UP THERE

THE TRAIL TOWARDS A MORE SUSTAINABLE ALPINE HUT.

A RENOVATION PROJECT FOR RIFUGIO CARDUCCI, 2297 MT., ALTA VAL GIRALBA, DOLOMITI.

TU Delft _ Faculty of Architecture

Explorelab 31

P5 Presentation | 13-09-2021

Francesco Longo - 4726579

Mentoring team: Henri van Bennekom | Andy van den Dobbelsteen | Gilbert Koskamp

Board of Examiner's delegate: Ronald van Warmerdam

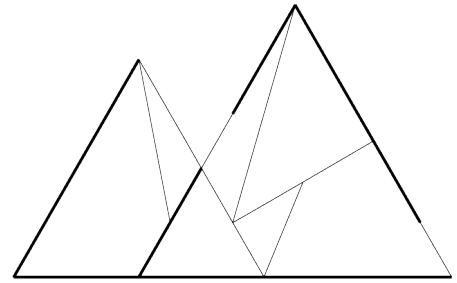
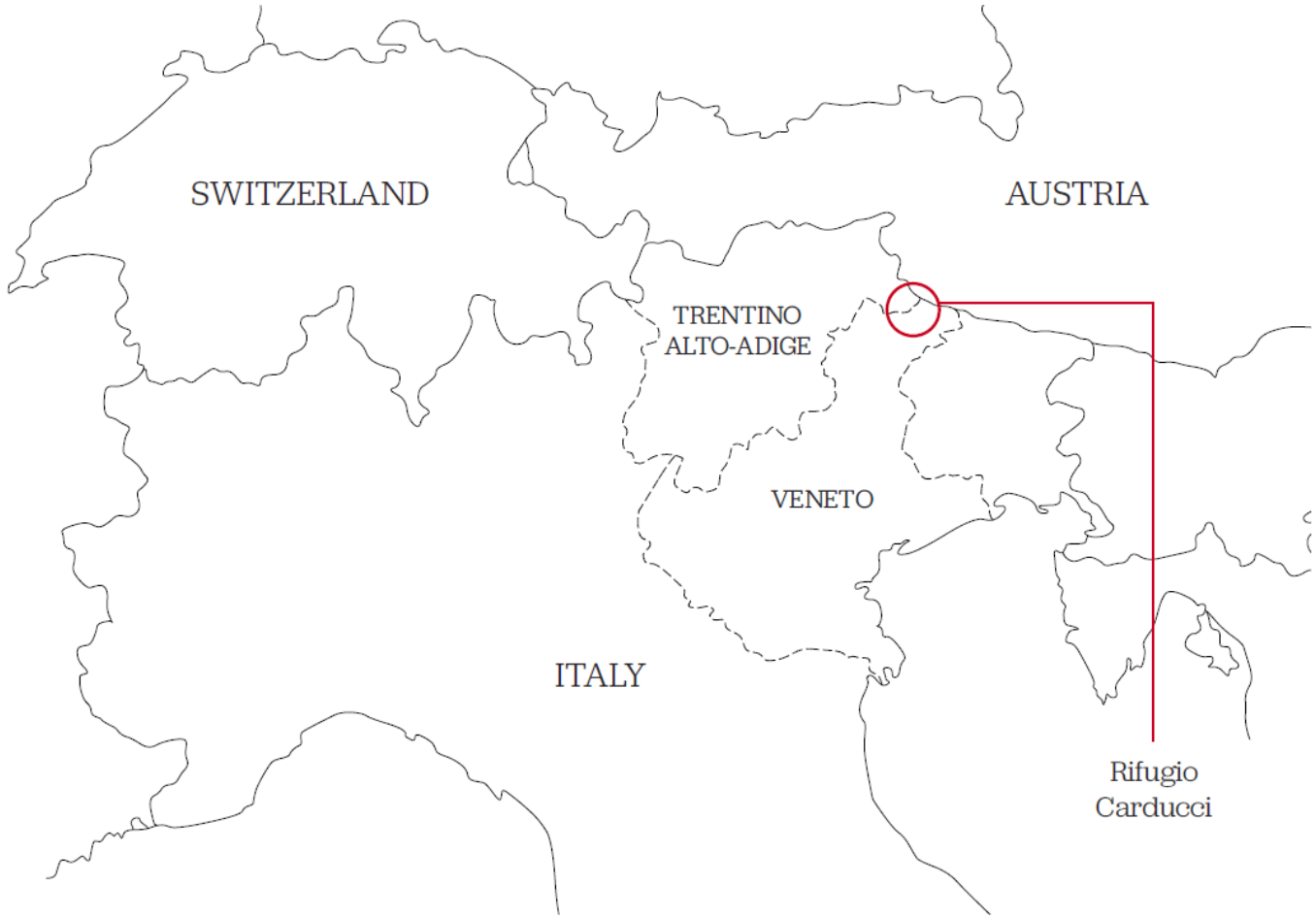
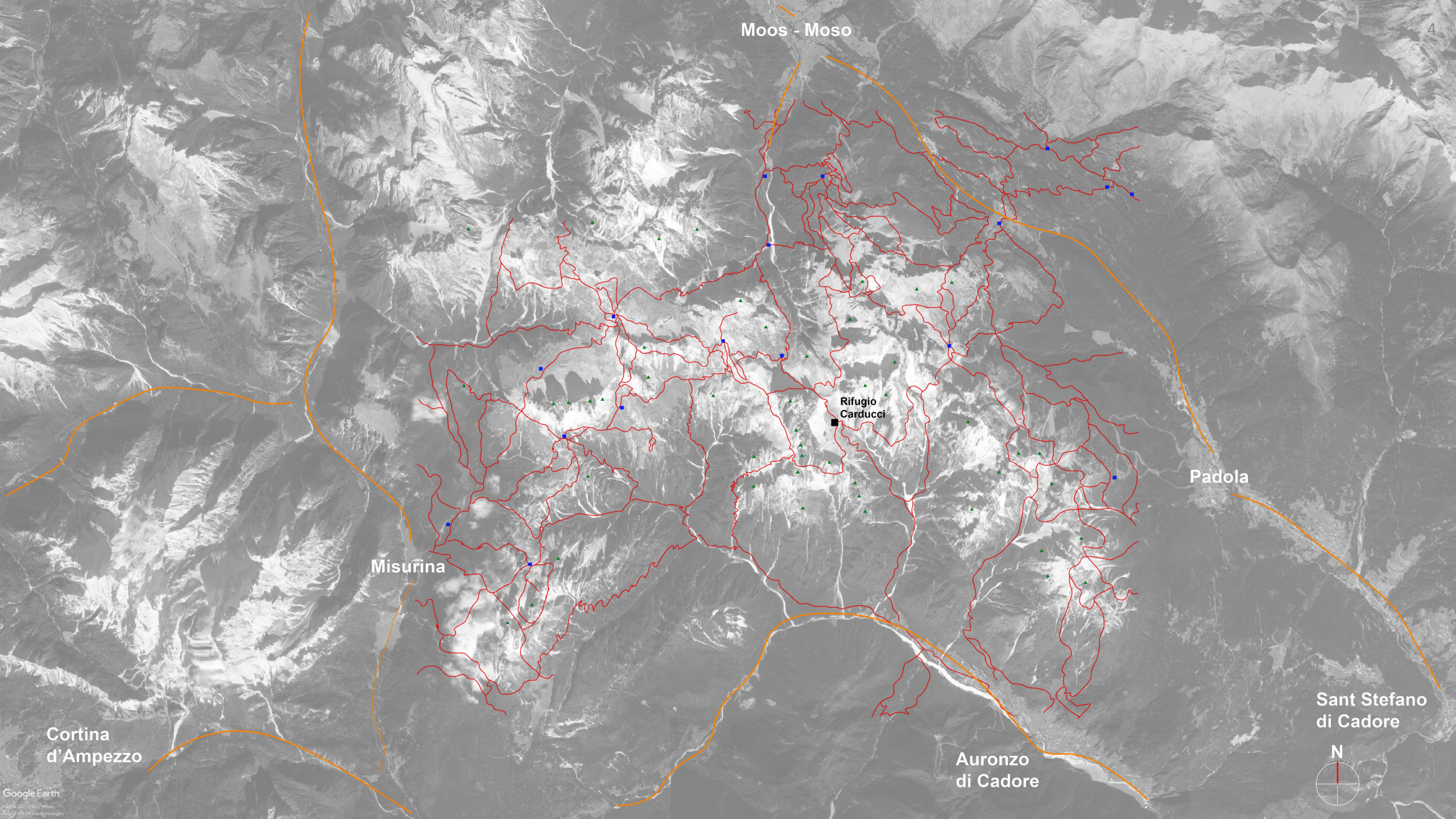


Photo Credit: Rifugio Carducci


SWITZERLAND
AUSTRIA
TRENTINO
ALTO-ADIGE
VENETO
ITALY
Rifugio
Carducci


Moos - Moso
Rifugio
Carducci
Padola
Misurina
Cortina
d'Ampezzo
Auronzo
di Cadore
Sant Stefano
di Cadore
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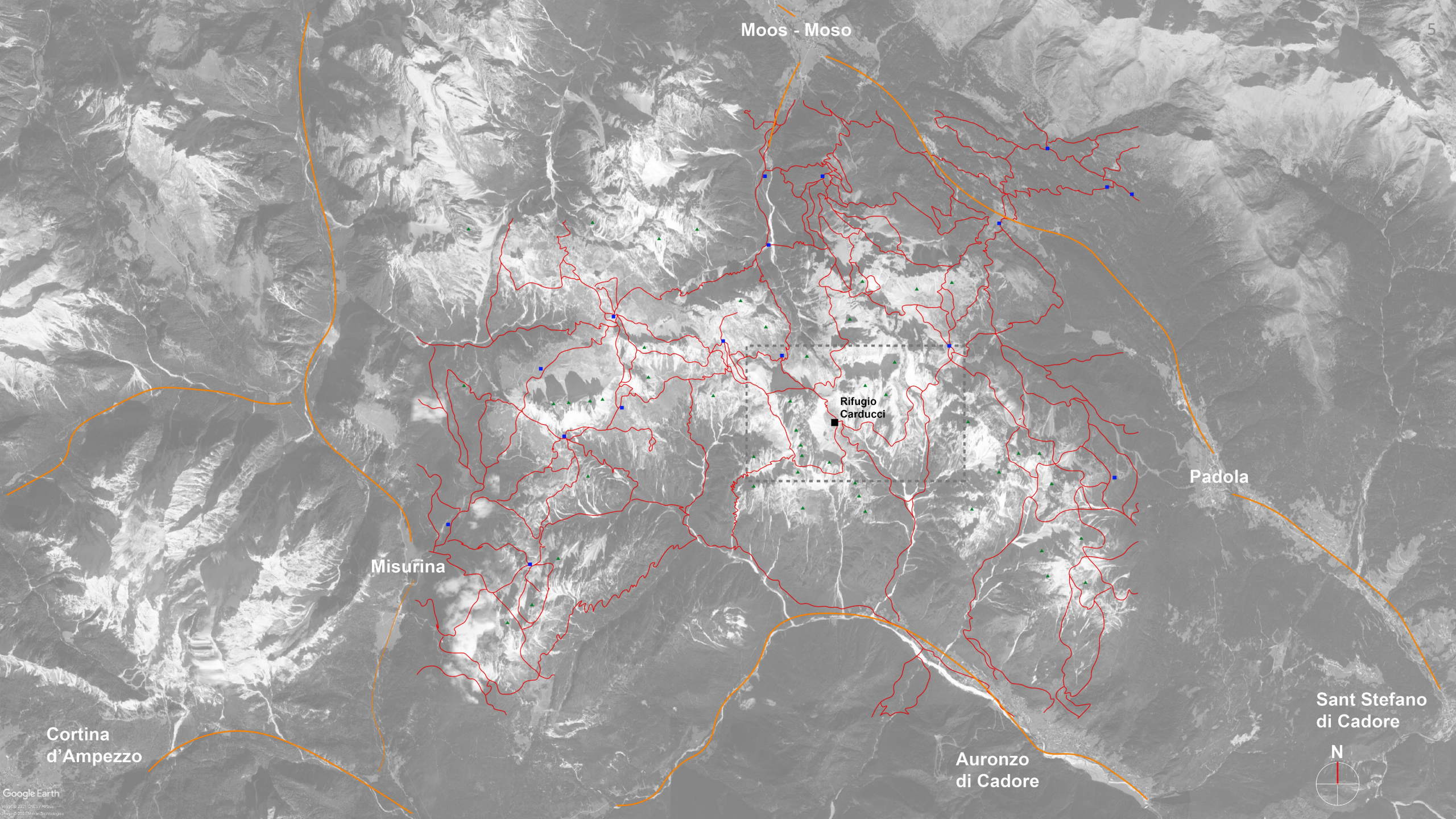
Google Earth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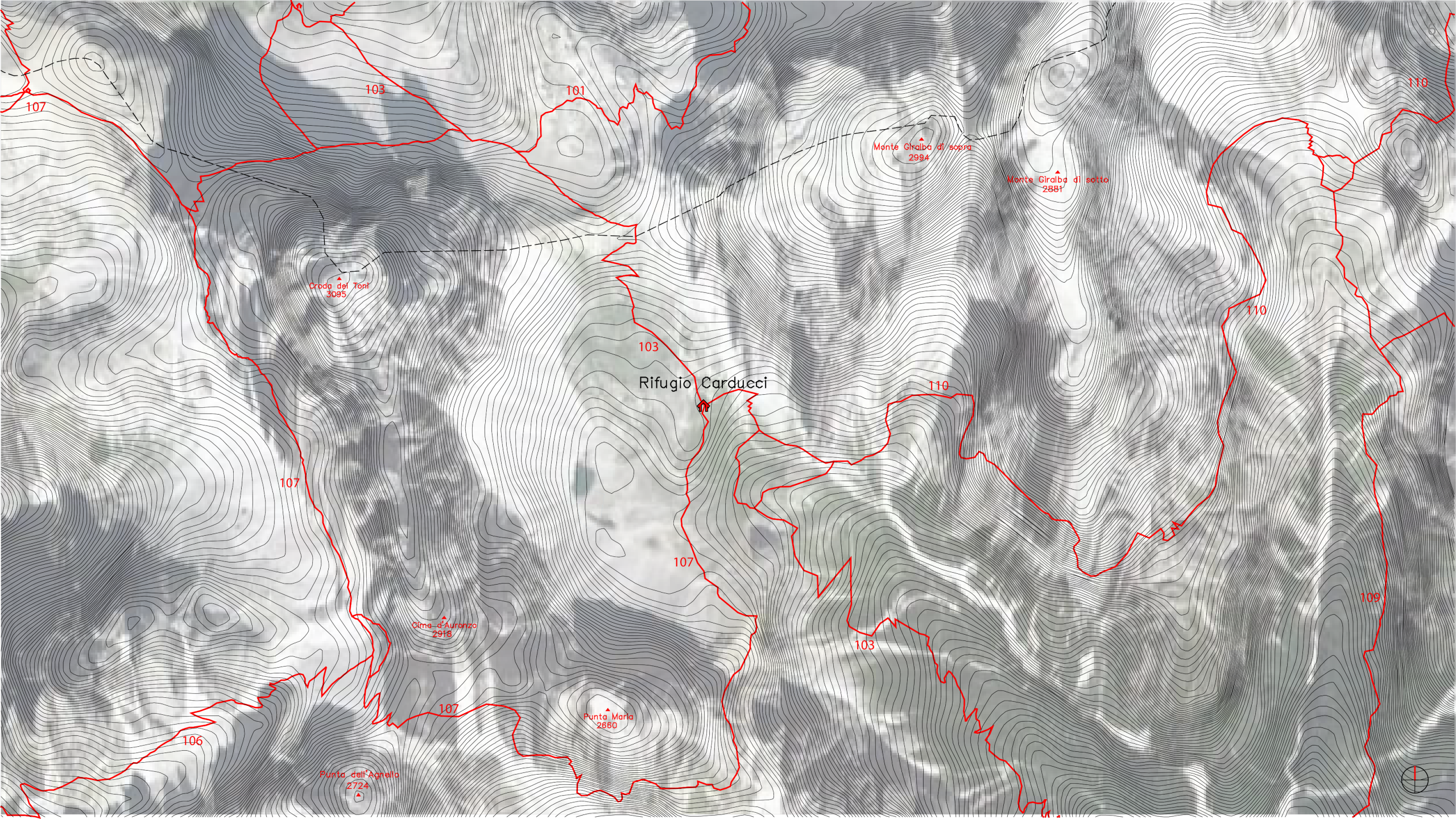
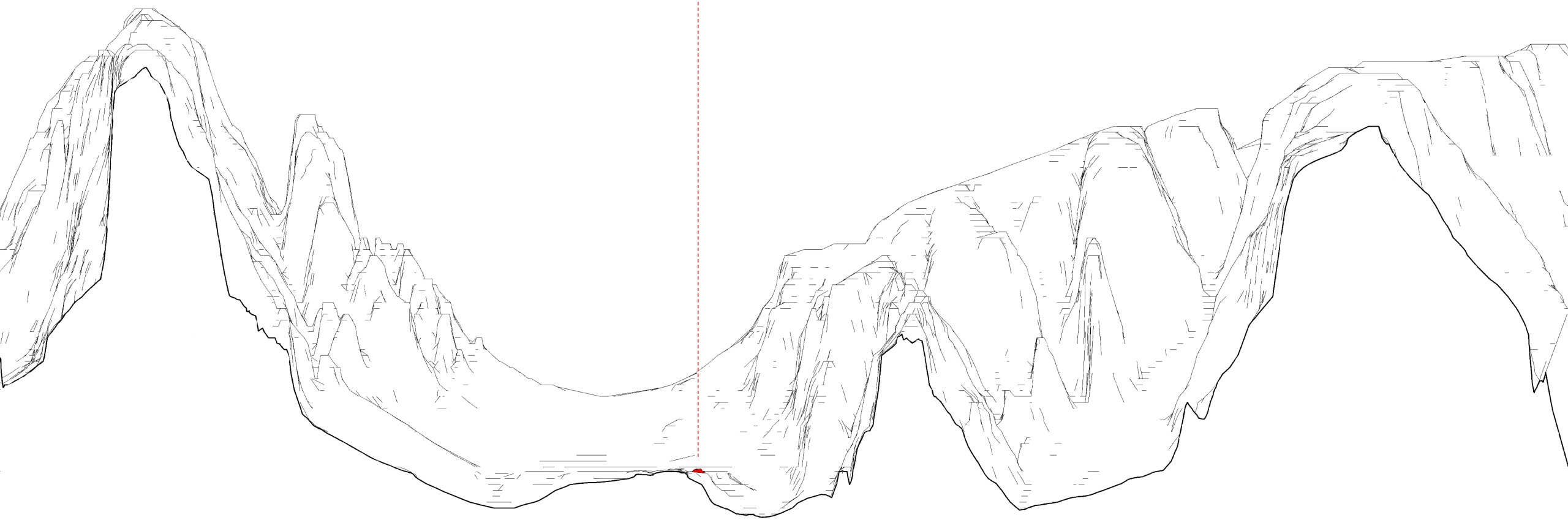

103
101
107
110
Monte Giralba di sopra
2994
Monte Giralba di sotto
2881
Croda dei Toni
3095
103
Rifugio Carducci
110
107
110
107
109
Cima d'Auronzo
2918
103
107
Punta Maria
2660
106
Punta dell'Agnello
2724

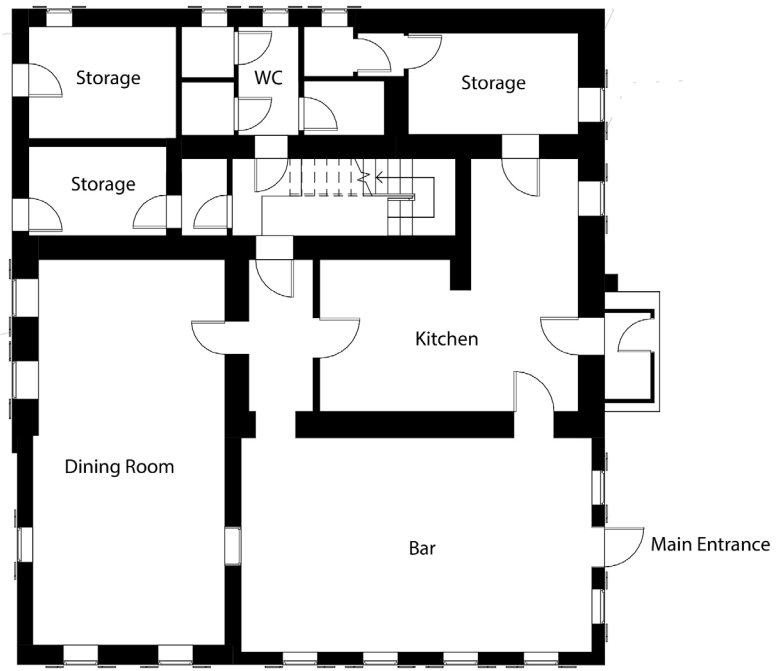
Site Section

The Refuge within its Context.

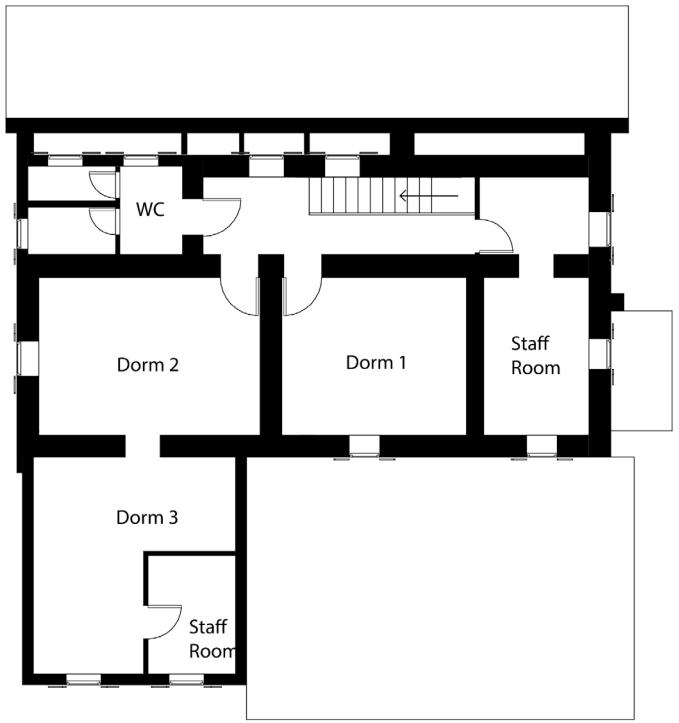
Rifugio Carducci



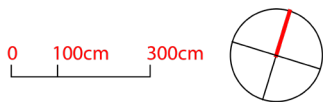
Existing Floor Plans



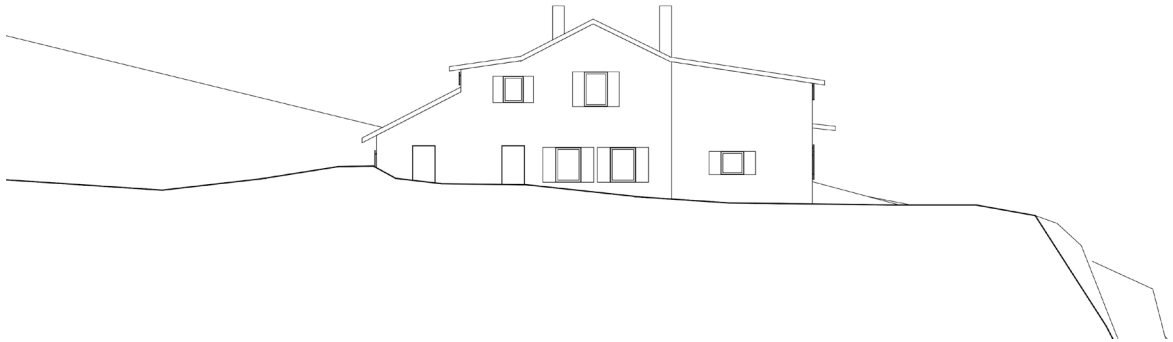
Ground Floor



First Floor

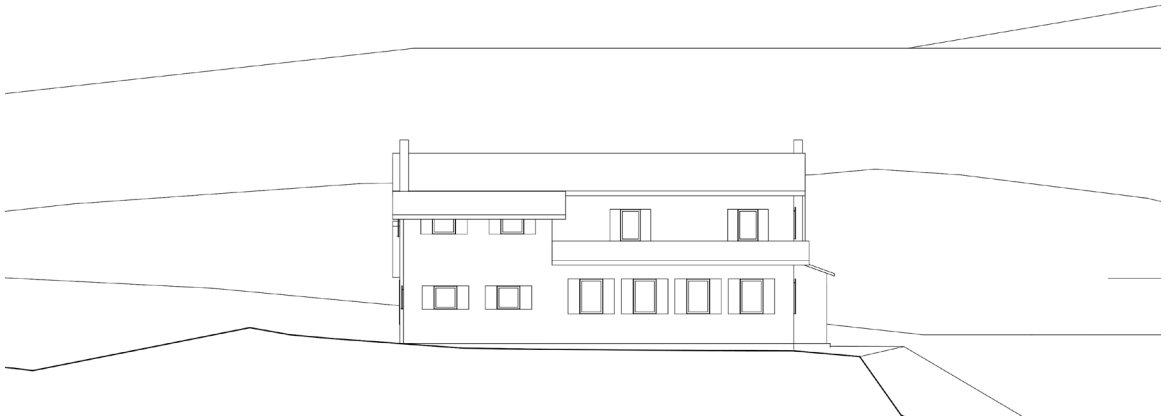


Existing Elevations

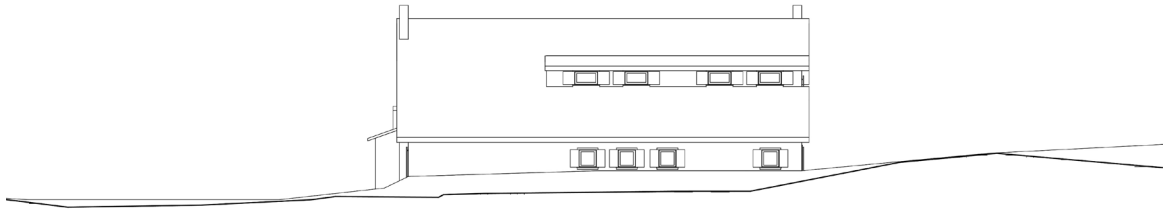


West Elevation

East Elevation



South Elevation



North Elevation

Photo Credit: own Picture

Photo Credit: Own Picture

Photo Credit: Rifugio Carducci

Photo Credit: Rifugio Carducci

- Renew the systems.
- Expand the refuge from 25 to at least 50 beds.
- Expand the dining area.
- Provide an independent winter bivouac.
- Enhance the experience of an alpine hut.

