Msc. Thesis

Sustainable Reuse of Brutalist Architecture:
Developing a Heritage-Conscious Evaluation System

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POLITECNICO DI TORINO

Master of Science in
Architecture and Construction City

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Academic Year: 2024/2025

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ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to Politecnico di Torino for providing me with an inspiring academic environment and the opportunity to develop this thesis.

My deepest thanks go to Professor Roberta Ingaramo, my thesis supervisor, for her invaluable guidance and insightful feedback throughout this process. I am also profoundly grateful to Umberto Mecca for his support as a co-supervisor. His critical advice, thoughtful suggestions, and generous mentorship were instrumental in shaping the direction and depth of my research.

I would also like to extend my heartfelt thanks to my family and friends for creating a supportive mental environment that greatly helped me while working on this research. They made every struggle manageable, not only for this thesis but throughout my entire academic journey.

Thank you.

ABSTRACT

Avcioglu, B. 2025.

Brutalism has been one of the most controversial movements in architecture throughout history, and often misunderstood and underappreciated. Brutalist buildings are increasingly at risk of demolition despite their cultural and architectural significance. Mainstream sustainability certification systems such as LEED, BREEAM, DGNB offer valuable frameworks for environmentally conscious design but largely overlook the heritage value of existing structures. This thesis explores the question: “What are the ways of reusing a brutalist building in a more sustainable way without losing its historical characters and values?” and differently from the other building sustainability certification systems, proposes a system that also considers and cares about the heritage values of buildings.

To address this gap, this research analyzed prominent sustainability assessment systems and identified their limitations regarding cultural and historical aspects. Building upon their strengths, a hybrid evaluation system that integrates cultural, ecological, social, and economic sustainability was developed. The system introduces criteria that prioritize architectural identity, historical continuity, and adaptive reuse strategies sensitive to the character of brutalist buildings.

The proposed framework was tested through a design project for the adaptive reuse of the abandoned “Marxer Pharmaceutical Research Institute” in Loranzé, Italy. The project was evaluated using the new system to demonstrate its viability and flexibility.

This research contributes to the evolving discourse on sustainable architecture by proposing a tool that not only promotes environmental responsibility but also ensures the conservation of modern architectural heritage.

Keywords: Brutalist Architecture, Sustainability Assessment, Adaptive Re-use, Cultural Heritage, Cultural Sustainability, Certification Systems

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Introduction

Figure 01 Pompeia Factory, Sao Paulo
Source: photo by Leticia Teixeira De Maria

“What are the ways of reusing a brutalist building in a more sustainable way without losing its historical characters and values?”

Brutalism has been one of the most controversial movements in architecture throughout history, and it is often misunderstood and underappreciated. From past to present, many Brutalist buildings have been demolished either because their aesthetic did not align with the publics taste or due to the ideological associations of the era in which they were constructed. In todays world, we can talk about the vulnerability of these buildings because they are often perceived as outdated, aesthetically controversial, and environmentally inefficient.

Reusing of these buildings, which typically use concrete as the dominant material, are particularly important in terms of both preserving the embodied carbon within them and sustaining their cultural and aesthetics value through adaptive reuse. However, while preserving the cultural significance of these structures, it is also essential to do so in a sustainable manner.

At this point, many of the sustainability certification systems used today encourage us to construct sustainable buildings or to reconsider and reuse existing ones. However, most sustainability certification systems (LEED, BREEAM, etc.) lack cultural or heritage-specific evaluation criteria, which poses the risk of erasing the architectural identity of such buildings. This becomes even more critical when dealing with a misunderstood architectural movement like Brutalism. Even when there is an intention to reuse these buildings, their cultural and aesthetic values may remain at risk.

In this context, this study analyzes existing sustainability assessment systems, identifies their limitations in evaluating buildings with heritage value, proposes a new system that also includes cultural dimension, and tests this system through a case study.

This research focuses specifically on Brutalist architecture as a case of culturally significant yet often neglected modern heritage. While ecological, social, and economic aspects of sustainability are considered, the main innovation lies in the addition of cultural dimension as the 4th dimension to the existing sustainability dimensions. The framework is tested on a single case study and is intended as a conceptual prototype, not a universal standard, because the main goal of this study is not to replace existing sustainability systems that are developed through years of accumulated knowledge, but to highlight and draw attention to a critical gap within them. In doing so, the choice to focus on Brutalism, an often unwanted architectural movement, aims according to the author to call attention to two common misconceptions in architecture through this work.

The research adopts a comparative and design based methodology. First, qualitative analysis is conducted on existing sustainability certification systems. A new hybrid system is then developed by synthesizing their strengths and incorporating cultural indicators. Finally, a design proposal for the adaptive reuse of the selected case study is developed and assessed using the new system to evaluate its effectiveness.

By addressing the gap between sustainability and heritage preservation, this study aims to initiate a broader dialogue on how contemporary sustainability practices can evolve to respect and integrate the cultural significance of architectural works. Brutalist buildings, often overlooked or dismissed, offer a unique opportunity to challenge prevailing biases and rethink how we value the built environment. Through the development and application of a culturally inclusive sustainability assessment system, this thesis proposes a method not only for preserving these structures, but also for redefining the role of cultural identity within sustainable architectural practice.

This thesis is structured as follows:

Chapter 01 provides information about the foundations and development of the Brutalist movement. It explains how Brutalism has been both embraced and rejected throughout history. Additionally, it addresses the role of sustainability in adaptive reuse, explores the dimensions of sustainability, and discusses academic debates surrounding the idea of culture as the “fourth dimension” of sustainability.

Chapter 02 discusses current sustainability certification systems available on the market today and analyzes them within the framework of cultural sustainability.

Chapter 03 proposes a new sustainability evaluation system that incorporates cultural sustainability, based on insights gained from the previous chapters. It explains the structure and functioning of the system and presents its criteria through the use of evaluation cards.

Chapter 04 analyzes an abandoned and architecturally significant building from the Brutalist period using the newly proposed sustainability evaluation system.

Chapter 05 offers a project proposal for the building previously analyzed in detail, based on the newly proposed sustainability evaluation system, and tests the system through this design intervention.

Chapter 01
Sustainable Reuse of Brutalist History

Figure 02 Wotruba Church, Vienna
Source: photo by Denis Esakov

1.1 Brutalism in Brief

The first use of the term brutalism dates back to the Swedish architect Hans Aplund, who described the design as 'nybrutalism' while examining a housing project called Villa Göth in 1949. Nybrutalism was the Swedish word for 'New Brutalism'. This description was later adopted by Alison and Peter Smithson, who used the term 'new brutal' to describe their first build. This was a school building in Hunstanton Norfolk UK, the construction of which was finished in 1954. This project can be seen as the place where Brutalism first emerged as an architectural concept. However, it was with Robert Banham's article 'The New Brutalism', written for the Architectural Review magazine in 1955, that the concept became widespread and recognised and accepted by a wider audience (Clement 2011, Stalder 2008).

According to Robert Benham, there were different criterias for a building to be considered brutalist. These were 'clear exhibition of structure', 'valuation of materials as found' and 'memorability as image'. The first and second criterias are quite clear in that brutalist buildings clearly assert their structure and use building materials 'as found', but when we come to the other criterion, Banham basically thinks that the building should be an immediately perceptible visual entity and that the form perceived by the eye should be verified by the experience of the building in use (Banham 1955).

It is quite possible to see the reflections of modernism in Brutalism. The main reason for this is that the starting point is originating from modernism. In the early 1940s, designers from Europe and the United States began to turn their backs on High Modernism, embracing what Swiss critic Sigfried Giedion and American architect Louis Kahn described as a New Monumentality, an imposing form of architecture that, as Kahn expressed in his 1944 essay "Monumentality," evokes a sense of timelessness. In the following years, the French-Swiss Modernist Le Corbusier started to build monolithic structures with raw concrete (Snyder, 2019).

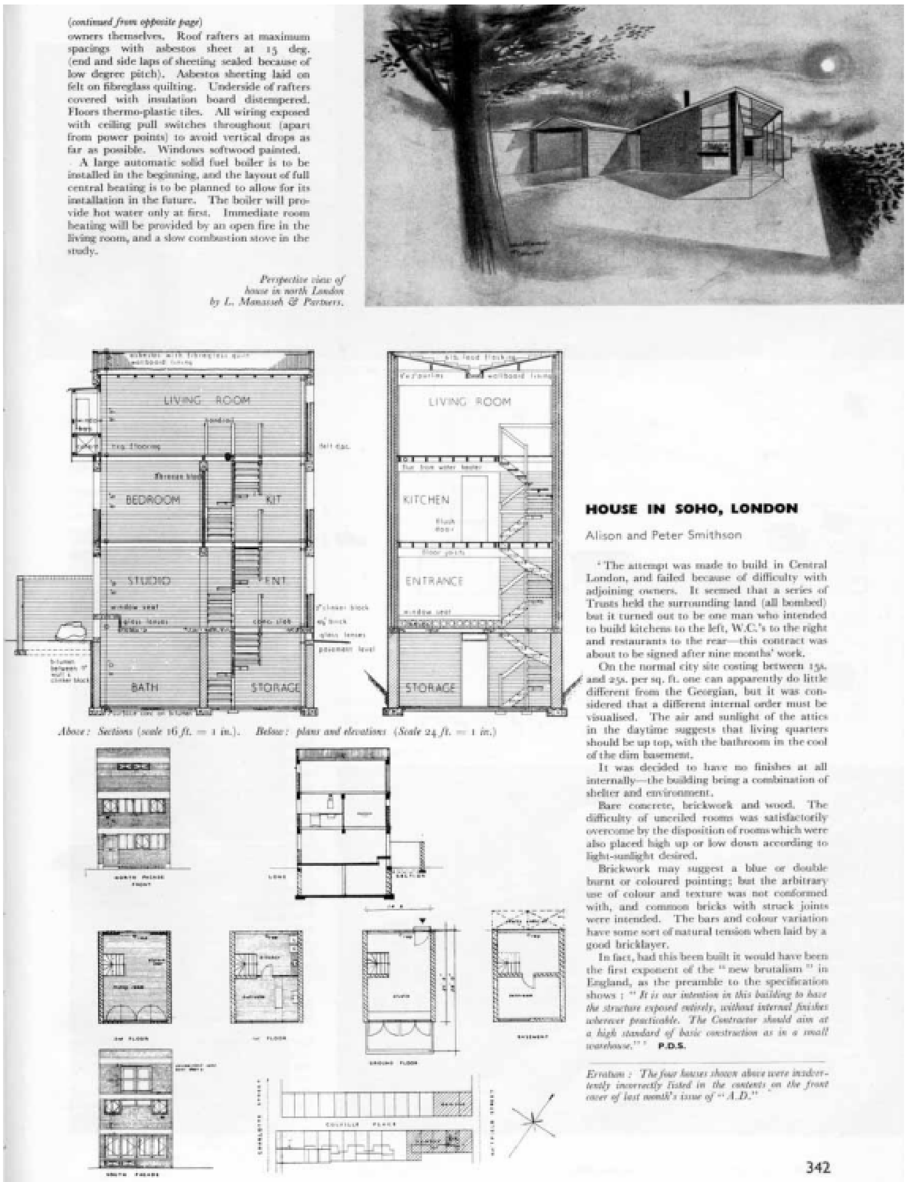
Le Corbusier also stated that the term 'béton brut' was born at the Unite d'Habitation in Marseille, where there were many contractors and it was difficult to make useful transitions between materials, so he decided to leave the concrete bare and called it 'béton brut'(Atlas of Brutalist Architecture, 2018, p. 7).

The Unite d'Habitation was an important building that brought forward the vision of how the conceptions of modernism could fulfill the need for rapid and economic construction. Although it was beyond the budget that most of the cities could offer, it exemplified especially for postwar construction as an influential case study. A simple but highly textured form of unpolished rough-cast concrete and steel used structurally, which need not be unnecessarily expensive (Banham 1966).

After the Second World War, there was a high need for building stock worldwide. At this point, the 1950s and 1970s were the times of the second wave of modernism. Following radical cultural and social changes after the war, architects were seeking to explore different approaches in terms of planning, design and technology(Gosser, Leuthauser 2005). Architects found what they were looking for in the Brutalism movement at a time when European cities were trying to re-home war-displaced populations and recreate the built environment (Highmore, 2006).

Unlike modernism, in brutalism materials were to be used as directly encountered or 'as found'. The forms are not intended to be disguised or transformed into geometric designs; instead, their inherent strength, adaptability, expressive character and unique, context-orientated impact should be appreciated (Thoburn 2018).

The second wave of modernist architects viewed architecture as both a social duty and a fundamental component of the modern age, bringing the concept of democratic urbanism into architectural design. With the use of concrete and steel, they were able to construct the largest buildings and complexes ever imagined. Concrete



(*continued from opposite page*)
owners themselves. Roof rafters at maximum spacings with asbestos sheet at 15 deg. (end and side laps of sheeting sealed because of low degree pitch). Asbestos sheeting laid on felt on fibreglass quilting. Underside of rafters covered with insulation board distempered. Floors thermo-plastic tiles. All wiring exposed with ceiling pull switches throughout (apart from power points) to avoid vertical drops as far as possible. Windows softwood painted.

A large automatic solid fuel boiler is to be installed in the beginning, and the layout of full central heating is to be planned to allow for its installation in the future. The boiler will provide hot water only at first. Immediate room heating will be provided by an open fire in the living room, and a slow combustion stove in the study.

Perspective view of house in north London by L. Manasseh & Partners.

Above: Sections (scale 16 ft. = 1 in.). Below: plans and elevations (Scale 24 ft. = 1 in.)

HOUSE IN SOHO, LONDON

Alison and Peter Smithson

"The attempt was made to build in Central London, and failed because of difficulty with adjoining owners. It seemed that a series of Trusts held the surrounding land (all bombed) but it turned out to be one man who intended to build kitchens to the left, W.C.'s to the right and restaurants to the rear—this contract was about to be signed after nine months' work.

On the normal city site costing between 15s. and 25s. per sq. ft. one can apparently do little different from the Georgian, but it was considered that a different internal order must be visualised. The air and sunlight of the attics in the daytime suggests that living quarters should be up top, with the bathroom in the cool of the dim basement.

It was decided to have no finishes at all internally—the building being a combination of shelter and environment.

Bare concrete, brickwork and wood. The difficulty of unceiled rooms was satisfactorily overcome by the disposition of rooms which were also placed high up or low down according to light-sunlight desired.

Brickwork may suggest a blue or double burnt or coloured pointing; but the arbitrary use of colour and texture was not conformed with, and common bricks with struck joints were intended. The bars and colour variation have some sort of natural tension when laid by a good bricklayer.

In fact, had this been built it would have been the first exponent of the "new brutalism" in England, as the preamble to the specification shows: "*It is our intention in this building to have the structure exposed entirely, without internal finishes wherever practicable. The Contractor should aim at a high standard of basic construction as in a small warehouse.*"' **P.D.S.**

Erratum: The four houses shown above were inadvertently incorrectly listed in the contents on the front cover of last month's issue of "A.D."

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Figure 03 House in Soho from a magazine
Source: P.D.S. [Alison Smithson], 'House in Soho', Architectural Design, 23, 12 (1953), p. 342 (# Architectural Design).

Figure 04 Unite Habitation
Source: photo by Gili Merin

became the ideal solution for meeting the structural, construction, and economic demands of these large projects, as it was both versatile and strong, easy to shape yet durable (Huppatz 2018).

Building large, influential structures was not seen as a means of seizing power, but as a necessary step in reshaping cities through rapid and often dramatic transformations. In this way, the style was designed to stand out and represent the authority of the state (Scott, 1998).

Rather than making the relationship between state power and citizens visible only in times of crisis, this architectural style made this connection apparent in everyday life, particularly through the provision of public services, emphasising the advantages of centralised planning. The presence of large architectural structures, often associated with social or socialist values (especially in Eastern Europe), symbolised the new relationship between the welfare state and citizens, who now assumed responsibility for managing more complex urban environments, housing, subsidised education and public health. Since most of these buildings were publicly owned and served the public, Brutalist architects believed that their style should convey an anti-bourgeois ideology, even in cities like London or Boston (Vidler, 2011). This was accomplished by using cheap, textured concrete, in stark contrast to the chrome, glass and steel commonly found in modernist towers in the same city centres (Thoburn, 2018).

Creating these monumental structures leaving the materials bare was not only an economic choice but it can also be read as an attitude towards the damage caused by the war. At this point brutalism corresponds well with the architectural behaviour sought to respond to the need for building stock in the post-war period. It was able to respond to the needs of it both economically and aesthetically by showing a radical attitude to social issues. For this reason, most of the buildings following this movement were created in these periods. Today, we generally see examples of this movement between the 1950s and 1980s.

1.2 Disfavour and Exclusion of the Movement

One of the two most necessary points to understand Brutalism is undoubtedly the aesthetic values mentioned by Banham, but the other point is its relationship with society. In today's world, the fate of buildings in need of protection in cities can be directly affected by the societies opinion about the building.

Whereas buildings from many other architectural styles do not require the same degree of defence and support from both professionals and the public for their preservation, brutalist buildings, despite following in the footsteps of recent-past architectural styles, often require much more support to be preserved and repurposed rather than demolished (Contreras 2013).

Defending these buildings requires confronting the label under which they were oppressed and misunderstood, since Brutalism was a loosely applied moniker that emerged from European discourses whose concerns were quite different from those of international architects. Although the moniker was initially born out of a reflection of aesthetic concerns, it was later labelled as coming from negative, "brutal" intentions. For this reason, the biggest misfortune of the Brutalism movement was the name itself (Mark Pasnik et al., 2015).

Since their construction, brutalist buildings have often been characterised as 'ugly concrete monstrocities'. However, the perceived "ugliness" of Brutalism is an essential aspect of its core principles; the all-encompassing style was intentionally "anti-aesthetic". The concern of brutalism has often been an environment in which its inhabitants can relate to and own the architecture of the building they live in, rather than beauty but most of the times this public prejudice turned into political contempt, which in turn turned into the destruction of the structures (Wilkinson 2014).

Figure 05 New Brutalism appearing in a magazine
Source: Reyner Banham, 'The New Brutalism', The Architectural Review, 118, 708 (1955), p. 359 (# Architectural Design).

Another misfortune of brutalism was that it formed an important part of communist architecture and became one of its symbols. Although some of the most iconic brutalist buildings can be found in the United States and the United Kingdom, the brutalist style seems to have been especially prevalent in the communist countries of Eastern Europe, where it became a good way of representing socialist power and unity (Bell, 2020).

Recent heritage still does not seem to be as important as older architectural heritage in the eyes of society, society is not yet aware of it. While architectural artifacts from hundreds of years ago are considered worthy of preservation, relatively recent artifacts are often undervalued because they are not considered 'ancient' enough in the view of the public and various authorities. This situation makes the work of a relatively new architectural movement such as Brutalism even more difficult, causing brutalist buildings to be demolished for new buildings to replace them, rather than being preserved or reused. In addition to that, most of the times the architectural characteristics of brutalist architecture have a hard time getting along with the architectural aesthetics of society.

Since the 1950s, brutalism evokes a more negative emotional response than any other architectural style. The blend of experimental forms and unfinished concrete, used both as an exterior finish and a structural component, often appeared unorthodox to the public eye. Uncovered by finishes or cladding, exposed concrete was uncommon, and the idea of displaying construction materials provoked skepticism (Croft 2004).

But in addition to all this, it is also possible to see some changes in public eye today. The situation that may perhaps be the saviour of these structures, which have difficulty in overlapping with the aesthetic understanding of the society, is that the aesthetic judgements of the society are also variable and this time the movement takes the wind behind it. The reevaluation that comes with time's passage is starting to become apparent. If we investigate how public opinion and the domains of architecture and preservation have evolved in terms of taste, and when we pose the question, "Why do we like some buildings and not others?", "Do our preferences and dislikes hold greater weight than those of others?" we see that our values are subject to change (McClelland, M. and Stewart, 2007).

There have been numerous calls for the demolition of brutalist structures during their existence since the 1950s. Numerous Brutalist buildings are being demolished and replaced by new, monotype towers reflecting late capitalist architectural trends, often clad in glass and composite materials. Some heritage organisations resist this trend and argue for the preservation of Brutalist buildings by listing them in order to preserve their architectural significance. While some of these campaigns have been successful, others have failed. As in most of the cases in Europe and the USA, the debate over the demolition or preservation of these buildings is in center on the preservation of a historically significant architectural style amidst the pressures of contemporary urban development (Mould 2016).

However, social media has also ignited movements to protect them and given them a newfound popularity today (Holleran, 2021). Important values of the style is started to get recognized. The 'anti-beauty' aesthetics of these buildings came to the fore and these abandoned monumental structures started to become trendy again. Yet, brutalist buildings are ignored most of the time until they are in danger of being demolished, and by that time they are in a very poor condition due to years of neglect and abandonment (Contreras, 2013).

At this point we have reached today, while the brutalism movement has taken the more positive judgements of the society behind it, we need to regain these buildings to the cities and emphasise the values they have. Perhaps the best way to do this is to reuse these buildings with the functions that citizens need, because most of buildings in need of protection are abandoned because they have lost the function they had in the past. However, their heritage values and usable structures can still be used and reusing these structures rather than demolishing them is important both in terms of cultural values and sustainability.

Greater caution needs to be exercised in demolition practices, not only because structures perceived as ugly today may be valued for their aesthetic qualities in the future, but also because of the significant environmental damage associated with such actions. Rather than focusing on notions of beauty or ugliness, the public discourse surrounding this issue addresses the underlying rationale: how can the removal of large quantities of concrete in contemporary society be justified, if only to replace it with an equal volume of new concrete? Given that about half of the materials extracted from the earth are used in construction, resulting in the production of significant amounts of waste, it is imperative that we reassess and reform our approach to these practices (MVRDV, 2023).

With this new perspective on brutalist buildings, we, as people with a voice, need to save them from demolition and reuse them in cities. At this point, the question we need to ask ourselves before reusing these buildings, whose building technology is behind today's technology and far from today's energy standards, is "What are the ways of reusing a brutalist building in a more sustainable way without losing its historical character and values?". Brutalist buildings cannot be used with ordinary retrofit interventions due to their unique facade character, but it is inevitable that we need to retrofit these buildings in order for them to be re-functionalized and used today. Therefore, a sustainable balance between retrofitting and conservation must be established.

Figure 06 City Hall Plaza, Boston city hall
Source: photo by jorgeantonio/Getty Images

1.3 Sustainable Reuse of Existing

Today, the importance of material and resource protection has increased considerably. Maintaining the existing rather than demolishing it is very necessary in terms of using our resources well and keeping our carbon emissions at lower levels.

In this age of urban sprawl, it is necessary to adopt more sustainable methods. At this point, the reuse of buildings in city centers can slow down the urban expansion and thus the destruction of green spaces (Snyder, 2005). The built environment represents one of humanity's most significant economic, social, and environmental investments, making up around 40% of global GDP (Langston et al., 2001). In addition to that, buildings account for approximately 30-40% of the world's primary energy consumption (Gonzalez et al., 2011). These show that the impact of buildings on the natural environment is substantial, both in terms of the resources required for their construction and the energy necessary for their operation. Inevitably, society needs and will always need the built environment to survive. For this reason, we can only limit the energy we use to operate our buildings but we do not always need to demolish existing buildings in order to build new ones.

The structures of the buildings often outlive their functions. We may no longer need their functions but we can still use their structures for adapting them into new functions. In this regard, we can follow some adaptive reuse methods to bring them back to life.

Adaptive reuse is the process of converting a disused, obsolete or inefficient building into a functional building for a new purpose (Burton,2014). Architectural debates on adaptive reuse emerged in the 1960s and 1970s, fuelled by growing environmental concerns (Cantell, 2005). Buildings can become obsolete for a number of reasons, including changes in economic and industrial practices, changes in demographics or increasing maintenance costs. In many cases, they are no longer fit for their original purpose and no alternative use has been identified (Orbaşlı, 2008). Adaptive reuse covers a range of changes from preserving a building for its historical or cultural significance to completely changing its function for new uses or purposes (Yazdani Mehr et al., 2017).

Several studies have shown that adaptive reuse is a more sustainable approach when considering economic, social and environmental impacts compared to conventional demolition of buildings (Aigwi et al., 2022; Chan et al., 2020). Reusing an existing building instead of constructing a new one reduces material consumption, transport costs, energy use and environmental pollution. As a result, it contributes significantly to low carbon emissions and environmental sustainability (Toprak and Sahil, 2021).

Most of the energy consumed in buildings is used for heating, cooling, and lighting (Langston et al., 2001). Minimising dependence on mechanical and electrical systems with natural ventilation and lighting leads to buildings with lower environmental impact. In addition, this approach also provides economic benefits as it increases occupant productivity and reduces operating costs (Snyder, 2005). So older buildings often use older inefficient systems. For this reason, operating costs are mostly higher. Therefore, retrofit interventions are required when adaptive reusing these buildings. However, one of the most compelling reasons to reuse buildings is the embodied energy that existing buildings have because recycling and reusing materials allows for the preservation of embodied energy and greenhouse gas emissions, which helps to reduce the overall carbon footprint (Malabi Eberhardt, Rønholt, et al., 2021; Muthu et al., 2015). Similarly, discarding old materials in landfills equates to wasting the embodied energy originally invested in them (Muthu et al., 2015).

Choosing the right building is one of the most critical aspect of an adaptive reuse project, as not all structures are suitable for repurposing. While a site may meet the criteria for sustainable development, the building itself may be unsuitable due to structural issues, inadequate or excessive square footage, extensive modifications required for the new use, or challenges with code compliance. In some cases, the effort required may outweigh the project's economic feasibility (Snyder, 2005). At this point, the heritage value of the building in question is an important issue to be taken into consideration. Because the intangible values of some buildings may override the material values. Revitalising heritage buildings provides environmental and social benefits to communities while preserving national heritage (Shen & Langston, 2010). In this regard, maintaining heritage values can sometimes leave other factors behind but also a balance between preserving heritage and reducing energy costs should be formed.

Adaptive reuse is a very complex process and the actors involved in this process should be competent to make the most accurate decision for the future of the building within the location and time (Kincaid, 2002). This importance is even more prominent when it comes to heritage buildings. The new function for a heritage building should respect its cultural importance. When adapting these structures for different uses, it is essential to preserve their original features and architectural integrity to avoid conveying inaccurate or incomplete historical information to future generations (Mısırlısoya & Günç, 2016). A building adaptation is successful if it does not ignore the values of the existing structure but respects it and adds a contemporary layer (DEH, 2004).

Figure 07 Hotel Marcel
Source: photo by Becker+Becker

1.4 Sustainability Dimensions

It is inevitable today to hear about sustainability more often in our lives as a response to increasing global problems. Instead of consuming more, it has become important to repair and repurpose what we already have.

'The verb "sustain" has been part of the English language since 1290 and comes from the Latin words "sub" and "tener" and means "to protect" or "to preserve" (Soflaee, 2004). According to the Oxford Dictionary, the word dates to 1400 years ago. In Persian, the concept of sustainability is synonymous with terms such as 'resistance', 'endurance' and 'stability'(Dehkhoda, 1998).

Sustainability is an important and broad concept that is widely recognised as an important conceptual framework for shaping urban policy and development, Sustainability underpins an extensive literature in planning, architecture and urban design (Williams et al., 2000).

The concept of sustainability has increased in popularity and importance with the global challenges we face in the 21st century. It has become a key element to make the world we have a better place. A desirable future can be framed and discussed through the concept of sustainable development, which can be interpreted and addressed in a variety of ways (Holmberg & Larsson, 2018).

As humans, we are part of the ecosystem on earth and we always have a great impact on the ecosystem. Therefore, in order to ensure sustainability in the long term, we need to adopt an attitude that harmonises with nature itself instead of an exploitative attitude. It would be more appropriate to adopt design approaches in harmony with nature, to use what we already have effectively, or to catch the flow of nature rather than acting completely separately from it.

A holistic design approach takes into account a broad range of factors, including the choice of construction materials, reducing the building's environmental impact on the site, and prioritising the well-being of its occupants. Design cannot of course solve all sustainability problems however, it can help align the built environment more closely with natural processes. At this point adaptive re-using existing structures can achieve many sustainability goals (Snyder, 2005).

Figure 08 Sustainable development goals
Source: from Agenda 2030

William McDonough, an architect who has made a significant contribution to the field of sustainability and has been one of the pioneers of the sustainable design movement, put forward a set of princibles called the "Hannover Principles" in 1992 (McDonogh, 1992).

1-Insist on the rights of humanity and nature to co-exist: Design should promote harmony between human activities and the natural world.

2-Recognize interdependence: Every element of design is connected to others, influencing both natural systems and human communities.

3-Respect relationships between spirit and matter: Sustainability should honor both the physical and non-physical aspects of life, acknowledging cultural and spiritual needs.

4- Accept responsibility for the consequences of design: Designers must take accountability for the environmental and social impacts of their work, from inception to disposal.

5- Create safe objects of long-term value: Designs should promote safety and usefulness, avoiding products that are wasteful or harmful over time.

6- Eliminate the concept of waste: Materials should be continuously reused in a closed-loop system, where waste is minimized or eliminated.

7- Rely on natural energy flows: Design should prioritize the use of renewable energy sources and respect natural energy cycles.

8- Understand the limitations of design: Designers must be humble in recognizing the complexity of ecological systems and avoid overestimating their control over the environment.

9- Seek constant improvement through the process of sharing knowledge: Design should evolve through learning, sharing knowledge, and striving for continual improvement.

These principles emphasised the basic factors that we should follow in terms of sustainability in the design of our cities. At this point, we can see that these principles have not changed much at the point we are at today, and that we need to continue similar steps as designers.

Sustainable development is generally understood to encompass ecological, economic and social dimensions, and these dimensions are often referred to as 'pillars' (Connelly, 2007; Black, 2007). These pillars were introduced at the Congress on Sustainable Development in Johannesburg (2002) and have been further elaborated by various scholars. Although the foundation of sustainable development is based on ecological issues, it has also brought many different issues into question in the time until today. Sustainable development is popularly defined in the Brundtland Commission report *Our Common Future* (1987) as development that meets current needs without jeopardising the ability of future generations to meet their own needs (Hedenus et al., 2018).

The ecological dimension covers a range of factors, including renewable natural resources such as forests, farmland and clean water, as well as the management of pollutants and other environmental impacts. While the economic dimension focuses on the efficient management of the economy and financial resources, the social dimension investigates the social structures necessary for people to fulfil their needs and how to maintain these structures (Hedenus et al., 2018). As an example of an agreement where it is used, the Agenda 2030 for Sustainable Development is a significant international agreement addressing the environmental, economic and social dimensions of sustainability. It is built around 17 Sustainable Development Goals (SDGs) and 169 related targets, calling on all nations globally to take action for a more sustainable future (Hedenus et al., 2018).

Another alternative suggestion for sustainable development is the lighthouse model. This model proposes human needs and wellbeing as a fourth pillar in addition to the three pillar model including social sustainability, economic sustainability and ecological sustainability (Holmberg & Larsson, 2018). One of the driving forces behind this proposal is the aim to define what constitutes human needs and well-being for a fulfilling and quality life. By realising what is considered desirable, it can offer purpose, motivation and direction in guiding change processes. The other one is that given the scale of current human activity on the planet, the way in which human needs and their fulfillment are addressed can significantly affect the dimensions of social, economic and ecological sustainability (Holmberg & Larsson, 2018).

Figure 09 Panoramic Cinema, Tashkent, Uzbekistan
Source: photo by Armin Linke

1.5 Culture as the 4th Sustainability Dimensions

The three- pillar system highlights several concerns in terms of the sustainability of the architecture and contributes to its development, but when it comes to reusing of heritage buildings, the concepts of sustainability and conservation overlap with each other and the three pillar system needs to be further elaborated. Cultural sustainability is often seen in relation to the other three pillars of sustainability, namely environmental, economic and social sustainability, rather than seen seperately (Khan, 1995; Chiu, 2003). It certainly needs recognition as a fundamental dimension of development and establish as a pillar in its own right (Hawkes, 2003).

There is growing interest among academics in integrating culture into sustainable development. Hawkes proposed cultural sustainability as the fourth pillar of sustainability and emphasised its importance in local planning (Hawkes, 2001). Chiu discussed the social and cultural aspects of sustainability in the context of housing (Chiu, 2004). Nurse analysed the role of culture in sustainable development (Nurse, 2006), while Birkeland focused on the cultural sustainability of post-industrial community regeneration (Birkeland, 2008). Throsby approached the issue from the perspective of cultural economy, evaluated cultural economy according to sustainability principles (Throsby, 2001) and then investigated the links between ecological and cultural sustainability (Throsby, 2008). Duxbury and Gillette analysed cultural sustainability through the lens of community development (Duxbury & Gillette, 2007). Despite this growing interest, no systematic scientific studies have been conducted to analyse and elaborate in depth the role and meanings of culture in sustainable development, and the cultural dimension is underrepresented and under-theorised (Throsby, 2008). Culture can be defined in various ways: as a cultured state of mind, as in 'cultural man'; as a process of personal development reflected in 'cultural interests' and 'cultural activities'; as the means of this process, including 'art' and 'human intellectual work'; and as a 'whole way of life' or a 'system of signs' through which the social order is communicated, reproduced, experienced and explored (Williams, 1976).

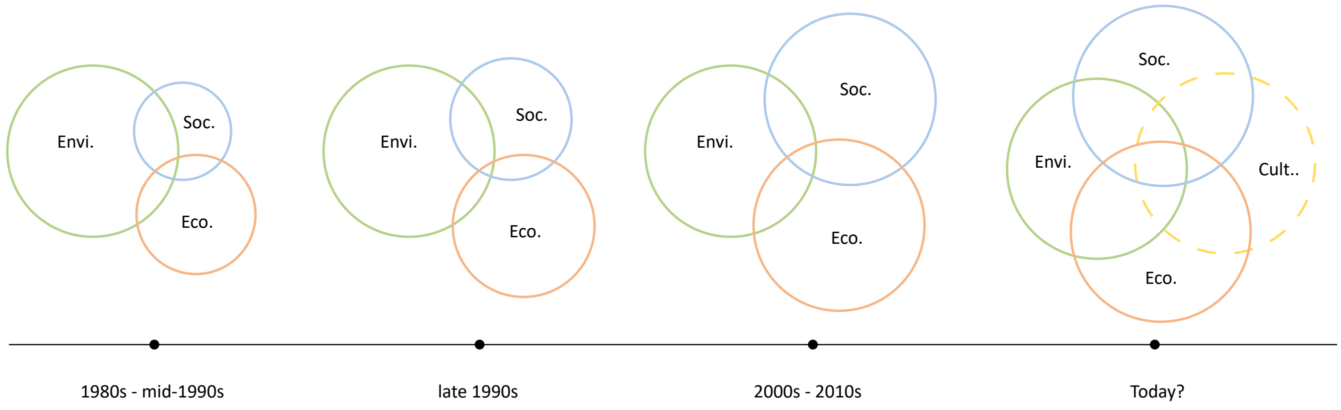


Figure 10 Change of importance of sustainability dimensions
Source: adapted by Social Sustainability: Linking Research to Policy and Practice by Colantonio, A.

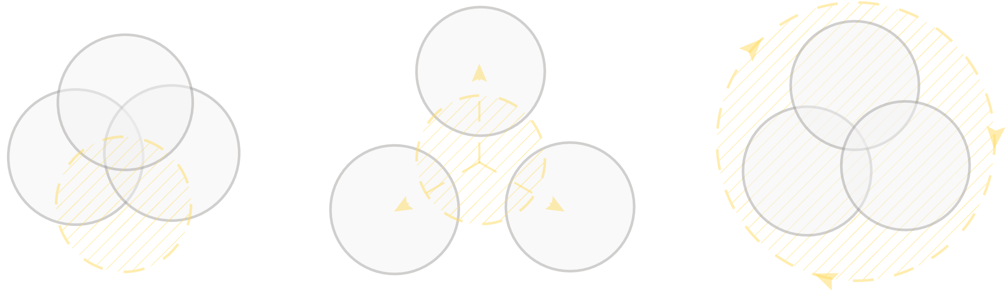
While tangible heritage is concerned with the preservation of physical cultural resources such as historic buildings, monuments and nature reserves, intangible heritage encompasses the knowledge and traditions attached to these material elements. There is often a strong link between tangible and intangible heritage (Soini and Birkeland, 2014). Cultural heritage is often seen as a source of identity closely linked to the local environment and provides compelling reasons for its preservation for future generations. The concept of cultural sustainability emphasises the recovery and preservation of cultural identities (Fersani et al., 2011). Built heritage is valued not only for its role in promoting physical and visual sustainability, but also for enhancing the social and cultural vitality of the area, promoting local identity and creating a sense of place (Vileniske, 2008).

Our understanding of culture and the ways we define it evolve over time and as a result, academics and researchers formulate different approaches to the concept of cultural sustainability, which is concerned with the preservation of cultural beliefs, practices and heritage while adapting to technological developments so cultural continuity and practices are seen as key indicators of cultural sustainability (Postalcı & Atay, 2019).

In social sciences, cultural continuity refers to the transmission of meanings and values inherent in culture over time and generations. It covers the processes related to the transfer of cultural heritage from one generation to another (Oxford References, 2018; Eggan, 1956). Cultural heritage represents a reserve of cultural capital that has been passed down from previous generations and can be preserved and passed on to future generations (Throsby, 2008). It is transmitted from one generation to the next, accumulating and developing over time and in different contexts. It may also, however, face the risk of extinction (Chiu, 2004).

As noted by Hardoy et al. we can identify two main interpretations of cultural sustainability. The first interpretation emphasises how shared values, perceptions and attitudes contribute to sustainable development. The second interpretation sees culture itself as a fundamental element of development and emphasises that culture must adapt with socio-economic changes over time. This transformation should be recognised through the preservation of cultural heritage (Hardoy et al., 1993).

As Cernea points out, even if development projects are economically and environmentally sound, they may fail if they lack cultural and social soundness. This emphasises that cultural sustainability is a prerequisite for sustainable development (Cernea, 1993). Similarly, Thaman argues that for development to be sustainable, it should be based on the cultural values of the society and emphasises that culture is the keystone of sustainable development (Thaman, 2002).



	Culture in sustainability	Culture for sustainability	Culture as sustainability
Definition of culture	cultrue as a capital	culture as a way of life	culture as a semiosis
Culture and development	culture as an achievement in development	culture as a resource and condition for development	development as a cultural process
Value of culture	intrinsic	instrumental and intrinsic	embedded
Culture and society	complementing	affording	transforming
Culture and nature	human perspective on nature	interaction of culture and nature	nature constituent of culture
Policy sectors	cultural policies	all policies	new policies
Modes of governence	hierarchical governance, 1st order	co-governance, 2nd order	self-governance, meta-governance
Research approach	mainly mono- and multidiciplinary	mainly multi- and interdiciplinary	mainly inter- and transdiciplinary

Figure 11 Culture and Sustainability Relation
Source: Culture-Sustainability Relation: Towards a Conceptual Framework by Katrina Soini and Joost Dessein

The concept of cultural sustainability is less developed than that of social sustainability and is frequently grouped under social sustainability because of its social aspects (Chiu, 2004, citing Munro, 1995). It is often seen as an element of social sustainability because of the factors such as equity, participation and sustainability awareness (Murphy, 2012). It also includes social elements such as social capital, infrastructure, justice, equity and active governance (Cuthill, 2009). In addition, it also includes the maintenance and behaviour of socio-cultural practices (Vallace et al., 2011). Cultural frameworks and values shape social life and, consequently, impact perceptions of sustainability and social sustainability as well as social structures affect cultural patterns and practices (Chiu, 2004). It is clear that social and cultural phenomena are interconnected, so to consider cultural sustainability as the fourth pillar, we need to distinguish it from the other three, especially form social sustainability.

While cultural sustainability extends beyond social sustainability, important aspects of sustainable development may be overlooked without a deeper exploration of the role of culture. However, it is also possible that cultural dimensions of sustainability need not be seen as a separate fourth pillar. Instead, culture can be seen as an essential element for achieving sustainable development goals, or as a lens through which social, economic and environmental sustainability can be understood (Soini and Birkeland, 2014).

Soini and Birkeland proposed three roles of culture in sustainable development through a review and analysis of scientific articles using the concept of 'cultural sustainability' and in the following work there are eight dimensions describing these roles. The roles have been systematically analysed and divided into eight dimensions that serve to highlight and distinguish the differences between them. These dimensions include Definition of Culture, Culture and Development, Value of Culture, Culture and Society, Culture and Nature, Policy Sectors, Forms of Governance and Research Approach (Soini & Birkeland, 2014; Soini & Dessein, 2016).

The first representation sees culture as having an independent role in sustainability and positions it as a fourth pillar alongside ecological, social and economic sustainability. This perspective emphasises the importance of protecting, sustaining and preserving cultural capital such as art, heritage, knowledge and cultural diversity for future generations. It recognises that culture is distinct from social sustainability.

The second representation sees culture as an element that plays a mediating role in ensuring economic, social and ecological sustainability. This perspective, called 'culture for sustainability', emphasises both material and immaterial culture as vital resources for local and regional economic development. It also suggests that cultural values and perceptions should be taken into account when achieving ecological and social sustainability goals.

The third representation treats culture as a necessary foundation for achieving the broader goals of sustainability. This perspective, known as 'culture as sustainability', encompasses the other pillars of sustainability by presenting culture as an overarching dimension. In this sense, sustainability is intertwined with culture, fostering the development of an eco-cultural civilisation (Soini & Dessein, 2016).As we see, culture can be involved in sustainable development in different ways. One thing is certain: no matter which categorization system is followed, there is no situation in which the cultural dimension is left behind.

The United Nations Educational, Scientific and Cultural Organisation (UNESCO) emphasises that development cannot be sustainable without the inclusion of 'culture' and its full integration into sustainable development policies (UNESCO, 2014) and today, cultural sustainability is recognised as the fourth pillar of sustainable development alongside economic, environmental and social dimensions (UCLG, 2010). Managing cultural assets involves much more than preserving them, as they are intricately linked to the wider cultural needs of society and can not be isolated. This dynamic interaction between cultural heritage and society closely mirrors the relationship between ecological resources and society (Loach, Rowley & Griffiths, 2016). The challenge here lies in balancing traditional and contemporary forms of material culture that raise visual and aesthetic concerns, especially in urban development where modern architecture is built close to historic structures (Tavenor, 2007; Gunce et al., 2008). While technology can offer effective solutions for the preservation of cultural heritage, such as concrete restoration, it also risks erasing the historic layers of these sites (Short, 2005).

