Explorelab 31_Up there. Renovation of Rifugio Carducci.

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Reflection

Living the outdoors has always been at the top of my interests, being this in the countryside, in the hills where I grew up, and mostly in the mountains.
One might argue that studying the built environment is somehow clashing with the love for the great outdoors. However, it is right there, at the border between wilderness and construction, that lies the challenge. How can something be built where it should not, and how does the margin between wild and built looks like? How can we live with and within our natural environments?
This passion and these questions sparked the idea for this research.
Throughout the academic path towards the architecture degree, as students, we are faced with many different projects, typologies, and countless challenges. What is uncommon is to compare and combine your profoundly personal experience of a specific space with what you learned throughout your education.
For me, this project has been precisely this: combining my love for the outdoors, a place that has so much personal value to me, and the conclusion of my academic studies—all in one experiment.
Experiment because, after all, this is what my final project has been about.

The design, as well as the research, have evolved into a broad project unveiling several layers and complexities. I started the design thinking that the building's relatively small size would make the process easier and faster. In reality, the design principles that I set for the project made it positively challenging and exciting. At this point, both design and research pushed me outside my comfort zone while working on my goals of improving my skills and enjoying the design process.
Furthermore, it needs to be noted that the three main aspects of the project (architecture, building technology, and research) were never three separate subjects. Throughout these past months, it was a continuous design cycle comparing each decision taken, for example, in the research, with its implications in the spatial qualities that I was looking for in the project. In other words, the renovation project for Rifugio Carducci would not be the same without the considerations made during the research phases. The research would not be the same without the principles needed for the hut's architecture. And the hut's spatial qualities would not be the same without the technical opportunities offered to the project by its uniqueness.

In the beginning, the research aimed at calculating the thermodynamic processes occurring in the refuge, calculating the tola emergy necessary for the existence of the hut itself. This task proved to be unfeasible without a finished construction since it requires estimating the energy necessary to produce each specific element. Although interesting and stimulating, this approach cannot be sufficiently implemented within the scope of an architecture master thesis project. Nevertheless, the concepts developed by Odum, Moe, and the researchers working on System Ecology, served as a base to understand the building. The study of system ecology thinking in architecture guided the basic decisions of the project, making clear that each element, regardless of its size, comes from a series of thermodynamic processes that required several stages and inputs of energy. This realisation showed that the built element, as it is, carries a tangible value, is the result of work (physics) and therefore when intervening on a built product, it needs to be considered if what we are doing justifies the next steps necessary: the use of energy and work to disassemble and process an element, more

energy and work to produce and install another.the use of energy and work to disassemble and process an element, more energy and work to produce and install another.the use of energy and work to disassemble and process an element, more energy and work to produce and install another. The question that guided the project was the following: "is this action improving the value of the hut, and therefore justifies the work and energy necessary to perform it?".

The project and the research

The project's embryo started with my friend's interest in expanding their hut and make their business more sustainable, more equipped for the years to come. This starting point evolved into looking at what was there: what Rifugio Carducci is all about, how it functions, why it is there. And it is there because of what is around it. So how can this piece of built environment become more and more part of its surroundings? How can this built element become part of the natural environment?
The answer came through the in-depth study and continuous development and questioning of each decision. The project became a tool for reading the environment, for reading the systems producing the architecture of high-altitudes, for interlocking layer after layer into one built element part of the environment.

How did the design process work?
Starting with preliminary steps taken in the initial research, it was possible to take some key decisions, some key principles, that would influence the entire project: the hut's location and exposition as it is, is favourable for maximising the use of renewable energy sources, and the building, in its layers, complexities, in its system ecology has a value worth preserving.

