A Nature-Based Approach to Enhance Children's Landscapes.

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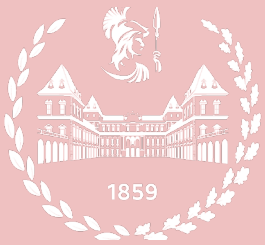

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A mi familia por siempre estar.

Ellos me enseñaron que el que persevera
alcanza y que siempre se debe ir sin prisa pero
sin pausa.

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“Si los espacios para la infancia se han diseñado para imponer la hegemonía de los adultos, la educación emancipadora conduciría a una apropiación y transformación de esos espacios por parte de la infancia”.

- (Raedó, 2023)

If spaces for children have been designed to impose adult hegemony, emancipatory education would lead to an appropriation and transformation of these spaces by children.

- (Translated from Raedó, 2023)

01| Research question

Could Nature-based design be the bridge between sustainability and children's social inclusion?

Abstract:

A direct and indirect connection with nature and natural ecosystems is essential for appropriate human development, growth, and general well-being. Different theories emphasize the significance of Biophilia (innate bond with nature) in the early stages of life, as well as Biophilic design in Children's urban landscapes and the power of playing spaces that reinforce their affinity with the natural environment, their sensory exploration, and the capacity of increasing social interaction. According to the research presented here, children are constrained to indoor environments with a reduced amount of natural resources. Their integration within the city is traditionally merged in adult-centered places where their inherent needs are hardly satisfied. Furthermore, the design of their urban landscapes does not necessarily connect them with nature and limits their ability to learn by using their sensory and natural curiosity. In contrast, an understanding of the city from the perspective of children enables the comprehension of their requirements. By meeting those necessities, also the rest of the inhabitants' needs could be fulfilled, which helps to solve several city issues. Moreover, with the incorporation of biophilic design principles, which stimulate the human senses and take a human-centered approach, caring of ecological sustainability, spaces become more inclusive, healthy, and comfortable.

The proposal presented in this thesis is constituted by the conceptual and architectonic design of a biophilic child-friendly library. The project aims to reevaluate these facilities in the technological era and rethink them as free learning spaces that foster creativity, participation, discovery, and refuge, tailored to children's immediate needs. Starting with the analysis of the potential users and considering their age, motor skills, problem-solving

abilities, social interactions, and communication capabilities. Moreover, by analyzing the state-of-the-art, and with the study of different models and biophilic solutions, detailing their relevance to biophilic attributes, the target human-nature relationship, the senses they activate, and the associated health benefits; it is presented different ways to integrate the biophilic design elements, and how to adapt them to the activities of interest. In this way, children's urban landscapes, as libraries, will encourage the bond with nature, a sensory experience through various stimuli, and the space created will be sustainable, accessible and will promote social inclusion.

The selection of the intervention area is based on the analysis of the city of Turin. This portion of the city, located in the western area, has the highest number of children per square meter and is well-connected with the city's infrastructure. The area has large green spaces and parks; however, they are not evenly distributed, and a significant portion of the sector remains highly urbanized. Additionally, the existing libraries are situated in other parts of the city. Moreover, the proposed site of intervention, despite some attempts to make use of the space, remains currently unused. This situation highlights the opportunity for a transformative project with the characteristics described in the thesis. Armed with the extensive research conducted and taking into account the physical aspects of the site, the proposal is developed. This thesis could be the base for further projects that aim to incorporate biophilic design into urban landscapes focused on children benefiting children's connection with nature, sensory exploration, their social interactions, and their general well-being, while also addressing environmental sustainability.

Keywords:

Children's urban landscapes
Children and nature
Child-friendly city
Nature-based and Biophilic design
Children's Health and Well- being

Potrebbe il design basato sulla natura essere il ponte tra la sostenibilità e l'inclusione sociale dei bambini?

Una connessione diretta e indiretta con la natura e gli ecosistemi naturali è essenziale per uno sviluppo umano adeguato, la crescita e il benessere generale. Diverse teorie sottolineano l'importanza della Biophilia (legame innato con la natura) nelle prime fasi della vita, così come del Biophilic design negli spazi urbani per bambini e del potere degli spazi ludici che rinforzano la loro affinità con l'ambiente naturale, l'esplorazione sensoriale e la capacità di aumentare l'interazione sociale. Secondo la ricerca qui presentata, i bambini sono confinati in ambienti interni con una quantità ridotta di risorse naturali. La loro integrazione nella città avviene tradizionalmente in luoghi incentrati sugli adulti dove i loro bisogni innati sono difficilmente soddisfatti. Inoltre, il design dei loro paesaggi urbani non li collega necessariamente con la natura e limita la loro capacità di apprendere utilizzando la loro curiosità sensoriale e naturale. Al contrario, comprendere la città dalla prospettiva dei bambini consente di capire i loro requisiti. Soddisfacendo tali necessità, potrebbero essere soddisfatti anche i bisogni degli altri abitanti, contribuendo a risolvere diversi problemi cittadini. Inoltre, con l'integrazione dei principi di biophilic design, che stimolano i sensi umani e adottano un approccio centrato sull'uomo, rispettoso della sostenibilità ecologica, gli spazi diventano più inclusivi, sani e confortevoli.

La proposta presentata in questa tesi è costituita dal progetto concettuale ed architettonico di una biblioteca adatta ai bambini disegnata secondo i principi del biophilic design. Il progetto mira a rivalutare queste strutture nell'era tecnologica e a ripensarle come spazi di apprendimento liberi che promuovono la creatività, la partecipazione, la scoperta e il rifugio, adattati ai bisogni immediati dei bambini. Lo studio parte dall'analisi degli utenti potenziali e si sviluppa considerando la loro età, le abilità motorie, le capacità

di risoluzione dei problemi, le interazioni sociali e le capacità comunicative. Inoltre, analizzando lo stato dell'arte e attraverso l'analisi di diversi modelli e soluzioni biofiliche, catalogando la loro rilevanza verso le caratteristiche biofiliche associate, il rapporto umano-natura, i sensi attivati e i derivanti benefici per la salute, vengono presentati diversi modi per integrare gli elementi di biophilic design e adattarli alle attività di interesse. In questo modo, i paesaggi urbani per bambini, come le biblioteche, possono incoraggiare il legame con la natura, un'esperienza sensoriale attraverso vari stimoli e lo spazio creato diventa sostenibile, accessibile e promotore dell'inclusione sociale.

La selezione dell'area di intervento si basa sull'analisi della città di Torino. Questa porzione della città, situata nella zona occidentale, ha il numero più elevato di bambini per metro quadrato ed è ben collegata con l'infrastruttura cittadina. L'area presenta grandi aree verdi e parchi; ciononostante, non sono distribuiti equamente ed una frazione significativa della circoscrizione resta fortemente urbanizzata. Inoltre, le biblioteche esistenti sono situate in altre parti della città. Infine il sito proposto per l'intervento, nonostante alcuni tentativi di utilizzo dello spazio, rimane attualmente inutilizzato. Questa situazione evidenzia l'opportunità di un progetto di trasformazione con le caratteristiche descritte nella tesi. Il progetto è sviluppato alla luce della estesa ricerca condotta e tenendo conto degli aspetti fisici del sito. Questa tesi può diventare la base per ulteriori progetti che mirano a incorporare il biophilic design in paesaggi urbani focalizzati sui bambini, beneficiando del legame dei bambini con la natura, l'esplorazione sensoriale, le loro interazioni sociali e benessere generale, trattando al contempo la sostenibilità ambientale.

¿Podría el diseño basado en la naturaleza ser el puente entre la sostenibilidad y la inclusión social de los niños?

Una conexión directa e indirecta con la naturaleza y los ecosistemas naturales es esencial para un adecuado desarrollo humano, crecimiento y bienestar general. Diversas teorías destacan la importancia de la Biofilia (vínculo innato con la naturaleza) en las primeras etapas de la vida, así como el diseño biofílico en espacios urbanos para niños y el poder que tienen los espacios lúdicos para reforzar su afinidad con el entorno natural, desarrollar la exploración sensorial y la capacidad de aumentar la interacción social. De acuerdo con la investigación presentada en esta tesis, los niños están confinados en ambientes interiores que carecen de recursos naturales. Su interacción con la ciudad se produce tradicionalmente en lugares que están centrados en los adultos, donde sus necesidades innatas apenas se satisfacen. Además, el diseño de sus paisajes urbanos no necesariamente los conecta con la naturaleza y limita su capacidad de aprender utilizando su curiosidad sensorial y natural. Al contrario, entender la ciudad desde la perspectiva de los niños permite comprender sus necesidades y al satisfacerlas, también se podrían satisfacer las necesidades del resto de la población, contribuyendo a resolver diversos problemas de la ciudad. Además, con la integración de principios de diseño biofílico, los cuales estimulan los sentidos humanos, adoptan un enfoque centrado en el ser humano y respeta la sostenibilidad ecológica, los espacios se vuelven más inclusivos, saludables y confortables.

La propuesta presentada en esta tesis consiste en el proyecto conceptual y arquitectónico de una biblioteca diseñada según los principios del diseño biofílico y apta para los niños. El proyecto pretende reevaluar estas estructuras en la era tecnológica y repensarlas como espacios de aprendizaje libre que promuevan la creatividad, la participación, el descubrimiento y el refugio, adaptándolas a las necesidades inmediatas de los niños. El estudio parte del

análisis de los potenciales usuarios y se desarrolla considerando su edad, habilidades motoras, habilidades de resolución de problemas, interacciones sociales y habilidades comunicativas. Además, analizando el estado del arte y a través del análisis de diferentes modelos y soluciones, catalogando su relevancia hacia las características biofílicas asociadas, la relación humano-naturaleza, los sentidos activados y los beneficios resultantes para la salud, se presentan diferentes formas de integrar elementos de diseño biofílicos y adaptarlos a las actividades de interés. De esta manera, los paisajes urbanos para niños, como las bibliotecas, pueden fomentar la conexión con la naturaleza, una experiencia sensorial a través de diversos estímulos y el espacio creado se vuelve sostenible y accesible, fomentando la inclusión social.

La selección del área de intervención se basa en el análisis de la ciudad de Turín. Esta parte de la ciudad, está ubicada en la zona occidental, es el area con ell mayor número de niños por metro cuadrado y está bien conectada con la infraestructura de la ciudad. La zona cuenta con amplias zonas verdes y parques; sin embargo, no están distribuidos equitativamente, las bibliotecas existentes están ubicadas en otras partes de la ciudad y una fracción significativa del sector está altamente urbanizado. Finalmente, el area de intervención propueta, a pesar de algunos intentos de utilización del espacio, actualmente permanece sin uso. Esta situación resalta la oportunidad de un proyecto de transformación con las características descritas en la tesis. El proyecto se desarrolla a la luz de la extensa investigación realizada y teniendo en cuenta los aspectos físicos del sitio. Esta tesis puede convertirse en la base para futuros proyectos que tengan como objetivo incorporar el diseño biofílico en paisajes urbanos centrados en los niños, para beneficiarse de su conexión con la naturaleza y aumentar la exploración sensorial, sus interacciones sociales y su bienestar general y al tiempo abordando la sostenibilidad ambiental.

"We do not inherit the Earth from our ancestors, we borrow it from our children." Proverb.

11 SUSTAINABLE CITIES AND COMMUNITIES

SUSTAINABLE DEVELOPMENT GOALS

01.1 Introduction:

Almost half of the world's population currently resides in urban areas as a result of the unprecedented rate of urbanization. According to the United Nations report of 2018, in 1950, 30% of the world's population was urban, and by 2050, 68% is projected to be urban (United Nations, 2019). Salvador Rueda's statement "The city is, above all, contact, regulation, exchange and communication" (Rueda, 2009) captures the essence of the urban environment as a place of constant interaction, transformation, and participation in a wide range of activities. Cities are dynamic and complex, the relationships are increasing and deal with a globalized world. The present investigation attempts to understand these encounters through the perspective of children, taking into account their interactions, social connections, and their inner relationship with nature. Looking for strategies for making cities more inclusive by adapting architectural and urban design and enhancing children's urban landscapes (See appendix 2) through a nature-based approach.

Several factors are driving children indoors and away from nature. Studies suggest that,

> "The city is, above all, contact, regulation, exchange and communication"
>
> – Salvador Rueda (2009)

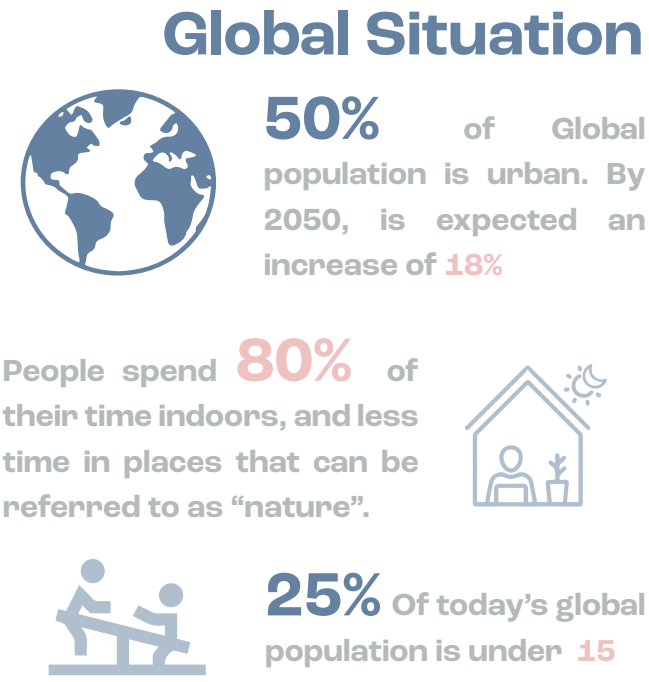


Fig. 1: Global Situation. Made by the author based on data.(United Nations, 2019, Pedersen Zari and Woodward, 2018).

on average, a person spends 80% of their time indoors. This indicates that inhabitants are spending only around 20% of their time outside and in places that can be referred to as "nature" (Pedersen Zari and Woodward, 2018). For children, this refers to the time they spend playing video games or with computers or doing their homework or even parental comfort, convenience or anxiety triggered by their concern about external threats, such as vehicle speed or security challenges, among others (Kellert, Heerwagen, and Mador, 2008). Over this scenario, the majority of social contact that kids have nowadays take place through the use of technology (Balogh et al., 2020). According to Russo and Andreucci's research (2023), twenty-five percent of today's global population is under the age of 15 (Fig. 1). In Italy, the children population only accounts

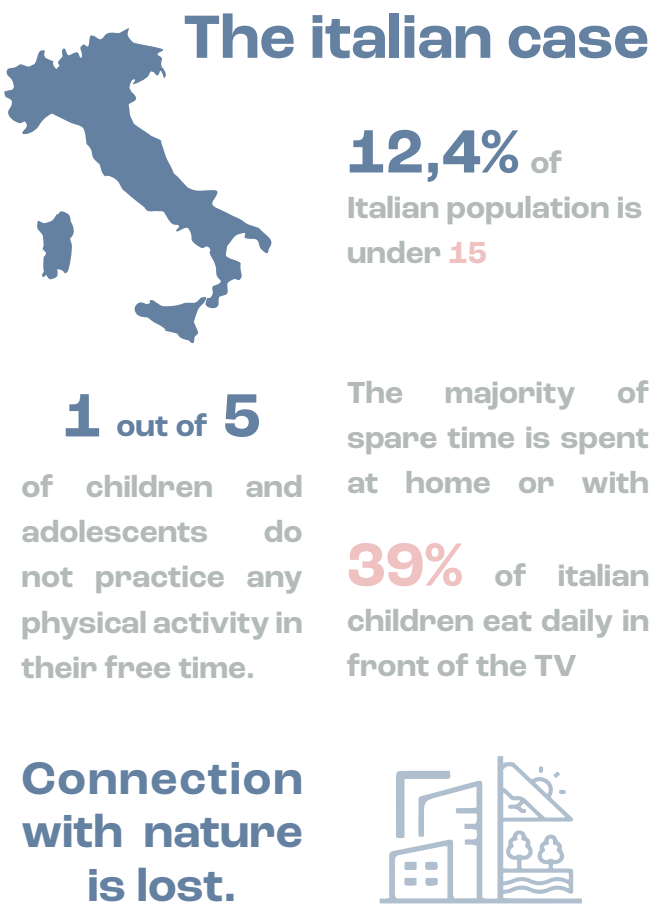


Fig. 2: The Italian Case. Made by the author based on data (Istituto Nazionale di Statistica - Istat, 2023; Save the Children Italia, 2016).

for 12.4% (Istituto Nazionale di Statistica - Istat, 2023), 60% of those kids spend their spare time indoors, 39% frequently eat in front of the television, and one-fifth of children and teenagers are not involved in any physical activity during their free time. Additionally, 60% of Italian parents indicate that their children spend most of their spare time at home or with friends at indoor spaces (Save the Children Italia, 2016) (Fig. 2).

Although there are significant advantages for children living in cities, such as improved life prospects and well-being, access to health care, education, and sanitation, most children in urban areas face major challenges (Balogh et al., 2020; Arup, 2017). Some of the consequences of increasing urbanization are the declining quality of the urban environment, the lack of public spaces, and the unhealthy and risky surroundings for children. The next generation will have fewer opportunities than their predecessors to play freely outside and appreciate the natural environment (Russo and Andreucci, 2023). Due to the lack of autonomous movement, children have less freedom to explore the urban environment than adults. This results in fewer opportunities for social interaction, less playful journeys, disconnection with nature, and difficulties in discovering the world through experience (Balogh et al., 2020; Russo and Andreucci, 2023; Arup, 2017).

The necessity for humans to have 'daily doses' of nature has become increasingly apparent. The prolonged period of social isolation, house confinement, and the closure of educational institutions and playgrounds that came with the COVID-19 pandemic have reinforced this necessity (Russo and

Architectural and urban design should help to strengthen the innate connection that exists between humans and their natural environment.

Andreucci, 2023). It served as a reminder of the value of maintaining a connection with nature (European Commission, 2021). This bond could be strengthened by incorporating natural features, bringing the 'outside in', and increasing the amount of green open spaces and public areas. Architectural and urban design should help to strengthen the innate connection that exists between humans and their natural environment (Kellert, Heerwagen, and Mador, 2008).

Urban green areas have the potential to promote social contact and physical activity, thereby improving the mental and physical health of the population. Accordingly, urban environments should prioritize the needs of children. By implementing strategies targeted at this specific group, we will be able to create a better society that is more inclusive, more creative, more pleasant, more enjoyable, healthier, greener, and safer; in short, a better place to live (Balogh et al., 2020). A child-friendly approach has the potential to address concerns such as health and well-being, sustainability, resilience, and safety. Acting as a catalyst for urban innovation (Balogh et al., 2020; Arup, 2017).

Biophilic design and Nature-Based Solutions (NBS) provides a model for solving urbanization's challenges. They are "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits." (Cohen-Shacham et al., 2016) The integration of those approaches

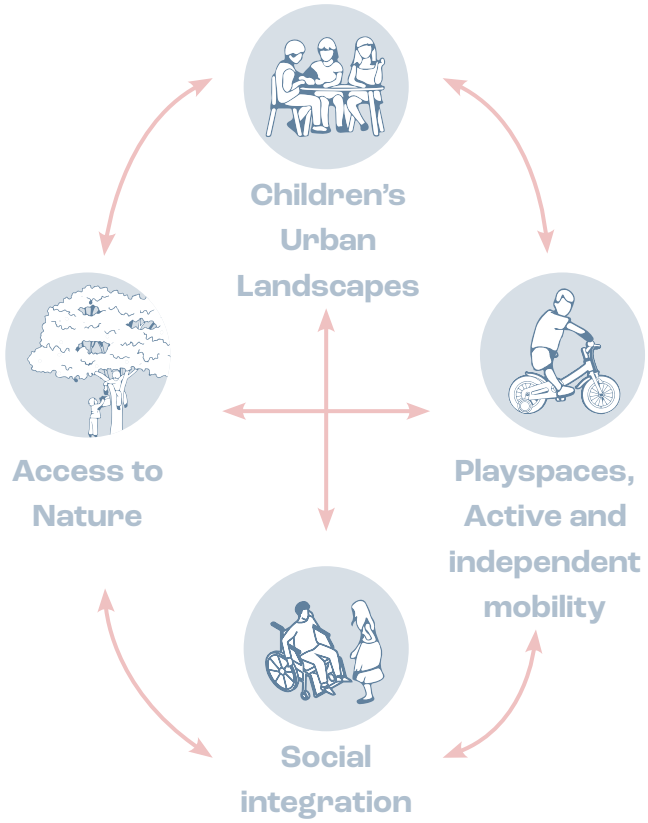


Fig. 3: Relationships addressed in the thesis. Made by the author.

into architectural and urban design and planning could enhance social cohesion and increase inhabitants' quality of life. In this thesis, I will examine the relationships between children's urban landscapes, their access to nature, and their connection to it. I will also explore the importance of biophilic design and the benefits to nature based design and the reformulation of play spaces in achieving social integration and interaction, as well as gaining active and independent mobility for children (See Fig. 3).

01.2 Problem statement:

Children have fewer opportunities than previous generations to bond with the natural environment and play freely.

Because of increased urbanization, children have fewer opportunities than previous generations to bond with the natural environment and play freely. The irregular and fragmented urban expansion leads to a reduced quality of the public space and a dearth of children's landscapes, leading to other repercussions, such as having kids facing dangerous, unhealthy, and unpleasant surroundings. This implies that they will be subject to a series of constraints that influence their interactions with nature and with each other, restricted access to urban infrastructure and services, and fewer play spaces or recreational opportunities (Russo and Andreucci, 2023).

Furthermore, the advancement of technology and the increasing overuse of computers and other electronic devices for entertainment or interaction have led to an increase in the number of interpersonal relationships that occur through screens (Balogh et al., 2020). Additionally, parental concerns about the potential risks associated with allowing children to engage in outdoor activities, or even just their convenience, contribute to children spending more time indoors and away from nature (Kellert, Heerwagen, and Mador, 2008). For that reason, the opportunities to enjoy urban open spaces are reduced and it is more often that kids spend time indoors in adult-centered places where the activities are adult-driven, like going to restaurants and shopping malls (Balogh et al., 2020). Moreover, the global pandemic and the confinement that took place during this period, may have harmed children's physical and mental health (Russo and Andreucci, 2023).

Kids spend time indoors in adult-centered places where the activities are adult-driven, like going to restaurants and shopping malls.

In general, when people are indoors, they are also away from natural environments. If children's inherent affinity for nature is not cultivated to thrive throughout their early years, the phenomenon of biophobia, aversion to nature (see Appendix 1), might emerge, and it could also be the cause of stress and anxiety. Libraries are one of the children's landscapes that could cultivate nature and social interaction outside of school. Traditionally, children libraries correspond to spaces related to improving academic performance (Merga, 2020). Most of the time, they remain as spaces that serve as archives for books. However, recent research suggests that libraries also

represent safe spaces where childrens can explore playful learning experiences and social interaction with interactive and entertaining activities (Hassinger-Das et al., 2020).

Additionally, numerous studies have demonstrated how being close to nature promotes children's healthy physical, intellectual, and social growth from infancy through adulthood. While the majority of these investigations have been conducted mainly in educational settings (Russo and Andreucci, 2023), they serve as a basis for the analysis of other children's spaces. The scope of this thesis is to broaden this research and analyze children's urban landscapes (see Appendix 2), having special attention on children's libraries.

01.3 Purpose and aim:

This thesis seeks to answer the following question: Could Nature-based design be the bridge between sustainability and children's social inclusion?

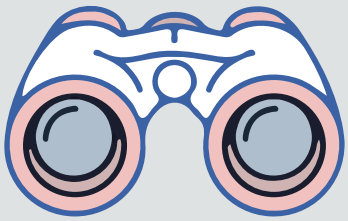
A key objective is to assess the effectiveness of nature-based approaches searching for strategies to enhance children's urban landscapes. The search for possible answers to this question will also lead to potential solutions to some of the city's problems. This thesis aims to promote the construction of biophilic child-friendly cities (see Appendix 3) by researching the multiple benefits of connecting with nature since the early stages of life and demonstrating the many positive effects on children's health, well-being, and

Biophilic child-friendly cities are more inclusive, greener, creative, pleasant, healthier, and safer. Cities for everyone.

happiness, as well as how it is connected to children's social interactions and integration. Children-centered urban planning and design will result in a better society that is more inclusive, greener, creative, pleasant, healthier, and safer. The objective is to create urban landscapes that can accommodate the diverse needs and interests of everyone.

01.4 Methodology:

The material required for the thesis development was gathered from books, articles, and online publications that precisely support the research and give a solid solution to the problem described before. A wide range of theoretical and analytical elements are presented in the process, including the state-of-the-art analysis of children's urban landscapes. Digging into the relationship between biophilic benefits and children's social inclusion and the implementation in the urban and architectural design. I present case study evaluations, definitions of tools and strategies, implementation of the lessons learned, and evaluation of results (Fig. 4).



Main Focus

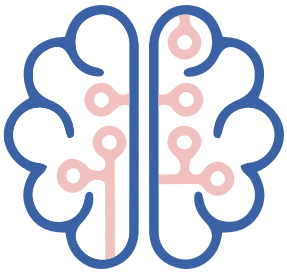
Children's urban landscapes

Aim

Connection with nature and improvement of children's interactions.

Approach

Biophilic design and Child-Frienly cities

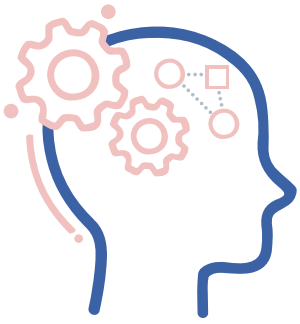


Research

- Children's urban landscapes in Child-friendly Cities
- Children's inner connection with Nature
- Children's social inclusion, interactions, and struggles
- Economic evaluation as a tool for estimating the relevance of green spaces on urban landscapes

Case studies

References with similar approaches, comparable techniques and features to the investigation.



Lessons learned

Moving to Biophilic Child- Friendly Cities

Proposal of a biophilic children's library

The project is developed by analyzing several models, looking for architectural solutions, knowing the user, and analyzing Turin, to identify the site of intervention and the optimal proposal.

Fig. 4: Aim, approach and methodology. Made by the author.

01.5 Sustainable Development goals:

Several Sustainable Development Goals (SDG) targets (see Appendix 4) (Fig. 5) may be achieved by incorporating a biophilic approach into children's urban landscapes, with a particular focus on their inclusion, as several SDGs are associated with children's development (Russo and Andreucci, 2023).

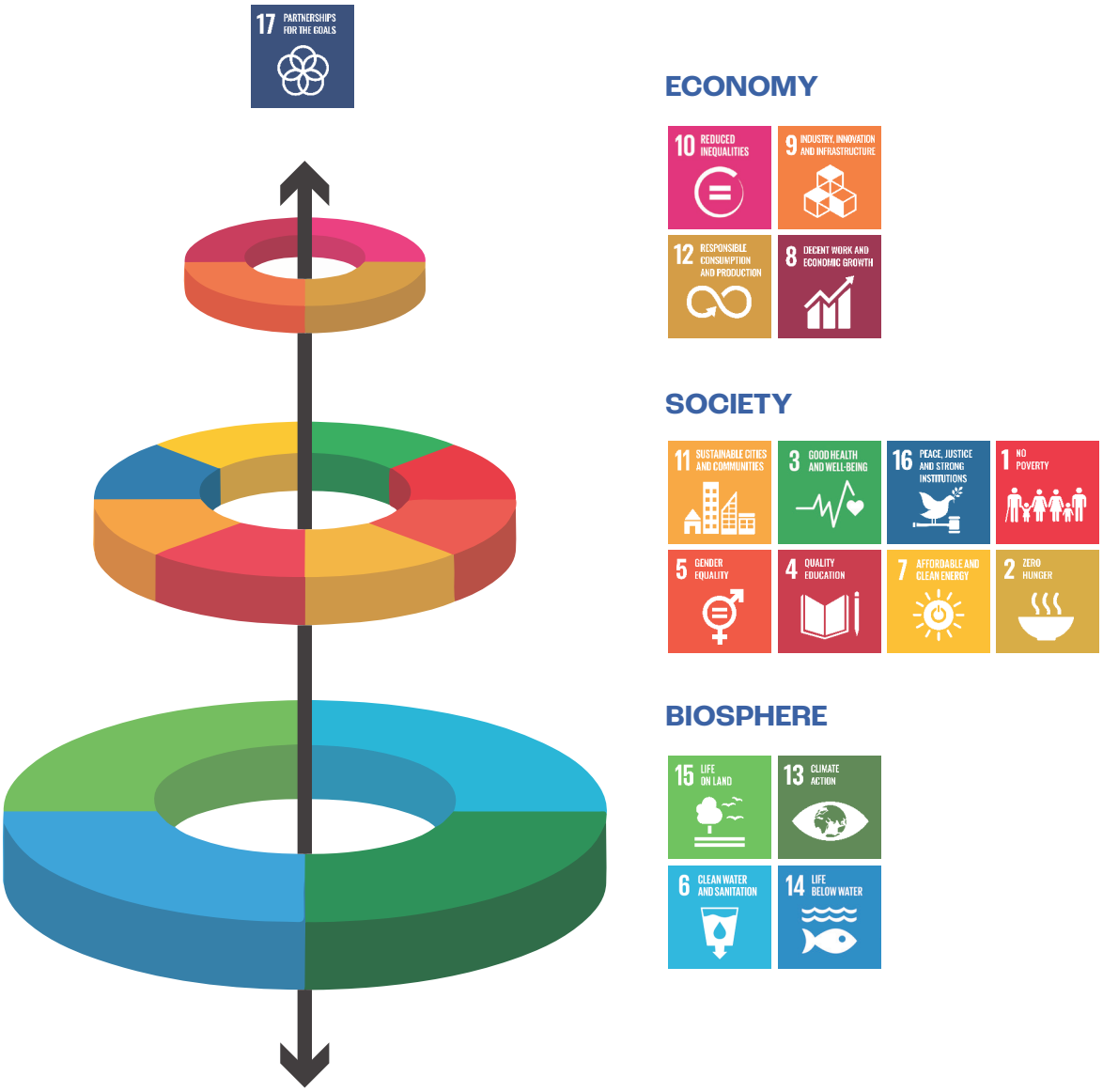


Fig. 5: Sustainable development goals. A new way of viewing the economic, social and ecological aspects of the Sustainable Development Goals (Stockholm Resilience Centre, 2017).

In light of the importance that cities play in promoting social and economic development, there is a worldwide responsibility for sustainability (see Appendix 5) and the development of safe, inclusive, and resilient urban areas. Nevertheless, despite the growing evidence that the social, economic, and ecological dimensions of sustainability are interrelated, the development practice still considers them separately. Consequently, environmental effects are disregarded. To fulfill the 2030 Agenda for Sustainable Development, a shift in perspective is required. Rather than viewing the relationship between nature and humans in a reductionist manner, it is necessary to recognize and highlight the interconnection between the two (Stockholm Resilience Centre, 2017).

Biosphere

The foundation for human progress and existence is the protection of the environment. It is crucial to provide everyone with indoor access to nature, as well as, green open and public spaces that are secure, welcoming, and accessible, especially for kids. To support healthy growth and a pleasant urban experience, it is necessary to consider the conservation of the planet and natural resources. To ensure their respectful preservation, it is essential to establish a closer relationship with natural systems. By adopting biophilic design principles in urban and architectural design, spaces enhance the connection between humans and nature (Park and Lee, 2019).

Society

The advancement of society is linked with the protection of the ecosystem. Studies have shown that the presence of natural surroundings is significantly associated with human health and well-being. Therefore it is important to increase the connection with nature during the early years of life. Besides, Inclusive and sustainable urban planning can mitigate the negative effects of urbanization, encouraging the use of outdoor spaces and giving access to green areas. Furthermore, the enhancement of children's landscapes through nature-based design has a positive impact on children's mental and physical health, which will be reflected in their adult lives. Overall, spending time surrounded by nature helps people's immune systems, and cognitive development, promotes physical activity, and reduces the risk of developing diseases (Kellert, Heerwagen and Mador, 2008).

Economy

Children from families with low incomes or those who have physical, mental, cognitive, or developmental disabilities are particularly vulnerable to the hazards of urbanization. These consequences can negatively impact their development. They also experience exclusion more frequently. Additionally, the COVID-19 pandemic made it more visible that those who are most susceptible are those who were the most affected, not just by the disease but the economic and social consequences that global crises generate (Russo and Andreucci, 2023, Arup, 2017).

02| State of the Art

02.1 Children's urban landscapes in Child-friendly Cities:

For the purposes of the research presented here, an urban landscape is defined as a complex combination of natural and human-made elements that includes buildings and urban open spaces; and children's urban landscapes as urban landscapes with a focus on children, and prioritize their perspectives, are safer, more exciting, and more active. Moreover, prioritizing children in urban planning and design will lead to livable, sustainable, secure, and inclusive cities. Furthermore, the presence of children in urban open spaces serves as a catalyst for social interaction within the city, encouraging parent socialization and community engagement (Balogh et al., 2020).

Children's urban landscapes prioritize children's perspectives and are safer, exciting, and more active.

Children who live in urban areas are often deprived of access to nature and green spaces, and their activities are frequently carried out indoors. Having the goal of fostering their connection with nature and positively impacting their social interactions, it is crucial to comprehend the specific requirements of children residing in urban areas. The implementation of child-friendly urban planning and design encourages the construction of urban landscapes that benefit children's development, health, and well-being, and expand their opportunities, creating inclusive and healthy communities. Child-friendly spaces are safe, fair, and green (Jansson et al., 2022; Arup, 2017) (Fig. 6). Therefore, a child-friendly strategy provides advantages that benefit everyone, not just children (Balogh et al., 2020, Arup, 2017).

In the first years of life, children as newborns and toddlers experience life on a small scale; their development is primarily shaped by their parents or other primary caregivers, due to their necessity to be always close to them. While they are growing and begin to walk, play, and move more autonomously around their homes or even in the streets of their neighborhoods; they begin to interact and explore their immediate surroundings. Children of a younger age have their first experience exploring the city on sidewalks or paved areas outside their homes. In contrast, older children may have broader access to neighborhood parks and public places, where the connection with nature is higher. A child-friendly city must consider every stage of a child's growth. An essential component of this process is having a multiscalar perspective for the analysis of the city's problems and potentials (Arup, 2017).

Fig. 6: Definition of a child-friendly city. Made by the author, based on the CFCI framework (Jansson et al., 2022).

The physical, psychological, and social development of children and adolescents is significantly influenced by their surroundings (Balogh et al., 2020). The built environment affects a child's lifestyle and could negatively affect their mental and physical health. Green areas and contact with nature significantly improve children's physical, mental, and social development from infancy through adulthood. Therefore, regardless of the area in which a child lives, there should be a secure, welcoming, and inclusive public green space in the vicinity that is easily accessible on foot (Russo and Andreucci, 2023). Additionally, every child should be able to fulfill their educational, recreational, social, and ecological needs in all children's landscapes (both indoor and outdoor spaces), such as their homes, kindergartens, childcare facilities, schools, classrooms, libraries, parks, playgrounds, and playscapes, as well as in other public spaces like the streets (Balogh et al., 2020).

Child-friendly cities should be designed to provide children with access to nature and green spaces, as well as opportunities to encourage social interaction among children. Social contact between children could be promoted by designing areas that encourage play and exploration (Balogh et al., 2020). Children's outdoor playtime, independence, and connection to nature are indicators of how effectively cities function for children, but also the rest of the inhabitants (Arup, 2017).

Child-friendly cities should be designed to provide children with access to nature and green spaces, as well as, play opportunities and to encourage social interaction.

The power of playspaces

Play is universally acknowledged as an inalienable right and an essential component of a child's social, emotional, and intellectual development. It was supported by the 1989 UN General Assembly approval of Article 31 of the International Convention on the Rights of the Child (Lauria and Montalti, 2015; Arup, 2017). According to experts, free play is essential for a child's proper development. However, in most circumstances, children's options to play in cities are limited and are decreasing (Balogh et al., 2020). A high degree of autonomous mobility combined with the ability to play, socialize, and interact with others, having everyday freedoms helps kids to understand the world and their place in it (Arup, 2017). It is essential to include play in regular activities and reimagine common places as play destinations (Balogh et al., 2020). According to Penny Wilson, cited in Laurìa and Montalti's research (2015) "play-deprived people may be physically desensitized, show symptoms of severe learning disabilities, physical ineptitude, or erratic behavior, be depressive and withdrawn, or have difficulty in forming bonds".

The word "play" can have a wide range of connotations. In essence, play is about having fun, it is an active kind of entertainment

When children play in natural environments, they engage in exploratory play, which helps them express feelings, spark creativity, and use their senses to learn. Nature offers diverse play situations unlike standard playground equipment.

that promotes good physical and mental health. Play is consequently a physiological need. Additionally, a positive social attitude is established as a result of playing, due to, play has a direct impact on children's social development and begins in the first few months of their life. The kid identifies himself or herself and builds their knowledge based on their understanding of their abilities, leading to the construction of their self-esteem (Lauria and Montalti, 2015). It is therefore fundamental to increase the number of play opportunities available in the built environment (Fig.7) . When children play in natural environments, they engage in exploratory play. This helps them to communicate their feelings, spark their creativity, and use their senses to learn about their surroundings. Nature frequently provides them with a range of play situations that are different from those that have common playground equipment, built by adults without considering all children's needs (Lauria and Montalti, 2015).

Playgrounds, playscapes, sports fields, and fitness centers are examples of outdoor recreation areas that are intended to encourage and facilitate physical activity. A review of the literature reveals that when children transition from preschool (ages 3-5) to primary school (ages 6–11), they frequently utilize parks for active recreation and physical activity. Additionally, the value of playground facilities and services in parks for motivating children, parents, and the general public to engage in physical activity has been demonstrated (Russo and Andreucci, 2023).

Playgrounds commonly tend to be isolated or separated from other population activities and have artificial limits and prefabricated play equipment. An alternative is the construction of playscapes that are less constrained or with formal boundaries, attempting to provide better quality play spaces. These open areas encourage children's imagination and creativity while enabling unstructured and spontaneous play while benefiting the entire neighborhood (Balogh et al., 2020). The preference for outdoor space among children is often attributed to the opportunities for play that they afford. It is also noteworthy that children frequently mention their preference for being outside due to the presence of trees, animals, water, natural elements, and fresh air. This indicates that the appeal of outdoor spaces extends beyond the play opportunities to also their bond with nature (Pedersen Zari and Woodward, 2018).

Playgrounds ought to be true "works of architecture", firmly founded on their specific sociocultural, environmental, and architectural

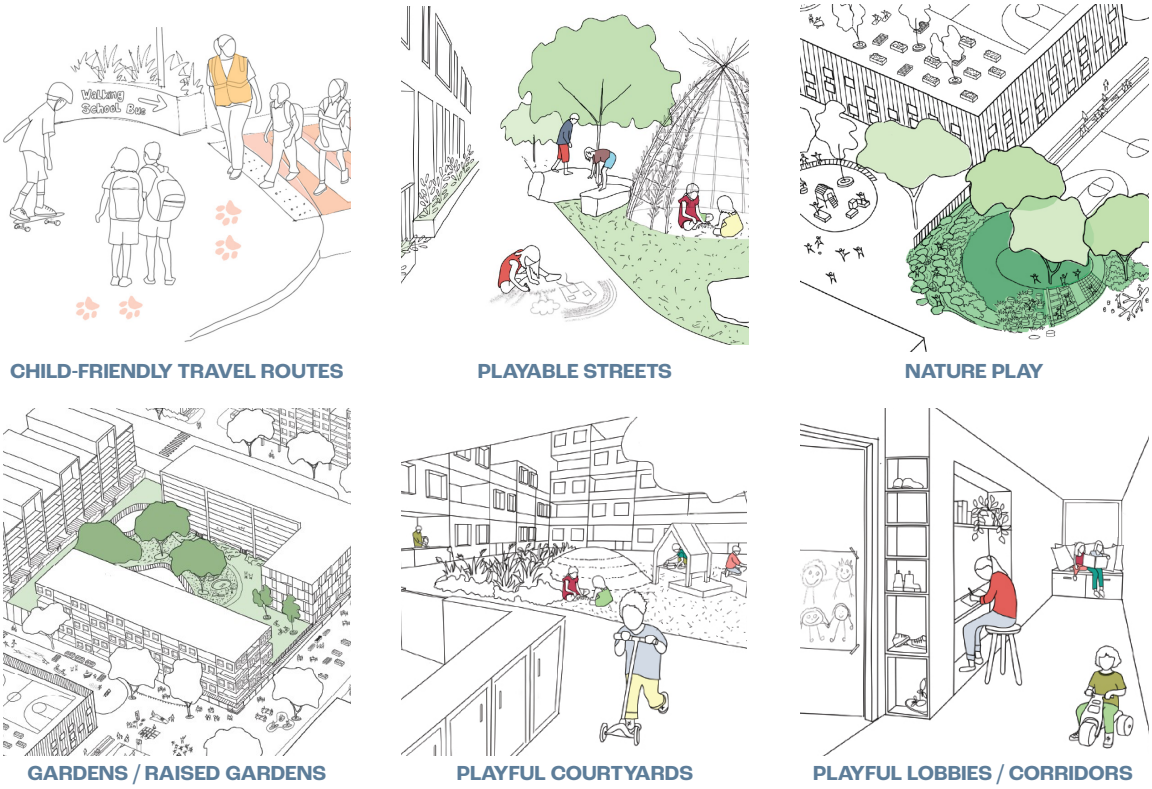


Fig. 7: Some strategies to increase play opportunities in built environments (Krysiak, 2020).

context and in dialogue with the natural world. They should be able to encourage encounters and mutual enrichment between children who come from diverse backgrounds and have different abilities (Lauria and Montalti, 2015).