In order to ensure the sustainability of built heritage, it is important to reuse them instead of isolating them, and at this point, doing this by considering the dimensions of sustainability is a high priority in today's world. For this reason, the process of reusing a building with heritage value needs more than the traditional three-pillar sustainability system compared to any building that is reused by considering sustainability dimensions for the embodied energy it contains or to protect the environment from the damage caused by the demolition and reconstruction process. Because heritage buildings carry cultural values in addition to other buildings and cultural factors as well as social, economic and ecological factors are involved in their reusing. Perhaps for this reason, we should include cultural sustainability in the reusing of heritage buildings in the same way as the other three sustainability dimensions.

Chapter 02

Sustainability Rating Systems

Figure 12 Salk Institute, California
Source: photo by Elizabeth Daniels

2.1 What is a Sustainable Building?

What does sustainable building mean? Sustainability has a place not only in architecture, but in almost every aspect of our lives, but as architects we need to be able to define how sustainable a building is, because if it is not sustainable in some terms, we need to be able to follow some strategies to make it more sustainable. At this point, different strategies will have different effects and consequences on buildings. These consequences are even more important if the building has heritage values.

Sustainability is more and more influencing the design and construction of new buildings, fuelled by stricter government regulations and growing environmental awareness among the public. The integration of sustainability into construction can lead to valuable building attributes such as lower resource consumption, improved environmental performance and the creation of healthier, more productive workspaces for building inhabitants. As these benefits have gained significant recognition today, many federal agencies, organisations and local governments are now mandated to incorporate sustainability principles into the planning and design of new development projects (Montoya, 2011).

At this point there are efforts by the authorities to implement sustainability certification systems aiming to reduce the consumption of natural resources and minimise pollution. Buildings certified under these rating systems are generally recognised for lower energy use, improved living conditions and increased property value (Yu and Tu, 2011). Given the different objectives, strategies and practical methods of sustainable development at various levels and fields, sustainability certification systems serve as a means to realise these goals and practices. Essentially, they provide a measurable standard for assessing sustainable development in each specific area (Hamedani and Huber, 2019).

2.2 Existing Sustainable Building Certification Methods

Originally, sustainability assessment tools were primarily designed for buildings, but recently there has been a noticeable shift towards assessing sustainability in neighbourhoods. Several factors are thought to have influenced this shift, including a growing awareness of the significant impact of urban areas on issues such as climate change, population dynamics and economic challenges (Hamedani and Huber, 2019). The growing emphasis on sustainable practices in urban planning reflects a realisation of the complex linkages between urban development and sustainability goals but from an another point, they miss the potential of an important issue which is the sustainable reuse of the heritage buildings.

Over 30% of Italy’s current building stock was constructed prior to World War II and is either in extremely poor conservation or requires significant maintenance (CRESME, 2012). Despite the importance of achieving sustainability targets, including energy efficiency, current European and Italian regulations (European Parliament and Council, 2010, 2012; Il Presidente della Repubblica, 2007) exempt planned buildings from any performance requirements. This has resulted in a missed opportunity to implement a widespread and effective strategy for the improvement of the built environment. However, considering the achievement of sustainability goals, and energy efficiency among them, existing European and Italian legislation (European Parliament and Council 2010, 2012; Il Presidente della Repubblica 2007) excluded scheduled buildings from the application of any performance requirements, thus missing the opportunity for a widespread and effective strategy on the built environment (Bertagni, Boarin & Zuppiroli, 2018).

Although sustainability rating systems have become quite widespread and are in use, their application to historic buildings is still not sufficiently encouraged because they do not include criteria for conservation issues, which are the main topic of discussion in historic buildings.

There are different opinions on the energy efficiency of historic buildings, generally related to high energy demand and poor indoor climate standards, which result in poor indoor comfort(Rasmussen, Møller & Buch-Hansen, 2015; Tomšiˇc et al., 2017). For some, energy efficiency of the heritage buildings is good (Wallsgrove, 2008; English Heritage, 2009; Wood, 2009) or for others they are poor (DCLG, 2006; EHCS, 2007; Boardman, 2007; DCLG, 2006) in terms of energy performance.

These buildings present opportunities for reducing carbon emissions and energy use. The main difficulty in achieving this reduction lies in determining how to make changes without risking the historical and architectural significance of the building (Godwin, 2011).

It is clear that there is a need for sustainability systems that are also considering the cultural part of the problem. We already have some building certification methods around the world to define the level of sustainability of architecture. These certification methods cover the designs of various building typologies and also reused buildings, and evaluate how sustainable the building has become as a result of retrofit interventions. At this point, it would be right to question to what extent these existing systems are connected with the cultural part of sustainability. Some of these evaluation methods that i will introduce in this paper are LEED, GBC Historic Building, BREEAM and DGNB.

2.2.1 LEED Certification System

2.2.1.1 LEED Background and General Concept

The United States Green Building Council (USGBC), which was established in 1993, is a non-profit organisation committed to improving the sustainability practices of the built environment in the United States and LEED (Leadership in Energy and Environmental Design) is a building sustainability certification system that is defined by the USGBC as the most widely used green building rating system in the world as it provides a framework applicable to a wide range of building projects, including new construction, interior renovations and ongoing operations. Achieving LEED certification is internationally recognised as a mark of sustainability based on USGBC (USGBC, 2024).

LEED was introduced in 1998 with the goal of establishing a uniform benchmark for measurement and encouraging integrative, whole-building design practises and since then, the market for green buildings has grown and is expected to continue to grow (Green Building Education Services, 2014). This can be linked to recognised commercial benefits, reductions in operating costs, improvements in the health and well-being of building occupants and other social benefits (Dodge Analytics, 2018). LEED has been a key player in the development of the green building certification system in the world as it focuses on reducing negative impacts on the environment and maximising energy efficiency (Reichardt, 2014). At present, LEED has become one of the most famous certification systems for buildings and is recognised all over the world.

In the LEED system, buildings are evaluated by scoring for each criteria. The total score determines how the building is classified and rated. The system is basically a voluntary certification designed to develop and promote high performance standards of sustainable buildings. It enables designers to assess the environmental impact of design decisions through a comprehensive assessment framework formed into nine key categories that focus on both human health and environmental sustainability. These categories are further divided into criteria that are assessed based on scientific principles. (USGBC, 2024).

Since its first version, the LEED reference guide has been updated and improved, and with each update it has forced the construction industry to stricter standards. LEED, first published as LEED version 1.0, was initially developed as a building rating system for new construction (NC) only. The second version, LEED NC v2.0, was published in 2001, followed by an update to LEED NC v2.2 in 2005. The third version in 2009 included a collection of rating systems for the design, construction and operation of different building types. LEED v4 was released in 2013 and LEED v3 was withdrawn in 2016. In 2020, LEED v4.1 was developed and used together with LEED v4. LEED v5 was introduced in beta form at the 2023 Greenbuild Conference and is expected to be fully released by 2025 and this update marks the most significant change to the LEED rating system in over a decade, aiming to address the pressing climate crisis through a restructured approach focusing on decarbonization, resilience, health, equitable outcomes, and ecosystem support (USGBC, 2024).

Since LEED Version 5 is still in development process, in this paper i will focus on the latest version of LEED which is LEED v4.1 because it introduces updated credit requirements compared to previous versions. With each new version, the requirements become more strict and harder to achieve (Scofield, 2013).

2.2.1.2 LEED V4.1 and LEED BD+C

LEED v4.1 is the latest version of LEED sustainability certification system that was released in 2019. It has multiple rating systems which are:

●LEED BD+C (Building Design + Construction)
●LEED ID+C (Interior Design + Construction)
●LEED O+M (Operations + Maintenance)
●LEED Residential
●LEED Cities and Communities
(USGBC, n.d.)

While each rating system is used in its own specific certification situation, the most appropriate rating systems that we can consider for situations where we can talk about the presence of cultural value are "LEED O+M" if we consider renovating an existing building and aiming to ensure its long-term sustainability," LEED Cities and Communities" if our focus is on cultural values in the larger urban setting or community development, or "LEED BD+C" if the degree to which cultural values in general are considered at the design and development stage.

LEED BD+C focuses on new construction and major renovations, which often involve integrating cultural elements in design, particularly in the context of preserving heritage buildings or reflecting local cultural identity in a more detailed level compared to the other rating systems. So analysing LEED BD+C, we can examine how cultural considerations are incorporated within sustainable building practices, alongside environmental and social factors.

2.2.1.3 LEED BD+C Structure and Point System/Weighting

LEED BD+C consists of nine categories. Each category has different criteria and some of these criteria are prerequisites while others have different values of points. The LEED rating system employs a points-based method to simplify the process by which building project teams deal with complex and frequently competing sustainability challenges. This strategy assists teams in making educated decisions regarding sustainable construction practices by utilizing an integrated process that ensures all building systems operate in harmony (Owens et al., 2013; USGBC, 2011)

Integrative Process (IP)
Location and Transportation (LT)
Sustainable Sites (SS)
Water Efficiency (WE)
Energy and Atmosphere (EA)
Materials and Resources (MR)
Indoor Environmental Quality (EQ)
Innovation (IN)
Regional Priority (RP)

Figure 13 LEED BD+C Categories
Source: LEED v4.1 BD+C

The projects applied to the LEED BD+C rating system must first meet the prerequisites and then must be able to meet the other criteria in the score table in order to obtain one of the various certification levels. The maximum score that can be obtained from the score table is 110. The applied project must score a minimum of 40 points in order to obtain LEED certification. In order for the project to be certified, it must reach 40-49 points, 50-59 points to obtain silver LEED certificate, 60-79 points to obtain gold LEED certificate, and 80-110 points to obtain platinum LEED certificate.

There are eight building/intervention types that LEED BD+C can be applied. These are “New Construction”, “Core and Shell”, “Schools”, “Retail”, “Data Centers”, “Warehouses & Distribution centers”, “Hospitality” and “Healthcare”. Under each category of LEED BD+C, prerequisites and max scores that can obtained are different for each one of these building/intervention types. Therefor each one of them has their own scorecards.

Each category has a different weight in the point system for each building/intervention types. For example for “Core and Shell” (Core and Shell system applies to projects where the developer or owner only controls the building’s shell (e.g., structural elements, facade, HVAC systems, etc.), while the tenants will manage their own interior spaces.) of the maximum 110 points, 1 belongs to Integrative Process (IP), 20 to Location and Transportation (LT), 11 to Sustainable Sites (SS), 11 to Water Efficiency (WE), 33 to Energy and Atmosphere (EA), 14 to Materials and Resources (MR), 10 to Indoor Environmental Quality (EQ), 6 to Innovation (IN) and 4 to Regional Priority (RP). Among these categories energy-related points dominate with a share of 30% of the overall certification score. A good score in the EA area usually results in a higher level of LEED accreditation (Gurgun & Arditi, 2018; Al-Ghamdi & Bilec, 2015). This shows us that the weight priority in the scoring system is generally related to the energy performance of the building in question.

Categories	New Cons.	Core and Shell	Schools	Retail	Data Centers	Warehou. and Dist. Cent.	Hospitality	Healthcare
Integrative Process (IP)	1	1	1	1	1	1	1	1
Location and Transportation (LT)	16	20	15	16	16	16	16	9
Sustainable Sites (SS)	10	11	12	10	10	10	10	9
Water Efficiency (WE)	11	11	12	12	11	11	11	11
Energy and Atmosphere (EA)	33	33	31	33	33	33	33	35
Materials and Resources (MR)	13	14	13	13	13	13	13	19
Indoor Environmental Quality (EQ)	16	10	16	15	16	16	16	16
Innovation (IN)	6	6	6	6	6	6	6	6
Regional Priority (RP)	4	4	4	4	4	4	4	4
Maximum Point	110	110	110	110	110	110	110	110

Figure 14 LEED BD+C Category Points for each Building Types
Source: LEED v4.1 BD+C

2.2.1.4 LEED BD+C For Core and Shell Analyses

Integrative Process (IP)

Intent:

Encouraging different project teams to work together to optimize different building systems and overall performance of the building. Supporting the early analysis of the interrelationships among systems to achieve high performance and cost effective projects (USGBC, 2024).

Integrative Process (IP) (for Core and Shell)	
Integrative Process	1
Maximum Point	1

Figure 15 LEED BD+C for Core and Shell Integrated Process Point Distribution
Source: LEED v4.1 BD+C

Evaluation of Cultural value aspects:

Since this category is about identifying and using the existing opportunities starting from pre-design phase suggesting the teamwork and communication of experts of different topics, it has a potential to include also the local communities and cultural experts to turn design phases into a process in which cultural factors are also taken into consideration. At the moment, the category mostly includes the harmonisation of technical systems. At the same time, it considers the dimension of social sustainability by taking into account concepts such as social equity and Health & Well-being, but including also the cultural sustainability can create an environment where the impact of the proposed technical systems on a historical building is also considered.

Location and Transportation (LT)

Intent:

Minimizing the environmental impact of the project site encouraging the selection of mostly dense urban locations for the project. Avoiding the development on inappropriate sites like environmentally sensitive lands. This category also encourages the use of public transportation, electric vehicle using or bicycling and reducing vehicle distance traveled considering greenhouse gas emissions, air pollution, and other environmental and public health harms associated with motor vehicle use. One of the other concerns of the category is reducing parking footprint (USGBC, 2024).

Figure 16 LEED BD+C for Core and Shell Location and Transportation Point Distribution
Source: LEED v4.1 BD+C

Location and Transportation (LT) (for Core and Shell)	
LEED for Neighborhood Development Location	20
Sensitive Land Protection	2
High Priority Site and Equitable Development	3
Surrounding Density and Diverse Uses	6
Access to Quality Transit	6
Bicycle Facilities	1
Reduced Parking Footprint	1
Electric Vehicles	1
Maximum Point	20

Evaluation of Cultural value aspects:

In general, the category proposes to design projects in dense, previously used areas of the city with a focus on minimising environmental impacts, but this proposal indirectly creates an opportunity to transform and reuse historic neighbourhoods. At this point, the opportunity to preserve cultural values can be emphasised at the site selection stage. Today most of the historical neighbourhoods are already placed in the dense areas of the cities and using the footprint of an existing building already fulfils some of the criteria under the category without any extra effort and shortens the distances travelled.

Sustainable Sites (SS)

Intent:

Selecting project sites in a way that minimising environmental impact and supporting natural ecosystems during the development of the project also restoring the natural habitats and promoting biodiversity. Minimizing the negative impacts of site development to preserve and promote natural environments around the project site. Category also values the open spaces that are created to encourage social interactions and physical activities (USGBC, 2024).

Sustainable Sites (SS) (for Core and Shell)	
Construction Activity Pollution Prevention	Required
Site Assessment	1
Protect or Restore Habitat	2
Open Space	1
Rainwater Management	3
Heat Island Reduction	2
Light Pollution Reduction	1
Tenant Design and Construction Guidelines	1
Maximum Point	11

Figure 17 LEED BD+C for Core and Shell Sustainable Sites Point Distribution
Source: LEED v4.1 BD+C

Evaluation of Cultural value aspects:

Although the category generally aims to prevent negative impacts on the natural ecosystem caused by the project, it also states that the cultural and social situation of the land should be evaluated before the project. Some of the criteria are related to conserving existing natural areas and restoring damaged areas to provide habitat and promote biodiversity, and although this is focused on ecology part, it has the potential to apply to the cultural values of the site. Some of the criteria of the category encourage the design of open space to foster social interactions and mention that tenants should be informed about sustainable design implementations. The only way culture can be sustained is if it lives through social interactions and is carried on by conscious users. At this point, these criteria have the potential to be applied to cultural sustainability.

Water Efficiency (WE)

Intent:

Reducing and optimizing the amount of indoor and outdoor water used in the building and minimizing the negative impacts on water resources (USGBC, 2024).

Water Efficiency (WE) (for Core and Shell)		
Outdoor Water Use Reduction		Required
Indoor Water Use Reduction		Required
Building-Level Water Metering		Required
Outdoor Water Use Reduction		3
Indoor Water Use Reduction		4
Optimize Process Water Use		3
Water Metering		1
	Maximum Point	11

Figure 18 LEED BD+C for Core and Shell Water Efficiency Point Distribution
Source: LEED v4.1 BD+C

Evaluation of Cultural value aspects:

This category is generally related to water efficiency and does not have much connection with cultural factors. If the subject project site contains a water feature of cultural significance, this category may be expanded to include the consideration of this feature in the project.

Energy and Atmosphere (EA)

Intent:

Optimizing energy performance through efficient HVAC systems, building envelope design, and lighting systems, reducing excessive energy use and greenhouse gas emissions, identifying opportunities for additional energy savings by tracking building-level and system-level energy use and reducing fossil fuel use (USGBC, 2024).

Energy and Atmosphere (EA) (for Core and Shell)	
Fundamental Commissioning and Verification	Required
Minimum Energy Performance	Required
Building-Level Energy Metering	Required
Fundamental Refrigerant Management	Required
Enhanced Commissioning	6
Optimize Energy Performance	18
Advanced Energy Metering	1
Grid Harmonization	2
Renewable Energy	5
Enhanced Refrigerant Management	1
Maximum Point	33

Figure 19 LEED BD+C for Core and Shell Energy and Atmosphere Point Distribution
Source: LEED v4.1 BD+C

Evaluation of Cultural value aspects:

This category little to no relation with the cultural aspects and mainly focused on the energy part of the building. In project scenarios where historical buildings are used, the quality of the existing building can be valued by using the fusion of the natural systems of the old building and the mechanical systems to be newly implemented.

Materials and Resources (MR)

Intent:

Reducing the amount of waste that may be generated during and after the project construction and to encourage the use of environmentally friendly materials such as recycled materials, locally sourced materials and rapidly renewable materials. Emphasizing the life-cycle assessments of building and encouraging adaptive reuse maintaining the existing building structure, envelope, and interior (USGBC, 2024).

Materials and Resources (MR) (for Core and Shell)	
Storage and Collection of Recyclables	Required
Building Life-Cycle Impact Reduction	6
Environmental Product Declarations	2
Sourcing of Raw Materials	2
Material Ingredients	2
Construction and Demolition Waste Management	2
Maximum Point	14

Figure 20 LEED BD+C for Core and Shell Materials and Resources Point Distribution
Source: LEED v4.1 BD+C

Evaluation of Cultural value aspects:

Using locally sourced materials or recycled materials can support and preserve cultural heritage and in addition to this, using traditional construction techniques specific to the region can be a way to sustain culture. This category also encourages the use of existing building structures, envelopes and interiors. This is directly related to the preservation of historic buildings. The reuse of an existing building provides significant material recycling and leads to the utilisation of existing embodied carbon. At the same time, the re-use of a forgotten building is an important potential for cultural sustainability if that building has cultural value.

Indoor Environmental Quality (EQ)

Intent:

Enhancing the indoor environment to improve occupant health, comfort, and well-being. Improving air quality through correct ventilation, reducing indoor pollutants, and using low-emitting materials. Providing daylight, quality views and thermal comfort to occupants (USGBC, 2024).

Indoor Environmental Quality (EQ) (for Core and Shell)	
Minimum Indoor Air Quality Performance	Required
Environmental Tobacco Smoke Control	Required
Enhanced Indoor Air Quality Strategies	2
Low-Emitting Materials	3
Construction Indoor Air Quality Management Plan	1
Daylight	3
Quality Views	1
Maximum Point	10

Figure 21 LEED BD+C for Core and Shell
Indoor Environmental Quality Point Distribution
Source: LEED v4.1 BD+C

Evaluation of Cultural value aspects:

Although this category is generally focussed on interventions that favour the health, comfort and well-being of users in heritage buildings, the preservation of original interior elements can also provide good environmental quality and contribute to the preservation of the cultural value of the building. Existing values can be preserved and interior quality can be improved with new technology systems.

Innovation (IN)

Intent:

Encouraging the adaptation of innovative strategies that are not addressed in the LEED green building rating system and allowing project teams to propose their own innovative credit for solutions that don' exist in LEED requirements (USGBC, 2024).

Innovation (IN) (for Core and Shell)	
Innovation	5
LEED Accredited Professional	1
Maximum Point	6

Figure 22 LEED BD+C for Core and Shell Innovation Point Distribution
Source: LEED v4.1 BD+C

Evaluation of Cultural value aspects:

This category gives project teams custom credits and these credits can be used related to cultural heritage preservation, or community-centered practices.

Reigonal Priority (RP)

Intent:

Providing an incentive for the achievement of credits that address geographically specific environmental, social equity, and public health priorities (USGBC, 2024).

Regional Priority (RP) (for Core and Shell)	
Regional Priority: Specific Credit	1
Regional Priority: Specific Credit	1
Regional Priority: Specific Credit	1
Regional Priority: Specific Credit	1
Maximum Point	4

Figure 23 LEED BD+C for Core and Shell Regional Priority Quality Point Distribution
Source: LEED v4.1 BD+C

Evaluation of Cultural value aspects:

In this category project can earn up to four of the six Regional Priority credits. It is design to address location-specific environmental challenges and mainly focused on environmental issues but it also has a potential to align regional cultural priorities within the broader sustainability framework.

2.2.1.5 Comparison of Different LEED Versions

From its 1998 pilot version, LEED was initially a rating system consisting of 57 criteria and a total of 70 points, but has since evolved into many different rating systems (e.g., LEED for New Construction, LEED for Core and Shell etc.), each with its own point and criteria system for specific cases. The scores assigned to each criteria can differ greatly, even when credits are the same across rating systems. This indicates that, in terms of sustainability requirements, projects that obtain the same degree of certification across the different systems are essentially equivalent (Madson et al., 2022). So the importance and weightings of each criteria changes over time and some topics gains more importance. Yet, there is also the perception that with each updated version, the new version becomes more demanding, and this is mainly due to the emergence of new technologies and materials with the passage of time, raising the standards (Scofield, 2013).

We can see that new categories are being added with the new LEED versions. For example unlike LEED v3 and before, with LEED v4, it is possible to read that the project location has gained importance and in this sense, the selection of the project site has become more remarkable. At this point, making especially abandoned buildings in dense urban areas a project focus becomes more attractive with LEED v4, but apart from such indirect readings, it is still difficult to say that the new LEED versions have started to prioritise the issue of cultural sustainability.

Categories	LEED v2.2	LEED v3 (2009)	LEED v4
Integrative Process (IP)	-	-	1 (0.9%)
Location and Transportation (LT)	-	-	16(14.6%)
Sustainable Sites (SS)	14 (20.3%)	26 (23.6%)	10 (9.1%)
Water Efficiency (WE)	5 (7.3%)	10 (9.1%)	11 (10%)
Energy and Atmosphere (EA)	17 (24.6%)	35 (31.8%)	33 (30%)
Materials and Resources (MR)	13 (18.8%)	14 (12.7%)	13 (11.8%)
Indoor Environmental Quality (EQ)	15 (21.7%)	15 (13.6%)	16 (14.5%)
Innovation (IN)	5 (7.3%)	6 (5.5%)	6 (5.5%)
Regional Priority (RP)	-	4 (3.7%)	4 (3.6%)
Maximum Point	69	110	110

Figure 24 Different LEED Versions Score Comparison
Source: Adapted from (Amiri, Ottelin, and Sorvari, 2019)

When we look at all LEED categories and the development between different versions in general, it is possible to see that cultural sustainability inevitably overlaps with the requirements of different categories due to its nature, but as I mentioned in the previous chapters, it has started to be understood that cultural sustainability has at least equal importance with other sustainability dimensions. At this point, sustainability rating systems need to treat it as of higher importance just like other dimensions. It is a primary necessity to produce different categories for this purpose or to reconsider the existing categories.

2.2.2 GBC Certification System

2.2.2.1 GBC Background and General Concept

The Italian Green Building Council developed a local version of one LEED rating system for New Construction and Major Renovation named "LEED Italia" using the existing LEED v3 (2009) in 2010 (GBC Italia, 2010). LEED Italia did not cover particular difficulties related to historical and cultural values that the built environment may have, although the protocol was technically applicable to historic buildings, it was not suitable for historic building retrofitting projects as it was not in line with established conservation principles and strategies (Castaldo et al., 2017). Because of that GBC Italy gathered more than 70 specialists that are experts in the green building practice and in the restoration field in total to develop a new system by the combination of two existing products: "LEED Italia 2009 New Construction and Major Renovation" and "GBC Home". The merged product is now called "GBC Historic Building" and the aim of it is to achieve high energy performances while maintaining and transmitting the historical and testimonial values of cultural heritage (GBC Italia, 2011).

According to the GBC, historic buildings are those that are considered 'material witnesses of civilisational power' (Franceschini, 1967). By this definition, the buildings analysed should show characteristics associated with pre-industrial construction methods, defined as those typically constructed in Europe before 1945 (end of World War 2) because this period marks a significant transformation in the construction industry in terms of materials, techniques and technologies. Specifically, at least 50% of the structure must consist of the current technical components, which must be confirmed by a certificate called the "historic building identity card." In accordance with the Italian Standard UNI 8290: 1981's classification of technological systems, this card gathers all pertinent qualitative and quantitative information about the building (Boarin, Guglielmino and Zuppiroli, 2014; UNI, 1981). It is important to transform the current LEED rating system to achieve a more appropriate system for the reuse of historic buildings, but at the same time, limiting it to pre-1945 buildings leads to the exclusion of recent heritage buildings (e.g. many buildings produced in the Brutalism movement).

The idea of "cultural sustainability" highlights how crucial it is to preserve existing structures that are recognized to have cultural significance. It implies that, especially when it comes to heritage monuments, contemporary restoration techniques can be viewed as sustainable acts. In this regard, GBC Historic Building stands out as an innovative system that positioning restoration as a crucial sustainable intervention for structures with acknowledged cultural value. This viewpoint is consistent with broader discussions in the field of historic conservation, where preserving the cultural significance of existing structures is crucial for advancing sustainability (Lucchi et al., 2016). At this point, the GBC Historic Building system is valuable because it seeks a solution to an important problem with its cultural approach to sustainability compared to other existing sustainable certification methods.

2.2.2.2 GBC Historic Building Structure and Point System/Weighting

The GBC Historic Building follows the structure of the LEED 2009 (v3) certification system and in addition includes perhaps the most critical category of the system, 'Historic Value'. Prerequisites, mandatory requirements and credits are available in each category, following the typical structure of LEED protocols. It has eight categories, including the newly added one.

The most current version available on the market is GBC Historic Building 2016 Edition which is lately revised in June 2024. In this version, just like LEED, the maximum points that can be earned is 110. 20 of the 110 points belong to Historic Value (HV), 13 to Sustainable Sites (SS), 8 to Water Efficiency (WE), 29 to Energy & Atmosphere (EA), 14 to Materials & Resources (MR), 16 to Indoor Environmental Quality (EQ), 6 to Innovation in design (IN) and 4 to Regional priority (RP). The GBC applied project must score a minimum of 40 points in order to obtain a certification. In order for the project to be certified, it must reach 40-49 points, 50-59 points to obtain silver certificate, 60-79 points to obtain gold certificate, and equal or more than 80 points to obtain platinum certificate (Green Building Council Italia, 2024a; Green Building Council Italia, 2024b)

Categories	Assignable Points	Weight of area compared to protocol [%]
Historic Value (HV)	20	18 %
Sustainable Sites (SS)	13	12 %
Water Efficiency (WE)	8	7 %
Energy and Atmosphere (EA)	29	26 %
Materials and Resources (MR)	14	13 %
Indoor Environmental Quality (EQ)	16	15 %
Innovation in Design (IN)	6	5 %
Regional Priority (RP)	4	4 %
Maximum Point	110	

Figure 25 GBC Historic Building Categories and Point Distribution
Source: adapted from (Green Building Council Italia, 2024a)

2.2.2.3 GBC Historic Building Analyses

Historic Value (HV)

Intent:

Promoting the detailed analyses of the historic buildings in terms of materials, degradation and the current status of the materials and current status of the existing structure before design phase to be able to recognize and describe the historical-cultural value of them. Encouraging the teams to determine the energy performance status of the buildings in question to develop design strategies to improve performance and preservation of elements of architectural interest. Identifying the principal causes of degradation and evaluating the static structure resistance characteristics of the building to preserve the existing historic structure minimizing the replacement of historic elements with new structures or materials and having compatibility. Minimizing the interventions and ensuring reversibility of the interventions to be sure they are not affecting the integrity of historic structures with historical-cultural value. Identifying the possible use which favours good preservation over time. Minimizing the adverse effects on the environment of construction site activities and integrating as much as professional knowledge and expertise in the process as possible (Green Building Council Italia, 2024a).

Historic Value (HV)	
Preliminary analysis	Required
Advanced analysis: energy audit	3
Advanced analysis: diagnostic tests on materials and degradation	2
Advanced analysis: diagnostic tests on structures and structural monitoring	3
Project reversibility	2
Compatible end-use	2
Chemical and physical compatibility of integrated materials	2
Structural compatibility	2
Sustainable restoration site	1
Scheduled maintenance plan	2
Specialist in restoration of architectural heritage and landscape	1
Maximum Point	20

Figure 26 GBC HB Historic Value Point Distribution
Source: GBC Historic Building 2016 Edition

Evaluation of Cultural value aspects:

'Historic Value' is as a newly added category on top of the categories in the LEED system with GBC Historic Building and it is the most remarkable part of the system when we consider cultural values. Other categories also include aspects of cultural sustainability under different criteria, but this category directly addresses the cultural and historical significance of buildings, focusing on preserving architectural features, materials and techniques that define the buildings historical character and value.

The category pays close attention to the different stages of the restoration process, such as the preliminary investigative stage, the project stage and the construction stage. Preliminary investigative stage creates the basics of the intervention thoughts and in the case of buildings with cultural value, it is perhaps of the greatest importance in order to understand the values of this structure and to shape the decisions to be made in the future in consideration of these values. At this point, it is very important to create intervention decisions by observing the preservation of the values of the structure in advance, but it is equally important to follow up the implementation of these decisions in appropriate ways during project and construction stages (Boarin, Guglielmino, and Zuppiroli, 2014).

The category promotes project reversibility under a separate criterion and structural compatibility under another criterion. These are some of the most important points in terms of restoring buildings of cultural value. It is important that the existing is not destroyed and is brought back to usable standards without disturbing it and losing its value. In addition, the category encourages working with architecture and landscape specialists as much as possible, which is an important aspect of the category in terms of cultural valuation.

Sustainable Sites (SS)

Intent:

Minimizing the environmental impact of the construction site. Minimizing environmental impact and supporting natural ecosystems during the development of the project also restoring the natural habitats, recovering and preserving existing habitats and cultural heritage, parks and historic gardens. This category also encourages the use of public transportation, bicycling and reducing vehicle distance traveled considering greenhouse gas emissions, air pollution, and other environmental and public health harms associated with motor vehicle use. One of the other concerns of the category is reducing parking footprint (Green Building Council Italia, 2024a).

Sustainable Sites (SS)	
Construction Activity Pollution Prevention	Required
Brownfield redevelopment	2
Alternative transportation: public transportation access	1
Alternative transportation: bicycle storage and changing rooms	1
Alternative transportation: low-emitting and fuel-efficient vehicles	1
Alternative transportation: parking capacity	1
Site development: open spaces recovery	2
Stormwater design: quantity and quality control	2
Heat island effect: non-roof and roof	2
Light pollution reduction	1
Maximum Point	13

Figure 27 GBC HB Sustainable Sites Point Distribution
Source: GBC Historic Building 2016 Edition

Evaluation of Cultural value aspects:

This category of GBC Historic Building shows a lot of similarities to LEED versions of it. In the newest LEED version (v4.1), this category is expanded into two categories as "Location and Transportation" and "Sustainable Sites". In that new version of LEED, the categories are more in depth and in this way they touch topic about culture more. Recovering and preserving existing habitats and cultural heritage, parks and historic gardens is a way of sustain the layered culture within the project area. In some criteria in the category it is suggested to recover the functionality of existing management systems. This is an important approach in terms of keeping the integrity of the historical building.

Water Efficiency (WE)

Intent:

Metering, reducing and optimizing the amount of indoor and outdoor water used in the building and minimizing the negative impacts on water resources (Green Building Council Italia, 2024a).

Water Efficiency (WE)	
Water use reduction	Required
Water efficient landscaping	3
Water use reduction	3
Water metering	2
Maximum Point	8

Figure 28 GBC HB
Water Efficiency Point Distribution
Source: GBC Historic Building 2016 Edition

Evaluation of Cultural value aspects:

This is a very technical focused category and does not relate to cultural side. If the subject project site contains a water feature of cultural significance, this category may be expanded to include the consideration of this feature in the project.

Energy and Atmosphere (EA)

Intent:

Promoting an increasing level of autonomous energy production from renewable sources in order to reduce environmental and economic impact of energy production from fossil fuels, optimizing energy performance, reducing excessive energy use and greenhouse gas emissions, identifying opportunities for additional energy savings by tracking energy use and reducing fossil fuel use (Green Building Council Italia, 2024a).

Energy and Atmosphere (EA)	
Fundamental commissioning of building energy systems	Required
Minimum energy performance	Required
Fundamental refrigerant management	Required
Optimize energy performance	17
Renewable energies	6
Enhanced commissioning	2
Enhanced refrigerant management	1
Measurement and verifi cation	3
Maximum Point	29

Figure 29 GBC HB Energy and Atmosphere Point Distribution
Source: GBC Historic Building 2016 Edition

Evaluation of Cultural value aspects:

This category little to no relation with the cultural aspects and mainly focused on the energy part of the building. Under some criteria, "respecting the historic-artistic and testimonial features of the building" is mentioned as th intent for energy efficiency interventions, but there is no encouragement when the details of the criteria are analysed.

Materials and Resources (MR)

Intent:

Reducing the amount of waste that may be generated during and after the project construction and to encourage the use of environmentally friendly materials such as recycled materials, locally sourced materials and rapidly renewable materials. Emphasizing the life-cycle assessments of building and encouraging adaptive reuse maintaining the existing building materials. Promoting the use of the existing technical elements and finishes (Green Building Council Italia, 2024a).

Materials and Resources (MR)	
Storage and collection of recyclables	Required
Demolition and construction waste management	Required
Building reuse	Required
Building reuse: maintaining existing technical element and finishing	3
Demolition and construction waste management	2
Materials reuse	2
Building product environmental optimization	5
Regional materials	2
Maximum Point	14

Figure 30 GBC HB
Materials and Resources Point Distribution
Source: GBC Historic Building 2016 Edition

Evaluation of Cultural value aspects:

Under the "building reuse" criteria of the category it is shown that using and existing heritage building and extending the life cycle of it preserving the "heritage material" as an environmental, social and cultural resource is mandatory so it does not bring any points to the certification but giving the project some points just to promote investing in the reuse of the existing heritage buildings could be a better way to preserve culture. This category also promotes the use of the existing technical elements and finishes so it helps maintaining the historic character of the building. In addition to that it encourages the use of materials from original quarries or production sites and this may also help keeping the cultural integrity and harmony of the heritage buildings in question supporting the use of local resources.

Indoor Environmental Quality (EQ)

Intent:

Enhancing the indoor environment to improve occupant health, comfort, and well-being. Improving air quality through correct ventilation, reducing indoor pollutants, and using low-emitting materials. Providing daylight, quality views and thermal comfort to occupants (Green Building Council Italia, 2024a).

Indoor Environmental Quality (EQ)	
Minimum indoor air quality performance (IAQ)	Required
Environmental Tobacco Smoke (ETS) control	Required
Air monitoring	2
Outdoor air delivery monitoring	2
Construction IAQ management plan: during construction	1
Construction IAQ management plan: before occupancy	1
Low-emitting materials: adhesives and sealants	1
Low-emitting materials: paints and coatings	1
Low-emitting materials: flooring systems	1
Low-emitting materials: composite wood and agrifiber products	1
Indoor chemical and pollutant source control	1
Controllability of systems: lighting	1
Controllability of systems: thermal comfort	1
Thermal comfort: design	1
Thermal comfort: verification	2
Maximum Point	16

Figure 31 GBC HB Indoor Environmental QualityPoint Distribution
Source: GBC Historic Building 2016 Edition

Evaluation of Cultural value aspects:

The category primarily focuses on occupant comfort and health. However, by promoting the preservation of original interior features like windows, moldings, or wall materials while enhancing indoor conditions, it indirectly promotes cultural sustainability when used in historic structures. Ensuring the quality of the interior is a matter of preserving, revitalising, and observing the existing quality architecture. At the same time, it is important for the cultural integrity of the building to preserve what already exists while making interventions.

Innovation in Design (IN)

Intent:

Encouraging the adaptation of innovative strategies that are not addressed in the GBC Historic Building rating system and allowing project teams to propose their own innovative credit for solutions that do not exist in GBC Historic Building requirements (Green Building Council Italia, 2024a).

Innovation in design (IN)	
Innovation in design	5
GBC Accredited Professional	1
Maximum Point	6

Figure 32 GBC HB Innovation in Design Point Distribution
Source: GBC Historic Building 2016 Edition

Evaluation of Cultural value aspects:

This category encourages project teams to innovate and adopt unique strategies, making it an ideal avenue for cultural sustainability, with great potential for each heritage building to have its own unique design possibilities. Each of the buildings with heritage value may have different characteristics of that period as they were produced in different periods. This category is therefore well suited to turning these differences into opportunities.

Regional Priority(RP)

Intent:

Providing an incentive for the achievement of credits that address local priorities (Green Building Council Italia, 2024a).

Regional Priority (RP)	
Regional priority	1
Regional priority	1
Regional priority	1
Regional priority	1
Maximum Point	4

Figure 33 GBC HB Indoor Environmental QualityPoint Distribution
Source: GBC Historic Building 2016 Edition

Evaluation of Cultural value aspects:

In this category project can earn up to four of the six Regional Priority credits. It is design to address location-specific environmental challenges and mainly focused on environmental issues but it also has a potential to align regional cultural priorities within the broader sustainability framework.

2.2.2.4 Comparison Gbc Historic Building and Leed Bd+C v4.1 in Terms Of Culture

If we compare LEED and GBC Historic Building, we can say that GBC HB has a positive intention by making additions and adjustments to LEED v3 to consider heritage buildings. The biggest change brought by GBC HB is the inclusion of the 'Historic Value' category. By using LEED v3 almost as it is, the system has included the points that it finds important in terms of heritage with this new category. The fact that the system follows this path is wise in terms of encouraging the market, which is familiar with LEED, to accept GBC HB more easily and to encourage the retrofit of historic buildings. The Historic Value category seems to be an incentive to follow the right way in retrofit interventions of buildings with heritage value. The category alone allows a total of 20 points to be collected in total and stands at an important point to reach the GBC HB "certified" level, which is the lowest level that can be reached by collecting 40 points. At the same time, with the Historic Value category, the weighting system in LEED v3 was almost preserved, and this new category was allocated an almost equal percentage of points from all other categories.

If we look at the situation from the other side, LEED has continuously updated its sustainability rating systems with different versions over the years and LEED v3 is not currently used in the market. As of today, we can reach LEED v4.1, the latest version of LEED, and the release of LEED v5 is planned for 2025. At this point, we can notice that GBC HB, which is based on LEED v3, is a little behind. With LEED v4.1, the system has become more comprehensive. With the newly added categories, the criteria have been more detailed and adapted to the changing sector conditions. When we look at LEED v4.1, we see that the general concern of the system is not cultural sustainability, but since the criteria are focused on solving current problems, we can say that they inevitably overlap with cultural sustainability concerns. If a system like GBC HB, which is integrated with LEED but centred on buildings with historic value, is desired, perhaps a system approach that updates itself in parallel with LEED systems can be adopted.

As a result, both sustainability rating systems have important potentials for cultural sustainability, which has become the 4th dimension of sustainability today. As I mentioned in the previous sections, cultural sustainability is not only a different 4th dimension, but can also be seen within other dimensions of sustainability. In this respect, we can see factors that indirectly consider cultural sustainability in the different criteria of the two systems. At this point, it may be better to make these factors more explicit in terms of cultural sustainability.

Categories	LEED v3		GBC Historic Building		LEED v4.1 (Core and Shell)	
	Points	Weightings	Points	Weightings	Points	Weightings
Integrative Process (IP)	-	-	-	-	1	1%
Location and Transportation (LT)	-	-	-	-	20	18
Historic Value (HV)	-	-	20	18%	-	-
Sustainable Sites (SS)	26	23%	13	12%	11	10%
Water Efficiency (WE)	10	9%	8	7%	11	10%
Energy and Atmosphere (EA)	35	31%	29	26%	33	30%
Materials and Resources (MR)	14	12%	14	13%	14	13%
Indoor Environmental Quality (EQ)	15	13%	16	15%	10	9%
Innovation in Design (IN)	6	5%	6	5%	6	5%
Regional Priority (RP)	4	3%	4	4%	4	4%
Maximum Point	110		110		110	

Figure 34 Comparison between the allocation of points and weightings for each topic in LEED v3, GBC Historic Building and LEED v4.1 Core and Shell

2.2.3 BREEAM Certification System

2.2.3.1 BREEAM Background and General Concept

BREEAM is recognized as the world's first and most commonly used sustainability assessment standard. It was developed in the United Kingdom by Building Research Establishment Global Limited (BRE Global Ltd.), and it is currently supported by National Scheme Operators (NSOs), which are independent organisations that adapt BREEAM to local situations. BREEAM provides both 'country-specific schemes', which are developed by NSOs for specific regions, and 'international schemes', which can be used for projects that are not covered by a local scheme. BREEAM's guiding principles include providing a 'universal assessment framework' that may be tailored to account for distinct geographical elements such as regulatory standards, climate, and sector-specific needs (BRE Global, 2024).

BRE was founded in 1921 as the Building Research Station, a UK government institution dedicated to developing construction and materials standards. There were other research organizations at the time, particularly those focused on wood-based materials and fire safety. In 1972, these groups joined to become the Building Research Establishment (BRE). In the early 1980s, BRE began developing a certification system, which culminated in the release of the first BREEAM version in 1990, tailored for office buildings. This certification established the framework for environmental performance requirements in the construction sector, eventually evolving into the comprehensive system that is BREEAM today (BRE Global, 2024)

BREEAM is an important system to consider because it has been used to certify over 590,000 assessments of buildings across the building life cycle and is being applied in over 85 countries over the years (BRE Global Ltd, 2023).