Photo Credit: Rifugio Carducci

“What would be the vision for a future Rifugio Carducci?.”

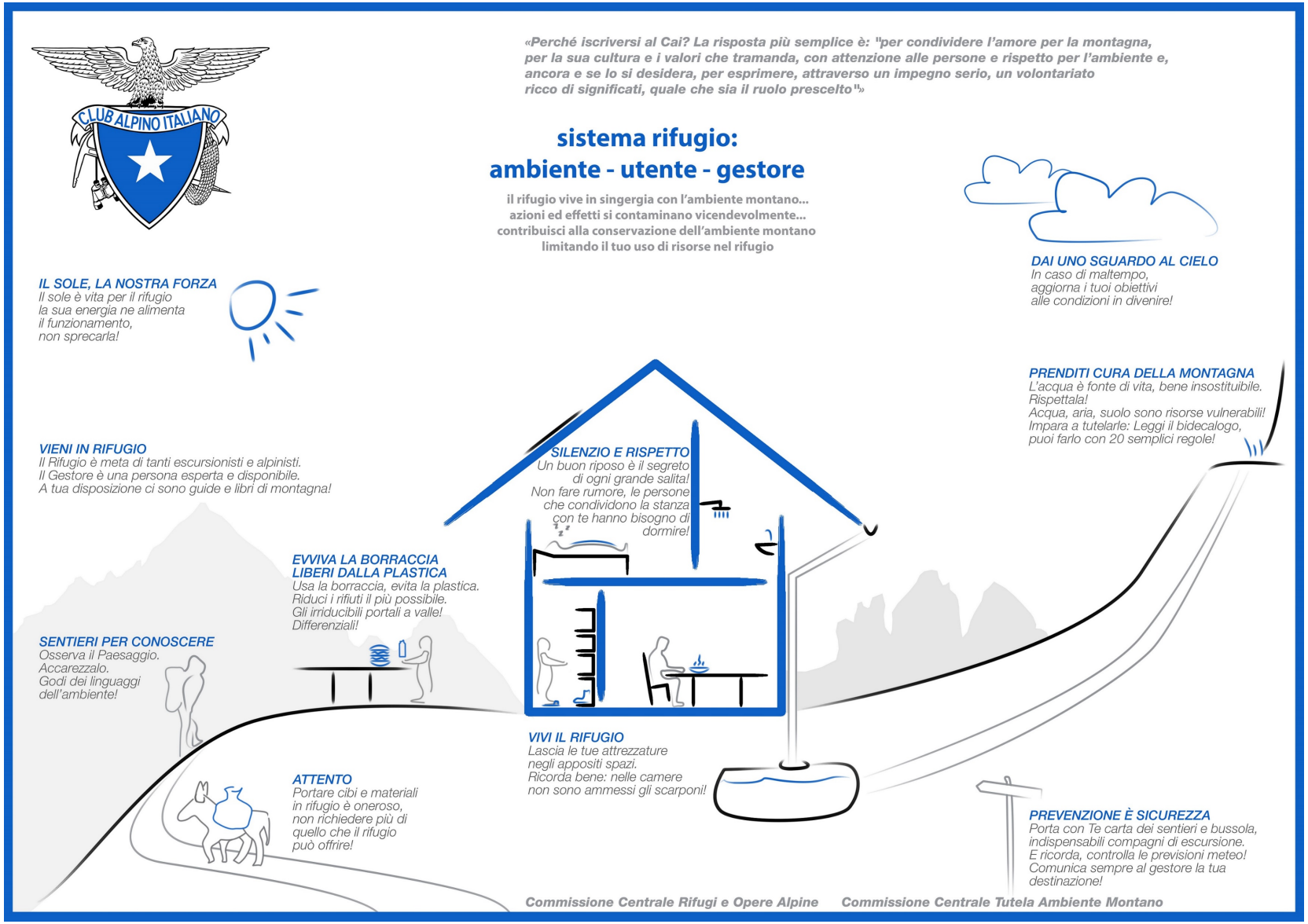
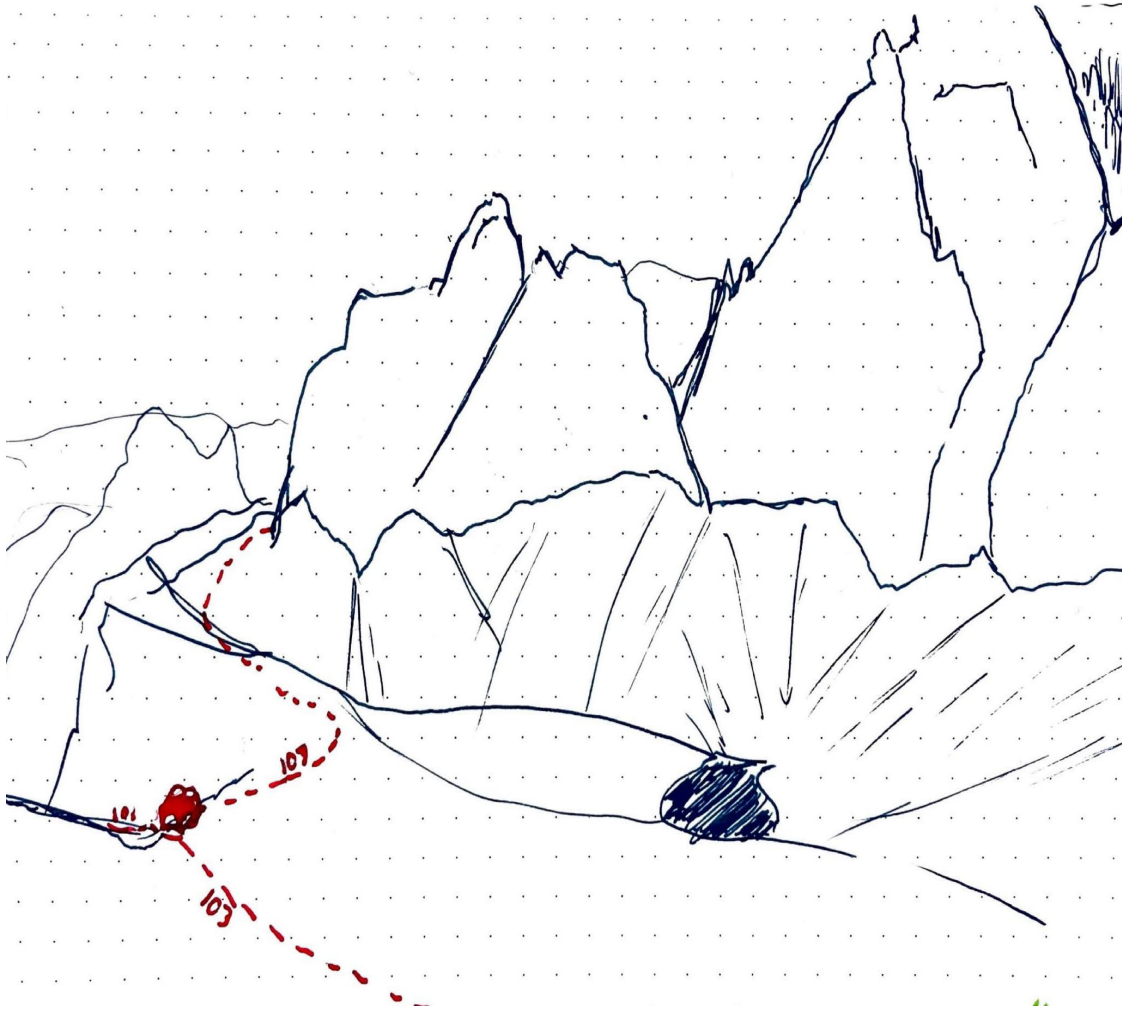


Photo Credit: Club Alpino italiano

Study sketch

Rifugio Carducci, Lago Nero, trails 101-103-109.



Current Site Plan

Highlighting supplies and storage areas.

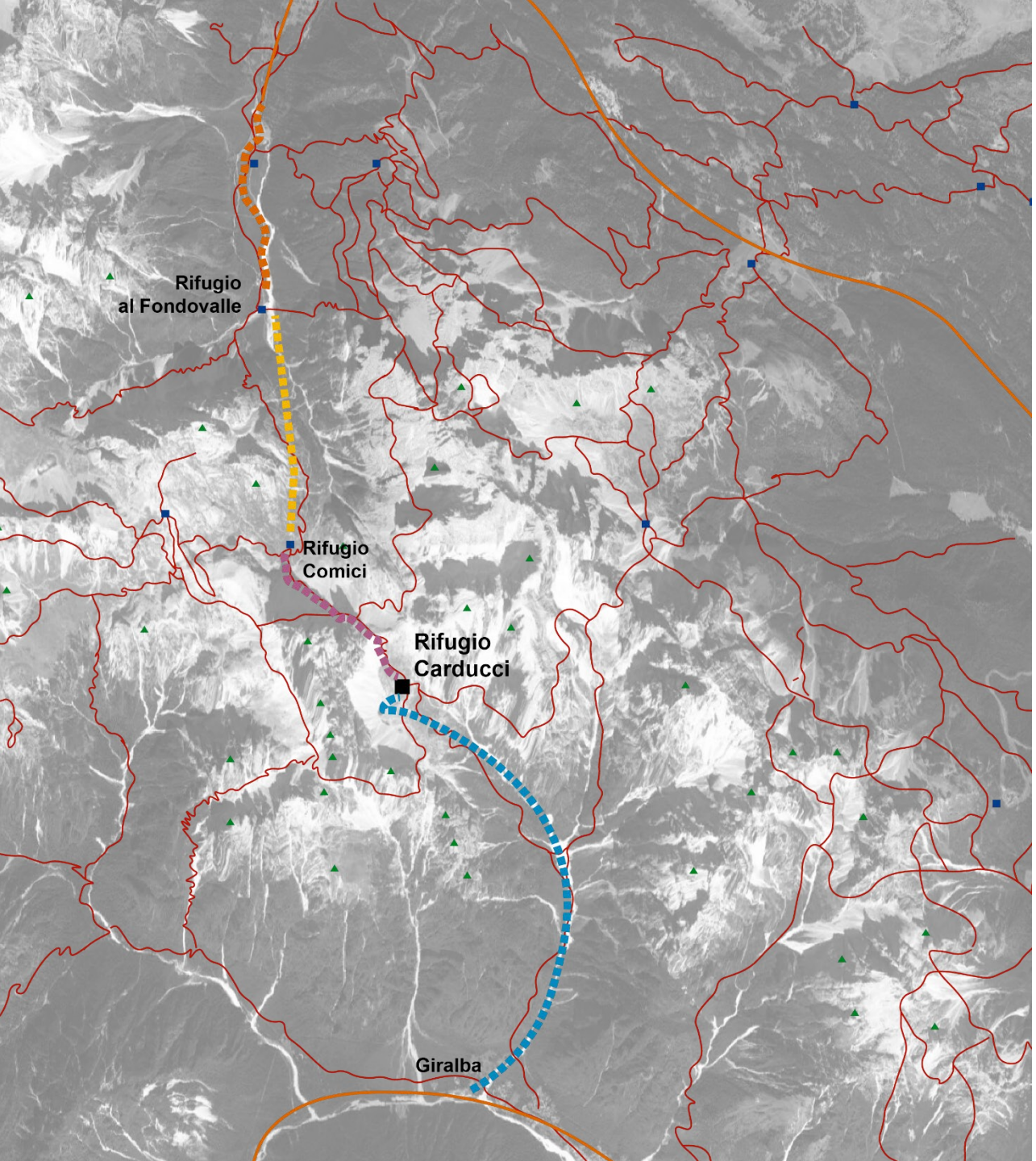
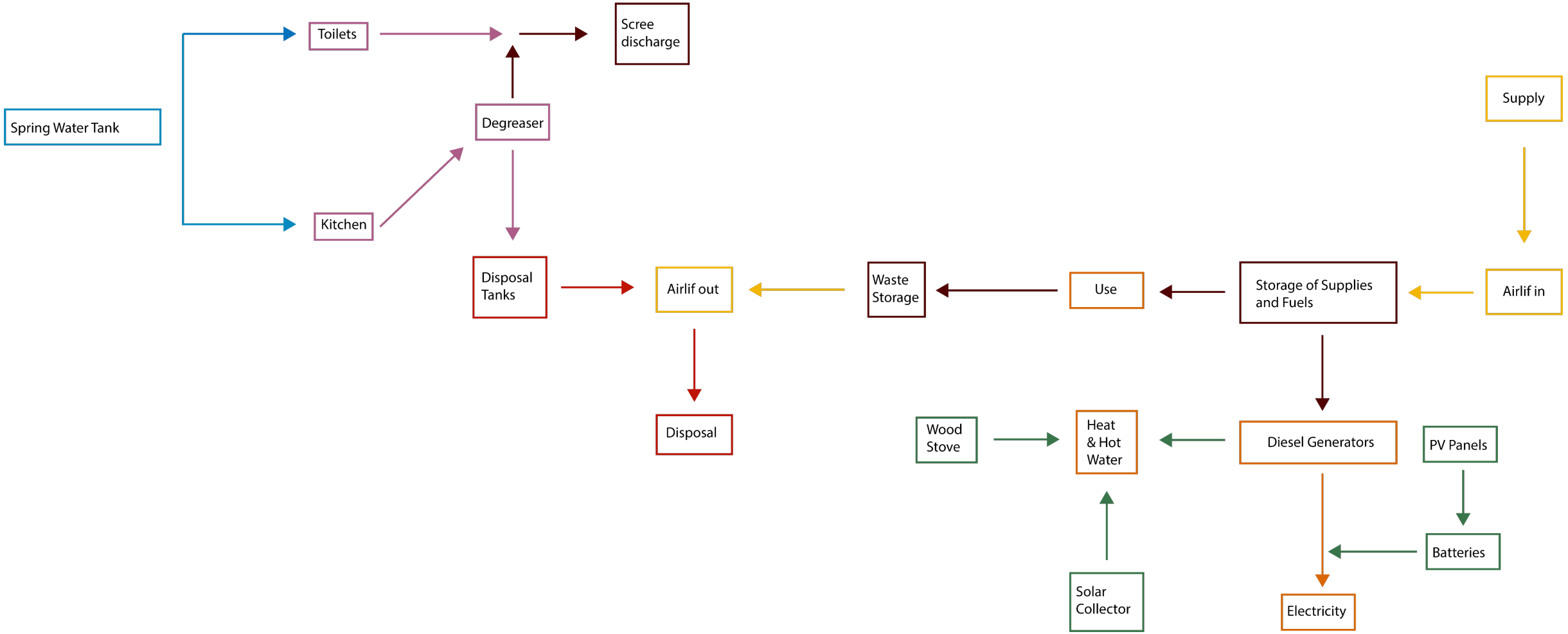


Photo Credit: Rifugio Carducci

Current Systems Integration

Existing Infrastructure of systems



Rather than seeing the built environment as a series of “earth-ships”

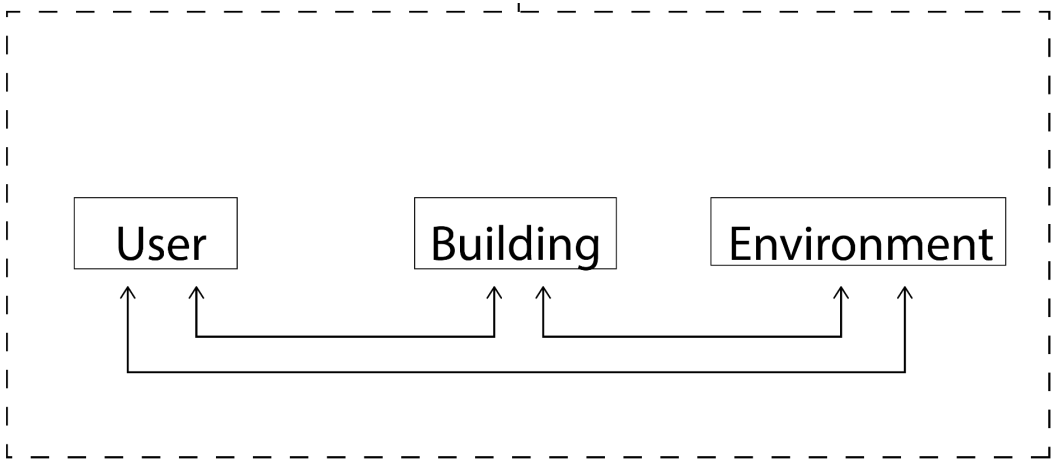
Why not looking “at the built element and the built environment as a connected system of systems?

Refuse self sufficiency to maximise the positive impact of the built in the environment

Photo Credit: Own Picture

Project diagram

Project's fundamentals.



Project diagram
Project's fundamentals.

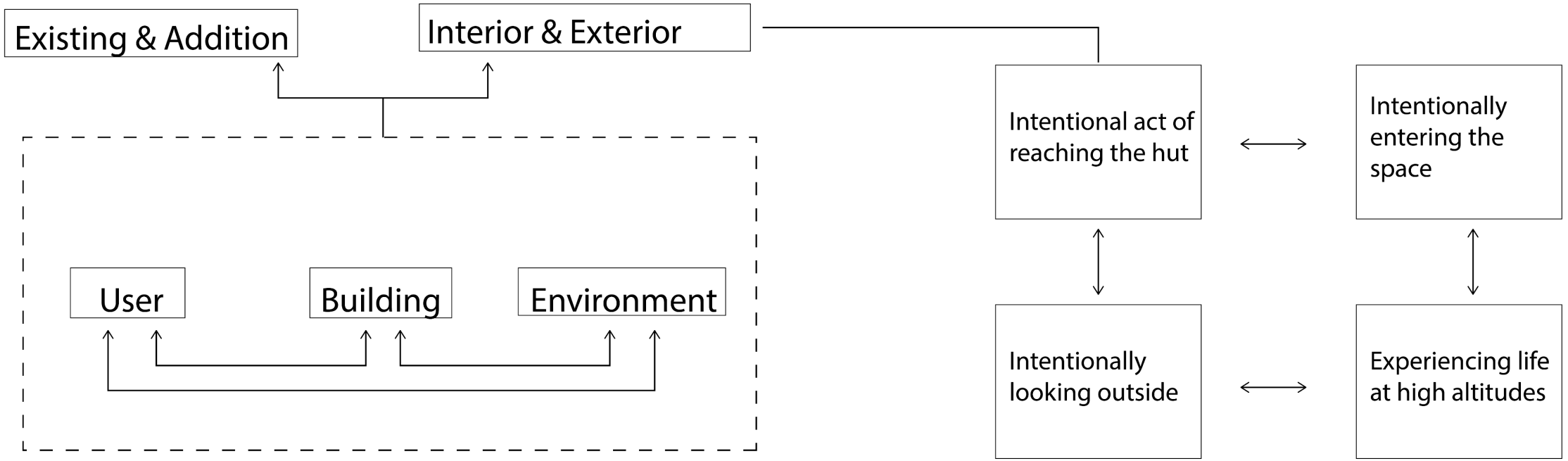


Photo Credit: Own Picture

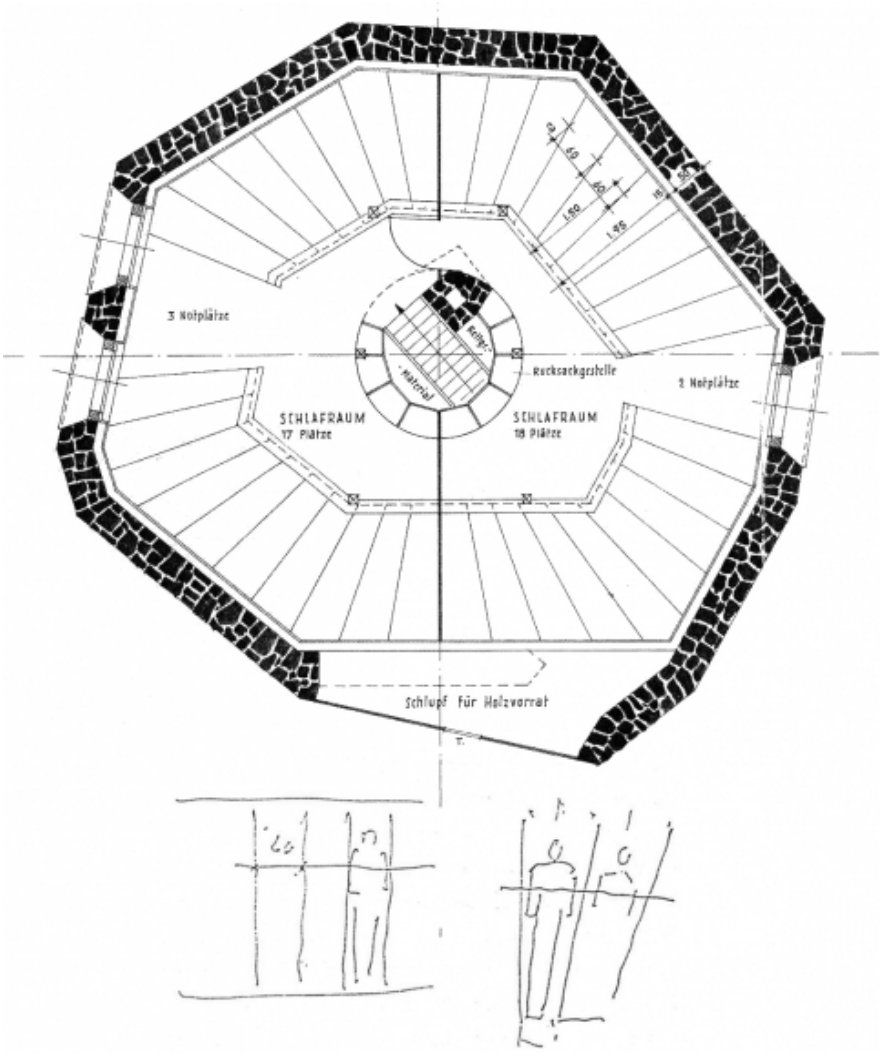
Main question

How can we maximise the positive impact of a high-altitude alpine refuge towards its (eco)system?

What is an alpine refuge?

Shelters and bivouacs

Early examples of shelters and current bivouacs basic structure.



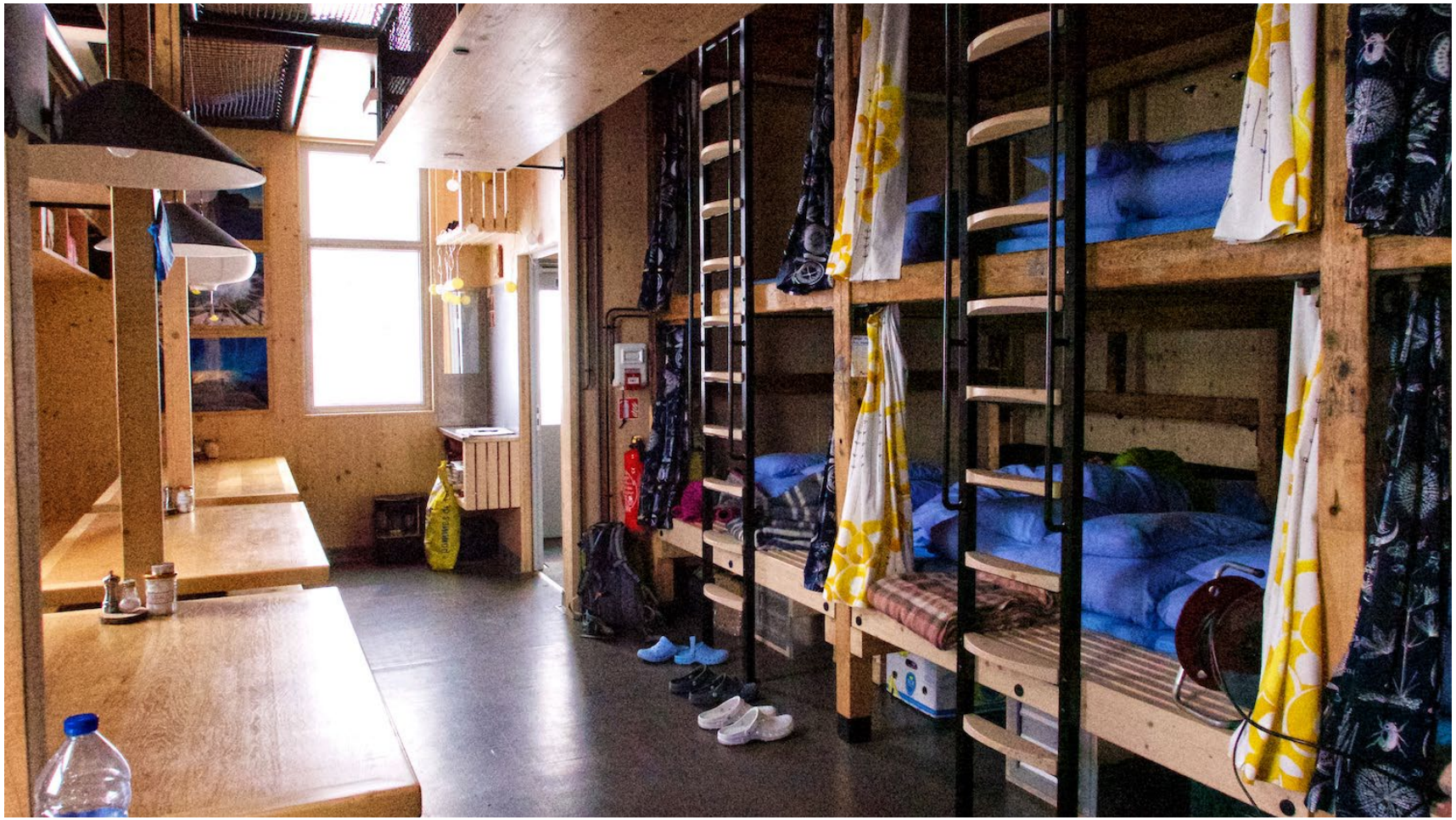


Photo Credit: Rifugi e Bivacchi, Gli imperdibili delle Alpi. Dini, Gibello, Girodo.

Photo Credit: Rifugi e Bivacchi, Gli imperdibili delle Alpi. Dini, Gibello, Girodo.

“Water, food, heat, space: High altitude teaches us to rediscover the use-value of the most precious things.”