Additionally, it is important to consider spaces for passive recreation such as sensory gardens and therapeutic gardens. The first ones are designed to be beneficial for humans and to increase wildlife, and they help us reconnect with nature by stimulating the five senses through a sensory experience. Therapeutic gardens promote active healing through gardening activities. Some examples include gardens created specifically for dementia, mobility, rehabilitation, and community cohesion (Russo and Andreucci, 2023). One example of incorporating biophilic design principles in playgrounds is the inclusion of teepees, climbing walls, and nets, given their potential to evoke a sense of risk and refuge (Pedersen Zari and Woodward, 2018). A section of this thesis is dedicated to explain the significance of biophilic design.

Playgrounds ought to be true 'works of architecture', firmly founded on their specific sociocultural, environmental, and architectural context and in dialogue with the natural world.

02.2 Children's inner connection with Nature:

Children are 'biophilic beings' from the moment they are born, they have a natural and inherent desire and curiosity to discover nature and gain knowledge of the world around them. Nature doesn't make them feel insecure or threatened. According to the biophilia hypothesis (see Appendix 6), kids tend to prefer outdoor activities due to the positive effects they have, reflected on their well-being, sense of freedom, and sense of control. At the same time, they obtain considerable health improvement and serve as preventative practices (Fig. 8).

Several studies have demonstrated that children's physical and neurological development occurs primarily in their first few years of life. Hence, it is crucial to provide children with diverse opportunities for engagement with natural environments and elements as a regular part of their daily routines, as this connection holds particular importance during their early stages of growth. These nature experiences (Fig. 9) should be designed to align with their developmental needs, enabling children to gain the majority of the biophilic benefits associated with exposure to nature (Kellert, Heerwagen, and Mador, 2008). Furthermore, if a child's innate attraction to nature is constrained and is not cultivated during their formative years, it is

Children as:

"biophilic beings"

The connection with nature provides them with:

- Freedom
- Well-being
- Health

Nature doesn't make them feel insecure or threatened. Outdoor engagement with nature as a regular part of their daily life. This is particularly important throughout their early stages of growth.

Fig. 8: Children's inner connection with nature. Made by the author based on (Kellert, Heerwagen, and Mador, 2008).

possible that biophobia (see Appendix 1), or an aversion to nature, could arise (Russo and Andreucci, 2023).

Even while many academics emphasize the numerous benefits of being surrounded by nature, the researched literature shows that children are losing their connection to the natural environment (Russo and Andreucci, 2023). Nowadays children's daily activities are increasingly disconnected from nature for several reasons. Their structured routines often confine them indoors, which results in them being raised in environments that do not promote or reinforce their relationship with the natural world. This disconnection starts with extensive time spent in classrooms and completing homework assignments, which minimizes their exposure to natural surroundings. Furthermore, the majority of their leisure time is typically spent at home, involved in activities such as watching television or playing video games (Kellert, Heerwagen, and Mador, 2008). This has resulted in the majority of children's social interactions occurring through the use of digital devices and in front of screens (Balogh et al., 2020).

Even when they spend time outside, their activities are usually supervised and do not provide them the chance to freely explore the outside world and fully immerse themselves in nature (Russo and Andreucci, 2023). Children are commonly invited to indoor locations that are adult-centered and be integrated into adult-driven activities such as restaurants and malls, and this tendency tends to increase (Balogh et al., 2020). Moreover, taking into account their parents' constraints, including their hectic schedules, their increased anxiety about urban safety, or that they are disconnected from nature (Kellert, Heerwagen, and Mador, 2008); the amount of time spent outdoors is generally brief (Balogh et al., 2020).

To enhance future environmental participation, it is crucial to establish a stronger relationship with the natural system and ensure its respectful conservation. This will encourage children to continue to protect and bond with the natural environment. Architects, urban designers, landscape architects, and interior designers who design and transform urban landscapes should be aware of the importance of human connection and involvement with nature in terms of social and environmental sustainability, and should therefore strive to integrate these elements into their projects in a way that strengthens the mentioned relationship (Pedersen Zari and Woodward, 2018; Kellert, Heerwagen, and Mador, 2008).

Nature's Contributions to Children's Health and Well-being:

As highlighted before, children need daily doses of nature to improve their health and well-being. Contact with natural features and environments has been linked to healthy childhood maturation and development, and high cognitive performance in activities demanding focus and memory (Kellert, Heerwagen, and Mador, 2008). When compared to children from rural regions, children who live in urban areas have fewer opportunities to encounter nature, and are

Biophilic design

Environmental Features

- Color
- Water
- Air
- Sunlight
- Plants
- Animals
- Natural materials
- Views and vistas
- Façade greening
- Geology and landscape
- Habitats and ecosystems
- Fire

Natural shapes and forms

- Botanical motifs
- Tree and columnar supports
- Animal (vertebrate) motifs
- Shells and spirals
- Egg, oval, and tubular forms
- Arches, vaults, domes
- Shapes resisting straight lines and right angles
- Simulation of natural features
- Biomorphy
- Geomorphology
- Biomimicry

Natural patterns and processes

- Sensory variability
- Information richness
- Age, change, and the patina of time
- Growth and efflorescence
- Central focal point
- Patterned wholes
- Bounded spaces
- Transitional spaces
- Linked series and chains
- Integration of parts to wholes
- Complementary contrasts
- Dynamic balance and tension
- Fractals
- Hierarchically organized ratios and scales

Light and space

- Natural light
- Filtered and diffused light
- Light and shadow
- Reflected light
- Light pools
- Warm light
- Light as shape and form
- Spaciousness
- Spatial variability
- Space as shape and form
- Spatial harmony
- Inside-outside spaces

Environmental Features

- Geographic and historic connection
- Ecological connection
- Cultural connection
- Indigenous materials
- Landscape orientation
- Landscape features that define
- building
- Form
- Landscape ecology
- Integration of culture and ecology
- Spirit of place
- Avoiding placelessness

Human-Nature Relationship

- Prospect and refuge
- Order and complexity
- Curiosity and enticement
- Change and metamorphosis
- Security and protection
- Mastery and control
- Affection and attachment
- Attraction and beauty
- Exploration and discovery
- Information and cognition
- Fear and awe
- Reverence and spirituality

Fig. 9: Elements and atributes of Biophilic design (Kellert, Heerwagen, and Mador, 2008).

more exposed to environmental hazards including air pollution, noise, and urban heat, among others. Conditions such as attention deficit, hyperactivity disorder, stress, obesity, and depression, are strongly correlated with reduced immersion in nature, therefore it is known as 'nature deficit disorder' (Russo and Andreucci, 2023).

Spending more time in environments that foster a stronger relationship with nature offers numerous benefits. These include reduced risks of emotional and behavioral issues, enhanced childbirth outcomes, improved academic performance, and overall mental health improvements and cognitive development, as well as, a reduced probability of developing adult mental or psychiatric disorders. Direct interaction with natural settings or certain elements associated with nature, such as specific materials, may also strengthen the immune system. Children exposed to specific allergens or microorganisms during their first year of life tend to experience lower rates of recurrent wheezing and allergic reactions. (Russo and Andreucci, 2023).

Childhood obesity is a clear indicator of an unhealthy body state. The prevalence of childhood inactivity has been on the rise over the past three decades, as a consequence of lifestyle changes. Nowadays, constructed settings frequently obstruct children's autonomous mobility and, therefore, their experience of nature. Urban planning should prioritize enhancing the 'activity friendliness' of neighborhoods for children by strategically placing shared spaces in residential areas and providing walking, biking, and skating paths (Kellert, Heerwagen, and Mador, 2008).

Children's development is strongly influenced by the environment in which they are raised.

Additionally, increasing greenery in urban structures such as roads, sidewalks, and parking areas can make the urban environment more attractive. This dual approach aims to promote both physical activity and exposure to natural elements for children. Direct experience with natural processes and materials should be encouraged in early childhood when sensory exploration is the primary way of learning. When their minds and bodies are open to all that the world has to offer to them, and where the seeds of understanding the world are planted. However, the lack of positive adult role models who have lost their biophilic attachment and do not engage in physical activity, in addition to the reduction in interaction with natural environments in schools where children spend the majority of their developmental stage, serves to exacerbate the barriers to achieving the mentioned goals (Kellert, Heerwagen, and Mador, 2008).

Biophilic design Patterns

Pattern	Health and well-being benefits	Design features
Visual Connection	• Lowered blood pressure and heart rate • Increased mental engagement and attention • Positive attitude and overall happiness	• Proximity to windows with a view to nature • Plants, flowers, and green walls/roofs • Connection to Natural ecosystems.
Non-Visual Connection	• Reduced systolic blood pressure and stress • Positively impacted on cognitive performance • Mental health improvement and tranquility	• Sound (animals, music, and water) • Smell (fragrant plants) • Touch (hand rails and water)
Non-Rhythmic Sensory Stimuli	• Positively impacted sympathetic nervous system activity, blood pressure and heart rate • Attentiveness and exploratory behaviors	• Indoor kinetic facades and interactive design displays. • Swaying grasses and falling water
Thermal and Airflow Variability	• Increased comfort, well-being and productivity • Positively impacted concentration • Improved perception of spatial pleasure	• Openable windows,manually or individually • Areas with external balconies • Mechanical ventilation
Presence of Water	• Reduced stress, heart rate/blood pressure. • Improved concentration, memory restoration. • Positive emotional responses, tranquillity.	• Water walls and Fountains • Paintings of ocean/water life • The colour blue
Dynamic and Diffuse Light	• Positively impacted circadian system functioning	• Daylight, Light distribution • Ambient diffuse lighting on walls/ceiling
Connection with Natural Systems	• Enhanced positive health responses • Shifted perception of the environment	• Spaces with patios or roof gardens • Native planting • Cultural and ecological attachment to place
Biomorphic Forms and Patterns	• Observed view preference	• Images of nature, Natural Colours • Organic forms and shapes, Evoking nature, Geometric forms, Biomimicry, Spirals, Fractals and Curves
Material Connection with Nature	• Decreased diastolic blood pressure • Improved creative performance • Improved comfort	• Materials that reflect native ecology such • as specific woods, clay, stones, and other • fabrics
Complexity and Order	• Positively impacted perceptual and • physiological stress responses • Observed view preference	• Repetitive and symmetrical shapes • Exposed structure and mechanical systems facades • Spandrel and window hierarchy

Fig. 10: Attributes, benefits, and design featurs of the 10 patterns of biophilic design. Made by the author based on (Ghaziani, Lemon and Atmodiwirjo, 2021).

Biophilic Design in Children's urban landscapes:

There is a growing interest in sustainable architecture (see Appendix 5), driven by the increasing awareness of environmental issues and the necessity for improved resource management. One of the most significant approaches for reducing the ecological impact of urbanization is environmentally sustainable design (ESD) (see Appendix 5). It encourages the use of renewable energy sources as well as having a building thermal performance (Wijesooriya and Brambilla, 2020). Studies have shown that settings with high environmental quality, are more neighborly and have a stronger sense of place (Kellert, Heerwagen, and Mador, 2008). However, there have been some critics because of its dependence on technological advancements rather than addressing the qualitative aspects of the human component. Applying the biophilic design (see Appendix 7) approach is a way of shifting to a more human-centered viewpoint, and still following the sustainable principles. A more effective outcome may be attained through an integrative approach that incorporates both environmentally sustainable design and biophilic design (Wijesooriya and Brambilla, 2021).

Applying the biophilic design approach is a way of shifting to a more human-centered viewpoint, and still following the sustainable principles.

Biophilic design was inspired by the hypothesis that Edward O. Wilson made in 1984, of 'biophilia' (see Appendix 6). It supports the inherent connection Human-nature and it is a sustainable strategy that promotes healthy human development. This reliance is a reflection of the fact that humans were developed in a world that is mostly natural rather than artificial or constructed (Kellert, Heerwagen, and Mador, 2008). With the Biophilic design approach, the urban and architectural environment strengthens the links of humans with nature using space as a medium (Park and Lee, 2019). Biophilic design is a strategy for obtaining sustainable development based on human rights, by connecting the physical and spatial elements of the built environment together, helping also the vulnerable or disadvantaged children and their communities (Russo and Andreucci, 2023) (Fig. 10).

Children's development is strongly influenced by the environment in which they are raised. As stated before, increasing the amount of nature and incorporating it into the built environment will bring many benefits. Living near green areas reduces the risk of developing social and health problems. It has been demonstrated that even small amounts of vegetation, like tiny pocket parks, grass areas, or a few amount of trees, can improve the quality of life. Even in our modern urban society,

preserving physical and emotional well-being is significantly reliant on the connection with nature. Our emotional, problem-solving, critical thinking, and constructive aptitudes, maintain a strong connection to the natural systems and processes that are still crucial for human health, growth, and productivity (Kellert, Heerwagen, and Mador, 2008).

The relationship with nature could be achieved in several ways, through a direct or indirect experience of nature, and the vernacular dimension. The first one is the nearly unstructured relationship with self-sustaining natural environment components including sunlight, plants, animals, natural habitats, and ecosystems. An indirect encounter with nature is a contact that requires continuous human intervention to sustain, such as potted plants, water fountains, or aquariums. The vernacular dimension is what has been called the 'spirit of place', and describes how meaningful buildings and landscapes get incorporated into people's individual and communal identities (Russo and Andreucci, 2023).

By adopting biophilic design philosophy into spatial design, human well-being will be higher compared to the current situation (Pedersen Zari and Woodward, 2018). The reconnection with nature is essential to allow people to live a healthy and fulfilled life and should not be a luxury (Kellert, Heerwagen, and Mador, 2008). Even though, children are considered to have a stronger relationship with nature than adults (Russo and Andreucci, 2023); recent research does not specifically include kids as the most important users of sustainable (see Appendix 5) 'green' development (Kellert, Heerwagen, and Mador, 2008).

Biophilic design improves human health and well-being. The reconnection with nature is essential to allow people to live a healthy and fulfilled life and should not be a luxury.

Children's physical and mental health should be a primary consideration when designing urban landscapes. The inclusion of a range of natural features based on biophilic design principles (Fig. 8) on architectural projects will benefit all kinds of users, fostering a connection with the environment (Ghaziani, Lemon and Atmodiwirjo, 2021). Children's urban landscapes should be safe, inclusive, and adaptable to various age groups (Arup, 2017). Biophilic design stimulate creativity, learning, exploration and imagination, increasing sensory experiences. In addition, designs should encourage social interaction among children, promoting both individual and group activities (Lee and Park, 2018).

Re-establishing a connection with nature is urgently needed in all urban landscapes. For example, school buildings and schoolyards should attempt to gain better connectivity between spaces linking them with the

environment. Almost all of the school grounds are made of concrete, they must be transformed into stimulating and diverse learning environments. One way to achieve it is the implementation of school gardens as they provide several advantages and promote learning through experience (Ghaziani, Lemon, and Atmodiwirjo, 2021). With more trees, gardens, and nature trails on their grounds, schools may encourage the students to exercise more and more effectively (Russo and Andreucci, 2023). Furthermore, many studies have shown that design features that take into consideration the use of the natural environment can improve academic performance because they foster a learning atmosphere that is friendlier and more collaborative, as well as one that is safer, quieter, and peaceful (Ghaziani, Lemon, and Atmodiwirjo, 2021).

Through the benefits of reading, learning opportunities, and social interaction; the construction of children's library projects should also foster cognitive and emotional growth during a child's formative years. Moreover, they positively impact social and cultural development. Children's libraries should be designed with a nature-based approach as they should provide opportunities for interaction with nature, incorporating them into the indoor space while taking into account the surrounding environment. They require natural shelter areas, open spaces with natural elements, spaces that employ natural elements to evoke curiosity and offer distinctive sensory experiences, among other features. Additionally, multipurpose spaces for reading, resting, gathering, and playing that encourage interaction between kids of different ages (Lee and Park, 2018).

Almost all of the school grounds are made of concrete, they must be transformed into stimulating and diverse learning environments.

Children's libraries designed with a nature-based approach provide opportunities for interaction with nature and foster cognitive and emotional growth during a child's formative years.

02.3 Children's social inclusion, interactions, and struggles:

There is a need to rethink a resilient and inclusive design strategy by integrating environmental and social principles, comprehending how these concepts might be used and translated into the creation of contemporary spaces, to achieve democratic, humanistic, and ecological architecture and urban landscapes.

A resilient and inclusive design strategy that integrates environmental and social principles to achieve democratic, humanistic, and ecological architecture and urban landscapes.

These principles refer to the ethical aspect of architecture, which includes the values of preserving and taking care of the environment and the community. What becomes clear is that nature-based design can be used to develop a new design methodology that involves rethinking the neglected spaces as areas of opportunity, giving them new ecological values and reinforcing social aspects. With resources to remodel the city while also educating citizens about the value of their "right to nature". The shift toward self-sufficient communities can be fostered by empowering marginalized and vulnerable populations (Santus and Scaioli, 2022).

Cities should guarantee access to high-quality urban landscapes, including the streets, buildings, parks and playgrounds, making them a place suitable for everyone. As stated before, the surrounding environment has a significant impact on children's growth and development (Sungur and Czaplinska, 2018). A child's involvement in the socio-physical environment includes their social connection. It shapes how kids interact with their surroundings and determines how they engage with their environment. Additionally, it is directly related to a sense of security, familiarity, and stability. This is also referred to as place-belonging or place attachment. Social connection is also about enabling people to meet and foster encounters. However, children who live in crowded cities have fewer opportunities and places to make these bonds. For that reason, the possibility for a child to establish a network of social relationships, including social interactions and connections, as well as a strong sense of community, should be provided. In this way, children's ties with their surroundings can be formed (Jansson et al., 2022).

In our daily social life, we frequently experience or evidence exclusion. Since our early years of life, groups begin to form, and choices are made regarding who to include and who to leave out. Peer interactions, friendships, partnerships, and social groupings make us all susceptible to exclusion. Even in adulthood, group dynamics are associated

with processes of exclusion. There is diverse research regarding the several judgments and evaluations of exclusion variables such as gender, race, ethnicity, and culture which are related to how children evaluate exclusion (Rubin, Bukowski, and Laursen, 2011).

Accessibility, (see Appendix 8) plays a crucial role in people's daily lives. It is a key measure of how permeable and inclusive a community is. It considers how well inherent human rights like freedom of movement and self-sufficiency are achieved. It is a crucial instrument for promoting both individual and social empowerment (Lauria and Montalti, 2015). Having physical, mental, cognitive, or developmental limitations shouldn't imply being isolated from the peer group. Many times, while discussing accessibility, only adults are considered, leaving children with disabilities out of the picture. Being a child at a developmental stage in the constructed world, which is designed by and for adults, presents several obstacles and challenges. However, these implications increase when there are extra limitations, and it may become impossible to develop in optimal conditions (Sungur and Czaplinska, 2018).

Many times, while discussing accessibility, only adults are considered, leaving children with disabilities out of the picture.

Universal design creates solutions for anybody, regardless of their age, origins, beliefs, gender or their mobile, visual, auditory, or mental capacity.

Instead of focusing on each particular characteristic or vulnerability, universal design creates solutions for anybody, regardless of their age, origins, beliefs, gender or their mobile, visual, auditory, or mental capacity. Moreover, it bases the design on the diverse abilities creating positive experiences. Children could build their sense of community, identification, and communication skills, as participation in social groups allows them to play or just spend time with others and develop these abilities (Sungur and Czaplinska, 2018). As mentioned before, integration among children comes primarily through play, and it is a key aspect in their 'capacity-building,' in fostering bonds between kids with different backgrounds, needs, and expectations; in reducing tensions, developing their bodies and senses; and encouraging various types of creativity. Unfortunately, play spaces are typically created for the "usual child," a completely artificial model that should represent a wide variety of lives, bodies, and desires. It is an example of the constrained adult viewpoint employed to analyze and arrange children's environments (Lauria and Montalti, 2015).

Children relation to the outdoor space is also essential as it is the place where they can freely experience their motor skills. Movement coordination should be considered to give children greater opportunities for mobility so they may attain a proper physical education. This aspect can be obtained through sports, games, and other activities that raise the degree of overall health and physical endurance. Like any other kid, children with reduced mobility have the same instinctive desire to run, jump, and climb everything. While it may be a challenge to allow their mobility, it is not impossible in many circumstances. In addition, playing and having fun is not necessarily limited to improving children's motor skills; it may also be about broadening their senses and improving their interpersonal abilities (Sungur and Czaplinska, 2018) As another example, a child with visual limitations lacks the ability to gain knowledge through observation, they need several opportunities to touch, hear, and smell what they cannot see. The experience of spaces should be related to the other senses. Indeed, their development could achieve the expected outcomes if the rest of their senses are stimulated properly (Sungur and Czaplinska, 2018).

Play spaces are typically created for the 'usual child', a completely artificial model that should represent the wide variety of lives, bodies, and desires.

The main source of sensory stimulation is the natural environment.

Therefore, it is essential to incorporate other ways of learning about the world. According to Pallasmaa (2012, pp. 12), "'life-enhancing' architecture has to address all the senses simultaneously, and help to fuse our image of self with the experience of the world". Architects should avoid the ocularcentrism or the prioritization of vision over the other senses. Due to, spaces with a visual dominant focus prioritize appearance, over the real experience of human presence. In brief, multi-sensory engagement is essential to creating meaningful and human-centered architectural designs (Pallasmaa, 2012). Since the main source of sensory stimulation is the natural environment, having the flexibility to connect with nature at multiple moments and places it is indispensable for children's healthy growth and for developing their ability to adapt to the world and use their senses to interact with it (Lauria and Montalti, 2015).

02.4 Economic evaluation as a tool for estimating the relevance of green spaces on urban landscapes:

A review of economic evaluation methodologies was carried out in this research to analyze the impacts of the amount of greenery in the urban environment on the real estate market and use it as a tool for site analysis and quality of life estimation. Furthermore, to correlate if nature-based design in an architectural intervention would result in the possible improvement of a neighborhood.

Both internal and external factors affect the property values. The intrinsic characteristics are all the elements directly related to the dwelling. The extrinsic ones are all the characteristics that differentiate the zone where the property unit is located and its surroundings. Leaving the intrinsic characteristics as constant, variables on extrinsic factors were researched in studies that demonstrated the importance of urban quality in increasing or reducing property values (D'Acci, 2013).

According to D'Acci (2013) a wide range of methodologies, including monetary ones like hedonic pricing (see Appendix 9), willingness-to-pay, and positional Value, may be used to describe and evaluate urban life's quality. Implicit or hedonic pricing is determined by the observed product prices and quantitative characteristics associated with each good. It enables the estimation of real estate price values by analyzing several variables (Rosen, 1974), such as the property's qualities, the location's features, and the environmental factors. The relevance and weight of measurable attributes and variables and their effect on the total value of a property could be assessed using Multiple Regression Analysis (D'Acci, 2019) (Fig. 11).

It has been proven that the value of a property is influenced by positional elements such as greenery, the social setting, pedestrian areas, pollution, aesthetics, views, and accessibility (D'Acci, 2019). Thus, the willingness to pay more for a property located near a park, green area, or open space is demonstrated by the real estate market, however, it is essential to note that some of these spaces are more desirable than others as places to live nearby (Crompton, 2001).

The Positional Value is determined by the site's desirable and undesirable characteristics. The process of capitalizing on the value of nearby properties is known as the 'proximate principle'. (Crompton, 2001) For the purpose of estimating the quality of life, it is useful to translate those characteristics into economic terms (D'Acci, 2019). The evaluation of the increase in property value could be comparable to the urban quality of life under specific circumstances (D'Acci, 2013) (Fig. 12).

Urban High-Quality

Property Prices Values (Va) = α + β1(G) + β2(A) + β3(PA) + β4(SC) + β5(PT) + β5(HV) + ε

Green (G), aesthetics (A), Pedestrian areas (PA)
Social Context (SC), Public Transport (PT), and
Historical area Value (HV)

Fig. 11: Mutliple regression analysis and variables that affect Real estate values . Made by the author based on the research (D'Acci, 2018, D'Acci, 2018).

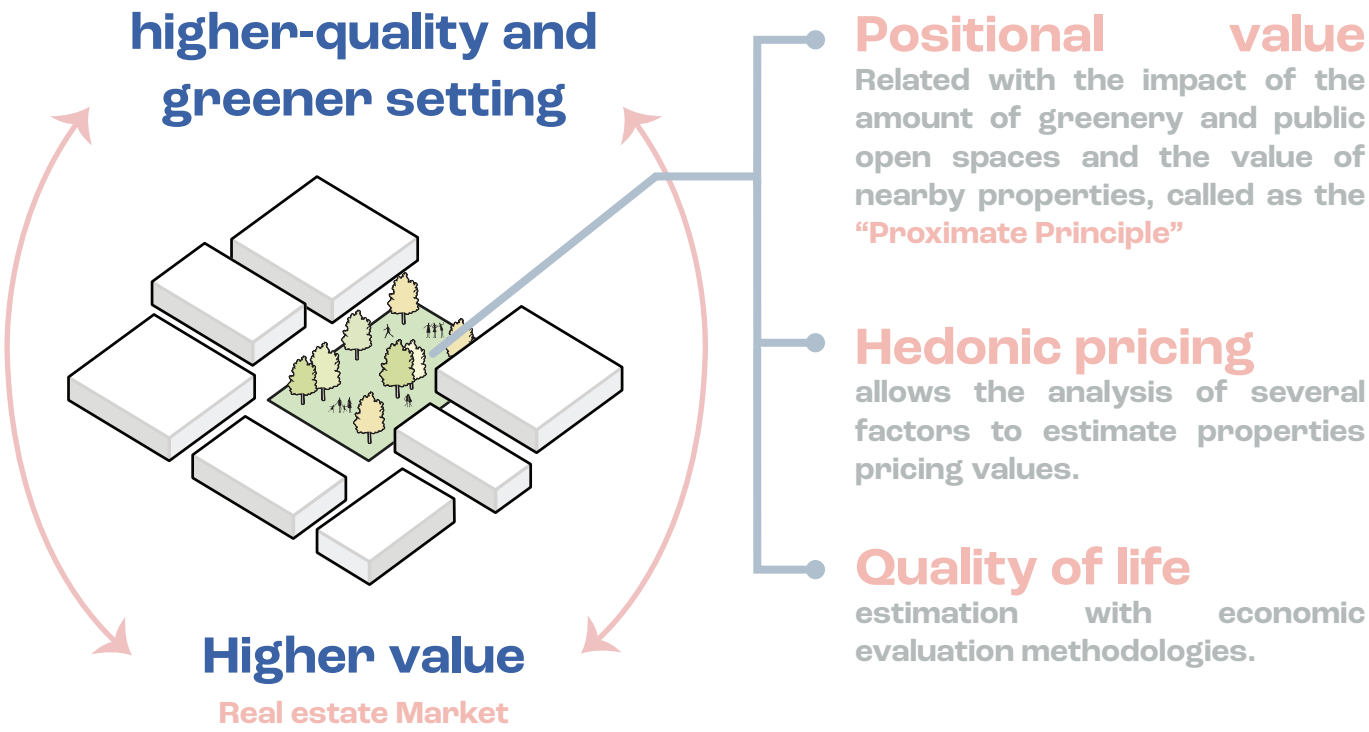


Fig. 12: Relation of the green spaces and the real estate price values. Made by the author based on economic evaluation methodologies (Rosen, 1974; Crompton, 2001; D'Acci, 2018)

03| Case Studies

03.1 Kids' City Christianshavn (Børnebyen Christianshavn):

COBE + NORD Architects

Location: Copenhagen, Denmark
Year: Competition 2012, completed 2017
Area: 4.670 sqm
Status: Built
Tipology: Nursery, daycare, after school club
Property owner: City of Copenhagen

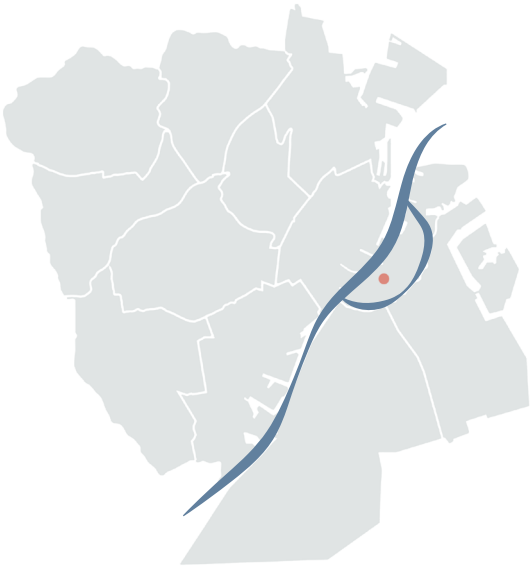


Fig. 13:
Location in Copenhagen. Made by the author based on google maps.

Fig. 14: Kids' City Christianshavn project. (Source: cobe.dk, n.d.)

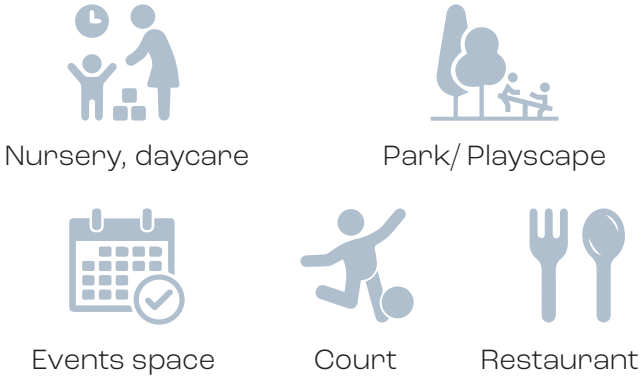
Description:

Kids' City Christianshavn is the largest preschool and youth club in Denmark, hosting 750 children. This facility is designed to be a small city for kids, rather than one big building. This 'new city' is modeled after Copenhagen, with distinct parks, squares, public areas, and houses. Copenahen has different types of citizens with different sets of preferences. Similarly, the Kids' City Christianshavn serves a variety of groups ages with different needs: infants, preschool children, and school children as well as young people. By embracing a city's diversity, the project aims to become the best city in the world for children (cobe.dk, n.d.).

Incorporating diversity in both indoor and outdoor spaces is absolutely essential when designing for a mix of ages, needs, and personalities. The project changes the spatial configuration, with a variety of scale and content. Including both small, secure, and intimate spaces as well as larger and more challenging areas (cobe.dk, n.d.; Furuto, 2012).

Kids interaction among them and with nature:

Program:



Daily life: From 7 to 22. 7/7 days

*assumed by the author

Age range: 0-15 years old. Age groups and specialized areas in the project:

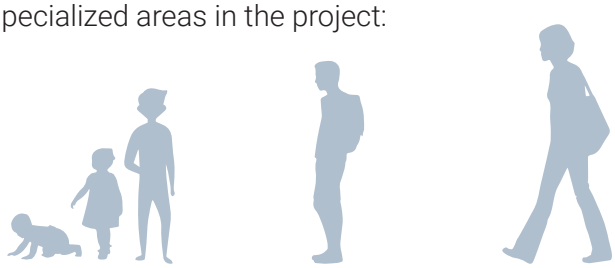


Fig. 15: Kids' City Christianshavn project and park. (Source: cobe.dk, n.d.)

03.2 Shanghai Children's Library:
Ennead

Location: Shanghai, China
Year: Competition 2017
Area: 10.220 sqm
Status: Competition proposal
Tipology: Library
Property owner: City of Shanghai

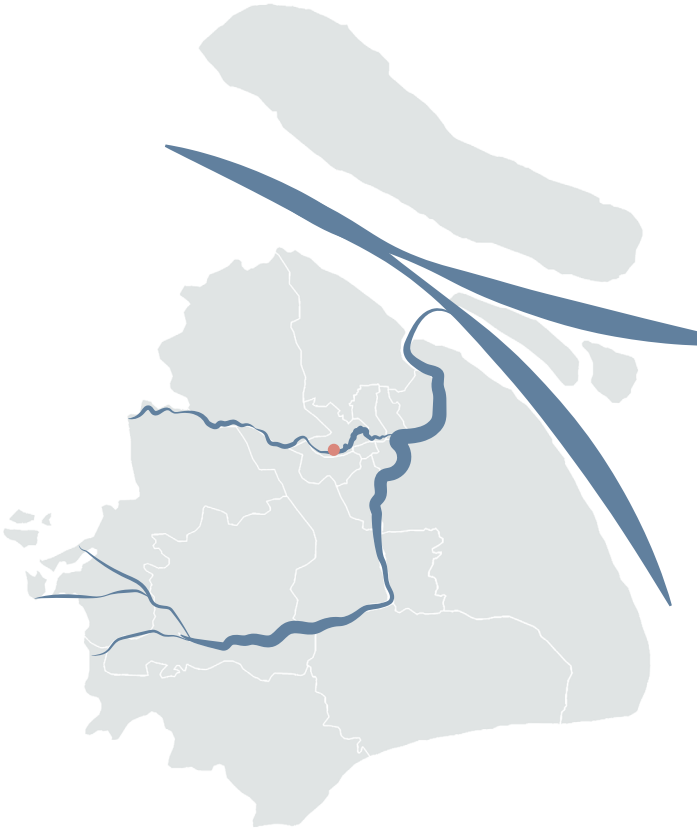


Fig. 16:
Location in Shanghai. Made by the author based on google maps.

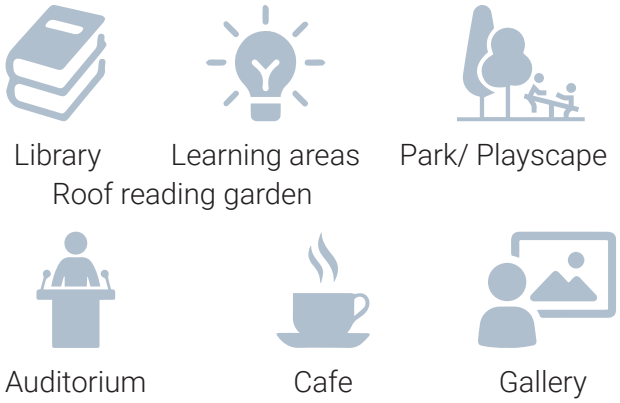
Fig. 17: Shanghai Children's Library. (Source: ennead, n.d.)

Description:

The Shanghai Children's Library is the first part of a wider comprehensive plan to build a creative indoor-outdoor learning environment known as a 'Reading Park' by combining architecture and landscape. The concept maximizes the park's potential as a public place, learning environment, and teaching instrument (ennead, n.d.).

The idea combines architectural and landscape design concepts to produce a holistic approach that mixes indoor and outdoors space, blurring the lines of the typical library to create a Reading Park and a Learning Landscape, resulting in a mutually beneficial outcome. The design's main volume evinces a resemblance to a wooden puzzle. Wood and glazed terracotta panels create different textures as you move around. The green roof serves as a secure outdoor learning terrace. (ennead, n.d.).

Program:



Daily life: From 7 to 22. 7/7 days

*assumed by the author

Age range: 3-15 years old. Age groups and specialized areas in the project:

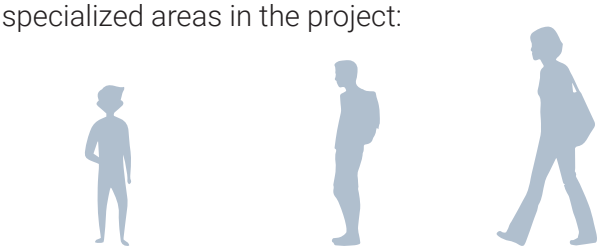
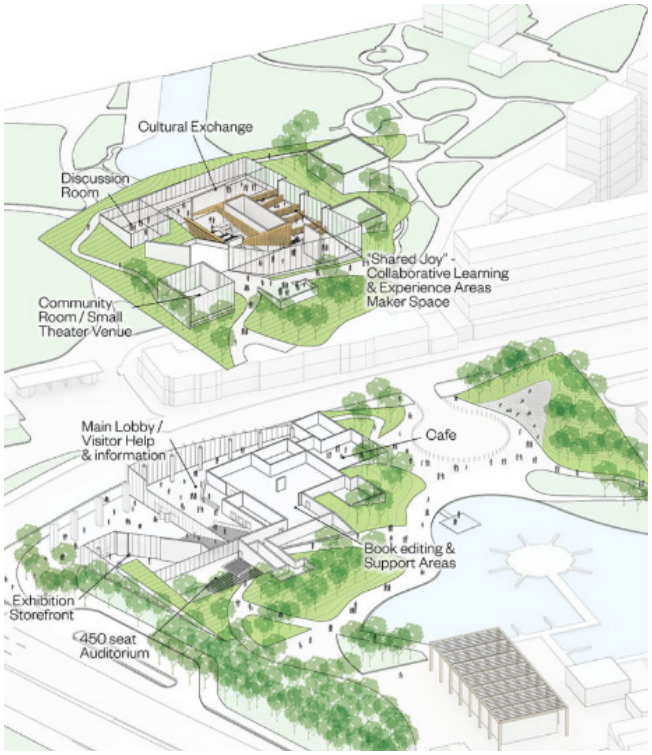


Fig. 18: Shanghai Children's Library. (Source: ennead, n.d.)

Kids interaction among them and with nature:



The design concept is based on the principle of breaking down the overall scale of the structure. This approach facilitates the integration of the building's program with the surrounding landscape. It achieves this by raising the ground plane and employing the 'fifth façade'. It also creates a public porch extending the borders, with shared learning spaces and connecting with the park. A a children's library of the 21st century must provide a range of opportunities and spaces for diverse learning methods. It is crucial for libraries to adapt and evolve to meet the changing needs. Libraries must not only provide access to traditional resources but must be flexible, offering spaces for large groups, individual learning, reading and writing, active play, and workshops (ennead, n.d.).

Fig. 19: Shanghai Children's Library. (Source: ennead, n.d.)

03.3 VAC-Library:
Farming Architects

Location: Duong Noi, Hanoi, Vietnam
Year: 2018
Area: 100 sqm
Status: Built
Tipology: Library
Property owner: City of Hanoi

Fig. 20:
Location in Hanoi. Made by the author based on google maps.

Fig. 21: VAC Library. (Source: ArchDaily, 2019)

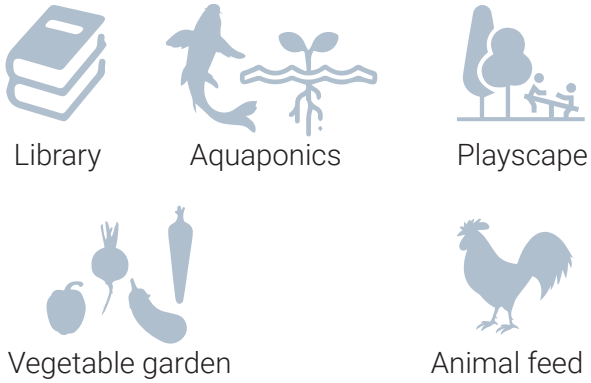
Description:

The VAC Library project is a large wooden climbing frame that employs solar-powered aquaponics to cultivate vegetables, and maintain koi carp, and chickens in Hanoi, Vietnam. Farming Architects designed a hybrid of a library and city farm as a pedagogical tool for children to learn about self-sustaining operations. The goal is not only to demonstrate effective utilization of natural resources, but also to facilitate experimentation with diverse plant and animal species within an urban context (ArchDaily, 2019).

The fundamental aspect of the VAC design is the aquaponics system, which integrates conventional aquaculture (the raising of aquatic animals) with hydroponics (the cultivation of plants in water) within a symbiotic environment (ArchDaily, 2019).

Kids interaction among them and with nature:

Program:



Daily life: From 9 to 18. 7/7 days

*assumed by the author

Age range: 0-10 years old.