BREEAM sustainability rating system has been revised several times over the years. There are different varients and different versions for each varient. The main varients are:

●BREEAM Communities: for the master-planning of a larger community of buildings.
●BREEAM Infrastructure (formerly CEEQUAL): for civil engineering, infrastructure, landscaping and public realm works.
●BREEAM New Construction: for new build domestic and non-domesticbuildings.
●Home Quality Mark: for new-build dwellings (in the UK only).
●BREEAM In-Use: for existing buildings in operation.
●BREEAM Refurbishment and Fit-out: for domestic and non-domestic building fit-outs and refurbishments.

In the search for the inclusion or exclusion of cultural elements in sustainability rating systems, BREEAM Communities, BREEAM New Construction and BREEAM Refurbishment and Fit-out variations seem to be more suitable. BREEAM Communities might relevant for analyzing community engagement and cultural considerations in large-scale developments while BREEAM New Construction might relevant because its the latest version and includes credits that can indirectly support cultural sustainability. BREEAM Refurbishment and Fit-out, on the other hand, seems to be more in line with cultural values as it includes the preservation, adaptation and retrofitting of existing buildings. For this reason it will be more efficient to look in depth at BREEAM Refurbishment and Fit-out.

At the same time in the technical manual of BREEAM, it is suggested that for smaller projects, where the total development area is less than 1000m^2, a single BREEAM assessment can be undertaken to cover both the new-build and refurbished areas and the choice of BREEAM New Construction or BREEAM Refurbishment and Fit-out scheme should be based on whichever (new-build or refurbishment) constitutes the majority of the assessed floor area (BRE Global Ltd, 2023).

2.2.3.2 BREEAM Structure and Point System/Weighting

BREEAM includes ten different categories. Each category has different criteria and different values of points for each criteria.

Management
Health and Wellbeing
Energy
Transport
Water
Materials
Waste
Land use and Ecology
Polution
Innovation

Figure 35 BREEAM Categories and Point Distribution
Source: adapted from (BRE Global Ltd, 2023)

BREEAM's scoring system assesses the environmental impact of a building by awarding credits in these ten assessment categories. The score for each category is then adjusted using specific 'environmental section weights' to reflect its importance. The combined, weighted scores provide an overall score which is then converted into one of five ratings: Pass, Good, Very Good, Excellent or Outstanding. Projects need to get at least 30 points to Pass, 45 points to get Good rating, 55 points to get Very good rating, 70 points to get Excellent rating and 85 points to get Outstanding rating (BRE Global, 2024).

Choosing the appropriate evaluation elements based on the project type and scope is the first step in determining the final BREEAM score. Using the standards outlined in the technical guidelines, the BREEAM Assessor then decides how many credits are given for each of the environmental areas. Each section's allocated weighting is multiplied by the proportion of credits earned in that part. The total environmental score is calculated by adding the weighted section scores. If all the minimal requirements are fulfilled, the project's rating is determined by comparing its total score to BREEAM rating benchmarks. Furthermore, each innovation credit acquired might raise the final score by 1% (up to a maximum of 10%), with a 100% cap on the total. This process ensures that a project's sustainability performance is evaluated and quantified across multiple environmental criteria, leading to an accurate final rating (BRE Global, 2024).Between different BREEAM systems, BREEAM International Non-Domestic Refurbishment can be the right choice to observe BREEAM's approach to cultural value on a building basis since it is aimed at the re-functionalisation of existing buildings. The last version of the system that can be accessed is the 2015 version. Based on this version, the BREEAM International Non-Domestic Refurbishment 2015 programme is a performance-based assessment method and certification scheme for existing non-domestic building refurbishment and fit-out projects (buildings other than dwellings or houses). Its main objective is to promote the provision of sustainable refurbishment and fit-out of existing buildings to reduce their life cycle impact on the environment in a robust and cost-effective way. This is achieved through the integration and use of the programme by clients and project teams at key stages of the design and refurbishment or fit-out works process.

2.2.3.3 BREEAM Analyses

Management

Intent:

Encouraging the adoption of sustainable management practices in connection with design, refurbishment, fit out, commissioning, handover and after care activities to ensure that robust sustainability objectives are set and followed through into the operation of the building. Focusing on embedding sustainability actions through the key stages of design, procurement and initial occupation from the initial project brief stage to the appropriate provision of aftercare (BRE Global Ltd, 2017).

Management	
Project brief and design	4
Life cycle cost and service life planning	4
Responsible construction practices	6
Commissioning and handover	4
Aftercare	3
Maximum Point	21

Figure 36 BREEAM Management Point Distribution
Source: BREEAM International Non-Domestic Refurbishment 2015

Evaluation of Cultural value aspects:

The Management category mainly is about addressing environmental management and planning but it also has a potential to make cultural sustainability incorporated by engaging with local stakeholders and cultural experts during planning phase. The BREEAM system in general mentions about involving cultural experts in the project phases but this can become one of the main necessities when it comes to buildings with heritage value. Stakeholder engagement could also include community members who hold cultural or historical insights into the building and consultation can be get from local heritage groups or cultural organizations to strengthen cultural care within the category.

The category also encourages the proper planning before handover. Sustainability of culture is only possible with sustaining the conservation ethic. In this case building occupants can be made aware of the cultural value of the building. This will also be good for the aftercare of not only the building but also the culture of the building.

Health and Wellbeing

Intent:

Encouraging the increased comfort, health and safety of building occupants, visitors and others within the vicinity. Enhancing the quality of life in buildings by recognising those that encourage a healthy and safe internal and external environment for occupants (BRE Global Ltd, 2017).

Health and Wellbeing	
Visual comfort	7
Indoor air quality	8*
Safe containment in laboratories	2*
Thermal comfort	3
Acoustic performance	4
Safety and security	-
Hazards	1
Maximum Point	

Figure 37 BREEAM Health and Wellbeing Point Distribution
Source: BREEAM International Non-Domestic Refurbishment 2015

(*: building type dependent)
(- : not applicable to the BREEAM International Non-Domestic Refurbishment 2015 scheme)

Evaluation of Cultural value aspects:

This category focuses mainly on indoor air quality, lighting, and occupant comfort, but also indirectly touches on the preservation of cultural elements. Creating quality and comfortable interiors for building occupants can be achieved by preserving heritage building features with unique layouts and original elements. This is made possible by the category's incorporation of preserving historic interiors, while meeting modern health standards and preserving the cultural identity of the building.

Energy

Intent:

Encouraging the specification and design of energy efficient building solutions, systems and equipment that support the sustainable use of energy in the building and sustainable management in the buildings operation. Improving the inherent energy efficiency of the building, encourage the reduction of carbon emissions and supporte fficient management through out the operational phase of the buildings life (BRE Global Ltd, 2017).

Figure 38 BREEAM Energy Point Distribution
Source: BREEAM International Non-Domestic Refurbishment 2015

Energy	
Reduction of energy use and carbon emissions	12*
Energy monitoring	2*
External lighting	1
Low carbon design	6
Energy efficient cold storage	3
Energy efficient transport systems	3
Energy efficient laboratory systems	5*
Energy efficient equipment	2
Drying space	1
Maximum Point	

(*: building type dependent)

Evaluation of Cultural value aspects:

The category generally includes technical criteria focused on saving energy and reducing the carbon footprint, but in some parts, some points are allocated to historical buildings based on the reading and reporting of the existing systems in the building by experts in the field.

It is suggested that a Qualified Heritage Conservation Specialist should investigate the implications of improving building fabric and services performance during the concept design stage while minimizing the potential negative impacts of both the historic character of the building, the condition of the building fabric and indoor air quality. This includes looking at the potential for improving ventilation, air tightness and moisture control within the building, ensuring that these are considered in balance with that of the welfare of the historic building fabric. At the same time, this section prioritises protection over increasing energy performance, but only adds 2 points in total. This category prioritises bringing the building in question closer to today's standards in terms of energy systems, but in the case of heritage buildings, the category can be further expanded and occupy a larger place in the points system.

Transport

Intent:

Encouraging better access to sustainable means of transport for building users, promoting accessibility of public transport and other alternative transport solutions (cyclist facilities, provision of amenities local to a building) that support reductions in car journeys and, therefore, congestion and CO_2 emissions over the life time of the building (BRE Global Ltd, 2017).

Transport	
Sustainable transport solutions	8
Proximity to amenities	2
Cyclist facilities	-
Maximum car parking capacity	2
Travel plan	1
Maximum Point	

Figure 39 BREEAM Transport Point Distribution
Source: BREEAM International Non-Domestic Refurbishment 2015

(*: building type dependent)
(- : not applicable to the BREEAM International Non-Domestic Refurbishment 2015 scheme)

Evaluation of Cultural value aspects:

The category aims to reduce the use of private cars, with a focus on sustainable transportation options and it doesn't directly address cultural factors. In this sense, it does not touch on cultural factors as much as the LEED system mentioned earlier, but the category can be expanded by considering the issue of care in selecting the project land in already dense areas. This encourages abandoned buildings with cultural value in the dense city centres to be the subject of the project.

Water

Intent:

Encouraging sustainable water use in the operation of the building and its site. Promoting the identification the means of reducing potable water consumption (internal and external) over the life time of the building and minimizing losses through leakage (BRE Global Ltd, 2017).

Water	
Water consumption	5
Water monitoring	1
Water leak detection	2
Water efficient equipment	1
Maximum Point	

Figure 40 BREEAM Water Point Distribution
Source: BREEAM International Non-Domestic Refurbishment 2015

Evaluation of Cultural value aspects:

This category is generally related to water efficiency and does not have much connection with cultural factors. If the subject project site contains a water feature of cultural significance, this category may be expanded to include the consideration of this feature in the project.

Materials

Intent:

Encouraging steps taken to reduce the impact of construction materials through design, refurbishment, maintenance and repair. Promoting focusing on the procurement of materials that are sourced in a responsible way and have a low embodied impact over their life including extraction, processing and manufacture and recycling (BRE Global Ltd, 2017).

Materials	
Environmental impact of materials	6
Hard landscaping and boundary protection	-
Responsible sourcing of materials (RSM)	4
Insulation	-
Designing for durability and resilience	1
Material efficiency	1
Maximum Point	

Figure 41 BREEAM Materials Point Distribution
Source: BREEAM International Non-Domestic Refurbishment 2015

(- : not applicable to the BREEAM International Non-Domestic Refurbishment 2015 scheme)

Evaluation of Cultural value aspects:

The Materials category strongly supports cultural sustainability by favoring the reuse of existing materials and the selection of locally sourced, traditional materials whenever possible. This harmonizes well with cultural preservation in heritage projects as it allows buildings to retain their original materials or use materials appropriate to the historic context. The category even gives points when the project reuse materials obtained in the site. So this category direcly overlaps with the reuse of existing heritage buildings in terms of cultural sustainability. The reuse of an existing building provides significant material recycling and leads to the utilisation of existing embodied carbon. At the same time, the re-use of a forgotten heritage building is an important potential for cultural sustainability.

Waste

Intent:

Encouraging the sustainable management (and reuse where feasible) of construction and operational waste through future maintenance and repairs associated with the building structure and interiors. By Encouraging good design and construction practices, aiming to optimize material reuse, reduce the waste arising from the refurbishment and fit-out as well as through operation of the building, encouraging its diversion from land fill. It includes recognition of measures to reduce future waste as a result of the need to alter the building in the light of future changes to climate (BRE Global Ltd, 2017).

Waste	
Project waste management	6
Recycled aggregates	1
Operational waste	1
Speculative finishes	1
Adaptation to climate change	1
Functional adaptability	1
Maximum Point	

Figure 42 BREEAM Waste Point Distribution
Source: BREEAM International Non-Domestic Refurbishment 2015

This category complements the Materials category in a sense. When it comes to repurposing an existing building, reuse of original building elements rather than disposal significantly reduces environmental damage. As an example, refurbishing instead of replacing architectural features, like original doors or windows that has cultural significance, would align with both waste reduction and cultural preservation. In this sense category also questions whether can existing elements be reused, preferably on site or not.

Land use and Ecology

Intent:

Encouraging habitat protection and creation, and improvement of long term biodiversity for the building site and surrounding land. Promoting the protection of ecology during refurbishment, enhancement of ecology and long term biodiversity management (BRE Global Ltd, 2017).

Land use and Ecology	
Site selection	-
Protection of ecological features	1
Minimizing impact on existing site ecology	-
Enhancing site ecology	1
Long term impact on biodiversity	2
Maximum Point	

Figure 43 BREEAM Land use and Ecology Point Distribution
Source: BREEAM International Non-Domestic Refurbishment 2015

(- : not applicable to the BREEAM International Non-Domestic Refurbishment 2015 scheme)

Evaluation of Cultural value aspects:

The category mostly focuses on preserving existing natural habitats and this can be related to culture in some specific situations like presence of historic landscapes or garden layouts. So in culturally significant sites, maintaining the ecological integrity of traditional landscapes can be possible and contributes to preservation of cultural heritage by considering culturally important plant species or historical landscape designs.

Pollution

Intent:

Addressing the prevention and control of pollution and surface water run-off associated with the building location and use. Promoting to reduce the buildings impact on surrounding communities and environments arising from light pollution, noise, flooding and emissions to air, land and water (BRE Global Ltd, 2017).

Polution	
Impact of refrigerants	4
NOx emissions	3
Flood risk management and reducing surface water run-off	5
Reduction of night time light pollution	1
Reduction of noise pollution	1
Maximum Point	

Figure 44 BREEAM Pollution Point Distribution
Source: BREEAM International Non-Domestic Refurbishment 2015

Evaluation of Cultural value aspects:

The category primarily targets environmental pollution with little explicit consideration for cultural factors but in some specific situations it can become important also for culture. Pollution control that respects the cultural significance of historic areas could enhance the integrity of the cultural heritage. For example, controlling noise pollution around historic buildings helps maintaining their cultural ambiance.

Innovation

Intent:

Supporting innovation within the construction industry through the recognition of sustainability related benefits which are not rewarded by standard BREEAM issues (BRE Global Ltd, 2017).

Innovation	
Innovation	10
Maximum Point	

Figure 45 BREEAM Innovation Point Distribution
Source: BREEAM International Non-Domestic Refurbishment 2015

Evaluation of Cultural value aspects:

The category offers flexibility to achieve performance beyond standard requirements and it allows specialized points, which can also include cultural sustainability. Methods like using reversible technologies to preserve historical authenticity can be proposed as a different approach to cultural heritage conservation. Each of the buildings with heritage value may have different characteristics of that period as they were produced in different periods. This category is therefore well suited to turning these differences into opportunities.

2.2.3.4 Comparison of BREEAM With Other Systems In Terms Of Culture

As the first sustainability rating system, BREEAM is very important in terms of being an example for the following systems. We can see that it clearly inspired the following systems in terms of forming their categories and criteria. When we look at each of the previously mentioned systems (LEED, GBC HB and BREEAM), we see that they emphasize different sustainability elements but the most mentioned and emphasized aspects are environmental and energy related ones. For example most of the times historic buildings are well adapted to the climate of their region and often display designs that naturally increase thermal comfort and improve energy efficiency (Karimi et al., 2022). In this sense, perhaps the sustainability factors we should consider when applying sustainability rating systems to heritage buildings should be slightly different.

Main target of BREEAM is the European market, where sustainability awareness is already quite high. It uses a more complex pre weighted category system unlike LEED, which is known for its relatively simple and transparent approach to scoring. This method involves weighting categories before scoring, which can make it appear more rigid and demanding. Due to this rigid approach, BREEAM generally has higher requirements for receiving credits compared to LEED (Doan et al., 2017). However, in both systems, high scores can often be achieved even if heritage values are ignored. Compared to BREEAM, GBC HB focuses mainly on historic buildings and tries to adapt the criteria borrowed from LEED to historic buildings, but still fails to do so adequately. BREEAM mentions the sensitivity to be shown towards historical buildings under some criteria, but the equivalent of this sensitivity is generally not reflected in the point system. In each of these systems, points related to cultural values can mostly be acquired through the use of categories like innovation that gives extra credits to creative proposals and solutions.

In the case of heritage buildings, a more balanced approach to sustainability, rather than an energy- and environmental-orientated approach, is more necessary for these buildings. On the other hand, by highlighting specific components within linked concepts, traditional heritage approaches frequently establish a hierarchy in how history is considered. This usually means that formal, expert-driven perspectives are preferred over informal or community-based perspectives, material artifacts are preferred over intangible practices, and cultural aspects are prioritized over natural elements. Additionally, a reliance on established or “official” cultural narratives shapes heritage management, and global or universal interpretations of heritage are frequently given precedence over local understandings. Therefore, a balance must be struck (Borges, Hammami & Wangel, 2020).

2.2.4 DGNB Certification System

2.2.4.1 DGNB Background and General Concept

The DGNB or "Deutsche Gesellschaft für Nachhaltiges Bauen" (German Sustainable Building Council) introduced its sustainability certification system in 2009 with to aim of promoting measurable, comparable sustainable construction standards. This system assesses buildings over their entire life cycle and focuses on a comprehensive and performance-orientated approach. The system is based on the three traditional pillars of sustainability that are environmental, economic and socio-cultural (includes cultural aspects together with social side), but also includes technical, procedural and site-specific factors (DGNB, 2024).

Since its establishment as a non-profit organization in Stuttgart in 2007, DGNB has been instrumental in advancing sustainable building practices and creating livable urban environments. With almost 1,500 participating organizations, it is currently the biggest network for sustainable building in Europe. Twelve preliminary certificates for upcoming projects and the DGNB's first 16 certificates for office and administrative buildings alone were issued in 2009. To accommodate a greater variety of projects, the system was extended to include six more building categories the same year. Additionally, DGNB certification has garnered international interest and catered to a global market since 2010 (DGNB, 2024).

The DGNB differentiates between three variants for certification: buildings, districts, and interiors. There is applicability for both new buildings and existing projects. The full life cycle, including stages like design, construction, operation, renovation, and even demolition, is covered by the system under the "Buildings" category. The accreditation is applicable to a wide range of building types, including residential, commercial, healthcare, and educational structures. By lowering CO2 emissions, enhancing urban and microclimates, encouraging biodiversity, and advancing sustainable mobility options, the "Districts" system prioritizes climate protection, resilience, and sustainability. In order to guarantee enduring environmental and social value, this strategy also incorporates resource-efficient methods using the circular economy paradigm. Lastly, by emphasizing ergonomics, well-being, and resource-sensitive design for places like offices, hotels, and retail establishments, the "Interiors" accreditation encourages the creation of healthy and ecologically friendly indoor environments. It is applicable to both new and existing structures, allowing them to be modified for a range of purposes (DGNB, 2024).

2.2.4.2 DGNB Structure and Point System/Weighting

The way the DGNB sustainability rating system works makes it even more important to analyse. The sustainability concept of the DGNB System is based on three pillars model and tries to go beyond it with a broader scope. It includes ecology, economy, sociocultural as well as functional aspects, technology and processes and site. The evaluation gives equal weight to the first three topics. Within the DGNB System, the attributes that are not included in the three pillars model have an interdisciplinary purpose and are assigned varying weights. The assessment's results are always analyzed over the course of the building's life cycle.

Environmental Quality (ENV)
Economic Quality (ECO)
Sociocultural and Functional Quality (SOC)
Technical Quality (TEC)
Process Quality (PRO)
Site Quality (SITE)

Figure 46 DGNB Categories and Point Distribution
Source: adapted from (DGNB GmbH, 2022)

Under the each six categories there are multiple criteria and these criteria have different weightings for each different building type. For example while office buildings have 2 relevance factor for the fifth criteria of Environmental Quality (ENV2.3), shopping centers 3 relevance factor for the same criteria if they fulfill the requirements.

Topic	Crieria	Criterion	Office	Education	Residential	Hotel	Consumer Market	Shopping Center	Department Store	Logistics	Production	Assembly Buildings
ENV	Effects On The Global And Local Environment (Env1)	ENV1.1	8 9.5%	8 9.5%	8 9.5%	8 9.5%	8 9.5%	8 9.0%	8 9.5%	8 9.5%	8 9.5%	8 9.0%
		ENV1.2	4 4.7%	4 4.7%	4 4.7%	4 4.7%	4 4.7%	4 4.5%	4 4.7%	4 4.7%	4 4.7%	4 4.5%
		ENV1.3	2 2.4%	2 2.4%	2 2.4%	2 2.4%	2 2.4%	2 2.3%	2 2.4%	2 2.4%	2 2.4%	2 2.3%
	Resource Consumption And Waste Generation (Env2)	ENV2.2	2 2.4%	2 2.4%	2 2.4%	2 2.4%	2 2.4%	2 2.3%	2 2.4%	2 2.4%	2 2.4%	2 2.3%
		ENV2.3	2 2.4%	2 2.4%	2 2.4%	2 2.4%	2 2.4%	3 3.4%	2 2.4%	2 2.4%	2 2.4%	3 3.4%
		ENV2.4	1 1.2%	1 1.2%	1 1.2%	1 1.2%	1 1.2%	1 1.1%	1 1.2%	1 1.2%	1 1.2%	1 1.1%

Figure 47 Comparison of different weightings of Environmental Quality category for each building types
Source: Adapted from (DGNB GmbH, 2022)

Buildings are evaluated by the DGNB System using performance metrics that span six categories and are weighted based on significance. The certification level of a project is determined by its overall performance index. DGNB Silver accreditation requires an index of at least 50%, Gold certification requires a minimum of 65%, and the coveted DGNB Platinum certification requires an index of 80% or above. Crucially, certificates are granted based on both achieving minimum requirements in each category and the total performance index in order to guarantee quality in every way. For instance, Platinum needs at least 65% in each category (not including "site quality"), Gold needs 50%, and Silver needs 35% (DGNB GmbH, 2022).

Under each criterion, there are indicators created in line with the definitions of that criterion. These indicators show how the scores can be obtained in this criterion. In some, different paths to be followed bring different scores, while in others, the scores of each item achieved are added on top of each other. In addition, some of the indicators mentioned at the beginning are included in the innovation area and are free to collect extra points. Some indicators include pre-determined agenda 2030 and circular economy bonuses. Overall, the DGNB has a good and well-planned structure.

2.2.4.3 DGNB Analyses

Environmental Quality (ENV)

Intent:

Reducing the ecological impact of buildings across their life cycle by encouraging sustainable resource use, enhancing biodiversity, minimizing water demand and supporting responsible land use. Considering the building's environmental footprint and its interaction with natural systems, focusing on minimizing harm and promoting ecological resilience (DGNB GmbH, 2022).

Environmental Quality (ENV) (for Education)	**Relevance Factor (Share of Total Score)**
Building life cycle assessment	8 (9.5%)
Local environmental impact	4 (4.7%)
Sustainable resource extraction	2 (2.4%)
Potable water demand and waste water volume	2 (2.4%)
Land use	2 (2.4%)
Biodiversity at the site	1 (1.2%)
Total Percentage	22.5%

Figure 48 DGNB Environmental Quality Criteria and Relevance Factor Distribution
Source: DGNB System – Criteria set for building renovation Version 2022 International

Evaluation of Cultural value aspects:

Main idea of this category is targeting environmental and ecological sides of sustainability rather than cultural aspects. However, it can be seen that it indirectly supports cultural sustainability by promoting the long-term preservation of natural resources. Natural resources are foundational to many heritage sites and emphazing on sustainable resource extraction and biodiversity may harmonize with cultures that prioritize ecological harmony.

Economic Quality (ECO)

Intent:

Focusing on long-term viability through life cycle cost efficiency, adaptability of design, and commercial potential. Supporting the development of buildings that maintain their usefulness and commercial relevance throughout time by promoting resource sensitive design from the beginning and offering financial flexibility (DGNB GmbH, 2022).

Economic Quality (ECO) (for Education)	**Relevance Factor (Share of Total Score)**
Life cycle cost	4 (10.0%)
Flexibility and adaptability	3 (7.5&)
Commercial viability	2 (5.0%)
Total Percentage	22.5%

Figure 49 DGNB Economic Quality Criteria and Relevance Factor Distribution
Source: DGNB System – Criteria set for building renovation Version 2022 International

Evaluation of Cultural value aspects:

Adaptability and longevity considerations are useful in contributing to cultural inclusiveness by ensuring that buildings can accommodate a variety of future uses, including culturally significant adaptations. In this sense, reusing a building with cultural significance is of great importance for this category although its not the main target of it. It is possible to save large amounts of money in many ways just by converting an existing building. Whilst economic sustainability does not directly target cultural factors, it promotes flexible spaces that can serve a variety of cultural needs.

Sociocultural And Functional Quality (SOC)

Intent:

Focusing on the health, comfort, and safety of building users. Addressing thermal and acoustic comfort, air quality, lighting, accessibility, and user control, aiming to create inclusive environments that support user well-being. Stressing the importance of quality indoor and outdoor spaces that are safe and accessible for everyone, regardless of personal circumstances (DGNB GmbH, 2022).

Sociocultural and Functional Quality (ENV) (for Education)	**Relevance Factor (Share of Total Score)**
Thermal comfort	4 (3.6%)
Indoor air quality	5 (4.5%)
Acoustic comfort	3 (2.7%)
Visual comfort	3 (2.7%)
User control	2 (1.8%)
Quality of indoor and outdoor spaces	2 (1.8%)
Safety and security	2 (1.8%)
Design for all	4 (3.6%)
Total Percentage	22.5%

Figure 50 DGNB Sociocultural And Functional Quality Criteria and Relevance Factor Distribution
Source: DGNB System – Criteria set for building renovation Version 2022 International

Evaluation of Cultural value aspects:

This category puts people at the centre and prioritizes accessible design and user-centred elements. In this sense, it is in line with the principles of inclusiveness, adaptability and cultural accessibility. The 'Design for all' attitude creates an approach in which cultural and social sustainability are intertwined.

Technical Quality (TEC)

Intent:

Focusing on the structural and functional durability of a building, covering fire safety, energy efficiency, sound insulation, and ease of maintenance. Promoting adaptability to changing technical demands and sustainable resource use as well as efficient recycling and recovery processes (DGNB GmbH, 2022).

Figure 51 DGNB Technical Quality Criteria and Relevance Factor Distribution
Source: DGNB System – Criteria set for building renovation Version 2022 International

Technical Quality (TEC) (for Education)	Relevance Factor (Share of Total Score)
Fire safety	4 (2.5%)
Sound insulation	3 (1.9%)
Quality of the building envelope	4 (2.5%)
Use and integration of building technology	3 (1.9%)
Ease of cleaning building components	2 (1.3%)
Ease of recovery and recycling	4 (2.5%)
Immissions control	1 (0.6%)
Mobility infrastructure	3 (1.9%)
Total Percentage	15%

Evaluation of Cultural value aspects:

The main concern of the category is to ensure the structural, functional and technical sustainability of the building. It has limited relevance to cultural inclusivity but being ensure that buildings can maintain their functionality across generations indirectly supports cultural preservation. The focus on technical flexibility can also facilitate culture-specific adaptations, help buildings meet different needs over time, and be reversible enough not to damage existing elements of the building.

Process Quality (PRO)

Intent:

Increasing sustainability in the planning, procurement and construction phases through quality assurance and holistic planning, as well as promoting transparency, user participation and sustainable construction practices to ensure that buildings meet high standards (DGNB GmbH, 2022).

Process Quality (PRO) (for Education)	Relevance Factor (Share of Total Score)
Comprehensive project brief	3 (1.6%)
Sustainability aspects in tender phase	3 (1.6%)
Documentation for sustainable management	2 (1.1%)
Urban planning and design procedure	3 (1.6%)
Construction site/construction process	3 (1.6%)
Quality assurance of the construction	3 (1.6%)
Systematic commissioning	3 (1.6%)
User communication	2 (1.1%)
FM-compliant planning	1 (0.5%)
Total Percentage	12.5%

Figure 52 DGNB Process Quality Criteria and Relevance Factor Distribution
Source: DGNB System – Criteria set for building renovation Version 2022 International

Evaluation of Cultural value aspects:

The categories main concern is to increase the quality of the phases of the project. Promoting high-quality planning and user engagement can support culturally sensitive design processes and encourage project teams to preserve existing cultural significance. Buildings with historical value require much more attention both in the design and construction process. In this sense, good planning and management of the process is of great importance in any historical building reusing project.

Site Quality (SITE)

Intent:

Encouraging buildings to blend in with their environment while emphasizing accessibility to nearby facilities, resilience, and sustainable mobility. Ensuring that buildings have a beneficial effect on their surroundings, promoting sustainable mobility, and offering convenient access to daily services in order to promote a socially inclusive atmosphere (DGNB GmbH, 2022).

Figure 53 DGNB Site Quality Criteria and Relevance Factor Distribution
Source: DGNB System – Criteria set for building renovation Version 2022 International

Site Quality (SITE) (for Education)	Relevance Factor (Share of Total Score)
Local environment	2 (1.1%)
Influence on the district	2 (1.1%)
Transport access	2 (1.1%)
Access to amenities	3 (1.7%)
Total Percentage	5%

Evaluation of Cultural value aspects:

The category is the most relatable to the cultural context in which the DGNB system is embedded. Influence on the district can be contextualised with the sustainability of culture, not only in the structural sense but also in terms of the cultural fabric around the building. The selection of culturally significant project areas or buildings naturally brings with it factors that need to be taken into consideration. In this sense, it is of great importance to consider the effects that the project may cause around the building and to plan in order to prevent negative consequences.

2.2.4.4 DGNB Evaluation And Comparison With Other Systems

A comparison of the indicators in each system sustainability rating systems shows that, on average, 55% of the three systems examined environmental aspects, while social factors are given approximately 30% weight. Among these, LEED and BREEAM are the systems that give the least importance to the economic dimension with weights of 5% and 2% respectively. In contrast, DGNB gives significantly more priority to economic factors with a weight of 60%, indicating a more balanced approach between environmental, social and economic aspects in the DGNB system (Jensen et al., 2018; Karimi et al., 2022).

In general, the DGNB system gives the three main pillars of sustainability an equal percentage and gives the impression that they are of equal importance, but different sustainability dimensions may be more prominent and of greater importance in different situations. At this point, it may be more useful if the score weights is intervened for spesific situations.

The DGNB system's high degree of adaptability is one of its best features, which makes it ideal for adaption and application in different markets. In addition to being modified to accommodate evolving technical and societal demands, the system can also be tailored to suit specific national or regional uniqueness. These aspects might include the climate, structural and legal requirements, or cultural factors (Lemaitre, C., 2014). The system does not mention specific scenarios where cultural factors are at the forefront, but it is not very difficult to shape the system according to the retrofit scenarios of buildings with cultural value, just as the GBC Historic Building does using existing LEED system as a base.

Chapter 03

A New System

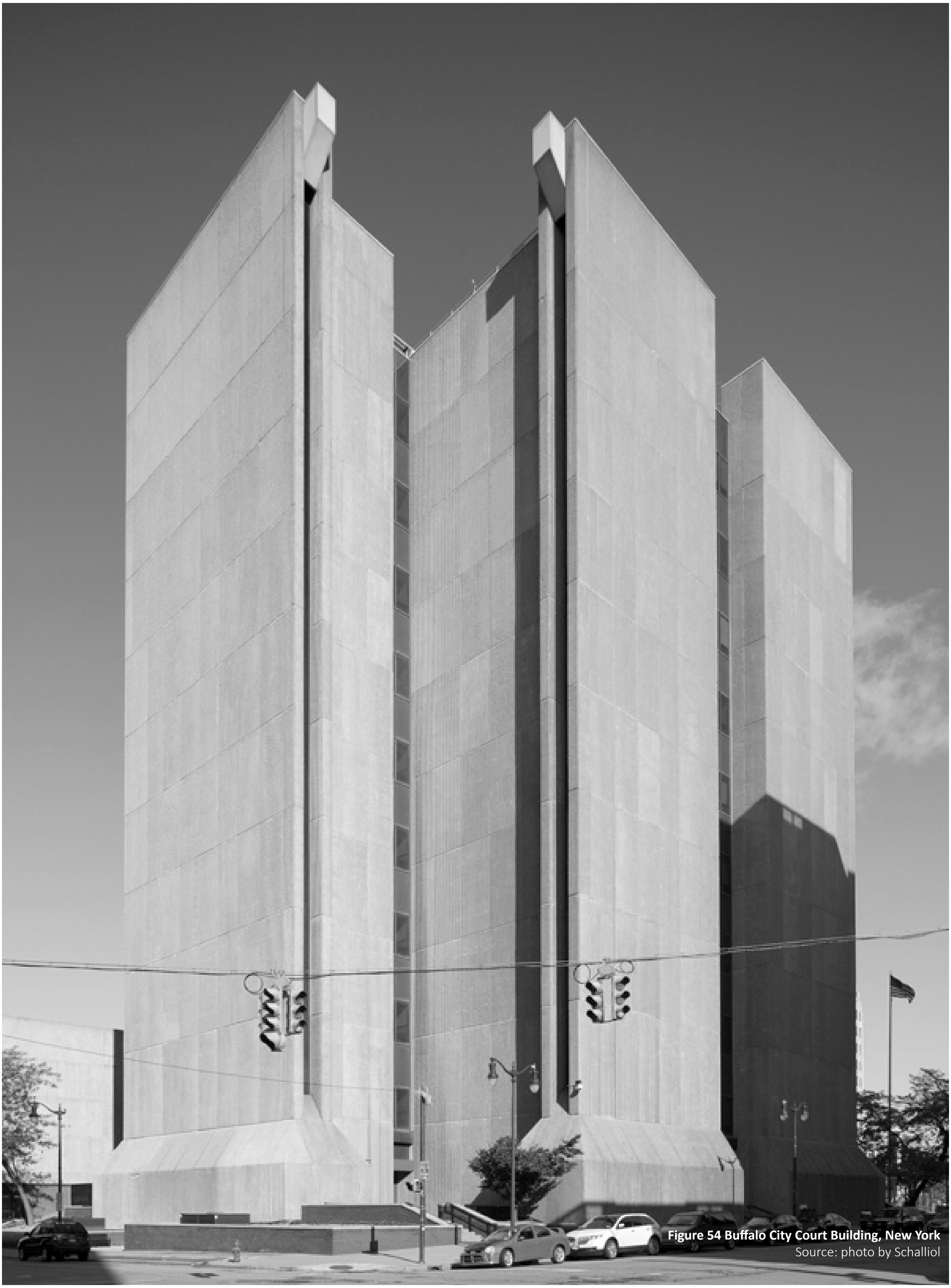


Figure 54 Buffalo City Court Building, New York
Source: photo by Schalliol

3.1 Proposal of a New System

In the previous chapters, the importance of reuse of existing, the dimensions of sustainability and how the culture can be considered as a fourth new dimension of sustainability were explained through the comments of different academics and personal ideas. In addition to all these, the functioning of some of the leading sustainability rating systems used in today's world has been extensively discussed and analysed in terms of how successful these systems can be in the cultural dimension and how well they can relate to the cultural values of buildings. As a result of the inferences made from all these, a new system that accepts the existence of cultural sustainability is proposed in this chapter within the scope of the thesis.

This proposed system was created by following the general structures of the analyzed existing sustainability rating systems, selecting the positive aspects of each and making use of the academic research mentioned in the previous sections placing cultural sustainability at its center.

At this point, the proposed system was created not to change or upgrade the existing sustainability rating systems that are available on the market and have taken many years and designed by various experts from different professions, but to emphasize the deficiency of a very important issue in today's world, such as "cultural sustainability", in these systems.

3.1.1 Structure of the New System

The system adds the cultural dimension as the fourth to the three main dimensions of sustainability accepted in academic discussions and classifies these dimensions as four main categories under which the criteria are categorized. Cultural sustainability, Social sustainability, Environmental sustainability and Economic sustainability are the categories that form the new system. Under each category, the criteria were taken from the existing systems and each was reinterpreted by the author by placing cultural sustainability at the center considering the information and debates in the academic atmosphere.

Information about each criteria is defined in the criteria cards created for each. In these criteria cards the criteria code, criteria name, sources, related criteria, criteria intents, indicators and total points that can be obtained when the criteria requirements are met are specified. While the points that can be earned from some criteria vary from criterion to criterion, meeting some criteria is mandatory in order to obtain the system's certificate. These criteria are defined as "mandatory" in the criteria cards.

3.1.2 Weightings and Point system

The points of the criteria are obtained by distributing the existing points of the existing system criteria they inspired in a direct proportion within the category. Each criterion brings points according to its level of importance compared to other criteria within the category.

Each category in the system ,as well as the whole system, has a maximum score of 100 points. The highest possible overall score, if all criteria across all categories are met, is 100. By default, the four categories are equally weighted at 25% each. For instance, if a project fulfills all criteria within the social sustainability category and earns 100 points, it will contribute 25 points to the final score, reflecting its 25% weight in the overall evaluation.

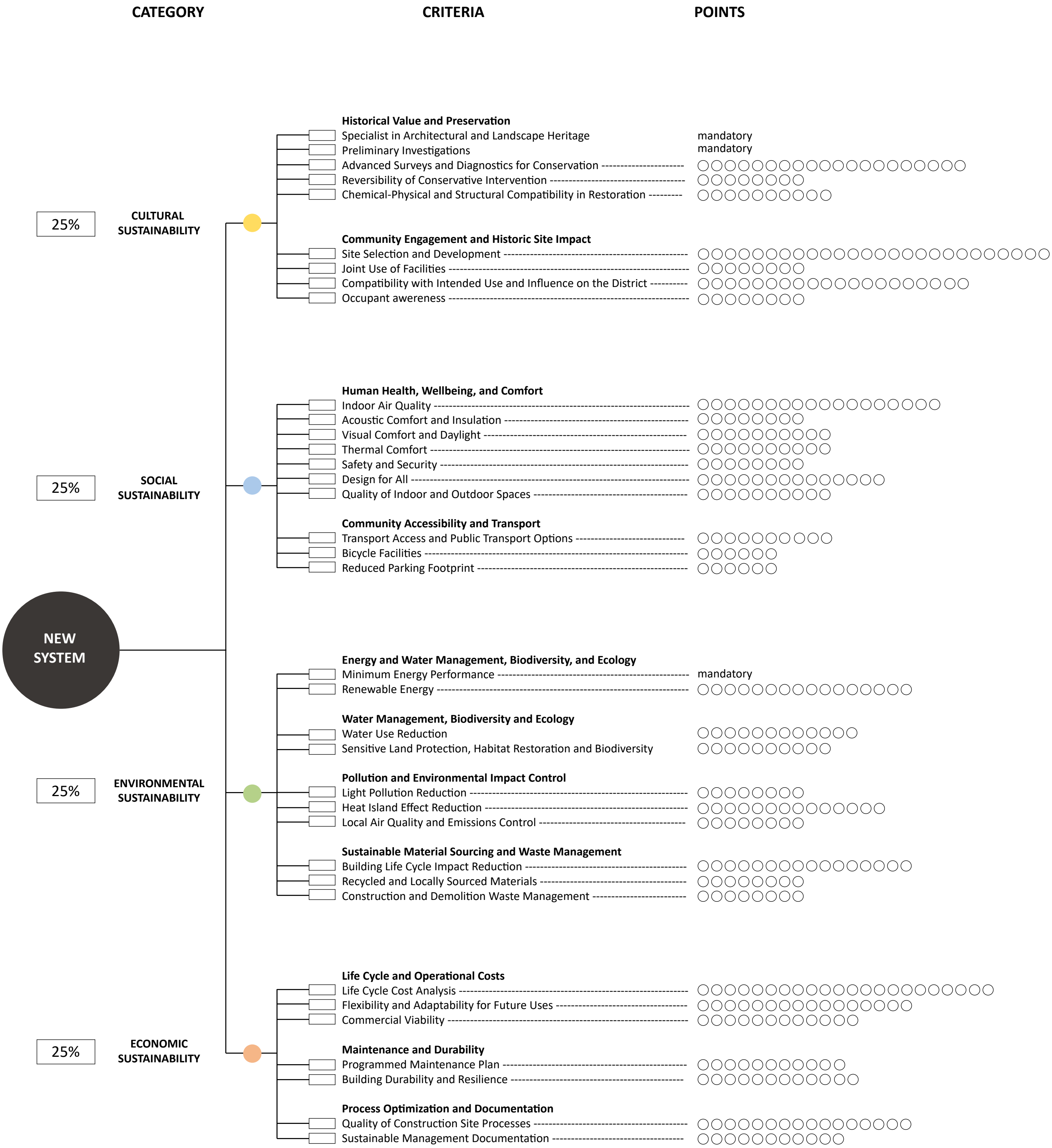


Figure 55 New Sustainability Rating System Proposal
Source: Produced by the author

This weighting system can be tailored to each project by a group of experts and stakeholders in the fields required by the project, and the categories deemed more important for that specific project can have a higher percentage and the criteria can have more points. For example, if economic concerns are not the priority but cultural issues are more important, economic sustainability may have a lower percentage while cultural sustainability may have a higher percentage.

In example sustainability rating systems, sometimes criteria scoring and even criteria requirements may vary according to the type of building, but in this system proposal, by excluding building types, such details are not included, and it is aimed to draw attention only to the basic issue with a simpler and understandable system proposal.

In this thesis, the scoring distribution and weighting system is kept as simple as possible because the main purpose of the thesis is to draw attention to the main problem that the thesis investigates rather than to propose an optimal scoring system.

While creating the score system, the score systems of the existing sustainability rating systems in the field were taken as an example. The points to be achieved in order to obtain a certificate have been kept a little higher compared to the existing systems (for example, the minimum score required to obtain a certificate in the LEED BD+C system is 40, this amount is 50-59 for silver certification, 60-79 for gold certification and 80-110 for platinum) because it is easier to collect points in the current state of the system than in these systems. With a new more detailed system that can be built on this system, the criteria can be made more specific and the scoring system can be updated accordingly.

In order for the project to be deemed eligible for certification, it must achieve a minimum score of 50 points out of 100. 60-74 points range earns silver certificate, 75-89 points range earns gold certificate and 90-100 points range earns platinum certificate.

The dynamic structure of this system can be refined over time with new applications and projects. Some criteria may need to be given more weight or new sub-criteria may need to be added in line with different project types, scales and contextual needs. This shows that the system is open to development and customization.

