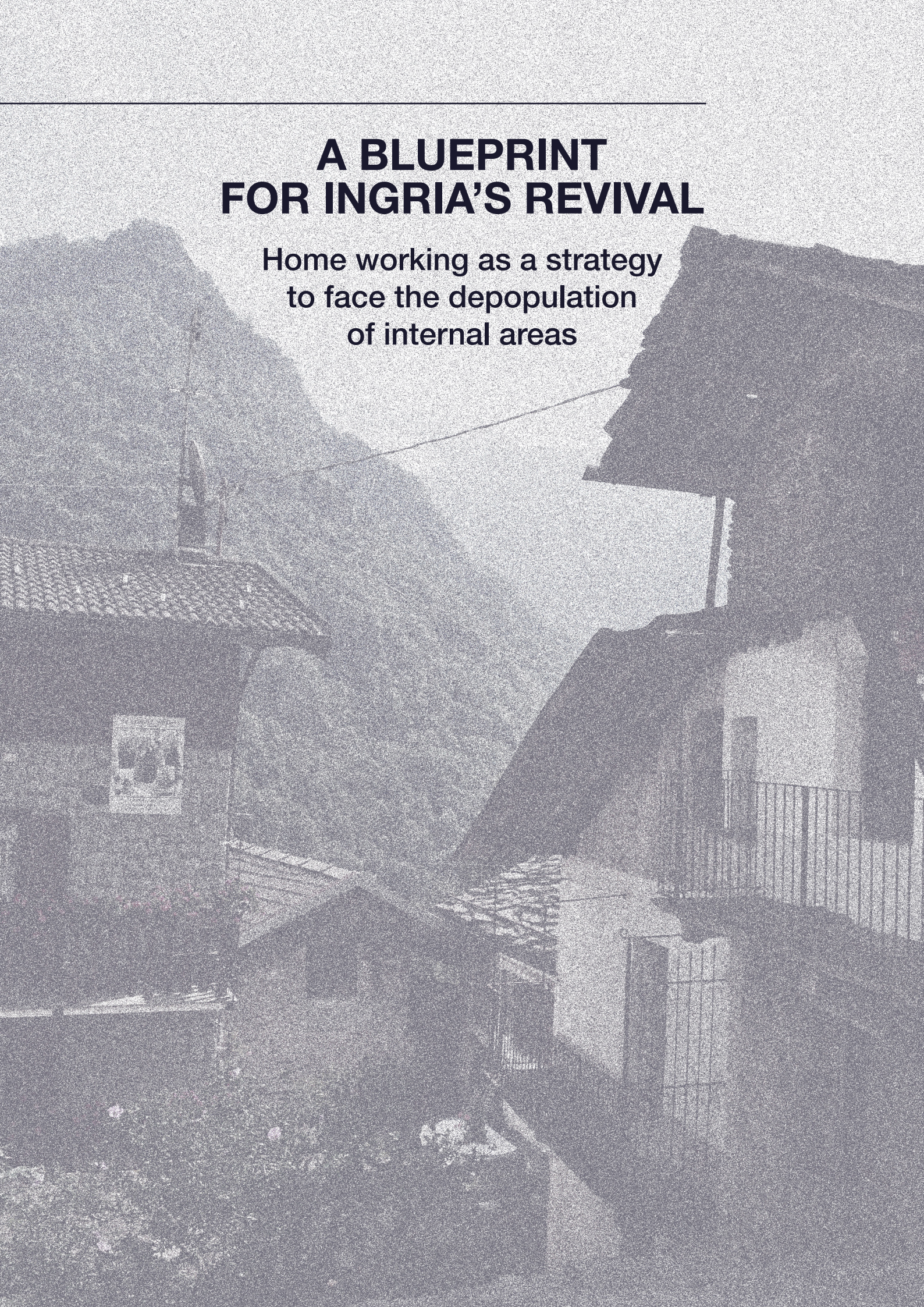
A BLUEPRINT FOR INGRIA'S REVIVAL

Home working as a strategy to face the depopulation of internal areas



“*In the darkness the imagination works more actively than in full light.*”

Immanuel Kant.

To myself, for always finding the strength to move forward, even in the darkest moments.

To my dad, for always standing by my side and helping me rise after every fall.

To my mom, for teaching me the true value of sacrifice and hard work.

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A Blueprint for Ingria's Revival.

Home working as a strategy to face the depopulation of internal areas

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LIST OF ABBREVIATIONS

AQI	Air Quality Index
ASL	Above Sea Level
CAM	Minimum Environmental Criteria
CO2	Carbon Dioxide
CS	Coworking Space
EC	Embodied Carbon
EE	Embodied Energy
EPS	Expanded Polystyrene Sintered
ERDF	European Regional Development Fund
FSC	Forest Stewardship Council
GHGE	GreenHouse Gasses Emission
HVAC	Heating Ventilation and Air Conditioning
NO2	Nitrogen Dioxide
NZEB	Net Zero Energy Building
OECD	Organization for Economic Cooperation and Development
PEFS	Programme for the Endorsement of Forest Certification
PM	Particulate Matter
SBS	Sick Bulding Syndrome
SNAI	National Strategy for Inner Areas
SWB	Subjective Well-Being
VIP	Vacuum Insulated Panel
VOC	Volatile Organic Compound
WFH	Working From Home
WFO	Working From Office
WHO	World Health Organization
WLB	Work Life Balance
XPS	Extruded Expanded Polystyrene

ABSTRACT

English

The Covid-19 pandemic has had a profound impact not only on the employment landscape, significantly influencing the balance between work and private life. Furthermore, overpopulation and the lack of green areas have called into question the quality and lifestyle of in cities, which until the 2020 seemed untouchable. For these reasons, over the past century, the internal areas of many countries have witnessed an uninterrupted depopulation in favor of urban centers. This ongoing migratory flow led, on the one hand, to increasingly larger and increasingly polluted cities, and on the other to internal locations losing their architectural, historical and cultural heritage. Therefore, not only social fabrics, local economies and traditions have been lost, but also all the infrastructures required for human settlement.

Thanks to advancements in technology and the internet, the spread of remote work, and a rethinking of city life, these internal areas have been rediscovered, revealing previously underestimated human and territorial capital, especially in the aftermath of the pandemic. Working remotely, and therefore not necessarily in the office, has in fact allowed workers to reconnect and strengthen their relationship with nature, to improve their quality of life and revitalise areas once considered neglected all while distancing themselves from the demands and pressures of urban life and its increasingly unhealthy environment.

With the support of the NODES project funding, this thesis aims to demonstrate how remote working can function as an effective strategy to address the depopulation phenomenon of these territories. This work specifically focuses specifically on an abandoned building in the heart of Ingria, one of the municipalities in the Soana Valley in the province of Turin and which has been most affected by the demographic decline and the subsequent economic decline. The reuse of existing vernacular structure poses a series of considerations, challenges and opportunities that are becoming increasingly central in the context of sustainable architecture.

Are municipalities and workers adequately prepared for this new world of work?
Are modern technologies capable of integrating with traditional solutions and strategies?

ABSTRACT

Italian

La pandemia di Covid-19 ha avuto un profondo impatto non solo sul mondo del lavoro, ma anche e soprattutto sui rapporti tra vita lavorativa e vita privata. Inoltre, il sovrappopolamento e la carenza di aree verdi hanno messo in discussione la qualità e lo stile di vita delle città, che fino al 2020 sembravano essere intoccabili. Per questi motivi, per quasi un secolo, le aree interne di tutti i Paesi hanno assistito a un ininterrotto spopolamento a favore dei centri urbani. Questo incessante flusso migratorio ha comportato ovviamente da un lato città sempre più grandi e sempre più inquinate, e dall'altro, allo stesso tempo, località interne che perdono i loro patrimoni architettonici, storici e culturali. Si sono persi perciò, e continuano tutt'ora a perdersi, non solo tessuti sociali, economie locali e tradizioni, ma anche tutte le infrastrutture che un insediamento abitativo richiede.

Grazie all'avanzamento delle tecnologie e internet, alla diffusione del lavoro da remoto e al ripensamento della vita cittadina, quelle aree interne sono state riscoperte, dimostrando di possedere un capitale umano e territoriale completamente sottovalutato, in modo particolare all'indomani della pandemia. Lavorare da remoto, e quindi non necessariamente in ufficio, ha permesso infatti ai lavoratori di riscoprire e rafforzare il rapporto con la natura, di migliorare la propria qualità di vita e di dare una seconda possibilità a località ormai considerate senza speranza, allontanandosi così dalla frenesia della città e dal suo ambiente sempre più insalubre.

Con il sostegno dei fondi del progetto NODES, questa tesi vuole fornire un esempio di come il lavoro da remoto possa essere un'ottima strategia per fronteggiare lo spopolamento di questi territori. Il lavoro si concentra nello specifico su un edificio abbandonato nel cuore di Ingria, uno dei comuni della Valle di Soana in provincia di Torino e che più di tutti ha sofferto il declino demografico e il conseguente declino economico. Il riuso di una struttura vernacolare esistente pone una serie di ragionamenti, sfide e opportunità che sono sempre più centrali in un contesto di architettura sostenibile.

Sono i comuni e i lavoratori preparati per questo nuovo mondo del lavoro?
Sono le tecnologie moderne pronte a dialogare con le soluzioni e strategie tradizionali?

INTRODUCTION

1 SOANA VALLEY

The thesis study focuses on a small municipality called Ingria in the Soana Valley. It is necessary to first make a general overview of the valley in order to better understand the dynamics of the town, and consequently the theme of the thesis itself.

Soana Valley it is one of the valleys of the Eastern Graian Alps and located in the upper Canavese area, part of the metropolitan city of Turin.
The valley has long been a site of human habitation that reflects a deep relationship between architecture, culture and natural environment.

The morphology is not very suitable for livestock breeding and for the practicing agriculture, therefore the economy of the valley since the 1920s has been based mainly on the presence of the hydroelectric production plants of the Turin Metropolitan Energy Company (now IREN S.p.A), thus constituting a great opportunity for development from traditional seasonal itinerant crafts, such as boilermakers, chimney sweepers.

However, since the 1950s with the economic boom, the valley, as well as worldwide internal areas, has been subject to a phenomenon of emigration towards the cities in search of better living conditions.

2 SILENT LANDSCAPES

This chapter addresses the problem of depopulation of the internal areas, as it represents a critical challenge for sustainable development, cultural preservation and environmental administration in these unique and fragile regions. By internal areas we mean *all those areas significantly distant from the centers offering essential services (education, health and mobility), rich in important environmental and cultural resources and highly diversified by nature and as a result of centuries-old processes of anthropization*[1]. Alpine areas, one of those internal areas, are experiencing a steady decline in population due to a combination of economic, social and environmental pressures.

This exodus began with the Industrial Revolution in the 1800s, as it offered rising industrialists higher wages and better living conditions, but also better accessibility. It is a process that began about 200 years ago, but which is destined to continue: in fact, "*at the beginning of the 19th century the population living in the city was just 10% of the overall population*"[2], nowadays however lives more than 50%.

It is also necessary to mention how the reduction in services, such as infrastructures or technology services, further accelerates outmigration, creating in this way a vicious cycle of decline.
The Soana Valley is a perfect example of this phenomenon which unfortunately has profound implications for the cultural heritage, economic viability and ecological health of mountainous areas. Understanding its demographic changes provides valuable insights into the challenges and opportunities faced by its communities.

1 Ministero dell'Instruzione del Merito. (online)
2 S. De Rubertis, Dinamiche insediative in Italia: spopolamento dei comuni rurali. (online)

3 NEW WAY OF LIVING

The chapter focuses on the topic of smart working, understood as a new way of conceiving both work and the relationship between work and private life. This concept has evolved significantly over the past few decades, transforming from a niche arrangement to a mainstream work model. The proliferation of high-speed internet, cloud computing and digital communication tools has expanded the feasibility of working from home within various industries. Time after time it became evident that remote working not only could offer more than just temporary solution during the pandemic crisis, but also it could serve as a viable long-term work arrangement.

In fact, precisely because of its characteristics and its innumerable positive effects, smart working can be evaluated as the main strategy in addressing and solving the problem of mountain depopulation.

From the perspective of architecture for sustainability, working from home represents unique opportunities and challenges because sustainable architecture seeks to minimize the environmental impact of buildings and promote a healthier living and working environment. The widespread of this new way of working and living can influence various aspects of sustainable design, including energy consumption and the planning of residential spaces.

4 REMOTE REVIVAL

In recent years, the advent of widespread WFH, especially after the pandemic crisis, has fundamentally reshaped where people live and work. Thanks to big technological advancements, many professionals are no longer tethered to urban center and the related urban life. They are increasingly seeking new rural and mountain sights because of their typical natural beauty, tranquility and above all for their better quality of life. This shift brought to a new wave of immigration to these once-declining regions, offering a potential solution and strategy to the challenges of depopulation phenomenon that have plagued those remote communities for decades.

This chapter explores the factors driving this immigration and the demographic changes it brings, thanks to the experiences lived during the lockdowns, which brought remote working to the peak of its use and the consequent awareness of wanting that lifestyle even once the virus crisis was over.

By examining some case studies, this chapter aims to provide a comprehensive understanding of how WFH is transforming internal areas into desirable destinations for a new generation of residents.

5 HOME AS OFFICE

The biggest challenge of WFH is perhaps the home office environment where people spend most of their working day. This chapter, therefore, focuses on defining what are the design choices to obtain the best possible home office. Choices that very often didn't have the necessary time to consolidate due to the sudden shift from WFO to WFH caused by the COVID-19 emergency. This shift has highlighted the critical need for well-designed, functional and ergonomic office space.

The trend of home office design spread in 2021 with the purpose of helping architects and designers who saw an exponential growth of the traditional workspaces in domestic buildings, thus giving voice to all those interior design articles that offer ideas and tips. The integration of WFH into sustainable architecture also requires a holistic approach, considering the interconnection of workspaces and living environments. By understanding the adverse effects of inadequate home office design, this chapter digs in into how architects can create spaces that promote productivity whilst, in the meantime, mental and physical health, considering the various aspects of home office design, from spatial layout to material selection.

6 INGRIA

Ingria, one of the municipalities of the Soana Valley, is a small yet historically significant village that embodies the complexities and potential of revitalizing mountain communities. With a population of less than 50 inhabitants, it stands out not only as one of the smallest municipalities in Italy, but also, as the municipality in the valley that has suffered the most depopulation phenomenon. This unique demographic and geographic context present both challenges and opportunities for a sustainable development.

By considering remote working as the main strategy to contrast depopulation flow, this chapter analyses in details the actual state of a building in the center of Ingria through photographs and drawings. Furthermore, an analysis of all the factors that can make the project successful, the SWOT analysis, is also shown. In this way the design choices and solutions can be adopted with a better awareness.

7 SCENARIOS

The basic requirements for a suitable home office are mostly the same everywhere, whilst its design is influenced by personal requirements, by the family's members or by the available square-footage. This chapter presents two different design scenarios of the same house. The goal is to be able to suggest design solutions both for adults who work remotely and for families with children whose parents work remotely too. These are therefore two different requirements and different needs to be taken into account. In the building there are spaces not suitable at all to be retrofitted into apartments: they are used as coworking spaces with the aim of increasing and developing the sense of community that had been lost due to the demographic decline. The aim is to demonstrate how an abandoned home can be restored by using sustainable methods, creating functional and energy-efficient spaces able to integrate seamlessly with the local environment.

Thanks to the presentation of those two projects, the aim is to demonstrate how, through the adaptation of WFH, it is possible to revive municipalities considered hopeless and guarantee a sustainable lifestyle and quality of life. It is emphasized how the concept of city life as a synonym for a better life is now outdated, and, consequently, how the concept of rural life as a synonym for poor life must be rethought considering a different wealth. In fact, it is no longer a question of material wealth, but rather wealth in terms of quality of life, contact with nature and time for oneself and for family members.

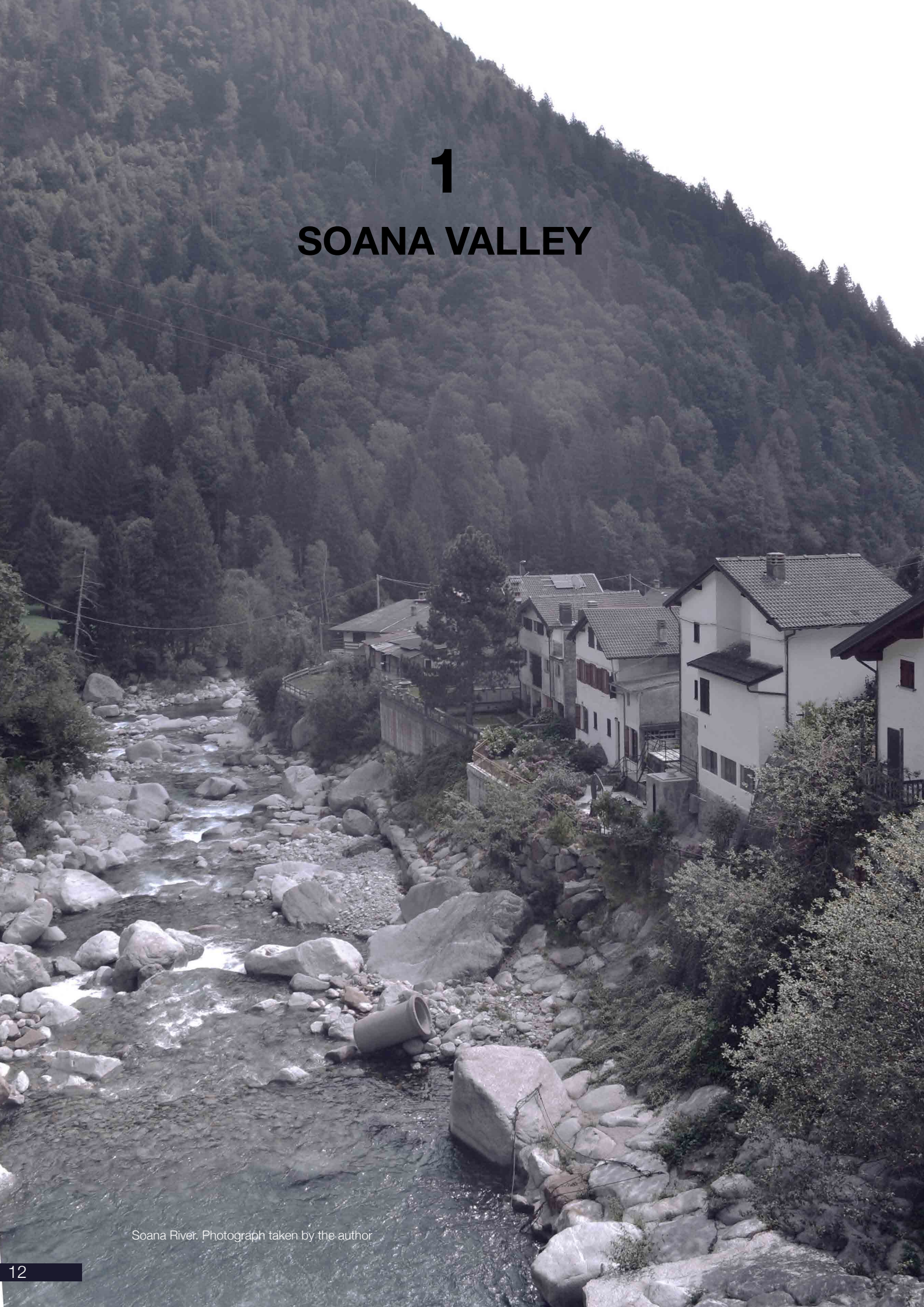
8 BALANCING TRADITION AND EFFICIENCY

These thesis proposals can be achieved because of NODES project (funded by MUR - M4C2 1.5 of the PNRR). It must, therefore, be explained which are the aims and which environmental and design criteria must be followed according to the guidelines.

One of the first points is to guarantee and ensure energy efficiency, especially for existing buildings since on one hand their reuse reduces carbon footprint, but on the other their old solutions can lead to greater energy consumption and costs. It must be checked and verified whether the passive design strategies typical of vernacular architecture are sufficient to guarantee not only compliance with the required environmental standards, but also the internal environmental comfort suitable for remote working.

Subsequently, this chapter focuses on the reasonings that led to certain design choices. Through simulation software and drawings, these choices are described and explained in more detail.

1
SOANA VALLEY



Soana River. Photograph taken by the author

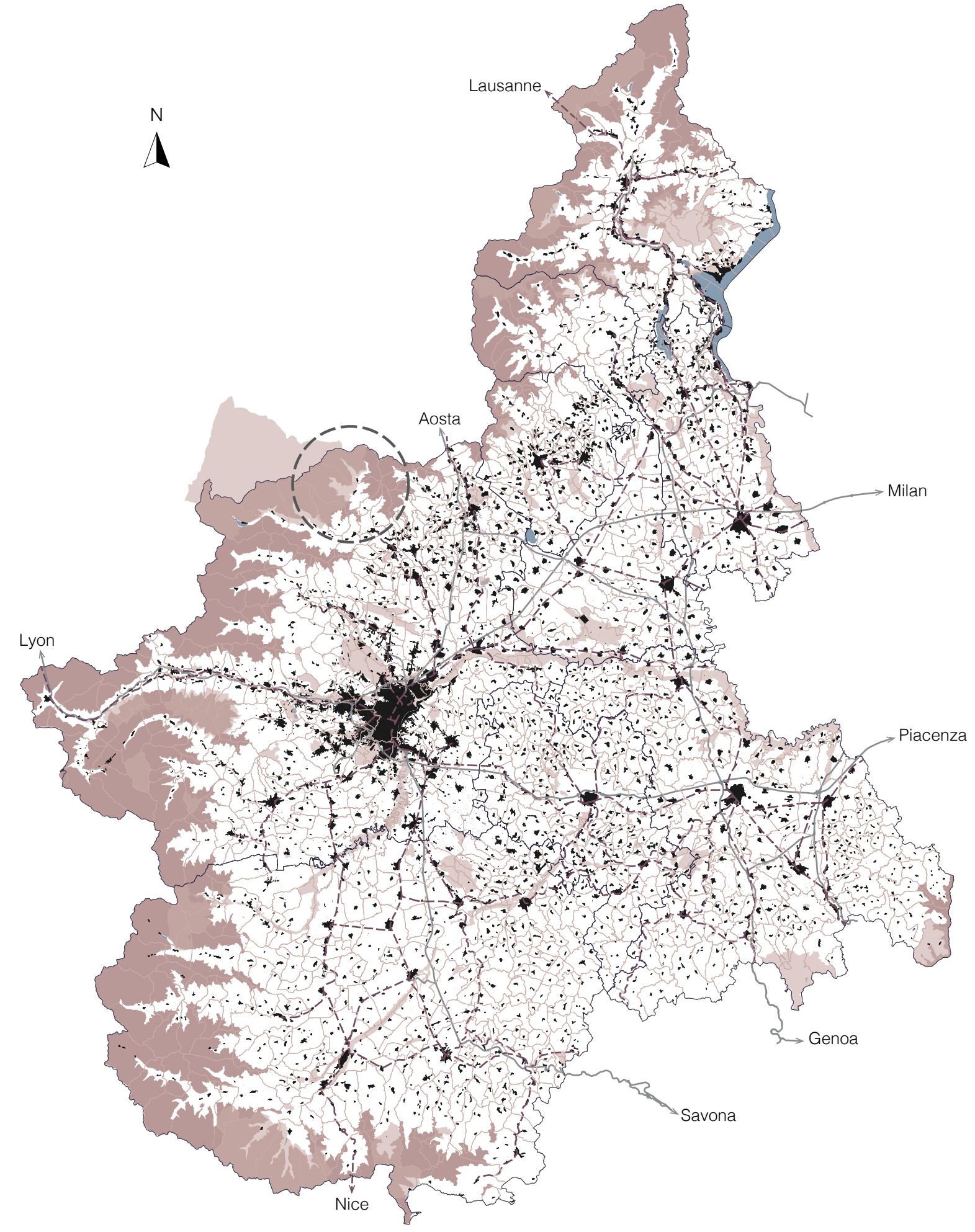
1.1 TERRITORIAL FRAMEWORK

The Soana valley, one of the Franco-Provençal valleys of Piedmont and whose gateway is Pont Canavese, is located on the Southern side of the Gran Paradiso Park and is wedged between the Orco Valley and the Chiusella Valley; whilst in the North it borders with Valle d'Aosta and France. The valley rises dramatically from about 800 meters above sea level at its entrance to over 3,300 meters at its highest peak of Monte Latina. The presence of the Soana River, along with numerous tributaries and glacial streams, has played a fundamental role in shaping the valley's geomorphology and from which the valley took its name.

Half of its territory is then confined within the Gran Paradiso National Park, the oldest national park in Italy established on 3rd December 1922 "*with the aim of conserving the fauna and flora and preserving the special geological formations, as well as the beauty of the landscape*"[3]. The park covers approximately 71,000 hectares between Valle d'Aosta and Piedmont and borders with the French Vanoise National Park. In the 2000s it was recognized as a site of community interest and in 2006 awarded with the European Diploma of Protected Areas, a title which was reconfirmed in 2012 together with the Vanoise Park. Finally, since 2014 it has been the only Italian park to be part of the global Green List of protected areas, a list created by the Council of Europe and represents "*the first global standard for the evaluation of Protected Areas*"[4] with the aim of "offering recognition to those protected areas which are actually the best in terms of naturalistic conservation and sustainable management" (IUCN, Comitato Italiano, online). Among all the territories within the protected areas, the Soana Valley is the only one that can boast the highest biodiversity index.

Geographically, the Soana Valley covers approximately 45 square kilometers from its alpine peaks to the lower elevations, encompassing a diverse range of topographical features and it is traversed by the main river Soana River and its numerous tributaries. The valley is then made up of five municipalities: Ingria which represents the natural entrance to the valley; Ronco Canavese, considered the capital of the valley as it is the largest and most populated; and Valprato Soana, divided into the valleys of Campiglia and Piemprato; Pont Canavese and Frassinetto, which are the municipalities bordering with the valley adjacent to the Orco valley.

3 Regio Decreto-Legge 3 dicembre 1922, n.1584. (online)
4 IUCN, Comitato Italiano. (online)


N
Lausanne
Aosta
Milan
Lyon
Piacenza
Genoa
Savona
Nice
0
10km
20km
30km
40km

PIEDMONT FRAMEWORK

Cartographic source: Geoportale Piemonte

LEGENDA:

Highways

Railways

Province

Municipalities

Cities

Mountains

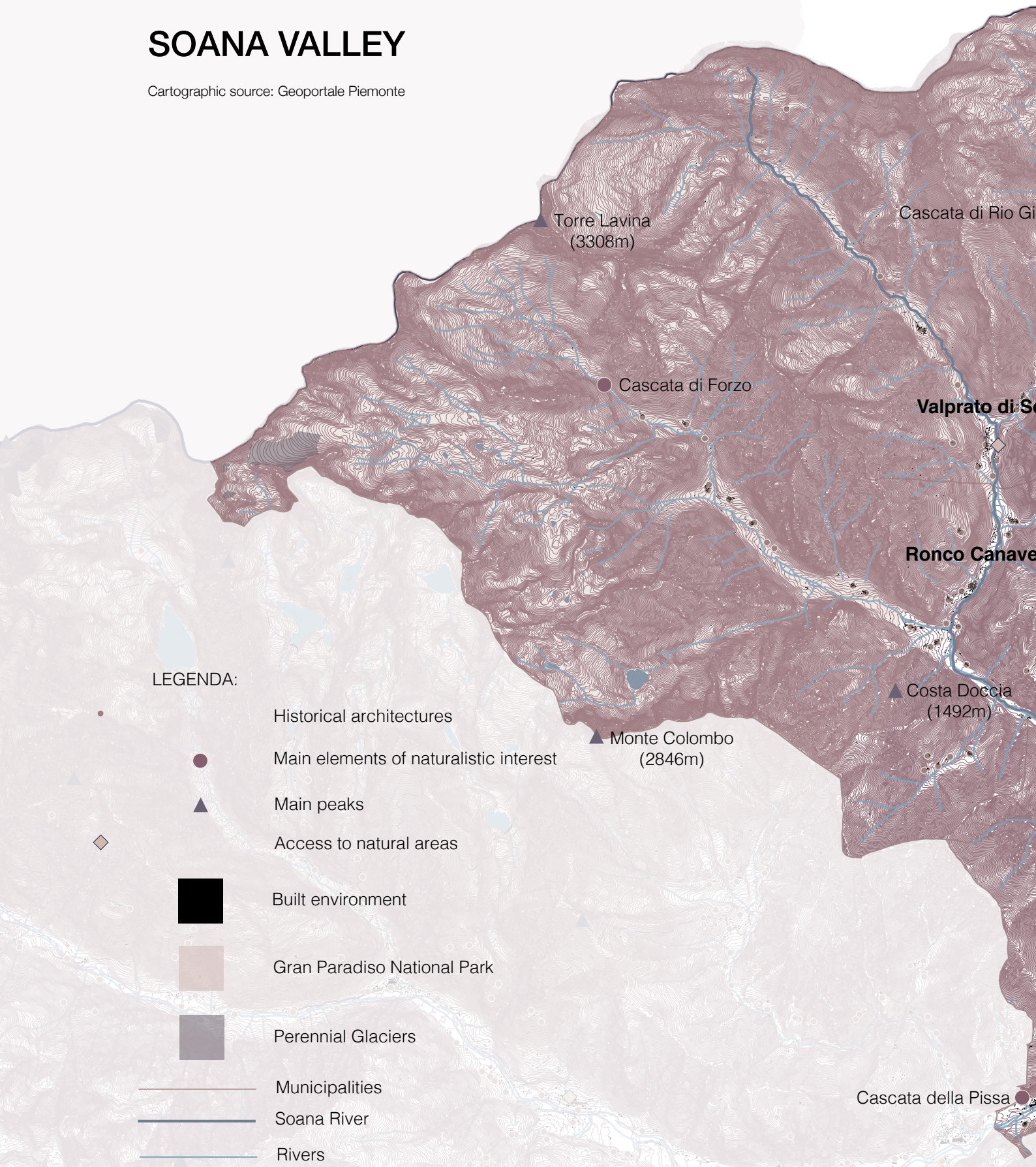
Parks

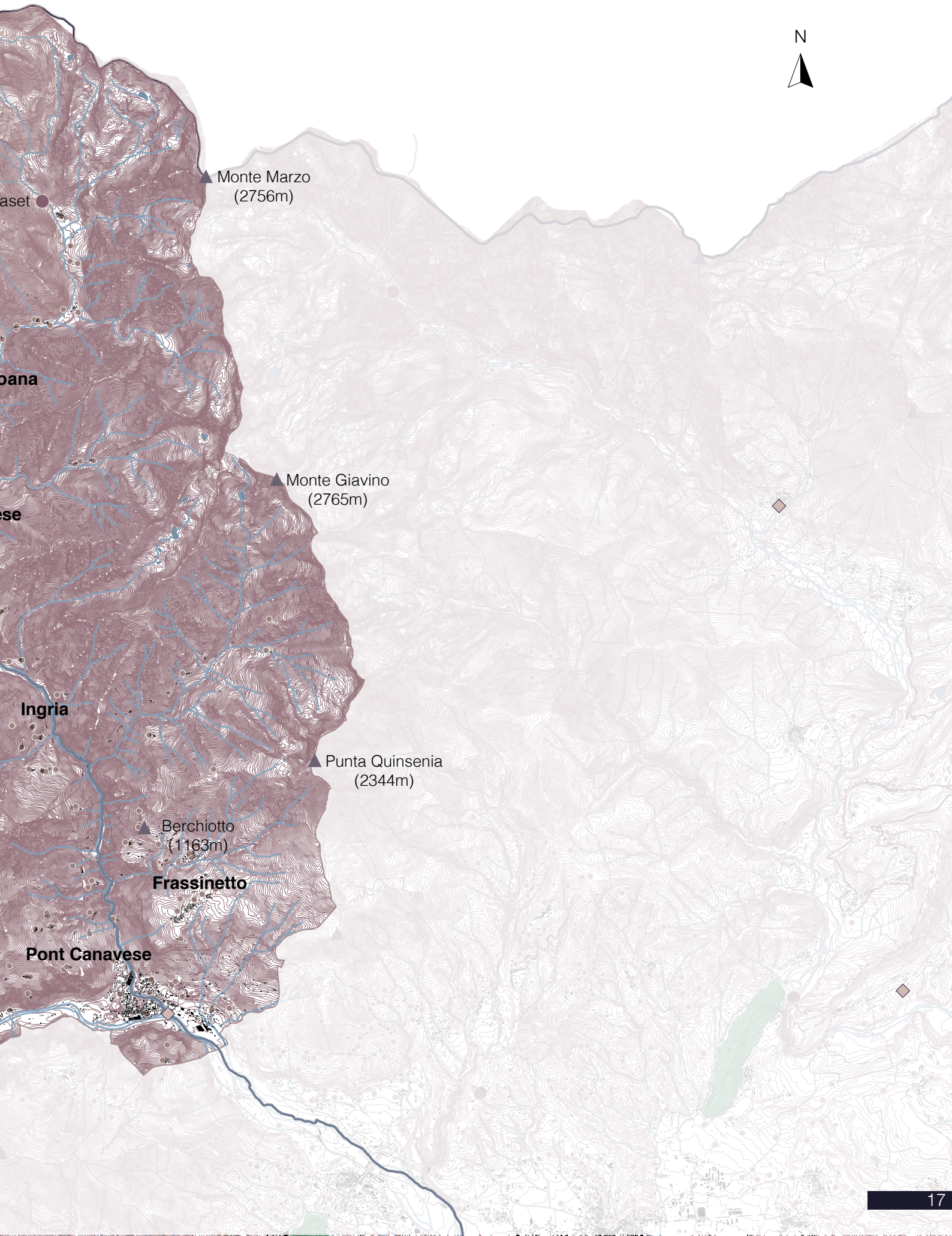
Lakes

Soana Valley

SOANA VALLEY

Cartographic source: Geoportale Piemonte




N
Monte Marzo
(2756m)
aset
oana
Monte Giavino
(2765m)
ese
Ingria
Punta Quinsenia
(2344m)
Berchiotto
(1163m)
Frassinetto
Pont Canavese

1.2 HISTORICAL BACKGROUND

The historical framework of the Soana Valley can be tracked back to ancient times because its strategic location with its natural passes though the Alps, made it a vital corridor for trade and communication between the Italian Peninsula and Transalpine regions. In fact, archeological evidences suggest that the area was inhabited since Neolithic period 5.500 years ago, with early human activities centered around hunting, gathering and rudimentary form of agriculture.

The valley fell under the influence of the expanding Roman Empire during the II century BC, defeating the Salassi in 25 BC, a people of Celtic origins who invaded the Aosta Valley and the upper Canavese between the IV and VI century BC. Some of them got away from Roman repression by settling in the Soana Valley, starting mining activities.

Following the fall of the Wester Roman Empire in 476 AC, the valley, like many other alpine regions, experienced a series of invasions and migrations; it became a contested frontier during the early medieval period, witnessing the incursions of the Germanic tribes and later the Lombards. The establishment of the feudalism brought about changes in the social and economic structure of the valley: feudal lords, such as Pont lords, and monastic orders, such as bishop Leone of Vercelli, played crucial roles in the development of the agriculture, from the clearing of forests, and the establishment of settlements. The medieval period also saw the construction of numerous religious and defensive structures, many of which have survived to these days. The presence of churches, chapels and castles from this era provides valuable insights into the valley's medieval society.

The Renaissance brought not only a period of economic growth, but it was also a time of challenges due to conflicts and plagues that affected the population.

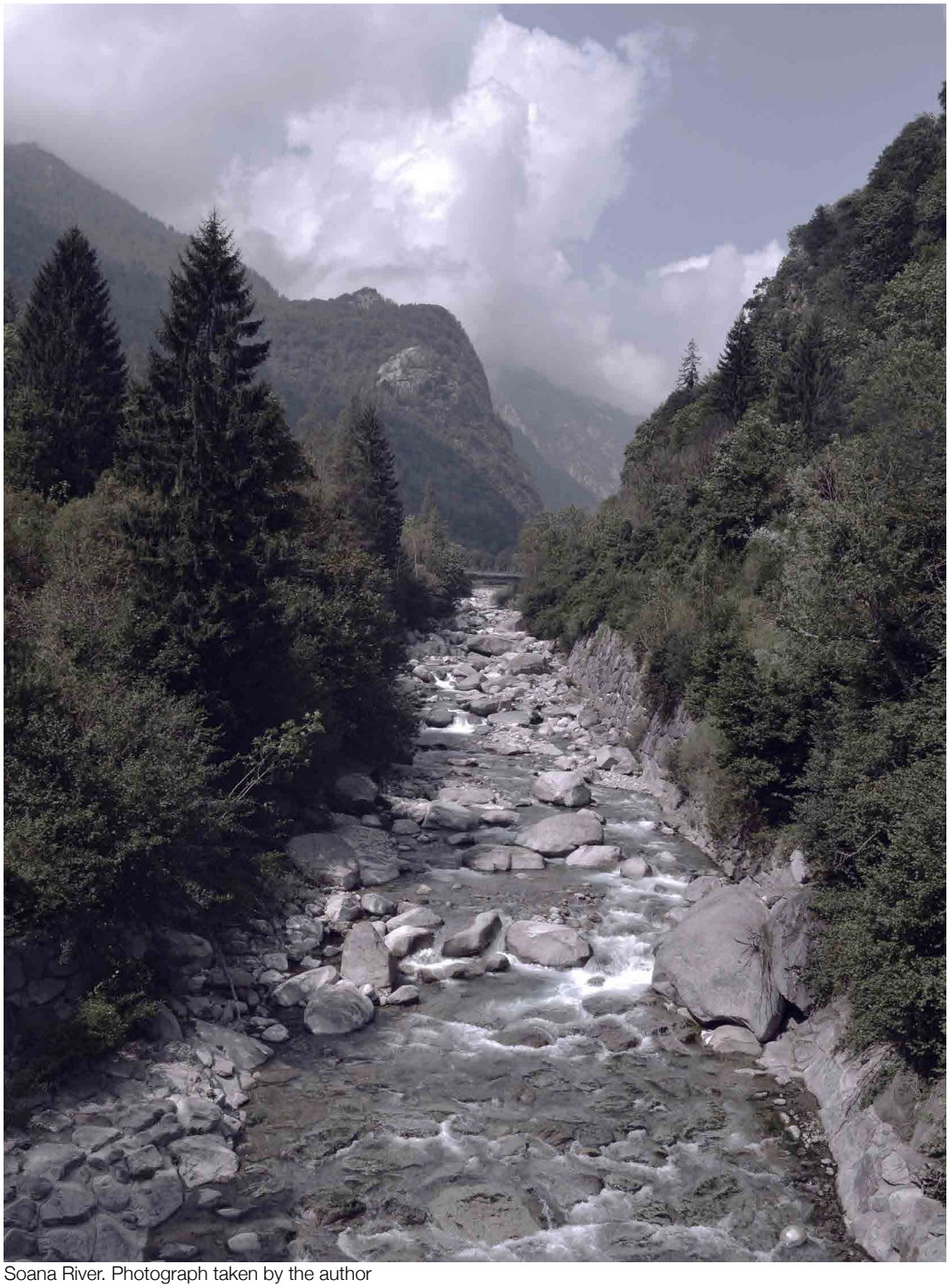
The strategic importance of the valley continued into the modern era, particularly during the Napoleonic Wars. Napoleon annexed the Canavese area to the French Republic in 1796, introducing the cultivation of potatoes and corn. Thanks to the Restoration, the Soana Valley returned to be an Italian territory, becoming part of the province of Ivrea.

In the 20th century, the Soana Valley underwent significant transformations. The establishment of the Gran Paradiso National Park in 1922 marked a turning point in the valley's history, with a shift towards conservation and tourism. The protection of the

valley's natural environment became a priority, leading to the preservation of its unique landscapes and biodiversity. This period also saw changes in the socio-economic fabric of the valley, with traditional agricultural practice giving away to new economic activities, also due to its not suitable morphology, centered around tourism and sustainable development.

Since the 1920s, the Soana Valley represented a strategic place for the development of hydroelectric projects, thanks to the steep gradient and consistent water flow throughout the year that are critical factors which enhance this feasibility; in addition, the valley's narrow gorges and natural basin, created by the Soana River, provide ideal sites for the construction of dams and reservoirs. In particular, in 2023 the municipalities of Pont, Frassinetto, Noasca (one of the mucipilities of the Orco Valley), Ingria, Ronco and Valprato signed the constitution of the association the Fervores energy community in collaboration with the Iren Group. In this way the valley will have the power to create renewable energy production plants with the aim of "enhancing the resources of the territory, encouraging energy production interventions from renewable sources and a conscious and rational use of energy, for the correct development of local supply chains".

5 Gruppo Iren. (online)



Soana River. Photograph taken by the author

1.3 THE TRADITIONAL ARCHITECTURE

The typical architecture of the Soana Valley is a remarkable example of how traditional building practices can harmonize with the natural environment to create sustainable and resilient communities. In fact, in one hand it evolved being influenced by the valley's isolation and by the consequent necessity for self-sufficiency; on the other hand, the buildings were developed very close to each other in such a way as to create, especially during the isolation of the winter months, both real protection from the elements and cooperation between the various families. As in all rural settlements, the heart of the village was made up by the church, the town hall or the fountain, the latter together with the oven, the mills and the press were available to all citizens.

The architectural development that can be observed in the Soana Valley is still at a rustic stage; farmhouses often used to include living quarters, stables and storage spaces under one roof, facilitating the management of livestock and agricultural activities. The typical rustic house in this valley is called *mesùn*[6] and is characterized by symmetry and regularity. The ground floor is usually reserved for animals and storage, which are side by side; while the upper floor, reachable by a wooden staircase, serve as living spaces, benefiting from better light and ventilation. This scale enters into a wooden balcony, called *lobia*[7], which can even surround the house for three quarters; on the one hand it disengages the rooms, on the other it constitutes a sheltered outdoor space to enjoy. On the first floor you can find the kitchen; while the sleeping area was located either next to the kitchen separated by dividers or on the upper floor, which was accessed via an internal wooden staircase. The top floor was rarely used as a barn, it was used rather as food storage. This type of home is also characterized by an alignment of the rooms so as to be able to equally exploit the benefits of the exposure of doors and windows towards the south; the north side instead has only the necessary openings.

In flat areas, with few trees and best protected from atmospheric events, this type of house just described, evolves into a larger and more massive structure, whilst still maintaining the same functional distribution between the various floors. In these cases, you can see how on one side the plan takes on a square shape; on the other side, the kitchen turns out to be not only the main space but also the largest one.

6 O. Baldacci, *Osservazioni di geografia antropica sulla Val Soana*, p.140. (online)
7 O. Baldacci, *Osservazioni di geografia antropica sulla Val Soana*, p.141. (online)

Furthermore, in the grazing areas of the valley we find yet another type of house called “hut”: a structure with two floors above ground, connected by a wooden staircase, and built in dry stone. The distribution of the rooms is always the same: the stable on the ground floor and the kitchen on the upper floor, always reflecting a functional and pragmatic spatial organization which responds to the needs of rural life and the local climate.

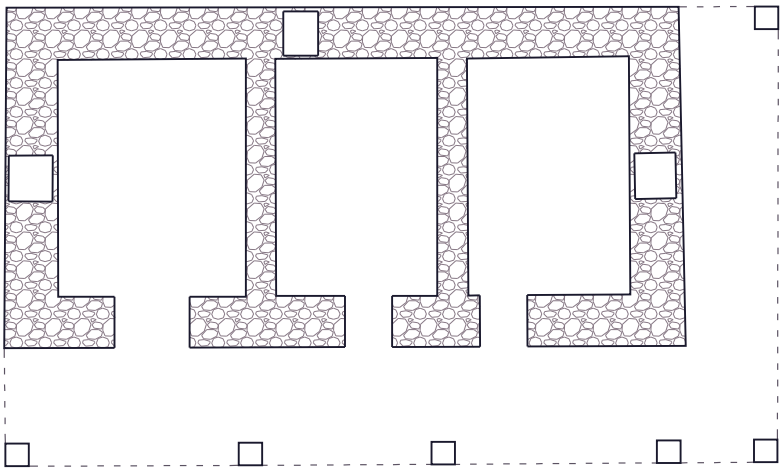


Fig.1 First floor of the lobia

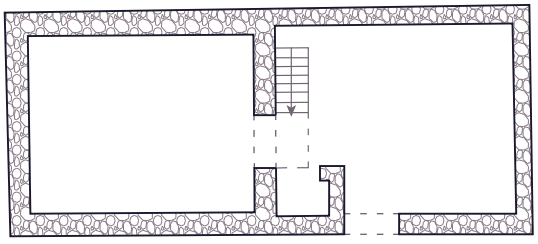


Fig.1.1 First floor of the hut

0 1m 2m 3m 4m 5m

Source: O. Baldacci, *Osservazioni di geografia antropica sulla Val Soana*, pg. 141-144.

Ingria (TO). Photograph taken by the author

Ingria (TO). Photograph taken by the author

Ronco Canavese (TO). Photograph taken by the author

1.3.1 SUSTAINABILITY WOVEN INTO TRADITION

The traditional architecture of the Soana Valley embodies a harmonious blend of natural materials, traditional building techniques and sustainable practices that have been passed down through generations.

One of the define features is the extensive use of local materials, particularly stone and wood. In fact, the abundant availability of these materials in the surrounding environment made them the natural choice for the construction. Stone was quarried from the valley's mountains, in particular below Nivolastro, above Scandosio, near Ronco and above Forzo, and it was used for the foundations, walls and roofing, using the *lose*[8]; whilst wood was sourced from the dense forests and employed for structural elements, balconies, stairs, roofing framework and interior finishes, offering flexibility and an easy construction operation.

The traditional building techniques reflect a deep understanding of the local environment and resources. The prominent feature is the dry-stone masonry: a method involving the careful *assembling of regular stone blocks without the use of mortar between bed and head joints*[9]. This technique not only enhances the structural integrity of buildings, but also allows for the natural movement of the earth, reducing the risk of damage from seismic activity.

Roofs are typically steeply pitched, with the corner on the horizon between 40°- 45°, and covered with stone (lose) or wooden shingles, designed to shed heavy snowfall efficiently. The overhanging eaves protect the walls from rain and snow and provide shaded areas during the summer months.

The architecture of the Soana Valley embodies several passive design strategies that enhance sustainability. The orientation of buildings is carefully considered to maximize solar gain in winter and minimize overheating in summer: in fact, as mentioned in the previous paragraph, the rooms are aligned in order to equally exploit the benefits of the exposure. Thick stone walls then act as thermal mass, which refers to the material inside a building that can help reduce the temperature fluctuations throughout the course of the day, thus reducing the heating and cooling demand of the building itself[10], therefore absorbing heat during the day and realize it at night, maintaining a stable indoor temperature. Optimizing it *has been regarded as an important measure for passive heating/cooling strategies and for designing low-energy buildings*[11].

8 Mica schist slabs with a thickness of 2-3cm. Baldacci, *O. Osservazioni di geografia antropica sulla Val Soana*, p.142. (online)

9 H. Smoljanovic, N. Zivajic, Z. Nikolic, *A Combined finite-discrete element analysis of dry-stone masonry structure*. (online)

10 Energy Education. (online)

Moreover, the use of local sources and natural materials reduces the environmental impact of construction and promotes a closed-loop system. Stone and wood are renewable and their use in traditional buildings demonstrates a *low carbon footprint, which considers all emissions of a product both backward in time from the point of consumption to emission sources and forward in time to include the use and disposal phase of products*[12] and a low embodied energy, which is the energy content of all the materials used in the building and technical installations[13] compared to modern construction materials.

All these features demonstrate a keen awareness of the natural environment and a commitment in creating comfortable and resilient living spaces.

11 R. Hu, G. Lu, J. Niu, *The impacts of a bulding's thermal mass on the cooling load of a radiant system under various typical climates*. (online)

12 G. P Peters, Carbon footprints an embodied carbon at multiple scales. (online)

13 C.K. Chau, W.Y. NG, A review on life cycle assessment, life cycle energy assessment and life cycle carbon emissions assessment on buildings. (online)

Ingria (TO). Photograph taken by the author

Ingria (TO). Photograph taken by the author

1.3.2 PRESERVING HERITAGE

Whilst the traditional architecture of the Soana Valley remains a testament to the ingenuity of the past generations, it also offers valuable lessons for contemporary sustainable design. In fact, integrating modern techniques and technologies with traditional practices can enhance energy efficiency and reduce environmental impact. Modern insulation materials, energy-efficient windows and renewable energy systems, like solar panel, can reduce the energy consumption of traditional buildings, maintaining, at the same time, their aesthetic and structural integrity. By embracing local materials, passive design strategies and adaptive techniques, the architecture of the valley offers valuable insights for contemporary sustainable design. This approach can be a possibility to bring new life into abandoned or underutilized structures, making them functional and sustainable. Through collaborative planning, adaptive reuse, technology innovations it is possible to harmonize modern sustainability practices with historical preservation, ensuring that the architectural heritage of the Soana Valley continues to thrive in a sustainable future. It is precisely the typical differences of each place that put the *relationship between architecture and environment at the center as a strategy for energy saving*[14].

However, preserving this heritage poses several challenges, such as including the problem of the depopulation, economic pressure and the impact of the climate change.

One of the primary challenges in integrating modern techniques into the architectural heritage of the Soana Valley is finding a balance between preservation and modernization. Historic buildings often have cultural and aesthetic values that need to be maintained. Introducing modern materials or technologies can risk altering these characteristics, leading to conflicts between conservationists and developers.

The architectural heritage of the Soana Valley is in fact a perfect example of vernacular architecture, which indicates the set of heritage built by individuals *without pedigree, anonymous, spontaneous, indigenous*[15], typical of the tradition of any population that mainly uses techniques local and it is the result of *collective gestures at different times*[16].

During the Architecture without Architect exhibition at the MOMA in New York in 1964, case studies were presented in which it was demonstrated that this type of architecture did nothing but respond to the needs due to geographical, climatic and social contexts. It is no coincidence that Bernard Rudofsky, whowas curator of the

14 A. Capuano with B. Di Donato, A. Lanzetta, *Cinque temi del moderno contemporaneo*, p. 245.
15 B. Rudofsky, Architecture without Architects, Museum of Modern Art, New York 1964, p.3, author's translation.
16 A. Capuano with B. Di Donato, A. Lanzetta, Cinque temi del moderno contemporaneo, p. 93.

exhibition, states that from those contexts there is a lot to learn" as *before architecture became an art for experts, uneducated builders, instead of trying to conquer nature like us, they welcome the variety of climate and the challenge of topography*[17].

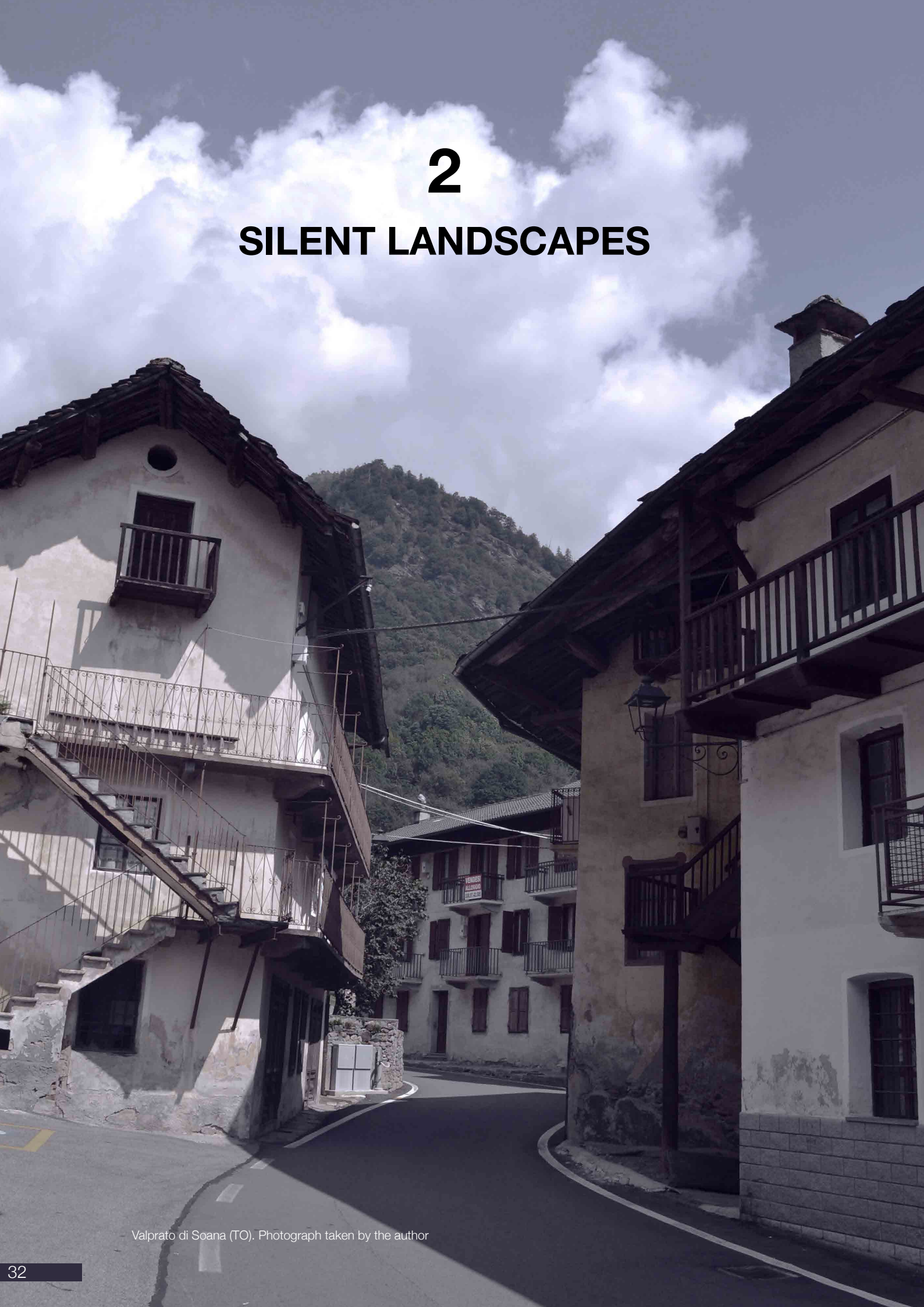
It is also necessary to take into account what can be defined as technical limitations: the traditional materials and methods typical of vernacular architecture are not always compatible with modern technologies. For instance, the structural integrity of ancient masonry may not support the installation of heavy solar panels, or the building's thermal performance may be difficult to enhance without compromising its original design. Traditional construction methods, contrary to what happens in modern ones, are close not only to the low-tech approach, concept theorized by Paolo Soleri in the "laboratory city" of Arcosanti; but also to Juhani Pallasma's Ecological Functionalism movement, according to which architecture should return to its primitivism. Glenn Murcutt is also a great supporter of this theory; in fact, all of his projects reduce the technological contribution to the necessary minimum as he believes that the only way to obtain a perfect union between comfort and sustainability is the study of the local climate, careful layout of the rooms and the use of local materials.

Fig.2 Installation view of the exhibition "Architecture Without Architects.", Photographic Archive. The Museum of Modern Art Archives, New York

17 B. Rudofsky, Architecture without Architects, Museum of Modern Art, New York 1964, p.9, author's translation.

2

SILENT LANDSCAPES



Valprato di Soana (TO). Photograph taken by the author

2.1 SPARSE POPULATION

Valle di Soana is today characterized by a low population density concentrated mainly in three of the five principal villages: Ronco Canavece, Ingria and Valprato Soana. These localities are able to offer services and better infrastructures and also serve as central hubs. The density accounts for about *10*[18] inhabitants per square meters, which reflects in one hand the broader trends of rural depopulation in mountainous areas and on the other one how the population is unevenly distributed. For example, in the East of Pont Canavese the scattered population is more widespread, but with obviously variations in density due to the morphology of the territory; furthermore, if you look at the long Soana river, at the bottom of the valley and to the side of the road some isolated houses can be noticed.

The density is also influenced by the harsh living conditions of some areas, so that the settlement of the valley is characterized by elementary *nuclei*[19], concentrated in the most profitable and mostly sheltered areas, whilst for the entire and vast areas no type of settlement is present.

All the urban locations of the Soana Valley, like any other Alpine landscape, try to capture the sunlight as much as possible, consequently no nucleus is exposed to the North. However, their layout strongly depends on the topography of the area: most of the urban centers are located on slopes; those that lie at the bottom of the valley are fewer; finally, a small percentage is located on glacial terraces.

This difference is even more marked if the Southern area compared with the Northern one, taking into consideration the morphology of the Soana river. In fact, in the Southern part, therefore Ingria, Frassinetto and Pont, the Soana flows deep and sunken, thus not allowing great development of the urban centres; the Northern part, therefore Ronco and Valprato, is characterized by a wide valley floor, therefore allowing a significantly greater number of urban locations compared to the previous case.

Another factor that must be taken into account, when it comes to the population density of the Soana Valley, is certainly the altitude distribution of its population. In fact, the valley's varied topography, with different elevations ranging from valley floors to high mountain peaks, significantly influences where people live, work and engage in various activities. In general, it can be said that the population tends to gather along the main waterways and develop around them. This is quite easy to understand since the higher the height, the less the choice for settlement.

18 Amministrazioni comunali. (online)
19 O. Baldacci, *Osservazioni di geografia antropica sulla Val Soana*, p.136. (online)

However, if the valley bottom is narrow, the density instead increases with height, a phenomenon known as *settlement inversion*[20]; on the contrary, where the valley is wider, the density is higher and therefore decreases with height. Key villages such as Ronco Canavese and Ingria are located within the rage 500 and 1000 meters above sea level; these areas offer relatively easier access to transportation, public services and arable land. Specifically, Ronco Canavese is divided into two slopes, in which there is a correspondence in population level: in both slopes there is an uninhabited area up to 1400m after which an urban settlement is found again between 1400 and 1600m, thanks to the presence of a symmetrical terrace; these mid-altitude zones host smaller and more dispersed settlements. Some sparsely populated settlements can also be found above 1600m and this is thanks to their Southern exposure which allows the population to live at greater heights.

20 O. Baldacci, *Osservazioni di geografia antropica sulla Val Soana*, p.139. (online)

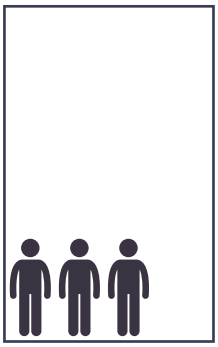
Ingria (TO). Photograph taken by the author

Valprato di Soana (TO). Photograph taken by the author

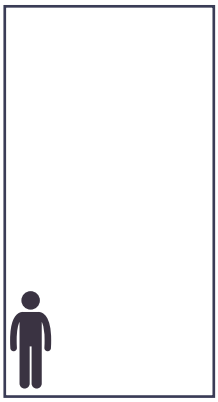
POPULATION DENSITY

Source: ISTAT

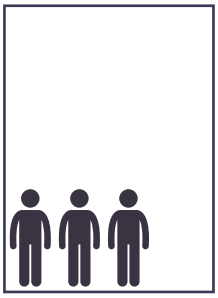
Ronco Canavese
956 a.s.l.



