



Graduation Report

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(Roel van de Pas/Inge Bobbink)

Acknowledgments

I have been truly fortunate to be able to further explore my on-going work in Ladakh through this graduation thesis at the Technical University of Delft. I would like to thank my mentors, Roel van de Pas and Inge Bobbink, for their relentless support and inspiration whilst being truly receptive to a context that is very different from the Netherlands. The extensive vernacular architecture study would not have been possible without the help of Edoardo Paolo Ferrari and his thorough work on Ladakhi architecture and its documentation. I would also like to extend my gratitude to my studio mates at Explore Lab who kept me company and inspired me with their own innovative projects. Additionally, I would like to thank my friends, Pranav, Mark, Anna, Claudio and Megha whose inputs have been truly valuable.

Since the foundation of this thesis began long before this graduation studio in the high mountains of Ladakh, I owe gratitude to the people that made it possible back home. The extensive site studies in the cold winter months would not have been possible without the help of my colleagues at the Himalayan Institute of Alternatives, Ladakh - especially Thupstan Tsering, Jigmat Paljor and my brother Neel Sengupta's photo documentation skills. Finally, I would like to thank my parents, Anindya Sengupta and Ruchira Sengupta, for their endless support and belief in me.



*An image of a 700 year old house in Kulum.
Photographed by Self, 2025*

Abstract

“Gangchen-Yul:Village of the Glaciers” is a project that is based in Kulum- a remote high altitude village in Ladakh (North Western Himalayan region in India). Kulum is one of many villages in Ladakh that has borne the brunt of climate change and subsequent abandonment- posing a threat to livelihood and vernacular history.

Situated at an altitude of 3800m, Kulum’s history dates back to the silk route era where it was a thriving agrarian community that was supported by the high glaciers. However, through the centuries, due to economic, climatic and geopolitical volatility, Kulum’s sustenance has been increasingly challenged. Glacial depletion and the 2011 floods led to a spike in emigration to cities due to loss of agricultural land. Because of Ladakh’s remote and extreme geographical location, the sustenance of these agrarian communities is critical. This has been increasingly recognized by governing authorities and researches leading to developments such as ice stupas or artificial glaciers which help in restoring agricultural land. While these new developments have incentivized the return of local communities, their built environment remains to be addressed.

Therefore, rooted in extensive site study and personal experiences in Ladakh, the thesis aims to propose an urban and architectural rehabilitation strategy for Kulum based on vernacular processes. This is essentially done through restoring the original relationship between living and production by proposing an architectural dialogue between new modes of living and production that continue to emerge in Kulum.

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PART -A

INTRODUCTION



Locating Ladakh
 Map of Western Tibet by
 H. Strachley, 1853

I. Introduction

“You’ve got to hunch a little to enter the homes-shows you are humble”—this was my colleague as we were exploring a home situated at a humbling altitude of 4000 meters in the north western Himalayan region of Ladakh, India. The word “Ladakh” also translates to “The Land of High Passes” which does justice to its extreme climatic and living conditions.

Ladakh occupies a strategically significant position at the crossroads of several regions, bordering Tibet to the east, Xinjiang to the north, Baltistan to the north-west, Kashmir to the west, and Himachal Pradesh to the south. Historically situated along the Silk Route, the region’s economy was closely tied to trade and commercial exchange¹. Environmental conditions have also played a decisive role in shaping settlement patterns and architecture. Located within the Himalayan rain shadow, Ladakh receives less than 100 mm of annual precipitation, resulting in an arid landscape that strongly influenced traditional building practices. As a high-altitude cold desert, the region experiences extreme seasonal variations, with winter temperatures dropping to as low as -40°C and summer temperatures reaching above 30°C. Over centuries, communities have developed resilient forms of habitation adapted to these challenging conditions. Geological processes associated with past glacial periods have further shaped the landscape, as expanding glaciers carved broad valleys and deposited fertile moraines, outwash sediments, and other glacial formations that continue to support cultivation today².

¹ A.G. Sheikh, *Ladakh and its Neighbours: Past and Present*, in J. Bray, N. Tsering Shakspo (eds.), *Recent Research on Ladakh 2007, Leh 2007*

² Ferrari, Edoardo. (2021). *High Altitude Houses: Vernacular Architecture of Ladakh*.

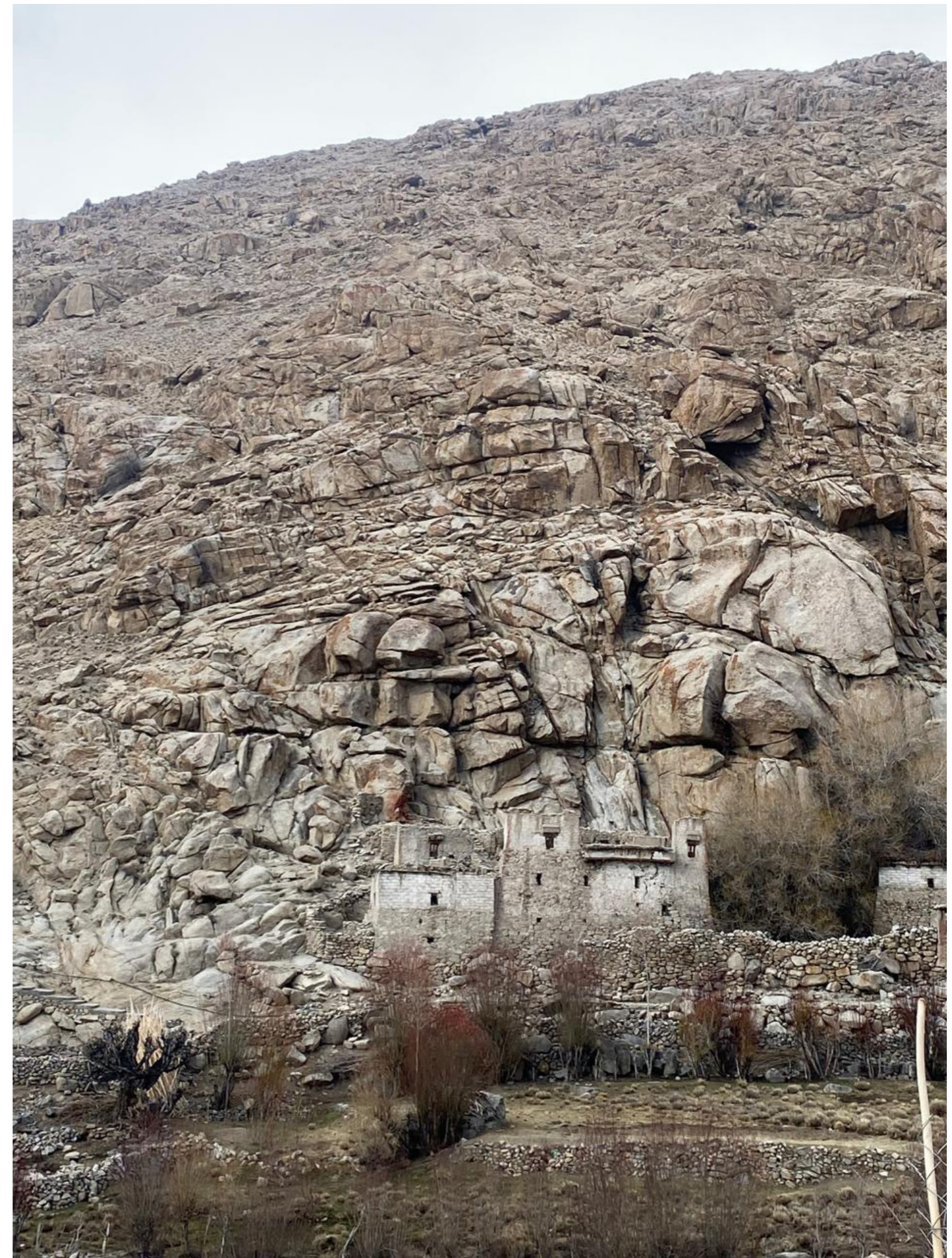
The location of the settlements was selected so that agricultural production and the availability of grazing fields was possible². Therefore, settlements are usually located in these deep glacial valleys at high altitudes as their agriculture produce largely depends on glacial melt.

The vernacular of Ladakh has molded itself to its agricultural and unique topographic patterns which largely entails using local materials (earth, stone and some timber) and local labor. This is also underscored by its remote nature which makes material transportation from other states inviable, especially in winters where all major roadways are frozen. These unique parameters has led to the development of an architecture that displays a symbiotic relationship between its environment, terrain and people.

However, the resilience of Ladakhis has been greatly challenged by the effects of climate change in recent times. These effects have manifested in terms of natural disasters such as earthquakes, landslides and floods and rapidly depleting glaciers. Whilst natural disasters have immediate visible affects that are visible in its context, depleting glaciers are gradually affecting the primary mode of village sustenance- agriculture. This has led to an increasing trend of village abandonment as their agricultural produce largely depends on water from glacial melt. This association between glacial depletion and village abandonment has imposed threats upon community livelihoods, sustenance and its vernacular heritage.



*Hiking up the glacier
from Kulum towards the
ice stupa
Photography by self, 2023*



*Photograph of Igo village
showing how the houses
blend into the rocks
Photograph by self, 2023*

In my time in Ladakh, I have been lucky to work with many such vulnerable villages and communities over the past few years. Similar to the Ladakhis, our first priority was always agriculture and water which would create an incentive for the villagers to return and therefore revive its sustenance. I was part of Ice Stupa teams which was involved in building artificial glaciers drawing from traditional water harvesting techniques. These stupas have been built across many villages whilst also creating a learning model wherein the villagers can build and maintain these stupas themselves. This framework has been successful in reviving agriculture in many vulnerable villages and has incentivized the return of its people. However, their homes and therefore their built heritage has not received the same attention. This is essential in order to ensure a holistic restoration model that re-establishes the relationship between their homes and their lands whilst honoring their rich vernacular heritage.

Through this thesis, I focus on one such vulnerable village- Kulum which is at the edge of abandonment and losing its heritage due to torrential floods and depleting glaciers. Whilst ice stupas have augmented its agricultural recession, its built environment remains ignored. Therefore, I aim to propose a holistic revival model for the village of Kulum that is rooted in its vernacular and potentially creates a restoration prototype for many such settlements that have borne the brunt of climate change.



*(above) ice stupa or artificial glaciers are built so as to harvest precious glacial water used for harvest season
Photograph by self, 2023*



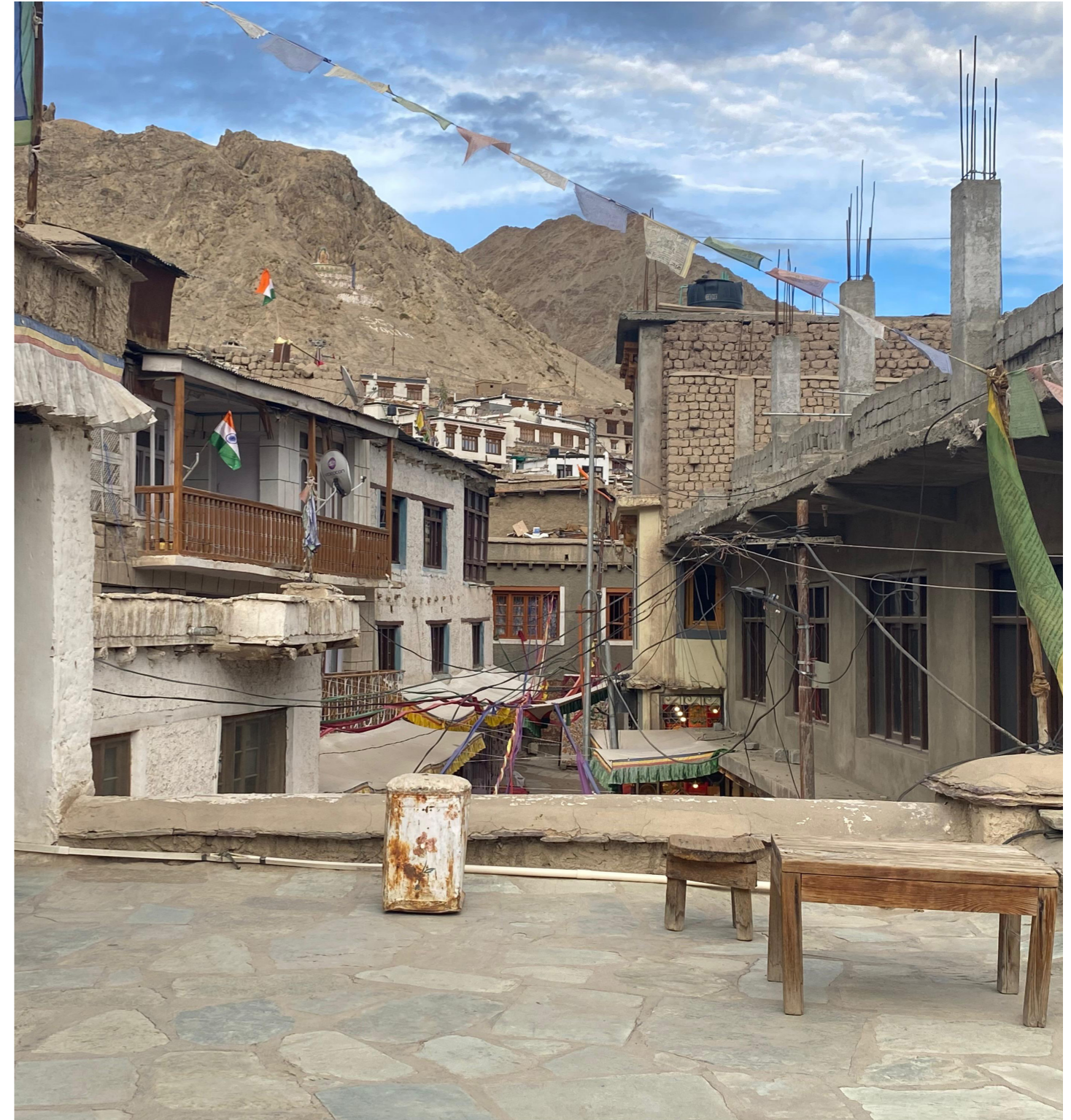
*(below) the village of Kulum looking towards the glaciers
Photograph by self, 2023*

conservation and history. It also poses a new palette of architecture in Ladakh that looks into the past and leans into local values that have understood the shape shifting nature of the Himalayas and its climate. Therefore, an architectural framework that focuses on people, terrain and subsequently-sustainability.

II. Relevance

Volatility in Ladakh is not limited to its natural elements. Considering its precarious position on the map, the union territory has witnessed increased geopolitical and economic tensions. This has manifested as increasing military occupations, a booming tourism industry and a large rural to urban migration in search for government jobs. This graphical economic ascent is contradicted by the grave environmental impact that supplements the ascent. Architecturally, this has resulted in a built environment that focuses on building quickly in the summer months with materials that aid the pace but are not suitable for Ladakh's unique terrain. The rising use of concrete and glass sourced from other states has not only resulted in loss of local employment but has also impacted the carbon footprint to a great extent. Thus, contemporary architecture in Ladakh has taken a turn that can create an illusion of development which has gradually overshadowed its rich vernacular and heritage.

In the context of this thesis, I particularly focus on villages that have slowly but surely been affected by the current state of affairs. Depleting glaciers and natural disasters have led to a loss of livelihood and sense of ownership. This has eventually had a severe impact on their built environment and thus, heritage. The history of architecture in Ladakh is only recorded within their walls and the lack of conservation attention in these times would lead to an erosion of its history and culture. It is important to note that this conversation about reviving the vernacular and re-establishing communal roots goes beyond the idea of



A picture of Leh, the main city in Ladakh-showing the main market

Himalayas bare and rocky after reduced winter snowfall, scientists warn

7 days ago

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Navin Singh Khadka
Environment correspondent



Much less winter snow is falling on the Himalayas, leaving the mountain rocky in many parts of the region in a season when they should be snow-covered, meteorologists have said.

Home News Sport Business Innovation Health Culture Arts Travel Earth Audio Video Live

The Ice Man of Ladakh building artificial glaciers in the Himalayas

13 June 2024

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Kanika Gupta



Ice stupas bringing life back to Ladakh's ghost villages

Amika Pandit@timesgroup.com

In the winter of 2019, Acho Tashi, 42, joined other men from his village of Kulum to make an 'ice stupa', a simple yet unique Ladakhi innovation that uses pipes and gravity to bring water to an arid landscape. In the summer of 2020, as the stupas started melting, water flowed once again into the channels that had dried up and forced many villagers to leave. The Kulumpas could once again water their farmlands.

Located 50km southeast of Leh, Kulum started feeling the effect of climate change around 2012 when the water stream they survived on dried up due to glacial reduction. Most of the residents, comprising 11 agrarian families with an average of six members each, were forced to move out of the village in search of work. They ended up as daily wagers or set up small utility shops like tea stalls in the nearby town of Upshi while their large habitable homes lay vacant with a handful of elderly people staying back. With the ice stupa concept working, the families are hopeful about returning home.

Kulum isn't the only village that has suffered; there are nearly six other villages that have experienced something similar. And there are about 16 to 18 villages that might have to be abandoned in the future with water channels drying up.

Keeping all this in mind, in 2019, the Union ministry of tribal affairs decided to financially support a two-year research project to expand on existing work on ice stupas by Students' Educational and Cultural Movement of Ladakh (SECMOL) and Himalayan Institute of Alternatives Ladakh (HIAL).

Under the pilot project, a 45-foot ice stupa that could store three lakh litres of water was built at Kulum. Twenty-five other villages also built such ice stupas between November 2019 and February 2020. Together, these were able to conserve over 60 million litres of water for agriculture and plantation, government data shows. Though mostly built by villagers in the age group of 18 to 30 years, even children and the elderly chipped in to make the stupas.

With it registering success, Tashi and others are hoping to make a bigger stupa this winter. He is also hopeful that his two children aged eight and 10 will get to grow wheat in Kulum just like him, along a meltwater stream for glaciers. The government has bigger plans — it not only wants to rebuild the stupas at all these 26 villages but also expand the project to include 24 more villages.

There are 242 inhabited villages in Ladakh.

HIAL CEO and Dean Gitanjali stresses that three major issues — water scarcity, low indoor temperatures in buildings, and a shift from the original agrarian-based economy — are causing migration of the youth. So, the project seeks to rehabilitate abandoned villages through ice stupas, preservation of farmlands, and enabling people to survive the severe winter.

On a government build or create a MoTA of SECMOL steering first project in 2013. The competition was to build a stupa.

HOW A STUPA WORKS

- A water source is identified and the base for the stupa built at another place. Both connected through an insulated pipe
- Stupas are makeshift structures supported by a tripod. Water is released vertically, and it freezes by the time it falls to the ground in sub-zero temperatures
- The ice mound thus formed rises up in a conical shape to reach a height of 45 feet or more. A 30-metre tall stupa can store around 10 lakh litres of water

Kulum Water Crisis: A wake-up call for Ladakh

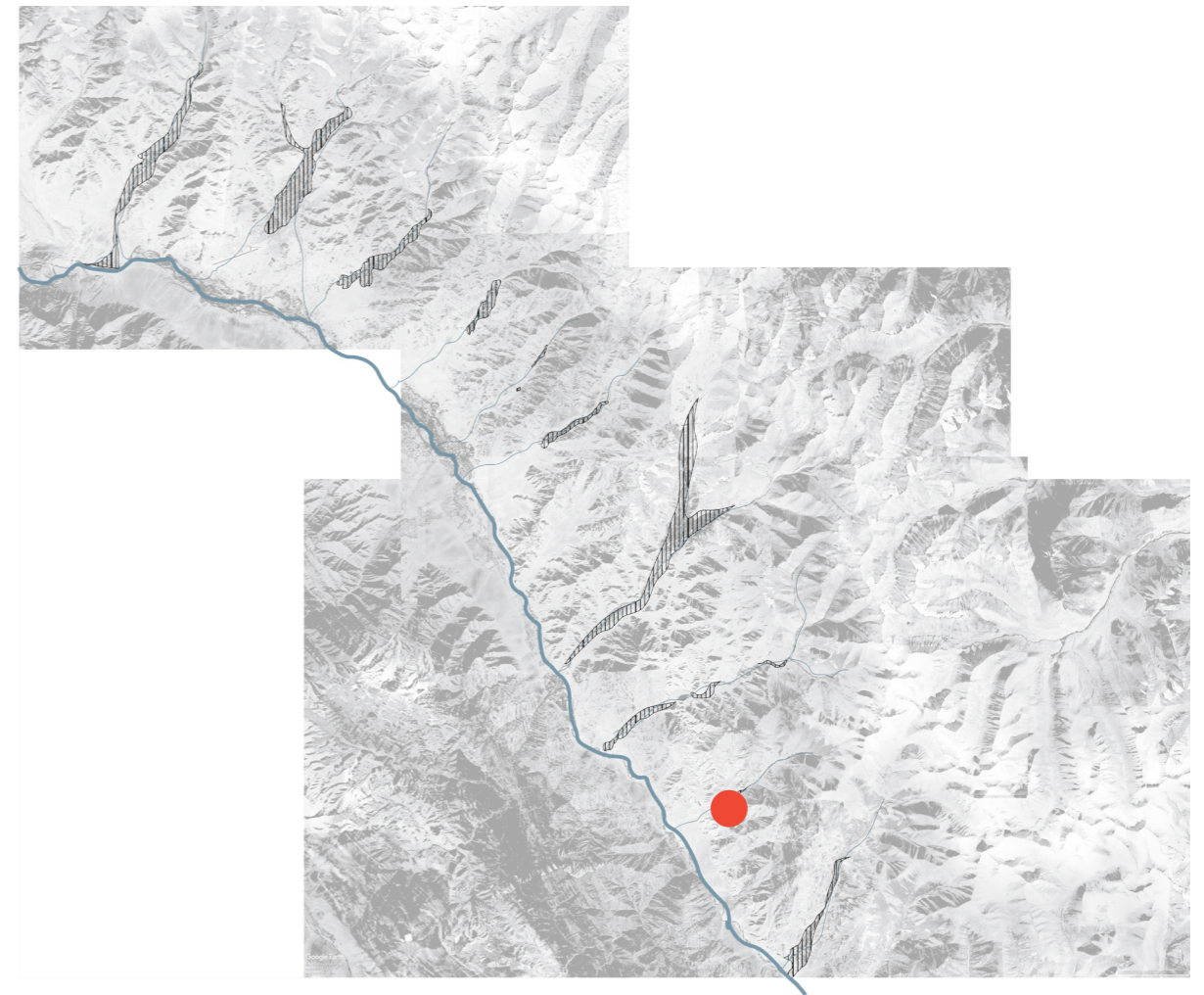
Residents forced to migrate due to water scarcity

By Stanzin Dasal | KULUM, Feb 20, 2021



Old abandoned house of Kulum village.

News articles that highlight increasing impact of climate change on Ladakhi villages.



III. Objective

Considering, the growing ecological and architectural urgency of the topic, the objective then becomes to propose a community anchored, vernacularly informed restoration model that enables the revival of self sustenance in Kulum. Further, it is also to use the thesis in a way to document the process so that it may act as a prototype for many such ecologically threatened villages.

In terms of interventions, the thesis aim to intervene in three aspects which form the anchors of any village- Agricultural, Architectural and Economical. It is important to note that similar to Ladakhi villages, these aspects co-exist and are co-dependent on each other. For instance, without glaciers there is no agriculture which leads to no built environment and therefore a loss of community, livelihood and heritage. The agricultural interventions may include spaces that facilitate water harvesting and storing granaries (common spaces); the architectural interventions would include a restoration of existing abandoned homes via vernacular processes to cater to new programs and users; the economical restoration would potentially be a result of the former aspects owing to income inflow due to new users (mountaineers and researchers that visit the ice stupa usually set a base in Kulum) and decreased dependency on energy grids due to passive solar retrofitting techniques.



(above) village morphologies in Ladakh

(below) the village of Kulum

change factors?

-What is the relationship between glacial melt/climate change and decreasing population in villages?

Design Question-

How can we build a self sustaining village model for Ladakh in the face of climate change and threats of abandonment?

-What kind of spatial interventions can lead to sustainable revival?

-In what ways can architectural restoration respond to agricultural restoration?

-How can traditional building methods be used to develop carbon neutral retrofitting strategies?

-How can the process of construction be community led?

-How can the process be incentivized economically?

-How can the process take from pre-existing methods of dealing with decaying buildings?

-How can the built space create a sense of ownership with the villagers?

-How can the process be recorded so as to form a prototype for many such villages?

V. Scope

IV. Research/ Design Questions

It is necessary for the thesis to find foundation in Ladakh's rich and dense context which necessitates several research and design questions that guide the project. These are then incorporated into the planning and design process via various methods that are elaborated in the subsequent chapters.

Research Question-

How have the Ladakhi villages displayed resilience in the face of extreme climatic and geographical challenges and what is the value in preserving them?

-What are the associations between settlement patterns and the terrain? (located close to glacier etc) Workings of the glacier and agriculture

-What is the general distribution of programs across a village?

-What are the heritage and cultural values associated with their built spaces?

-What is the construction process and who are the various stakeholders?

-How are the materials sourced and what is the general carbon footprint?

-How do these villages contribute to the larger hydrological system in the state?

-What factors have led to increased receding glaciers?

-What are the existing coping mechanisms of villages to deal with climate change and degradation?

-How high is the general incentive to save their homes?

-What are their general livelihood patterns and how has it evolved with climate

The scope of the project is limited to the village of Kulum. Since the village is also divided into upper and lower parts, the project would focus on the older part (upper village) to better exhibit the ideas of restoration. Whilst the thesis is rooted in glaciology and agriculture, I do not aim to intervene in the glacial engineering aspects. Finally, the restoration project caters to its residents and visitors while potentially setting a precedent for its neighboring villages that share similar circumstances.

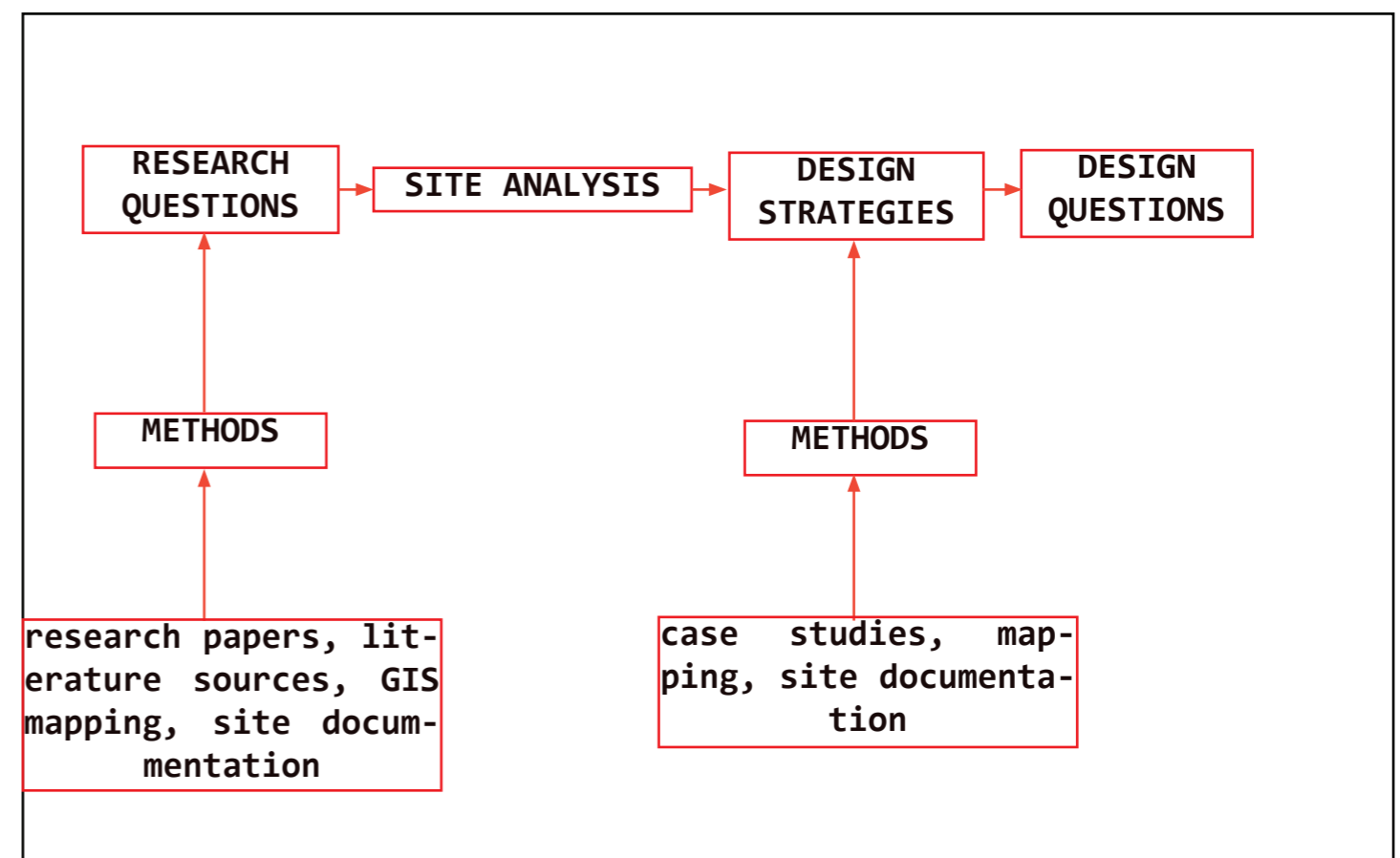
PART-II

APPROACH

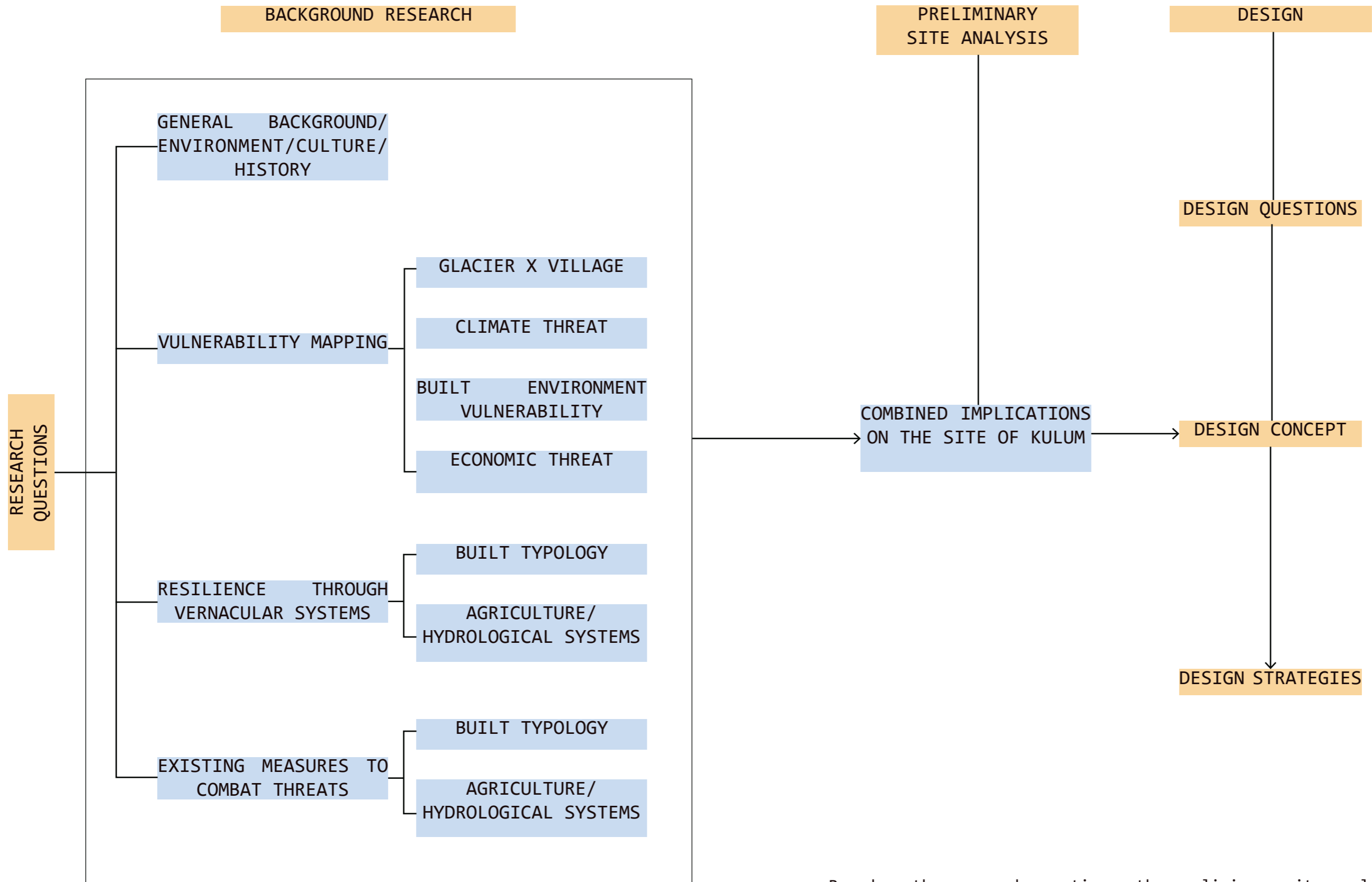
VI. Methods/Planning

The organization of research in the thesis is done in a design oriented way where every research aims to answer key questions about the site which eventually leads to the design process. The adjacent chart shows how research questions are routed into a planning which leads to a preliminary site analysis which eventually leads to answering design questions via design strategies. The research questions are first broadly answered via 'the macro planning' chart through various listed methods which then narrow down to the site of Kulum.

The methods adopted are-personal experiences, several research papers and literature sources, GIS mapping tools and on-site documentation.



The guiding process for research and design



Detailing planning process and how research and site analysis leads to design strategies

Based on the research questions, the preliminary site analysis is conducted through specific lenses- **general background and history, vulnerability mapping, resilience through vernacular processes and existing measures to combat threats**(elaborated in subsequent chapters). Analyzing the site based on each of these categories leads to specific results and observations which eventually results in a **design concept** which is explored through architectural explorations-thus answering the various **design questions**.

VII. Theoretical Framework

Before proceeding with the preliminary site analysis, it is important to understand the theoretical framework. The research questions are answered based on the categorized theory in the next page. It starts with the concept of climate change vulnerability in Ladakh which has been researched and documented extensively. This includes more scientific mapping including glacier depletion and agricultural degradation but also a lot of economic impacts. This consists of papers by various locals and news articles that have elaborated upon the artificial glaciers, environment pollution, threats to community etc. Vernacular processes relating to landscape and architecture in Ladakh have also garnered increasing interest in the present times and there exists sufficient research about its history and performance. For instance, Edoardo Paolo Ferrari's "High Altitude Houses" has formed a strong foundation for decoding architectural and urban systems in Ladakh. Additionally, there are many other case studies whose restoration and conservation have been documented extensively and can provide useful insights for the project as well. Restoration and conservation have been carried out by various local organizations such as Tibetan Heritage Fund, Achi Association etc. These help form guidelines for the restoration process to be carried out. These varied researches are explored in detail in relation to the thesis in the appendices.

The thesis aims to explore a more unexplored realm of heritage villages that are losing their homes due to depleting glaciers. It explores the built environment and a resilient restoration that is anchored in its vernacular.

