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	Francesco Longo
Student number	4729579

Studio		
Name / Theme	Explorelab 31 / High-altitude architecture	
Main mentor	Henri van Bennekom	Architecture
Second mentor	Gilbert Koskamp	BT
Third mentor	Andy van den Dobbelsteen	Climate design
Argumentation of choice of the studio	Living the outdoors has always been top of my interests, being this in the countryside, in the hills where I grew up, sailing, and mostly in the mountains. One might argue that studying the built environment can be seen as clashing with the love for the great outdoors. However, it is right there, at the border between wilderness and construction that lies the challenge for me. How can something be built where it should not, and how does the margin between wild and built looks? How can we live with and within our natural environments? Thanks to the Explorelab I have the possibility to look for an answer to these questions and more.	

Graduation project	
Title of the graduation project	Research for a more sustainable alpine hut. The renovation of Rifugio Carducci
Goal	
Location:	Alta val Giralba, Auronzo (BL) ITA
The posed problem,	Alpine huts give access to the high altitude areas of the Alps, and in the specific Dolomiti. With the increasing number of visitors, and the reliance on fossil fuel to operate, the huts risk to have a negative impact on the environment that they grant access to.

research questions and	How can the positive impact of a high-altitude alpine refuge towards its (eco)system be maximised?
design assignment in which these result.	Renovation and expansion of Rifugio Carducci

This research takes inspiration from Kiel Moe's work and his push towards understanding the built environment as a connected system of systems.
Starting from the laws of thermodynamics, the research aims at understanding Rifugio Carducci as a *node within an (eco)system*. This definition, developed during this research, identifies the refuge as an element within an infrastructure of refuges, trails, routes. It sees it as a combination of systems for the supply and functioning of the refuge. To cite Kiel Moe's work, in this research the alpine refuge "is an open thermodynamic and ecological system" (Moe, Empire, State & Building, 2017).
As part of the physical environment (Stremke, van den Dobbelsteen, & Koh, 2011), the built elements are governed by the two laws of thermodynamics:
1) Energy is always conserved;
2) during any process, the quality of energy is decreased (exergy) and disorder (entropy) is increased.

What these two fundamental concepts entail for architecture is a call for the designers to consider buildings at a broader scale, considering the effects and the necessary steps and ingredients necessary to the lifecycle of a built element.
In Odum's words this process of understanding the systems connected to, in this case, a refuge is intended to achieve three ends: "maximise the *intake* of available matter-energy, maximise the *transformation* of the matter-energy, and reinforce the system through *feedback*" (Moe, Empire, State & Building, 2017).
What results evident is that "the ability to do work is dependent not only on the form of energy, but also the system being considered" (Brown & Ulgiati, 2004).

The consequences of these considerations are twofold: the substantial refusal of a building as an autarchic system, and the research's positioning on *maximising* the *positive impact* of the *built-with(in) the environment*, a thermodynamic equilibrium of the building's (eco)system.

Autarky, a theory described as "an economic system of self-sufficiency and limited trade" (Bondarenko, 2018), suggests that a system can work autonomously, without external influence. If this concept is considered with the laws of thermodynamics in mind, it appears evident that autarky simply can not exist.
A similar conclusion has been noted by Ákos Moravánszky while discussing the Monte Rosa hut in the Swiss Alps. In his article "My blue heaven: the architecture of atmospheres", he notes that the high altitude refuge "while almost entirely cut off from the physical energy networks, it is very much part of the socio-economic networks of attention-making" (Moravánszky, 2010).
In conclusion, if even a high-altitude alpine hut is not autarchic, but instead part of systems, and even more part of its ecosystem, the natural consequence is that a built element can not be anything else than a thermodynamic process of intake, transformation, and feedback. It is, therefore, the role of the designer to tune the thermodynamic processes of building to work in balance with the

(eco)systems feeding the building, maximising the positive feedback, reducing as much as possible the increase of entropy.

