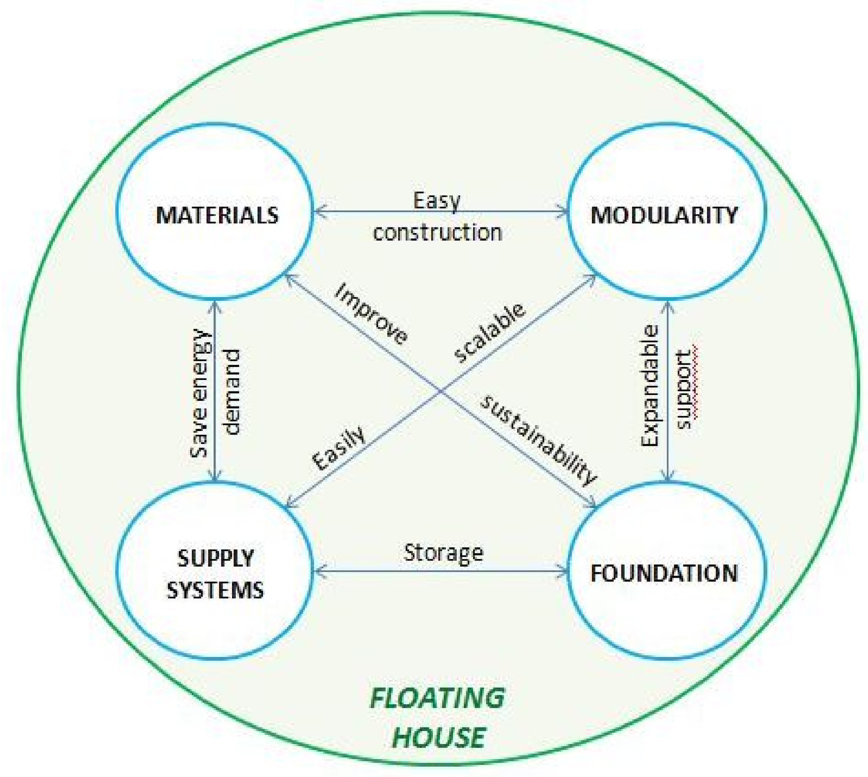
Trabajo Final de Grado Arquitectura Técnica modalidad de intercambio académico curso 2016-017

Hanze University of Applied Sciences - Netherlands

Self-sufficient floating house for students in Groningen
Materials for upper structure and Modularity

Year after year, Groningen is becoming an even more important student city. Both the University of Groningen and Hanze University of Applied Sciences are increasing the number of students and staff. Demand for student housing has become a problem. In order to continue to offer to students an affordable and sustainable way of living in the city from the Kenniscentrum with the client Michael Bosscher came the idea of creating floating structures as accommodation. So the main question to be addressed in this project is: how can existing sustainable engineering technologies be integrated to create a self-sufficient floating houses for students in Groningen? Four themes will be developed throughout the project that will be studied in more depth to finally combine them into a final product. These four sections are the foundation, integration of renewable energies, building materials and modularity. These themes are developed from the principles that include sustainable and bioclimatic architecture, that is, from a way of conceiving the architectural design in a sustainable way, trying to optimize natural resources and building systems to minimize impact of buildings on the environment and its inhabitants. In addition to studying these four sections separately, their whole will be taken into account, since they include relationships that represent the complexity of the system, these are the points that offer the possibility of reaching innovative conclusions and solve them is the true motivation of this report. So after this in-depth analysis of the characteristics of these four building components and applying the principles of sustainable and bioclimatic architecture, it will developed the design of a student residence where the customer's requirements are met.