Multitemporal glacier inventory revealing four decades of glacier changes in the Ladakh region

Mohd Soheb¹, Alagappan Ramanathan¹, Anshuman Bhardwaj², Millie Coleman^{2,3}, Brice Rea², Matteo Spagnolo², Shaktiman Singh², Lydia Sam²



Community-scale analysis of the farmland abandonment occurrence process in the mountain region of Ladakh, India

Takayoshi Yamaguchi, Sonam Ngodup, Mitsuhiro Nose & Shinya Takeda

CLIMATE/COMMUNITY/
ECONOMIC THREATS



Research Article

Two Decades of Conservation in Ladakh: Accessing the Achi Association (AA) and Achi Association India (AAI) Archives

Cultural Systems in Water Management for Disaster Risk Reduction: The Case of the Ladakh Region

Sweta Kandari¹, Ram Sateesh Pasupuleti^{1*}, and Subhajyoti Samaddar²

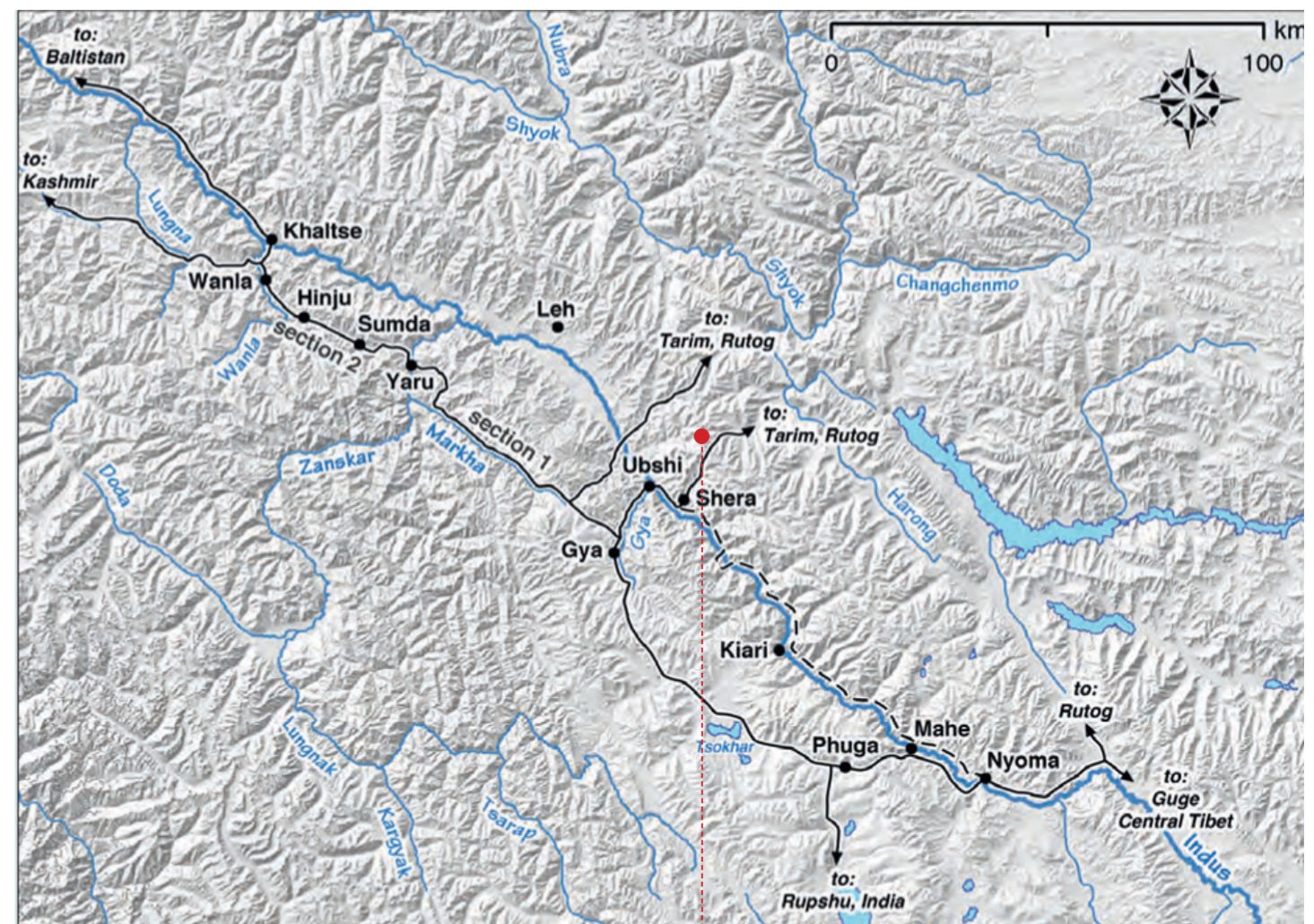
VERNACULAR SYSTEMS



EXISTING MEASURES TO
COMBAT THREATS

VIII. Preliminary Site Analysis | General Background and History

Kulum is a remote hamlet located roughly 50km north of Leh (the main city) in Ladakh, India. Situated in the rugged, high-altitude terrain north of the Indus Valley, its altitude ranges between 4000m to 4500m and currently consists of eleven resident families which is approximately sixty to seventy people. As elaborated previously, Kulum, despite its remote and humble appearances, has been part of a crucial agrarian and geopolitical history in Central Asia. The adjacent image is a scan from the book “An Atlas of the Himalayas by a 19th Century Tibetan Lama” and it accurately depicts how the villages shared a close relationship with the Indus river and the glacial systems. It was almost an interconnected system between these seemingly remote villages in the high passes of Ladakh that collectively contributed to the long term sustenance of the region. After an exploration into ancient silk routes that passed through Ladakh, I also happened to locate Kulum precisely on an important part of the silk route which only reinforces the long standing history of the village¹. However, over the years, due to increasing climate change, Kulum experienced an increase in natural disasters and glacial depletion that threatened its main source of livelihood-agriculture. The most significant disaster that led to a sharp decrease in its population was the floods in 2010 which made the village a center of attention for agricultural restoration policies and researches.



(above) scan from “An Atlas of the Himalayas by a 19th Century Tibetan Lama”

Kulum as part of silk routes and ancient trading routes

(below) the village of Kulum in Quentin Devers: Charting Ancient Routes in Ladakh: An Archaeological Documentation

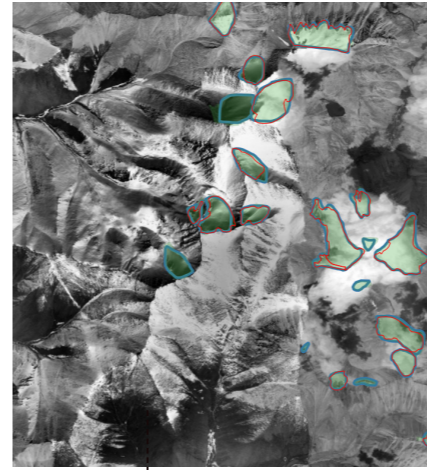
¹ Quentin Devers: Charting Ancient Routes in Ladakh: An Archaeological Documentation



part of silk route



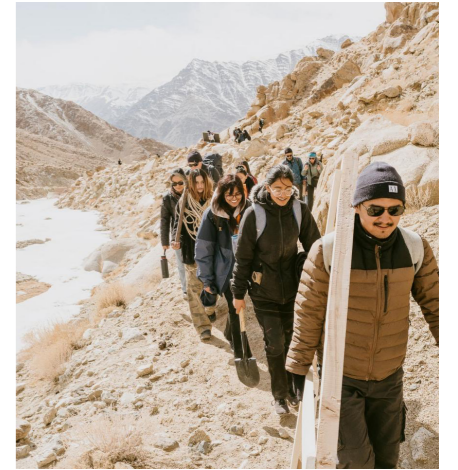
Floods causing agricultural decline/ 2010



Glacial depletion mapping



Artificial glaciers/2021



New demographic of researchers and volunteers helping maintain the glacier/2022-present



a host of people / active agriculture and activity/pre 2010



Residential abandonment/2011



Active agriculture/2022



Architectural restoration still needed/current state

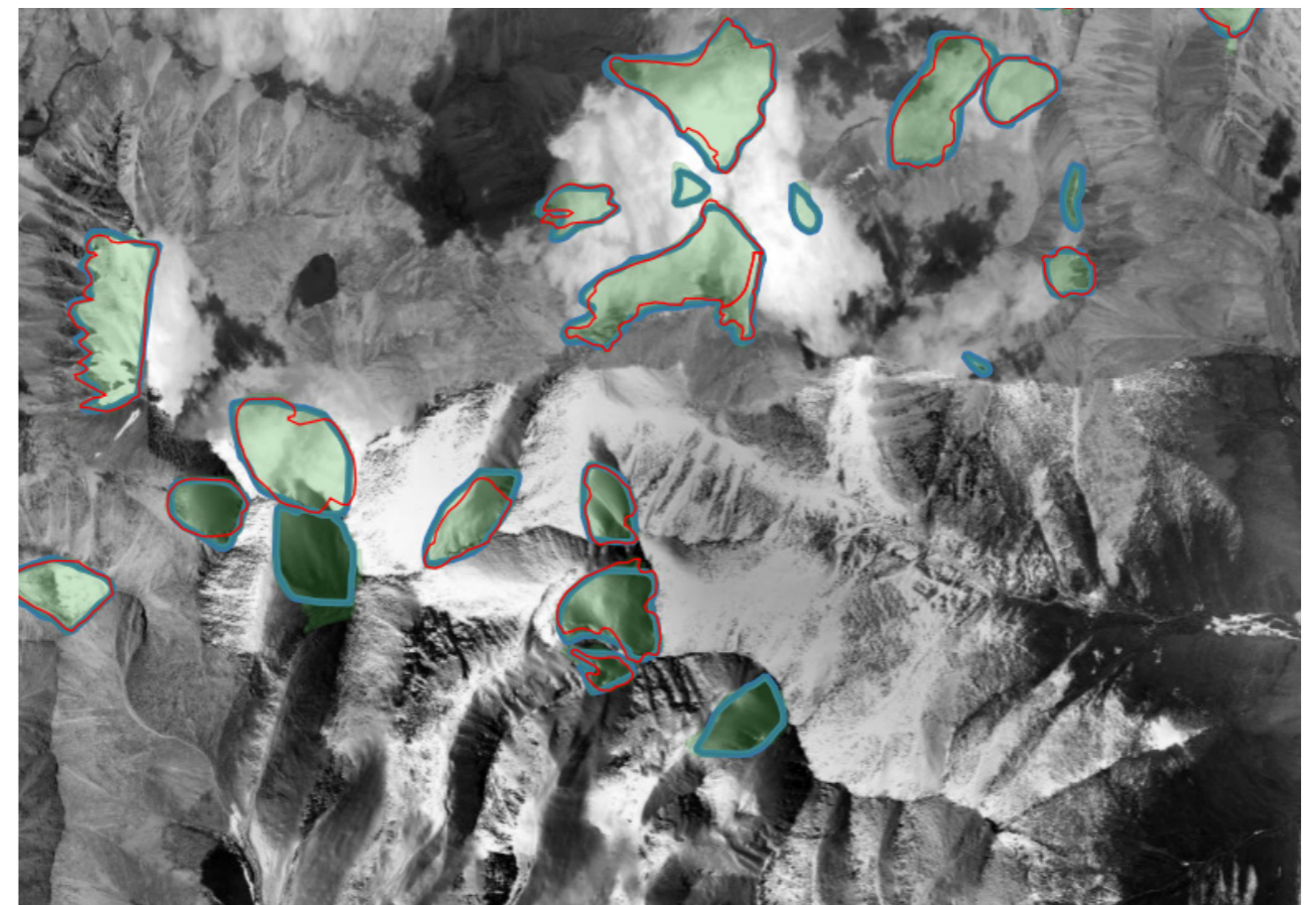
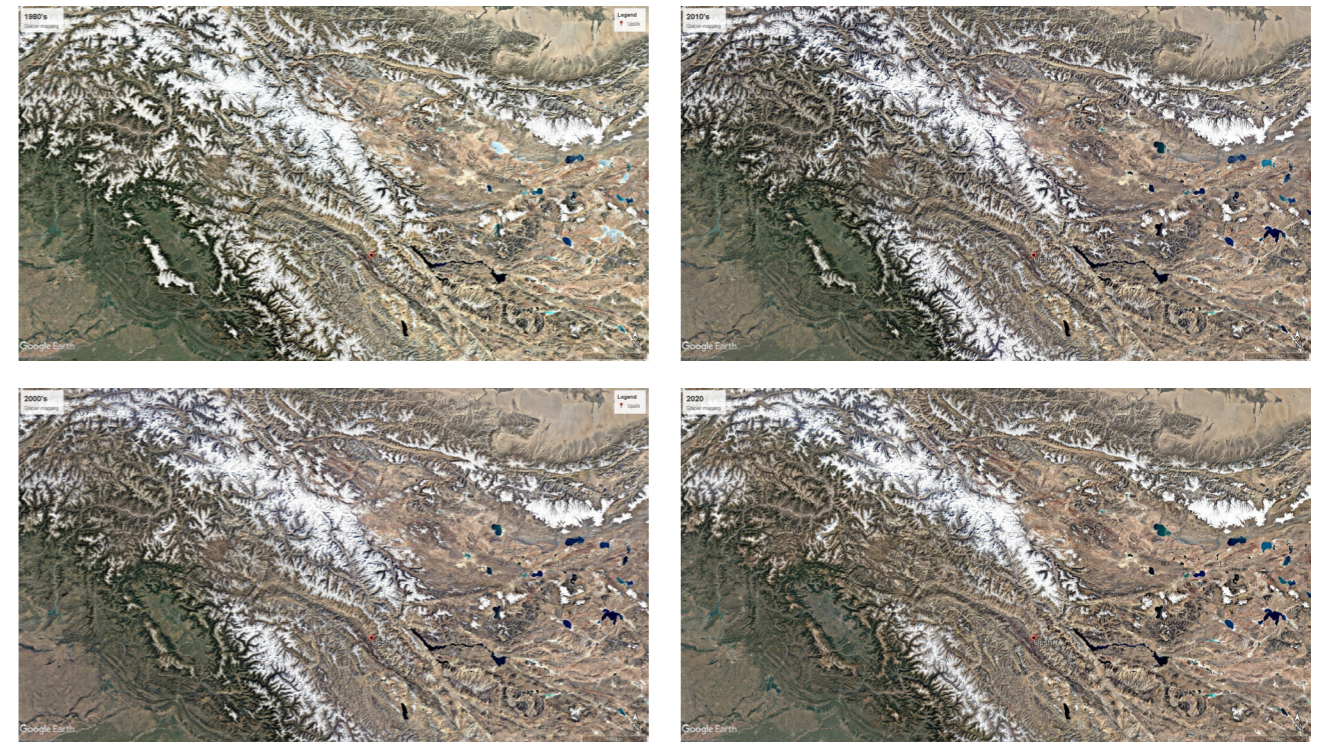
This eventually became one of the sites for artificial glaciers (explained in further chapters) or ice stupas (a project I assisted in collaboration with the Himalayan Institute of Alternatives, Ladakh in 2023). The artificial glaciers significantly helped in ground water table restoration which led to agricultural restoration and has incentivized the residents of Kulum to return. At present, the site mainly consists of sixty residents, of which only about 20 residents (mostly women) would tend to stay in the village and tend to the fields. The village is mainly composed of two parts- lower village and upper village. The lower village because of easier accessibility, is built with relatively contemporary materials and the upper village is older and mostly abandoned and composed of local materials. In addition to this, the site would a host of researchers and scientists (for example- the organization I worked at) that worked on the maintenance of agricultural fields and the glaciers. Beyond this, Kulum would host a series of transitory visitors and hikers that would use the site as a sort of base camp before climbing further up. This would result in economic returns for the villagers.

(above) a timeline of events in Kulum

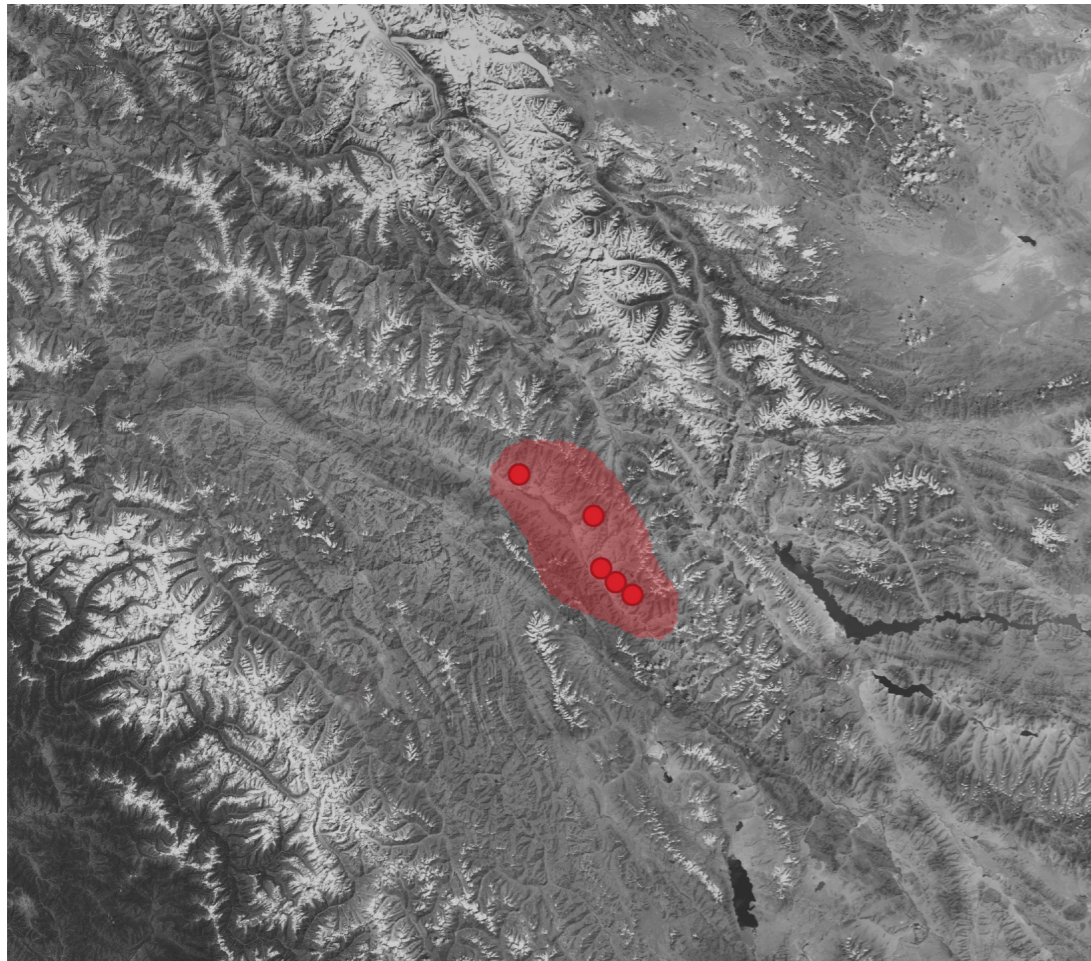
IX. Preliminary Site Analysis | Vulnerability Mapping

This segment of the analysis is important to not only understand the current state of vulnerability of Kulum with regards to climate change and decrease in livelihood but also to chart an approximate prediction of its increasing vulnerability with respect to many such villages in Ladakh. Since glacial depletion is the leading cause of livelihood loss, I first mapped glacial reduction outlines over the past five years via QGIS and Google Earth. These outlines indicate an ever increasing glacial depletion. Beyond this, many authors have performed a climate change based vulnerability analysis for villages across Ladakh¹. This further validated the high risk region that Kulum is situated in and necessitates intervention.

¹ Padma Namgyal, Shyamal Sarkar, Ramesh Kumar, Vulnerability assessment of rural households to climate change using livelihood vulnerability framework approach in the trans-Himalayan region of Ladakh, India



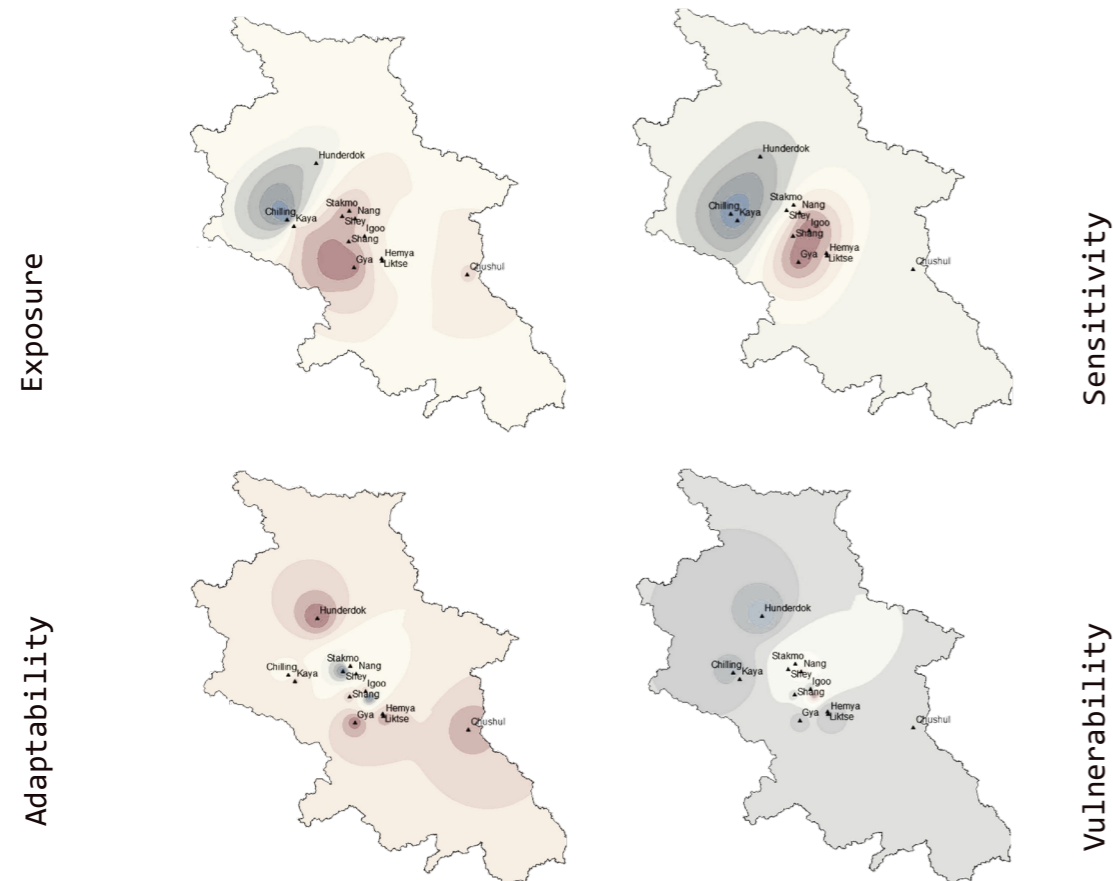
(above) mapping of glacial outlines over the years via Google Earth and QGIS



The adjacent maps indicate villages in Ladakh that are most vulnerable to climate change threats. Kulum falls in the central risk prone zone (marked with a square). This suggests that Kulum is only one of many villages that would need urgent future intervention.

The patterns of vulnerability identified in the region are reflected in the gradual deterioration of its architectural heritage. Traditional Ladakhi architecture evolved through a close relationship with the local climate, terrain, available resources, and everyday practices of its inhabitants. In recent decades, however, rapid infrastructural development has encouraged the widespread adoption of materials such as concrete, steel, and glass. Their use often relies on specialised construction knowledge and external labour, leading to an increasing dependence on workers and contractors from outside the region. As a result, local building knowledge and craftsmanship are gradually being displaced. Many younger Ladakhis now participate in construction processes directed by external actors who may have limited understanding of local environmental and cultural conditions. This shift is contributing to a changing social and economic structure in which communities rely more heavily on imported materials, expertise, and construction systems. At the same time, the long-term environmental impacts of these building practices remain uncertain, while the growing preference for modern materials poses significant challenges to the preservation and continuity of Ladakh's built heritage¹. Moreover, the decline of Ladakhi built heritage is also a matter of urgency as its history has not been recorded in books or archives and remains stored within its walls and folklore. In his work, Ferrari states that- "If one can attempt to analyse the history of the territories which, wholly or partly, make up today's Ladakh through the inscriptions, text, forts, temples and ruins, it is harder to understand the history of simple houses. Residential architecture is by its nature constantly adapted, changed, dismantled or rapidly eroded by weather, making the understanding of its history challenging. This history made of slowly evolving patterns which are diluted over centuries, has partly survived in the remnant layers of older constructions and – often unconsciously – in the practice and gestures of a few masons, whose knowledge is partly rooted in a recent, and at the same time, ancient past."²

Therefore, it is not only important to build an architecture that adapts to the changing climate and provides a home to vulnerable communities but to also take measures to conserve and record Ladakh's unique built heritage. This would ensure a future wherein the built environment molds itself to the changing times whilst also being informed by its rich history.



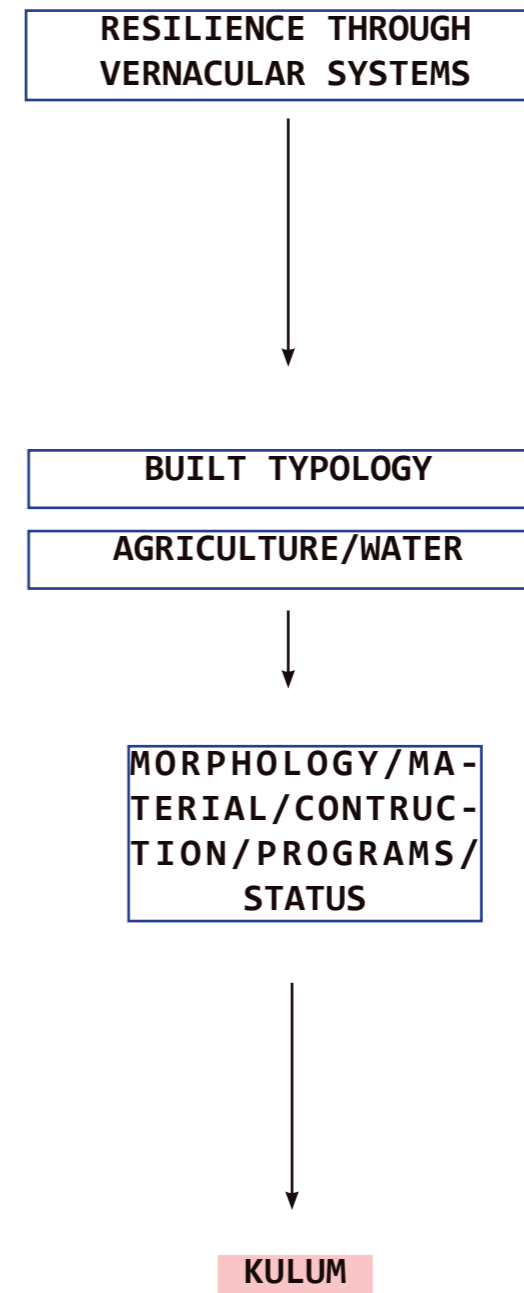
(above)
 Vulnerability maps showing which zones are increasingly affected by climate change
 source-Takayoshi Yamaguchi, Sonam Ngodup, Mitsuhiro Nose & Shinya Takeda (2016) Community-scale analysis of the farmland abandonment occurrence process in the mountain region of Ladakh, India, *Journal of Land Use Science*

¹ Building Processes and Challenges Ladakh by Debasish Borah, pg70

² Ferrari, Edoardo. (2021). *High Altitude Houses: Vernacular Architecture of Ladakh*.

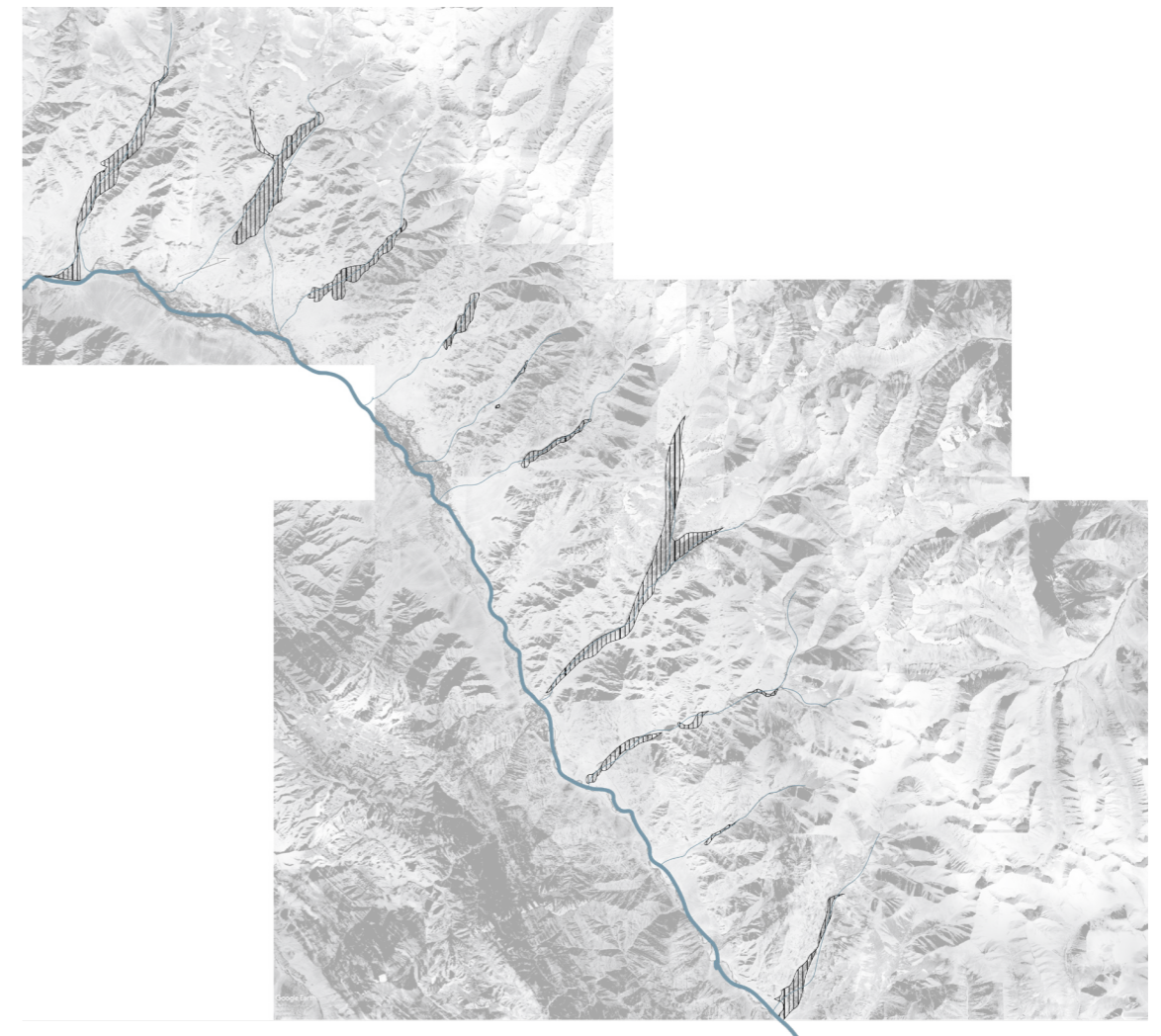
X. Preliminary Site Analysis | Resilience through Vernacular Processes

This segment of the analysis is critical in terms of leading to design concepts and decisions. In this, I analyze the village in terms of its landscape and built morphology, built characteristics and qualities and how vernacular systems have made the fabric of Kulum stand the test of time. I begin with an agricultural analysis as most villages in Ladakh are agrarian and their built environment molds as per the agricultural land. Settlement morphology is typically based on land, water and cultivable land. For instance, it is first assessed what parts of land are cultivable and then the remaining land is used to build homes. In terms of location, these villages are mostly located closer to glacial or water sources and where self sustenance is possible given the remote nature of Ladakh. Before I analyse the specific built and landscape morphology of Kulum, I studied some other settlements around Ladakh as case studies to understand the underlying influencing factors of these villages. This is then followed by a study of interior spaces and programs and how typical architectural standards are different in Ladakhi construction.





Map by Edoardo Paolo Ferrari's "High Altitude Houses in Ladakh" showing how settlement locations are determined by the rivers and glacial streams.