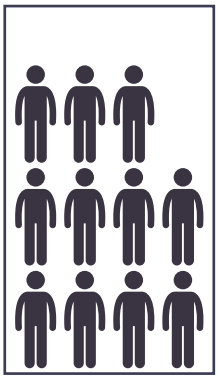
Valprato Soana
1113 a.s.l.



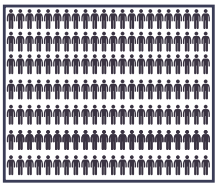
Ingria
816 a.s.l.



Frassinetto
1048 a.s.l.



Pont Canavese
451 a.s.l.



2.2 THE GREAT EMPTYING

Early inhabitants were attracted to the valley's fertile land, abundant water resources and strategic locations. Throughout the Middle Ages and into the early modern eras, the valley experienced periods of population growth, driven by agricultural expansion, pastoralism and trade. However, the advent of the Industrial Revolution in the 19th century marked a turning point, as during the 20th century industrialization changed the relationship between the rural areas and the urban development of the Po Valley. In fact, the traditional Alpine characteristics have been overwhelmed by the new modern urban cultures, which have also imposed their new patterns. These new schemes have thus gradually led to an ever-greater reduction in the autonomy of local communities, consequently underlining a detachment between the mountain inhabitants and the mountain itself, which was once the basis of their subsistence. Mountain depopulation is therefore a complex phenomenon in which the emigratory dimension is only the tip of the iceberg: *depopulation and abandonment are not exclusively demographic, economic or environmental phenomena, but affect all these spheres together*[21]. For this reason, to understand it fully it is necessary to first know the social and cultural contexts, both internal and external, in which the depopulation phenomenon is manifested.

The internal depopulation has obviously made the transmission of works and styles much more difficult. However, those traditional economic and cultural models, that had survived the predominance of the modern ones following the Industrial Revolution, managed to resist between the end of the Second World War and the 1970s. This was possible because both models first mixed and then adapted to the new lifestyles and work linked to the new economic system. In this period the migratory phenomenon developed on two different scales: *a local one, at which the population of the smaller urban centers moved towards the larger regional centers, and an interregional one, at which the large industrialized urban centers of the North drained the population of southern rural areas, to a very intense extent in the years of the so-called economic boom*[22]. Subsequently, the crisis of the 70s led to a rethinking of the importance of traditional practices and life models in favor of the new urban and industrial culture, consequently to a more marked increase in migration.

The growing depopulation was then further intensified by the fact that the worsening of socio-economic conditions was transferring the internal workforce to the new

21 For what is considered by the author to be a timely and precise definition of mountain depopulation as a complex phenomenon, compare with the essay by Luigi Zanzi, in Varotto 2003, pg. 45-46.

22 S. De Rubertis, *Dinamiche insediative in Italia: spopolamento dei comuni rurali*, p.73. (online)

rapidly developing industrial areas, thus highlighting not only the inadequacy of the traditional rural economy, but also a total subordination among the worlds of the city and the internal areas. The lack of economic opportunities is therefore the first cause of depopulation phenomenon in the areas. These regions often suffered from a mono-industrial economic base, relying on agriculture, mining or manufacturing, which were very vulnerable to economic downturns and global market fluctuations. Of course, as traditional economies declined due to the globalization, automation or resource depletion, job opportunities decreased, prompting residents, particularly the younger and more mobile populations, to migrate to urban areas in order to reach better employment prospects. The closure of local business, schools and services further contributed to the economic decline, leading to a vicious cycle that accelerated and underlined the depopulation phenomenon.

On the one hand the urban centers that were consolidating the most were certainly the Northern ones, on the other hand rural internal areas were experiencing a process of desertification, not only in demographic terms, but also in terms of abandonment of land, traditional cultural models and maintenance of the territory.

In fact, even today the processes of depopulation and abandonment are continually growing. It is a phenomenon that encompasses several dimensions, including demographic shift, social fragmentation and environmental degradation. Unfortunately, this can only result in an overall impoverishment of the territorial capital (T. Amodio, Una lettura della marginalità attraverso lo spopolamento e l'abbandono nei piccolo comuni, p.51), understood as historical-cultural heritage from both a material point of views, therefore monuments, landscapes, etc., and an immaterial one, therefore languages, dialects, traditions. Many internal areas used to be rich in cultural heritage, with unique architectural styles, crafts and folklore. As communities declined, the social fabric weakened and traditional knowledge and practices risked to be lost. The abandonment of historic villages also resulted in the decay of cultural heritage sites, which could have otherwise represented a valuable asset for sustainable development.

As you can see from the graph below, the Soana Valley is a perfect example of how it has experienced this demographic collapse. The municipality that has suffered the most is certainly Ingra, going from 691 inhabitants registered in 1951 to 45 in 2019.

Since this phenomenon is not destined to stop, it is necessary to intervene so that municipalities like Ingria do not become ghost towns, thus losing their beauty and their heritage that have often given them, as in Ingria, the title of *one of the most beautiful villages in Italy*[23].

Overall, there is therefore a loss in value of what can be defined as fixed capital and local human capital, understood as the *set of skills, competences, knowledge, professional and relational abilities generally possessed by the individual, acquired not only through school education, but also through long learning or experience in the workplace and therefore not easily replaceable as they are intrinsically developed by the subject who acquired them*[24]. In the territorial capital that is concentrated in infrastructures and plants, while the human capital refers to social, cultural and institutional relational goods.

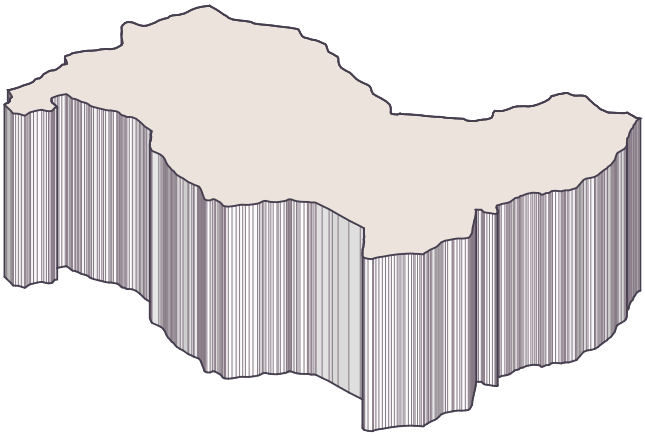
It is important to underline how it became necessary to move beyond the narrative of the decline and instead focus on the potential transformation and regeneration in which the strategies are. By levering sustainable architectural practices, community-led planning and integrated policy frameworks, it is possible to create vibrant, resilient and inclusive communities that honor their own heritage, protect their natural environment and raise a sustainable economic development. Internal areas, in fact, should not be seen as lost or without hope, but as space to reimagine human settlements and redefine a new relationship between nature and people.

23 Borghi più belli d'Italia. (online)
24 Treccani. (online)

Ronco Canavese (TO). Photograph taken by the author

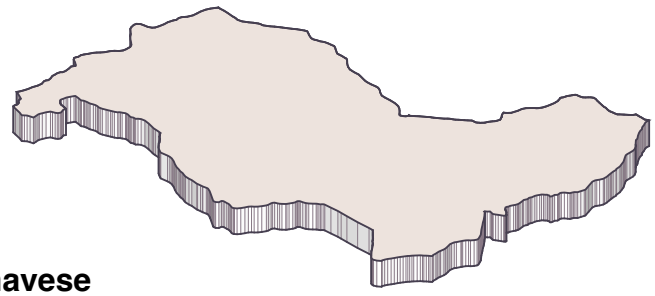
1951

2009 Inhabitants



2019

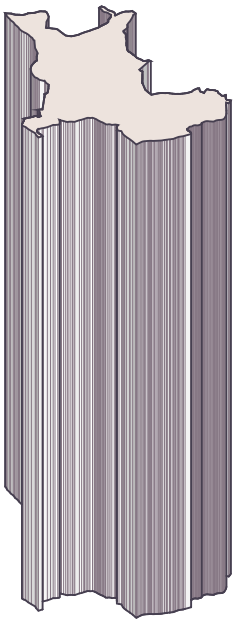
297 Inhabitants



Ronco Canavese

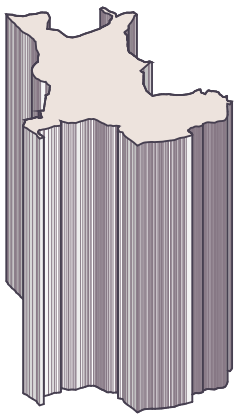
1951

5689 Inhabitants



2019

3210 Inhabitants



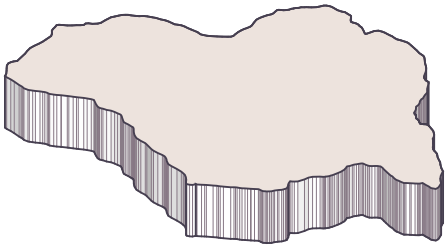
Pont Canavese

POPULATION DECLINE

Source: ISTAT

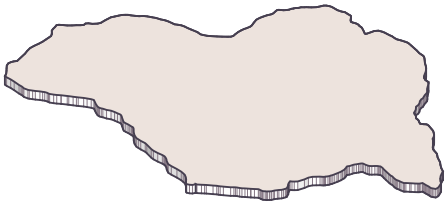
1951

676 Inhabitants



2019

95 Inhabitants



Valprato Soana

1951

691 Inhabitants

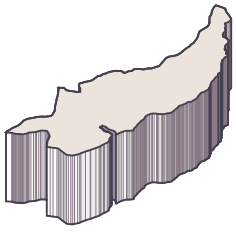
2019

45 Inhabitants

Ingria

1951

1030 Inhabitants



2019

265 Inhabitants

Frassinetto

2.3 THE ACCESS DILEMMA

The phenomenon of depopulation in internal localities is mainly strongly influenced by infrastructure factors, digital connectivity, energy systems and public services because they play a central role in shaping the livability, the accessibility and overall the viability.

Alpine regions are characterized by rugged terrain and challenging weather conditions, which pose significant threats to developing and maintaining transportation infrastructures. In this context accessibility goes beyond the merely physical access because it encompasses a broader spectrum of issues, including mobility, digital connectivity and access to services, social inclusion and economic opportunities. The steep slopes, deep gorges and narrow passes, that are typical of these landscapes, make the construction of roads, bridges and tunnels both technically and financially challenging.

The isolation of these areas is exacerbated by narrow, winding roads, limited connections and infrequent public transport services. The lack of reliable public transportation further highlights the problem, forcing residents to rely on private vehicles. Poor accessibility makes it difficult for the residents to commute, to access essential services and to engage in economic activities.

This isolation is a significant deterrent for potential new residents and business, so it is not surprising why inhabitants choose to move towards urban centers where access to those services is certainly easier and faster. Hence, in log-term, social exclusion and the isolation of the communities can lead to a loss of cultural identity, since traditional practices, languages and lifestyle are eroded by depopulation and by the lack of intergenerational transmissions. A fundamental factor closely linked to viability is certainly the maintenance of transportation infrastructures because it is both complex and costly, resulting in a limited access and development of primary services, such as healthcare, education and employments.

The harsh climatic conditions, including heavy snowfall, ice and the potential for avalanches and landslides, requires constant maintenance; these costs can divert funds from other critical services, further diminishing the attractiveness of the region.

The larger urban centers therefore attract those residents who can move from the small centers and with them also all the related cultural activities. *The phenomenon then happens that those who remain feel truly isolated and that community spirit is no longer created*[25]. In fact, previously it was possible to observe a development of the cultural and social heritage of the rural areas of the mountains thanks to the

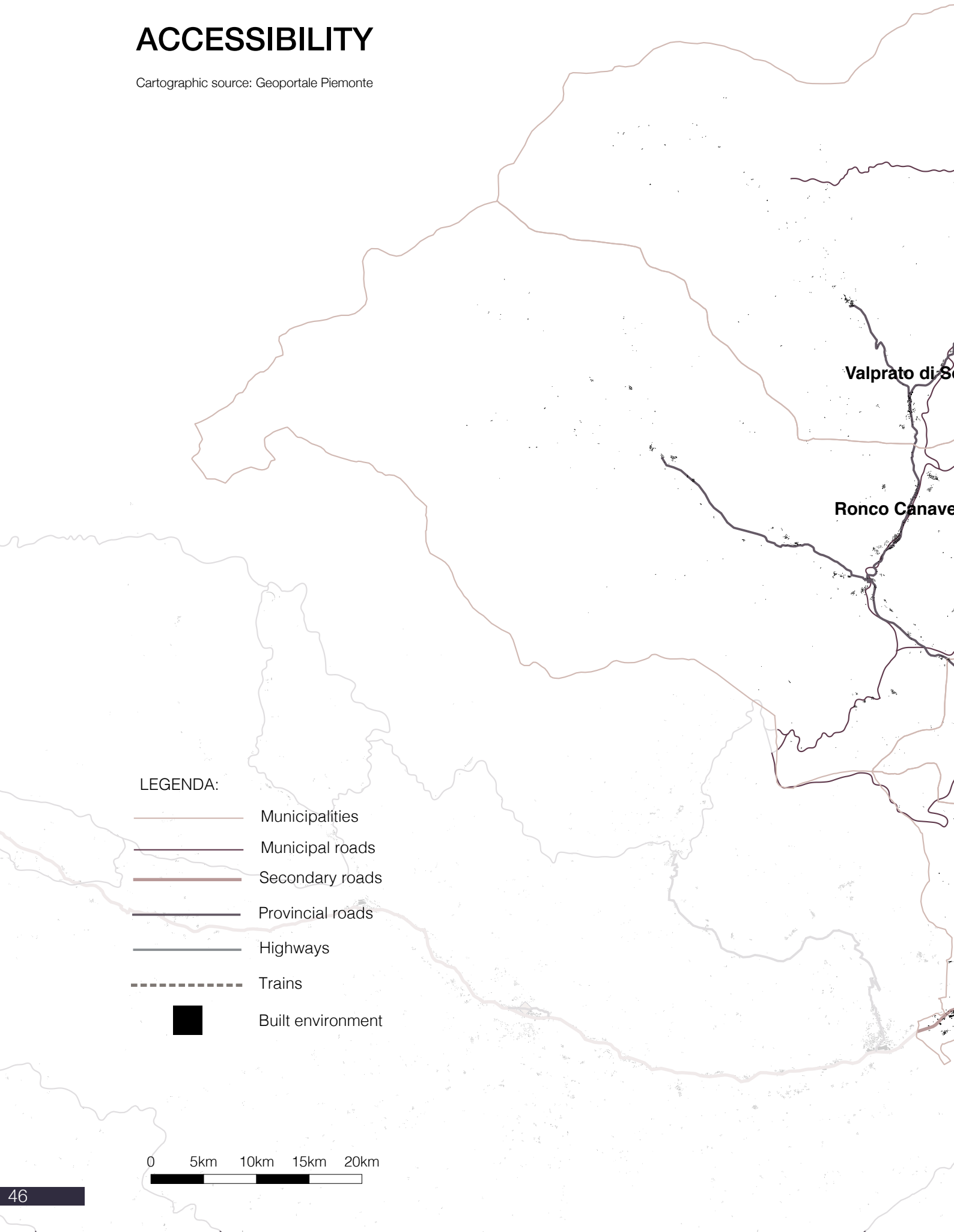
25 Dott. A. Aggio, *Strade di montagna e modelli di sviluppo*, p.186. (online)

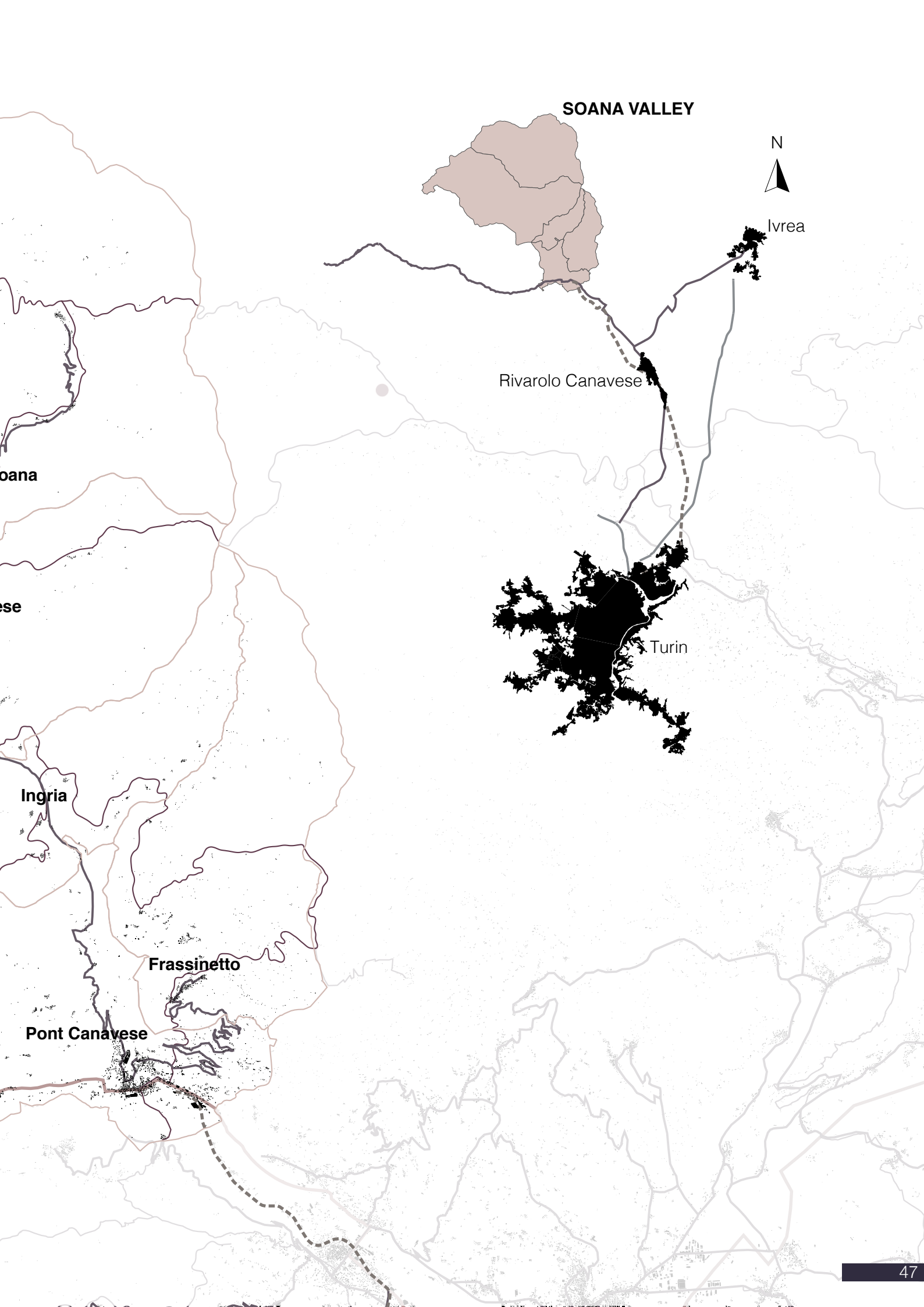
participation and creation of a community within the population. Nowadays that heritage is progressively disappearing as residents remain isolated both from an infrastructural and psychological point of view.

Like many Alpine regions, the case of the Soana Valley faces significant challenges related to its transportation infrastructures. Roads are a critical component of this infrastructure, influencing the economic development, the accessibility and the quality of life for local residents. In fact, the valley's network is sparse e discontinuous in some areas, especially at higher altitudes. During winter months heavy snowfall can block the roads, further isolating the few left communities. The large arteries of motorways and railways connect the nearest large cities Turin and Ivrea with Pont Canavese, which is the terminus of the valley; whilst all other municipalities are connected to each other through local streets. The network is characterized by narrow roads that follow the valley's contours, with limited straight stretches due to the mountain terrain. The challenges of accessibility are very evident, it is possible to infer how in the internal areas there are also unique opportunities for a sustainable development, including architecture and urban planning, in order to enhance accessibility and preserving cultural and ecological heritage. Some strategies can be designing low-impact road networks, promoting public transportation such as cable cars, electric buses and funiculars; but also developing pedestrian and cycling infrastructures that enhances connectivity while minimizing environmental impact.

ACCESSIBILITY

Cartographic source: Geoportale Piemonte




SOANA VALLEY
N
Ivrea
Rivarolo Canavese
oana
ese
Turin
Ingria
Frassinetto
Pont Canavese

2.4 THE DIGITAL DIVIDE WITHIN

In an interconnected world, digital connectivity, understood as access to internet and digital communication tools, has become a fundamental tool of modern life. From education and healthcare to commerce and governance, digital connectivity supports a wide range of essential services and opportunities. However, mountain localities, characterized by often remote locations, face distinct challenges when it comes to digital connectivity and technology. As the world increases its digital network, access to reliable and high-speed internet has become a critical factor for the social inclusion, the economic development and for the quality of life. In rural mountain regions the deployment of digital infrastructure encounters significant obstacles: from technical and environmental challenges to economic and social considerations.

This lack of digital connectivity not only affects the daily lives of the inhabitants, but it has also far-reaching implications for sustainable architecture, rural development and climate resilience. The *digital divide*[26], in fact, exacerbates existing inequalities, limits access to primary services and restricts opportunities for sustainable development.

The presence of mountains, valleys and steep slopes complicates the laying of cables and the installation and maintenance of the communication towers. Additionally, the natural barriers created by mountains can obstruct signal transmission, making it challenging to achieve reliable wireless coverage. Traditional broadband infrastructure, such as fiber-optic cables, requires extensive groundwork, which is often difficult and costly in such terrains. Moreover, harsh weather conditions, such as snowfalls, avalanches, landslides or rockfalls, further complicate the maintenance and reliability of the digital networks. For these reasons the costs therefore are much higher compared to lowland areas.

As mountain localities have lower population density, which is decreasing, the cost per user for providing digital services is higher. Hence, this low density makes it economically less viable for private companies to invest in digital infrastructures, because the return on investment is generally lower compared to urban areas. As a result, many internal localities are left underserved or unserved by broadband providers, perpetuating the digital divide. This means that even when connectivity is available, it might not be enough to support high-speed internet access or emerging technologies, such as 5G or smart grids.

Another important factor to consider is a reliable power supply that is essential for the operation of digital infrastructures; in these regions it is limited or unstable, due to the difficulty of extending power lines to remote and inaccessible areas.

26 Massimo Ragnedda, and Glenn W. Muscher, *The Digital Divide: The Internet and Social Inequality in International Perspective*. (online)

Moreover, the digital connectivity has also socio-economic impacts, being a key driver of economic development in modern societies. Its limited access can hinder the growth of business, restrict access to markets and reduce competitiveness, contributing to economic marginalization and limited livelihood opportunities. E-commerce and remote working, which offer potential for economic diversification, are in this way limited by poor and unstable connectivity. This limit reduces income opportunities and highlights poverty and outmigration from mountain areas, further exacerbating rural depopulation and social fragmentation.

Digital connectivity is also a critical factor for social inclusion and community connectivity. In mountain localities, where physical distances and difficult terrain can isolate communities and where physical isolation is already a big challenge, digital platform provide vital channels for communication, social interaction and cultural exchange. Having limited access can lead to social isolation and social networks, reducing the ability to participate in civic and cultural life and becoming therefore another reason for the depopulation phenomenon.

Addressing all these challenges requires a holistic approach able to combine technological innovation, policy support and community engagement. By exploring and implementing innovative connectivity solutions, fostering public-private partnership and integrating digital connectivity into sustainable development strategies, internal areas can therefore overcome not only that digital divide, but above all the phenomenon of the depopulation.

3

NEW WAY OF LIVING

Ingria (TO). Photograph taken by the author

3.1 THE WFH WAVE

Working from home is a modern work approach through which employees are empowered to choose when, where and how they work, leveraging technology to collaborate and deliver tasks more efficiently. This is why the aim of this approach is to emphasizes productivity and performance over the mere presence in a physical workplace.

In fact, its development was possible for many reasons. The widespread of high-speed internet led to a new way of interconnections between people and between data, permitting to communicate in real-time, the advancements in communication and technologies, such as emails, instant messaging, video conferencing. The rise of cloud computing allows employees to access and store documents, applications and data, regardless of any geographical location. The development of digital tools for project management, collaboration and workflow automation, improving efficiency and reducing the cognitive load on employees. Let's not forget the importance of globalization; the growth of global businesses implied the need to manage teams across different time zones: WFH became a perfect solution to coordinate and integrate geographically dispersed teams. In this way, workers became able to choose their workstation precisely because they could do the exact same work and talk with other workers as they would have done in the office.

However, WFH remained basically a fringe benefit or just a simple temporary solution for most of the companies since the outbreak of the pandemic crisis of COVID-19 in 2020. Before it, it was estimated that only *6%*[27] of all workers worked exclusively from home. The pandemic has brought unprecedented disruptions across all facets of society, fundamentally reshaping the way we live, work and interact. To mitigate the spread of the virus, all the worldwide governments adopted lockdown measures. This meant all the daily activities had to take place at home, especially work. Therefore, one of the most consequences and response of the companies was the adoption of the remote working in order to deal with all the circumstances that the global crisis involved. This period demonstrated how many jobs could be performed remotely without loss of productivity, challenging traditional notions of workplaces and office culture.

After the state of emergency, WFH turned into the default mode of work for millions of employees around the world, becoming a fundamental aspect of the modern work environment, with profound implications on individuals, on companies and on society.

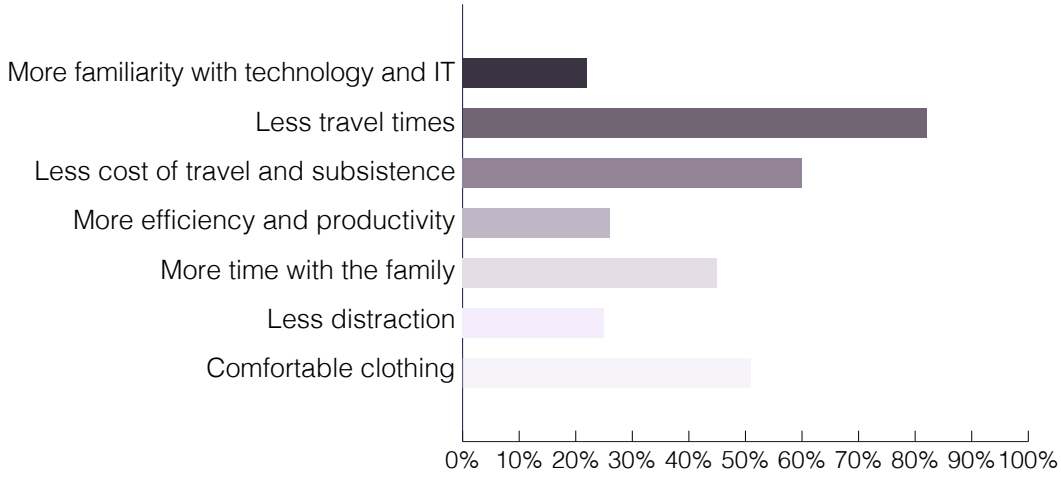
27 A. Bick, A. Blandin and Karel Mertens, *Work from home after the COVID-19 outbreak*, p.4. (online)

According to a recent survey by Global Workplace Analytics about 80-90% of US workers want to work from home at least part of the time.

By enabling people to work from any remote locations, smart working can rejuvenate mountain localities, offering new economic opportunities, improving the quality of life and promoting environmental sustainability. WFH has the potential to address many of the challenges associated with the phenomenon of depopulation of these areas. In fact, the flexibility offered by this new way of working can attract new residents to mountain localities. Consequentially, it can stimulate the demand for local goods and services, including housing and recreational activities. This increased economic activity can support the growth of small business contributing to a more vibrant local economy.

The adoption of this new way of working is and will continue to grow, especially after experiencing the many positive effects during the COVID-19 lockdown. For example, in Europe and in USA it is estimated that about 20 million people adopted remote working and in UK is more or less 7.5%[28] of the population. The Australian Bureau of Statistics (ABS) showed how in 2018-2019 workers who worked remotely were 43%[29] and this percentage increased in 2021 to 65%[30] during the pandemic crisis reached 90%.

Fig.3 Success factors of WFH.



Source: Amin Al-Habaibeh*, Matthew Watkins, Kafel Waried, Maryam Bathaei Javareshk, *Challenges and opportunities of remotely working from home during Covid-19 pandemic*, p.104.

28,29,30 S. Navaratnam, A. Jaylath, L. Aye, *Effects of working from home on greenhouse gas emissions and the associated energy costs in six Australian cities*, p.1. (online)

3.2 WFH: WORK, FASTER, HAPPIER

The shift from traditional way of working to the remote one led, of course, to an intensive and extensive research and debate about its impacts, especially on productivity. Without any distractions and interruptions, typical of the traditional office, many employees claim that they could concentrate better and complete several tasks more efficiently at home. Firstly, we must define productivity in a different way. Productivity has now to be measured with real workers' outputs, rather than their performance of the so called "ideal worker"[31], no longer only as long working hours and presenteeism.

What emerged from several studies and real-world experiences is that WFH brought, and still does, an increase of the productivity deriving from the result of multiple interrelated factors. Among these studies, the one conducted by Stanford University reports that in nine months 16.000 workers increased their productivity by 13% working through a remote mode. At first, the impulse was to always check in on employees; however, time after time it was clear that productivity was increasing thanks to fewer breaks, less sick days and the elimination of commuting time.

One of the primary reasons WFH enhances productivity is the flexibility that authorizes employees to manage their work schedules. Remote work makes possible a more personalized timetable whilst traditional office settings had to follow fixed hours.

The key of this aspect is the recognition and utilization of the employees' peak performance times, which vary among them due to differences in biological rhythms and personal preferences. More precisely, this concept is closely connected to chronotypes that distinguish people as *morning larks, night owls*[32] or intermediate types based on their natural sleep-wake cycle: the first are more productive in the early hours of the day and for this reason they tend to wake up early and complete their tasks early too; night owls, instead, are more energetic and more focused in the late afternoon and evening, they excel when allowed to work later in the day, that's why WFH is the best solution for them; the latter experience both periods of peak performance in mid-morning and mid-afternoon. In other words, early chronotypes are able to perform at their best earlier in the day, whilst late chronotypes, on the contrary, have higher daytime sleepless and therefore they perform worse in the morning. Brian Kropp, the group vice president at Gartner Research, frequent contributor to CNN, The Economist, Financial Times, Wall Street Journal and one of the Top 100 Human Resource Technology in 2020, in a February 2021 interview with David J Faulds and P S Raju declared: "*Another potentially long-term advantage for employers is the*

31 Heejung Chung, *Flexible working: a deep dive into the impact of remote working on gender equity*, p.24. (online)
32 Elise R. Facer-Childs, Sophie Boiling and George M. Balanos, *The effects of times of day and chronotype on cognitive and physical performance on healthy volunteers*. (online)

productivity gains that result from a more flexible environment. As I started previously, companies are now more confident that employees are going to be just as productive at home as they were but when they work. Companies are finding that not all employees are the same; some are more productive at different times of the day, some are more productive on weekends, and so on. For example, a financial services company we work with primarily processes claims. They found that some employees who work from home are dramatically more productive from 6 to 10 in the morning, others are more productive from 1 to 5 in the afternoon, and others are most productive in the middle of the night. We do not really know why this occurs, but it offers a potential long-term benefit to employers to let employees adjust their work habits to be most productive"[33].

The convenience of the WFH format is further facilitated by technological and communication advancements which have been fundamental in making WFH a practical and effective model, offering numerous benefits, including an increase of productivity. They have been instrumental in enabling a seamless transition from traditional office to remote work environment.

First of all, hardware and devices used setup significantly impact productivity. The availability of high-performance and portable hardware has enabled employees to perform complex tasks virtually from any locations. Modern laptops and desktops come equipped with powerful processors, ample storage and high-resolution displays, making them suitable for a wide range of professional tasks. Laptops, in particular, are able to offer also portability, allowing people to work in different places. This is, in fact, the main characteristic of smart working giving workers to have greater flexibility, not only temporal but also spatial. As a result, it allows them to change their working location, above all for reasons related to private life. Moreover, dual monitors and ergonomic keyboards and mouses can enhance productivity by providing more screen performances and reducing physical strain. Then, mobile devices, such as smartphones and tablets, are essential for communication and accessing work applications on the go. Providing flexibility and portability allows employees to stay connected even when they are not at their primary workstation.

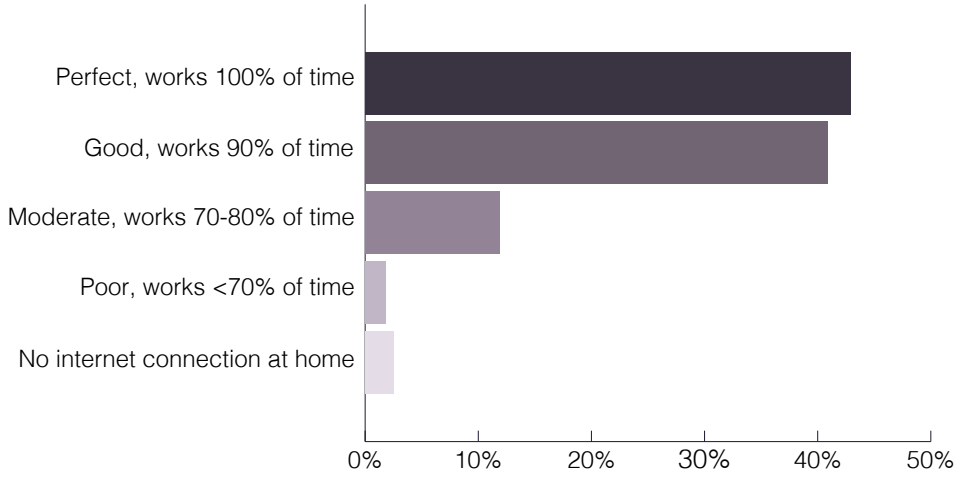
Above all, the advent of high-speed internet and enhanced connectivity has profoundly transformed the traditional work environment, especially with the increasing prevalence of WFH arrangements. The expansion of broadband infrastructure has made high-speed internet more accessible, in this way workers can quickly access

33 (David J. Faulds and P.S. Rajiu, *The work-from-home trend: An interview with Brian Kropp.* (online)

cloud-based applications, download and upload large files and participate in real-time in collaborative efforts without any delays due to slower internet speed. The access to digital tools and resources ensures that work processes are efficient enough, reducing downtime and inefficiencies. Moreover, high-speed internet allows the uninterrupted use of video for conferencing platforms, project management tools and other softwares that are essential for maintaining high productivity levels in a remote work environment. It is then necessary to underline how the quality of Wi-Fi within the home is crucial, since the modern routers offer stable connections and support multiple devices simultaneously. Internet access quality improved as a consequence of the pandemic crisis, because WFH accounted for a larger share of labor services.
In September 2021, Jose Maria Barrero, Nicholas Bloom and Steven J. Davis in "Internet Access and Its Implications for Productivity, Inequality and Resilience" presented an examination of the critical role that internet access plays in modern economies, focusing on its effects on productivity. The reliability of internet access and its quality strongly influence both the productivity and extent of WFH. From the study described in the article it emerges that only 2.5% of the people involved do not have an internet network at home and only 1.8% of them report a connection that works less than 70% of the time. The more high-quality and reliable connection, the higher the self-assessed efficiency. In fact, those who can boast of having internet access that always works report an average difference close to 8% in favor of WFH, whilst workers with an always working internet access and workers without internet access report an average productivity difference of nearly only 1% in favor of the employers. Overall, it is estimated that employees saw an improvement of productivity by 13%[34]: 9% is attributed simply to a quieter and more convenient working environment, the remaining 4% derives from saving from breaks and sick days.
From this analysis it can therefore be deduced that by extending a good internet connection even in rural mountain areas, where today it is missing or deficient, it will be easier to implement smart working as a strategy against the depopulation of mountain areas.

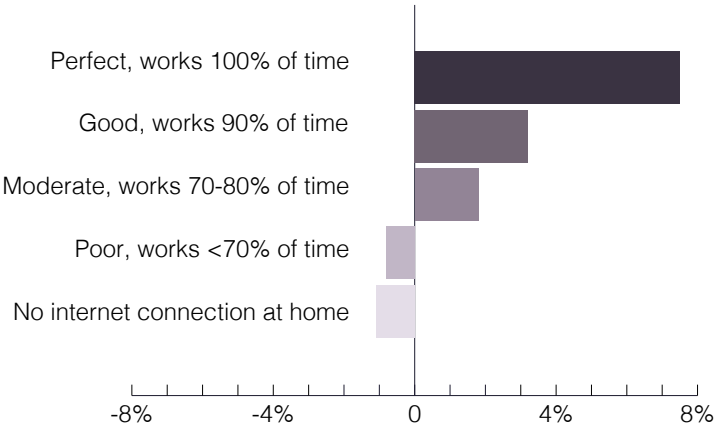
34 Sumit. S. Deole, M. Deter, Y Huang, *Home sweet home: working from home and employee performance during the COVID-19 pandemic in the UK*, p.4. (online)

Fig.4 Distribution of internet quality. Responses to the following question during the study:
"How reliable is your internet connection?"



Source: Jose Maria Barrero Nicholas Bloom Steven J. Davis, *Internet access and its implications for productivity, inequality and resilience*, p.10. (online)

Fig.5 Distribution of internet quality. Responses to the following questions during the study:
"How reliable is your internet connection?"
"How does your efficiency working from home during the COVID-19 pandemic compare to your efficiency working on business premises before the pandemic?"
"How much more [less] efficient have you been working from home during the COVID-19 pandemic than on business premises before the COVID-19 pandemic?"



Source: Jose Maria Barrero Nicholas Bloom Steven J. Davis, *Internet access and its implications for productivity, inequality and resilience*, p.12. (online)

3.3 FLEXING FOR SUCCESS

The flexibility that WFH offers is not only temporary in terms of organizing working hours, but is also working place flexibility, understood as the environment in which one works. Unlike the traditional office model, where work is confined to a specific geographic location, workstation flexibility allows employees to choose environments that best suit their needs and preferences, leading to a more dynamic and adaptable work experience and leading to increase productivity and focus, reducing stress. It, therefore, involves the ability to work from various locations, not limited at home, including coworking spaces, cafes or while travelling.

In fact, employees often have limited control on their workstations, which can lead over time to discomfort and health issues. The workplace flexibility is then characterized by several key dimensions: first of all, location independence allows employees to perform their duties from any place with adequate technological infrastructure, such as reliable internet and necessary hardware; then, through the environmental control they have the autonomy to choose their work environment, which can range from quite, isolated settings to vibrant, communal spaces; the mobility permits the transition seamlessly between different work locations without significant disruption to work processes. As a result, a fundamental advantage for the remote workers is the possibility to design a workplace that prioritize comfort and ergonomics. A personalized work environment can only bring to an increased productivity since employees are able to select furniture on their own in order to suit their ergonomic needs and arrange their workplaces to minimize stress. In other words, a person would prefer to work in a quiet and secluded area, whilst for another one the best place to work is a space with natural light and with presence of greenery.

By creating an environment that aligns with their personal preferences, employees can work more efficiently and effectively. In fact, the feeling of comfort in any workplace is a necessary factor in order to reach a high working efficiency. Remote workers in this way practice what can be said as *care of place*[35] because of their concern for aesthetics and atmosphere in cultivating productivity and creativity. Hence, it is estimated that personal satisfaction with the indoor environmental conditions of home offices can only bring to a better perceived productivity and satisfaction.

Inside the concept of workplace flexibility, it possible to identify three different types. The first is the *organizational flexibility*[36], which refers to the ability of the organizations to adapt to changes in the environment and it is conceptualized in relation to companies having to be more flexible.

35 Ciolfi, Luigina, Gray, Breda and Pinatti De Carvalho, Aparecido Fabiano, *Making Home Work Places*, p.3. (online)
36 P. Matthijs Bal, M. Izak, *Paradigms of Flexibility: a systematic review of research on workplace flexibility*, p. 39. (online)

The *employee flexibility*[37] is on the other hand the workers' ability to adapt to changes in their work or in their organizations and whose aim is to focus on the flexibility of each individual. Then, the *flexible work*[38] is referred to the possibility to adapt employees' contracts with companies which allow greater adjustability to any circumstances. The last type is the flexible *work arrangement*[39], seen as the possibility to let employees to decide when and where the work is conducted.

All this was possible thanks to several factors that have driven the adoption and the expansion of the workplace flexibility. Above all, the proliferation of digital communication tools, cloud computing and collaborative software has made it easier to work remotely while staying connected and productive. The mobile technology enables employees to work almost everywhere. However, the main factor was obviously the pandemic-driven adaptations, since the COVID-19 forced many organizations to adopt WFH models, demonstrating the viability of remote work and accelerating the acceptance of flexible work practices.

37,38,39 P. Matthijs Bal, M. Izak, *Paradigms of Flexibility: a systematic review of research on workplace flexibility*, p. 39. (online)

3.4 WORK, LIFE, BALANCE

The global shift towards remote work has become a defining feature of contemporary professional life, significantly accelerated by the global COVID-19 pandemic. The adoption of WFH practices has not only altered the geographical landscape of work, but also brought to the forefront a numerous of benefits related to health and wellbeing due to the fact that work and private life can coexist more harmoniously.

One of the most immediate and tangible benefits is the reduction in commuting. That's because the personal wellbeing can be estimated through two different points of view: either, the *objective measures*[40], such as the income, or the subjective measures, like happiness. From these second measures, in 2013 OECD Guidelines defined what is called Subjective Wellbeing (SWB), described as: "*Good mental states, including all of the various evaluations, positive and negative, that people make of their lives and the affective reactions of people to their experiences*"[41]. The two dimensions of SWB, such as the self-evaluations of satisfaction with aspects of everyone's life and the frequency with which individuals experience emotions, are related to pleasure and satisfaction of the workers.

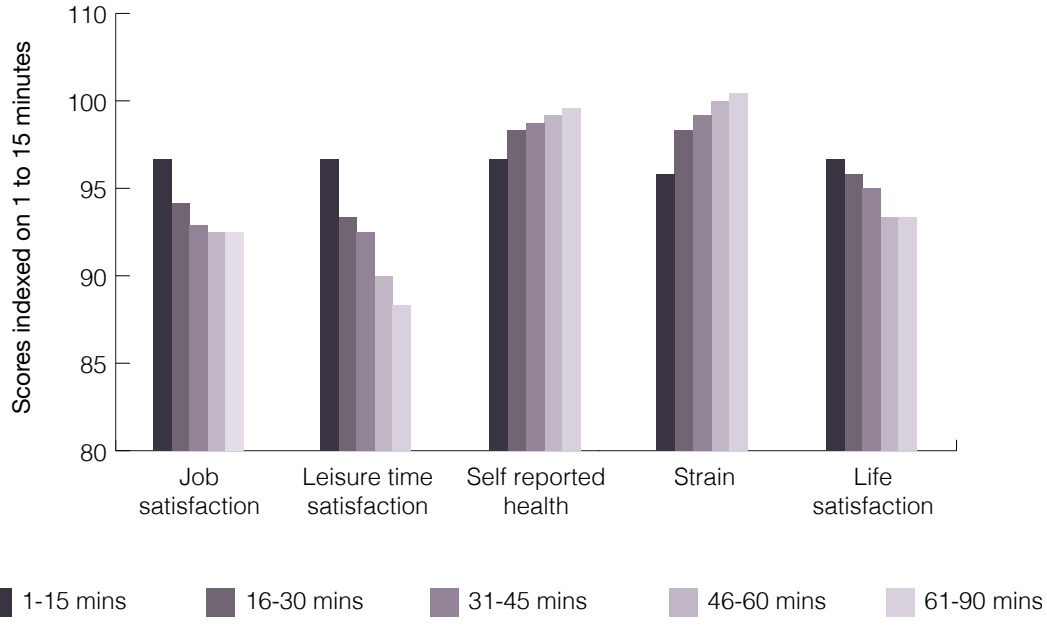
The daily commute, often characterized by long hours in traffic or crowded public transportation, has been associated with elevated stress level, increased exposure to pollution and physic fatigue, impacting on the SWB of employees. Of course, the more the workers live further from their workplace, the more this condition is higher: people with longer commute times tend to have lower job and leisure satisfaction, and therefore an increase of strain and poor mental health. Time, often cited as our most valuable resource, is directly impacted by commuting; eliminating it allows individuals to reclaim hours previously spent in transit. In fact, it is estimated that full-time workers in England spend *160*[42] days each year just commuting to work. This reclaimed time can be redirected towards work, family, leisure or personal hobbies, potentially leading to improve work-life balance and increased productivity. So, it does not surprise how longer commute times are associated to a lower life satisfaction.

Commuting time has also several effects on mental health, where mental health is defined by WHO as a " state of wellbeing in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her own community"; it is then different from SWB because mental health refers to an objective state of the individual. In fact, Martin A. in his study "Does Active Commuting Improve Psychological Wellbeing?" proved how car journeys report "being constantly under strain" and "being unable to concentrate"

40,42 B. Clark, K. Chatterjee, A. Martin, A. Davis, *How commuting affects subjective wellbeing*, p.2778. (online)
41 OECD, *Guidelines on Measuring subjective well-being*. (online)

The graphic below shows the relation between commute time and each measure of SWB. It is clear how the job satisfaction, leisure time and life satisfaction are lower with longer commuting times; strain is higher with longer commute times and this reflects on a lower mental health and therefore in those cases self-reported health is higher. It is important to underline how job satisfaction of females is more sensitive to longer commute times and this is easily understandable since traditionally it is on them that the family responsibilities and management lies. Therefore, the longer the commute from home to work, the less time they have for family life. Moreover, strain is strongly associated both to longer commute times and long working hours and also in this case, for the same reasons indicated above, females tend to report higher levels of strain than males.

Fig.6 Association between subjective wellbeing and commute time.



Source: B. Clark, K. Chatterjee, A. Martin, A. Davis, How commuting affects subjective wellbeing. (online)

The stress associated is well-documented and long commute are linked to high level of anxiety and physical health issues, such as obesity. Remote working eliminates these stressors, promoting a better mental and physical health. In fact, a recurring feeling resulting from the elimination of those stressors is a surely certain sense of *relief*[43] that the reduction in commute brought with it. It is thus an important feeling people were left with, in relation to how the pandemic crisis affected their mobility which underlines negative relations associated with the loss of time and energy, and therefore an increase of stress.

The fact that WFH offers the possibility of not having to commute to work, it allows workers to have more available time to engage activities more than usual with their surroundings. Furthermore, the typical flexibility of WFH can lead to healthier lifestyle choices, like regular exercise and better dietary habits, or in general more time and energy for other activities. For example, it is possible to have daily walks often without any purpose but just to discover, enjoy or familiarize with the local neighborhood which led to a more appreciation of nature. This greater appreciation of nature is also enhanced by having quieter street and urban areas than usual and therefore a drop of noise pollution, due to the fact that after the COVID-19 crisis more and more people have been able to shift to remote working. Moreover, those walks brought more direct contacts with neighbors, creating a greater sense of *local community*[44]. It is, in fact, estimated that employees who work from home more than 50% of the week report lower stressors and higher motivations than those who work in the office at least 50% of working days.

Another important benefit as a consequence of having more time and more energy is certainly better work-life balance (WLB). Historically, work and life were always distinctly separate domains: employees were expected to be physically present at their place of workplace, adhering to strict schedules and often enduring long commutes, as explained in the previous paragraph. This separation also led to significant challenges in maintaining a healthy work-life balance. The time and energy expended on commuting, combined with the pressures of fixed working hours, often left little room for personal pursuit, family time and self-care. WFH offers therefore a unique opportunity to redefine the work-life balance by providing greater flexibility and control over one's work environment and schedule. Without the need to commute to the office, employees can then allocate their time more efficiently, integrating work and personal

43 A. Nikolaeva, Ying-Tzu Lin, S. Nello-Deakin, O. Rubin, K.C. von Schonfel, *Living without commuting: experiences of a less mobile life under COVID-19*, p.7. (online)

44 A. Nikolaeva, Ying-Tzu Lin, S. Nello-Deakin, O. Rubin, K.C. von Schonfel, *Living without commuting: experiences of a less mobile life under COVID-19*, p.12. (online)

and family activities in a way that suits their individual needs. This flexibility can lead to a more harmonious integration of work and life, where both domains can coexist and even complement each other.

The concept of work-life balance can be then defined as the *relationship between the institutional and cultural times and spaces of work and non-work in society where income is predominantly generated and distributed through labor markets*[45]; in other words, it is the whole practices that co-ordinate, synchronize and integrate work and non-work aspects of workers' lives. The balance enhances this autonomy and flexibility of workers in negotiating attention and presence in employment.

That flexibility, in terms of the autonomy of when people work, improved not only the productivity and satisfaction, but above all the sense of the work-life balance too. In fact, the workplace flexibility lead workers to spend more time and energy with family and care for children; possibility that at first was well experienced during the pandemic crisis. The rigidity of the traditional office-base work can be particular challenging for individuals with family responsibilities, as well as those with personal commitments or health issues. Hence, the higher the workplace flexibility is, the higher the work productivity, the satisfaction and the WLB will be, thanks to the possibility to tailor the workday with the private life.

Again, the flexibility and time savings typical of WFH allow to enhance integration of work with family time and family responsibilities, in fact remote work can be defines *family-friendly*[46] too. This concept, which only recently has been taken into consideration, it can be conceptualized as an intrinsic part of work-life balance. In this way WFH gives workers the opportunity not only to be more involved in their children's life, but even more present in case there is a need for assistance to older family members. Parents can be physically present at home, enabling them to take a more active role in their children's education. This increased involvement can strengthen parentshood relationship, provide more emotional support and contribute to better developmental outcomes for children; they have the possibility to structure their workday around the family needs. Additionally, WFH enables parents to respond more quickly to family emergencies or unexpected situations or events, reducing then the stress and anxiety associated with work and family life. This increased time spent at home can also foster stronger family bonds: families have more opportunities to engage in shared activities, such as meals, conversations and leisure time. These interactions can enhance communication, promote better emotional well-being and create a supportive

45,46 A. Felstead, N. Jewson, A. Phizacklea, S. Walters, *Opportunities to work at home in the context of work-life balance*, p.56,54. (online)

home environment.

The rise of WFH represents a significant shift in the way we approach work and life, offering new opportunities to achieve a better WLB. The flexibility, time savings and enhanced integration of work and personal life that remote work offers can lead to a more sustainable and fulfilling lifestyle; also because it is important to underline how remote working is estimated to be deemed equivalent to an *8%*[47] pay rise to employees. As we move towards a future where WFH will be increasingly common sustainable architecture will play a crucial role in creating room that enables individuals to achieve this harmonious balance.

47 Heejung Chung, *Flexible working: a deep dive into the impact of remote working on gender equity*, p.17. (online)

3.5 REMOTE FOR ALL

Gender equity in the workplace has always been a focal point for social, economic and policy discussions. The historical division of labor, deeply rooted in patriarchal structures, has traditionally placed men in the role of primary breadwinners, while women have been relegated to the domestic sphere. The Industrial Revolution brought about significant changes, as work became increasingly separate from home. Men moved into factory or office jobs, while women were expected to focus on domestic duties and childcare. This separation reinforced the notion of the male breadwinner and the female homemaker, strengthening gender inequalities in both public and private realms. Traditionally, women have endured the load of all domestic labors, including childcare, eldercare and household chores, that makes a shocking contrast with the market "choices". Still nowadays, even in contemporary developed countries, there is a big gap in domestic labors. In fact, women not only are accountable for the running of the household, but also, they have to be responsible for managing the relationship between household and workplace.

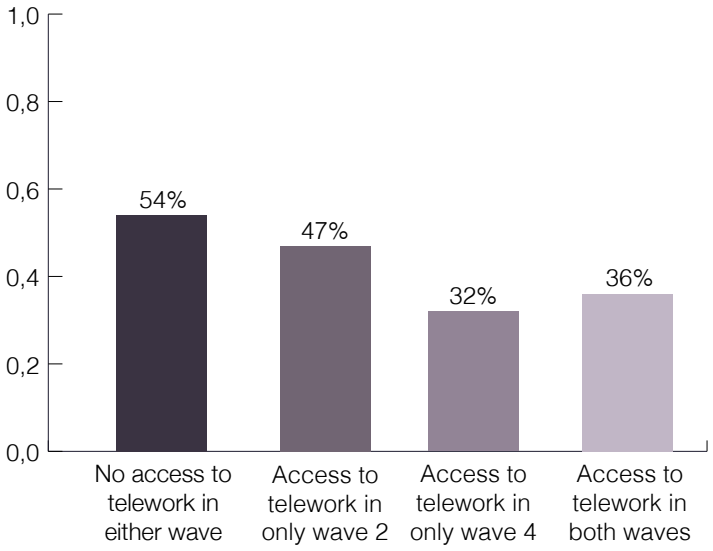
The 20th century witnessed an important shift in those gender roles, particularly with the rise of the feminist movement, which advocated for women's rights to education, employment and political participation. However, despite these advancements, women have continued to face significant challenges in achieving full equity in the workplace, including the gender pay gap and the double burden of paid work and unpaid domestic work.

The advent of WFH as a mainstream work model, accelerated by the COVID-19 pandemic and prompted by advances in digital technology, represents a potential turning point in the quest for gender equity. Remote working, with its typical flexibility and its family-friendly approach, enables them to integrate their professional and personal responsibilities more effectively. By reducing the need for strict 9-to-5 office hours and allowing work to be conducted from home, WFH empowers women to pursue their careers while fulfilling domestic obligations, potentially leading to greater job satisfaction and career progression. This is because remote working allows more diverse leadership styles and recognizes the value of results-oriented work. This shift can open up opportunities to assume leadership roles, especially those who may have previously been sidelined due to caregiving responsibilities or the inability to participate in traditional office-based model. Hence, women with more possibilities to access to smart working are less likely to drop out of labor market. For this reason, it is easy to understand how the work-life balance is strongly connected with gender

equity. Access to flexible work arrangement can lead women to be in higher positions within the company they work for and also be more valued, more productive and be the type of worker more likely to retain their labor market position after childbirth; they have then more possibilities for career progression.

In fact, taking data provided by Understanding Society the two variables *wave 2*[48] and *wave 4*[49] were analyzed. In the first the respondent is still employed and in the second she reduced his working hours. The first graph shows the likelihood in reducing working hours after childbirth with or without access to remote working. It is easy to understand how women with access to telework in wave 4, always wave 4/2, reduce 32-36% their hours; whilst women who have no access to WFH have had to reduce their working hours by 54%, more or less 20% more than the previous ones. The second graph shows the comparison of the probabilities of reducing working hours for women using and not using flexibility. Women who do not use flexible time in either wave have a likelihood of 53% to reduce their working hours after childbirth; in case they use this flexibility in both waves more than halved this likelihood to only 23%.

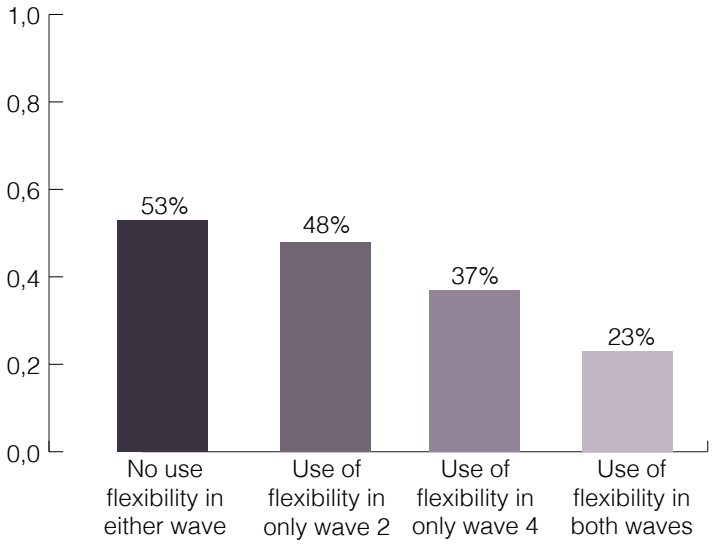
Fig.7 Predicted probabilities access to telework.



Source: Heejung Chung, Mariska van der Horst, *Women's employment patterns after childbirth and the perceived access to and use of flexitime and teleworking*, p.60. (online)

48,49 Understanding Society: user guide. (online)

Fig.7 Predicted probabilities use flexibility



Source: Heejung Chung, Mariska van der Horst, *Women's employment patterns after childbirth and the perceived access to and use of flexitime and teleworking*, p.61. (online)

In the traditional WFO model women with caregiving responsivities often face limitation in their ability to relocate for work or travel for professional opportunities. WFH removes these geographic barriers, enabling them to pursue career opportunities regardless of their location. This increased access can be particularly beneficial for those women in rural areas or those with disabilities who may have previously been excluded from certain career paths due to either logistical challenges or stereotypes. In fact, the rise of online meeting and networking allowed a better access to training and opportunities for employees with additional demands outside workplace, including therefore women and disabled women; they can connect each other across the world and above all enabling them more representation of marginalized workers to be seen and valued.

Furthermore, remote working allows disabled individuals to create a customized and accessible work environment suited for their specific needs. In fact, at home they are able to control their workplace, such as right ergonomic furniture or adjustable desks; customization that is not always possible in a traditional office setting. Additionally, WFH eliminates the need to navigate physical barriers, such as stairs, narrow doorways or inaccessible restroom, reducing, in this way, the physical strain, effort

and stress required to work effectively.

WFH is able to promote a more equitable distribution of domestic responsibilities between men and women: with both working from home, there is greater visibility and awareness of the demands of household and caregiving tasks. This shared experience can lead to a more collaborative approach to managing domestic responsibilities, encouraging men to rake on a more active role in caregiving and household duties.

The shift towards WFH represents a significant opportunity to enhance accessibility and inclusivity. By addressing the barriers that people have to face in traditional work environments and providing a more flexible, autonomous and supportive work arrangements, remote working can align with the principles of sustainable architecture and inclusive design.

3.6 REMOTE WORK, CLEAN EARTH

The environmental impact of work has evolved in parallel with the development of industrial and post-industrial periods. The Industrial Revolution marked the beginning of an era where the concentration of work in urban center, often in large factories and offices, brought to important environmental challenges. The need for employees to commute to centralized areas resulted in development of extensive transportation networks, which over time, turned into major sources of air pollution and greenhouse gas emissions. The construction and maintenance of large office buildings required significant energy and resources, contributing to the urban sprawl and habitat destruction. As the global economy grew and urbanization increased, the environmental footprint of work continued to expand. The rise of the service economy and the proliferation of WFO jobs in the 20th century further underlined the need for commuting and the use of energy-intense office spaces. At the beginning of the 21st century, the environmental costs of traditional work models became increasingly apparent, prompting calls for more sustainable approaches to work.