Toddler, preschool (0-6)
School age (6-10)

Fig. 22: VAC Library Library. (Source: ArchDaily, 2019)

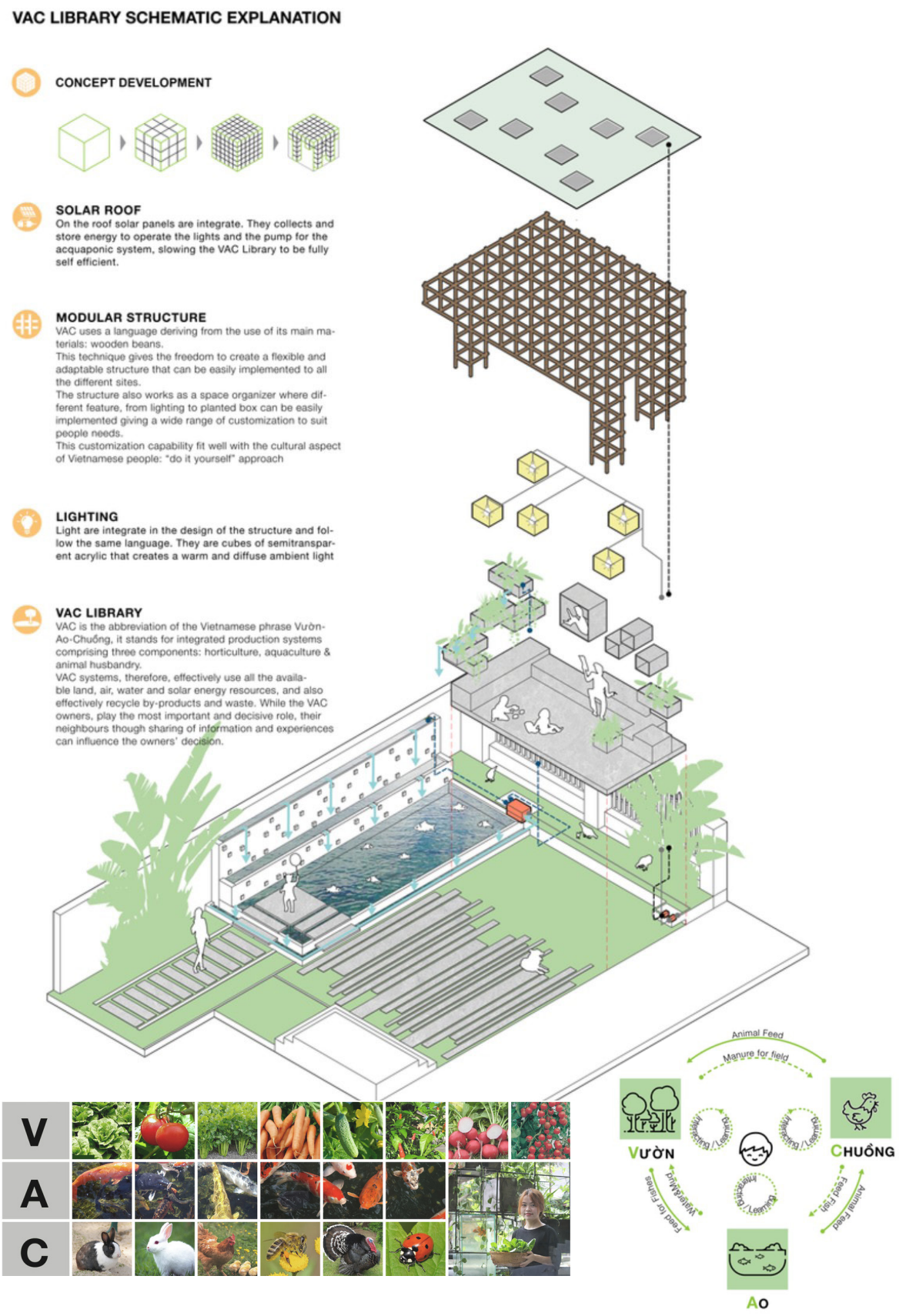


Fig. 23: VAC Library Library. (Source: ArchDaily, 2019)

03.4 Farming Kindergarten:
VTN Architects

Location: Biên Hòa, Dong Nai, Vietnam.
Year: 2013
Area: 3800 sqm
Status: Built
Tipology: Kindergarten
Property owner: City of Biên Hòa.

Fig. 24: Location in Biên Hòa. Made by the author based on google maps.

Fig. 25: Farming Kindergarten. (Source: ArchDaily, 2014)

Description:

The goal of the Farming Kindergarten project is to address the issue of rapid urbanization, which deprives Vietnamese children of green spaces and playgrounds, and has led to a lack of contact with the natural environment. The impact of climate change, including increased droughts, floods, and salinization, has resulted in food security concerns. The rising number of motorbikes has contributed to congestion and air pollution in urban areas.The design is based on the concept of a continuous green roof. A 200m² garden has been planted with five distinct varieties of vegetables, offering an educational experience in agriculture while simultaneously providing food and serving as an extensive playground. The green roof has a triple-ring shape which encircles three courtyards creating safe inner playgrounds. It has a slope that guarantees easy access (ArchDaily, 2014).

Program:

Learning areas

Vegetable garden and agriculture education.

Daily life: From 8 to 18. 5/7 days

*assumed by the author

Age range: 3-6 years old.

Preschool (3-6)

Kids interaction among them and with nature:

Fig. 26: Farming Kindergarten. (Source: ArchDaily, 2014)

03.5 Case Studies Comparative research:

By Size:

VAC-Library
100 sqm.

Farming Kindergarten
3.800 sqm.

Kids' City
4.670 sqm.

Shanghai Children's Library
10.220 sqm.

By program:

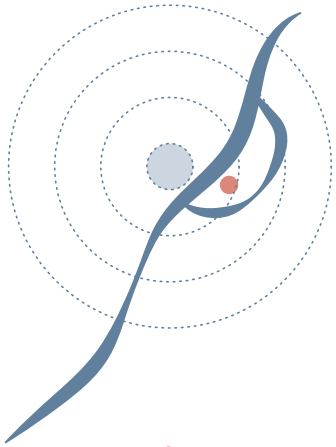
	Nursery and daycare	Park or Playscape	Events space or Auditorium	Court	Restaurant or cafe	Library	Learning areas	Gallery	Aquaponics and animal feed	Vegetable garden
Kids' City Christianshavn	✓	✓	✓	✓	✓					
Shanghai Children's Library			✓		✓	✓	✓	✓		
VAC-Library		✓				✓			✓	✓
Farming Kindergarten							✓			✓

Location from the city center:

City Center

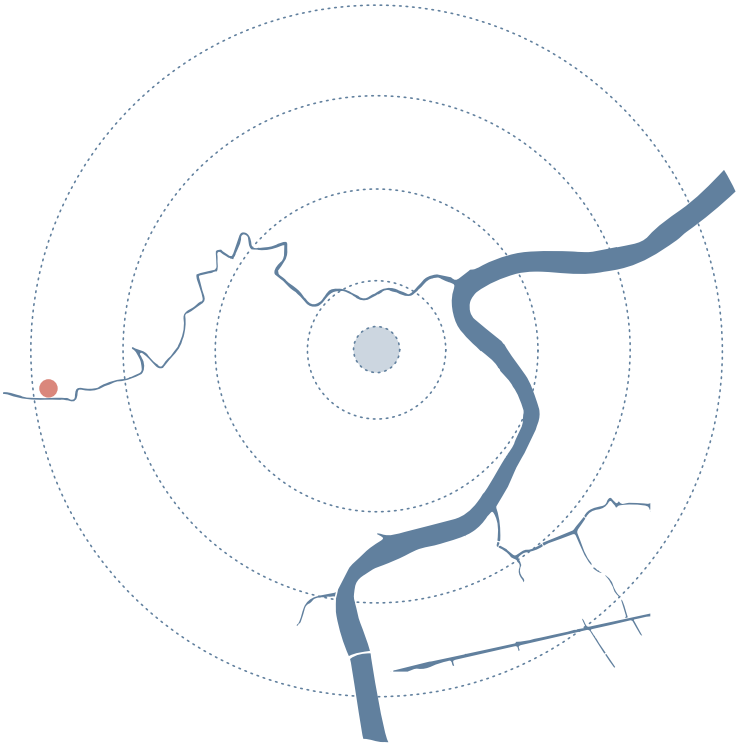
Project location

Water



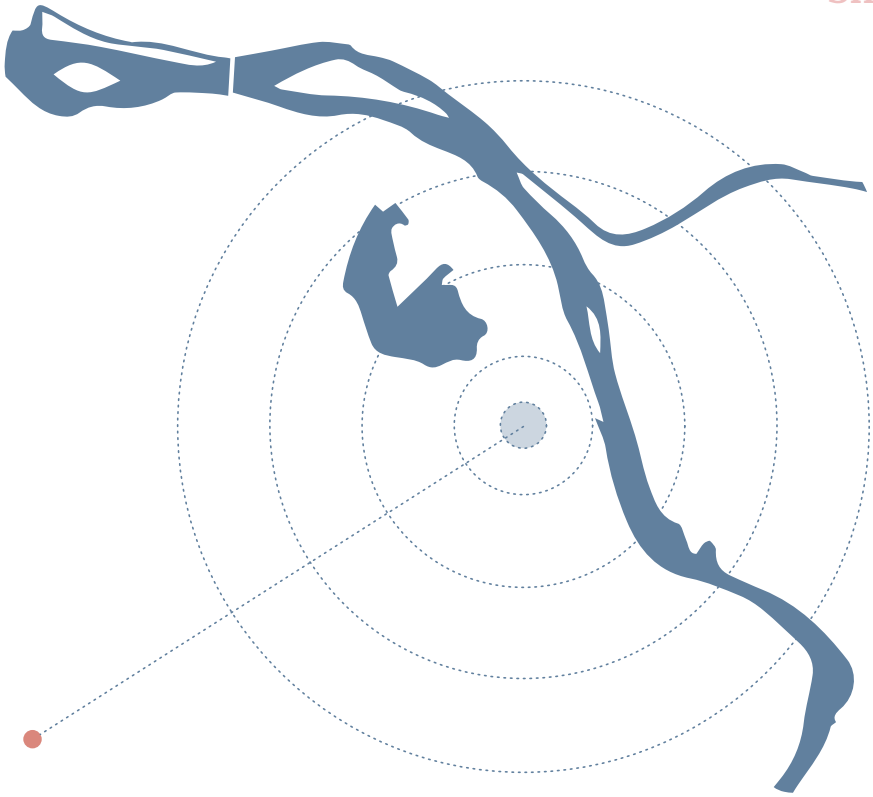
Kids' City Christianshavn

> 1 Km.



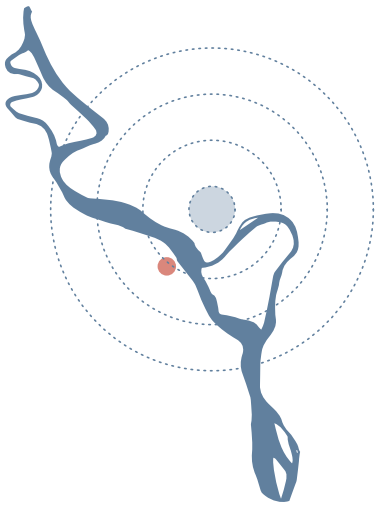
Shanghai Children's Library

>7 Km.



VAC-Library

> 12 Km.



Farming Kindergarten

1 km.

04| Lessons Learned

Numerous factors influence a child's future and development. Among them, the living environment has an important influence in determining their mental and physical health, behavior, growth, and well-being, and those factors will be reflected in their adult life. Regular activities like walking, cycling, and playing can encourage physical activity from childhood (Fig. 27). Contrarily, of a lack of open and green spaces and bad environmental conditions, such as pollution and excessive traffic. Those are direct barriers for kids to go outside their houses, have contact with nature, for participating in physical exercise or play activities, and in increasing their social interactions.

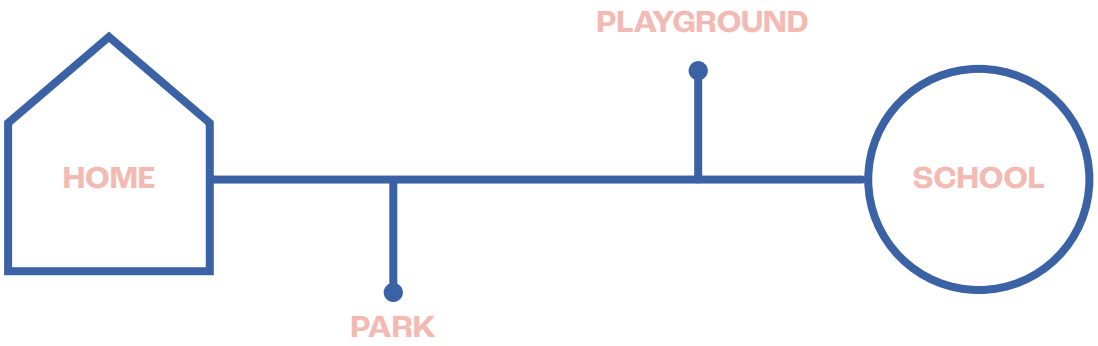
All children's landscapes, including their homes, kindergartens, schools, classrooms, libraries, museums, parks, and playgrounds, among others, should be able to satisfy their social and environmental needs. Every stage of children's development is taken into account in a child-friendly city. Children in arms require constant vigilance and care, however, as they begin to walk, their curiosity and desire for exploration grow, and as they gain independence, their way of relating to the city changes. Furthermore, the closeness of the facilities and green areas also becomes important at this point, because it is preferred that they be reachable by foot.

Fig. 27: Health benefits from being in touch with nature and access to playspaces. Made by the author.

Several projects have introduced nature and biophilic elements into children's landscapes. Proving that children's-nature connection can be achieved into the city and promoted by it. The Kids' City Christianshavn project targeted kids from age 0 to 15 having a preschool and a youth club. This project presents the school as a city itself in a kids scale, simulating spontaneous diversity and highlighting natural forms and resources (Russo and Andreucci, 2023). Shanghai Children's Library, targets children between 3 to 15 years old and it creates an environment to learn and explore without the boundaries among indoor and outdoor spaces; embracing the concept of a "reading park" (ennead, n.d.). The VAC Library, is a space where kids from 0 to 10 years old can connect with nature as long as they potentiate their learning abilities, recognizing agriculture, farming and animal affinity as an important resources for their integral development; they incorporate the biophilic elements such as the use of light to integrate the design, the wooden materials and modular structure that allowed kids to interact with the whole infrastructure (ArchDaily, 2019). Finally, the Farming Kindergarten in Vietnam, uses the roof of the infrastructure to create a continuous green space to promote food sustainability through agricultural practices. All these cases of study show that by embracing direct and indirect human bond with nature would improve not only the correct children's development and learning and curiosity ability but also would have a positive impact in the community aligned by the Sustainable Development Goals (Russo and Andreucci, 2023). These will be reflected, for example, in the integration of ecosystems and biodiversity into local planning, enhancing adaptive capabilities and resilience to climate and natural disasters, and fostering greater public awareness of sustainable development that promotes harmony with nature, among other benefits (Russo and Andreucci, 2023). Corroborating the hypothesis that a city designed for children is a city for everyone.

As a result of my research, I identified that there's a need for achieving Biophilic Child-Friendly Cities and Buildings. With this strategy, cities will be developed in a way that makes its population feel safe, healthy, alive, and it will be sustainable. Moreover, the inclusion of all the community will be guaranteed and the interactions will increase. The biophilic design integrates and connects humans with nature. Having a holistic approach with an environmentally sustainable design method and a child-friendly city perspective, the sustainable principles can be obtained in a more human-centered way. This model seeks for an inclusive society, where all kinds of users will acquire the benefits (Fig. 28).

Current situation



Biophilic Child- Friendly City

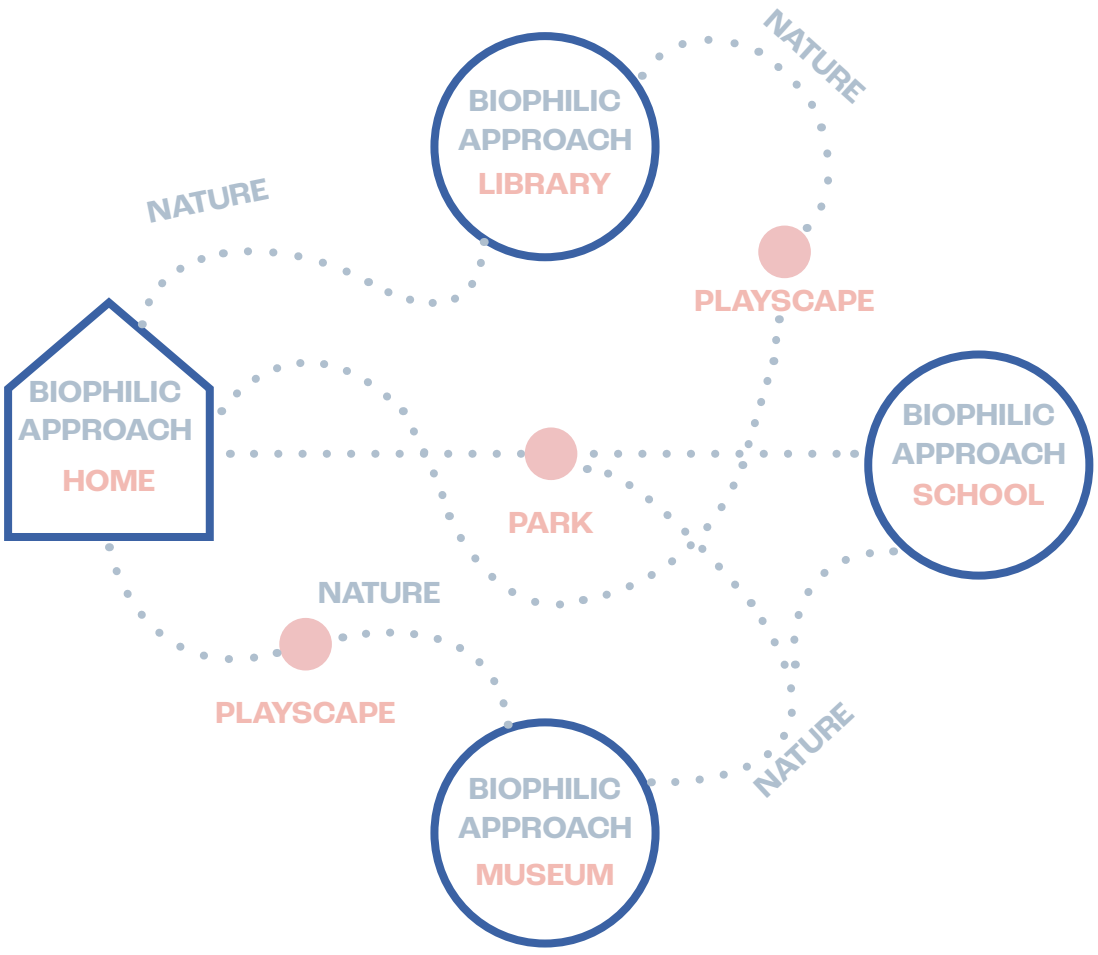


Fig. 28: Current Situation vs Biophilic Child-Friendly city outcome. Made by the author.

05| Project development

There are several promising research studies, on interdisciplinary areas of knowledge, that help us to understand better the connection between children and nature and their social relationships and interactions. By reviewing the state-of-the-art and analyzing the study cases, the present thesis provides a starting point for further research that is focused on children's urban landscapes with a nature-based approach.

The thesis attempts to address the issues and concerns discussed by proposing children's urban landscapes for the Italian city of Turin, that strengthen children's relationships with nature while promoting social interaction and reduction of exclusion among them, with 'play' taking a key role in both goals. Children will be the main target of this intervention, but as was already indicated, the entire community's quality of life is anticipated to improve, as the population's health and well-being are also enhanced by biophilic and nature-based architecture.

My proposal will present a general analysis of Turin, green areas, urban landscapes focused on children's, libraries, and bike lanes, to identify the current general status that allows me to determine a suitable location for the planned intervention. In this way, it would be possible to propose a project that will benefit the growth of the city, following the aims presented in this thesis.

Fig. 29: Turin. Photo taken by the author on October 10 /2021.

05.1 What and why?

A Public Children's Library that goes beyond books and enhances the connection with nature.

Even though schools are primary sources of education and social development, as presented in this report, the urban planning of learning landscapes besides schools, such as libraries and museums are quite important for children's learning process. The value of these locations lies in their capacity to provide free learning spaces. With a Biophilic design approach these spaces generate an environment of relaxation that increases their learning capabilities. Furthermore, the research demonstrates the opportunities that these spaces offer if the design takes into account the relationship among social interaction, natural resources, and children's development.

In this sense, libraries set up an environment of new discoveries, learning and enlarge social interactions giving a sense of community. A shift in perspective is required to recognize the potential of libraries. Rather than viewing libraries as repositories of books, it is necessary to consider their capacity to function as forums for the exchange of ideas and the acquisition of collective insights. This change of perspective has the potential to significantly contribute to the advancement of personal and collective growth and development. Combining them with a Biophilic design approach these spaces generate an environment of relaxation that enhances the capacity for learning while addressing the aforementioned contemporary global issues.

The project will apply diverse models to achieve the mentioned goals. Using the four spaces of the public library model the library will achieve the goal of experience, involvement, empowerment and innovation (Jochumsen, Hvenegaard Rasmussen and Skot-Hansen, 2012) (Fig. 30). Additionally, my proposal is founded on the intrinsic relationship between biophilic design features and their connection to the human senses (Fig. 31). Aiming to increase the evolved human-nature relationship, that according to Kellert, Heerwagen and Mador, (2008) are the principal aspects of the inherent human relationship with nature. The combination of order, change, security, and the emotional responses

Libraries set up an environment of new discoveries, learning and enlarge social interactions giving a sense of community.

evoked by these interactions, such as refuge, affection, spirituality and attachment change the perception of the space that leads to an increase of curiosity, cognition and discovery (Fig. 32). The goal is to create spaces and environments that evoke emotions and cater to human needs.

The goal is to create spaces and environments that evoke emotions and cater to human needs.

To reinforce the association between biophilic concepts and architecture, particularly in libraries, I adopted the approach of architect Rosan Bosch. I analyzed the learning principles she emphasizes (Figs. 33 and 34) and connected them with the aforementioned features (Fig. 35 and 36). Additionally, I made an analysis of the users, their different skills and needs, because it is important to consider that this target group is not homogeneous. This methodology enabled me to design a child-friendly library that not only considers learning environments but also facilitates emotional engagement and the innate human need to connect with nature.

Particularly, for the city of Turin, as it is analyzed further on the document, the urban integration plan (Città di Torino, 2022) includes the investment on libraries as a social urban infrastructure to promote: culture, accessibility, inclusion and participation. They advocate for the use of innovative infrastructures improving the quality of the green areas and open public spaces. To enhance social participation, inclusion, territorial reach, and to create environments for learning, sports, and cultural activities. To select the optimal area of the city, where the proposal could take place, an analysis of the children's distribution by age was performed. This evaluation was accompanied with the green area distribution, as well as the main transportation routes and the location of libraries around the city. Through this method, a zone located in the western region with sparse green areas, limited urban growth and a high portion of families and children was selected.

05.2 Models

The four spaces of the public library

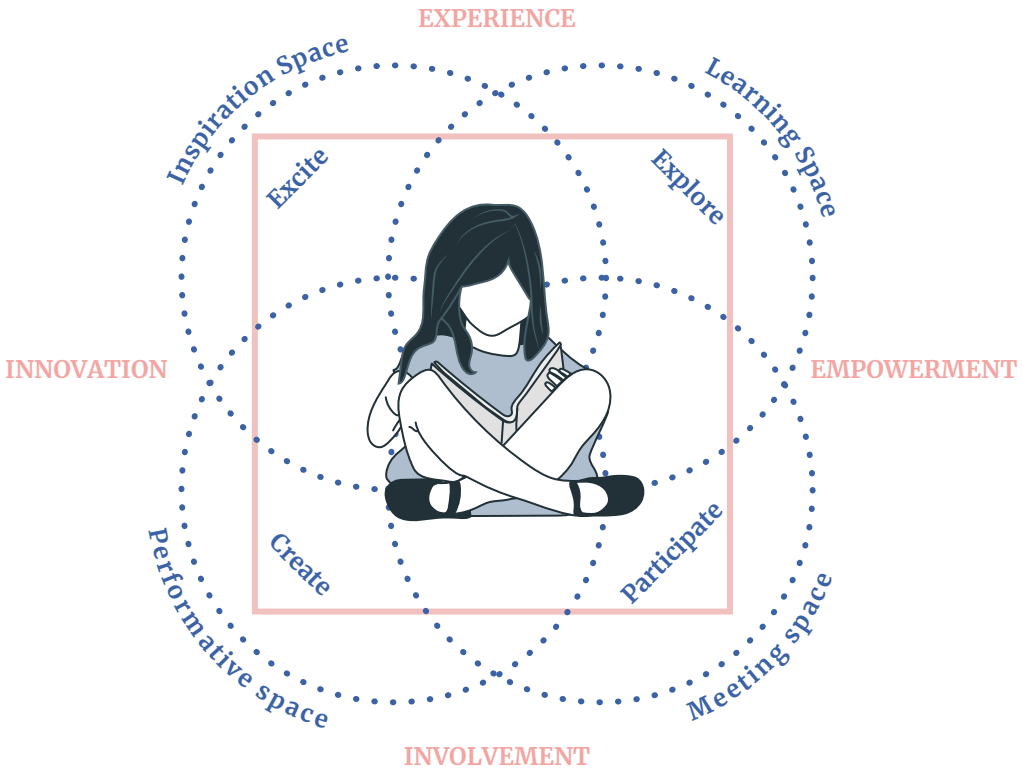


Fig. 30: The four spaces of the public library based on Jochumsen, Hvenegaard Rasmussen and Skot-Hansen model (2012).

The four spaces are not necessarily physical spaces, but rather conceptual spaces that can exist in both physical libraries and digital places. The model encourages libraries to integrate these spaces through their architecture to create a dynamic, multifaceted environment that supports inspiration, learning, gathering, and performance, thereby enhancing the library's role in the community (Jochumsen, Hvenegaard Rasmussen and Skot-Hansen, 2012).

The **Inspiration Space** is designed to provide transformative experiences that go beyond conventional choices and encourage exploration through diverse aesthetic encounters and meaningful experiences. The **Learning Space** is focused on fostering learning through free access to information and knowledge. It adapts to the evolving needs of users, especially children who prefer playful and interactive learning methods. The **Meeting Space** serves as a public, communal area where people can interact, engage in discussions, and encounter diverse perspectives. The **Performative Space** emphasizes user involvement and creativity, providing tools and platforms for human expression and artistic and cultural development (Jochumsen, Hvenegaard Rasmussen and Skot-Hansen, 2012).

Biophilic design

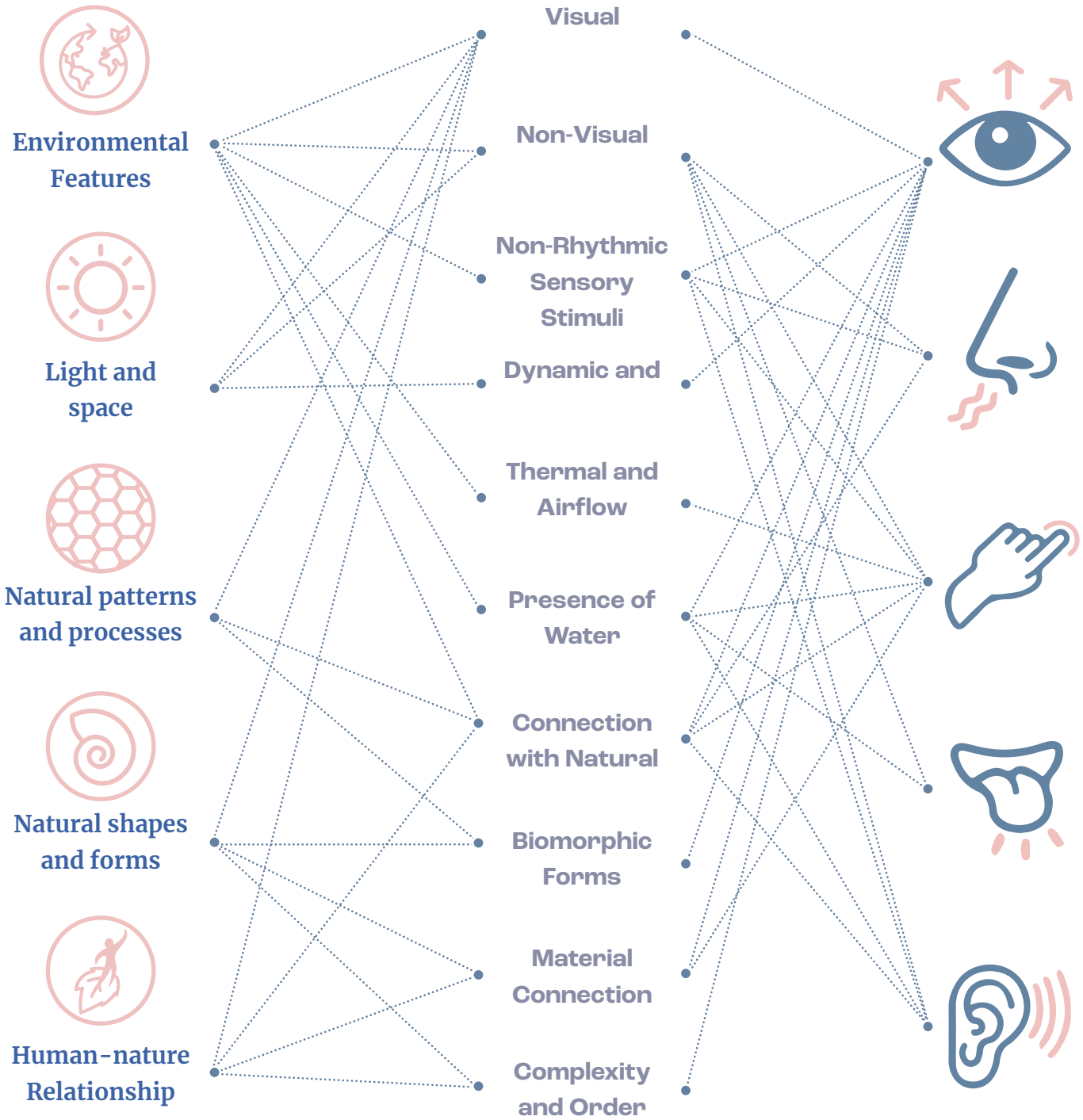


Fig. 31: Biophilic design atributes, patterns and sensory stimulation. Made by the author based on the state of the art. (Kellert, Heerwagen, and Mador, 2008; Ghaziani, Lemon and Atmodiwirjo, 2021)

Human-nature Relationship

Human-nature Relationship

The focus of this design element is on the fundamental aspects of the inherent human relationship with nature, which are not just biological affinities (Kellert, Heerwagen and Mador, 2008).

A. Prospect and refuge

Prospect is the evolutionary ability of finding resources and identifying danger. **Refuge** is the secure and protected space, comfortable interiors and secreted places (Kellert, Heerwagen and Mador, 2008).

D. Change and metamorphosis

Change reflect the process of growth maturation and **metamorphosis.** The design of the space should include this dynamic and developmental quality (Kellert, Heerwagen and Mador, 2008).

.

E. Security and protection

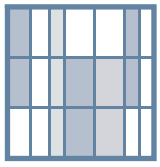
The built environment should ensure **security** and **protection**, safeguarding them from the potential hazards. However, the design should neither isolate individuals or create a barrier between people and nature (Kellert, Heerwagen and Mador, 2008).

H. Attraction and beauty

The **attraction** with nature is innate in humans. It fosters curiosity, imagination, creativity, exploration and problem solving. An appreciation for the **beauty** of the natural elements and processes is present in successful urban landscapes (Kellert, Heerwagen and Mador, 2008).

I. Exploration and discovery

Spaces that increase opportunities for **exploration** and **discovery** are places that enhance intellectual stimulation, interest, and appreciation of natural information (Kellert, Heerwagen and Mador, 2008).

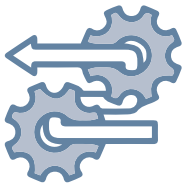


B. Order and complexity

Order imposes structure and is found in the build or natural environment. **Contrast** is focused on the detail and the variability. A correct combination of both results in stimulating spaces (Kellert, Heerwagen and Mador, 2008).

C. Curiosity and enticement

Curiosity is the innate human desire for exploration and exploration. **Enticement** fosters curiosity. Combined these characteristics increase human intellect and imagination (Kellert, Heerwagen and Mador, 2008).



F. Mastery and control

The constructed environment is a reflection of human nature's desire for **mastery** and **control**. By increasing respect for the environment and fostering abilities, it is possible to enhance human self-confidence in a responsible way (Kellert, Heerwagen and Mador, 2008).

G. Affection and attachment

Affection for the natural environment has the effect of enhancing human capacity to bond and form **attachments**. The strengthening of this characteristic through the development of strong emotional affinities with nature will result in the creation of enduring spaces (Kellert, Heerwagen and Mador, 2008).

J. Information and cognition

Nature is the greatest source of **information**. The direct and indirect experience promotes critical thinking and problem solving and develops **cognition**. It can be fostered through the understanding of nature's forms and shapes (Kellert, Heerwagen and Mador, 2008).

K. Reverence and spirituality

The design should evoke feelings of transcendence. It should be able to evoke feelings of **reverence** and **spirituality** (Kellert, Heerwagen and Mador, 2008).

Fig. 32: Biophilic design Human-Nature Relationship. Made by the author based on Kellert, Heerwagen, and Mador (2008) research.

Rosan Bosch's approach

Rosan Bosch is well known worldwide for her work as founder and creative director of Rosan Bosch Studio. Her inspiring viewpoints and ideas have made her a valuable reference in the architecture and design field, in particular of learning environments. Her projects are distinguished by their visual appeal, dynamism, flexibility, playfulness and color. She designs spaces with a thoughtful user experience that encourages learning and creativity in libraries, educational settings, and other institutions (Bosch, n.d.; Hernández Muñoz and López Alonso, 2023).

Additionally, she fosters the creation of spaces that not only meet the functional needs but also inspire and motivate users. Moreover, her projects facilitate social integration and interaction through collaborative work, fostering encounters and offering opportunities for play. They also facilitate the development of other skills, such as addressing groups, debate, and expressing own opinions (Bosch, n.d.).

> "The children get a space for active learning where they can play, run and sing while exploring the wonders of children's literature and culture".
>
> – Bosch (n.d.)

Libraries have traditionally served as a space free of noise and disturbances. However, the development of technology has facilitated the access of information and knowledge. This evolution calls for a reevaluation of the role of public spaces and the transformation of libraries to meet the current demands and serve as community meeting places (Bosch, n.d.). According to Bosch (n.d.) "libraries are places where the children get a space for active learning where they can play, run and sing while exploring the wonders of children's literature and culture".

Rosan Bosch learning principles (Bosch, n.d.)

Mountain Top | Cave | Campfire | Watering Hole | Hands-on | Movement

Mountain Top

A space where an individual can address a gathering situation.

The Mountain Top is a learning environment that creates a forum where people can speak to a group and share their ideas, opinions, and knowledge. The role of the 'educator' is assumed by the speaker (Bosch, n.d.).

Movement

Movement as a natural part of all spaces.

Movement is integrated into the design as a natural and integral part of the space experience. Regardless of a person's personality, movement has a crucial role in enhancing cognitive abilities and dynamizing the learning process. The outcome is the creation of learning environments that are active and participatory, and that uses other forms of learning, such as movement and play (Bosch, n.d.).

Campfire

A space for group-based learning situations.

The Campfire is a learning environment that provides a setting for collaborative learning. It enhances the ability to communicate and cooperate with others building their overall teamwork capabilities (Bosch, n.d.).

Fig. 33: Part 1. The six Bosch learning principles related to work carried out in her studio (Bosch, n.d.; Hernández and López, 2023).

Cave

A space for concentration and introspection.

The Cave is a compact and clearly designated area for one or two students. They are characterized by a sense of tranquility. Despite being situated away from more active areas, they are not isolated (Bosch, n.d.). Is an essential place that offers the occasion for individual reading and reflection (Hernández Muñoz and López Alonso, 2023).

Watering Hole

Informal meeting spaces where users encounter unexpected ideas.

The Watering Hole is a place to relax and share informal knowledge and experiences. They are mainly located in informal meeting places that are frequented by a considerable number of passersby. Users expand their skills, encounter unexpected ideas and knowledge that inspire and motivate them (Bosch, n.d.; Hernández Muñoz and López Alonso, 2023).

Hands-on

A space that enriches communication

Hands-on is the space for group collaboration and construction, where workshops take place (Hernández Muñoz and López Alonso, 2023). It enriches communication beyond words, facilitating a bridge among theory and practice, integrating mind and body, and fostering creativity and insight (Bosch, n.d.).

Fig. 34: Part 2. The six Bosch learning principles related to work carried out in her studio. (Bosch, n.d.; Hernández and López, 2023).

05.3 Interconnection of models. Rosan Bosch's approach association with biophilic design Human-Nature Relationship

In analyzing the six Bosch learning principles, I draw some parallels to the biophilic relationship between humans and nature. I illustrate it in the following scheme:

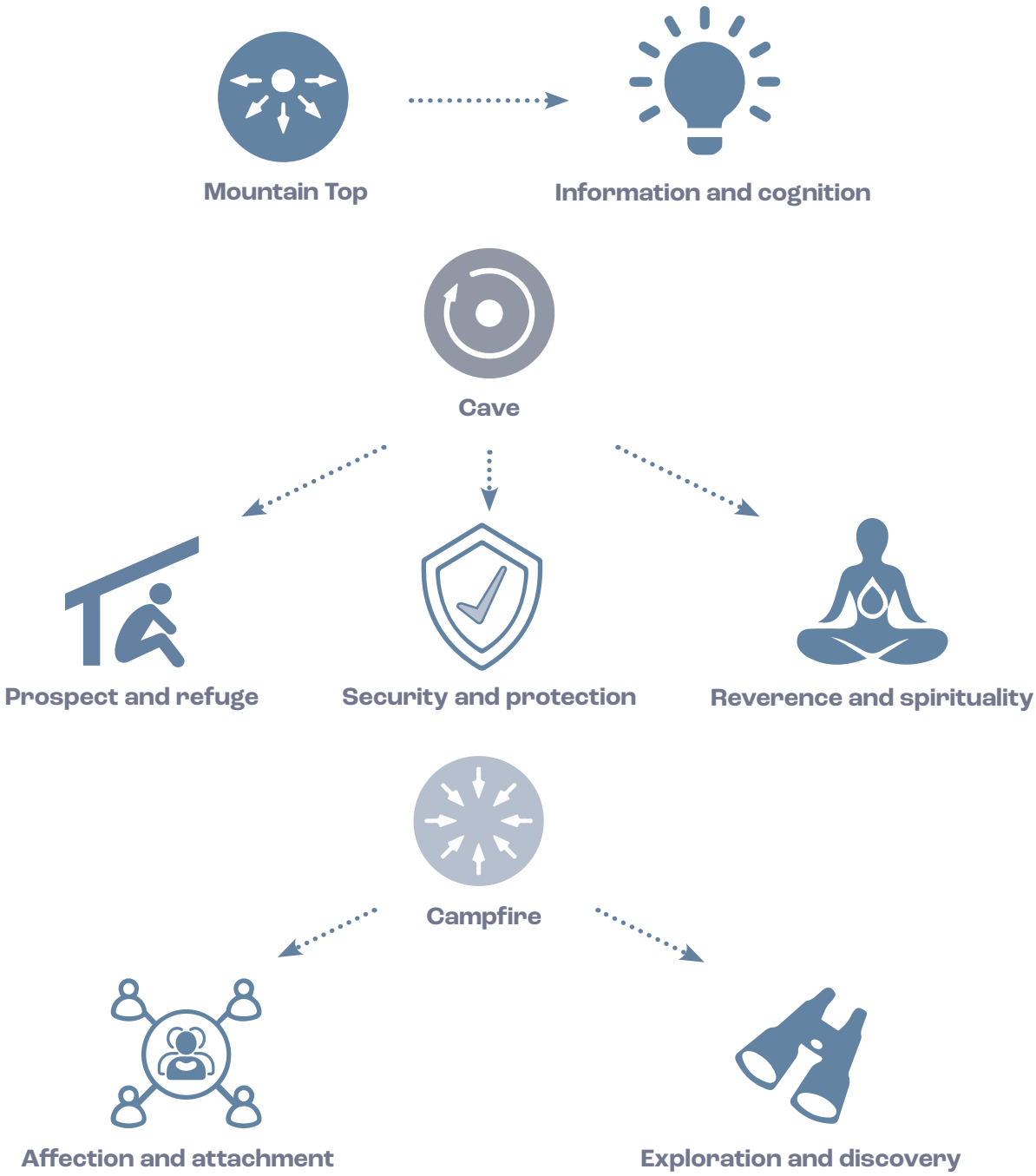


Fig. 35: Part 1. Rosan Bosch's approach association with Biophilic design Human-Nature Relationship. Made by the author based on the state of the art. (Kellert, Heerwagen, and Mador, 2008; Bosch, n.d.)