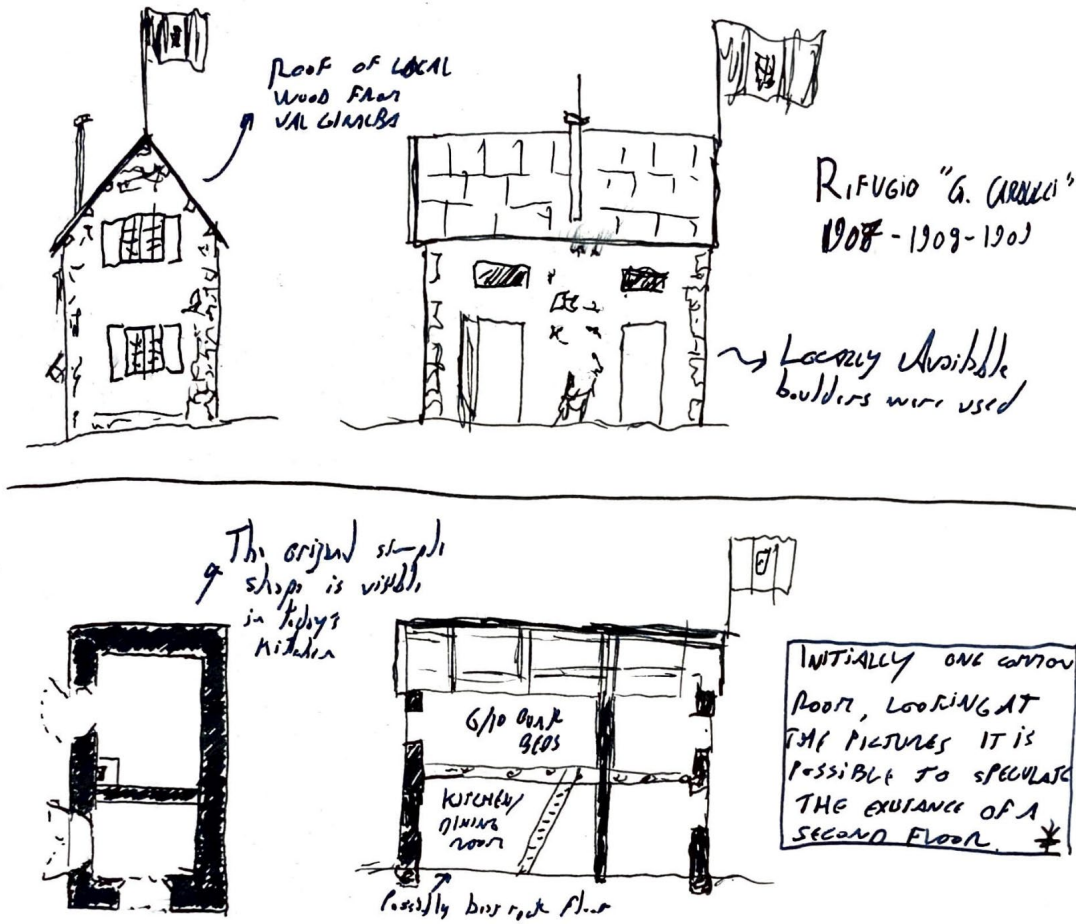
Roberto Dini, Luca Gibello, Stefano Girodo
-Andare per rifugi-

Photo Credit: Alagna.it

Photo Credit: The Architectural Review

Why are they there?

Rifugio Carducci
As built in 1908.



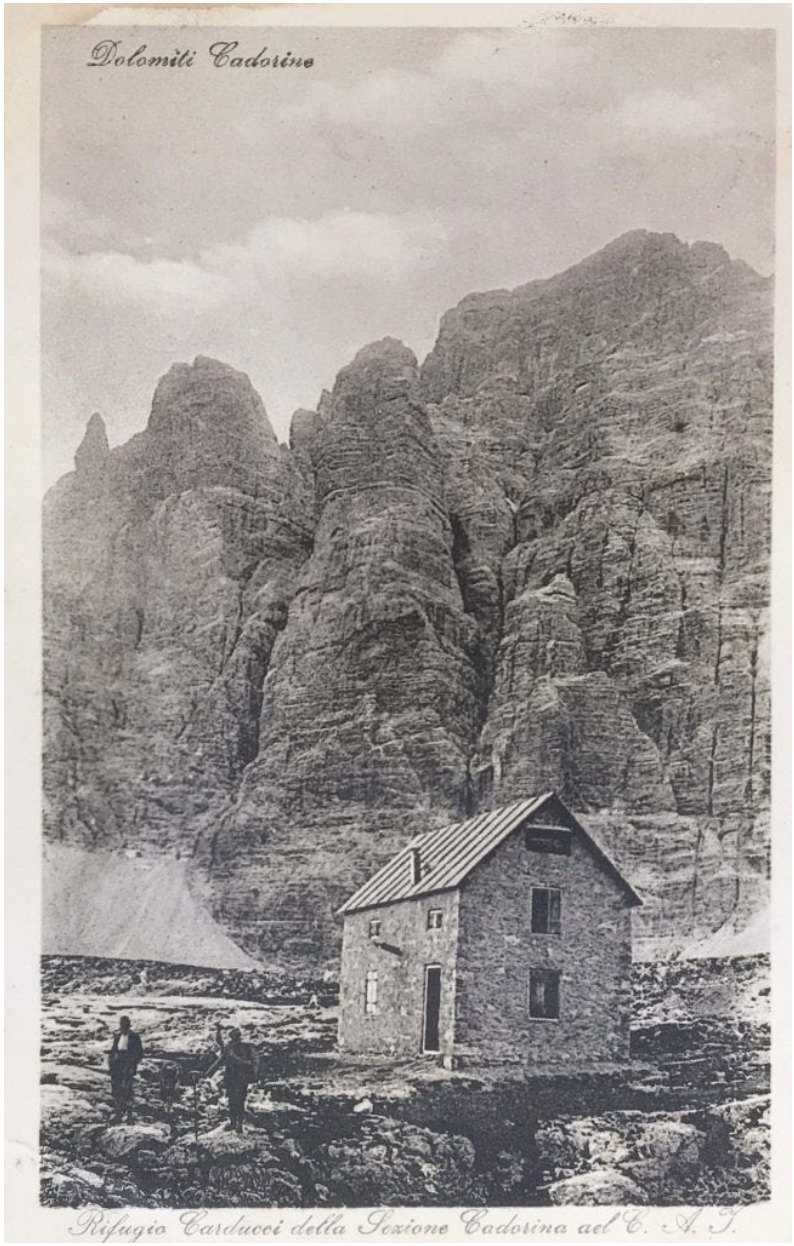


Photo Credit: Cartolinedairifugi.it

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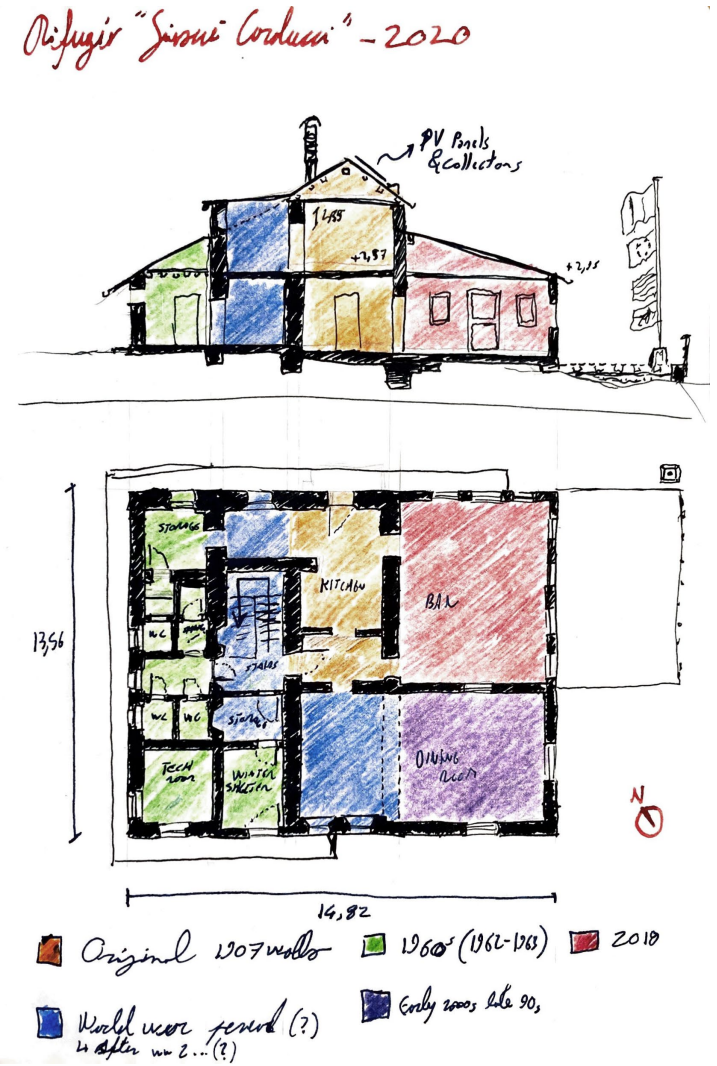
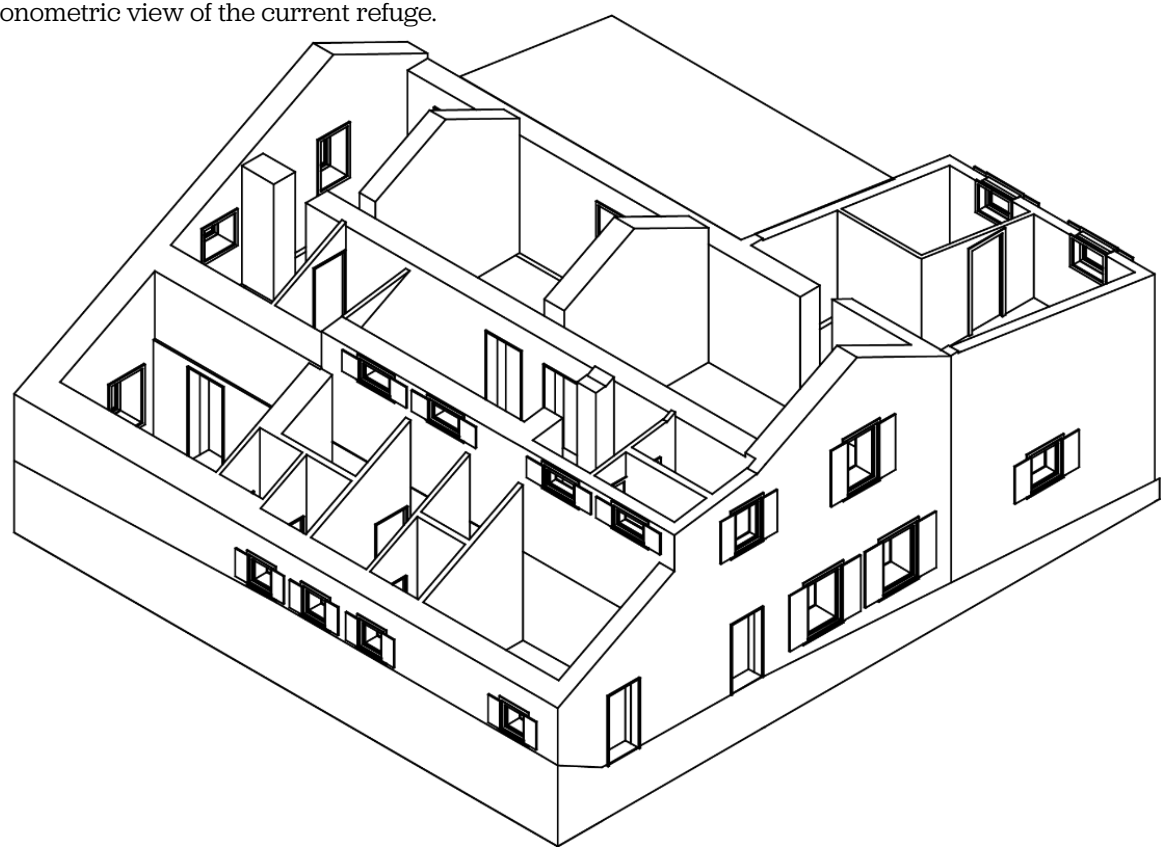


Photo Credit: Rifugio Carducci

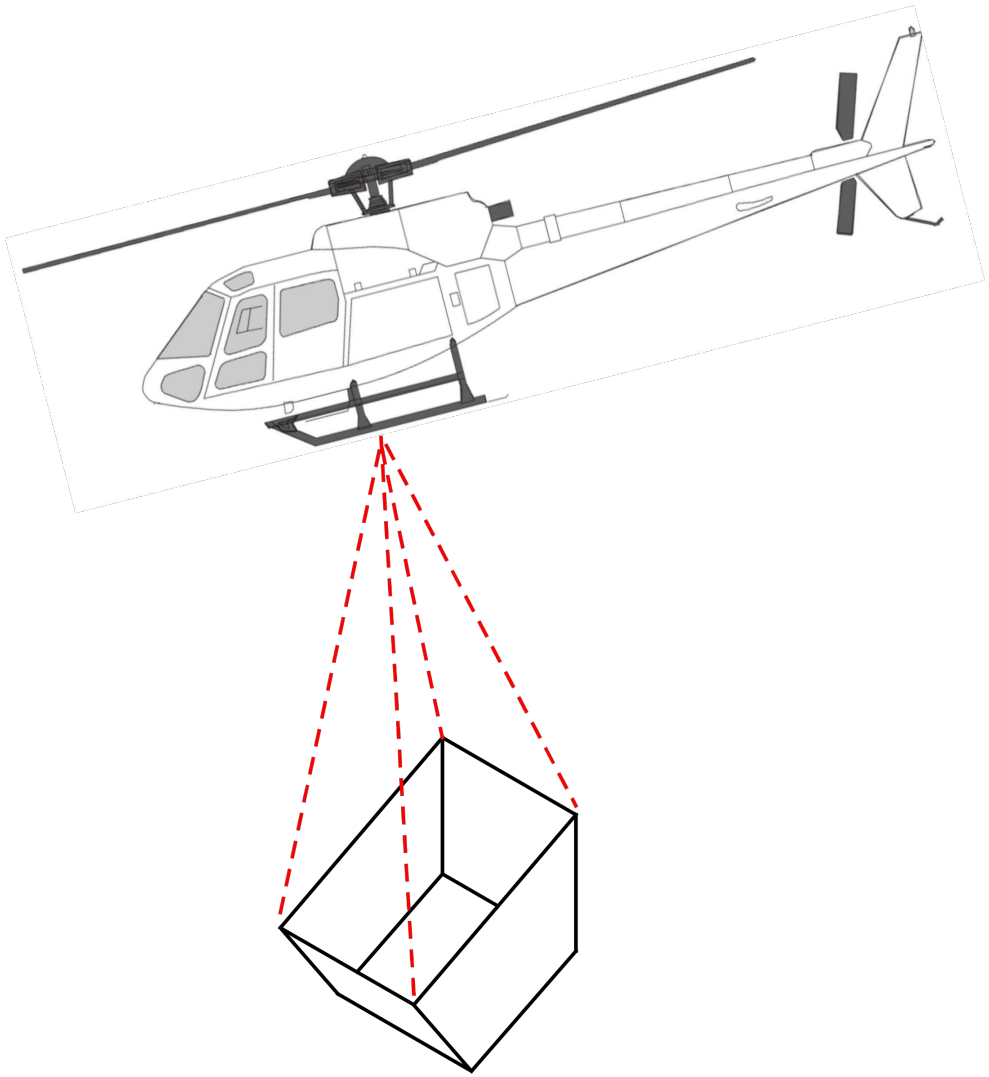
Rifugio Carducci

Axonometric view of the current refuge.



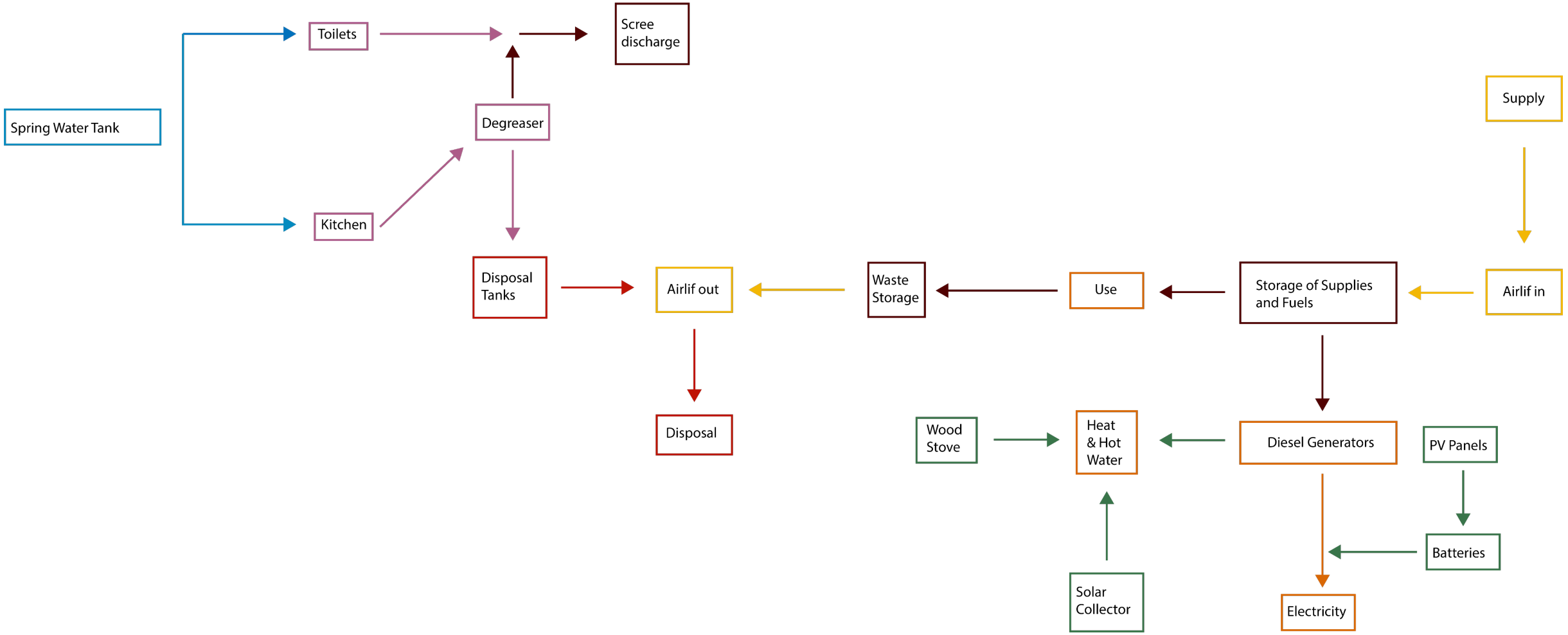
187.3 m^3 of Dolomia stone walls

187.3 m^3 at 2.6 ton per m^3 = 486.980 Kg



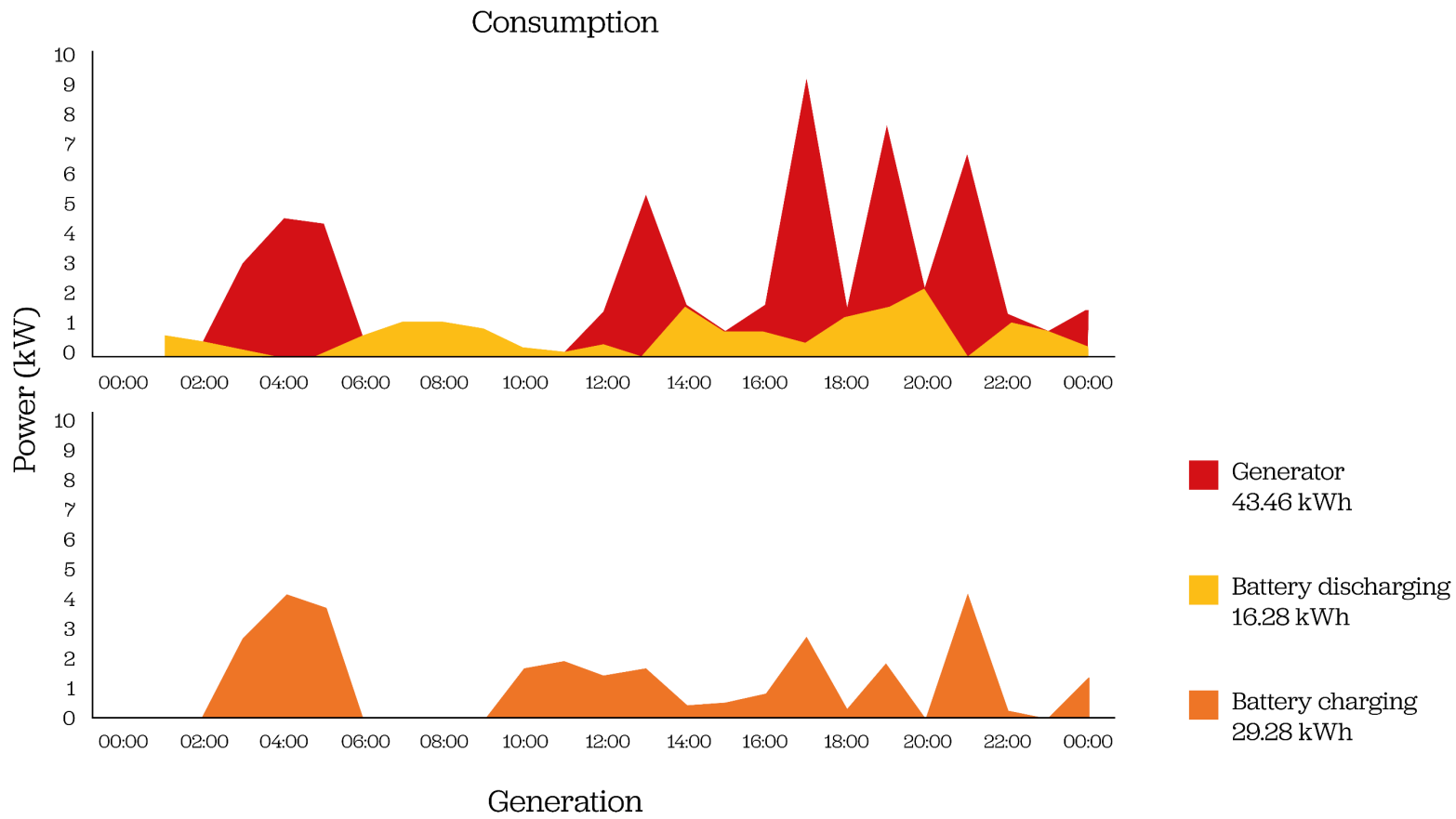
= 350+ helicopter flights

Current Systems Integration
Existing Infrastructure



Energy Consumption and Generation

Extract from a normal operation day of the current refuge.



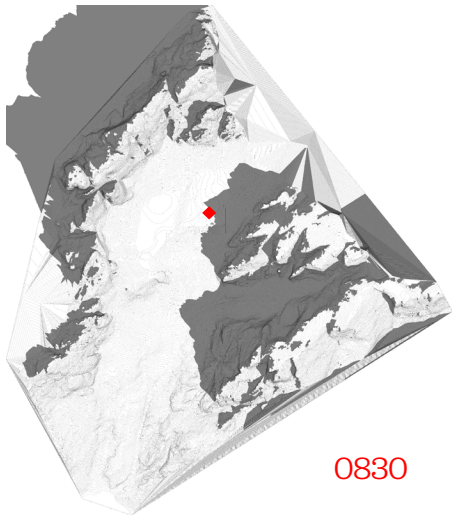
Cast Shadow Study

The Refuge within its natural Context.