To go into more details, what emerged from the physical study of the built element is that the favourable exposition, coupled with the hut's height, would allow for significantly higher efficiency of the solar panels, but at the same time, given the proximity to the surrounding peaks, almost one thousand meters higher than the refuge, it became fundamental to harvest as much solar energy as possible, in the shortest time possible. The nearby peaks are casting a shadow on the hut, reducing the window of time in which it is possible to collect solar energy.
These considerations led to the design decision to maximise the photovoltaic surface of the refuge, as well as considering a way for storing the harvested energy in an effective manner.
In this instance, what emerged from the study of the existing is the tremendous consumption of diesel that the current system has. With around 2500 litres of diesel per season, the hut's generators consume more than 20 litres of fuel per day. This is given by two main aspects: at high altitudes, combustion engines lose in efficiency (against the gain in efficiency of PV panels) and the current building is almost entirely not insulated, requiring large amounts of energy to be used for its heating.
The second mentioned fundamental aspect that emerged during the research phase was, in fact, connected to those uninsulated, thick, and heavy existing walls.

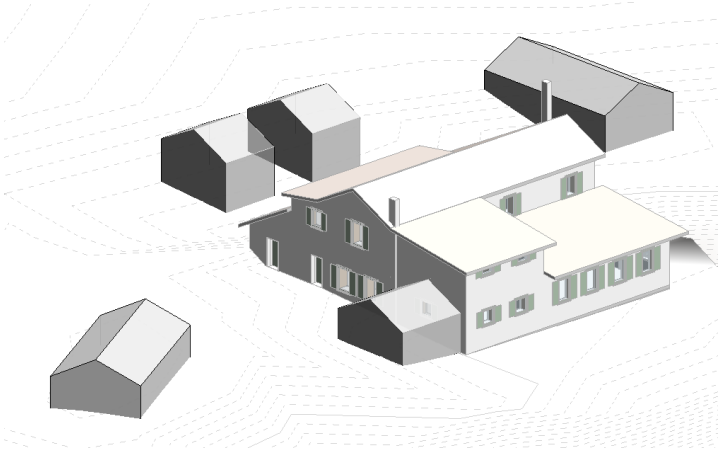
Built with Dolomite stones collected on-site, those walls are yes uninsulated and cold, but at the same time, they have a tremendous heat-storing potential, and most importantly, a history storing potential. Those walls, first erected in 1908, tell an important and unique story, that of Rifugio Carducci. Within those walls, pages of alpinism history were written. Those walls were witness to the events of the first world war. Those walls served as a base for expanding the refuge throughout the decades, adjusting it to the changing nature of alpinism and, now, tourism.
So, what the research showed is that the existing, as it is, has value (it is a result of work, energy, history), and has the potential to continue its usefulness; it has the potential to adjust to the needs of

contemporary use.
A consequence of the above-mentioned findings was the design decision to keep as much as possible of the building intact. Strengthened by the clear difficulty of opening a construction site at 2300 meters, with limited access, and a limited time in which the construction would be able to start (as soon as the snow is sufficiently melted), and until it would need to be completely watertight and strengthened in early autumn when the snow would start covering it again. In other words, it was fundamental, essential, mandatory to find a design solution capable of being started and completely finished within four to five months depending on the weather while allowing a minimum use of the refuge at least as an emergency shelter. This last consideration was done together with the hut's caretakers.
The main struggle became merging the design decision of keeping as much as possible with the needs for a quick and lightweight construction process.

By being expanded throughout the years, the refuge is a combination of spaces and elements essentially added without a "masterplan". A sort of incidental architecture. Each time what was added was just the necessary, leading to a conglomerate of different walls, different floor heights, sacrificed spaces used as much as possible. Let's think, for example, of the three-tier bunk beds in rooms with a ceiling height not higher than two meters fifty.
So, on the one hand, there was the intention of keeping these layers of historic evolution showcased in the different additions made throughout the years, and on the other, there was the need for an optimisation of the existing space, as presented in the program of requirements, locating where a further addition, expansion, or change of program was more effective for improving the spatial quality of Rifugio Carducci.