In addition, with more detailed definitions of the criteria, it can be ensured that scoring requires a more qualified effort; thus, achieving high scores will be an indicator of not only quantitative but also qualitative achievements. This approach will both increase the reliability of the certificate and contribute to the more meticulous implementation of sustainability goals.

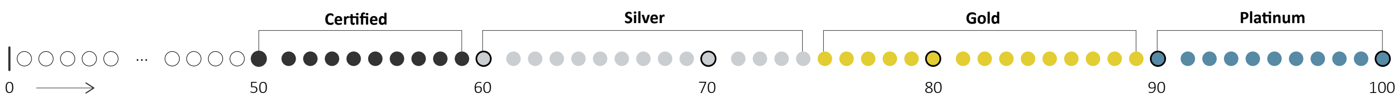


Figure 56 Certificate levels based on the score
Source: Produced by the author

3.2 System Categories

The new systems criteria are collected under sustainability dimensions to make weighting adjustments easier based on the project. Additionally to the todays existing sustainability dimensions, which are social, environmental and economical, cultural sustainability has also added. This makes proposed idea easier to understand in this thesis's scope.

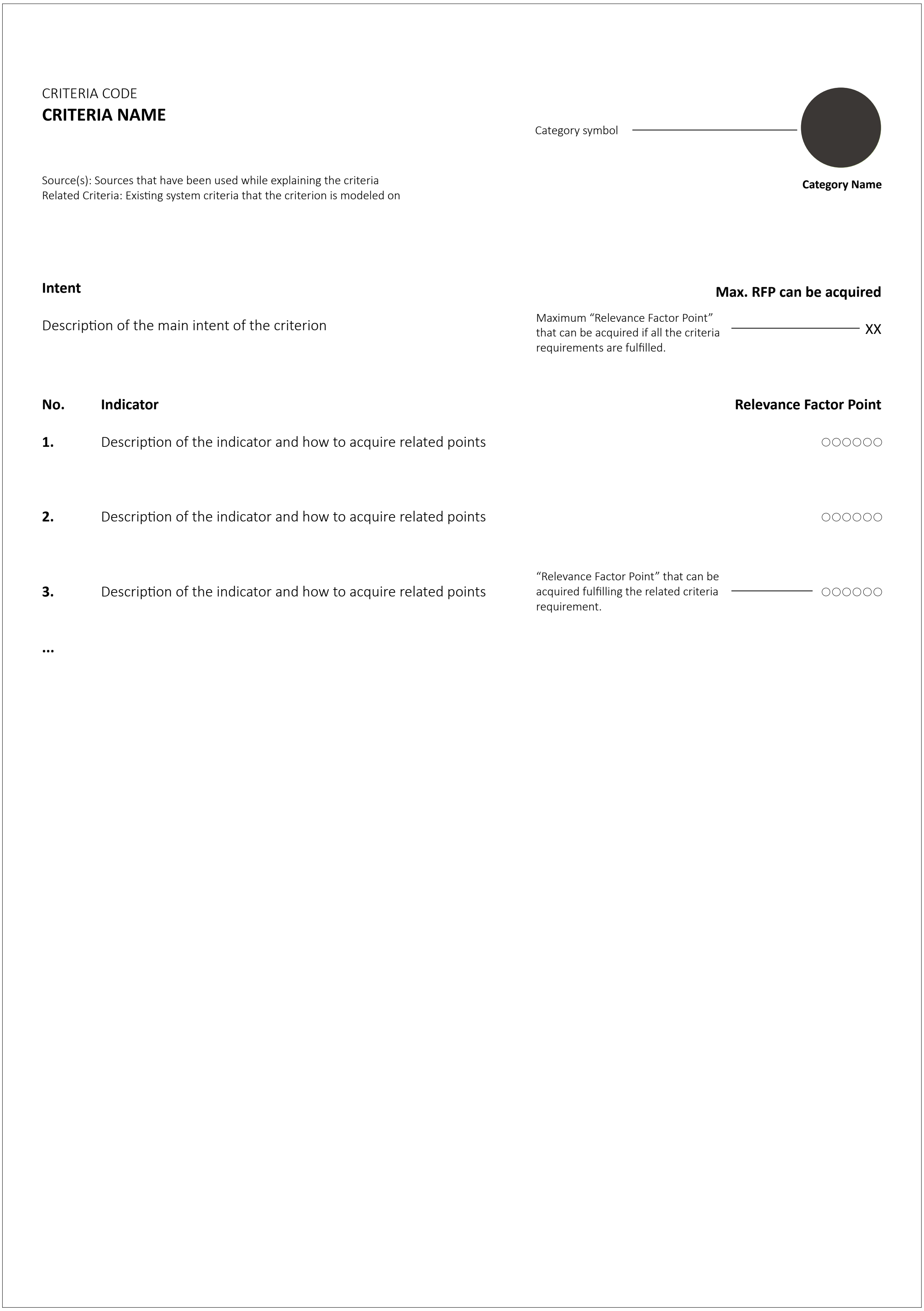


Figure 57 Criteria Card Example and How It Works
Source: Produced by the author

3.2.1 Cultural Sustainability

Cultural sustainability aims to ensure the continuity of cultural heritage by preserving the relationship of buildings with their historical, spatial and social context. Architecture is not only a physical production but also a carrier of identity and memory. In this context, cultural sustainability involves the creation of spaces that can respond to the needs of the present without erasing the traces of the past and that carry meaning for future generations. The basis of this approach is that the building respects the historical texture of its location, does not harm cultural values and considers the interaction with its surroundings. Under this category, the extent to which the design decisions produced with a conservation consciousness overlap with holistic sustainability goals is evaluated.

CUL-1.1

Specialist in Architectural and Landscape Heritage

Cultural Sustainability

Source(s): (Green Building Council Italia, 2024a)
Related Criteria: GBC- HV Credit 6

Intent

Assisting the design team in selecting sustainable practices compatible with the preservation of the cultural and historic features of the building and in facilitating design and operations to minimise costs and disruption while maximising the integration of professional knowledge and expertise as much as possible.

Max. RFP can be acquired

mandatory

No.	**Indicator**	**Relevance Factor Point**
1.	The design team should have at least one main member that is specialist in the restoration of architectural and landscape heritage. The member should also have at least one of the following qualifications and experience: • postgraduate diploma specializing in the restoration of architectural and landscape heritage; • demonstrated expertise in the restoration of historic buildings, with specific focus on: - identifying and evaluating historic structures; - material analysis and degradation assessment; - surface restoration techniques; - structural reinforcement and consolidation of load-bearing elements; - active participation as a member of the design and/or construction team in at least two historic building restoration projects.	mandatory

CUL-1.2

Preliminary Investigations

Source(s): (Green Building Council Italia, 2024a)
Related Criteria: GBC- HV Prerequisite 1

Cultural Sustainability

Intent

Identifying and explaining the historical and cultural significance of historic structures as demonstrated by their construction and architectural features as well as any alterations made over time.

Max. RFP can be acquired

mandatory

No.	Indicator	Relevance Factor Point
1.	Describing the building elements that can be the object of conservation activities through number of documents and checking the possible oppurtunities of adapting existing elements in a sustainable manner.	mandatory

The documents should also establish the presence or absence of historical structures and materials to be able to take responsible decisions in terms of sustainability.

The features of the documents to be submitted are as follows:

- A brief, comprehensive summary of the construction phases and the primary functions hosted. Floor plans must be created in which the key construction phases (additions, demolitions, renovations, floor additions, etc.) are emphasized and differentiated by colors that correlate to the phases defined and the functions hosted;

- The building's structural layouts must be illustrated on relevant plans. Simple symbols should indicate the nature, structural frame, and kind of historical structural elements;

- The presence and location of existing finishes should be highlighted on elevations and floor plan surveys (it is possible to make these surveys during the development phase or deriving from previous studies existed), indicating construction techniques, especially if there are some unique, local techniques;

- Analyses of building layers that is identifying the layer sequences of materials. It is also possible to compare the analyses with the previous studies existed;

- Identification of degregation and/or dislocation of materials and structures. Determination of any alterations in the materials with multisensory analysis (sight, touch, hearing) in macroscopic scale.

- General description of existing system compenents and operations. Identification of these systems is required to observe their differences from todays systems in terms of performance.

CUL-1.3

Advanced Surveys and Diagnostics for Conservation

Source(s): (Green Building Council Italia, 2024a)
Related Criteria: GBC- HV Credits 1.1, 1.2, 1.3

Cultural Sustainability

Intent | **Max. RFP can be acquired**

Assessing the energy performance of the building to determine the current state of efficiency. Analysing and describing the chemical and physical properties of historic building materials to identify the main causes of deterioration and assessing the structural soundness and resilience of the building to develop strategies to both improve its performance and ensure the preservation of architecturally significant elements. In addition to that, identifying existing systems within the building that can be retained, upgraded or optimised to improve functionality and enhance occupant comfort.

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No.	Indicator	Relevance Factor Point
1.	**ASHRAE Level 1 Survey** Completing a preaudit that is prescribed in “Procedures for Commercial Building Energy Audit for Level I Analysis- Walk-Through Analysis” by the ASHRAE considering items 1, 2 and 3.	○○○○
2.	**In-depth Thermography Survey** To qualitatively determine whether thermal bridges and inhomogeneities exist in the building envelope's thermal performance, conduct a thermographic survey. Infrared techniques should be used to conduct the survey in compliance with UNI EN ISO 6781-1:2023 Part 1: General Procedures for Building Performance: Detection of heat, air and moisture irregularities in buildings. Note any inaccuracies in the envelope's thermographic mapping.	○○○
3.	**In-depth Evaluation Thermal Conductance** An assessment of the current thermal conductivity of envelop should be done. The survey may be performed in according to the requirements of UNI ISO 9869-1:2015 Thermal insulation- Technological construction elements- In-situ measurement of thermal resistance and thermal transmittance- Part 1: Thermal flowmeter method. Carrying out the assessment is only possible if the envelope conditions gives reliable results, i.e., temperature difference between indoor and outdoor environment. How the results correlate with the building envelope layouts identified must also be reported.	○○○
4.	**Building Materials of the Historic Building and Degregation** Existing building materials should be characterised. This will enable design teams to select materials that are as compatible as possible and/or from the same region/area. In this case, the compatibility of new materials with existing materials can also be assessed. In addition to that, degregation mapping should be included using proper drawings. The analysis of degregation required will depend on what has already been stated during “preliminary investigations”.	○○○○○
5.	**Diagnostic Investigations and Monitoring of Structures** The structural integrity of the building should be investigated by qualified experts with different tests and if necessary, which structural interventions should be reported. As a result of this it is possible to avoid replacing or consolidating large sections of the existing structure: with this approach the structures can be considered to be suitable for use, while ensuring safety and security.	○○○○○

CUL-1.4

Reversibility of Conservative Intervention

Cultural Sustainability

Source(s): (Green Building Council Italia, 2024a)
Related Criteria: GBC- HV Credit 2

Intent

Ensuring that, through careful technological planning, any expansions, changes, or adjustments to the building are created with reversibility in mind. The goal is to minimize obvious links or changes between the original and new components in order to preserve the historic fabric. By allowing the removal of contemporary modifications without sacrificing the authenticity or significance of old characteristics, this strategy seeks to maintain the building's historic and cultural integrity.

Max. RFP can be acquired

8

No.	**Indicator**	**Relevance Factor Point**
1.	The reversibility requirement is assessed by measuring the possibility of restoring the quo ante operam state, limiting the damage to the historical support and minimizing the dismantlement work required to insert the new parts.	○○○○○○○○

The requirement is evaluated by calculating the possibility of going back to “the quo ante operam state”, minimizing the amount of disassembly needed to install the new components, and limiting the harm to the historical support. Consideration covers:

- insertion of structures;
- finishes and guards;
- internal partitions.

Reversibility of the interventions carried out should be verified through a series of demonstrations. It should be proved that reversibility tecniques are possible and appropriate when its necessary. Reversibility check is carried out by experts and if at least 40% of the interventions are reversible, project gets 3 points that can be acquired from this criteria. If the number is equal or more than 60%, the project gets 5 points that can be acquired from this criteria. If the number is equal or more than 80%, the project gets all of the points that can be acquired from this criteria.

CUL-1.5

Chemical-Physical and Structural Compatibility in Restoration

Cultural Sustainability

Source(s): (Green Building Council Italia, 2024a)
Related Criteria: GBC- HV Credits 3.2, 3.3

Intent

Max. RFP can be acquired

10

Ensuring the compatibility of the mortars used for restoration (plaster and flooring) with the original materials and walls. Considering the aesthetic indicators and fulfilment of physical mechanical requirements. Avoiding major changes that could affect the original load distribution, making the best possible utilisation of the static properties of the pre-existing building.t

No.	Indicator	Relevance Factor Point
1.	**Compatibility of Materials** Within the scope of adaptive reuse interventions to be made to the existing building, the compatibility of new building materials that are not within the structure of the building should be investigated and reported. These materials and application techniques should not damage the integrity of the existing structure.	○○○
2.	**Compatibility of Mortars** Requires the compatibility of the mortars widely used for plaster and floor restoration during the restoration of the structures with existing historic value. The criteria also related to the previous "Advanced Surveys and Diagnostics for Conservation" as it encourages to know the identification of the current state of degradation as well as the knowledge of the composition and main properties of the materials. In this sense, the compatibility of the mortars to be used in the repair of the structure with the existing building materials should be investigated and reported. Within the framework of architectural conservation, new interventions should be distinguishable from the original building materials and interventions.	○○○○
3.	**Compatibility of the Structure** It should be determined whether local strengthening and repair efforts or global improvements lead to an overall improvement in the existing building's seismic response and structural behavior. Should be considered the most of the pre-existing building's static features while avoiding significant changes that could alter the original load distribution and maintenance costs will help to reduce the intervention's invasiveness and resource consumption. Project team should determine any strengthening interventions, localized repairs, or global structural improvements that would enhance the existing building's overall seismic response and structural behavior and create a plan to enhance the building's structural behavior, including the necessary calculations, and show that the building's IS-V safety index, which is the ratio of the Peak Ground Acceleration (PGA) that establishes the Safeguards Limit State attainment (PGAC) to the PGA standard assigned to a new building on the same site and for the same limit state (PGAD), is greater than or equal to 45% (the legal limit of "controlled seismic movement").	○○○

CUL-2.1

Site Selection and Development

Cultural Sustainability

Source(s): (Green Building Council Italia, 2024a; DGNB GmbH, 2022)
Related Criteria: GBC- SS Credit 1, DGNB- SITE1.4

Intent

Max. RFP can be acquired

26

Choosing a project location with the least possible impact on the environment to prevent construction on inappropriate sites. Making the building appropriate to serve the daily needs of its users by providing easily accessible social and commercial infrastructure in the area. Encouraging to take actions on abondoned structures or deteriorated locations to improve the safety and health of the impacted communities.

No. **Indicator** **Relevance Factor Point**

1. Using an existing structure ○○○○○

It covers the prioritisation of the reuse of buildings of historical value that have lost their function or have been abandoned, and their adaptation to today's standards and needs. Instead of building a new structure from scratch, the project can only score points by reusing an existing one. In doing so, project teams should preserve the historical value of existing buildings without destroying them.

2. Recovery of Degraded Sites ○○

Developing projects in degraded areas or in buildings hampered by man-made environmental pollution (soil, subsoil or groundwater, hazardous substances, etc.). Lowering the risk of exposure to dangerous substances as well as the consumption of undeveloped land. All activities involving the remediation and removal of hazardous materials are included, such as activities to remove environmental pollutants in the soil, subsoil, and groundwater (such as unintentional hazardous material spills or fuel leaks from underground tanks) according to current legislation.

3. Social Infrastructure ○○○○○○○○○

- The project area is expected to be surrounded by acceptable amount of educational facilities that can be reached in 15 minutes by walking, cycling or public transport. The type of educational structure required (kindergarten, highschool, higher education etc.) is determined according to the profile and needs of the users. Up to 3 points.

- The project area is expected to be surrounded by acceptable amount of leisure facilities (Art and culture (cinema, theatre, galleries), library, district centre, community centre, youth centre, senior citizens' centre, fitness studio etc.) that can be reached in 15 minutes by walking, cycling or public transport. Up to 3 points.

- The project area is expected to be surrounded by acceptable amount of playgrounds and sport facilities (Gymnasium and sports hall, outdoor sports /sports area with an athletics track, indoor or outdoor swimming pool etc) that can be reached in 15 minutes by walking, cycling or public transport. Up to 3 points.

If any of these variety of amenities can be provided within the building, project also earns the related points.

No.	Indicator	Relevance Factor Point
4.	**Commercial Infrastructure**	○○○○○○○○○○

- The project area is expected to be surrounded by acceptable amount of full-range supplier (supply of everyday goods) that can be reached in 15 minutes by walking, cycling or public transport.Up to 4 points.

- The project area is expected to be surrounded by acceptable amount of small retail outlets (bakery, butcher, drug store, bank, post office etc.) that can be reached in 15 minutes by walking, cycling or public transport. Up to 3 points.

- The project area is expected to be surrounded by acceptable amount of weekly market, restaurant, café, hairdresser, fitness studio, wellness facilities, etc. that can be reached in 15 minutes by walking, cycling or public transport. Up to 3 points.

If any of these variety of amenities can be provided within the building, project also earns the related points.

CUL-2.2

Joint use of facilities

Cultural Sustainability

Source(s): (Green Building Council Italia, 2024a)
Related Criteria: LEED- SS Credit Joint Use of Facilities, GBC- HV Credit 3.1

Intent

Sharing some interior or exterior parts of the building with the public for different activities and functions to make it more integrated with the community.

Max. RFP can be acquired

8

No.	**Indicator**	**Relevance Factor Point**
1.	The project should provide public spaces within its boundaries. In this sense multiple senarios are possible;	○○○○○○○○

- **Interior Spaces**

  -If the project has interior spaces allocated to collective or public use equal to 10% or bigger of the total interior area it gets 2 points.

  -If the project has interior spaces allocated to collective or public use equal to 30% or bigger of the total interior area it gets 4 points.

  -If the project has interior spaces allocated to collective or public use equal to 80% or bigger of the total interior area it gets 8 points.

- **Exterior Spaces**

  -If the project has exterior spaces allocated to collective or public use equal to 10% or bigger of the total exterior area it gets 3 points.

  -If the project has exterior spaces allocated to collective or public use equal to 30% or bigger of the total exterior area it gets 4 points.

  -If the project has exterior spaces allocated to collective or public use equal to 80% or bigger of the total exterior area it gets 8 points.

The points that is acquired from both indicators can be stacked up to 8.

CUL-2.3

Compatibility with Intended Use and Influence on the District

Cultural Sustainability

Source(s): (Green Building Council Italia, 2024a; DGNB GmbH, 2022)
Related Criteria: GBC- HV Credit 3.1, DGNB- SITE1.2

Intent

Max. RFP can be acquired

20

Chosing the right possible use for the building (which favours good preservation over time in case of historic buildings) that triggers positive settlement dynamics regarding social, cultural, economic, and human health. Using the building to regenerate the area and have a positive impact on the neighbourhood.

No.	Indicator	Relevance Factor Point
1.	**Perception of the Project Area** It is assessed whether the public perception of the site will allow or detract from the sustainable use objectives of the planned project. If the site has a neutral image and secondary location in the district without positive or negative impact with an acceptable neutral image for the intended use, it gets 2 points If it has positive "local" impact due to its location in the district is the basis for high-quality architecture and use, it gets 5 points and if it has positive impact "regionally and nationally" due to desirable location within the district (the site might has a special significance due to its location or history) it gets 7 points.	○○○○○○○
2.	**General Fuction of the Building** Establishing the general function of the building (by considering its old use if its an existing structure) based on the relationship with the surrounding buildings. Showing the new functions positive contrubution to the district and harmonization with the existing texture with a descriptive report and drawings. If the building will have a neutral image in the district without positive or negative impact (and its new function fits into the existing structure if there is), it gets 2 points, if the building will have a positive "local" impact with a positive image and will enhance the district with a unique impact and character it gets 5 points. If the building will have a positive impact "regionally and nationally" with a very positive image for the district as making it a desirable area, it gets 7 points.	○○○○○○○
3.	**Purpose of Use of Each Space** It is necessary to demonstrate, with a descriptive report, the purpose of use of "each scape and function" in the building to show they are compatible with the character of existing building and surroundings. The fulfilment of the criteria requirements is assessed by experts.	○○○
4.	**Synergy with the Existing Texture** It is assessed whether the new project creates synergy with the site and whether it indirectly serves other buildings in the neighbourhood.	○○○

CUL-2.4

Occupant awereness

Cultural Sustainability

Source(s): (USGBC, 2024)
Related Criteria: LEED- SS Credit Tenant Design and Construction guidelines

Intent

Ecucating the occupants on the application of sustainable design and construction features for possible need of future renovations and daily use.

Max. RFP can be acquired

8

No.	**Indicator**	**Relevance Factor Point**
1.	To ensure the longevity of the building's sustainable design and interventions, important actions should be taken to raise occupant awareness, such as: • publishing illustrated documents for building occupants that describes sustainability dimensions as well as projects sustainability goals and objectives, recommendations, including examples, for sustainable strategies, products, materials, and services; • organising collective training seminars before the building is put into use, if deemed necessary; • sharing the contact information of the authorities that building occupants can contact in case they need any modification, renovation or repair.	○○○○○○○○

3.2.2 Social Sustainability

Social sustainability assesses the impact of the built environment on individuals quality of life, social integration and equity. This approach requires the physical environment to be not only functional but also fair, accessible and people oriented. The accessibility of the building for all user groups, safety, health conditions and qualities that encourage social interaction have an important place in this context. In addition, the high quality of both interior and exterior spaces contributes to the promotion of social welfare through architecture. Beyond individual comfort, social sustainability analyses the role of space in society and how it affects social inclusion.

SOC-1.1

Indoor Air Quality

Social Sustainability

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a; BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: LEED- EQ Prerequisite Fundamental Refrigerant Management, GBC IQ Prerequsite 1,2-IQ Credit 1,2,3.1,3.2, BREEAM- Hea02, DGNB- SOC1.2

Max. RFP can be acquired

18

Intent

Contributing to the comfort and well-being of building occupants. Establishing minimum standards for indoor air quality and being ensure that indoor air is not adversely affecting the users health and well-being.

No.	**Indicator**	**Relevance Factor Point**
1.	**Quality Assessment**	○○○○○

- For mechanical ventilated spaces, installing a mechanical ventilation system capable of meeting the minimum fresh air flow rates for Class II. mandatory in accordance with UNI EN 16798-1 (using method 1, relying on perceived indoor air quality), for all regularly used rooms, having pollution levels suitable for their specific purposes. Every regularly occupied room must have a mechanical ventilation system that meets the minimum renewal air flow rates needed for Class I of UNI EN 16798-1 (ISO 17772-1), with the right amount of pollution for each room's intended use. Any technical or historical limitations that prevent the inclusion of mechanical ventilation systems should be noted. In these situations, think about setting up engineered natural ventilation systems, dispersed local air intake and extraction systems, or mechanical ventilation systems with lower external air flow rates up to the IV Class of EN16798-1. Install carbon dioxide measurement sensors with a locally visible display in every room that is frequently occupied if mechanical ventilation systems cannot be installed. Then, store the measured data history.

- For naturally ventilated spaces, according to the verification methodology outlined in the flowchart in Figure 1.18 of the CIBSE (Chartered Institution of Building Services Engineers) Application Manual 10:2005, show that natural ventilation has been a successful tactic.

- Install air extraction systems in bathrooms (minimum 80 m^3/h per toilet), kitchens (in accordance with the anticipated equipment), and, if not otherwise needed, basement parking lots and garages (minimum 10 m^3/h per unit area) as part of the fire prevention regulations.

2.	**Tobacco Smoke Control**	○○○

Prohibit smoking at least 8 meters away from air intakes, windows that can be opened, and entrances. Establish a complete smoking ban on the property or clearly mark the areas where smoking is allowed and those that are not with the proper signage.

In case of need, locate smoking areas outside the building that are at least 8 m distant from entrances, air intakes and windows that can be opened.

No.	Indicator	Relevance Factor Point

3. **Air Quality Monitoring** ○○○○

- Install permanent monitoring systems with sensors that can measure PM2.5, temperature, and humidity to protect indoor areas.

- If the space is mechanically ventilated, to guarantee that the design's minimum requirements for outdoor air flow are met, install permanent monitoring systems. When monitored values diverge by 10% from design values, monitoring systems are required to notify the building or facilities manager. Monitor the CO2 concentration in every area where the design occupation density is 4 m²/person or higher. The typically occupied volume should be used for reference contaminant monitoring.

- If the space is naturally ventilated, advanced sensors to measure temperature, humidity, CO2, PM2.5, and TVOC should be permanently installed in all regularly occupied rooms.

- Although the number of monitoring points for comparable rooms can be restricted based on use, area, and ventilation systems, there should always be at least one sensor installed per floor and 200 m² of gross project area. An on-board or network-connected backup system should be included with sensors so that the collected data can be kept for at least three years.

- Provide control systems for all ventilation units that can notify building occupants or plant operators in the event of a malfunction.

4. **Construction Phase Air Quality Management** ○○○

Have an Interior Air Quality Management Plan (Indoor Air Quality- IAQ) for the construction phase. Meet or surpass the requirements (Control Measures) specified in IAQ Guidelines for Occupied Buildings under Construction, 2nd Edition 2007, published by ANSI/SMACNA 008-2008, Chapter 3-Sheet Metal and Air Conditioning Contractors National Association (2007); protect valuable surfaces (decorative elements) from dust and moisture damage;absorbent materials that are installed or stored on site from moisture damage.

5. **Before Occupancy Air Quality Management** ○○○

After construction is finished and all interior finishes are completed, flush out the building by supplying more than 4.400 m³ of outside air for every square meter of interior surface while simultaneously keeping the interior temperature at or below 16 °C and the relative humidity at or below 60%. It is also possible to conduct IAQ testing, using protocols consistent with the ISO 16000 Standards and demonstrate that the concentration limits for the pollutants have been met.

SOC-1.2

Acoustic Comfort and Insulation

Social Sustainability

Source(s): (USGBC, 2024; BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: LEED- EQ Credit Acustic Performance, BREEAM- Hea05, DGNB- SOC1.3

Intent

Max. RFP can be acquired

Ensuring appropriate user comfort by achieving room acoustic conditions that correspond to the intended use.

8

No.	**Indicator**	**Relevance Factor Point**
1.	**Determination of Acustic Comfort Requirements** It is necessary to determine what kind of acoustic requirements the spaces of the building should have and based on these requirements acoustic concepts should be formulated in the planning process. If a room has special requirements in terms of speech intelligibility (such as meeting rooms, seminar rooms or classrooms) or special requirements for noise reduction and/or room acoustics comfort (such as cafeterias, libraries or break rooms), this should be determined and reported in the planning process. If an existing building is being intervened in, the heritage values of the building should be taken into account when determining these requirements.	○○
2.	**Sound Insulation** Based on the previous indicator (Determination of Acustic Comfort Requirements), type of the building and requirements of sound insulation should be specified. Insulation of the building should achive the performance standards set outs and acoustic testing should be carried out by a compliant test body that are specified in following documents related parts; -Education Funding Agency, 2003. Building Bulletin 93: Acoustic design of schools- performance standards. London: Department for Education. -ANC, 2011. ANC Good Practice Guide: Acoustics testing of schools. Version 1.2. St Albans: Association of Noise Consultants. -Department of Health, 2013. HTM 08-01: Health sector buildings: acoustic design requirements. London: Department of Health. -British Standards Institution, 2014. BS 8233:2014- Guidance on sound insulation and noise reduction for buildings. London: BSI Standards Limited. -HM Courts & Tribunals Service, 2019. Court and Tribunal Design Guide. Public Version 1.1. If the building has heritage value, care should be taken to ensure that the isolation interventions do not disturb the aesthetics and uniqueness of the building. If interventions are to be made that will alter the integrity of the building, the project team should present the necessity of these interventions to conservation specialists.	○○

No.	Indicator	Relevance Factor Point
3.	**Indoor Ambient Noise Levels** Based on the previous indicator (Determination of Acustic Comfort Requirements), type of the building and requirements of limitation of indoor noise levels should be specified. Appropriate indoor noise levels should be achieved based on the performance standards set outs and acoustic testing should be carried out by a compliant test body that are specified in following documents related parts; -Education Funding Agency, 2003. Building Bulletin 93: Acoustic design of schools- performance standards. London: Department for Education. -ANC, 2011. ANC Good Practice Guide: Acoustics testing of schools. Version 1.2. St Albans: Association of Noise Consultants. -Department of Health, 2013. HTM 08-01: Health sector buildings: acoustic design requirements. London: Department of Health. -British Standards Institution, 2014. BS 8233:2014- Guidance on sound insulation and noise reduction for buildings. London: BSI Standards Limited. -HM Courts & Tribunals Service, 2019. Court and Tribunal Design Guide. Public Version 1.1. If the building has heritage value, care should be taken to ensure that the interventions do not disturb the aesthetics and uniqueness of the building.	○○
4.	**Room Acoustics** Based on the previous indicator (Determination of Acustic Comfort Requirements), type of the building and requirements of acoustics for all rooms should be specified. Proper control of reverberation, sound absorption and speech transmission index (STI) should be achieved through performance standards set outs should be carried out by a compliant test body that are specified in following documents related parts; -Education Funding Agency, 2003. Building Bulletin 93: Acoustic design of schools- performance standards. London: Department for Education. -ANC, 2011. ANC Good Practice Guide: Acoustics testing of schools. Version 1.2. St Albans: Association of Noise Consultants. -Department of Health, 2013. HTM 08-01: Health sector buildings: acoustic design requirements. London: Department of Health. -British Standards Institution, 2014. BS 8233:2014- Guidance on sound insulation and noise reduction for buildings. London: BSI Standards Limited. -HM Courts & Tribunals Service, 2019. Court and Tribunal Design Guide. Public Version 1.1. If the building has heritage value, care should be taken to ensure that the interventions do not disturb the aesthetics and uniqueness of the building.	○○

SOC-1.3

Visual Comfort and Daylight

Social Sustainability

Source(s): (BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: BREEAM- Hea01, DGNB- SOC1.4

Intent

Ensuring appropriate user comfort by achieving daylight and artificial light conditions that correspond to the intended use in all interior areas which are in constant use by the occupants.

Max. RFP can be acquired

10

No.	Indicator	Relevance Factor Point
1.	**Absence of glare in daylight** Design team should use a glare control assessment to pinpoint areas that are vulnerable to glare. Any areas determined not to be at risk of glare are also justified by the glare control assessment. A glare control strategy should be used to design out the possibility of glare in areas of a building where risk has been identified. The energy used for lighting should not increased by the glare control technique. This is accomplished by: -Increasing the amount of daylight in all conditions, whether sunny or cloudy AND -Assuring that the placement or application of shading does not interfere with lighting control system functionality.	○
	Daylighting Design team should achieve proper daylight factors or average and minimum point daylight illuminance for the relevant building parts.	○○
	Visual contact with the outside 95% of the floor area in 95% of spaces for each relevant building area should provide an adequate view out. Spaces that are rarely used and/or does not need daylight (storages, underground car parking etc.) can be excluded.	○○
	Internal lighting According to the SLL Code for Lighting 2012 (CIBSE, 2012) and any other applicable industry standard, internal lighting is designed to provide illuminance (lux) levels and color rendering index in all pertinent areas of the building. Internal lighting should be suitable for the tasks being performed, taking into consideration the comfort and focus of building users.	○○
	External lighting Particularly at night, external lighting should have illuminance levels that allow users to carry out visual tasks outside with accuracy and efficiency.	○○
	Zoning and occupant control Internal lighting should be zoned to allow for occupant control. Each parts of different spaces should have proper zoning. Ocupants of the building should be able to control light levels easily.	○

SOC-1.4

Thermal Comfort

Social Sustainability

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a; BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: LEED- EQ Credit Thermal Comfort, GBC IQ CREDIT 7.1,7.2, BREEAM- Hea04, DGNB- SOC1.1

Max. RFP can be acquired

10

Intent

Ensuring thermal comfort throughout the year, regardless of the season, to ensure that occupant health and well-being is not adversely affected.

No.	Indicator	Relevance Factor Point
1.	**Thermal Comfort Design** HVAC systems and the building envelope should be designed to satisfy ASHRAE Standard 55-2017, Thermal Comfort Conditions for Human Occupancy, with errata or a region-specific equivalent. In case the building is being reused and has haritage values, design team should create the building envelope and HVAC systems in accordance with the "AIcarr Guide: Energy Efficiency in Historic Buildings"(AICARR,2014) showing that the project alligns with the aforementioned standards and guidelines. On top of these the HVAC facilities' and the building envelope's design criteria should aim to prevent or minimize material, structural, and decorative feature deterioration and take into account the findings of studies on the building's condition (materials, finishes, restoration work, thermal hygrometric problems of the building envelope).	○○○○○
2.	**Thermal Comfort Control** At least 50% of each occupant space should have its own thermal comfort controls. All common areas with multiple occupants should have group thermal comfort controls. Air temperature, radiant temperature, air speed, and humidity should all be able to changed locally by occupants using thermal comfort controls, whether they are in shared multioccupant spaces or private areas.	○○○○○

SOC-1.5

Safety and Security

Social Sustainability

Source(s): (BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: BREEAM- Hea06, DGNB- SOC1.7

Intent

Encouraging the planning and implementation of effective measures to having appropriate level of security in the building and site for occupant safety.

Max. RFP can be acquired

8

No.	Indicator	Relevance Factor Point
1.	**Level of Visibility** Clear visibility is provided by general areas (entrance areas, main thoroughfares, inner courtyard paths), underground garages, ground-level parking lots, and multi-story or rooftop parking lots (if available).	○○
2.	**Level of Lighting** There is sufficient light on the main roads, bike parking lots, and pathways leading to parking lots.	○○
3.	**Safety Equipments** There are enough safety installations (emergency telephones, CCTV, PA systems (in offices), voice alarm systems or comparable installations).	○○
4.	**Preventive Safety Measures** There are burglary prevention measures, such as RC protection classes, alarm systems, and roller shutters on the lower floors.	○○

SOC-1.6

Design for All

Social Sustainability

Source(s): (DGNB GmbH, 2022)
Related Criteria: DGNB- SOC2.1

Intent

Making the whole built environment accessible to everyone and without restrictions on its use.

Max. RFP can be acquired

14

No.	**Indicator**	**Relevance Factor Point**
	The indicators are evaluated according to how effectively it meets barrier-free design requirements. The more areas of the building that are barrier-free and accessible to and usable by people with impaired motor skills, sensory impairments, and/or cognitive impairments without significant difficulty or the need for assistance from others, the better the building's evaluation will be. The requirements of the national building regulations with regard to barrier-free design should be fulfilled.	
1.	**Circulation** According to ISO 21542:2021 (The built environment's usability and accessibility), access routes to entrances, areas for movement in front of the entrance door or doors (and lift, if installed), as well as the related circulation and secondary areas and general areas of the building that are crucial for use, should be barrier-free in both internal and external infrastructure of the building (alternatively, DIN 18040 and/or local norms can be used as valid standards). In addition to that, barrier-free design should be provided whether they are used by one or multiple people. Operating information (e.g., for entrance doors, lift) should be presented in accordance with the "multiple-sense principle" ("at-least-two-senses principle"- e.g., visible, aural, tactile). If there are staffs in the building, either dedicated barrier-free staff entrances or barrier-free access to the main entrance areas through the publicly accessible general areas should be open to use for staff entrances, as long as all units have barrier-free access.	○○○
2.	**Disabled Parking** There should be dedicated circulation sections for disabled passenger parking places. The number of disabled parking spaces required is determined according to local regulations.	○○
3.	**Disabled Toilets** In private and public areas there needs to be barrier-free toilets that can be accessed. The number of disabled toilets required is determined by local regulations. If the the it is a private residential building, it must be confirmed that the required number of apartments have suitable toilets.	○○○

No.	Indicator	Relevance Factor Point
4	**Indoor and Outdoor Spaces**	○○○○○○

If at least 25% of the areas that have the potential to be used by disabled people within the scope of daily activities provided by the building, such as work areas, offices, common areas, etc. are designed to be barrier-free based on buildings type, project gets 1 points from this indicator.

If at least 50% of the areas that have the potential to be used by disabled people within the scope of daily activities provided by the building, such as work areas, offices, common areas, etc. are designed to be barrier-free based on buildings type, project gets 3 points from this indicator.

If at least 75% of the areas that have the potential to be used by disabled people within the scope of daily activities provided by the building, such as work areas, offices, common areas, etc. are designed to be barrier-free based on buildings type, project gets 6 points from this indicator.

SOC-1.7

Quality of Indoor and Outdoor Spaces

Source(s): (USGBC, 2024; BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: LEED- SS Credit Open Space, SS Credit Direct Exterior Access, DGNB- SOC1.6

Social Sustainability

Intent

To provide occupants, indoor and outdoor spaces that can promote social interactions and accommodate as wide a variety of recreational and functional uses as possible.

Max. RFP can be acquired

10

No.	Indicator	Relevance Factor Point
1.	**Indoor Common Spaces** Design team should provide indoor common spaces that is at least 8% of the total building area and can be used by all the building occupants for recreational and socialization purposes.	○○○○○
2.	**Quality Outdoor Spaces** Design team should provide outdoor space that is at least 30% of the overall site area and at least 25% of this outdoor open area must be vegetated, either with two or more types of vegetation or with an overhead vegetated canopy.	○○○○○

The outdoor space should be physically accessible as well as designated as at least one of the following:

- social area that has pedestrian-oriented paving or landscape which can accommodate outdoor social activities;
- recreational area that has a recreation-oriented paving or landscape which encourages physical activity;
- diverse green space that is a landscape area with different types of vegetation and gives different opportunities to use around the year;
- garden space that is dedicated to community gardens or urban food production;
- habitat area that is preserved or recreated which includes elements of human interaction.

Qualifying roof-based physically accessible paving areas can be used toward credit compliance, and extensive or intensive vegetated roofs that are physically accessible can be used toward the minimum vegetation requirement. If the side slope gradients are vegetated and average 1:4 (vertical:horizontal) or less, wetlands or naturally constructed ponds may be considered open space.

SOC-2.1

Transport Access and Public Transport Options

Social Sustainability

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a; BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: LEED- LT Credit Access to Quality Transit, GBC- SS Credits 2.1, BREEAM- Tra01,Tra02, DGNB - SITE1.3

Max. RFP can be acquired

10

Intent

Encouraging the reducing of greenhouse gas emissions, air pollution, and other environmental and public health harms associated with motor vehicle use and developing the project in locations that have multimodal transportation choices.

No.	Indicator	Relevance Factor Point
1.	**Stops** The project area should be located at a maximum distance of 400 metres from one or more bus stops belonging to two or more public buses, trams or shuttle buses that can be used by the residents of the building.	○○○
2.	**Public Transportation Frequency** Daily public transportation frequency avarage should be maximum 20 minutes (except 00.00 to 06.00).	○○○
3.	**Railway or Underground Station** The project area should be located at a maximum distance of 800 metres from a railway or metropolitan station that already exists or planned and financed.	○○○
4.	**Information** Building or site should display a map of the surrounding area and show the location of the stops and how far away they are in minutes; alternatively, signposting is provided.	○

SOC-2.2

Bicycle Facilities and Paths

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a; BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: LEED- LT Credit Bicycle Facilities, GBC- SS Credit 2.2, BREEAM- Tra01,Tra02, DNGB SITE 1.3

Social Sustainability

Max. RFP can be acquired

6

Intent

Promoting cycling and transport efficiency to reduce the distance travelled by car and improve public health. Also encouraging travellers to engage in recreational physical activies.

No.	Indicator	Relevance Factor Point
1.	**Bicycle Facilities** At least 2.5 percent of all peak visitors should have access to short-term bicycle storage, with a minimum of four storage spaces per building. In addition to the short-term bike storage spaces, each building should have a minimum of four long-term bike storage spaces for at least 5% of all regular building occupants. If the building is residential, this becomes 15% of all regular building occupants. For the first 100 regular building occupants, there should be at least one on-site shower with changing facilities; after that, there should be one more shower for every 150 regular building occupants. In some senarios, provided facilities can be maximum 200 meters away from the buildings if needed.	○○○
2.	**Bicyle Paths** Bicyle paths should be maximum 500 meters away from the site and have a regional access and continuty.	○○○

SOC-2.3

Reduced Parking Footprint

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a; BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: LEED- LT Credit Reduced Parking Footprint, GBC- SS Credits 2.4

Social Sustainability

Max. RFP can be acquired

6

Intent

Minimising the environmental damage linked to car parking facilities, including car dependency, land consumption and stormwater runoff.

No.	**Indicator**	**Relevance Factor Point**
1.	**Parking Spaces** Design team should minimize the size of the parking areas, considering the possibility of sharing parking spaces with adjacent buildings. For both Buildings in urban and suburban settings, design teams should provide the minimum required by regulations without exceeding it. Parking should be large enough to accommodate carpools and vanpools, accounting for 10% of the total number of parking spaces, without going over the minimum amount stipulated by local urban planning regulations.	○○○○○○

3.2.3 Environmental Sustainability

Ecological sustainability is a comprehensive evaluation field that questions the relationship between buildings and nature and aims to minimise their environmental impacts. Environmental impacts such as energy consumption, resource utilisation and waste generation that occur during the design, construction and operation of buildings are addressed in a holistic manner under this heading. At the same time, factors such as site selection, adaptation to climate data, sensitivity to biodiversity and integration into nature are also part of this approach. Ecological sustainability adopts an understanding of architecture that aims to solve environmental problems at their source, is in harmony with nature and respects the right to life of future generations.

ENV-1.1

Minimum Energy Performance

Environmental Sustainability

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a; BRE Global Ltd., 2017)
Related Criteria: LEED- EA Prerequisite Minimum Energy Performance, Credit Optimize Energy Performance; GBC- EA Prerequisites 1-2, Credits 1; BREEAM- Ene01

Max. RFP can be acquired

mandatory

Intent

Setting basic standard for enhancing energy efficiency in buildings and facilities to decrease the negative effects of high energy use on the environment and economy, while preserving the historical and artistic integrity of the building.