Outlining morphologies of villages and how they are shaped along valleys



Phyang

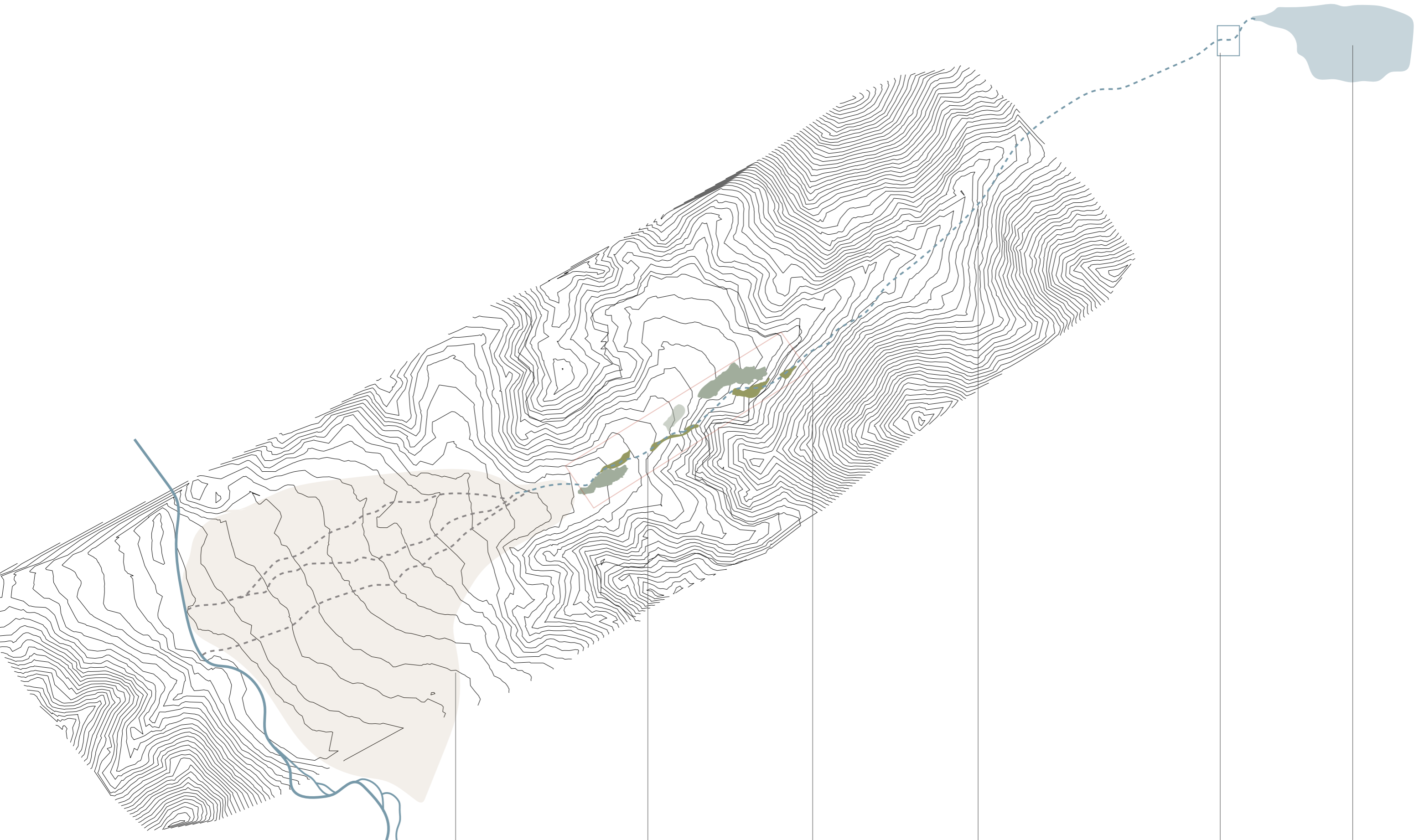


Igoo



Shara

Examples of some surrounding settlements via Google Earth that show a relationship between terrain, agriculture, glacier and architecture. This was important to understand the possible systemic village construction in Kulum. (see Appendices for a morphological analysis of Phyang (a village close to the capital city Leh))



Indus

*Unbuilt zone/ old military area/
not suitable for agriculture due
to dried glacial stream*

*Reviving agriculture via
ice stupa

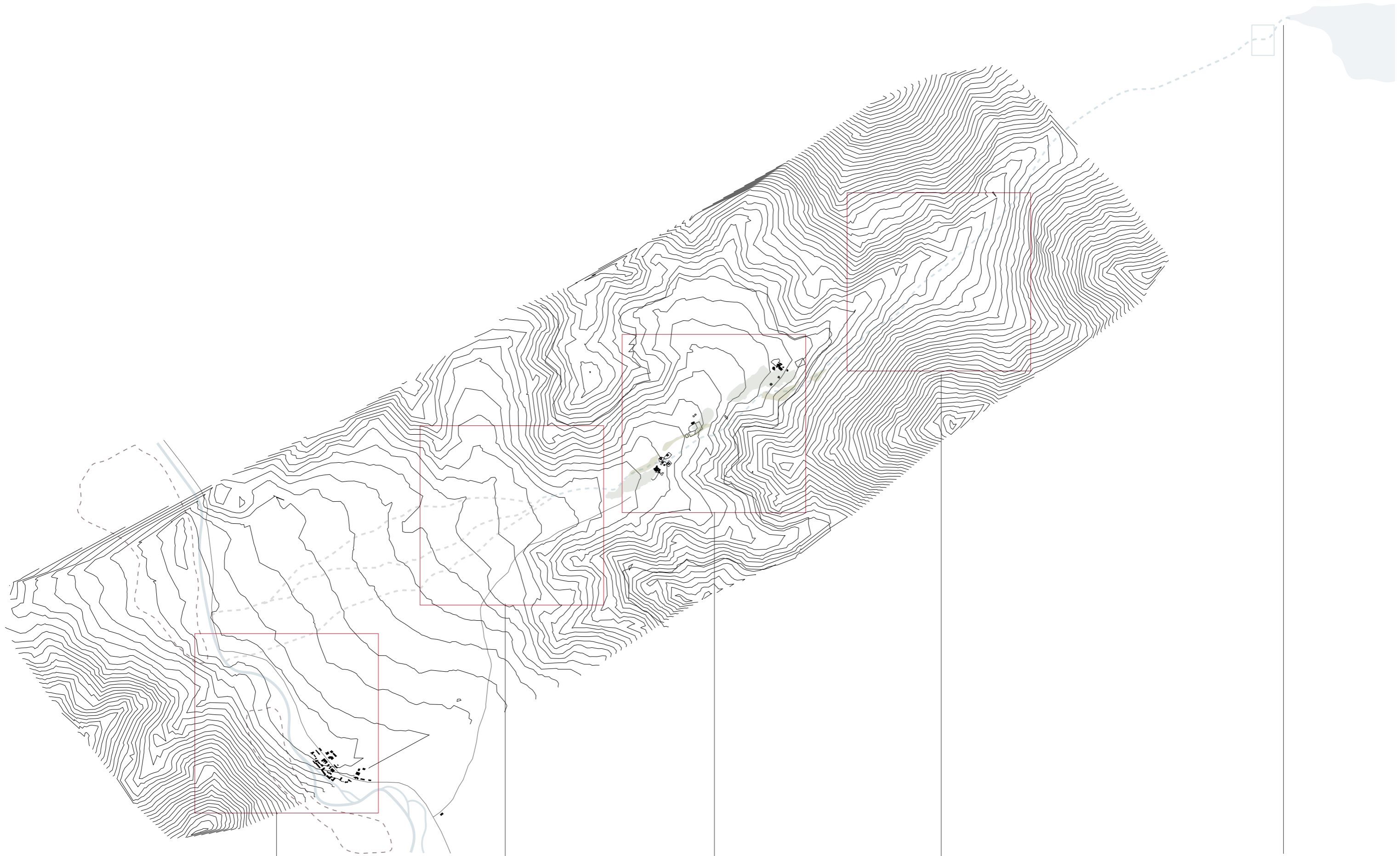
Inhabited zone of village*

*Willow/Poplar trees (used
for construction)*

Glacial Stream

*Ice stupa/ ar-
tificial glacier*

Receding glacier



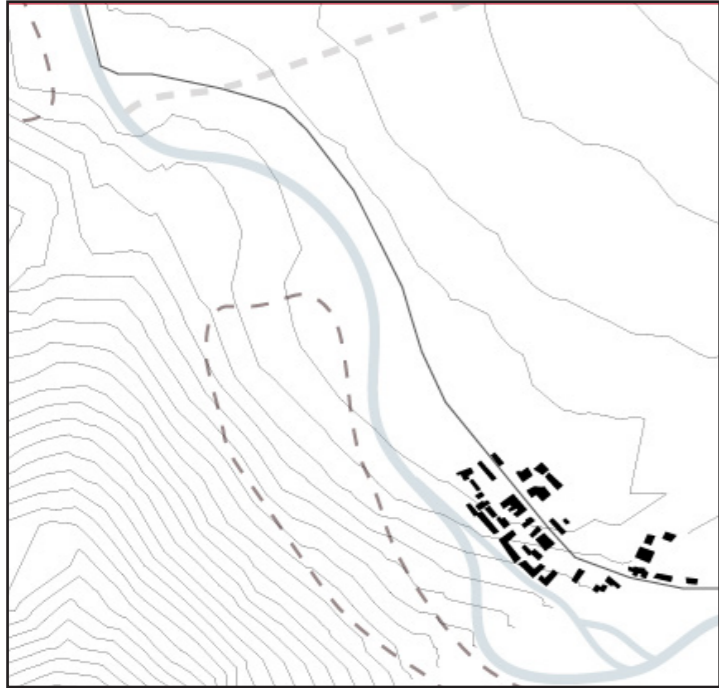
Town of Upshi and military areas

Newly built road leading to lowest part of village

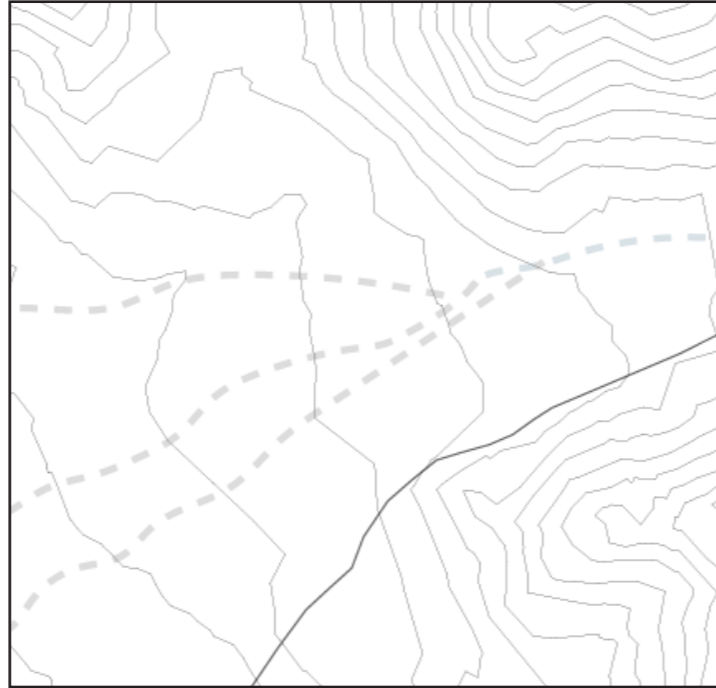
Kulum

Way to Glaciers/Ice stupa

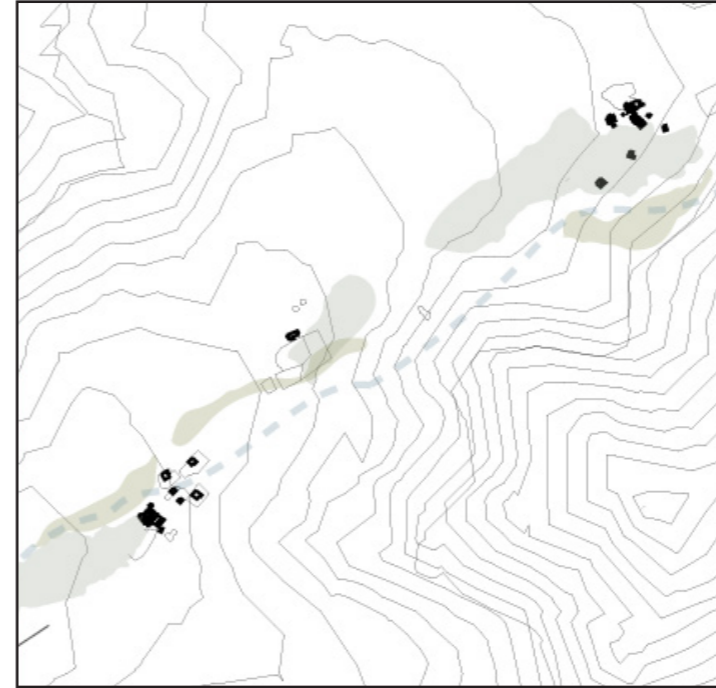
Glaciers/Ice stupa



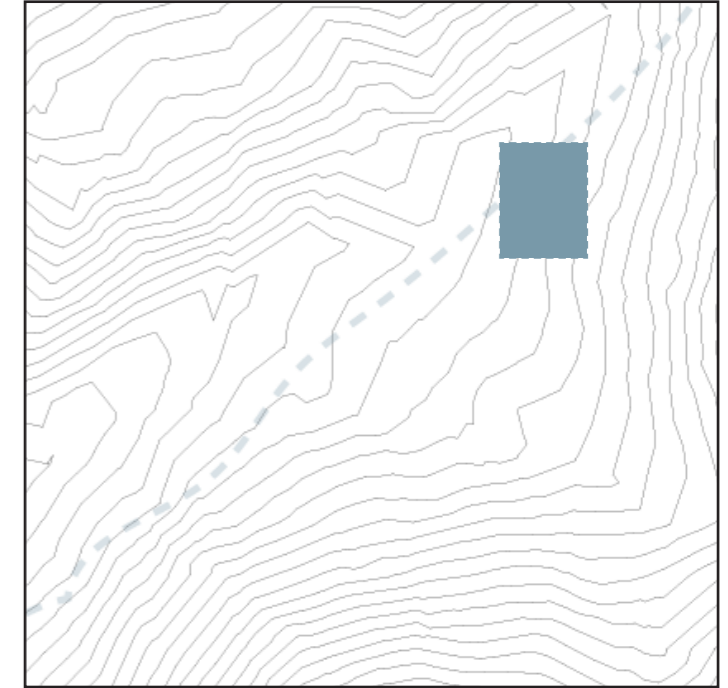
Town of Upshi and military areas



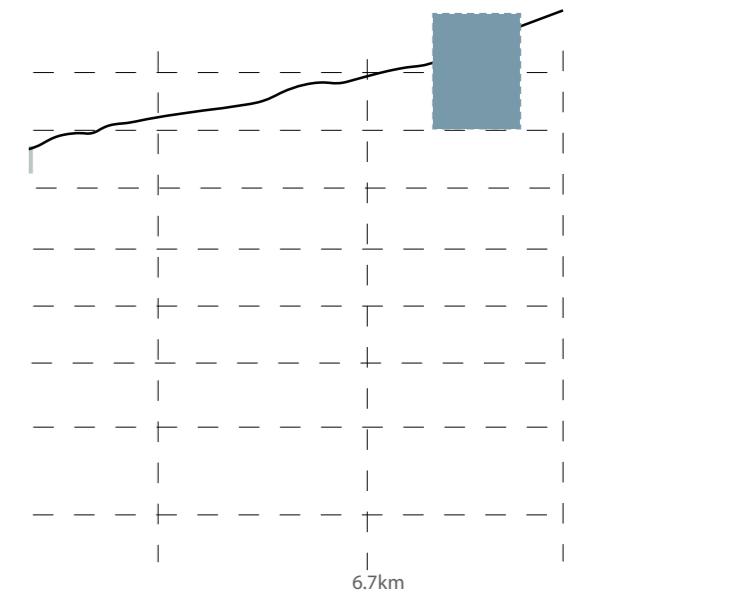
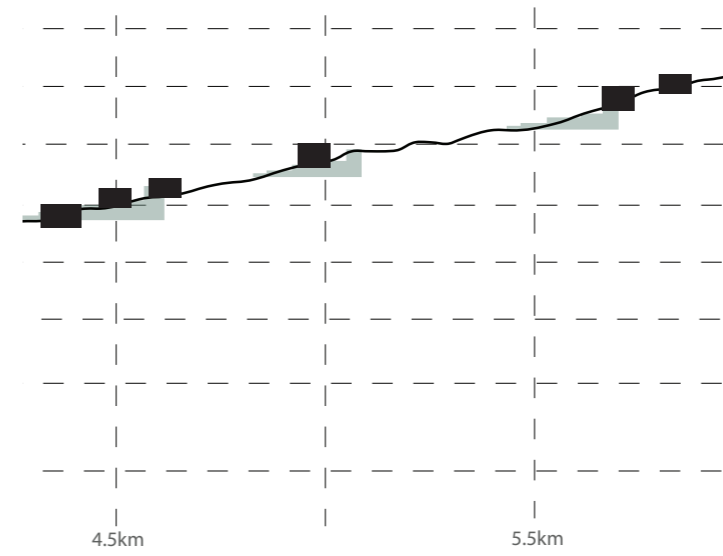
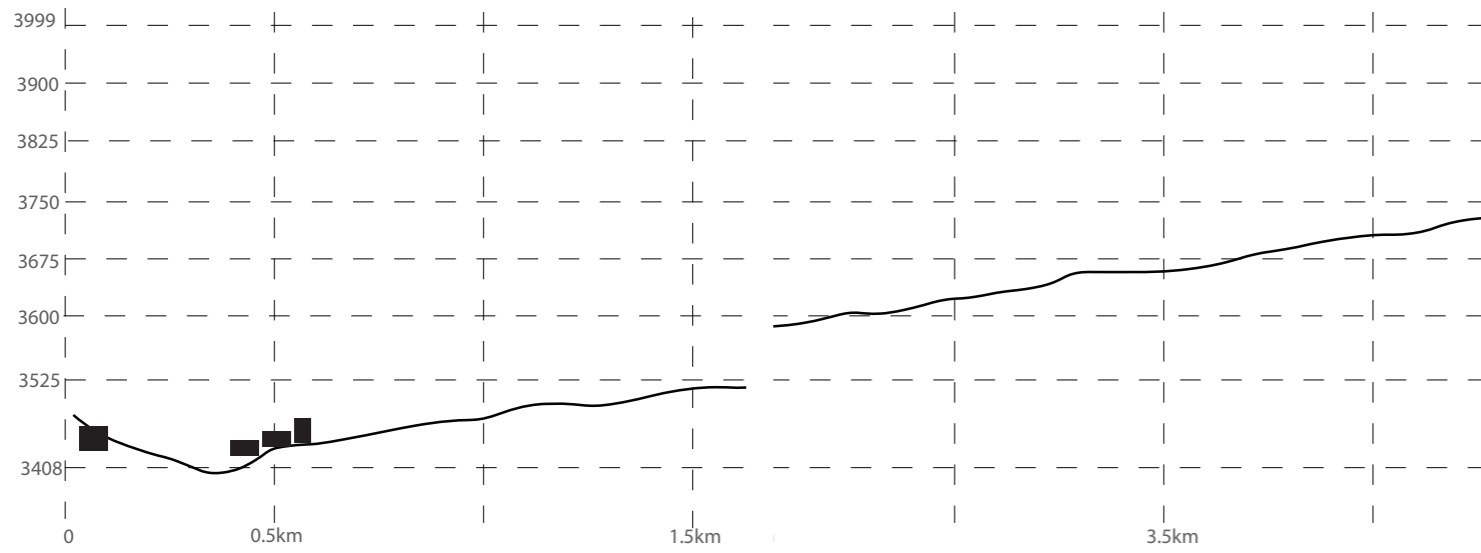
Newly built road leading to lowest part of village

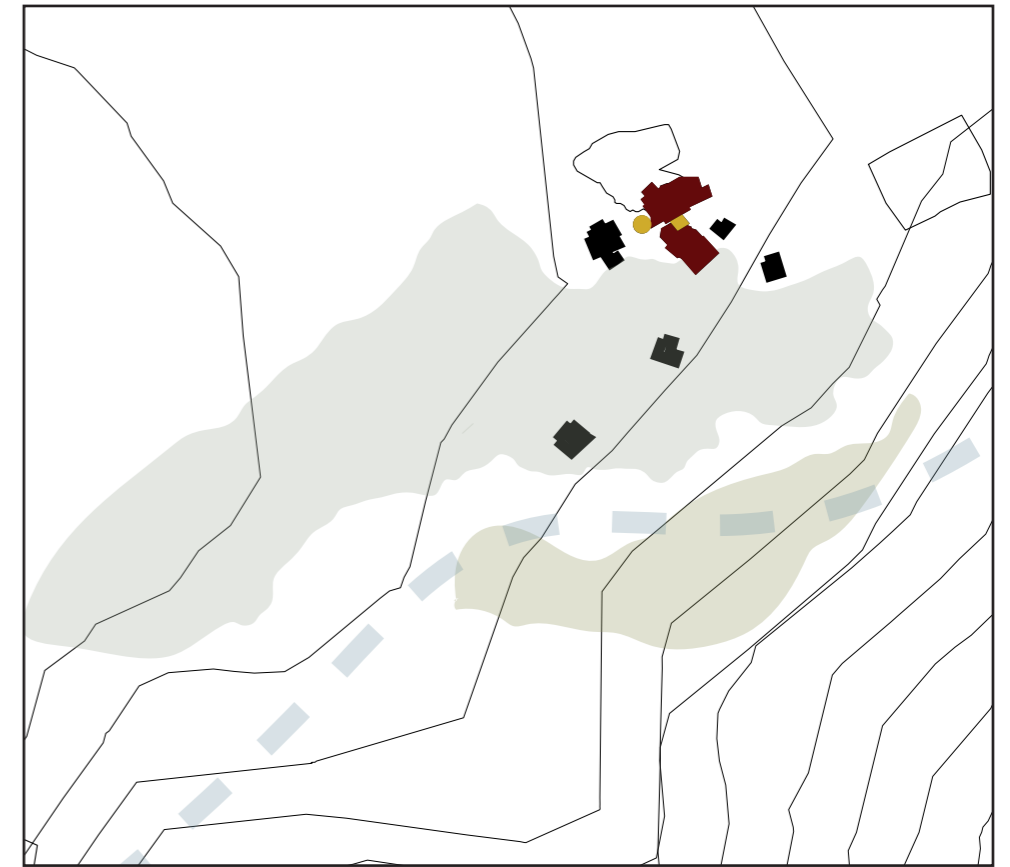
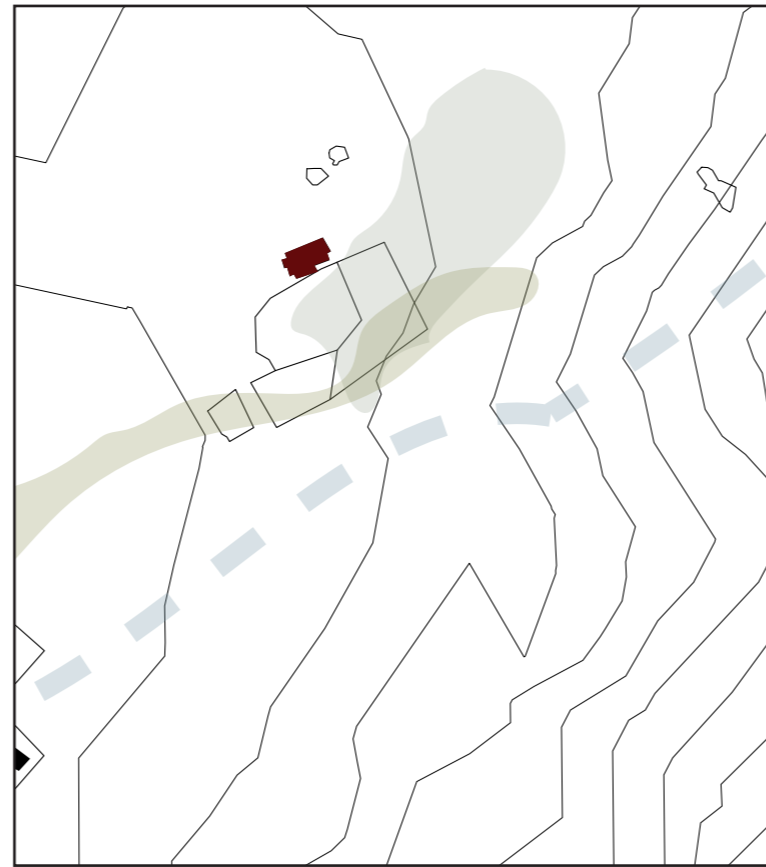
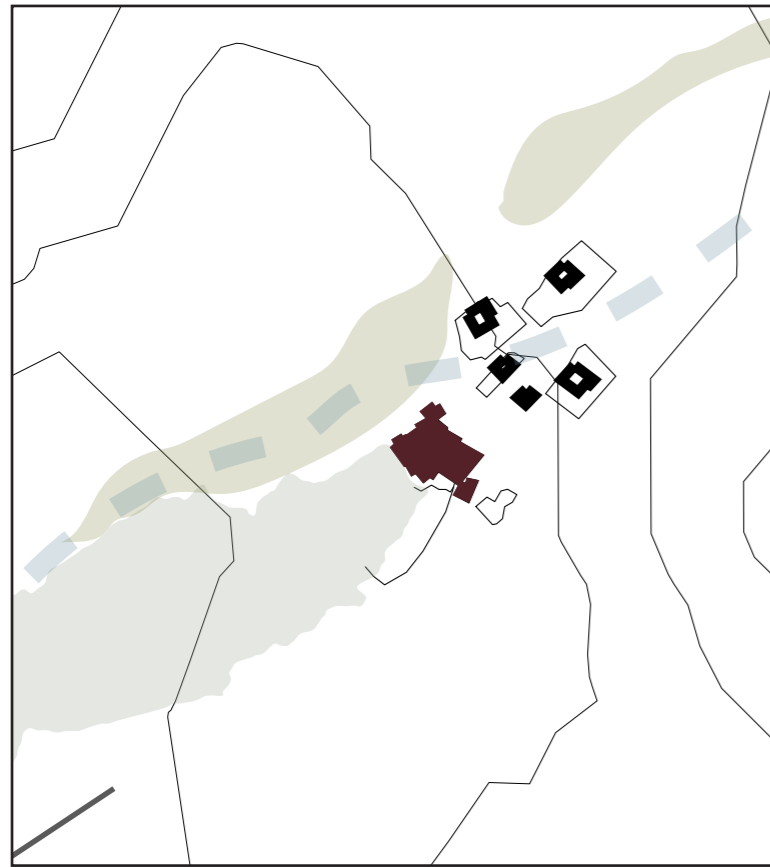


Kulum

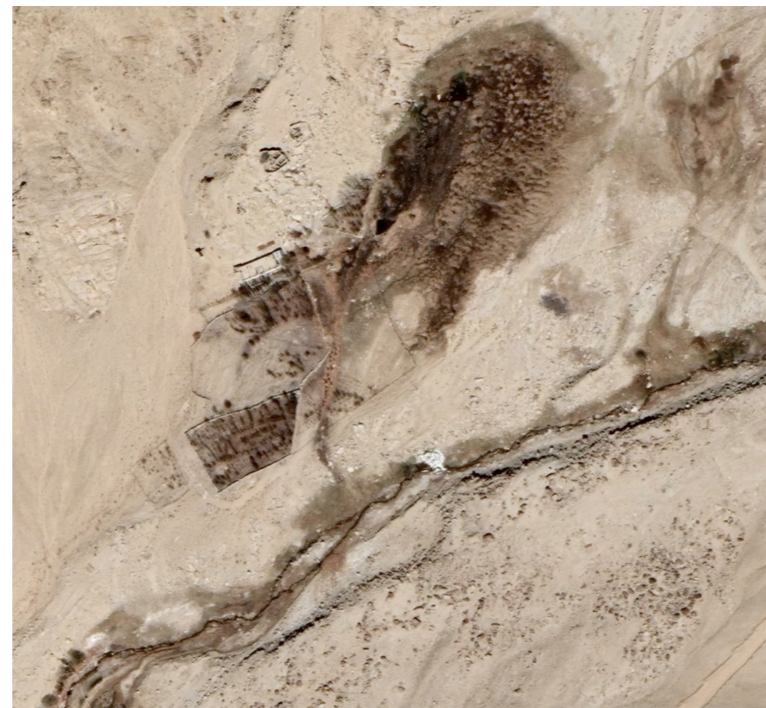


Way to Glaciers/Ice stupa





Lower Village/ More inhabitants because of access road

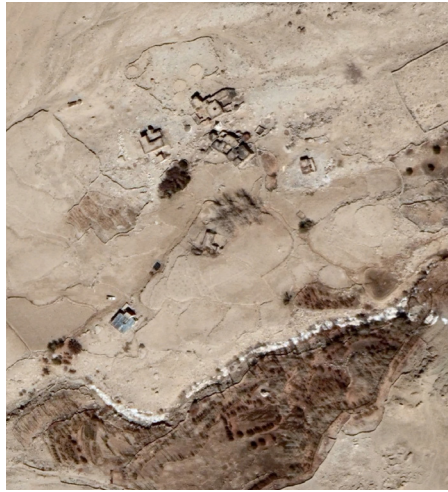


Abandoned middle village because of depleted agricultural land

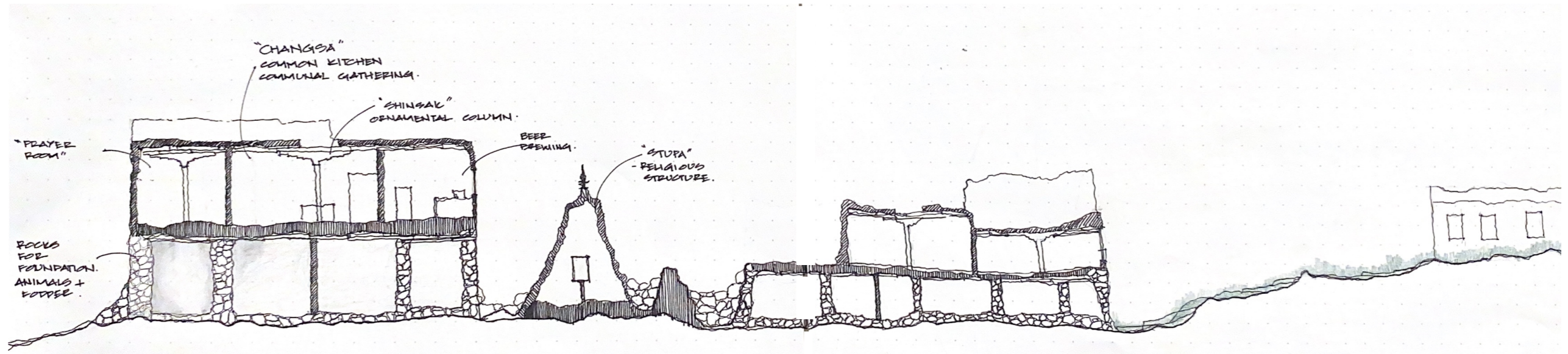


Upper Village with active agriculture, older homes, not very easy access

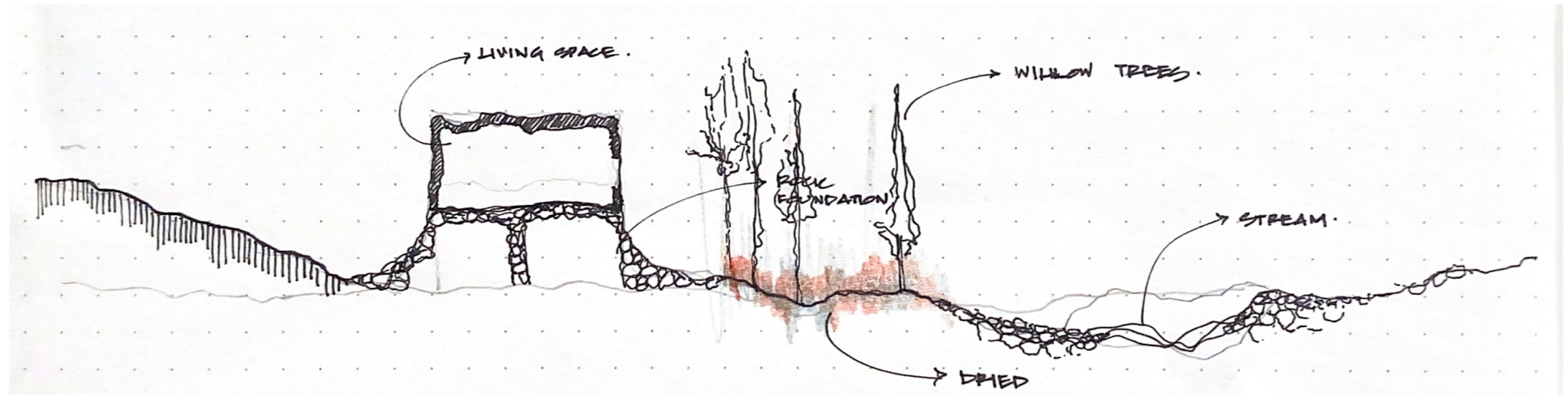
- New and Inhabited*
- Old and Uninhabited*
- Religious Structures*



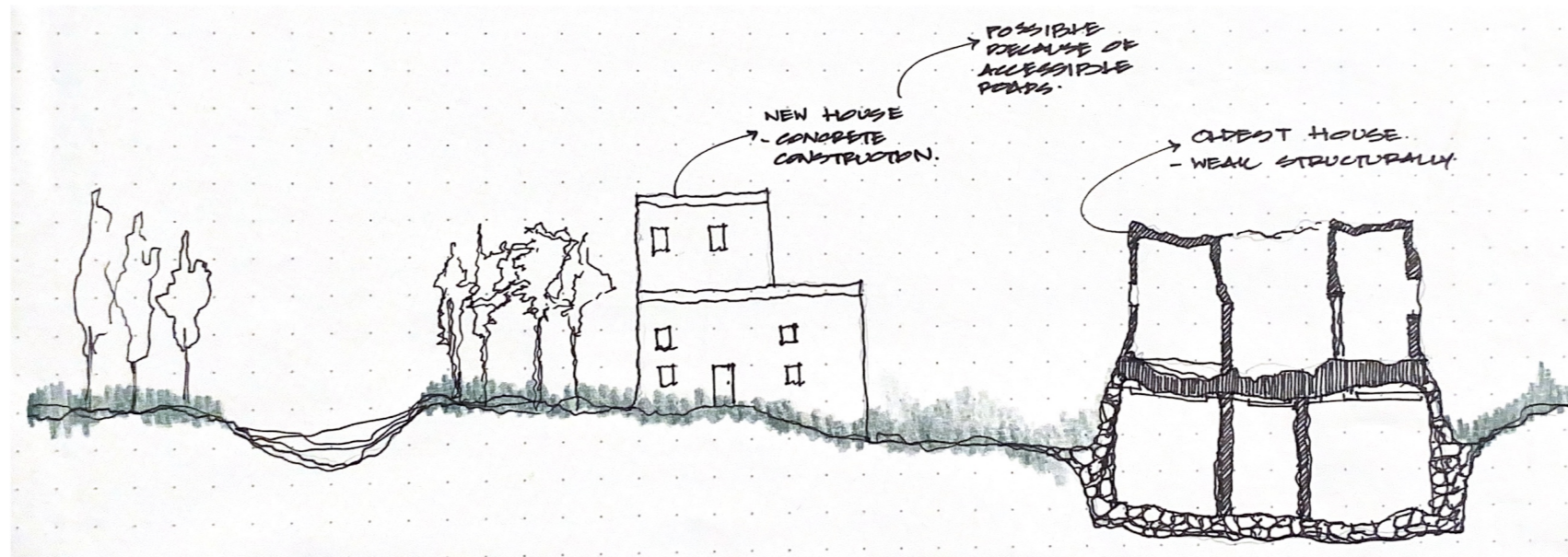
Upper Village | Older and Abandoned

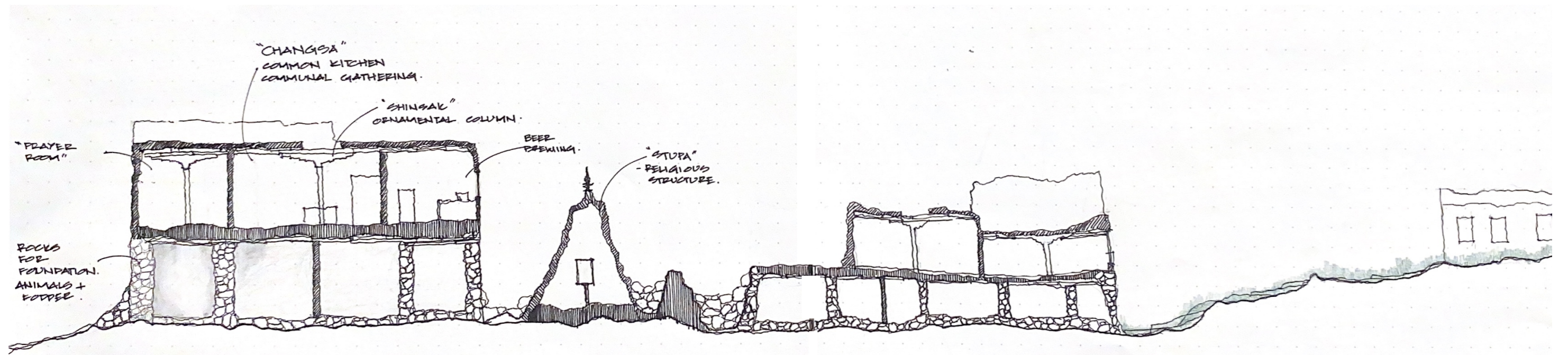


Middle Village | Abandoned and only footprints of homes left



Lower Village | Inhabited and more modern construction because of road access





Basement for cattle, fodder, and granaries

Upper Courtyard where people would potentially get together

Main fireplace room or changsa

Low windows and low heights characterise the spaces and are important to keep warm in the cool months

Prayer rooms are key in every house and timber for ornamentation is used based on economic viability

PART-C

RESULTS

XI.A. Typical agricultural timelines and tendencies

Broadly speaking, agriculture in Ladakh operates across four main seasons-

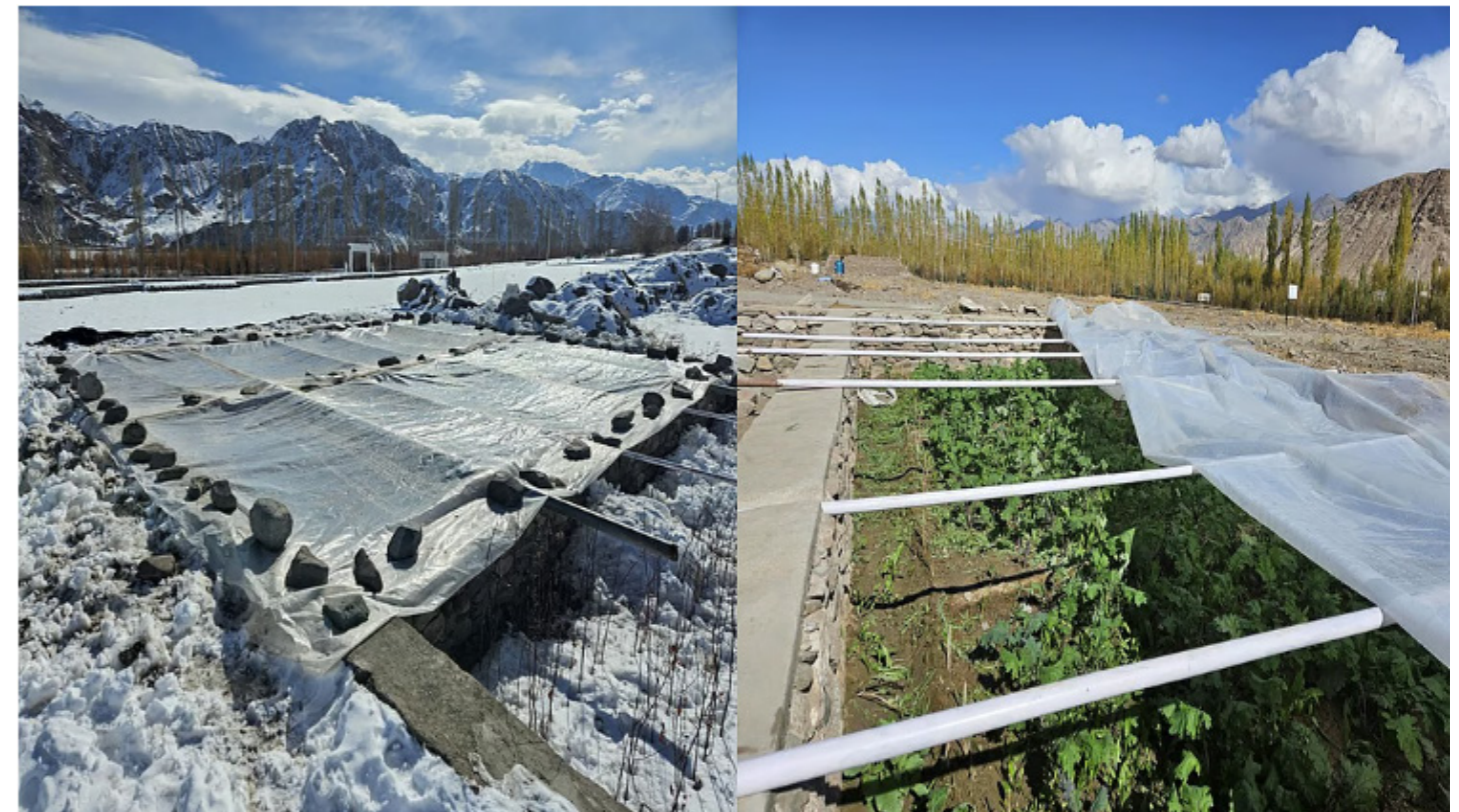
- 1) **October-March** - storing season/ winter/ minimal agriculture/ getting ready for the summer
- 2) **April-May** - sowing season/ peak agricultural labor
- 3) **June-August** - active cultivation/ busiest season
- 4) **September** - harvest season/ storage

1)October-March/ Tendencies

Open-field agriculture completely halts during these months as the ground freezes and irrigation canals (kuhls) ice over.