Materials for upper structure

Which materials fulfil the project requirements? In this chapter the selection of materials for the construction of the upper structure of the student residence will be carried out. The first step is to develop a selection criterion based on the principles demanded by the client, sustainability, adaptability and modularity. In addition, will take into account the design requirements of a floating construction system. To do this, it will be carried out the analysis of the materials currently used in the construction from an ecological point of view, studying their environmental impact throughout their useful life, and we will also study the current materials regarding the function they can perform within the construction system. After this analysis it will obtained the most appropriate materials, with them will be created different alternatives of enclosures from which its transmittance will be studied to choose the best possible solution depending on the materials that are available in the area where it is going to be carried out the project, in this case Groningen, Netherlands.

Methodology

State of requirements → Sustainability analysis of materials → Guidelines and principles → Materials selection → Wood and natural materials → Alternatives → Final design

e= thickness (m)	EXTERIOR	SHEET 1		SHEET 2		SHEET 3		SHEET 4		SHEET 5		INTERIOR	THICKNESS OF THE WALL (M)
λ = conductivity (W/mK)		WOOD		WOOD FIBER		AIR CHAMBER		WOOD FIBER		WOOD			
	Rse	e	λ	e	λ	e	λ	e	λ	e	λ	Rsi	
U (W/m²K)	-	0.02	0.04	0.11	0.04	0.02	0.017	0.11	0.04	0.02	0.04	-	
0.14954	0.04	0.5		2.75		0.017		2.75		0.5		0.13	0.28

e= thickness (m)	EXTERIOR	SHEET 1		SHEET 2		SHEET 3		SHEET 4		SHEET 5		INTERIOR	THICKNESS OF THE WALL (M)
λ = conductivity (W/mK)		WOOD		CORK		AIR CHAMBER		CORK		WOOD			
	Rse	e	λ	e	λ	e	λ	e	λ	e	λ	Rsi	
U (W/m²K)	-	0.02	0.04	0.11	0.04	0.02	0.017	0.11	0.04	0.02	0.04	-	
0.14954	0.04	0.5		2.75		0.017		2.75		0.5		0.13	0.28

e= thickness (m)	EXTERIOR	SHEET 1		SHEET 2		SHEET 3		SHEET 4		SHEET 5		INTERIOR	THICKNESS OF THE WALL (M)
λ = conductivity (W/mK)		WOOD		CELLULOSE		AIR CHAMBER		CELLULOSE		WOOD			
	Rse	e	λ	e	λ	e	λ	e	λ	e	λ	Rsi	
U (W/m²K)	-	0.02	0.04	0.11	0.039	0.02	0.017	0.11	0.039	0.02	0.04	-	
0.14646	0.04	0.5		2.82		0.017		2.82		0.5		0.13	0.28

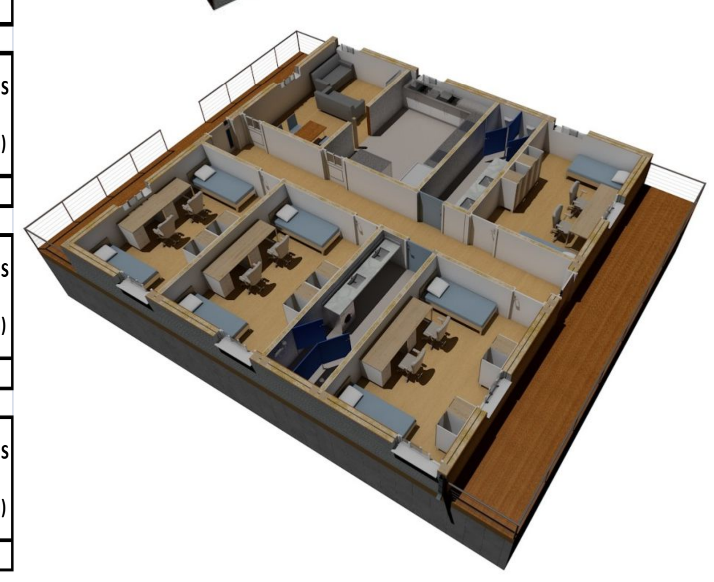
e= thickness (m)	EXTERIOR	SHEET 1		SHEET 2		SHEET 3		SHEET 4		SHEET 5		INTERIOR	THICKNESS OF THE WALL (M)
λ = conductivity (W/mK)		WOOD		EXPANDED CLAY		AIR CHAMBER		EXPANDED CLAY		WOOD			
	Rse	e	λ	e	λ	e	λ	e	λ	e	λ	Rsi	
U (W/m²K)	-	0.02	0.04	0.3	0.11	0.02	0.017	0.3	0.11	0.02	0.04	-	
0.15057	0.04	0.5		2.73		0.017		2.73		0.5		0.13	0.66