No.	Indicator	Relevance Factor Point
1.	**Determine climate zone** Project team should identify the climate zone using ASHRAE 90.1–2016, Annex 1	mandatory

Review and address ASHRAE mandatory requirements

Project team should review the required sections of ANSI/ASHRAE/IESNA Standard 90.1 2016 with errata early in the design process (or equivalent standard). They should examine Sections 5.4, 6.4, 7.4, 8.4, 9.4, and 10.4 learn how the building design needs to address these specifications. It is much more difficult to include many mandatory requirements later in the design process or during construction than it is to include them in the early stages of the project.

Section 5.4, Building Envelope, is usually the responsibility of the architect; Sections 6.4, HVAC, and 7.4, Service Water Heating, are the responsibility of the mechanical engineer and plumbing designer; and Sections 8.4, Power, and 9.4, Lighting, are the responsibility of the electrical engineer.

Determine the Energy Performance of the Building

The total energy requirements for the building's climatization in the summer and winter, hot water production for household use, interior lighting installations, and power supply processes must be computed in order to determine the building's energy performance.

Based on the relationship between the building's energy performance and a set of suitably defined limits, the process determines the percentage value of improvement in the building's energy performance—the focus of the intervention—when compared to the standard reference scenario.

Identify Energy Use Target for Building

Early in the design phase, project team should establish an energy target for the project prioritizing efficiency tactics, integrating systems, lowering initial costs, and enhancing building performance.

Establish a Minimum Level of Energy Efficiency Improvement

Project team should set a minimum standard for energy efficiency improvement for the buildings and facilities in order to minimize the negative effects that excessive energy use has on the economy and the environment while maintaining the building's character and historic-artistic appearance.

ENV-1.2

Renewable Energy

Environmental Sustainability

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a; DGNB GmbH, 2022)
Related Criteria: LEED- EA Credit Renewable Energy, GBC- EA Credit 2, DGNB- ENV1.3

Max. RFP can be acquired

16

Intent

Reducing the negative impacts of fossil fuel energy on the environment and economy and to reduce greenhouse gas emissions by expanding renewable energy projects, while supporting a just transition towards a sustainable economy.

No. **Indicator** **Relevance Factor Point**

1. **Renewable Energy Production**

Project should use green energy generated on-site or off-site renewable energy sources. Combination of both is also possible.

- For green energy produced On-site,

Buildings should use on-site renewable generation systems with respect to the building energy demand.

- For green energy produced Off-site,

Buildings should utilize the energy that is generated from an off-site renewable source to meet the building's electricity needs through a minimum two-year certified renewable energy supply contract.

Forms of certification that are accepted by international organizations or national authorities and are based on certification systems that attest to the proper accounting of electricity derived from renewable energy sources may be used to prove compliance for this indicator.

- For combination of on-site and off-site green energy production,

Buildings can also meet the energy requirements using the combination of these two methods.

On-site		Off-site		Points
3%	+	25%	=	4 point
6%	+	50%	=	8 points
9%	+	75%	=	12 points
12%	+	100%	=	16 points

ENV-2.1

Water Use Reduction

Environmental Sustainability

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a; BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: LEED- WE Prerequisites, Credits; GBC- WM Prerequisites, Credits; BREEAM- Wat01, Wat02, DGNB- ENV2.2

Max. RFP can be acquired

12

Intent

Improving water use efficiency in buildings to reduce reliance on municipal water supplies and relieve pressure on water systems. Also supporting water resource management by monitoring luminaire performance to identify leaks and saving opportunities through accurate water consumption measurements as well as promoting the natural water cycle by reducing demand for potable water through wastewater recycling and utilisation of locally available resources. Where applicable, restoring and optimising the functionality of existing historic stormwater management systems to comply with sustainable practices while preserving heritage elements.

No.	Indicator	Relevance Factor Point
1.	**Water Consumption Metering** Project team should intrude methods to meter both indoor and outdoor water consumption. Monthly and annual summaries of meter data should be compiled; automated or manual meter readings are both possible. **Indoor Water Use Reduction** Project team should calculate the water use of the buildings. Calculations should be based on estimated occupant use and should include only the following devices and accessories (if it is applicable to the project): -toilets; -urinals; -washbasin and bidet taps; -showers; -kitchen sinks and prewash spray taps. Project team should put into practice measures that result in a 20% overall decrease in water use when compared to estimated average water use determined (not including irrigation) to get 2 points from the indicator. If the reduction percentage is 30%, it gets 4 points and if its 40% or more it gets 6 points in total.	○○○○○○
2.	**Outdoor Water Use Reduction** Building should achieve 50% less potable water used for ornamentals or irrigation than the base value determined in the middle of summer. The two systems (ornamentals or irrigation) consumption should be calculated independently, and one of the systems must save at least 50% of its water usage.	○○○○○○

No.	Indicator	Relevance Factor Point

This decline could be the result of any combination of the following intervention areas:

-use of rainwater collected through specific systems;
-use of recycled water;
-use of water treated and piped in from public systems for non-potable uses;
-incorporation of recirculation systems, or programmed shut-off, or control systems for fountains and/or other water features;
-efficiency of irrigation systems;
-presence of certain plant species, density, and microclimate factors;
-restoration and reuse of original rainwater collection systems (cisterns, channels, and storm drains, etc.).

If the indicator can be provided for either irrigation or ornamental reasons, it provides 2 point, if for both it provides 4 points.

If potable water is not used at all or for all non-potable uses, such as irrigation and/or decorative (such as fountains and water features), only water that has been collected from rainfall, recovered wastewater, recycled grey water, treated waters is used or vegetation installed that do not require permanent irrigation systems, 6 points are awarded.

ENV-2.2

Sensitive Land Protection, Habitat Restoration and Biodiversity

Environmental Sustainability

Source(s): (USGBC, 2024; BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: LEED- LT Credit Sensitive Land Protection, SS Prerequisite Environmental Site Assessment, SS Credit Protect or Restore Habitat; BREEAM- LE03, LE04; DGNB- ENV2.3- ENV2.4

Max. RFP can be acquired

10

Intent

Reducing the environmental impact resulting from the location of a building on a site to avoid the development of environmentally sensitive land that provides critical ecosystem services and to enhance community resilience. Protecting biodiversity in the local environment and limit, as far as possible, adverse ecological impacts associated with the site and surrounding areas arising from the project.

No.	Indicator	Relevance Factor Point
1.	**Managing Negative Impacts and Ecologic Risks** Project team should plan and manage the possible negative ecological impacts on-site. It should be done early enough to have an impact on site preparation planning, concept design, and design brief (usually Concept Design stage). To ascertain whether environmental contamination is present at the site, project team should perform a Phase I Environmental Site Assessment in accordance with ASTM E1527-13 (or a local equivalent) and perform a Phase II Environmental Site Assessment in accordance with ASTM E1903-11 (or a local equivalent) if contamination is suspected. Remediate a contaminated site to satisfy the most stringent local, state, or federal environmental protection agency region residential (unrestricted) standards.	○○○○○
2.	**Creating, Protecting and Restoring Habitats** At least 6 species of local or adapted vegetation should be planted in the project area at least two of the following plant types: ground cover, shrubs, and trees. If there is a greenfield area exists in the site, project team should preserve and protect 40% of it from all development and construction activities. If there is a previously disturbed area in the site, project team should also restore at least 20% of it.	○○○○○

ENV-3.1

Light Pollution Reduction

Environmental Sustainability

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a; BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: LEED- SS Credit Light Pollution Reduction, GBC- SS Credit 6, BREEAM- Pol04, DGNB Tec 1.7

Max. RFP can be acquired

8

Intent

Minimizing the light dispersion from the building and the site to enhance the architectural character of buildings. Increasing nighttime visibility of the sky by limiting light pollution can be caused by the building and the site. Improving visibility at night by reducing glare and preventing negative impacts of building lights in general.

No.	Indicator	Relevance Factor Point
1.	**Interrior Lighting** Project team either uses automatic devices or shields the opening controlling the possible light pollution. For the use of automatic devices, project team should use automatic devices to cut the power of all non-emergency interior lighting fixtures that are directly visible from any opening (translucent or transparent) of the building envelope by at least 50% between 11pm and 5 am. Use a manual switch or a movement sensor to turn lights on between 23:00 and 5:00 is encouraged. For the shielded opening method, project team should design screens for all of the envelope's openings, whether translucent or transparent, that provide direct access to non-emergency interior lighting. These screens must be operated by automated devices that can lower light transmittance to less than 10% between 23:00 and 5:00.	○○○○
2.	**Lighting of Outdoor Areas** For the outdoor areas, only the areas that are necessary for safety, aesthetic comfort, and the highlighting of significant architectural elements should be illuminated. Project team should comply to the requirements for limiting upward cattering of light flux specified in UNI 10819:1999- Light and Lighting- Outdoor Lighting Installations. According to the classification zone, the light output can not be greater than that permitted by ANSI/ASHRAE/IESNA Standard 90.1-2007- Energy Standard for Buildings Except Low-Rise Residential Buildings. They should also show that none of the project's lighting fixtures emit light upward (with respect to the luminaire's horizontal plane and taking into account the luminaires' final placement), with the exception of energy-saving devices used to illuminate architectural features with aesthetic value.	○○○○

ENV-3.2

Heat Island Effect Reduction

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a)
Related Criteria: LEED- SS Credit Heat Island Reduction, GBC- SS Credit 5

Environmental Sustainability

Max. RFP can be acquired

14

Intent

Reducing the heat island effect to minimize the impact on the microclimate and on human and animal habitats with appropriate design criteria that respect the existing typological morphological balance.

No.	**Indicator**	**Relevance Factor Point**

Project team should aim to reduce the effects of local heat islands by carefully planning outdoor areas.

In a historical building case, it can be achived by reinterpreting historic solutions (tree management, urban ventilation flows, etc.) or restoring historic systems (e.g., fountains, playgrounds, water, etc.). It is important to preserve the existing building's typological and morphological characteristics. Thus, all solutions that make sense within the project framework of conserving historical heritage through conservative and philological valorization will be approved.

1. Nonroof and Roof ○○○○○○○○

$$\frac{\text{Area of Nonroof Measures}}{0.5} + \frac{\text{Area of High Reflectance Roof}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.75} \geq \text{Total Site Paving Area} + \text{Total Roof Area}$$

For nonroof measures, project team should;

-Within ten years of planting, either use the existing plant material or plant shade-producing plants over the paved areas. Put in planters with vegetation. Artificial turf is not permitted at the time of occupancy permit; plants must be present.

-Structures with energy-generating components, such as wind turbines, photovoltaics, and solar thermal collectors, can provide shade.

-Use architectural elements or structures to create shade. According to ANSI/CRRC S100, a device or structure that is a roof must have an aged solar reflectance (SR) value of at least 0.28. According to ANSI/CRRC S100, the device or structure must have an initial SR of at least 0.33 at installation if it is not a roof or if information on aged solar reflectance is unavailable.

-Use vegetated structures to create shade.

-Choose paving materials that have a minimum initial solar reflectance (SR) of 0.33.

-Employ a pavement system that is open-grid (at least 50% unbound).

No.	Indicator	Relevance Factor Point

For High-Reflectance Roof, project team should;

-Should use roofing materials that adhere to the Solar Reflectance Index (SRI) values specified for various roof slopes in order to produce a high-reflectance roof. A aged SRI of 64 or higher is required for low-sloped roofs (slopes ≤ 2:12); if this value is not available, the roofing material must meet an initial SRI of 82 or higher. The roofing material for steep-sloped roofs (slopes > 2:12) must have an aged SRI of at least 32, or an initial SRI of 39 in the absence of aged values. Better thermal performance and fewer heat island effects are guaranteed by these standards.

The requirements of nonroof measures may be satisfied by roof space that is made up of useful, functional areas (like recreation courts, helipads, and other comparable amenity areas). Roof space occupied by skylights, solar panels, mechanical equipment, and other accessories is not included in the applicable roof area.

For Vegetated Roof, project team should;

-design the vegetated roof using native or adapted plant species.

2. **Parking Under Cover** ○○○○○○

Project team should be sure that at least 75% of the parking spots are covered. Any roof that is used to shade or cover parking must either be vegetated, (have an aged SRI of at least 32 (if information on aged values is not available, use materials with an initial SRI of at least 39 at installation), or be covered by energy-generating systems like wind turbines, solar thermal collectors, and photovoltaics. All off-street parking spots, both new and existing, that are owned or leased by the project—including parking that is outside the project boundary but is utilized by the project—must be included in the credit calculations. Public rights-of-way parking on the street is not included in these calculations.

ENV-3.3

Local Air Quality and Emissions Control

Source(s): (BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: BREEAM- Pol02, DGNB- TEC1.7

Environmental Sustainability

Max. RFP can be acquired

8

Intent

Contributing to the minimisation of local air pollution through the use of low emission combustion appliances in the building.

No.	Indicator	Relevance Factor Point
1.	**Sustainable Systems** All hot water and heating should be provided by non-combustion systems. For instance, solely using electricity. Ventilation systems should be designed to reduce the infiltration of outdoor pollutants, particularly in areas with heavy traffic or industrial activity. Project team should be sure systems have filters (like HEPA or something similar) to catch pollutants and particulates.	○○○○
2.	**Air Emission Reduction Strategies** Project team should be sure that every HVAC system satisfies or surpasses national and international regulations governing the emission of air pollutants, such as nitrogen oxides (NOx), volatile organic compounds (VOCs), and particulate matter (PM2.5, PM10). They should use vegetative buffers, living walls, or green roofs to enhance the quality of the local air and make use of native plants in your landscaping to reduce pollution and promote biodiversity.	○○○○

ENV-4.1
Building Life Cycle Impact Reduction

Environmental Sustainability

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a; DGNB GmbH, 2022)
Related Criteria: LEED- MR Credit Building Life Cycle Impact Reduction, GBC MR Prequisite 3; DGNB- ENV1.1

Max. RFP can be acquired

16

Intent

Encouraging the adaptive reuse of existing buildings and optimizing the environmental performance of products and materials.

No.	**Indicator**	**Relevance Factor Point**
1.	**Reuse of an Existing Structure**	○○○○○○○○○○

Project team should preserve the building's current envelope, interior nonstructural components, and structure. The building's use of off-site salvaged or repurposed materials may also be taken into account when determining the indicator. Historic, deserted, or decaying structures: A portion of a building that is considered dangerous or structurally unstable may not be included in the calculations.

There are two ways to acquire points from this indicator.

- Preserve Existing Structural Elements: Walls, Floors, Roofs, and Envelope

Preserve the building's envelope (the outer skin and framing, excluding window assemblies and nonstructural roofing materials) and structure (including the floor and roof decking). The points that can be acquired from this indicator is based on the calculation of reuse of the existing building area.

15% = 2 points
30% = 4 points
45% = 6 points
60% = 8 points
75% = 10 points

AND/OR

- Preserve Interior Nonstructural Elements

For at least 30% of the finished building, including additions, project team should use the interior nonstructural components that are already there, such as the interior walls, doors, floor coverings, and ceiling systems. Achieving by this, project team can get 4 points from the indicator.

No.	Indicator	Relevance Factor Point
2.	**Reduction of materials Through Life-cycle Assessment**	○○○○○○

For new construction, project team should evaluate a cradle-to-grave life-cycle assessment of the project’s structure and enclosure.

If the project team only evaluates the life cycle assessment of the projects structure and enclosure, project acquires 2 point from this indicator.

If the project team perform a life cycle assessment of the project's enclosure and structure that shows at least a 5% reduction in at least three of the six impact categories listed below, with the potential for global warming being one of them, project acquires 4 points from this indicator. If the reduction is 10%, it gets 5 points and if its 20%, it gets 6 points in total.

Impact categories for reduction are:

-global warming potential (greenhouse gases), in kg CO_2e;
-depletion of the stratospheric ozone layer, in kg CFC-11e;
-acidification of land and water sources, in moles H^+ or kg SO_2e;
-eutrophication, in kg nitrogen eq or kg phosphate eq;
-formation of tropospheric ozone, in kg NO_x, kg O_3 eq, or kg ethene; and
-depletion of nonrenewable energy resources, in MJ using CML / depletion of fossil fuels in TRACI.

If the project reuses and existing building and provides at least one point from the previous indicator “Reuse of an Existing Structure”, it automaticly earns the points of this indicator.

ENV-4.2

Recycled and Locally Sourced Materials

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a; DGNB GmbH, 2022)
Related Criteria: LEED- MR Credit Sourcing of Raw Materials, Material Ingrediants; GBC- MR Credit 3,5; DGNB- ENV1.3

Environmental Sustainability

Max. RFP can be acquired

8

Intent

Encouraging the use of products and materials that have environmentally, economically, and socially preferable life cycle impacts. Chosing products which life cycle information is available and have been extracted or sourced in a responsible manner. Reusing construction materials if possible to reduce both the raw materials required and generate less waste.

No.	Indicator	Relevance Factor Point
1.	**Local Sources** At least 30% of the construction materials and products that have been mined, harvested, recovered, and processed should be get within 180 kilometers of the construction site. Recycled building materials can be also counted. Project teams should use the products and materials which their life cycle information is available.	○○○○
2.	**Material Recycling** Use recovered or reprocessed materials to the extent that they constitute at least 10% or 15% of the total quantity of materials used in the project. If these materials are 10% or more, the project gets 1 point from the indicator, if it is 15% or more, it gets 2 points. Special items like lifts and systems, as well as mechanical, electrical, and hydraulic components, are not included in this calculation. Nonetheless, some parts or installations with particular historical significance might be assessed for renovation and reactivated as a useful functional substitute for new systems (e.g., historic ductwork of plumbing and heating systems, special mounting systems, characteristic kitchen fixtures, etc.). Project teams should use the products and materials which their life cycle information is available.	○○○○

ENV-4.3

Construction and Demolition Waste Management

Environmental Sustainability

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a; BRE Global Ltd., 2017)
Related Criteria: LEED- MR Credit Construction and Demolition Waste Management; GBC- MR Prerequisite 2, BREEAM- Wst01

Max. RFP can be acquired

8

Intent

Removing waste from demolition and construction projects from landfills or incineration plants. Recycling recovered recyclable resources back into the production process and sending reusable materials to the correct collection areas.

No.	Indicator	Relevance Factor Point
1.	**Waste Management Planning** Project team should create and carry out a waste management strategy for construction and demolition, and earn points by preventing or diverting waste. Every project needs to create and carry out a waste management strategy for construction and demolition: • Determine ways to cut down on waste production during project planning and building. • Determine the materials (structural and nonstructural) that are to be diverted in order to set waste diversion goals for the project. • Explain the project's intended diversionary tactics. Give the location of the materials to be taken, along with the anticipated rates of diversion for each material. Provide a final waste management report that lists all of the waste produced, along with the project's disposal and diversion rates.	○○
2.	**Diversion of the Construction Materials** At least half of all construction and demolition materials should be diverted from landfills and incinerators in accordance with the Waste Management Plan.	○○○
3.	**Waste Prevention** Utilize reuse and source reduction design techniques to avoid waste and adhere to the waste management plan. For new construction components, use waste-minimizing design strategies and construction techniques, and salvage or recycle at least 50% of demolition debris. From the beginning of construction to the end of the project, keep track of all the demolition debris produced. To ascertain the project's overall waste generation from new construction activities, keep track of all new construction waste materials produced from the beginning of construction to the end. Keep land-clearing debris and hazardous materials out of the calculations.	○○○

3.2.4 Economic Sustainability

Economic sustainability is based on the efficient utilisation of financial resources and ensuring long term economic resilience throughout the entire life cycle of buildings. This approach comprehensively assesses not only the initial investment costs, but also the maintenance and repair processes, the potential for transformability and the economic burdens that will occur during use. Encouraging local production, reducing operating costs and efficient resource management are critical in this context. Economic sustainability aims to ensure that buildings maintain their functionality without losing value over time and do not create an economic burden on the user. It also encourages economic planning in line with sustainable development principles.

ECO-1.1

Life Cycle Cost Analysis

Source(s): (BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: BREEAM- Man02, DGNB- ECO1.1

Economic Sustainability

Max. RFP can be acquired

22

Intent

Encouraging the use of life cycle costing to improve design, specification, maintenance and operation to promote sustainable buildings and ensure whole life value for business viability.

No.	**Indicator**	**Relevance Factor Point**
1.	**Elemental Level Life Cycle Cost**	○○○○○○○○○○

During the concept design stage, a competent person should carry out an LCC outline together with any design options appraisals in line with 'Standardised method of life cycle costing for construction procurement' PD 156865: 2008 (British Standards Institution, 2008).

This elemental LCC plan should offer an estimate future replacement costs over a specified analysis period (e.g. 20, 30, 50, or 60 years) as requested by the client and include estimates for operation, maintenance, and service life.

The client should ideally agree on the study period in accordance with the building's design life expectancy. However, a default design life should be used based on local defaults for modeling purposes in cases where the building's life expectancy has not yet been formally agreed upon (because it is still in the very early stages of design).

It should also be shown the elemental LCC plan has influenced building and systems design and specification to minimize life cycle costs and maximize critical value using relevant examples supplied by the design team.

2. Component Level Life Cycle Cost Options Appraisal ○○○○○○

During the technical design stage, a competent person should carry out a component level LCC options appraisal in line with PD 156865: 2008. (British Standards Institution, 2008). The component level LCC should include (where present):

-Envelope, e.g. cladding, windows, or roofing
-Services, e.g. heat source, cooling source, or controls
-Finishes, e.g. walls, floors or ceilings
-External spaces, e.g. alternative hard landscaping, boundary protection.

All of the aforementioned component types (where present) should be examined in the Componentlevel LCC option appraisal. Only a selection of the examples that are most likely to generate useful comparisons should be taken into consideration, rather than all of the examples listed under each component. This will help concentrate the analysis on the elements that would gain the most from appraisal and guarantee that a variety of options are taken into account.

3. Capital Cost Reporting ○○○○○○

Include in the submission the building's capital cost expressed in euros per square meter of gross internal floor area (€k/m²).

ECO-1.2

Flexibility and Adaptability for Future Uses

Economic Sustainability

Source(s): (USGBC, 2024; BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: LEED- MR Credit Design for Flexibility, BREEAM- Wst05, DGNB- ECO2.1

Intent

Encouraging the flexible design and ease of future adaptation to conserve resources associated with the construction and management of buildings.

Max. RFP can be acquired

16

No.	Indicator	Relevance Factor Point
1.	**Multi-use of Spaces** Design team should introduce a possibility of multiple use of relevant usable building areas implemented in accordance with the area utilisation concept. They should design and point out the flexibility aspects of some areas on floor plans.	○○○○○○○○
2.	**Building Technology Compatibility** Design team should be sure that the systems that are used in the building (e.g., HVAC, electrical etc.) are adaptable to future technology upgrades or additions.	○○○○
3.	**Ease of Material Reuse** Design team should use materials that can be easily dissassembled and reused for future uses and modifications. In the case of historical buildings, materials should be reversable (this is also related to the criteria CUL 1.4)	○○○○

ECO-1.3

Commercial Viability

Economic Sustainability

Source(s): (DGNB GmbH, 2022)
Related Criteria: DGNB- ECO2.2

Intent

Creating buildings with maximum user acceptance and long-term market potential.

Max. RFP can be acquired

12

No.	Indicator	Relevance Factor Point
1.	**Entrance Situation, Routing and Signposting** The entrance of the building site should be easy to find and identify. Routing/markings like building name, house number, building entrance, car/HGV entrance/parking spaces etc. should be provided.	○○○
	Parking Space Access Designated parking spaces should be the immediate vicinity of the main entrance or delivery entrance. Up to 50 m from the main entrance, there needs to be suitable points for drop-off and pick-up.	○○○
	Public Parking Space Access If the building is accessible by public, public parking spaces should be 200 m from the main or side entrance.	○○
	Potential Income There should be spaces that can be rented to the community for diverse uses when out of use.	○○
	Appeal to New Market Segments Building should be appealing to emerging demographics (e.g., tech startups, remote workers) and target new market segments.	○○

ECO-2.1

Programmed Maintenance Plan

Source(s): (Green Building Council Italia, 2024a)
Related Criteria: GBC- HV Credit 5

Economic Sustainability

Intent

Minimizing the overall expenses of the project (particularly in terms of construction site supervision) by opting for smaller maintenance tasks that have a lesser financial impact compared to major interventions. Ensuring the sustainability of the building in the long term.

Max. RFP can be acquired

11

No.	Indicator	Relevance Factor Point
1.	**Maintenanance Plan** Project team should develop a maintenance plan that is aiming to maintain functionality, quality, efficiency and economic value of the intervention over time. If an historical building is in question, the plan should also focus on the preservation and sustainability characteristics of the building planning inspection activities and describing intervention methods. The Maintenance Plan shoul contain; • explanation of the project's sustainability strategies, with particular reference to the checklist and the credits sought during the certification phase; • indications about how to use a building to maintain the environmental performance attained; • determining conservation strategies; • organizing and creating inspection-related activities; • plans for maintenance management that include thorough explanations of the characteristics and methods of maintenance.	○○○○○○○○○○○

ECO-2.2

Building Durability and Resilience

Source(s): (BRE Global Ltd., 2017; DGNB GmbH, 2022)
Related Criteria: BREEAM- Mat05, DGNB- TEC1.5

Economic Sustainability

Intent

Reducing the need for repair and replacement of materials caused by damage to exposed elements of the building and landscape.

Max. RFP can be acquired

12

No.	Indicator	Relevance Factor Point
1.	**Protection of Vulnerable Parts from People**	○○○○○○
2.	**Protection of Exposed Parts from Material Degradation**	○○○○○○

1. Protection of Vulnerable Parts from People

Design team should design some protective measures to minimize potential damage to building parts, materials and structure also considering the potential events of accidental or intentional harm. This can be achieved by;

- Carefully designing the heavily used spaces like corridors, staircases, elevators, and doorways, to prevent wear and tear caused by user traffic;
- Featuring protective elements within one meter of internal surfaces in areas like storage rooms, delivery zones, corridors, and kitchens to prevent damage from vehicles;
- Featuring measures like bollards or protective rails to shield the buildings external facade from potential damage that can be caused by vehicles (especially near parking and maneuvering areas close to building).
- Featuring protective elements in public and shared areas to prevent deliberate harm to building materials and finishes can be caused by people.

2. Protection of Exposed Parts from Material Degradation

Design team should use the right materials that can limit long and short term degradation due to environmental factors for key exposed building elements.

This can be demonstrated through showing the element or products used achieve an appropriate quality or durability standard. A detailed assessment of the materials resilience when exposed to the applicable material degradation and environmental factors can be done to prove its eligable.

Roof and facades of the building should have convenient access for cost-effective cleaning, replacement and repair and design of these elements should prevent water damage, ingress and detrimental ponding.

ECO-3.1

Quality of Construction Site Processes

Economic Sustainability

Source(s): (USGBC, 2024; Green Building Council Italia, 2024a; DGNB GmbH, 2022)
Related Criteria: LEED- SS Prerequisite Construction Activity Pollution Prevention; GBC- HV Credit 4; DGNB - PRO2.1

Intent

Reducing the negative environmental impacts of construction site operations by implementing tactics to decrease the consumption of nonrenewable resources by restricting the environmental effects of restoration methods. Minimizing pollution caused by construction activities and reduce their negative effects on neighborhoods by managing soil erosion, waterway sedimentation, and airborne dust.

Max. RFP can be acquired

16

No.	Indicator	Relevance Factor Point
1.	**Constructor Training for Energy Efficiency** Constructors should be trained and encouraged to use the energy efficiently to minimize climate-change gas emissions, with particular reference to the use of low-impact technologies (gas discharge, low-energy or LED lamps, eco-diesel power generators with silencers, solar panels for hot water, etc.);	○○○○
2.	**Reducing Visual Disturbance** Visual impact of the construction site should be reduces through screening and green landscaping specifically when there is the existence of nearby housing and natural habitats of animals that can be affected.	○○○○
3.	**Reducing Noise Disturbance** A low-noise construction site concept should be formulated and the constructors should be trained to follow it.	○○○○
4.	**Construction Dust Prevention** A low-dust construction site concept should be formulated and the constructors should be trained to follow it.	○○○○

ECO-3.2

Sustainable Management Documentation

Source(s): (DGNB GmbH, 2022)
Related Criteria: DGNB- PRO1.5

Economic Sustainability

Intent

Ensuring that the building's planned performance is attained in reality to operate the building as soon as it is complete with as little deviation as possible from the plans. Providing all the relevant information in a clear and organised format.

Max. RFP can be acquired

11

No.	Indicator	Relevance Factor Point
1.	**Up-to-date Documentation** After the end of the construction of the building, all technical drawings,documentation and calculations of the building should be submitted, including the differences, if any, between the design phase and the post-construction situation. With these documents, it should be presented in a simple and understandable way that the sustainability objectives targeted by the project have been achieved. Maintenance, inspection, operating and care instructions should also be described.	○○○○○○○○○○○

Chapter 04

An Abandoned Brutalism

Figure 58 Marxer Institude, Torino
Source: photo by the author 2025

Figure 59 Marxer Building Research and Laboratory Volume
Source: divisare.com photo by Paolo Mazzo 2017

MARXER PHARMACEUTICAL RESEARCH INSTITUTE AND LABORATORY

Typology: Industrial and manufacturing architecture

Original Function: Chemical and pharmacological research centre, production of drugs

Current Condition: Abandoned

Municipality: Loranzé

Adress: Strada Provinciale 222, 33 – Loranzè (TO)

Important Building Dates: 1959(Design), 1960(Building permit),1964 (Serviceability)

Client: Olivetti Company

Authors: Alberto Galardi (Architectural design), Antonio Migliasso (Structural design)

Legal status: Public capital agency

Property: Private property

(Ministero della Cultura, 2024)

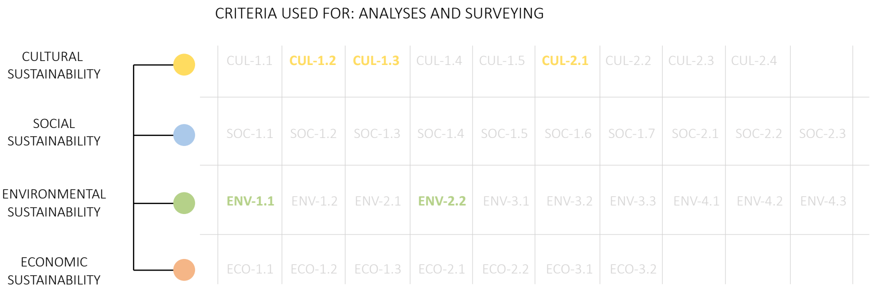


Figure 60 Criteria that are used for Analyses and Surveying
Source: produced by the author

4.1 Marxer Pharmaceutical Research Institude and Laboratory Background

Marxer Pharmaceutical Research Institude and Laboratory was designed by Alberto Galardi from 1959 to 1962 and commissioned by Adriano Olivetti. It housed pharmacological research and production for Società Italiana Prodotti Marxer, founded by Dino Olivetti, Adriano Olivetti, and Antoine Marxer. Marxer, as a medical academic, influenced the Olivetti philosophy of industrial innovation.

Olivetti played a critical role in blending industrial innovation with human-centered design, especially under Adriano Olivetti's leadership. Adriano's personal vision emphasized creating workspaces that were both functional and inspiring, prioritizing human well-being and collaboration with nature.

Marxer, who was born on May 11, 1880, was a significant figure in pharmacology and medicine. In 1909, he was appointed Director of the Bacteriological Institute of the Schering Chemical Industry in Berlin, where he also taught at the Faculty of Chemistry. He had previously taught at the Institute of Hygiene in Berlin and Strasbourg from 1902 to 1906. He went on to teach chemotherapy at the University of Strasbourg, where he also held the positions of Director of the City of Metz Research Laboratory from 1928 to 1938 and Scientific Director of the Salkantale Laboratories (Delledonne and Massari, 2019).

He established his own research facility in Argentina after leaving his native Germany. Marxer and his wife were already working together in Argentina; they were responsible for the Argentine Olivetti at the time. After getting married in Argentina in 1945, they moved back to Europe and settled in Ivrea, Italy, at the end of World War II. In 1949, Dino Olivetti, Adriano Olivetti, and Antoine Marxer established the Società Italiana Prodotti Marxer, which subsequently became Marxer S.r.l., confirming the two families' professional collaboration.

Figure 61 Old image of the interior of the production department
Source: Alberto Galardi, Architettura italiana contemporanea, Edizione Comunita, Milano 1967

Figure 62 Research,Laboratory and Production Buildings around 1962
Source: Alberto Galardi: Architetto, Fundacion Gordon, Buenos Aires, 2001

Figure 63 General view of the Complex around 1962
Source: Alberto Galardi: Architetto, Fundacion Gordon, Buenos Aires, 2001

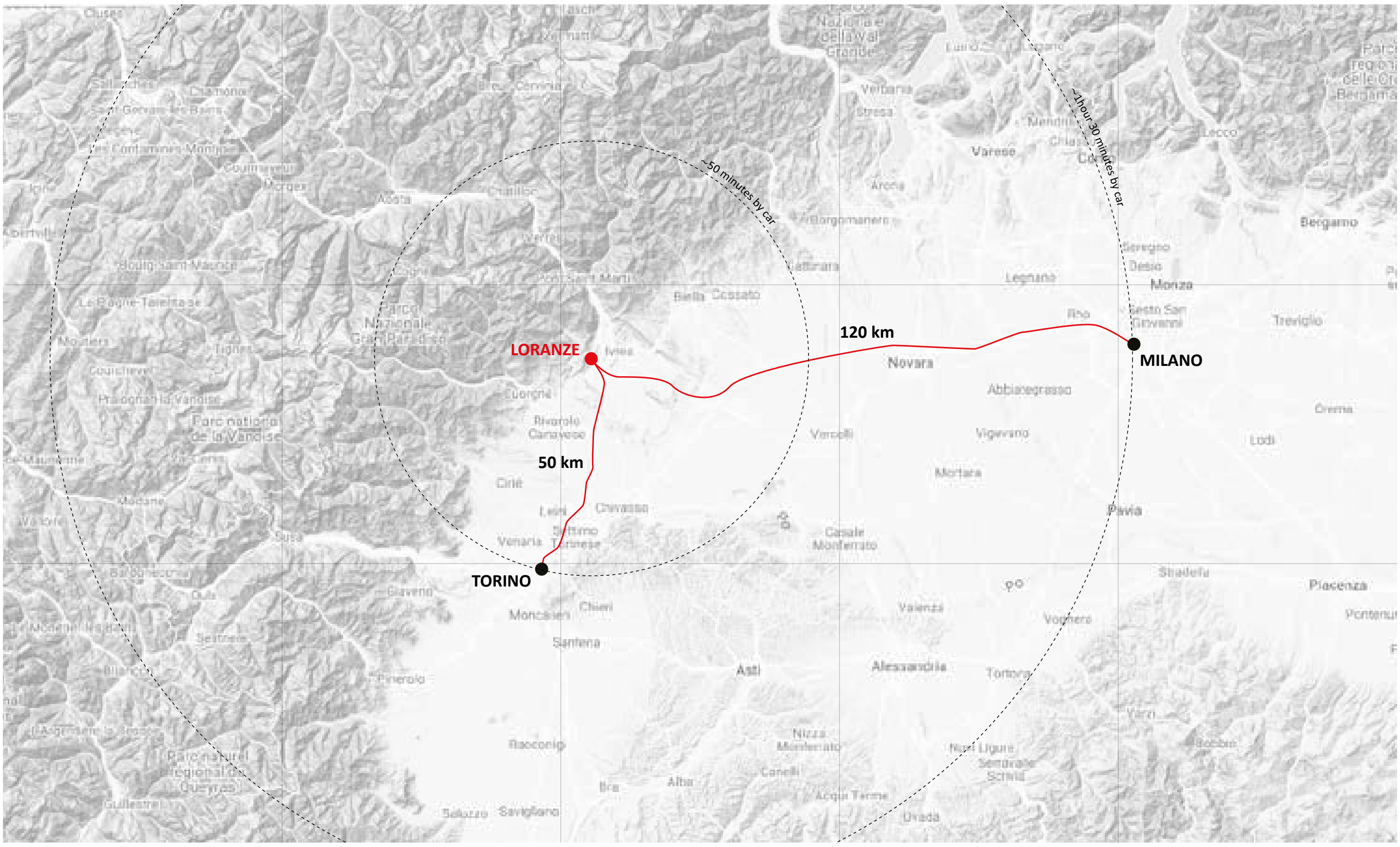
4.2 Territorial and urban framework

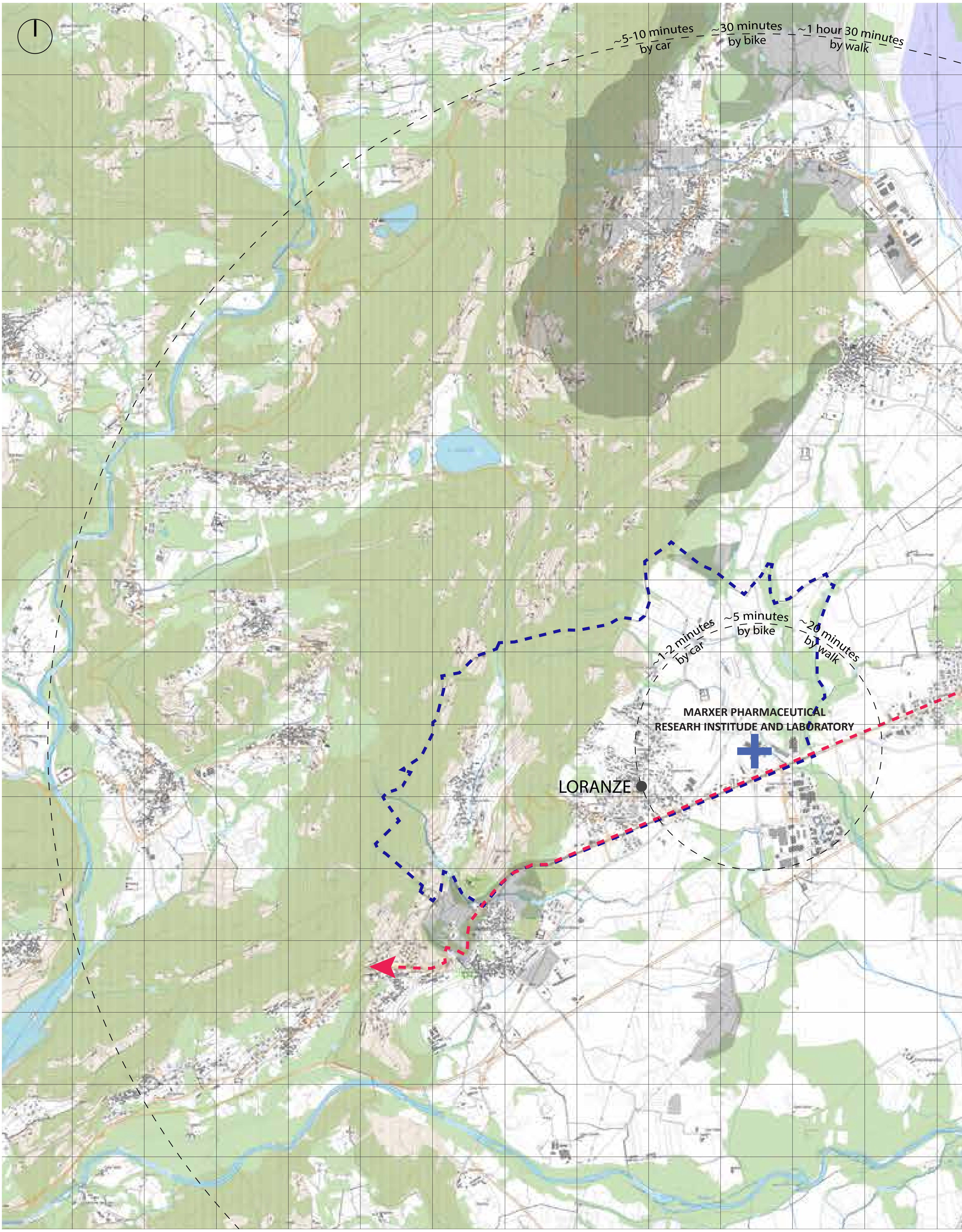
Figure 64 Production Building from top of the Research Building
Source: divisare.com photo by Paolo Mazzo 2017

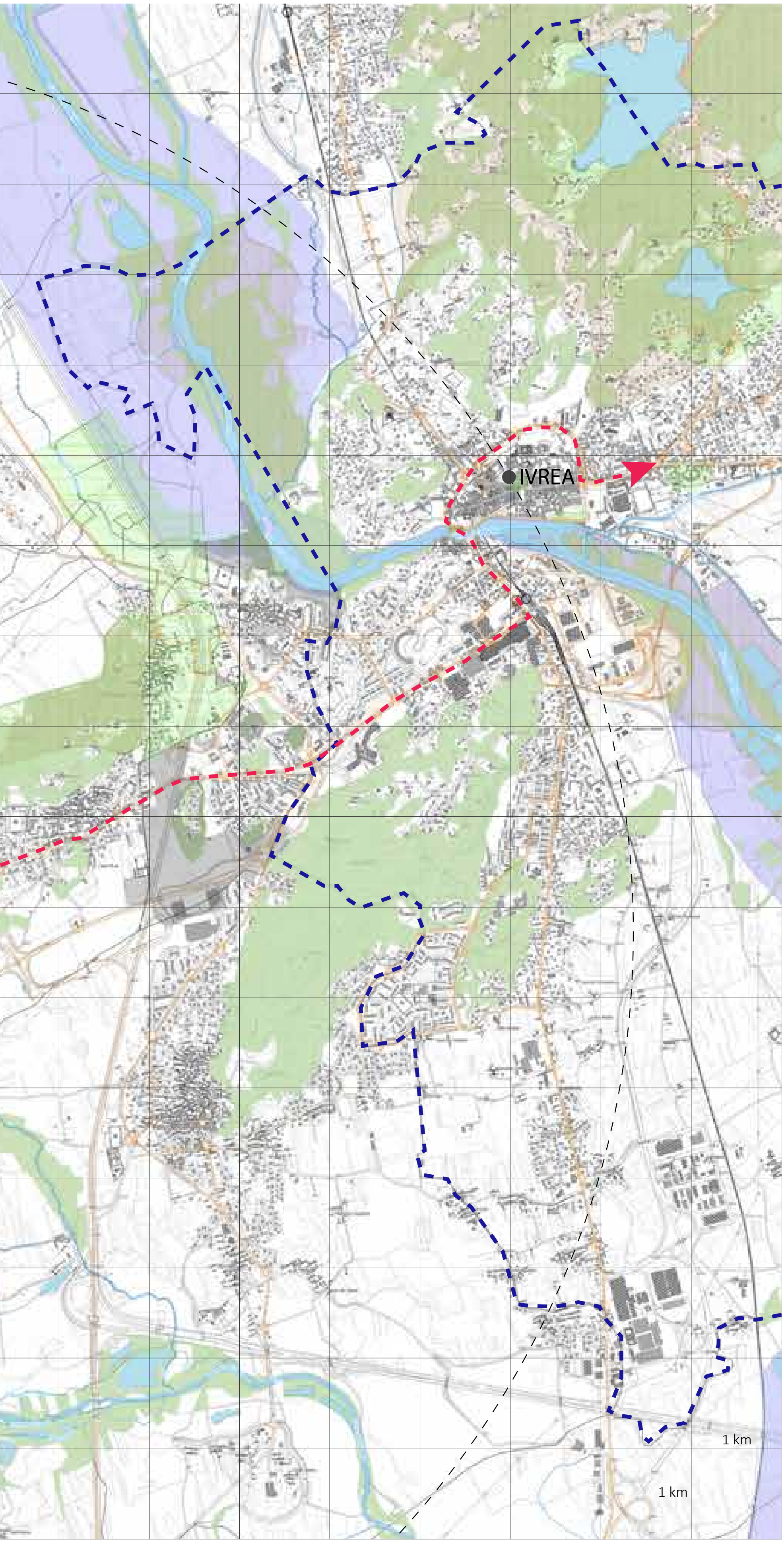
The site is located on the Loranzè plain and about 1.5 km from from the inhabited area. It is right next to the Provincial road connecting Loranze and Ivrea. Loranzè is a municipality of the metropolitan city of Turin in Piedmont with 1,164 inhabitants. It is located in the Canavese region, a historical and geographical area in Piedmont stretching from the Serra di Ivrea to the Po River, the Stura di Lanzo and the Graie Alps, connecting to the Valle d'Aosta and extending eastwards towards the regions of Biellese and Vercellese. Although small in size and population, Loranzè benefits from strong motorway links, making it accessible to major cities such as Milan and Turin.