XI. Results

Something that became very clear to me after the research and site analysis, was that Kulum's lifestyle is governed mainly by agricultural seasons. This meant that the village (like many villages in Ladakh) adapts its physical surroundings based on the sowing, harvesting, cultivation or storing seasons. In broader terms, this means that the village would contract in the winter seasons and expand in the summer seasons. These shifting agricultural timelines then become the basis for informing various design strategies that adapt to seasonal needs. In the following chapters, I first conduct a seasonal analysis based on agricultural timelines, then I investigate various processes within these seasons which is then used to propose adaptable design strategies.



Agricultural conditions in the winter
Source- <https://www.downtoearth.org>.

- **Greenhouse Cultivation:** Traditional farming is replaced by specialized Ladakh Winter Greenhouses (often trench-style or polycarbonate). These structures maintain internal temperatures 20°C higher than the outside, allowing for the growth of freeze-tolerant leafy greens like spinach, Swiss chard, coriander, and kale.
- **Transition to Stored Food:** Agriculture becomes a matter of management rather than growth. Families rely on “sun-dried” stores from the September harvest, including dried apricots, apples, and vegetables, alongside roasted barley flour (tsampa).
- **Livestock Husbandry:** With grasslands covered in snow, agricultural work shifts to stall-feeding livestock with alfalfa and fodder harvested in late summer.
- **Greenhouse Preparation (March):** As March approaches, these greenhouses are used to raise vegetable seedlings (tomatoes, cabbage) for 1-1.5 months before they can be transplanted into open fields once the ground thaws in April.

In Ladakh, seeds for the upcoming sowing season are stored in specialized architectural compartments within the home or in high-altitude communal facilities to maintain their viability through the winter. In vernacular Ladakhi architecture, seeds are typically kept on the ground floor or in a dedicated cold-storage area that utilizes the earth’s natural insulation.



Sowing Season
Source- <https://commons.wikimedia.org/>

2) April-May / Tendencies

The months of April and May represent a pivotal “thaw” period where architectural usage shifts from a survival-oriented winter mode to an active agricultural spring mode. This marks the main sowing season and is accompanied by various festivals to celebrate the same.

- **Kuhls (Canals):** Small canals or nala are integrated into the property layout. In April and May, these are cleared of winter debris to allow glacier meltwater to reach the fields and the house’s internal hand pumps.
- **Greenhouse Synergy:** For many households, passive solar greenhouses (often built with three mud-brick walls and a south-facing slope) are critical in April. They are used as off-season nurseries to raise seedlings for 1-1.5 months before they are transplanted into open fields in late May or June.

3) June to August/ Tendencies

These months are the core of the single-cropping season, where survival depends on managing scarce water and maximizing the brief heat.

- **Glacial Irrigation (Kuhls/Yuras):** As the summer heat peaks, glaciers supply vital meltwater. Communities collectively manage stone-lined canals (Kuhls) to ensure equitable distribution to terraced fields.
- **Active Maintenance:** Farmers focus on weeding, earthing up root crops (carrot, radish), and top-dressing vegetables like brinjals and chillies.
- **Summer Vegetable Glut:** During August, there is a “glut” of fresh farm produce. Open fields yield tomatoes, cabbage, cauliflower, and carrots, while apricots reach peak ripeness for picking.
- **Horticulture Harvest:** Harvesting of temperate fruits like apricots (Chuli), plums, and peaches typically completes by late August.



Sowing Season
Source- <https://commons.wikimedia.org/>

4) September/ Harvest Season/ Storage

September is the most critical month of the year, marking the end of the agricultural season before the first frosts.

- Principal Crop Harvest: The region's staple crops—Barley (Nas) and Wheat—are harvested from August through October, peaking in September.
- The Ladakh Harvest Festival: Held annually from September 1-15, this festival celebrates the season's bounty with traditional archery, masked dances, and music across Leh and Kargil.
- Solar Drying & Storage: This is the primary window for "sun-drying" fruits (apricots, apples) and vegetables to ensure food security for the 6-month winter. Alfalfa and grass are harvested and stored as fodder for livestock.
- Rabi Preparation: In early September, nurseries for "Rabi" (winter) vegetables like Chinese cabbage, lettuce, and kale are sown in passive solar greenhouses to provide fresh greens during the sub-zero months



A photograph of my time in Kulum hiking up the mountains with my colleagues to maintain the ice stupa

XI.B. Seasonal analysis/Kulum

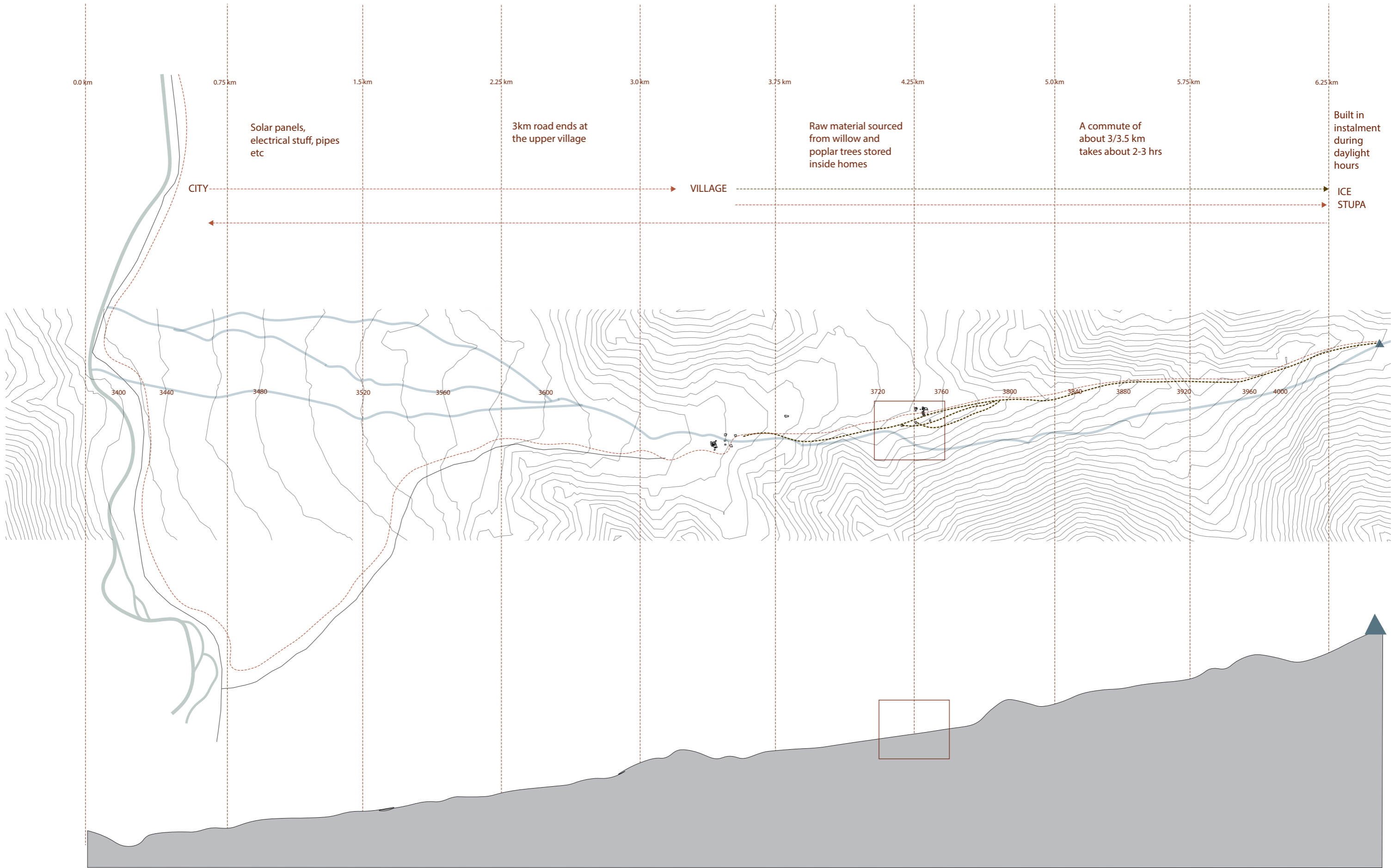
In this chapter, I conduct a seasonal analysis based on agricultural seasons (previous chapter) in Kulum. I explore three broad aspects- agricultural patterns, architectural (and occupational patterns), user groups. These seasonal patterns then eventually help in narrowing down the design decisions both urban and architectural. The overarching theme is that the village contracts in the winter and becomes a place for community gathering and preparing for the agriculture intensive summer wherein it expands and becomes largely production oriented. I attempt to map these patterns so as to understand the relationships between various systems seasonally.

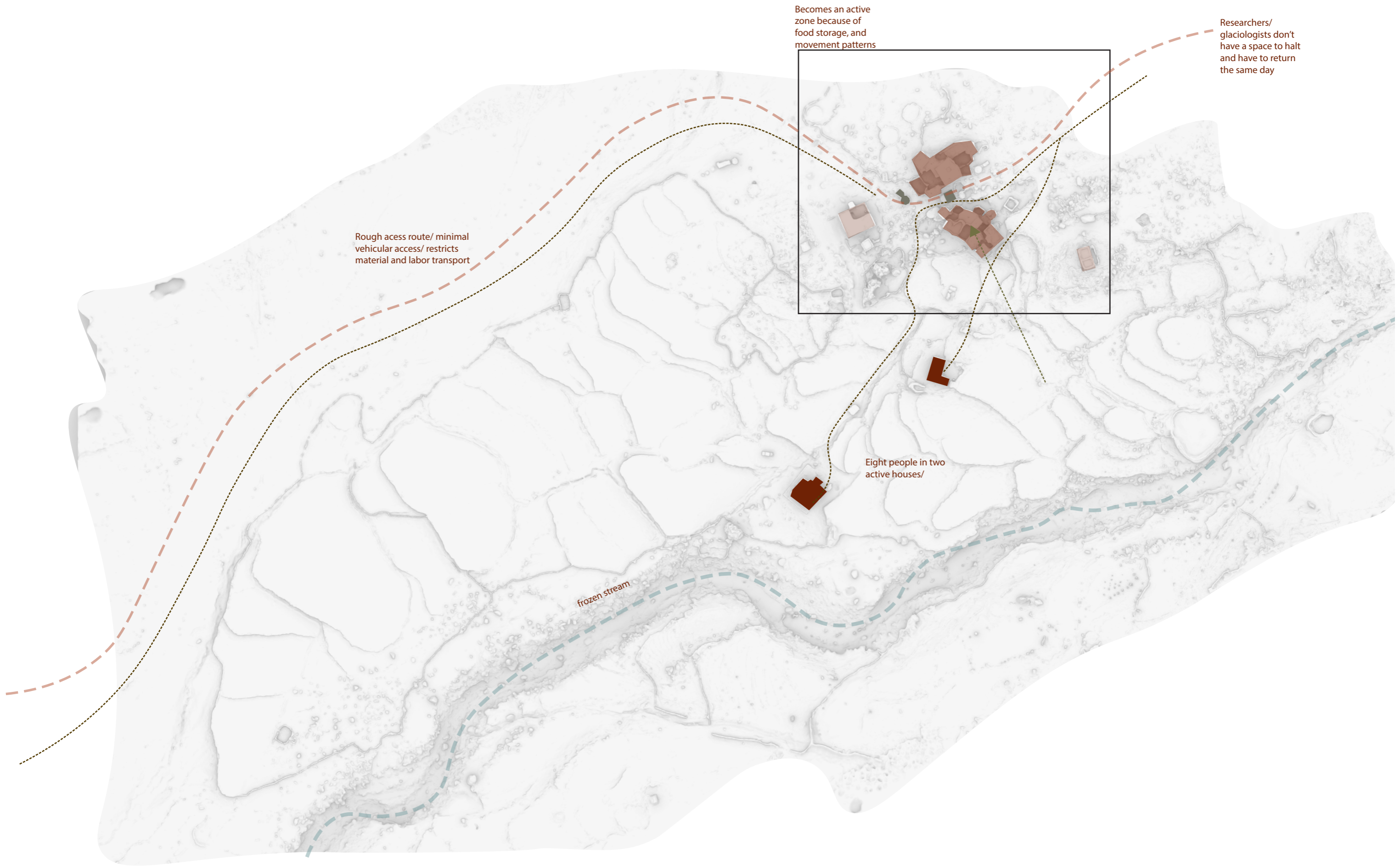
a). The winter months (October to March) is analysed on a larger scale from the lowest point of the main Indus river to the highest point which is the ice stupa or artificial glacier. These months are characterized by an increase in communal activities, preparing for the agricultural season in the summer and a new dimension in Kulum which is preparing and maintaining the ice stupa or artificial glacier so that the village gets water in the sowing season. These conditions result in a new demographic group of locals and researchers that help set up the ice stupa. This is a process that involves carrying material relevant for the maintenance of the ice stupa from the cities to a high altitude of 4000m in the cold winter months. Since the daylight hours are minimal in the winters, this would mean that the entire set up process would have to be done fairly quickly and because there are no resting stops in the journey, one has to carry the material via manual labor. Architecturally, active spaces are limited and only the basements are used to source food supplies and the main changsa for people to collectively live together.

b). The sowing season (April- May) is when the water from the ice stupa is released which coincides just in time for the sowing. This water is directed via drip irrigation pipes onto the field and now the villagers became extremely active on the farms and start preparing for the busy upcoming summer season. This also a time when researchers and volunteers (like myself previously) would step in to help out because the locals are now having to mold their agricultural practices. This is to make them self reliant again as soon as possible. Architecturally, more spaces start becoming habitable and the village begins to programmatically expand.

c). The cultivation and harvesting season (June to September) is very busy in terms of the number of people coming in to Kulum, agricultural activities and communal interactions. This is a time when the villagers can maximise their economic benefits via agricultural produce and earning a nominal fee from trekkers who would sometimes use Kulum as a base camp before climbing upwards. The architecture becomes completely active with every space from the basement to the roof being used for production or living. Therefore, a clear systemic link between living and production systems arises across various seasons which eventually becomes the basis for the design concept.

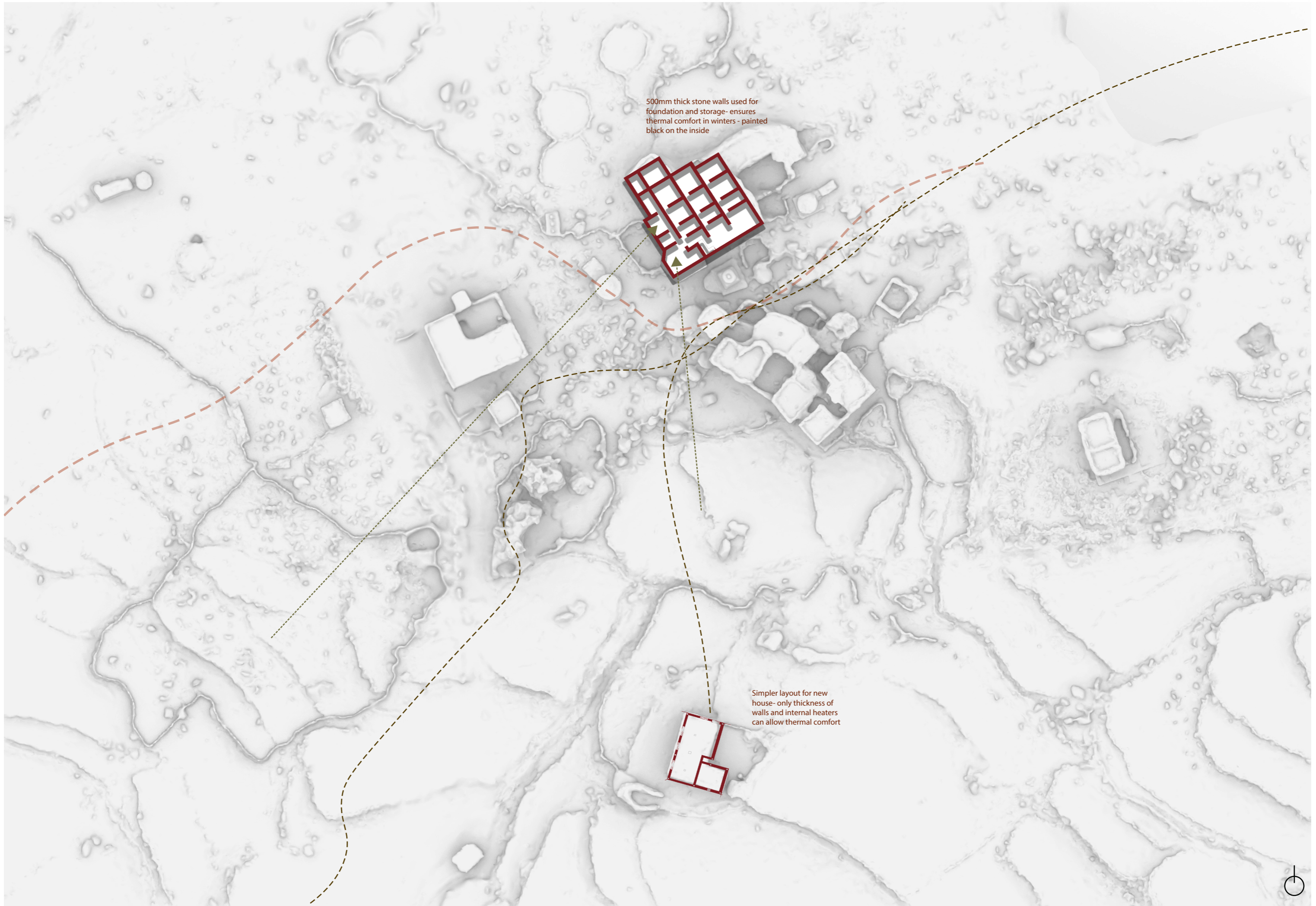
The subsequent maps show a seasonal analysis decoding living, agricultural and glacial systems.





OCT-MAR
 Highs: -6.5°C to -15.5°C
 Lows: -17.5°C to -27°C
 Snow: Light-moderate accumulation; persistent from Nov onward; 10-30 cm typical





500mm thick stone walls used for foundation and storage- ensures thermal comfort in winters - painted black on the inside

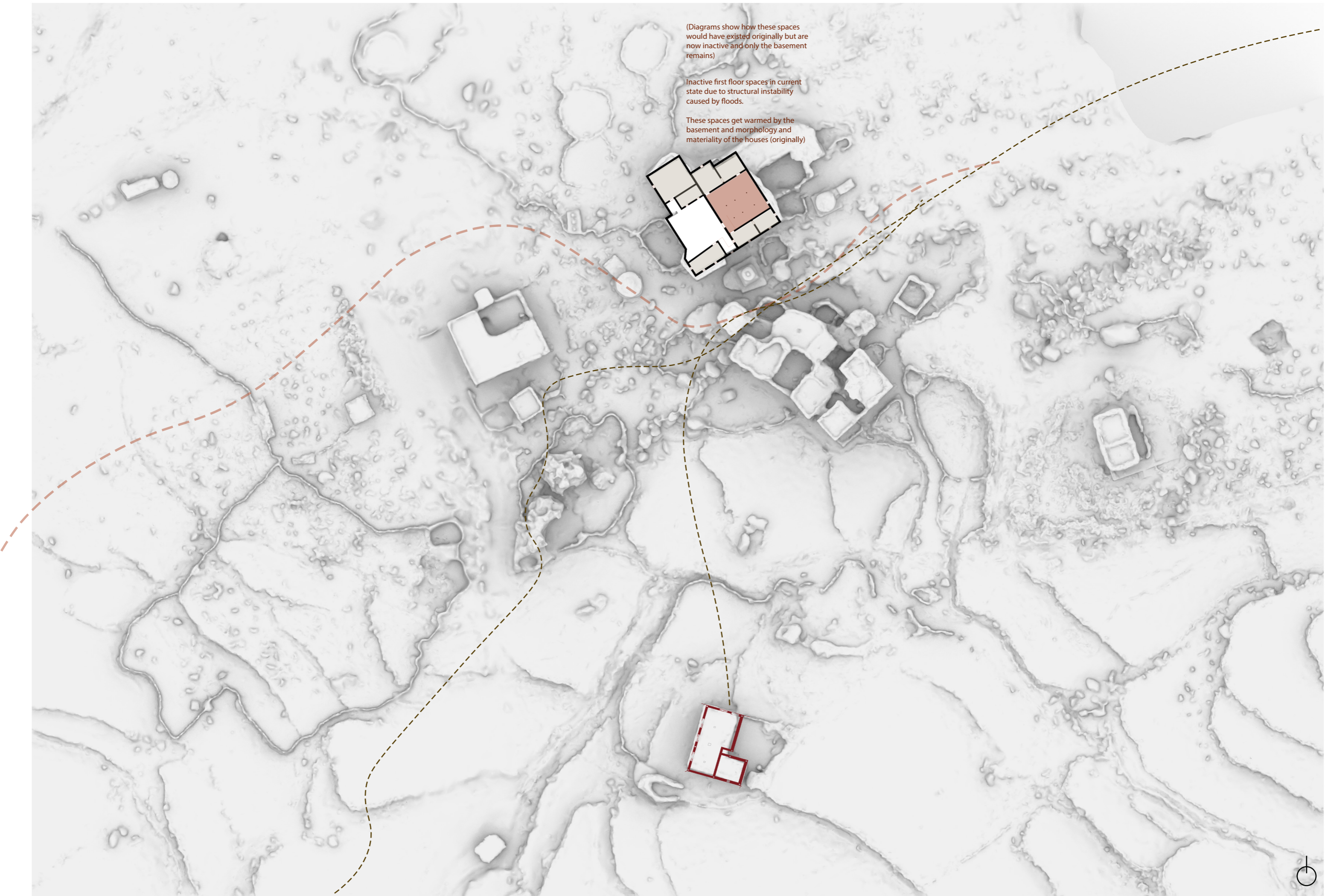
Simpler layout for new house- only thickness of walls and internal heaters can allow thermal comfort

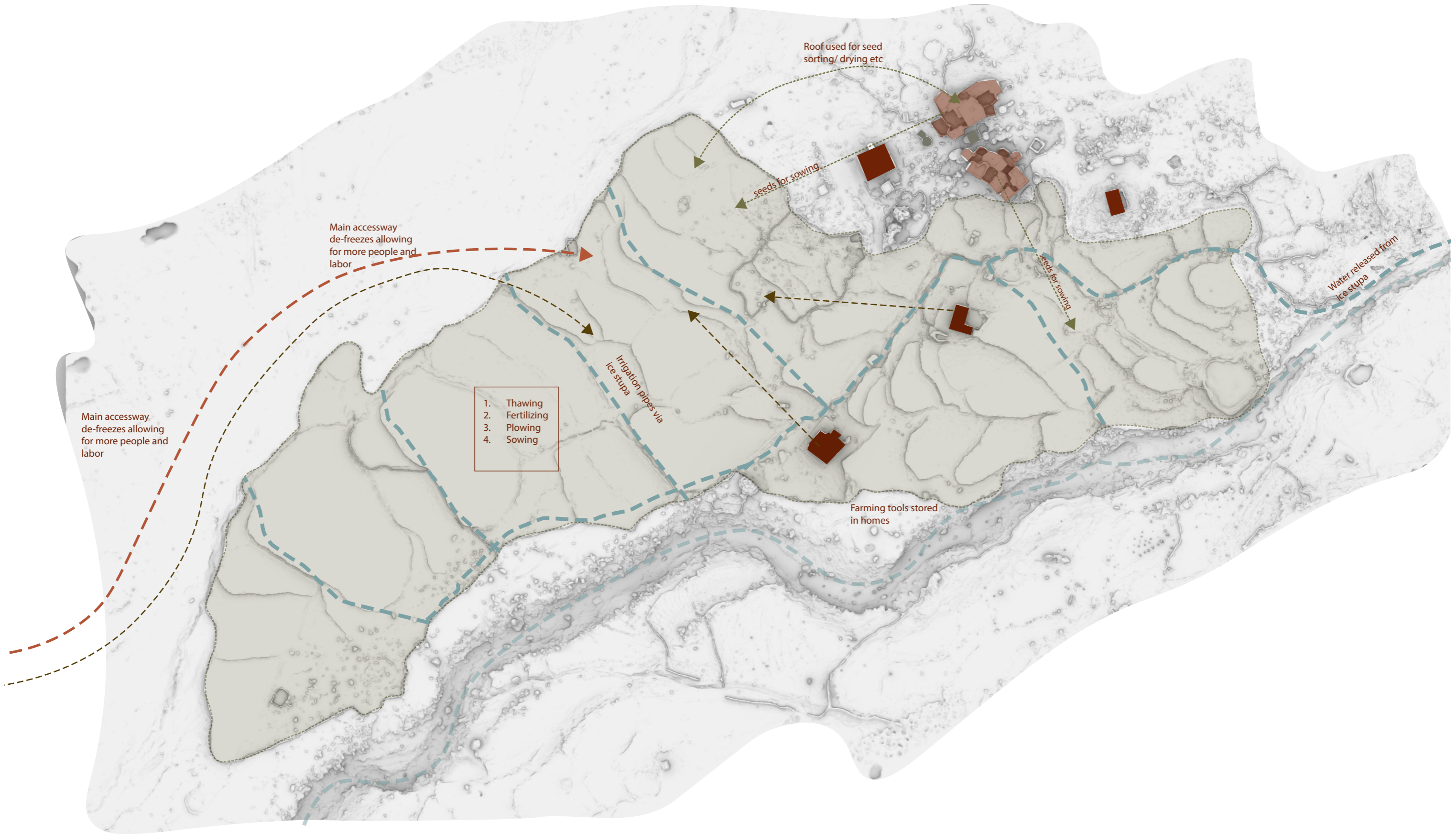


(Diagrams show how these spaces would have existed originally but are now inactive and only the basement remains)

Inactive first floor spaces in current state due to structural instability caused by floods.

These spaces get warmed by the basement and morphology and materiality of the houses (originally)



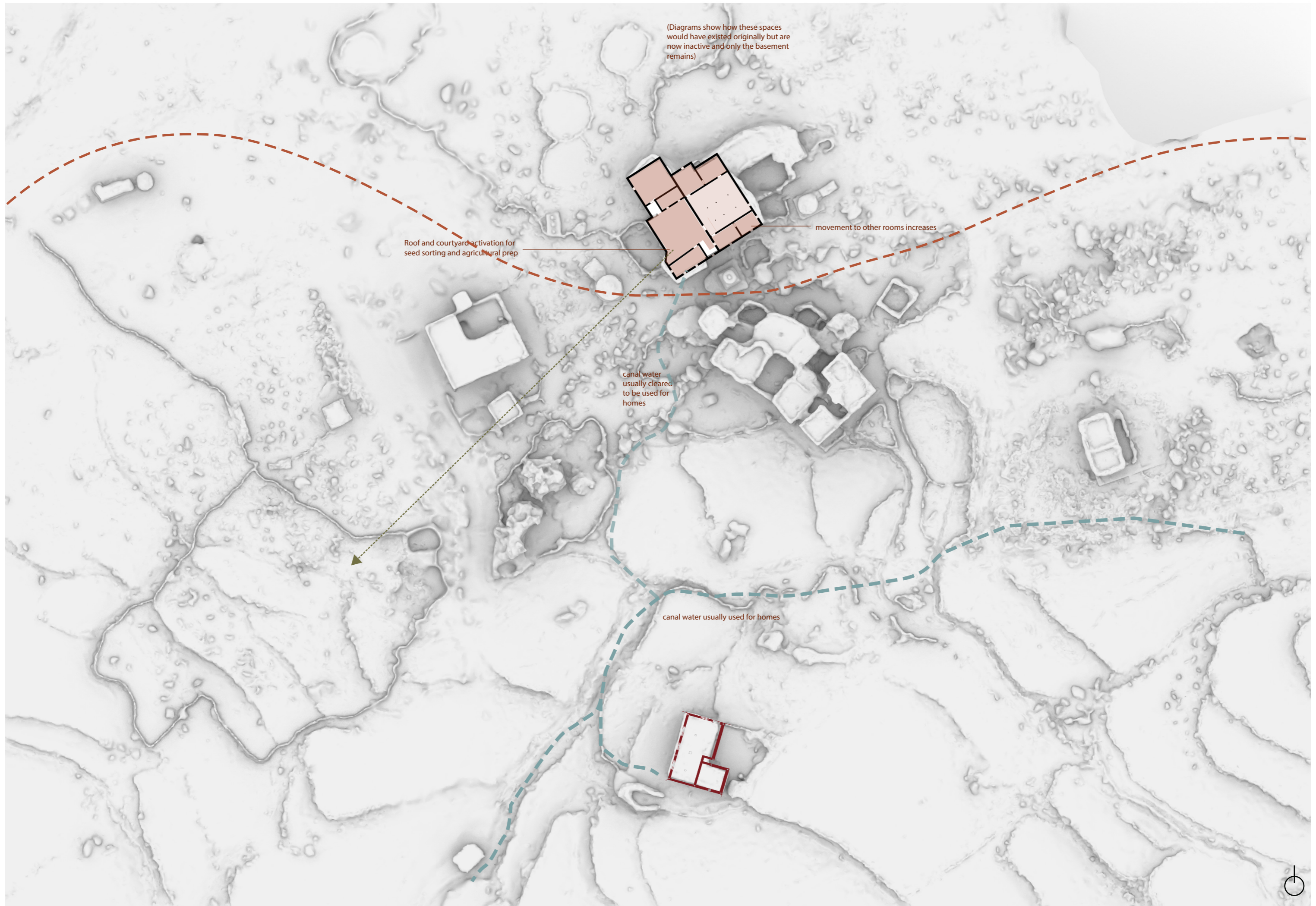


APR - MAY (sowing season)

Highs: 10°C to 22°C
 Lows: -2°C to -5°C
 Daylight- 13-14hrs



(Diagrams show how these spaces would have existed originally but are now inactive and only the basement remains)

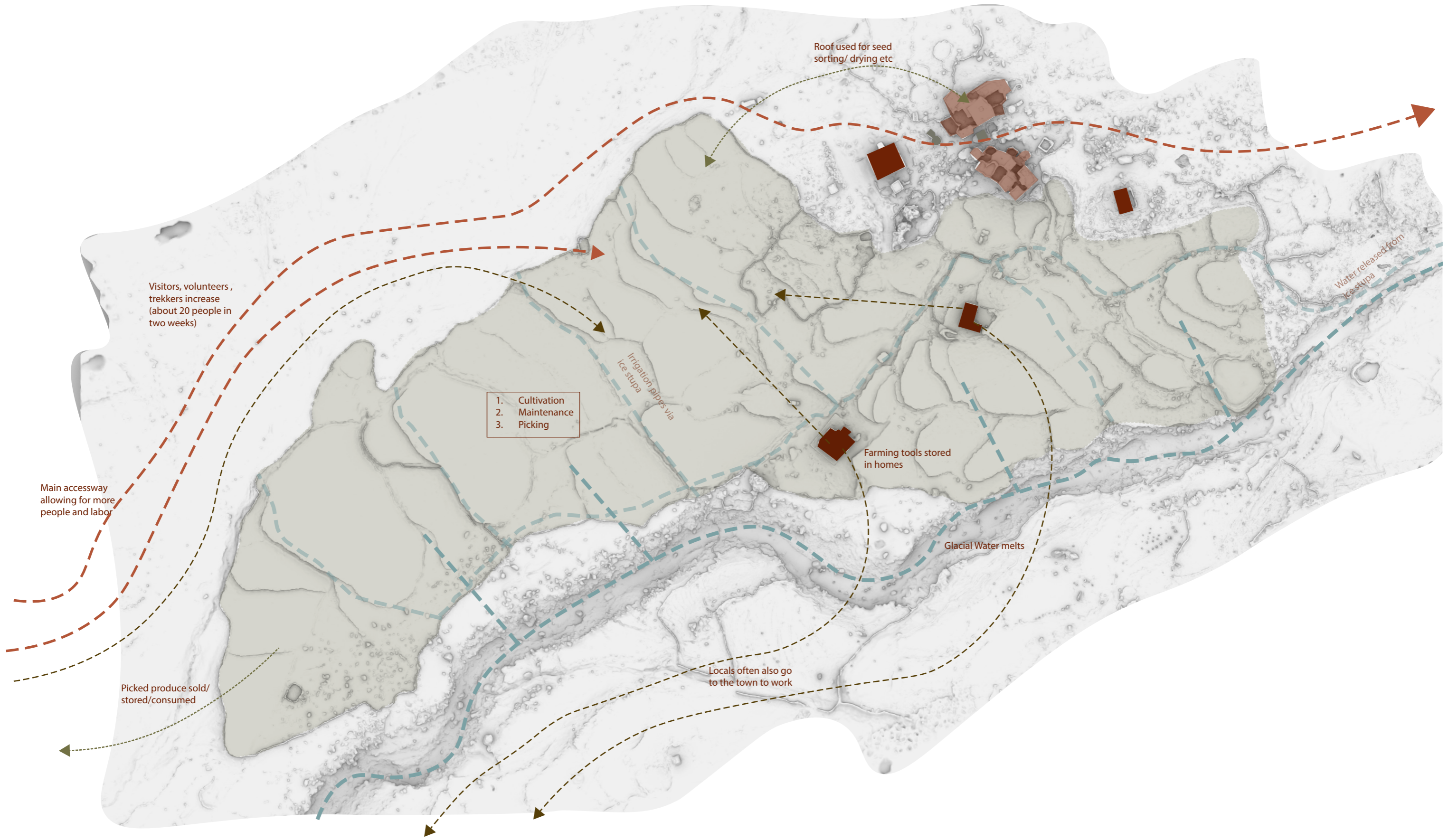


Roof and courtyard activation for seed sorting and agricultural prep

movement to other rooms increases

canal water usually cleared to be used for homes

canal water usually used for homes



JUN-AUG (Active cultivation season)
 Highs: 20°C to 28°C
 Lows: 7°C to 9°C
 Daylight: 14-15hrs





(Diagrams show how these spaces would have existed originally but are now inactive and only the basement remains)

Roof and courtyard activation for seed sorting and agricultural prep

movement to other rooms increases

canal water usually cleared to be used for homes

canal water usually used for homes

XI.C. Decoding seasonal processes of production and living

The seasonal analysis helped me understand the ways in which Kulum would morph agriculturally and architecturally every couple of months. Living is never static and is closely tied to production patterns. The interesting aspect about Kulum which is not typical to traditional Ladakhi villages is this new production system of the “ice stupa” or the artificial glacier (explained in previous chapters) that has imprinted itself upon existing living and production patterns. Therefore, an architectural proposal needs to facilitate and mediate these new patterns in order to enable a holistic restoration.

This necessitates a decoding of these processes to understand where exactly could architecture intervene.

1) The Ice Stupa process

Traditionally, ice stupas are built by assembling a conical structure made of soil, rope and grass. Water from a nearby stream is fed into the stupa through a pipe. This can be done either from below (fountain-style) or the top (sprinkler-style), which allows the sprinkled water drops to instantly freeze and form a tiny ice tower. In the summers, the ice stupa starts to melt, and villagers divert the water to their farmlands. Chewang Norphel, an 88-year-old retired civil engineer from Leh, also known as the Ice Man, popularised the concept of artificial glaciers in the cold desert. Since the 1990s, a number of NGOs have built these ice structures in Ladakh. Sonam Wangchuk, an innovator and engineer, introduced ice stupas, which, unlike artificial glaciers, are vertical ice towers. These have become popular in Ladakh in the past decade.

However, traditional ice stupas tend to require a lot of human labor in cold months to ensure the water in the pipes does not freeze over. Therefore, many associations such as the Acres of Ice have initiated projects that automate this process via solar power and automatic valves to ensure the water is not released during freezing temperatures. These valves are also connected via mobile applications so as to ensure remote calibration and minimal manual labor by the locals. While this might need an initial level of infrastructural intervention (example- weather station, valves, pipes)- it is a long term investment to ensure a sustainable and self-reliant future.



How are ice reservoirs built?



Step 1

Pipeline connects the ice stupa to a source on higher ground, drawing water downhill.