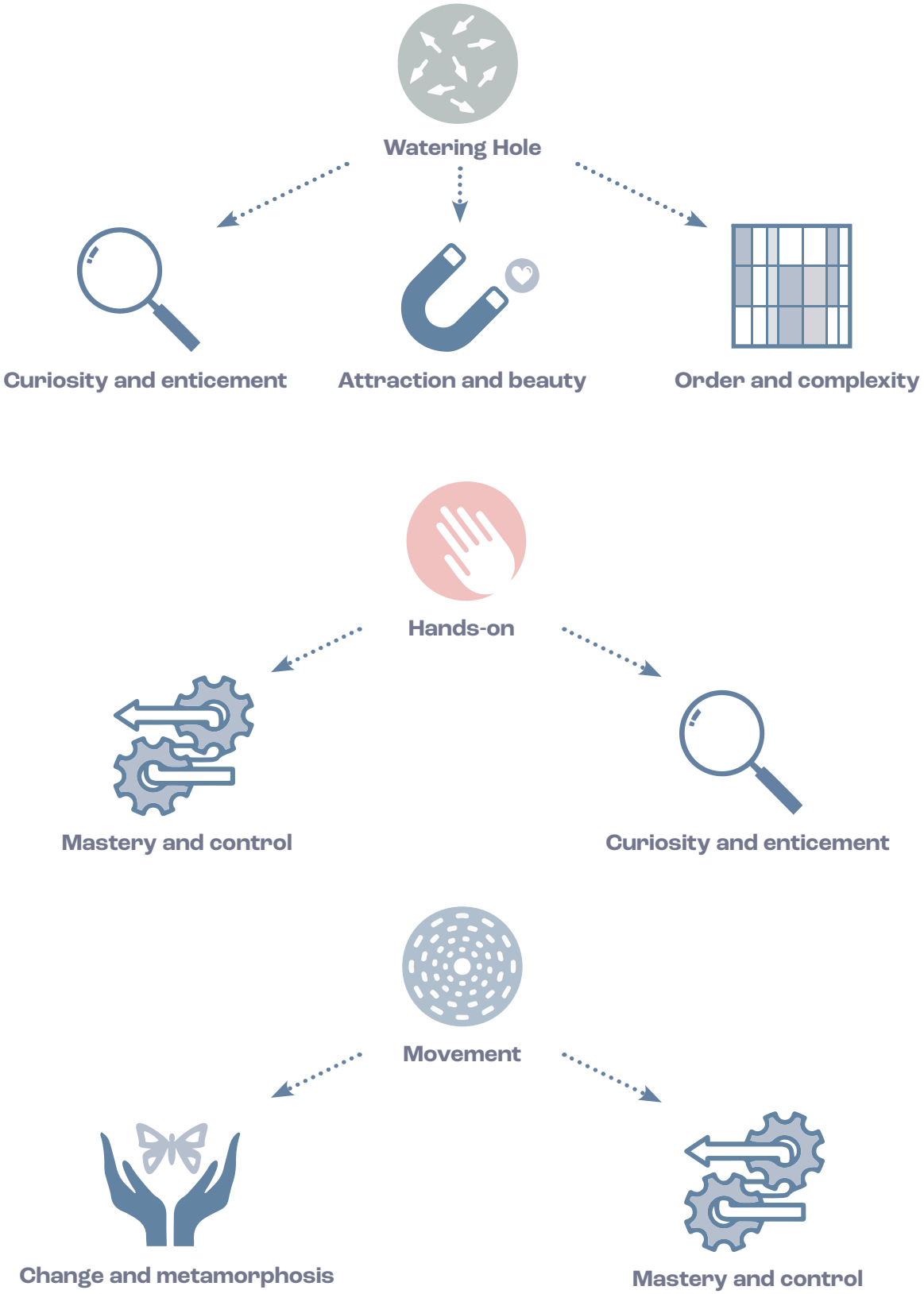


Fig. 36: Part 2. Rosan Bosch's approach association with Biophilic design Human-Nature Relationship. Made by the author based on the state of the art. (Kellert, Heerwagen, and Mador, 2008; Bosch, n.d.)

05.4 User's profiles and needs

Toddler age

1-3 years old

Socialization and developing creativity

	1 year	2 years	3 years
Motor skills	• Walks with one hand held • Independent steps • Stands well	• Walks Up and down stairs holding rail (Both feet/ step) • Runs well and kicks a ball	• Goes up stairs, alternating feet, no rail • Starts to cut with scissors
Problem Solving	• **Looks at pictures in books** • Lifts box lid to find a toy	• Matches objects to pictures • **Turns pages in book** • Shows use of familiar objects	• Knows own gender and age • Matches letters/numerals • Points to body parts
Social	• Shows objects to parent to share interest • Points to get desired object	• **Parallel play** • Begins to mask emotions for social etiquette.	• **Imaginative play** • Imitates adult activities • **Starts to share**
Language	• Uses several gestures with vocalizing (eg. waving, reaching). Vocalizes to songs	• Uses 50+ words • 50% intelligibility • Refers to self by name	• Uses 200+ words • 75% intelligibility • **Asks to be read to**.

Fig. 37: Summary of developmental Milestones according to Scharf, Scharf and Stroustrup (2016)

Target visiting hours

Saturdays and sundays all day, in the remaining days of the week, in general all day, mainly on the first hours of the afternoons.

Needs

Often requires childcare services or remains in company of a parent or caregiver. Need places to interact with other kids and enhance creativity growth. At this age, it's essential to engage the connections and encourage interactions with nature.

Activities

Daycare

Reading area

Playing areas

Sensory garden

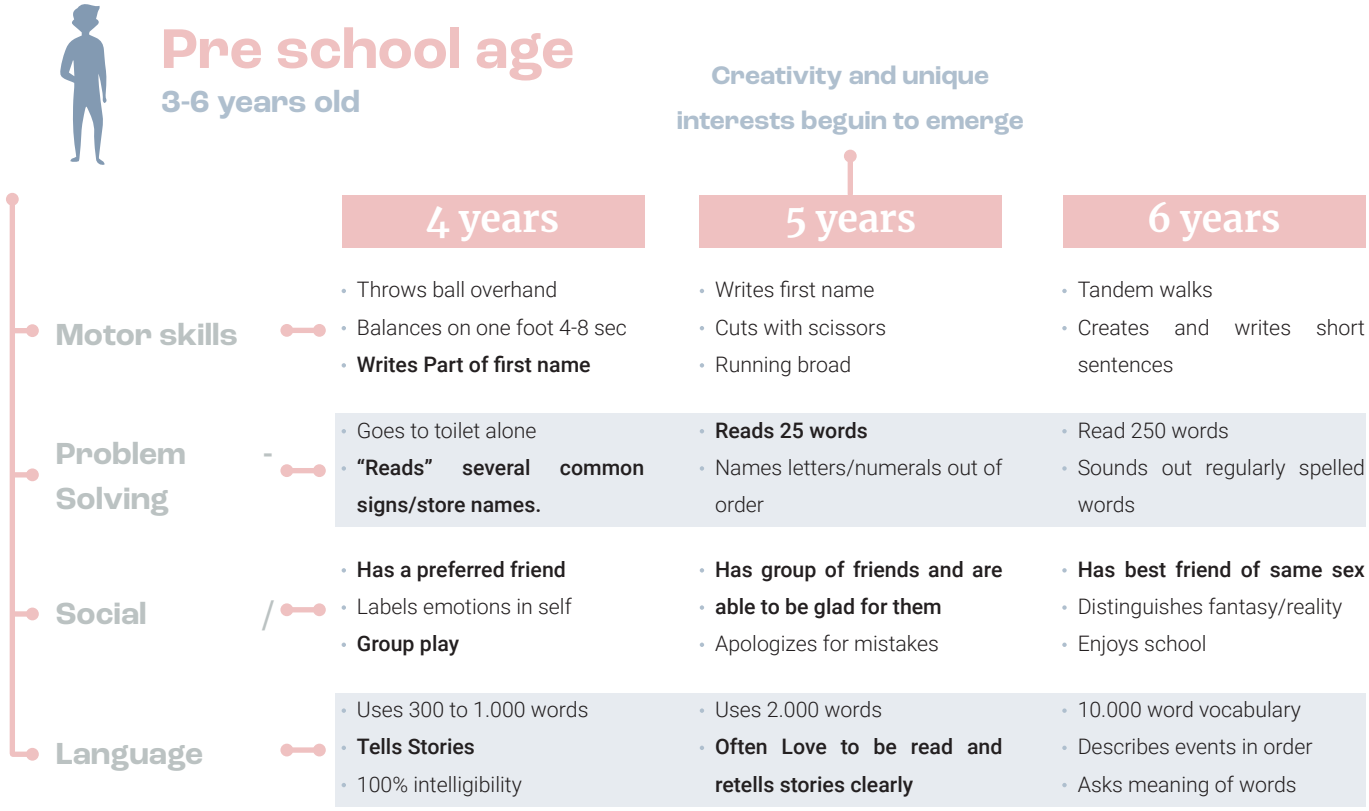


Fig. 38: Summary of developmental Milestones according to Scharf, Scharf and Stroustrup (2016)

Target visiting hours

Saturdays and sundays all day, in the remaining days of the week, during opening hours but mainly on the afternoons.

Needs

Have more independence than a toddler but may need child care or to be with their parent or caregiver. Need places to interact with other kids and develop their social skills, increase their creativity and encourage reading as an habit. At this age, it's important to reinforce their connections with nature.

Activities

Primary School age

6-12 years old

The main focus during the school years is on learning and developing abilities. Children have more advanced motor skills. Many kids can ride a bicycle without training wheels by the time they are 6 years old. The development of fine motor abilities leads to better handwriting and more challenging tasks like drawing and painting (Scharf, Scharf and Stroustrup, 2016).

Children are able to have conversations, give an in-depth narrative of what happened and recount detailed stories. At around age 8 or 9, kids begin reading for educational and learning purposes, which opens them a world of knowledge (Scharf, Scharf and Stroustrup, 2016).

Target visiting hours

Saturdays and sundays all day, in the remaining days of the week, on school trips on the morning but mainly on the afternoons.

Needs

Often requires childcare services or remains in company of a parent or caregiver. Need places to interact with other kids and enhance creativity growth. At this age, it's essential to engage the connections and encourage interactions with nature.

Activities

Reading area

Worksops/ After school Activities

Events

Playing areas

Study room

Playscape

Kids with special needs

Needs

Often requires childcare services or remains in company of a parent or caregiver. Need places to interact with other kids, enhance creativity growth and sensory stimulation. It is important to guarantee the connection with nature and the access to play spaces.

Special Activities

Sensory exploration workshops

Sensory/ therapeutic garden

Parents and Caregivers

Target visiting hours

Parents: Saturdays and sundays all day, in the remaining days of the week, mainly on the afternoons.

Needs

The parents and caregivers bring children to the library, they need places to interact with their kids. Thus, they are interested on the events and the family activities. They need places to relax and places to interact with other parents/ adults and gain community cohesion.
Usually need a reconnection with nature.

Activities


Reading area


Worksops/ Family activities


Events


Cafe


Green areas


Sensory/ therapeutic garden

Librarians and Staff

Needs

They need spaces to organize the resources, and plan library's activities. Could need a cloakroom, a rest room and a meeting room.
Usually need a reconnection with nature.

Activities


Offices


Activities planning


Meetings


Cafe


Green areas


Sensory/ therapeutic garden

05.5 Biophilic Design Solutions - Architectural scale

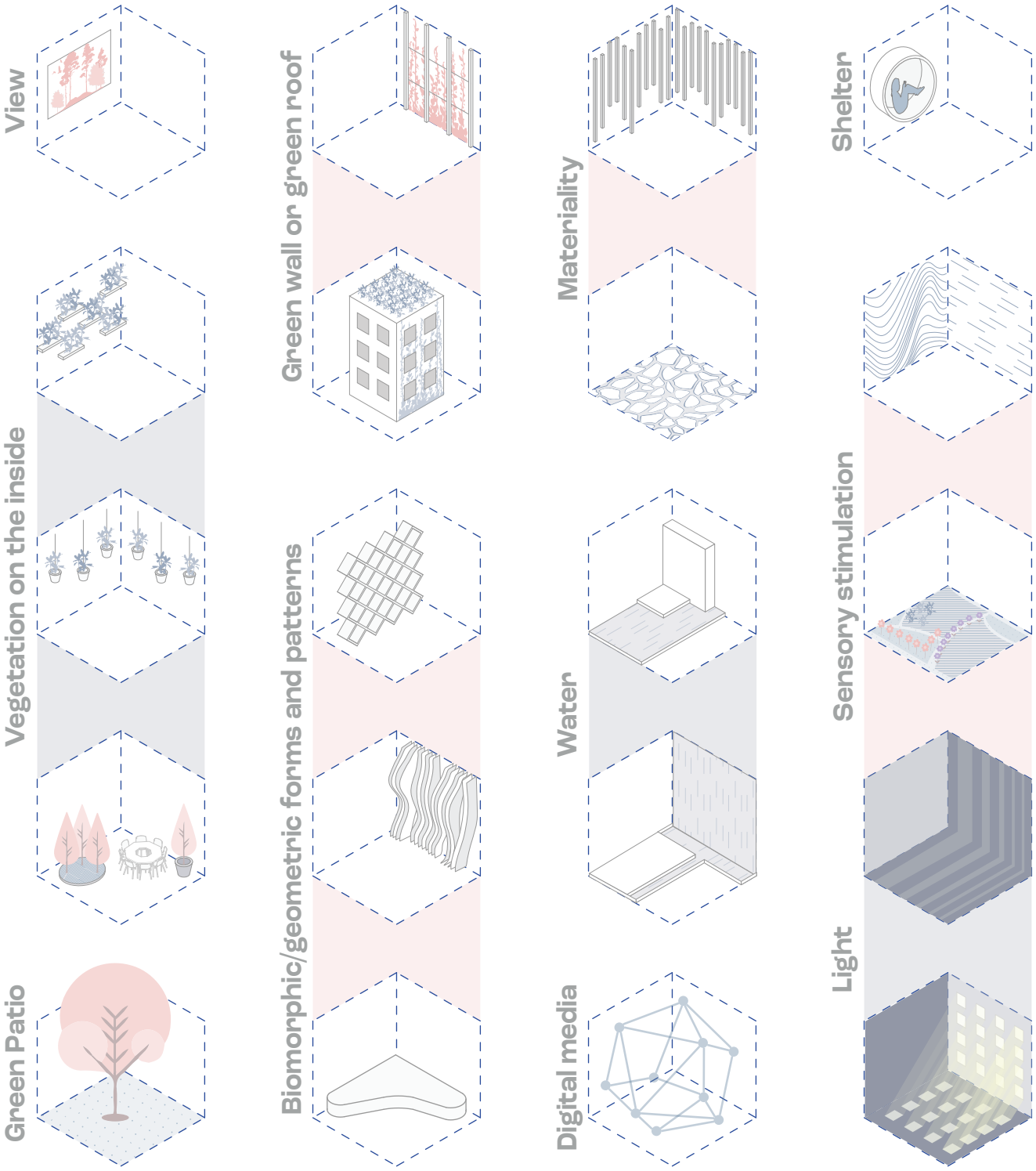


Fig. 39: Biophilic Design Solutions. Made by the author.

Windows with a view of nature

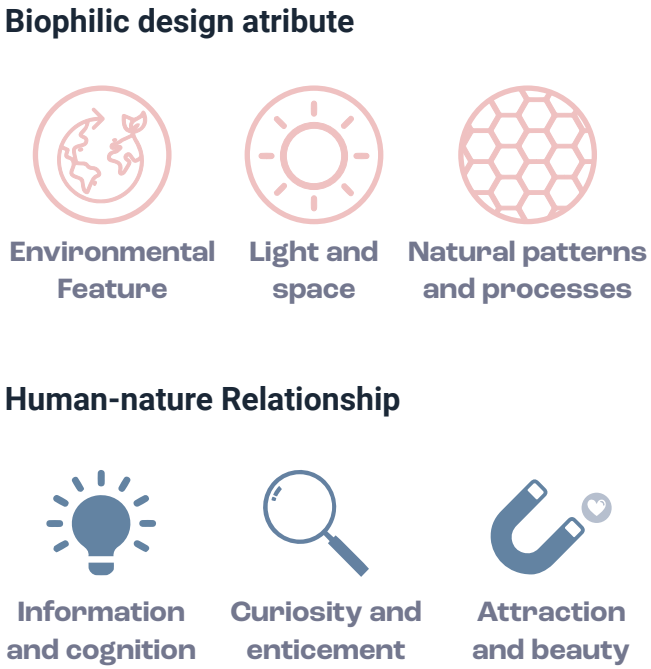
Studies have shown that projects that have windows with views of nature, boost cognitive involvement and concentration (Pedersen Zari and Woodward, 2018). Empirical studies are beginning to show significant associations between the concentration of natural elements and contact with them, even at low levels, such as trees seen through a window. Exposure to small doses of nature functions as a preventive treatment and as a control measure for certain diseases (Kellert, Heerwagen and Mador, 2008).

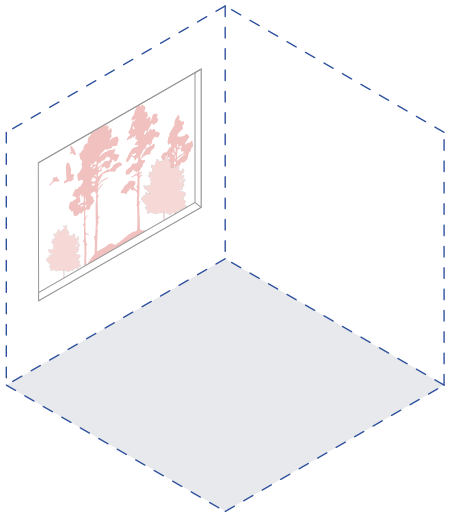
According to Ghaziani, et al. (2021) research, this resource improves human health in the following ways:

Stress Reduction
Reduced heart rate and blood pressure.

Cognitive Performance
Improved cognitive development and concentration.

Emotion, Mood, and Preference
Favorable effects on behavior, icreased happiness, and general well-being.





Some examples on the next page

Fig. 40: Day Nursery and Toy Library / a+samueldelmas architectes (ArchDaily, n.d.).

Fig. 41: CALS Children's Library / Polk Stanley Wilcox Architects (ArchDaily, n.d.).

Interior vegetation

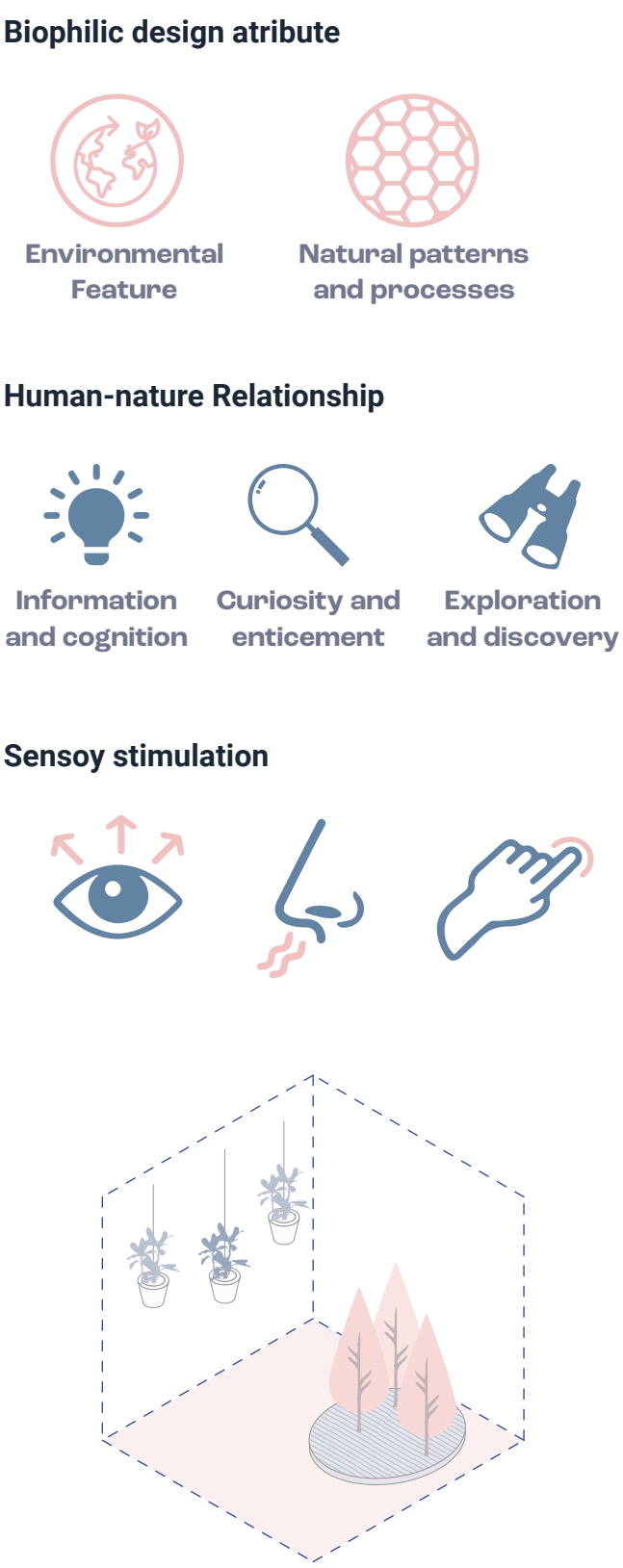
Nowadays, children are allowed to be outside under adult supervision. However, parents are becoming increasingly concerned about their children's safety, coupled with the demands of modern life, often confine children to indoor settings for the majority of their time. Hence the importance of bringing the biophilic design as a strategy in interior architecture scale. Furthermore, incorporating natural elements into the interior space not only enhances the aesthetic appeal of indoor environments but also provides children with the benefits of nature exposure. A simple way to increase natural resources indoors is through the use of potted plants or indoor gardens (Ünal and Sarıman Özen, 2021).

As mentioned, numerous studies have shown that indoor plants enhance mental health, productivity, and concentration. It is evident that contact with nature can mitigate many situations that have a negative impact on our lives. Additionally, indoor plants serve as a versatile, inexpensive, low-maintenance, and air-cleaning element that contributes to the overall well-being of occupants (Xing, Jones and Donnison, 2017).

Some examples on the next page

Fig. 42: Eureka Center in Anglo Colombiano School / Taller de arquitectura de Bogotá (ArchDaily, n.d.).

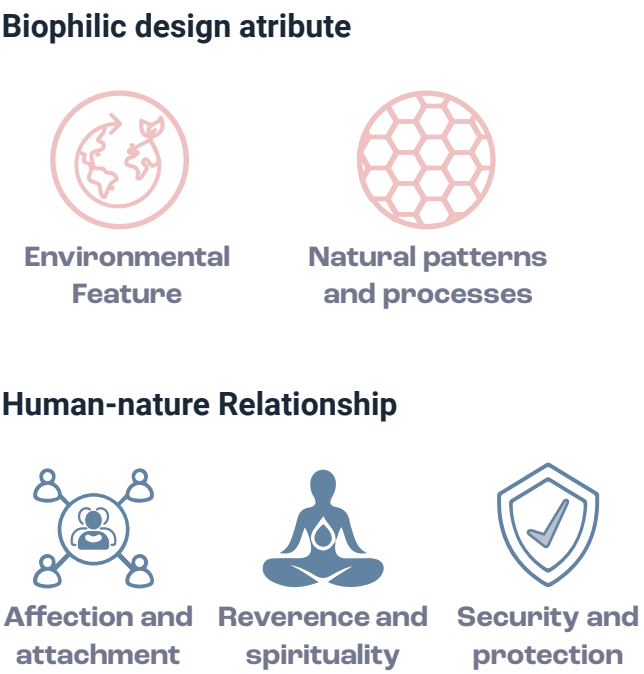
Fig. 43: Huntington Beach Public Library / Richard Neutra (Modarchitecture, 2016).

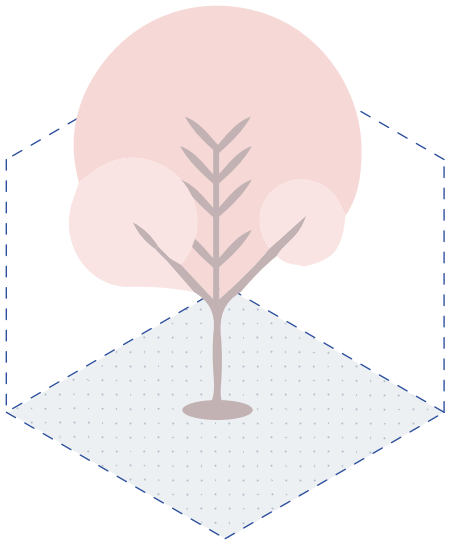



MIDDLE
READING
DECK

Green Patios

People have consistently found refuge in nature, it serves as a teacher and a therapeutic medium (Ünal and Sarıman Özen, 2021). Currently, the majority of urban children's landscapes are made of concrete, and the green areas are just grass, However, they could potentially be converted into environmentally friendly spaces. The incorporation of green patios serves to foster a calmer, quieter, and safer environment, that will provide considerable opportunities for experiential learning (Ghaziani, Lemon and Atmodiwirjo, 2021). Green spaces can also enhance social interaction, social inclusion, and cohesion (Cohen-Shacham et al., 2016). Moreover, this can serve as an educational tool for children, teaching them about plant care and the importance of nature (Ünal and Sarıman Özen, 2021).





Some examples on the next page

Fig. 44: Noosa Libraries / Maurice Hurst (Noosa Library, n.d.).

Fig. 45: Barn Klong Bon School & Art Spaces / Vin Varavarn Architects (VVA) (Lertwicha, 2020).

Green wall or roof gardens

There are several ways to incorporate plants into building facades. Using currently available technology, green initiatives support the construction of green walls and green roofs, to increase the amount of urban vegetation. There are three primary types of green walls: traditional green facades, where climbing plants use the facade material as support; double-skin green facades, where the goal is to create a green curtain that is separated from the wall; and perimeter flowerpots, where hanging pots are planted around the building (Xing, Jones and Donnison, 2017).

For a long time, there has been interest in the design of the fifth facade. The installation of green roofs represents an ecologically conscious approach to urban development. These roofs are constructed with a layered system including a growing medium, waterproof membrane, root barriers, drainage, and irrigation systems, designed to support a variety of plant life. Green roofs can be partially or fully covered with vegetation, contributing to environmental sustainability by reducing stormwater runoff, improving air quality, and enhancing insulation (Xing, Jones and Donnison, 2017).

Some examples on the next page

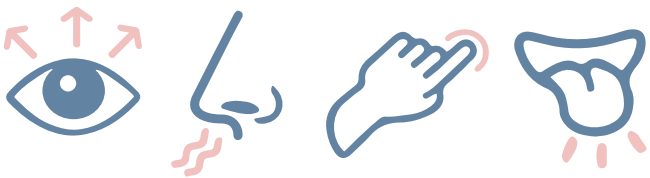
Fig. 46: Bankstown Library and Knowledge Centre / Francis-Jones Morehen Thorp (Looby, 2014)

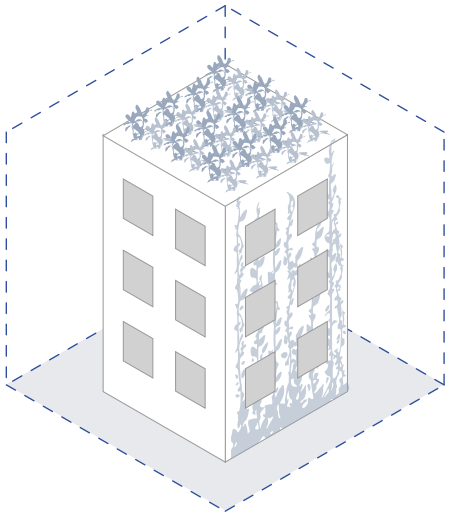
Fig. 47: Farming Kindergarten / VTN Architects (ArchDaily, 2014).

Biophilic design atribute

Human-nature Relationship

Sensoy stimulation

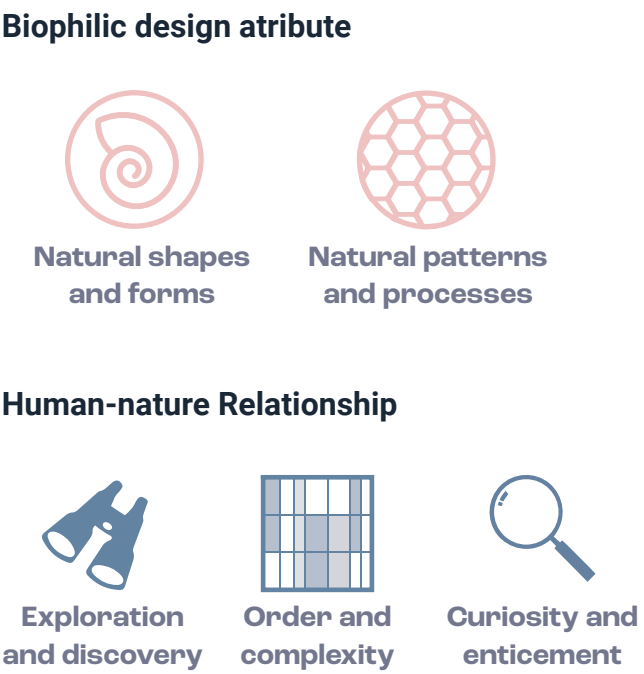




Biomorphic/geometric forms

Architectural shapes and patterns, whether directly, indirectly, or symbolically, reflect the natural environment, thereby enhancing the innate human connection to nature (Russo and Andreucci, 2023). Imitating shapes and patterns observed in nature fosters exploration, increases curiosity, and incentivizes discovery (Kellert, Heerwagen and Mador, 2008). There are different ways to incorporate them, such as organic shapes, natural colors, spirals, fractals, curves, and geometric forms (Ghaziani, Lemon and Atmodiwirjo, 2021).

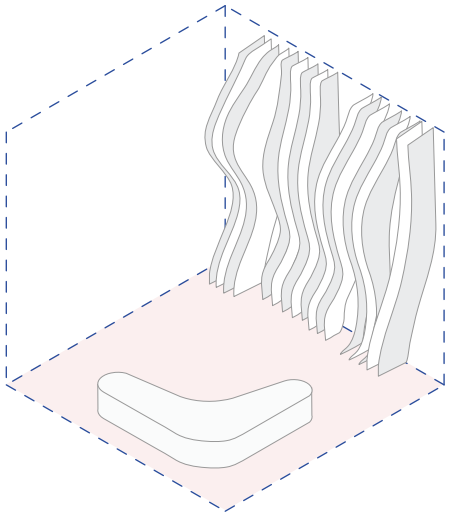
The incorporation of elements that evoke natural shapes into spatial design is a viable strategy. The incorporation of divisions, arrangements, and sculptures that resemble natural shapes, such as waves, trees, mountains, caves, and forests, serves to enhance the human experience within the space (Park and Lee, 2019).



Some examples on the next page

Fig. 48: Farming Kindergarten / VTN Architects (ArchDaily, 2014).

Fig. 49: Virgilio Barco Library / Rogelio Salmona (ArchDaily, n.d.).



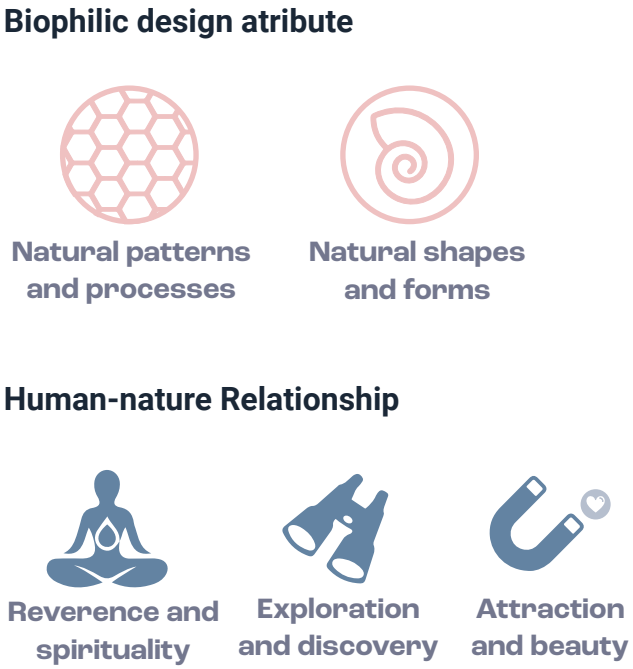
Material connection with nature

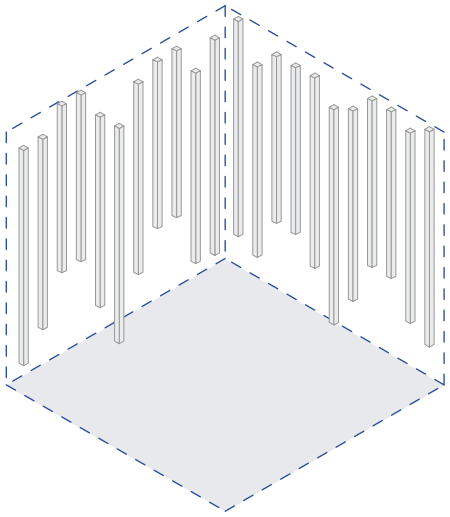
Designing nature-inspired spaces using natural materials or materials that replicate or resemble natural components is another strategy for enhancing young children's sensory stimulation and curiosity (Park and Lee, 2019). Natural materials can help people feel more comfortable (Ünal and Sarıman Özen, 2021). Furthermore, given the prevalence of indoor activities for kids, it is essential to incorporate as many natural elements as possible in the interior design.

According to Ghaziani, et al. (2021) research, the use of natural materials and color palettes associated with nature, such as woods, clay, stones, and other fabrics improves human health in the following ways:

Cognitive Performance
A decrease in blood pressure and an increase in creativity have been noted.

Emotion, Mood, and Preference
Increased comfort and relaxation.





Some examples on the next page

Fig. 50: Eureka Center in Anglo Colombiano School / Taller de arquitectura de Bogotá (ArchDaily, n.d.).
Fig. 51: VAC Library / Farming Architects (ArchDaily, 2019).

Water

Clean water not only sustains life but also supports the development of civilizations. The attractiveness of clean water originates from its evolutionary significance in human survival. It has provided access to drinking water, attracted animals for hunting, and acted as a natural defense. While these primal motivations are not as important as they were in the past, the subconscious memory of these benefits continues to increase human well-being (Pedersen Zari and Woodward, 2018). Beyond its practical uses, clean water has several mental, psychological, and emotional benefits. Furthermore, the sense of place is enhanced by being near, hearing, or touching the water (Ghaziani, Lemon and Atmodiwirjo, 2021).

According to Ghaziani, et al. (2021) research, this resource improves human health in the following ways:

Stress Reduction
Decreased stress due to greater comfort.

Cognitive Performance
Improved concentration and memory.

Emotion, Mood, and Preference
General well-being.

Some examples on the next page

Fig. 52: Huntington Beach Public Library / Richard Neutra (Modarchitecture, 2016).
Fig. 53: VAC Library / Farming Architects (ArchDaily, 2019).

Biophilic design atribute

Environmental Feature

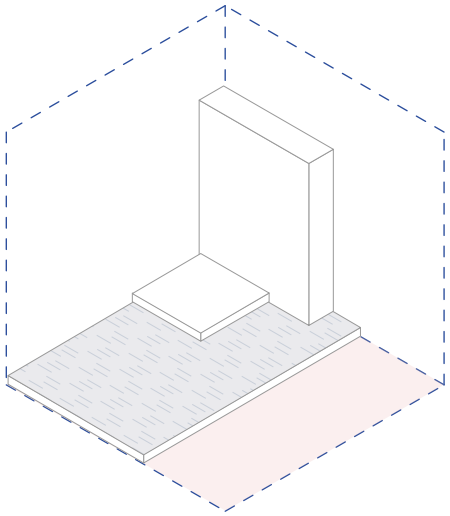
Human-nature Relationship

Reverence and spirituality

Change and metamorphosis

Attraction and beauty

Sensoy stimulation



Digital media interactions

Children's libraries are valuable urban facilities and resources for fostering imagination and creativity (Lee and Park, 2018). Biophilic design encompasses the incorporation of symbolic experiences derived from natural environments. This goal can be accomplished through the use of a variety of media, including pictures, images, and videos (Russo and Andreucci, 2023), among other sources such as interactive displays.

Proposals that provide immersive experiences, as those offered by the art collective teamLab, allow users to experience nature from another perspective. These kinds of initiatives might also be a strategy for those who do not have an immediate connection with nature.

TeamLab Borderless exhibition is an example of the interaction with digital media where "People understand and recognize the world through their bodies, moving freely and forming connections and relationships with others" (TeamLab Borderless,2018).

Some examples on the next page

Fig. 54: TeamLab Borderless Odaiba (TeamLab Borderless, n.d.).

Fig. 55: TeamLab Borderless Odaiba (TeamLab Borderless, n.d.).

Biophilic design atribute

Natural shapes and forms

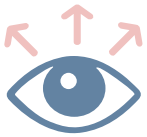
Human-nature Relationship

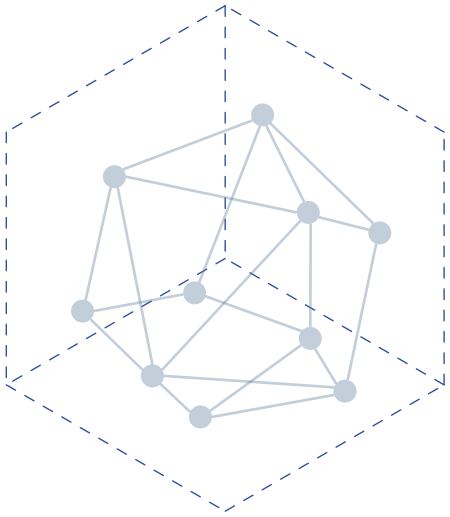
Information and cognition

Curiosity and enticement

Exploration and discovery

Sensoy stimulation






Born
Shanghai

Shelter

A refuge is a space that is safe and secure. The refuge in architecture is present in cozy and comfortable spaces (Kellert, Heerwagen and Mador, 2008). According to Lee and Park (2018) research children's libraries require shelter space designs based on natural elements. A Shelter space offers psychological stability, which is beneficial for children's emotional and cognitive development. Thus, access to the shelter areas should be guaranteed. Additionally, It provides the feeling of protection in an unfamiliar place. The incorporation of shapes inspired by nature such as caves, mountains, or waves, as well as using natural materials, stimulates children's curiosity and wellbeing.

Rosan Bosch Studio integrates shelter into their projects, through what she refers to as 'cave' environments. Those areas provide an intimate space for kids that allows them to concentrate (Bosch, n.d.).

Biophilic design atribute

Human-nature Relationship

Sensoy stimulation

Some examples on the next page

Fig. 56: Hjørring Central Library / Rosan Bosch Studio (Bosch, n.d.).

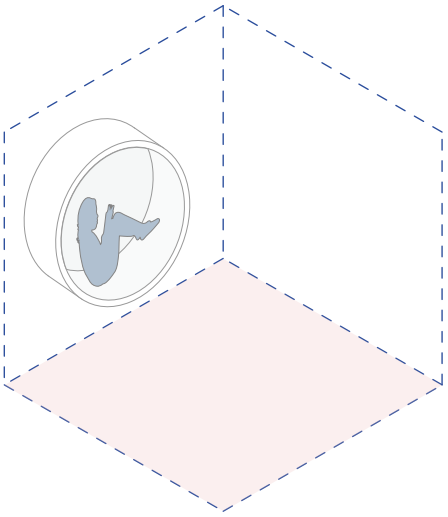


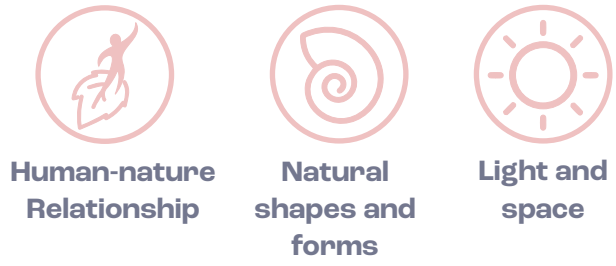
Fig. 57: Hjørring Central Library / Rosan Bosch Studio (Bosch, n.d.).

Sensory stimulation

Sensors enable us to perceive and respond to our environment. The evolution of our sensory systems has led to the development of consciousness and cognition (Kellert, Heerwagen and Mador, 2008). Although an increasing number of designers and architects are beginning to include other senses, such as smell, touch, hearing, and even taste, usually the eye-only design remains in architectural practice (Spence, 2020, Pallasmaa, 2012).

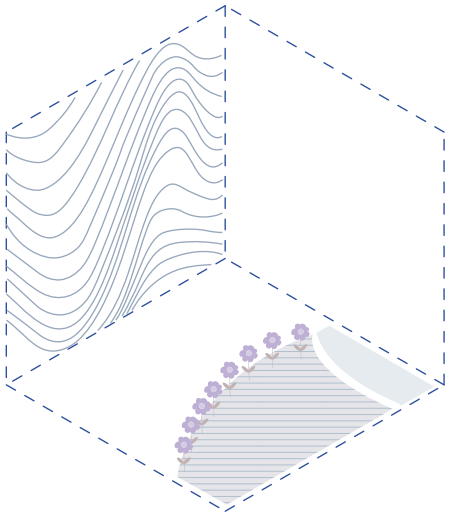
It is essential to recognize the multisensory nature of the human mind (Pallasmaa, 2012). The focus on designing for experience, rather than merely for appearance, is becoming increasingly important. Having a multisensory approach contributes to developing spaces that promote human social, cognitive, and emotional growth (Spence, 2020). Furthermore, by incorporating sensory gardens in the design, the five senses can be stimulated. They are designed to improve our relationship with the environment and enhance our connection with nature (Russo and Andreucci, 2023).

Biophilic design atribute



Human-nature Relationship

Sensoy stimulation



Some examples on the next page

Fig. 58: School for Blind and Visually Impaired Children / SEAlab (ArchDaily, 2022).

Fig. 59: School for Blind and Visually Impaired Children / SEAlab (ArchDaily, 2022).