As is often the case, a renovation project is research for the right compromise between design intentions and design requirements. It is about finding the balance point between what is worth keeping and what must be changed.
In this project, it was important to allow the refuge to continue its function, and because of its history and meaning for those who experienced it, it was important to still detect the original refuge within the renovated spaces. The form, the shape of the hut makes it unique, makes it recognisable for those who experience it. Therefore, in this renovation project, it was important to give value to the existing, celebrate it, but still protect it and enhance it. To keep existing, improve it, allow the refuge experience to be fulfilling. In other words, the main challenge was to finely balance all the restrictions and requirements imposed on the design.

Looking back, it would have been extremely interesting to explore two different alternatives considered in the early phases of the project: one with a completely new hut and one that I called "Rifugio *diffuso*".



1 - Screenshot of "Rifugio Diffuso" Volume Study

This route would have taken a fundamentally different approach, leaving the existing refuge as it is, only insulating it, and would have transferred the expanded functions into a series of detached small buildings. In other words, it would have disassembled the idea of hut, diffusing it in the nearby area, with several independent buildings.
This option would have taken the prefabrication aspect to its maximum potential, simply transporting the different modules/buildings on site. Possibly a less expensive solution, reducing to the minimum the construction on-site and permitting a scalability not reachable with alternative solutions. On the other hand, it would have required an intervention on the existing refuge to insulate it, and each new building would have needed independent lighting, heating, and possibly plumbing.

In many cases, when an alpine hut needs extensive renovation works, the designers opted for a completely new building, using the existing one to house the construction workers, demolishing it once the new one is completed. This option was chosen, for example, when rebuilding Rifugio Ponte di Ghiaccio and for Cabane de Tracuit.
This option simplifies the construction logistics, allows for greater design freedom, it frees from the question of what to do with the existing, it simplifies the challenge. It allows for a completely new approach to hospitality in that particular location. It closes a book to start a new one.
A renovation, on the other hand, writes one more chapter to continue a story.

Nevertheless, because of what Rifugio Carducci is for those who visit it, rebuilding it from scratch and demolish the existing building did not respect the intentions of the projects and the intentions of the caretakers.

As it can be seen, the decision taken for this project, driven by the research, to maintain as much as possible the existing hut, made the design process more challenging, forced to make compromises, at times made the process frustrating. In a new building, it would not have been a constant battle for every millimetre of the design. But at the end of the day, a new building would have told a new story, not the story of Rifugio Carducci in Alta Val Giralba.

By being a project done through the Explore Lab, it was up to me to develop an approach and method for reaching the project's intended results. As is often the case, it started with high and demanding expectations, hoping to precisely calculate every aspect, to mathematically prove that the project as designed was a perfectly functioning thermodynamic machine.
The research and the design development have shown that the project, rather than calculations, needed an appropriate way of reading and interpreting it. Therefore, the project evolved into experimentation on how to read a building within its context. Through this way of reading, it was possible to understand the refuge and develop one possible proposal for each of the many challenges presented by the project.

The methodology employed for reading the building, reading the systems composing the built element in the environment was then a fundamental and foundational aspect for all the decisions taken during the project. As examples:

- The simple act of connecting the dining area of the refuge with its environment with two types of openings: a narrow horizontal window on the south-facing wall to frame the infinite landscape of the Dolomites beyond the Val Giralba; and the thin vertical openings on the west wall for allowing the visitor to appreciate the full height of the sharp vertical cliffs of the 2914 meters of Cima d'Auronzo or the 3090 meters of Croda dei Toni.
- The use of well-exposed south-facing roofs to harvest the strong potential of using PV panels at high altitudes. To extract hydrogen from the water collected during the many days of rain of the hut's opening season necessary to power the primary needs of shelter that the hut is giving to the visitors.
- The development of a structural system made from locally sourced larch (harvested in the valley and processed in the villages' industrial zones) that expands the refuge and protects it from the harsh and challenging natural environment, without cancelling the hut's history but protecting and continuing it.

So this project, in its entirety, has been a long experimentation of connecting layer after layer, integrating system after system, connecting space after space.