The concept of remote working is not entirely new; in fact, despite the technological advancements, WFH remained relatively common until the spread of the COVID-19 crisis, which forced all the worldwide organizations to adopt it as a strategy to deal with the spread of the virus. It is no coincidence that lockdown strategies have not only inspired human resourcefulness, but they have also affected ecological sustainability. Therefore, this sudden and widespread shift to smart working provided a glimpse into the potential environmental benefits of reducing reliability on traditional WFO models.

First of all, one of the main immediate and measurable environmental benefits is the reduction of emissions related to the commuting, specifying that the longest commutes are typical of those urban environments characterized by sprawl and not only for work but also for all other activities. In traditional work models, daily commutes by car, by bus, by train or by other modes of transportations are an important source of greenhouse gas emissions (GHGEs), particularly in urban areas. WFH, eliminating or reducing that need of daily travel, led to a substantial decrease in the carbon footprint associated to commuting and a decreased water contamination in rural areas and urban communities worldwide. Moreover, the reduction in peak traffic demand, traffic congestion, fuel consumption and of the air pollution contributes to improve the quality of the air and public health. Hence, WFH can be adopted as a strategy option for cities and regions struggling with air pollution, as well as congestion. It is in fact

estimated, according to a European study, that workers may save *178 Euros and 2 to 14 hours per week*[50] on average if they *travel off-peak*[51]. This money and time are actually a waste of energy that could be used and invested in other personal and recreational activities. As a matter of fact, if commute travels are spread throughout the day, road and infrastructure networks can be more efficient.

It is now well known that not only transportation but also buildings represent the main contributors to realizing a higher percentage of GHGEs during their life cycle, which counts for the building's entire life, taking into account the design, construction, operation, demolition and waste phases. In Australia, for example, buildings are responsible for *23%*[52] of the national GHGEs; it is *43%*[53] in the USA and *50%*[54] in China. World population in cities is estimated to continue to grow and this means that cities demand more infrastructures. In this way, the energy demand and energy use increase and this produces a significant amount of GHGEs in the environment. Because building sector face a lot of challenges in achieving the goals of the Net Zero Energy Buildings, such as net-zero site energy, net-zero source energy, net-zero energy costs and net-zero energy emissions, WFH represents a sustainable option to reduce energy consumption. Looking at the operational energy, heating and cooling are responsible for 75% of the entire energy consumption, the rest is due to equipment and lighting; it can be lower by just reducing the building space and the activities within. For this reason, WFH is able to decrease this operational energy consumption and the related GHGE. It is necessary to underline that WFH practices increase a lot the time spent at home, consequentially there is an increase of energy usage in residential buildings and the related GHGEs whilst reducing the energy consumed in the office buildings. Despite that, it can be assumed that it is easier to implement more sustainable actions by working from home rather than in the office. Staying at home makes it easier to pay attention to energy waste or material waste. For example, WFH employees can reduce the reliance on convenience foods and single-use packaging, potentially reducing in this way food waste and plastic consumption, and so on.

However, the GHGE cut due to the elimination of the commuting is higher than the one emitted from buildings. Just think about how in Italy the transport sector was responsible for 25,2% of the total national GHGEs in 2019, 92,6% of which deriving from road transport. It is, in fact, estimated that an increase of people working at home at least half their week, it would cut peak hour traffic by 5%, *saving 120 ml of fuel and 320 kg of carbon*[55]. Obviously, the more the days of remote working are, the

50,51 Halefom, T. H., Moglia, M., Nygaard, C. (Andi), & Pojani, D. , *Sustainability Implications of Working-From Home (WFH): A Systematic Review of the Travel Behavior Literature. Journal of Planning Literature*, p.9 . (online)

52,53,54,55 S. Navaratnam, A. Jaylath, L. Aye, *Effects of working from home on greenhouse gas emissions and the associated energy costs in six Australian cities*, p.2-3. (online)

more it is possible to cut down not only GHGEs, but also other pollutants that can cause human toxicity, abiotic depletion or photochemical oxidation.

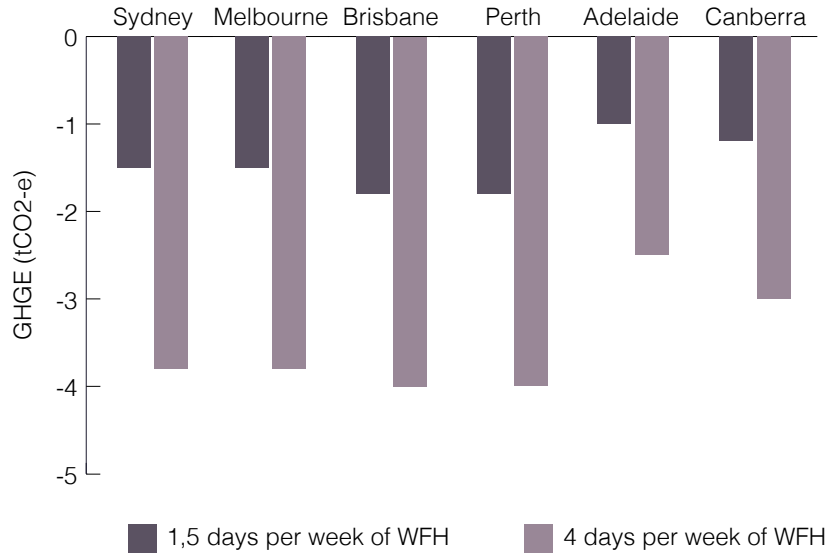
A Chinese study[56] compared air pollution indicators of 2019 and 2020; it is true that in 2020 due to the pandemic crisis WFH was forced on everyone and therefore data collected shows a perfect scenario from an environmental point of view that however can no longer be repeated. This data makes it clear how much this new way of working can have a great impact on the environment and air quality. What emerged is that for 20 days consecutive, the values in 2020 of AQI (Air Quality Index), CO and PM2,5 were found lower that the same registered the previous here in the same period. Where PM stands for particulate matter: the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are larger or darker enough to be seen with the naked eye. PM2.5 defines fine inhalable particles, with diameters that are generally 2.5 micrometers or smaller. More specifically, the mean value of AQI decreased from 77.758 to 54.201; the mean daily concentration of CO dropped down from 0,933 mg/m3 to 0,692 mg/m3; and PM2,5 went from 55.968 μg/m3 to 36.169 μg/m3. In addition, the daily concentration of NO2, PM10 (particulate matter with inhalable particles, with diameters that are generally 10 micrometers and smaller) and SO2 decreased as well: the fist from 43.824 μg/m3 to 24.755 μg/m3; PM10 from 73.338 μg/m3 to 47.695 μg/m3; the latter decreased from 8.091 μg/m3 to 6.278 μg/m3. This data demonstrate how WFH is able to offer empirical evidences about the effects on enhancing urban air quality.

Hence, taking six Australian cities as example, with the adoption of smart working in the aftermath of the pandemic crisis, it is estimated that in Brisbane about 1,5 tCO2-e/year GHGE is reduced in case an employee adopts WFH only 1,5 days per week; this reduction becomes 2% and 1% lower in Melbourne. In case the employee works remotely 4 days per week, the GHGE reduction increases up to 80% in all six cities. The International Energy Agency (IEA) estimates net CO2 emissions savings from smart working in different areas, including both transport and household energy consumption. *The average daily net CO2 emission savings are around 4.9 to 6.0 kg/day in the United States, in winter and summer respectively, and 3.1 to 4.9 in the European Union in the same seasons*[57].

56 Li Chen, Chuanyao Li, *Understanding the benefits and mechanism of working from home as a sustainable urban strategy on air pollution: empirical study in 19 cities in China*. (online)

57 R. Roberto, A. Zini, B. Felici, M. Rao, M. Noussan, *Potential benefits of remote working on urban mobility and related environmental impacts: results from a case study in Italy*, p.15. (online)

Fig.8 GHGE changes from transportation per year when an employee adopts WFH



Source: S. Navaratnam, A. Jaylath, L. Aye, *Effects of working from home on greenhouse gas emissions and the associated energy costs in six Australian cities*, p.8. (online)

Additionally, office environments require a significant amount of resources, not only the construction and maintenance, but also the daily use of paper, water and office supplies. WFH decrease the need of these resources just by shifting work activities to home environment, where those resources can be more easily controlled and minimized. For instance, the reduction in paper usage as a result of digital workflows and the decreased demand for office supplies contribute to a lower environmental footprint.

The rise of WFH offers therefore a unique opportunity to reverse the trend of the depopulation in mountain rural areas, promoting a balanced regional development. Its environmental benefits, such as reduction of carbon emissions, lower energy consumption in cities makes it an attractive strategy fostering both environmental sustainability and social resilience.

3.7 CHALLENGES BEHIND THE SCEEN

While WFH offers undeniable benefits, as shown in the previous paragraphs, such as increased temporal and spatial flexibility, reduced commuting time and better productivity and work-life balance, it is crucial however to examine the numerous challenges that remote working involves, which span across technology, social, psychological and architectural domains.

One of the most immediate technological challenges is obliviously the need for robust digital infrastructure. High-speed internet, reliable communication tools and secure data access are nowadays requirements for effective remote work. However, the existing residential infrastructures were not designed to accommodate the bandwidth and connectivity requirements of full-time remote workforce. This has led to issues such as network congestion, data security concerns and digital inequality. This latter is particularly pressing, as it highlights the disparity in access to high-quality digital resources across different socioeconomic population, leading to what is called *digital divide*[58]. Those inequities, in which individuals have less access to computers and internet, effect the lowest level of digital skills. This factor not only affects productivity, but also exacerbates social inequities. Above all, people in internal areas may lack access to high-speed internet effectively, excluding them from the several benefits WFH is able to offer. Moreover, the increased demand for digital connectivity has environmental implications. In one hand data centers, the backbone of internet infrastructure, are significant energy consumers and their growing footprint contributes to carbon emissions; on the other hand, in many internal areas, especially mountainous ones, it is difficult to install all the necessary infrastructure due to the terrain and the insidious climatic where people do not have internet access because they tend to have for that reason lower earning and lower productivity.

The shift to WFH has also altered the energy consumption patterns, with important implications on sustainability. In commercial and office buildings energy is centralized, and organizations can implement large-scale energy efficiency measurements. However, in the WFH scenario the energy consumption is instead distributed across millions of homes, many of which are not equipped and/or designed properly with energy-efficient technologies. This leads to an increased energy consumption, in particular, in regions where weather conditions are extreme and where heating and cooling systems are not heavily relied on.

58 Massimo Ragnedda, and Glenn W. Muscher, *The Digital Divide: The Internet and Social Inequality in International Perspective*. (online)

WFH has also social implications and one of the highest risks is the isolation. In a traditional office environment, social interactions are a natural and integral part of the workday: casual conversations, team meetings or collaborative projects create a sense of community and belonging, as well as a cohesive and collaborative work culture. These interactions are not only important for professional development and collaboration, but also for the mental well-being, as they provide opportunities for social support or networking. On the opposite, remote working leads to a reduction in these social interactions and employees feel physically isolated from colleagues, leading to feelings of loneliness and disconnection. This is also powered by the fact that digital communication lack of richness and nuance of face-to-face interaction, making it more difficult to convey emotions and build trust. The elimination of those interactions reduces the chances to build and maintain professional relationships, which are the reflection of job satisfaction. Additionally, the absence of non-verbal cues, such as body language or facial expressions, can lead to misunderstandings and miscommunications, which may strain team relationship. This isolation dilemma is compounded by the diversity of different home environments, due to the fact that not all individuals have access to a conducive and socially enriching home setting. For instance, people living alone, in small apartments or in environments with poor social interaction opportunities are particularly vulnerable to the negative effects of WFH. In such settings, the lack of dedicated and suitable workplaces may bring to frequent interruptions and distractions.

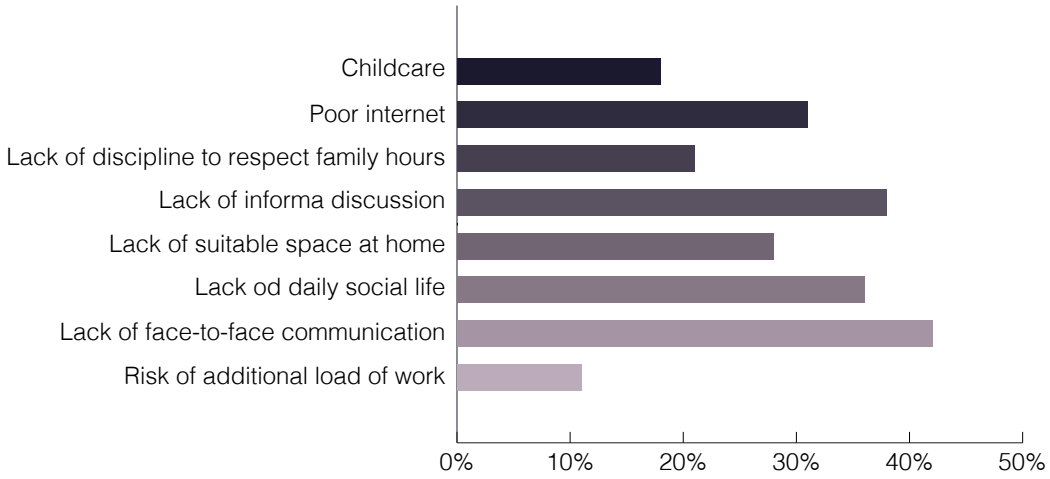
Furthermore, WFH drastically reshaped the landscape of modern work, bringing profound changes in how individuals manage the interplay between their professional responsibilities and personal life. In fact, in WFO the physical separation between the office and home used to represent a clear demarcation, helping individuals maintain distinct boundaries between work life and private life. Remote working broke these boundaries, making it more complicated to achieve a healthy work-life balance. Without the definite separation provided by the traditional physical workplace, the home became a multi-functional space where professional, domestic, family and leisure activities coexist. This convergence of roles and duties within the same environment can report challenges for boundary management, leading to issues of overwork, stress and burnout. This is because the overlap of all the responsibilities lead to role conflict, where the demands of one role interferes with the possibility and ability to fulfill the

other; then, the lack of structured work environment run into feelings of chaos and disorganizations.
The flexibility offered by the WFH, whilst it is often seen as a great benefit, can paradoxically contribute to the boundary erosion. In fact, the possibility to work at any time and from any place can carry out the temptation to overwork, such as checking emails outside normal hours, or take on additional tasks. Over time, due to those temptations, the lines between work and private life becomes very likely harder and more difficult to control. As a result, individuals become mentally and constantly engaged with work, even during personal or family time.

If in a previous paragraph it was explained how remote working has helped to mitigate the gap of the division of the domestic labor and the household between men and women, this not always happens. WFH, by merging the boundaries between the professional and domestic spheres, can unintentionally reinforce these gendered expectations. The dwelling, both by tradition and by imposed obligation seen as a woman's domain, becomes both a workplace and a living space, placing therefore additional pressure on women to fulfil professional and domestic roles simultaneously. If on one hand remote working, providing its typical flexibilities, offers opportunities to overcome gender inequalities, on the other hand, it may entrench the gendered division of labor, leading unequal burdens for women.
This is particular evident in household with children or elder care. In fact, single mothers or caregivers, who are usually women, have to balance work with caregiving activities and responsibilities. It is not a case that these remote workers report a negative correlation with respect to the typical WFH flexibility and the quality of job deliverables. This situation is enhanced when women lack access to support system and resources, such as affordable childcare, mental health services and technology, that are essential in determining how remote work impacts the gendered division of labor.

Another important challenge is the work environment because many homes are not designed with dedicated workplace in mind or the only space present is not suitable at all. These working conditions can carry out negative effects not only on productivity, but above all, on health and well-being.

Fig.9 Challeges of WFH



Source: Amin Al-Habaibeh, Matthew Watkins, Kafel Waried, Maryam Bathaei Javareshk, *Challenges and opportunities of remotely working from home during Covid-19 pandemic*, p.104. (online)

3.8 CONCLUSIONS

The phenomenon of remote working has gained immense popularity and relevance, shaping the global workforce into a new mode of operation. It was clear that it was not only a temporary solution to face the pandemic crisis, but it became also a potential permanent shift in how we conceptualize work and design environments and plan urban landscapes.

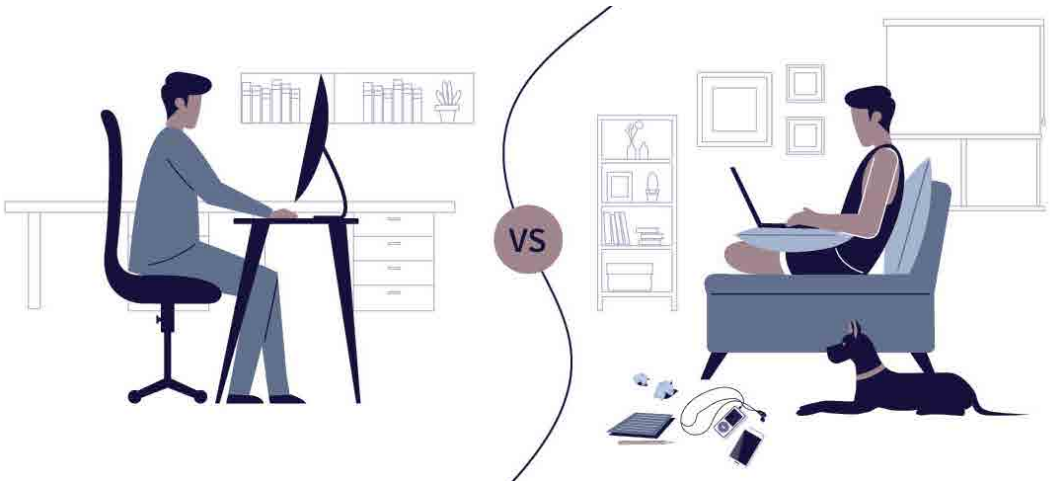
It is well known that there are benefits, such as the reduction or the elimination of the commuting time and the potential for more residential energy-efficient homes, but in the meanwhile, there are also significant long-term drawbacks, including social isolation and inequality access to remote working infrastructures. Despite that, this trend of the WFH is destined to be increasingly adopted by companies precisely because its opportunities far outweigh its critical issues.

However, this transition from traditional work to the remote one has profound implications, not only for workers and employers, but also for economies, for the built environment and for the architectural practices. That's because the shift has reshaped the dialogue around sustainable architecture by challenging traditional notions of office spaces, urban planning, energy consumption and environmental impacts. Cities and communities must adapt to this new model. In fact, it is necessary to highlight how WFH has also shaped all the local economic activities: all the commuters used to spend a lot of time away from their home and their lifestyle reflected it, such as having lunch in bars or restaurants or after-work drinks. Remote working, especially during and after the COVID-19 pandemic, led to what is called *zoomshock*[59]. This term refers to the fact that WFH brought significant consequences for providers of local consumed services in the cities, causing, therefore, economic damages.

For these reasons the transition is not and will not be neither immediate nor easy because it will involve long-lasting and profound changes in the productive sectors and structures. For example, it could be assumed that all those activities affected by economic damages, due to the reduction of customers working from home, could be transferred to internal areas affected by depopulation and in which remote working could be used to face this problem. This is because WFH involves rethinking both in the way through which the city is experienced and how all economic activities are carried out. The future of work, living and urban development is interlinked; sustainable architecture should play a central role in shaping a more balanced equitable and sustainable world.

59 Gianni De Fraja, Jesse Matheson, James Rockey, *Zoomshock: The geography and local labor market consequences of working from home*, p.2. (online)

Fig.10 WFO vs WFH



Source: Google Images

4
REMOTE REVIVAL

Gotland Island, Sweden. Source: Google Images

4.1 BACK TO THE HEIGHTS

Before the pandemic years, urban areas were the epicenters of economic growth, cultural diversity and social interaction. The concentration of all kind of jobs and services made the city highly attractive, in particular for young professionals and families seeking more opportunities and convenience. However, the onset of the COVID-19 pandemic revealed the hidden vulnerabilities of the urban life: crowded spaces, high population densities and reliance on public transports became liabilities. Therefore, the pandemic period underscored the fragility of urban living, leading many questions about the long-standing assumption that cities are the best places to live, work and prosper.

One of the most significant factors driving the reevaluation of urban life during the pandemic was the experience of lockdowns and social distancing limitations. For many people, the confinement to small apartments, the lack of access to green spaces and the overwhelming sense of isolation in densely populated areas highlighted those limitations. Urban residents found themselves longing for more space, both indoor and outdoor, and above all a greater connection with nature and greenery; as well as desiring for alternatives living arrangements that prioritize health, well-being and good quality of life. Environmental reasons also have their weight since they are closely linked to health, so places with less contaminated air and less noise pollution have started to be increasingly sought after. Hence, in recent years there has been a noticeable shift in population dynamics with a growing movement of people returning to or newly settling in mountain areas.

Remote working has been the key driver of this phenomenon. The new advancements in digital technologies and the widespread adoption of WFH policies have liberated many professionals from the need to live close their workplace. The typical WFH's flexibility has opened up opportunities for people to relocate to mountain regions, whilst they are able to enjoy a peaceful and healthier lifestyle, maintaining their careers. Mountain areas, once considered too remote or economically disadvantaged, become now rediscovered as ideal locations for those seeking a good and healthy work-life balance thank to the digital connectivity. The rise of WFH has also urged new reevaluations of housing preferences. Because of the limitation or elimination of the commuting time to the office, many workers started to prioritize other factors, such as space, affordability and access to nature over proximity to urban centers. Mountain areas have a more affordable real estate market, larger properties and natural beauty, so they become increasingly attractive options for those people

seeking healthier life. This is because lifestyle choices reflect each individual's aspirations, values and attitudes. It can also be seen how in late modernity there a kind of disaggregation of the traditional guidelines through which people is defined themselves in relation to the social context they live, and this gives them a new kind of freedom. For this reason, the so-called digital nomad lifestyle has begun to grow and becomes increasingly successful; it has further contributed to the repopulation of the mountain areas. *Digital nomads*[60] can be defined as those people working remotely because they take advantage of portable computing technologies and widespread internet access in order to achieve a unique and healthier lifestyle. They are drawn to mountain regions for their natural beauty and outdoor recreational opportunities. Therefore, many mountain locations have responded to this trend by improving their digital infrastructures to accommodate the needs of remote workers and digital entrepreneurs. Their key explanation can be found in the root of the noun "freedom" which is evoked to be in contrast with "the 9-5 routine". In fact, digital nomadism offers an escape from the traditional social system and from the traditional work culture.

As mentioned, one of the primary factors of the repopulation of mountain areas is the desire for a better life quality. As urban living becomes increasingly stressful, expensive and disconnected from nature, many individuals are looking for new ways of living. Mountain regions, because of their very low levels of pollution and their stunning landscapes, are seen as ideal places to achieve those desires. In fact, those areas can offer a chance to escape from the noise, pollution and congestion of the city and to reconnect with nature. The psychological and physical benefits of living in natural environments are well known as the exposure to nature is able to reduce stress, improve mental health and enhance well-being. In these locations, inhabitants enjoy outdoor activities and provide a sense of connection to the natural world. Hence, that slower pace of life is also appealing to those who feel overwhelmed by the fast pace and demands of urban living. In the mountains, there is a typical stronger sense of community that, with the beauty and tranquility of the natural environment, is a powerful option for these seeking a more meaningful and sustainable lifestyle.

The growing awareness of environmental sustainability and the desire for self-sufficiency should be considered as another key driver for the repopulation trend of the mountain areas. Since there has been concern about climate changes, resource depletion and the fragility of global supply chains, individuals are looking for way to live more sustainably and reduce their environmental footprint. Mountain regions, with

60 F. Mancinelli, *Digital nomads: freedom, responsibility and the neoliberal order*, p.418. (online)

their almost direct access to natural resources, opportunities for small-scale agriculture and potential for renewable energy production, offer a promising setting for a sustainable living. This desire for self-sufficiency was amplified by the COVID-19 as people experienced disruptions in food and supply. Mountain areas are in fact often known to be resilient places to live in, facing environmental and social challenges.

This demographic shift has the potential to revitalize mountain communities by bringing new labor, ideas and skills. In fact, new younger residents, particularly those with remote jobs or entrepreneurial ambitions, can contribute to the local economy by starting business, purchasing homes and investing in community initiatives. Moreover, the presence of families with children breathe in new life into schools, cultural institutions and community organizations.

In this new trend of migration, however, it is important to distinguish two categories of new inhabitants related to their daily travelling, work and life. In fact, in one hand, there are the temporary inhabitants as multi-local dwellers, seasonal workers or second home inhabitants; on the other hand, there are the resident inhabitants, namely those individuals that live for a long time on mountain territories for different reasons, such as job, living cost or presence of specific resources, and therefore they play the most important role in these migration processes. The crucial factor of these migrations is a strong relationship between the territorial capital[61] of mountain and the needs expressed by people who move to mountain localities; this relation can be both vertical and horizontal.

The *vertical relations*[62] are set up by the new inhabitants and the local resources. In other words, the relation is between the natural environment, local amenities, social capital, territorial services, communication infrastructures and the quality of life and the new residents who use those points to achieve their new goals in their new life. This kind of relation is crucial to deeply understand the reasons why more and more people decide to move to the mountains. Within it, dynamic innovation plays the main role as the arrival of those new inhabitants carrying a more vibrant and diverse community, with new cultural events, social networks and opportunities for collaborations. Newcomers can contribute to the preservation and revitalization of local traditions, as well as the creation of new cultural expressions that reflect the evolving identity of the community.

The *horizontal relations*[63] are made of two different levels. The first is referred to the local level, in which there is the interaction between the newcomers and the resident

61 Set of material and immaterial territorial elements recognized by a community historically defined as a resource for its own social reproduction, Treccani. (online)

62,63 Mountain Dossier, *New perspectives for Alpine research*, n.1 February 2013, pg. 20. (online)

inhabitants. Relations are in this case based on socio-cultural aspects, such as human capital or the capacity to integrate into new cultures, and on institutional aspects, such as local policies, local economic incentives to attract human capital, concrete job opportunities or the possibilities to improve innovative economic activities. The second level, named supra-local level, is referred to those relations defined as the interaction between the new inhabitants and the supra-local actors or networks. In this case newcomers bring with themselves their previous knowledge that should be properly balanced at local level as well because the exchange of ideas and practices between permanent residents and new ones can lead to a richer and more dynamic cultural life.

In all these processes and relations, the past represents the roots of the future for the mountain localities where modernity and tradition are integrated in a new innovative way. It is important to understand properly all the needs that the new residents demand, such as welfare, quality of life and job opportunities, but also schools, medical centers, post offices, banks, efficient communication infrastructures, sport activities and so on.

This migration trend can be seen therefore as a great opportunity to solve all the challenges that the mountain areas had to face up to then. In fact, it promotes processes of re-territorialization, the use of local resources, it creates new jobs, it can bring additional taxable incomes and new workforces. New and old residents may work together in order to build new ideas of mountain regions as *places of green, ethic and sustainable economy, eco-renewable architectures, cultural integration and environmental quality*[64].

64 Mountain Dossier, *New perspectives for Alpine research*, n.1 February 2013, pg. 21. (online)

4.2 CASE STUDY 1: GOTLAND ISLAND, SWEDEN

In the wake of the pandemic, urban dwellers across Europe, North America and other parts of the world have increasingly sought refuge in rural areas. The desire for more space, more connection with nature and a lifestyle that allows social distancing has driven this trend. This movement is referred as *green wave*[65] and it represents an important cultural trend in which young families chose to move to the countryside in order to achieve a more sustainable life, both on a household level and on a larger scale. In Sweden, where the pandemic restrictions were relatively lenient compared to other nations, this migration has been popular particularly in areas with existing infrastructures and natural amenities. This trend is not new, but it has been intensified by the pandemic that acted as a catalyst for individuals to reassess their living conditions.

Remote working played a crucial role and when it became more and more a viable option, the necessity to live close to the workplace diminished, allowing urban residents to look for a better quality of life in rural settings. In fact, rural life is usually known to be connected to certain ideas of simpler life, free from stress and social pressures; for this reason we speak of *rural idyll*[66] that is able to offer land-based recreational activities, opportunities to reconnect with rural past and provide a better life in attractive landscapes.

It is estimated that in a Swedish study a third of the interviewed people reported changes in their living preferences during and above all after the pandemic; more or less 5% of all those interviewed individuals would like to move to the countryside full-time from the urban city.

The case study focuses on the Swedish Gotland Island that shows an example about the effects of pandemic-drive rural migration and the related WFH and architectural responses needed to support sustainable development. In particular, it focuses on the three coastal and agricultural areas of the Gotland Island that presents a territorial size of 3140km2 and until 1951 counted 92 municipalities.

Gotland, known for its natural beauty and historical significance, has seen a significant increase of pressure of tourism, both part-time and full-time residents during the pandemic. The three rural areas, Östergarnslandet, Sudret and Fårö, are far away from the only city of the island, Visby, and this confirms all the studies and researches on the rural-migration, and the Green Wave. The first one is located about 40 minutes from Visby and it has a significant percentage of part-time residents, making up nearly 69% of all housing. The natural beauty of the area and the proximity to the sea

65,66 H.E. Aberg, S. Tondelli, *Escape to the Country: a reaction-driven rural renaissance on a Swedish island post COVID-19*, p.1-2. (online)

make it a desirable location for those seeking tranquility and space. Sudret is another peninsula of Gotland 80 minutes away from the Visby and it is similarly attractive for new residents, with part-time residents accounting for 67% of housing; its remoteness and natural landscapes make it a prime destination for those looking to escape the urban life. Fårö, instead, is a small island off the coasts of Gotland and for this reason it is 1-1,5 hours away from Visby and reachable only by ferry; it has the highest increase in part-time residency, with 74,5% of homes used seasonally.

The study explores the significant influence of second-home ownership and the possibility to work remotely on the development of the case study area, highlighting that this trend is not new and is prevalent across Sweden and Scandinavia. In Sweden, more than half of the population has access to a second home, which traditionally consists of small houses primarily used for recreational purposes and often located in scenic, nature-accessible areas like coastlines and mountains.

What emerges from this study is that behind this Green Wave from Visby city to the three rural areas the motivations are more or less always the same: alternative lifestyle, land-based recreational activities and quieter life; this last point results to be the main reason. These motivations turn out to be the same in either case of part-time or full-time living and with the same purpose regardless of any intention of its use. Even though second homeowners spend long periods of the year, they contribute anyway to the rural development as well as permanent residents. In fact, without the increase of the temporary inhabitants, not only these areas would have weaker or no demands for services, but also only fewer individuals to maintain the social fabric to encourage the economy. According to this study more or less 6000 people live and work from their second homes only in 2020.

As any rural areas of world, Gotland experienced the depopulation phenomenon from the 1950s; the situation changed in the 1990s reaching about the same number of inhabitants of 50 years before. This situation remained stationary since the 2000s and this coincides with the development of technologies that have allowed them to begin to develop and enable remote working, without people having to leave these places to move to the city, as it happened in the mountainous areas. The highest peak was obviously reached as a consequence of the pandemic in 2020 when the number of inhabitants reached 60,124; at the same time the number of tourists also grew at the same rate.

What comes out from this Green Wave is certainly a great improvement in infrastructures,

such as mobility, work and living conditions. For instance, in 2017 fiber-optic networks were installed all over the island, reaching the most distant areas, in order to improve the connectivity for all the remote workers. Since 70% of the households are not permanent, a desalination system was installed, capable of serving 450 households. This was an important step because on one hand it allowed to create economic opportunities for local landowners selling their land and on the other it allowed to save the water supply for those households fully dependent on it.

This case demonstrated technology advancements can improve not only life quality of the communities, but above all the quality of life of each individual. They show how technology makes it possible to work more flexibly and from home. Therefore, governments and local authorities should invest and believe in these rural areas in order to support both inhabitants and in-migrants and, at the same time, providing those areas services that can support all-year-around living.

4.3 CASE STUDY 2: MIGRATION TO NON-URBAN AREAS IN ESTONIA

The global COVID-19 pandemic has significantly altered patterns of human mobility, with the notable trend of being a renewed interest in *counter-urbanization*[67]. Counter-urbanization, or the movement from urban to rural areas, has been observed during the pandemic as people sought safer and less densely populated environments to mitigate the risk of infection. This phenomenon raises questions about whether this migration is temporary or represents a more enduring shift in domestic migration patterns. Additionally, the pandemic crisis has accelerated existing trends of multi-local lifestyle, where urban residents maintain second homes in rural areas showing strengthened desire for permanent relocation to the countryside.

This phenomenon is shaped by complex interplay of socio-economic, environmental and lifestyle factors. In fact, the key drivers which motivated the moving to non-metropolitan rural areas are essentially five: aspiration towards a rural lifestyle, known as "rural idyll"; environmental considerations, such as closer connection with nature; housing-related motivations in order to have more space; economic considerations due to the rising of living costs and housing prices or due to the job losses because of global crisis; health-triggered motivations due to global pandemic crisis. This shift, as specified several times in this thesis, was also helped by the rise of digital technologies that increased the possibilities to work from home, further both influencing this migration trend and reducing the need to live near workplaces located in cities.

This case study focuses on domestic migration trends in Estonia, relying on census data from 1989, 2000s and 2020. Data shows the migration patterns from the capital Tallinn and its metropolitan region to rural areas.

Estonia's history as part of Soviet Union from 1944 to 1991 and its subsequent rapid transition to a market economy provides a unique backdrop for studying counter-urbanization. Estonia is the smallest and sparsely populated State of the European Union, as it counts only 1.3 million inhabitants with a population density of 29.5 people per square kilometer. Tallinn is the most populated city with its 450 000 inhabitants. Jo˜hvi, Tartu and P¨arnu represent the urban regional centers of North-West, North-East, South-East and South-West; whilst the counties of Raplamaa, Pa¨rnumaa, Viljandimaa, Ja¨rvamaa, Jo˜gevamaa and southern La¨˜ane-Virumaa act as the agricultural areas in central Estonia. Before entering the Soviet Union in 1944, two thirds of the population lived in rural and internal areas, while during the Soviet period, urbanization was driven primarily by the immigration of Russian-speaking workers to cities such as Tallinn and the industrial city of Ida-Viruma. In fact, in 1989 city

67 Tiit Tammaru, Jaak Kliimask, Kadi Kalm, Ja¯nis ZaT̄ite, *Did the pandemic bring new features to counter-urbanisation? Evidence from Estonia*, pg. 346. (online)

inhabitants counted to be 70% of the total population. Additionally, the inefficiency of a central planned economy and the collapse of large agricultural production units in rural areas led to a significant rural-to-urban migration and the subsequent decline of rural communities. The situation changed after the collapse of the USSR in 1991 because rural areas experienced an exodus of young people to urban centers in order to find better job opportunities due to high levels of unemployment, loss of solidarity and loss of a good future in the countryside.

In recent decades, Estonia has seen fluctuating patterns of urbanization and counter-urbanization that resulted to a broader economic trend. Economic booms in the 2000 and 2011 strengthened urbanization, during which 68% of moves were from lower-to-higher levels in the Estonian settlement system that were related to Tallinn urban region for 28%. The economic crisis of 2009 and 2011-2015 brought to a weakened urbanization and the consequent increase of the counter-urbanization. Between 2015 and 2019 rural areas experienced migration losses towards metropolitan areas again. The pandemic, as a period of economic bust coupled with unique health concerns, provides an opportunity to examine how this last period has introduced new features to the ongoing processes of counter-urbanization in Estonia whether it was driven by high-income households seeking rural amenities or by lower-income households displaced from urban housing markets due to the rising costs. In fact, both families with children and retired people are the main characters of the migration into non-metropolitan areas, especially after the COVID-19 outbreak, in order to have a better working conditions and above all a better quality of life. In this way, parents can adapt their work and family duties switching to working from home, having therefore enough time to commute children to school.

By comparing pandemic-period migration patterns with those from earlier periods of economic boom or bust, this case study shows new features of counter-urbanization and assesses their potential long-term implications. In fact, pandemic crisis highlights how there are no longer just temporary moving out the city in the second homes, but now there are above all an increase of residential relocations towards rural areas.

This is, has been and will be possible thanks to the increasingly widespread possibility of working remotely. Remote working shows how rural areas are no longer a place to escape in times of crisis, but places where it is possible to find a style and quality of life that cities can’t offer.

4.4 CASE STUDY 3: PIACENZA APENNINE AREA, ITALY

While the impact of COVID-19 on densely populated urban areas has been widely documented, its effects on internal and marginal areas remain pretty underexplored. In Italy these areas are usually characterized by aging populations because of the depopulation flows of younger generations, low employment rates and incomes, limited services and socio-economic deprivation, but also other essential services such as schools, healthcare, public transport, bars and anything that makes possible to create a typical sense of community.

The Apennine area of Piacenza is located in the Emilia Romagna region of Italy and it shows two characterized areas: a flat and hilly northern side with bigger centers and higher population density and a southern side which presents mountainous environment with high valleys and many small and dispersed villages at high altitudes, with a low employment rate, especially for young inhabitants, and low accessibility to services. As all the other inner worldwide regions, these areas experienced a significant population loss due to migration towards dynamic metropolitan areas.

However, the pandemic with its consequent lockdown periods triggered a reverse migration trend from urban centers to rural areas, prompted mostly by the rise of the remote work in sparsely populated, low-connected and low accessible municipalities. Hence, these areas have now the possibility to revitalize and strengthen their role for present and future crisis which may happen suddenly and unexpectedly

This case study employs mobile phone data provided by TIM, one of Italy's leading telecommunication operators, to analyze the space-time variability of human presence before, during and after the COVID-19 lockdowns. The data covers thirty-one municipalities, including twenty-nine in the Piacenza province and two in the neighboring Parma province. All these municipalities vary widely in terms of their socio-economic characteristics, settlement patterns and accessibility to essential services. Bobbio in Val Trebbia and Bettola in Nure Valley, for example, act as the most important centers for mountain marginal areas thanks to their accessibility and availability of services.

Data is collected at every 15-minute intervals, providing a highly granular view of human mobility, in order to check the variability of the average number of people present in different timeslots. The analysis compares data from five different weeks: July 2019 (pre-lockdown summer), September 2019 (pre-lockdown working week), March 2020 (lockdown), July 2020 (post-lockdown summer) and September 2020 (post-lockdown working week).

According to the analysis made in September 2019, among the thirty-one municipal-

ities only one, Castel San Giovanni, was referred as *attractor*[68], understood as those municipalities with an increase of human presence from the morning until the evening, in other words an increase of people during the working hours. This raise is due to platforms of transport and logistics that attract people towards this city. The remain thirty municipalities are instead considered as *generators*[69] which means that they decrease human presence from the morning and they gain it again in the late afternoon due to the commute for work or study reasons.

The situation changed during the first lockdown in March 2020 and in September 2020. Many municipalities in these periods, referred as generators, exhibited a significant reduction in daily outflows of human presence compared to the same months in 2019. This shows that a shift toward remote working system as fewer residents commuted to urban centers for work. For example, in municipalities like Bobbio, Travo, Ponte dell'Olio and Carpaneto Piacentino there was a noticeable decrease in the difference between day and night presence of number of people during the lockdown period, suggesting an increased remote working practice.

This trend was not uniform across all municipalities. In the more remote and less accessible areas, such as Zerba, Corte Brugnatella and Ottone, the population instead declined during the lockdown period. This suggests that low accessibility to services and internet infrastructures might have driven a temporary exodus to more accessible and better equipped areas. Mobile phone data offers a powerful tool and insights for understanding these dynamics, whilst its use in research requires careful considerations on its limitations. Future research should focus on integrating multiple data sources and enhancing the spatial granularity of data to provide more insights into the evolving socio-economic landscapes of inner areas.

However, it is important to emphasize that major improvements and changes are needed to consider remote working as the main strategy to awaken internal areas. In fact, the lack or shortage of public transportation and the absence or poor quality of digital connections are the main reasons why people do not move permanently to those areas.

Enhancing digital connectivity and creating coworking spaces could help leverage the trend to counteract depopulation phenomenon typical of the inner areas.

Hence, y addressing these challenges and leveraging the opportunities presented by the pandemic, policymaker and planners can develop more effective strategies for reviving marginalized localities and ensuring their long-term sustainability and resilience.

68,69 TeMA, *Mobile phone data for exploring spatio-temporal transformations in contemporary*, Special Issue 2.2022, pg. 79. (online)

4.5 INCENTIVES FOR INNER GROWTH

Italy is composed in large territorial groups profoundly different on the physical, socio-cultural and economic level and for the evolutionary and development paths. The internal areas therefore represent a fundamental aspect of this territorial diversity. However, on one hand they are marked by numerous critical issues, such as structural geographical isolation, small size of the inhabited centers, depopulation phenomenon, poor supply of essential public services, but on the other hand they are widely equipped with environmental and cultural resources. This awareness led to the idea of dedicating specific policies and development strategies to these areas.

Therefore, giving these territories a second chance is possible thanks to Italian and European incentives. In fact, in recent decades, greater attention has been paid to the human, social and ecological sphere in the attempt to repopulate those areas, and not only from a productive and merely economic point of view.

One of the main instruments used by the European Union is the European Regional Development Fund (ERDF, FERS in Italian) in order to consolidate economic and social cohesion, correcting imbalances between regions. It therefore aims to support the intelligent and sustainable development of territories, co-financing interventions in the field of innovation and research, support small and medium-sized enterprises, as well as the transition to a low-carbon economy and the implementation of the European digital agenda. The ERDF regional program of Piedmont was re-approved in 2021 with a validity until 2027. This program is composed in five priorities: competitiveness and digital transition; the ecological transition and resilience; the sustainable urban mobility; the infrastructure for the development of skills; and the cohesion and territorial development. Specifically, the priority relating to ecological transition and resilience aims to support, in particular, the energy not only the building efficiency and the promotion of renewable energy, but also the adaptation to climate change and the resilience of territories, the circular economy, the protection of biodiversity and natural ecosystems. Priority V includes interventions aimed at promoting development paths in internal areas. Therefore, interventions related to enhancing the territory in terms of sustainable development and enhancing the cultural and natural heritage are considered, increasing the potential of the tourist accommodation sector of the territory.

Another European instrument that must be mentioned is certainly the Interreg which is funded by ERDF and it supports cooperation across borders. One of its programmes is the Interreg Alpine Space; it supports collaborations across of seven Alpine countries: Austria, France, Germany, Italy, Liechtenstein, Slovenia and Switzerland. It deals

with both most important European metropolitan areas and remote rural areas. That cooperation is necessary as the Alpine region is affected not only by accessibility problems, a wide biodiversity, a sensitive environment and economic disparities, but it has issues due to global trends such as climate change, globalization and digital divide too.

At a national level, the National Strategy for Internal Areas (SNAI) was established in 2014 and it has been confirmed again for the period 2021-2027. The SNAI proposes all actions aimed at local development and the strengthening of essential services to achieve the development of those internal areas of the country that are significantly distant from the essential services and face a demographic decline, but they are rich in important environmental and cultural resources. These territories, which have been undervalued and considered marginal for decades, have now become perfect tests of an inclusive and sustainable development. Proposing a sustainable project does not only involve the ecological sphere, but it is the ability to make populations less vulnerable and more resilient to any type of event as well. This strategy in fact highlights above all the opportunities for growth and development that they offer, from a sustainability and resilience perspective. There are a series of objectives: not only the increase in the well-being of the local population and the demand for local labor, but also and above all the increase in the degree of use of territorial capital and the reduction of social costs due to the degradation of human, historical and architectural capital.

5
HOME AS OFFICE

Pianezza (TO), Photograph taken by the author

5.1 SPACE STRUGGLE

The rapid and often unplanned transition to remote work has left many individuals working in spaces that are not suitable at all and far to be ideal. Whe benefits of working from home are well-documented, whilst there is a growing awareness of the potential downsides of working in spaces that are not suitable. In fact, the lack of a proper and ergonomic home office can have far-reaching consequences. A poorly conceived home office can lead to physical, psychological and professional issues which have an impact on both the individual and the broader society. These conditions can be increased by the absence of the dedicated spaces or the inadequacy of existing ones. In other words, the sudden shift for many workers meant transforming dining tables, bedrooms and living rooms into makeshift offices. These spaces, originally designed for leisure, rest or social activities, were now expected to function as efficient and productive work environments.

The lack of suitable space for remote working is not just a practical inconvenience, but it has profound implications on multiple levels. For individuals living in small apartments or shared accommodations, the absence of a dedicated workspace often leads to the blurring of boundaries between professional and personal life. This blurring can result to an increased stress level, a reduced productivity and a significant strain on mental health. The inability to “switch off” from work due to the constant presence of work-related items in living spaces can lead to burnout and a decreased sense of well-being. Not having a dedicated workspace often results to makeshift arrangements, such as kitchen tables, couches or even beds. Furthermore, the absence of physical boundaries between work and leisure spaces can bring to a blurring of roles as well, where the mind is constantly struggling between professional and personal responsibilities and leading to a cognitive overload and decreased work output.

This WFH challenge is particularly pronounced in households with multiple occupants, such as families or shared living situations. In these contexts, the competition for space can bring to conflicts, distractions and reduced productivity. Parents working from home face the additional challenge of balancing work responsibilities with childcare, often without access to separate spaces which would allow an uninterrupted workday. Similarly, the individuals in shared housing, such as students or young professionals, may find it difficult to unlock a space that should be conducive to focused work, leading to frustration and decreased work performance. In long term, all these conditions can erode job satisfaction and engagement. Employees

may struggle to maintain the same level of performance they would have in a traditional office environment, potentially jeopardizing their career progression. In addition, without a private space feeling like claustrophobia and social withdrawal can show up, exacerbating issues of loneliness and isolation. Over time, these situations can contribute to more serious mental health issues, such as depression, which could have a lasting impact.

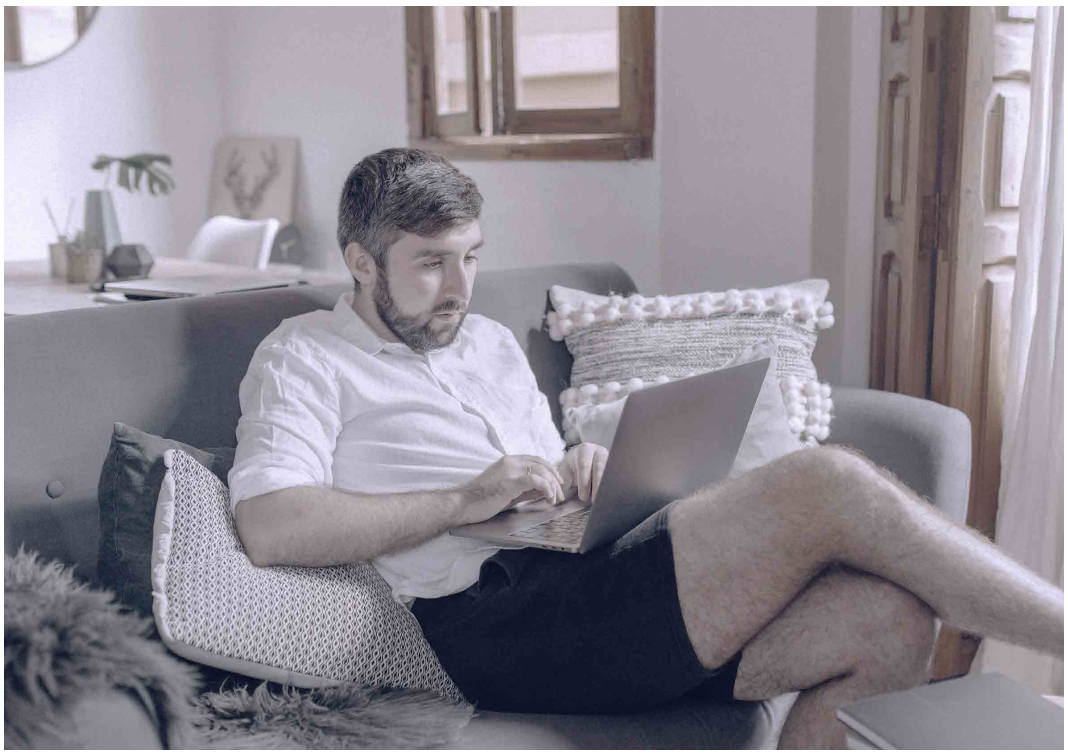
According to a study conducted in Italy in 2021, *68%*[70] of the people involved, who had a space suitable for WFH, expressed their desire to continue working remotely even after the pandemic emergency; whilst only *54%*[71] with inadequate space reported the same desire. In the last case, it is important to suggest flexible furniture able to guarantee enough storage and workplace in which all the tasks areas should be arranged in a hierarchy way. This proves how remote working is strongly related to the environment types in which the individual works. Employees with enough sufficient home working space are more open and in favor of remote working in the future. In fact, it emerged that 74% said they have enough space and only 13% have a separate room to use exclusively for work. From this last data it is possible to deduct that the household real estate market is not able to guarantee proposals with a separated room to use as studio. In fact, finding the right spot and arranging it is crucial in order to provide as much visual and acoustic separation and thermal comfort as possible. For these reasons, flexible and movable interiors elements, such as walls, curtains or furniture should be taken into account.

Since remote work is becoming rising in demand but also increasingly offered by companies and given its countless benefits, it can be seen how it is becoming increasingly necessary to consider a dedicated room an essential point in the real estate market, since 44% say they have to work in the bedroom, 33% in the living room and 5% in the kitchen. From these percentages it is possible to deduce how the homemade “working corners” (Agata Bonenberg, Marco Lucchini, Home Office: Working and Studying Spaces in Residential Interiors during and after Forced Social Isolation, pg. 102 – online) are far from being suitable. Bedrooms and living rooms can be comfortable enough, but only if the work organization, the forniture and the lighting system mirror ergonomic criteria. In other words, working in those rooms is a successful strategy only if those “pop-up” spaces are correctly arranged in order not to collide with all the other daily activities. Their different spots can help to overcome the sameness and promote regular breaks in screen time.

70,71 Agata Bonenberg, *Home ofice spaces for smart work. Impact of Covid-19 lockdown on arragements of residential interiors*, pg. 6. (online)

In the light of this study, the people involved were also asked what changes or rearrangements they would make to improve their workstation. The main requests were increased exposure to natural light, greater insulation from noise and more privacy.
The challenge of inadequate space for remote working is therefore a complex issue that reflects on many aspects of modern life. It is not merely a matter of finding a quiet corner to work in, but it involves rethinking how to design homes in order to better support a way of working that is likely here to stay. Hence, architects and designers have a unique opportunity to address these challenges through innovative and sustainable design solutions that are able to enhance the quality of life for remote workers and to contribute to broaden goals of environmental and social sustainability.

Fig.11 Example of a bad WFH workstation



Source: Google Images

Fig.12 Comparison between groups with sufficient and insufficient home office space regarding the willingness to continue working or studying partially from home after the emergency finishes.

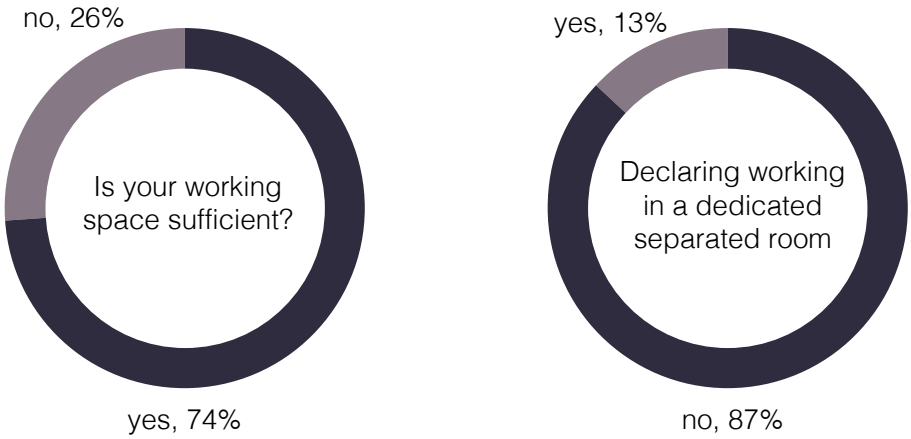
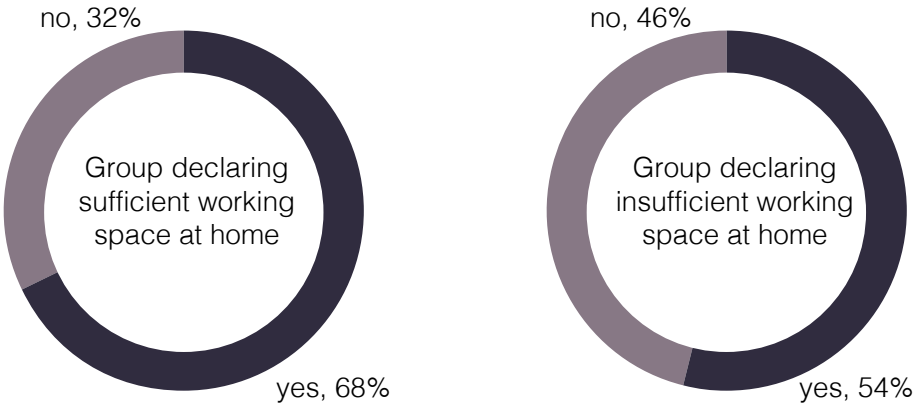


Fig.13 Comparison between the number of people declaring sufficient working space and ones who work in a dedicated studio or home office.



Source: Agata Bonenberg, *Home ofice spaces for smart work. Impact of Covid-19 lockdown on arragements of residential interiors*, pg. 6. (online)

Fig.14 Distribution of spaces in which respondents work from home.

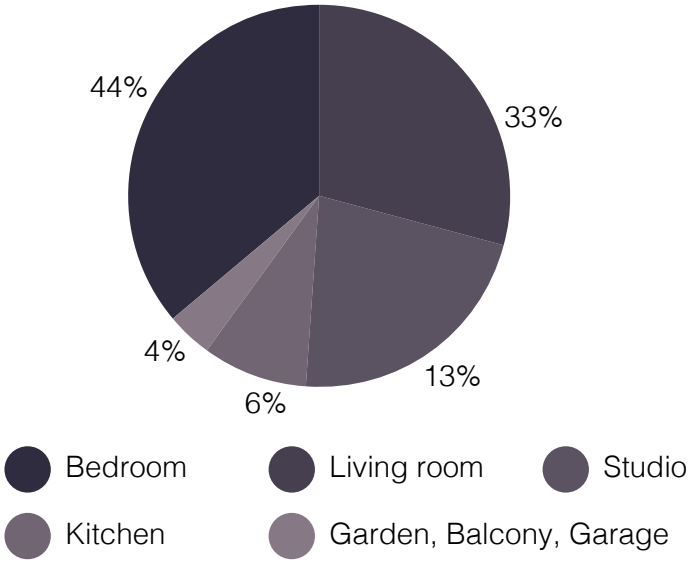
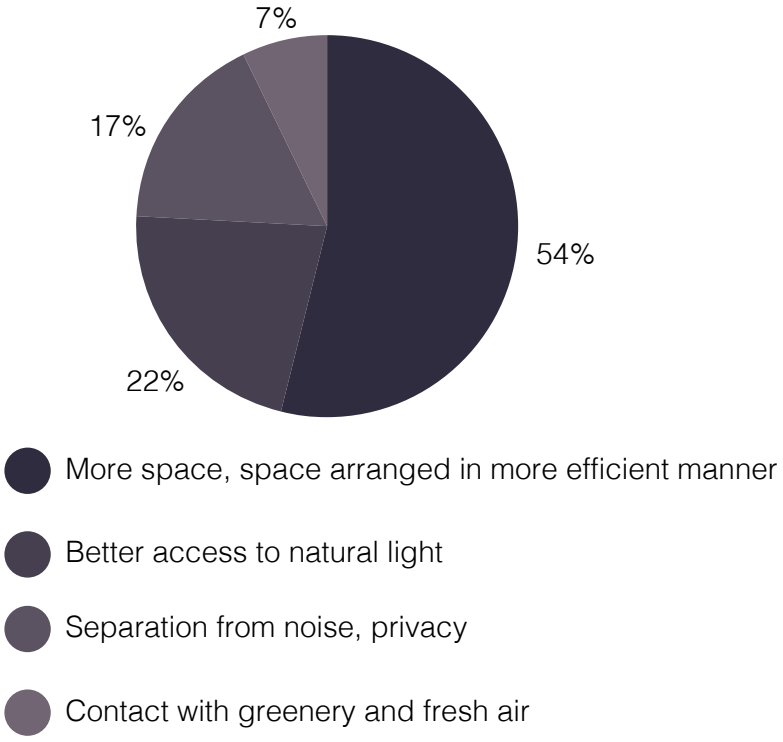


Fig.15 Workspace improve- ments which respondents would like to introduce in their homesice



Source: Agata Bonenberg, *Home ofice spaces for smart work. Impact of Covid-19 lockdown on arragements of residential interiors*, pg. 16-17. (online)

5.2 QUIET SPACE, BETTER WORK

When we talk about acoustic comfort, we mean the "*state of well-being experienced in an appropriate sound environment, where noise is controlled and managed. This comfort goes far beyond a simple decibel measurement: it encompasses the quality* of sound and its impact on our concentration, communication, rest and health"[72]. It is a central concern in the design of offices, educational facilities and public spaces and nowadays it has dived into the domestic spheres.

Traditionally, houses have neither been arranged in order to accommodate work activities, collaborative meetings and individual work, nor built to mitigate properly the noise. It has therefore an important impact on the productivity and overall on the quality of work. Poor acoustics can increase stress, decrease focus and even anxiety and burnout in terms of long-term effects. In fact, it is crucial not only to manage noise pollution, but also to create the right home office able to foster productivity, hold meetings or in general engage all the work activities.

Traditional offices are usually equipped with acoustic control measures like soundproofing, noise barriers and quite zones, whilst residential buildings are multi-functional and with spaces shared by different users. Within the house, noise can be divided in external and internal noises. The first can be identified in sound pollution from traffic, construction or general outdoor social gatherings; the latter includes all the sources within the home, such as kitchen appliances, HVAC systems, television activities of other household members. The internal noise may get even worse if there are children playing, screaming and running around. Both noises should be managed properly in order to help a person to concentrate and enhance his work efficiency.

In fact, noisy environments can increase cognitive load, mental fatigue and decrease attention span. In a WFH environment, these problems are amplified by the same acoustic control technologies or strategies that are, on the contrary, present in office settings. It is easy to understand therefore how much important the acoustic comfort is, as the discomfort literally poses a barrier in the productivity and well-being. This issue is significantly higher in urban areas where homes are located very close to sources of traffic, construction or densely populated areas. In rural and internal regions, on the other hand, these problems are restrained as homes are in less busy and less populated areas.

The growing awareness of the importance and influence of acoustic comfort in WFH setting represents an important opportunity to rethink about the residential design from a sustainability point of view. Hence, acoustic comfort not only improves work

72 Wattsense. (online)

efficiency and mental health but also enhances the soundscape, "*the acoustic environment as perceived or experienced and/or understood by a person or people*"[73], of the built environment by reducing noise pollution.