The nearest railway station is in Ivrea, 8 km away. Loranzè offers cycling and pedestrian routes in Ivrea, while the surrounding landscapes have excellent nature trails for walks and hikes. As far as the territory is concerned, Loranzè is defined by landscape unit 2816 of the Regional Landscape Plan (PPR) of the Piedmont Region as a 'natural/rural or rural landscape of medium relevance and integrity', without considering the presence of production sites in the external areas.

Figure 65 Location of Loranze Commune and its relationship with Torino and Milano
Source: Produced by the author




~5-10 minutes
by car
~30 minutes
by bike
~1 hour 30 minutes
by walk
~1-2 minutes
by car
~5 minutes
by bike
~20 minutes
by walk
MARXER PHARMACEUTICAL
RESEARH INSTITUDE AND LABORATORY
LORANZE



Residential
Administrative or Public Service
Commercial
Industrial
Warehouse
Water element
Build Restricted Zone
Bus Line
Bus Stop
Railway
Railway station
Indogeological Restriction Zone
Forest Area
Monumental/Archaeological Restricted Area
Environmental Cultural Restricted Area
Areas at Risk of Removal/Erosion
Loranze and Ivrea Comune Borders
Loranze and Ivrea Main Connection

Figure 66 Marxer Building and Relationshio with Surroundings
Source: geoportale.piemonte.it

Figure 67 Satelite Photo of the Area
Source: Google Earth image

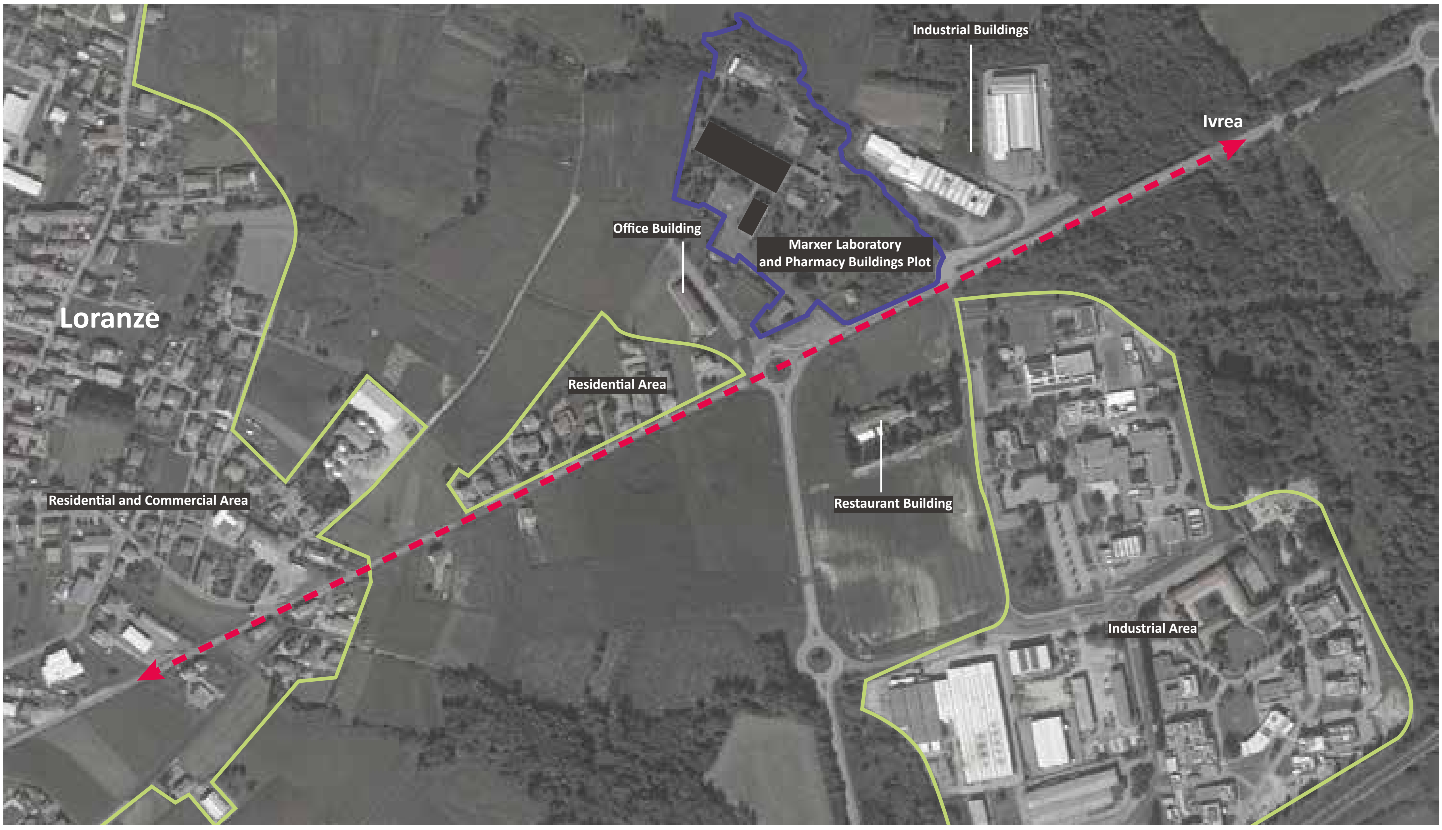


Figure 68 Existing Situation of the Area
Source: Google Earth images Produced by the author

Figure 69 Existing Master Plan of the Complex and the Original Functions
Source: Produced by the author

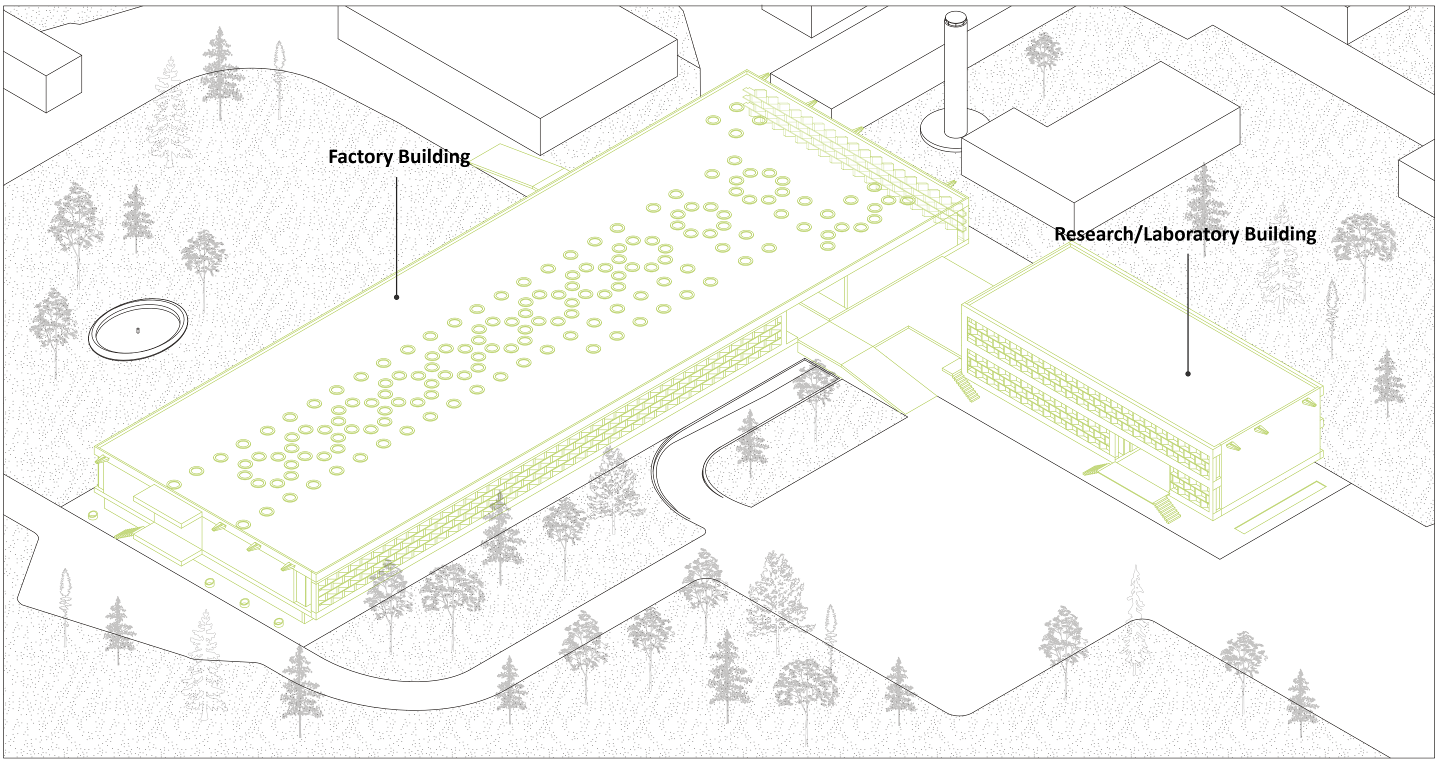


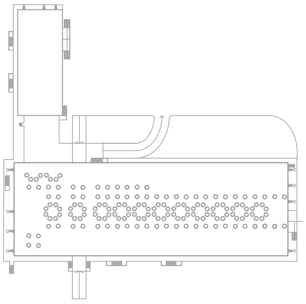
Figure 70 General view of the Existing Buildings
Source: Produced by the author

4.3 Architectural and Structural Characteristics of the Buildings

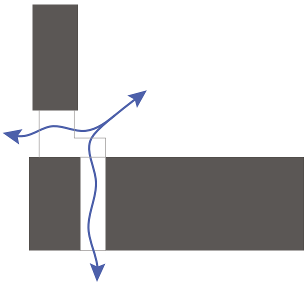
The whole project was built on a 70.000 square meters land near the provincial road that connects Loranzè and Ivrea. Dating back to the early 1960s, the complex was characterised by two main buildings: the building dedicated to office/research activities and the one that was for production. Other than these two main buildings, the complex also included an enclosure, an area for the breeding and observation of animals for research purposes. The two-storey caretaker's cabin housed a telephone exchange and transformer cabinet totalling 600 square meters. Finally, there was a connection building, covering an area of 350 square metres, in which a canteen and kitchen were installed. In the 1970s, the production system was expanded with water treatment infrastructure and operating departments. The surrounding park, which is about 7000 square metres in size, had numerous facilities, including a tennis court, a football pitch and a bowling alley. The streets of the open area were paved with a red-coloured porphyry-based asphalt surface (Boltri et al., 1998).

The office and research building, is a two-storey building with nine laboratories dedicated to biological, chemical and pharmaceutical research and the whole building is 1800 square meters in total, including the basement. The research laboratories were located on the first floor, which also housed a library and a workshop for equipment maintenance and repair. The secretariat, management and administrative offices, and the office for scientific reports were located on the ground floor, while the rooms for virological research were located in the basement. A self-supporting double ramp staircase that is joined at the ends with a cantilever connects the building's floors.

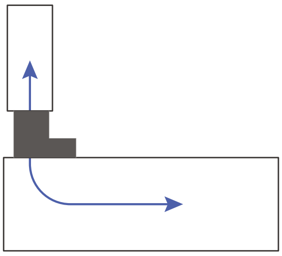
The production plant has only one floor and its total area is 7000 square meters including the technical basement. The building is cut by a driveway that facilitated the loading and unloading of goods. The heating plant remains on one side of this passage and, because of its size, also takes up the corresponding mezzanine floor. Women's changing rooms and restrooms are also located here. A long corridor, with full-height glass walls separating the various production departments on either side, once separated the production area for two thirds of its length. The packaging and goods dispatch departments were located at the far end of the building. Today this area consists of a single large space and some of the walls are missing. These two buildings have a homogenous appearance and are connected to the basement floor by underground corridors whose dimensions allowed the passage of motor vehicles.



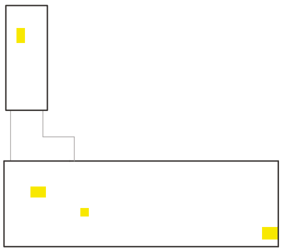
General view



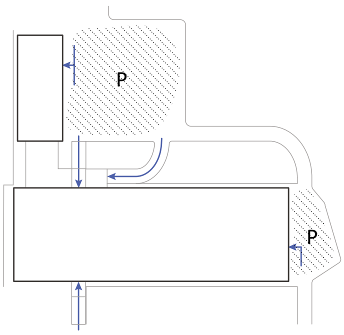
Composition of the Volumes



Continuation of the Volumes

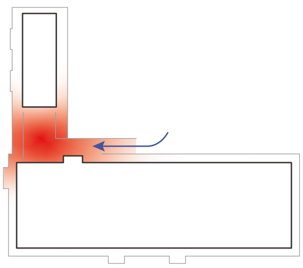


Upper Floors Vertical Circulations

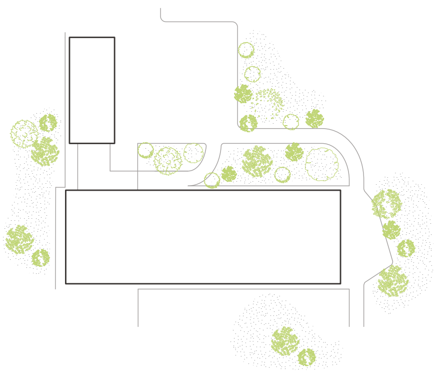


Entrances and Logistics

Underground Vertical Circulations



Underground Motor Vehicle Connection



Green surrounding the structures

Figure 71 Formation of the Existing Buildings
Source: Produced by the author

Figure 72 Existing Basement Floor Plan and Original Functions
Source: Produced by the author

Figure 73 Existing Ground Floor Plan and Original Functions
Source: Produced by the author

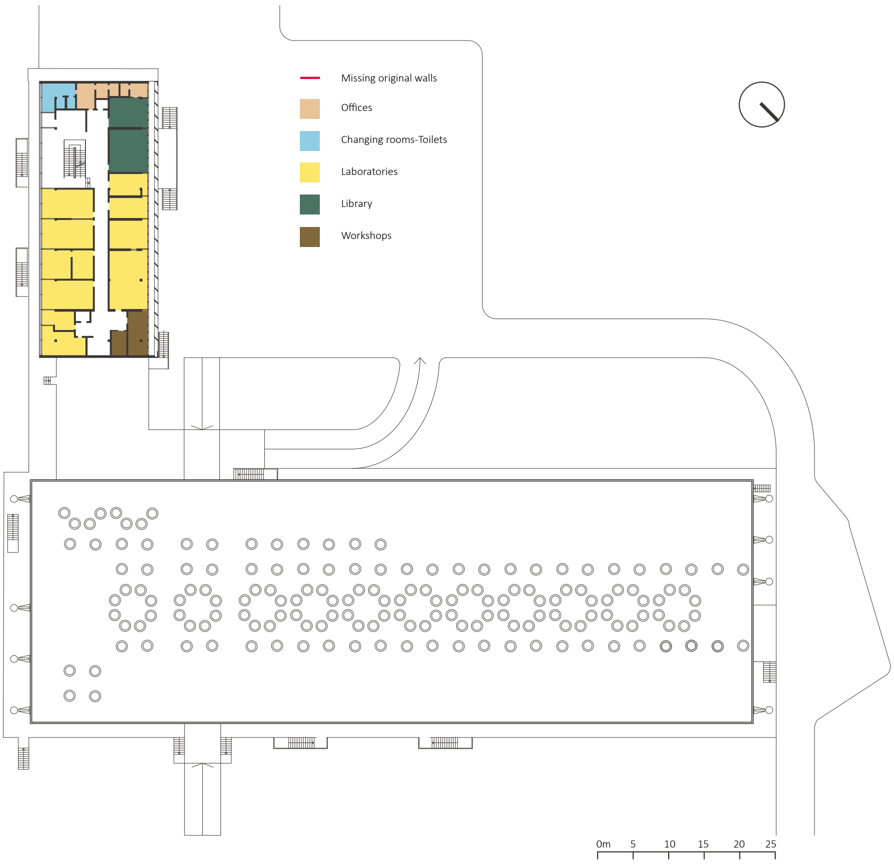


Figure 74 Existing First Floor Plan and Original Functions
Source: Produced by the author

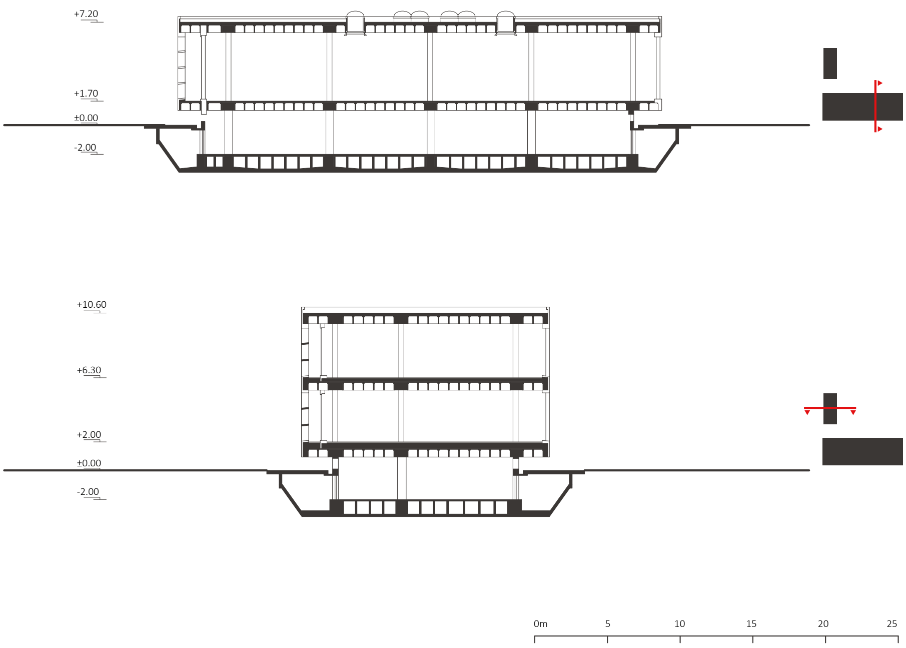


Figure 75 Existing Sections
Source: Produced by the author

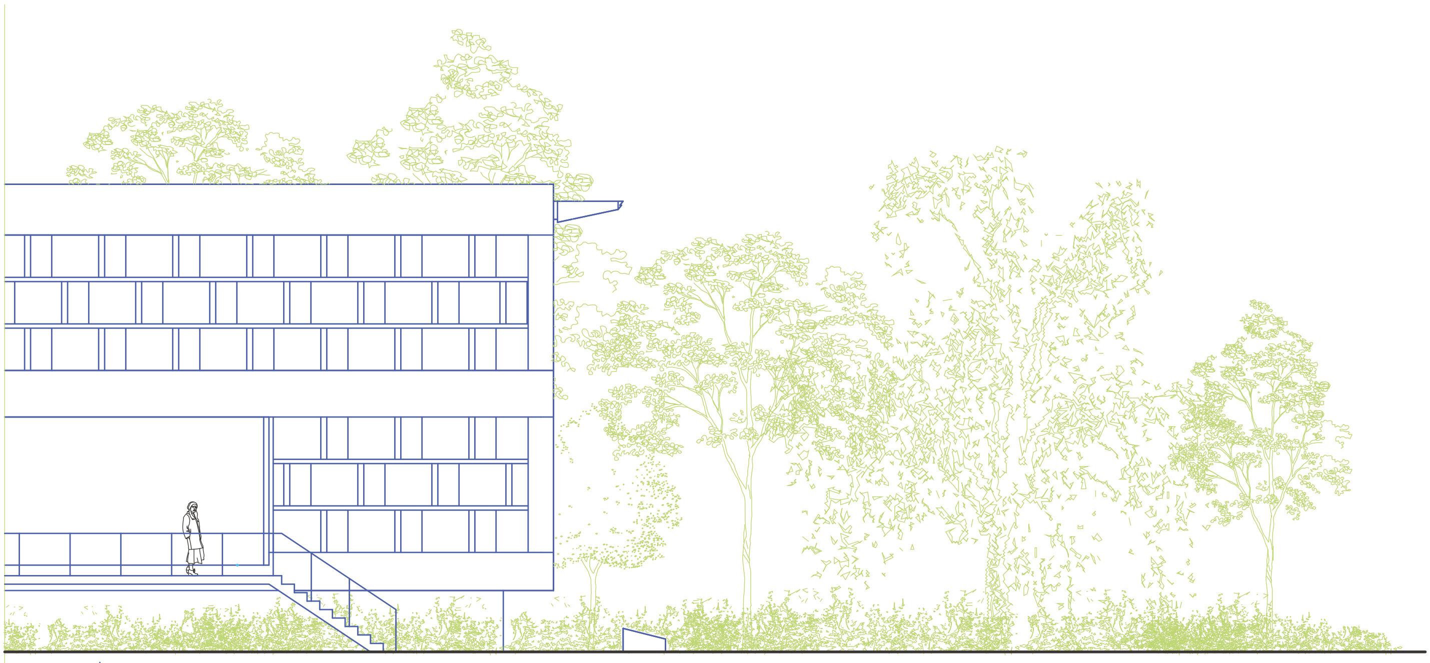


Figure 76 Facade, Human scale and Nature
Source: Produced by the author

Figure 77 Materiality and the green
Source: divisare.com photo by Paolo Mazzo 2017

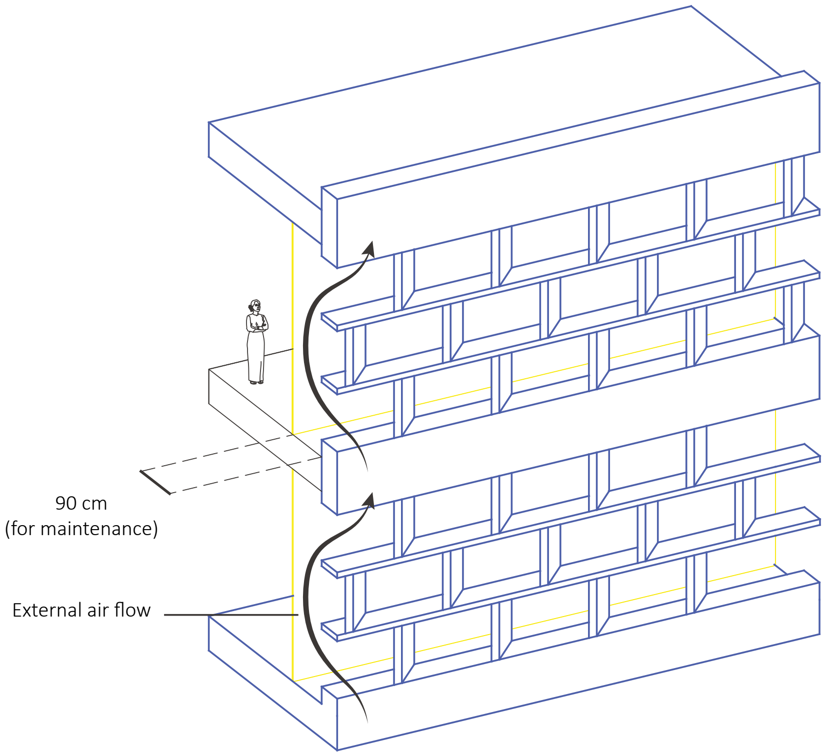
4.3.1 Main concept

The main idea of the project was to have a place that could provide a work place with a human-scale environment completely surrounded by nature for two hundred workers, twenty-five employees and twenty researchers. This was the reason having garden and outdoor areas that sets relationship with green and Loranzè was a place to answer these needs with its natural character. The architect used the exposed materials to harmonize the brutalist architecture with Loranzè's green. This idea of exposed concrete totally characterises the project and gives an homogenous appearance that creates continuity between the two buildings. The brutalist appearance of the buildings characterise Galardi's architecture with all the elements in the project: the sunshades, the gargoyles with their ground collection tanks and the chimney.

4.3.2 Envelope of the Building

Sunbreakers, which are the most important facade elements that form the character of the buildings, consist of horizontal and vertical facade brut concrete combs. The horizontal components, which are slightly inclined outwards (10%), and the vertical components, which are placed at an angle of 45 degrees to the window frames, form rectangles with sides of 1 m and 1.61 m.

These sunbreakers are located on the north-west facade of the office and research building and on the south-west facade of the production plant and are approximately 90 cm away from the curtain walls of both buildings in order to ensure the maintenance and repair of the facades. At the same time they ensure better external air circulation for effective facade ventilation.



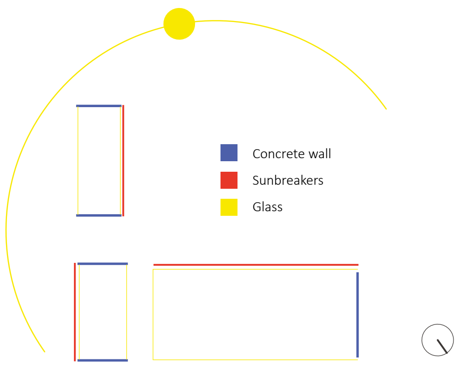


Figure 78 Facade and the Sunbreakers
Source: Produced by the author

Another prominent feature of the project is the circular skylights on the roof of the production building. These circular openings, which are 160 in total and provide natural light, cover 3500 square metres of roof and are mounted with prefabricated cylindrical domes.

The skylights are high enough to avoid direct sunlight and have a circular neon light so that they can be used even when there is no external light. These 1.14-meter-diameter domes on top of the circular openings are known as Lanterplex and are composed of perspex, an acrylic material. This material was chosen due to its many benefits: superior to glass in terms of resistance to breakage; light weight, with a skylight weighing roughly 10 kg/sqm; and the removal of condensation due to the shape of the walls and the collection channel at the base. This prevents any dripping by moving the condensation that builds up on the interior surface outside; high luminous efficiency, allowing for the interior to receive up to 92% of solar radiation; low cost because of the ease of installation, longevity, and lack of maintenance—rain is sufficient to keep the skylights clean.

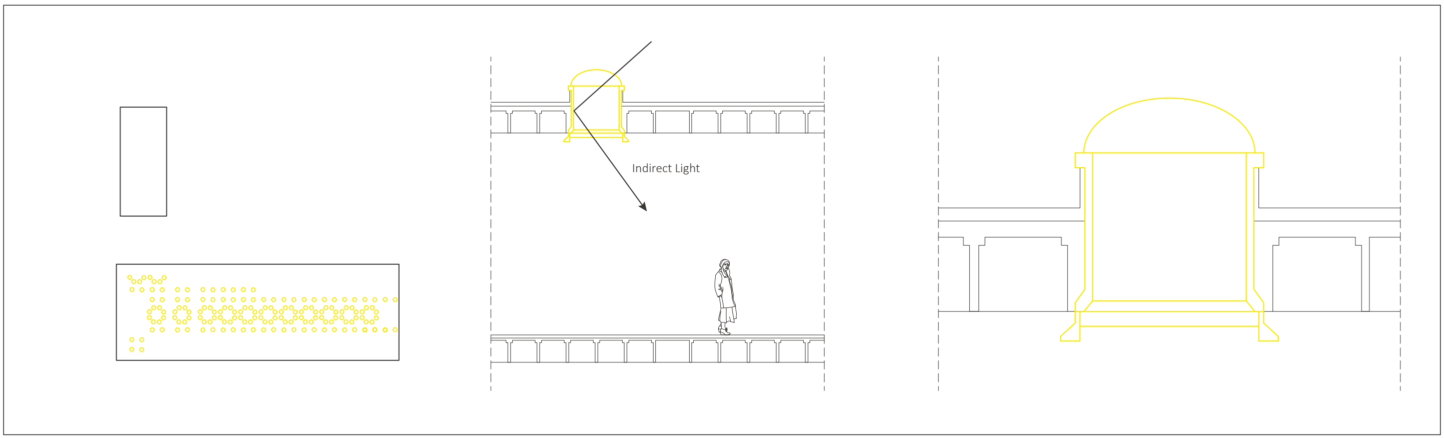


Figure 79 Lightwells
Source: Produced by the author

The gargoyles and the rainwater collection tanks underneath are made of prefabricated reinforced concrete elements in a single casting using plaster moulds. The forms of the gargoyles, obtained through multiple combinations of ellipses, protrude orthogonally from the elevations and cast long, thin shadows on the exposed concrete surfaces under certain light conditions. The circular rainwater collection tanks with raised sides towards the building side have a diameter of 1.10 m and a height ranging from 30 cm to 80 cm. These tanks, eight in total, are filled with stones to soften the water falling on the surface.

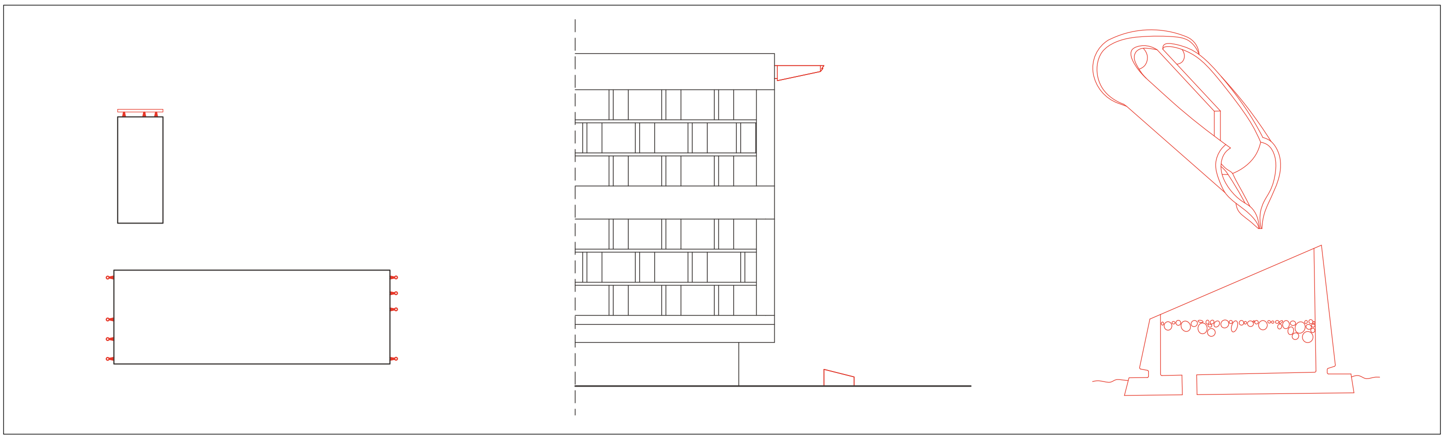


Figure 80 Gargoyles and Water Collecters
Source: Produced by the author

The cylindrical chimney, also made of prefabricated reinforced concrete elements; in the base of the chimney, which extends to the basement, there is a staircase that descends to the base of the chimneys, allowing periodic cleaning operations to be carried out.

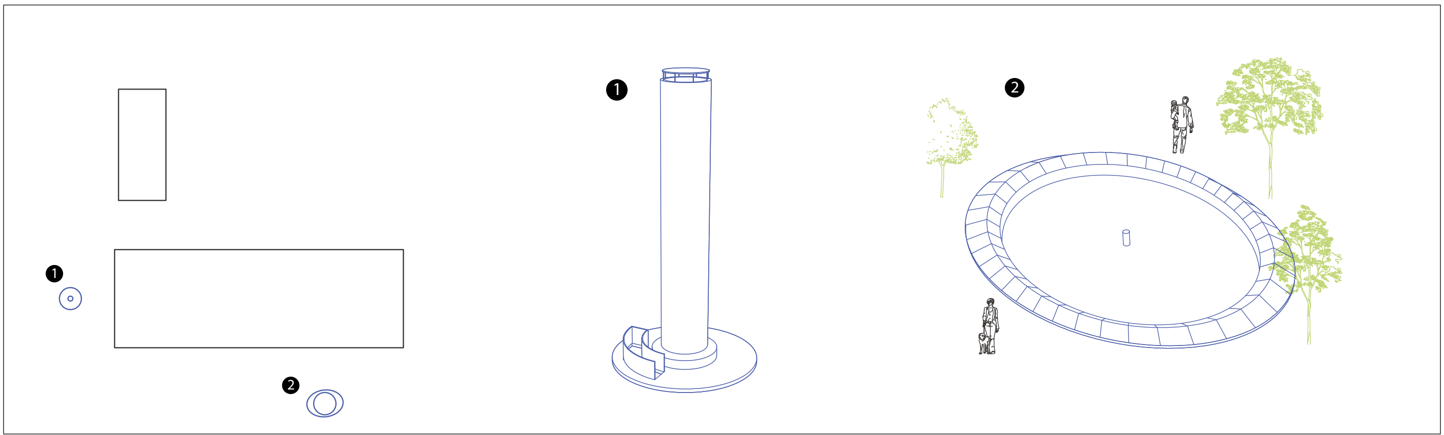
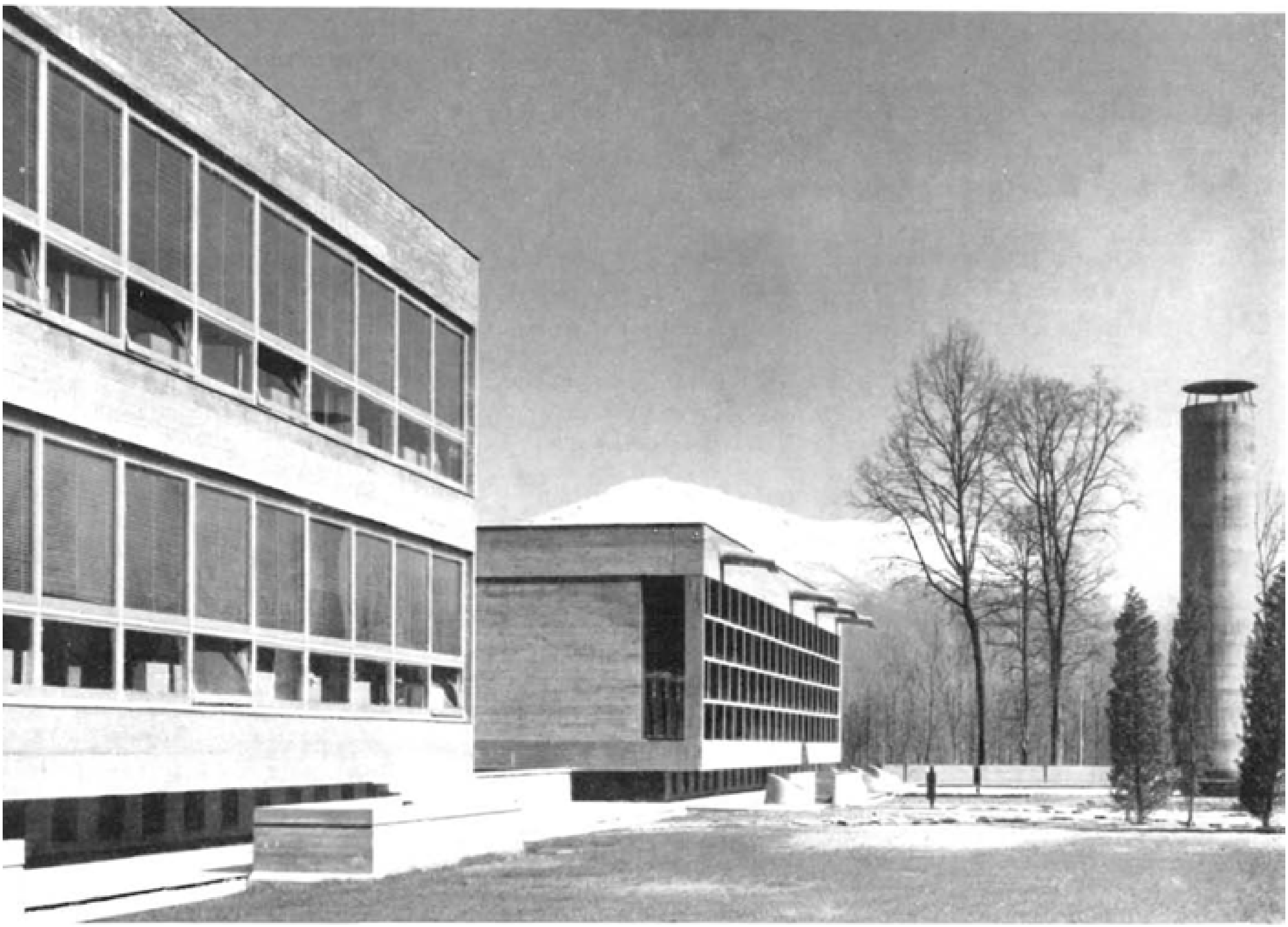


Figure 81 Chimney and the Fountain
Source: Produced by the author

Figure 82 Historical photo of the Gargoyles and Tanks from northwest side of the plant
Source: Informes de la Construcción, 1965

Figure 83 Historical photo of the Office Building and the Factory
Source: Informes de la Construcción, 1965



4.3.3 Materials and tecniques used

Lightweight anodised aluminium alloy was used for the windows and doors of the buildings in the complex, while the main frames of the curtain wall were made of steel. In total, an estimated 4500 square metres of external glazing and internal partition walls were installed.

Some windows, like the one in the office building, could rotate on the vertical axis to allow for the best possible air exchange, while the smaller modules were distinguished by a horizontal pivot opening that could be controlled by remote cranks.

The internal walls that close the cavity have a layered structure composed of cement mortar plaster (1 cm), 8 cm four-hole bricks, a 14 cm air chamber, 2 cm of plaster, and 10 cm of solid bricks.

All the floors are of the "Stimip" type, with heights between 50 and 70 centimetres and useful loads of 1000-1200 kg/m2. The production building's floors differ from those of the office and research building. The production's floor is made of concrete and brick, with crossed ribs positioned atop thick beams that are bent in two directions. Although the office and research building's floors differ, they are both composed of concrete and brick with parallel reinforcement. Interspaces in the intrados and extrados for system housing are a defining feature of all brick and concrete floors.

The flat roof is about 70 centimeters thick, from the outside towards the inside, of a floor with concrete slabs, a layer of bituminous cardboard, a layer of asphalt, more bituminous cardboard under which pumice cement is laid, a thin layer of ruberolo under which the stimip floor is located (58 cm). Under the floor is an 18 cm thick air cavity, followed by a painted sheet metal ceiling panel for the countertop.

The factory's roof is also distinguished by prefabricated reinforced concrete drums that support the perpex dome skylights for lighting. The internal stairs of the Office building are also noteworthy, as they are constructed with a double self-supporting ramp and are only tied at the lower and upper ends, with an intermediate cantilevered landing (Boltri et al., 1998).

The foundations were designed to overcome issues caused by clay-rich soil. oil analysis showed that resistance was negligible in the top 3 meters but improved significantly at depths beyond 9 meters, becoming optimal at 14 meters. A crawl space, 80 cm high, was included, with walls inclined at 45 degrees to reduce stress on the brackets. Layers under the slab consisted of 6 cm of gravel, 6 cm of lean concrete, 1 cm of asphalt, and 2 cm of mortar. Waterproofing protected the foundation slab and brick crawl space from humidity, while a perimeter cavity facilitated drainage and housed utility systems. This robust design ensured structural integrity despite challenging soil conditions (Galardi, 2001; Delledonne and Massari, 2019)

This is the original material condition of the building in the light of the available documents, but in its current state, most of the materials have been damaged, fragmented and vandalised and almost destroyed.

4.4 Current state

After more than thirty years of abandonment and lack of maintenance, degradation of the structures and architectural parts have become significantly apparent. At the moment, all of the systems are unusable, the majority of the internal construction and non-structural finishing works are missing or severely damaged, very little of the original windows and doors are left; the glazed portions have mostly lost and roof waterproofing is absent. Despite the risk, the relevant buildings demonstrate relevant resilience in terms of load-bearing structures and parts of the reinforced concrete shell, consistent with the recognized testimonial and architectural value.