Step 2

A fountain system sprays freezes water on a domed structure.



Step 3

As ice accumulates, more piping can be added to increase the height of the structure.



Step 4

Drip-irrigation systems distribute their meltwater.



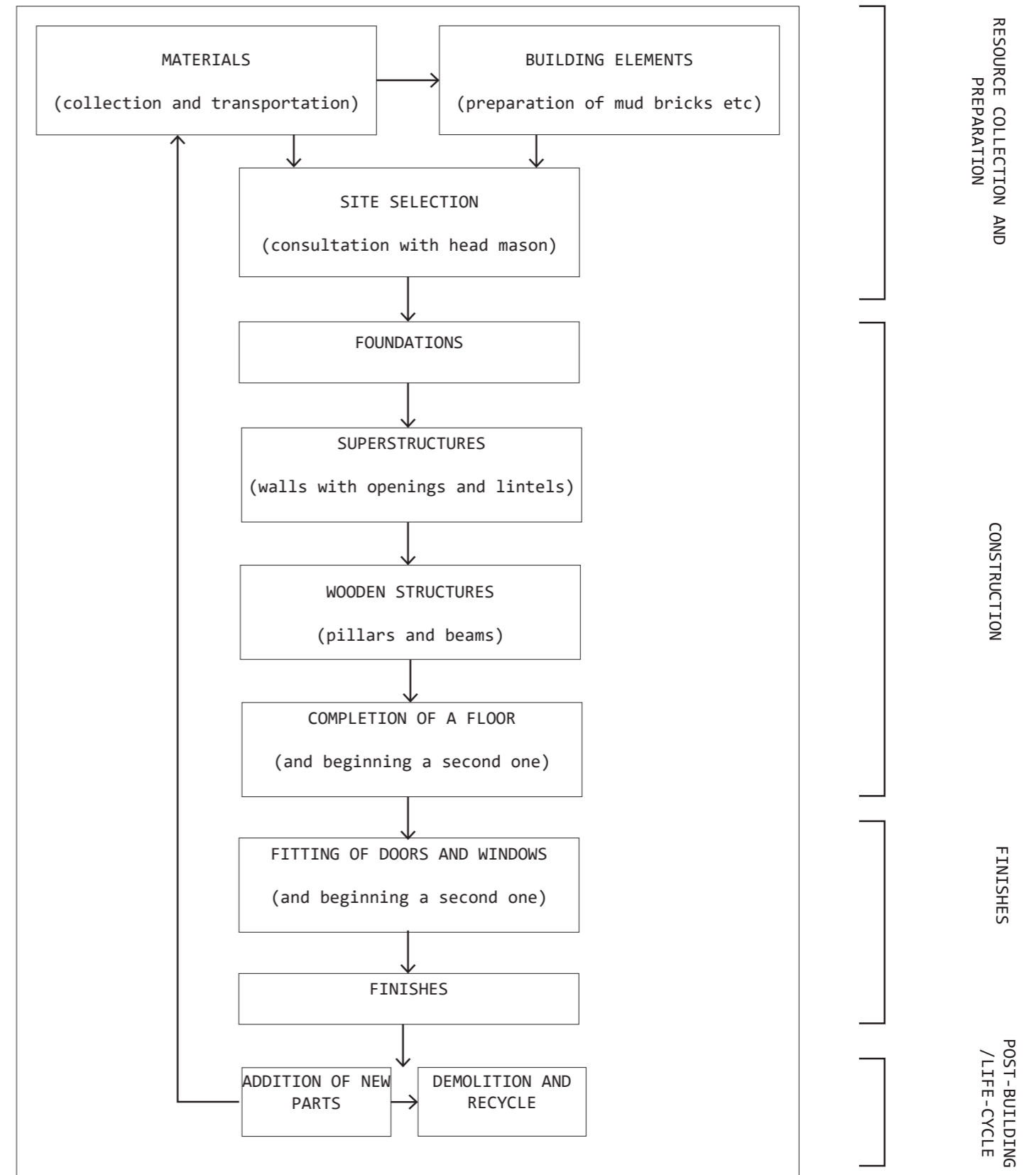
The artificial glacier process
Source- acresofice.com

2) Typical Ladakhi Vernacular Construction Processes

Construction in Ladakh is a tricky balance between functionality, production and the harsh environment. This is translated as a certain programmatic layout that facilitates communal living and shared production--that molds itself as per the terrain. Through this thesis, beyond my extensive personal experiences in Ladakh, my conversations with Edoardo Paolo Ferrari and his detailed documentations of living in Ladakh have been fundamental in understanding construction methodologies and philosophies. This is a paragraph from his book "High Altitude Houses-Vernacular Architecture of Ladakh"-

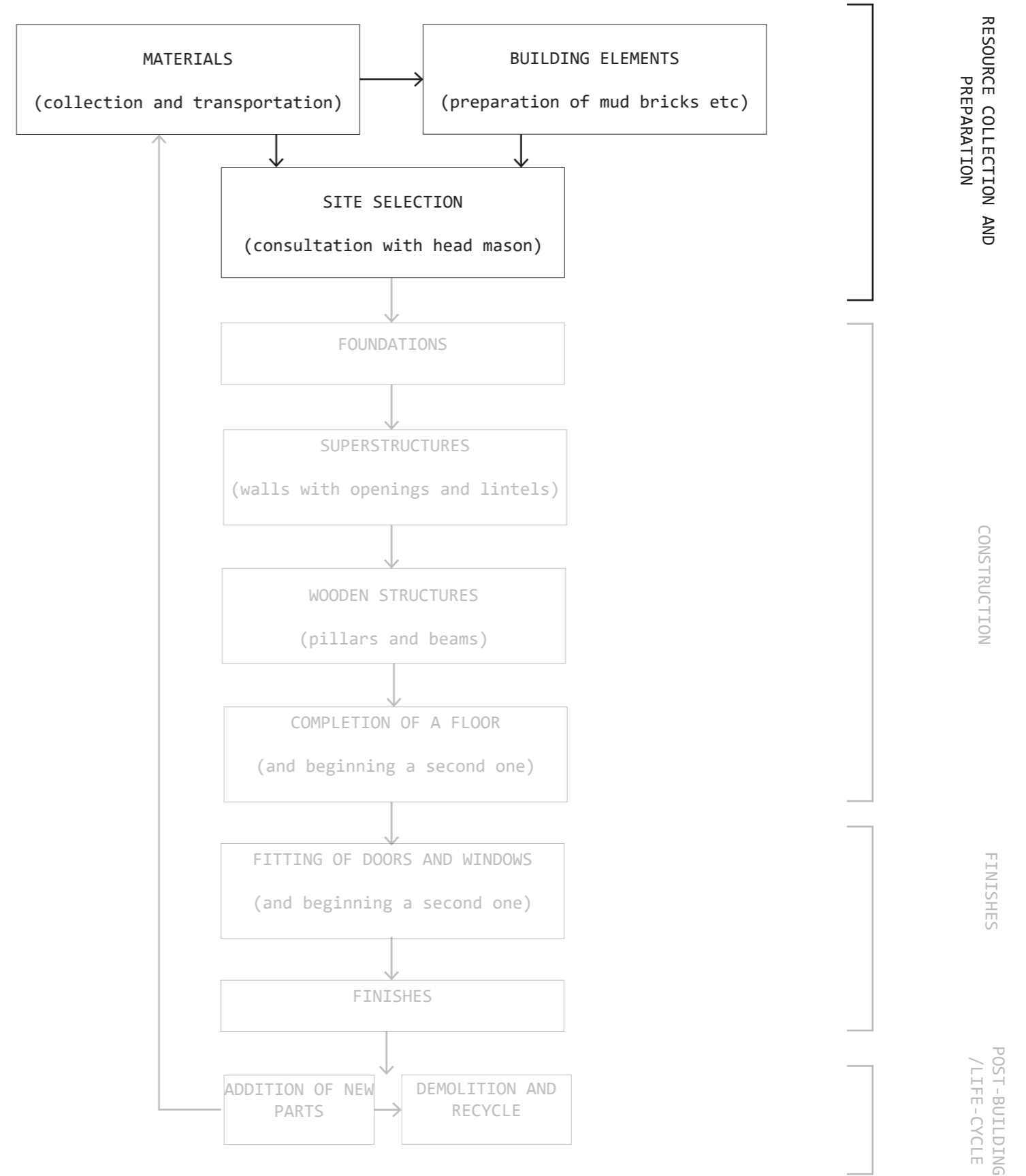
"The house is the family ground, the 'inside' and the first production unit, while being the hinge for most social activities. The house in Ladakh had been the centre of life because of the absence of any other civil structure. The main social gathering events like births, weddings and death ceremonies take place in it. Furthermore, the house had been the anchor for the family, establishing a direct connection with the ancestors. The house is a microcosm which embodies the universe and its parts, a world in miniature often thought of as a square pointing to the four main directions. The house form, shaped during centuries by a lifestyle that was inseparable from the land products and the herds, has been reshaped mainly in the last four decades. Dwellings are made of a series of rooms that are not only for the family members, but especially made for the products stored and animals kept, a feature mirrored in particular in the old ones, whose inhabitants relied only on farming. Houses usually had two to three storeys, while today new constructions often have only the ground floor. Family members often shared a single room, the fireplace room. There used to be no specific rooms for each family member, since space was scarce and collective life was common. Socially, being alone was not even considered polite in many cases. It is in summer that family members sleep in different parts of the house, including the rooftop, freed from the restrictions of the cold weather."

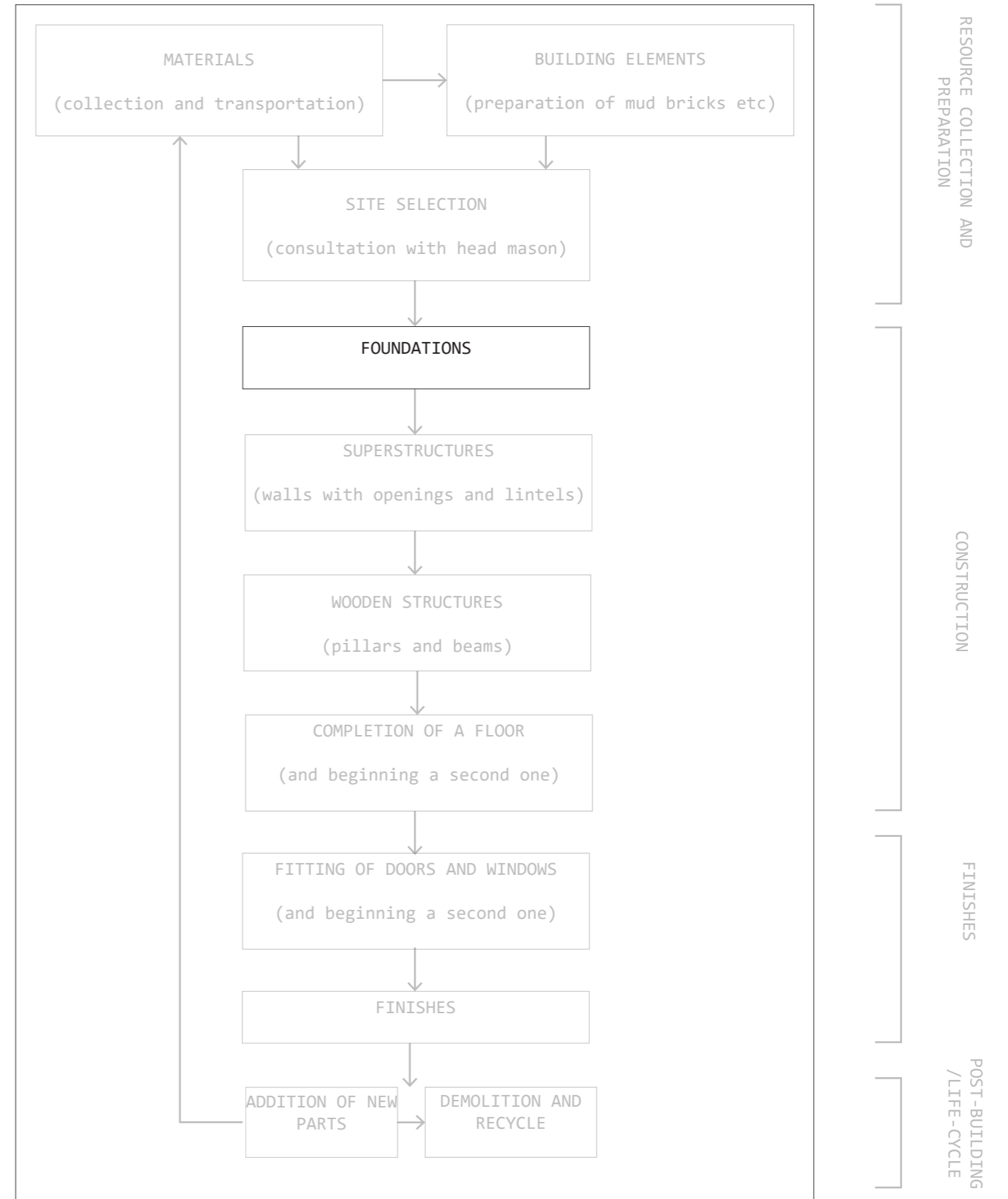
At its core, a Ladakhi house is a unique combination of production and living. These are two entities that are constantly intertwined and is a dynamic that is not commonly observed elsewhere.



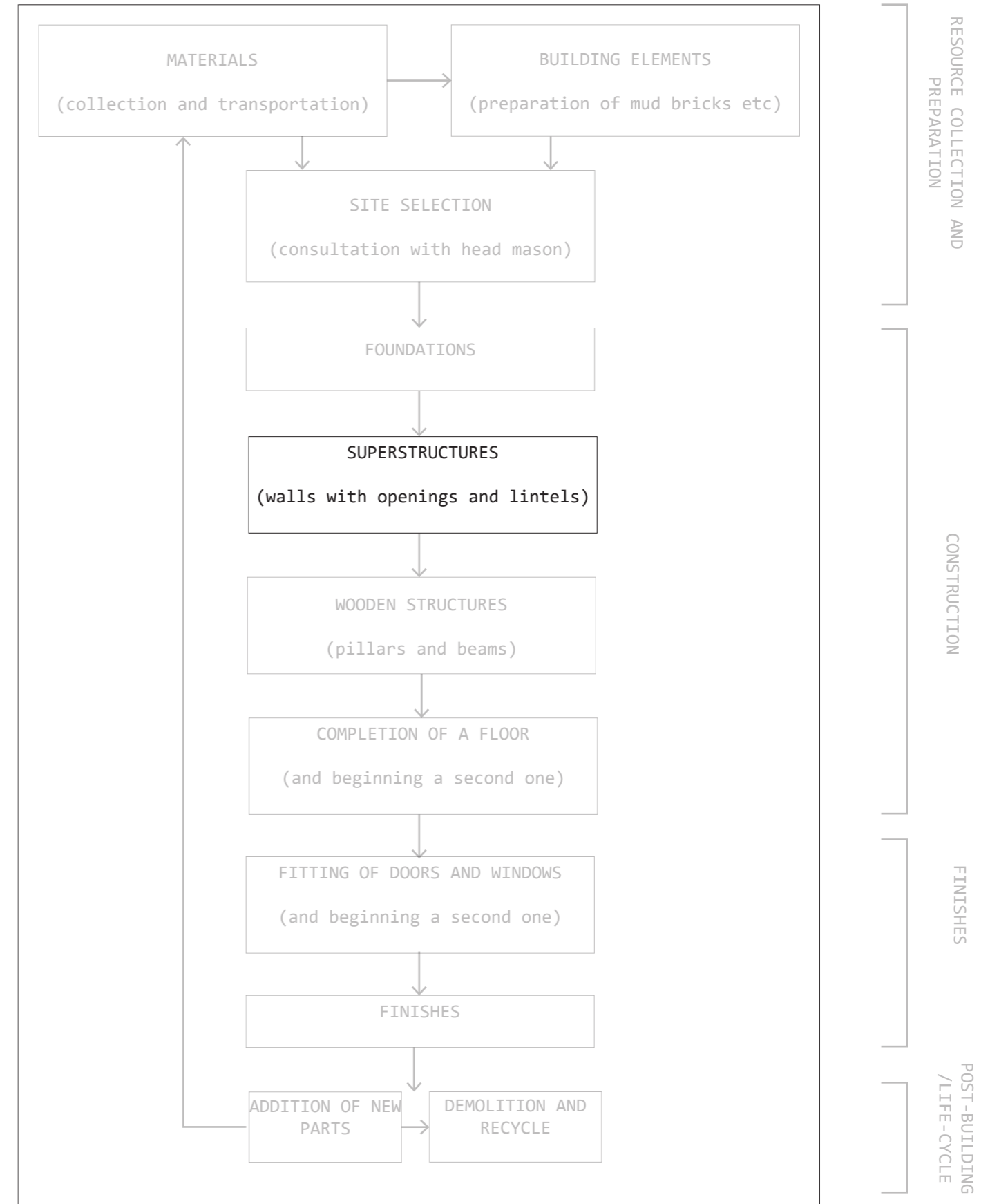
GENERAL CONSTRUCTION PROCESS SCHEME

(by Edoardo Paolo Ferrari)



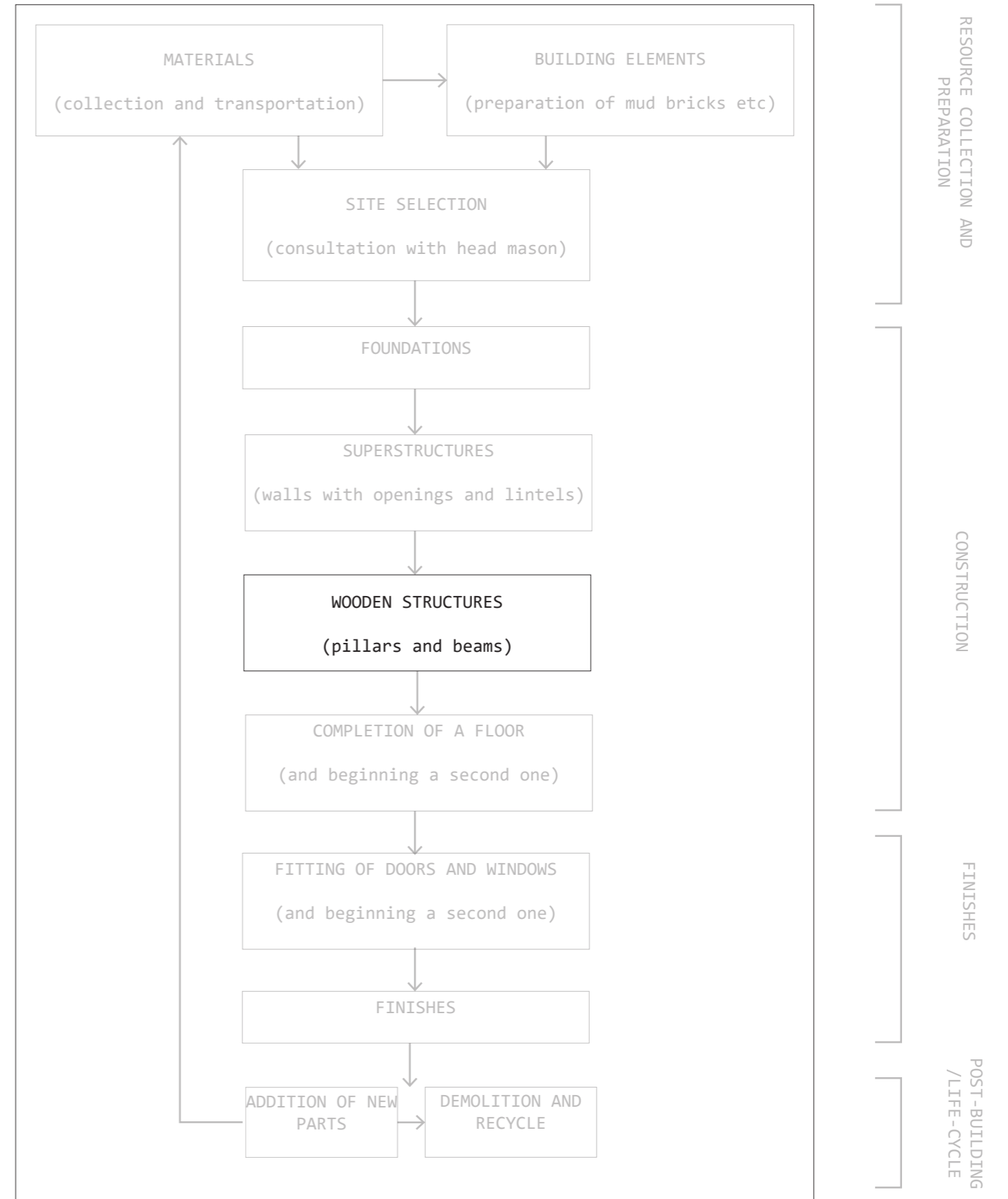


GENERAL CONSTRUCTION PROCESS SCHEME
(by edoardo paolo ferrari)

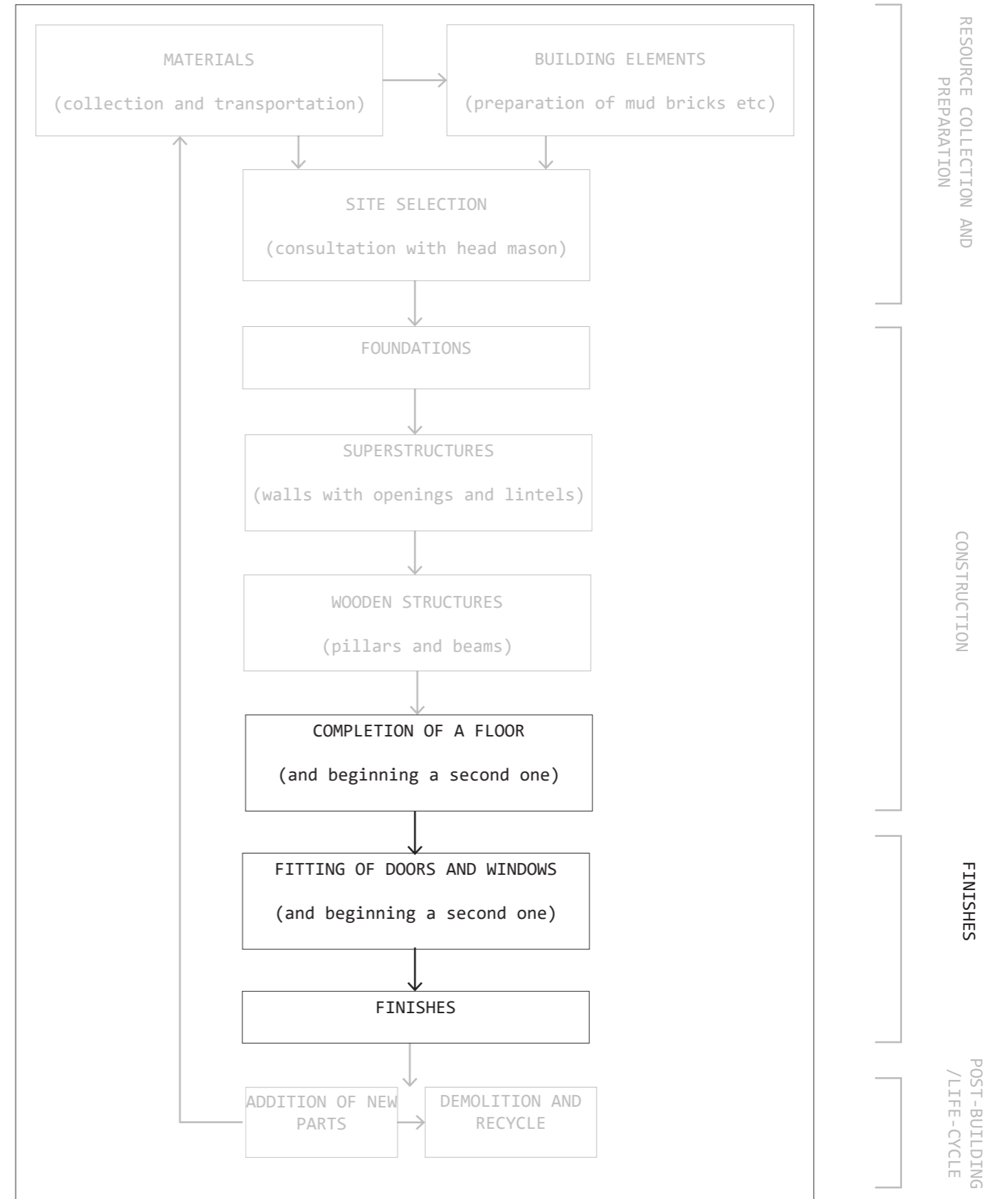


GENERAL CONSTRUCTION PROCESS SCHEME

(by edoardo paolo ferrari)



GENERAL CONSTRUCTION PROCESS SCHEME
(by edoardo paolo ferrari)



GENERAL CONSTRUCTION PROCESS SCHEME
(by edoardo paolo ferrari)



- Second Floor
Rooftop**
1. Open toilet
 2. Room
 3. Offering room / Private chapel
 4. Glass room
 5. Guest room



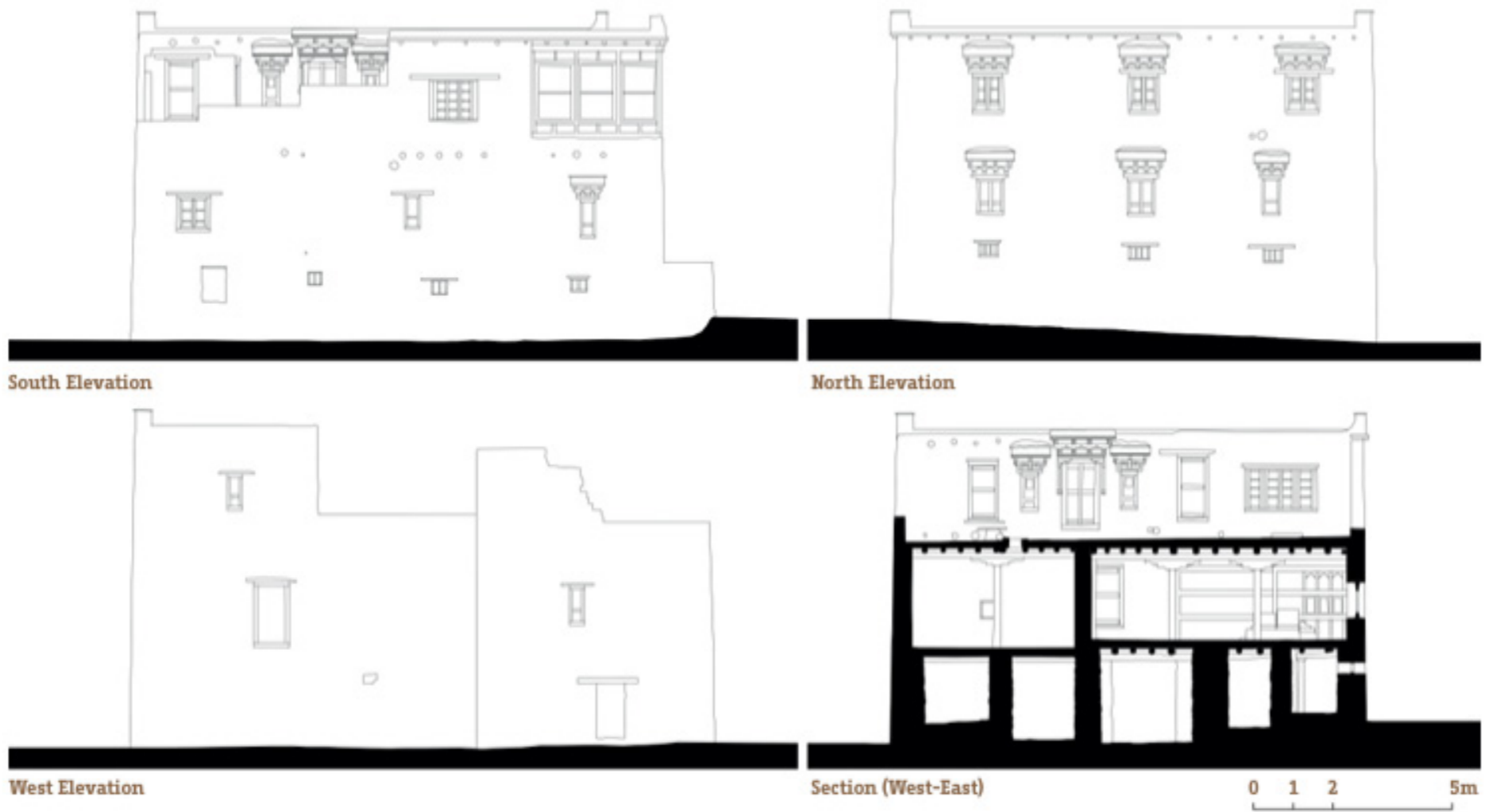
- First Floor**
1. Room
 2. Toilet
 3. Grain containers
 4. Store room
 5. Fireplace room / Kitchen
 6. Guest room
 7. New main entrance



- Ground Floor**
1. Toilet outlet
 2. Fuel storage
 3. Fodder storage
 4. Stable
 5. Ground floor entrance
 6. Old connection to the first floor

0 1 2 5m



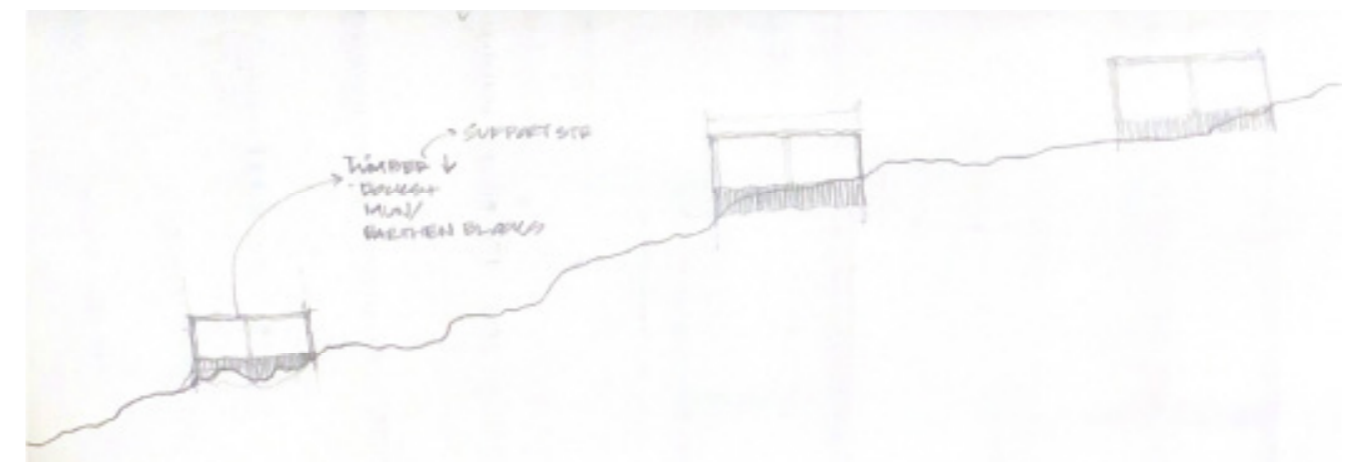
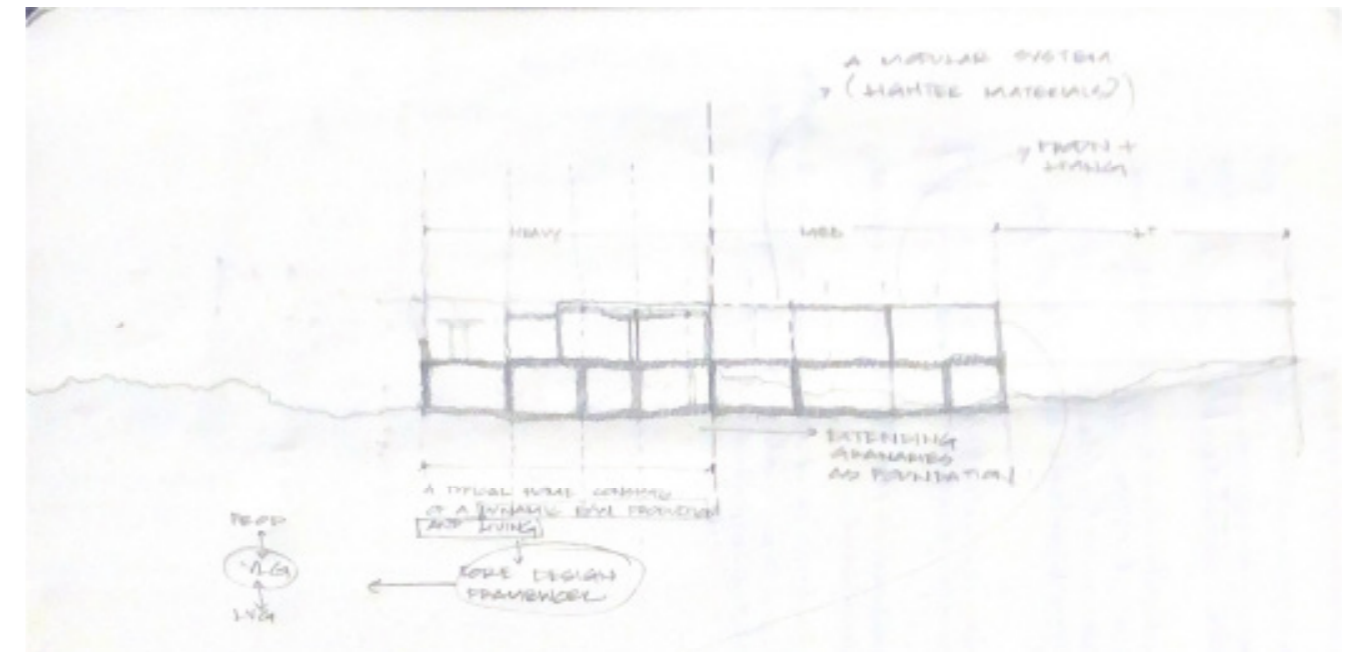


XII. The concept

Following the various internal processes and seasonal patterns-- I attempt to propose an architecture that re-establishes links between production and living systems in Kulum (that have been altered due to climate change) based on vernacular logic systems that adapt to seasonal conditions.

The adjacent image is a concept diagram that show where architecture could intervene in existing systems and potentially repair/establish relationships between the same. This then becomes the basis for exploring more specifically the programmatic requirements for each season which is then translated into built form.

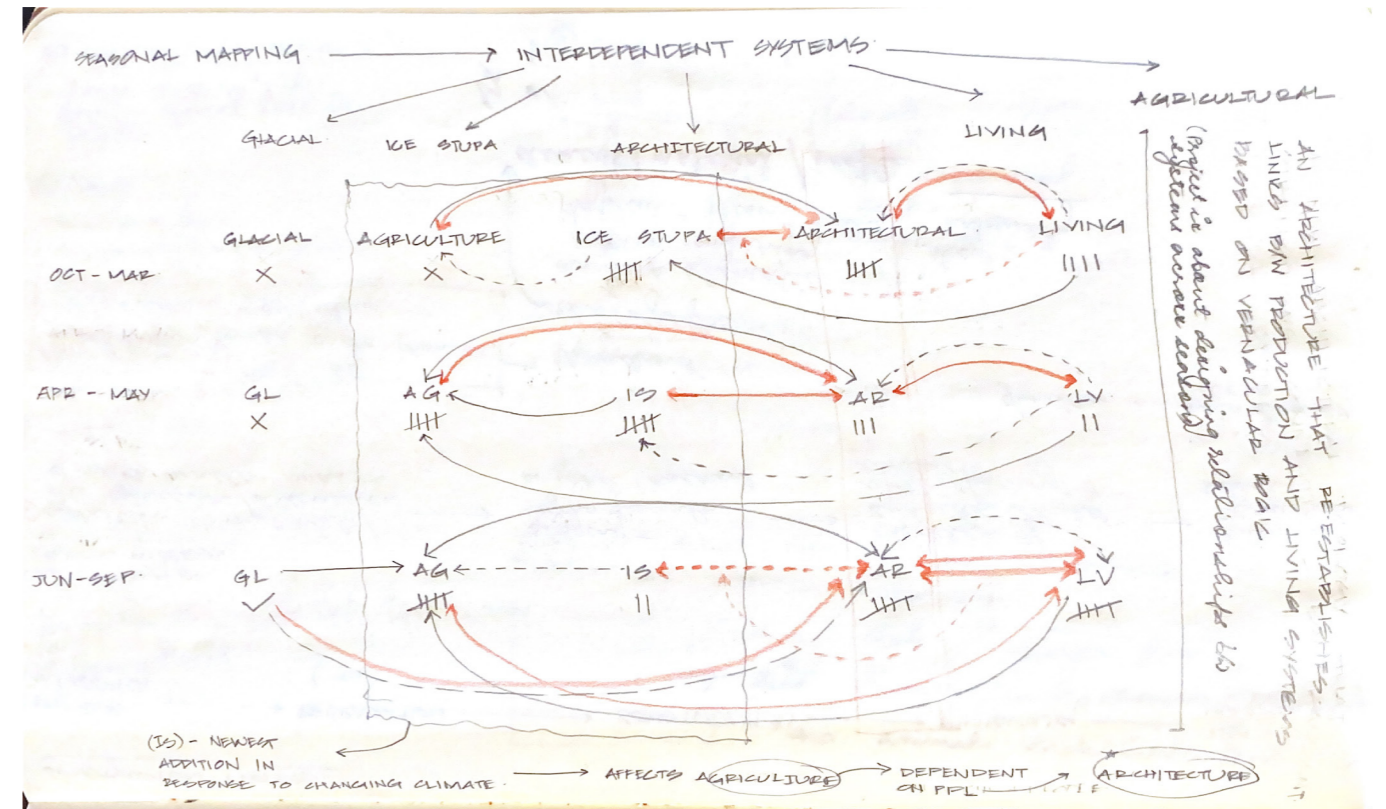
At this stage, it is important to stress that the thesis is not merely a architectural restoration assignment. It aims to revive a built heritage by restoring relationships between landscape, production and living--which has been the core concept of Ladakhi vernacular.