The architectural design and the layout of the house, as well as materials, can influence acoustic comfort. One of the first and simplest strategy to achieve it is the spatial zoning, through which workspace is physically separated from noisy rooms such as kitchens, living rooms and play areas. In larger homes reaching acoustic comfort is easier because there is more space to design a specific and separated rooms. On the contrary, smaller houses require more creative solutions, like using flexible partitions, flexible furniture or soundproof room dividers.

It is necessary to mention that sustainable design encourages to use passive strategies to control noise. They rely on the inherent properties of a building's design and its materials to alleviate sound propagation. For instance, window and doors are usually the weakest spots in the home's acoustic performance because they allow external noises to enter the interiors. High-performance windows with double or triple glazing are optimal to reduce sound transmission, as well as at improving thermal insulation, thus contributing to energy efficiency. Even furniture is useful for reducing the propagation of noise. The blackout curtains that you buy to block out sunlight during the day or city lights at night can also muffle street noise; sound-absorbing panels or sound-absorbing lamps are certainly able to solve this issue too.

As remote work continues to shape the future of work, it is fundamental that homes will be designed or retrofitted taking into account sound control solutions. Using sustainable materials, innovative design techniques and passive noise control strategies, it is possible to create home workspaces that are not only quiet and suitable but also environmentally friendly.

73 European Acoustic Association. (online)

5.3 HEATING UP COMFORT

Thermal comfort refers to "*personal subjective psychological condition an individual experience in a given environment, which can also be objectively assessed based on certain factors to predict how the majority of occupants will feel*"[74]. It is then a subjective sensation that is influenced by different factors, including air temperature, relative humidity, air movement, radiant heat and individual specific clothing and activity, meaning the heat and mass transfer from the body. The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) reports thermal comfort as the condition in which 80% of occupants feel neither too hot nor too cold. In a traditional office space, it is usually standardized by law with building managers controlling the temperature settings through HVAC systems to guarantee a general comfortable environment for the majority of workers. On the contrary, in a residential setting the conditions to achieve thermal comfort highly depend on the diversity in the home design, climate conditions and individual needs.

For people working remotely achieving and maintaining a thermal comfort is, in fact, very challenging because houses are designed for daily living and daily activities as households move between rooms. Home offices have to provide thermal comfort, adjusting how heating and cooling are managed during all seasons, although this have an impact in terms of energy use and costs.

Thermal comfort is not simply a personal and a matter of preference, but it has a direct influence on health, cognitive function and productivity. In fact, temperature below or above the optimal range for thermal comfort, which is between 21-22°C, can lead to a decline in work output, slower reaction times and increased mental fatigue. Prolonged exposure to those situations can also contribute to increase stress, reduce motivation and worsen health conditions such as respiratory problems.

In WFH environments, the issue of thermal discomfort can be highlighted by bad insulation solutions, poor air circulation or inefficient heating and cooling systems. Sustainable architecture must take care of these challenges in order to reduce the environmental impact of the buildings, designing comfortable, healthy and efficient spaces. Thermal comfort can be achieved through the integration of passive design strategies, renewable energy systems and eco-friendly materials and, at the same time, reduce energy consumptions and promote long-term environmental resilience. Passive design strategies profit by the natural energy flows of the building environment, like sunlight, wind and thermal mass to regulate indoor temperatures.

In the WFH context one of the first of these strategies that can enhance thermal

74 Encyclopedia of Sustainable Technologies, Second Edition, 2024. (online)

comfort is the orientation of the workplace and the windows placement. In fact, by strategically orienting windows to capture natural sunlight as much as possible during winter and providing shading or overhangs to block excessive heat during summer, houses can maintain more stable indoor temperatures. Therefore, it is important to place the workstation close to well-insulated South-facing windows that are able to provide natural light and heat, reducing the need of mechanical heating.

Natural ventilation is paramount in order to guarantee a good air quality and consequentially the indoor comfort. Specifically, cross ventilation lets air move naturally through the building thanks to windows strategically placed. Opening them on opposite sides of a room can create a natural airflow, cooling the room without the use of air conditioning.

Moreover, the use of materials with high thermal mass, such as concrete, brick or stone, can help to regulate indoor temperatures just by absorbing heat during the day and releasing it during the night. This is particularly useful and important for home office because maintaining a stable temperature throughout the workday creates comfort and productivity.

Finally, the most important passive design strategy is a proper insulation solution. High-performance insulation in walls, floors and roofs can significantly reduce or eliminate heat losses in winter and heat gain in summer, creating thus a comfortable environment without excessive use of heating and cooling through mechanical systems.

By rethinking how homes are designed and retrofitted for WFH settings, it is possible to create spaces that can not only offer a better and more reliable thermal comfort, but also align with environmental goals, contributing to healthier and more sustainable living and working conditions.

5.4 WORK BRIGHT, WORK RIGHT

Lighting comfort is usually referred to the quality and effectiveness of light which produces a visual and psychological comfortable environment, even though there is not an official and unique definition for this. It is also known as *visual discomfort*[75], which produces a lot of symptoms that can be clearly identified, because it is easier and more immediate to provide a quantitative and qualitative evaluation of visual discomfort parameters, rather than visual comfort parameters that have not a unique definition.

In the context of WFH environment, lighting comfort is fundamental because it affects the ability to perform tasks, such as reading, writing and general computer work, without discomfort or strain. The main aspects of lighting comfort are the illuminance, light distribution, color temperature and the balance between natural and artificial light. Hence, optimal lighting conditions ensure that remote workers are able to work comfortably for extended periods, maintaining focus and avoid common issues such as glare, shadows or irregular light distribution.

In residential settings, lighting conditions are often inadequate for professional work activities, although, due to the COVID emergency, many workers have had to improvise a workstation even in poorly lit or poorly lit areas of the house. Homes are, in fact, designed with aesthetics and relaxation in mind, whereas warm and diffuse lighting is prioritized to create a cozy atmosphere, not suitable for a home office. Many home offices are often set up in rooms with poor natural light and inefficient artificial lighting, influencing therefore visual clarity, eye strain and creating an environment that does not allow focus, concentration and productivity.

The first key factor that determines the work lighting comfort is the light intensity which is referred to the brightness of light in a space. Too little light can make tasks such as reading, writing or working on computer difficult and challenging, leading to eye strain and mental fatigue. On the contrary, an excessive bright lighting can bring glare causing visual discomfort and making it difficult to concentrate.

The uniformity of the light distribution across the workspace is crucial because an uneven lighting, wherein some areas are too bright than others, can lead to harsh contrast that strains the eyes. Hence, in WFH settings it is paramount to ensure that light is equally distributed across the entire workplace minimizing shadows and glare.

Moreover, the color temperature of the light is important too as it can alter the state of mind, affects how the space is perceived and it influences productivity. The warm light is defined to be between 2700K-3000K and it tends to create a cozy and relaxed

75 Paola Iacomussi, Michela Radis, Giuseppe Rossi, Laura Rossi, *Visual Comfort with LED Lighting*, pg.729. (online)

atmosphere; on the contrary, the cold light, between 4000K-5000K, is preferred for task-oriented activities because it mimics daylight and it helps maintain alertness. The balance between natural and artificial light is important because the first, with its changes during the day, have positive effects on mood, productivity and circadian rhythms, which govern sleep-wake cycles. Unfortunately, the access to natural light in home office is often limited by objective factors such as building orientation, window placement and surrounding buildings. Therefore, artificial light is necessary to replace the natural one and for this reason it must be designed in order to mimic those beneficial qualities without causing discomfort or a waste of energy. Sustainable lighting design not only improves comfort, but also minimizes the environmental impact by the reduction of energy consumption.

First of all, it is crucial to maximize the natural light through the building orientation and the windows placement. In one hand, South-facing windows allow the maximum daylight exposure during the day, reducing in this way the need of artificial lights. Specifically, in WFH settings, it is important to position the workplace near large windows that are able to enhance lighting comfort by providing consistent access to natural light. However, on the other hand, an excessive exposure to daylight can cause glare and overheating; that's why shading devices should be taken into account because they can help to control the amount of sunlight entering the room, ensuring a balance between natural light and visual comfort.

When artificial lights are required, sustainable artificial lighting solutions focus on reducing energy consumption maintaining at the same time a high-quality illumination achieved by the use of LED lighting. It is one of the most modern energy-efficient lighting technologies available because it consumes significantly less energy than the traditional bulbs and it has a longer lifespan, reducing both energy costs and wastes. In WFH environment, this kind of lights can be used to create a bright and uniformly illuminated workstation with the minimum consumption of energy.

5.5 GREENERY EFFECTS

Greenery plays an important role in improving the quality and livability of indoor and outdoor spaces, offering psychological, emotional and physiological benefits essential for individuals who are used to spend long hours working from home. From an architecture point of view, greenery is usually referred to the incorporation of plant life and other general natural elements into the built environment. This concept is strongly linked to the biophilic design[76] which highlights the inclusion of fauna in architecture to improve human well-being making it happier and healthier. Greenery became so important and grew so much to let create a new profession referred to as interiorscaping or plantscaping[77].

It is well known that natural elements are able to reduce stress as well as anxiety and improve the overall emotional well-being. This is very important for remote workers because boundaries between work and private life are often blurred. Above all, plants play a crucial and fundamental role in improving and cleaning the indoor air quality by filtering out toxins and producing oxygen. In fact, indoor air pollution is usually worse than the one outdoor due to the presence of the VOCs (volatile organic compounds) coming from household products, cleaning detergents and from building materials, or simply because lack of ventilation.

Despite its several benefits, many home and home offices are not designed to integrate greenery. This is particularly true for urban houses due to the space limitations, poor natural lighting and limited access to outdoor spaces.

Not all plants are suitable for indoor spaces and therefore it is important to select the right species that thrives in indoor environments. The absence of greenery in WFH settings can have negative effects for remote workers in terms of both mental and physical health. In fact, the stark and sterile atmosphere brings to feelings of isolation, disconnection from nature and increases stress levels. Without greenery people can experience what is referred to SBS (sick building syndrome) where people working inside a building do not feel well because they might have respiratory problems, headaches and fatigue, but when they go outside the building they start to feel better again; it is a discomfort connected to the compounds present in the indoor spaces. Additionally, both the lack of greenery and outdoor access may contribute to create a monotonous and uninspiring environment, bringing to burnout, decreased motivation and less productivity.

One of the first and easiest way to integrate greenery into WFH environments is through indoor plants because they are also able to create a visually appealing and

76 Weijie Zhong, Torsten Schro¨der, Juliette Bekkering, *Biophilic design in architecture and its contributions to health, well-being, and sustainability*. (online)

77 Penny Sparke, *Nature Inside*, pg.164

calming environment. From a sustainable point of view, it would be perfect to select low-maintenance plants not only because they require a minimal watering and care, but also because they are known to purify air removing toxins, such as formaldehyde and benzene; the aloe plant is one of the most popular. Another strategy to incorporate greenery into WFH settings is the access to outdoor spaces such as gardens and balconies. Outdoor green spaces, in fact, could be used as an extension of the home office, providing a peaceful retreat for breaks, relaxation and even outdoor working.

6
INGRIA

Ingria (TO). Photograph taken by the author

6.1 THE VILLAGE

Ingria is a municipality of small and scattered hamlets and is located at about 800 meters above sea level immersed in the greenery of chestnut groves. It is known for its beautiful landscapes, characterized by rugged mountain terrains, lush forests and cascading rivers. This natural environment has shaped not only the local vernacular architecture, but also the way of life for generations. Historically, the village is a strategic location along the ancient routes connecting the Po Valley to the Alpine passes facilitating the exchange of goods, ideas and cultural practices.
However, like many inner and marginal areas in the Italian Alps, Ingria has faced significant socio-economic challenges over the past century, above all, the dramatic depopulation phenomenon, which was followed, as a consequence, by the economic decline and the erosion of traditional practices. This demographic shift has led to the abandonment of traditional buildings, the deterioration of infrastructures and the loss of community cohesion.
Despite these challenges, Ingria remains a living repository of architectural ad cultural heritage that dates back to medieval times. The built environment is characterized by its vernacular architecture which includes stone houses with slate roofs, narrow cobblestone streets and terraced landscapes that reflect centuries of adaptation to the mountainous terrain. These typical structures not only embody the architectural and construction styles and methods, but also represent sustainable practices that were designed to face the local climate, topography and the available resources. Nowadays, the village architectural heritage is an invaluable asset that offers insights into sustainable building practices that can be adapted to modern needs.
Additionally, its architectural heritage is so unique that since 2022 the municipality of Ingria has been on the list of the most beautiful villages in Italy. This quote *was founded in 2002 within the ANCI Tourism Council with the aim of enhancing and promoting the great heritage of history, art, culture and landscapes present in small Italian towns*[78]; today the list includes 360 villages and they represent the *expression of the beauty and charm of which Italy is a world leader*[79].

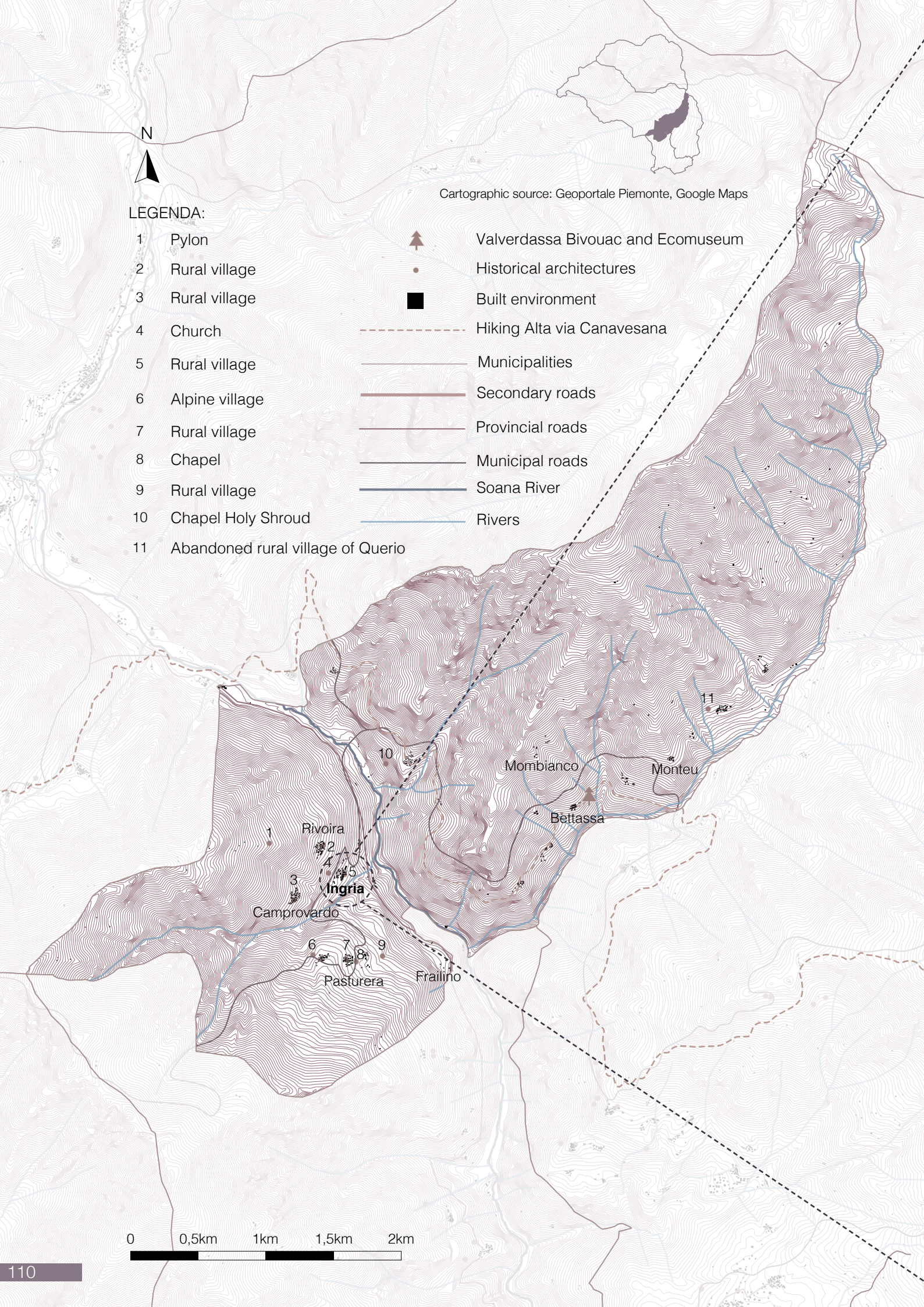
The need for a sustainable development is also related to environmental concerns. Ingria, as well as all the other Soana Valley's municipalities, is highly susceptible to climate changes, such as increased temperatures, changes in precipitation patterns and the frequency of extreme weather events. These environmental changes overhang not only the natural landscapes but also the historical built environment and the

78,79 Borghi più beli d'Italia . (online)

socio-economic fabric of the community, already weakened by depopulation flows. The traditional vernacular architecture of Ingria, which includes passive design strategies such as thick stone walls for thermal mass, small windows to minimize heat losses, south-facing orientation to maximize solar gains and buildings built close together to provide additional shelter during the winter seasons, provides a foundation for developing climate-adaptive architectural solutions.

Furthermore, the socio-economic sustainability of Ingria depends on a viable future that balances the preservation of its cultural heritage with the needs of contemporary living. In fact, when we talk about sustainable architecture, it is not only referred to energy efficiency, the so-called green buildings or to green materials, but it also fosters a sense of place, community and belonging. Projects that promote community engagement, local craftsmanship and cultural tourism can contribute to a more sustainable economy, whilst reinforcing the social fabric of the village and above all trying to face and stop the depopulation phenomenon.

Ingria (TO). Photograph taken by the author


N
Cartographic source: Geoportale Piemonte, Google Maps
LEGENDA:
1 Pylon
2 Rural village
3 Rural village
4 Church
5 Rural village
6 Alpine village
7 Rural village
8 Chapel
9 Rural village
10 Chapel Holy Shroud
11 Abandoned rural village of Querio
Valverdassa Bivouac and Ecomuseum
Historical architectures
Built environment
Hiking Alta via Canavesana
Municipalities
Secondary roads
Provincial roads
Municipal roads
Soana River
Rivers
Mombianco
Monteu
Bettassa
Rivoira
Ingria
Camprovardo
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0
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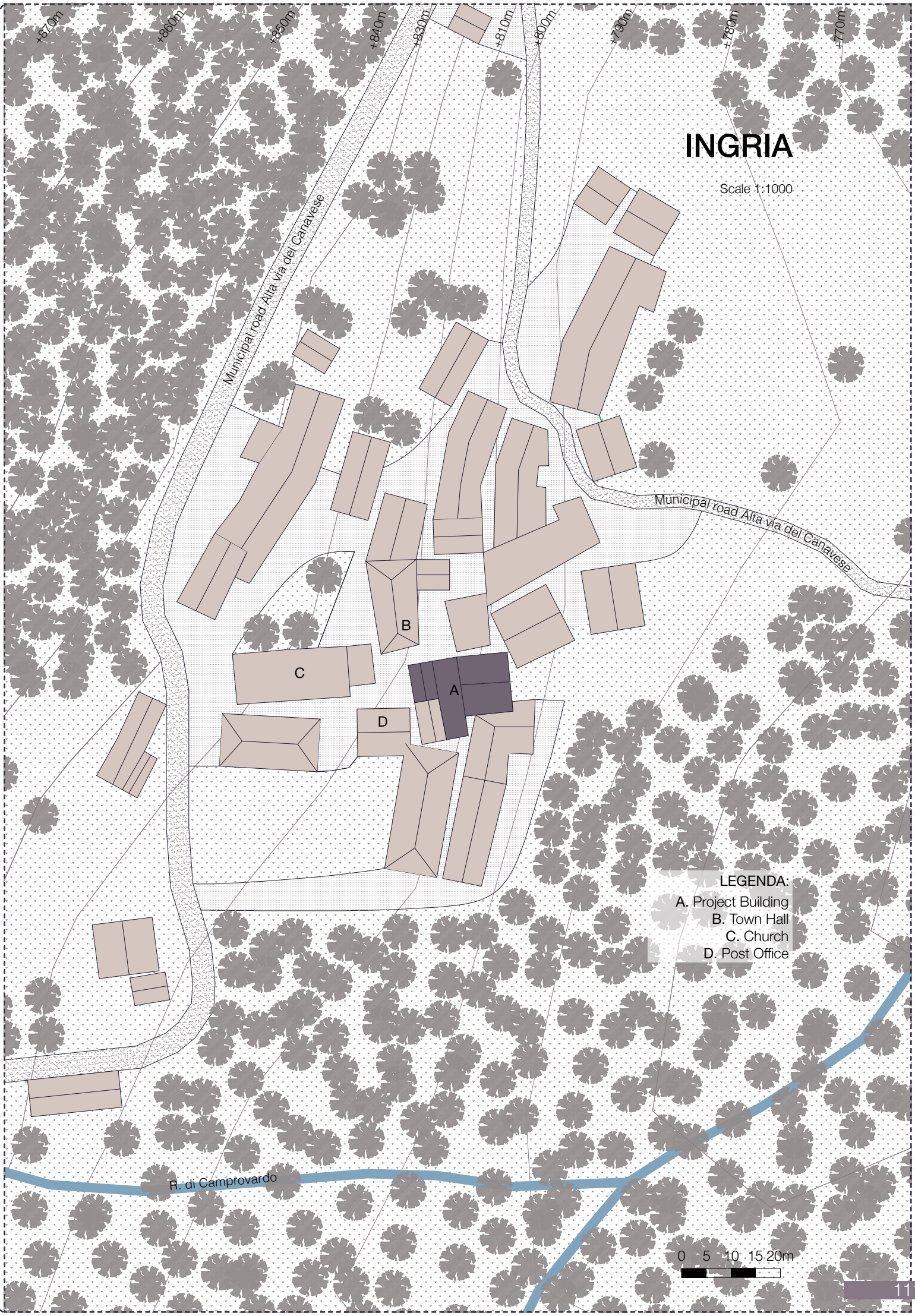
2km


+870m
+860m
+850m
+840m
+830m
+810m
+800m
+790m
+780m
+770m
INGRIA
Scale 1:1000
Municipal road Alta via del Canavese
Municipal road Alta via del Canavese
A
B
C
D
LEGENDA:
A. Project Building
B. Town Hall
C. Church
D. Post Office
R. di Camprovardo
0 5 10 15 20m

6.2 THE AIM

At the heart of this thesis is an abandoned building located in the center of Ingria and that reflects and holds the potential to be transformed into a hub of activity, creativity and sustainability. This thesis explores the possibilities of repurposing this building to accommodate coworking spaces and a remote work apartment, providing a new vision for sustainable rural regeneration.

The building in question, actually, is in a state of total disrepair and it is an example of Ingria's rich architectural heritage. Constructed in a traditional Alpine style with stone masonry walls, a steeply pitched slate roofs and small, wooden-framed windows, the structure shows the typical vernacular architecture that characterized the region. Its robust construction and strategic location in the village center make it an ideal candidate for adaptive reuse, transforming it from a perfect emblem of decline to a sample of sustainable development. The project's aim is not merely restoring a single building but rather revitalizing an entire community by reimagining how historical structures can meet contemporary needs.

The proposal of two design scenarios to repurpose the abandoned building for coworking and remote work is rooted in several contemporary trends and challenges. The rise of remote work accelerated by the COVID-19 pandemic, has significantly reshaped the way people live and work. More individuals are seeking to escape congested urban centers towards quieter and more natural environments that offer a better quality of life. Ingria, with its beautiful landscapes, fresh air and close community, represents an attractive alternative for those looking for properly balance work and private life in a rural setting. This shift in lifestyle and work patterns provides an unprecedented opportunity for rural areas like Ingria to attract a new demographic development through remote workers, digital nomads and professionals who can bring new energy and economic activity into the region.

The concept of coworking spaces and remote work aligns with broader goals of sustainability in both terms of environment and socio-economic. In the first case, the adaptive reuse of the existing building minimizes the carbon footprint, promotes the conversion of the resources and retains the embodied energy within the structure. Additionally, joining the Fervores energy community, a collaboration between the Iren group and Soana and Orco Valley was born in 2023, has the *objectives of enhancing the resources of the territory, promoting interventions for the production of energy from renewable sources and a conscious and rational use of energy, for a correct development of local supply chains*[80].

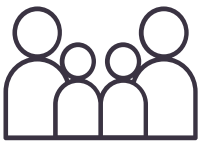
80 Iren. (oline)

The main themes implemented range from the *development of renewable sources, to the forestry supply chain, from energy communities to the study of climate change phenomena, from energy efficiency of buildings to the promotion of tourism, sports and education in the area*[81]. Furthermore, building traditional materials can be integrated into a sustainable design that respects and enhances the existing architectural language, whilst integrating modern and energy-efficiency systems. Passive design strategies, such as optimizing natural light, maximizing solar gain and improving thermal insulation, can reduce energy consumption and create comfortable indoor environment all year around. The Fervores energy community acting in line with the decarbonization objectives in order to achieve the so-called carbon neutrality, it is the main player in the integration of renewable energy systems that can provide self-sufficiency and reduce reliance on external energy sources. Water conservation measures, including rainwater harvesting and greywater recycling might be considered to ensure a sustainable water management. The use of natural and low-impact building materials, coupled with a circular economy approach that minimizes waste and encourages recycling materials, aligns the project with sustainable principles.
Project scenarios aim to address the pressing issue of rural depopulation by creating a space that fosters economic activity to attract new residents. By offering flexible coworking spaces, the building can supply both local residents and visitors a platform for networking, collaboration and innovation. The designed apartment for remote workers and families with remote workers will provide a live-work environment that meets the needs of modern professionals, encouraging longer or permanent stays and a deeper engagement with the local community. This dual function creates a synergistic effect, where the presence of remote workers can stimulate demand for local services, such as cafes, grocery stores and cultural activities, thereby supporting local business and creating new employment opportunities. In fact, this new trend is also a big opportunity for those local services economically weakened in cities due to the ever-increasing number of remote workers who consequently no longer take advantage of those services as they once did.

81 Iren. (oline)

SCENARIO 1:
ONLY REMOTE WORKERS

SCENARIO 2:
FAMILIES WITH REMOTE WORKERS



NEEDS
- Technology support
- Support from the society
- Suitable workspace setup
- Privacy
- Internet connection
- Transportation
- Education
- Health care

WANTS
- Space
- Leisure time
- Contact with the nature
- Follow your passions
- Inclusion into the society
- Comfort
- Economic opportunities
- Wellbeing

EXPERIENCES
- Share experiences
- Go performance to support tradition
- Interact with technology
- Outside activities
- Social connection
- Eco-friendly living
- Travel opportunities
- Cultural events
- Creative activities
- Adventure activities

EMOTIONS
- Tranquility
- Passionate
- Focus
- Curious
- Experienced
- Satisfaction
- Freedom
- Resilience
- Indipendence

6.1 STATE OF ART

The building is located in the historic center of Ingria, a small village in the Canavese area in the province of Turin. The fastest way to get there from Turin is the highway which leads to a provincial road and then to a state road. Once reached Pont Canavese, there is only one road that leads to Ingria and the to the other towns in the Soana Valley.

The property borders with two other properties, one to the West and one to the South-East. The first neighboring building is a three-story building above ground, the first two of which are the subject of intervention, whilst the second is made of two floors above ground and is excluded from the project. As being the typical residential nuclei of the valley, all these constructions were built close one to the other in order to protect themselves from the adverse winter weather conditions. In fact, by observing the thickness of the perimeter walls on the first-floor plan of the property under study, it is possible to deduce that originally there were two separate buildings but then they were subsequently connected with a simple brick wall.

The property is therefore composed of three buildings located on three different levels. All three are load-bearing stone masonry buildings and their external facades have a layer of plaster. On the East, West and North fronts, the external facades are characterized by half exposed stone and the other half plaster in apparently good condition. The South front, however, is entirely plastered with evident signs of deterioration due to the detachment of the plaster itself and rising damp. From the East facade you can see an unused green area shared with the adjacent buildings which can be accessed through a passage from the North facade.

The roofs are pitched type and are all made of wood reflecting the use of local raw materials. In addition, the roof covering is made of stone slabs that show a traditional characteristic of mountain locations; a feature that must also be maintained in the design phase in order to keep that artistic and cultural heritage.

Windows and doors, both internal and external, are made of wood too. Specifically, the windows are double-hung and single-glazed, whilst doors, especially the external ones, are in fairly advanced conditions of degradation, in particular the entrance part of the first floor.

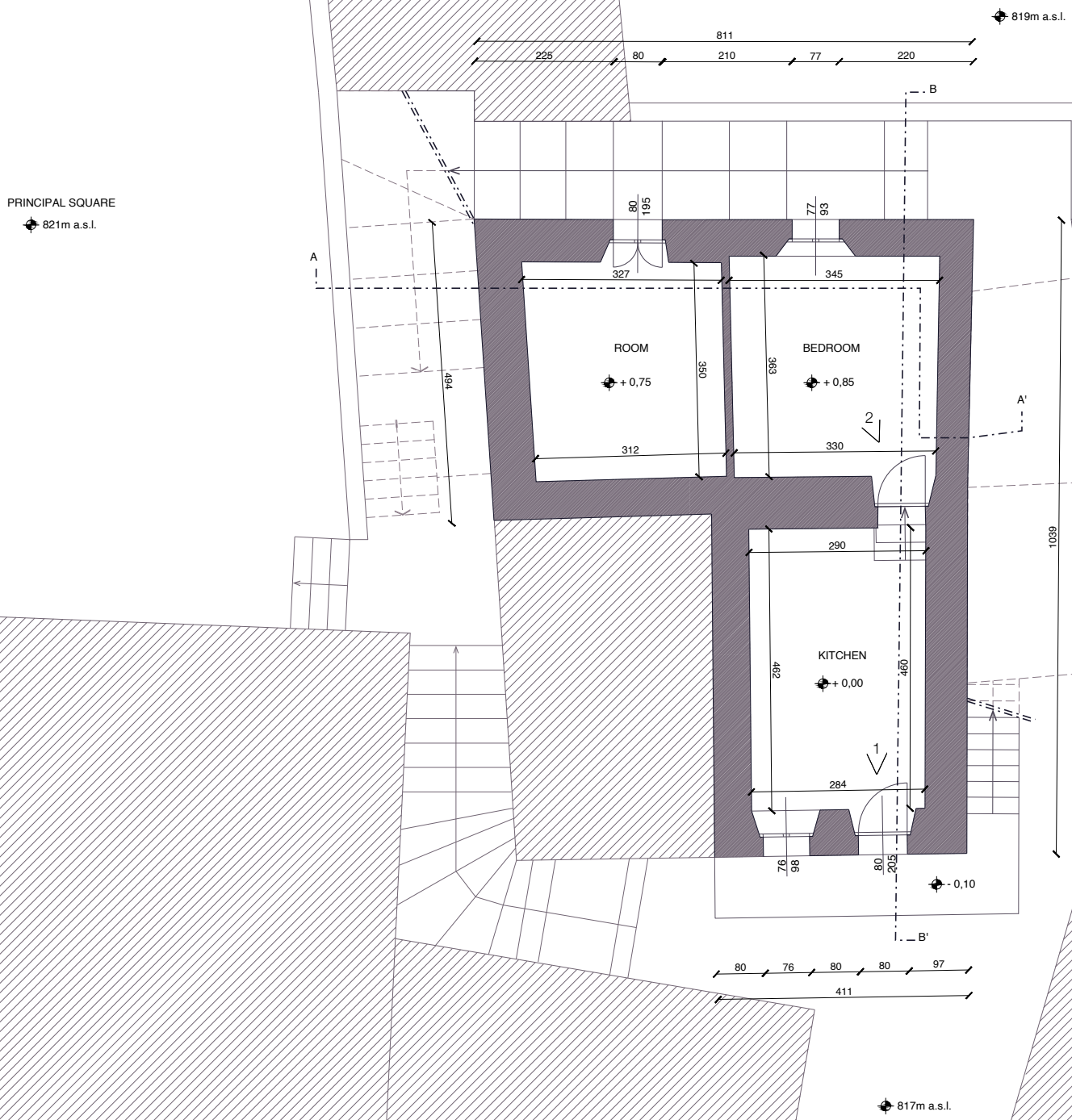
The ground floor, accessible directly from the outside, is composed of three rooms located on two different levels connected by a small staircase: the first at the entrance and two divided by a partition wall without openings. The first room, originally intended for the kitchen and living room, consists of a terracotta floor and a ceiling probably

made up of a plastered false ceiling. The South and West walls are plastered, the other two are decorated with wallpaper. A door divides the first and second room, which was intended as a bedroom. The latter is characterized by a wooden floor, plastered walls and a wooden ceiling with exposed beams. It is not possible to detect the third room as it is not accessible, but since it is part of the same building and is at the same height, it can be deduced that it has the same characteristics as the second room.
The first floor, accessible via an external stone staircase, is composed of seven rooms, also arranged on different levels. The large entrance hall is characterized by a wooden floor and a wooden ceiling with exposed beams and plastered walls. From it you access the bathroom which was probably renovated more recently as it is furnished with ceramic tiles. From the entrance you can directly access four rooms via two small stone stairs. The first kitchen is located to the East and consists of a small kitchenette powered by a gas cylinder and it shows a wooden floor and a plastered ceiling with exposed wooden beams. Through a French window, you can access the balcony which offers a view of the valley. The living room is located at a higher level than the kitchen, but it has the same features, including access to the same balcony. The bedroom, exposed to the South, is on an even different level and it has a wooden floor, wooden ceiling with exposed beams and plastered walls. The second kitchen, located to the North, is accessible from both the entrance and the bedroom and it has the same characteristics as the latter. The last room, located to the East, is inaccessible and it is not possible to describe it, because the wall that divides it from the second kitchen has no openings; however, as on the ground floor, it is possible to deduce the same characteristics as the adjacent room.

View of the balcony. Photograph taken by the author

GROUND FLOOR PLAN

Scale 1:100



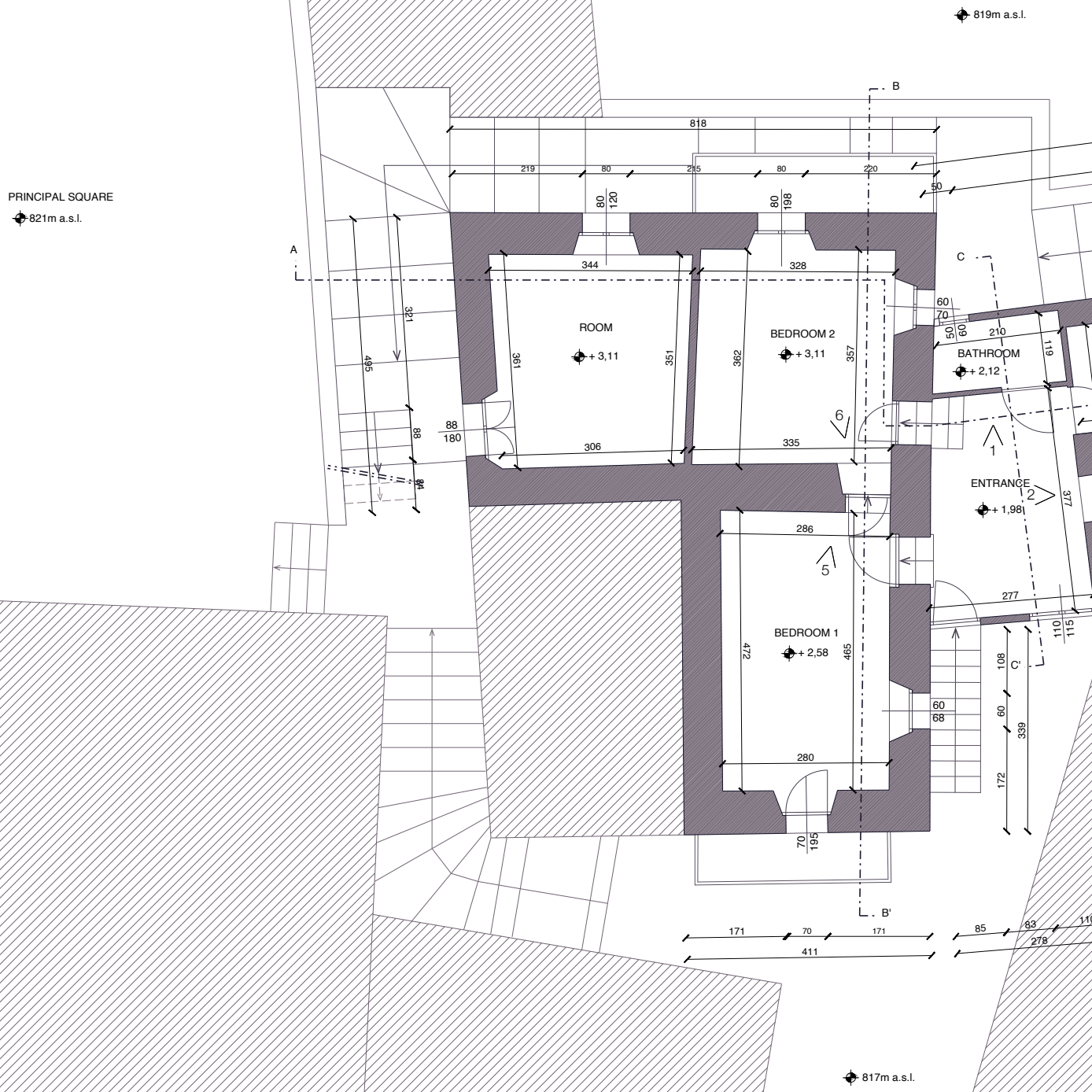

N
COMMON GREEN AREA
- 1,80
814m a.s.l.

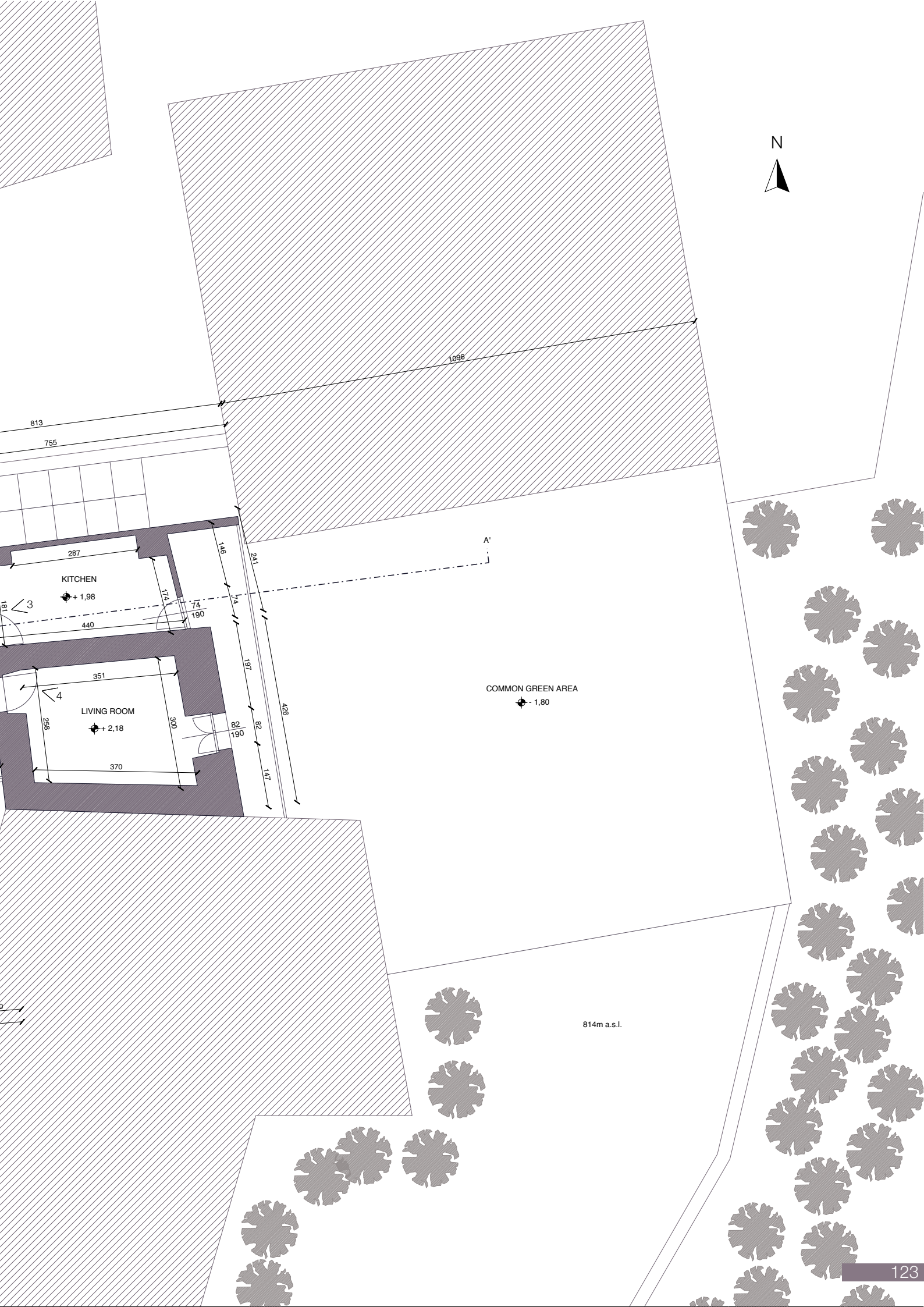
View n°1 Ground Floor. Photograph taken by the author

View n°2 Ground Floor. Photograph taken by the author

FIRST FLOOR PLAN

Scale 1:100




N
1096
813
755
287
KITCHEN
+ 1,98
146
241
174
74
74
190
181
3
440
A'
351
4
LIVING ROOM
+ 2,18
258
300
82
190
82
197
426
147
370
COMMON GREEN AREA
- 1,80
814m a.s.l.

View n°1 First Floor. Photograph taken by the author

View n°2 First Floor. Photograph taken by the author

View n°3 First Floor. Photograph taken by the author

View n°4 First Floor. Photograph taken by the author

View n°5 First Floor. Photograph taken by the author

View n°6 First Floor. Photograph taken by the author

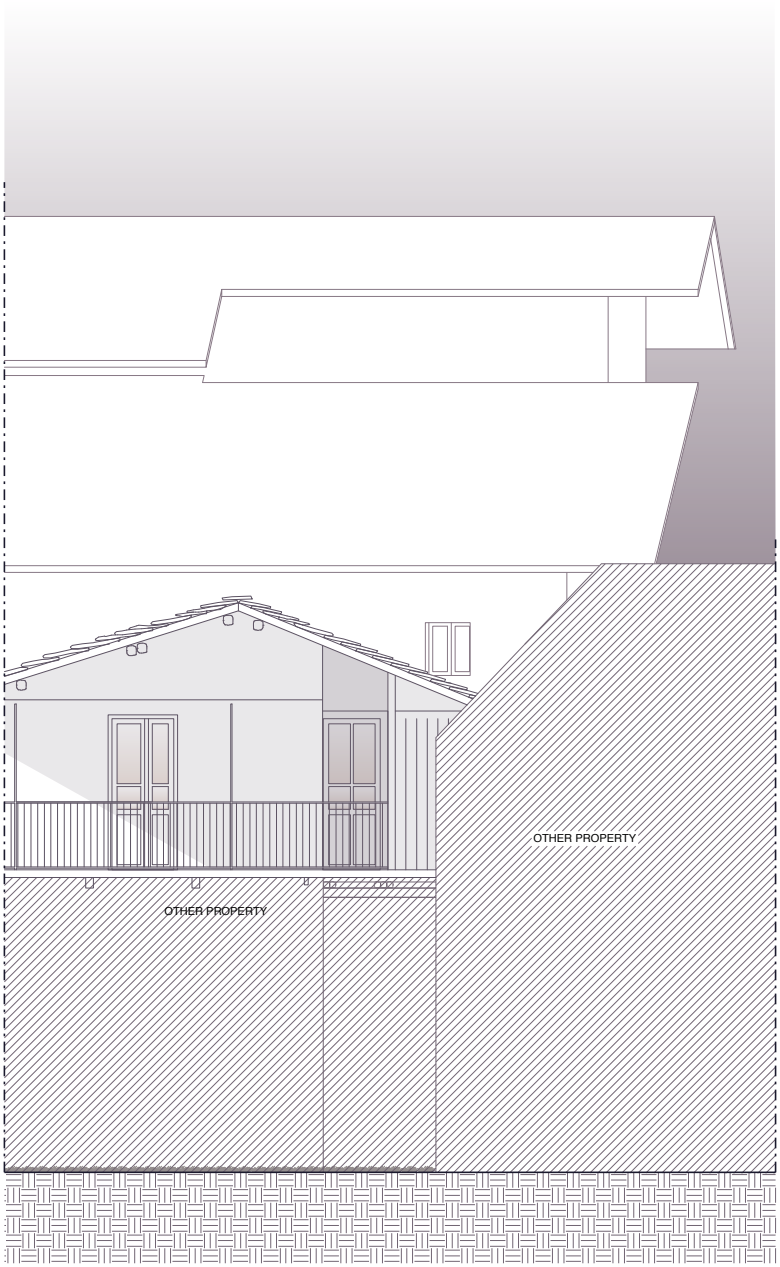
FRONT NORTH

Scale 1:100

Front North. Photograph taken by the author

FRONT EAST

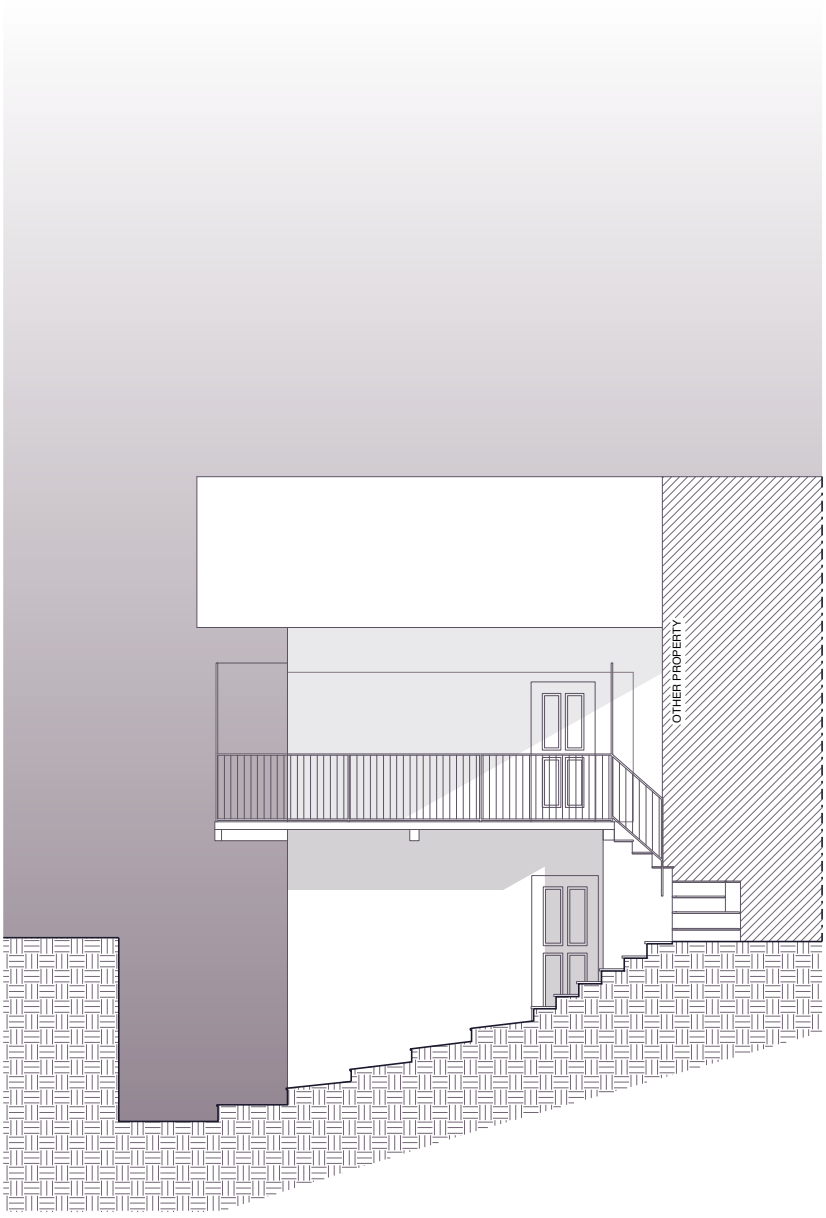
Scale 1:100



Front East. Photograph taken by the author

FRONT WEST

Scale 1:100



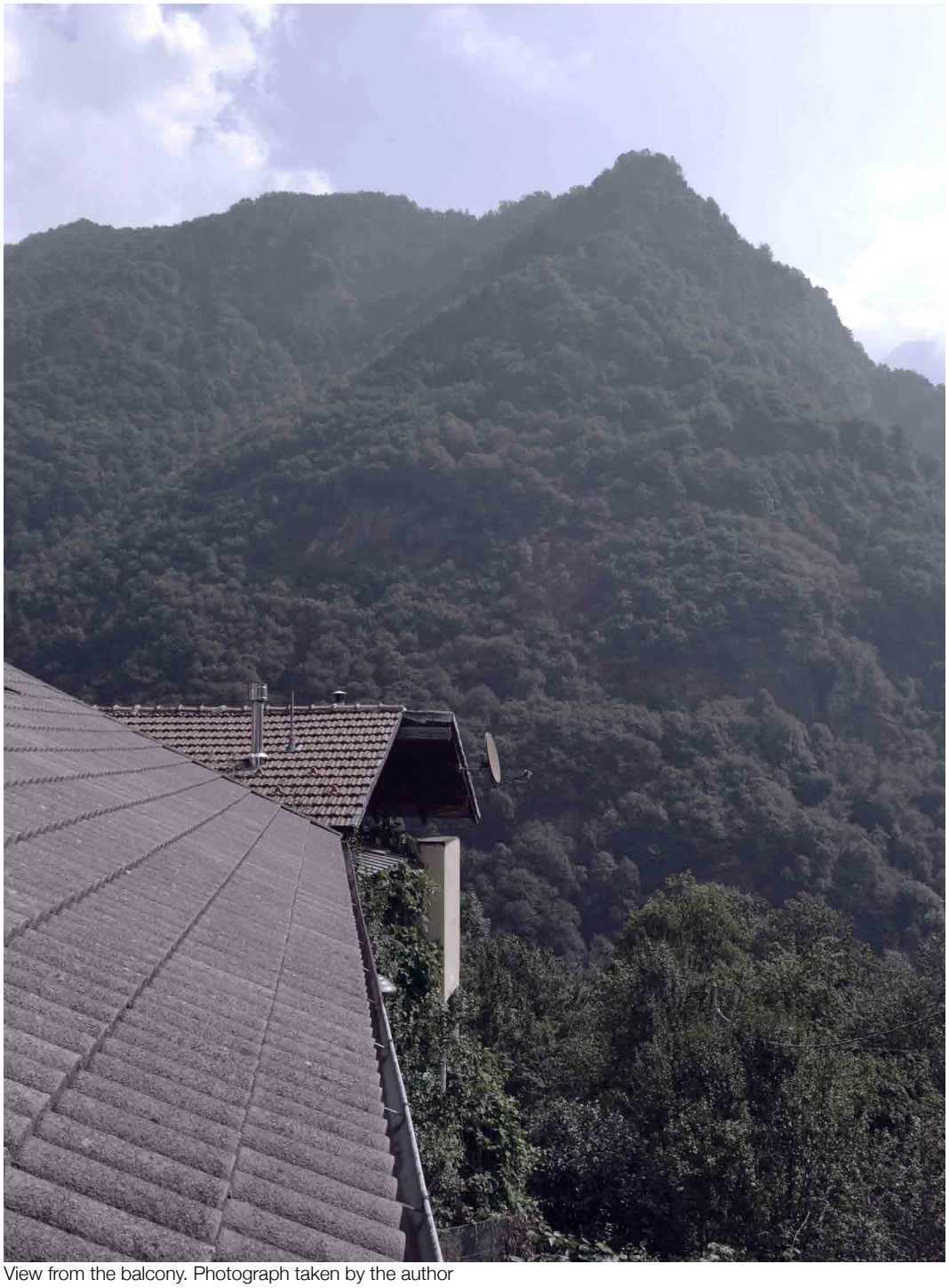
Front West. Photograph taken by the author

FRONT SOUTH

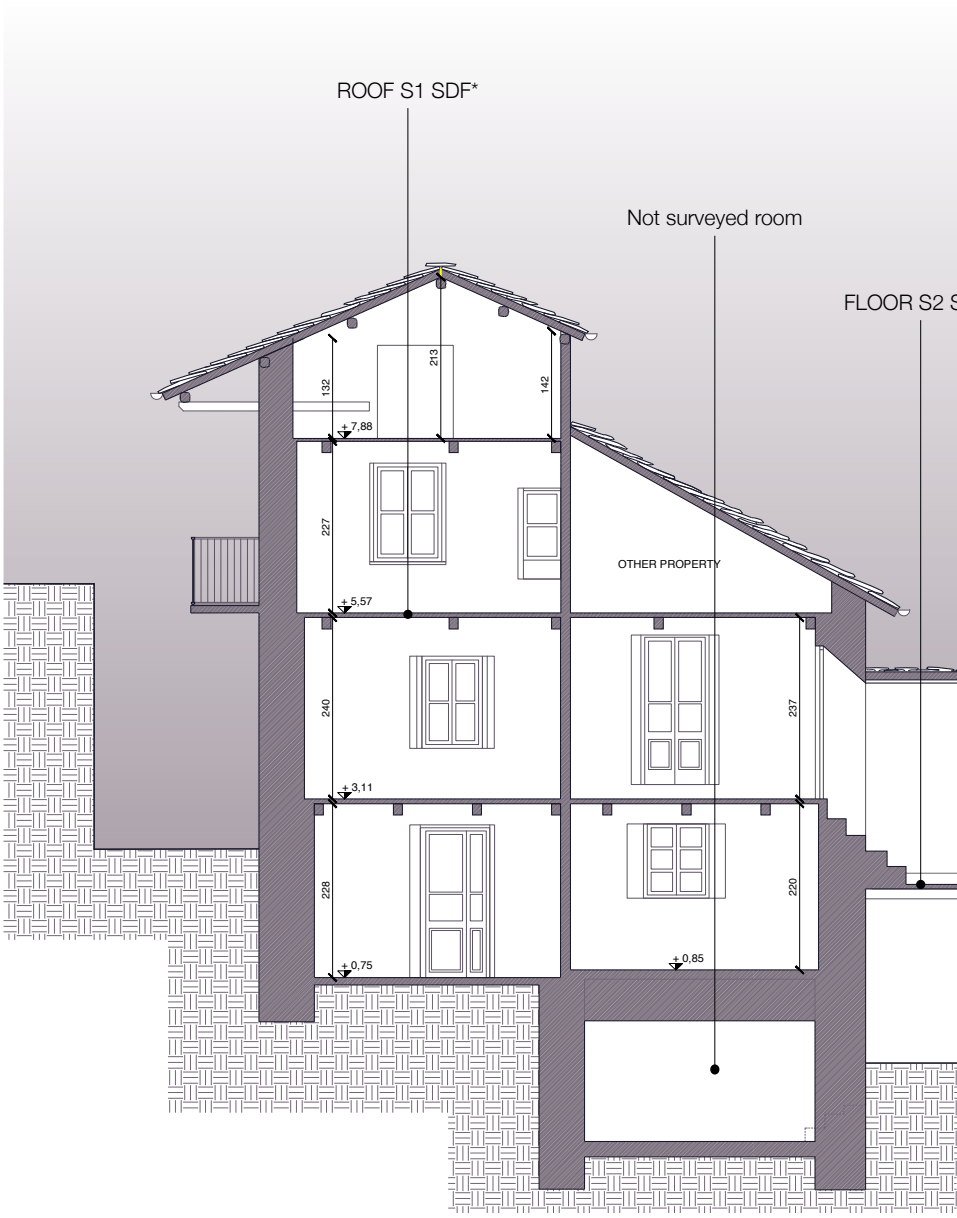
Scale 1:100

Front South. Photograph taken by the author

Front South. Photograph taken by the author



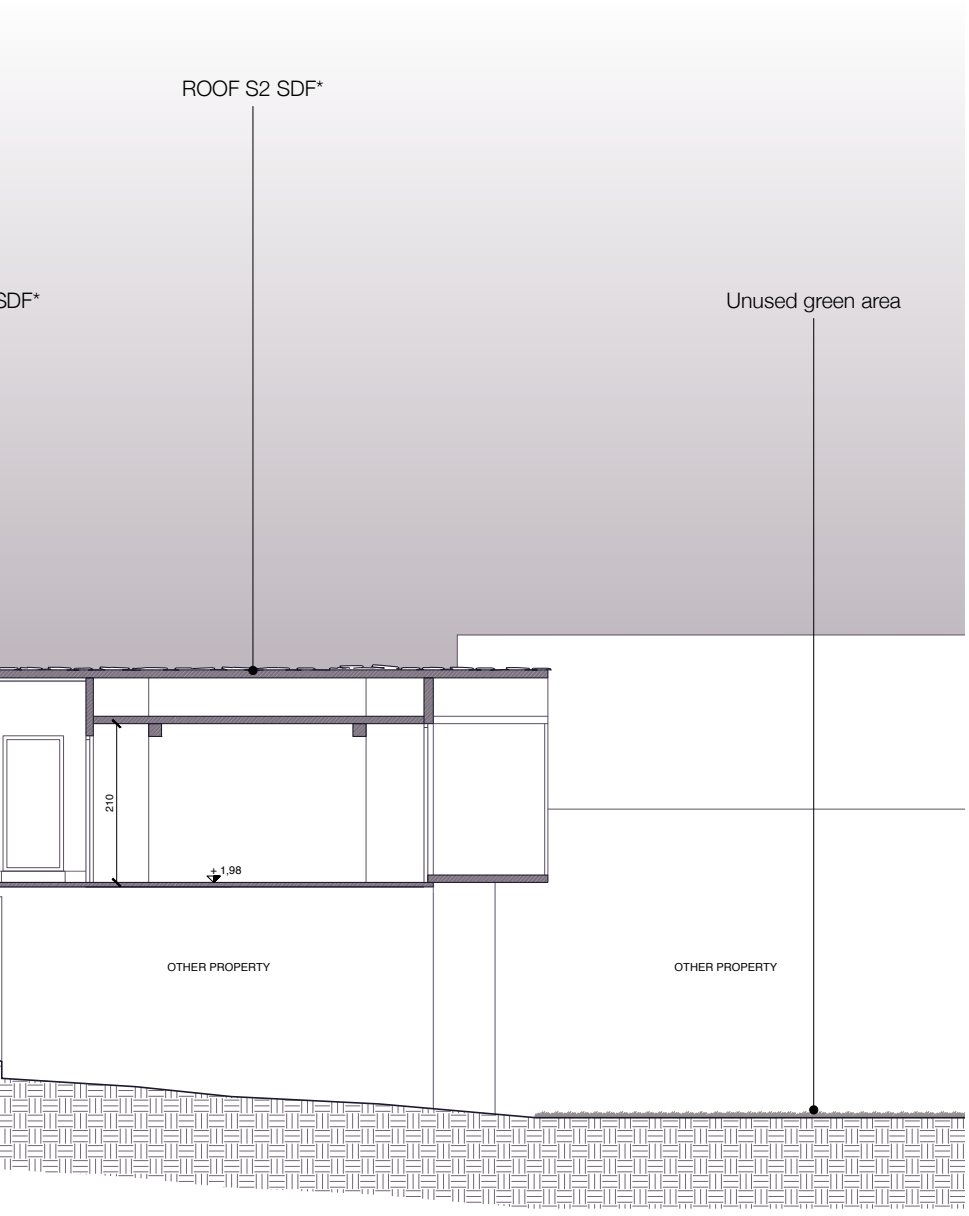
View from the balcony. Photograph taken by the author