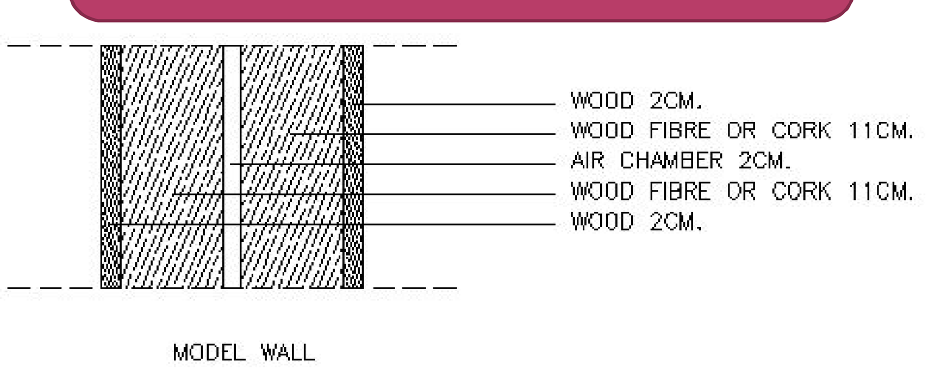
e= thickness (m)	EXTERIOR	SHEET 1		SHEET 2		SHEET 3		SHEET 4		SHEET 5		INTERIOR	THICKNESS OF THE WALL (M)
λ = conductivity (W/mK)		WOOD		COTTON		AIR CHAMBER		COTTON		WOOD			
	Rse	e	λ	e	λ	e	λ	e	λ	e	λ	Rsi	
U (W/m²K)	-	0.02	0.04	0.09	0.03	0.02	0.017	0.08	0.03	0.02	0.04	-	
0.14591	0.04	0.5		3		0.017		2.67		0.5		0.13	0.23

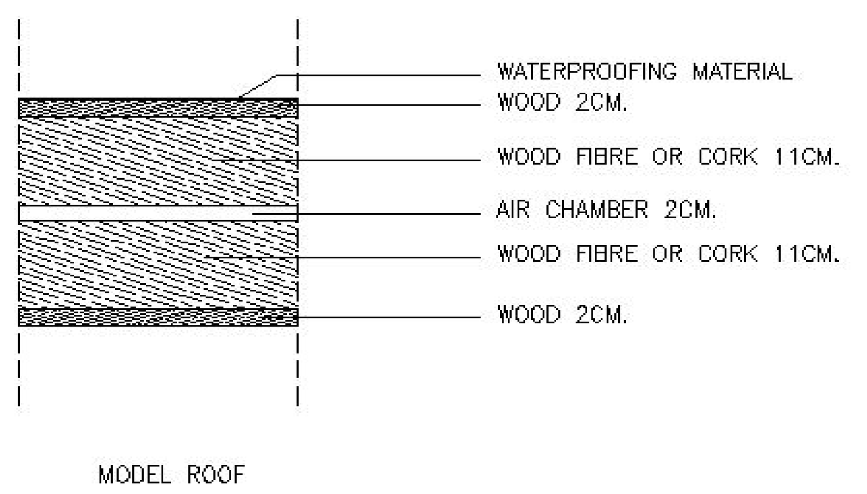
e= thickness (m)	EXTERIOR	SHEET 1		SHEET 2		SHEET 3		SHEET 4		SHEET 5		INTERIOR	THICKNESS OF THE WALL (M)
λ = conductivity (W/mK)		WOOD		MINERAL WOOL		AIR CHAMBER		MINERAL WOOL		WOOD			
	Rse	e	λ	e	λ	e	λ	e	λ	e	λ	Rsi	
U (W/m²K)	-	0.02	0.04	0.11	0.04	0.02	0.017	0.11	0.04	0.02	0.04	-	
0.14954	0.04	0.5		2.75		0.017		2.75		0.5		0.13	0.28