Concept sketches show a system of follies distributed along the landscape with a living core in the center. Functions of each space alter based on the seasons and the needs



A terrain map showing interconnected systems of interventions



An initial relationship diagram that explains where architecture could intervene to re-establish broken links between distinct systems.

XIII. Area program

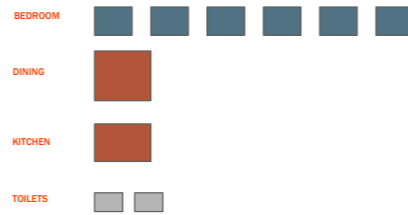
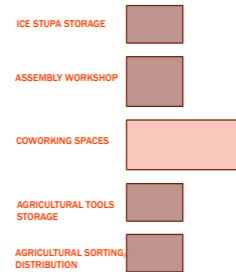
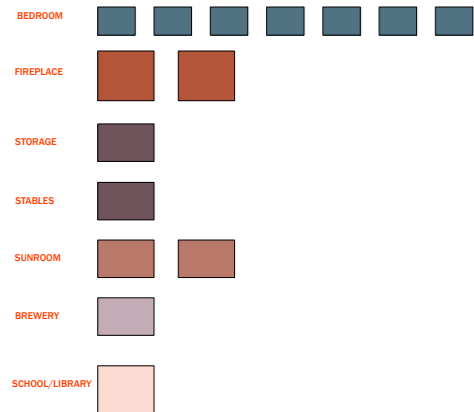
Based on site studies, I formed a rough area program governed by vernacular logic, people and production systems. This was then arranged and re-arranged to formulate a rough programmatic arrangement that integrated both production and living systems.

	Program (based on typical spatial req)	Area sqm (based on typical modular sizes)	Qty	Total area (approx min req)
LOCALS (14 always 20 max)	bedroom	12	7	84
	fireplace/dining/kitchen	32	2	64
	prayer room	24	1	24
	terrace	~	~	0
	storage food	12	all foundation	12
	stables	12	all foundation	12
	sunroom	12	2	24
	brewery	12	1	12
	school/library	64	1	64
	toilets	6	2	12
VISITORS (15 max at a time)	bedroom	12	6	72
	dining	32	1	32
	kitchen	24	1	24
	toilets	6	2	12
	common areas	~	~	0
PRODUCTION	storage ice stupa	24	1	24
	assembly workshop	32	1	32
	co-working spaces	64	1	64
	common granaries	Foundation area	~	0
	agricultural tools storage	24	1	24
	agri sorting spaces	24	1	24
				~700

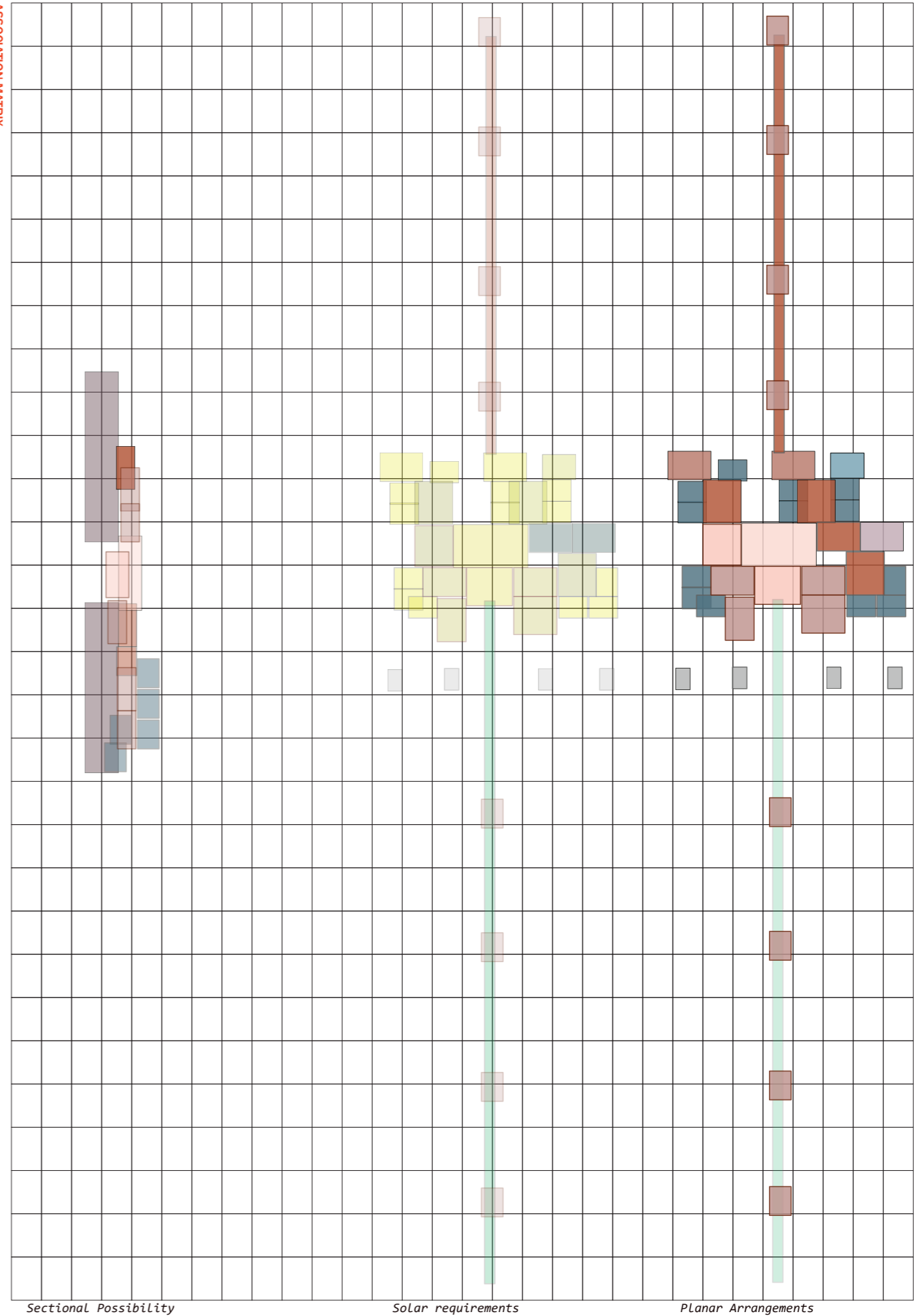
LOCALS

PRODUCTION

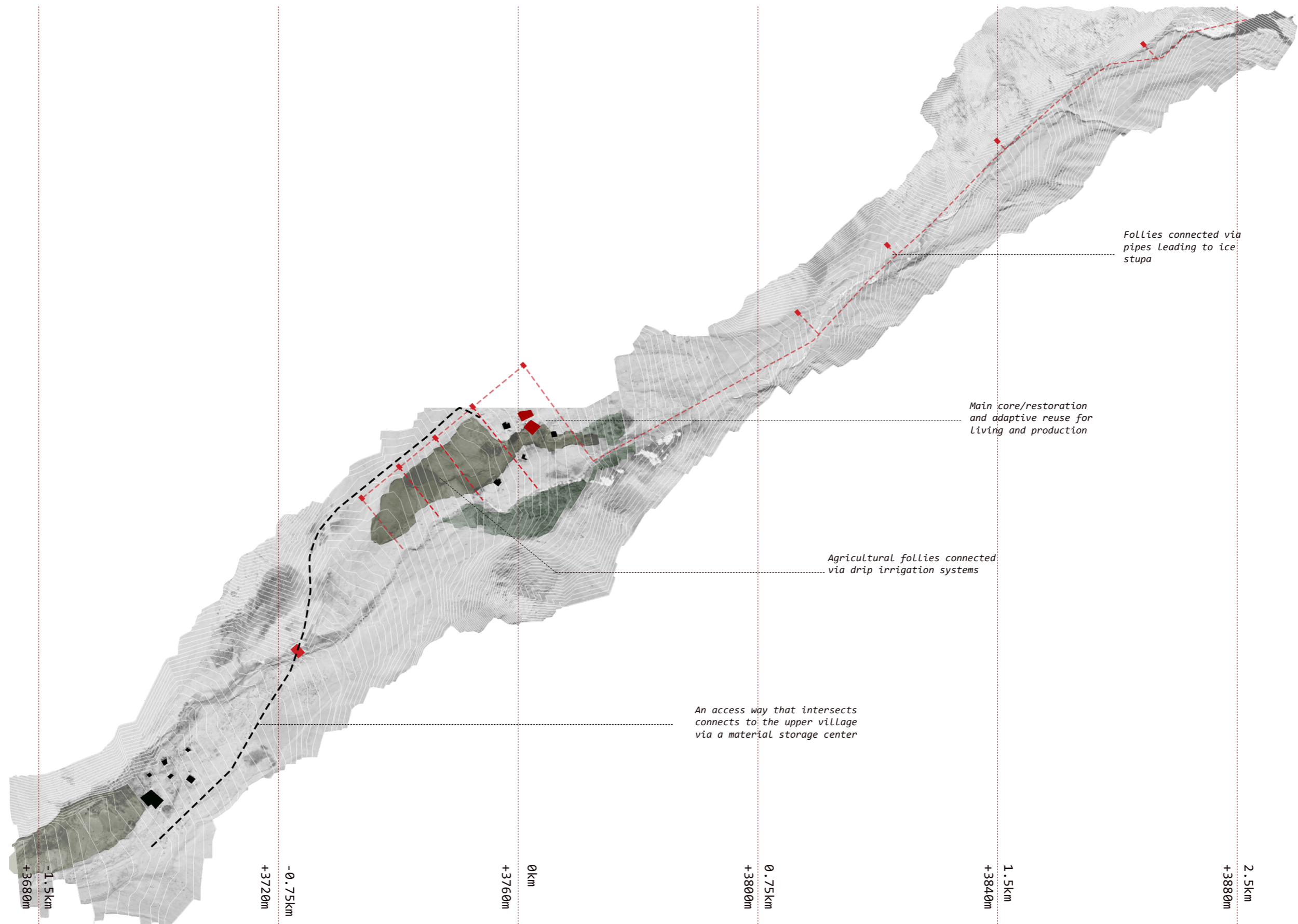
VISITORS



ASSOCIATION MATRIX

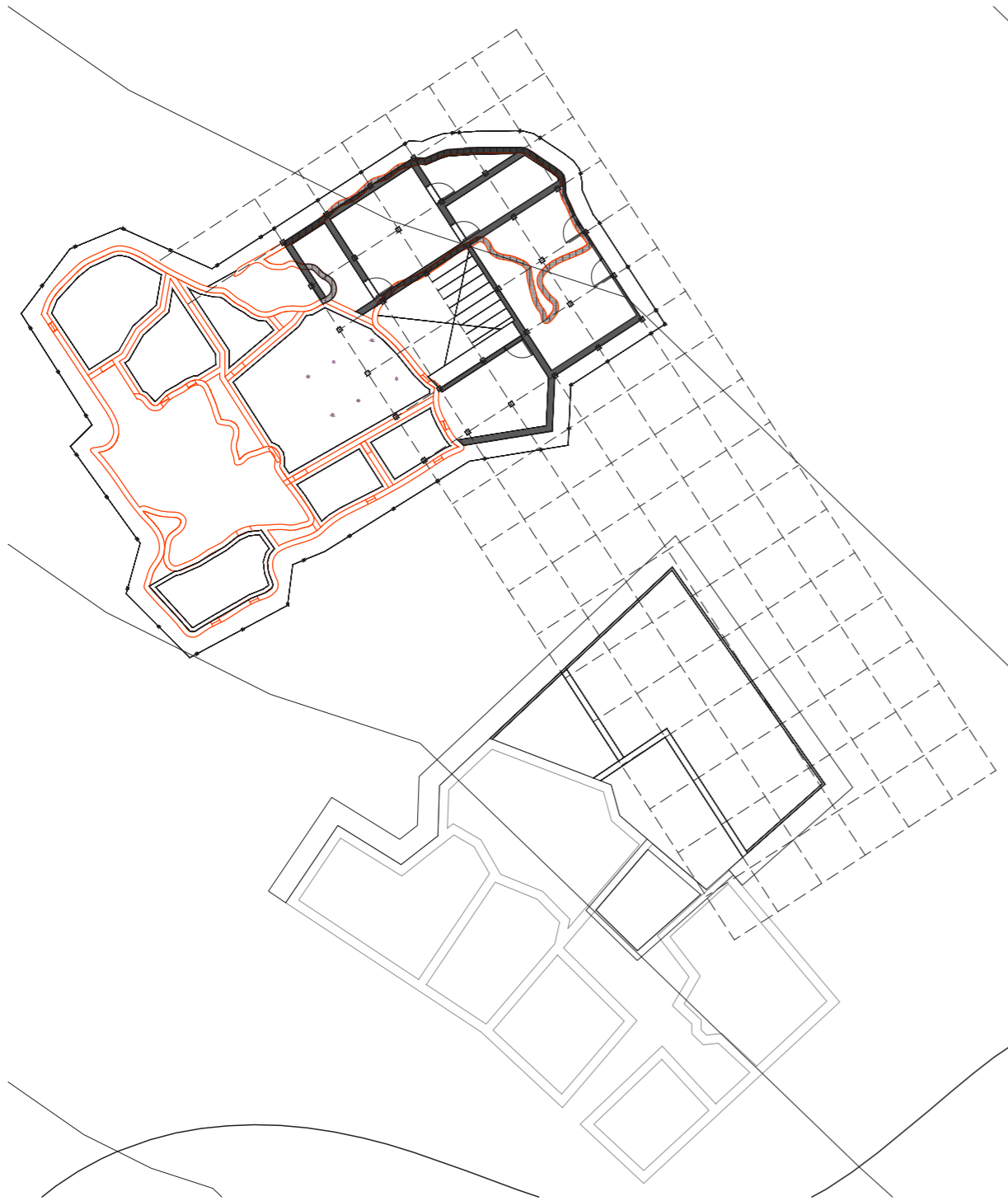


XIV. The Site and Intervention Zones



The main underpinning intervention is aimed across the village in three aspects-agricultural, architectural restoration of the main house (the core) and supporting structures towards the ice stupa. Following the seasonal processes of a typical Ladakhi village, these structures would operate during suitable seasons and foster the strengthening of links between production, living and landscape.

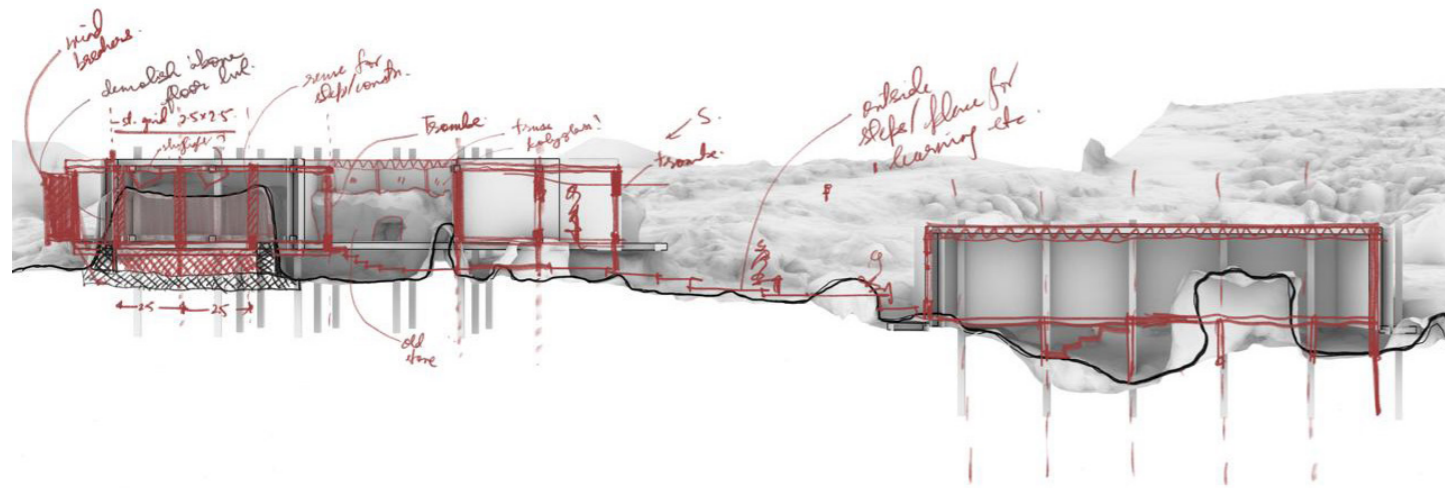
XV. Initial Design Strategies/ Architectural Restoration



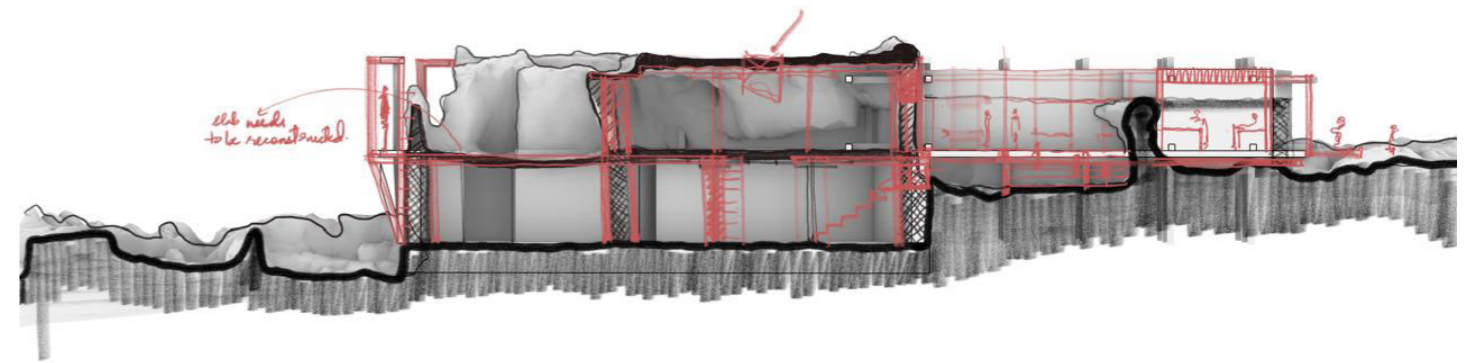
The red shows the old walls of the structure and the rest is a simplistic modular structure that is inserted gently into the existing walls and is comprised of living, production and open school systems that follow a base vernacular logic wherein materials are sourced locally and innovated within existing programmatic frameworks.



A circumambulatory structure traces a perimeter around the old walls and echoes a spiritual relevance whilst also providing structural reinforcement and climatic buffers (through trombe walls and wind breakers)

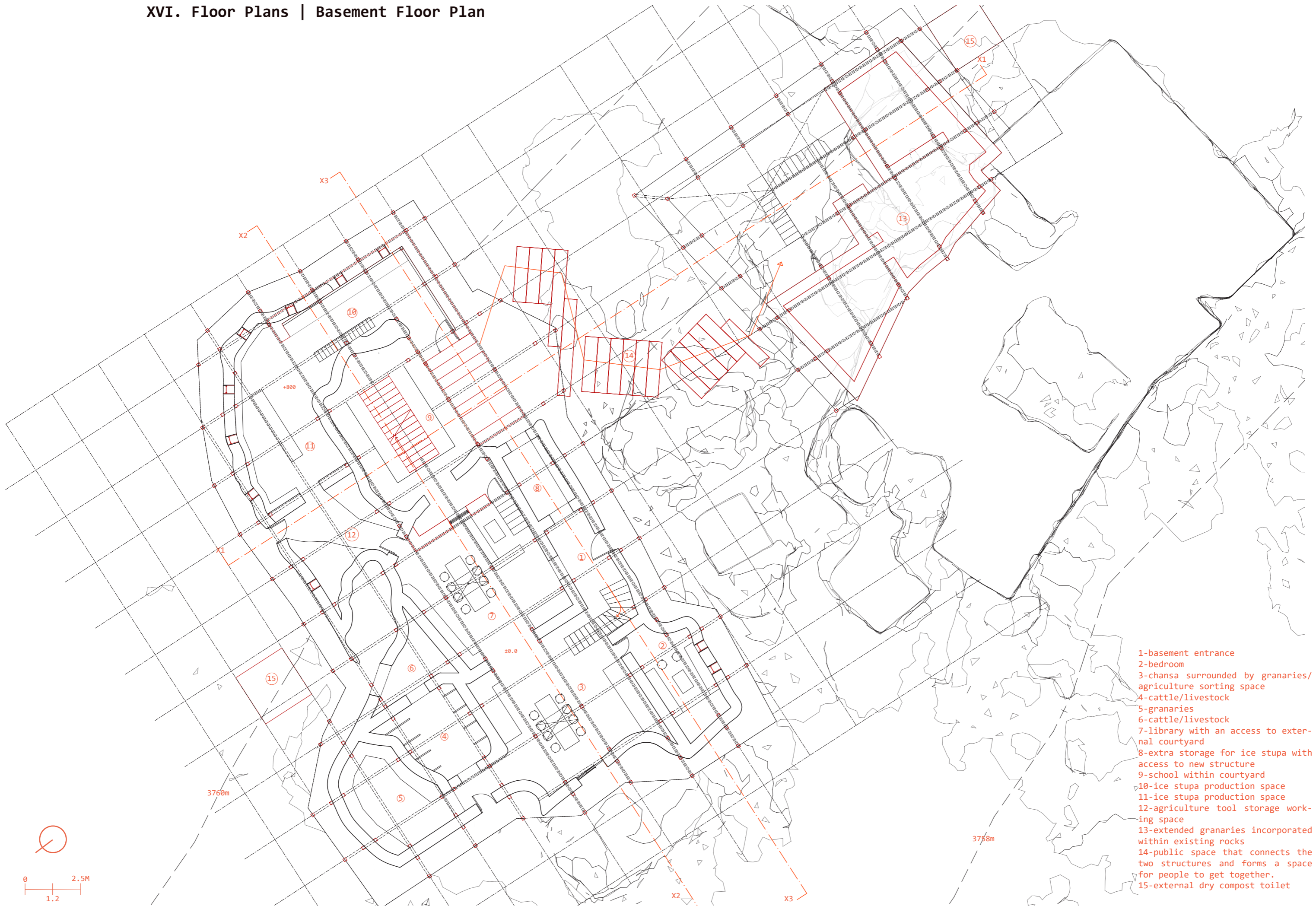


Section sketch through the two old buildings show ideas of demolition and newer material use.

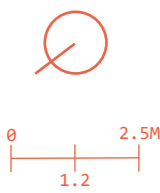


Section sketch through the old buildings shows how the granaries can be potentially accessed and the corridors along with the integration of the newer structures.

XVI. Floor Plans | Basement Floor Plan



- 1-basement entrance
- 2-bedroom
- 3-chansa surrounded by granaries/
agriculture sorting space
- 4-cattle/livestock
- 5-granaries
- 6-cattle/livestock
- 7-library with an access to external
courtyard
- 8-extra storage for ice stupa with
access to new structure
- 9-school within courtyard
- 10-ice stupa production space
- 11-ice stupa production space
- 12-agriculture tool storage working
space
- 13-extended granaries incorporated
within existing rocks
- 14-public space that connects the
two structures and forms a space
for people to get together.
- 15-external dry compost toilet

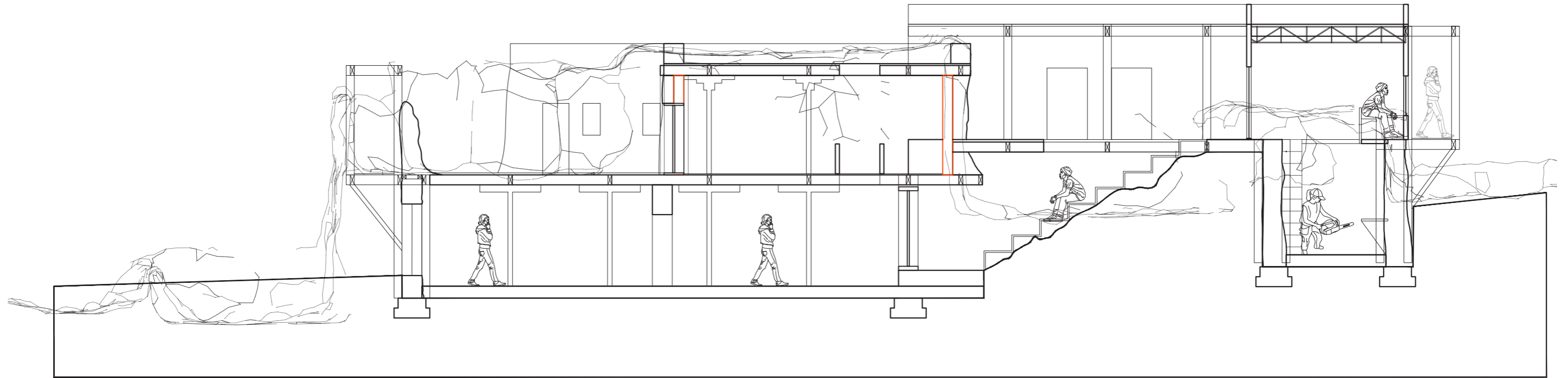


XVII. Floor Plans | First Floor Plan

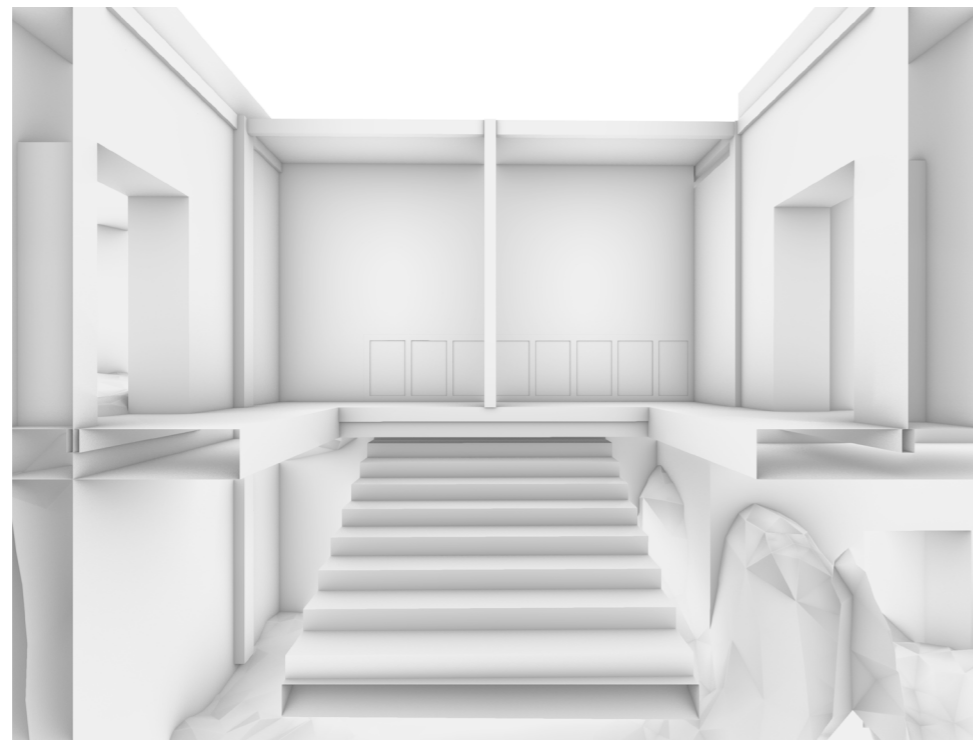


- 16-Old first floor courtyard retained
- 17-sunroom
- 18-circumambulatory structure that becomes a balcony all around and also the structural support
- 19-prayer room
- 20-bedroom
- 21-common brewery
- 22-chansa for locals (fireplace)
- 23-bedroom for locals
- 24-chansa for visitors
- 25-bedroom/living for visitors
- 26-double height space for ice stupa working and production space
- 27-bedroom/living for visitors
- 28-external corridor looking onto the courtyard/school below

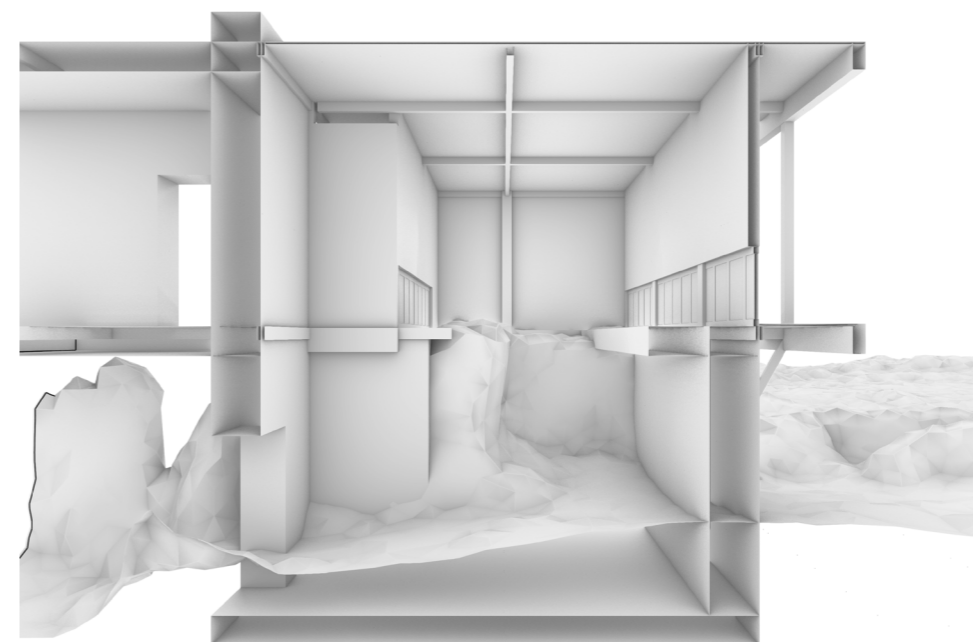
XVIII. Sections | Section X2



to be revised with color difference



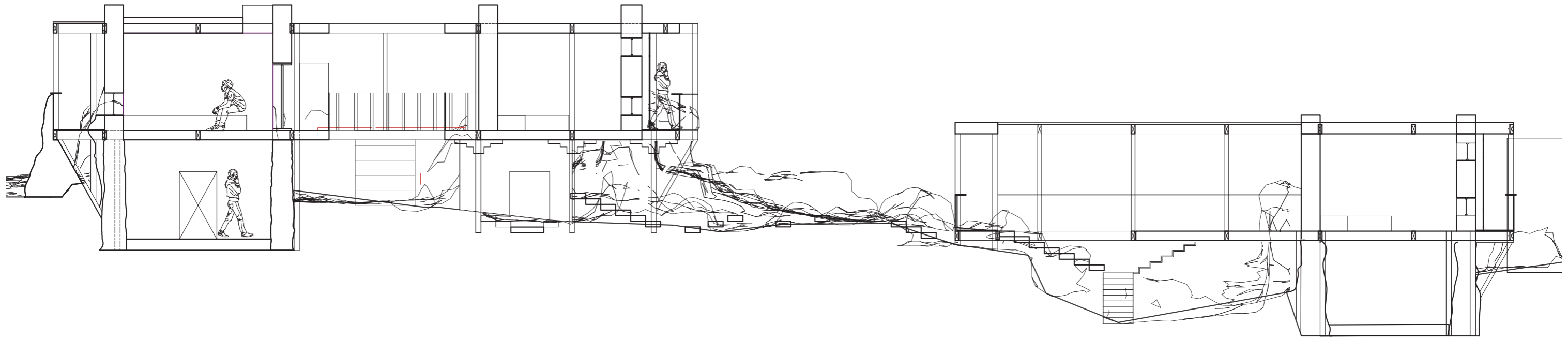
view of central courtyard



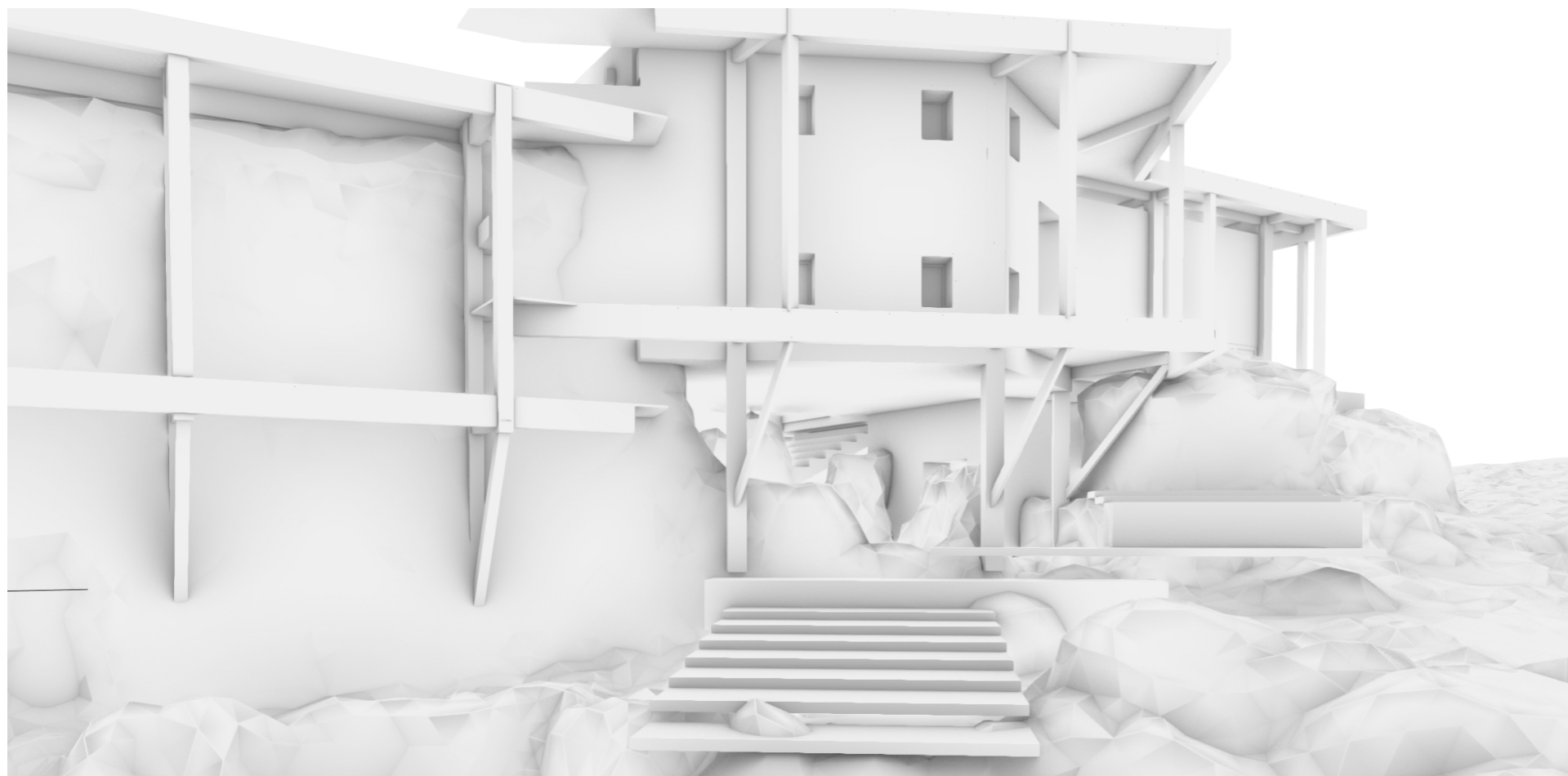
to be revised with material

view of double height ice stupa production space

XIX. Sections | Section X1



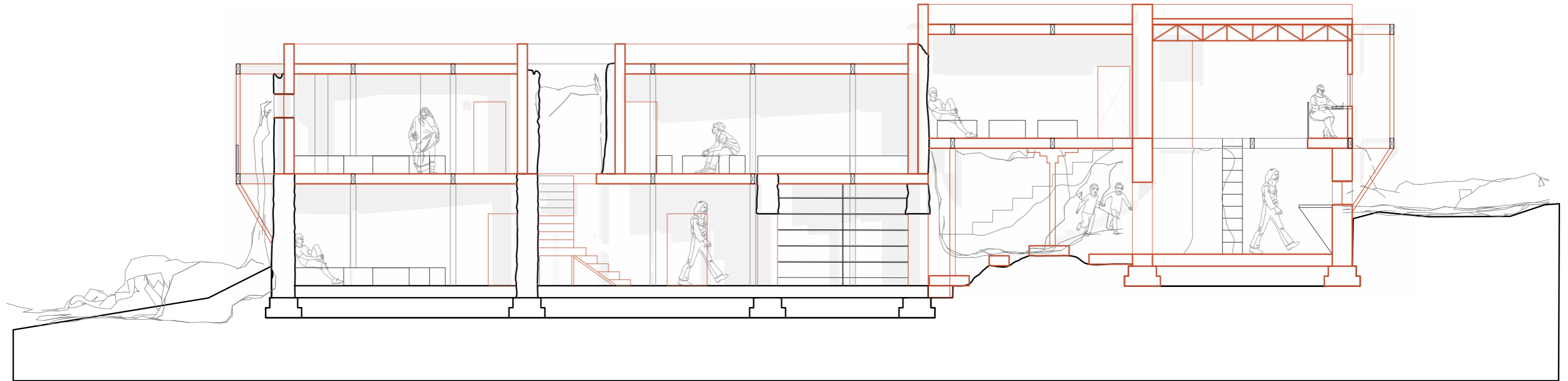
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to be revised with material

view of common space for gathering

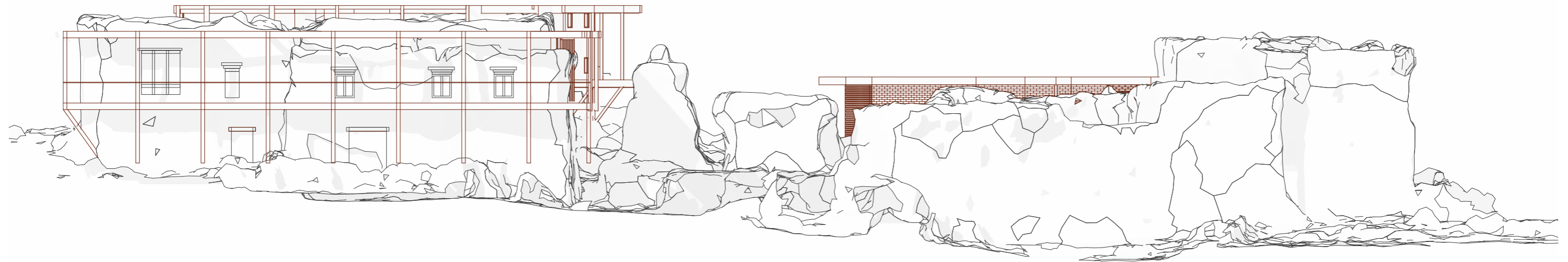
XX. Sections | Section X3



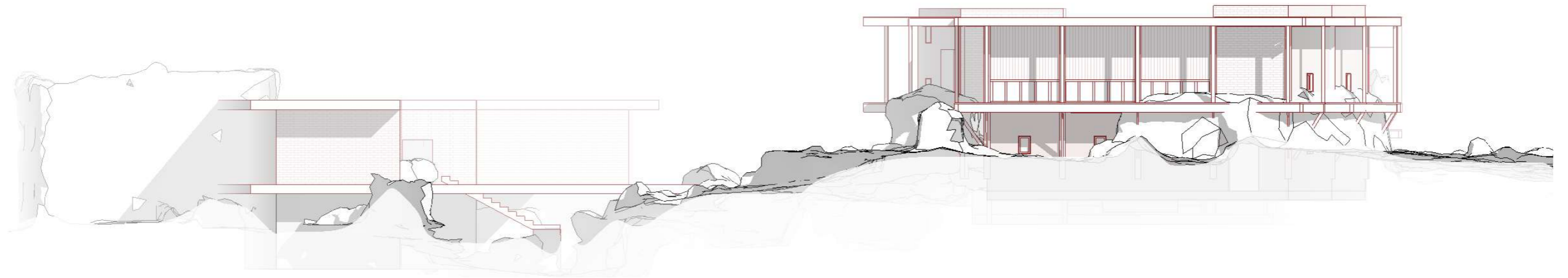
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External view showing the circumambulatory structure