* Identification names used in Edilclima software, Chapter 8 pg.208, 209, 210

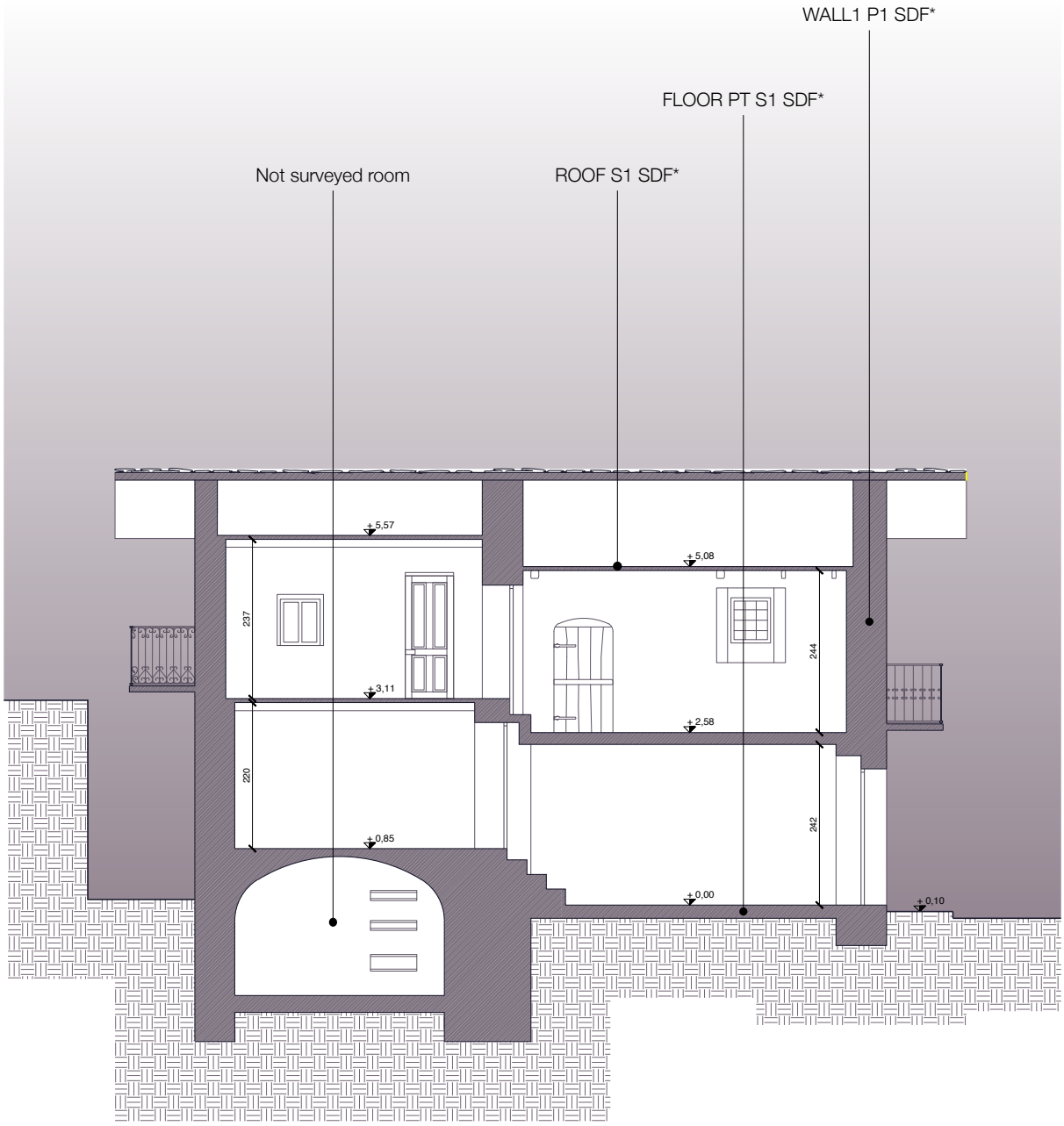
SECTION A-A’

Scale 1:100



SECTION B-B’

Scale 1:100



* Identification names used in Edilclima software, Chapter 8 pg.208, 209, 210

SECTION C-C’

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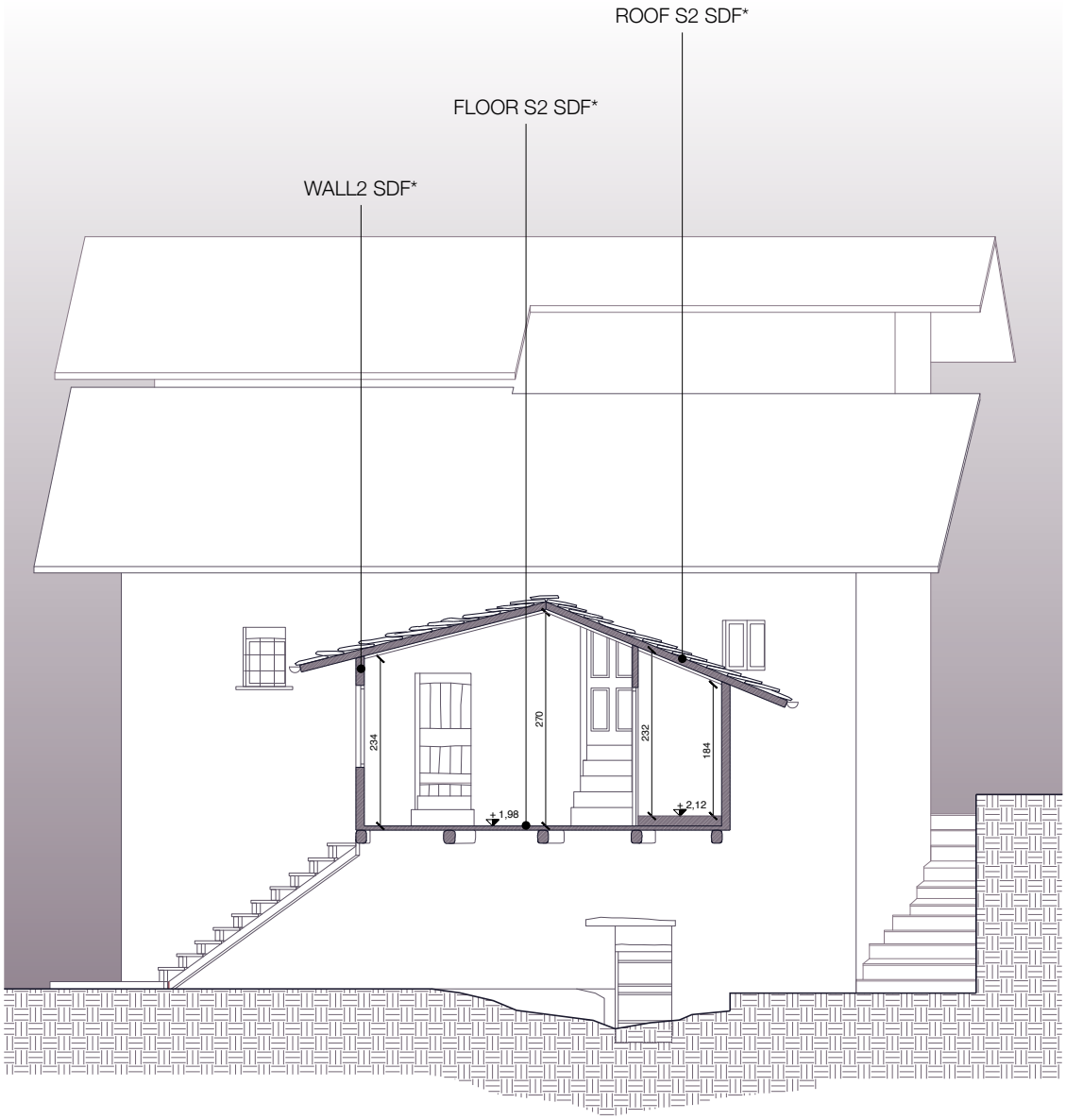


* Identification names used in Edilclima software, Chapter 8 pg.208, 209, 210

6.4 THE SWOT ANALYSIS

The SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) is a strategic planning and a design tool. In the architectural projects it is used as comprehensive framework to understand better the internal and external factors that can influence the success or the failure of the project. It provides a structured and schematic approach to evaluate the potential and the challenges associated with the project itself and its development. By examining the points of the strengths, weaknesses, opportunities and threats, the SWOT analysis enables informed decision-making, strategic prioritization and risks, ultimately leading to more resilient, sustainable and impactful architectural solutions. In fact, any project is influenced by a lot of factors, including the site context, regulatory frameworks, environmental conditions, cultural significance or community needs. A SWOT analysis provides therefore a clear and systematic tool to identify these factors and understand how they interrelate and overlap, helping to align the project's goals with its contents and constraints.
In the context of reusing a vernacular building in the center of Ingria for remote working, the SWOT analysis is useful as framework to understand the potential and challenges, as well as the opportunities and risks associated with this project.

6.4.1 STRENGHTS

The strengths of this project can be found in the unique characteristics of Ingria's vernacular architecture, the natural beauty, breathtaking landscapes of the Soana Valley, the alignment of the project with current socio-economic trends and sustainable development goals. These internal strengths provide a robust foundation upon which the project can be developed to achieve its objectives.

The traditional homes of Ingria are built using local material such as stone, wood and slate, reflecting the architectural style of the region. These unique features, such as thick stone walls, wooden balconies, compact and energy-efficient solutions, were adopted in order to face effectively the local harsh climate and landscape. The architectural aesthetic appeal of these houses might attract remote workers who value authenticity and cultural heritage, creating a unique selling point for the project.

Typical vernacular houses of Ingria are harmoniously integrated into the natural landscape of the Soana Valley, which is covered by forest, rivers and mountains. The uncontaminated natural environment, coupled with the tranquility and the beauty of the region, offers an exceptional quality of life for potential remote workers. This natural setting aligns well with the growing trend of seeking wellness, sustainability and work-life balance. Living in such close contact with nature is exactly what those who escape from cities are looking for, whilst in cities the relationship with nature has been completely transformed. In this context no longer is man who has to adapt to nature, but nature that has to bend to the needs and requests of small and large urban centers. The negative effects of this reversal have emerged thanks to the lockdowns during the pandemic crisis.

Contact with nature in Ingria is one of the "must" of the municipality and all its hamlets. In fact, citizens not only live surrounded by greenery, but have the opportunity to go on excursions and trips in the surrounding mountains on routes close to home too. The choice of excursions is quite vast. The most famous is certainly the track number 10 of the Alta Via Canavesana that crosses the municipality of Ingria, as shown in the framework map. It is a circular route made of 12 stages that starts and ends in Pont Canavese, crossing Val Gallenca, the Tesso and Malone valleys, the Orco and Soana valleys and touching the Valle Sacra. The municipality of Ingria offers a varied choice of excursions and trips in the midst of nature. Among these, one of the most popular is the path that leads to Monte Alto, over 1990m high, starting from Cavagnole and covering a difference in altitude of 1600 m. The Mombianco ring, whose starting point is the hamlet of Frailino, is an easy excursion of 400 m of difference in altitude on the

transverse of the Soana valley floor and passes through the abandoned villages of the valley but still able to convey the flavor of times gone by. the abandoned villages of the valley but still able to convey the flavor of times gone by. Another excursion that can be mentioned is the ring for Punta Arbella that starts from the hamlet of Reverso up to Uja d'Ingria and which enters the path of the Alta via Canavesana.

Ingria's vernacular homes use to be designed to be energy-efficient, with features such as thick stone walls for insulation, small windows to reduce heat losses and natural ventilation systems. The use of local material and traditional construction methods enables to have, in fact, a low carbon footprint and a low embodied energy. These inherent qualities provide a solid foundation for retrofitting those houses with modern energy-efficient technologies and sustainable materials, enhancing their appeal to eco-conscious remote workers who prioritize low-impact living. This is aided by the creation of the Fervores energy community which helps and supports the creation of increasingly eco-sustainable buildings. In these modernizations, however, it is necessary to maintain the vernacular identity in order to balance the traditional with the contemporary in the right proportions.

Moreover, by repurposing abandoned vernacular houses for remote working, the project has the possibility to contribute to the revitalization of the local community. New residents are able to bring diversity, economic activity and social vibrancy to Ingria, fostering a renewed sense of community and helping to sustain not only local services, business and costums, but all those activities weakened in cities due to the rise of remote working during and after lockdowns.

Additionally, the COVID-19 pandemic has accelerated the adoption of remote working worldwide, making it a viable and attractive lifestyle for many professionals. This project aligns with the growing demand for remote working environments that offer a high quality of life, strong internet connectivity and a conductive work-life balance. The initiative influences this trend to attract a new demographic era to Ingria, addressing the depopulation challenges and trying to slow down this phenomenon which hit all the localities in the valley, Ingria more than others.

6.4.2 WEAKNESSES

Although the project has several strengths, it faces inherent weaknesses that must be addressed to ensure its success. These weaknesses derive primarily from the current state of infrastructure, accessibility and the challenges of adapting vernacular homes to meet modern living and working requirements.

Many of these vernacular homes in Ingria have been abandoned for years or decades and they can be found in different states of art. Renovating them to meet modern standards of safety, comfort and functionally can be expensive and more complex than it seems. Structural reinforcements, updated plumbing, electrical systems and modern heating solutions might be required, all of which can significantly increase the project's cost and timeline. It must be taken into account the transportation of new materials and furniture to the project site. Transportation could be more expensive due to narrow and steep roads to get to Ingria and the difficulty of movement within the village.

Moreover, vernacular homes often have layouts and spaces that are not conducive to modern living or working. For instance, small, compartmentalized rooms and low ceilings may not provide the open and flexible spaces required by modern laws. Adapting these traditional layouts as well as preserving their typical and architectural value can be challenging, requiring creative design solutions and careful planning.

Ingria, like many villages in internal areas, suffers from limited accessibility due to narrow roads, steep terrains and lack of public transportations. Additionally, a reliable high-speed internet connectivity, which is the main and most important tool for remote workers, might be inadequate or non-existent in some areas. Addressing these infrastructural deficiencies is essential to make Ingria a viable destination for remote workers.There is a lack of many basic amenities and services in the village, things that remote workers and new residents might expect, such as healthcare facilities, schools, shops or recreational areas. The absence of these factors will discourage potential newcomers, especially families, who want to settle permanently. Developing a plan to gradually introduce or improve these services is of crucial importance for a long-term successful project.Whilst the reuse of vernacular homes can bring economic and social benefits, it might also face resistance from local residents who are concerned about changes to their traditional way of life. It is well known that communities in these internal areas are quite closed to the outside world, especially those in the mountains. By ensuring the project is inclusive and benefits the existing community is essential to mitigate these concerns and build local support.

6.4.3 OPPORTUNITIES

The project, in order to reuse vernacular houses for remote working, is aligned with several emerging trends and external opportunities that can be stimulated to achieve its goals. These opportunities include shifts in social preferences, policy incentives and technological advancements that can enhance the viability and attractiveness of the initiative.

The pandemic crisis has brought to a significant shift in lifestyle preferences with more and more people opting for rural living to overcrowded urban and metropolitan areas. This trend, with a growing emphasis on sustainability and a desire to reconnect with nature, gives chances to attract new inhabitants in Ingria who will be able to work from home. The village can market itself as a model of sustainable rural living that integrates traditional architecture, community and environmental administration.

Ingria's rich cultural heritage, unique vernacular architecture and the beauty of landscapes can be leveraged to attract not only remote workers, but also heritage and natural tourist and visitors interested in enviromental experiences. By integrating remote working with heritage and natural tourism, the project can create additional income streams for the local community and promote the preservation of the traditional and natural environment.

Collaboration between public authorities, private developers and local businesses will provide the necessary expertise, resources and support a long-term success. Both public and private partnerships can facilitate investments in infrastructures, broadband internet and amenities, ensuring a better comprehensive approach to rural regeneration and sustainable development.

Above all, advances in digital technologies, smart homes systems and sustainable building practices provide opportunities to enhance the functionality and feasibility of vernacular homes for remote workers. The application of smart technologies, energy-efficient solutions and modern communication systems will make these traditional and historical houses more attractive.

6.4.4 THREATS

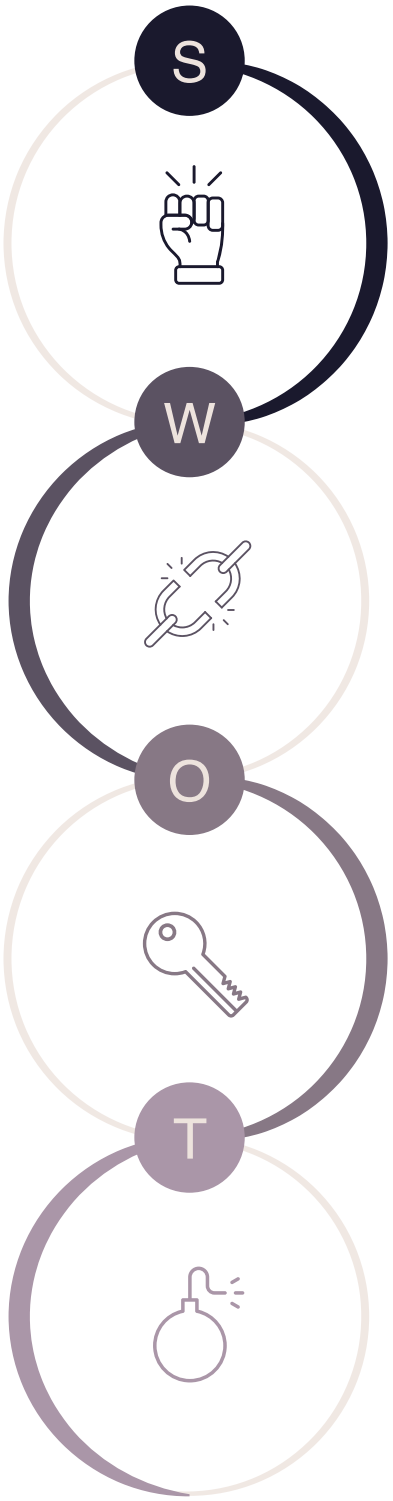
The threats introduced in this project are largely related to the demographic trend, to economic uncertainties, environmental risks and social dynamics.

Despite the potential to attract new inhabitants, the broader trend of depopulation and the consequent aging population in internal areas remains probably the main threat. If younger generations continue to leave the area in order to look for better opportunities, the local workforce and community vitality could be further decreased, limiting the project's long-term feasibility.

The economic factors are dependent on sustained demand for remote workers and rural living. Economic downturns, changes in the housing market or shift in employer policies regarding remote work will reduce the possibility of Ingria to be a remote working site as a permanent destination. This economic uncertainty poses a risk to the viability of the project.

In addition, Soana Valley, like many other mountainous localities, is susceptible to environmental risks such as landslides, flooding and forest fires, exacerbated by climate change. These risks show a threat to the safety and attractiveness of the village for potential new inhabitants. Implementing risk management and environmental protection measures is essential to mitigate and solve these problems.

Moreover, to go through complex environmental regulatory related to heritage conservation, building codes and internal development in Italy might present significant challenges. Delays in obtaining permits, approvals or funding can slowdown the project and increased costs, will jeopardize the success of the project.



Strenghts

- Unique vernacular architecture and cultural heritage
- Integration with the nature
- Energy efficiency and sustainable living
- Potential for community revitalization
- Remote working as strategy against depopulation

Weaknesses

- State of direpair and high renovation costs
- Adapting traditional layout to modern needs
- Limited accessibility and digital technology
- Lack of local amenities and services
- Potential resistance from local community

Opportunities

- Growing interest in rural living
- Natural and heritage tourism
- Potential for public - private partnership
- Technological advancements

Threats

- Continued depopulation and aging population
- Economic instability
- Enviromental risks
- Burocratic obstacles

6.4.5 CONCLUSIONS

The SWOT analysis shows a clear overview of the potential of strengths, weaknesses, opportunities and threats associated with the project of reusing a typical vernacular building in Ingria, as a strategy to face and try to solve the depopulation through remote working. By stimulating the unique cultural and natural assets of the village, addressing infrastructural and social challenges and capitalizing on emerging trends and opportunities over weaknesses and threats, the project has the potential to create a successful example, embracing the future of work and living.

The idea of reusing an abandoned home in Ingria aims to contrast those trends of depopulation by proposing an example of sustainable rehabilitation strategy able to present itself as a model for similar villages and towns facing the same fate

7
SCENARIOS

Ingria (TO). Photograph taken by the author

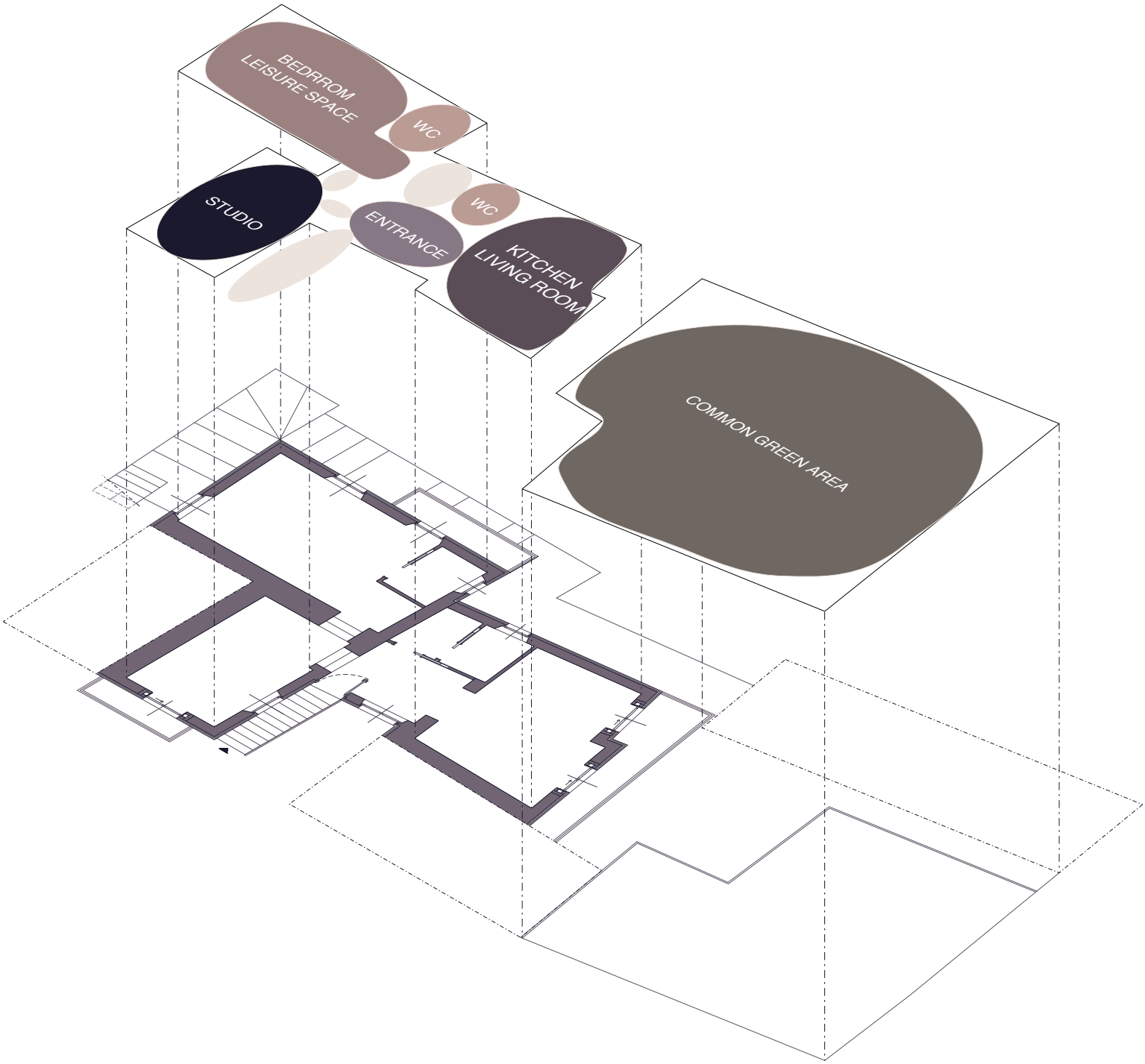
7.1 SCENARIO 1: FROM ROOM TO WORKSPACE

The first scenario focuses on creating a functional and comfortable home office in a dedicated and separated room. This possibility is on one hand the best condition for a remote worker, on the other it is the best situation for a designer as few practical measures will be enough in order to make the space as much suitable as possible. The project reflects a point of view that merges sustainability, modern living and cultural heritage in order to provide a model for the adaptive reuse of abandoned houses in depopulated internal areas. The heart of the intervention is the conversion of the South-facing room into the home office in order to provide a productive and comfortable workplace, well illuminated by natural light, equipped with the proper technology as well as being energy-efficient and thermally comfortable. Moreover, its separation from the living room, from the leisure and external common areas gives privacy and quiet, essential requirements for productivity in a home office environment. In fact, after having analyzed the origin of the noise sources and their intensity, the studio is located close to the quietest spaces, namely the entrance and the bedroom and far from the noisiest ones, the kitchen and the common green area. This room is enhanced with improved insolation too in order to ensure the best possible comfort without excessive energy use. In addition, the South-facing windows allow natural daylight as much as possible, reducing the need of artificial lighting during the working hours. The first step of the project is the reorganization of the interior spaces: by demolishing the walls that divided the spaces in two on the East and North sides, it is possible to create two large spaces respectively for the kitchen and for the living room on the East side, and the bedroom on the North. Kitchen and living room are the main and central social areas of the house. The idea is showing a balance between private and shared spaces and between work and private life. The inclusion of the bedroom and additional leisure space in the same room ensures that the house still remains functional as a complete home, with again the distinction from relaxation and work. One of the main benefits of WFH is certainly a better work-life balance. Having a space dedicated exclusively to work allows the separation from working hours to non-working hours without interference.

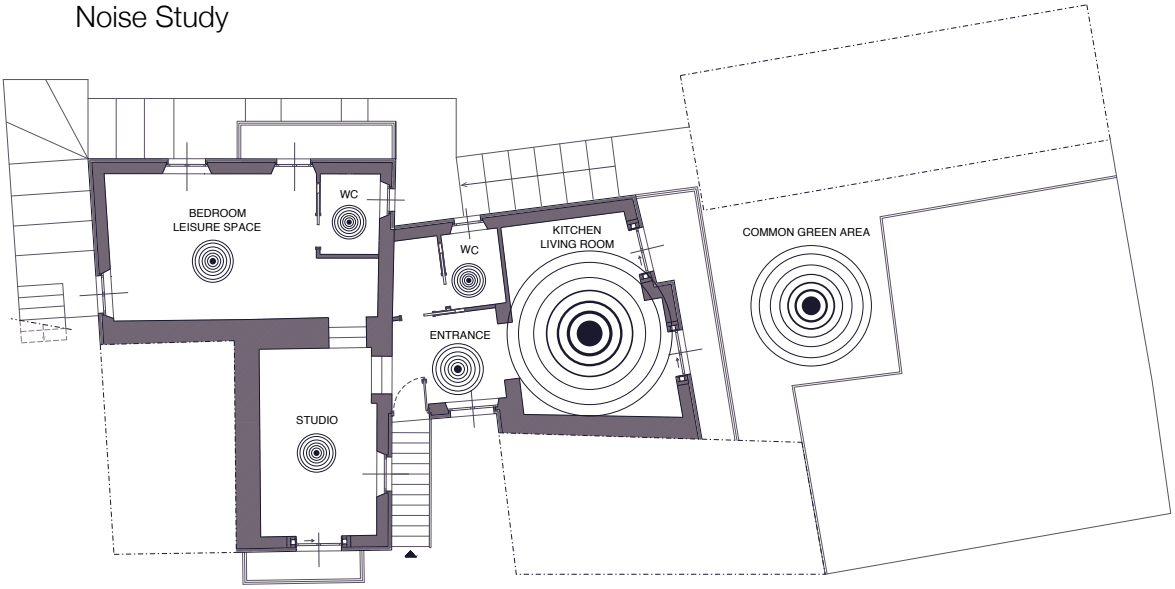
Green areas are probably the main requirement requested by those who escape the city. The lack of contact with nature or the scarcity of greenery in cities, especially after the COVID19 pandemic, has given us the chance us to re-evaluate internal areas. The common green area suggests a potential communal engagement and a shared use of space with neighbors. This connection with natural surroundings is paramount to encourage a sustainable and a new community-oriented lifestyle

CONCEPTS

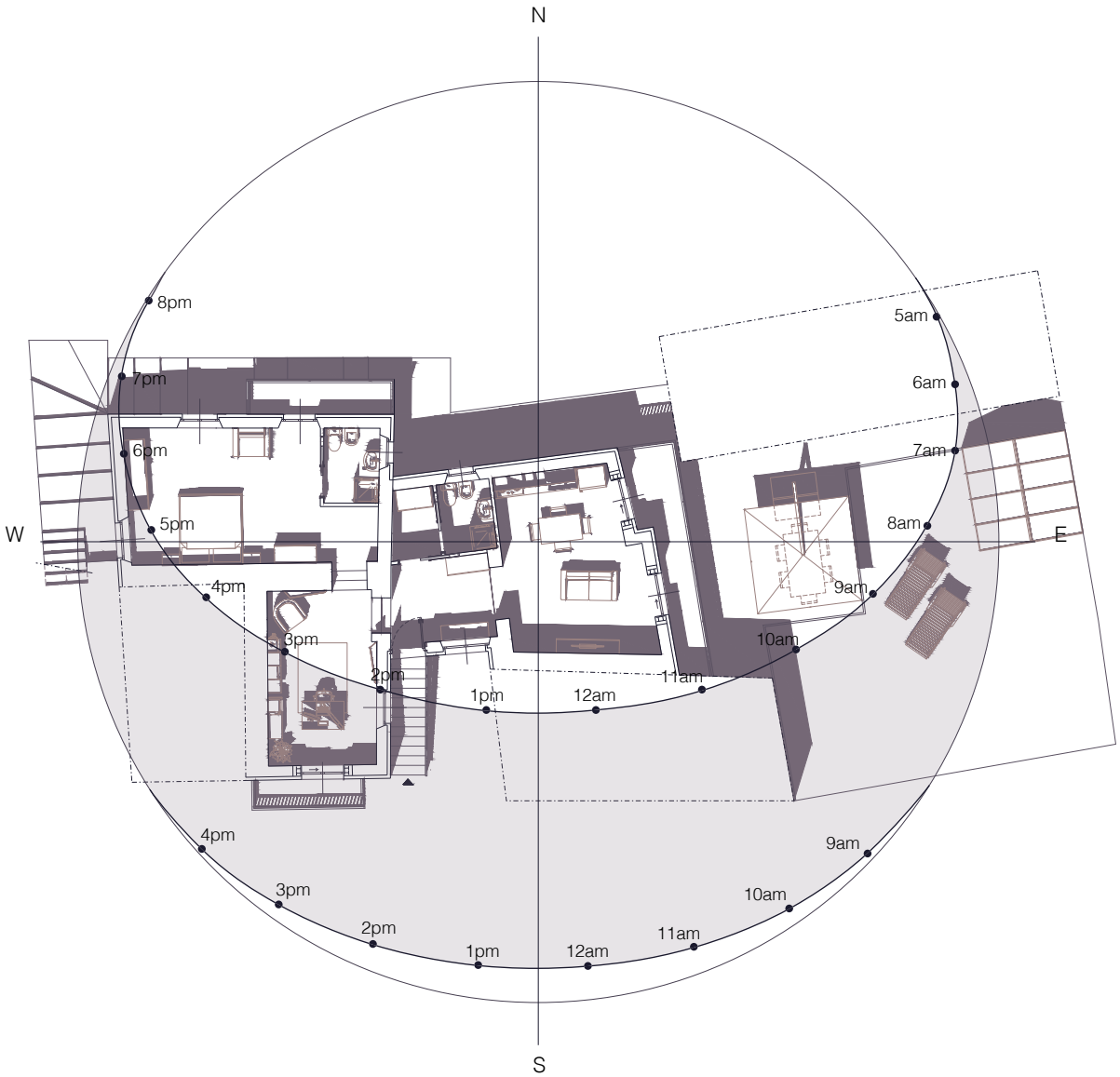
Blubble Diagram

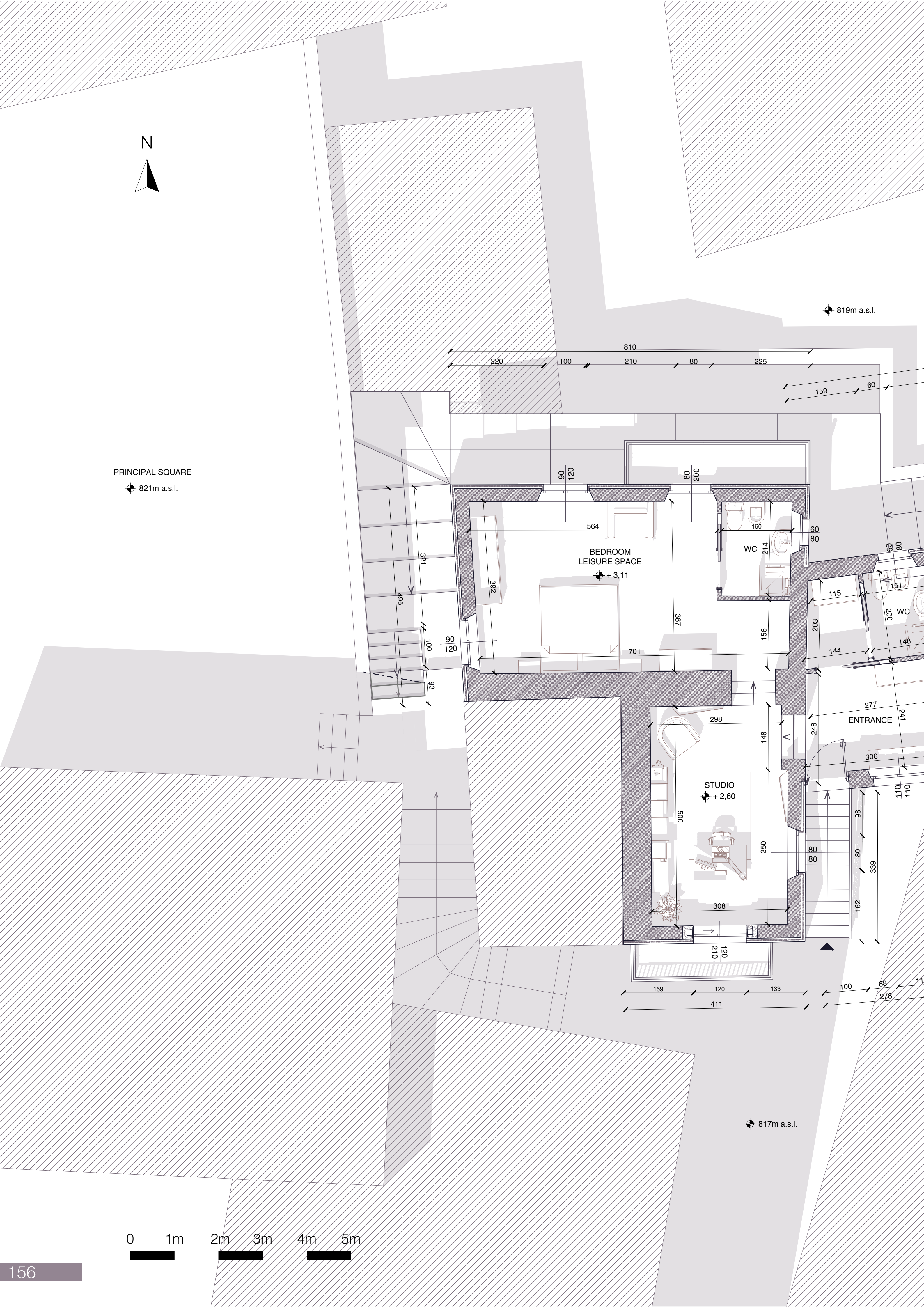


Noise Study



Sunpath Diagram (21/06, h 2.00pm)



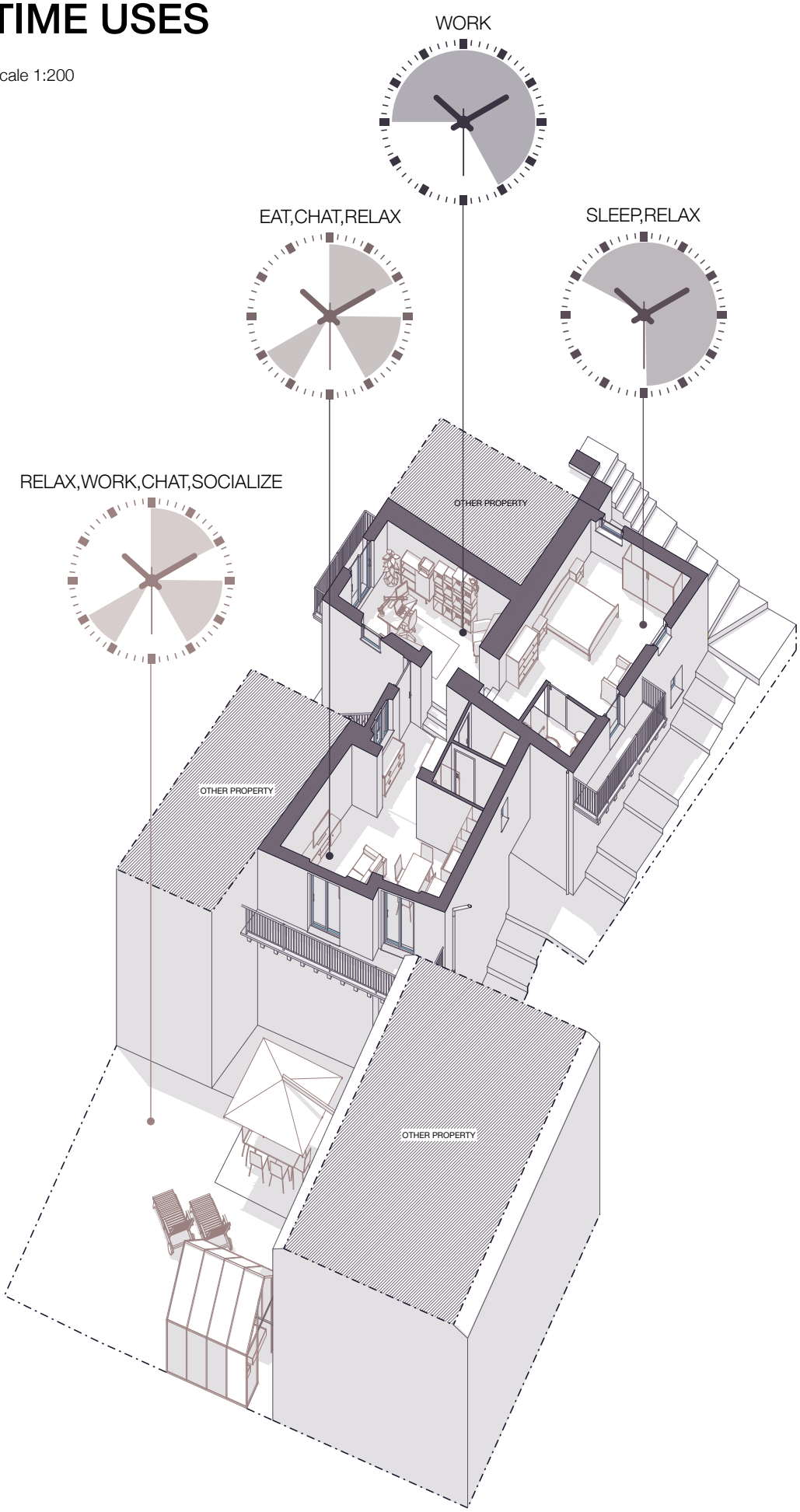

N
PRINCIPAL SQUARE
821m a.s.l.
819m a.s.l.
BEDROOM
LEISURE SPACE
+ 3,11
WC
WC
ENTRANCE
STUDIO
+ 2,60
817m a.s.l.
0
1m
2m
3m
4m
5m

FIRST FLOOR PLAN

Scale 1:100

TIME USES

Scale 1:200



7.1.1 HOME OFFICE

As explained in chapter 5, a proper home office is a space that links functionality, comfort, aesthetics and productivity. It should provide both practical working requirements and personal well-being, creating an environment able to encourage focus and at the same time having a cozy design.

Reflecting the vernacular architecture style, the room doesn't have to be large as it must be well-organized with a layout that supports workflow. A minimal but functional design is essential to maximize the feeling of open and free. The desk is positioned in the center of the room, so that it is easily reachable lined up with the two windows, so it receives as much natural light as possible. It is not positioned against a wall as we want to avoid excessive exposure to sunlight, which leads to difficulty viewing screens and to ensure maximum possible movement. Near the desk there is a bookcase and the printer to ensure maximum comfort.

The windows allow plenty daylight and help to reduce eye strain creating a more pleasant working environment. Natural light is important not only for energy efficiency and thermal comfort thanks to windows' glazing able to balance heat gain and loss but, as mentioned in the previous chapters, it has a positive impact in mood and productivity too.

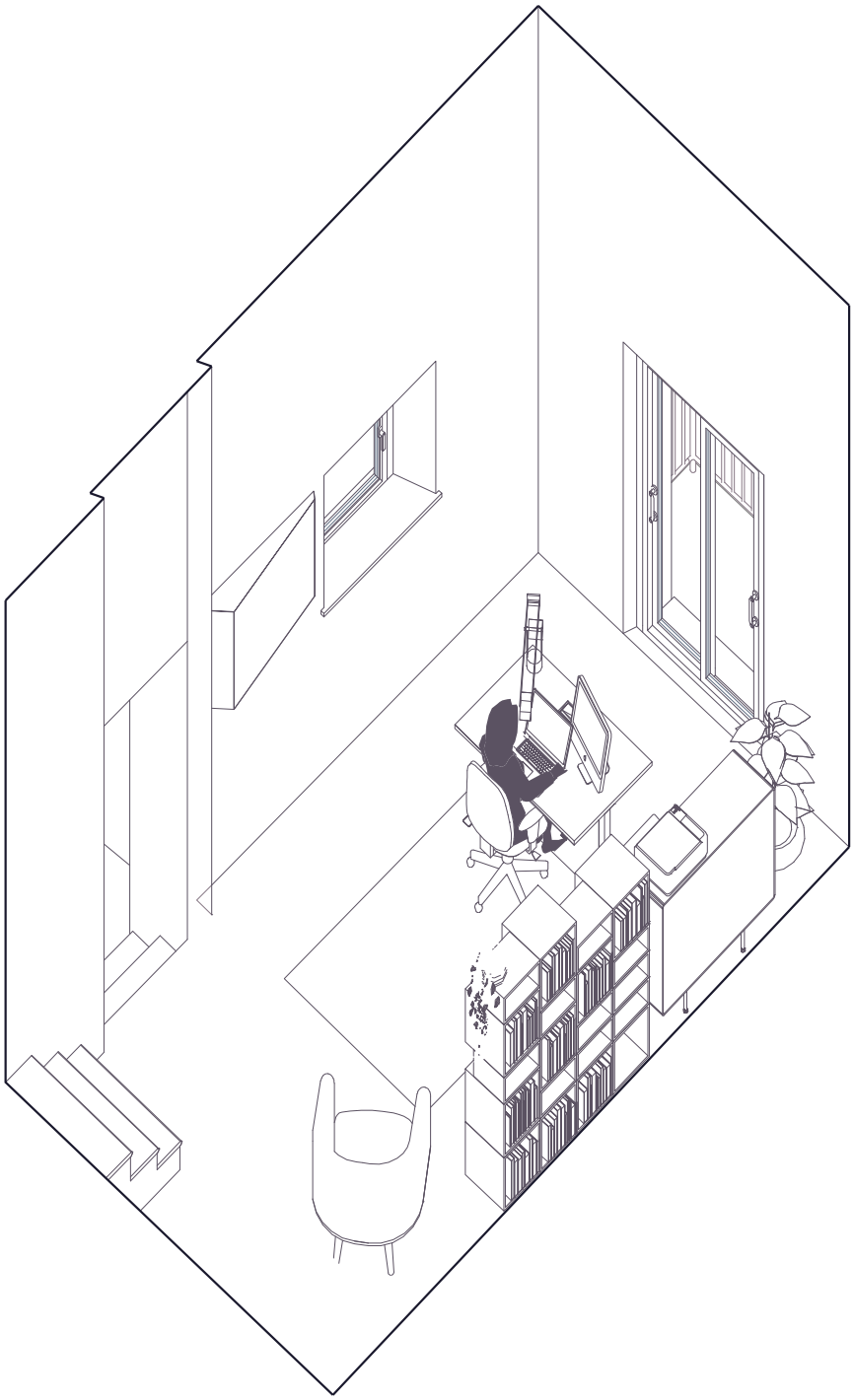
Acoustic comfort is crucial in a home office that's why it has been given great importance in this project. The room is far from noisy sources and it is equipped with features and elements that improve acoustic insulation. First of all, an anti-impact flooring is planned in order to reduce step noise, falls and minimize injuries. These surfaces are engineered to absorb and dissipate energy upon impact. This kind of material not only is able to maintain a good sound environment, but it guarantees durability as they are made of highly resilient materials like rubber or foam. A further layer of carpet is added on the anti-impact flooring which is sound absorbent as it is composed of multilayers of fabric and it is able to effectively reduce footsteps and airborne noises. They are made of dense, high-pile fibers which catch sound waves and prevent them from bouncing back into the room. Both acoustic and lighting influence personal well-being and are the major contributors for a positive workspace. The pendant lamp minimizes external noise levels. Thanks to its large surface area and concave shape, it traps sound waves as they travel upwards. As it can be seen from the plants, the studio is connected to the entrance and the bedroom but without a door separating it from the surrounding rooms, thus increasing noise infiltrations. To further mitigate this situation, two sound-absorbing panels made of aluminum and

containing moss and foliage are hung on the wall. These panels reduce the impact of sounds and promote relaxation and emotionally improve morale.

All the elements of the office are ergonomic to ensure and guarantee the best comfort, the best productivity and the best working environment. The ergonomic chair which is specially designed to support the human body during long periods of sitting is an example. It avoids physical strain, improving posture and preventing discomfort or health issues, thanks to its adjustable seat height, adjustable seat depth and lumbar support. The height-adjustable desk allows workers to alternate sitting and standing throughout the workday to suit their needs and comfort. In fact, allowing varied working positions, this kind of desk enhances a healthier and more dynamic work environment, reducing physical strain and guaranteeing productivity and as well as comfort.

AXONOMETRIC VIEW

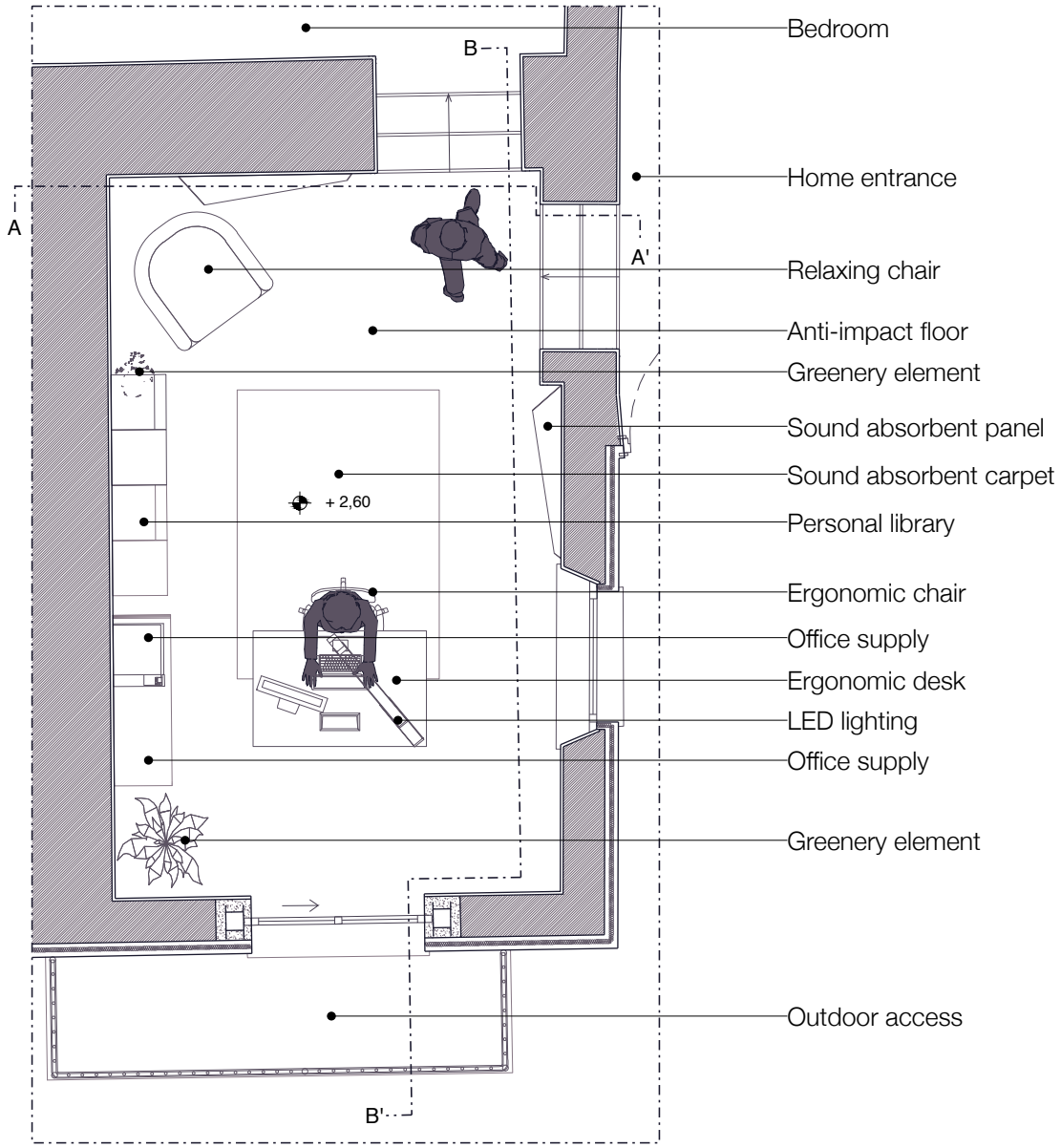
Out of Scale



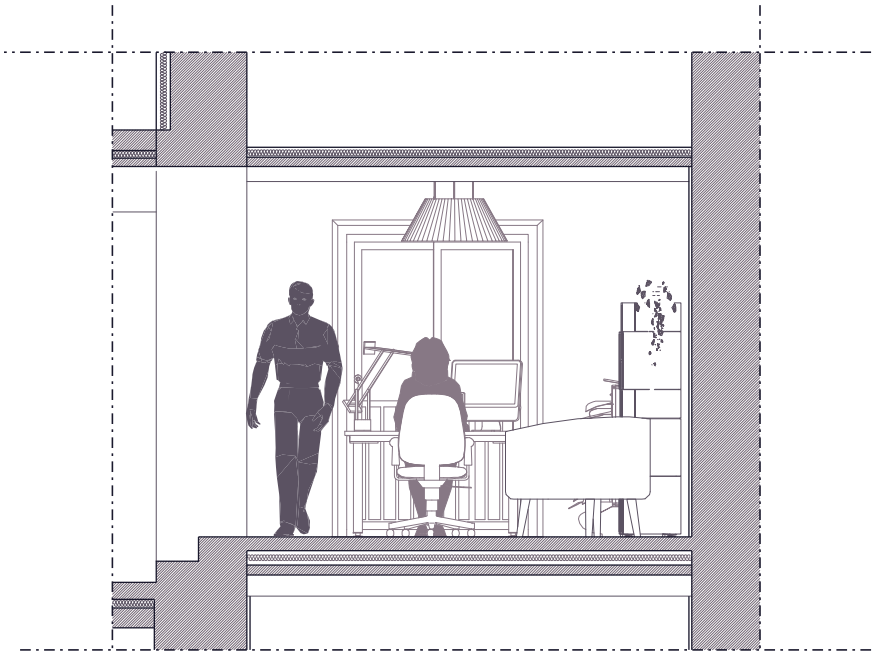
THE HOME OFFICE

Scale 1:50

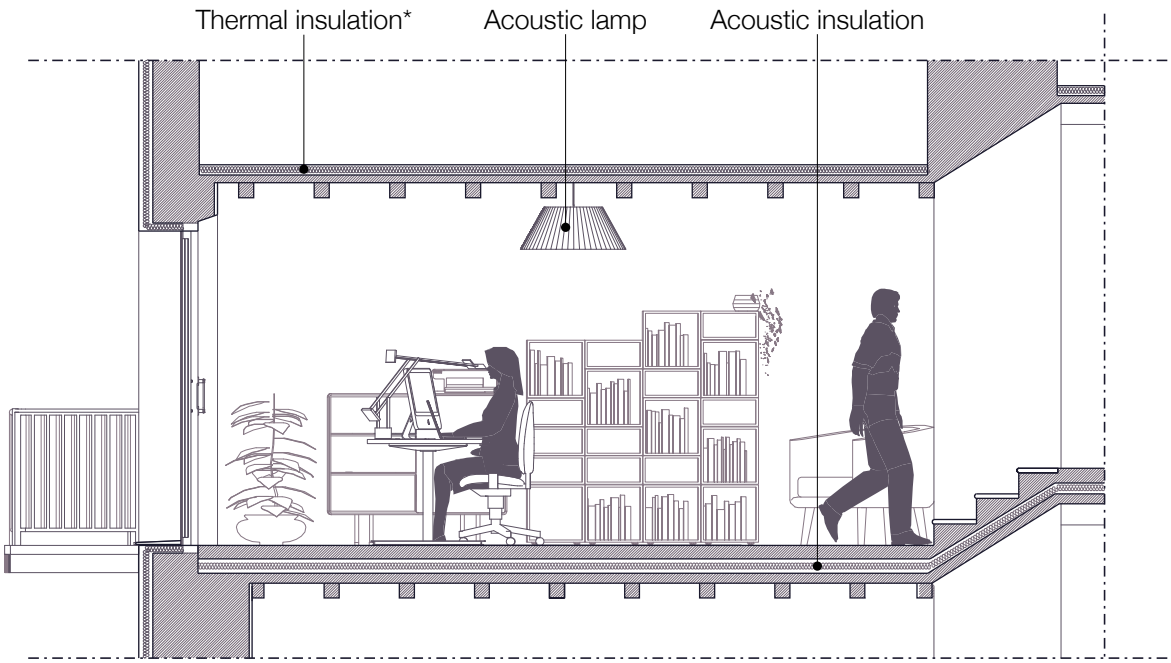
Plan



Section A-A'



Section B-B'



* See Chapter 8

INTERNAL VIEW

Before

After

7.2 SCENARIO 2: THE ENTRYWAY WORKSTATION

The second scenario represents the most common case among all remote workers as most of them do not have the possibility to use a room exclusively for work. It is clear that in this case on one hand many more variables need to be taken into account during the design phase, on the other it is not possible to use the same furniture that would be used in a normal office due to space issues.

The project focuses on the use of the South-facing big entrance as workstation, creating in this way a multifunctional space that enhances the usage of the house without compromising its architectural character. The location is able to offer a greater amount of natural light, which is maximized through the design of the workstation. Energy-efficient lighting and thermal insulation will be integrated to guarantee that the space remains comfortable throughout the day with a minimal reliance on artificial lighting and heating.

The two main problems in this case are certainly the worker's privacy and the acoustic comfort as we are in common spaces. The choice of the entrance is not accidental. It is, in fact, a filter area in which the presence of other family members is only passing through, thus allowing moderate tranquility. In addition, it is a relatively large space but too small to be used differently. However, it is close to the kitchen and the living room, two large sources of noise, and for this reason it is necessary to close the passage, unlike the first scenario, through a glass door which still allows the passage of light.