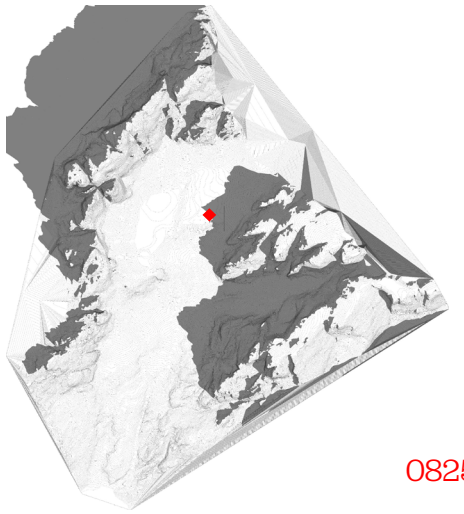
May

June

October



0830



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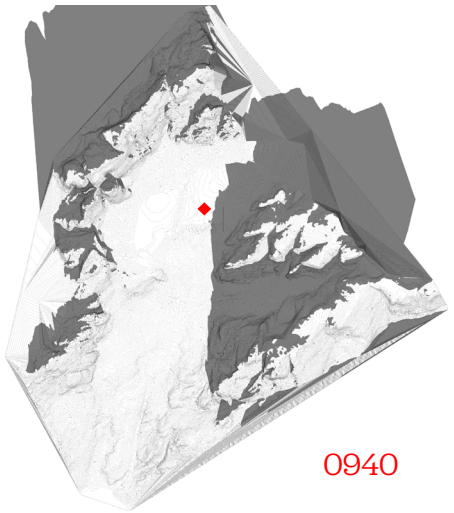
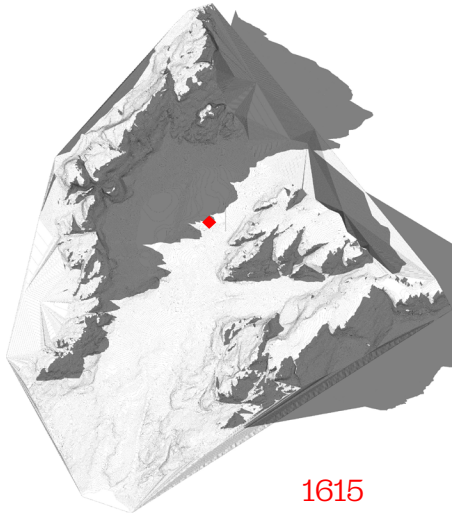


0940

Morning



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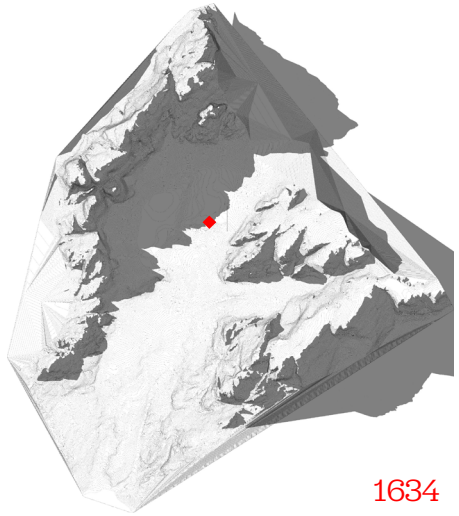

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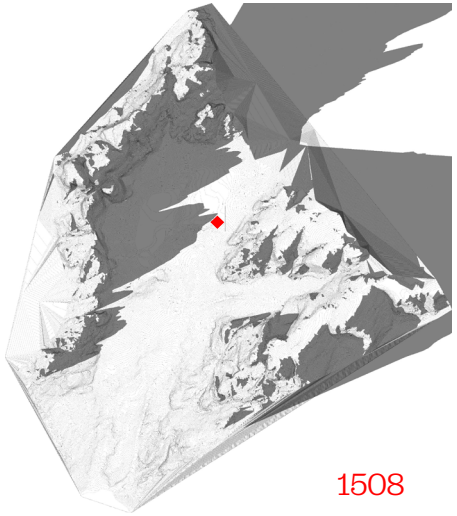


1508

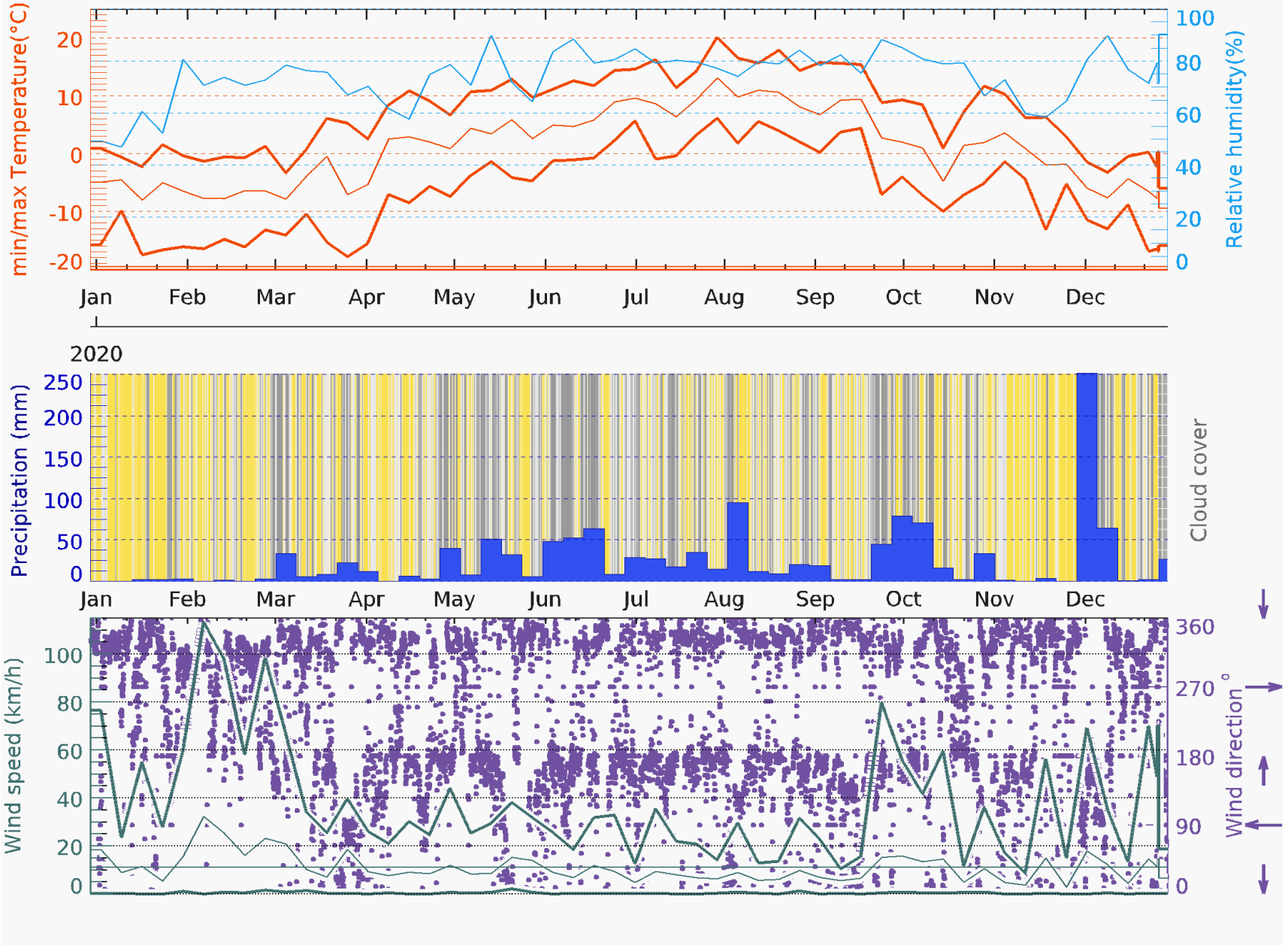
Afternoon

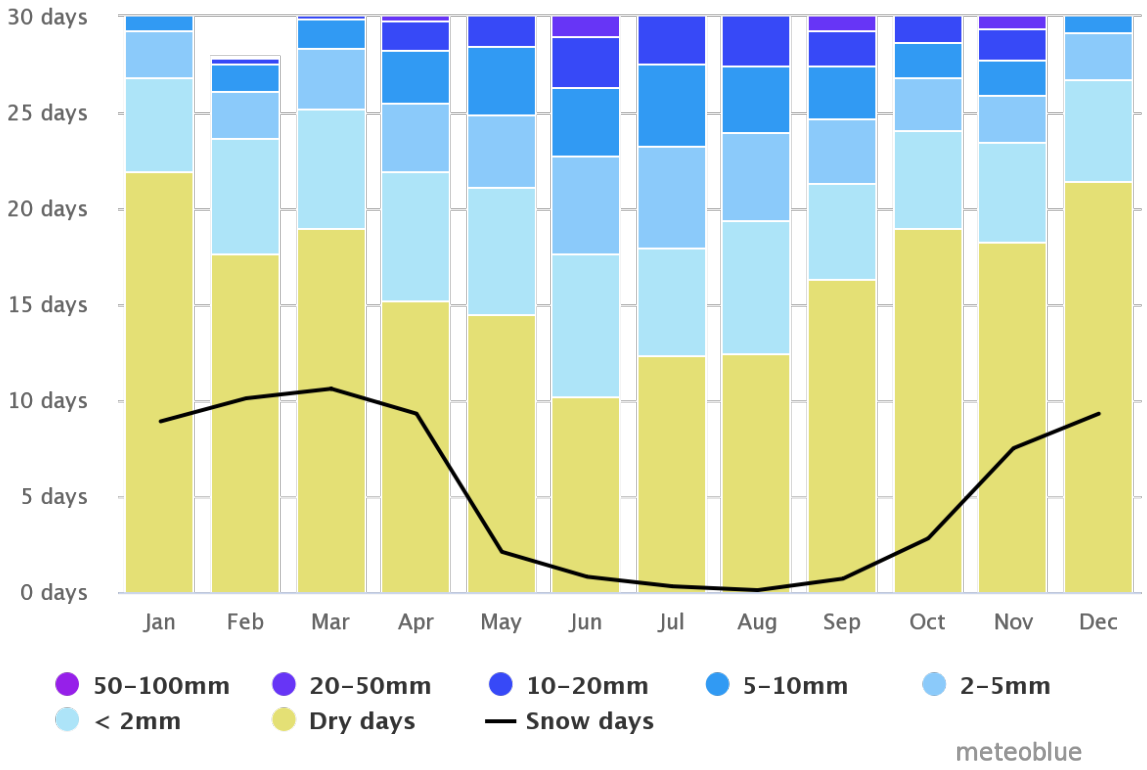
Rifugio G. Carducci

46.62°N / 12.37°E 1764m asl
(12 x 12 km)

2019-12-31 - 2020-12-30
366 days

meteoblue





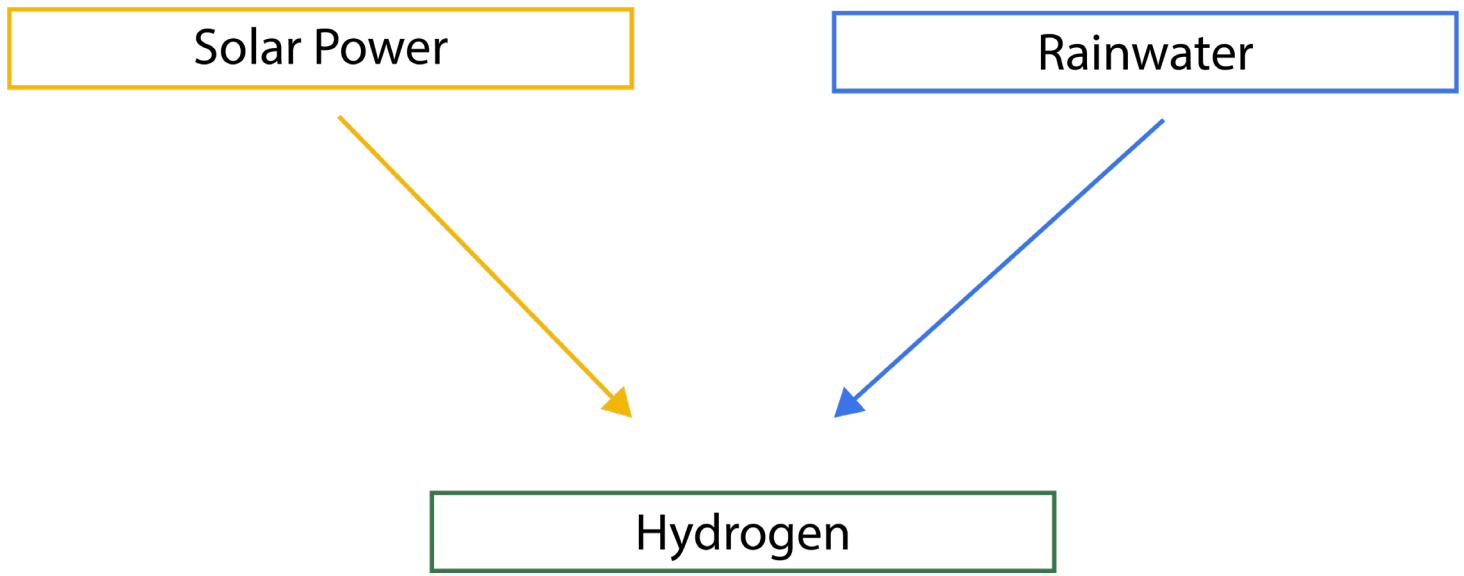
Highly efficient solar panels and
abundant rain fall led me to
consider hydrogen as energy carrier.

Photo Credit: sas-cas.ch

What is the best way to use the rainwater and to store energy?

Hydrogen

Energy storage through available resources.



kWh comparison

Amount of fuel necessary to cover the daily needs of the refuge.

50 to 60 kWh per day

12 kWh per Kg of Diesel

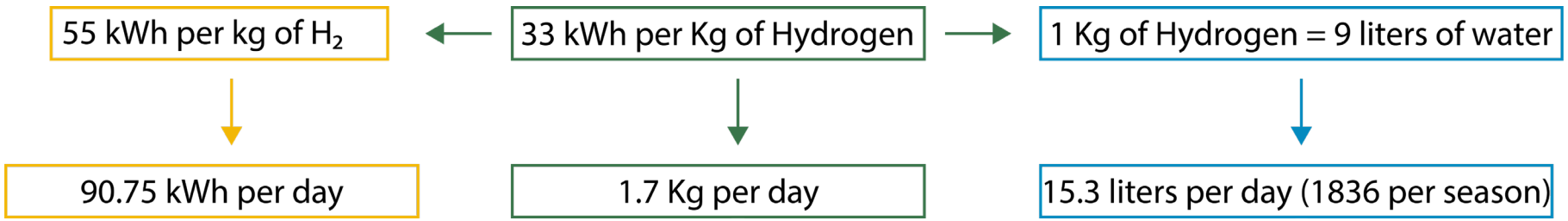
5.7 Kg per day

33 kWh per Kg of Hydrogen

1.7 Kg per day

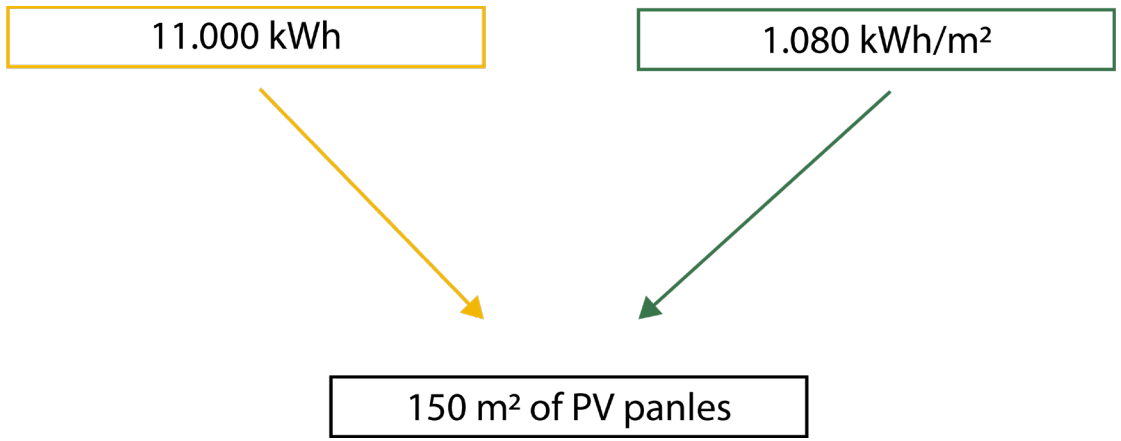
Required resources

kWh and water necessary to extract the necessary Hydrogen.



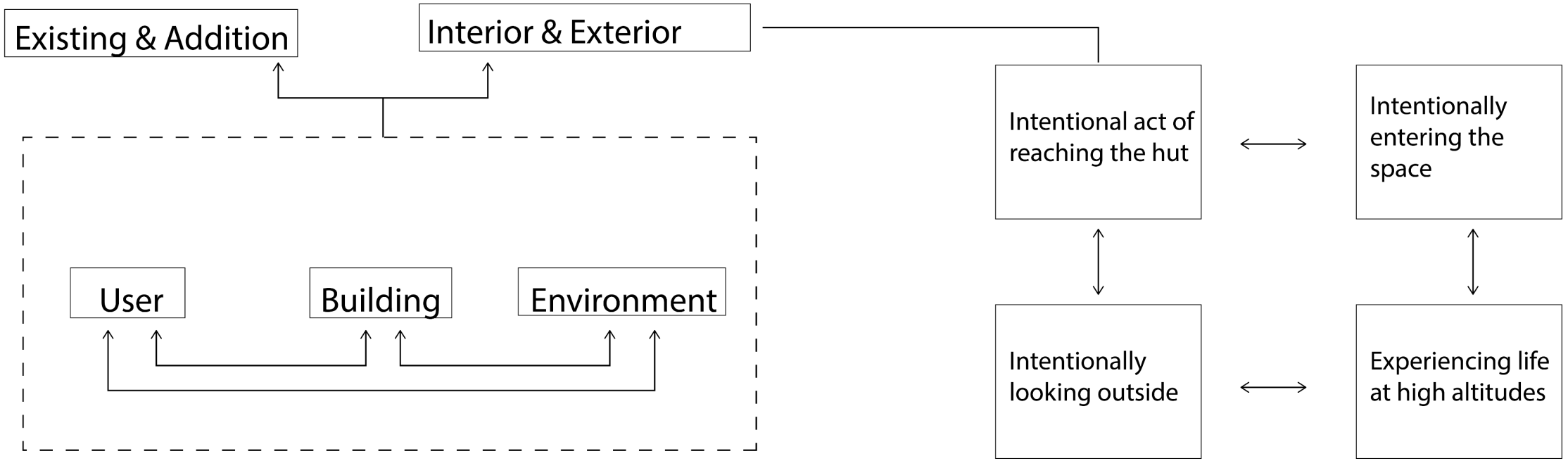
Demand, resource, Necessary PV surface

Season's required energy, peak solar irradiation, necessary PV surface to cover the needs.



How?

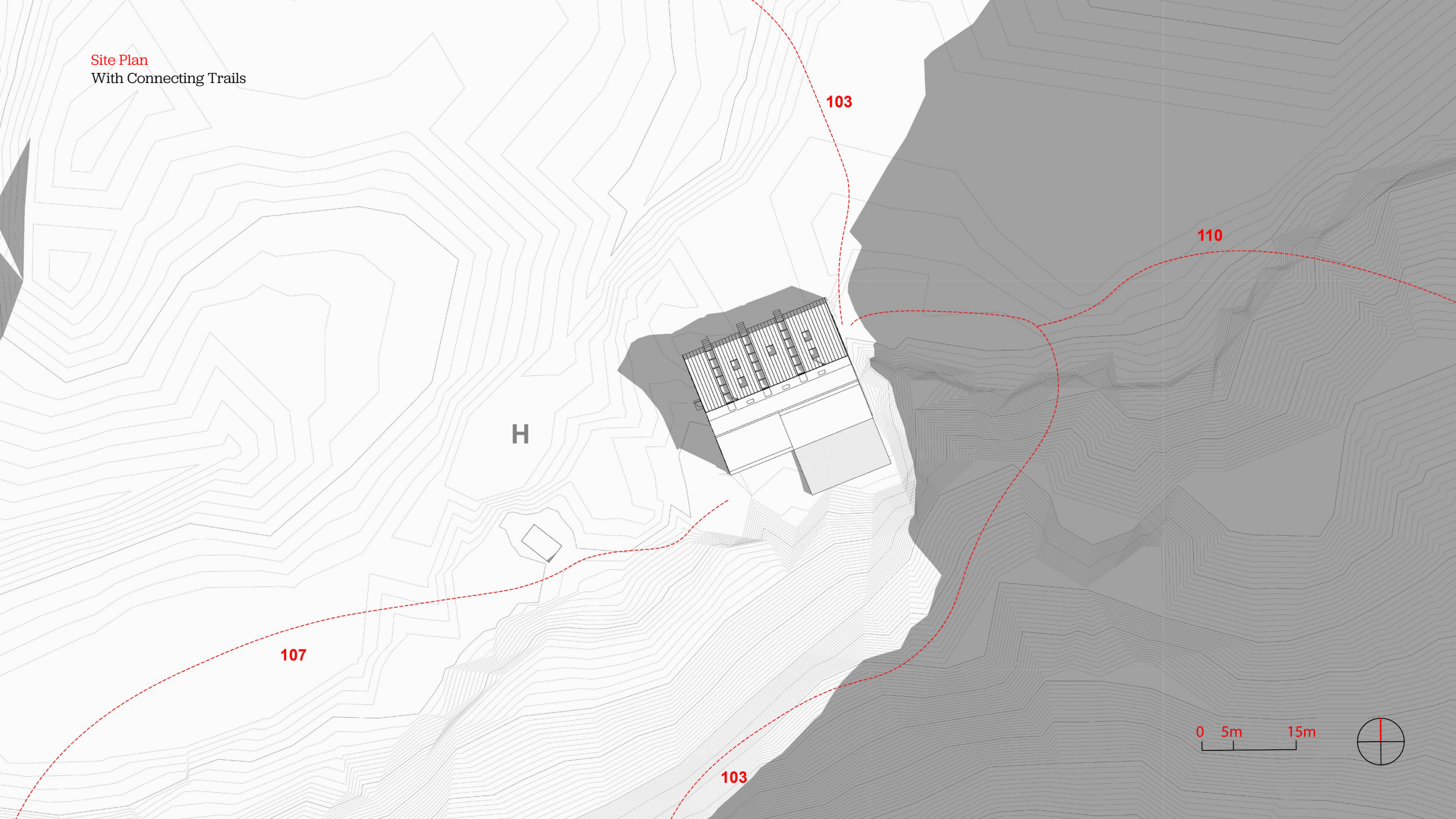
Project diagram
Project's fundamentals.



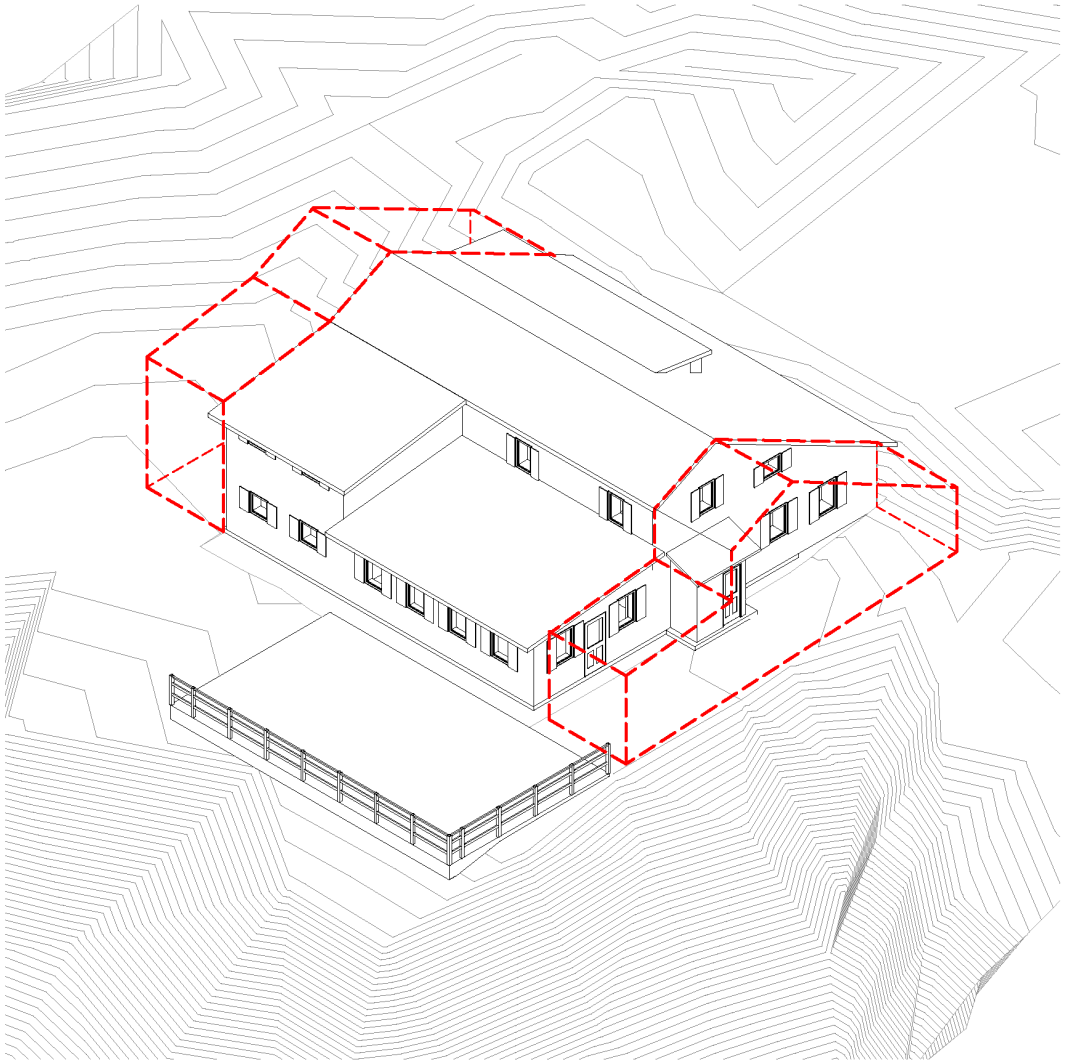
By integrating technology and design.