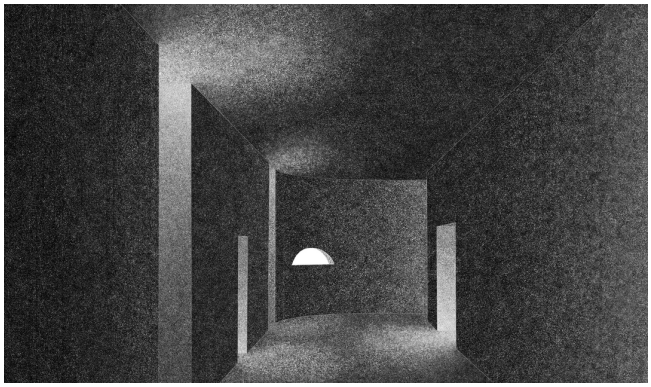
The School for Blind and Visually Impaired Children is one example of a project that incorporates sensory stimulation into its design. The SEAlab's project employs diverse strategies to enable children to experience the space the area through their senses in the following ways:

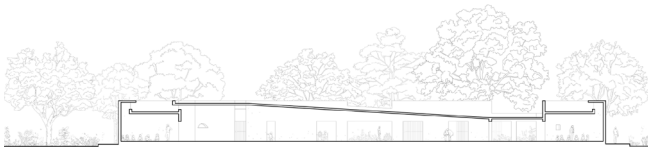
Sight: The connection to external areas enables regulated lighting conditions. The project plays with light contrast and depending on the space functions, the openings provide varying light levels (ArchDaily, 2022).

Hearing: A person's voice or footsteps sound change depending on the echo that is produced in the space. This project differentiates the heights and widths of corridors and classroom areas so that they may be recognized by sound, facilitating space identification (ArchDaily, 2022).

Smell: The project strengthens the connection with the natural environment through the incorporation of courtyards in the design. Those open spaces have different aromatic plants and trees and are located next to the classrooms and corridor. This makes it easier to move throughout the building using the smell. Furthermore, the courtyards enable outdoor learning opportunities (ArchDaily, 2022).

Touch: Students are guided around the spaces by the materials and textures of the walls and floor, which have rough or smooth surfaces to differentiate them (ArchDaily, 2022).





Dynamic Light

Light is one of the most important aspects that affect the space experience, considering the high value that people rely on sight. According to Ünal and Sarıman Özen (2021), it consists of "the elements of natural light, filtered and diffused light, light and shadow, reflected light, light pools, light as shape and form, warm light, spatial variability and harmony, and inside-outside spaces".

As mentioned before, architectural projects must include variations in light contrasts in their designs. It is essential to evaluate the amount of illumination, to correspond to the space's intended function and to make the greatest use of natural light. This will raise a positive visual perception (Ünal and Sarıman Özen, 2021).

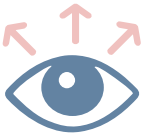
Biophilic design atribute

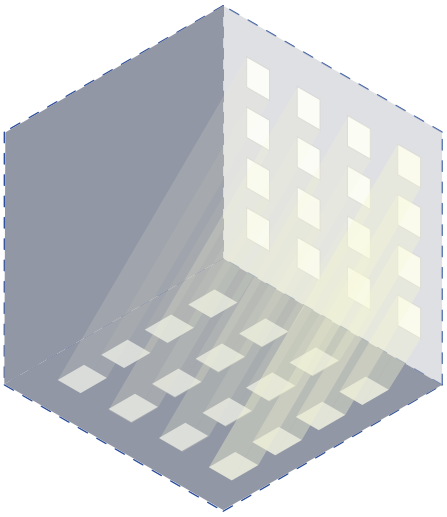
Light and space

Human-nature Relationship

Change and metamorphosis | Exploration and discovery | Attraction and beauty

Sensoy stimulation





Some examples on the next page

Fig. 60: City Library in Seinäjoki / JKMM Architects (ArchDaily, n.d.).

Fig. 61: Virgilio Barco Library / Rogelio Salmona (ArchDaily, n.d.).

05.6 Architectural strategies and solutions matrix.

The matrix represents the architectural solutions and strategies generated by incorporating the biophilic solutions into the library spaces. Some of them are reflected in the following schemes (Figs. 62-64) and will be implemented during the proposed project development.

Biophilic design strategies	Use/activities: Bookshelf space / reading room	Study room	Daycare	Auditorium/ multipurpose room	Cafe	Workshops	Administration	Connective spaces	Complementary spaces
Windows with a view to nature	A1	A2	A3	A4	A5	A6	A7	A8	A9
Vegetation on the inside	B1	B2	B3	B4	B5	B6	B7	B8	B9
Green patios	C1	C2	C3	C4	C5	C6	C7	C8	C9
Green wall or roof gardens	D1	D2	D3	D4	D5	D6	D7	D8	D9
Biomorphic/geometric forms	E1	E2	E3	E4	E5	E6	E7	E8	E9
Material connection with nature	F1	F2	F3	F4	F5	F6	F7	F8	F9
Water	G1	G2	G3	G4	G5	G6	G7	G8	G9
Digital media interactions	H1	H2	H3	H4	H5	H6	H7	H8	H9
Shelter	I1	I2	I3	I4	I5	I6	I7	I8	I9
Sensory stimulation	J1	J2	J3	J4	J5	J6	J7	J8	J9
Dynamic Light	K1	K2	K3	K4	K5	K6	K7	K8	K9

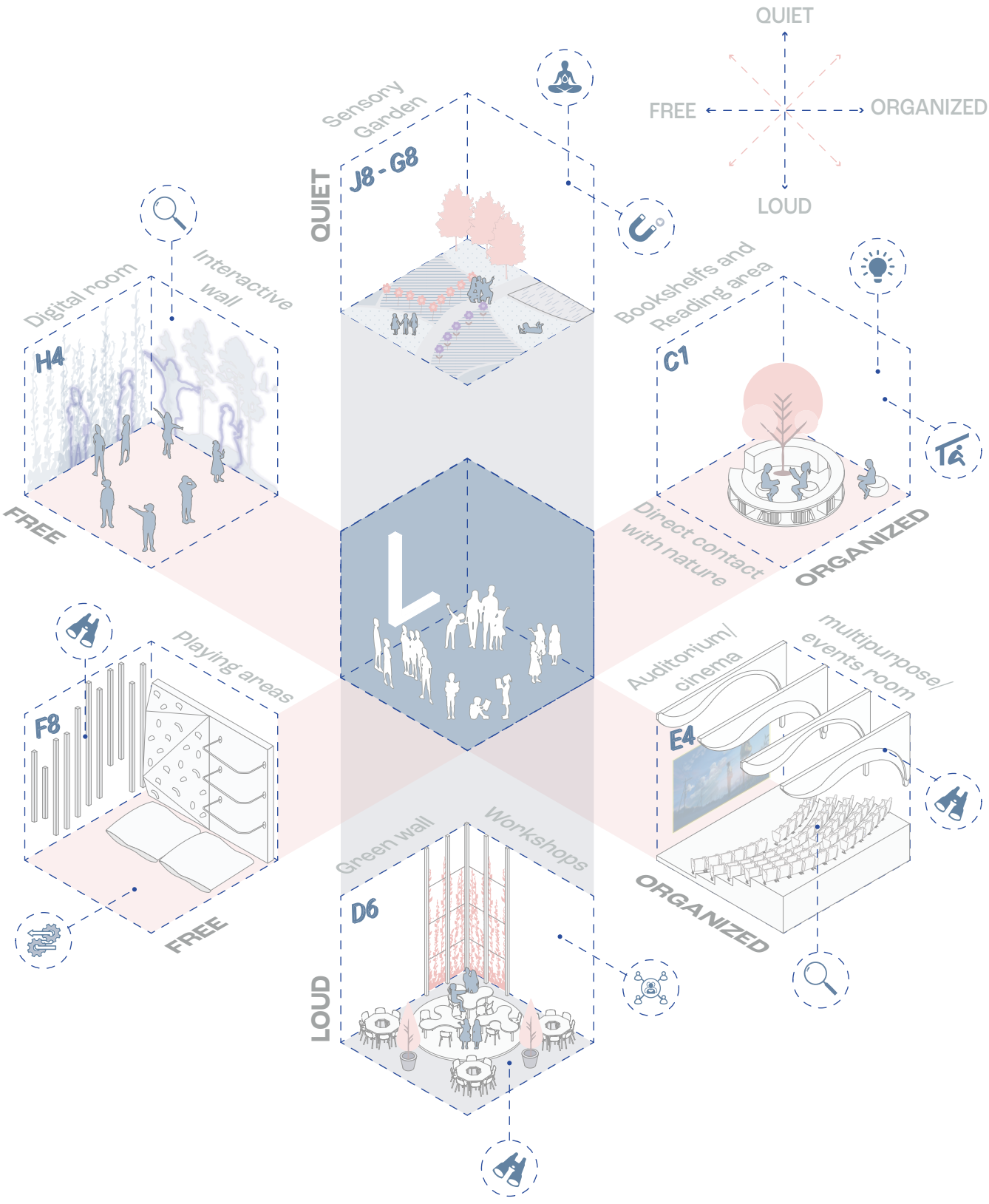


Fig. 62: Building solutions L size. Made by the author based on research.

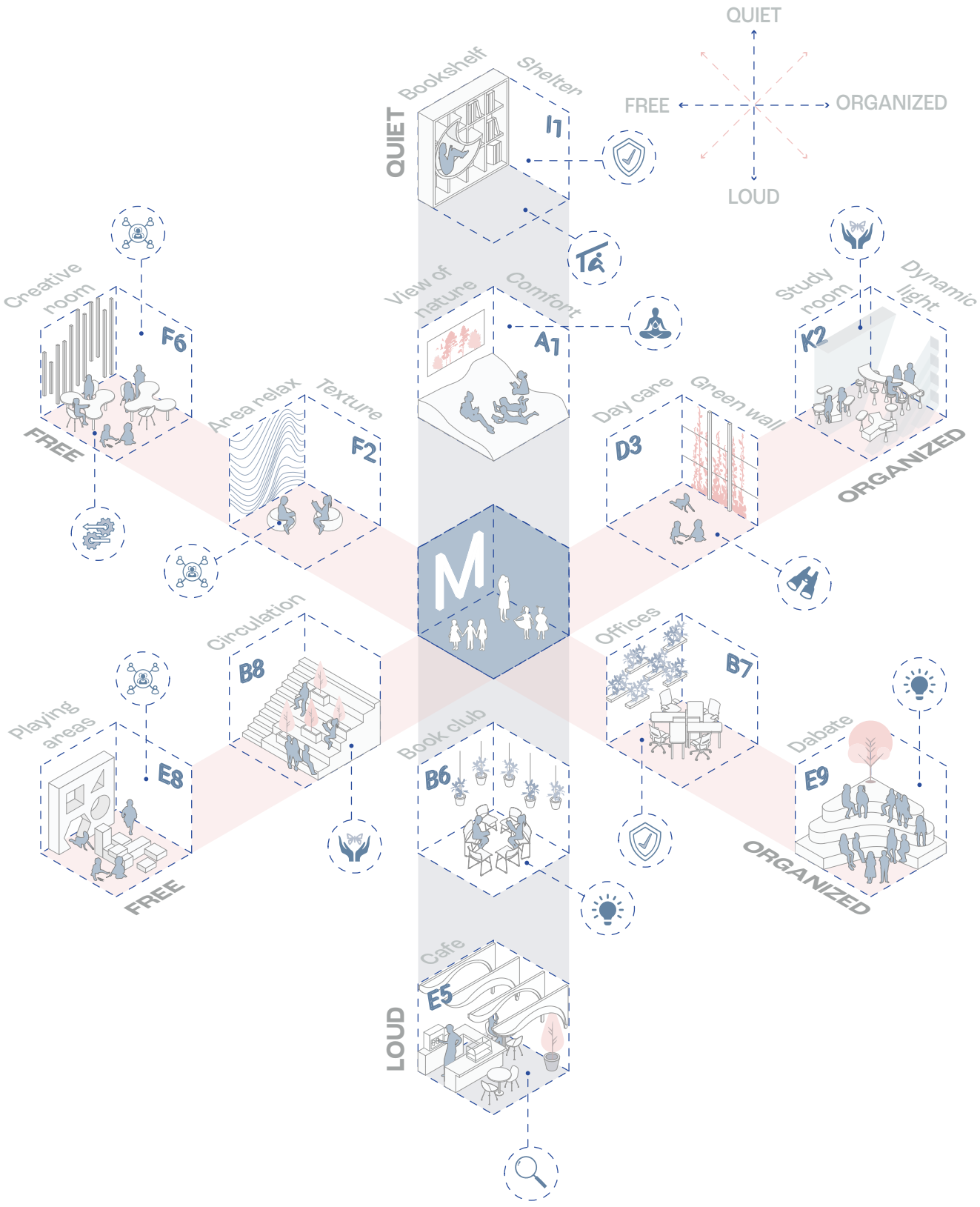


Fig. 63: Building solutions M size. Made by the author based on research.

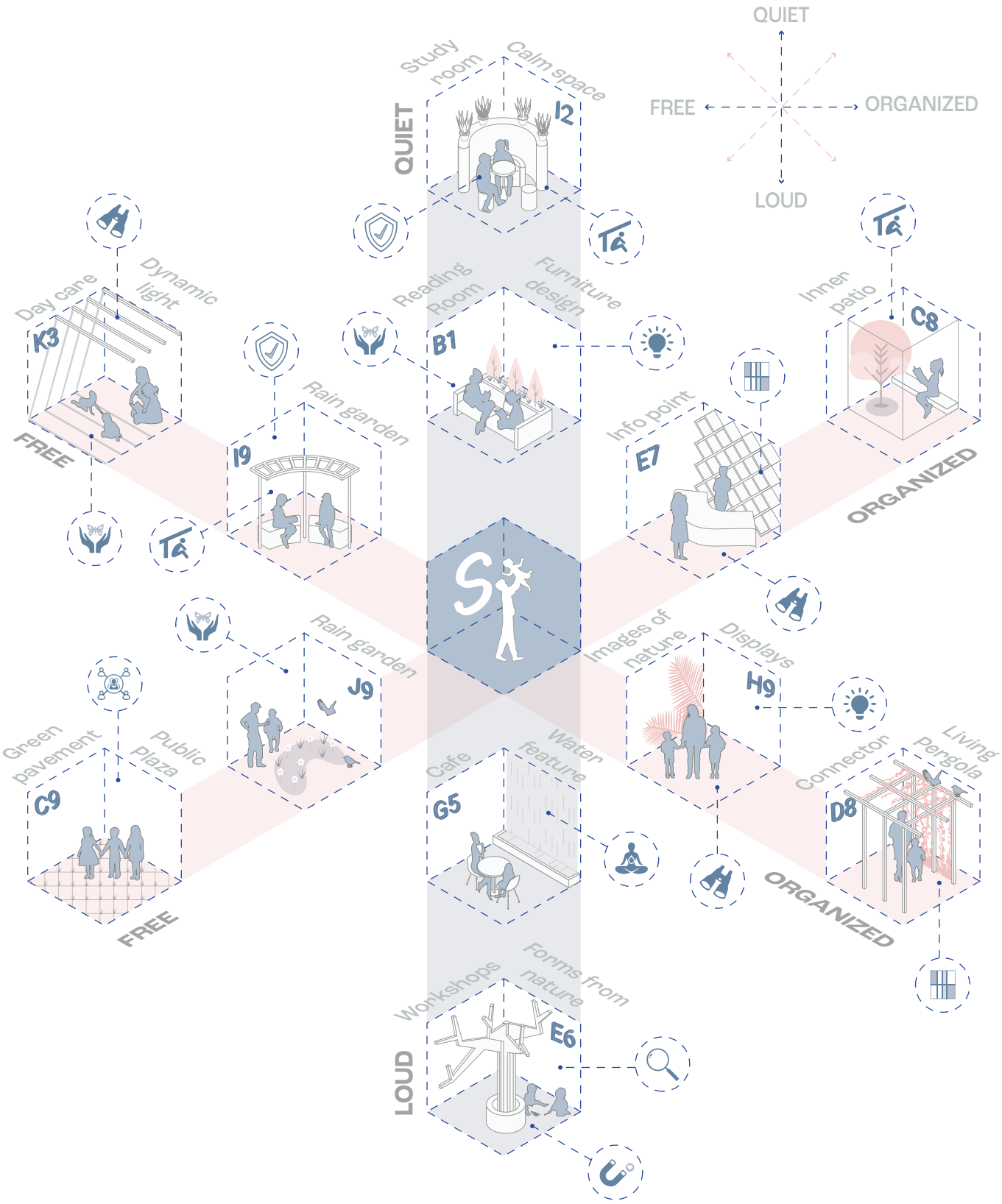


Fig. 64: Building solutions S size. Made by the author based on research.

05.7 Site analysis: Turin -Italy

Turin, the regional capital of Piedmont, is located at the foot of the Alpine mountains and valleys and is connected to the municipalities of the first belt by a continuous urban fabric. Turin is surrounded to the east by the mountains, is bordered by four courses of water, by parks and agricultural areas, some of which have been incorporated into the city. Turin's urban fabric has expanded through time, particularly during the Second World War, until joining the adjacent municipalities. Turin has experienced significant urban redevelopment, especially after the decommissioning of industrial areas, through the reuse of existing spaces. Notable projects include the revitalization of those areas, the enhancement of public spaces, and the inclusion of sustainable urban planning. (Torino Urban Lab, 2018).

The Turin region is particularly water-rich due to it is crossed by four rivers: the Po (12,770 meters), Stura di Lanzo (7,100 meters), Dora Riparia (11,560 meters), and Sangone (8,700 meters). Since the 1970s, there have been many proposals and projects in Turin about redeveloping marginal and deteriorated districts, and riversides aiming to create an organic network connecting the parks of the city. Since 1994, two significant initiatives have started, Torino Città d'Acque, supported by the Municipality of Turin, and Corona Verde, developed by the Piedmont Region, to create an organic network of green spaces and ecological connectors in the Turin metropolitan region (Comune di Torino, 2020).

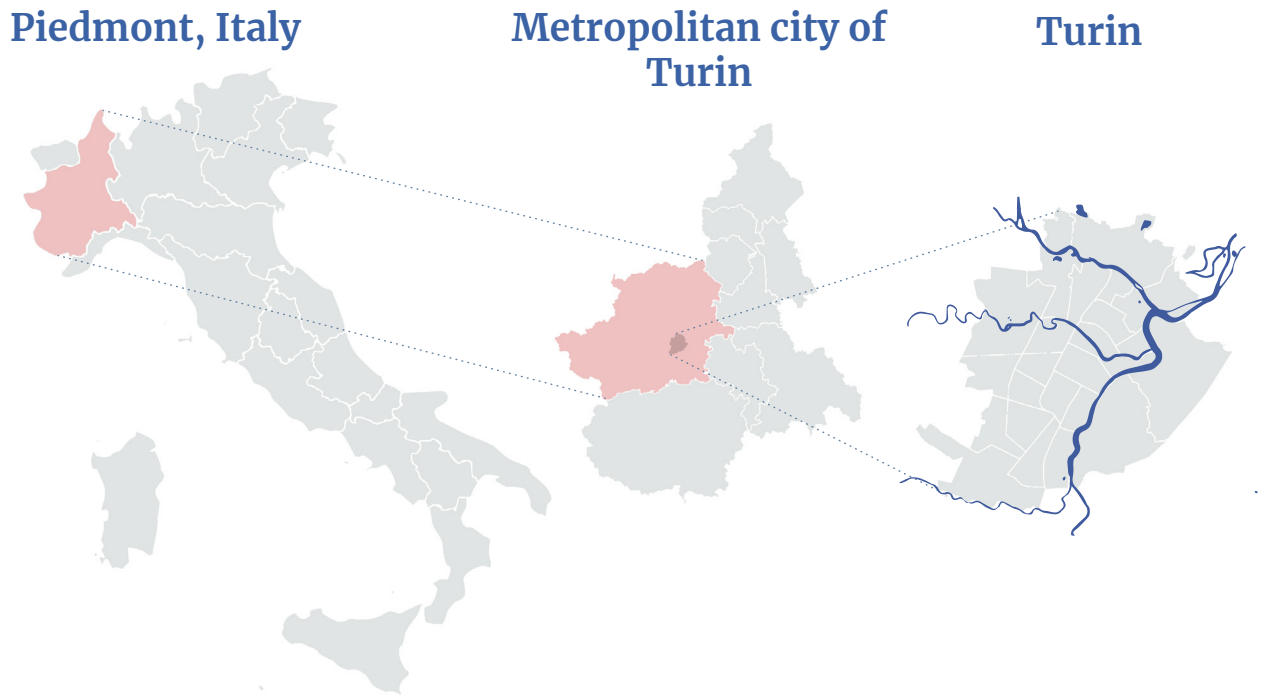


Fig. 65: Turin location.

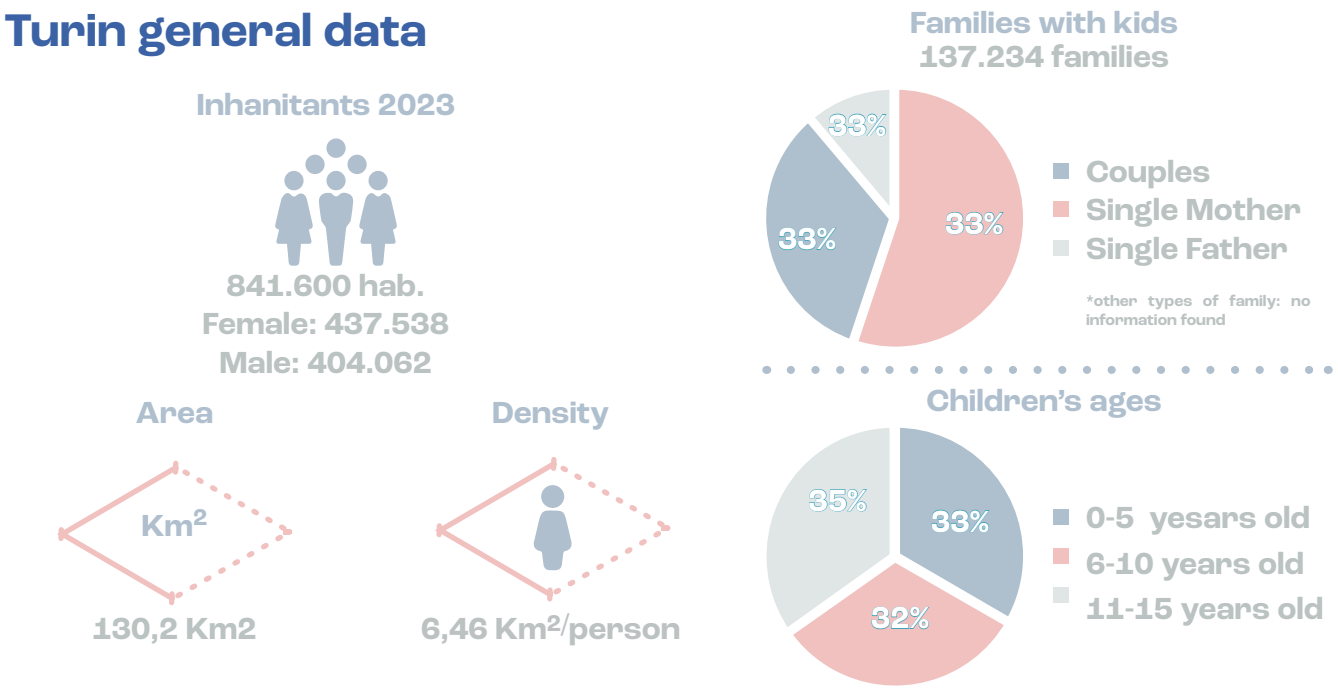


Fig. 67: Turin general data. Made by the author based on Turin's information. (Istituto Nazionale di Statistica - Istat, 2023; Comune di Torino, 2022;Torino Urban Lab,2018).

Location of the child population

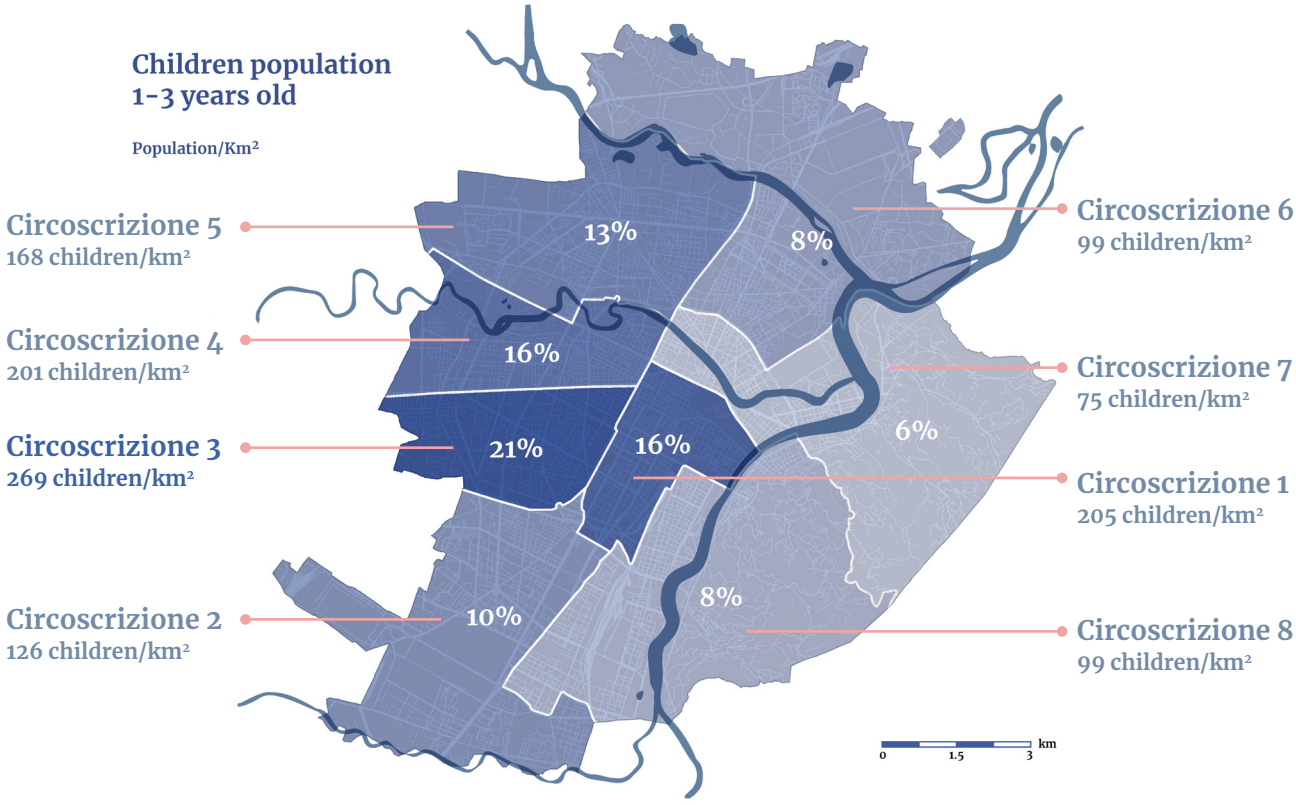
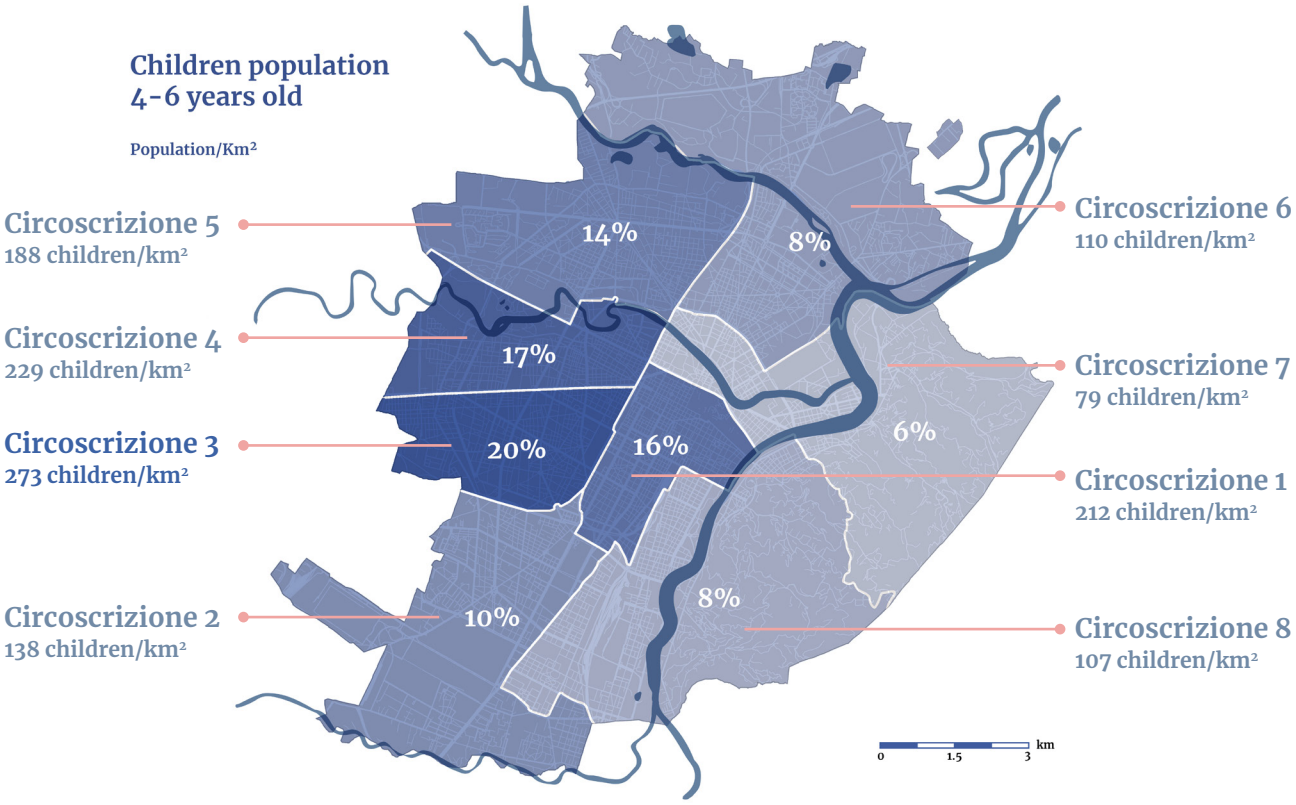


Fig. 66: Child Population in Turin from 1 to 3 years old. Made by the author based on Turin's information. (Istituto Nazionale di Statistica - Istat, 2023; Comune di Torino, 2022)



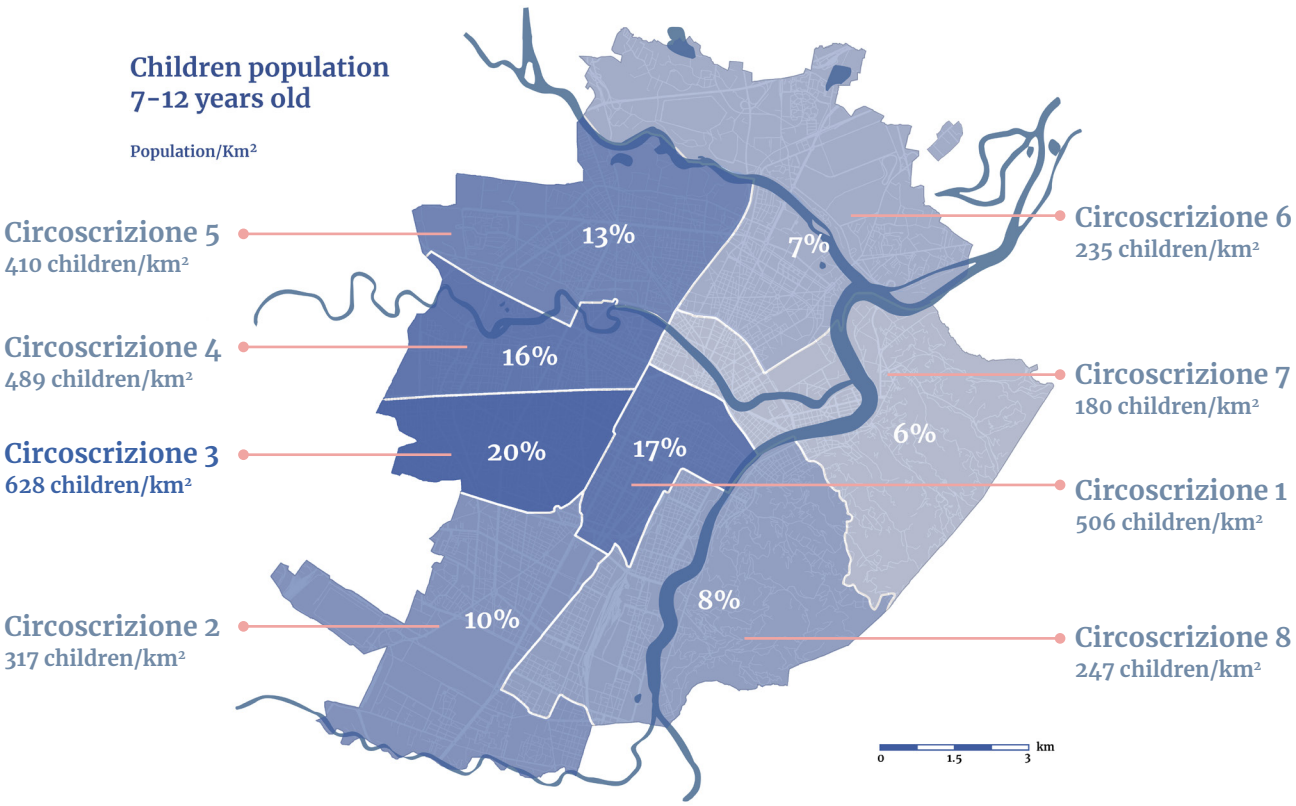


Fig. 68: Child Population in Turin from 4 to 6 and from 7 to 12 years old. Made by the author based on Turin's information. (Istituto Nazionale di Statistica - Istat, 2023; Comune di Torino, 2022)

Green areas:

The historical development of Turin's urban green areas dates back to 1559 when the Duchy of Savoy moved the capital there. The Savoy dukes started the process of acquiring territory surrounding the city, leading the expansion of the urban borders to the south, east, and west. The magnificent gardens of these royal residences, which UNESCO has designated as a World Heritage Site since 1997, were connected during the 18th century by what are known as 'tiranti verdi' (green ties), which refers to tree-lined streets that became public pathways. It was only in the second half of the 19th century that the first public gardens in Turin were born: the Valentino Park, the Ripari Garden, the Sambuy Garden, and the Cittadella area (Comune di Torino, 2020).

The current condition, location, and quantity of green areas in the city attests to the access to green spaces within a walking radius for all inhabitants. In Turin, 93% of residents reside at a distance of no more than 300 meters from a green space. Urban green areas in Turin represent 37% of the municipal area (approx 4.800 ha). Moreover, each resident in Turin has access to 20 square meters of public green space, increasing to 55 square meters when including private green space. The green spaces include parks, riverbanks, cultivated fields, nature reserves, and urban gardens. (Torino Urban Lab, n.d.) (Figs. 69 and 72).

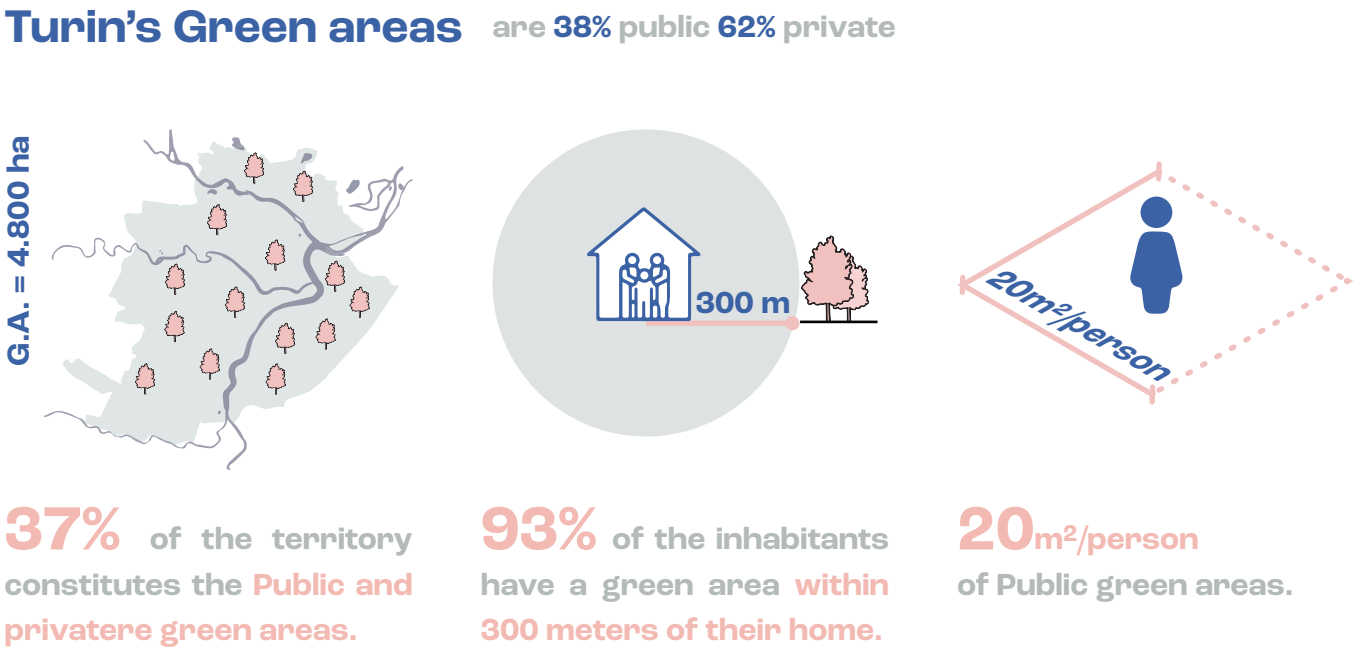


Fig. 69: Green areas in Turin Infographic. Torino Urban Lab (Torino Urban Lab, n.d).

Fig. 70: Trees in Turin's urban area, Tram and Bike lane - Parco del Valentino. Photo taken by the author on October 08 /2021.

There are around 110.000 trees in the urban area, and over 60.000 trees in the city avenues, forming a significant arboreal legacy. (Fig. 70) The species with the greatest number of specimens are the hybrid plane tree (Platanus acerifolia), with over 15.000 of them, the linden (Tilia hybrid), with about 10.000, the hackberry or nettle tree (Celtis australis), with nearly 5.000, and the Norway maple (Acer Platanoides), which has over 5.000, among other species (Comune di Torino, 2020).

Bike Paths:

Over 270 km of bike lanes have been constructed in Turin, of which 32 km pass through green areas, and 85% of those are separated from motorized traffic. Part of Turin's bicycle infrastructure also crosses through parks, is situated along the river, and other natural spaces, defining a kind of urban green belt (Torino Urban Lab, n.d.) (Fig. 71). This heritage has been beneficial in promoting biodiversity, regenerating the air, improving the permeability of the land, reducing the consequences of global warming, and improving the health and well-being of Turin's residents (Torino Urban Lab, n.d.). According to these data, Turin is one of the Italian cities with the highest availability of useful urban greenery (Comune di Torino, 2020) (Fig. 73).