1- Stainless steel flashing
2- Waterproofing membrane (0.5cm)
3- Concrete
4- Aluminium window frame
5- Glass glazing
6- Concrete screed
7- Waterproofing membrane (0.5cm)
8- Rockwool thermal insulation (10cm)
9- PVC vapour barrier (0.3cm)
10- Slope concrete (8cm, %1)
11- Seramic tiles (20cm x 20xm)
12- Adhesive glue
13- Waterproofing membrane (0.5cm)
14- Slope concrete (8cm, %1)
15- Installation screed
16- Concrete slab (58cm)
17- Hollow slab brick
18- Aluminium profile
19- Plasterboard ceiling (2cm)
20- Ceiling hanger
21- Aluminium window frame
22- Glass glazing
23- Plaster (3cm)
24- Semi-hollow bricks (12cm)
25- Air gap (9cm)
26- Hollow bricks (8cm)
27-Rock wool thermal insulation (6cm)
28- Plaster mesh
29- Plaster (3cm)
30- Concrete flooring (2cm)
31- Waterproofing membrane (0.5cm)
32- Slope concrete (8cm, %1)
33- Rock wool thermal insulation (6cm)
34- Concrete screed
35- Ventilated underfloor cavity
36- Aluminium window frame
37- Glass glazing
38- Marble sill
39- Brick wall (12cm)
40- Adhesive glue
41- Seramic tiles (20cm x 20xm)

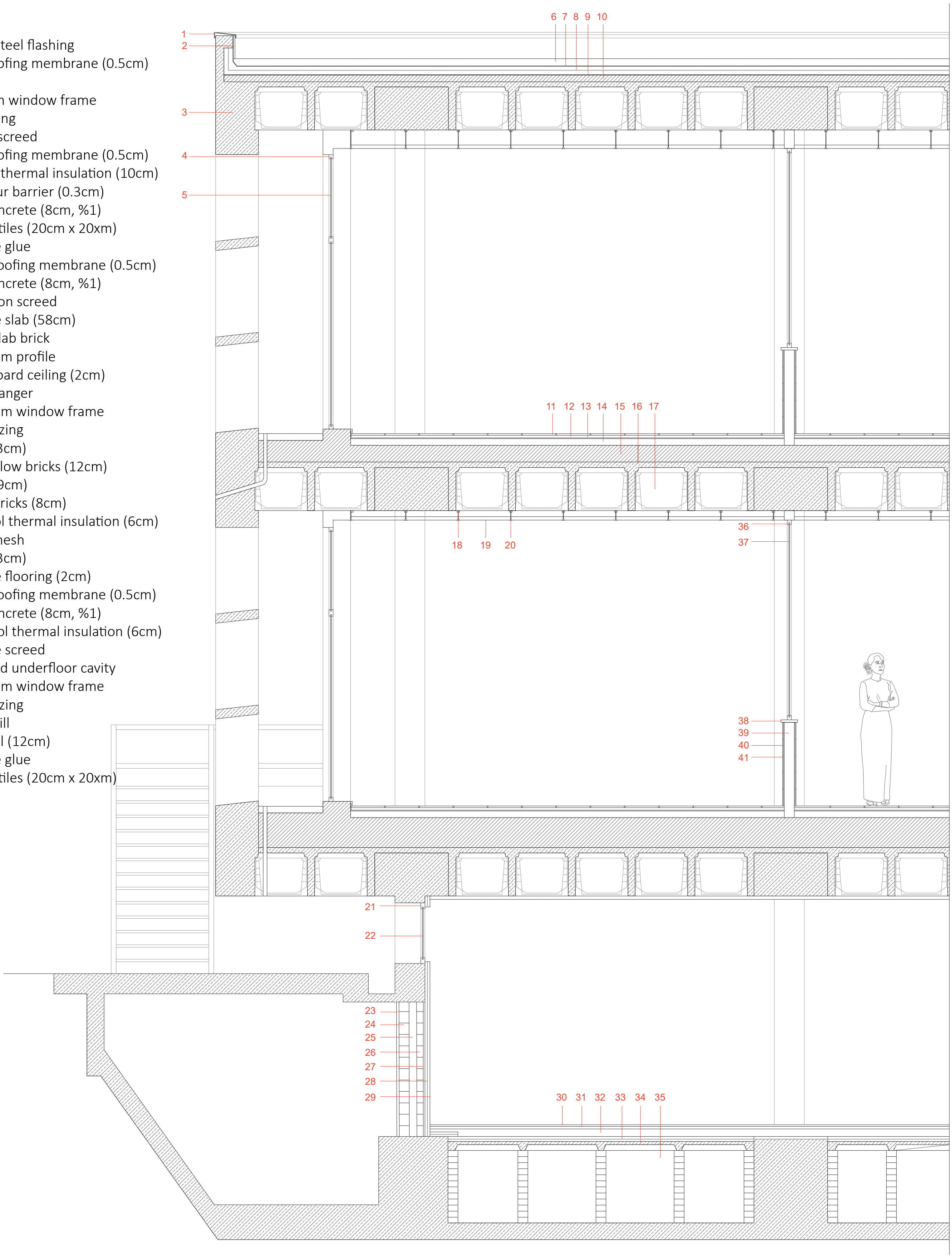


Figure 84 Original System Section and Materials Research and Lab Building Example
Source: Produced by the author

*These are only the material data that could be reached

Figure 85 Existing Condition of the Lab Building Entrance
Source: photo by the author 2025

Figure 86 Existing Condition of the Factory Space
Source: photo by the author 2025

Figure 87 Existing Condition of the Corridor
Source: photo by the author 2025

Figure 88 Existing Condition of the Rooftop
Source: divisare.com photo by Paolo Mazzo 2017

Figure 89 Existing Condition of the Factory Entrance
Source: photo by the author 2025

Figure 90 Existing Condition of the Factory from Outside
Source: photo by the author 2025

Figure 91 Green surrounding the Building
Source: divisare.com photo by Paolo Mazzo 2017

4.4.1 Existing Habitats

In the current situation, the buildings have been overtaken by nature, with wild grasses growing uncontrollably and flowing from the exteriors almost into the interiors. Abandoned and neglected for many years in a location like Loranze, where nature is a major factor, the buildings have naturally remained in the green ecosystem. At this point, the design interventions to be made should find a common balance by making the building functional, while respecting the existence of this ecosystem that has taken over the built environment in the absence of human beings. The green factor should be an important dimension in the design proposal and should be seen as a separate element in addition to concrete structures in new use proposals.

Figure 92 New condition of the green landscape
Source: divisare.com photo by Paolo Mazzo 2017

4.4.2 Condition of the Structure

In the two main buildings, it is possible to read modules of 1.75 metres. In the production building there are columns every four modules (every 7 metres) and in the office and research building their frequency is reduced to every two and a half modules (every 4.5 metres) (Boltri et al., 1998).

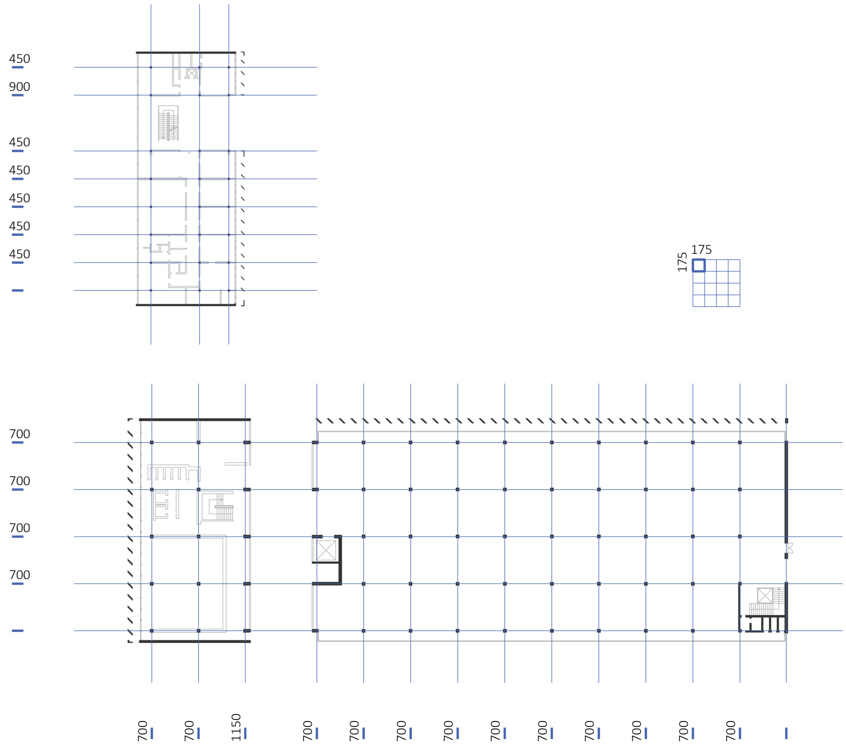


Figure 93 Formation and Dimensions of the Structure
Source: Produced by the author

The restoration of a historic reinforced concrete building is even more difficult if it was built in brutalist style. Because in these buildings, in addition to being a structural element, concrete is also the building finish. Repair work can be challenging due to factors such as the original construction techniques, visible finishes, the need to preserve historic materials, or other complexities.

A rehabilitation strategy should be developed in order to repair the building structure in the most appropriate way. The first step in formulating a rehabilitation strategy for the concrete building is to carry out an assessment of the concrete structure. This assessment should focus on the current condition of the structure and identify the causes of distress and deterioration. The results of this assessment should form the basis for the development of a rehabilitation plan, which will usually include a repair and maintenance program (Harrer and Gaudette, 2019).

The rehabilitation strategy must address technical factors, including the mechanisms of deterioration and durability, the properties of the original concrete, as well as the aesthetic aspects of ensuring the new elements blend with the original concrete features (American Concrete Institute, 2014). Repair implementations demand a high level of contractor expertise and skill to preserve the overall aesthetic design of the structure. Completing mock-ups and trial repairs is crucial to set the standards for the entire repair process. In this way it becomes possible to repair the structure similar to original condition (Harrer and Gaudette, 2019).

The shells of the existing buildings show easily detectable wear and deterioration. At this point, different methods should be determined for different types of deterioration and solutions should be produced considering the original condition of the building.

For example one effective method to enhance or restore the load-bearing capacity of structures and prolong their service life is strengthening with advanced composites or fiber-reinforced polymers (FRP) (Shaaban and Seoud, 2018). FRP is an efficient retrofitting technique due to its high strength-to-weight ratio, damping properties, excellent corrosion resistance, fatigue resistance, and the quick repair process it offers (Panahi et al., 2021). Among the various types of FRP, Glass Fiber Reinforced Polymer (GFRP) and Carbon Fiber Reinforced Polymer (CFRP) are the most commonly used in strengthening structural components (Montaser et al., 2022).

Figure 94 Deformation of structural elements
Source: photo by the author 2025

4.4.3 Degregation

All of the buildings in the area have been degregated in various ways as a result of long years of neglect. In some cases, this situation has arisen consciously due to the human factor, while in other cases it has arisen due to the effect of the intense density and climate in Loranze. As a result of these degregations, some elements of the building group have completely disappeared or have become unrecoverable. Some of these degregation causes are as follows:

Detachment of parts: Some sections of concrete are becoming loose or falling off due to structural weakness, poor adhesion, or environmental factors in the envelope as well as in interiors. In envelope, this sometimes leads to the appearance of metal reinforcements after the broken pieces and thus to structural weakening. At the same time, it causes damage to the integrity of the sculptural concrete that forms the character of the building. In architectural conservation, detachment is critical because it can compromise structural integrity and historic authenticity.

In the interiors, it is possible to say that many structural elements, as well as some items that have remained from the past, have been fragmented and largely disappeared. Some of the window frames and most of the existing glazing have been destroyed and become unusable.

Figure 95 Detachment of Concrete Facade
Source: photo by the author 2025

Figure 96 Detachment of Skylights from Inside
Source: photo by the author 2025

Cracking: It is possible to observe a large number of cracks in the concrete facades of the buildings as well as in the concrete of the interiors. This situation damages the monumental stance of the building and disrupts its integrity.

In the interiors, it is possible to observe that many other materials other than concrete are also cracked. In this case, conservation strategies must consider whether cracks are active (continuing to grow) or stable over time and find solutions according to that.

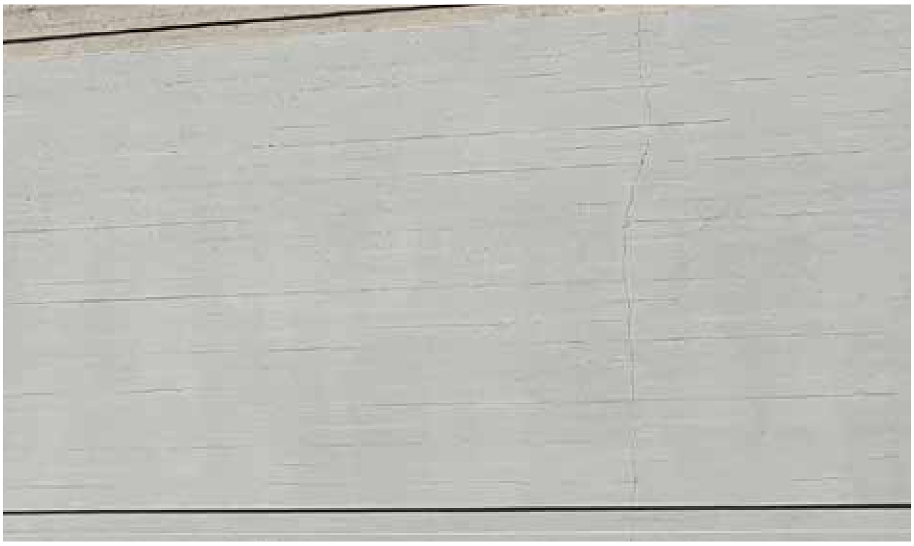


Figure 97 Continuous crack on the Side Facade
Source: photo by the author 2025

Figure 98 Big crack and the Sunbreakers
Source: photo by the author 2025

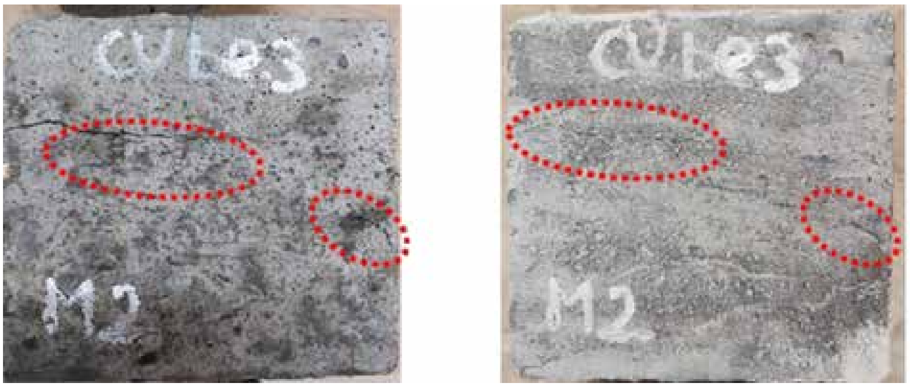


Figure 99 Self healing Concrete Samples from the researches of University of West London
Source: (Shaaban et. al 2023)

Efflorescence: Efflorescence is powdery deposit on the concrete surface caused by water-soluble salts migrating to the surface and crystallizing and its common in areas with high humidity, poor drainage, or water infiltration so its not suprizing seeing some examples in this building that have been left for several years. Most of the times, efflorescence is not structurally damaging but at the same time can worsen degradation over time.

Figure 100 Efflorescence example on Concrete
Source: photo by the author 2025

Vandalism: Vandalism cover intentional damages to the buildings and in Marxer buildings its easy to detect its examples. Multiple parts of the buildings have graffities that were created by trespassers in abandoned buildings. At the same time, it is possible to guess that many structural elements in the interior of the building were damaged and that the cause of these damages were the people who entered the building without permission.

Figure 101 One of many examples of Graffities on the Buildings
Source: photo by the author 2025

Biological patina: It is easy to detect natural growth of moss, lichen, algae, or fungi on concrete surfaces of the buildings, that caused by humidity. It is quite natural that this situation is detected in a neglected building in an area such as Loranze, which is intertwined with nature.

Biological patina can give the building an aged aesthetic and contribute to the expression of the lived experience and memories of the spaces, it can create interesting textures in a brutalist structure, but at the same time it can accelerate the degregation process of the structure by trapping moisture. At this point, the intervention method should be decided after further analyses.

Figure 102 Sunbreakers and the Patina
Source: photo by the author 2025

Figure 103 Biological Patina on Concrete
Source: photo by the author 2025

Oxidation: In the area where the main material is reinforced concrete and is used to a large extent from the structures of the buildings to the finishing materials, some structural elements are steel and it is possible to detect oxidation on these structural elements.

In addition, it is possible to see staining caused by corroded metal elements in some concrete parts.

Figure 104 Oxidation on the Staircase
Source: photo by the author 2025

Delamination: Although the building shell is reinforced concretve, it is possible to detect delamination in some painted materials used in the interiors.

Figure 105 Delamination Example from Interiors
Source: photo by the author 2025

Chapter 05

A Proposal

Figure 106 View of the building from green plaza
Source: Produced by the author

5.1 Design proposal

5.1.1 Importance of the site and design approach

Looking at the current condition of the former Marxer Pharmaceutical Research Institute complex, it is easy to observe a great deal of wear and tear, but the buildings still retain their strong characteristic elements even today. It is clear that culturally sensitive and forward-looking approach is needed to sustainable rehabilitate the area in Ivrea region as well as the builiding elements in the area. In this way it can be possible to reflect needs and potential of the region.

The buildings in the area in question are relics of post-war industrial optimism and scientific progress, and are part of the architectural experiments for which Ivrea is recognised, especially through the legacy of Olivetti. With the influence of Olivetti, a company renowned for producing typewriters, mechanical calculators and early office computers, Ivrea emerged as a hub for architectural innovation, marked by the development of modernist buildings that embodied the progressive ideals of the time. Recognising its historical and cultural value, UNESCO inscribed the area as the "Industrial City of the 20th Century" on the World Heritage List on 1 July 2018 (UNESCO, 2018).

Ivrea developed as an experimental platform for Olivetti. From the 1930s to the 1960s, the city was shaped by some of Italy's leading architects and urban planners, who designed not only industrial facilities but also administrative buildings, residential units, and spaces for social services. This ensemble of structures reflects the principles of the Movimento Comunità (Community Movement), founded in Ivrea in 1947 and inspired by Adriano Olivetti's 1945 book L'Ordine politico delle Comunità (The Political Order of Communities). The project embodied a forward-thinking integration of industrial production, architectural innovation, and social responsibility. As one of the earliest and most complete expressions of this modern vision, Ivrea represents a landmark in 20th-century urban development, anticipating the transition from mechanical to digital technologies within an industrial and architectural context (UNESCO, 2018).

At this point, it is essential to maintain the narrative of the buildings original function and its architectural era. It is also possible to go further and use these buildings and this project as an opportunity to emphasise the architectural significance of the region. As well as preserving the cultural elements of the structure like its exposed concrete surfaces, monumental spatial rhythm, and the rational organization of its volumes, enchancing what buildings have and transforming them based on current needs can be a solution to re-use whats abandoned behind. This thesis proposes that the complex can be a building community that expresses and elevates the character of the region, including mix-used functions with art and architecture at its centre.

The complex is outside of Ivrea and between the center and Loranze. Being outside of the central area creates the potential of being more connected to the nature. This brings a huge interaction between built spaces and green. In terms of "ecological sustainability", areas characteristic supports of the use of nature friendly solutions. The project integrates a combination of passive design strategies including natural ventilation, optimized daylighting through retained and adapted window openings and uses low-carbon and recycled materials that are compatible with the building's existing concrete structure. On a systems level, solar panels, rainwater harvesting, and a high efficiency heat pump system will reduce the buildings operational footprint while ensuring year-round usability. As can be seen in the photographs from the times when the original function of the buildings continued, the area tries to exist in the green by integrating with it. After all this time, the green has continued to take over the building complex. At this point, the new project strengthens this invasive behaviour of the green rather than destroying it.

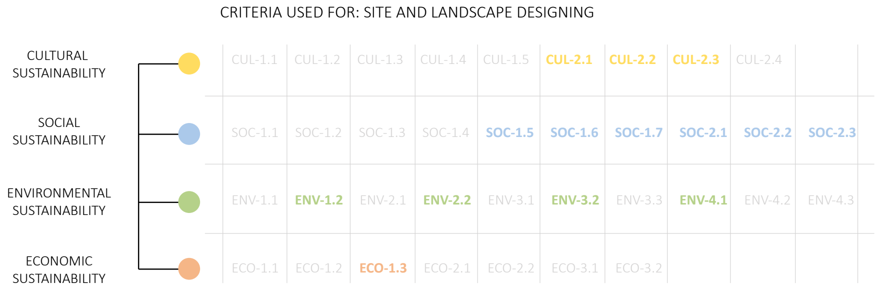


Figure 107 Criteria that are used for Site and Landscape Designing
Source: produced by the author

- (black dot) : The existing trees were marked with an up-to-date google earth scan. Exact locations and number of trees may vary with reality.
- (red dot) : With the new trees added to the event square, it was ensured to bring scale to it and to create various shade areas. The rest of the square is left open for various events and at the same time, the sculptural stances of the buildings are not hidden by too much green by spliting the area into two.
- (yellow dot) : Shading in the car park is provided by organically distributed trees in accordance with the spirit of the area rather than artificial shading elements.
- (blue dot) : The long road from the entrance to the main buildings is planted with trees to provide shading for pedestrians.
- (green dot) : The public park has been supplemented with new trees in addition to the existing trees and has been made more dense. The variety of tree species has been increased.

Figure 108 New vegetation approach
Source: produced by the author

Figure 109 Master Plan Proposal of the Complex and the Functions
Source: Produced by the author

The new master plan proposal was developed with minimum intervention to the existing situation. The existing green texture density of the area was not reduced except in some cases where it was needed, but on the contrary, it was supported. This was important to support the perception of the site since it was first built and to create a positive local impact. Today, the project area is forgotten and the buildings are abandoned to their fate. For this reason, it is important to bring a positive image to the site by making it a centre for art and architecture by integrating it with the existing presence of Ivrea and Loranze. At this point, the functions of the buildings overlap with the functions of the surrounding areas building functions. This is important to create a synergy with the existing texture (CUL-2.3).

A barrier-free design approach has been adopted from the entrance till the buildings. The circulation in the project area is designed to be disabled-friendly and all spaces to be used by both visitors and employees working in the building ecosystem are designed to be accessible by wheelchairs (SOC-1.6).

The quality of the outdoor spaces is another factor taken into consideration. The condition of the project site allows for a large percentage of the area to consist of outdoor spaces that can be used by urbanites. The outdoor spaces have landscapes that can host social activities, pedestrian priority pavements, recreational areas with diverse greenery that allows human interaction. At this point nearely 70% of the exterior spaces are allocated to collective and public use (SOC-1.7, CUL-2.2).

Intended public parking spaces in the area are 175 meters away from the main entrance of the big main building. At the same time area has several drop-off and pick-up points for both people and products (ECO-1.3). Instead of using the basement level of the buildings or the big empty area in the middle of the site as parking spaces, project offers to create a new parking space combined with greenary near the main entrance. This way the approach to the buildings after leaving the cars become way more interesting since public starts to percieve the buildings from far and understand that they are the intented part of the exibition (SOC-2.3). All the parking areas also include dedicated circulation section for the disabled passenger parking spaces. From parking to the buildings, all the circulation is possible to be used by disabled people (SOC-1.6). Site also includes some bicyle facilites. There are bicyle parking areas outside as well as in the basement level which are protected from weather conditions. Security info building also includes some showers and changing rooms that cyclists can use after arriving to the area (SOC-2.2).

To prevent possible negative ecological impacts on site, the main vision was not to disturb any exsiting habitats in the area. In this sense existing greenfield areas preserved and additionally to that it was tried to enhance the existing vegatation adapting some other local spicies to the site. These new vegetation was used to also cover some areas creating shaded spaces. The main parking area is designed between newly placed vegetation instead of being under a built covered area. The main opening in the site is also half covered by green. This also helped reducing the effect of heat island in the area (ENV-2.2, ENV-3.2).

The project also produces its own green energy using pv panels on the roof of the building facing the square. The reason pv panels is placed there is to hide the unwanted look from outside. This way the important characteristics and esthetics of the buildings is not disturbed but also green energy need of the area is somehow provided (ENV-1.2).

Secondary building that faces the square mostly has spaces that can be rented to the comunity for diverse uses when out of use just to create potential income for the whole ecosystem. It is also aimed to be appealing to the emerging demographics and target new market segments. It is possible to achieve this by turning the whole project area a place that has an important part in the community and is attractive to the public (ECO-1.3).

Figure 110 View of the building between green
Source: Produced by the author

5.1.2 Architectural concept and program decisions

The aim of the new project from "social sustainability" point of view is to create a platform where artists and visitors can learn, experience and produce, while keeping and sustaining the architectural memory of the Ivrea region. For this, the new program offers inclusive, accessible, and diverse functions. The spatial organization encourages community-building and interaction, with open areas and exhibition spaces to foster public engagement. Project also accommodate more private uses such as artist studios, workshops, and rentable offices. These uses support creative networks and intergenerational knowledge exchange, empowering both local citizens and visiting practitioners while also being available for educational programs, prioritizing youth engagement and hands-on learning opportunities.

On the other hand, "economic sustainability" is achieved through a smart reuse strategy that minimizes demolition and maximizes the potential of the existing structure. This was also important to keep important building elements to enhance what was already there (at least the things have been left after a lot of years). In addition to that, the program is designed to create a self-sustaining ecosystem, generating income through rentable spaces (such as artist residencies, co-working offices, and event rentals) while simultaneously offering free or low-cost public access to cultural programming. With these functions, it is also aimed to achieve a harmony with the surrounding parcels that have office functions on the opposite parcel of the sit. By supporting a mixed-use financial model, the project not only extends the life of the building but contributes to the revitalization of Loranzé, Ivrea and their integration into the regional creative economy.

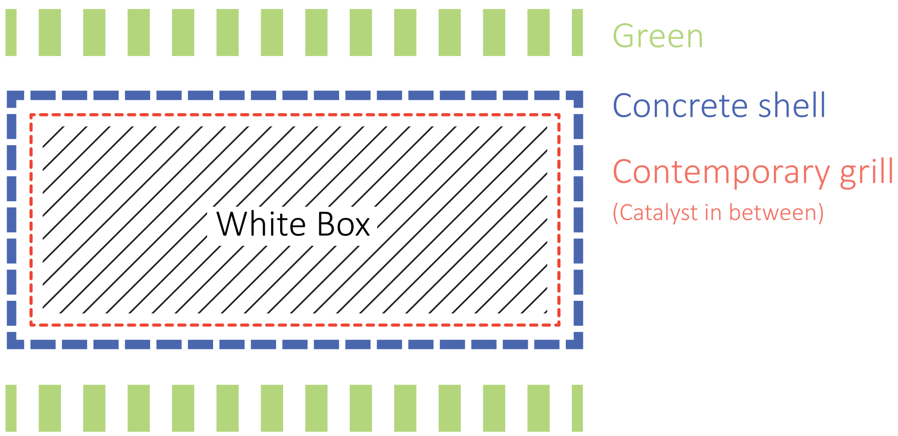


Figure 111 Exibition space concept idea
Source: produced by the author

The multi-purpose exhibition space, which forms the focal point in the spatial hierarchy and reveals the character of the new design, consists of two parts; the free plan exhibition space on the ground floor and the exhibition rooms isolated from daylight in the basement. The main design idea of the main exhibition space on the ground floor is to enhance the meaning of the reinforced concrete facade grill, which is the most important element of the existing space. For this reason, a more contemporary grill, which will reflect the character of the new exhibition function in the interior, surrounds the large space from the inside. Inspired by the semi-permeable glass bricks of the original building, this grill forms a "catalyzing layer" between the green, reinforced concrete facade grill and the large interior space. This layering is designed to create a harmony between the past, the present and the future, and not to overshadow each other.

The main element that was paid the most importance during the design is to ensure that any intervention does not interfere with the original brutalist aesthetics of the buildings, and to ensure that the existing and the present elevate each other in the memory of the area.

Figure 112 Look of contemporary grill from outside
Source: Produced by the author

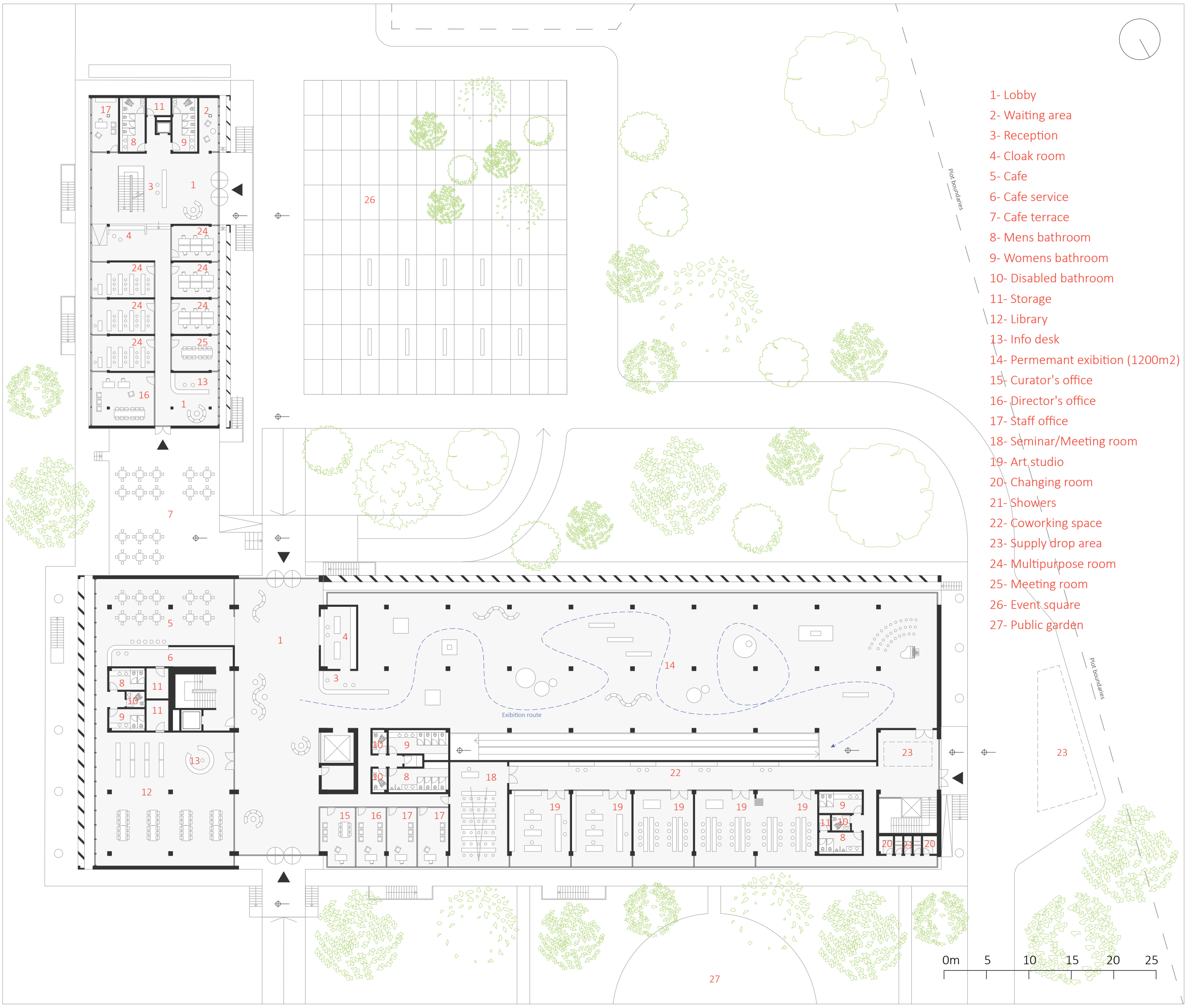


Figure 113 Ground Floor Plan Proposal
Source: Produced by the author

5.1.3 Architectural plan schemes

Plan schemes are designed in a way not to disturb the character of the building. While the previous functions and spatial formations of the buildings are taken into consideration, the requirements of the new building functions are responded to and these functions are clearly expressed in the plan drawings (CUL-2.3). The brutalist characteristics of the old buildings (reinforced concrete facade grilles, gargoyles, metal staircases, etc.) were retained in the project and layered with the new functions in such a way that the new and old are intertwined (CUL-2.1).

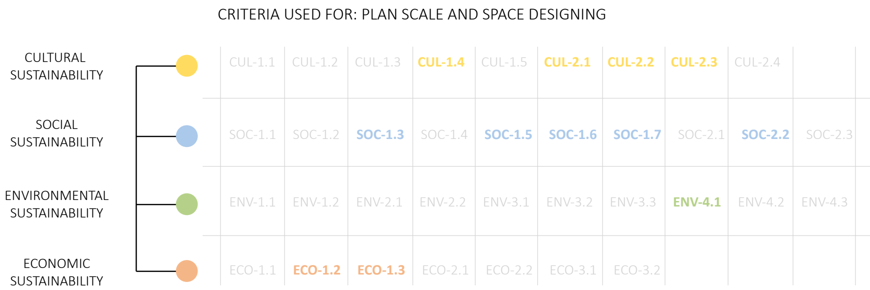


Figure 114 Criteria that are used for Plan Scale and Space Designing
Source: produced by the author

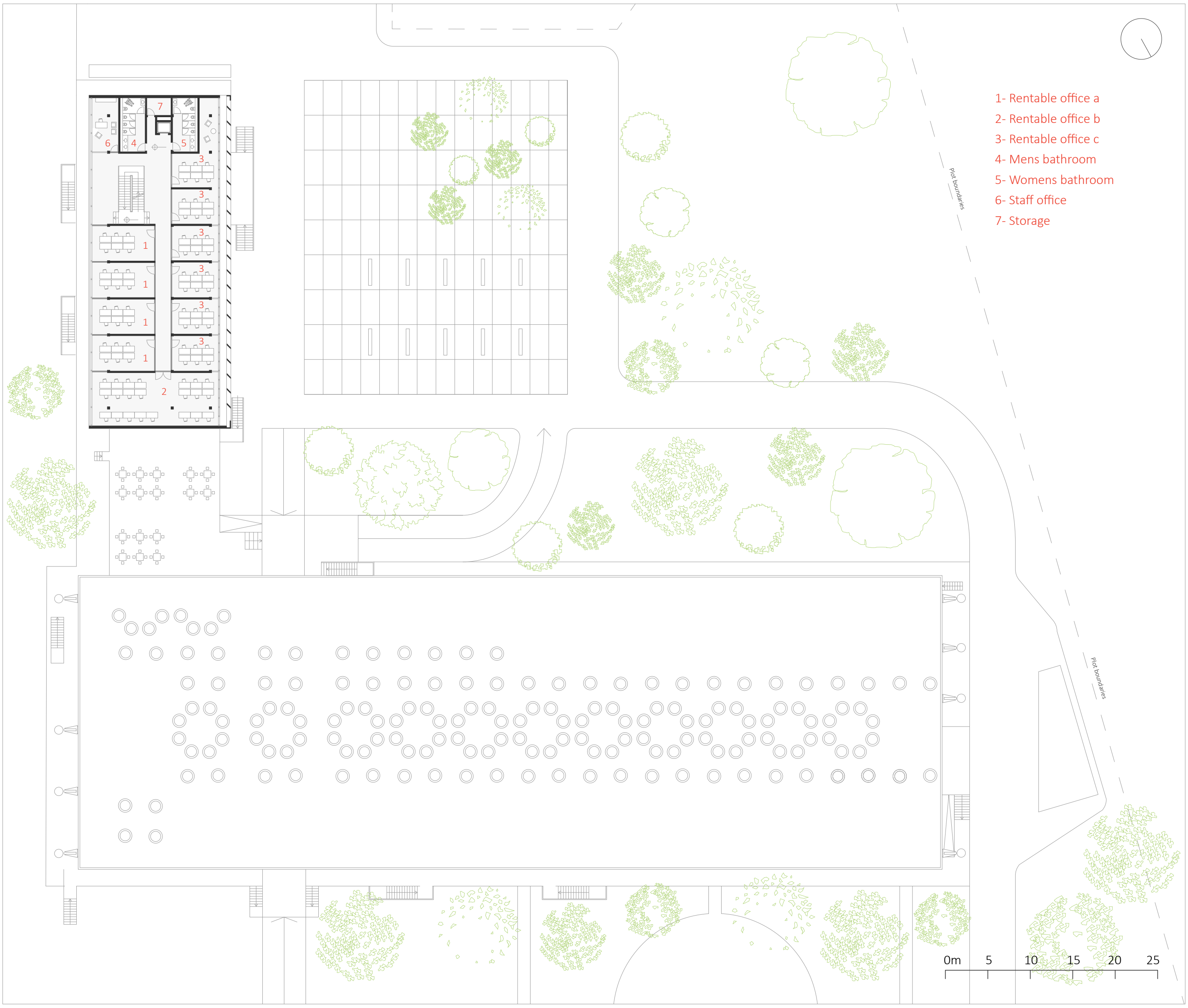


Figure 115 First Floor Plan Proposal
Source: Produced by the author

The existing structural elements, especially the façade elements, have been retained and are envisaged to be repaired and strengthened, but the non-structural interior elements and interior finishes have been replaced with new elements that are compatible with the existing structure, as they are mostly irreversibly damaged (CUL-1.5, ENV-4.1).The facades of the building are left as free and open as possible in order to maximise the use of natural light and to maintain the function of the sun shades that form an important part of the building character. In addition, the exhibition area in the main building is wrapped with a second, more contemporary layer, while other spaces such as offices are supported by shutters to be used as needed (SOC-1.3, ENV-3.1).

In order to facilitate the accessibility of the buildings, the building entrances, which are very easy to perceive thanks to the existing mass formation, have been preserved in the proposed project (ECO-1.3). In order to make the buildings very disabled-friendly, the building circulation is designed barrier-free and all parts of the buildings used by the public and staff are accessible with a disabled chair. In addition, there are disabled toilets in every wet area (SOC-1.6).

Approximately 12% (aproximetely 1000m2) of the total of the two buildings can be used by the public and 45% (aproximetely 3800m2) by ticketed visitors (SOC-1.7, CUL-2.2). The buildings also have flexible multi-use spaces that can be easily organised for different functions. Exhibitions with a free plan due to the building function can be reorganised according to the situation, while the rentable spaces can be used in differ-

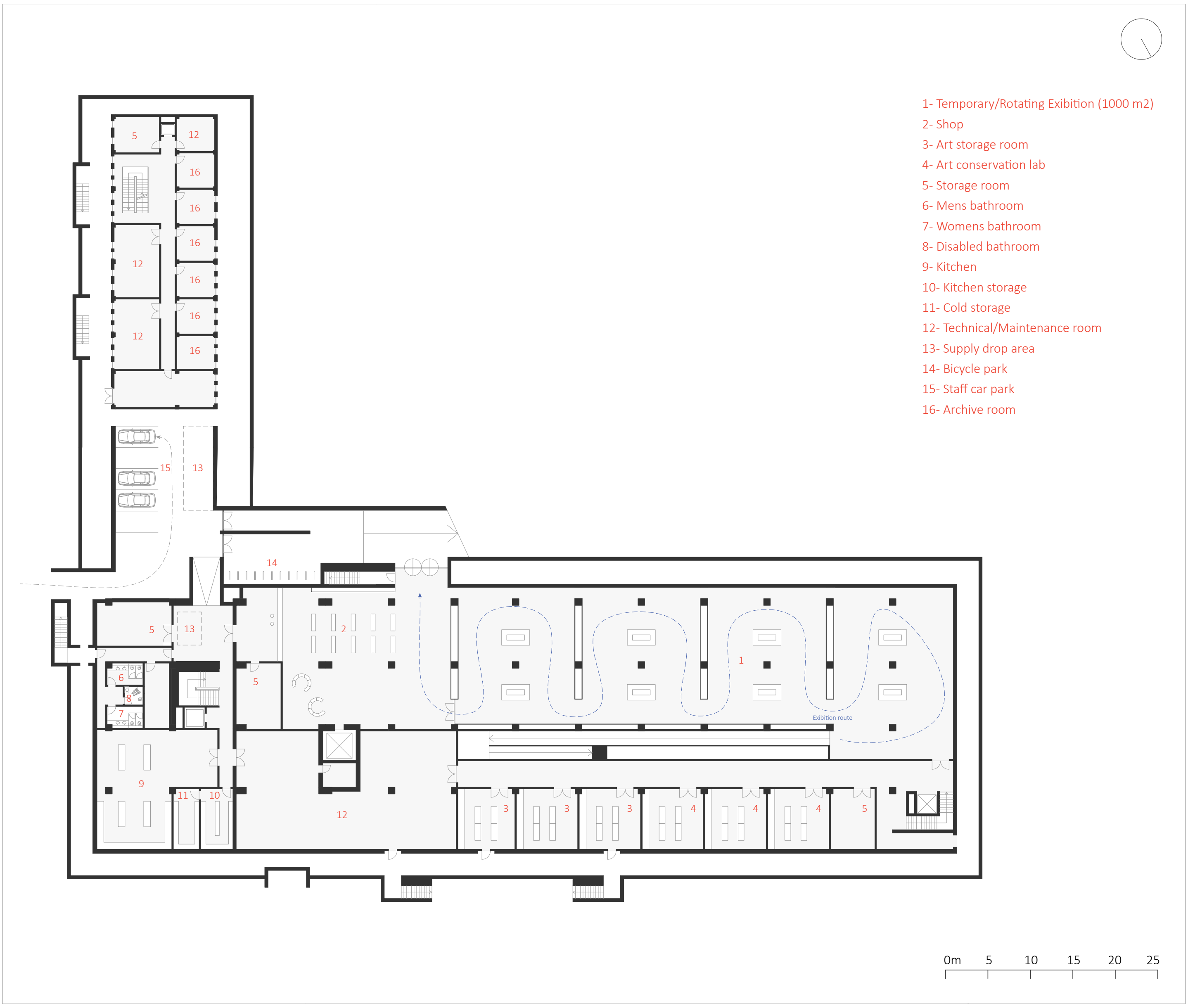


Figure 116 Basement Plan Proposal
Source: Produced by the author

ent ways. At the same time, artist workshops also provide spaces that can be shaped according to needs (ECO-1.2).