Shelter & View

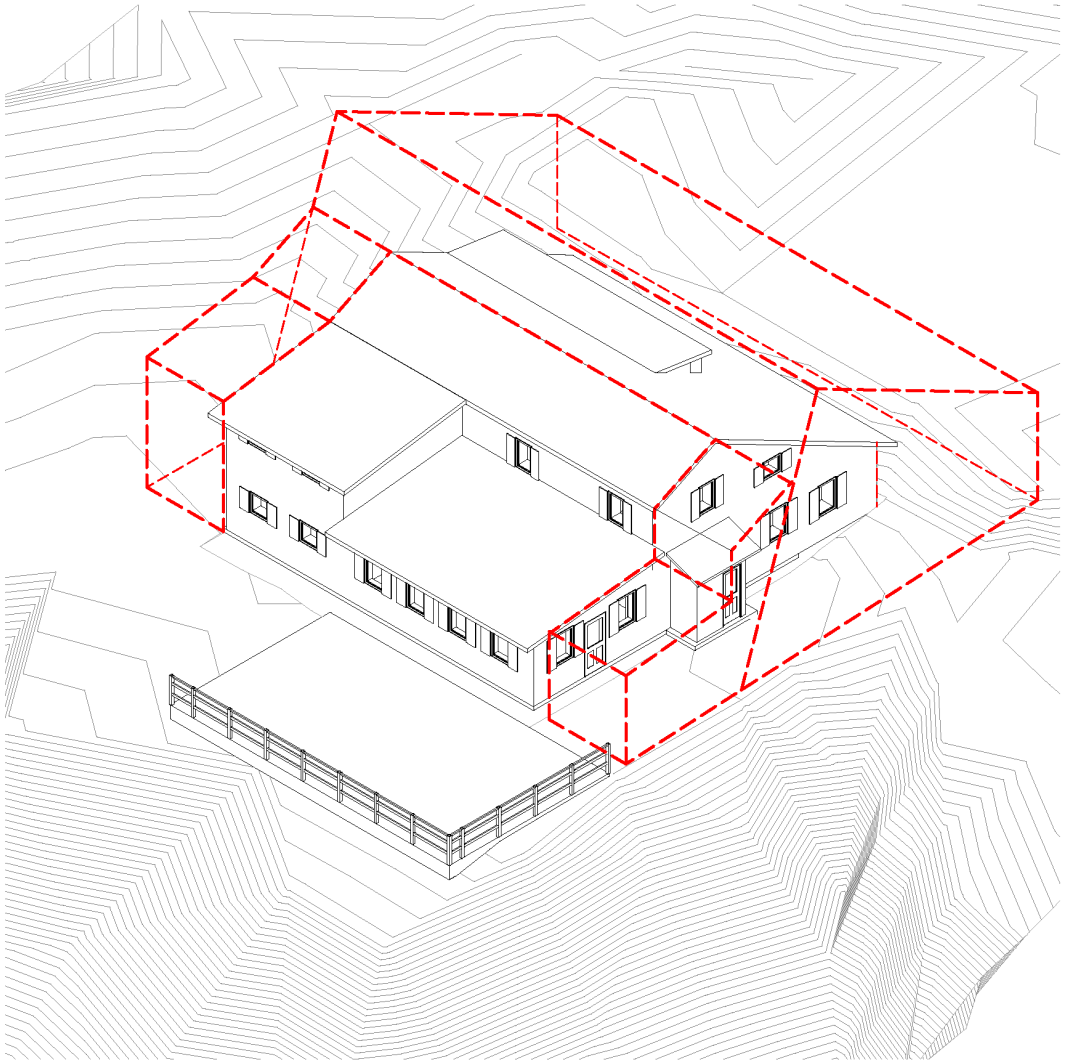
Site Plan
With Connecting Trails



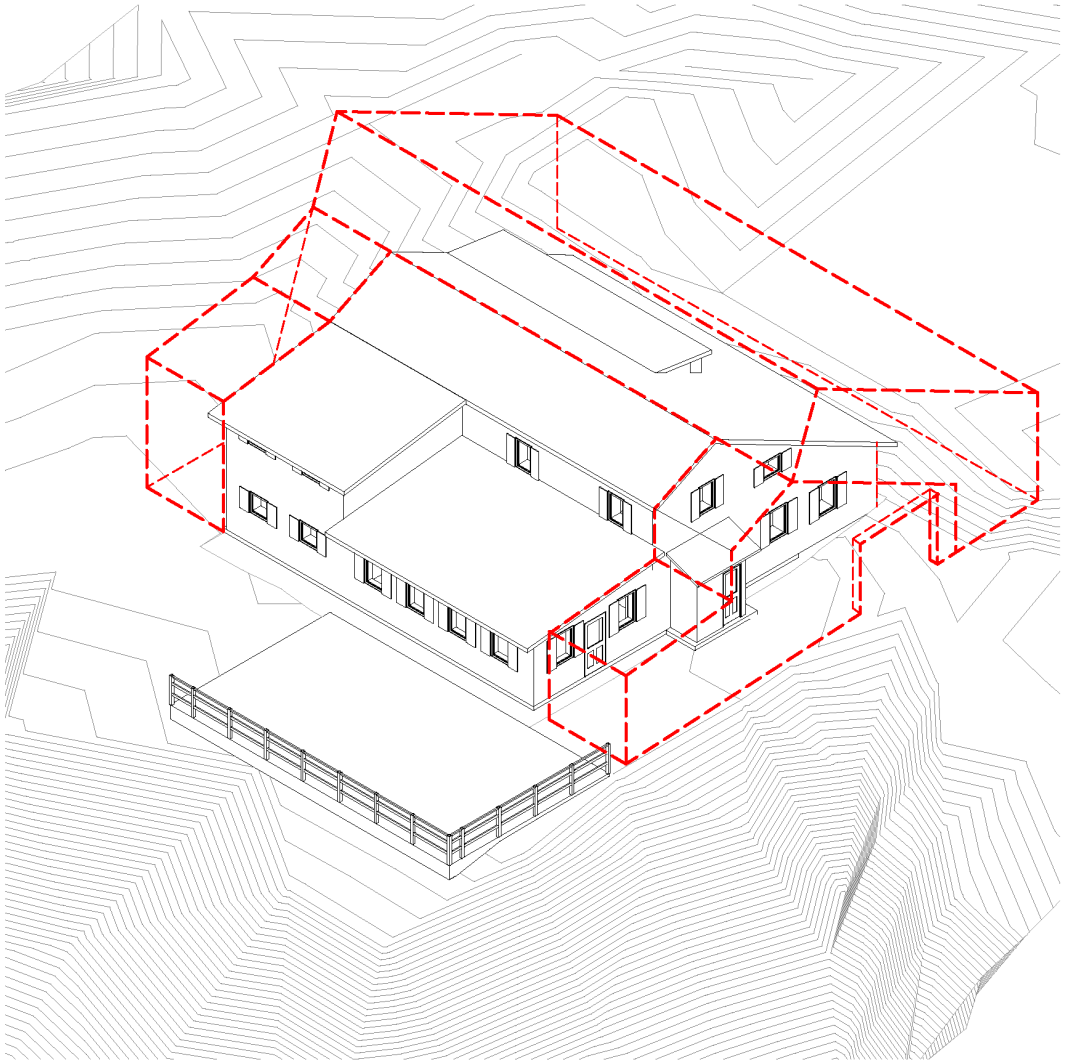
Strategy Diagram
Expansion; New and Existing.



Strategy Diagram
Shelter; New and Existing.

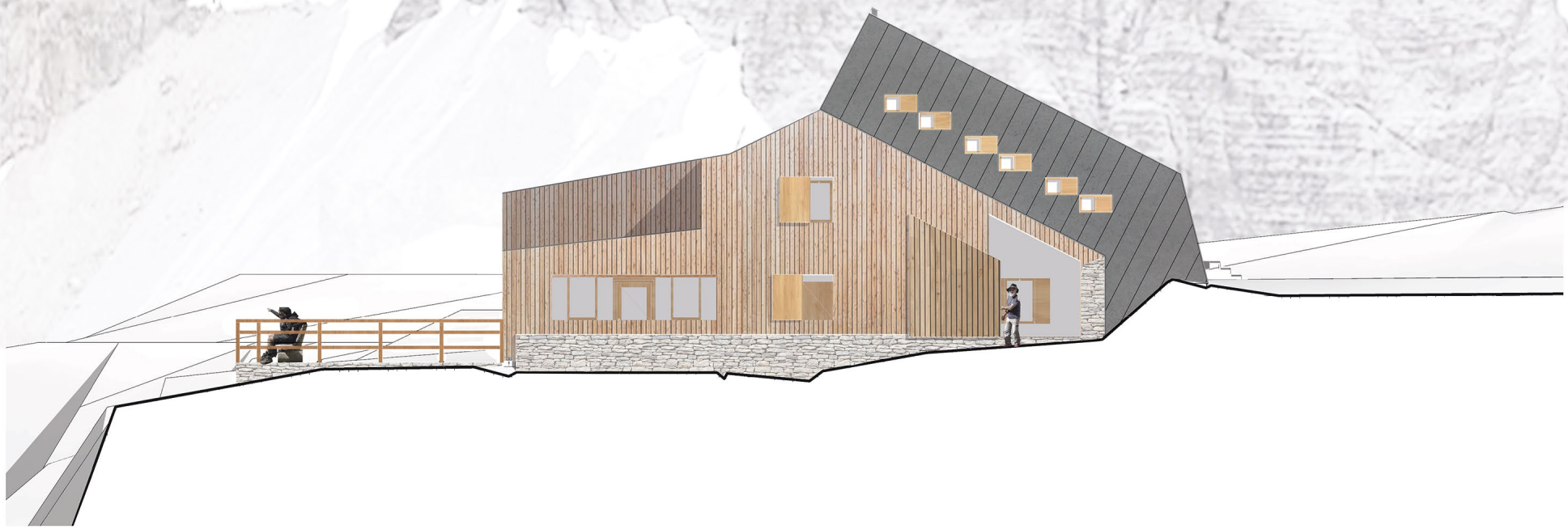


Strategy Diagram
Access; New and Existing.



West Elevation

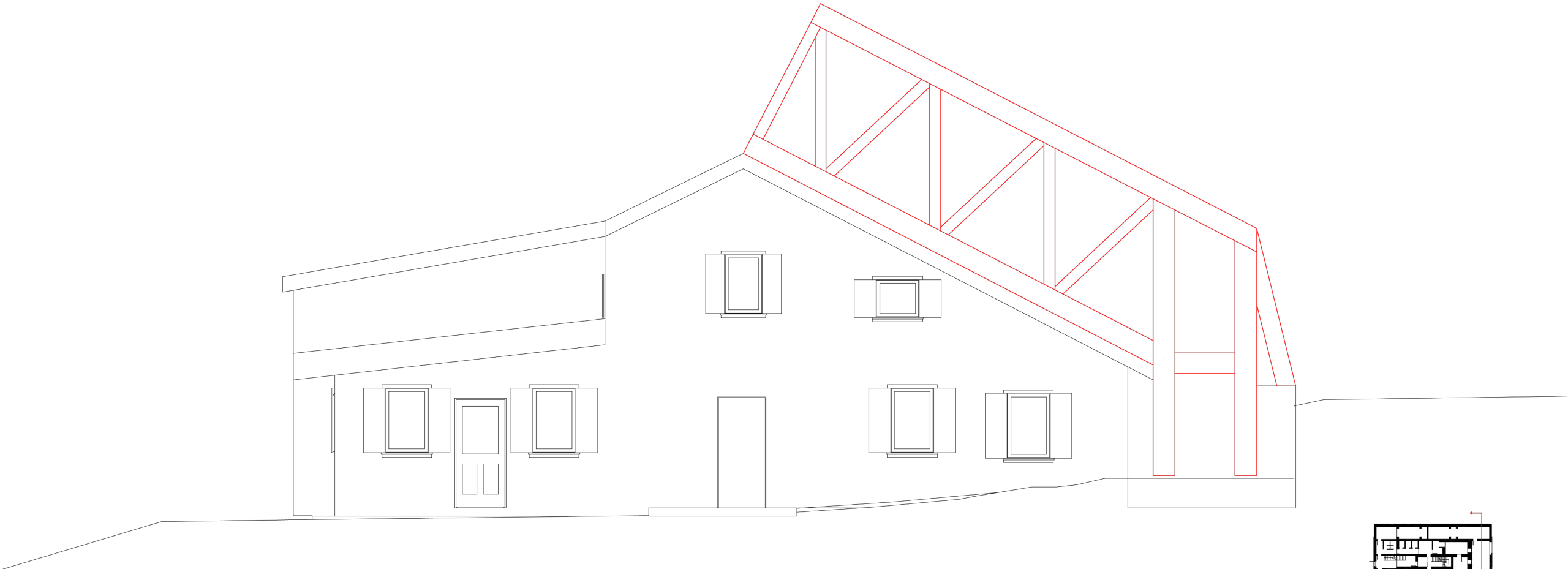
East Elevation

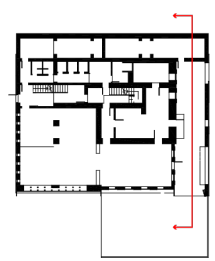


0 100cm 300cm

Supestructure

Sheltering the shelter.

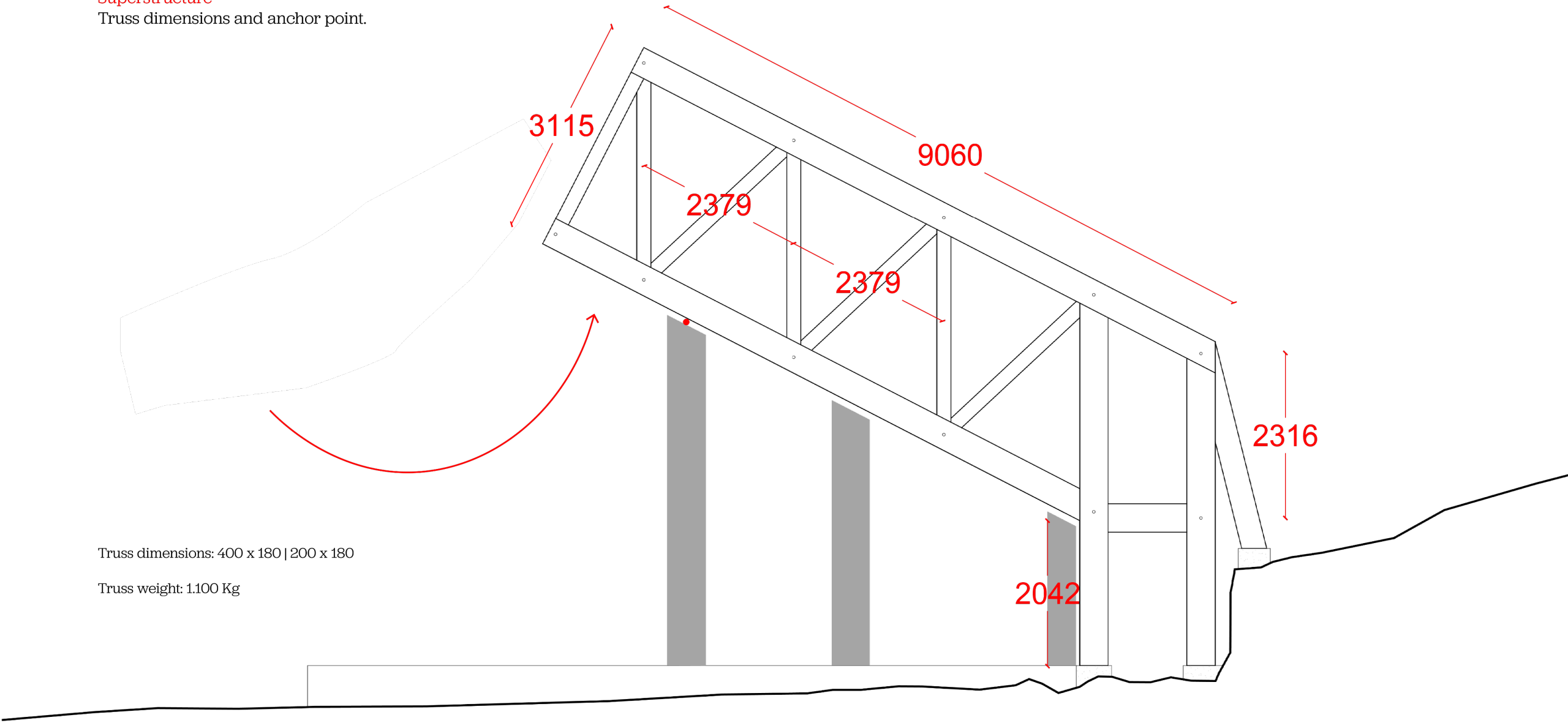




0 2m

Superstructure

Truss dimensions and anchor point.

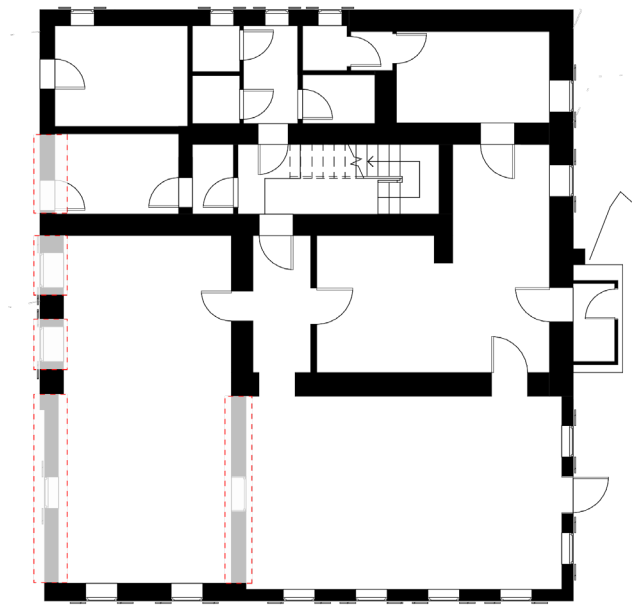


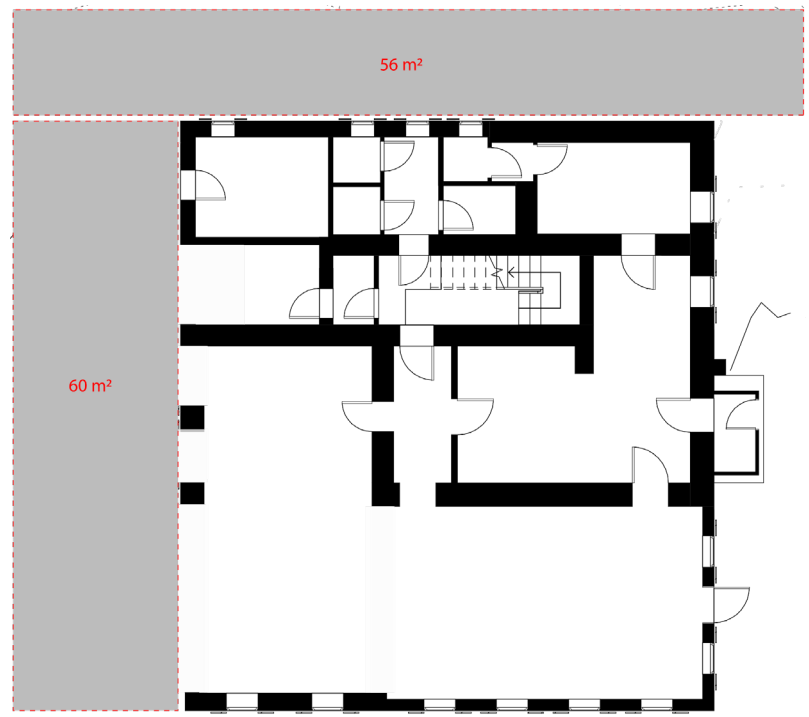
Truss dimensions: 400 x 180 | 200 x 180

Truss weight: 1.100 Kg

Demolition and Excavation Diagrams

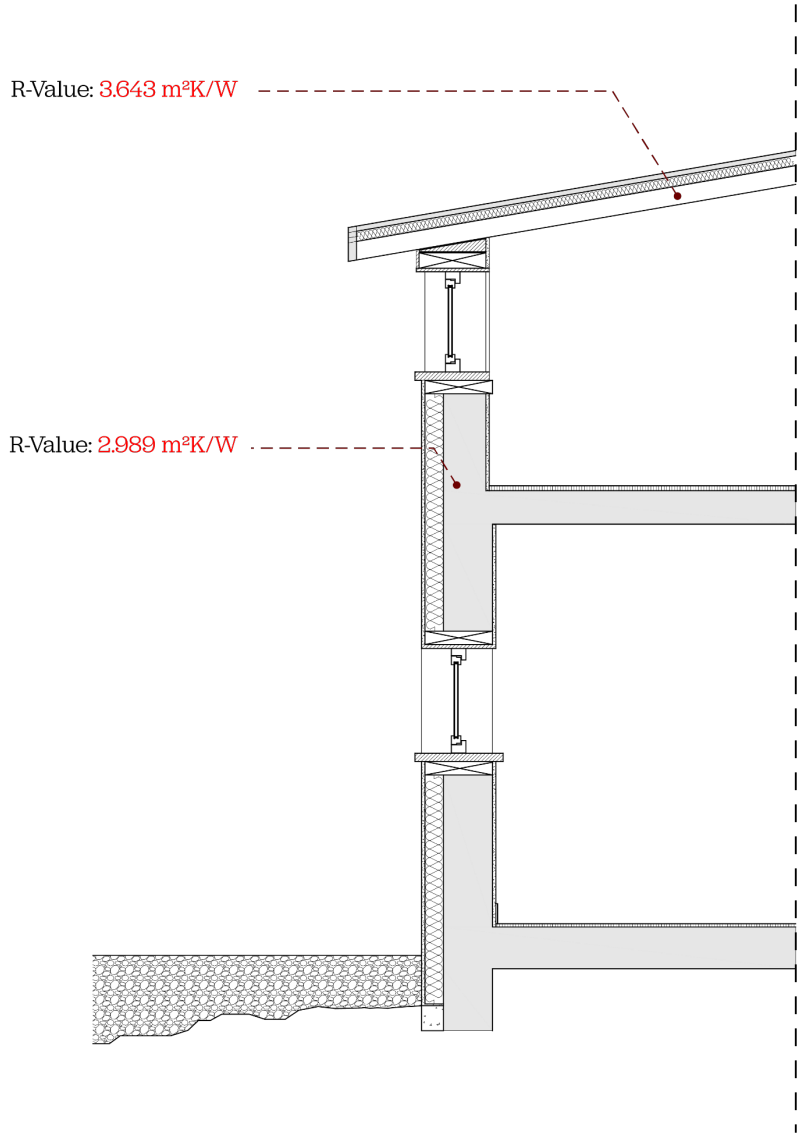
Internal and External Walls and Rock Excavation

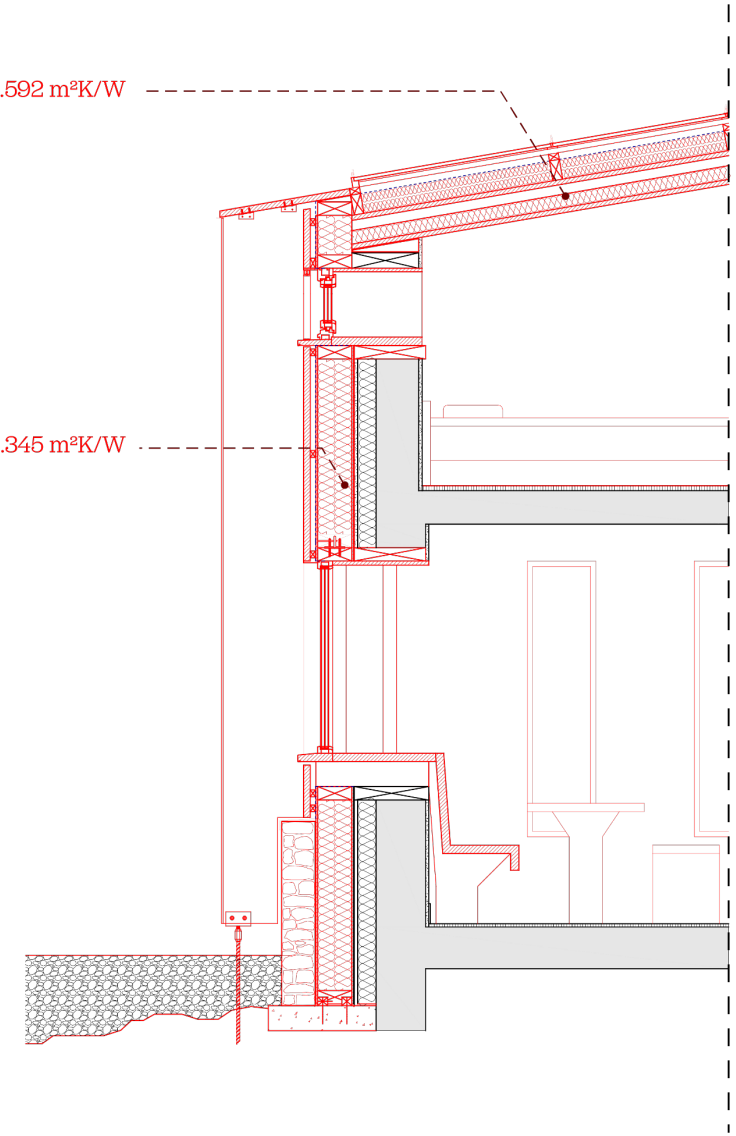


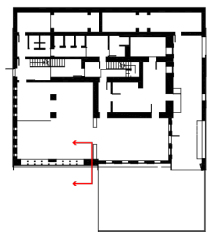


Comparison

Existing R-Values and Project R-Values.

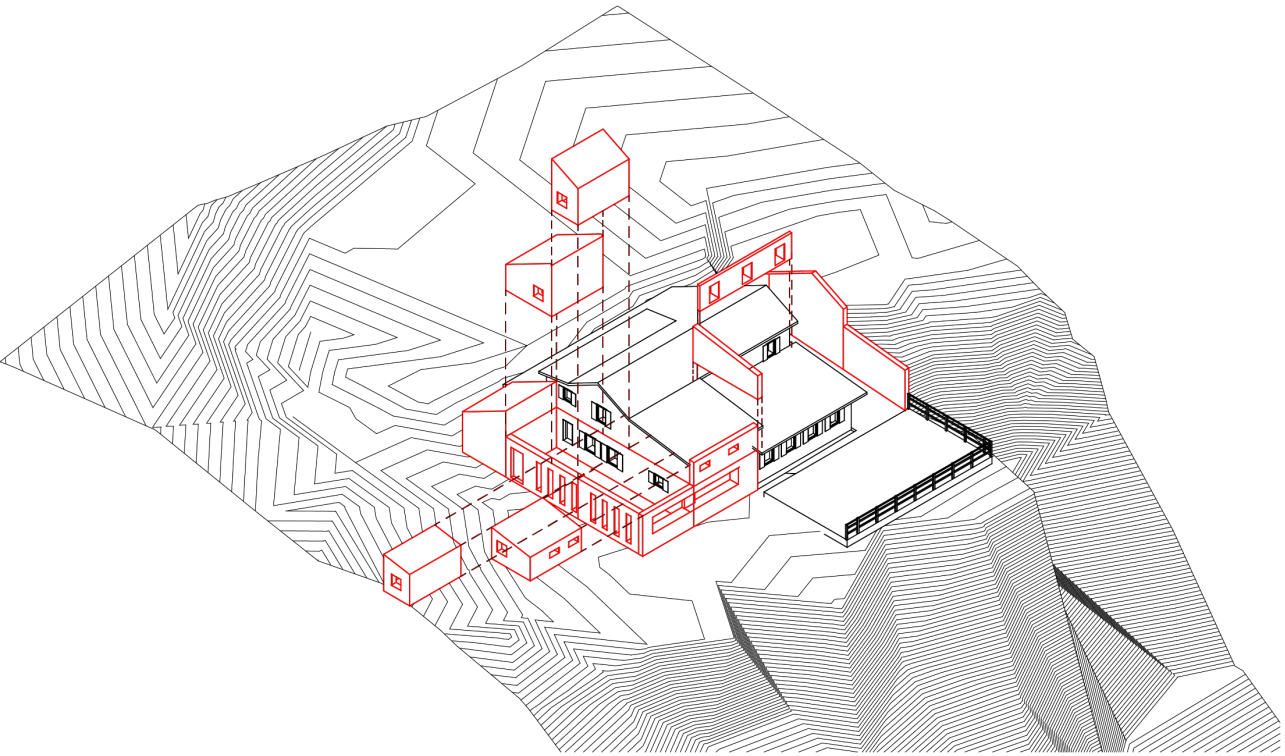




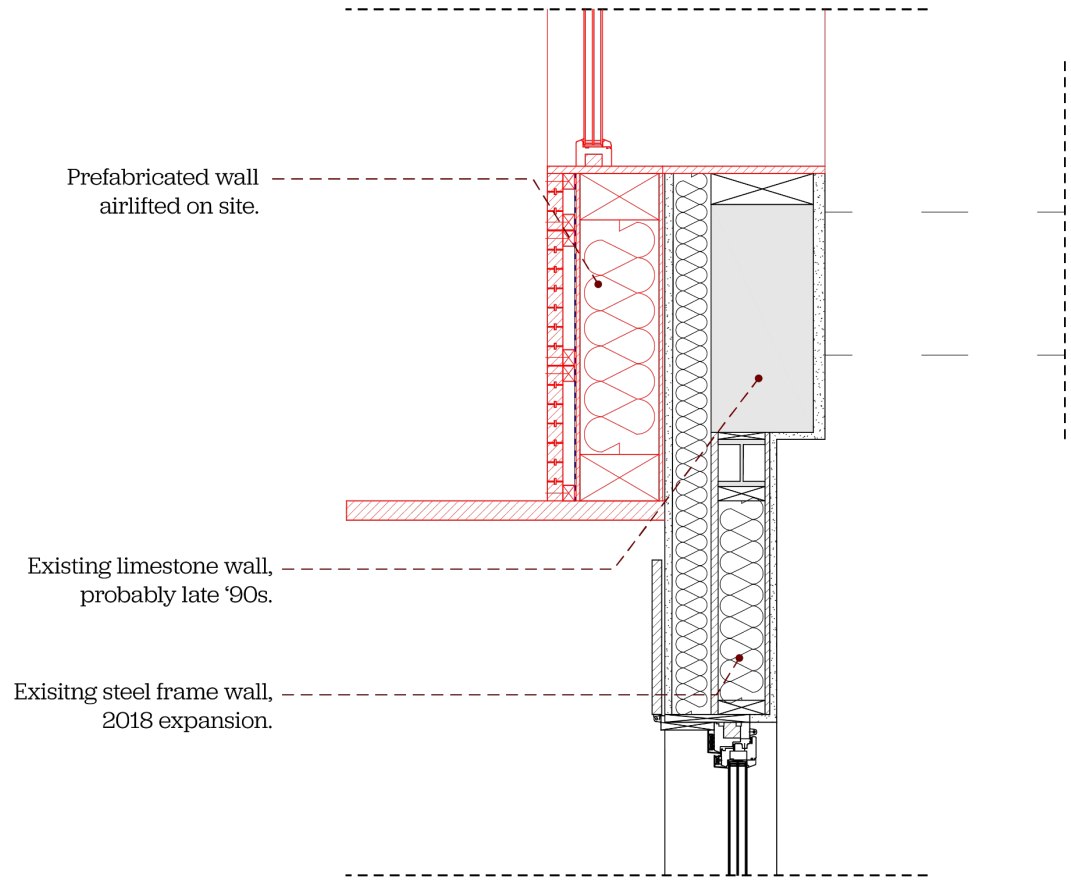


Assembly

Renovation, Superstructure, Boxes assembly.