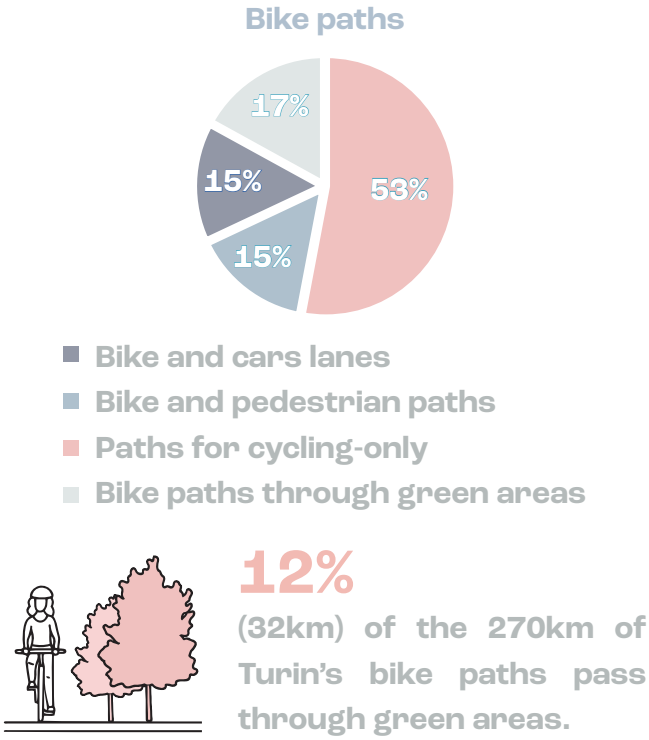
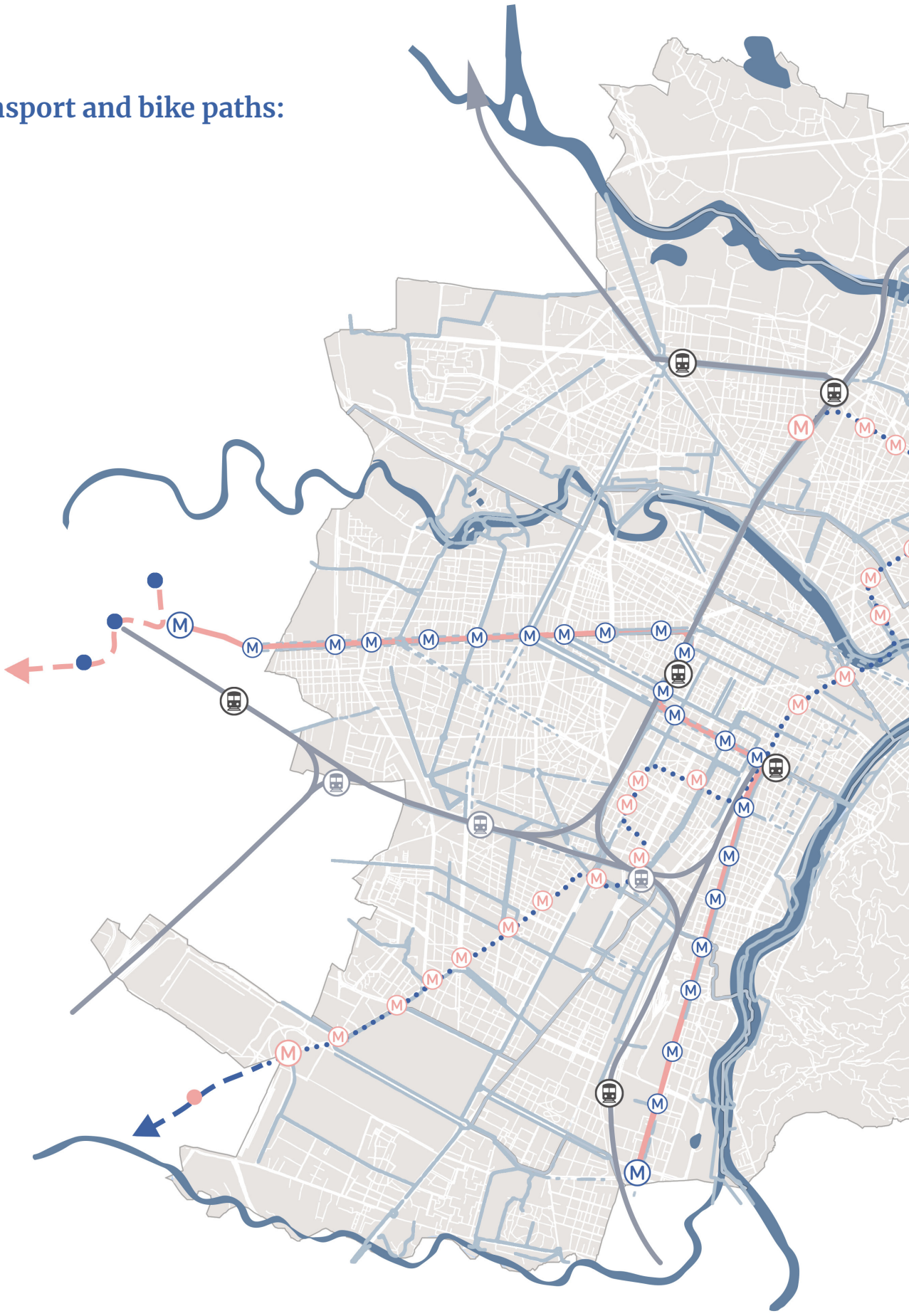


Fig. 71: Bike paths based on Torino Urban Lab data (Torino Urban Lab,n.d).

Public green areas, forests and rivers

Fig. 72: Public green areas in Turin. Made by the author based on (Torino Urban Lab,2018; Città di Torino, 2020)

Public transport and bike paths:



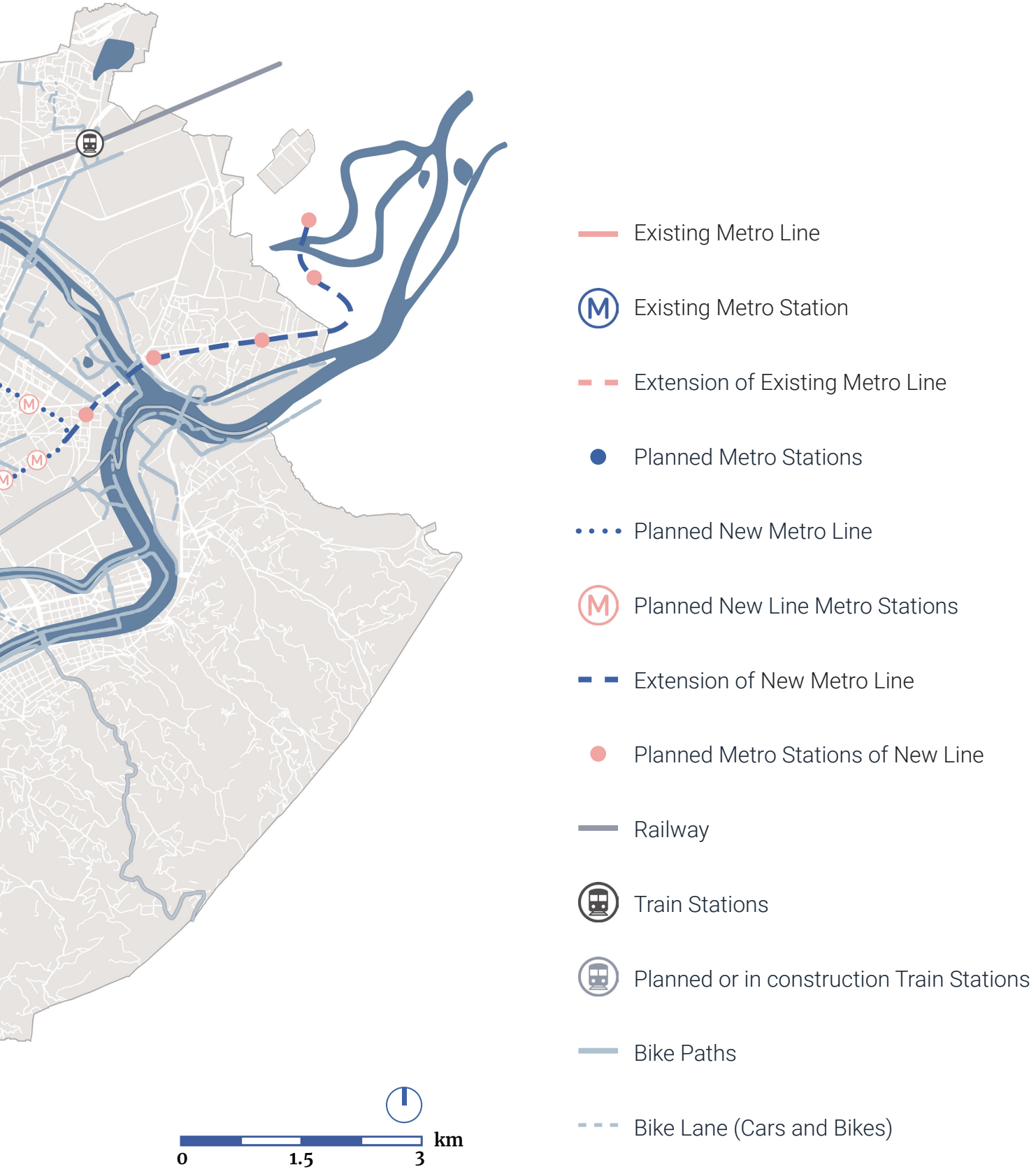


Fig. 73: Made by the author based on Trino Urban Lab (2018). Torino Atlas mappe del territorio metropolitano.

Libraries and mobile libraries

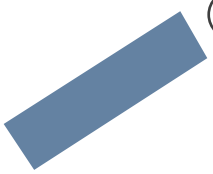
Nati per Leggere is an Italian national reading promotion program for families with children. The libraries listed here have adequate space to welcome young readers and their parents, a stock of books for preschool children, properly selected, labeled and differentiated (Biblioteche Civiche Torinesi, 2021).

1 Don Lorenzo Milani
1675 m²

32 reading seatsin the children's area

2 Biblioteca del Centro Interculturale
3000 m²

1 kids area
1 outdoor garden with community garden



3 Primo Levi
2087 m²

3 meeting spaces
1 greenhouse

4 Italo Calvino
2000 m²

130 seats in the conference room

5 I ragazzi e le ragazze di Utøya
450 m²

12 seats in the meeting room
44 reading seats

6 Bianca Guidetti Serra
722 m²

10 seats in the meeting room
32 reading seats

7 Alessandro Passerin d'Entrèves
1000 m²

140 reading seats

8 Villa Amoretti
3229 m²

50 reading seatsin the children's area
2 conference rooms

9 Dietrich Bonhoeffer
1200 m²

176 reading seats

10 Cesare Pavese
1350 m²

18 workstations in the computer lab

*Some buildings host aditional services unrelated to the library.

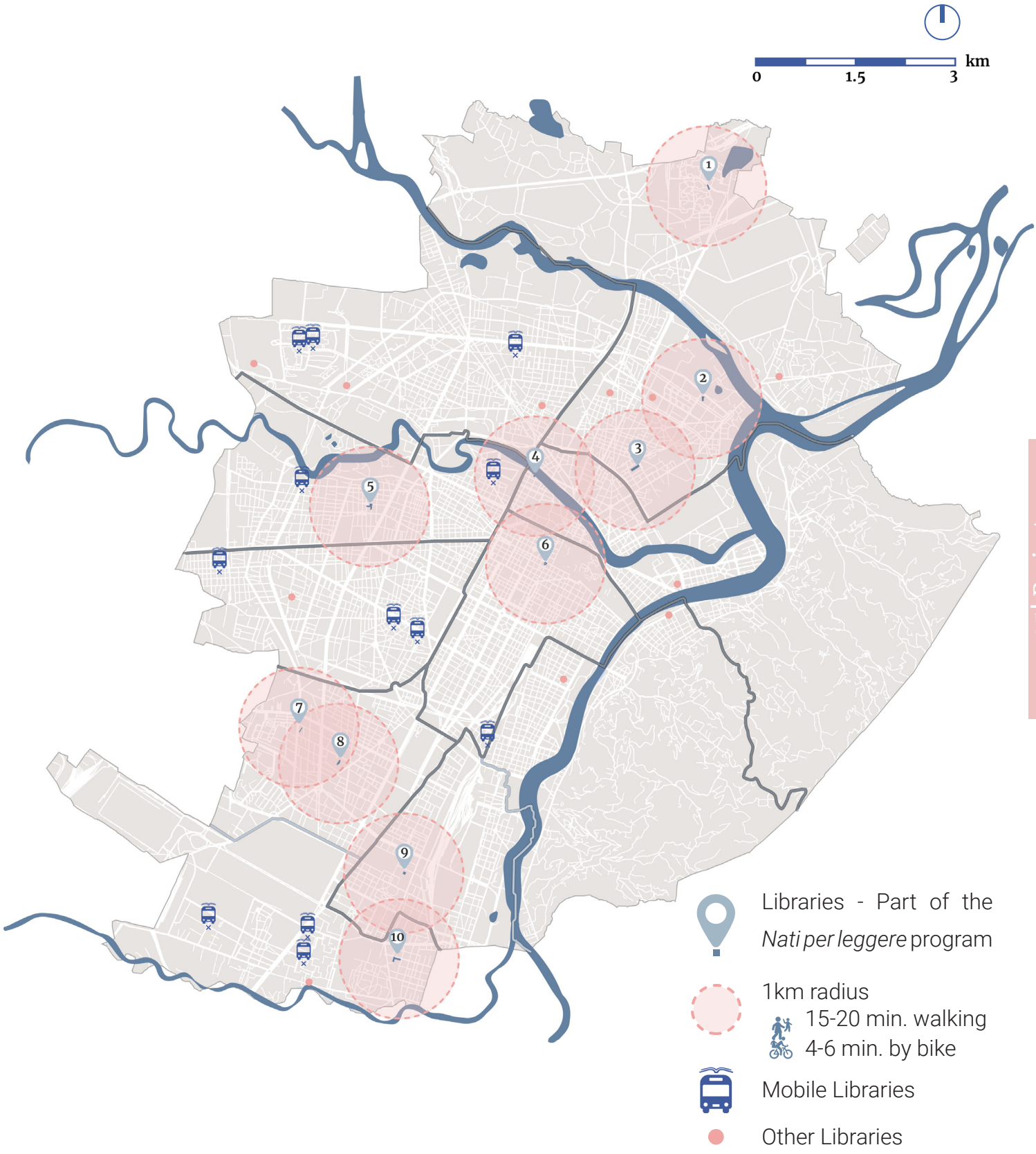


Fig. 74: Libraries that are part of the *Nati per leggere* program, Moblile libraries and other libraries (Biblioteche Civiche Torinesi, 2021)

Playgrounds in Turin :

Playgrounds have an important role in children's social interaction and in enhancing their connection with nature. These environments allow them to discover the world around them by playing, encountering other peers, and exchanging experiences among them. Playgrounds could also be their first encounter with nature as many playgrounds are located near parks surrounded by green areas. Currently, in Turin, playgrounds have artificial limits and prefabricated play equipment (Figs. 75 and 76). Even tho, they are located in green areas they do not fulfill all the children's needs. Including biophilic solutions for the city becomes necessary to promote spaces for achieving the goals of inclusion, well-being, and sensory development.

Fig. 75: Some examples of playgrounds in Turin. Made by the author based on Google street view.

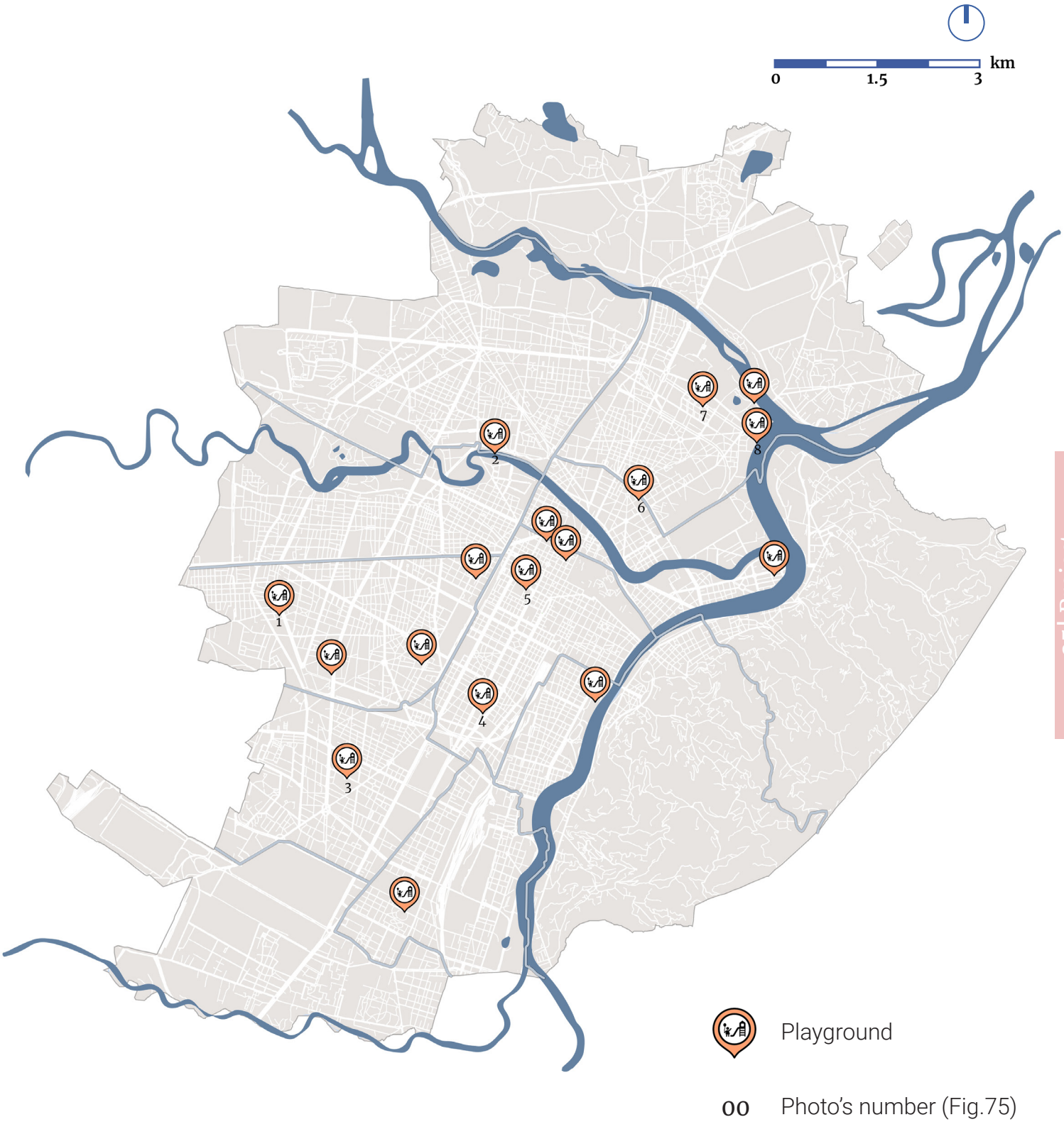


Fig. 76: Location of some examples of playgrounds in Turin. Made by the author.

05.8 Area of intervention

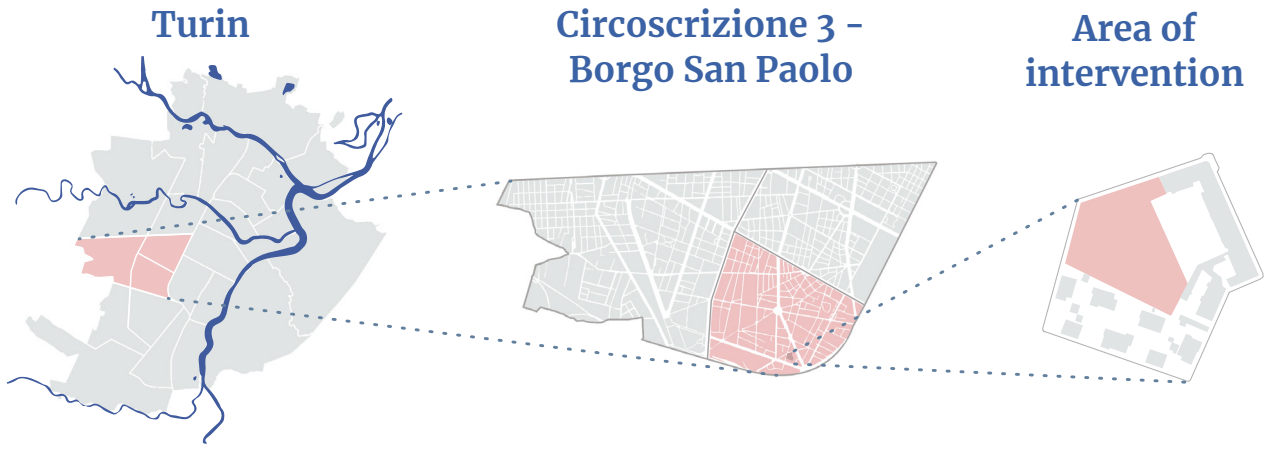


Fig. 77: Location of the area of intervention.

The selection of the intervention area is based on the analysis of the city of Turin. This portion of the city, located in the western area, between via Malta e via Lussimpiccolo, in the Borgo San Paolo neighborhood within the Circoscrizione 3, is distinguished by its high density of children per square meter. The area is notable for its considerable green spaces and parks, given the sector key components for ensuring an urban high quality of life. However, the distribution of these green areas is not evenly distributed. A substantial portion of the sector remains highly urbanized, resulting in a disparity between the availability of natural spaces and the densely built environment.

The area has large green spaces and parks; however, they are not evenly distributed, and a significant portion of the sector remains highly urbanized. Additionally, the existing libraries are situated in other parts of the city. Moreover, the proposed site of intervention, despite some attempts to make use of the space, remains currently unused. This situation highlights the opportunity for a transformative project with the characteristics described on the thesis.

Furthermore, the existing libraries, which are essential learning and recreational environments, are located in other parts of the city, creating a gap in walkable and accessible facilities for children and residents of this area. Additionally, the proposed site of intervention, despite various attempts to utilize the area, such as constructing a polyclinic or developing a parking lots, the space remains currently unused. The current state of the site highlights the opportunity for a transformative project that can effectively leverage the existing characteristics of the area. By aligning with the approach outlined in the thesis, such a project has the potential to enhance the current space, improve access to libraries for children, foster connections with nature, increase the social interaction, create a sensory experience and promote overall heath and well-being through biophilic design.

Fig. 78: Area of intervention (Source: Google, 2022).

Estratto Cartografico

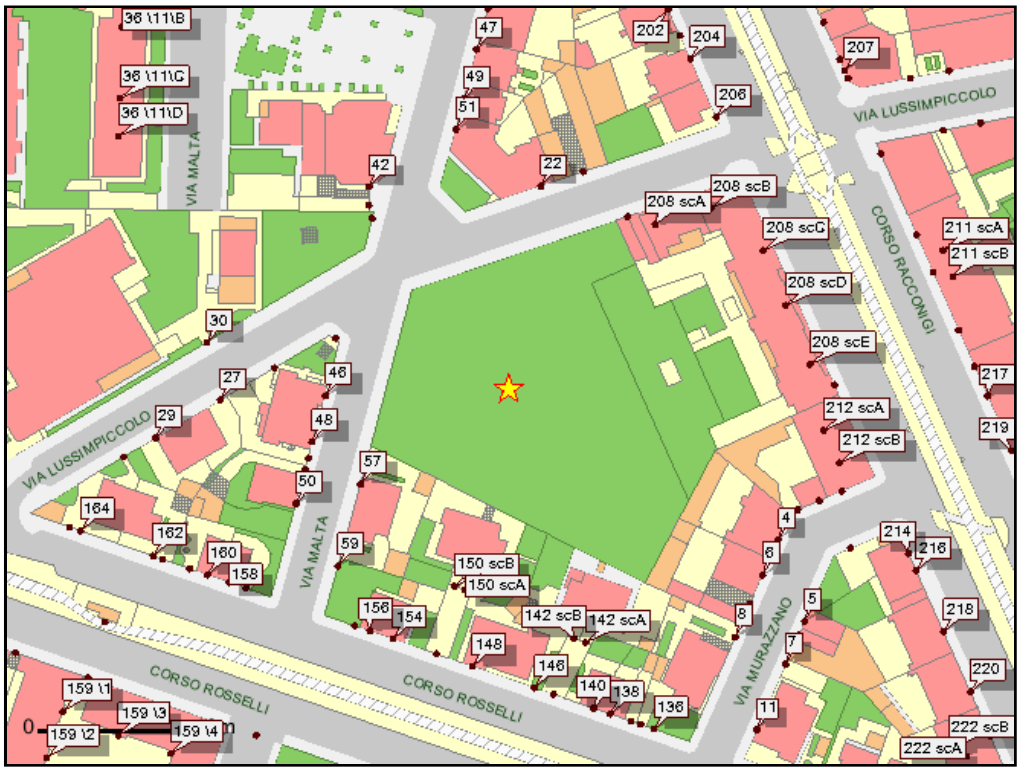
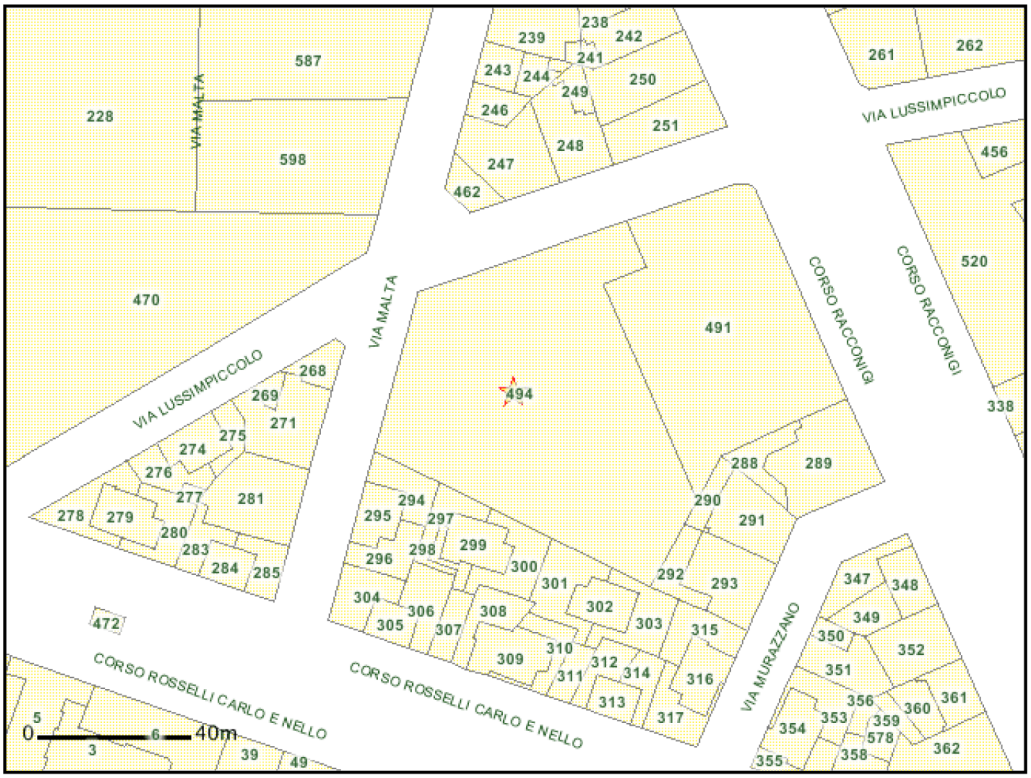


Fig. 79: Cartographic extract of the Area of intervention - "Foglio 1297, Particella 494" (Source: Citta di Torino, 2023a).

Extract of the regulations “Piano Regolatore Generale” and normative calculation.

Inquadramento catastale su carta tecnica



Informazioni relative alla Tavola 1 del PRGC di Torino - Azzonamento

Zona/Area Normativa - Ambito 12.1 - PONS E CANTAMESSA (Zone Urbane di Trasformazione) (12.1)

Riferimenti normativi

Scheda normativa

- Zone a servizi nelle zone urbane di trasformazione

  Indice di edificabilità territorale (I.T.): 0.7 - mq/mq

Interventi I tipi di intervento consentiti sono:

Riferimenti normativi

Art. 4

- Completamento f1
- Completamento f2
- Manutenzione ordinaria
- Manutenzione straordinaria
- Nuovo impianto
- Restauro e risanamento conservativo
- RIE - Ristrutturazione edilizia
- RIS - Risanamento conservativo
- Ristrutturazione edilizia
- Ristrutturazione edilizia d1
- Ristrutturazione edilizia d2
- Ristrutturazione edilizia d3
- Ristrutturazione edilizia d4
- Ristrutturazione urbanistica
- Sostituzione edilizia

Fig. 80: Extract of the regulations “Piano Regolatore Generale” (Source: Citta di Torino, 2023a).

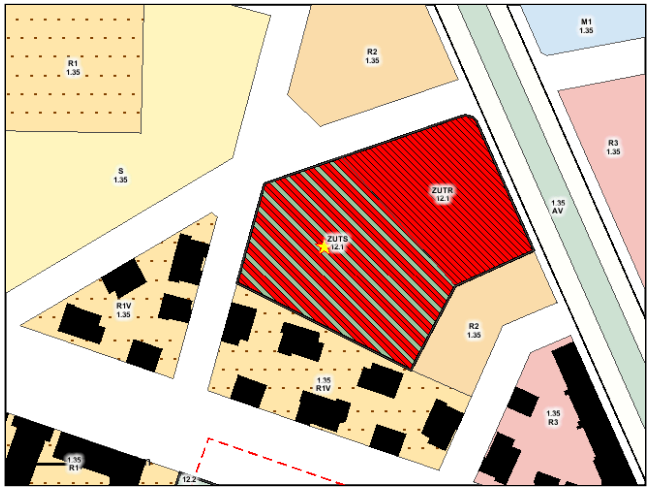


Fig. 81: Estratto Urbanistico Piano Regolatore Generale PRG (Città di Torino, 2023a).

Indice di edificabilità territorale (IT)

IT=SL/ST. The maximum amount of building surface that can be constructed on a given land area. *"Quantità massima di superficie edificabile su una determinata superficie territoriale, comprensiva dell'edificato esistente. Ai fini del corretto calcolo [...] IT=SL/ST"* (Città di Torino, 2018).

Superficie territoriale (ST)

The total area defined by the P.R.G. *"Superficie reale di una porzione di territorio oggetto di intervento di trasformazione urbanistica. l'area complessiva definita dal P.R.G."* (Città di Torino, 2018).

Superficie lorda (SL)

The total surface area of all floors excluding accessory surfaces. *"Somma delle superfici di tutti i piani comprese nel profilo perimetrale esterno dell'edificio escluse le superfici accessorie"* (Città di Torino, 2018).

Area of intervention PRG Data (Piano Regolatore Generale di Torino):

Zone a servizi nelle zone urbane di trasformazione

Allineamento/ Alignment:
C.so Racconigi; Via Lussimpiccolo.

Numero Max. Di Piani/ Maximum Number of Floors: 8

Tipo Di Servizio Previsto/ Type of Service:
Areas for public park spaces, for games and sports; Facilities of common interest. *Aree per spazi pubblici a parco, per il gioco e lo sport; Attrezzature di interesse comune.*

Nuovo impianto/New intervention:
Intervention permitted. Intervento consentito.

Proprietà/property: City of Turin

Indice di edificabilità territorale (IT) = **0.7 mq SLP/mq ST**

ST = **4767.54 mq**

Normative calculation (Made by the author)

SL = **IT** x **ST**
= **0.7** x **476.54**
= **3337.27 mq**

Newspaper article - Area of intervention conditions.

Via Malta: dietrofront Asl, no al Poliambulatorio nell'area abbandonata

L'Asl ha deciso di riconsegnare il terreno alla Città. In via Malta non lascerà nessun ambulatorio. In piedi rimane sempre l'ipotesi del pertinenziale

La novità è trapelata nei giorni scorsi. Silenziosa è arrivata anche alle orecchie del quartiere. L'area ex PontCantamessa tra le vie Malta e Lussimpiccolo tornerà presto nelle mani della Città di Torino. L'Asl, l'attuale proprietaria del vecchio terreno, ha deciso di rinunciare alla realizzazione di quell'ambulatorio che avrebbe visto la luce soltanto con il nuovo piano sanitario della Regione Piemonte. Un dietrofront davvero inaspettato. E dopo venti lunghi anni di abbandono, di polemiche, di proteste e di progetti mai partiti la circoscrizione Tre ha deciso di prendere la palla al balzo e di chiedere la riqualificazione del terreno. Attraverso la progettazione di alcuni parcheggi pertinenziali, utili per i residenti del quartiere borgo San Paolo.

"Tempo addietro ci era stato proposto dalla Città di realizzare un parcheggio nei pressi di via Rivalta – racconta il presidente della circoscrizione Tre Daniele Valle -. A questo punto, viste le ultime evoluzioni, speriamo che il Comune di Torino rinunci a quel progetto portando avanti un piano di studi per l'area ex PontCantamessa di via Malta, per porre finalmente la parola fine ai disagi di quella zona. Disagi che durano da troppo tempo". Il terreno, negli ultimi mesi, si è trasformato in un'immensa giungla. Come si può vedere transitando a piedi o in auto. Poche settimane fa alcune mamme della zona eran persin scese in strada per una protesta alquanto singolare.

Le signore armate di forbici e strumenti del mestiere si erano messe a tagliare l'erba e a potare i rami. Il tutto accompagnato dai soliti striscioni. Una mossa che ha richiamato l'attenzione delle istituzioni. "Le piante stanno crescendo a dismisura senza contare che qualcuno ha pensato bene di trasformare via Malta in un'area per cani – denuncia Giancarlo, un residente di corso Rosselli -. Dopo anni di parole siamo di nuovo da punto a capo. A questo punto speriamo che l'amministrazione comunale decida di prendere seriamente in considerazione l'ipotesi di realizzare un parcheggio".

Fig. 82: Newspaper article (Versienti, 2012)

In the absence of a suitable development project, this area could be converted into parking lots.

Via Malta: ASL has cancelled the construction of the outpatient clinic in the abandoned area via Malta.

L'Asl ha deciso di riconsegnare il terreno alla Città. In via Malta non lascerà nessun ambulatorio. In piedi rimane sempre l'ipotesi del pertinenziale

The ASL has decided to return the piece of land to the City. There will be no clinic on via Malta. The hypothesis of service destination remains in place.

quartiere. **L'area ex PontCantamessa tra le vie Malta e Lussimpiccolo tornerà presto nelle mani della Città di Torino. L'Asl, l'attuale proprietaria del vecchio terreno, ha deciso di rinunciare alla realizzazione di quell'ambulatorio che avrebbe visto la luce soltanto con il nuovo piano sanitario della Regione Piemonte.** Un dietrofront davvero inaspettato. E dopo

The former exPontCantamessa area between Malta and Lussimpiccolo streets will soon be returned to the City of Turin. The ASL, the current owner of the abandoned land, has decided not to proceed with the construction of the clinic that was planned as part of the new health plan for the Piedmont Region

nuovo piano sanitario della Regione Piemonte. Un dietrofront davvero inaspettato. **E dopo venti lunghi anni di abbandono, di polemiche, di proteste e di progetti mai partiti la circoscrizione Tre ha deciso di prendere la palla al balzo e di chiedere la riqualificazione del terreno. Attraverso la progettazione di alcuni parcheggi pertinenziali, utili per i residenti del quartiere borgo San Paolo.**

After twenty long years of abandonment, controversy, protests, as well as a number of failed projects. The circoscrizione 3 have decided to request the redevelopment of the area. Through the design of some parking lots, which will be of benefit to residents of the Borgo San Paolo neighbourhood.

parola fine ai disagi di quella zona. Disagi che durano da troppo tempo". **Il terreno, negli ultimi mesi, si è trasformato in un'immensa giungla.** Come si può vedere transitando a piedi o in

The area has become a jungle.

l'attenzione delle istituzioni. **"Le piante stanno crescendo a dismisura senza contare che qualcuno ha pensato bene di trasformare via Malta in un'area per cani – denuncia Giancarlo,**

The plants are growing out of control, not to mention that someone has thought its a good idea to transform via Malta into a dog area. – reports a resident of the neighbourhood.

Area of intervention Analysis - Density

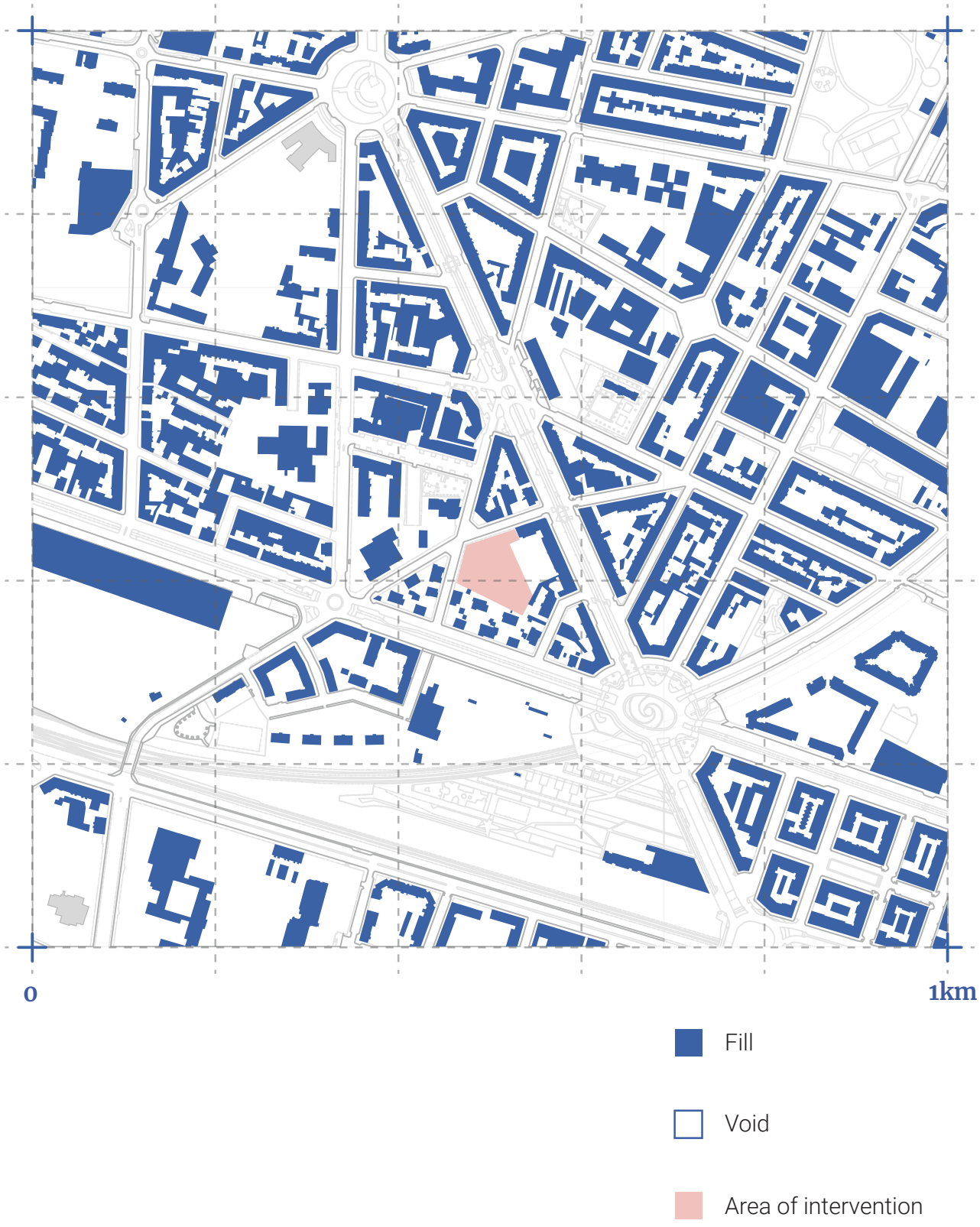


Fig. 83: Density: Fill and void. Made by the author based on Turin's cartographic information (Città di Torino, 2023b).

Green areas and Recreational spaces

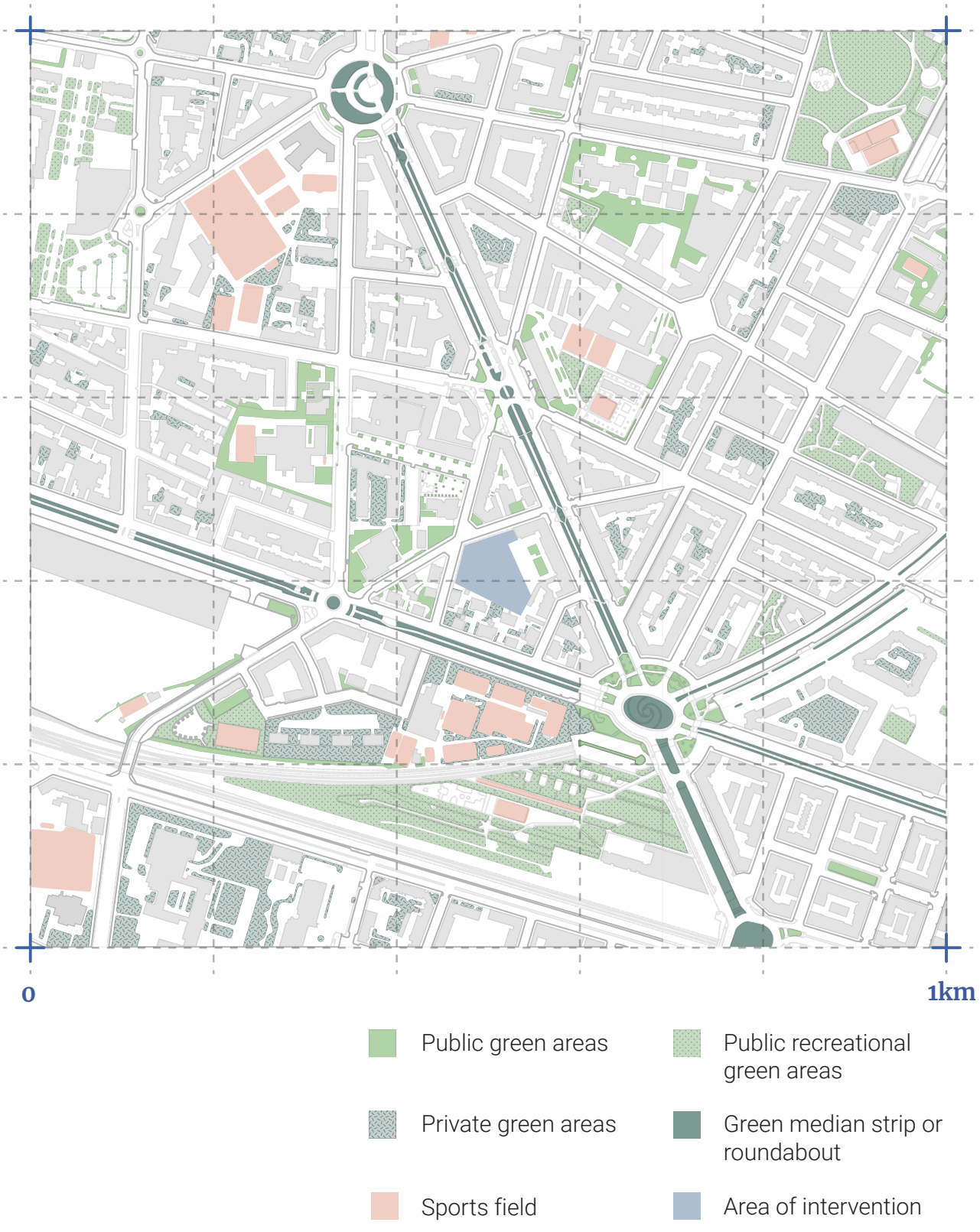


Fig. 84: Green areas and Recreational spaces. Made by the author based on Turin's cartographic information (Città di Torino, 2023b).