The offices and artist workshop rooms in the buildings, which can be rented, offer the potential to contribute financially to the project and to cover the costs of the building itself. At the same time, the roof of the old office building offers the opportunity to produce green energy with solar panels (ECO-1.3, ENV-1.2).

There are short-term bicycle parking areas in the basement for visitors to use. Showers and changing rooms are located in the entrance building 175 metres away from the main buildings (SOC-2.2).

In the original structure, the space separating the two sides of the large building mass functions as a lobby in the new design proposal. The main focus of the space hierarchy in the plans is the multi-purpose exhibition space directly connected to this lobby. In addition, the ground floor of the large building accommodates offices, various artists' rooms overlooking the garden to the north of the buildings, a library and a café that can be used by the citizens at any time.

The ground floor is connected by a long ramp from the large exhibition space to the extra exhibition rooms in the basement. There is also a sales unit at the end of the

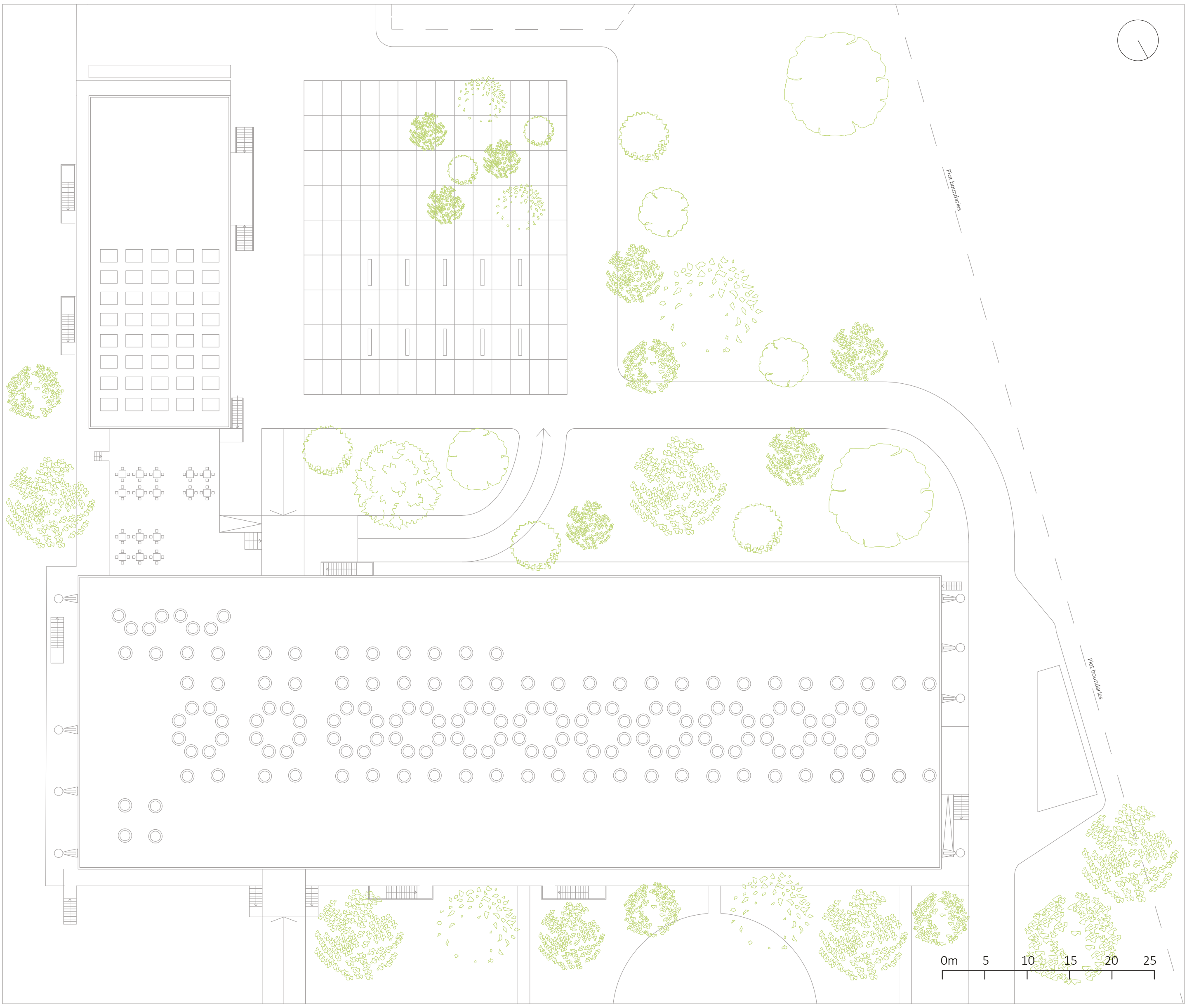


Figure 117 Roof Plan Proposal
Source: Produced by the author

exhibition route. In addition to the exhibition rooms, the basement contains various storage units and services, kitchen and technical areas. At the same time, in order to minimise the vehicle circulation around the buildings and to make the area as pedestrianised as possible, the vehicle entrances of the buildings are also provided from the basement floor.

In addition, the smaller building, which has a relatively simpler layout, houses multi-purpose rooms, meeting rooms, various services and rentable office units that are intended to raise money for the maintenance and funding of the building. Both structures work in coordination with each other. Their circulation is pedestrian friendly and has been created taking into account any physical disabilities. Their designs were made without losing their original mass aesthetics, but with spatial constructions that function more in accordance with today's standards.

The large building continues to display the light chimneys on its roof, which are an important part of the building character. The roof of the small building contains pv panels to provide green energy to the buildings. These panels are positioned so that they cannot be seen by people. Thus, the original mass plastics of the masses were preserved as much as possible and most of the interventions were limited to the interior spaces.

5.1.4 System section and materiality

When we look at the details of the proposed new system, the materials in the original condition have been tried to be preserved as much as possible, but as can be seen in the previous sections, we see that most of the interior surfaces and elements are ruined in the current state of the building. At this point, the building skeleton forms a base for new detail designs and material proposals. The new material proposals are intended to make the buildings more energy efficient and functional while re-imagining the original design.

The design vision is planned to remain as simple as possible, not to get in front of the brutalist structure itself, but to respond to spatial needs. The existing buildings can not meet the current energy requirements or the spatial needs of the proposed spaces. For this reason, necessary changes were made that would not harm the cultural and historical values of the buildings, would not disrupt the building characters, but would enhance them and meet the spatial needs.

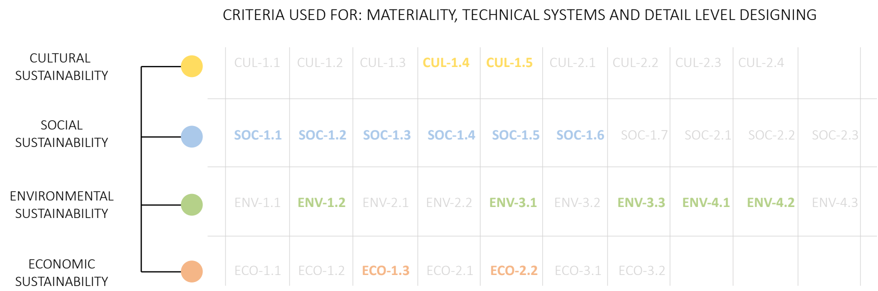
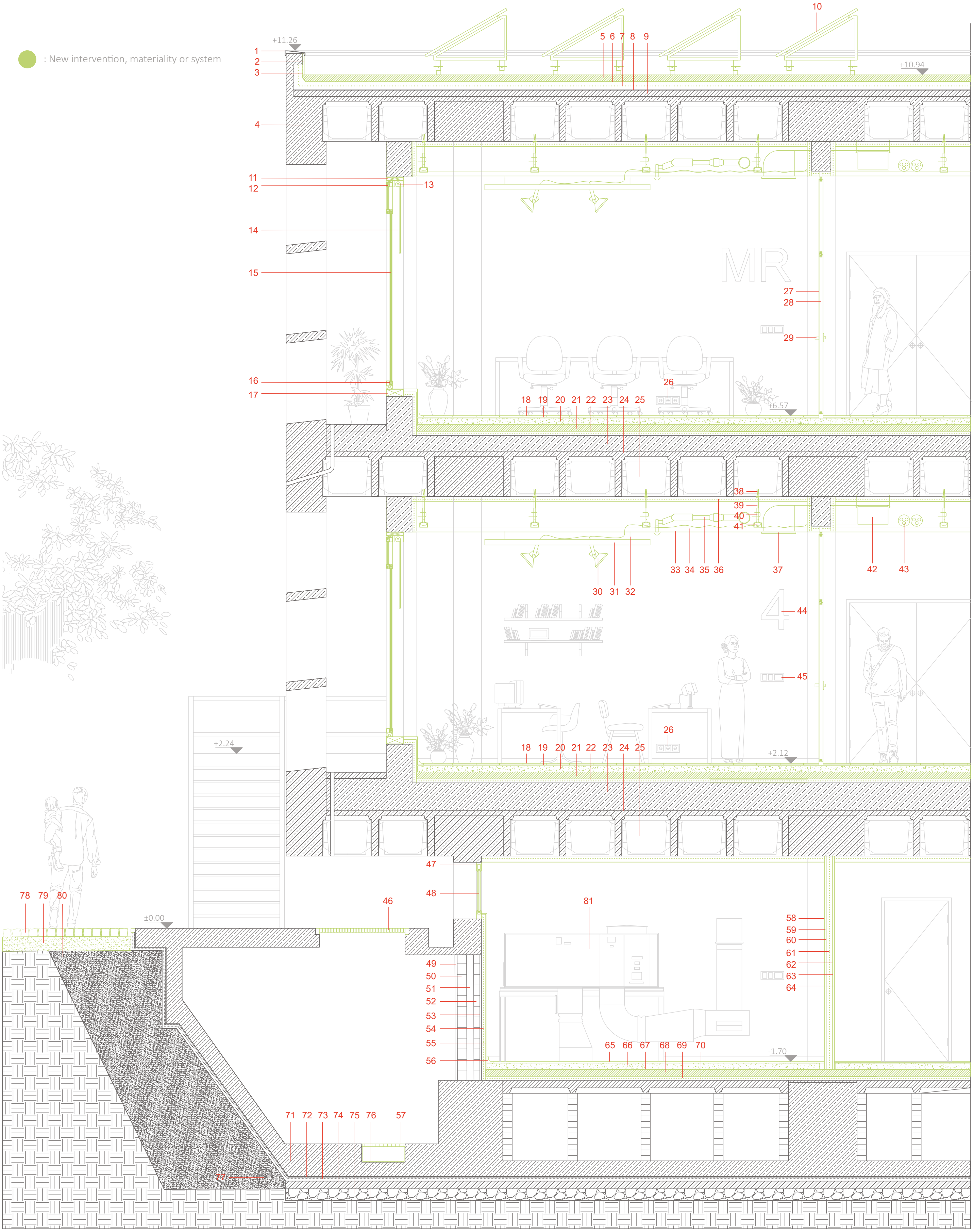


Figure 118 Criteria that used for Materiality, Technical Systems and Detail Level Designing
Source: produced by the author

1- Stainless steel flashing
2- Plaster (3cm)
3- Waterproofing membrane (0.5cm)
4- Concrete frame
5- Concrete screed (8cm)
6- Waterproof membrane (0.5cm)
7- Termal insulation (10cm)
8- Geotextile wool+PVC Vapour barrier
9- Slope concrete (8cm 1%)
10- PV panel
11- Sub frame
12- Rigid window frame
13- Shutter box
14- Shutter
15- Double glazed window
16- Sliding window frame
17- Sub frame
18- Marble tiles (30cmx30cmx2cm)
19- Adhesive glue (1cm)
20- Fiberglass slope screed (8cm)
21- Lightweight filling concrete (9cm)
22- Xps insulation (5cm)
23- Installation screed
24- Concrete slab (58cm)
25- Semi hallow slab brick
26- Plug sockets
27- Cladded door
28- Eps sandwich panel
29- Door handle
30- Lightning device
31- Grid panel
32- Metal suspension rope
33- Suspended ceiling panel
34- Ceiling profile
35- Ceiling fire extinguisher
36- Xps insulation (6cm)
37- Ventilation pipe
38- Steel dowel
39- Suspension rod
40- Suspension clip
41- Ceiling profile
42- Ventilation pipe
43- Electricity cables
44- Room number/code
45- Temperature/Light control panel
46- Steel grill
47- Window frame
48- Double glazed window
49- Plaster (3cm)
50- Semi-hollow bricks (12cm)
51- Air gap (9cm)
52- Hollow bricks (8cm)
53- Vapor barrier
54- Rock wool thermal insulation (6cm)
55- Plaster (3cm)
56- Plinth
57- Steel gutter
58- Galvanized sheet metal (2mm)
59- Box profile construction (2cmx4cm)
60- Vapor balancer
61- Rockwool insulation (8cm)
62- Vapor barrier
63- Box profile construction (2cmx4cm)
64- Galvanized sheet metal (2mm)
65- Epoxy finish (2cm)
66- Concrete screed (8cm)
67- Waterproofing membrane (0.5cm)
68- Slope concrete (8cm 1%)
69- Xps insulation (6cm)
70- Concrete slab
71- Raft foundation
72- Xps insulation (6cm)
73- Waterproofing membrane (0.5cm)
74- Lean concrete (10cm)
75- Blockage (15cm)
76- Compacted soil
77- Drainage pipe
78- Cube stone
79- Sand bedding
80- Gravel filling

Figure 119 New System Section and Proposed Materials Research and Lab Building Example
Source: Produced by the author

: New intervention, materiality or system



When renovating the building materials, it was important not to disturb the integrity of the existing building and to make choices that are compatible with it. At this point, floor coverings and ceiling details were solved by analysing the original situation and producing details similar to that situation. The ceiling panels, including the electrical wiring in the original situation, did not contain insulation and hid the bare hollow brick floor surfaces. With the new design, the spaces were surrounded with insulation materials in order to cut the thermal bridges in the reinforced concrete structure. The ceiling panels also occupy a larger volume than in the original case, lowering the clear ceiling height, but containing insulation materials as well as various building systems. The interior finishes are designed with new materials for various functions such as office, exhibition space or café. However, it is envisaged that they can be easily disassembled and modified for possible future interventions. In this sense, waste prevention is also planned to be provided. It is a priority that the newly added building materials are reversible and do not damage the original skeleton (CUL-1.5, ECO-1.2, ENV-4.3, CUL-1.4).

The current state of the building does not comply with today's energy standards. For this reason, the use of various insulation elements and environmentally friendly energy-saving materials is a necessity within the scope of the design project, but due to the character of brutalist buildings, it is not possible to cover the facade material with another material. For this reason, in order not to spoil the characteristic perception of the buildings, the insulation and finishes should be made from the interior spaces. Although the Marxer buildings in question utilise the strong aesthetics of concrete in their exterior building shells, they do not exhibit exposed concrete in the interiors and contain different building finishes. This situation makes the material intervention to be made through the interior space easier. Of course, the original building elements used in the interiors are also part of the building history and are important, but building materials that have spent decades in disuse have become unusable due to the neglect and vandalism. On the other hand, new building finishes added to the spaces will also protect the original structure from external impacts such as intensive human use and will significantly reduce material degradation (ECO-2.2, CUL-1.4).

Another important situation that should be considered while carrying out renovation works is the selection of recycled and locally sourced materials. The majority of interior materials are unusable, but it is possible to transform these materials and use them when creating new materials. Building elements that can be recycled are materials such as glass, plastic and steel (ENV-4.2).

When the lighting of the spaces is considered, the facades of the buildings with characteristic concrete sun breakers provide self-controlled spaces. The glass windows and frames, most of which have been lost, have been replaced with heat-insulated frames and double-glazed windows. In addition, shutter elements have been proposed to cut unwanted sun glare in office spaces. In the large exhibition space, a new metal contemporary facade layer has been added in addition to these double-glazed glasses, creating a different spatial feeling. In order to establish visual communication with the outside, windows extending along the floor were used in the spaces. For interior lighting, regional lighting that would respond to spatial functions was preferred (SOC-1.3).

Control panels were suggested for indoor spaces to increase user control of spatial lighting. In outdoor spaces, point light units targeting pedestrian routes were used. It was important that these light units were directed to the ground so as not to create unnecessary light pollution (ENV-3.1). It is possible to say that the control panels in question can be used by users to ensure thermal comfort in indoor spaces (SOC-1.4).

It is planned that ventilation, fire extinguishing, lighting and electrical systems will be located in the space created by the ceiling panels. MEP devices are located in the basement. Here, there are also batteries where green energy provided by the PV panels placed on the roof of the office building is stored (ENV-1.2, ENV-3.3). After the building renovation is completed, maintenance of all building systems must be carried out at regular intervals, and the energy consumption and efficiency of the buildings must be measured and evaluated (ECO-2.1).

Figure 120 View of the entrance
Source: Produced by the author

Figure 121 General morning view of the building
Source: Produced by the author

Figure 122 General evening view of the building
Source: Produced by the author

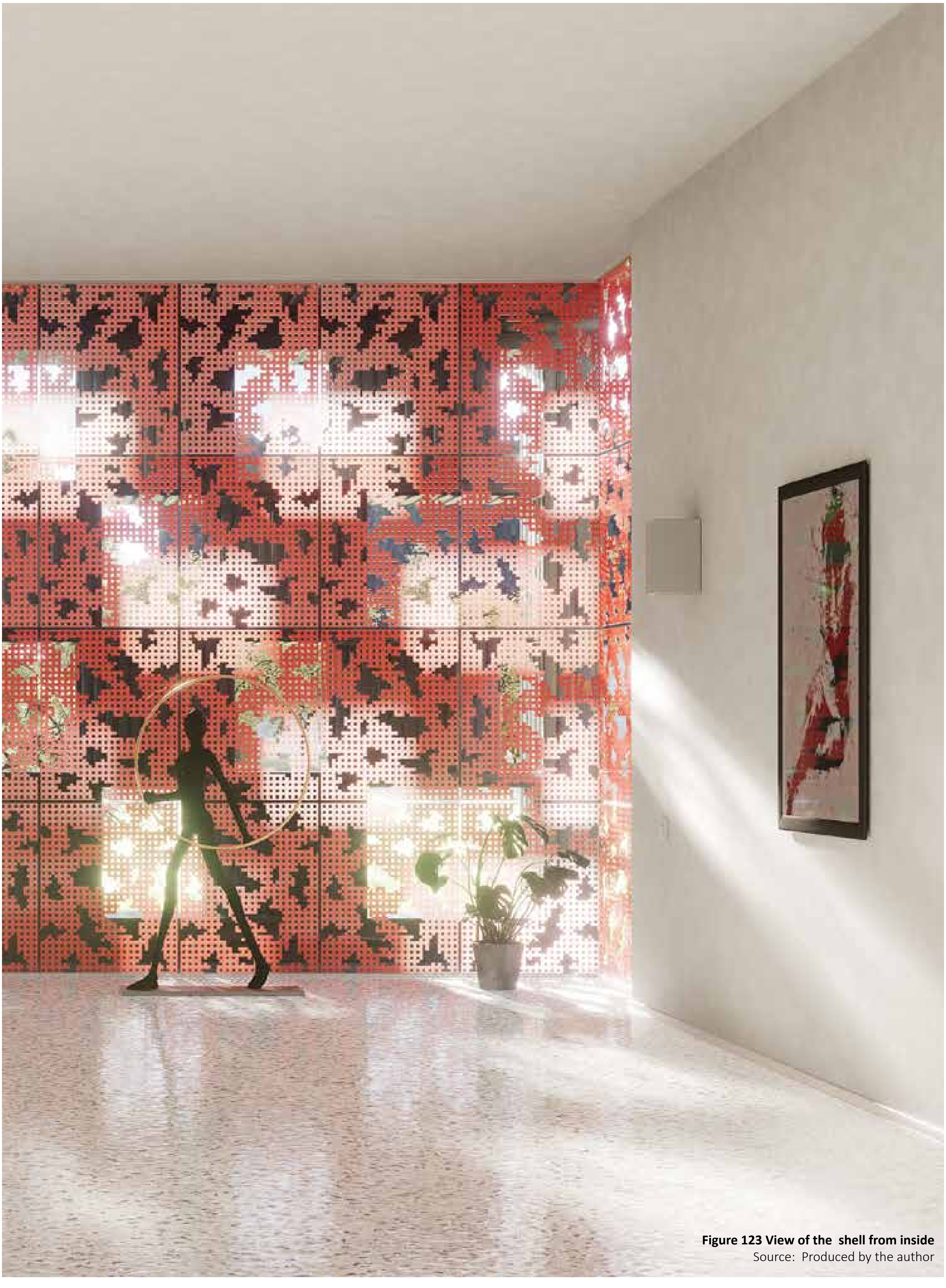


Figure 123 View of the shell from inside
Source: Produced by the author

Figure 124 View of the exibition
Source: Produced by the author

5.2 Evaluation of the Project

5.2.1 General Overview

After analysing and synthesising the site, the building complex, the original architectural decisions of the two main buildings, the current state of materials, conservation and wear and tear, a possible project proposal was made. This project proposal not only aims to draw attention to the inactive state of such high value and important buildings for Ivrea and Loranze, but also to criticise the inadequacy of today's sustainability rating systems to cover buildings of historical and cultural significance. In this section, in order to bring this thesis to a conclusion, the thesis and the project proposed in the previous part are evaluated in order to test the usability of the newly proposed sustainability rating system.

As stated in the previous sections, the main purpose of this project is to react to some of today's problems and to generate ideas on their solutions. The solutions to these problems require much more detailed research and discussions. For this reason, this evaluation section also includes personal reflections of the author.

When we look at the diagram where the project is evaluated on the basis of criteria, we see how many points the project has collected from each category. The dark coloured dots show the points that the project can get from that category, which can be measured at this stage, while the light coloured dots show the maximum points that can be achieved in the following stages, which cannot be achieved by the author at this stage, but can be achieved by professionals. This scoring shows the most positive situation possible within the scope of the project.

For example, in the 'Design for All' criterion coded SOC-1.6 under the Social Sustainability category, there are indicators that require the accessible built environment in the project to be usable by all users, including disabled individuals. These indicators have various design requirements such as the presence of disabled car parking spaces and disabled toilets in the project. It is possible to provide and propose these at this stage of the project design. For this reason, the project can receive points at this stage. However, it would be more realistic to create indicators for the creation of maintenance plans that include quality, usefulness, effectiveness, economic value maintenance of the structures in the project, which are required in the ECO-2.1 coded 'Programmed Maintenance Plan' criterion under the Economic Sustainability category, together with and after the construction of the building. It seems possible to fulfil all the requirements in this criterion. Therefore, the project has a potential score of 11 points for this criterion. These are expressed as light grey points in the diagram.

Another example is the 'Joint Use of Facilities' criterion coded CUL-2.2 under the Cultural Sustainability category. The indicators under the criterion give various scores according to what percentage of the indoor and outdoor spaces in the project have collective and public functions. It is possible to decide this with our interventions and function choices during the design phase and calculate how many points we can get from the criterion, but when we look at the ECO-3.1 coded 'Quality of Construction Site Processes' criterion under the Economic Sustainability category, the indicators ask us to constructor training for energy efficiency or to minimise visual, noise and dust disturbance during construction. It is possible to take various measures and make plans for these, but it will only be hypothetical to see how successful this is until the measurements during construction. At this point, it would be more accurate to leave the points of this criterion as potential points.

In the later stages of the project, most of the points that are currently considered as potential points will become permanent with the implementation of the necessary practices. These scores are particularly dependent on the steps to be taken during the construction process, maintenance plans and operation phases. Therefore, the final sustainability score of the project will only be finalised once the construction is completed and the structures are operational. This process also represents an important stage in terms of testing the applicability and validity of the system in the field.

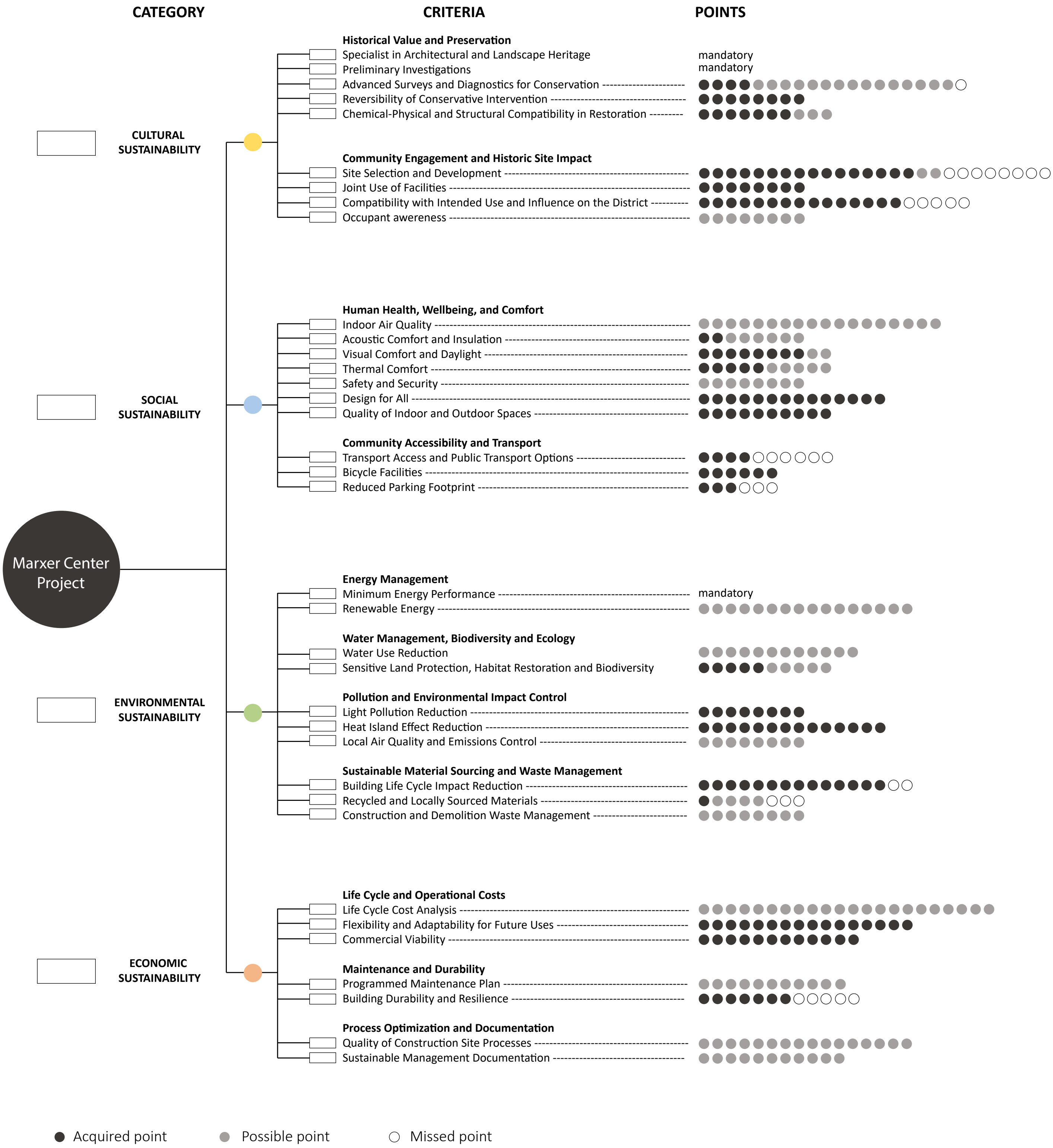


Figure 125 Scoring of the Project based on New Proposed Sustainability Rating System
Source: Produced by the author

5.2.2 Ratings and Certification based on Weightings

When we evaluate the proposed project on the adaptive reuse of the old Marxer buildings within the scope of this thesis, as mentioned above, since only a design proposal has been made for the project, it is possible to evaluate some of the criteria in the proposed sustainability rating system at this stage, while for others it is too early for this. However, in order to form an idea in terms of the evaluation part, we can say something by assuming two possibilities and taking into account the potential points that can be earned. In the previous chapters, category weights were mentioned when explaining the proposed new system. To summarise, there are four categories in total in the system and the score weights of these categories and also the criteria under the categories can be determined by the evaluation of a competent team to be convened before the project design phase. At this stage, we can assume that the score weights of each of the criteria are equal.

The first possibility we can consider is that all four categories have equal weight and contribute 25% to the total score calculation. As can be seen in the figure, in this case, the project can reach a total of 47 points and 45 possible points that we can foresee in the design phase. In total, the maximum score that the project can achieve can be 92. In this possibility, current situation of the project can not be certified but the project can reach platinum certification according to the proposed system.

A second possibility we can assume is that the competent team at the beginning of the project treats different category headings with different importance. For this possibility, we can assume that the weights of all criteria are equal for ease of calculation. In this possibility, instead of taking the contribution of the points obtained from each of the four categories to the total score as 25%, let's say 50% for 'Cultural Sustainability', 25% for 'Social Sustainability', 10% for 'Environmental Sustainability' and 15% for 'Economic Sustainability'. In this case, the project can reach a total of 51.55 points and 35.05 possible points that we can foresee at the design stage. In total, the maximum score that the project can achieve can be 89.6. In this possibility, the project can already be certified but it can only reach the gold certificate according to the proposed system.

As can be seen, even the level of certification that the project can earn can vary due to the fact that different sustainability categories have different levels of importance in specific projects/situations and therefore have different weights in the score system. However, since the category weights are established at the beginning of the project, the categories and criteria to be prioritised by the design team and stakeholders during the project can be shaped accordingly, and this can create a win-win situation both for ensuring sustainability and for the project to achieve a high score.

This situation shows that the concept of sustainability requires a context-sensitive and flexible evaluation approach rather than a fixed formula. Especially in structures with historical and cultural heritage characteristics, project priorities should be determined not with standard templates, but by considering local needs, social expectations and the identity of the structure itself. Determining the category weights at the beginning of the project is not only a technical requirement of the scoring system, but also a strategic decision in order to clarify the values that guide the project. Thanks to this approach, the design process can be shaped not only by aesthetic or technical concerns, but also by a more holistic and meaningful perspective that considers different dimensions of sustainability. Therefore, this system, beyond being just an evaluation tool, also makes it possible to establish a common language between the design team and stakeholders on the axis of sustainability. This strengthens the success of the project not only at the level of certification, but also in terms of long-term social, cultural and environmental impacts.

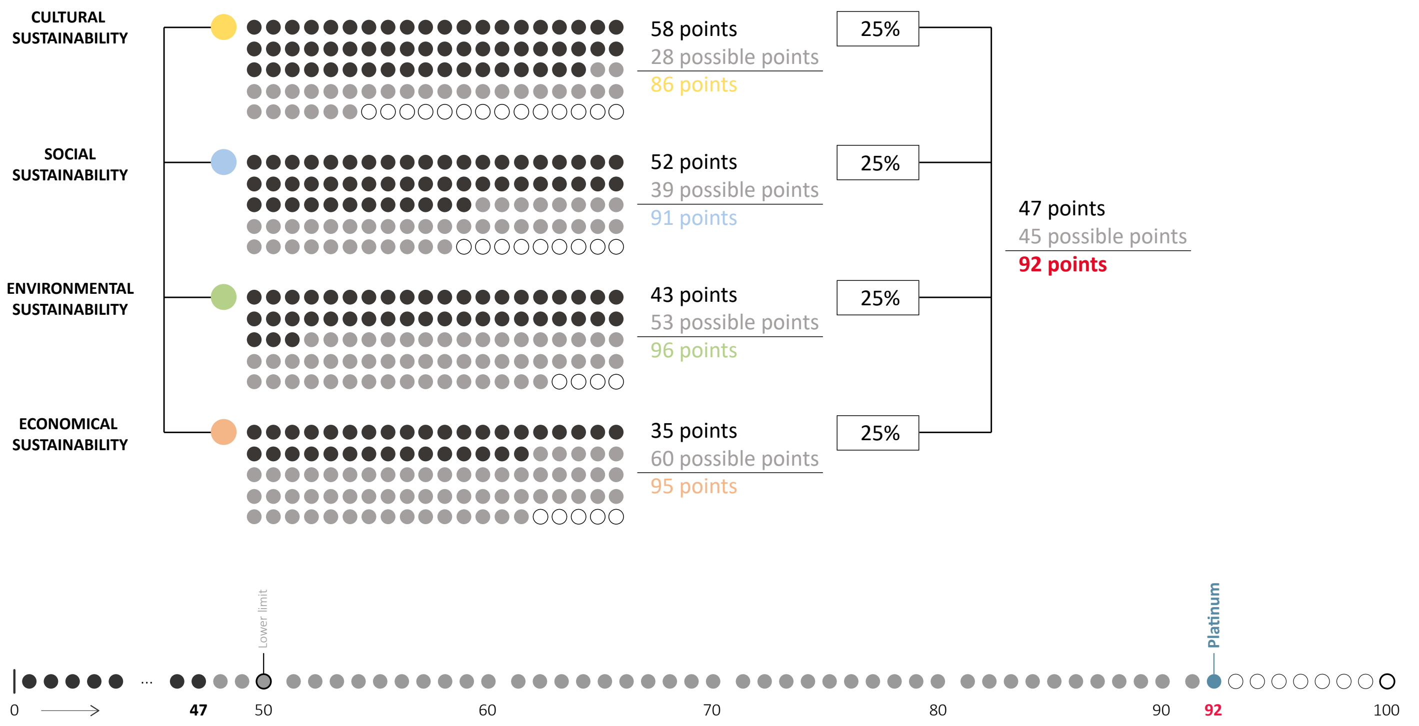


Figure 126 Scoring example of the Project based on Equal Distribution
Source: Produced by the author

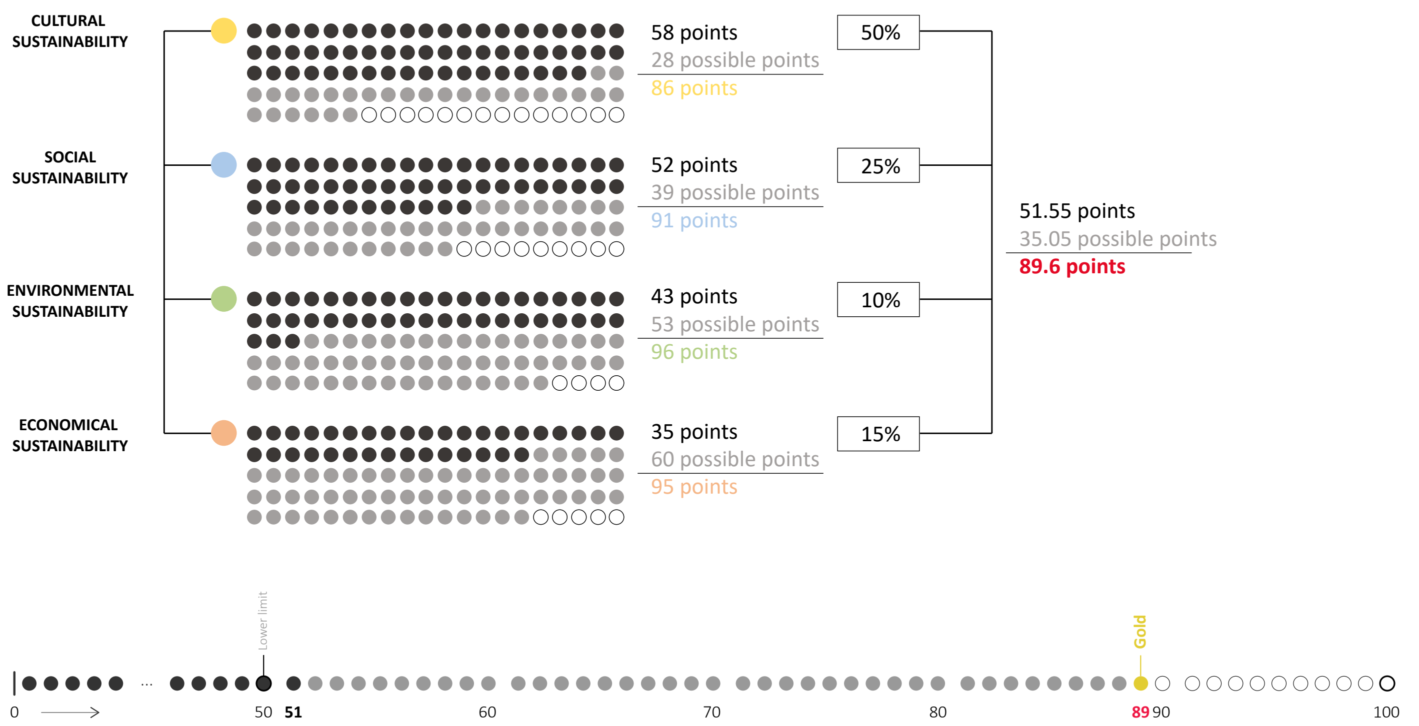


Figure 127 Scoring example of the Project based on Unequal Distribution
Source: Produced by the author

Chapter 06

Conclusion

Figure 128 Church of Jesus the Redeemer, Torino
Source: photo by the author

Sustainability has become a concept that we need to include in every aspect of our lives. In these days when natural resources are decreasing, forests are being destroyed, the environment and social balance are in danger, meeting our needs as a society by considering not to endanger future generations has become perhaps the most important thing we need to discuss. The concept of sustainability supports long-term development, optimising our production and consumption processes, ensuring fair resource sharing with future generations and supporting social justice. At this point, it is a compulsory approach that we need to address in every field in order to secure the long-term existence of both the planet and humanity.

One area where we are trying to incorporate sustainability, and where it is also very necessary, is in the architecture and construction sector. The built environment is directly shaped by natural resource use, energy consumption, carbon emissions and social life, and is the main stage where sustainability goals can be implemented or fail. For this reason, it becomes very important to follow the design and construction processes of the buildings we build under sustainability requirements and to encourage these processes to be sustainable. Sustainability certification and rating systems, which enable us to monitor this and reward successful projects, have a very important place in this sense. These systems exist, but their priorities are often focused on energy, feasibility and social dimensions, and they fail to focus on cultural values when necessary. The cultural dimension of sustainability is often included briefly under the heading of social sustainability, but cultural sustainability is very important in order to pass on the identity, history, values and forms of expression of societies to future generations, and its weight in this equation should be as much as the other three currently accepted sustainability dimensions. Preserving the cultural context in architecture makes it possible to produce not only physical but also meaningful and unique spaces. Cultural sustainability ensures the preservation of differences such as language, architecture, art and lifestyle. This feeds the common memory and creativity of humanity.

In this study, a new sustainability assessment system is proposed in which the cultural dimension is added as a fourth dimension in addition to the three accepted dimensions of sustainability (social, environmental and economic). While creating this system, the main sustainability certification systems that are frequently used today have been analysed especially in terms of cultural elements, and their correct and incomplete aspects have been evaluated. As a result of these analyses, a system in which sustainability dimensions form four categories has been reached by taking into consideration the ongoing discussions on cultural sustainability in the academic environment until today. The proposed system is a synthesis of the existing systems analysed with cultural factors and categorises sustainability under these four categories. The criteria of the system use the criteria of existing systems as a reference. At the same time, the system suggests that the category and criteria weights can be changed according to the specific conditions and priorities of each project. With all these, an environment has been created in which buildings with prominent cultural value can be adaptively reused in a healthier way.

The abandoned Marxer Pharmaceutical Research Institude and Laboratory buildings near Ivrea, Turin, were selected to test the proposed sustainability assessment system. These buildings are brutalist buildings of high quality, which are nowadays in a very worn-out condition due to their long years of non-functioning. In this study, an abandoned brutalist building was selected for testing the proposed system, not a random abandoned building. The reason for this is that brutalist buildings, which are an important part of architectural cultural heritage, are currently being demolished in various parts of the world. Brutalist buildings are generally undesirable because of the ideologies they represented in the past or because they are considered ugly and monstrous. Brutalism has been a controversial architectural movement since its emergence and early popularity, but these buildings still have an important cultural significance. On the other hand, the reuse of these buildings, the main material of which is concrete and which contain very large volumes of concrete, is also of great importance in terms of the environment. The embodied energy that will be gained through the reuse of these buildings cannot be ignored. At this point, in addition to drawing attention to the cultural dimension of sustainability, this study also draws attention to the marginalisation and monstrosity of brutalism, one of the cultural values of architecture, and its destruction in various parts of the world.

While reusing the Marxer Pharmaceutical Research Institude and Laboratory buildings, the main path in the design phase is focused on touching the buildings at various scales by going from the general to the specific. All these interventions were made within the scope of the design definitions and requirements of the proposed new sustainability system. The main idea of the project is to emphasise the sculptural aesthetics of the buildings as much as possible and to ensure that the interventions do not override the qualities of these buildings. At this point, the proposed system has been followed as a guide.

The use of the proposed sustainability assessment system during the concept design phase of the reuse of the Marxer Pharmaceutical Research Institute and Laboratory buildings was the first step in testing the system. In the next stage, the proposed project was evaluated and the extent to which the criteria specified in the system could be fulfilled was observed. In the scoring phase, potential scores were obtained according to two different situations according to which of the criteria the project fulfils in the concept design phase, which of them are not possible to fulfil and which of them are possible to fulfil in the later stages. At this point, it can be seen that which sustainability category has how much weight in the scoring directly affects how many points the project can get and which certificate it can achieve. In this case, the importance of a competent team to create specific category and criterion weights for each project before each project is revealed.

Within the scope of this study, the main sustainability assessment systems existing in the sector have been analysed and a new system has been proposed in which the cultural sustainability dimension is adequately taken into account in line with these analyses. This system was then tested in a brutalist structure. The existing systems in the sector have been designed by many professionals from different branches with the knowledge accumulated over many years. In addition, these systems are regularly updated at certain intervals and try to adapt to today's conditions. At this point, the new system proposed within the scope of this thesis does not aim to compete with or replace the existing systems, on the contrary, it aims to draw attention to a different issue by using their suggestions. The main purpose of this thesis is to draw attention to the fact that these actors, which play such an important role in today's market, do not prioritise the cultural dimension of sustainability to the extent required and to create a discussion within the framework of this issue. In addition, it is to draw attention to the fact that brutalism, which is an important part of cultural heritage, is as valuable as any other movement that has become cultural heritage and should be protected and repurposed.

LIST OF FIGURES

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