XXI. Elevations



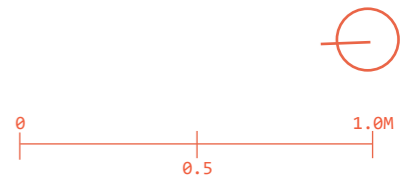
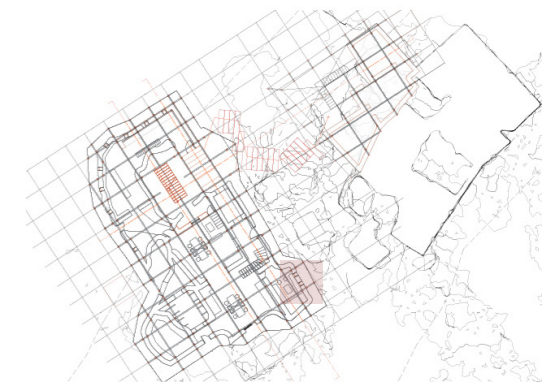
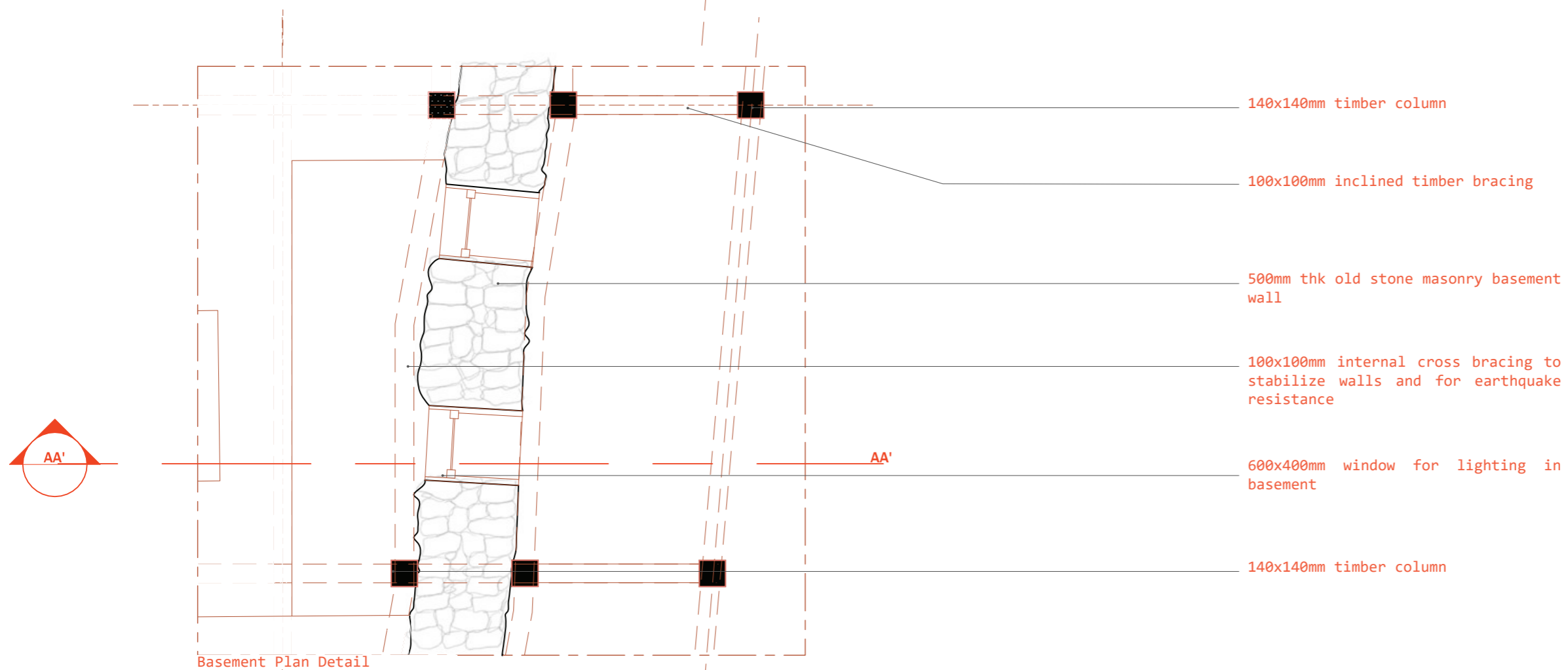
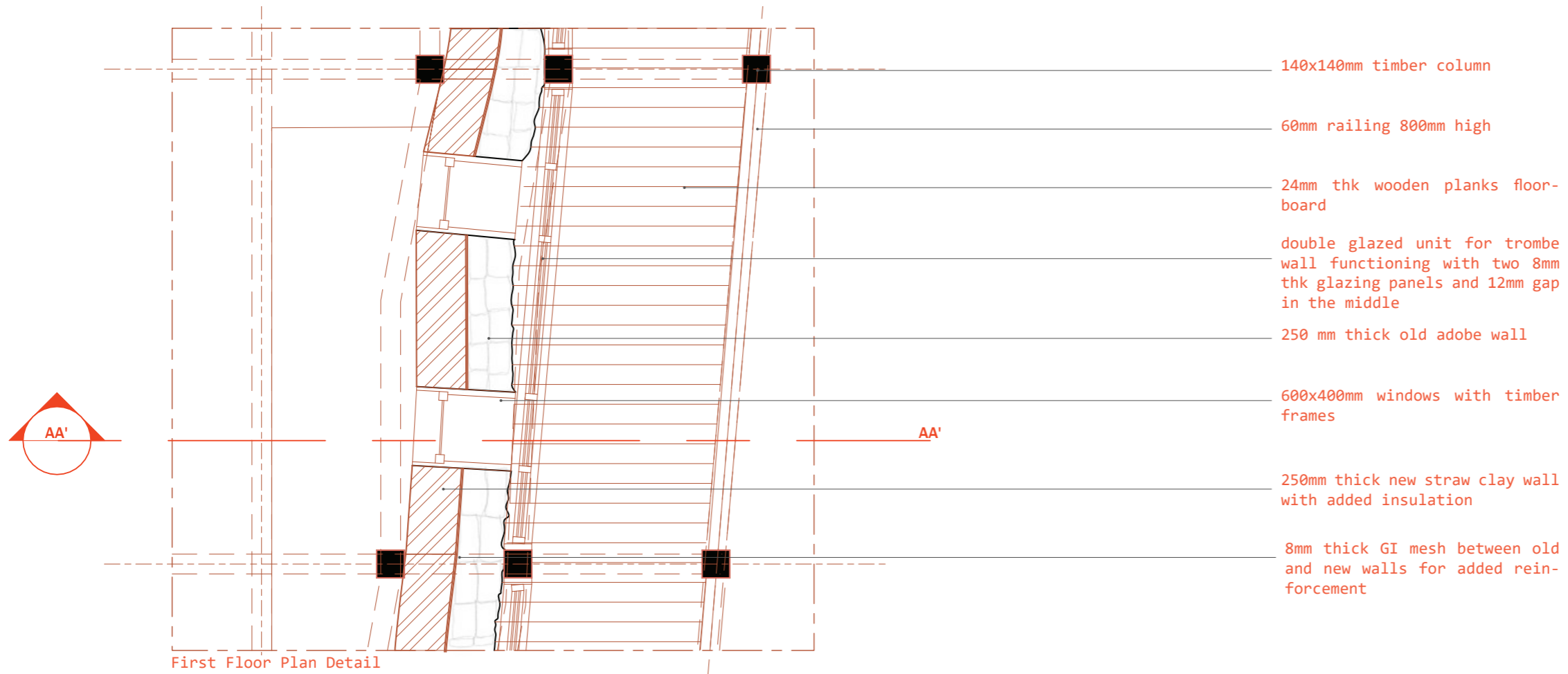
Front Elevation

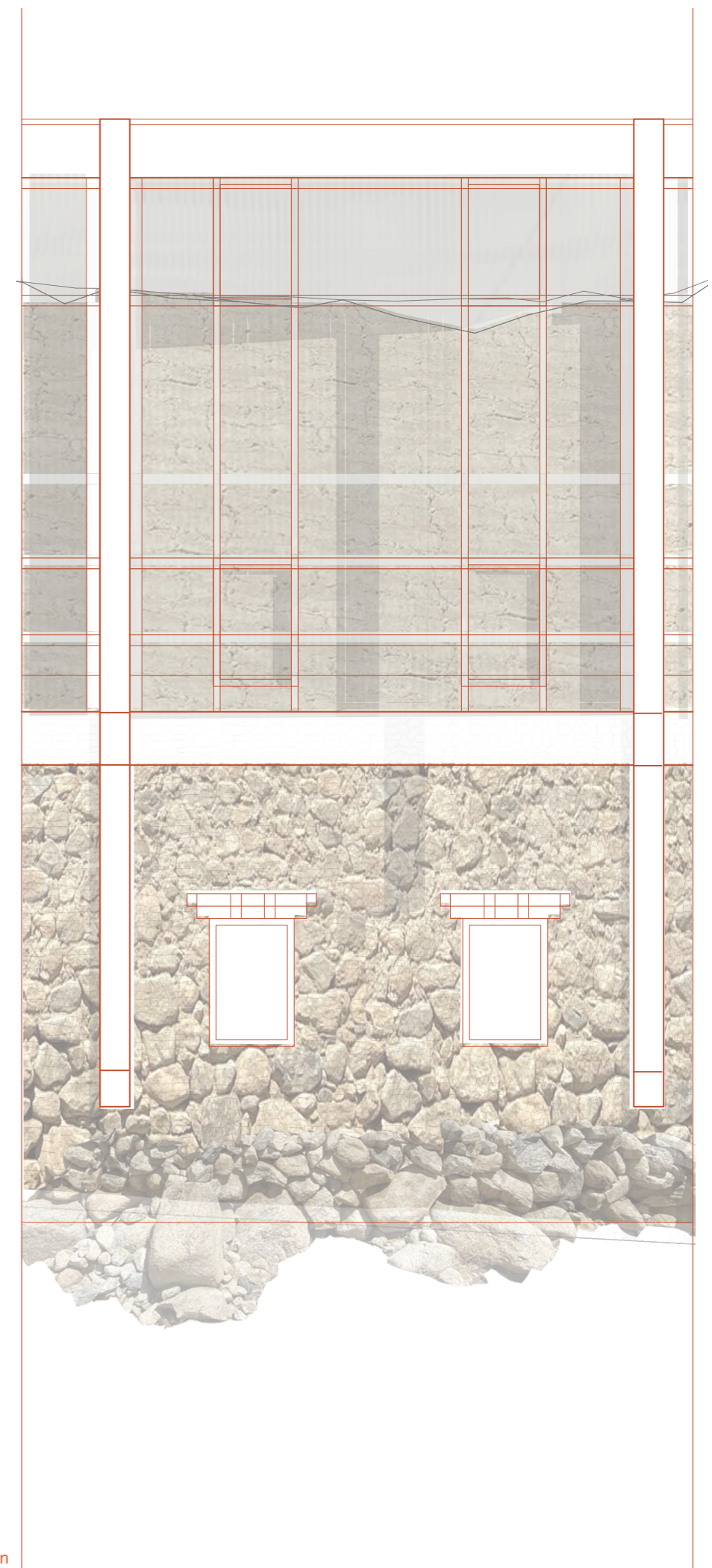
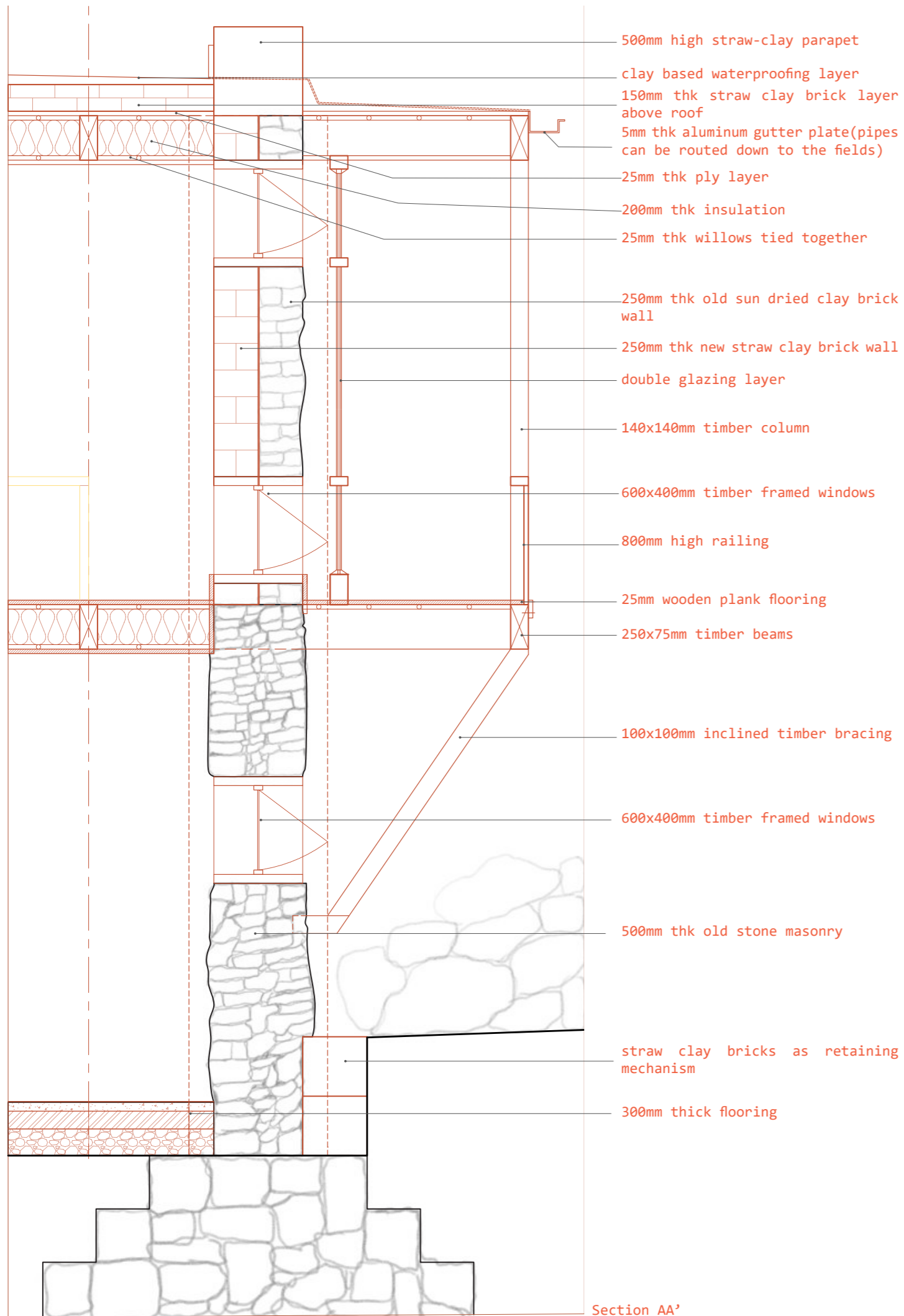


Rear Elevation



XXII. Construction Detail Showing Old X New





XXIII. Scenes From The Construction Process

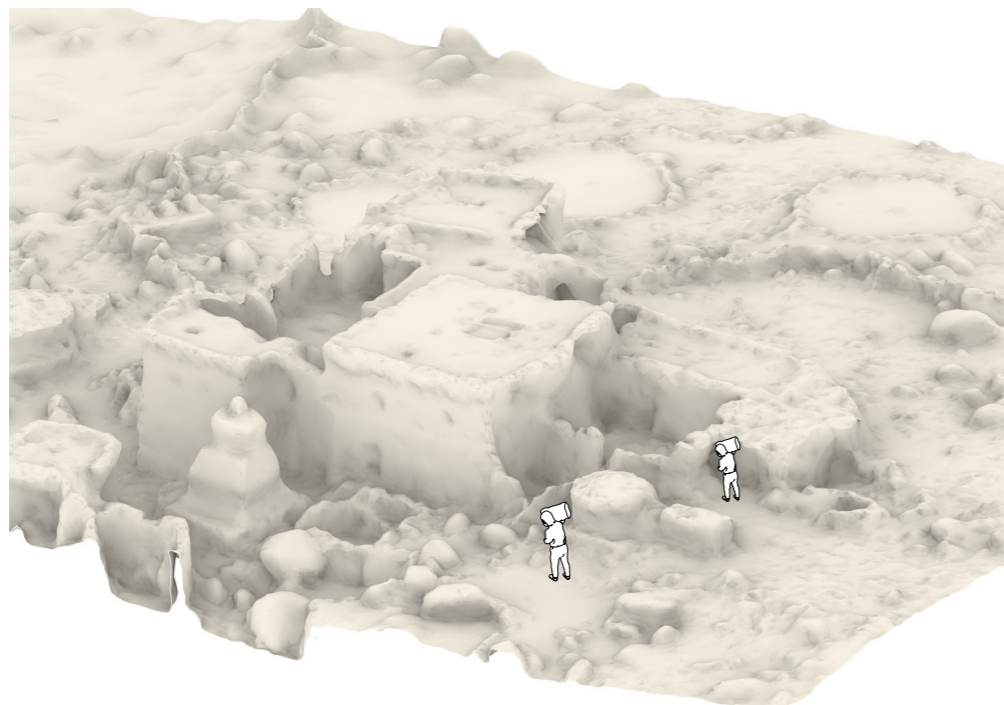
Since the underlying foundation of the thesis is a design that adapts to the seasons, it becomes vital to understand how the construction process and its various stakeholders would schedule within this seasonal timeframe. In the images below I indicate the season, the phase of construction, and the people involved. Perhaps, at a stretch, even this construction process could be curated in a way to incentivize restoration.

Step 1- Sourcing materials, material storage, preparing bricks

Season- One summer before construction June-September

Source- Riverine stones from the streams, clay from the surrounding mountains and straw from agriculture waste, timber from Kashmir, steel waste from military camps

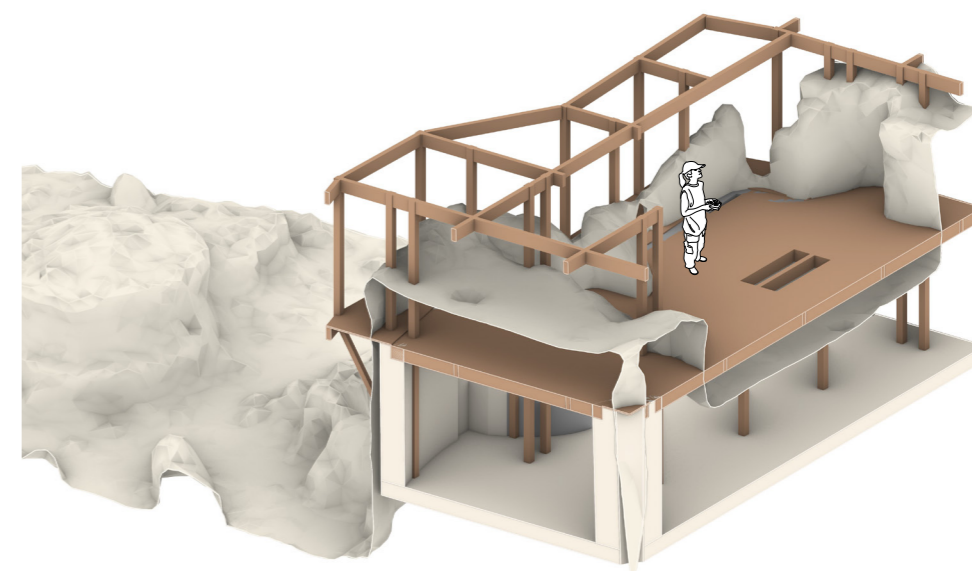
People-Local carpenters, masons from the nearby village



Step 2- Laying the 2.5x2.5m grid, demolishing the old slabs, strengthening the old walls

Season- Next summer (1yr later) June-September

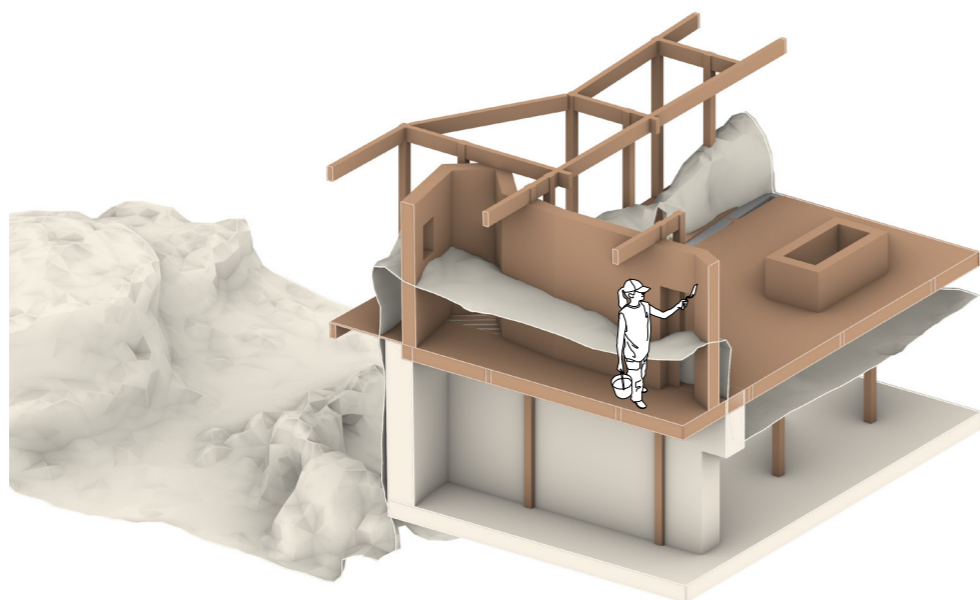
People-Local carpenters, masons from the nearby village, potentially an architecture workshop where students can come help build and villagers can economically benefit by teaching local building techniques



Step 3- Building new walls within the old frame

Season- Late summer

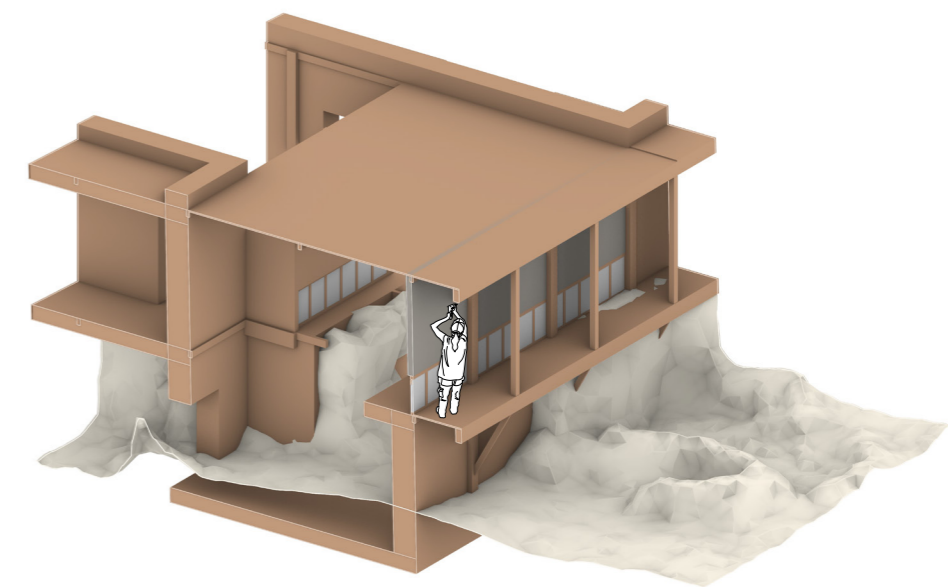
People-Local carpenters, masons from the nearby village

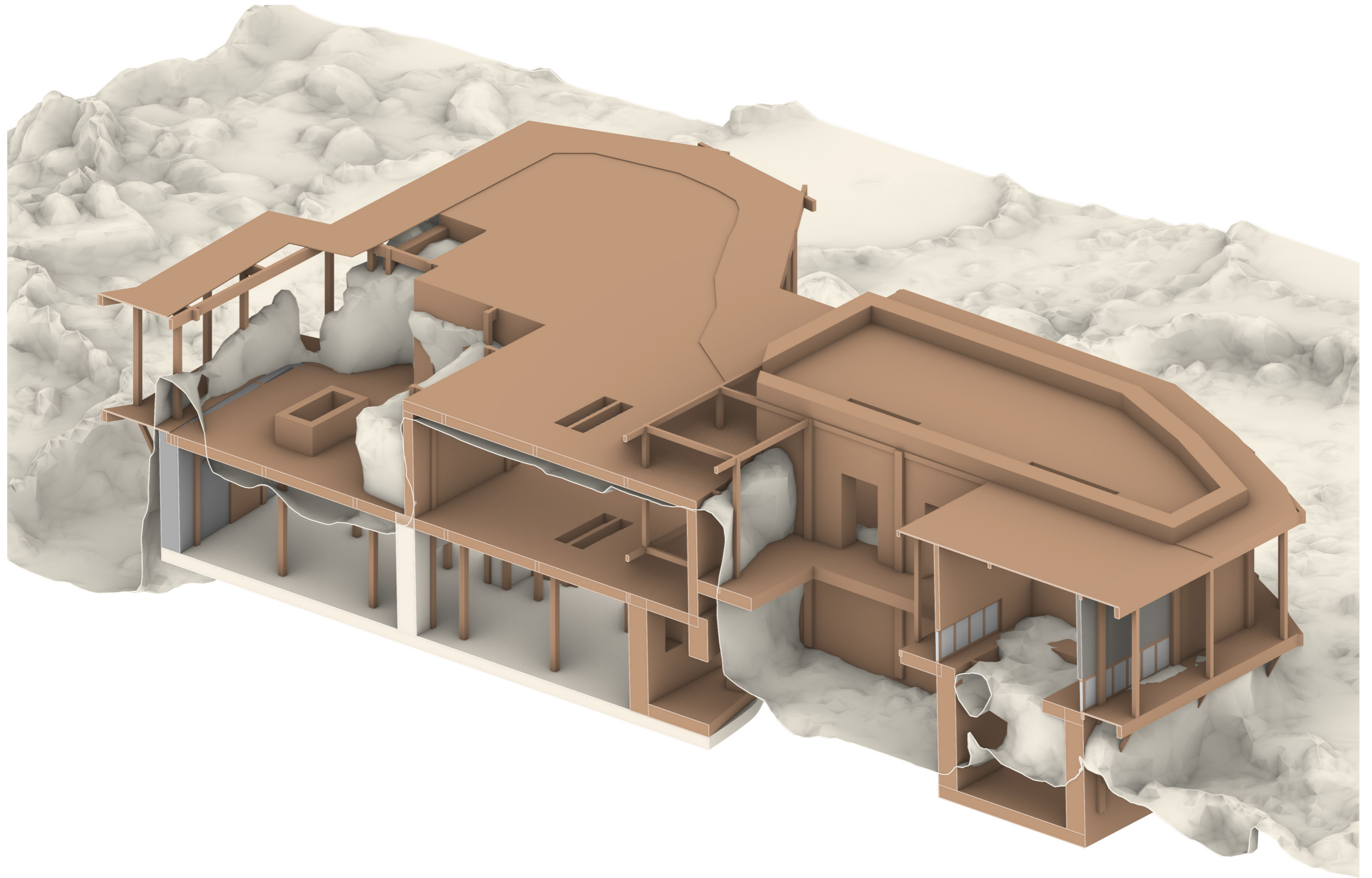


Step 4- The new additional structure with new materials like steel waste. Suggests a new vernacular and architectural language

Season- September-October

People-Local carpenters, masons from the nearby village, steel fabricators and people from Leh city who are familiar with a more modular construction thus facilitating a knowledge exchange

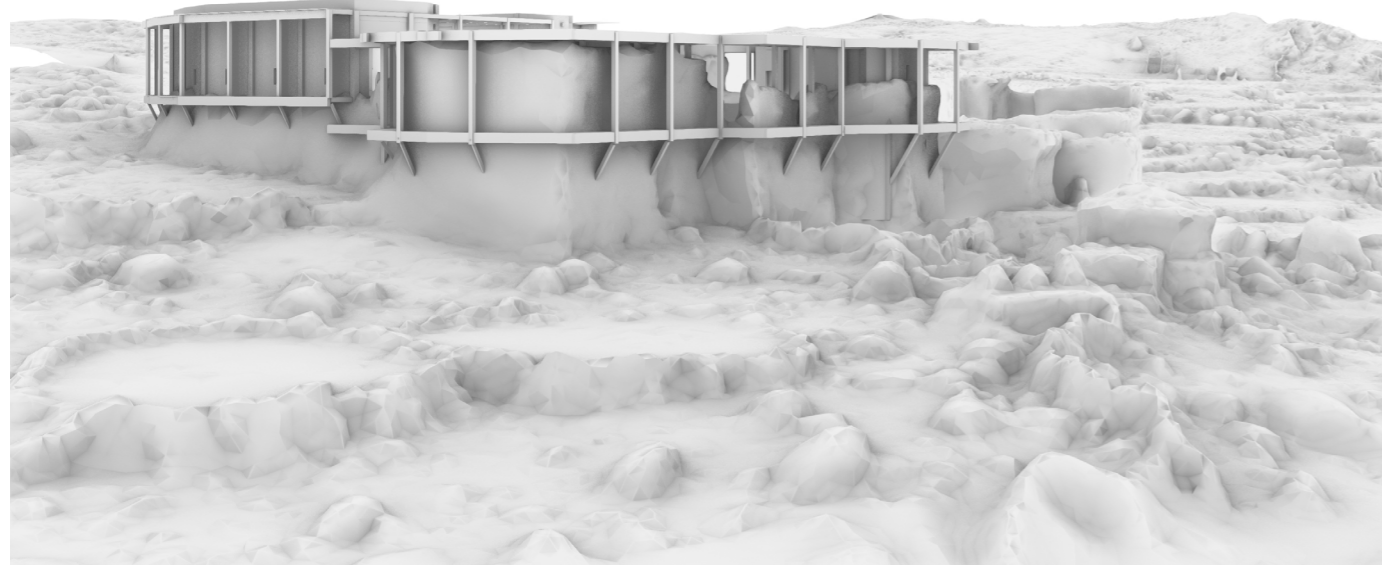




Step 5- Opening Ceremony!

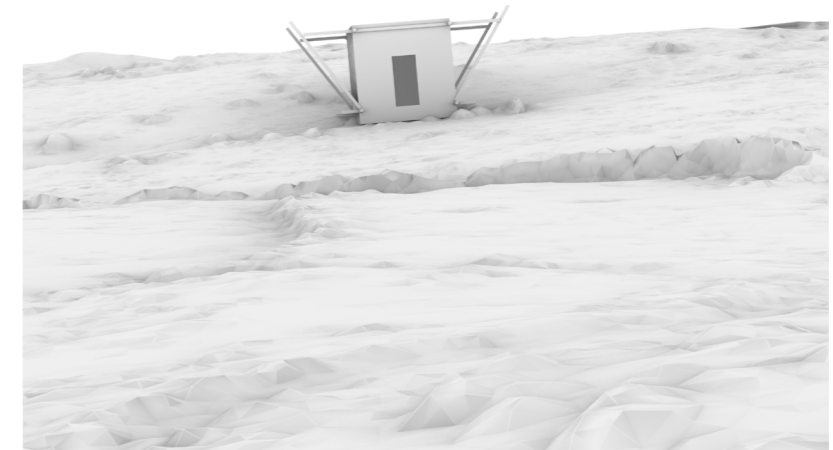
Season- December - to get communities together and take a well deserved break after a busy agriculture and construction season and embrace new connections and possibilities.