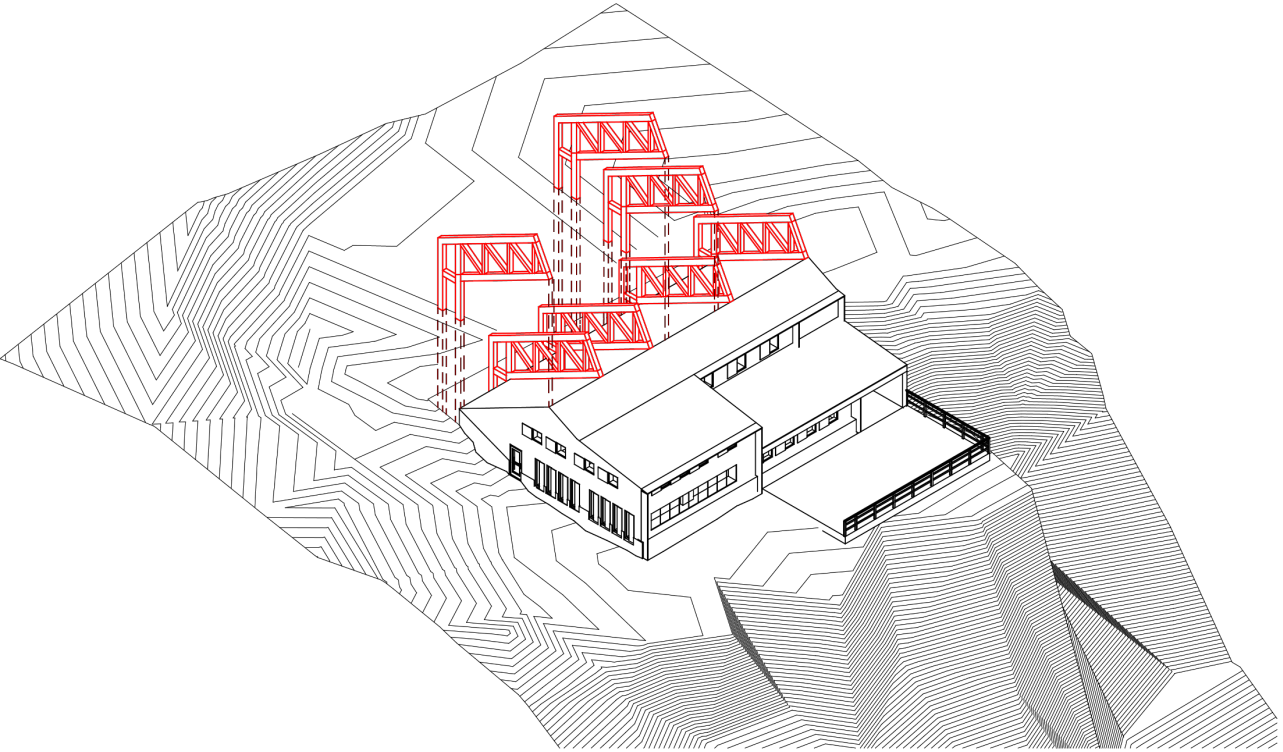
Prefabricated elements are used for the expansion and insulation of the existing refuge.



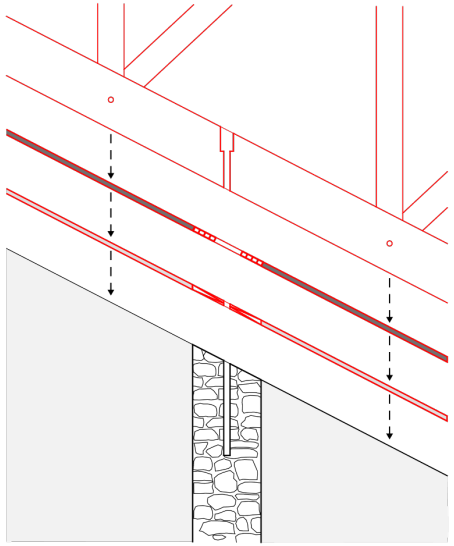
1/10 plan detail of the Integration between the different expansions.

Assembly

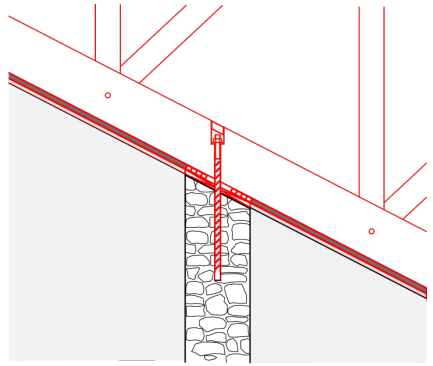
Renovation, Superstructure, Boxes assembly.



The superstructure is airlifted on-site.



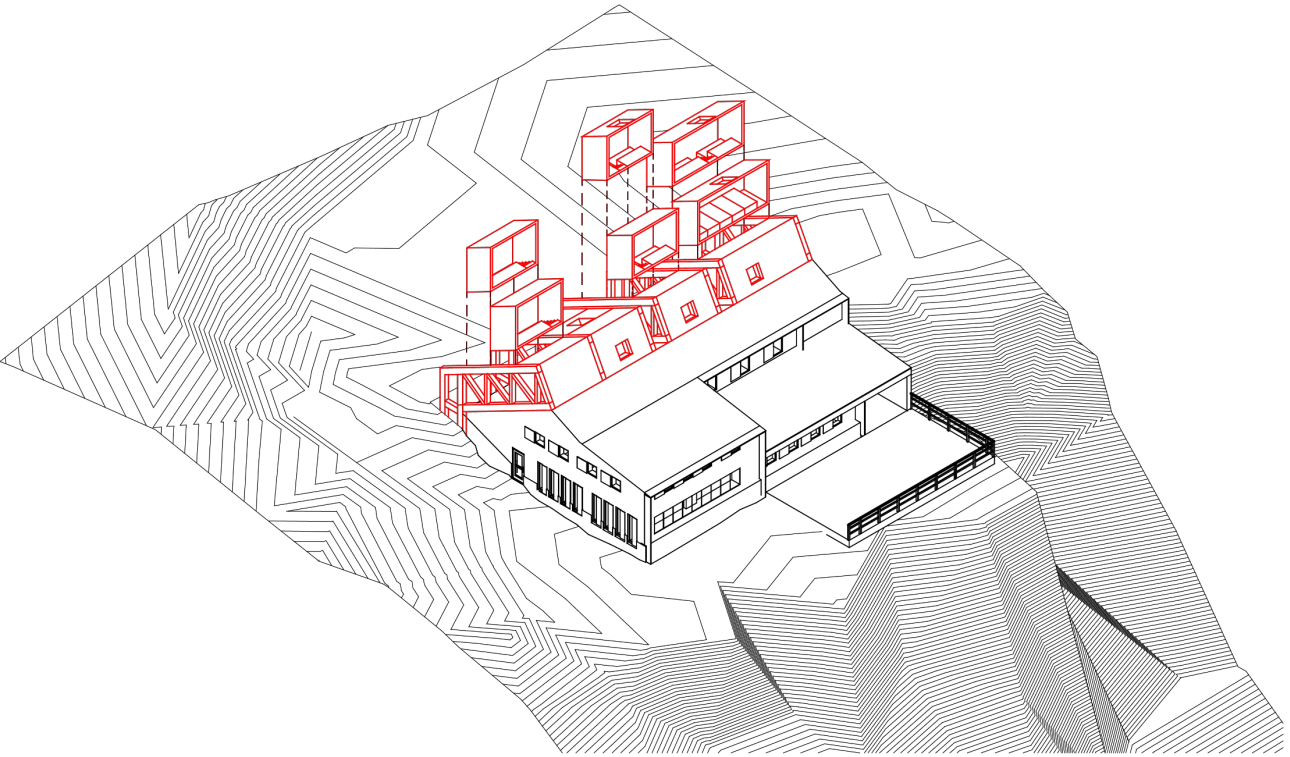
The superstructure is positioned above the exisitng walls and sealed with rubber gaskets.



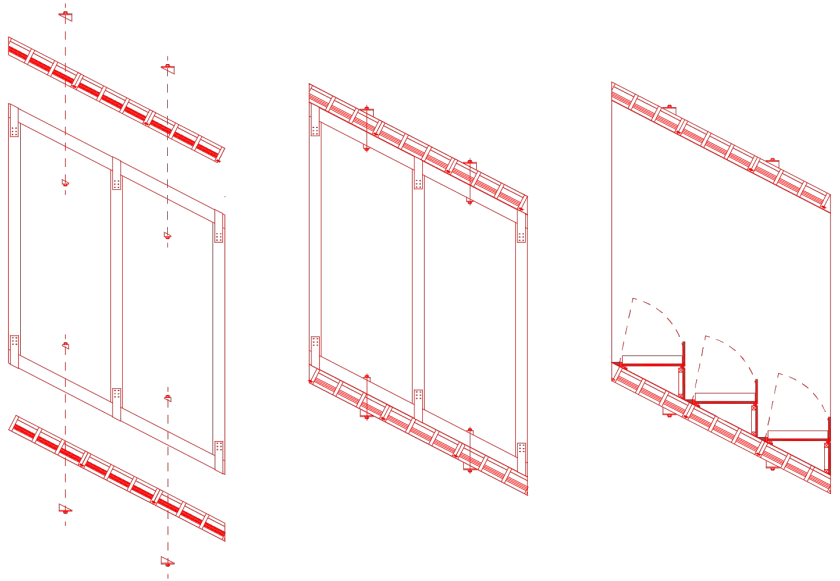
Superstrucuture and exisitng structure are connected through rebars and throughbolted.

Assembly

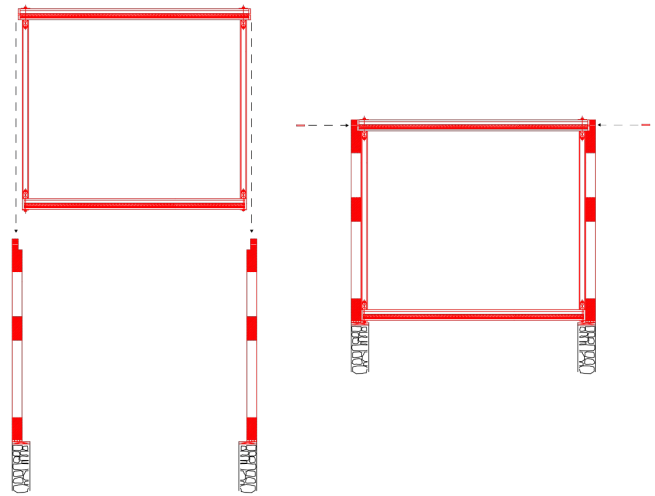
Renovation, Superstructure, Boxes assembly.



The prefabricated boxes are airlifted
and anchored to the Superstructure

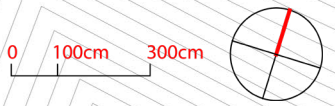


The boxes are pre-assembled and airlifted on site, including interior fittings.



The boxes are airlifted and anchored to the Superstructure.

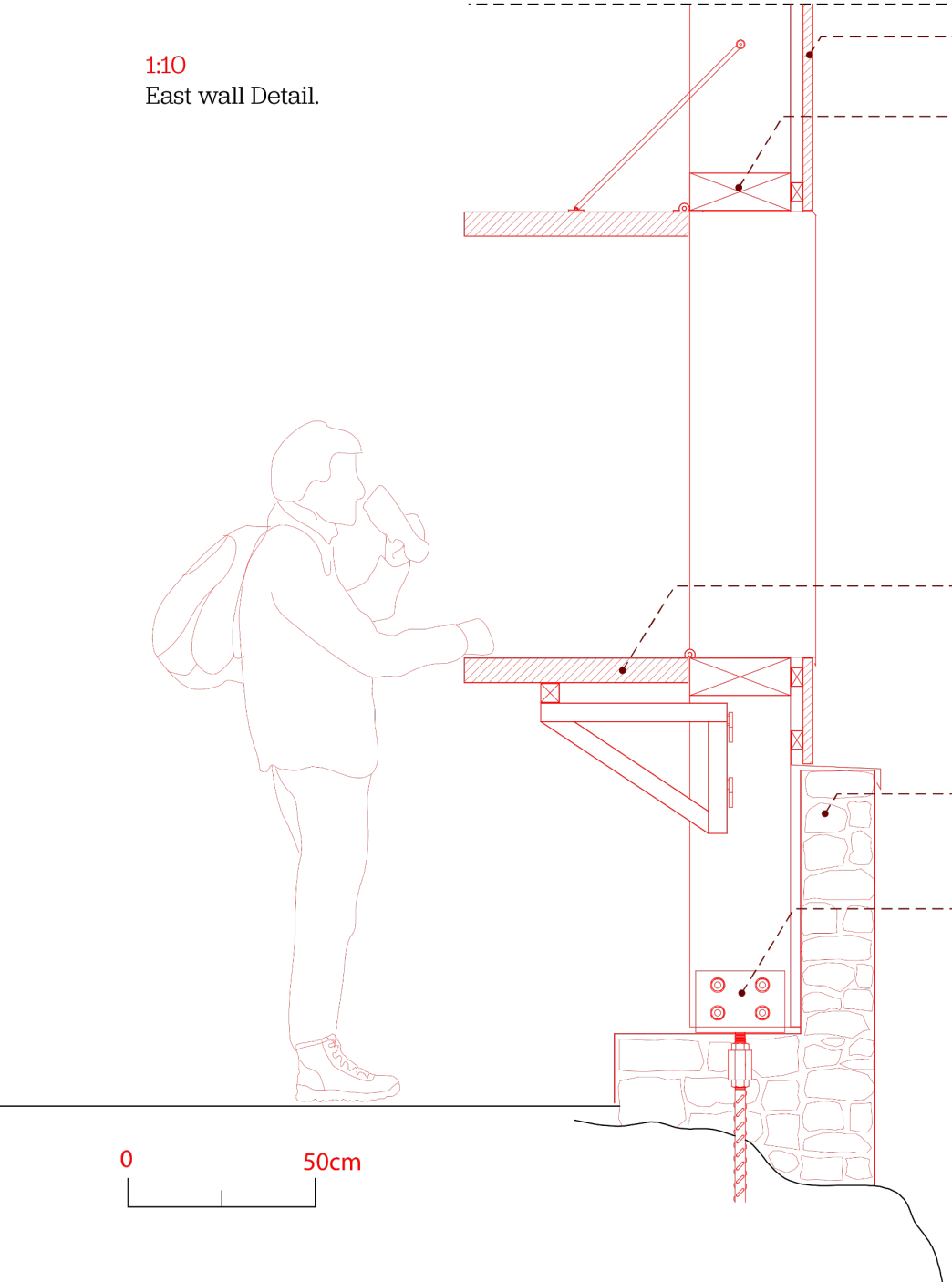
Ground Floor Plan
New and Existing

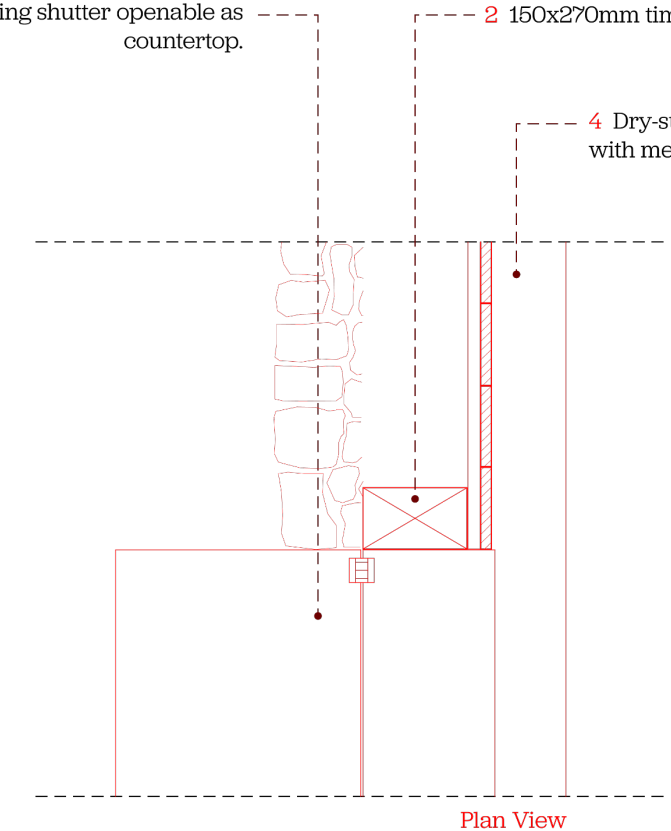


View

Entrance porch.

1:10
East wall Detail.



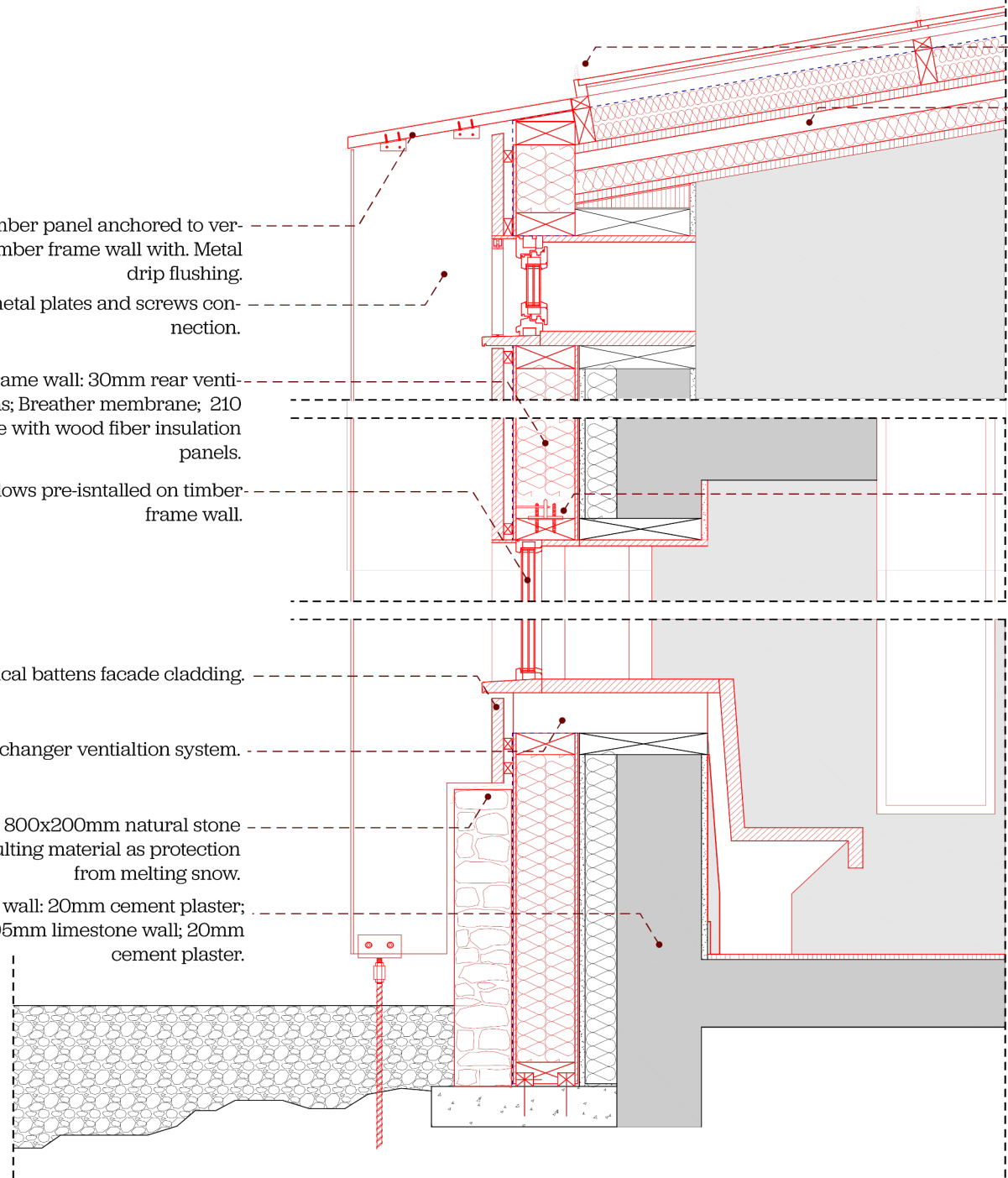


Plan View

View
Expanded dining area

1:10

South facade detail.



1 Tubular snow breakers on in-roof solar panels.

2 Renovate roof: 60mm In-roof solar panels; Rear ventilated level with 40x60mm larch battens; Breather membrane; 120mm natural wool insulation with 60mm larch rafters; 200mm Lignatur geometry surface elements between existing rafters.

3 3 layers 50x800mm timber panel anchored to vertical louvers and new timber frame wall with. Metal drip flushing.

4 Larch louveres with metal plates and screws connection.

5 Prefabricated timber frame wall: 30mm rear ventilated level on larch battens; Breather membrane; 210 mm larch timber frame with wood fiber insulation panels.

7 Triple glazing windows pre-isntalled on timber-frame wall.

6 Walco bolt system connection between vertical prefabricated timber frame walls.

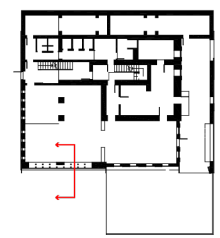
8 Larch vertical battens facade cladding.

9 Concealed heat exchanger ventialtion system.

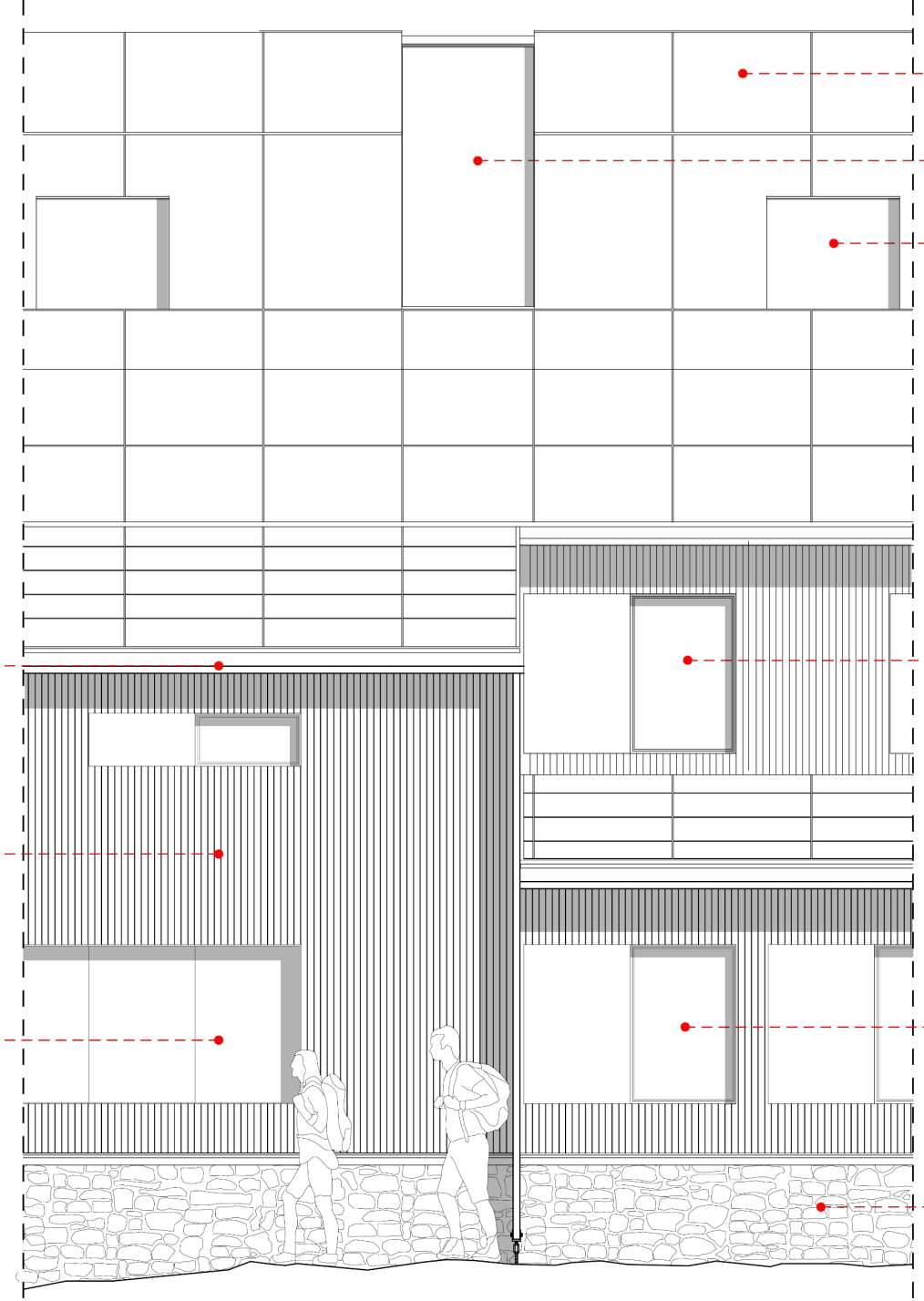
10 Sheet metal flishing; 800x200mm natural stone wall from excavation resulting material as protection from melting snow.

