *Standard Bulletin: Offshore Special Edition*, p. 7.

IDES Floor. (2015, 12 21). Retrieved from Cepezed: http://www.cepezed.nl/en/projects/149-ides-floor

Maguire, D. (2008). *The Business Benefits of GIS: an ROI approach.* Redlands: ESRI Press.

NORAC AC. (2015, 12 22). Marine Interior Systems - Product Manual. *Marine Interior Systems*.

Offshore Accommodation and Workspace Modules. (2015, 12 21). Retrieved from http://www.ferguson-group.com: http://www.ferguson-group.com/ferguson-modular/

Otheguy, M. (2014). Designing with Flows: Energy-Efficient Offshore Accommodations. *KOMtech Technology Review* .

P. Torcellini, S. P. (2006). *Lessons Learned from Case-studies of six High Performance Buildings.* Golden: National Renewable Energy Laboratory.

Peters, A. (2016, 01 06). *The top 10 most innovative sustainable buildings of 2014*. Retrieved from FastCoexits: http://www.fastcoexist.com/3029434/the-top-10-most-innovative-sustainable-buildings-of-2014

Price Industries. (2011). *Natural Ventilation Engineering Guide.*

Sneep, T. (2014). *Energy-Efficient Offshore Accommodations, research paper toward warm areas.*

TU Delft. (2014). Extreme Project Introduction. TU Delft.

Vella, H. (2015, 12 22). *Offshore Savety Design, Preventing The Next Deepwater Horizon*. Retrieved from Offshore-Technology: http://www.offshore-technology.com/features/featureoffshore-fire-safety-design-preventing-deepwater-horizon/

Reflection

Relevance

Societal Relevance

The research is based on providing knowledge of sustainable accommodation and therefor will benefit the society in lower costs and a healthier environment.

Especially in this time the societal relevance of new and more sustainable strategies will have a greater impact than ever before. With the past economic crash of 2008, the ongoing oil-crisis, but also the current and future climate change, the need for sustainable strategies and solutions, in a way costs and environment are positively

linked, has a never been bigger, while the research into sustainable offshore accommodation is just a small part of a big innovative puzzle, any research and progress in this field will benefit society and environment as a whole.

When the research and design will indeed deliver a concrete solution, there will be economic as well as environmental advantages, which could promote more research into this area.

Scientific relevance

The research & design will explore into different strategies and application which can then be considered for further scientific research. Researching which strategies will be successful and unsuccessful with different simulations. This research could be added to the scientific realm for use in other future research.

Projected Innovation

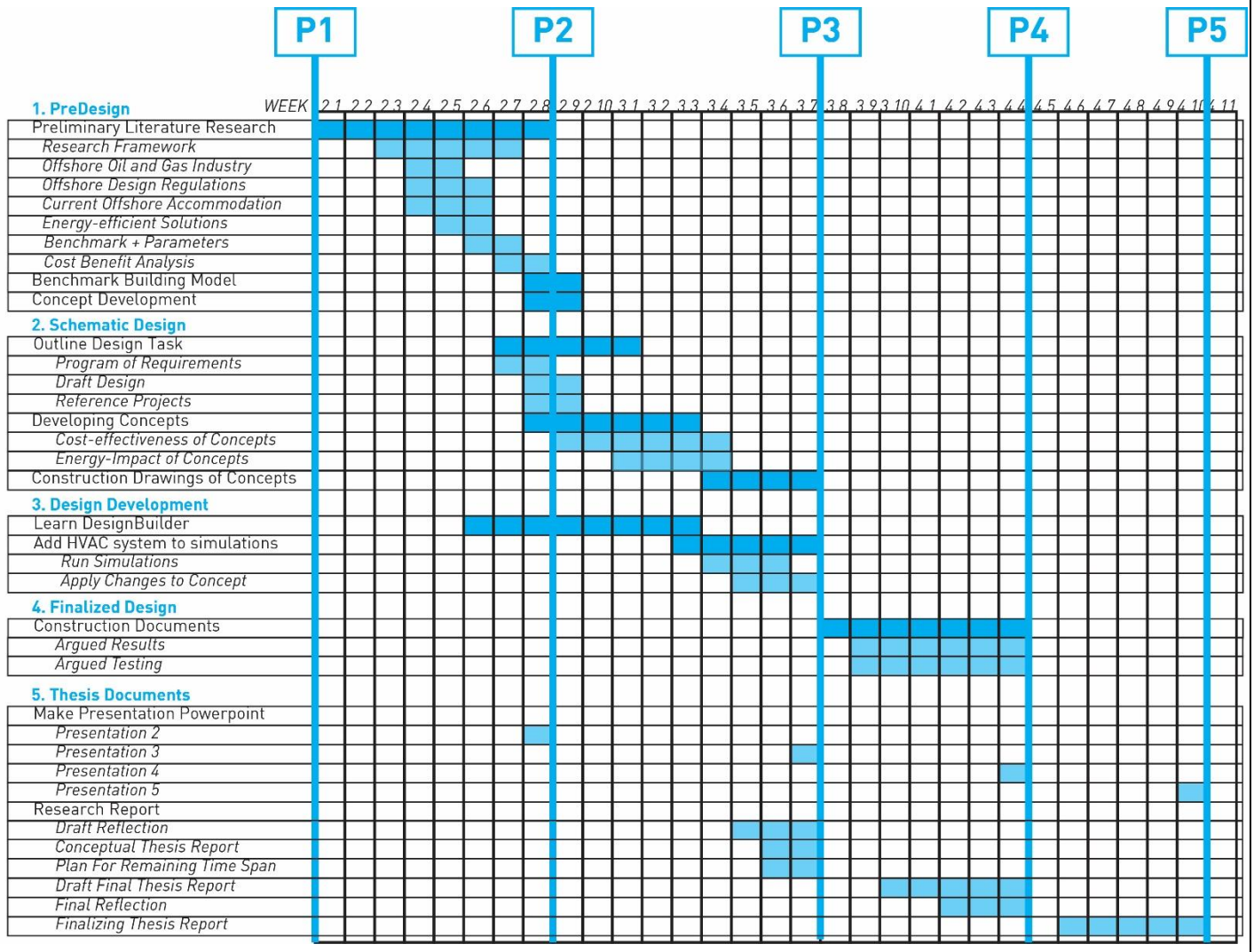
Researching different strategies and which provide different innovative possibilities in the offshore industry. Creating an efficient example of an energy efficient offshore accommodation could lead to a new product for Keppel Verolme, which would save their client money in energy costs, primarily fuel costs. Currently the offshore accommodation is not as sophisticated as several zero energy on shore houses. Therefor this project could be really innovative in applying several new strategies, which are currently not really known in the offshore industry.

Embedding in research programs and relationship to other research projects

The research is an extension of an ongoing research by Mariano Otheguy at Keppel Verolme in the field of Energy Efficient Offshore Accommodation.

Time planning

Below is the expected time planning with week numbers. And corresponding topics and presentations.



(Fig 3): Time-Planning Research Project