XXIV. The House And Follies



Main house

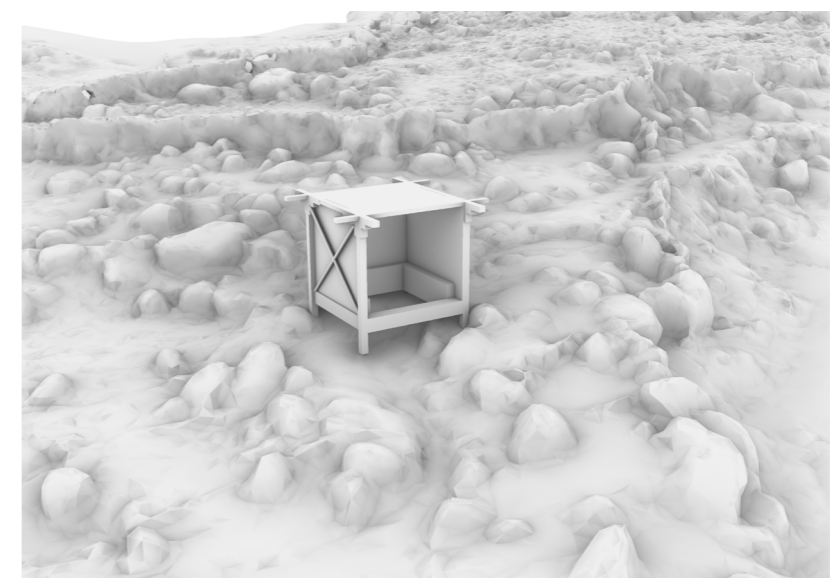
to be revised with material render



Agricultural Follies



Ice Stupa Follies



Ice Stupa Follies

ly perceive an evolution of the vernacular. Based on my experience on the site, I had also realised that due to its remote nature, the children in Kulum had no access to schools or even the internet. They would mainly tend to the agricultural grounds or maintain the stupa. Considering that Kulum witnesses a plethora of researchers and volunteers especially now that it has garnered state wide attention- the design proposes an open school or learning space that is situated at the intersection of the new and the old and could be a space where volunteers could offer to teach them vocational skills or other relevant skills that inspire them to revive the original significance of Kulum. Therefore, the design then becomes an intertwined mix of programs that mediate between several living and production spaces whilst also setting an example for what the future of Kulum and many such vulnerable villages in Ladakh would look like. Beyond the core of the house, I also proposed a series of functional follies across the landscape. These are simplistic modules derived from the 2.5mx2.5m grid of the core of the house and serve different functions depending on their location across the site. For instance, the agricultural follies are partly infrastructural in nature as they route the drip irrigation pipes from the ice stupa, partly storage for common granaries and partly resting spots for the farmers during intensive production seasons. These pipes also aim to serve the homes with water as they come down from the glaciers and the stupas which makes it an interconnected infrastructural and spatial network. This infrastructural and pipe network then connects to other intermediary follies towards the ice stupa beyond the house. Since the walk to

XXV. Conclusions

Having worked in Kulum and Ladakh from before I commenced my studies at the faculty, I have been truly fortunate to continue my explorations in Kulum through Explore Lab. What started as a simplistic architectural restoration program, quickly turned into something more complex and tailored to the landscape and its people--the core vernacular archetype of Ladakh. Understanding the mechanism of how the village transformed seasonally was key in formulating the design framework which operates across production, living and landscape. This involved moving beyond a nostalgic imitation of the Ladakhi vernacular and imbibing the vernacular mindset in the programming and reprogramming of the various systems in Kulum. The core of the design became the main house which entailed - a structural strengthening system that literally and spatially tied the old and the new together in a constant dialogue between living systems and production systems. Further, the design attempts to adapt to the new demographic of Kulum (researchers, trekkers, volunteers etc) and the new production systems of the ice stupa by creating a mixed use space that fosters interactions between varied communities and production systems- thus reviving the vernacular processes through new programs. The architectural language across the project also varies and points to changing times. For instance, the old house consists of cautious structural bracing and insertion of additional walls and slabs within the skin of the old house which then gradually transitions into the new spaces of living and ice stupa production which also use local materials which stand apart from the old as they are derived from current resources. Therefore, as one looks at the structure, they can clear-



the stupa is fairly strenuous and long and consists of manually carrying heavy materials for maintenance, these follies serve as resting spots and storage spots for these materials- therefore allowing a degree of self reliance for the locals. Again these are derived from the core of the design and are simplistic in terms of form and respond to the varying landscape conditions.

Finally, the design then becomes a network of adaptable structures that activate based on seasonal requirements and re-establish an age-old link between people, landscape and production, thus proposing a holistic restoration and rehabilitation framework. This design process has also eventually answered the main research question of how communities display resilience in the face of climate change and how can they adapt to our ever transient context.

Personally, during this graduation process, I have also been working with my colleagues back in Ladakh to bring to reality a prototype version of this restoration module in Kulum. Hopefully, this becomes an example for many such vulnerable communities in Ladakh that have borne the brunt of climate change and are witnessing rapid demographic and livelihood transitions. However, the relevance of this thesis goes beyond the limits of Kulum and Ladakh and can extend to many such communities whose vernacular histories are threatened in the face of modern and fast paced times. For instance, while sustainable materials and inventing new materials takes over the architectural industry today, this thesis highlights that rather than the future, perhaps innovation may lie within the walls of our past and stories of our ancestors. This might even be relevant in many parts of Europe that has many settlements whose histories have been diluted with the onslaught of tourism, climate change and a general negligence of architectural preservation.

Finally, I hope this thesis not only proposes a restoration mechanism and module but also highlights the increasing vulnerability of communities in extreme climates and the need to consider the same in the field of architecture.



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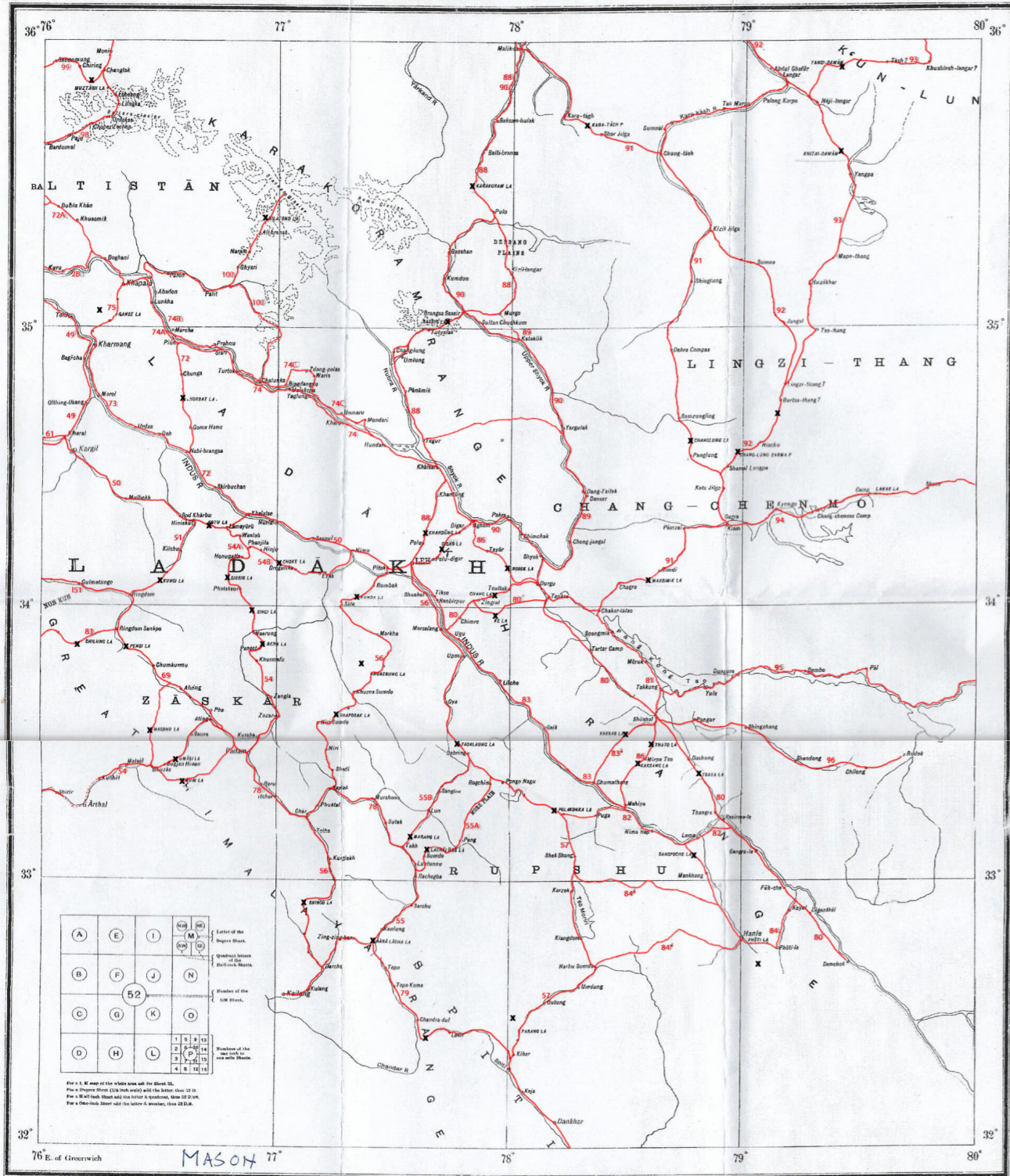
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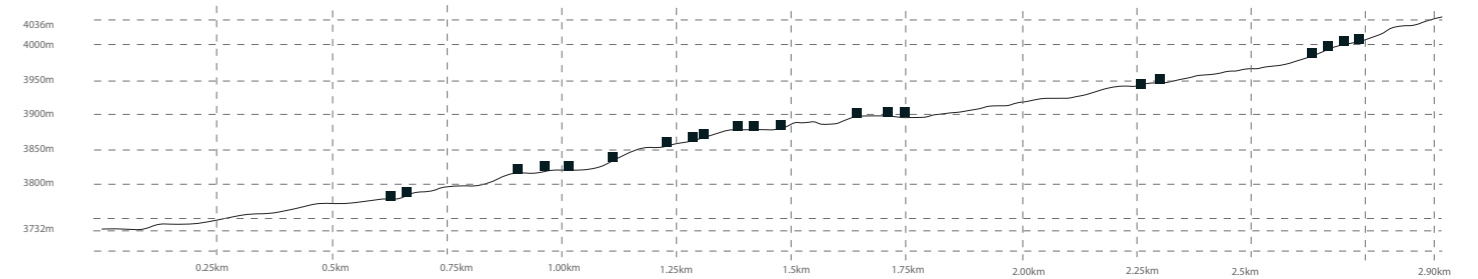
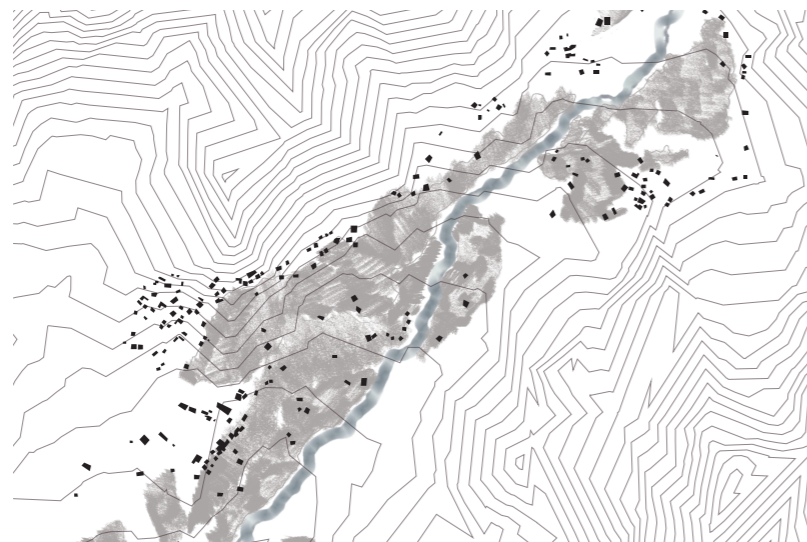
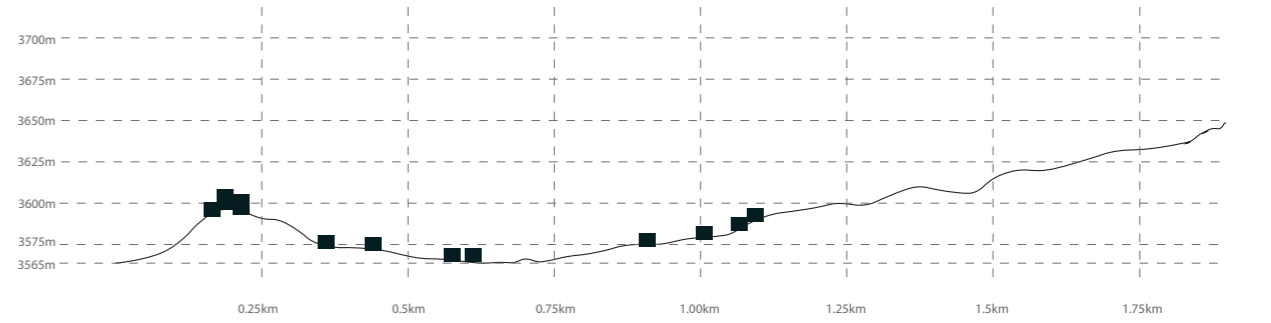
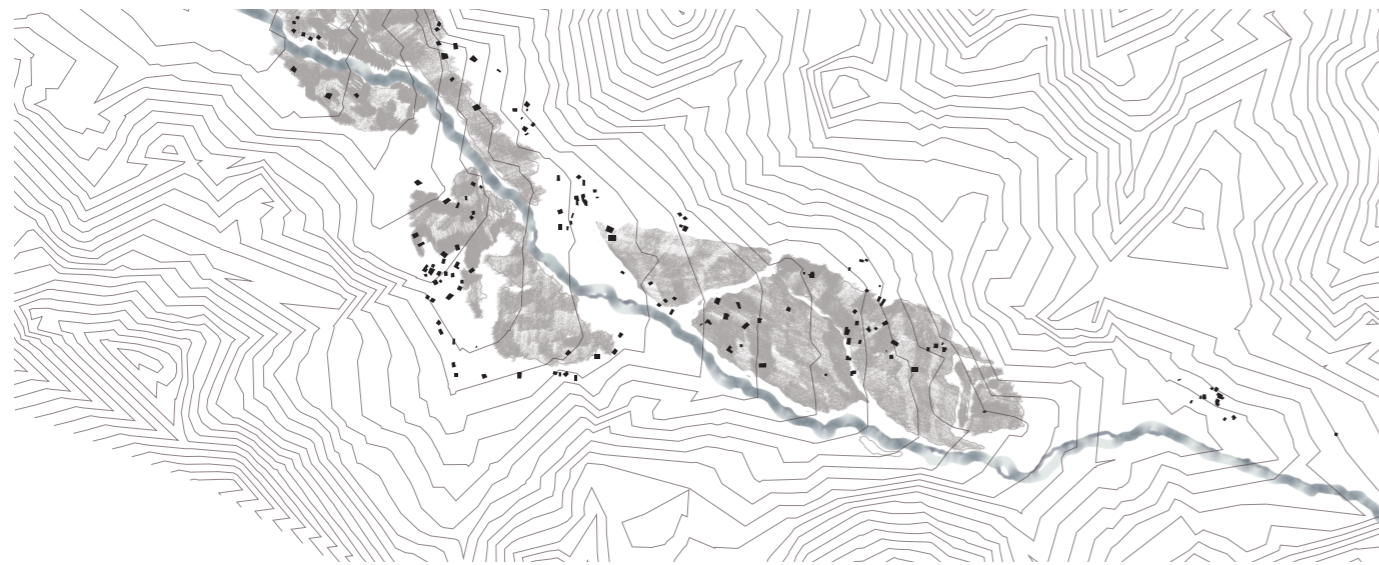
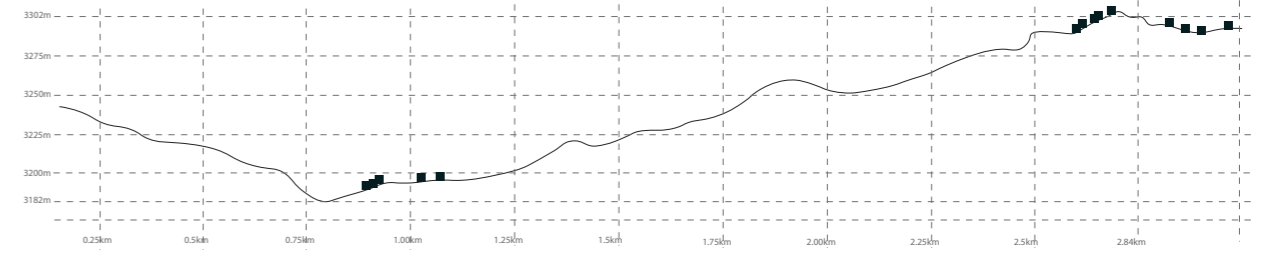
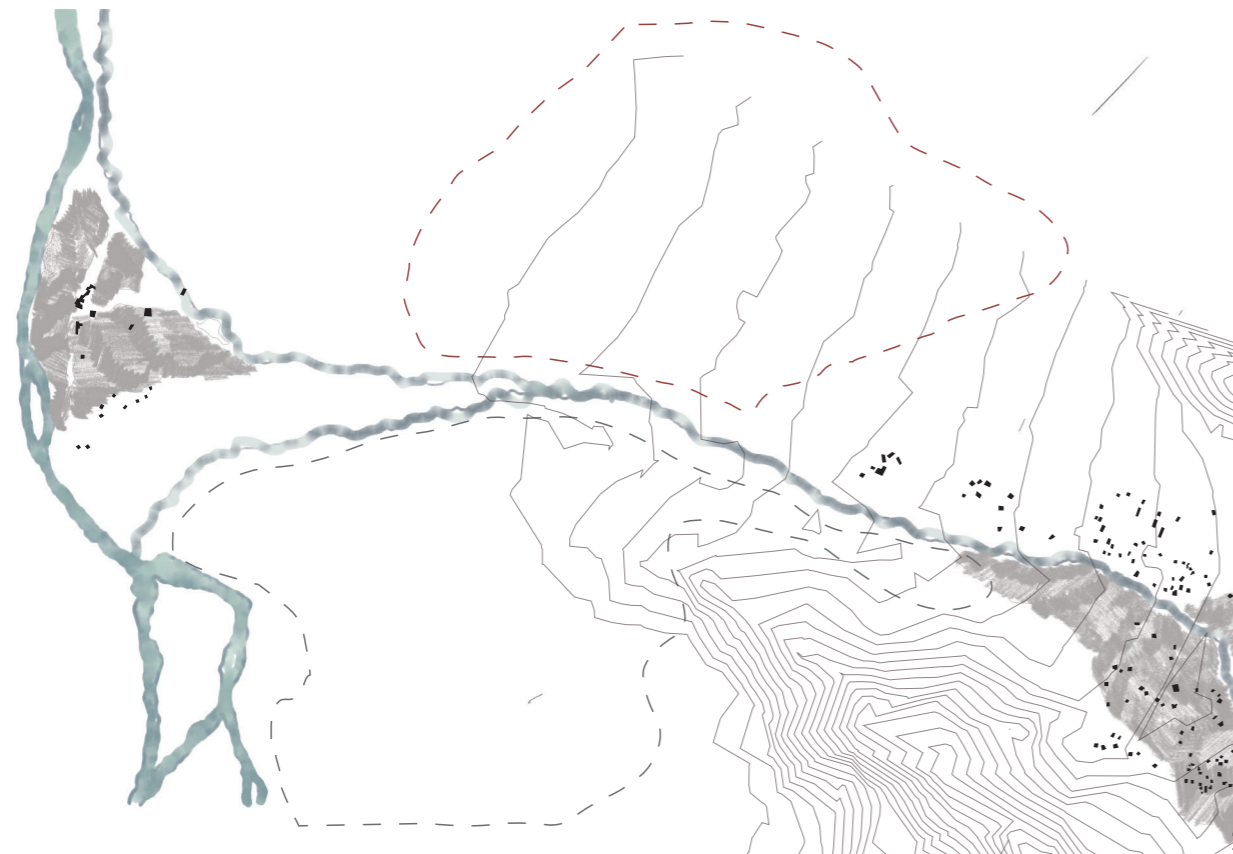
Padma Namgyal, Shyamal Sarkar, Ramesh Kumar, Vulnerability assessment of rural households to climate change using livelihood vulnerability framework approach in the trans-Himalayan region of Ladakh, India

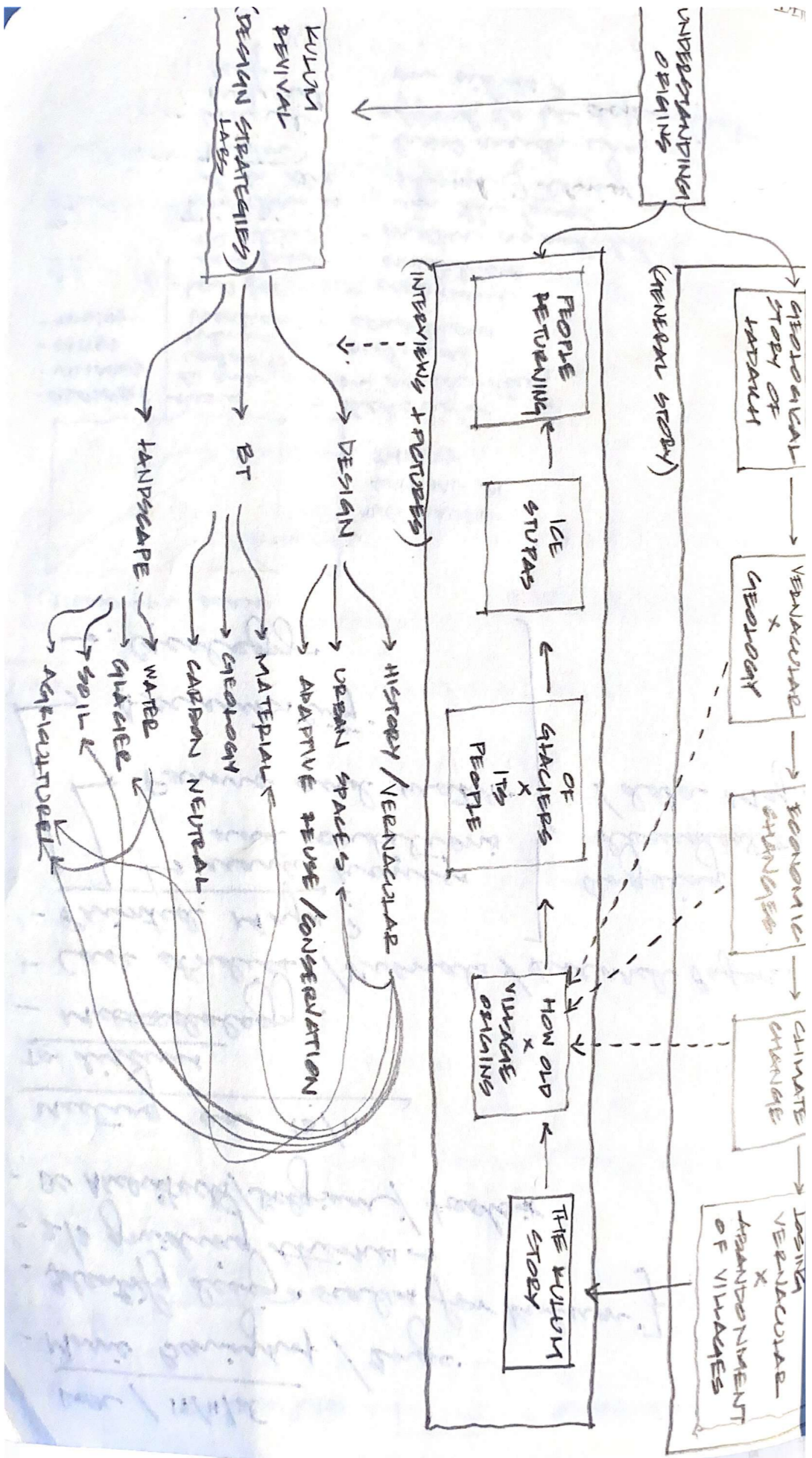
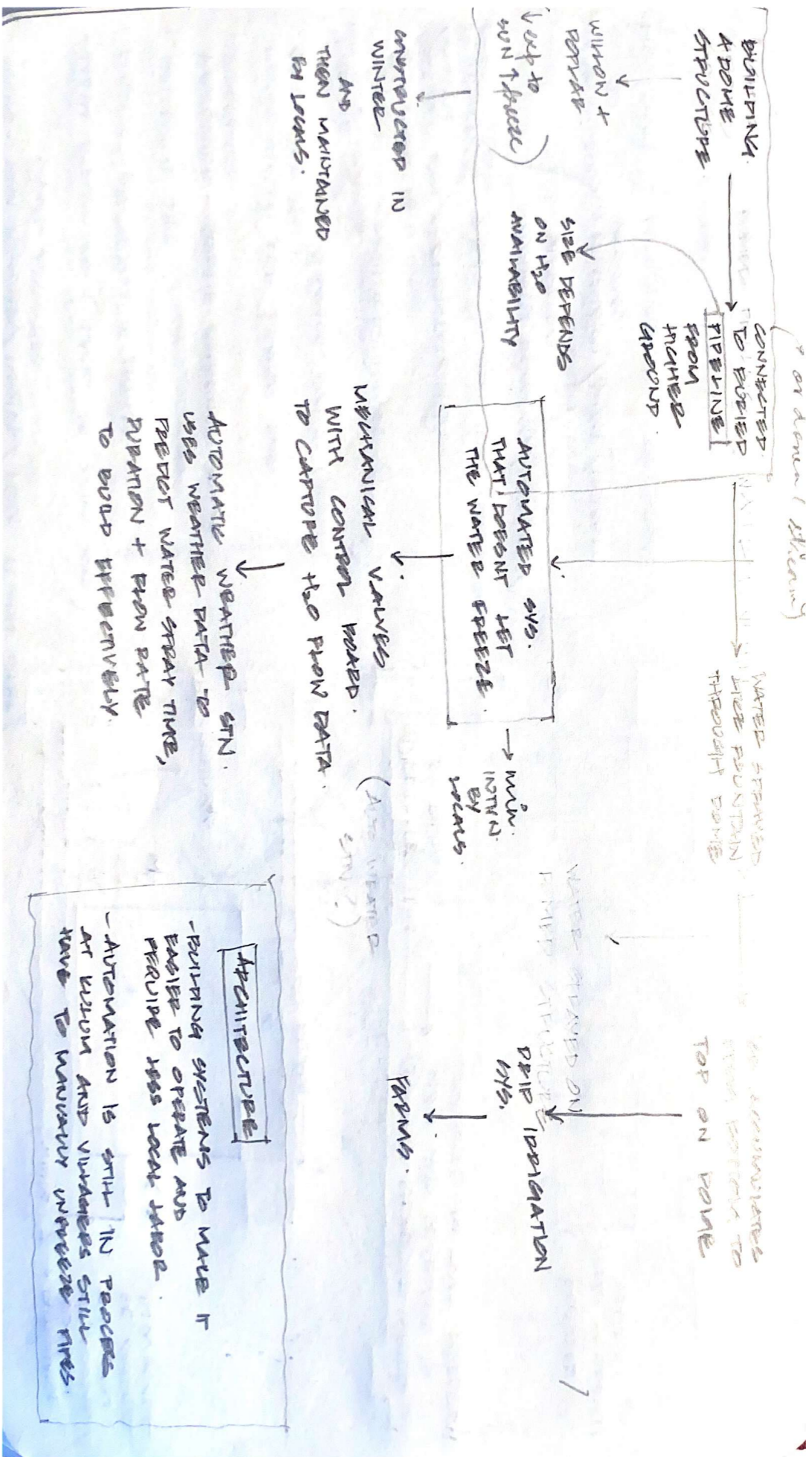
Building Processes and Challenges Ladakh by Debasish Borah, pg70

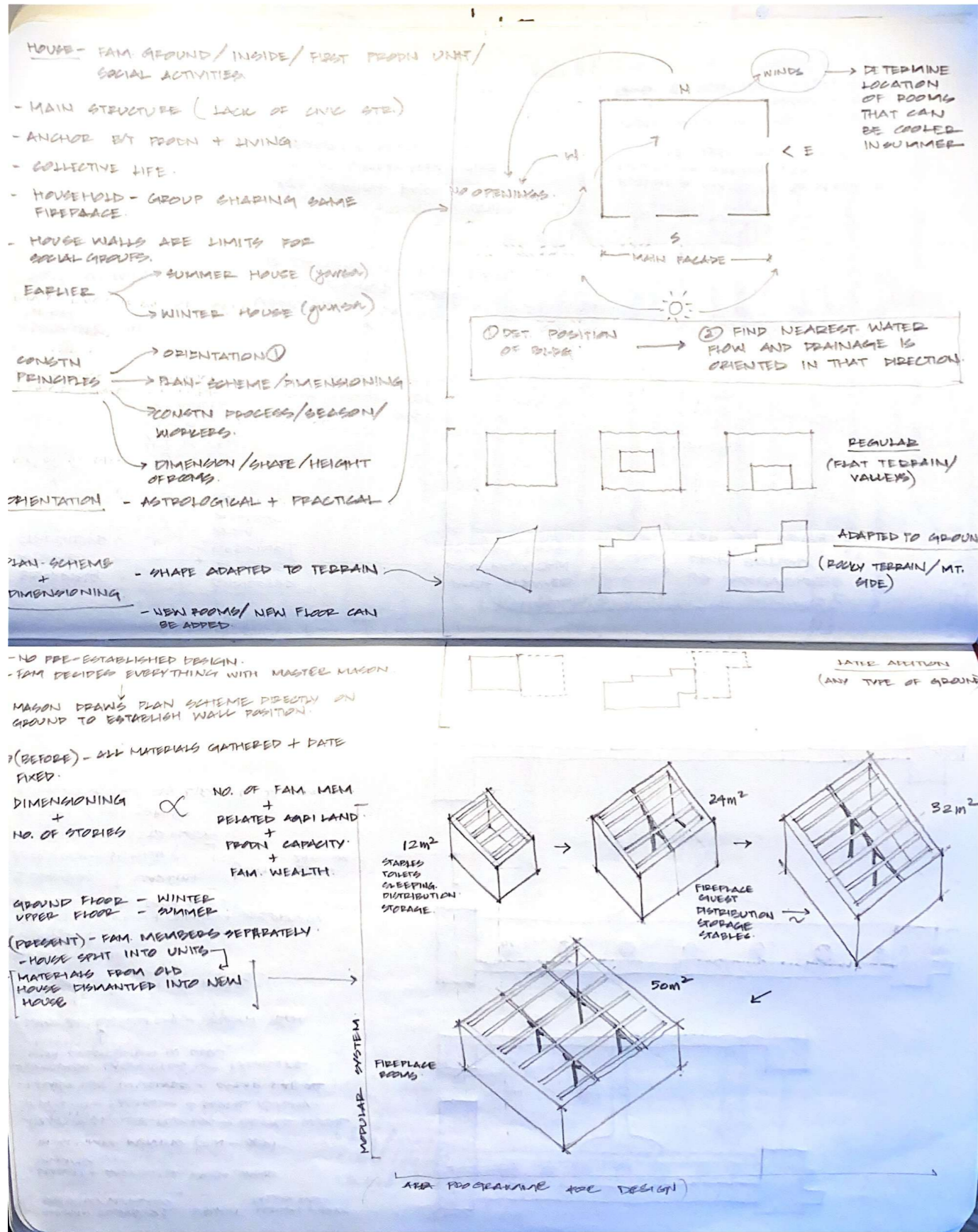
Appendix











CONSTRN PROCESS / SEASON / WORKERS

- (PAST) - MASON + FAM TAKES PART
- MASON + CARPENTER FROM SAME VILLAGES
- IN SUMMER MONTHS (JUN - SEP)
- (PAST) → SLOWER PROCESS → BETTER WORK
- (PRESENT) → FASTER → ↓ WORK QUALITY
- FAMILY NOT INVOLVED + CHEAP LABOR
- EXTERNAL LABORERS NOT FAMILIAR WITH CONSTRN IN HWL
- LOSS OF KNOWLEDGE + CONSTRN TECH

DIM / SHAPE / HEIGHT OF ROOMS

SMALL ROOMS

CHANGSA ↑

SYS OF COLUMNS + PRIMARY + SECONDARY BEAMS → LARGE ROOM GRIDS

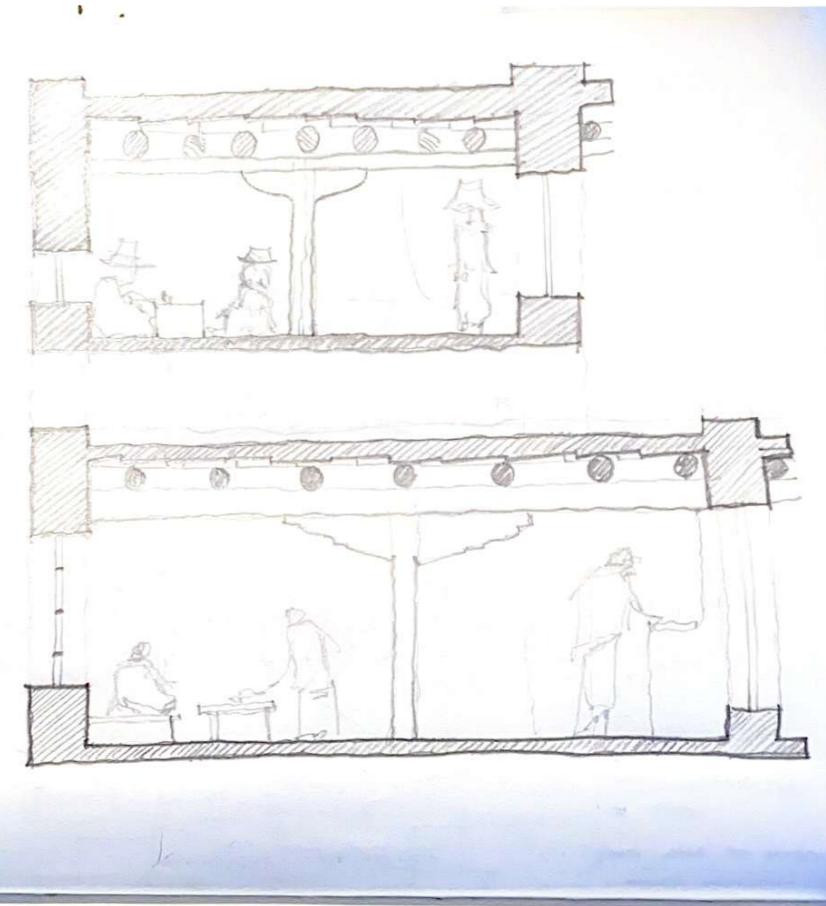
↓ CEILINGS ↑ WARMTH

ACTIVITIES - SITTING

WINDING CLOSE TO FLOOR

NO FURN / LOW TABLES

ANTHROPOMETRY AS MEASURING TOOL



CONSTITUENT HOUSE PARTS

1) STABLES

- BASEMENT ANIMALS → ↑ HEAT
- SMALL OPENINGS → HARDEST
- WINDOWS ONLY FOR VENTILATION
- PPL / FODDER

2) FIREPLACE / CHANGSA

LIVING + DINING + STOVE

CENTRAL SPACE

1st FL - COMMON

2nd FL - GUEST ROOMS

GROUND FLOOR - ↑ INSULATED

NEXT TO STABLES

HOUSE CAN HAVE MULTIPLE

(PRESENT) → CHANGSA USE ↓ INSULATED

WINTER CHANGSA VS SUMMER CHANGSA

(OLD) ASSEMBLY HALL FOR VILG

↓ HOUSE = ONLY LIVING SPACE CHANGSA

MARKER OF HOUSEHOLD WEALTH

— FIREPLACE

— MAIN PILLAR / PILLAR

— SHELVES

3) STORAGE ROOMS

- latrine
- chana fermentation room
- wood
- fodder
- dry dung
- cold room
- weed storage