e= thickness (m)	EXTERIOR	SHEET 1		SHEET 2		SHEET 3		SHEET 4		SHEET 5		INTERIOR	THICKNESS OF THE WALL (M)
λ = conductivity (W/mK)		WOOD		SHEEP WOOL		AIR CHAMBER		SHEEP WOOL		WOOD			
	Rse	e	λ	e	λ	e	λ	e	λ	e	λ	Rsi	
U (W/m²K)	-	0.02	0.04	0.16	0.06	0.02	0.017	0.17	0.06	0.02	0.04	-	
0.14954	0.04	0.5		2.67		0.017		2.83		0.5		0.13	0.39

e= espesor (m)	EXTERIOR	SHEET 1		SHEET 2		SHEET 3		SHEET 4		SHEET 5		INTERIOR	THICKNESS OF THE WALL (M)
λ = conductividad (W/mK)		WOOD		WICKER		AIR CHAMBER		WICKER		WOOD			
	Rse	e	λ	e	λ	e	λ	e	λ	e	λ	Rsi	
U (W/m²K)	-	0.02	0.04	0.12	0.045	0.02	0.017	0.13	0.045	0.02	0.04	-	
0.14831	0.04	0.5		2.67		0.017		2.89		0.5		0.13	0.31



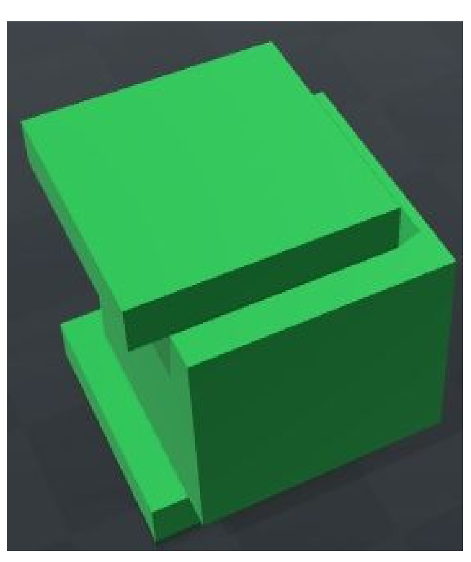




It has been chosen as a constructive solution for the enclosure composite walls of two sheets with a thickness of 28cm. With this enclosure made of wood as outer cladding and cork or wood fibres as thermal insulation is possible to fulfil the requirements demanded by the project. Including theFirestone UltraPly TPO sheet as waterproofing on the roof. This enclosure achieves a transmittance less than 0.15 W / m2K with wood and cork, the most environmentally friendly materials.