Turin's Urban Plan Extraxt

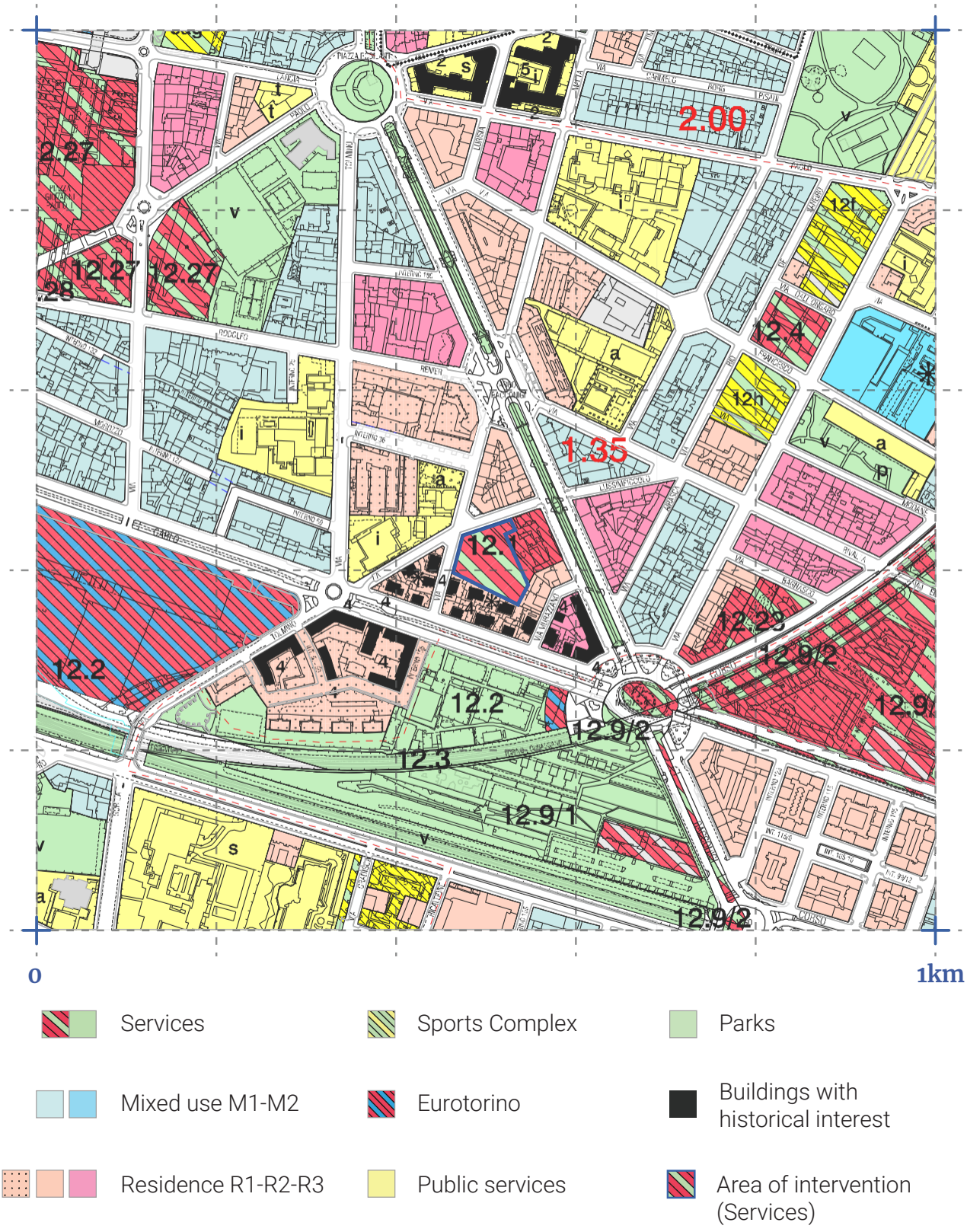


Fig. 85: Turin's Urban Plan Extraxt - "Piano regolatore generale" (Città di Torino, 2023b).

Urban facilities

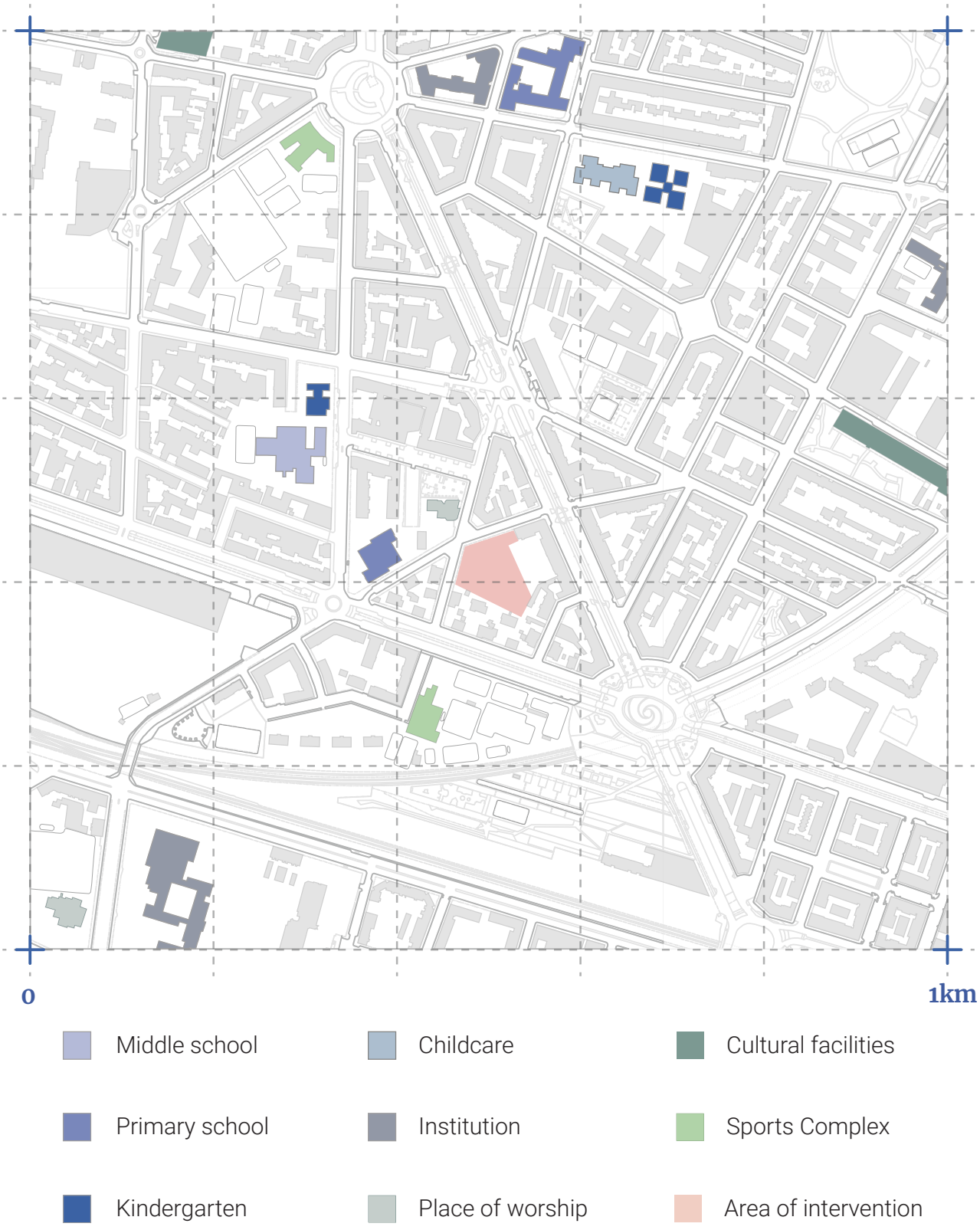


Fig. 86: Urban facilities. Made by the author based on Turin's cartographic information (Città di Torino, 2023b).

Transportation Network, Bus stations and bike paths

Fig. 87: Transportation Network, Bus stations and bike paths. Made by the author based on Turin's cartographic information (Città di Torino, 2023b).

Buildings' height

Fig. 88: Buildings' height. Made by the author based on Turin's cartographic information (Città di Torino, 2023b).

05.9 Biophilic Child-Friendly Library

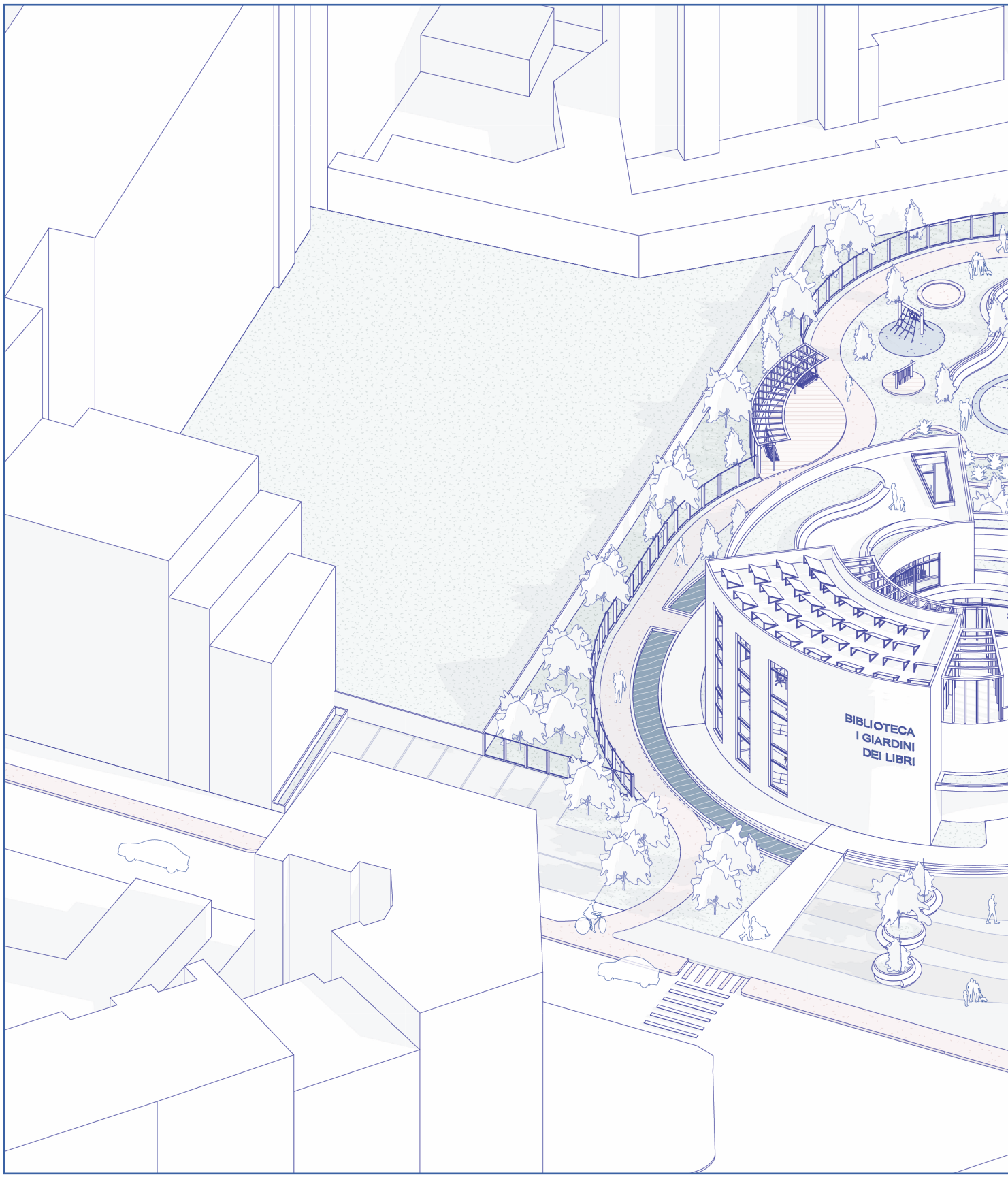
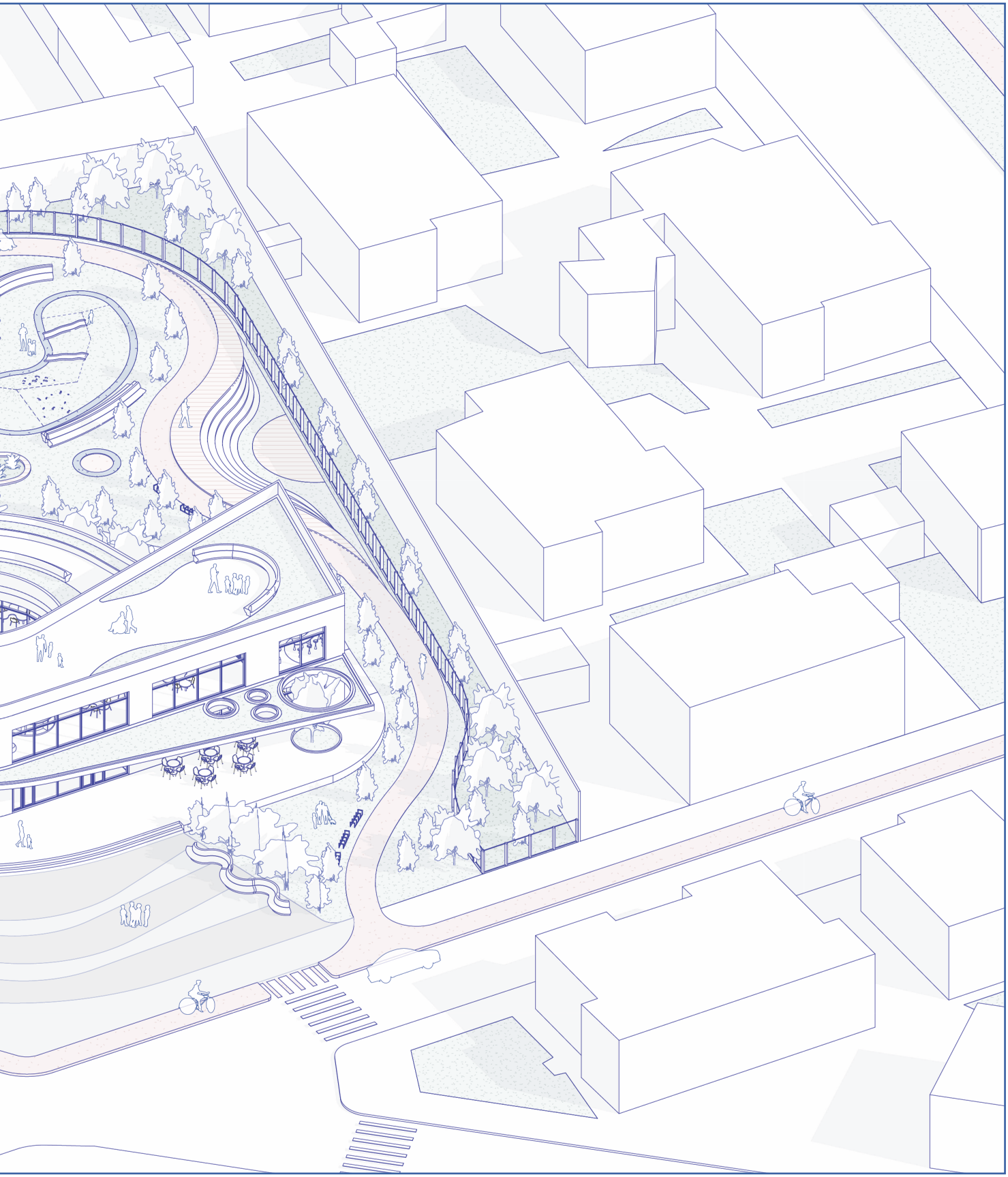
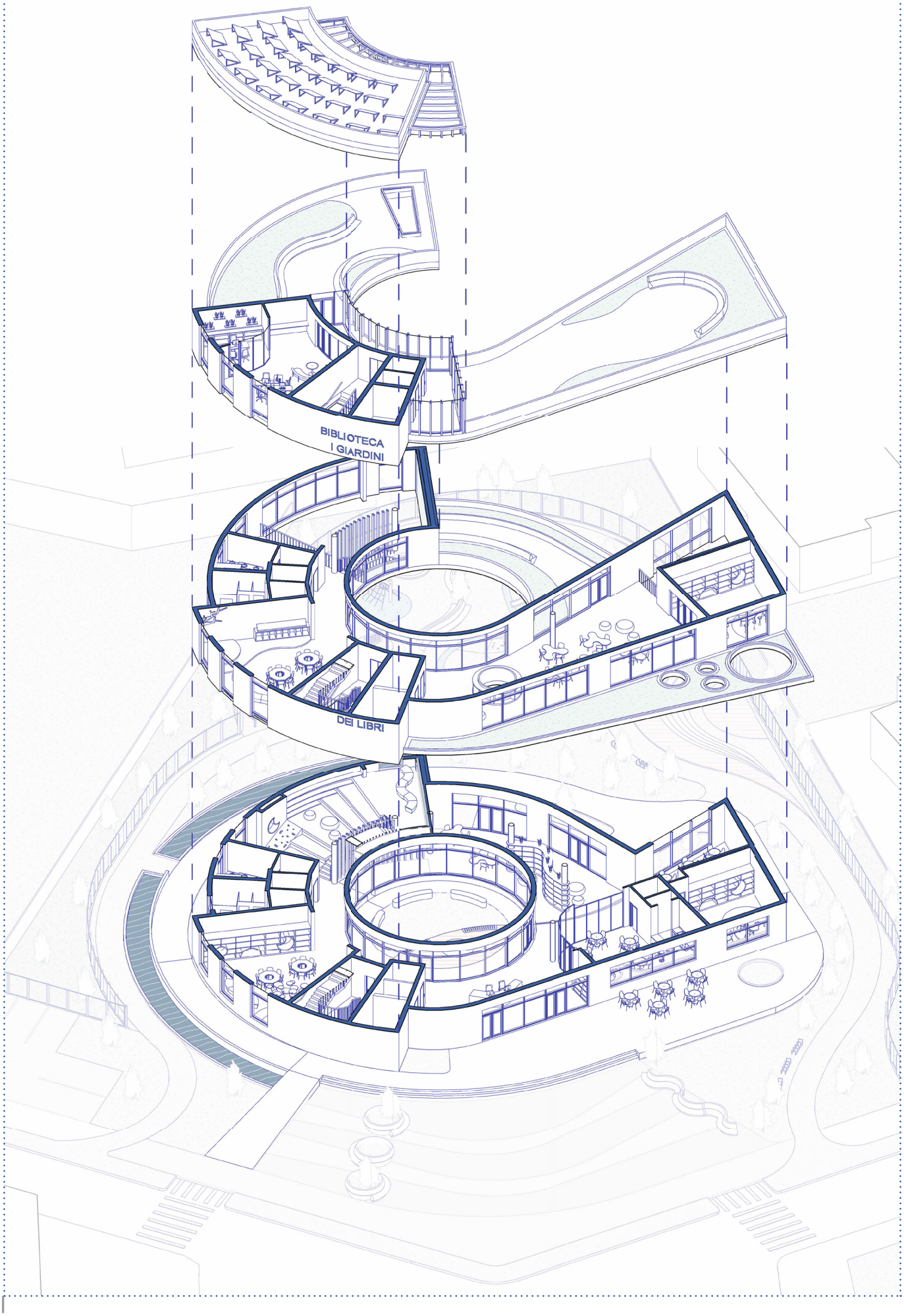


Fig. 89: Biophilic Child-Friendly Library. Made by the author.

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'La Biblioteca i giardini dei libri' is a nature-based library designed specifically for children with the principles of biophilic design and the research explained in this thesis. It is intended to be a library that is more than just a place for book reading. Its goal is to create an immersive environment that encourages reading and increases curiosity about the natural world. It provides an interactive space where children can explore, learn, connect with nature, and enhance their social relationships.

Shape: The library has a concentric floor plan, creating an interior garden. It has a wing that is extended to create a protected area. The shape opens the view to different areas of the surrounding landscape. This characteristic fosters exploration and discovery.

Levels: The building consists of three levels. The ground floor is partially elevated, creating interconnected spaces that offer different experiences and make exploration of the library more dynamic.

Green Patio: The circulation of the library revolves around a central courtyard, creating a reading garden that provides a peaceful environment and encourages a connection with nature.

Roof: The project's roof is used to install photovoltaic systems and green terraces to create private outdoor reading spaces, while regulating the building's temperature and reducing rainwater runoff. The skylights are strategically placed to let in natural light for the interior vegetation.

Façades: It has floor-to-ceiling windows that maximize the amount of natural light entering the space. This reduces the need for artificial lighting. Some of the exterior and interior walls are green walls. In addition to enhancing the aesthetics of the building, these living walls provide insulation and promote biodiversity by attracting nearby species.

The outdoor area of the project is composed of the following spaces:

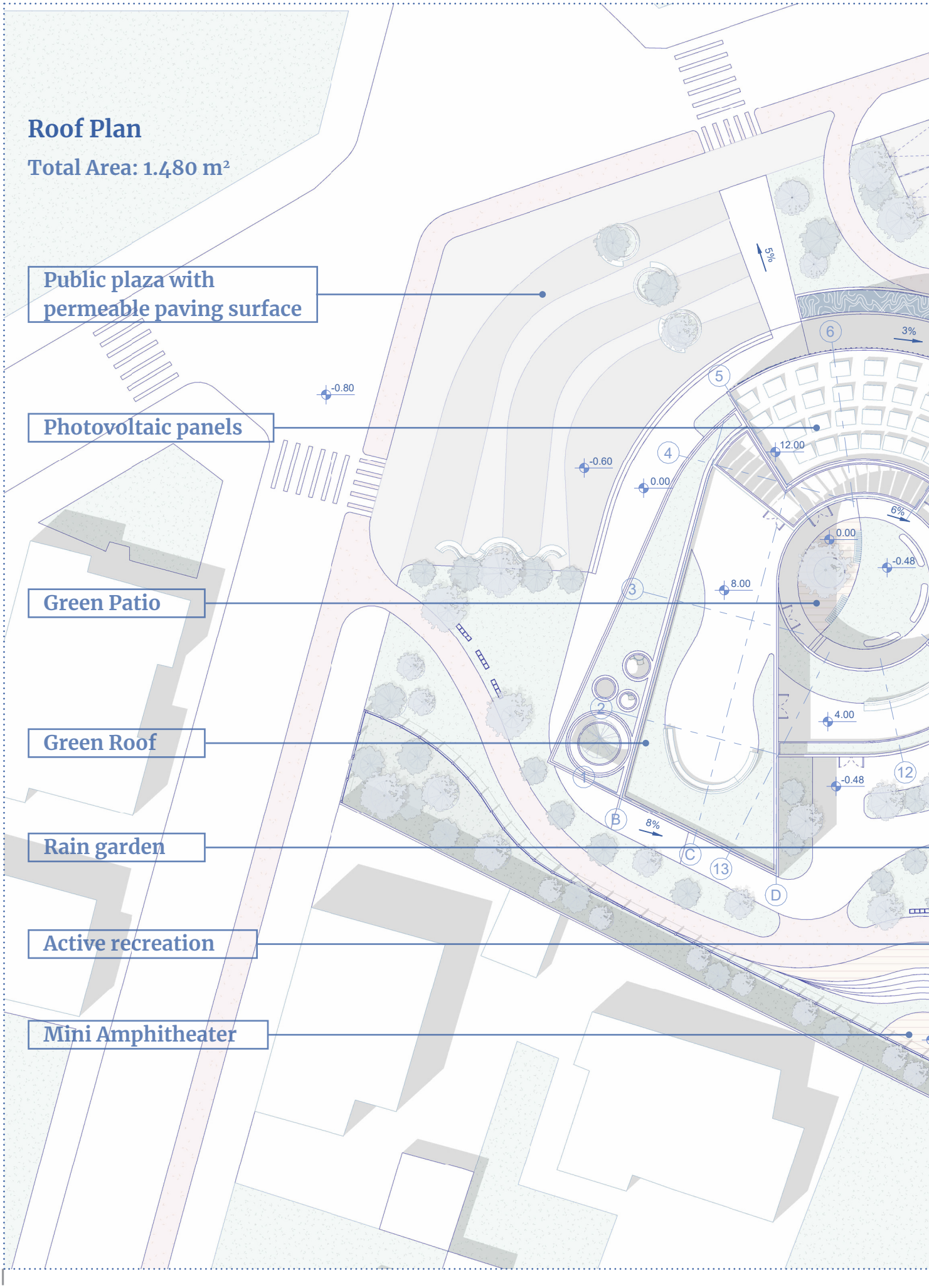
An **Urban Plaza** that connects the project with the city, is an open and flexible space that serves as a gathering area. The plaza is paved with permeable materials that allow rainwater to seep through and prevent flooding.

Walking and cycling path through gardens, a water feature and sensory pathways, a nature observation area filled with native plants that are protected by a face to grow freely.

A **playground** designed to bring children closer to nature, to encourage them to play outdoors, and to teach them about the natural world through experiential and sensorial learning. It is designed to include passive and active recreation. It includes sound games, the use of sand and natural materials, climbing and sliding games. Additionally, a section of the playground is dedicated to a rain garden that collects rainwater, an It has seating areas for parents and caregivers. Furthermore, a natural stone and wood amphitheater is set up for storytelling, puppet shows, and outdoor learning activities.

Roof Plan

Total Area: 1.480 m²



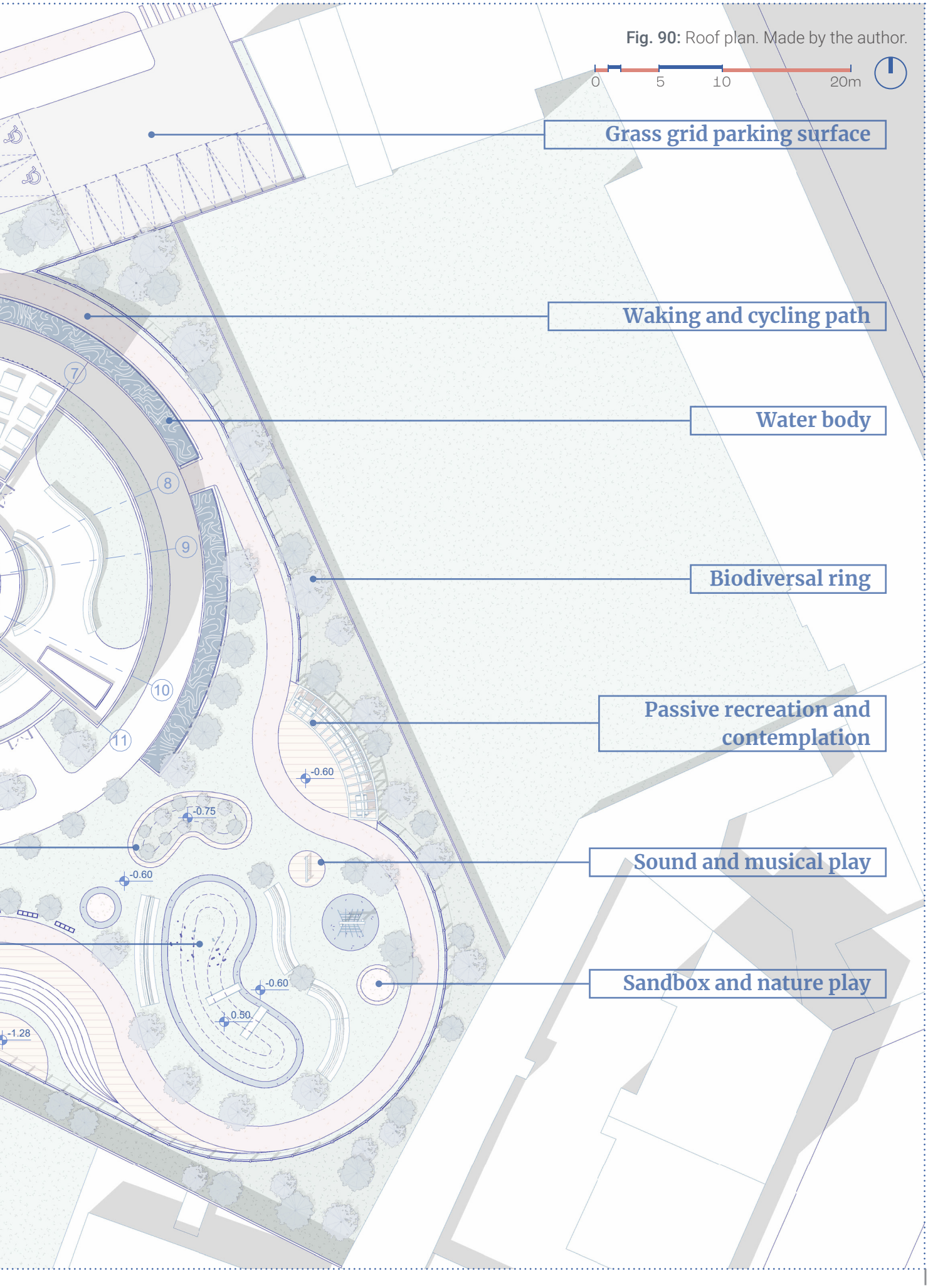


Fig. 90: Roof plan. Made by the author.

Ground floor

Area: 780 m²

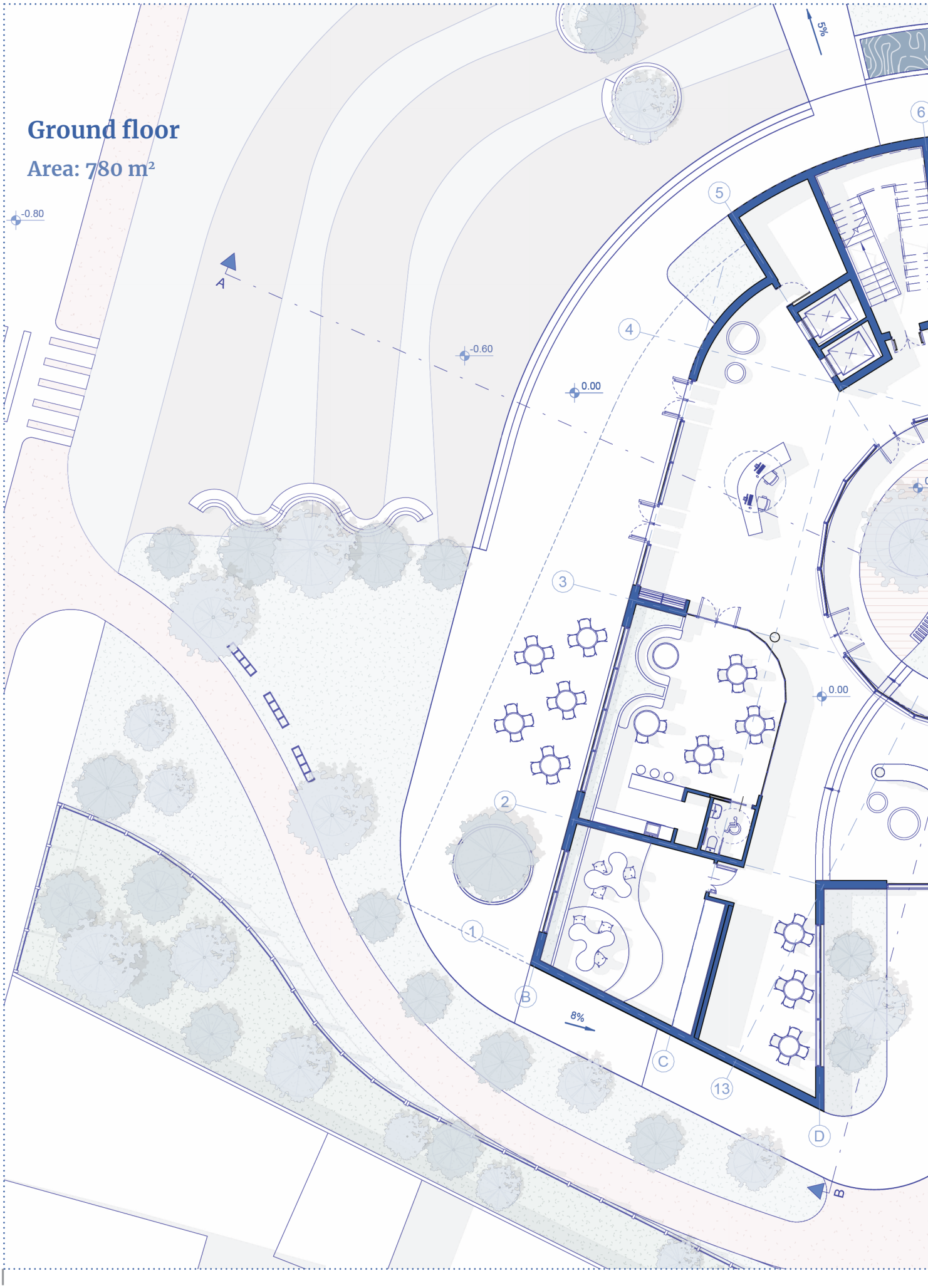
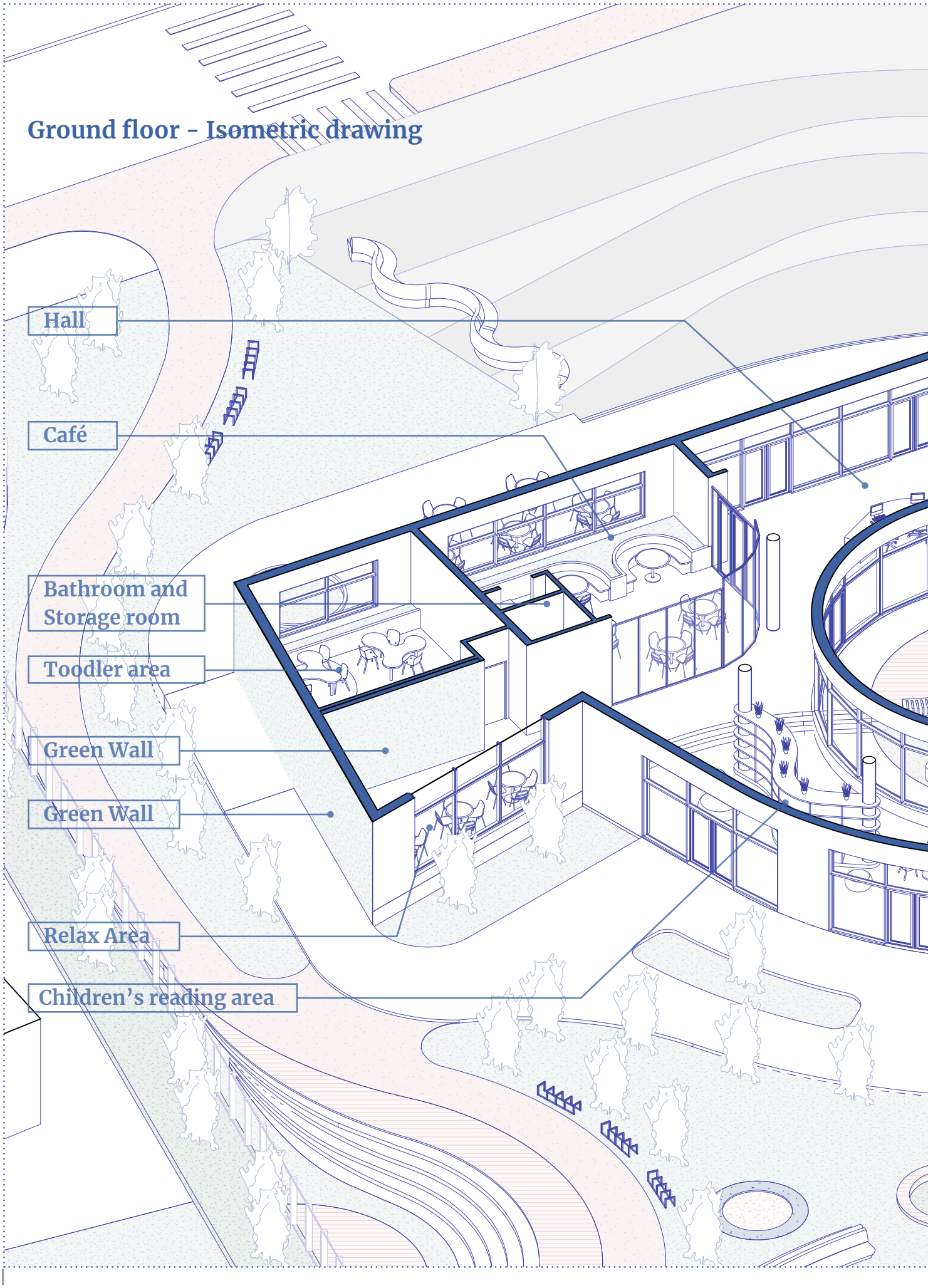


Fig. 91: Ground floor. Scale: 1:200. Made by the author.

Ground floor - Isometric drawing



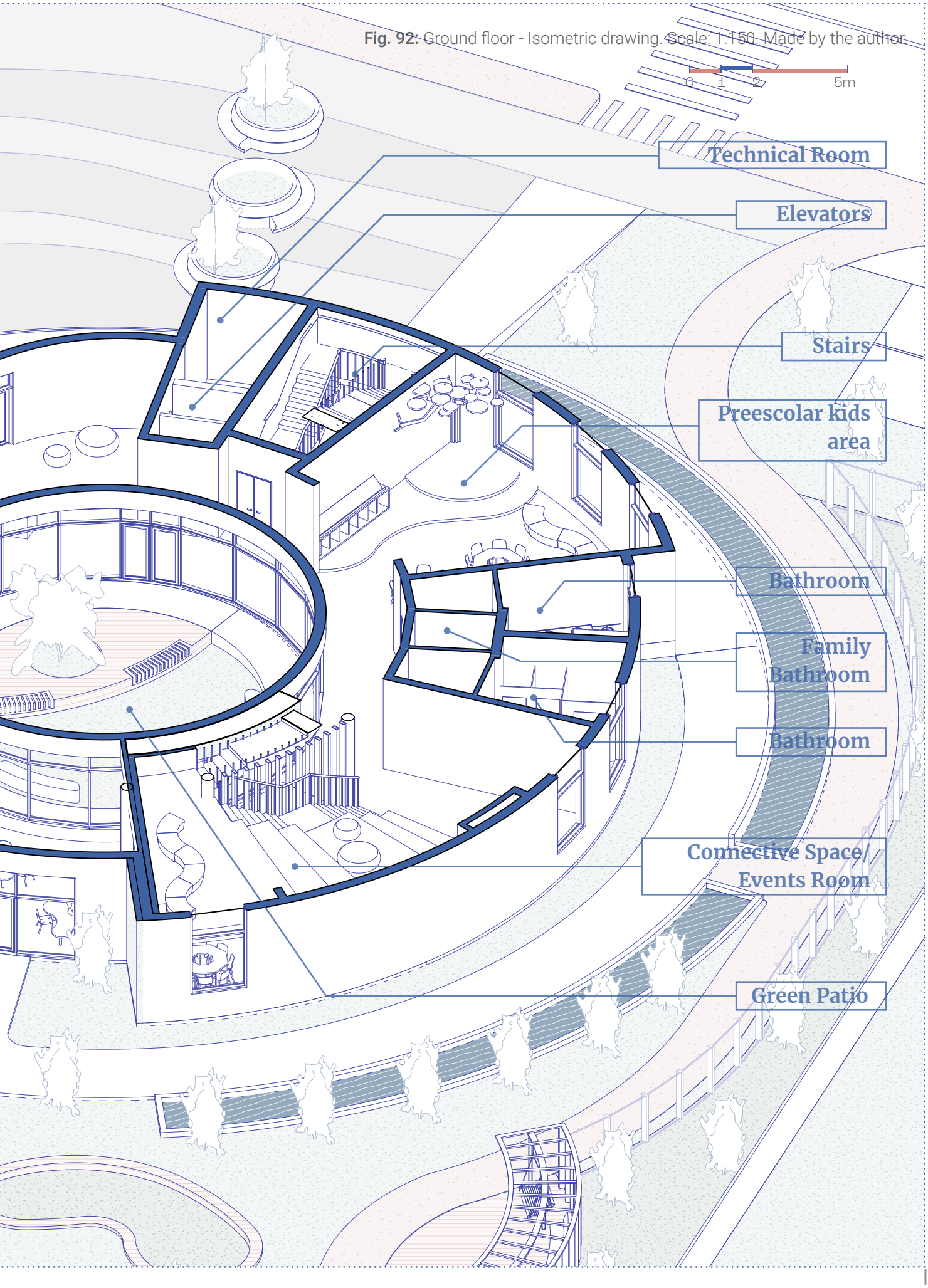
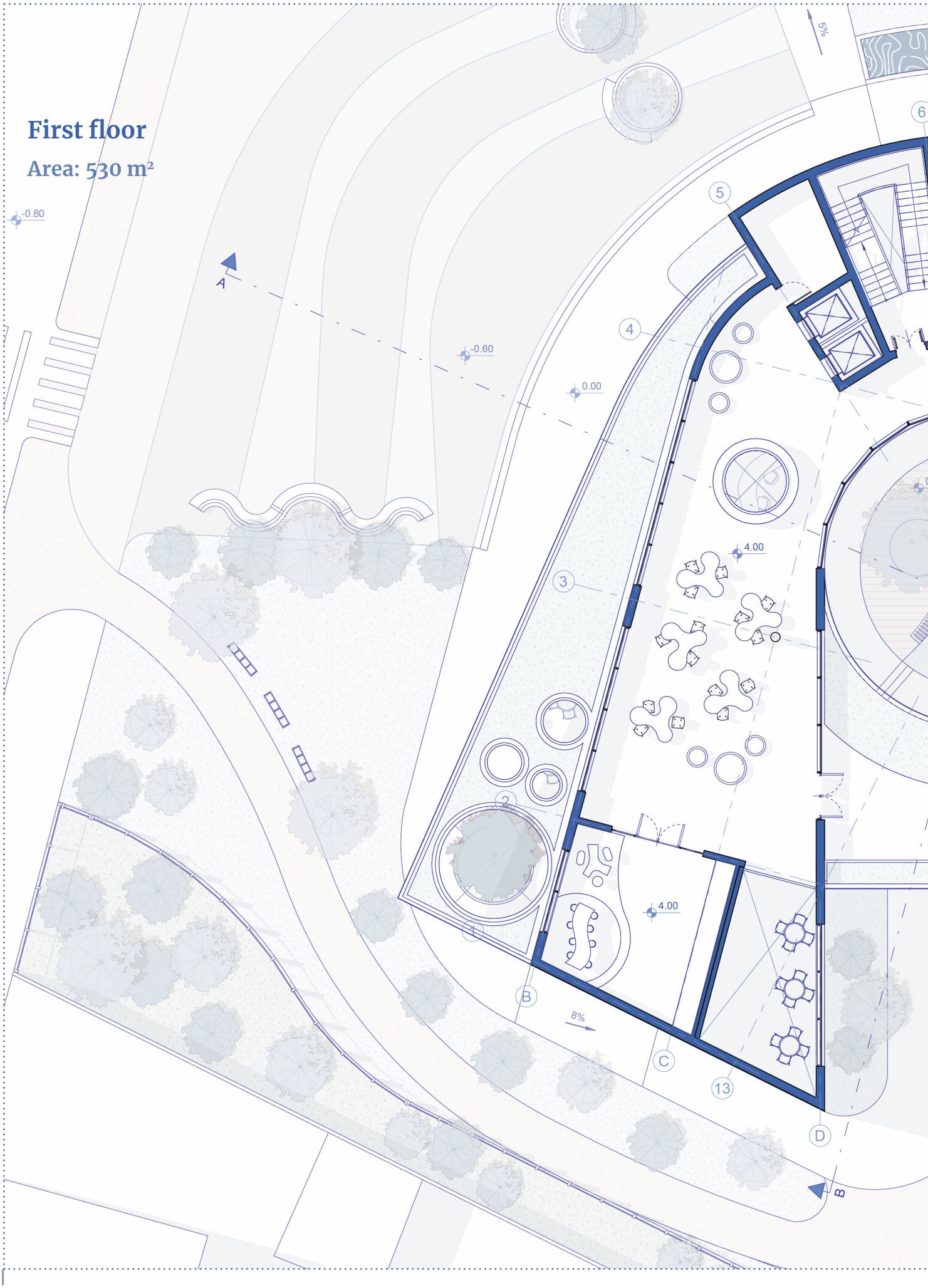


Fig. 92: Ground floor - Isometric drawing. Scale: 1:150. Made by the author.