11 Exisitng limestone wall: 20mm cement plaster; 110mm XPS insulation; 295mm limestone wall; 20mm cement plaster.

0 50cm



1:20
Elevation Section Detail.



1 Metal drip flushing.

2 Vertical cladding of 5cm wide raw-cut larch battens.

3 720x80cm Triple glazing landscape window. 12x80cm glazing elements. Behind the glazing the wall is supported by 2 8x8cm timber columns with 80cm spacing.

4 In-roof intergated PV surface integrated with snow breakers.

5 100cm Triple galzing. Corridor skylights.

6 100cm triple glazing. Dorm windows.

7 80x120cm Triple glazing windows on prefabricated wall elements. Larch sliding shutter.

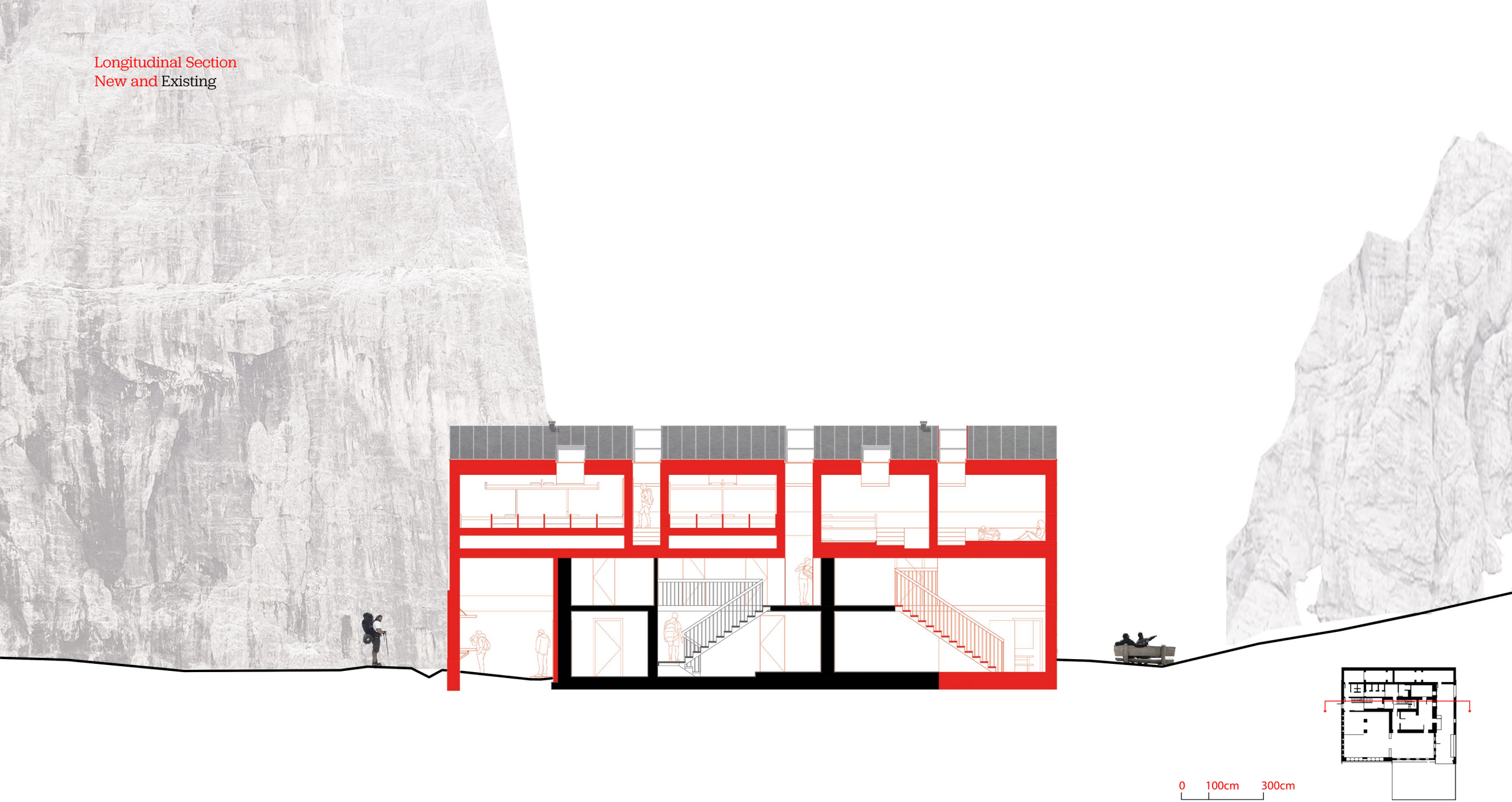
8 80x120cm Triple glazing existing windows. Added larch sliding shutter.

9 85cm Natural stone wall with metal coping for protection from melting snow.

0 50cm 100cm

South Elevation

Longitudinal Section
New and Existing



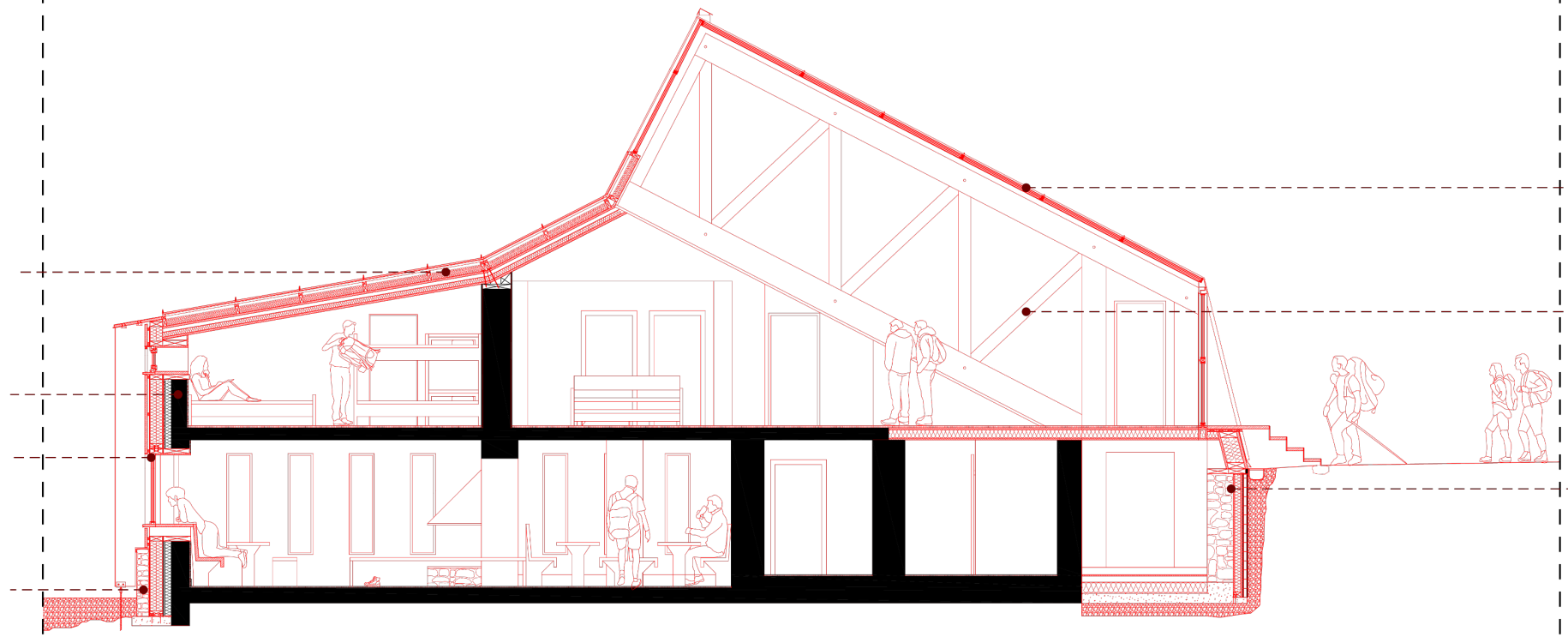
First Floor Plan
New and Existing

0 100cm 300cm

View

The corridor connecting the existing, the new, and the landscape.

1:50
Full Section Detail.
New and Existing



1 In-roof sonal panels on renovated roof. 120mm natural wool insulation; 200mm Lignatur geometry surface elements.

2 Existing natural stone wall.

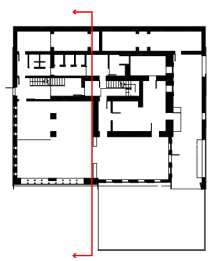
3 Prefabricated wall elemetns with Triple glazing windows and larch battens cladding.

4 Natural stone wall with metal coping for protection from melting snow.

5 1000mm triple glazing elements on circulation spaces.

6 180mm GLT Truss Frame Superstructure.

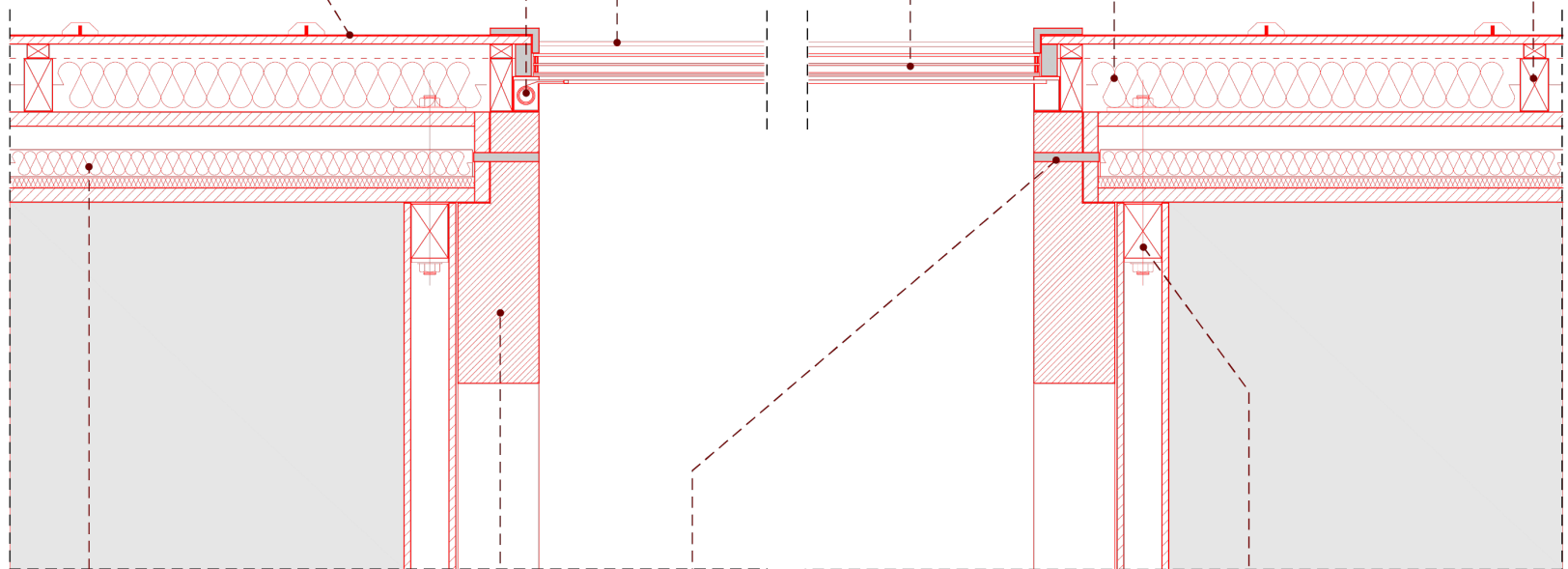
6 Insulated exterior wall built with excavation resulting material.



0 2m

1:5

Roof-Superstructure-Corridor Glazing-Interior boxes Detail.



1 Standing seam metal roofing 500mm wide panels; waterproof membrane; 18mm paneling; 50x30mm larch battens (85mm) ventilated layer.

3 Automatic rolled blinds.

4 Snow braker rod.

5 45mm triple safety glazing.

6 118mm locally sourced natural wool insulation.

7 118x60mm larch battens. 950mm spacing.

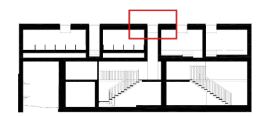
8 200mm Lignatur Surface element.

9 Superstructure:500x180mm Larch GLT Truss Frame.

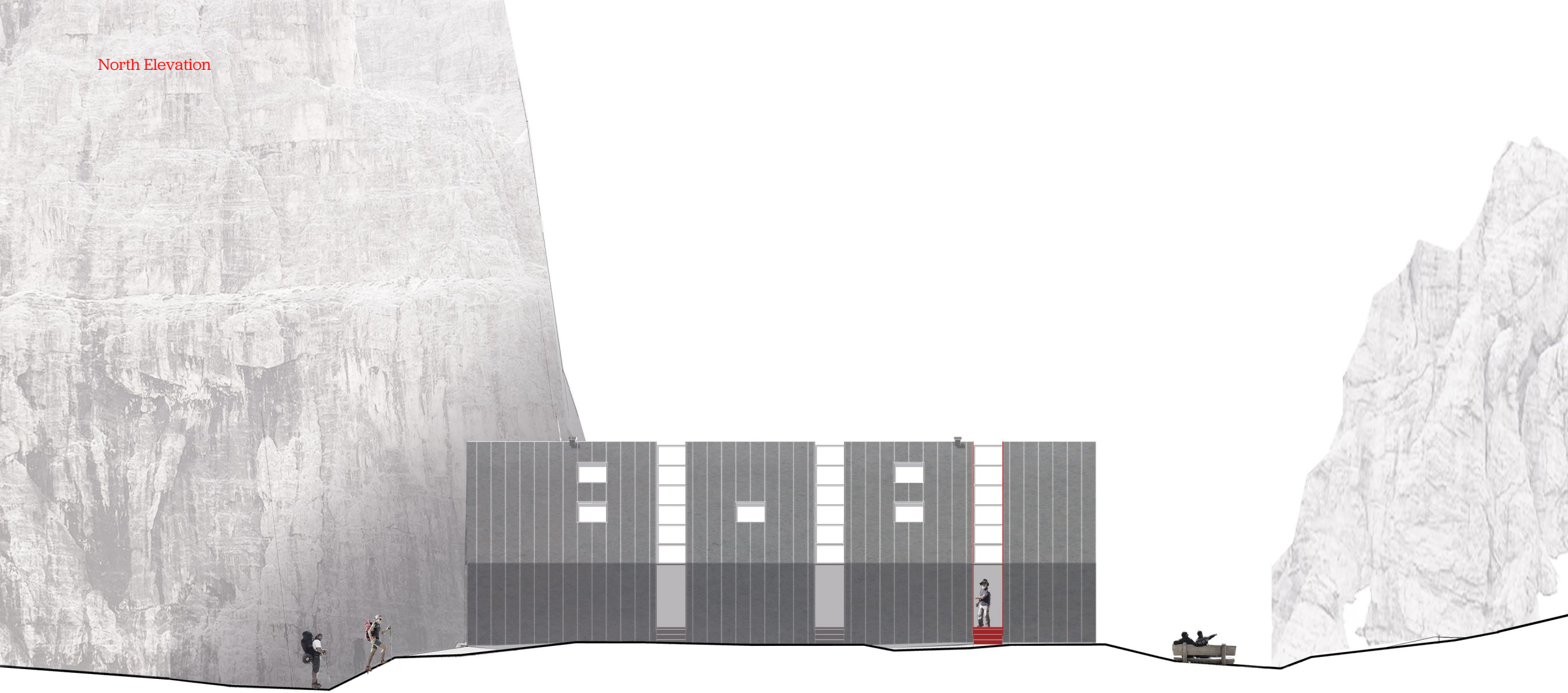
10 20mm diameter larch dowel. Locking airlifted boxes to GLT timber frame.