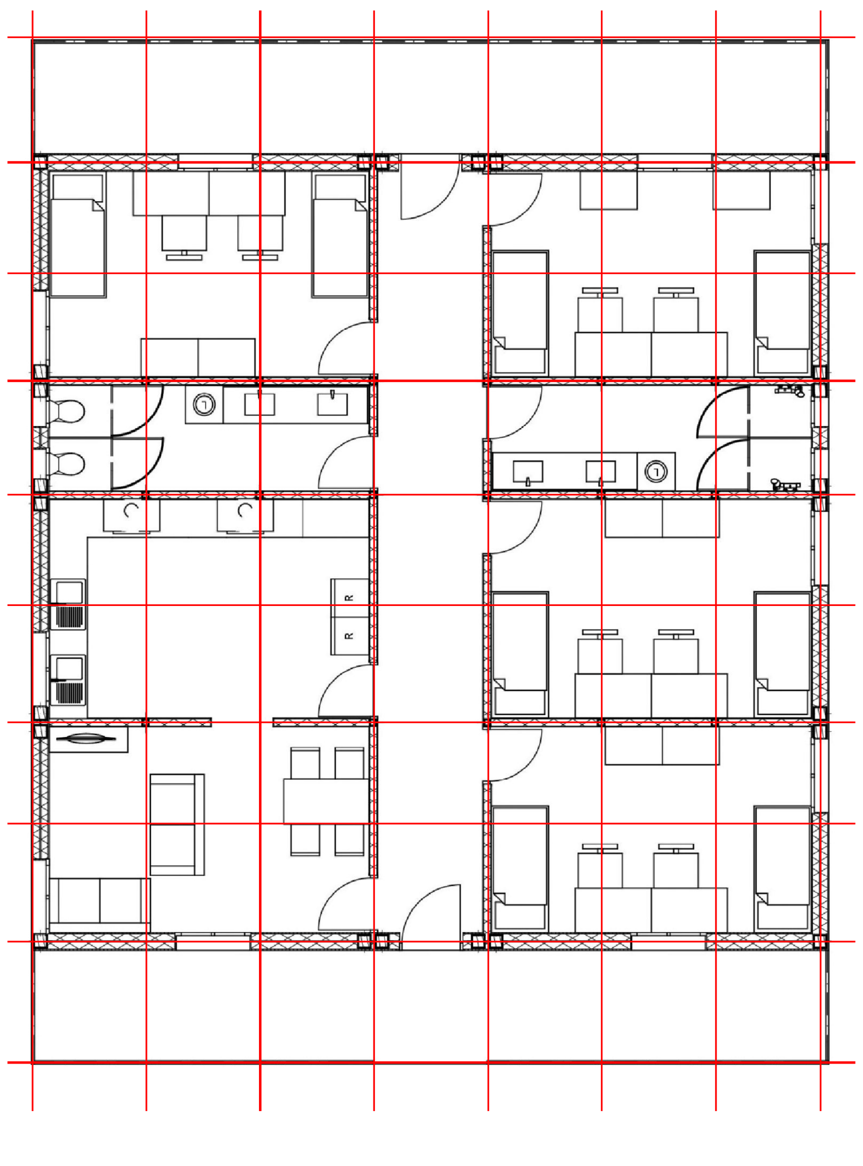
Modularity

Modular architecture, why choose it? The modular architecture consists of the design and management of systems composed of separate repetitive elements (modules), similar in size, shape and functionality. These can be connected to each other, replaced or added together. All of this has as objective the optimization of the resources by means of the standardization of the constructive methods and their components.



For the project has been opted as base module the foundation, since the foundation is the part of the construction that will receive the efforts of the flotation in water and for this it is advisable that the pieces are as large as possible to achieve great stability and reduce the number of pieces required, reducing the number of anchors and joints. So size of foundation block determine the size of each room. In contrast to the upper structure a panel system has been chosen, to optimize truck transport and on-site assembly.

This allows us to have all the advantages of modularity in our project and thus offer a system totally adaptable to any need, offering different sizes of rooms to which any use can be destined since, due to its assembly system, the Enclosure allows the installation of any plumbing and electricity system to give the desired functionality for each room.



Alumno: **Jorge R. Forés Montesinos**
tutor ETSIE: **Milagro Iborra Lucas**
tutor destino: **Alex Van oost**
Hanze University of Applied Sciences Groningen
UNIVERSITAT POLITÈCNICA DE VALÈNCIA
ESCUELA TÉCNICA SUPERIOR INGENIERÍA DE EDIFICACIÓN