The heart of the project is a flexible design that incorporates multifunctional and adaptable office furniture that can be reconfigured as needed, ensuring that the workspace does not dominate the entrance but rather integrates gently into the overall flow of the house. In cases where there is no separate room, the greatest risk for these remote workers is the absence of boundaries between work life and private life, running into all the consequences described in the previous chapters. For this reason, it is paramount to design a solution that can be adapted to both working and non-working hours, becoming in the latter case a functional piece of furniture. Foldable furniture is the best design solution to ensure a workspace that can be easily hidden or transformed, allowing the space to accommodate different activities, such welcoming guests, library or a simple reading area. A wall-mounted and a foldable desk are the centerpiece of the home office arrangement. This flexibility is particularly important in a rural context due to the fact that homes are usually more compact. It reinforces the adaptability necessary for future residents who might use that space

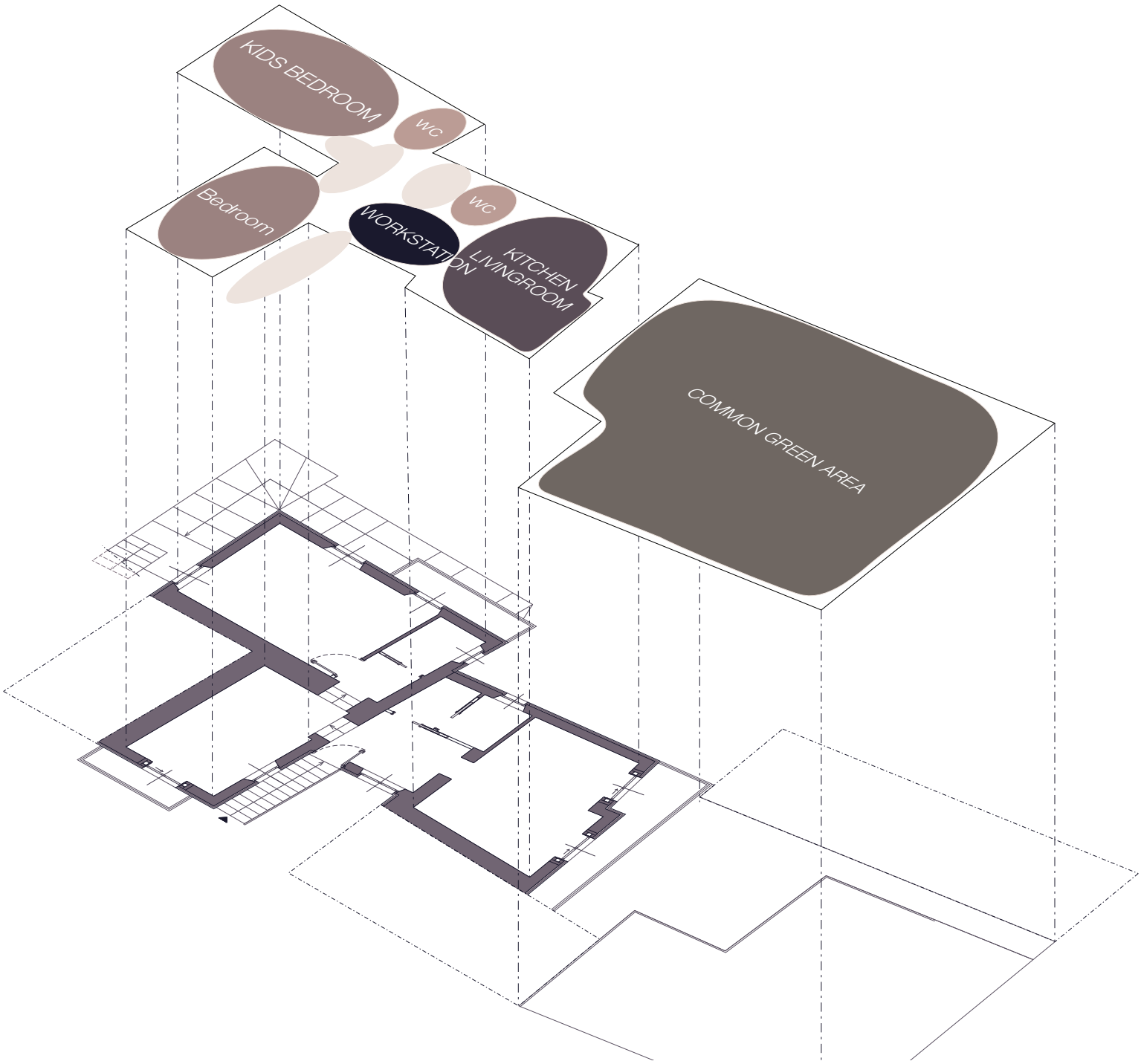
differently as their lifestyle or work situation evolves.

The design incorporates acoustic solutions to manage sounds levels, ensuring that noise from the rest of house does not disrupt the workplace. The materials of those pieces of furniture are not only natural but are sound-absorbing materials allowing the greatest acoustic comfort. The placement of bookshelves can help to absorb sounds and create a more comfortable work environment.

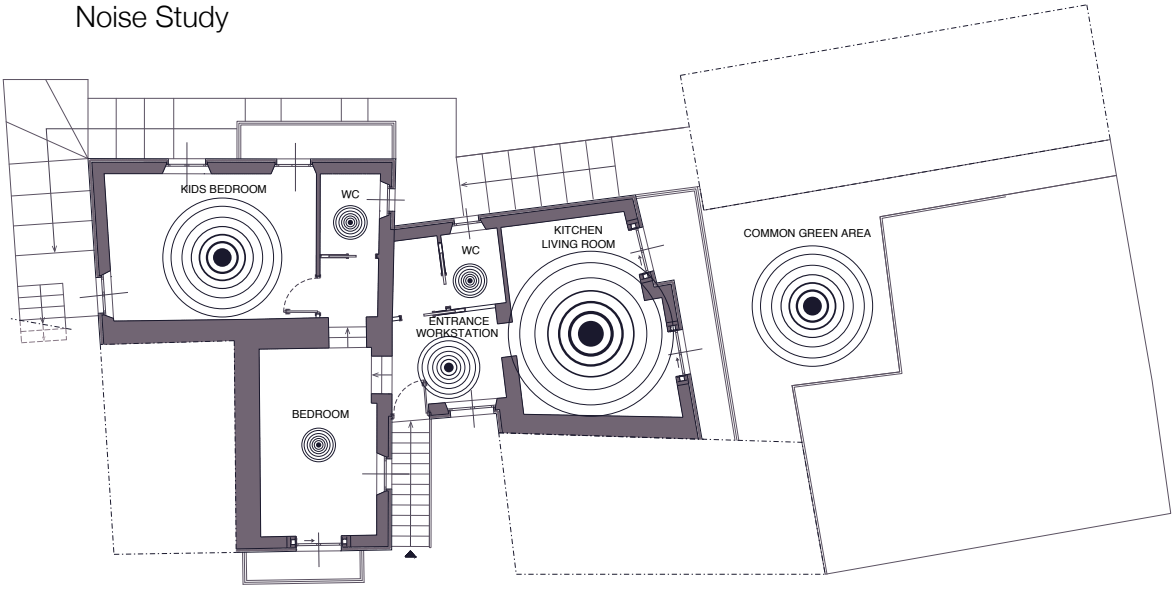
This approach minimizes the need for additional construction or invasive renovations, aligning with the sustainability of the project's goals by reducing material wastage.

CONCEPTS

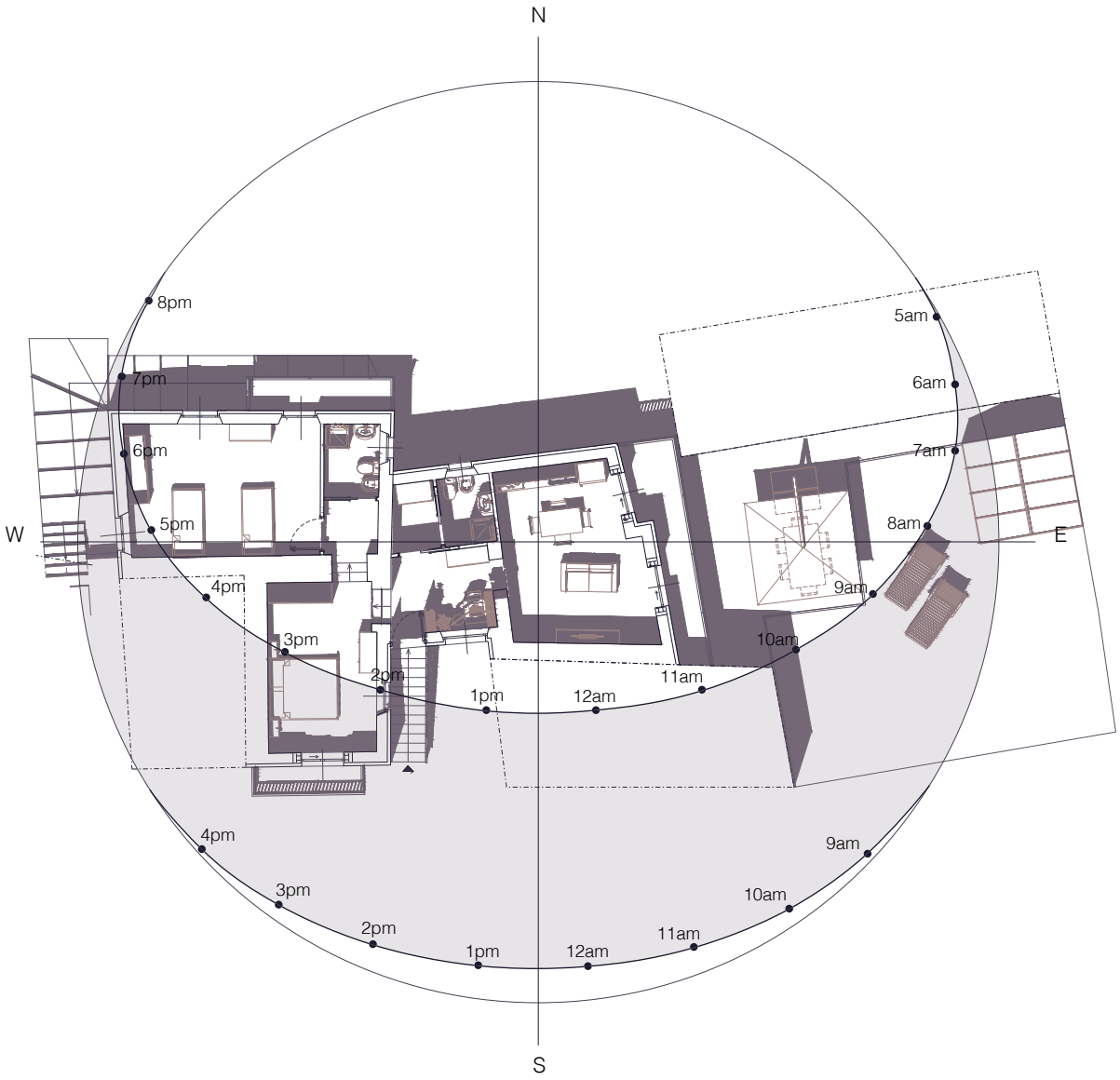
Blubble Diagram

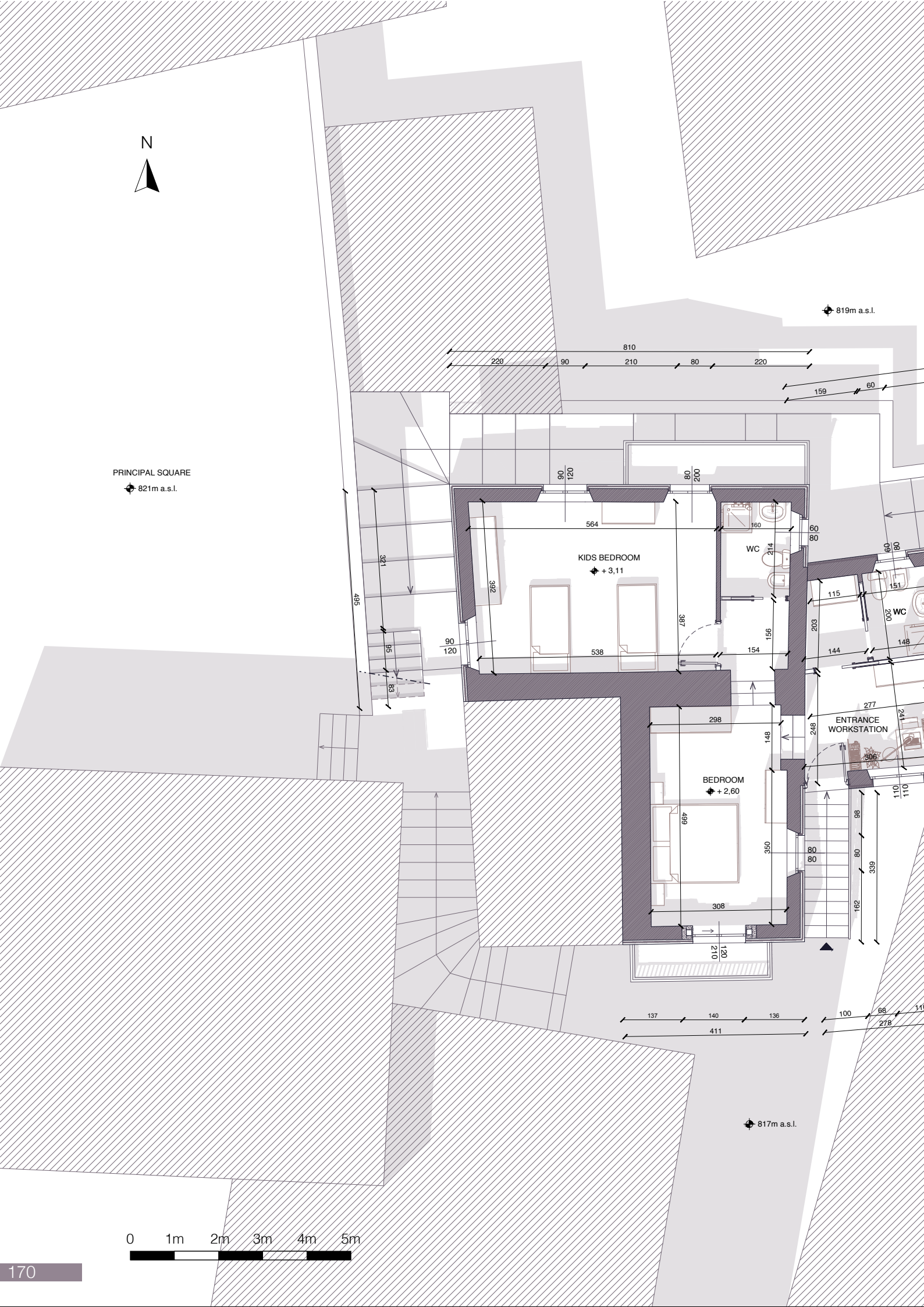


Noise Study



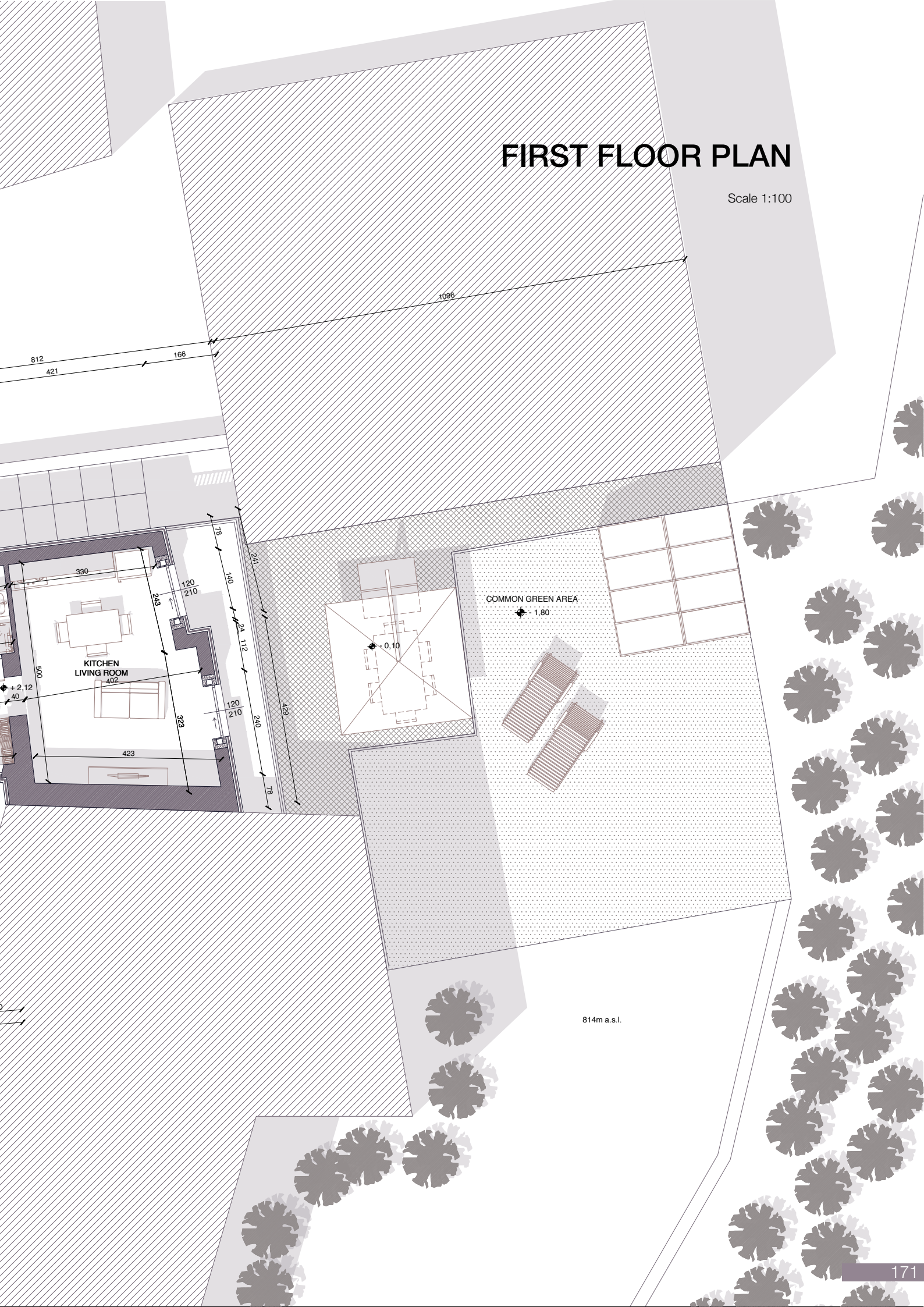
Sunpath Diagram (21/06, h 2.00pm)




N
PRINCIPAL SQUARE
821m a.s.l.
819m a.s.l.
817m a.s.l.
KIDS BEDROOM
+ 3,11
BEDROOM
+ 2,60
WC
WC
ENTRANCE
WORKSTATION
0
1m
2m
3m
4m
5m

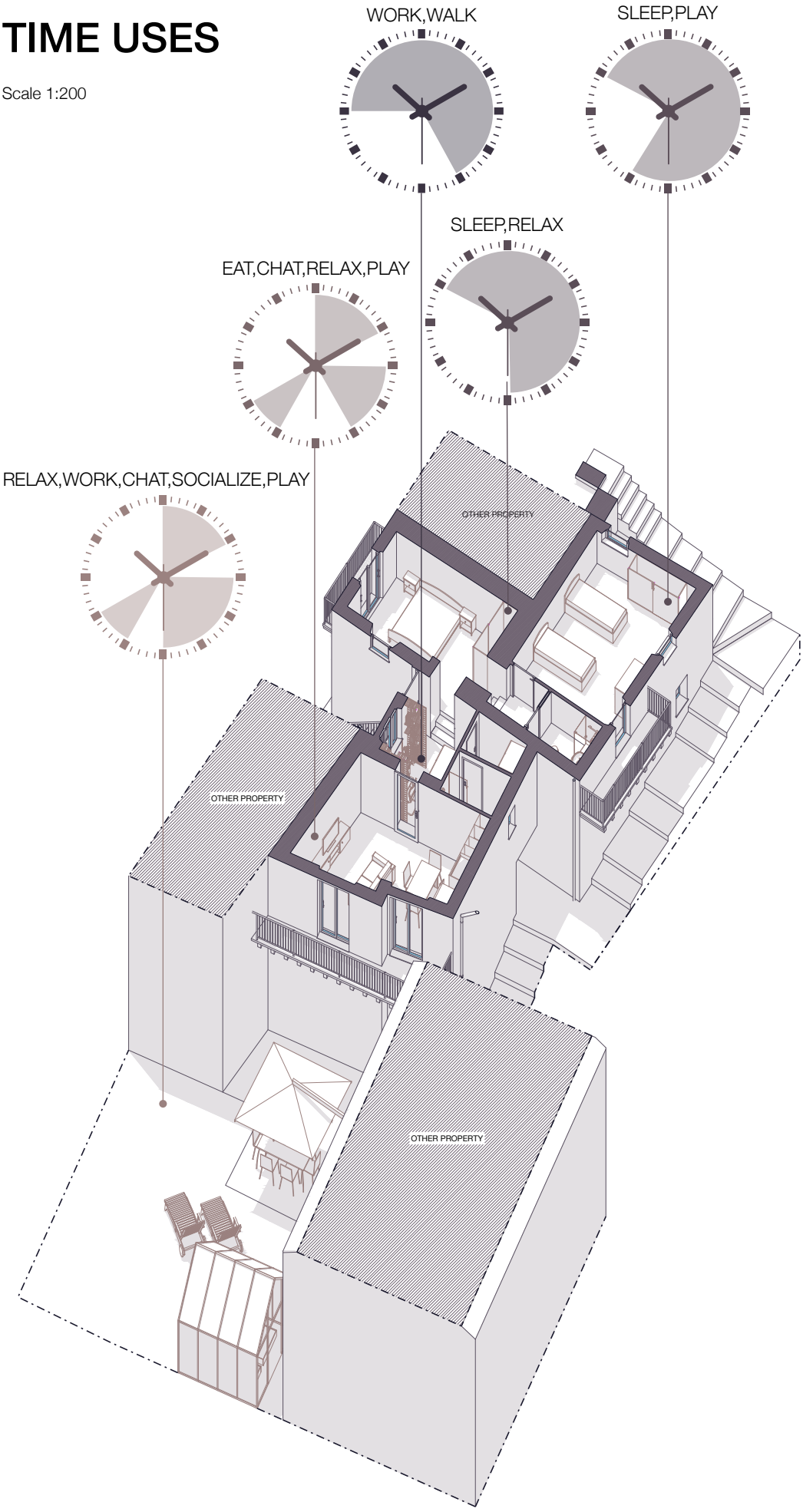
FIRST FLOOR PLAN

Scale 1:100



TIME USES

Scale 1:200



7.2.1 FLEXIBLE FURNITURE

Designed for versatility, flexible furniture is particularly useful in environment where space optimization and mobility are prioritized. In a WFH environment without a dedicated and separated room, the principle aim is to guarantee a multi-functionality feature in order to allow a perfect transition from work environment to a relaxation space. Mentally and physically dividing work from private life is the key point of the second scenario.

Taking advantage of the large entrance, the best solution is a foldable desk into the wall which offers creative work or leisure area. It can be easily folded down during the workday and tucked away when not in use, allowing workers to make of the most limited space. When not folded away, this desk is able to free up space for other activities, enabling a flexible room layout too.

This scenario features two high panels: one consisting of the folding desk and one actually dividing the entrance door; in the middle there is the work area.

In the first case, when the it is used, the desk provides ample workspace for laptops, notebooks and other office supplies. When not in use, it can be folded up to clear the floor space, allowing all the entrance space to function as a regular transitional space, such as a reading spot close to the window. The desk and its floor stand can be folded using hinges that make opening and closing quick and easy.

The second panel is actually a dividing wall of the same design with the double purpose of giving more privacy to the worker and create an acoustic panel capable of isolating the work area from noise coming from the entrance door.

Both panels are equipped with shelves, which can be used both as a bookcase or as a shelf on which storing all the office supplies and documents. These shelves are the peculiarity of this piece of furniture as they do not have a fixed position, but can be hung according to pleasure and needs, giving a higher level of flexibility and adaptability. For example, they can be positioned lower if a worker is not tall enough to take what he needs or because objects are taken and put down more frequently.

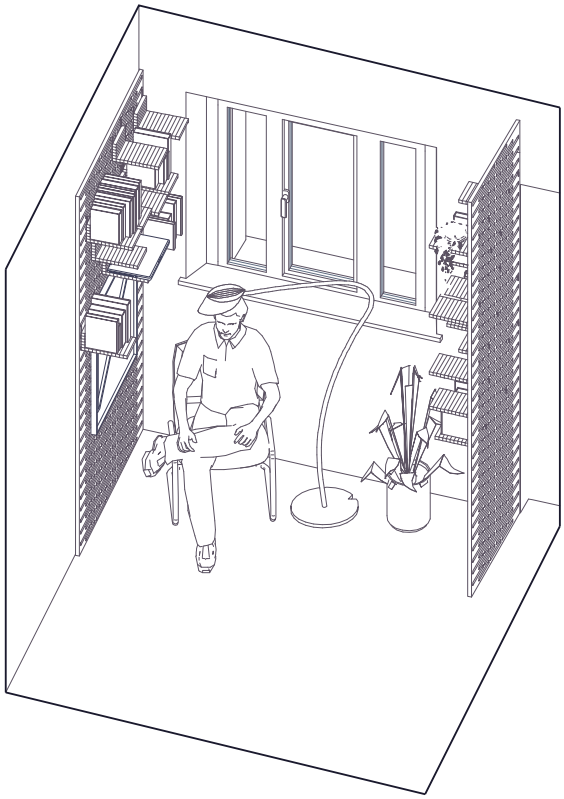
Particular attention has been given to both sustainability of the materials and the limitation on its production waste. They are made of wood wool slab which is manufactured by compressing long strands of chemically stabilized wood fibers coated in Portland cement, magnesite or gypsum. Fibers are not bounded together with toxic glue, such as formaldehyde. In case of fire they don’t release any health hazards and they are easily disposable too.

Rectangular holes are extruded into these wood wool slab panels to form the openings into which the shelves can be hung. Beside the function of completely closing the work area, these holes leave the necessary room for both the view and the passage of light. The extruded pieces are not thrown away, they constitute the components of each flexible furnishing shelf, possibly other shelves or other furnishing elements to be used in the rest of the house.

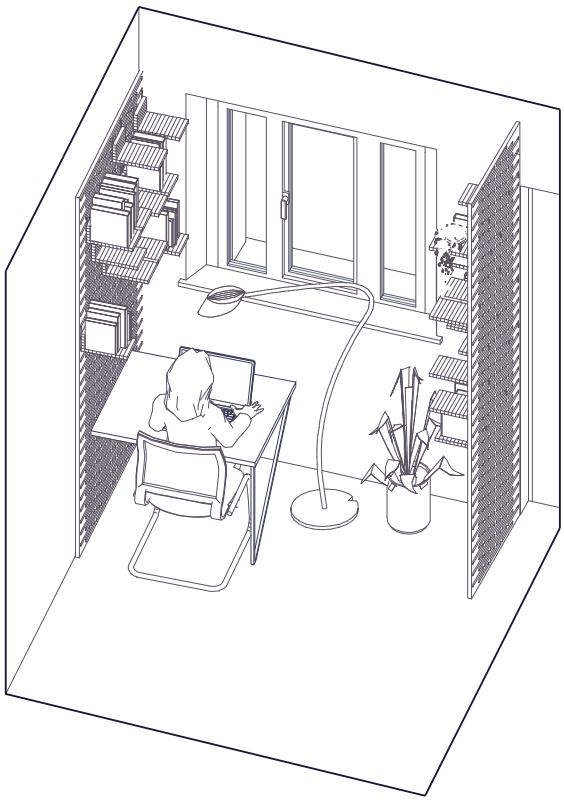
AXONOMETRIC VIEWS

Out of Scale

Non-working hours



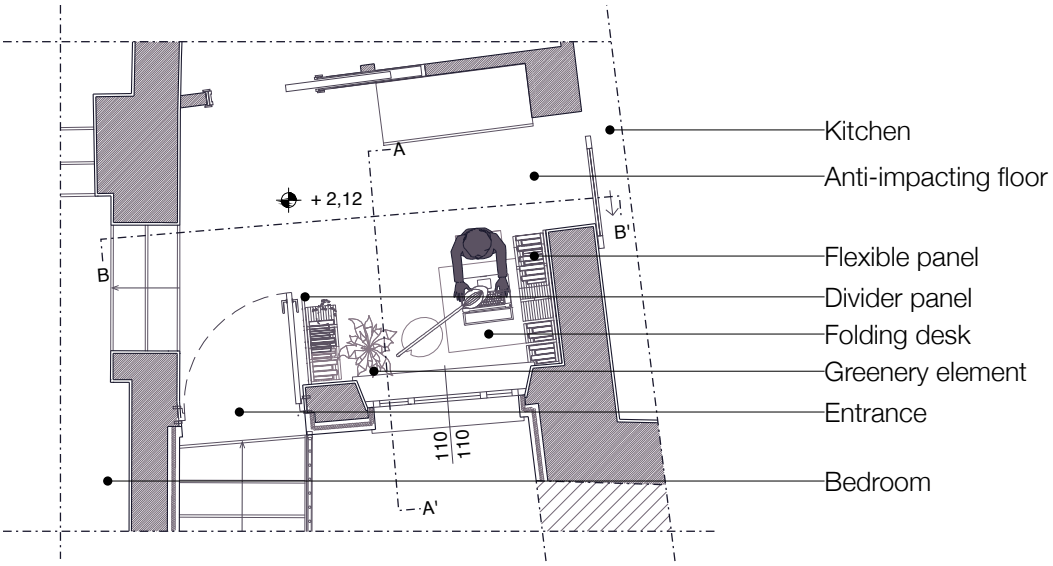
Working hours



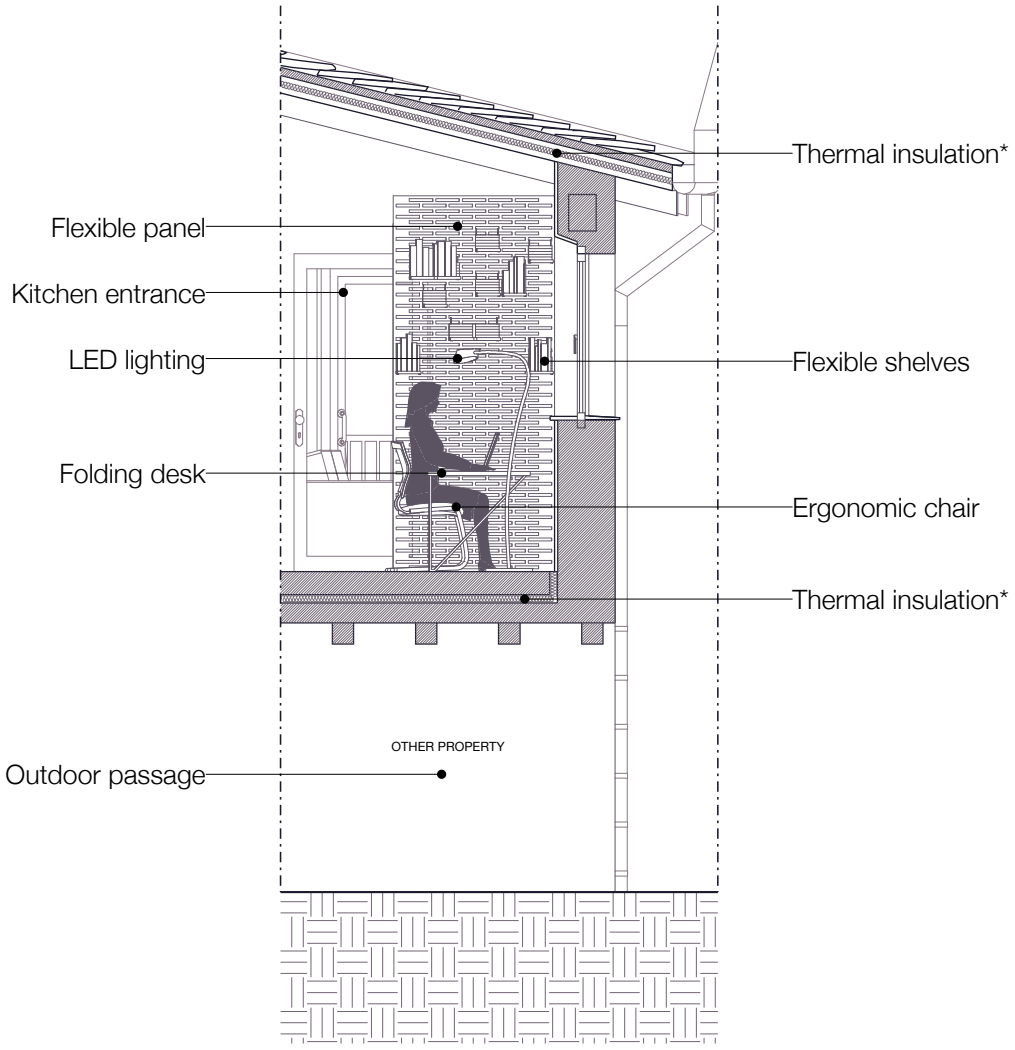
THE FLEXIBLE WORKSTATION

Scale 1:50

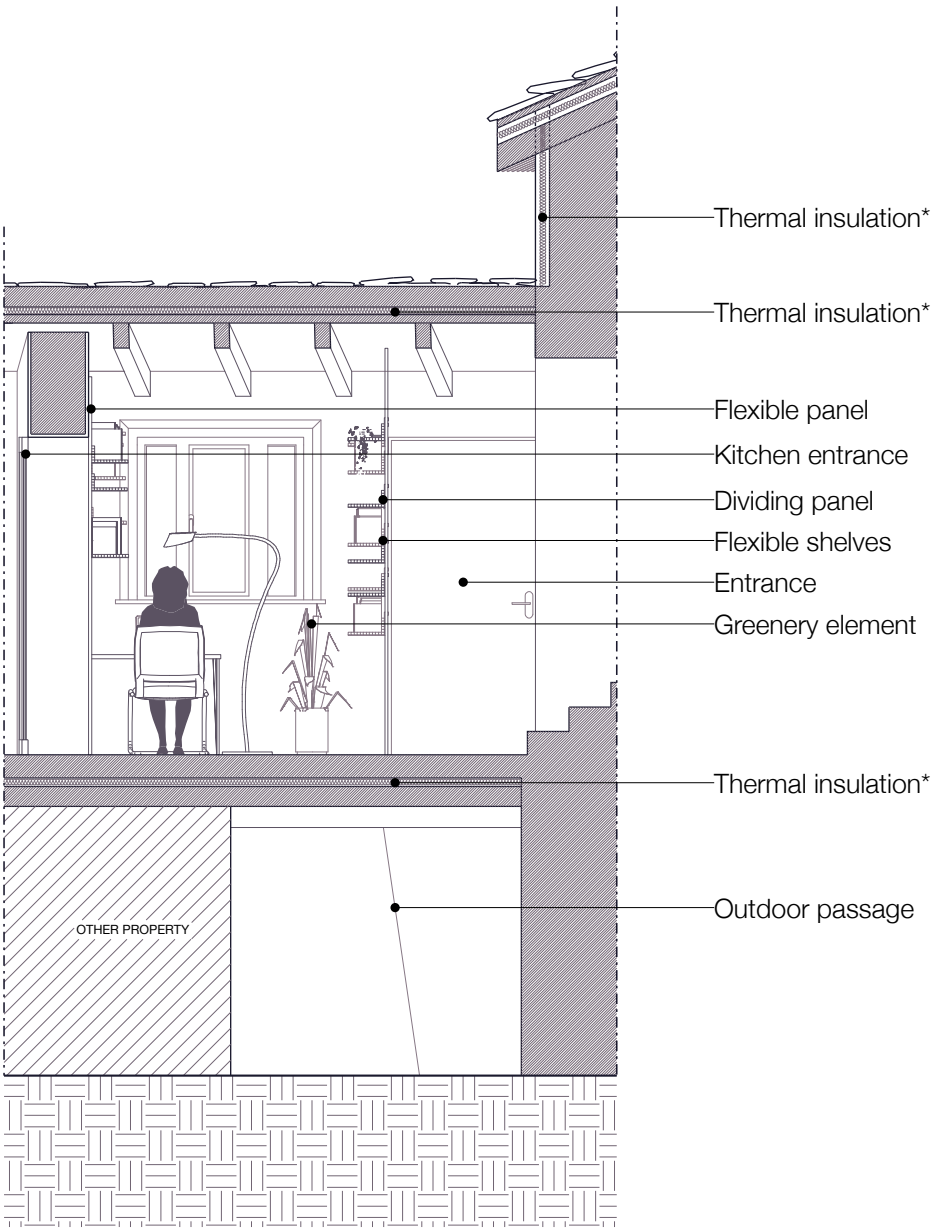
Plan



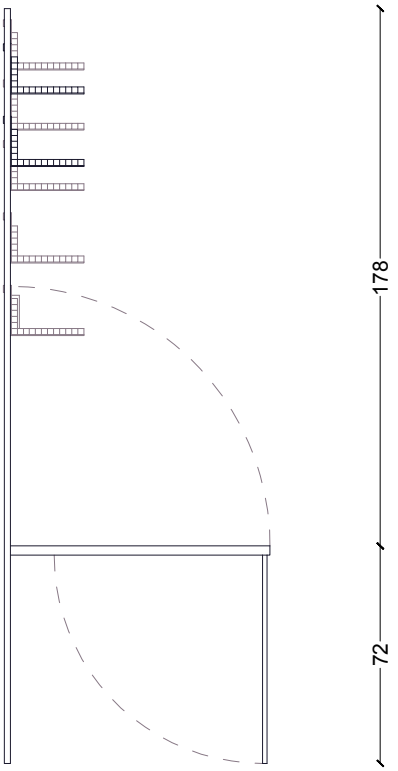
Section A-A'



Section B-B'



* See Chapter 8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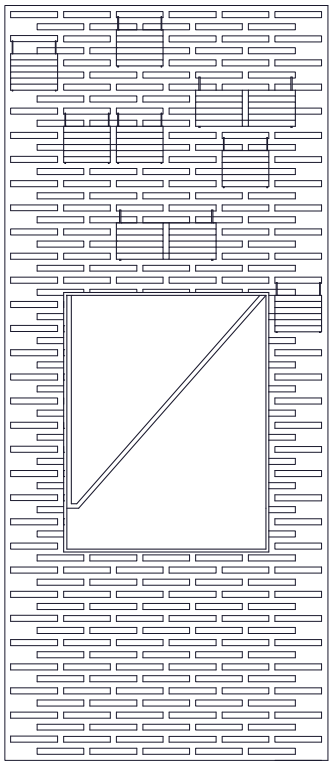
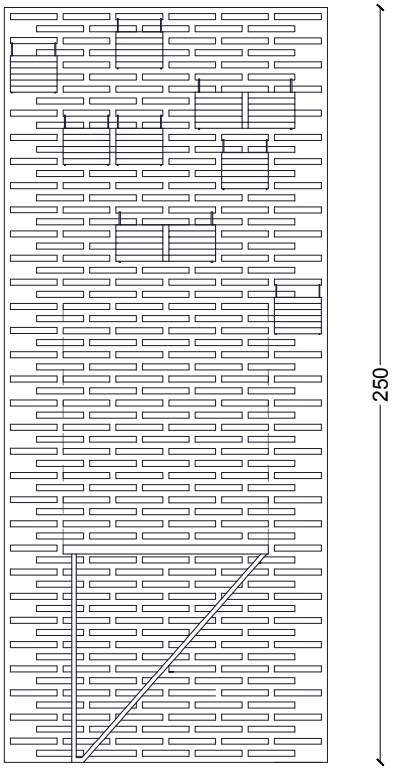
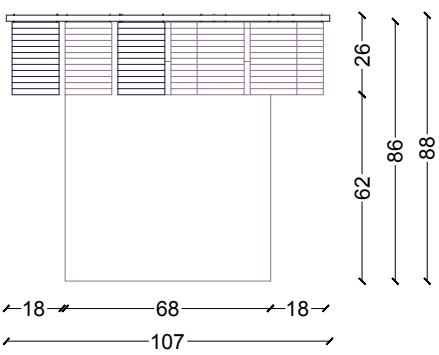
72

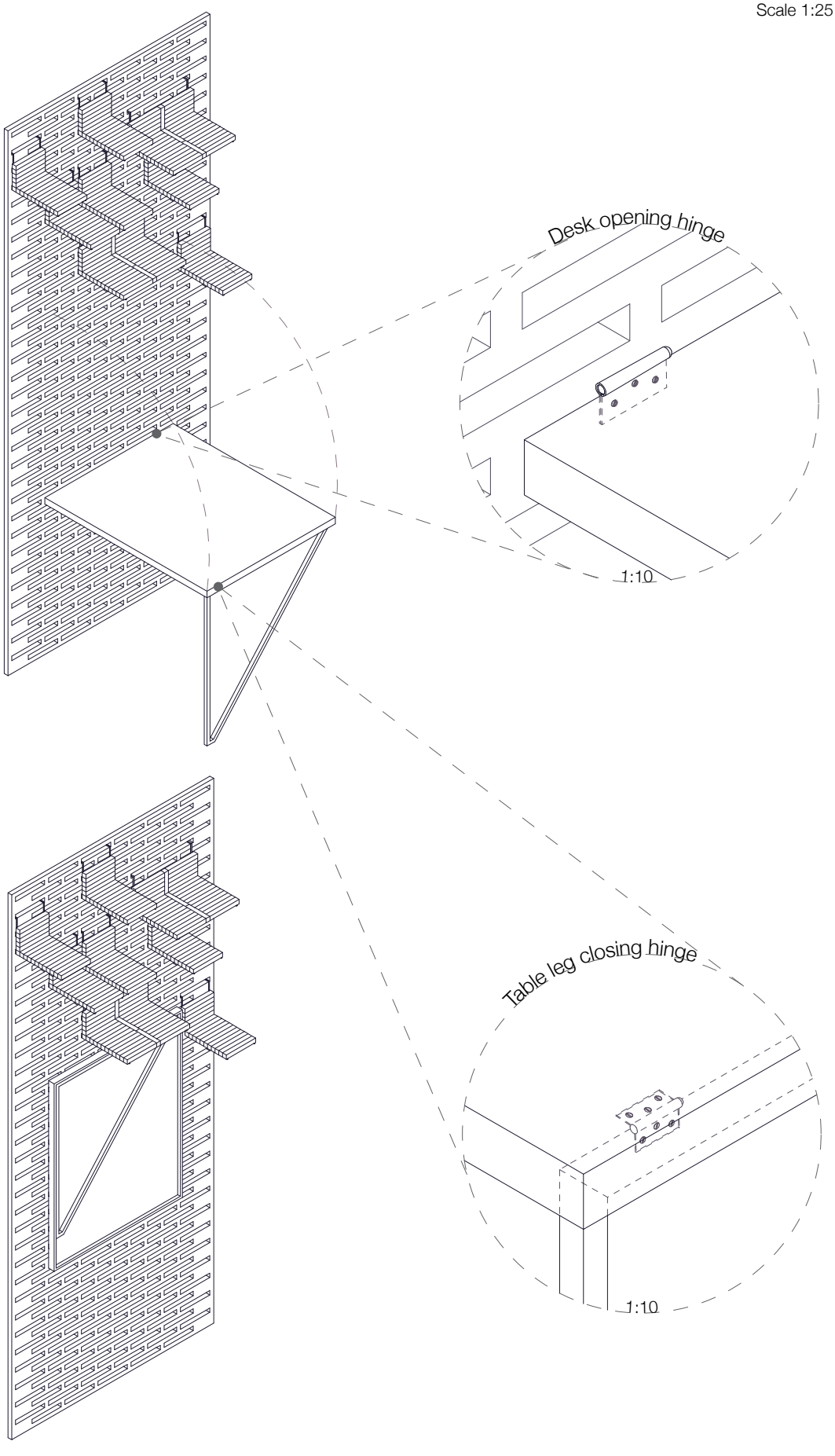



250


26
62
86
88
18
68
18
107

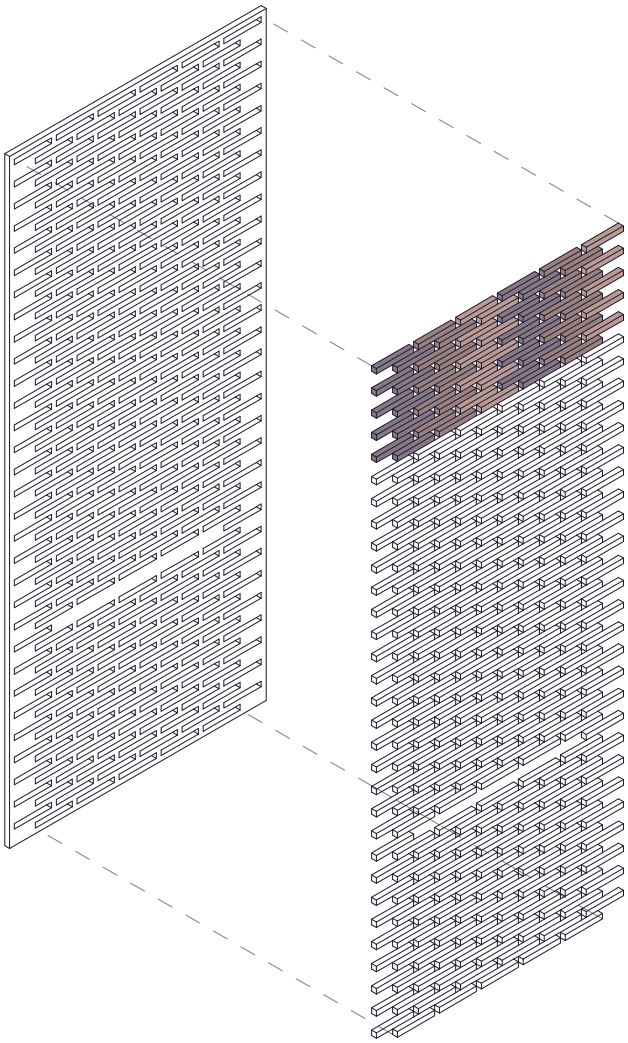
THE FOLDING DESK

Scale 1:25



ZERO WASTE

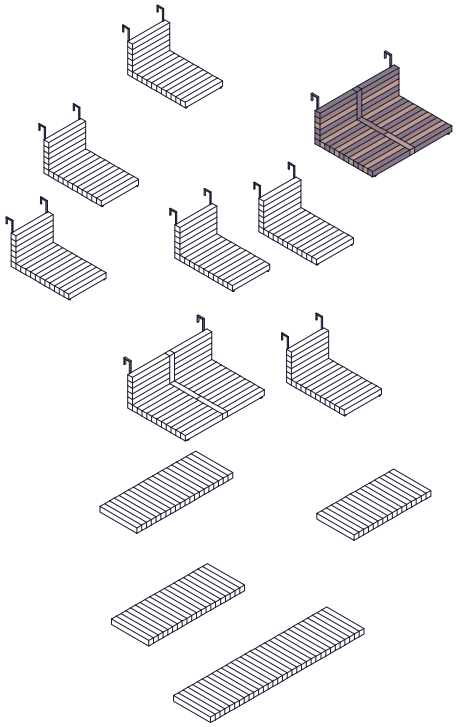
Scale 1:25



Holes are created in the wood wool slab panel. The blocks obtained by extrusion are not thrown away.

The main purpose is to obtain a piece of furniture whose construction process does not involve any waste, as well as the choice of material.

Wood wool slabs have a good sound absorption; they are not health hazard; there is no any problem of waste disposal.

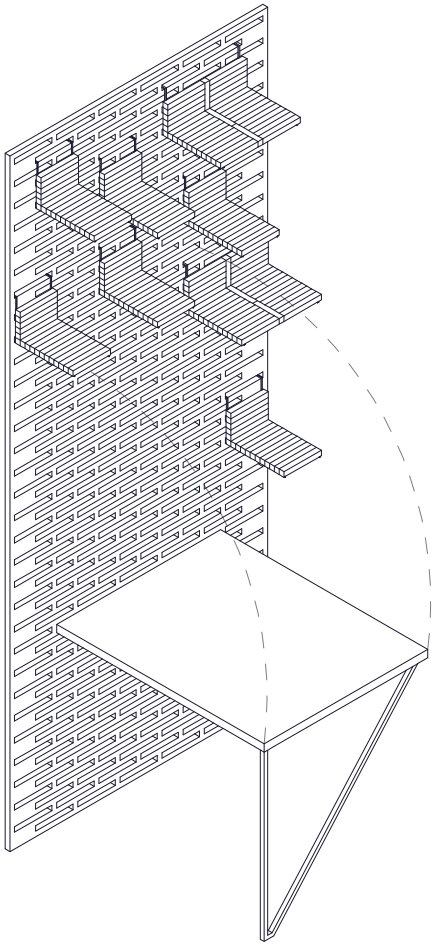


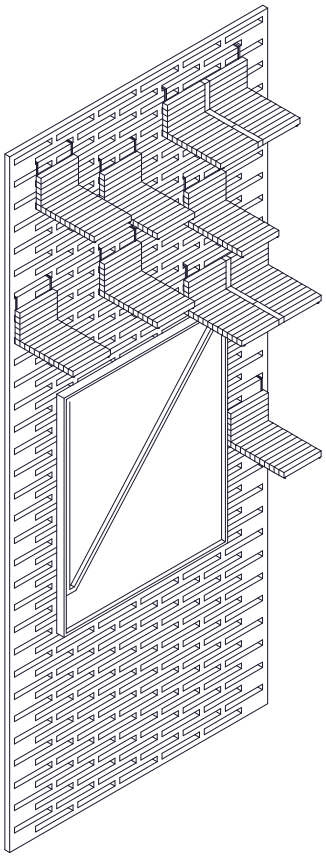
The extruded **blocks** have dimensions 2x15x2cm cm and are **joined to form the shelves** to be hung in the panel. The width 15cm is not random because the union of two shelf blocks allows you to store a 15-inch computer.

They can also be used to form shelves to hang in the rest of the house, not necessarily in the panel.

FLEXIBILITY AND ADAPTABILITY

Scale 1:25

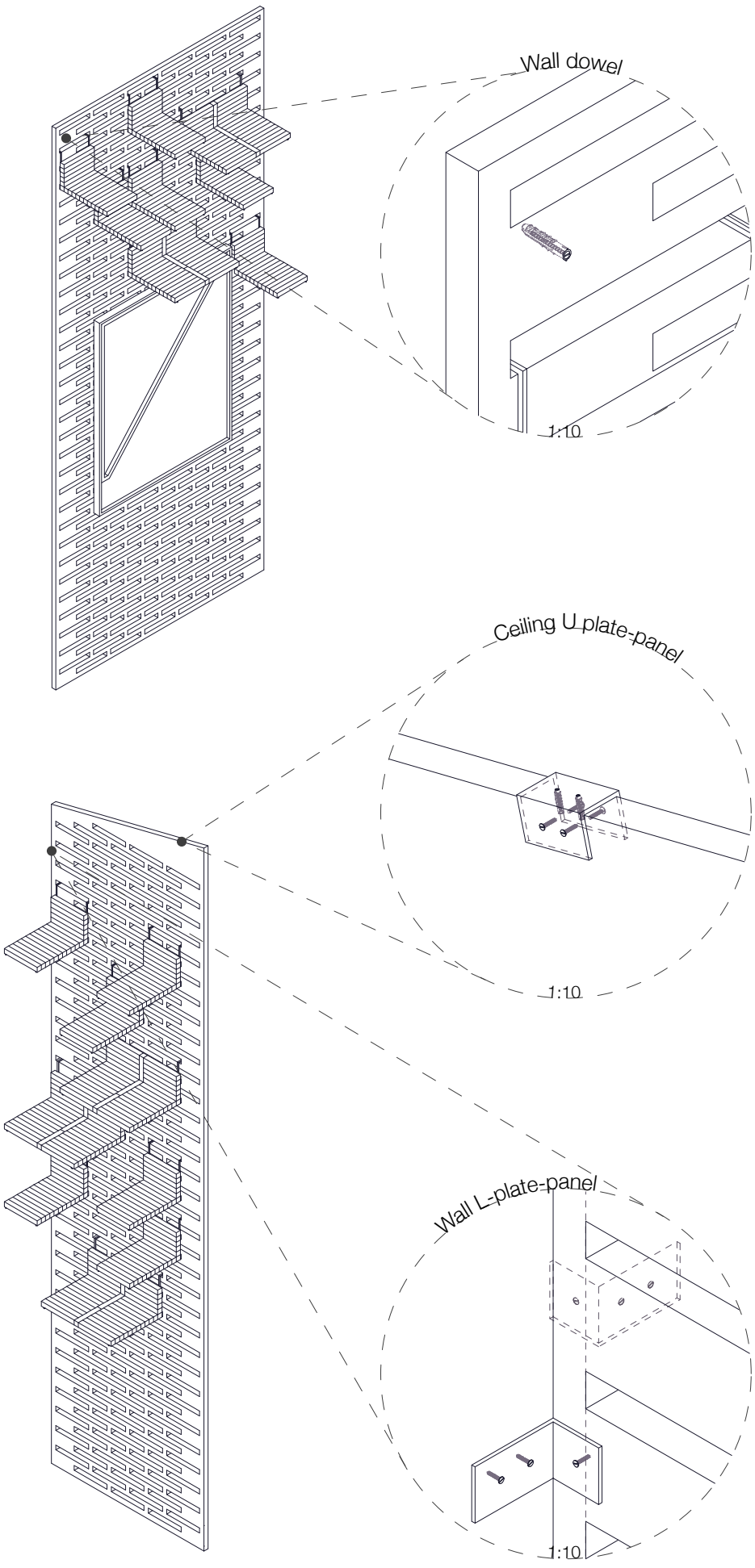




Through metal brackets the shelves can be hung on the holes created in the panel. In this way, the shelves may **not have a fixed position**, but can be placed according to your needs or taste.

Thanks to this system it is possible to guarantee a high level of **adaptability** and **flexibility** that make the workstation even more pleasant and practical.

Here, in fact, a **second option** for arranging the shelves is presented to show an example of the versatility of this element.


Wall dowel
1:10
Ceiling U-plate-panel
1:10
Wall L-plate-panel
1:10

LINKING DETAILS

Scale 1:25

When the panel is leaning against the wall it can be fixed simply by means of **dowels** that are positioned on the external sides. In this way the panel will have the necessary stability to open the desk. Furthermore, **no glues** are used, avoiding both the possibility of using potentially harmful products and problems when you want to detach the panel.

The partition panel is perpendicular to the perimeter wall and for this reason it needs additional support, for this reason it is as high as the ceiling. To obtain the correct stability it is necessary to anchor it to both the ceiling and the wall. First there are **U-shaped plates** fixed to the ceiling with **dowels**. The panel is then inserted inside these plates and fixed to them with **screws**.

L-shaped plates and **screws** are then used to anchor the panel to the wall. They are positioned on both sides of the panel in order to obtain the maximum possible stability.

INTERNAL VIEW

Before

After

7.3 COWORKING SPACES

The migratory flows, which have involved the countries of all the internal territories towards the urban areas, have not only decimated the number of their inhabitants, but they have reduced or deleted the relationship between communities and their identities.

COVID-19 pandemic has changed the perception of work life balance and the consequent interest and attraction for those internal areas. It allowed the growth of new workspaces, helping to support economic and infrastructure development in rural areas. In fact, as agriculture, mining and manufacturing declined, many internal areas sought strategies and possibilities to diversify their economies, attracting new residents and improving the quality of life. This context created opportunities for the establishment of new workspaces, known as coworking spaces (CSs).

As many individuals started to embrace the flexibility of the remote working, internal areas gained appeal to be a permanent location for living and working. Lower costs of living, greater access to nature and better quality of life are the main reasons why more and more professionals decided to move in these areas, spreading interest in new modes of working and interacting. CSs in this way offer a big support in this transition, enabling collaboration and economic resilience addressing social isolation and regional disparities. Hence, they contribute to the transformation and development of rural economies and societies.

From an economic point of view, CSs can create jobs, attract investment and facilitate local entrepreneurship by providing shared resources and by reducing the high costs linked to business operation. In addition, by housing multiple enterprises under one roof, CSs are able to stimulate the share of knowledges and networking opportunities, helping the local economies to prosper.

On the social sustainability point of view, by building networks of support and connection, these shared spaces reduce social isolation and empower individuals through access to skills training, technologies and professional network. In rural context, CSs usually represent a multifunctional community hub, hosting cultural and educational events, strengthening social cohesion and contributing to the inhabitants' wellbeing. In one hand they shape the identity of the place and on the other they are shaped by the traditional identity of the place. In other words, these new workspaces are able to affect the perception of internal areas and to improve individual's place attachment or place identity.

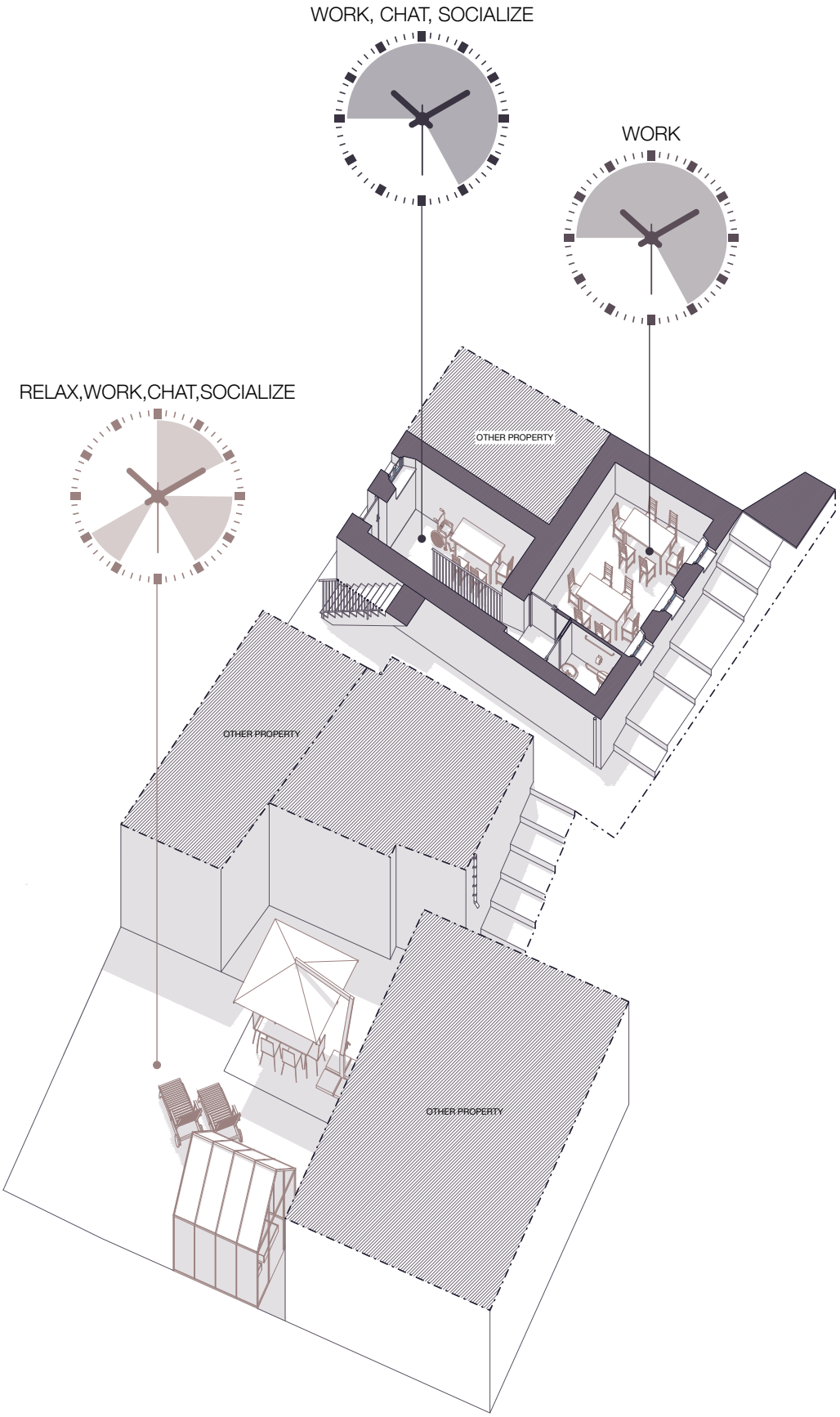
From an environmental perspective, rural coworking spaces bring a range of advantages. Many of these spaces repurpose existing buildings, minimizing the environmental impact of new constructions. WFH, CSs reduce commuting distances, commuting time, carbon footprints and promote a better sustainable lifestyle which is what this thesis is all about.