11 Through bolted box structure.

0 50cm

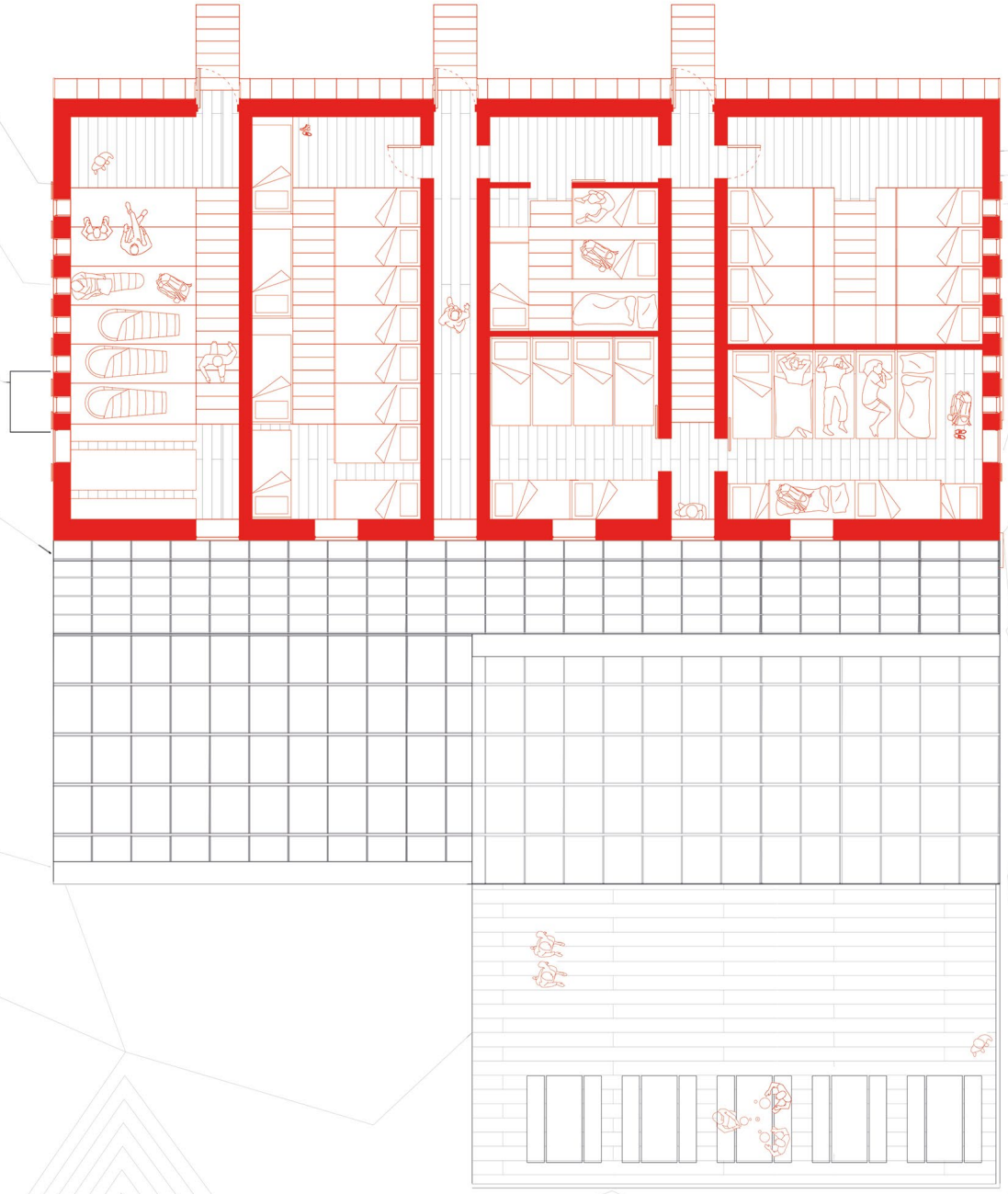


North Elevation



0 100cm 300cm

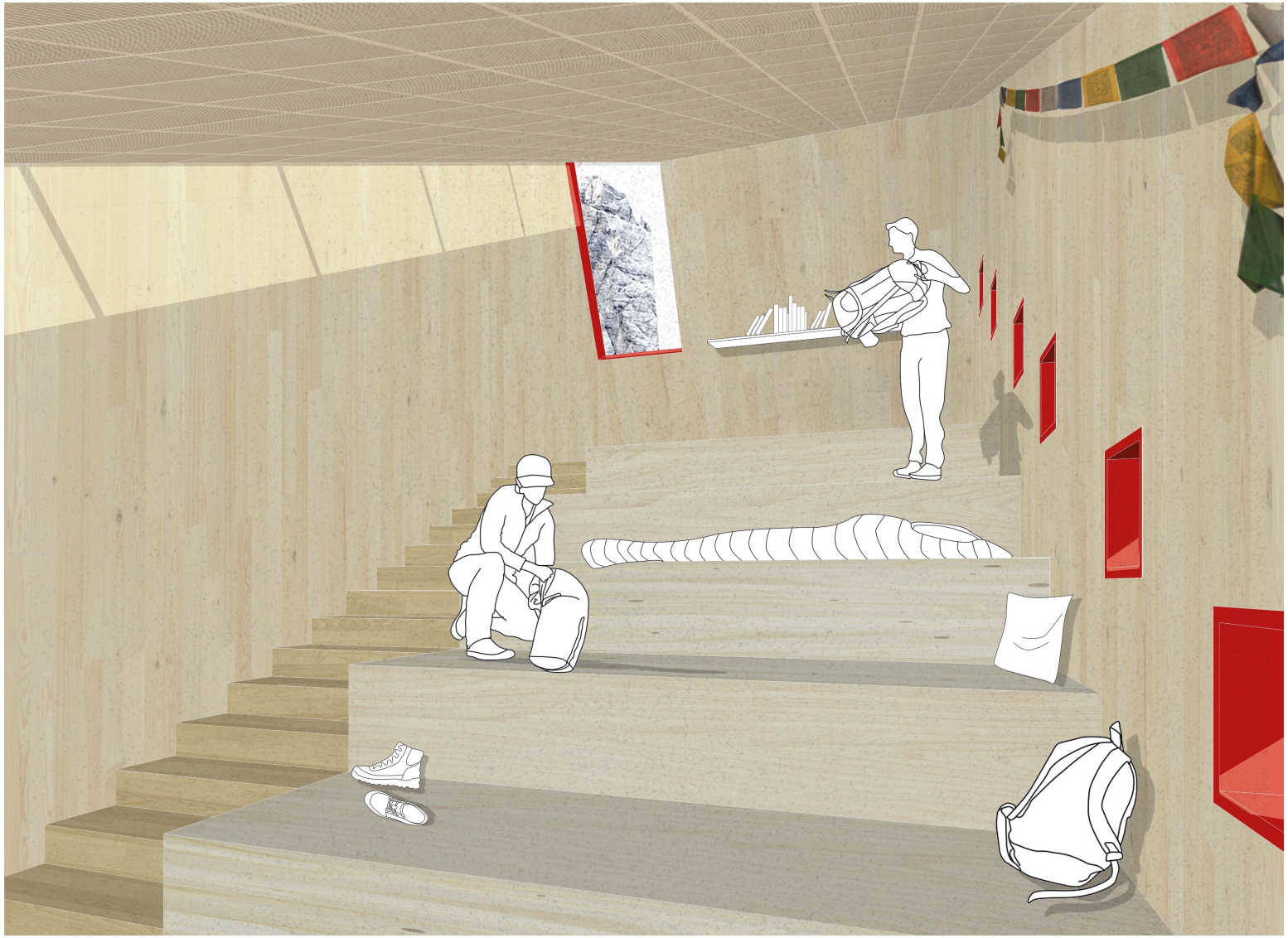
Second Floor Plan
New and Existing



0 100cm 300cm

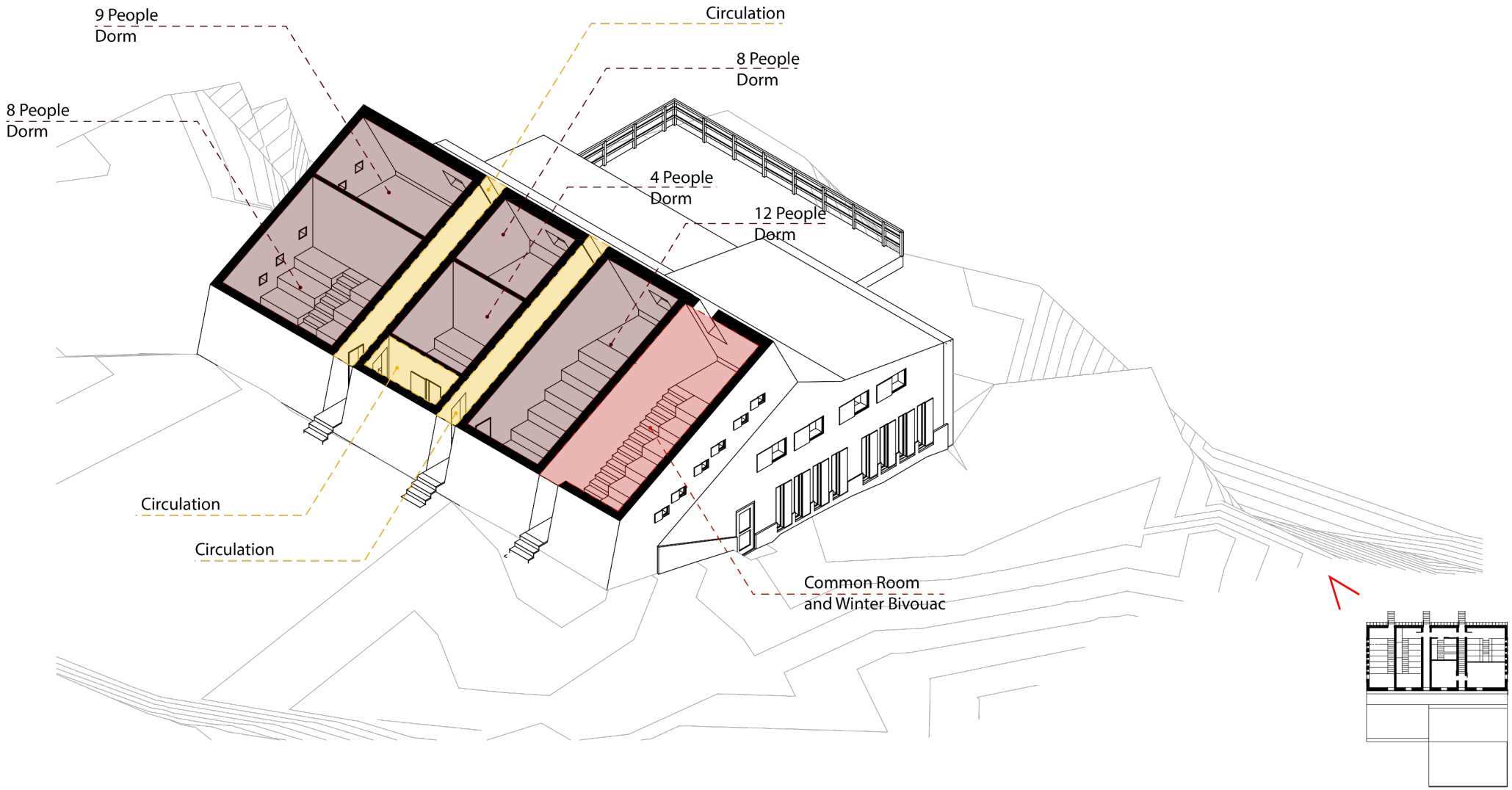
View

Winter Bivouac view



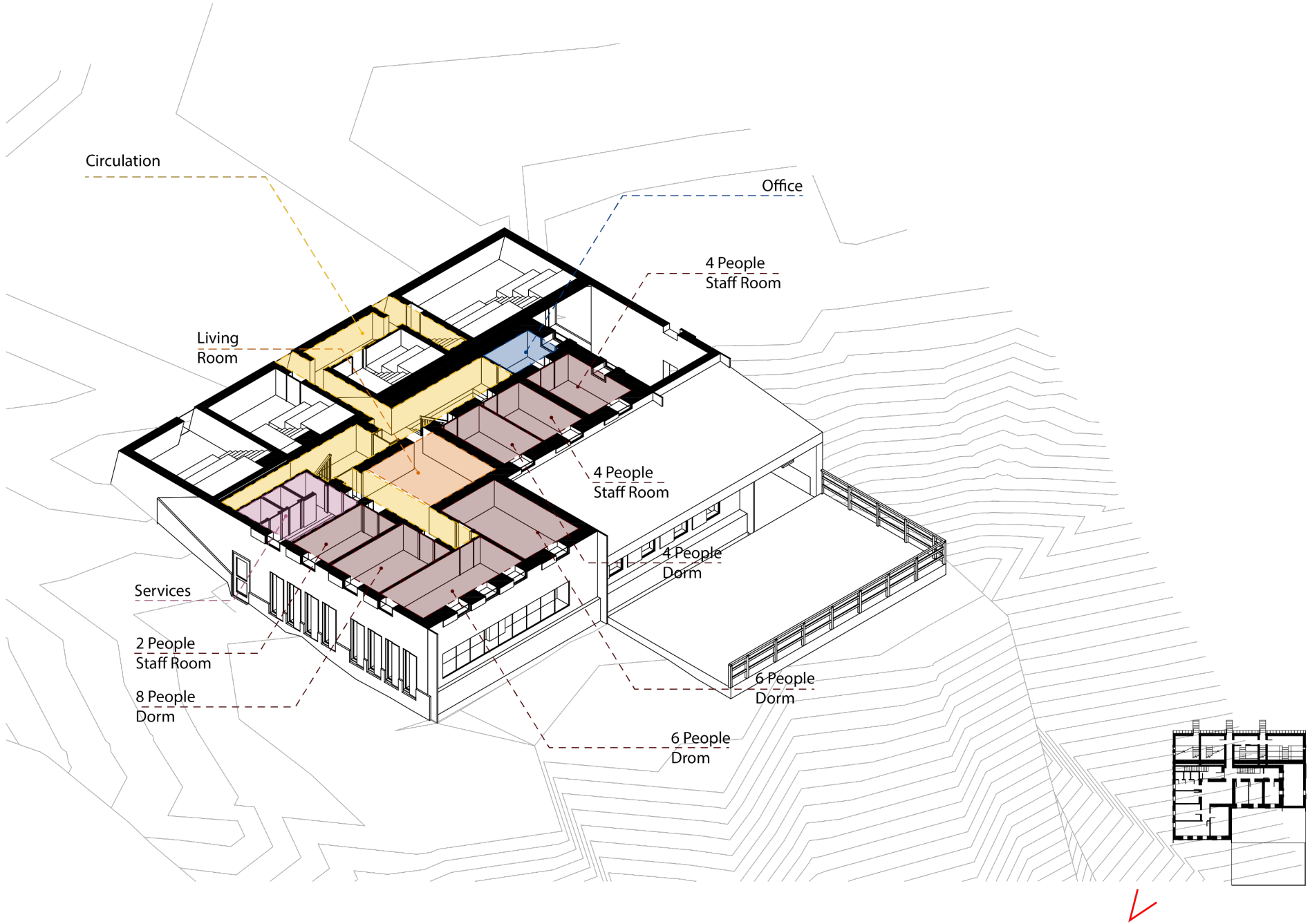
Program

Second Floor-Bivouac Axonometry.

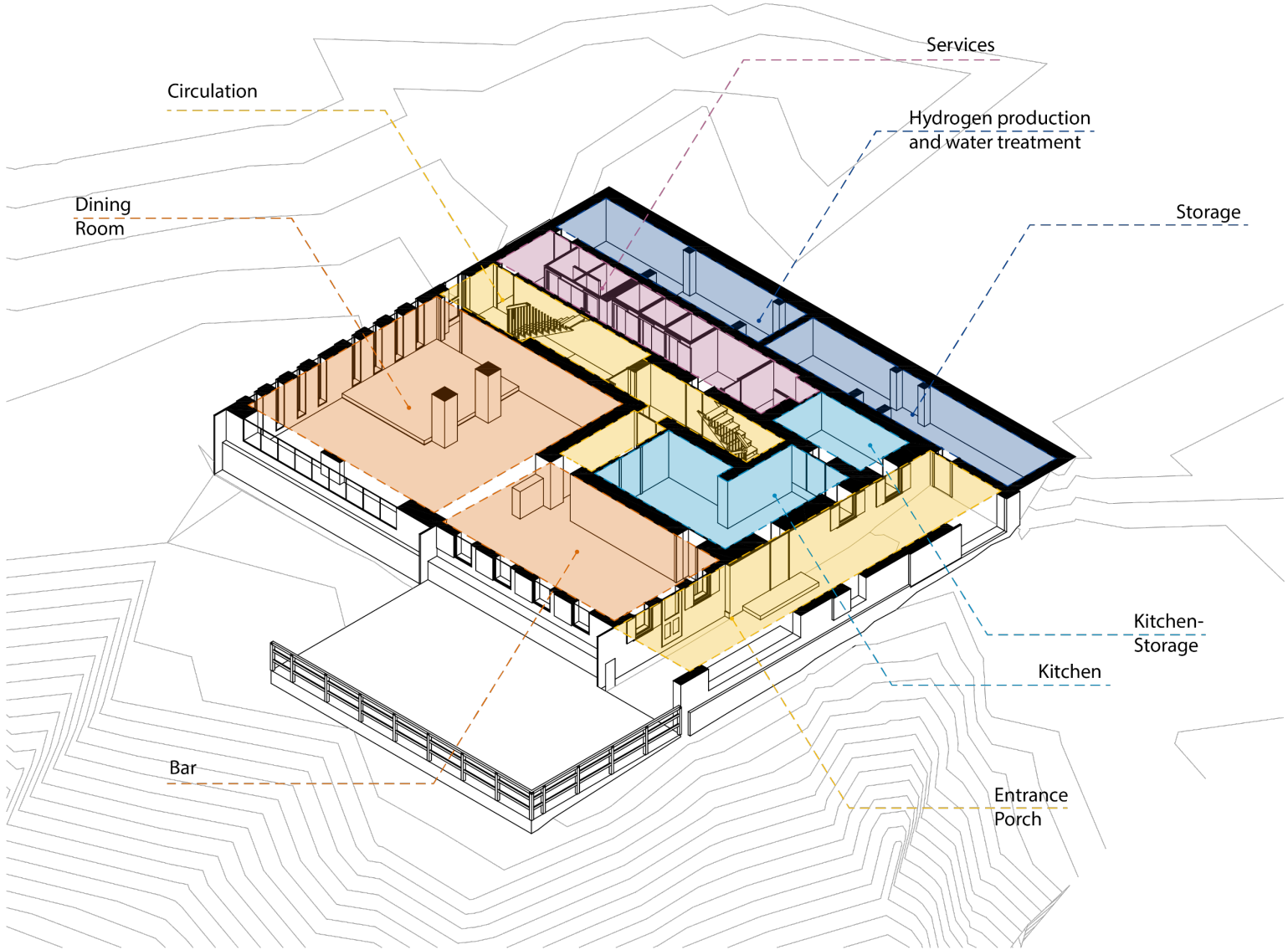


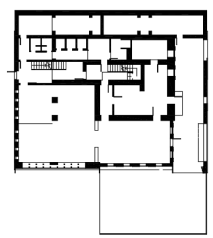
Program

First Floor Axonometry.

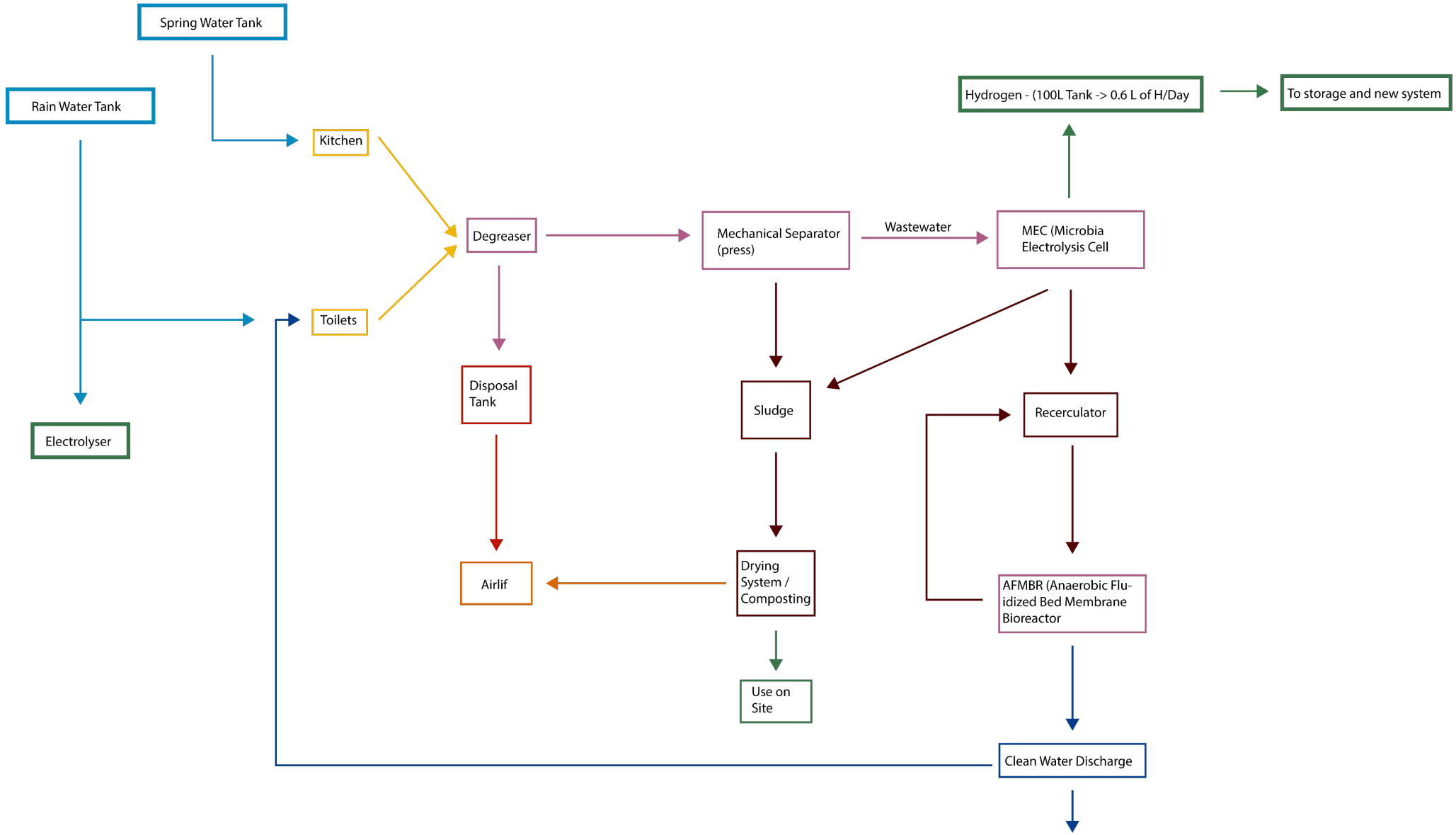


Program
Ground Floor Axonometry.

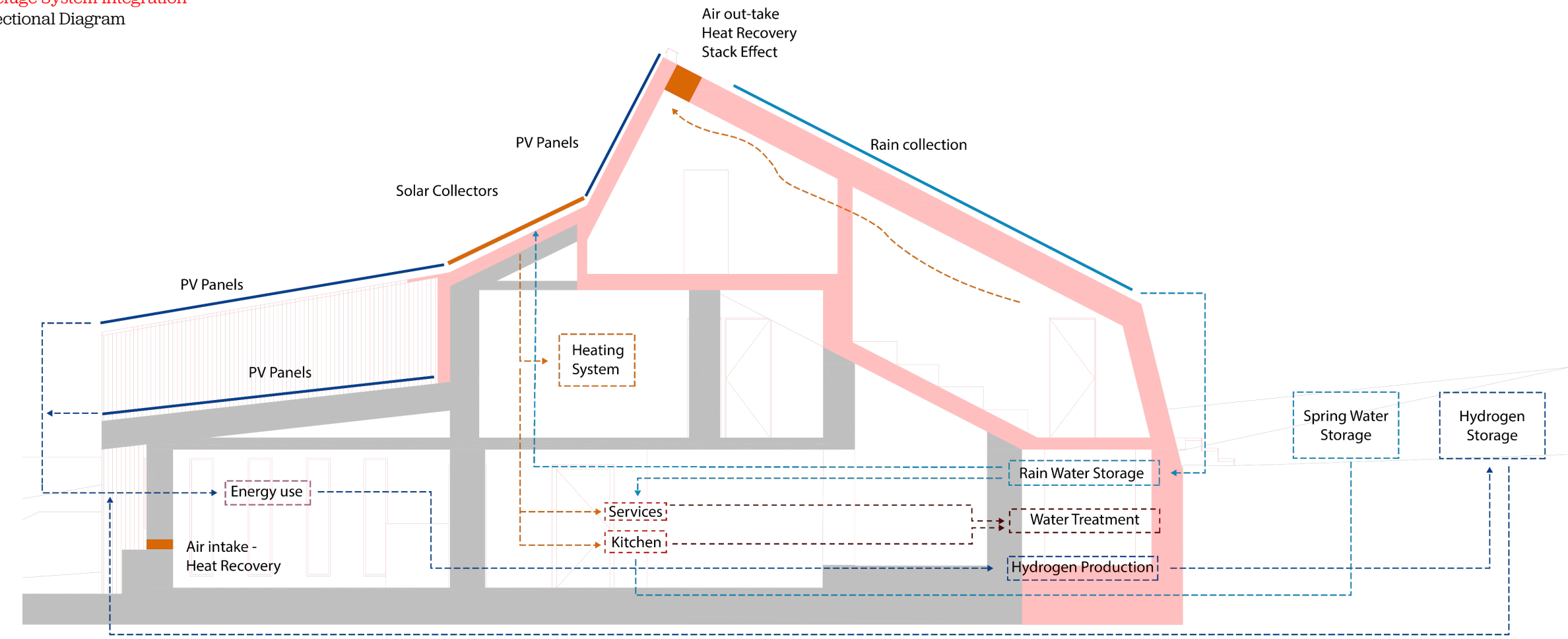


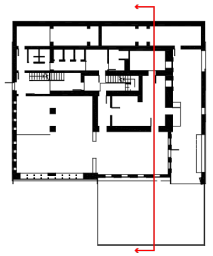


Project Water System Integration
Proposed Cycle



Refuge System Integration
Sectional Diagram





View

Approaching the hut from Auronzo.

46 helicopter flights

7 Main Structure Assembly
12 Boxes Assembly
3 Cladding Materials
14 Expansion and Renovation
10 General materials and construction machinery

1 Reduces demolition waste
2 Valorizes the existing
3 Relies on the local resources

View
Approach from Forcella Giralba.

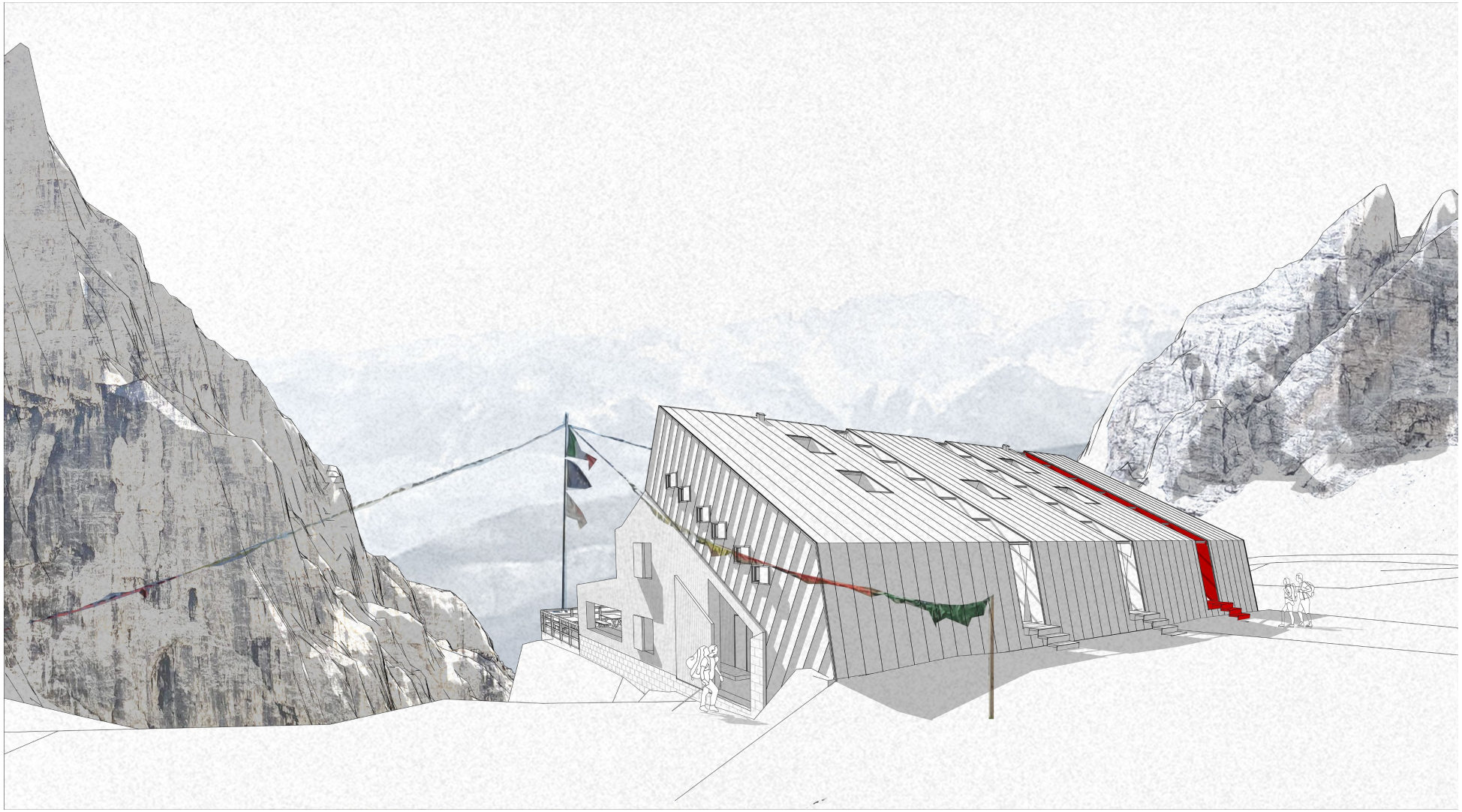
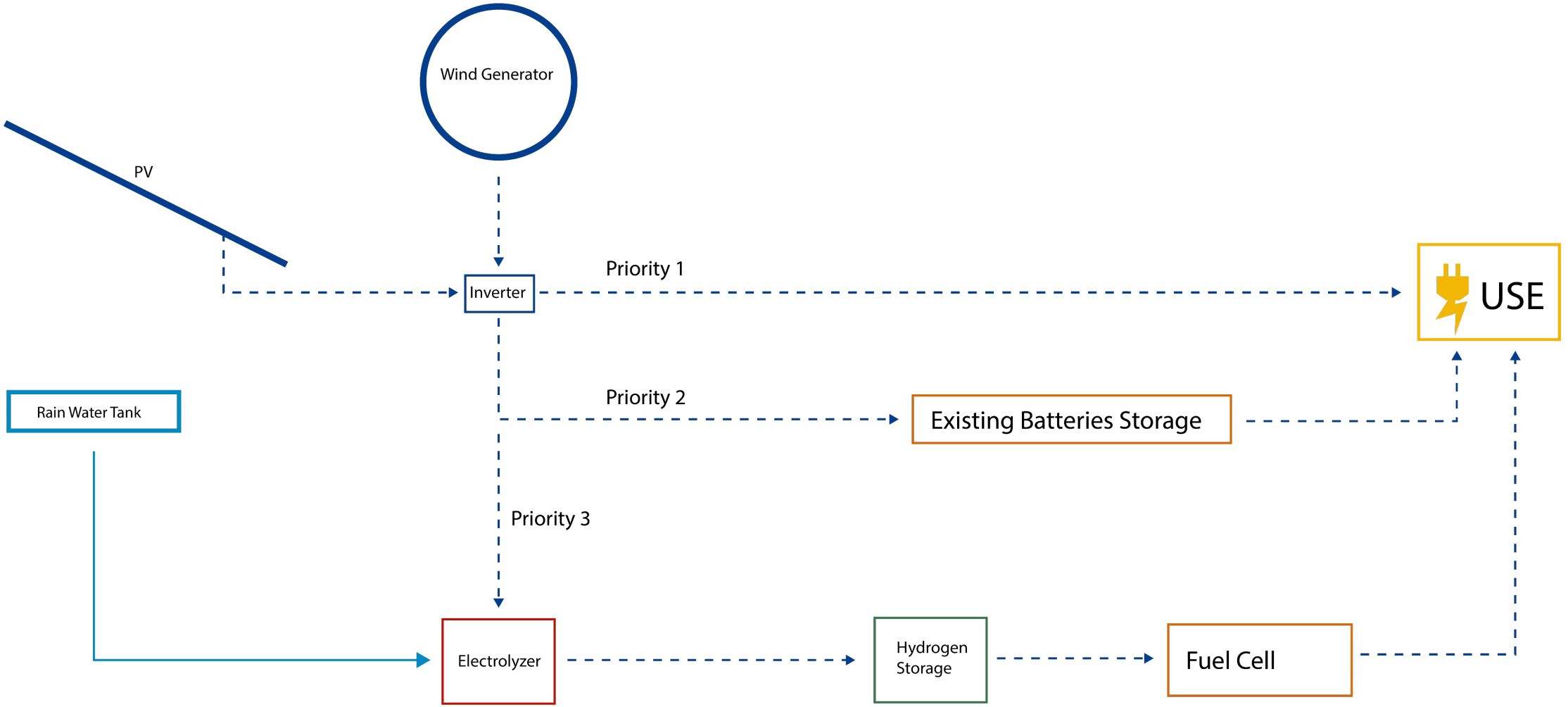


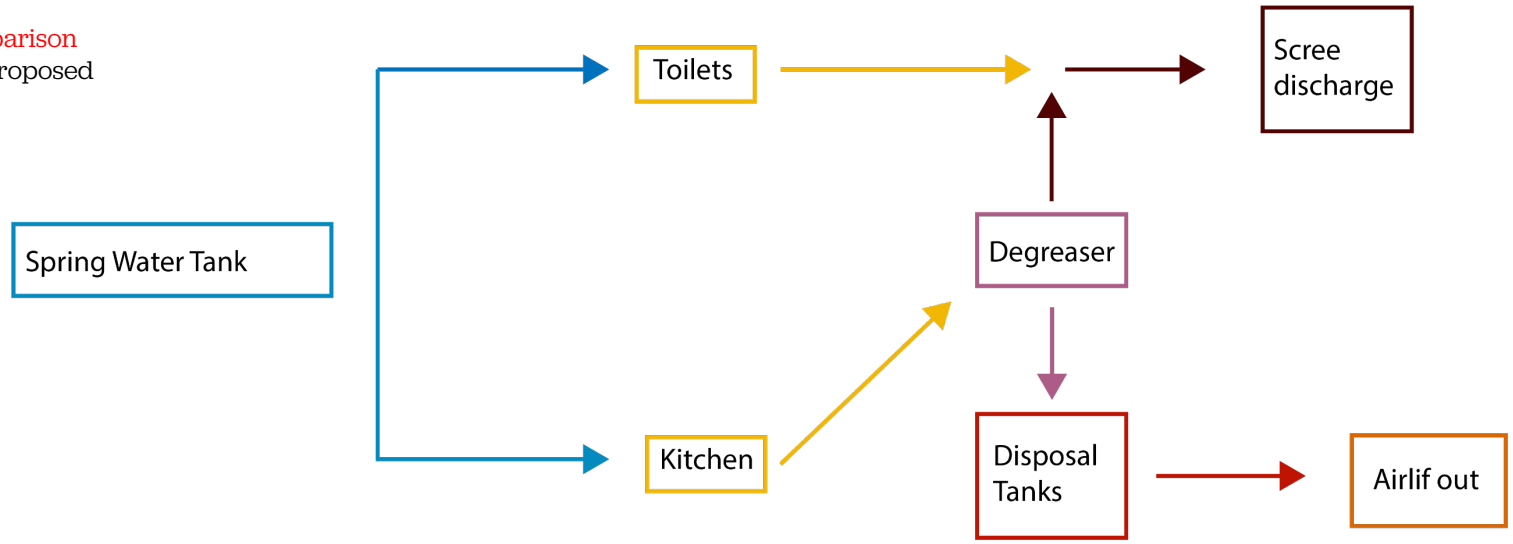
Photo Credit: Rifugio Carducci

Project Energy System Integration
Proposed System Infrastructure



Systems Comparison
Existing and Proposed

Current System



Proposed System