From a broader perspective, a similar approach could have been followed for other built elements within a different environment. But what this project has shown is that the high-altitudes are not "the middle of nowhere" and do not harbour independent "Earthships" but are instead a tremendous opportunity for experimenting with architecture in its most broad and integrated forms.
An alpine hut is a sub-typology of hospitality buildings, but given its location and the visitor's attitude, it allows the designer to rethink the hospitality space. No visitor would expect a hotel feeling in a high-altitude hut. Every visitor is instead looking for the experience of living in the natural environment, connect to it, share it. So the Alpine refuge can make use of this and experiment with it. For example, the hut's design can question the form of sleeping rooms, rethinking the experience of sharing the space with friends and other visitors.
Furthermore, the design of high altitude architectures is an exercise for experimenting with the interaction between building, visitor, and the environment. The first instinct of designing a building in such a majestic natural environment is to do everything to see everything. Every opaque surface covers a spectacular and unique view. But at the same time, the reality of the location calls for the primary need of shelter, safety, a welcoming space. So the high-altitude architecture becomes the continuous debate between the "I want to see everything, I want to feel everything" and the "I want to escape the storm, I want to leave the cold behind that door". And finally, the architecture of high-altitudes comes down to the need of building a long-lasting and robust shelter that stays in place. But this solid and unmovable shelter can only be reached after many hours of uphill hike or by air. So the dialogue becomes real and practical: "how can I build it? I need to fly it there! And I need to do it between the last and the first snowfall!".
So, the design of architecture for the high-altitudes becomes an exercise of essentials. An architecture of fundamental aspect taken to the limits and often answered by many small different actions.

Conclusions

I started this final project to improve my understanding of the design process and to combine research, build technology and design into one meaningful architecture project. Although, as they say, design is never finished, I do believe that the several layers of this project were combined, resulting in a well-rounded project. During the process, several challenges emerged, at times self-imposed. The technical complexity of a renovation project was coupled with the challenges presented by the project's location. Furthermore, it was particularly challenging to combine my personal attachment to the building as it is with the necessity of the expansion. In other words, this very special place, dear to me, presented me with the challenge of modifying it while retaining its spirit. I was often caught between the perspective of the user and the perspective of the designer. Furthermore, by being in close contact with the caretakers, at times, it was necessary to remember that this was an academic project rather than a project for a client. On another note, this relationship with the place, and the caretakers, allowed me to have a deep and clear understating of the hut, having direct access to the experts of the location, their knowledge, and their data.

Finally, to answer the main research question of "how can we maximise the positive impact of a high-altitude alpine refuge towards its (eco)system?":
The positive impact of the hut is achieved at different levels: at a technological level, at an architectural level, and at an economic level.
Starting from the last mentioned, the hut is positively impacting its economic system, expanding the economic viability of running the refuge, providing more work for the local to both work at the refuge itself, and to supply it with local products. Furthermore, using the locally available larch timber as the primary material for the expansion of the refuge, it is providing an opportunity for the local economy to supply the building material, as well as prefabricating the elements.
From a technological perspective, the positive impact of the refuge on its ecosystem is maximised by removing the need for fossil fuels. The refuge will solely work thanks to the installed solar panels, and it will store the energy-producing hydrogen from the collected rainwater, reducing the need for taking water from the nearby spring. Furthermore, the refuge will purify the wastewater that as of today, is directly discharged into the environment. The water purification process will, at the same time, contribute to the production of hydrogen while discharging in the environment only clean water. In this way, the refuge will transform from a polluter and CO2 producer to a machine that purifies water and harvests and stores energy only through its available resource, water and sun.
Finally, from an architectural perspective, the refuge will positively impact its system of trails providing a safe shelter for visitors, a reliable location to reach and experience. The architecture of the hut provides the opportunity to be sheltered, and at the same time to be always in contact with the natural beauty surrounding the built element. The refuge will continue to be a destination and will become a platform through which to experience the environment, providing interaction between visitor, building, and nature. The hut will positively impact the visitor by protecting, welcoming, and providing a fulfilling experience; it will cease to be a polluter; it will connect people with the high altitudes.