Offering coworking spaces in the center of Ingria facilitates their use not only for work, but to host other types of events too. This new space also represents an alternative for those remote workers who do not want to spend their workday alone at home, thus contributing to rebuilding and intensifying the social fabric weakened or lost by the demographic collapse.

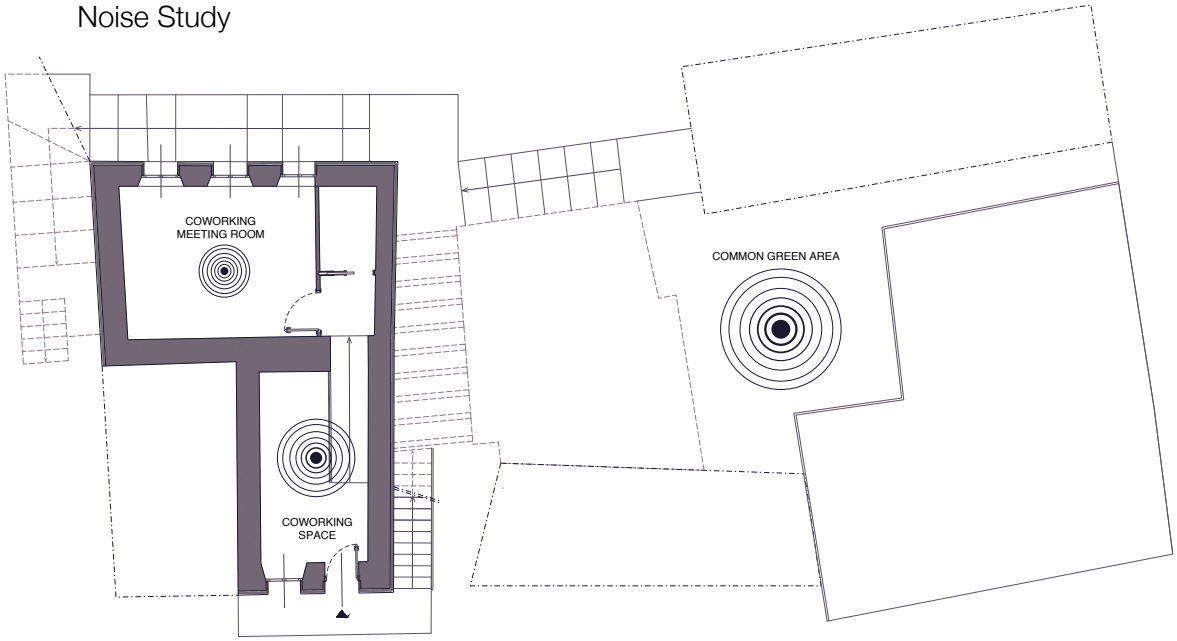
The coworking spaces are on the ground floor of the same building like the two previous scenarios. The internal environment is divided into two rooms at different levels; the room at the highest level was obtained by demolishing the wall that in the current state divided it into two separate spaces. The internal stairs are replaced with a ramp in order to allow everyone the access and the use of the spaces. Having to connect a difference in height of 60cm and having to guarantee a maximum slope of 8%, the ramp is rather long and cumbersome inside the first room. The second room allows a greater privacy and meeting spaces as the opening or closing of a door can guarantee greater tranquility and silence.

TIME USES

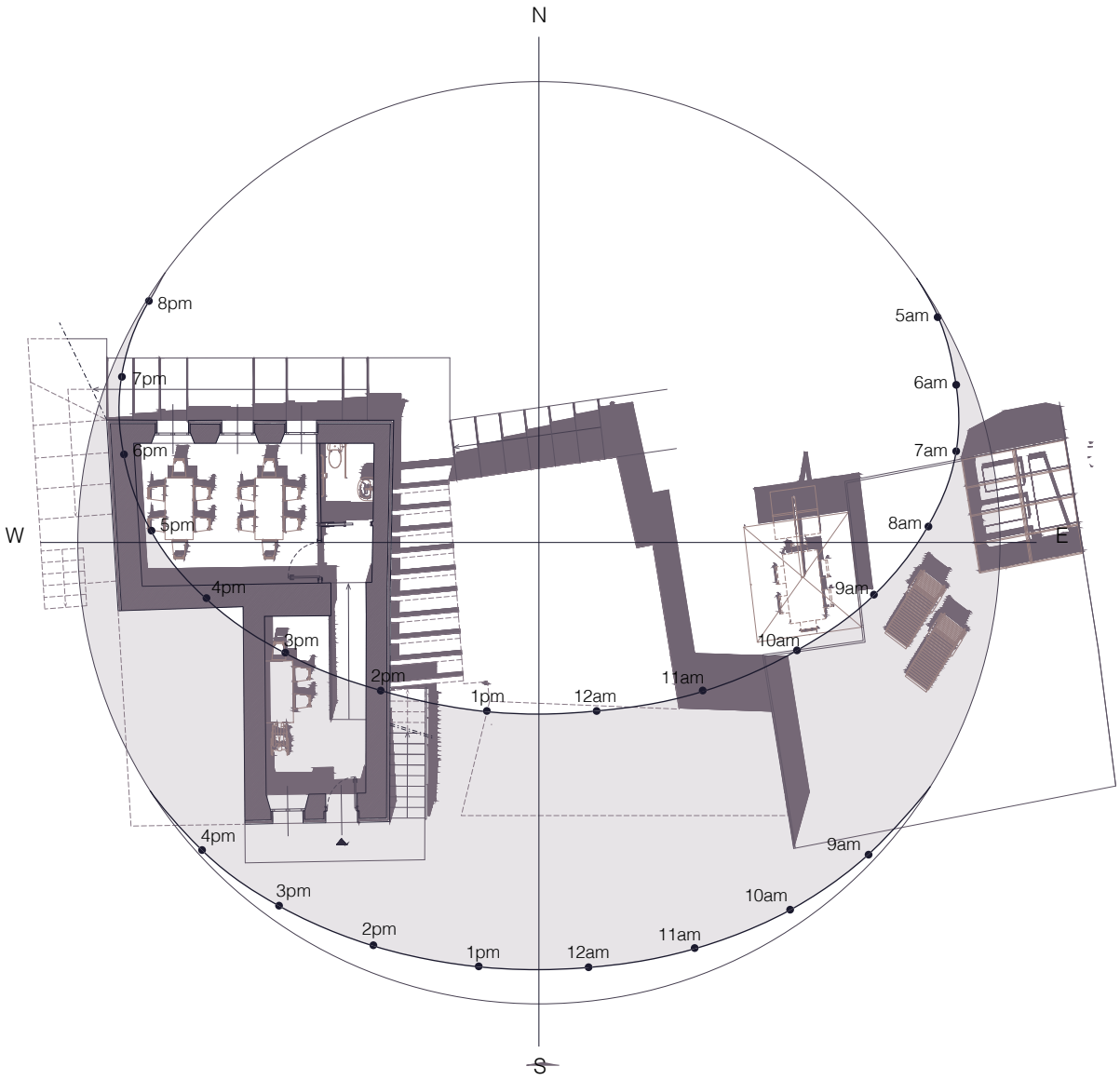
Scale 1:200

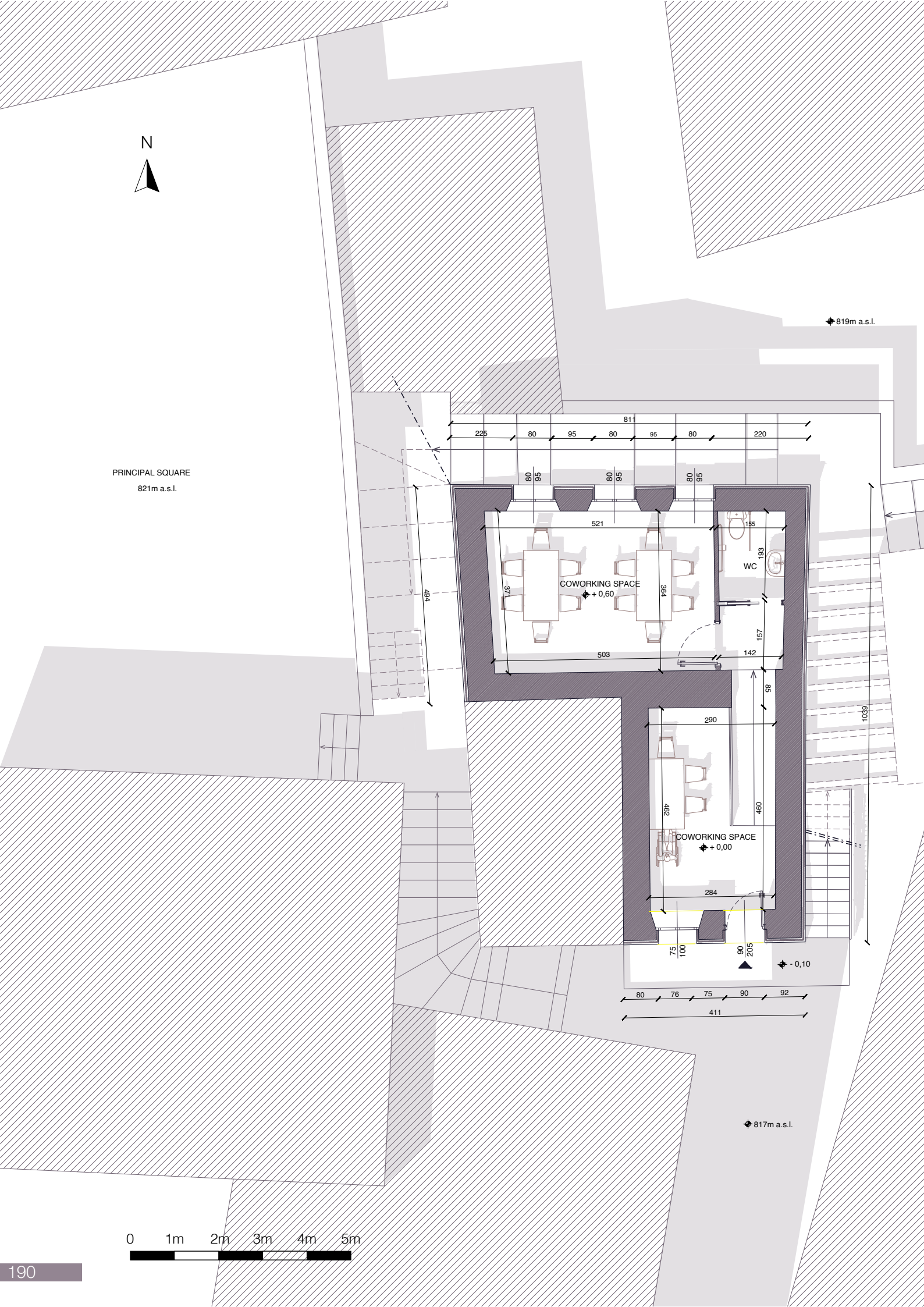


Noise Study



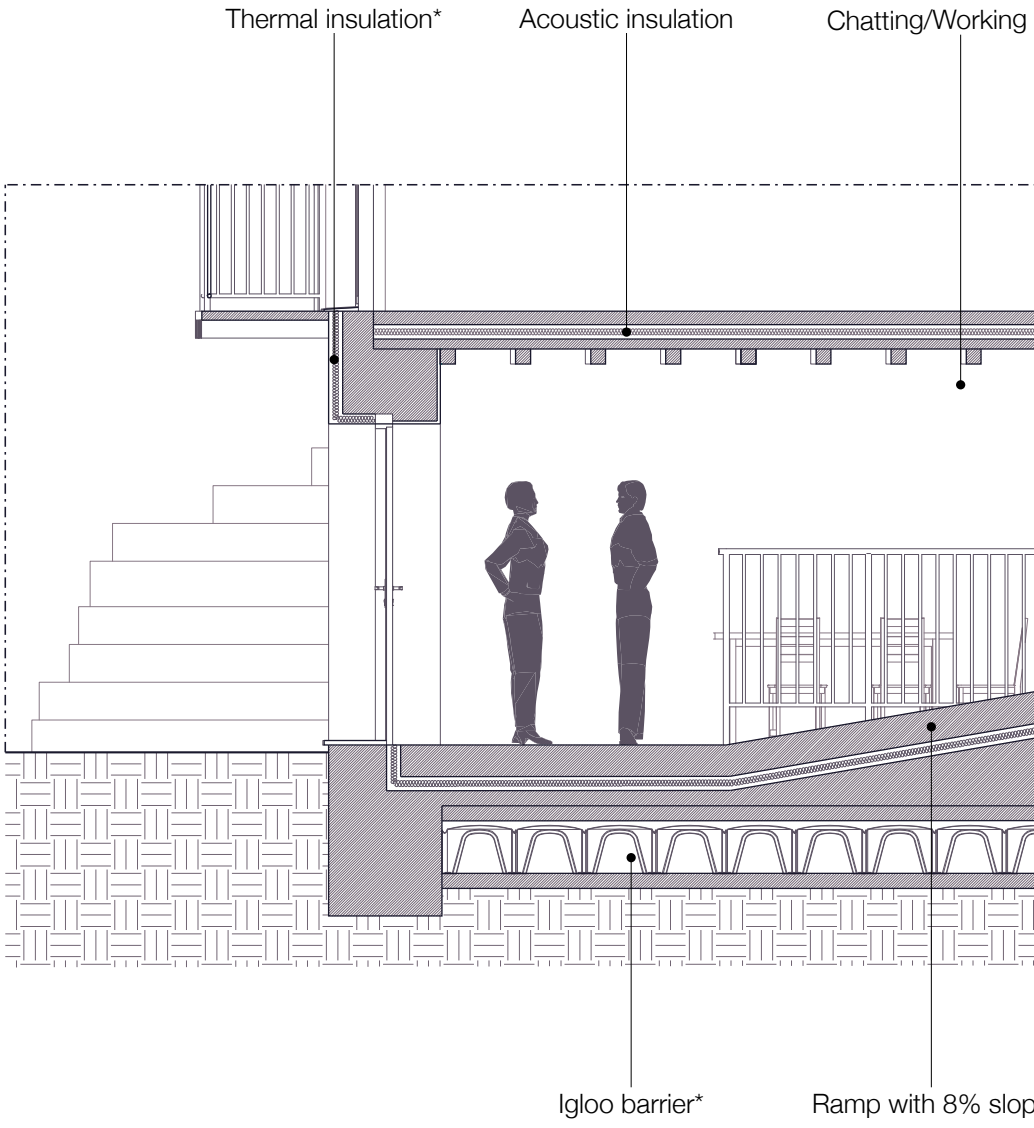
Sunpath Diagram (21/06, h 2.00pm)




N
PRINCIPAL SQUARE
821m a.s.l.
819m a.s.l.
811
225
80
95
80
95
80
220
80
95
80
95
80
95
521
155
193
WC
COWORKING SPACE
+ 0,60
371
364
494
157
503
142
58
1039
290
492
460
COWORKING SPACE
+ 0,00
284
75
100
90
205
- 0,10
80
76
75
90
92
411
817m a.s.l.
0
1m
2m
3m
4m
5m

FIRST FLOOR PLAN

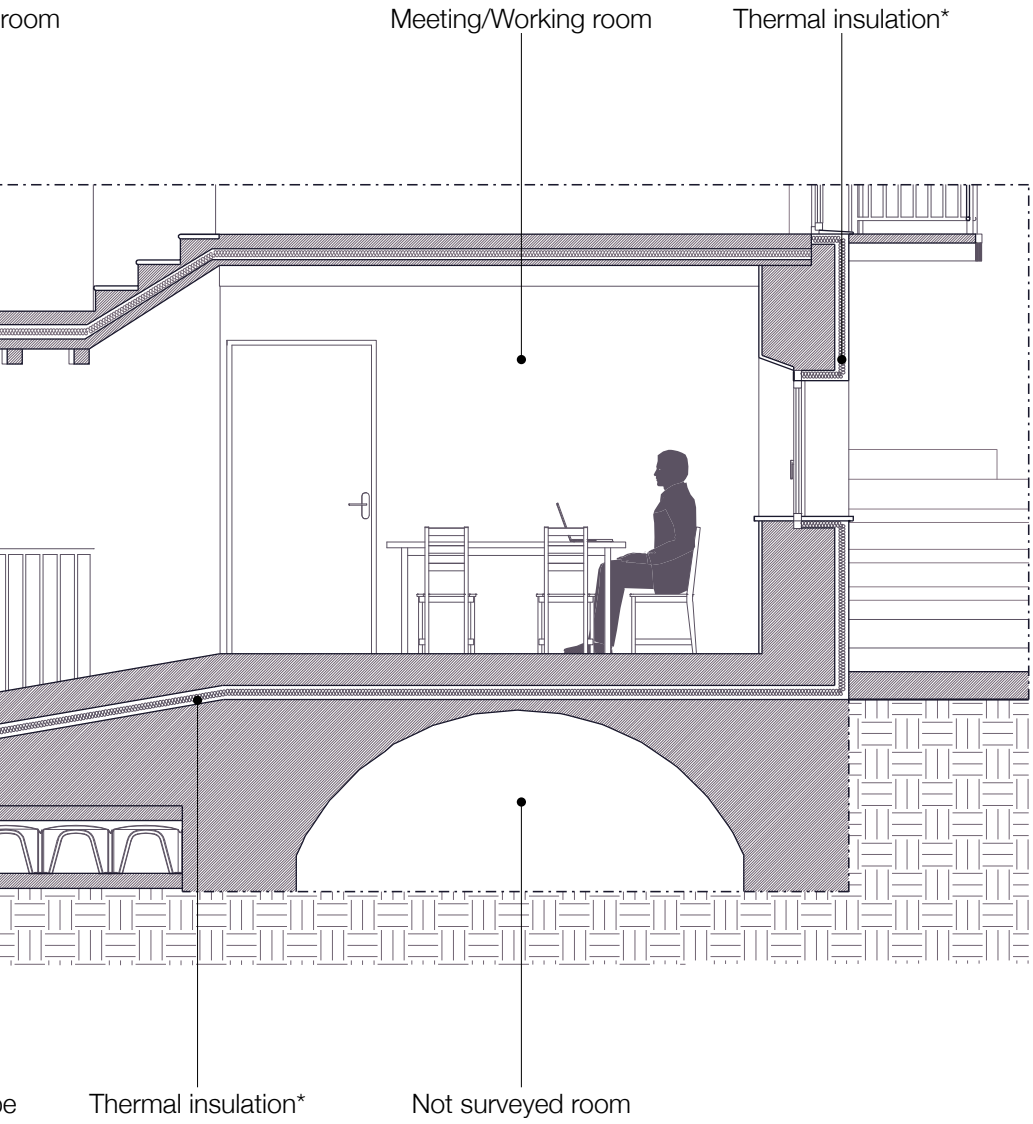
Scale 1:100



* See Chapter 8

Section A-A’

Scale 1:50



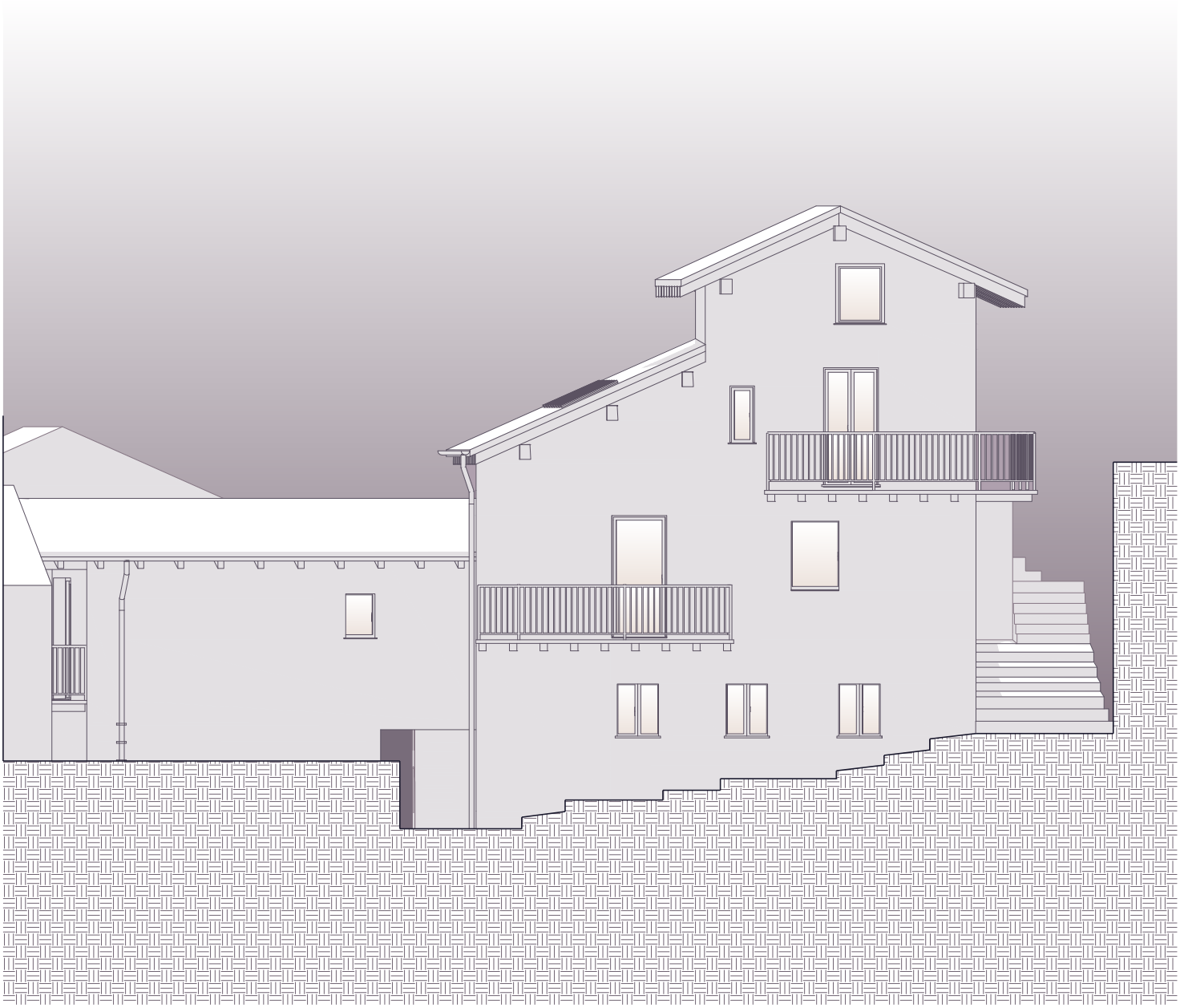
INTERNAL VIEW

Before

After

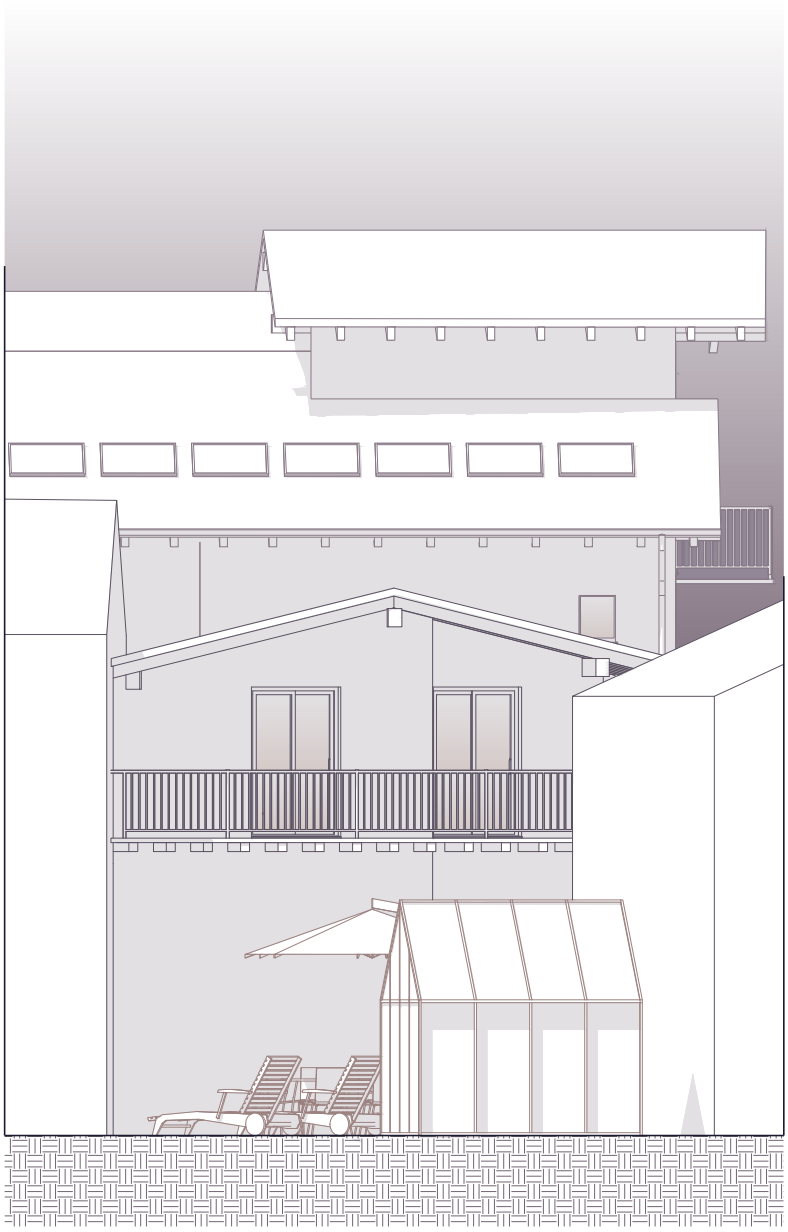
FRONT NORTH

Scale 1:100



FRONT EAST

Scale 1:100



FRONT WEST

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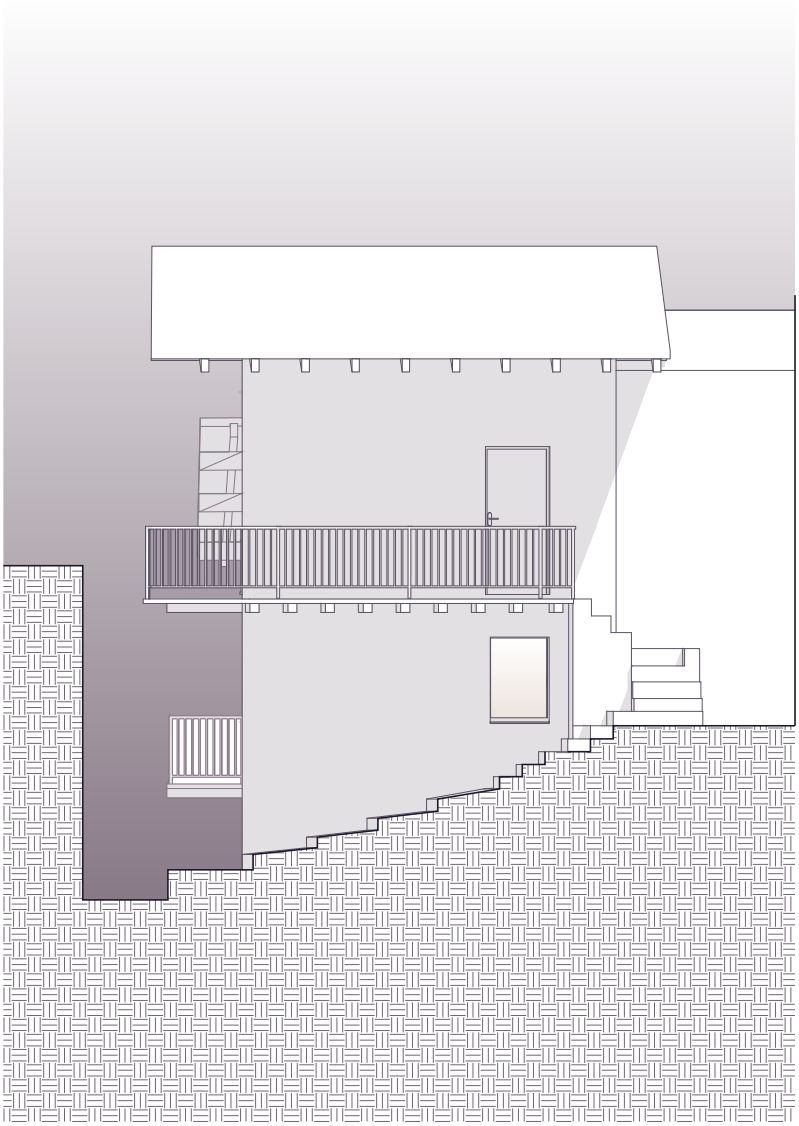


FRONT SOUTH

Scale 1:100

8

BALANCING TRADITION AND EFFICIENCY

Ingria (TO). Photograph taken by the author

8.1 NODES CRITERIA

The project of this thesis being part of the NODES project and receiving funds from MUR - M4C2 1.5 of PNRR obviously has a series of design and environmental criteria that it must follow and guarantee. The NODES project (Nord-Ovest Digitale E Sostenibile) represents the innovation ecosystem of Piedmont, Valle d'Aosta and the Western Lombard provinces of Como, Varese and Pavia. Its aim is to encourage sustainable and inclusive growth of the territories through both digital and ecological transition. In particular, the focus includes sustainability and green transition in order to sustain eco-friendly technologies and encourage sustainable practices across all types of industries with the aim of the carbon footprint reduction and the promotion of environmental responsibility. This project focuses on the regional economic development too by fostering new jobs opportunities, by upskilling the workforce and by addressing regional disparities in infrastructure and digital connectivity.

NODES is divided into 7 *spokes*[82], each with its own specific focus, for example spoke 4 covers the digitalization and sustainability of mountains.

The main focus of the project, and especially of the MUR - M4C2 1.5 component, is the advancement in sustainable technologies that supports Italy's environment goals, such as the reduction of carbon emissions, the promotion of the circular economy practices and the implementation of green energy solutions. In order to reach these objectives, MUR - M4C2 1.5 put the emphasis on different fields. First of all, digital and physical infrastructure development through investments in cloud computing and data storage that will make the digital transition easier for advanced researches and innovation. It relates to an important attention in fields paramount for sustainability, meeting the emerging needs of the green economy. In fact, funding and investments are available for innovative researches about renewable energies, waste reduction or biodiversity.

According to the guidelines, energy-efficient renovation and retrofitting of buildings make a substantial contribution to climate change mitigation by reducing energy consumption and connected to greenhouse gas emissions. Paying attention to the adaptation of the building to climate change, the rational use of water resources and the correct selection of materials are crucial points.

The interventions for the sustainable use and protection of waters must follow and guarantee compliance with water saving for users. Therefore, the design solutions adopted must comply with international product standards, including for example the EN 1111 standard "Sanitary taps - Thermostatic mixers (PN 10) - General technical

82 Nodes | Nord Ovest Digitale e Sostenibile. (online)

specifications".

It must be taken into account the aspect of the circular economy, too. In fact, at least 70% of non-hazardous waste from construction and demolition activities must be recycled.

The guidelines are concerned about the protection and restoration of biodiversity and ecosystems, in fact for the construction of wooden structures, cladding and finishes, it must be guaranteed that 80% is virgin wood and has FSC/PEFS label or other equivalent certification.

All materials and components chosen must then ensure compliance with the current CAM (Minimum Environmental Criteria). The CAM can be applied to buildings containing the code of cultural heritage and landscape, as well as those of historical-cultural and testimonial value identified by urban planning. In fact, the design thinking of "bio-eco-sustainable approach" implies much broader concepts that consider healthiness as an added value of a design not only based on a sum of technologies, but also on a dialoguing set of low environmental impact materials, which should be renewable, durable, reusable and recyclable as well as current technological knowledge. Therefore, a truly sustainable design starts from the assumption of bioclimatic concern knowledge, the use and conservation of material resources, their healthiness and emissivity and, finally, their correct installation in the construction phase. These concepts must be taken into consideration in their entirety and from the early stages of the project in order to be amalgamated and integrated organically, not "added" or adapted posteriori. Low environmental impact buildings must be made of sustainable building materials that activate virtuous supply chains, promoters of the transition towards a circular economy.

8.1.1 CHARACTERISTICS OF MATERIALS

The CAM is a set of environmental guidelines established to reach the sustainability of the processes. Its goal is to reduce the environmental impact of goods, services and works by incorporating sustainability principles, starting from the production to the disposal phases.

In fact, by setting minimum environmental criteria, it is possible to minimize the ecological footprint of products and services throughout their entire lifecycle, stimulating their market and incentivizing companies and industries to fulfill environmental standards. The standards are designed to reduce pollutants and hazardous substances, contributing to a better public health and safety.

According to the CAM regulations of the Ministerial Decree of 23rd June 2022, the construction materials and products used in the design phase must comply with certain technical specifications.

Internal and external windows and doors must be made in a way as to resist mechanical stress and atmospheric agents in order to contribute to the maintenance of thermal, acoustic, light and ventilation conditions in the rooms; the performance of the aforementioned functions must be maintained over time. Specifically, windows must be able to guarantee sound insulation, water, air and wind tightness and mechanical resistance. Internal doors must be resistant to impact, fire and heat radiation. External doors must have good water, air and wind tightness and good anti-intrusion resistance.

The stone elements used for both internal and external entrance stairs must also have certain technical characteristics in order to satisfy the CAM requirements. The real and apparent density must be measured according to the UNI EN 13755:2008 and UNI EN 14617-1:2013 standards; they must have a good compressive strength, a standard flexural strength and a sufficient abrasion resistance.

In this project, thermal insulation and acoustic insulators have a fundamental importance. When we talk about sound-insulating materials, we mean all those materials capable of significantly reducing the transmission of sound energy that goes through them. They must have an elasticity modulus, a loss factor and a reaction or behavior to fire; they must also guarantee low levels of emission of harmful substances and good chemical-physical compatibility with other materials. Thermal insulating materials must be capable of reducing significantly the heat flow through the surfaces on which they are applied. These materials must have an air mass and a specific thermal

resistance complied with the limits prescribed in the UNI standards and/or the limits provided in the design documents. They must also have a fire reaction or behavior and have minimal or no emissions of harmful substances to health, as well as good chemical-physical compatibility with other materials.

The internal partitions are made of plasterboard, a material widely used to create functional layers of the building. Specifically, plasterboard-based products are able to resist imprinting, impact and localized stress. Plasterboards have a low water absorption, low vapor permeability and sound insulation as well as fire resistant. Plasters are coatings made with plaster mortar consisting of a binder of lime, cement or gypsum, an extra inert material, like sand, dust or marble granules, with an addition of pigments or coloring earths, additives and reinforcers. They have a good capacity for filling cavities and levelling surfaces, good fire resistance, impermeability to water in order to function as fluid barrier and good adhesion to support mechanical characteristics. Plasterboards have a good surface aesthetic effect too.

The floors must guarantee an impact resistance of at least 2Nm (0.20 kgm), a bending resistance of at least 2.5 N/mm^2 (25 kg/cm^2) of 15 mm for 1 km of path. They have a load-bearing with the function of resisting mechanical stress due to permanent or operating loads; the sliding layer, with the function of compensating and making it compatible with any differential sliding between adjacent layers; the connecting layer, with the function of anchoring the covering; the covering layer with aesthetic tasks and resistance to mechanical and chemical stress. In addition, due to the geographical location and the design function, a waterproofing layer must be added in order to give to the floor a pre-established impermeability to liquids and vapours. A thermal insulation layer with the function of bringing the pavement to a pre-established thermal insulation must applied, as well as a sound insulation layer. The floor on the ground, on the other hand, will be made of the ground (soil) with the function of resisting the mechanical stress transmitted by the pavement, the waterproofing layer, the distribution layer, the compensation and/or slope layers and the covering; in addition, there is a protective layer generally made of igloo barriers, with the function of thermal insulation, but above all with the aim of protecting the building from the rising radon gas and damp.

All the roofs present in mountainous locations are type of discontinuous, also known as pitched. The waterproof element ensures its function only for slope values greater than a minimum, which depends mainly on the material and the conformation of the

products.

In order to ensure and guarantee the maximum possible comfort, the wooden roofing foreseen by the project is thermo-insulated and ventilated. This means a heat-insulating element, a ventilation layer, a slope layer, a load-bearing element, a support element and a sealing element.

The project also includes rainwater drainage systems too, basically all those pipes that allow the correct flow of water. These systems are made of conduits and gutter channels, collection points for discharge, pipes for conveying the collection points to the disposal points. The vertical ones are called drainpipes. Disposal points are in the receiving bodies, such as sewers, basins and waterways.

8.2 TESTING TIMELESS DESIGNS

The building, as shown in the explanation of the state of art, is made of load-bearing stone masonry, a typical feature of vernacular dwellings. Consequently, its perimeter walls are very thick on the ground floor and thins up as tapered walls on the higher levels. The peculiarity of these structures is therefore to have a large thermal mass which over the centuries has been an excellent insulation passive strategy, especially where the climate is extreme. This is because the mass of the building structure is strongly influenced by the seasonal and daily variations in temperature. Thermal mass is paramount to balance the indoor temperatures. The result is a slow heating of the building in summer and the maximal indoor temperature is achieved during the late hours when the outdoor air temperature is already low. The capability to store energy helps in winter and by and large in mountain regions, since energy can be stored in walls from one sunny winter day to the next cloudy one. In other words, thermal mass is able to reduce the heat gain, as well as cold gain, in the structure just by delaying the entry of the heat or the cold into the building. In fact, the mass of the external buildings' walls is a factor related not only to the thickness and the type of the construction material selected, but also to capability to delay heat/cold transferred through the structure. Nowadays this type of passive design strategy of thermal insulation is most often no longer sufficient both because of today's standards of internal comfort and because of heat dispersion and, therefore, energy and costs.

The first parameter to follow in order to obtain internal comfort for legal obligations is the thermal transmittance, defined as a U-value. *Thermal transmittance is the rate of heat flow through a unit surface area of a component with unit (1K) temperature difference between the surfaces of the two sides of the component. It is the reciprocal of the sum of the resistances of all layers composing that component plus the inside and outside air films resistances*[83].

In Italy its value, expressed in W/m2K, varies depending on the climate zone in which it is located. The Presidential Decree 412/1993 has, in fact, divided the country into six climate zones based on the degree days, which correspond to the sum, spread over all days of the year to the difference (only the positive one) between the internal ambient temperature and the average daily external temperature, (Certifico, online), or based on the average climate of the municipality regardless of the geographical location. These zones are referred as zone A, B, C, D, E and F; Ingria is counted in zone F.

83 Dr. Mohammad S. Al-Homoud, *Performance characteristics and practical applications of common building thermal insulation materials*, pg. 3. (online)

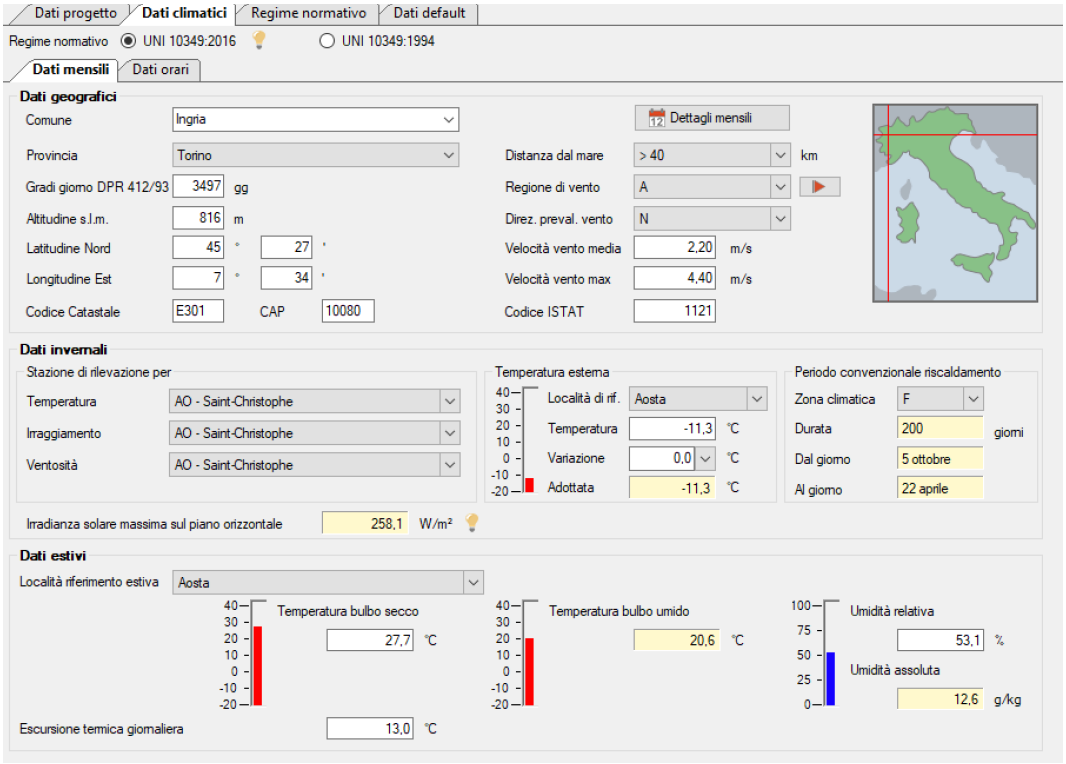


Fig.16 Ingria's climate data

This is why the first step in the renovation of the building of this thesis is to verify whether its envelope is currently able to satisfy the minimum values of the thermal transmittance of the imposed by climate zone F. Through the Edilclima software it is possible to reproduce all the elements which make up the building structure, walls and roofs, by inserting its components each one with its own thermo-hygrometric characteristics.

In the analysis of the external masonry, two types of wall are considered: the load-bearing stone masonry and the brick wall that connects the two buildings. In the first case, both inside and outside, a layer of cement mortar and a layer of lime and gypsum plaster are considered too. What emerges from the simulation is that the typical thermal mass of thick stone walls is not sufficient to satisfy the minimum requirement of thermal transmittance. In fact, the value obtained is equal to 2.009 W/m2K, but the minimum value required by the Decree 6.8.2020 - Annex E for climate zone F must be at least 0.22 W/m2K.

Source Fig.16: Screenshot from Edilclima software

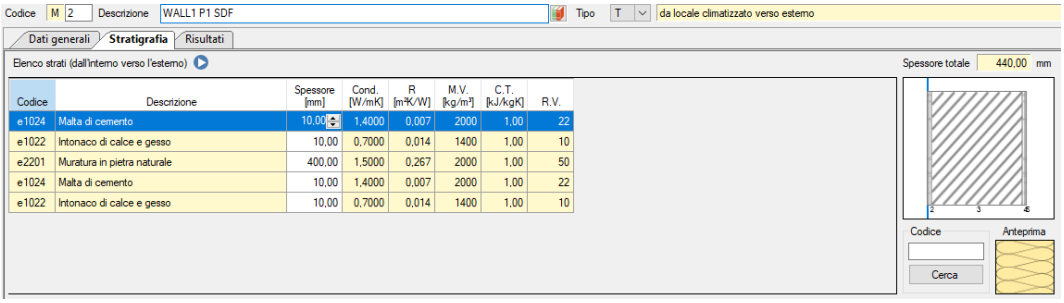


Fig.17 Stratigraphy of WALL1 P1 SDF

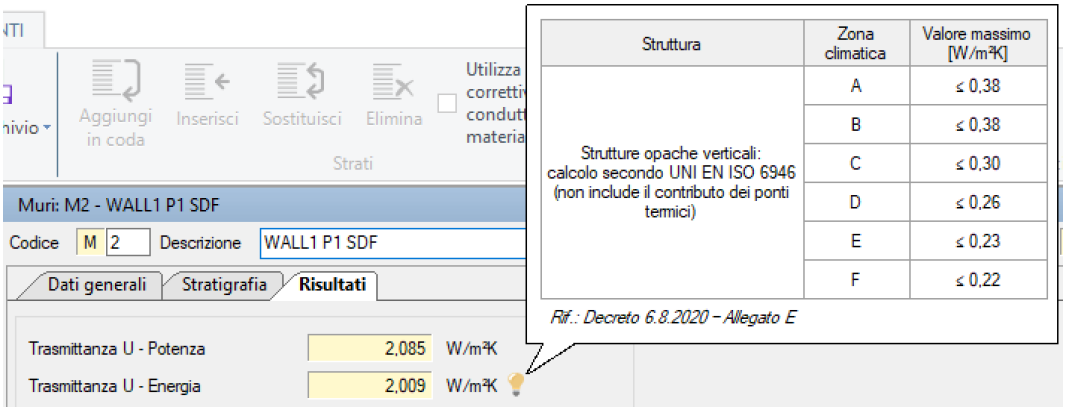


Fig.18 Thermal trasmittance value of WALL1 P1 SDF

The value of the brick wall is verified using the same principle. It is a very thin wall, as shown in the plan of the current state in the previous chapter, which was most likely added later to join the two buildings that were previously independent. This is why it does not have the same thermal mass properties as the previous wall. The Edilclima software generated a transmittance value equal to 1.956 W/m2K much higher than the required one.

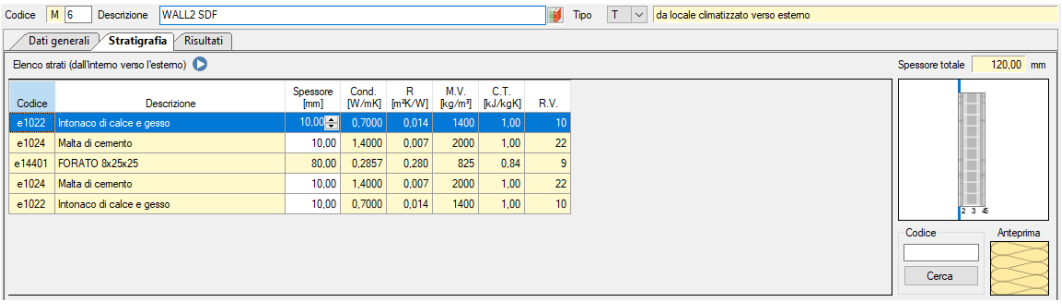


Fig.19 Stratigraphy of WALL2 SDF

Source Fig.16-19: Screenshot from Edilclima software

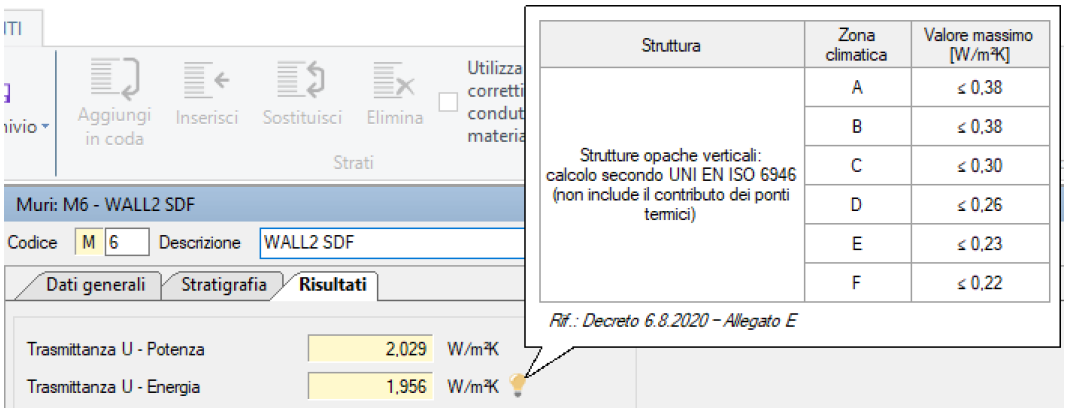


Fig.20 Thermal trasmittance value of WALL2 SDF

The same procedure is applied in the verification of the ground floor. Since these are old buildings, a very simple stratigraphy attached to the ground is assumed, therefore, there are no space for ventilation and thermal insulation. In fact, the thermal transmittance value obtained from the simulation, 0.699 W/m2K, is much higher than that required by law equal to 0.23 W/m2K.

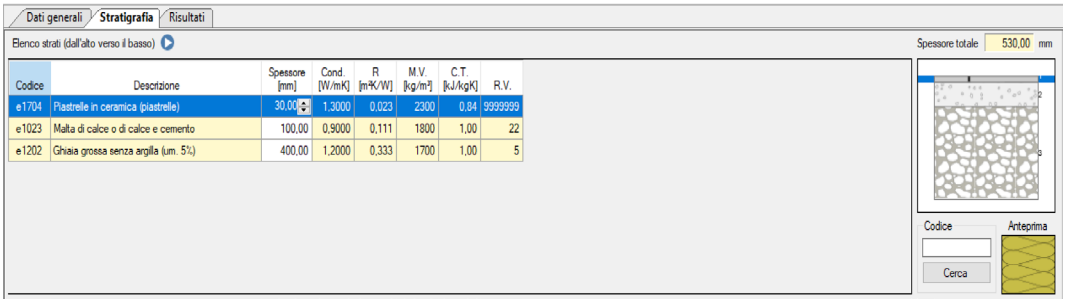


Fig.21 Stratigraphy of FLOOR PT S1 SDF

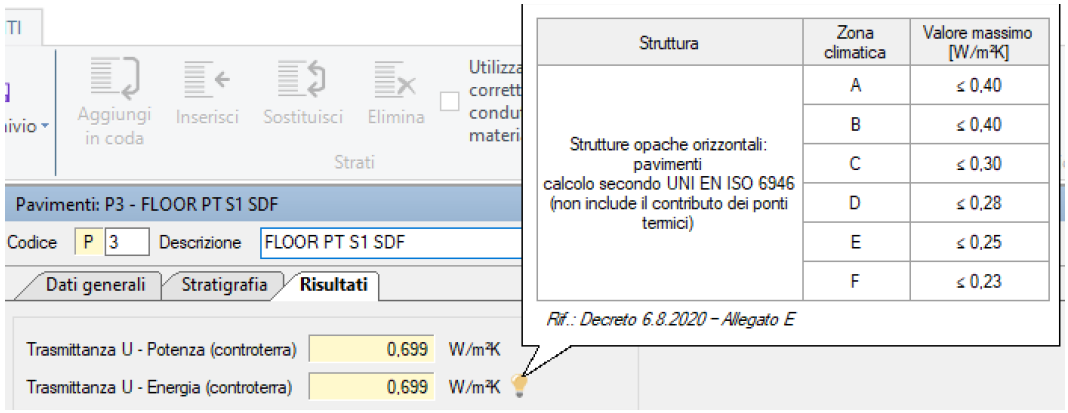


Fig.22 Thermal trasmittance value of FLOOR PT S1 SDF

Source Fig.20-22: Screenshot from Edilclima software

Once the vertical and horizontal closures have been checked, the covers were verified as well, and two types of them were simulated. The first relates to the flat inter-floor slab that divides the first floor from the second, unheated and unusable; the second is the pitched roof of the first floor. In both cases, the values obtained do not even minimally fall within those required by the regulations, equal to 0.19 W/m2K. In fact, in the first case a value of 2.795 W/m2K is obtained and in the second a value of 3.209 W/m2K.

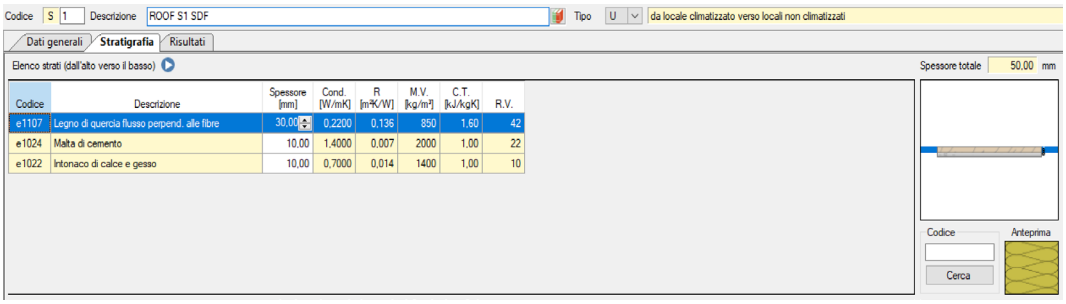


Fig.23 Stratigraphy of ROOF S1 SDF

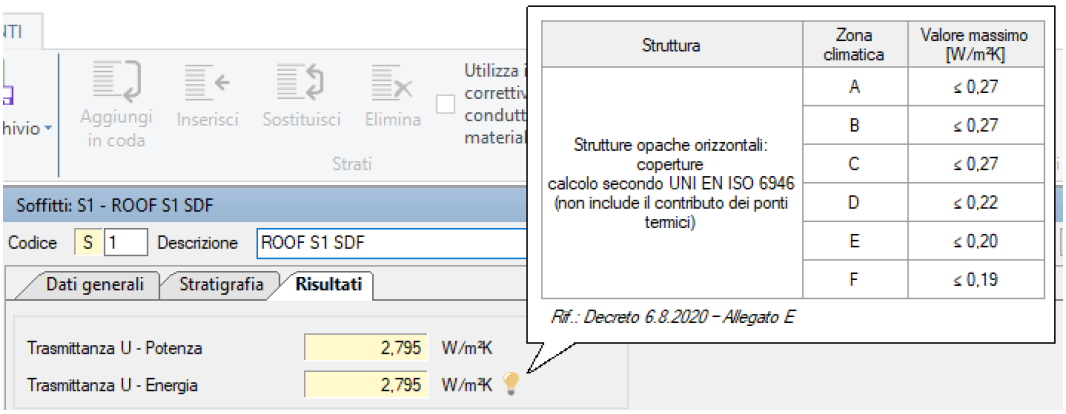


Fig.24 Thermal trasmittance value of ROOF S1 SDF

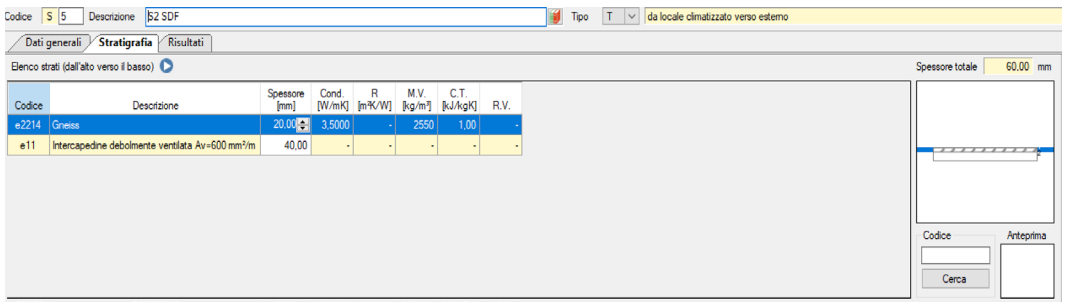


Fig.25 Stratigraphy of S2 SDF

Source Fig.23-25: Screenshot from Edilclima software

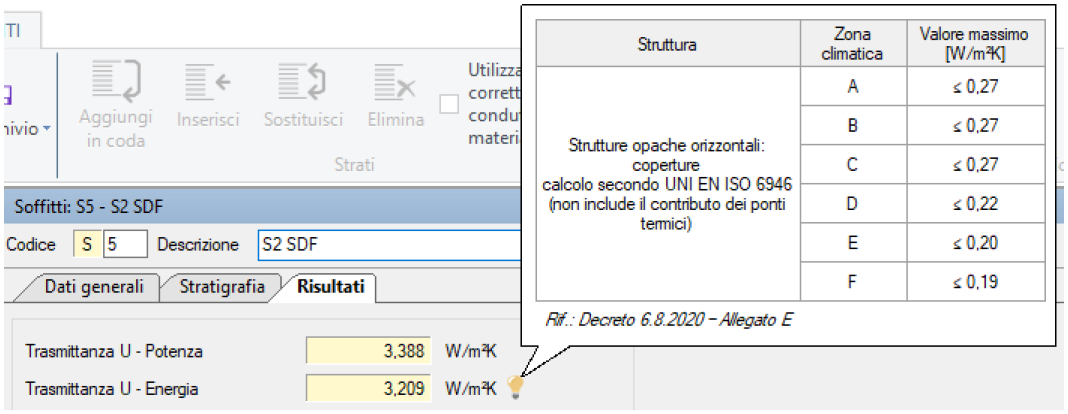


Fig.26 Thermal trasmittance value of S2 SDF

To obtain minimum legal values of the U-value it is necessary to improve the thermal performance of the building envelope because the quantity of energy required to cool or heat a building relies on how well that envelope is treated thermally. In fact, the thermal performance of the building not only depends on the thermal properties of the used material, but on the overall U-value of the corresponding component insulation included, too.

Improving the thermal performance of the building is equivalent to improve its energy behavior, which means the reduction of the energy consumed for heating, cooling and air-conditioning. This is only possible through an improvement of the thermal protection of the building, meaning through thermal insulation. In order to cut the energy consumption, insulating materials with thermal conductivity below 0,4 W/mK have been created. Thermal conduction is the phenomenon by which heat is transported from high-to-low temperatures regions of a substance through a unit area of 1m thick. In other words, it is a measure of the effectiveness of a material in conducting heat and for this reason it allows a quantitative comparison in the selection of the thermal insulation material.

In addition, hygroscopic, acoustic and fire resistance properties of an insulating material are fundamental as well to control indoor air humidity, ensure acoustic comfort and minimize health risks. Hygroscopicity is the ability of a material to absorb humidity from surrounding air and store it until the relative humidity decreases favoring indoor climate, known as moisture absorption capacity. The higher its factor is, the lower this hygroscopic capacity will be. Buildings equipped with this type of relative humidity control strategy are able to decrease the operational energy use of the air conditioning

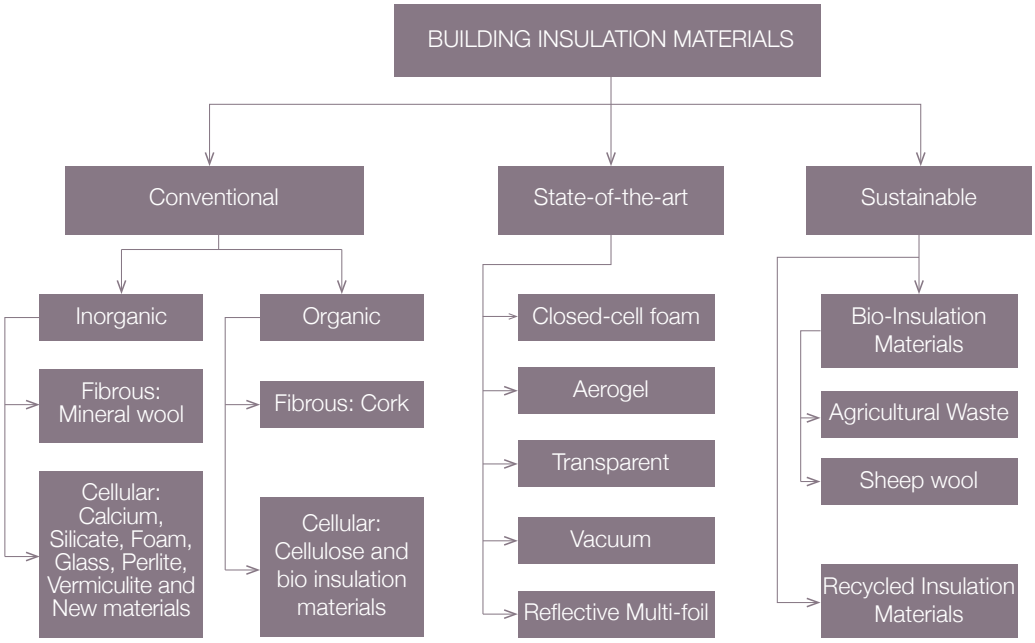
Source Fig.26: Screenshot from Edilclima software

mechanical system. Acoustic properties of insulators are independent from the operational energy use, but acoustic comfort is one of the most important elements of the indoor environment quality, especially home office settings. Fire hazards happen both accidently and intentionally threatening the occupants' life, damaging the dwelling and its structure. Obviously, there are materials that are more flammable than others. For this reason, they are divided in six categories from A to F, where class A is an incombustible material whilst class F is highly combustible. When we talk about comfort, we should take into account health risks due to fire too.