Process

Method description

The research for a more sustainable alpine hut is divided into two main areas that will then be combined to develop the renovation project for Rifugio Carducci.
Individual methods are combined in different documents and phases to form a complete and diverse methodology necessary to answer the main research question and to develop the project.

A first area of research is focused on the understanding of the high-altitude alpine refuge as an architectural typology.
Starting from a historiographic study of the relationship between humans and mountains, it aims to understand why we, as a civilisation, as a society, are attracted to the high-altitude areas.
By doing so, it will aim at understanding why, in the heart of Europe's mountains, alpinists have started to construct buildings where until a few centuries ago there was limited widespread interest for any activity. With the study of specialised literature, media articles, and the conversation with the Rifugio Carducci caretakers, this area of the research is aimed at understanding the characteristics of the alpine huts, based on their role as “sentinels” (Dini, Gibello, & Girodo, Andare per rifugi, 2020) of the border between wilderness and built environment. Their role within the infrastructure of trails and climbing routes that characterise the Alps; their role of destination and meeting place for those living the high-altitudes.
This section of the research will then discuss how the functions and reasons of existence of a refuge are translated into an architecture element within the natural (eco)system, studying some example of alpine huts through written documents, the study of drawings, and the production of sketches.

At the same time, another section of the research project is developed, focused on the more technical and technological aspects of a high-altitude alpine refuge.
Starting from an understanding of the Alpine and Dolomitic ecosystems, through its geography, climate, economy, and natural resources, this section of the research will shed light on the technical and technological potential of the alpine refuge (Rifugio Carducci). By collecting hard-data of the case-study refuge, the research will study the building as a node within its ecosystems, indicating the supplies necessary to make the refuge work, studying its energy requirements, the water demand and waste production.
By knowing the supply system of the refuge, it will be possible to locate and explore the potential for improving the effects of the node within its environment.
This technical section will continue to be developed throughout the project, assessing and exploring the potential for improved systems, starting from improving the energy storage system, through the research for the appropriate materials for the renovation and expansion of the refuge. As well as continue forwards to improving the hut’s waste (and wastewater) management system. Sources for this section are the specific information provided by the refuge's caretakers, the publications of the foundation Dolomites UNESCO, and the several technical guides/best practices reports for managing huts (i.e. the already mentioned guide by Espace Mont Blanc).

The combination of the two mentioned sections of this research will be the dialogue between the characteristics of the hut as a sentinel, refuge, shelter and destination, and the technical functioning

of the hut itself, seen as a node within an (eco)system of people and resources (as introduced in the theoretical framework section). This discussion and combination between the meaning of refuge and technical functioning of the refuge will shed light on the potential for an architecture of high-altitudes that maximises the positive impact for its (eco)system. Initially as a sort of *position paper,* this section will be reflected upon and continued during the design phase of this research project.

In conclusion, the methodology developed for this research combines different methods:

- Specialised and scientific literature study
- Study and analytical sketches of precedents
- Collection and interpretation of hard data
- Feasibility and potential calculations
- Conversations with the caretakers of Rifugio Carducci
- Study of interviews, magazines, videos
- Mapping of resources, supplies, local potential

Literature and general practical preference

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

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Reflection

The topic of climate change and the role of the built environment professionals play is ever more clear. While the focus is almost entirely on urban environment and cities, many buildings are constructed at the border with the wilderness. These buildings provide several topics that can be developed during the studies; from the scarcity of resources, to the inexistence of regular infrastructures, and to the need for careful design. Renovating an alpine refuge it is therefore, for me, the perfect testing ground for implementing the spacial and social qualities of a building, with the best possible technological solutions, merging them into a better form of architecture that is in conversation with the natural environment rather than harming, or isolating from it.

At the same time, producing a project for a more sustainable alpine hut has the potential for initiating the discussion with those charged with renovating and upgrading the alpine huts infrastructure.