In addition, from a sustainable point of view, energy efficiency, thermal comfort and low carbon emissions play a crucial role in fighting climate changes, resources depletion and in the creation of NZE buildings.

8.3 PICKING THE PERFECT INSULATOR

The selection of the optimal insulating material is not immediate as on one hand there is a wide range of choice depending on the nature of the material, on the other it is necessary to take into account a conceptual multi-objective optimization.
Building insulating materials are divided into three categories based on their natural origin, chemical essence and their availability. They can be conventional, state-of-the-art and sustainable. Each of these categories is further subdivided into sub-categories, which have different thermo-hygrometric characteristics.



Source: Dileep Kumar, Morshed Alam, Patrick X.W. Zou, Jay G. Sanjayan, Rizwan Ahmed Memon, *Comparative analysis of building insulation material properties and performance*, pg.3. (online)

The first category includes organic and inorganic materials. This class is the most commercially available and the most presently used in the building sector. Inorganic insulation materials are made of non-renewable resources and they can be fibrous or cellular, such as XPS or EPS. Among the first we can find mineral wools which are composed of rock, glass, slag wool and derived from cullet, quartz sand, diabase and basalt. They consume a lot of energy during the production stage as forming glass and rock fibers requires 1400°C up to 1500°C. At the end of the process they present a thermal conductivity between 0,3 and 0,4 W/mK. Inorganic cellular insulation materials refer to calcium silicate, foam glass, perlite and vermiculite and they are based on plaster, sand, cellulose fibers, cullet, dolomite, oxide and magnesium-aluminum silicate.

Foamed materials show a low thermal conductivity because of their typical high porosity which equals to a lower mechanical strength. Organic insulation materials, instead, come from vegetal or renewable resources and they can be fibrous or cellular just like the inorganic materials. Fibrous organic materials are composed by cellulose, nanocellulose, cotton, wood or cane. They capture air within fibers, preventing heat transmission by convection. Cork, with a thermal conductivity between 0,3 and 0,4 W/mK, is the most known cellular organic insulation material which derives from the cork oak. Products derived from it, both filler and boards, can be perforated, cut and placed directly at building site without compromising its thermal insulation.

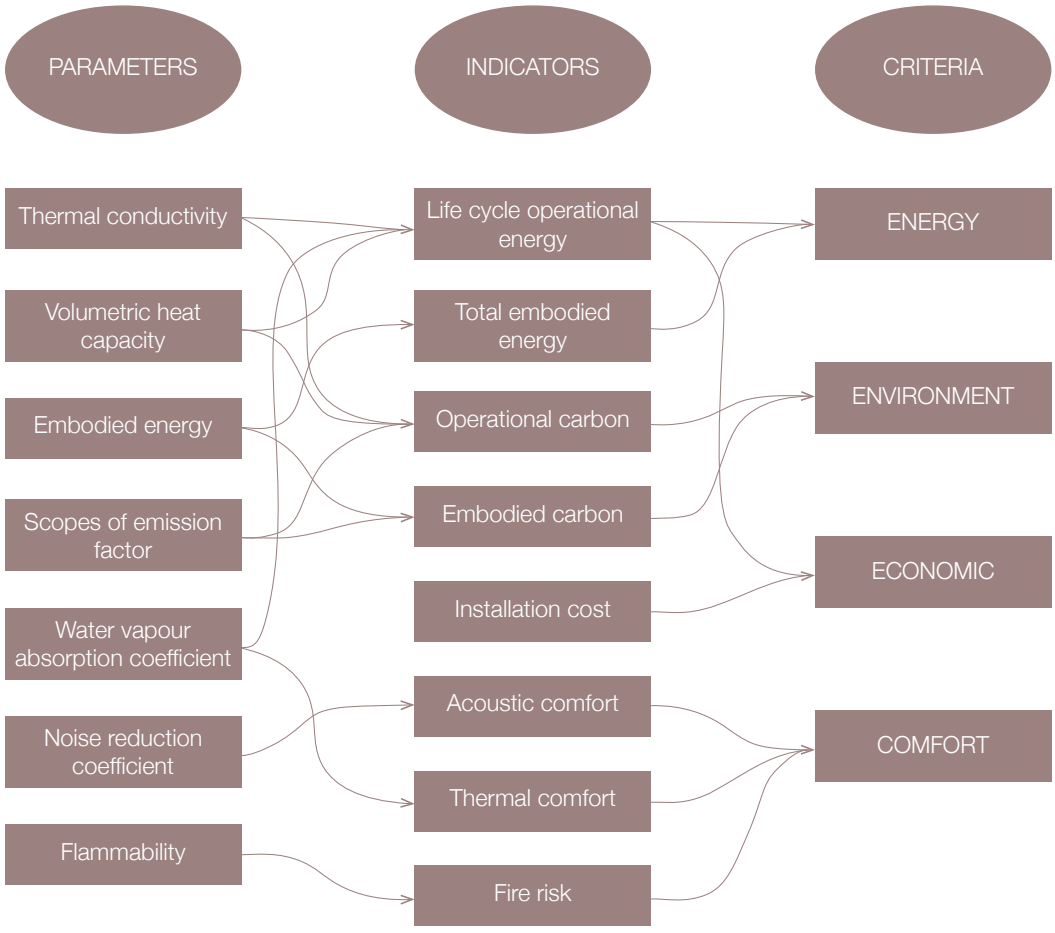
The state-of-the-art insulation materials are the category having the lowest thermal conductivity we have nowadays. Vacuum insulation panels (VIP) are the most popular and they are made of an open porous core of fumed silica wrapped in multiple metallized polymer laminate layers. They are able to remove the conduction of heat transfer with their highest thermal resistance and slimmer structure; as thermal transmittance is referred to the capacity to resist heat flow as a result of suppressing conduction, convection and radiation. It is a matter of material thermal conductivity, thickness and density. In fact, their thermal conductivity is between 0,02 and 0,04 W/mK with a thickness of 1-2 cm. For this reason, they are useful in case of confined spaces for retrofitting and refurbishing historical and existing buildings. Their thermal conductivity value rises with time due to the water vapor and air penetration by diffusion by a factor of 5, even though their special thermal performance is guaranteed for 20-25 years.

The last category is the sustainable insulation materials, where the adjective “sustainable” is referred to their typical lower embodied energy and embodied carbon. In fact, these materials can be obtained from agro and forest residues, from sheep wools and from recycled insulation materials.

Selecting the optimal insulating material starts hence by comparing the properties and characteristics of those different types of insulation available on the market. First of all, if we consider hygroscopicity, the inorganic cellular insulators are vapor retarder material, which means that they are able to reduce the transfer of water vapor; the lower its permeability, the higher the material can be defined as vapor retarder. Mineral insulators are more hygroscopic material as they absorb moister, increasing their thermal conductivity as well as the operational energy use. Natural insulators have the hygroscopic ability as they absorb moister without significant changes in their thermal

performance and properties. As far as acoustic insulation is concerned, fibrous insulators can isolate from sounds more efficiently than cellular materials because their natural fibers are capable to absorb more sound waves and dissipate more sound energy. Mineral wools have a better acoustic isolation ability than inorganic cellular material, whilst natural insulators claim the highest rate of noise reduction coefficient as the use of sheep or vegetable wools isolate more the indoor environment than rock wool. If we consider the fire hazards too, all the inorganic insulation materials are incombustible but, at the same time, they are toxic due to the glue used to bind the fibers together. Within these last insulators, glass and rock wools are the less toxic as the amount of glue is more or less 2%.

As anticipated at the beginning of the paragraph, the choice of the optimal insulator must be based on a multi-objective optimization too and not only on the capabilities and properties of the single material.



Source: Dileep Kumar, Morshed Alam, Patrick X.W. Zou, Jay G. Sanjayan, Rizwan Ahmed Memon, *Comparative analysis of building insulation material properties and performance*, pg.16. (online)

This optimization is basically based on a framework made of four criteria: energy, environment, economy and comfort; each criterion is then obtained through a set of indicators. The first criterion is calculated using the indicators of lifecycle operational energy consumption and the embodied energy of the insulator.
The second criterion is obtained through indicators of embodied carbon and embodied carbon emissions. The economy criterion is instead based on installation costs and lifecycle operational costs indicators. The comfort criterion refers to health risks due to fire, acoustic comfort and thermal comfort.
These parameters are calculated from a series of indicators. For instance, thermal conductivity, thermal mass and hygroscopicity are necessary to calculate the lifecycle operational energy of an insulation material and so on. It is important to underline how information and data about thermal conductivity are available and known, whilst there is limited data about heat capacity, hygroscopicity, embodied energy and embodied carbon properties. In fact, embodied energy (EE) depends on the approach followed, if cradle-to-grave or cradle-to-gate. The first considers impacts at each stage of a product's lifecycle, from the time natural resources are extracted from the ground and processed through each subsequent stage of manufacturing, transportation, product use, and ultimately disposal. The second is an assessment of a partial product lifecycle from resource extraction (cradle) to the factory gate, in other words before it is transported to the consumer. Embodied carbon (EC) relies on the availability of the local energy resources.
Having said this preamble, four insulating materials are compared, one for each category as all of them are validly acceptable.
If we talk about sustainable insulation materials, sheep wool may seem to be the most sustainable material as it has the lowest EE, EC and sound absorption values as well as thermal conduction values. However, if being a hygroscopic material is a positive characteristic, its natural origin does not guarantee a good durability and, above all, it has a poor fire resistance. The second material with natural origin is cork, which is part of the category of conventional insulators. It is one of the most used insulators as it has good thermal, acoustic and fire resistance properties. It has a higher costs and higher EE value despite its natural origin than mineral wools. Obtaining excellent thermal performance from a building is very important to guarantee excellent energy efficiency.

State-of-the-art insulation materials, such as VIPs, have the lowest values of thermal conductivity, however, they have the highest costs from an economic point of view and the highest values of EE and EC too. This is why their use is very limited. In fact, they have EE values 25-38 times higher than sheep wool and 6-9 times higher than cork, whilst the EC values are 50-92 times higher than sheep wool and 7-13 times higher than cork. Hence, it is true that they are the materials which guarantee the best thermal performance, but they are the least sustainable materials too.

Consequently, the optimal insulating material turns out to be rock wool, as it shows an excellent compromise between excellent thermo-hygrometric and acoustic properties, low health risks due to fire, low operational costs and low EE and EC values, as well as being sustainable.

Fig.27 Properties of building insulation materials

Material	*k-value* (W/mK)	Vapour Resistance *(μ factor)*	Sound Absorption *(α factor)*	Reaction to fire *(class)*	Costs ($/m3)	EE (MJ/kg)	EC (kg CO_2eq/kg)
Rockwool	0,33-0,4	1-1,3	0,29-0,9	A	12-20	16,8	1,05
Cork	0,37-0,43	5-30	0,39-0,85	E	25-44	26	0,82
VIP	0,035-0,08	340	0,1-0,3	A	90-172	149-226	6-11
Sheep wool	0,38-0,54	4-5	0,056-1,12	E	24	5,4	0,12

Source: Dileep Kumar, Morshed Alam, Patrick X.W. Zou, Jay G. Sanjayan, Rizwan Ahmed Memon, *Comparative analysis of building insulation material properties and performance*, pg.5-6. (online)

8.4 STRATIGRAPHY REDEFINED

Once the optimal insulation material has been selected, the design and project phases can begin. The Ediclima software allowed us to understand the thickness of the insulation to obtain a correct thermal transmittance value. It must be highlighted how the heat transferred through the insulation material doesn't depend on the thickness of the insulator, but it effects on thermal resistance. Thermal transmittance and thermal resistance have a strong relationship because the lower is the first, the higher the second will be and, therefore, the thermal insulation of the wall structure will be consequentially higher.

Another important factor to take into account is the positioning of the insulation as it can be internal or external. External insulation is a type of insulating method developed in the last thirty years for the refurbishment of exterior masonry in existing buildings. In addition, any old types of solid walls soon or later attract water vapor to internal face due to the introduction of a heat source and resulting in surface condensation. Hence, the application of the external insulator allows an increase temperature of the wall thus helping to reduce and prevent the condensation of the wall surface. The existing masonry can remain dry with the reduction of the possibility of the fungus formation, preserving the structure from its decay too. In addition, external insulation can improve the internal comfort levels for occupants as heating and cooling reactions are faster, water penetration is reduced or eliminated as well as the reduction of sound transmission. The stone perimeter wall will have a thermal transmittance value of 0.198 W/m2K, compared to the previous 2.009 W/m2K. A clear improvement is obtained just by basically adding a layer of insulation which allows better internal comfort and heat loss reduction.

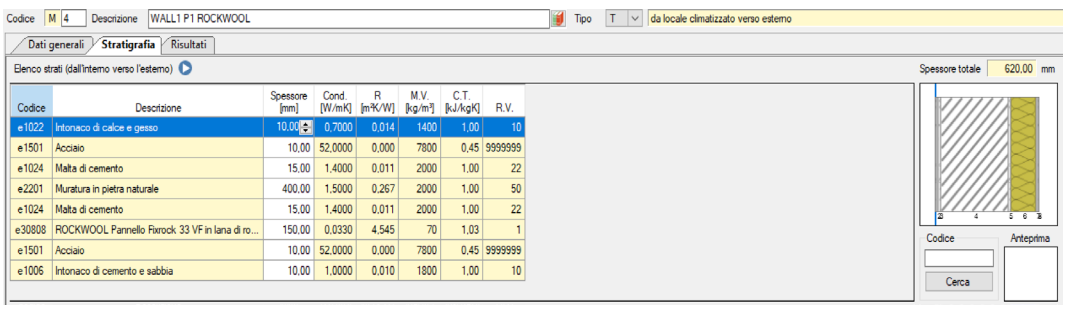


Fig.28 Stratigraphy of WALL1 P1 ROCKWOOL

Source Fig.28: Screenshot from Edilclima software

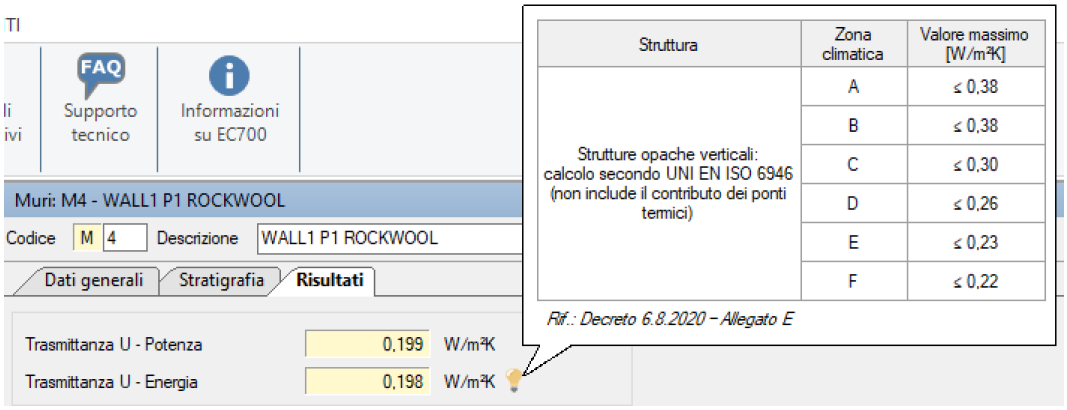


Fig.29 Thermal trasmittance value of WALL1 P1 ROCKWOOL

Another important operation needed to ensure the best internal comfort is the design of a new stratigraphy for the ground floor. As shown in the previous paragraph, at the state of art this stratigraphy is not only very basic but, above all, it does not contain the aeration layer that acts as a filter from radon gas. It comes from the decomposition of uranium, which can be found in the soil, and for this reason it is a radioactive gas. Without any protection, it can enter inside buildings as an indoor pollutant gas, which is dangerous for people in case of inhalation; in fact, it alternates the DNA inducing genetic mutation and causes cancers and leukemia. That's why it is necessary to create a ventilation and aeration space that allows the disposal and escape of this gas. The new stratigraphy guarantees not only thermal insulation and better humidity control, but a health protection too. The thermal transmittance value in fact goes from 0.699 W/m2K to 0.18 W/m2K.

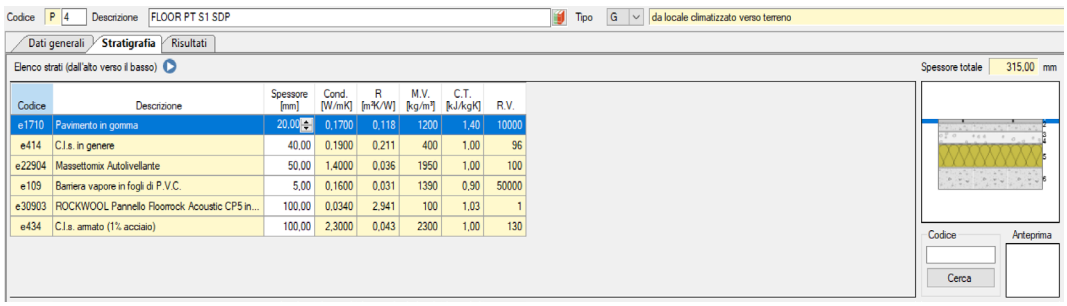
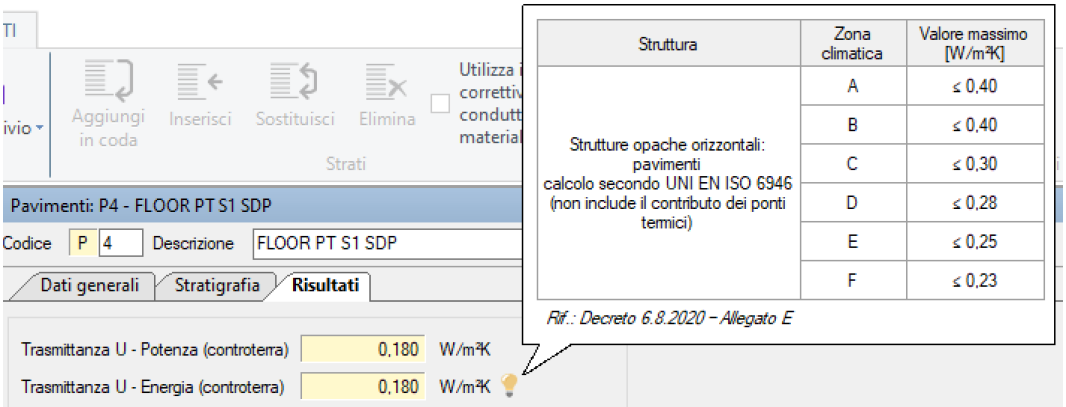


Fig.30 Stratigraphy of FLOOR PT S1 SDP

Source Fig.29-30: Screenshot from Edilclima software



Struttura	Zona climatica	Valore massimo [W/m²K]
Strutture opache orizzontali: pavimenti calcolo secondo UNI EN ISO 6946 (non include il contributo dei ponti termici)	A	≤ 0,40
	B	≤ 0,40
	C	≤ 0,30
	D	≤ 0,28
	E	≤ 0,25
	F	≤ 0,23

Fig.31 Thermal trasmittance value of FLOOR PT S1 SDP

The thinner external wall that once very probably, as specified in the previous paragraphs, was connecting the two separate buildings had to be redesigned, as well as the floor and the roof. In this case, however, it was not possible to simply apply the new layer of insulation to obtain adequate thermal performance so the original bricks were replaced with Poroton blocks. These lightweight thermo-brick blocks make a wall with good thermal resistance and good thermal inertia. Specifically, thermal resistance remains constant over time, influencing energy consumption, improving living comfort with lower construction costs. They are made of “reinforced masonry” construction system and beside a considerable ductility they have the capacity to absorb tensile stresses too. For this reason, these Poroton blocks act more similarly like reinforced concrete wall structures than normal masonry and it represents an evolution of load-bearing masonry structures for the areas with greater seismic risk. With this new technology it is possible to obtain a good value of thermal transmittance equal to 0,19 W/m2K.

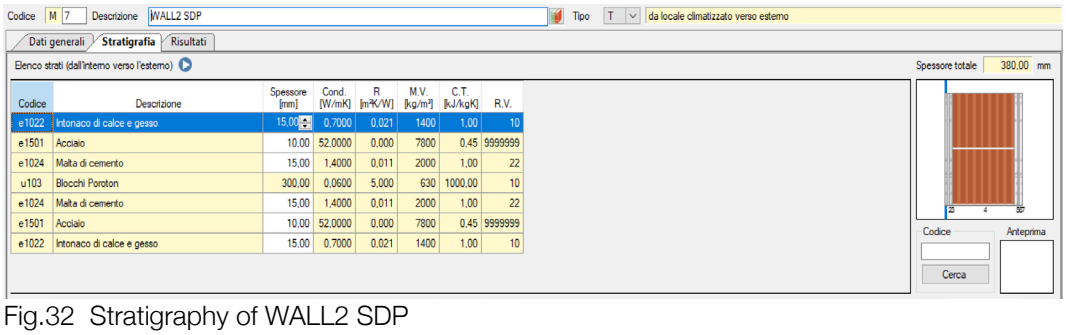


Fig.32 Stratigraphy of WALL2 SDP

Source Fig.31-35: Screenshot from Edilclima software

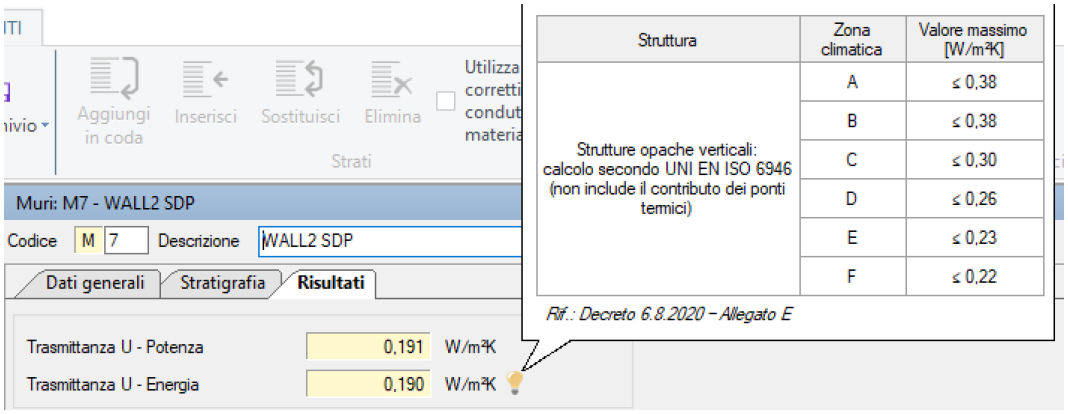


Fig.33 Thermal trasmittance value of WALL2 SDP

The new roof is insulated and ventilated as it adds a sort of ventilation air chamber to the traditional stratifications. This additional layer is positioned above the thermal insulation and helps to improve the thermal comfort conditions of the roofing itself. In fact, the chamber allows on one hand to let out the excess heat produced in the hot seasons and during the day in the intrados of the underlying elements due to solar radiation, and on the other to keep the thermal insulator dry in the humid seasons and at night. In addition, the durability of the roof increases thanks to the smaller excursion of temperature between the external and internal parts. Stone “lose” were maintained to keep the original appearance as much as possible. Thanks to these modifications, the thermal transmittance value obtained is equal to 0.177 W/m2K.

Fig.34 Stratigraphy of ROOF S2 SDP

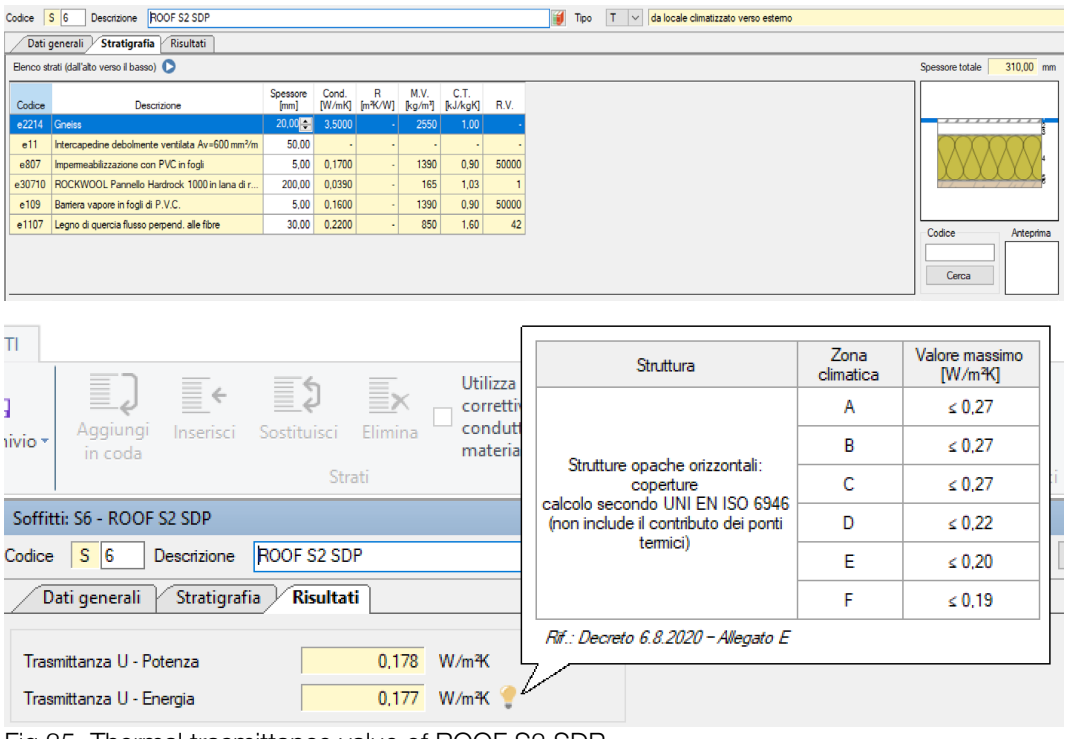
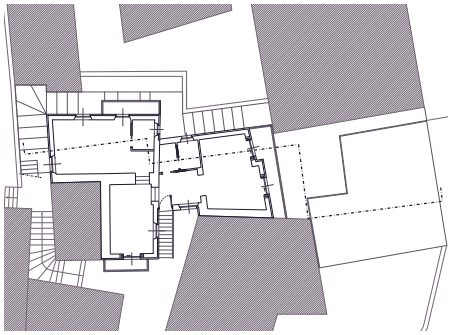
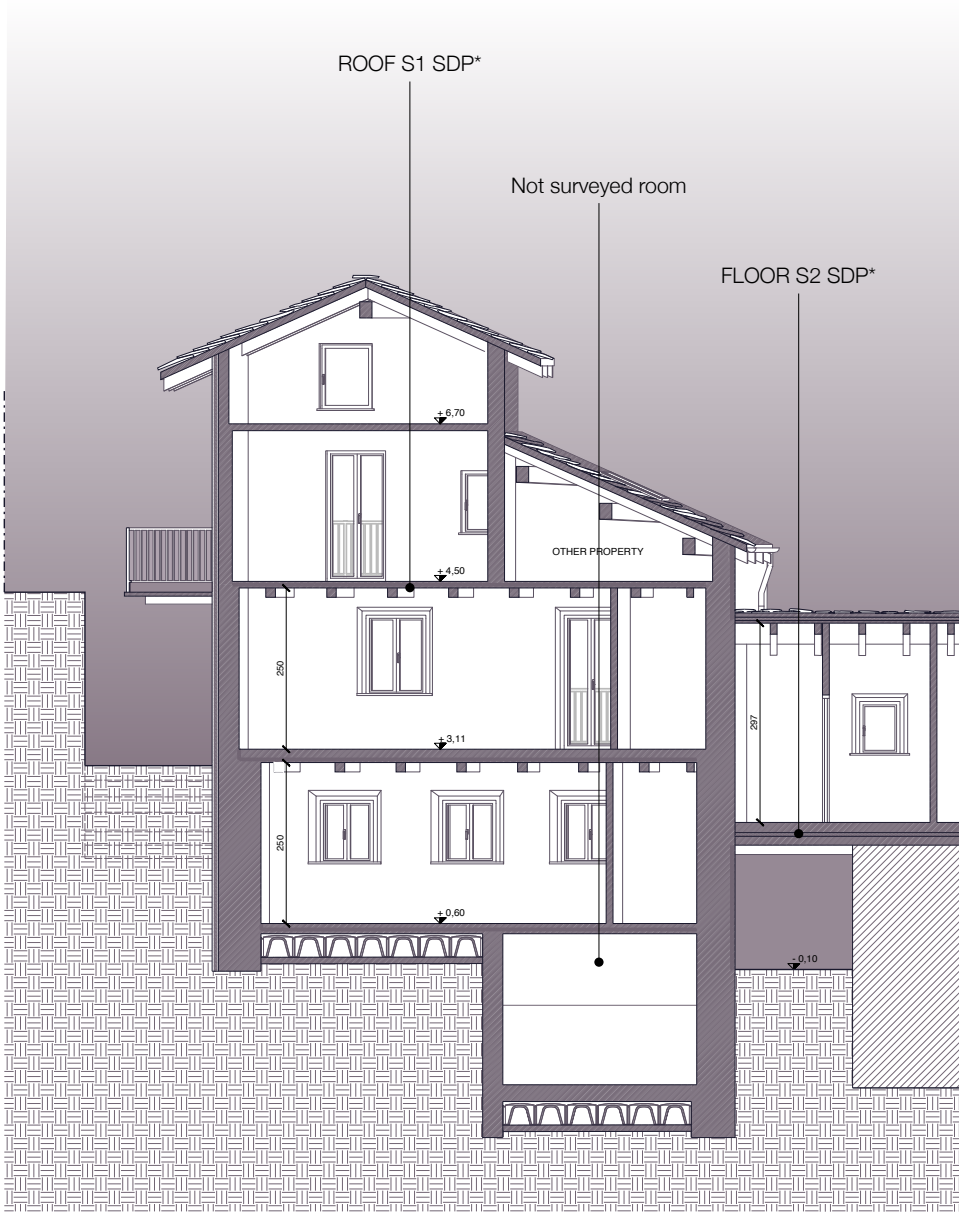


Fig.35 Thermal trasmittance value of ROOF S2 SDP





* Identification names used in Edilclima software

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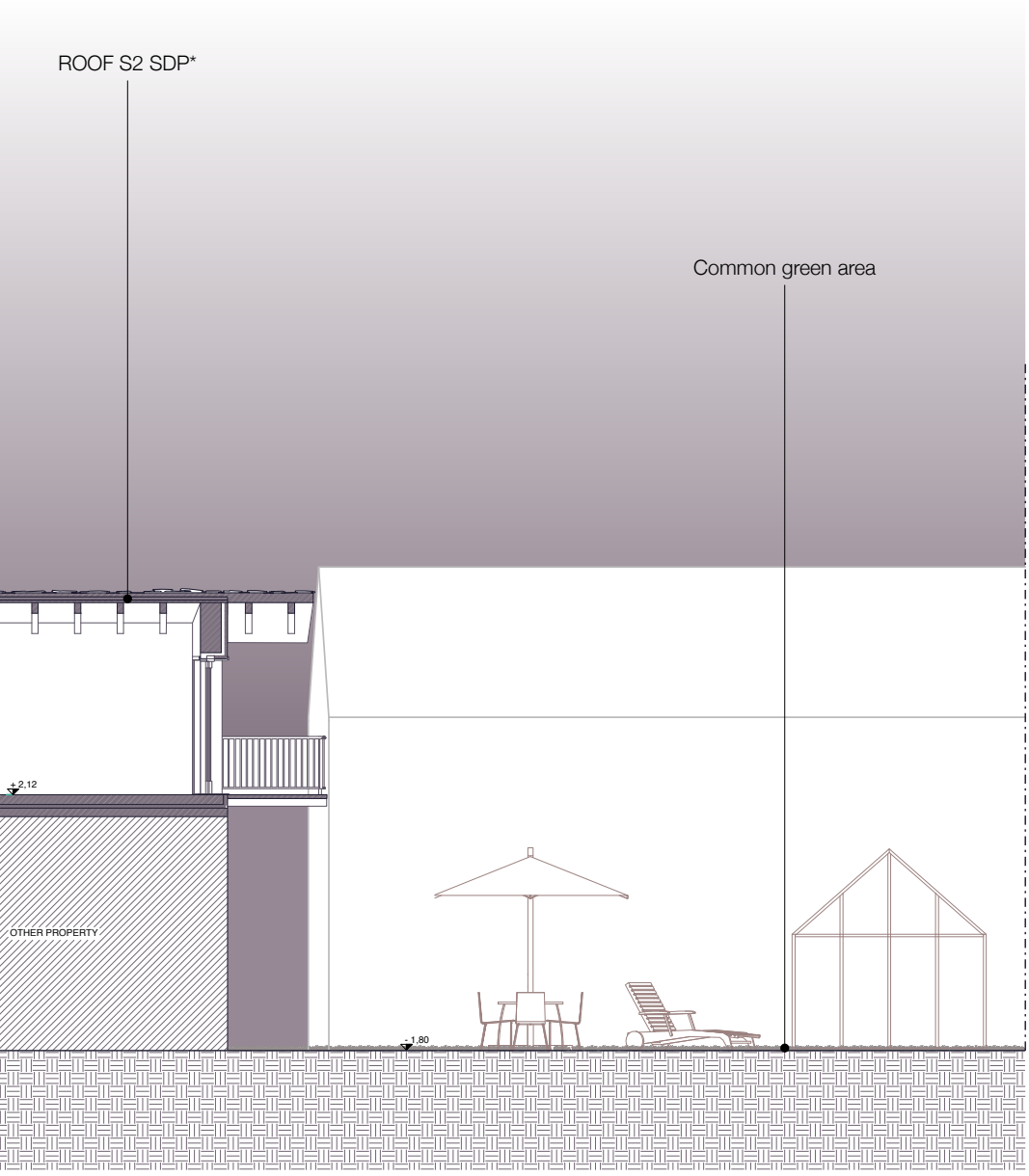

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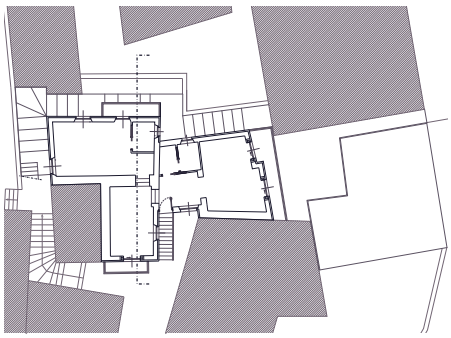

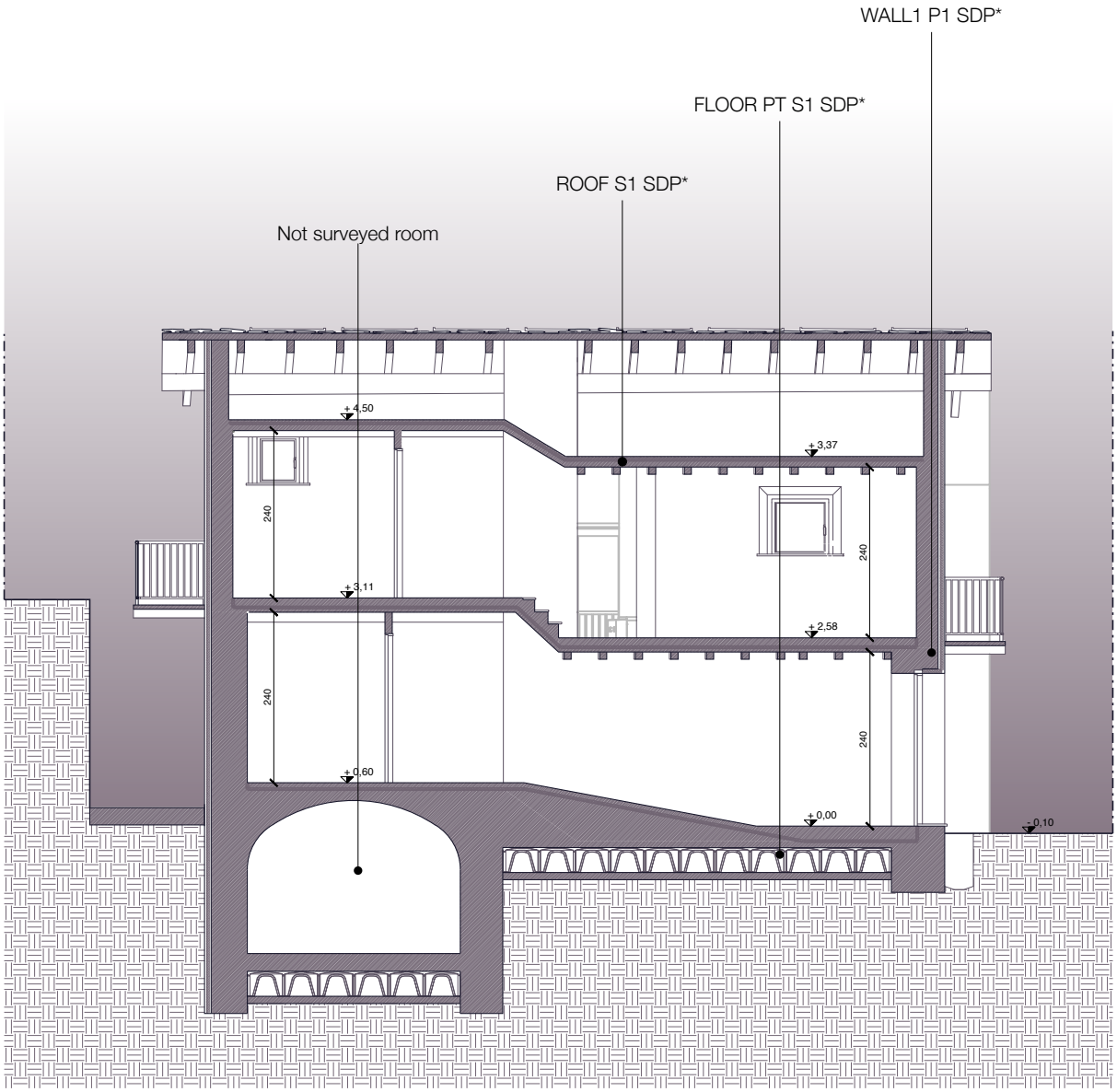

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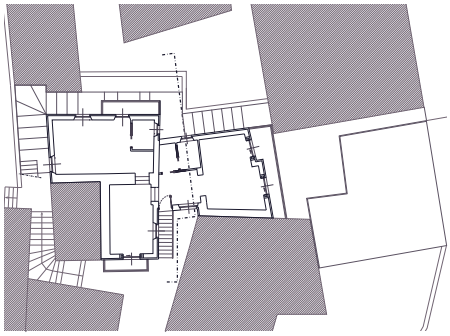

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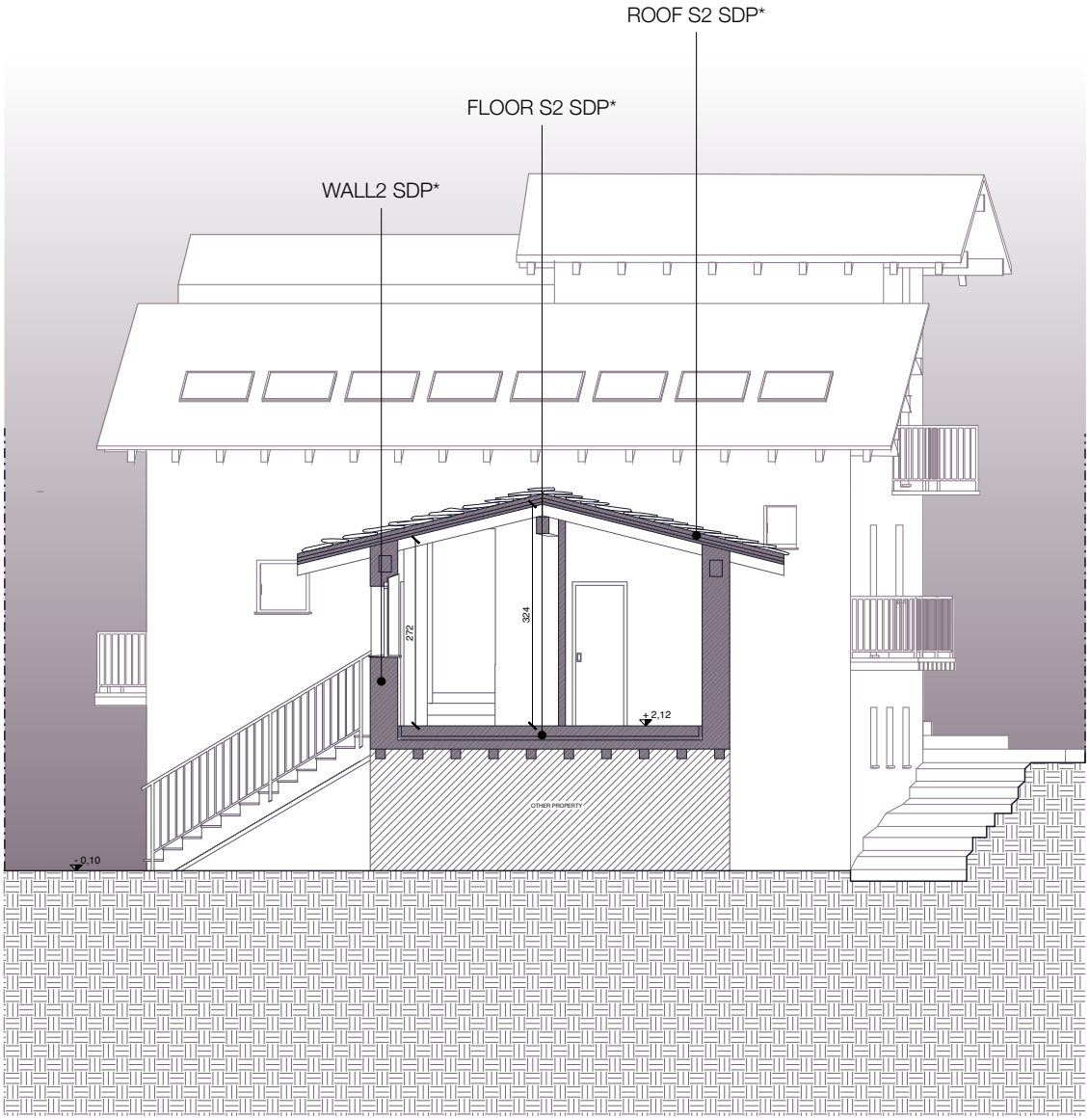

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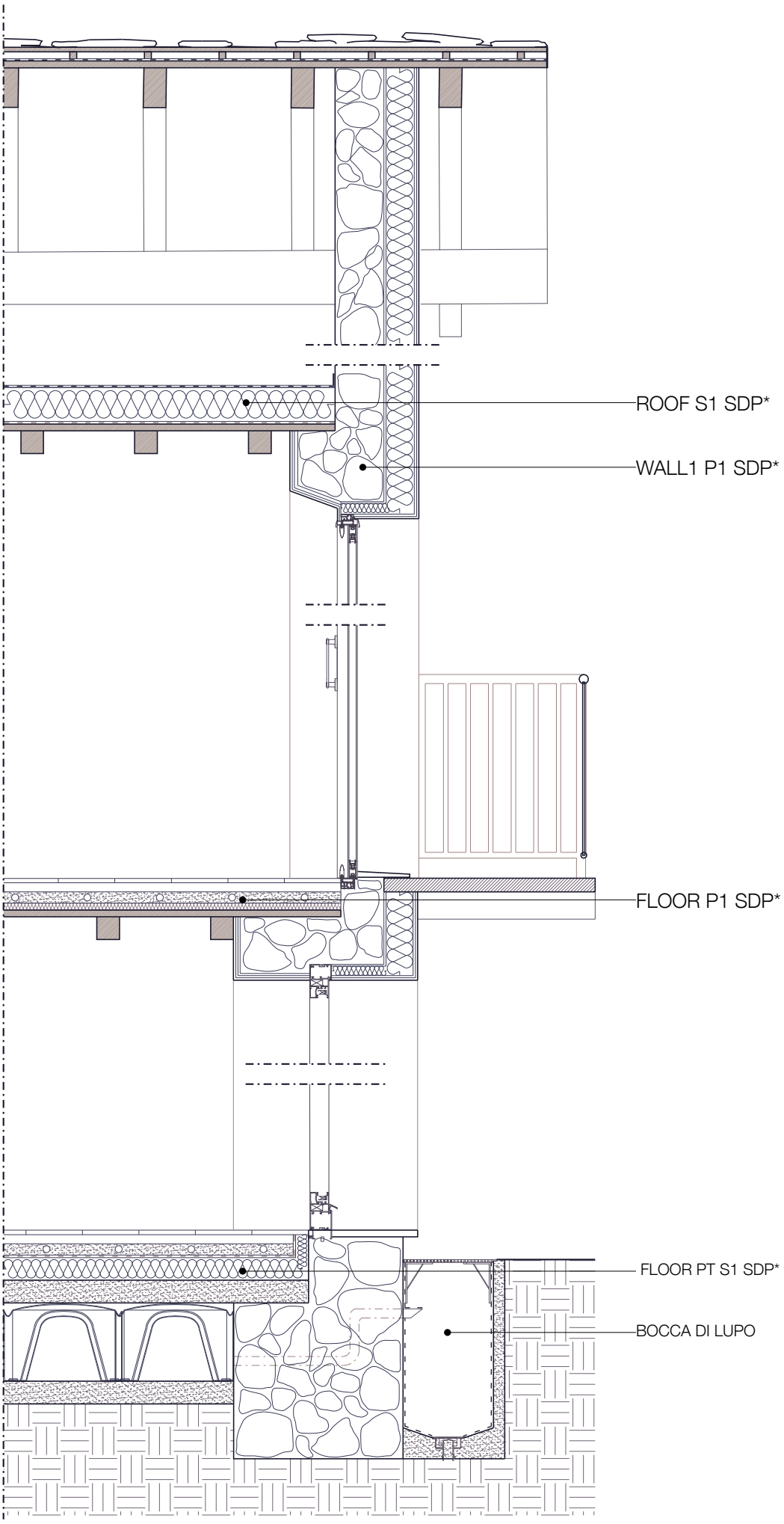

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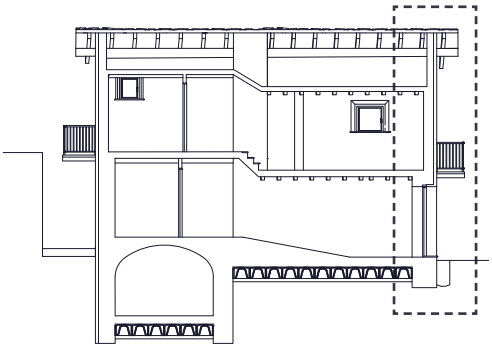


NEW STRATIGRAPHY N°1

Scale 1:25

ROOF S1 SDP:

- Wooden beams 120mmx120mm
- Wooden board 40mm
- Vapor barrier 5mm
- Thermal insulation - ROCKWOOL** 170mm
- Waterproof layer 5mm

WALL1 P1 SDP:

- Levelling layer 10mm
- Metal support structure 10mm
- Plaster 15mm
- Masonry wall - stone 400mm
- Plaster 15mm
- Thermal insulation - ROCKWOOL** 150mm
- Metal support structure 10mm
- Levelling layer 10mm

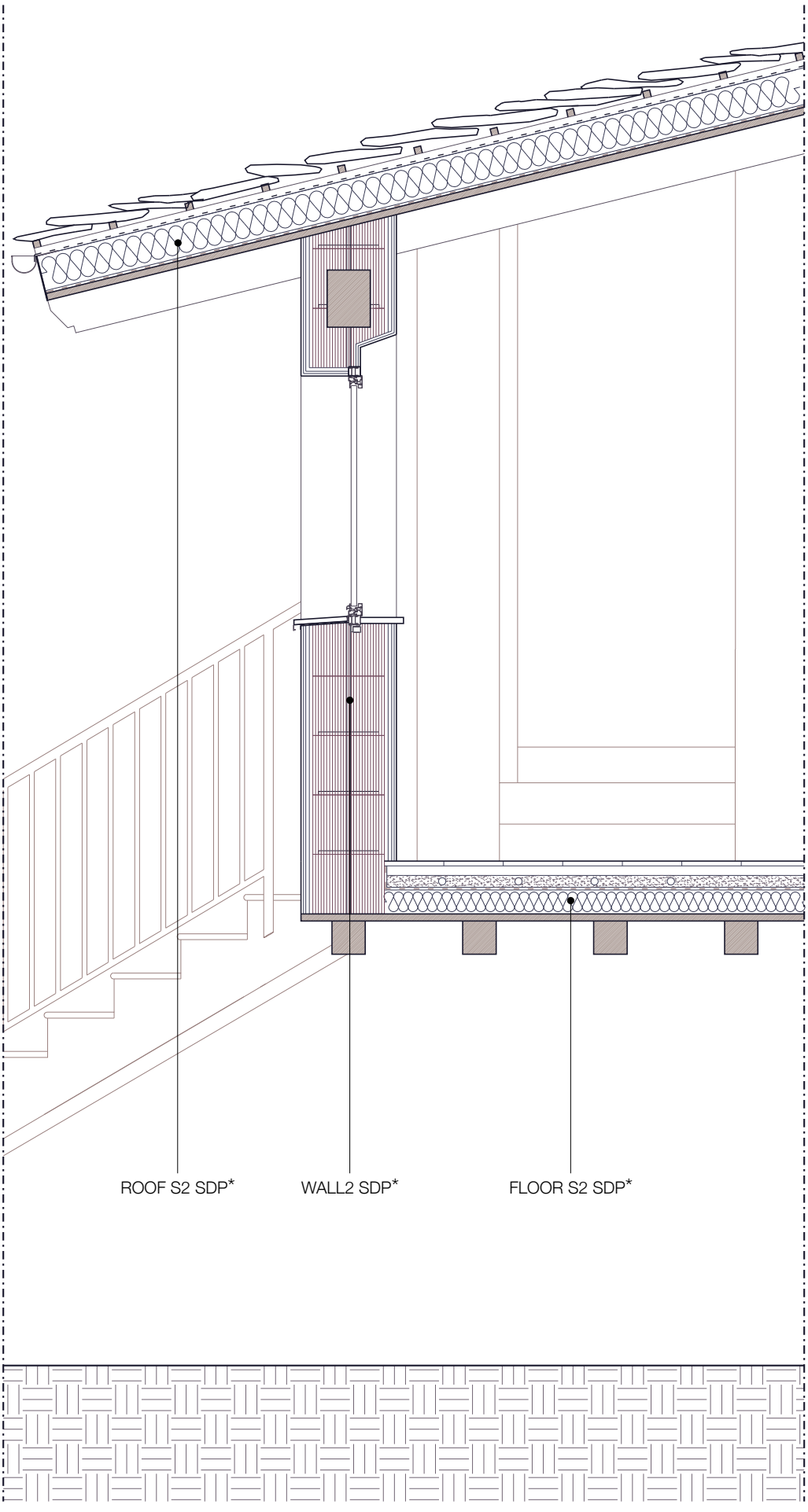
FLOOR P1 SDP:

- Wooden beams 120mmx120mm
- Wooden board 40mm
- Acoustic insulation - ROCKWOOL** 40mm
- Screed 50mm
- Radiant floor 30mm
- Anti-impact floor 20mm

FLOOR PT P1 SDP:

- Concrete foundation 100mm
- Igloo barrier 400mm
- Reinforced concrete 100mm
- Thermal insulation - ROCKWOOL** 100mm
- Vapor barrier 5mm
- Screed 50mm
- Radiant floor 30mm
- Anti-impact floor 20mm

** CAM labelled material



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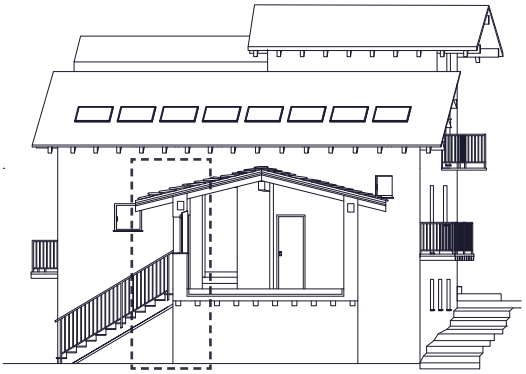

NEW STRATIGRAPHY N°2

Scale 1:25

ROOF S2 SDP:

- Wooden beams 160mmx160mm
- Wooden board 40mm
- Vapor barrier 5mm
- Thermal insulation - ROCKWOOL** 200mm
- Waterproof layer 5mm
- Airy layer 30mm
- Joists 40mmx40mm
- Gneiss stone layer

WALL2 SDP:

- Levelling layer 10mm
- Metal support structure 10mm
- Plaster 15mm
- Insulated and reinforced POROTON BLOCKS** 30mmx25mmx25mm
- Plaster 15mm
- Metal support structure 10mm
- Levelling layer 10mm

FLOOR S2 SDP:

- Wooden beams 140mmx140mm
- Wooden board 40mm
- Vapor barrier 5mm
- Thermal insulation - ROCKWOOL** 100mm
- Screed 50mm
- Radiant floor 30mm
- Anti-impact floor 20mm

** CAM labelled material

CONCLUSIONS

The core of this thesis is to investigate what is the best strategy to sustainably deal with the demographic decline that has affected, and still does, the so-called internal areas. The aim is providing a solution to this problem, seeking to give, at the same time, a concrete example for all similar situations.

The first step is to study and understand the dynamics that have transformed those areas into marginal territories, forcing the inhabitants to move towards the cities. The migratory flows towards urban centers, which began with the industrial revolution and intensified since the beginning of the 20th century, derive from multiple causes that are linked one to another: an economy only based on agriculture and craftsmanship, a lack of essential primary services and a difficult accessibility. The new work models and the new lifestyles cannot be adapted to internal areas and the new opportunities offered by cities have attracted more and more people to the point of decimating entire countries. The economic and social disparity that has been created does amplify further this phenomenon, thus triggering a vicious circle. To this loop nowadays, especially in the last twenty years, a poor network of digital infrastructures has been added too: in a world increasingly dependent on internet, the absence or weakness of its connection is another reason that explains the strong attraction towards urban areas.

The result are countries that have lost and are losing all those characteristics that contribute to diversifying and making Italy's artistic and cultural heritage unique, and cities that are becoming increasingly larger, increasingly suffering and chaotic often due to urban sprawl.

The best strategy to face and put to an end the demographic decline of internal areas is remote working. In fact, it is not simply a technological advancement, but, above all, the birth and spread of Internet allows activities to be carried out at home which would have been done in the office. Remote working was born in the 2000s, but it remained beneficial for a few until the outbreak of the Covid-19 pandemic in 2020. With the lockdowns imposed by governments to deal with the pandemic, working from home was the only possible alternative to avoid the collapse of all the economies. During those months, the positive effects of outnumbered some critical issues. Thanks to its typical flexibility, both temporal and spatial, remote working guarantees greater satisfaction in both work and private life. This results in greater productivity, constituting the main reason why more and more companies have adapted this new way of working, even after of the pandemic crisis.

However, this has not always been a positive experience because not everyone had adequate space and materials as well as the surrounding environment in which some workers had to work was counterproductive. In the first case, many people had to do with bedrooms, kitchens or living rooms; in the second case, the presence of other family members in the same room did not allow a productive and healthy environment. A workstation that is not properly set up for remote working, as well as for office work, entails long-term risks for physical and mental health, negative effect on productivity and the quality of work. A careful analysis shows all those components and characteristics that a home office must have in order to satisfy not only the requests of users, but the standards and limits set by law. A properly lit, well-insulated and equipped with ergonomic furnishings are just some of the essential characteristics to make an adequate and productive environment. Although some individuals has not a positive experience with remote working, surveys showed that most workers wanted to continue with it even after the health emergency was over.

The pandemic has not only shaken the vision of the world of work, but it has called into question the lifestyle in cities too. The physical and mental health of workers gained priority through a better balance between work and private life. The lack of green areas and the effects of overpopulation in cities, felt more during lockdowns, resulted in the rediscovery and revaluation of internal areas.

These territories, until then undervalued, offer everything that cities are no longer able to guarantee, such as contact with nature, clean air and more sustainable lifestyle. Being able to work remotely makes it possible to live far from urban centers. Internal areas can repopulate thanks to an ever-increasing number of people escaping the city. After further investigation and reflection, it is necessary to underline that this strategy does not simply put a brake on demographic decline, but the increase in population is consequently reflected in the development of missing or deficient essential services and infrastructures. This translates into an important attempt to reduce the economic, political and social gap that exists between internal areas and urban centers.

This project shows how those territories present a forgotten traditional architectural heritage that has an enormous sustainable potential. A sustainable project does not necessarily translate into the use of modern technologies. In fact, the solutions adapted from the vernacular architecture, typical of those territories, are an excellent starting point as their passive design strategies often meet modern standards in terms of

energy efficiency.

Retrofitting those structures does not only mean saving the traditions of an artistic cultural heritage, but drastically reducing the environmental impact that a new construction would have. The adaptation to modern needs must respect and dialogue with these ancient structures.

From this thesis we can notice how the process of repopulation and development of internal areas is neither immediate nor easy. First of all, because many companies are still tied to traditional working models: what must change is not the perception that people have of remote working, but rather the vision towards work itself. For instance, it does not necessarily have to be 9am-5pm, but you can have more breaks in the same day whilst working the same number of hours and this does not mean that the employee is less productive and his quality of work lower. Secondly, it is a process that requires time as it has profound implications. In fact, all the commercial activities that benefited most from office work have suffered great economic damage, such as bars or restaurants. Those activities thus have the opportunity to move to the internal areas enriching them with new services. Finally, it is a very costly process as it is not enough for the workers to decide to change their lives. Policies and incentive funds for resettlement are needed, as well as a careful territorial planning.

With this thesis we can draw the conclusion that the future of work, life and urban development are interconnected. Sustainable architecture must play a central role in shaping a more balanced, fair and sustainable world.

ACKNOWLEDGMENT

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