First floor

Area: 530 m²



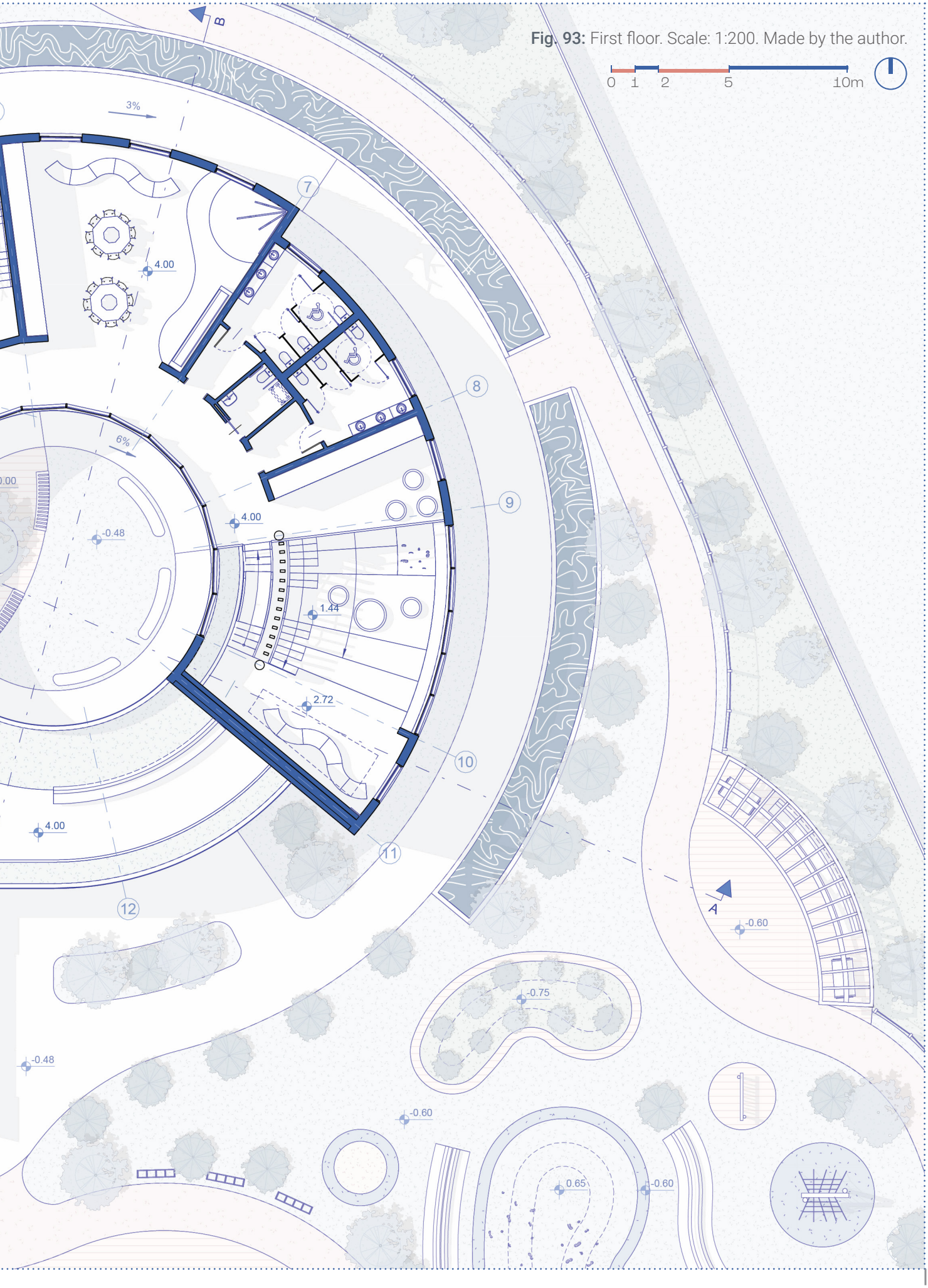


Fig. 93: First floor. Scale: 1:200. Made by the author.

First floor - Isometric drawing

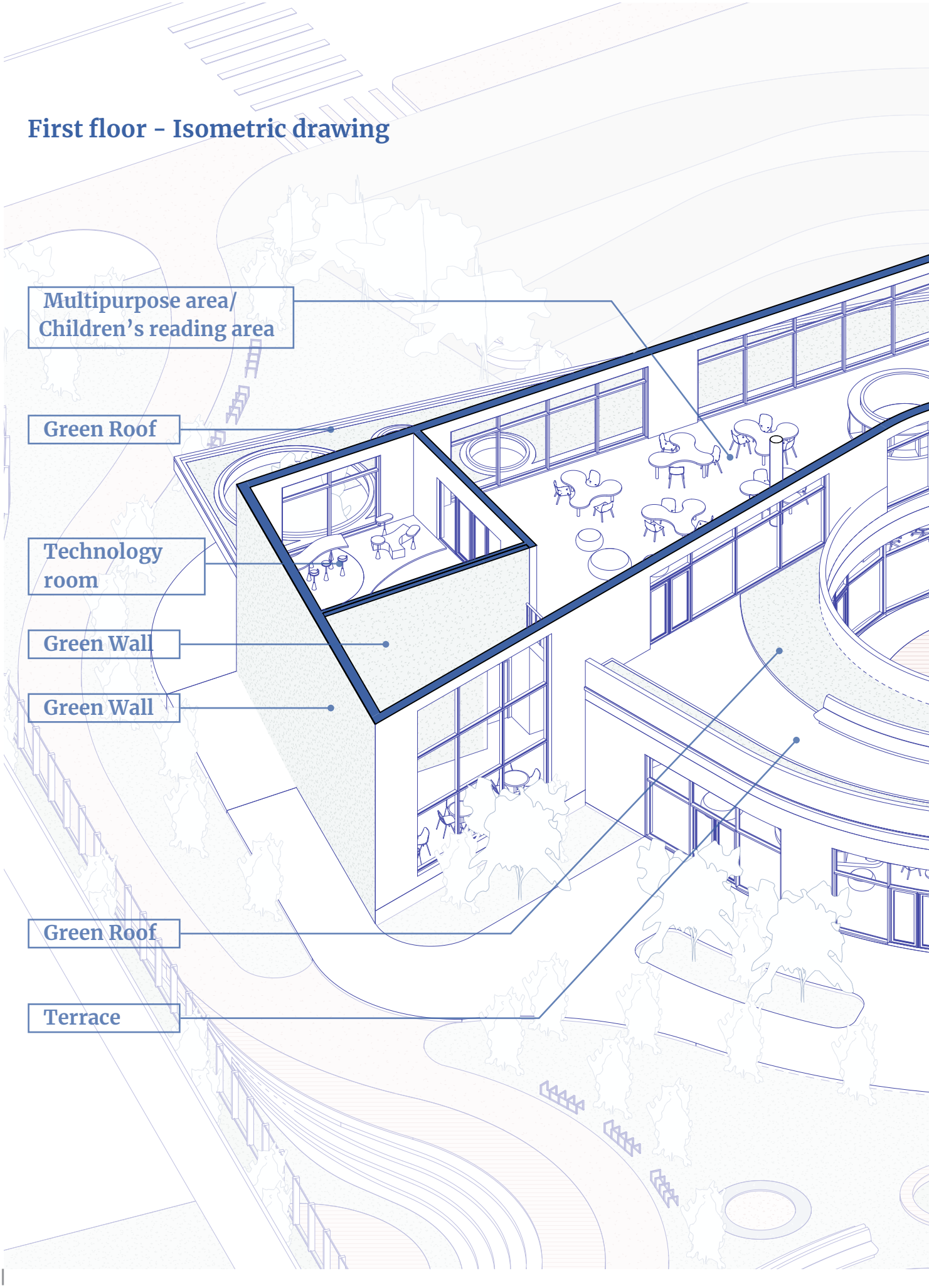
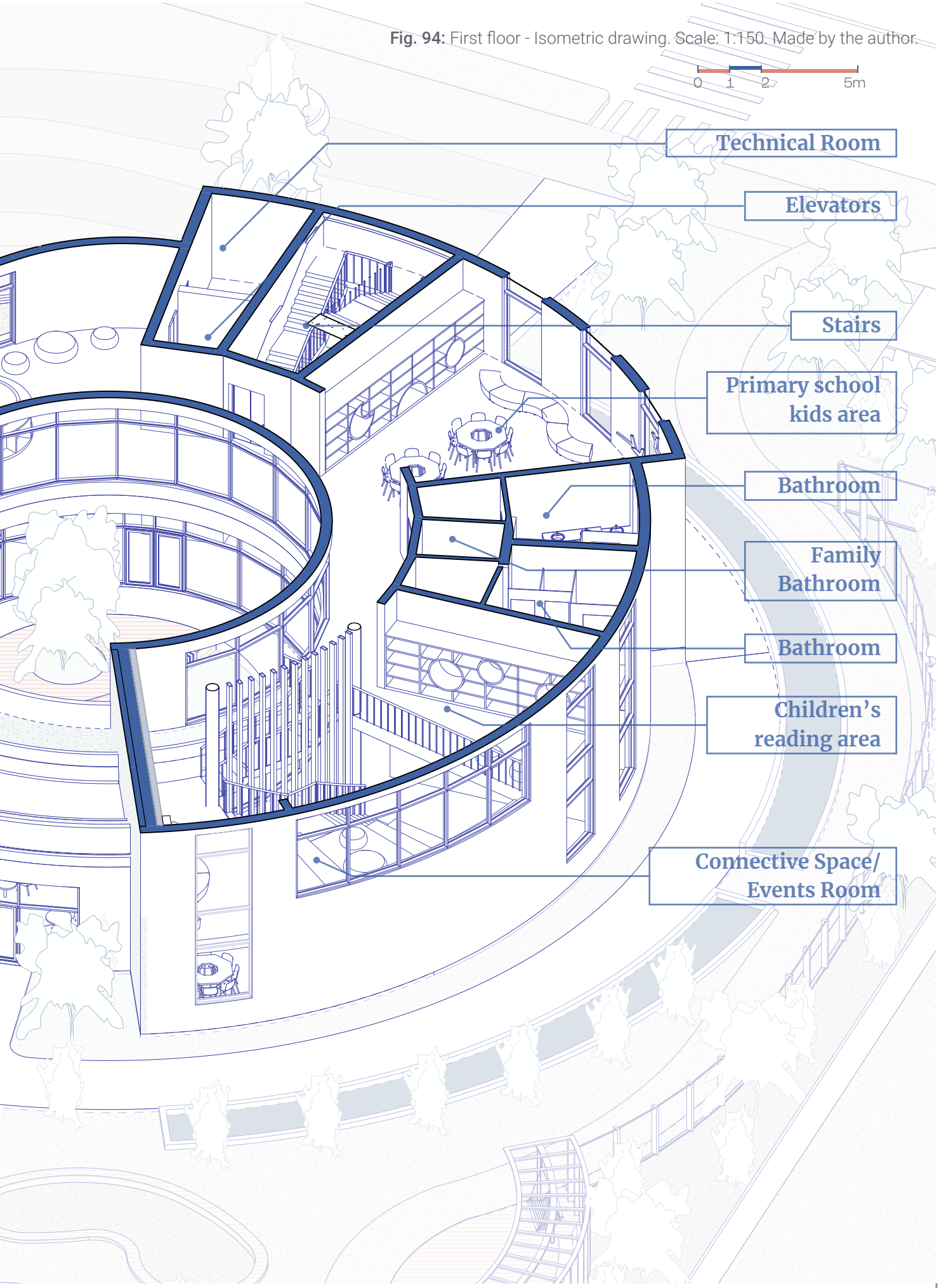
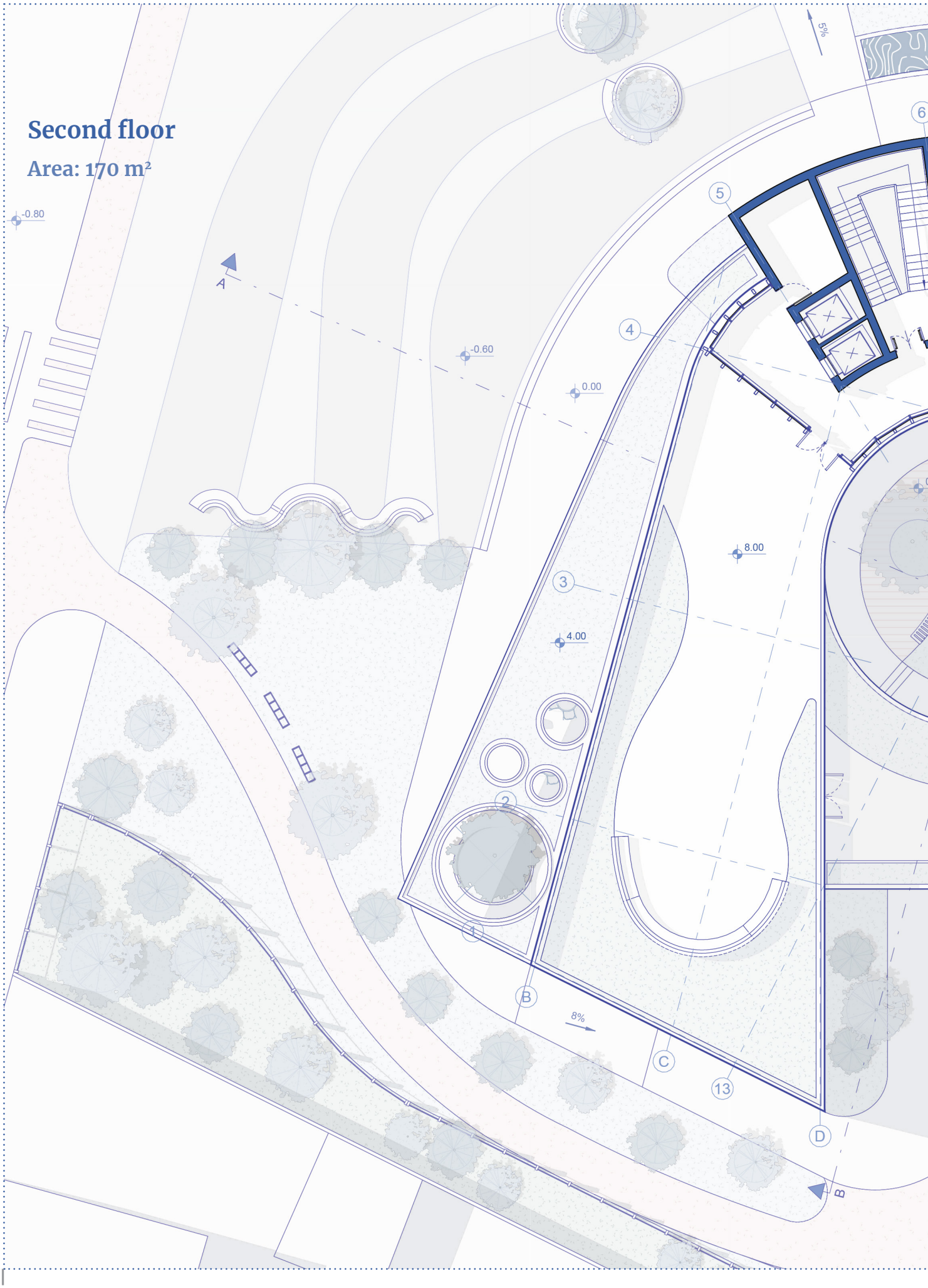


Fig. 94: First floor - Isometric drawing. Scale: 1:150. Made by the author.



Second floor

Area: 170 m²



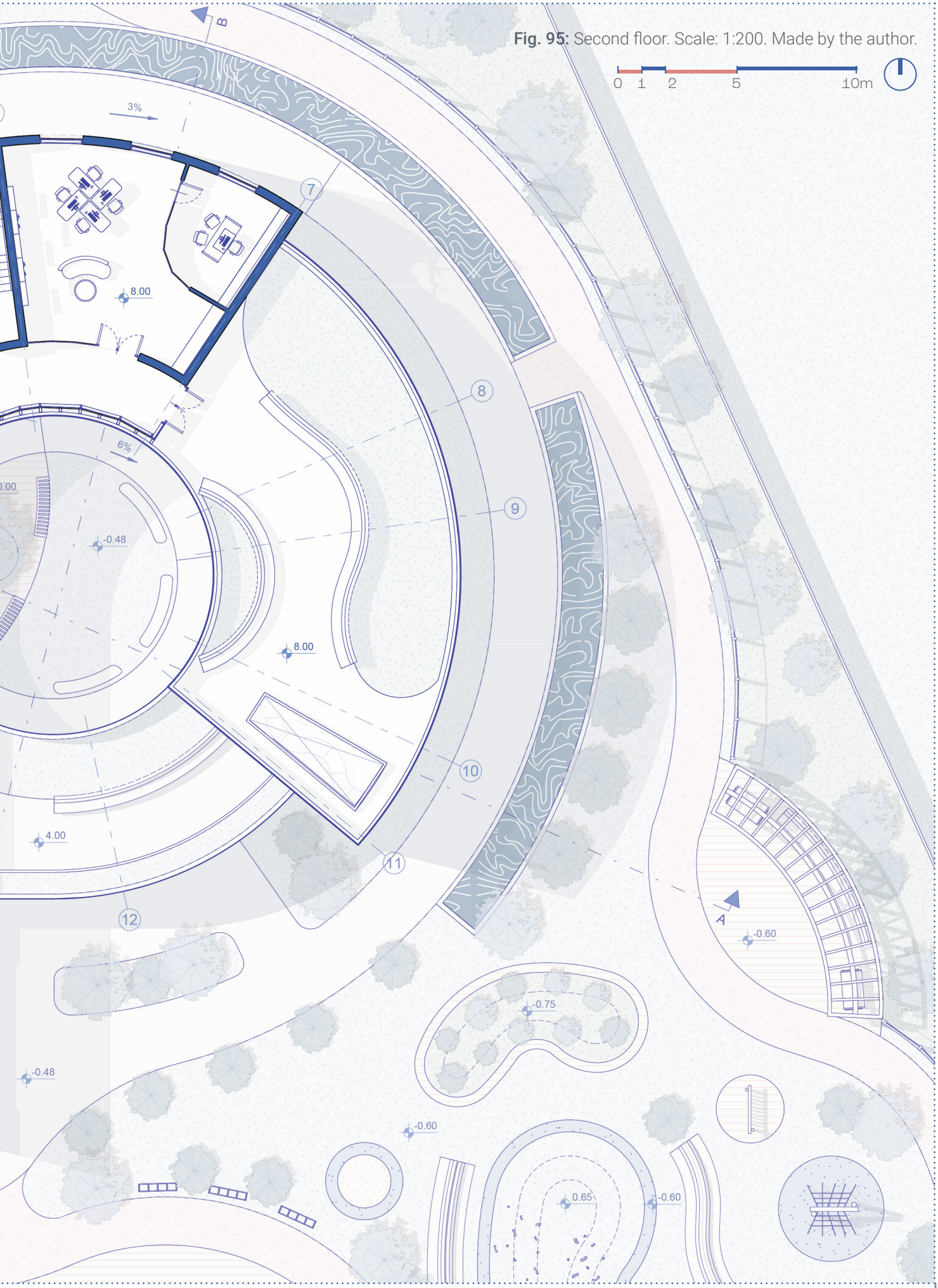


Fig. 95: Second floor. Scale: 1:200. Made by the author.

Second floor - Isometric drawing

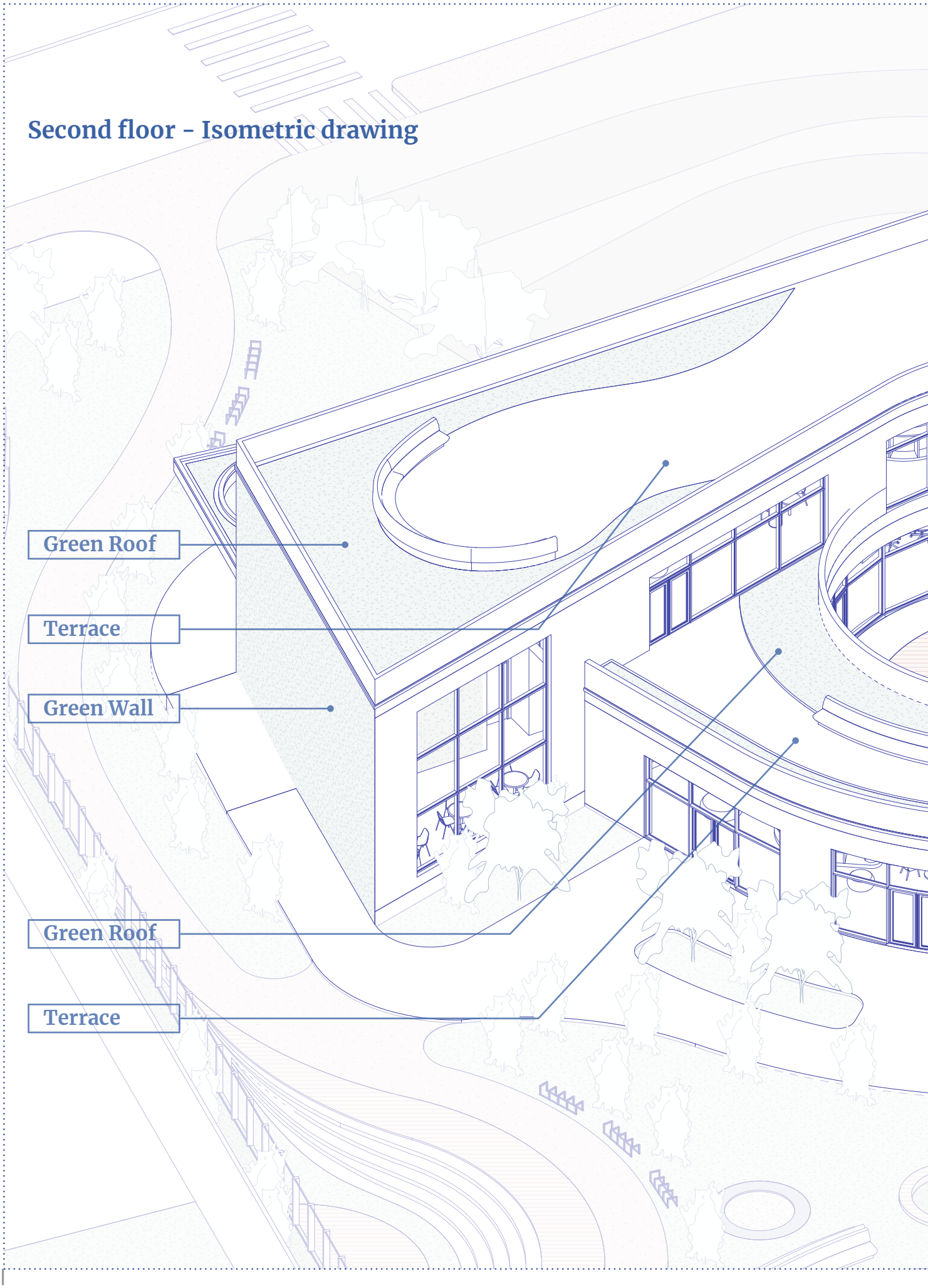
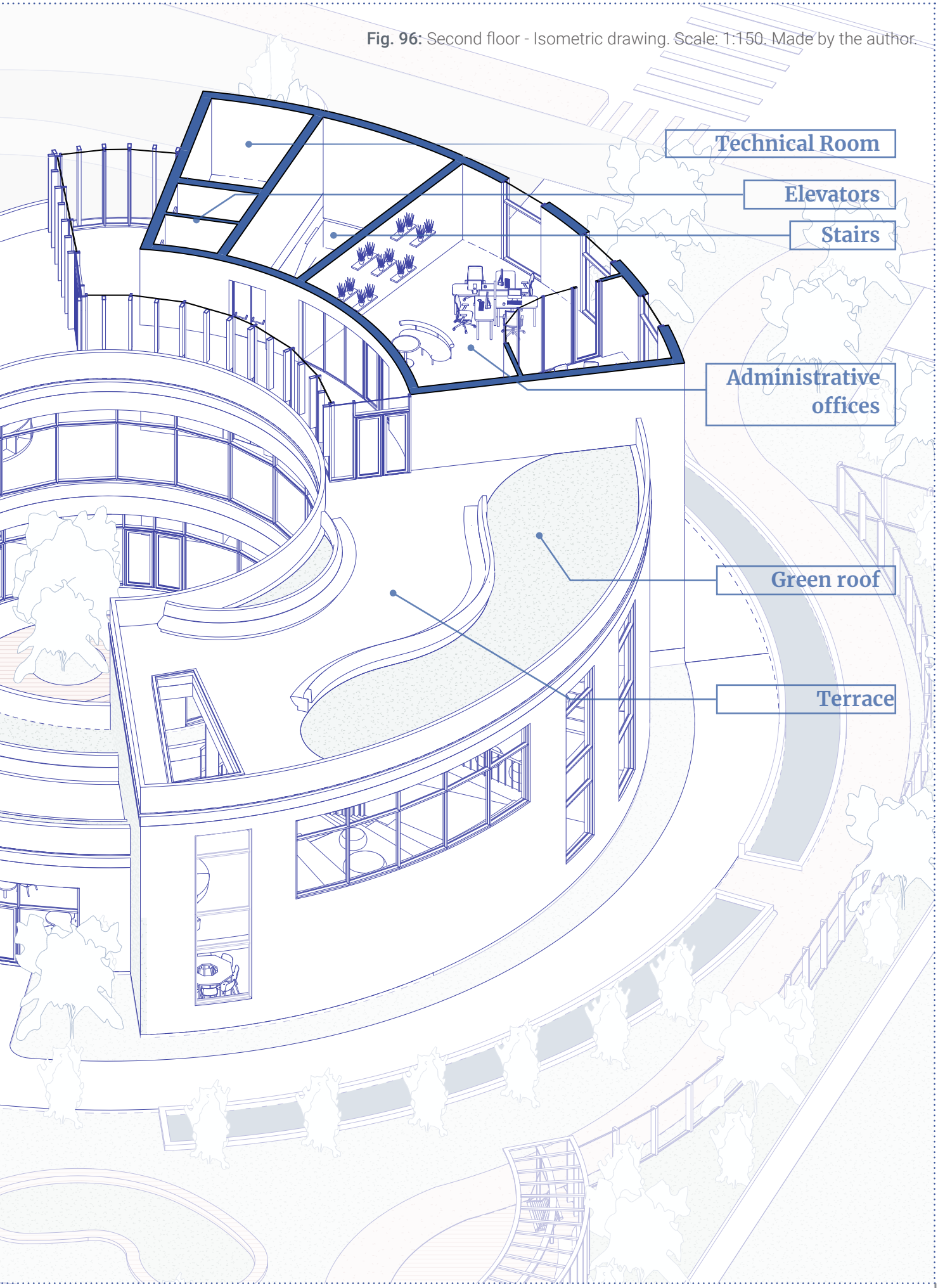
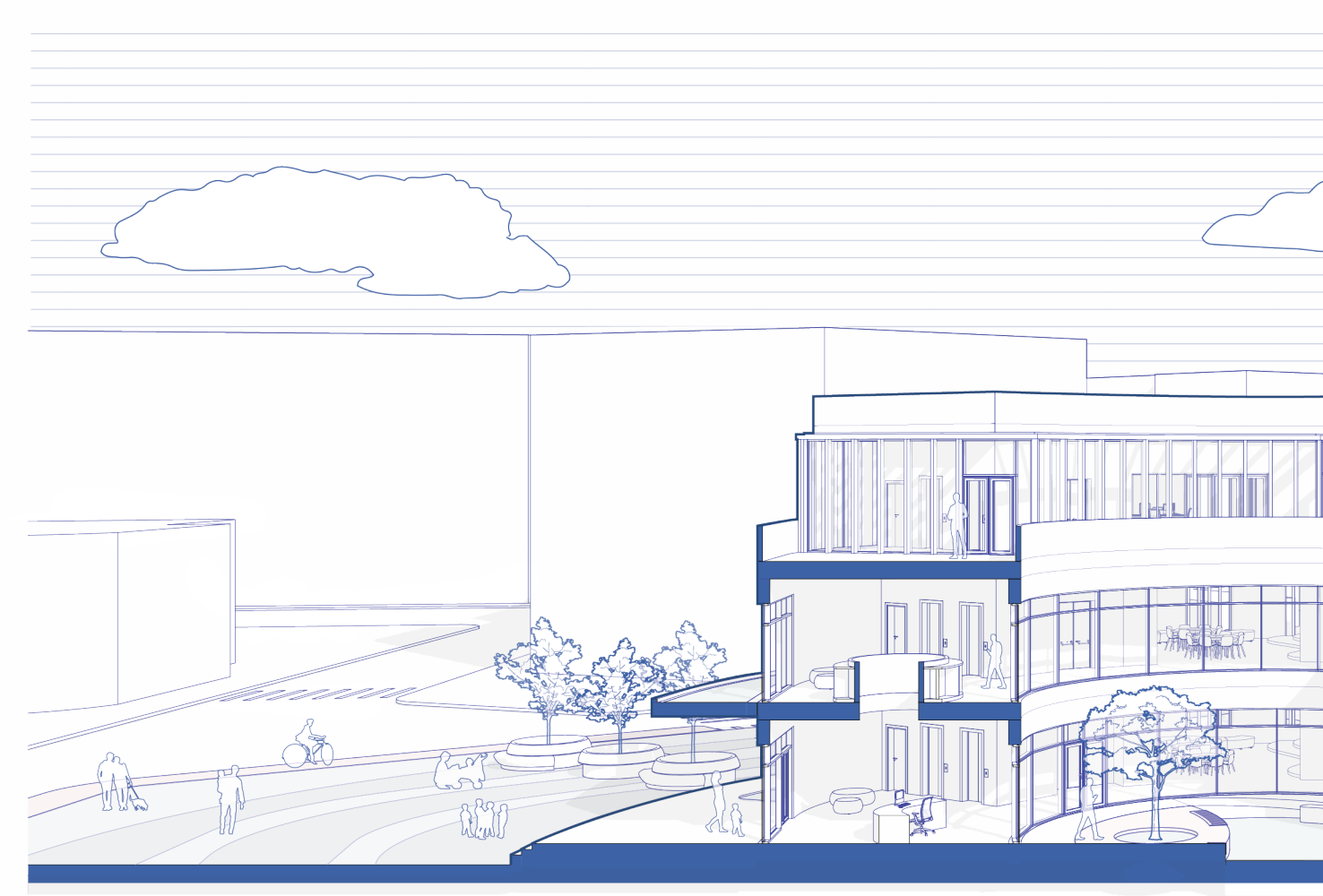


Fig. 96: Second floor - Isometric drawing. Scale: 1:150. Made by the author.



Perspective Section A-A



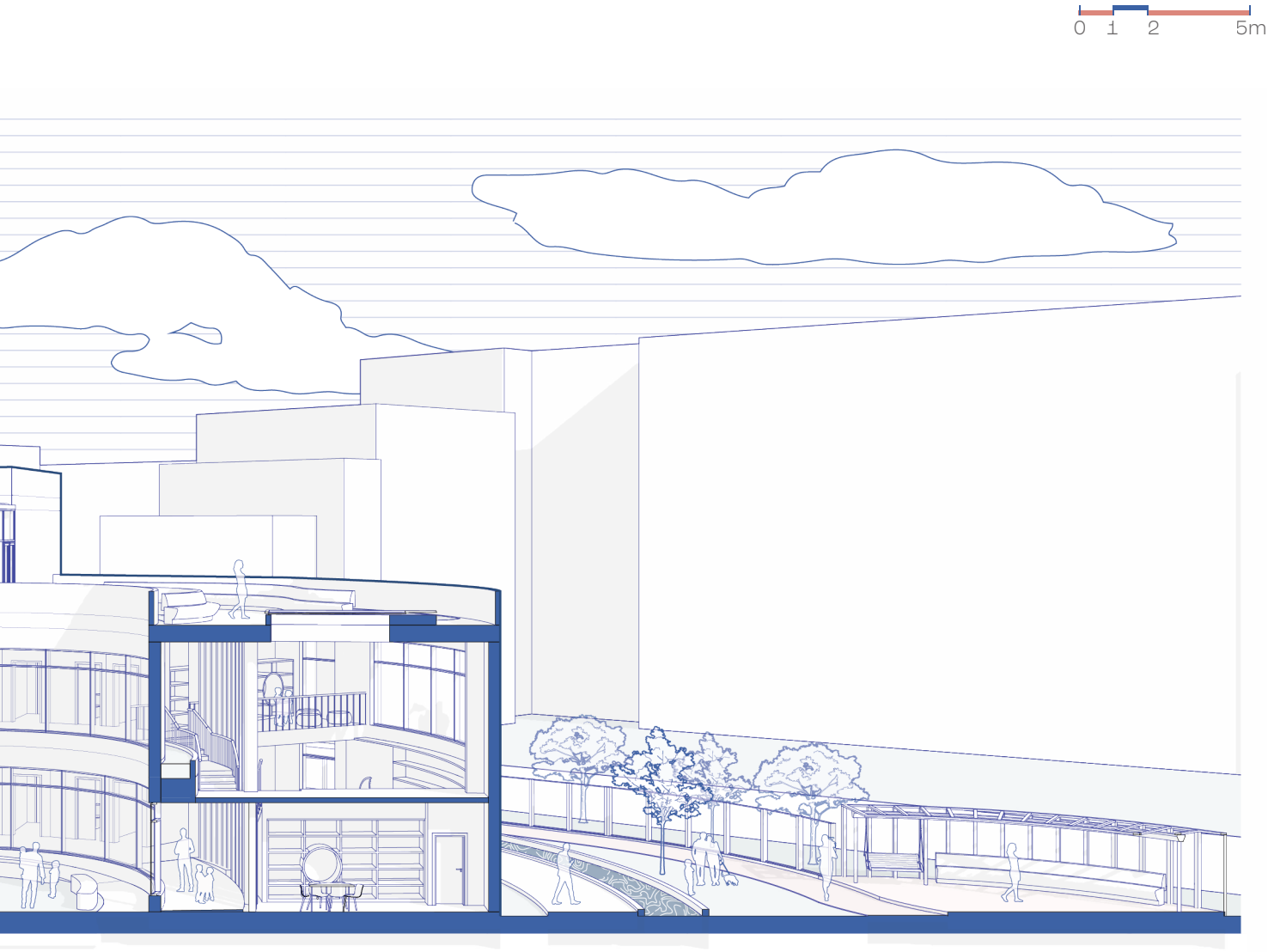
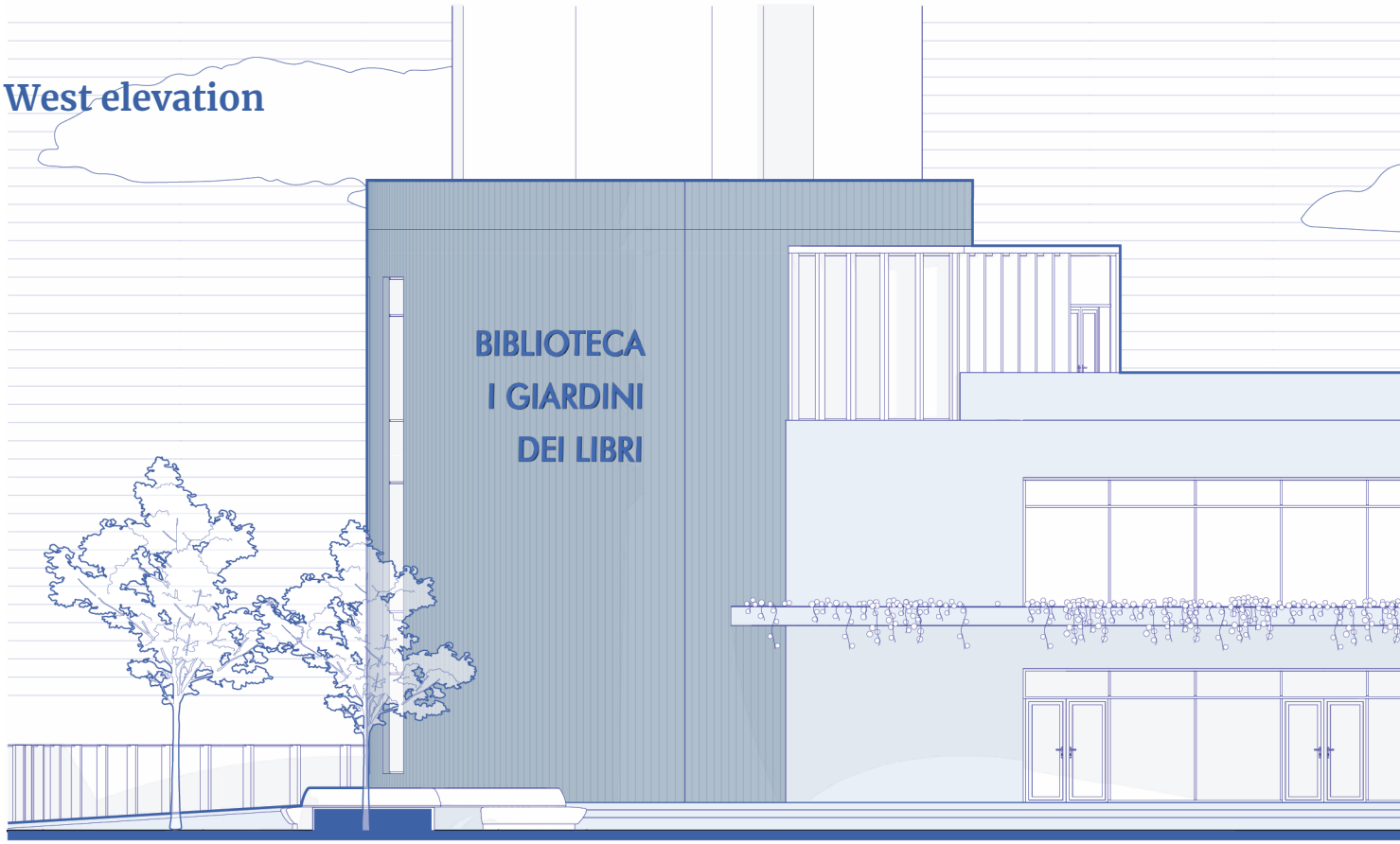
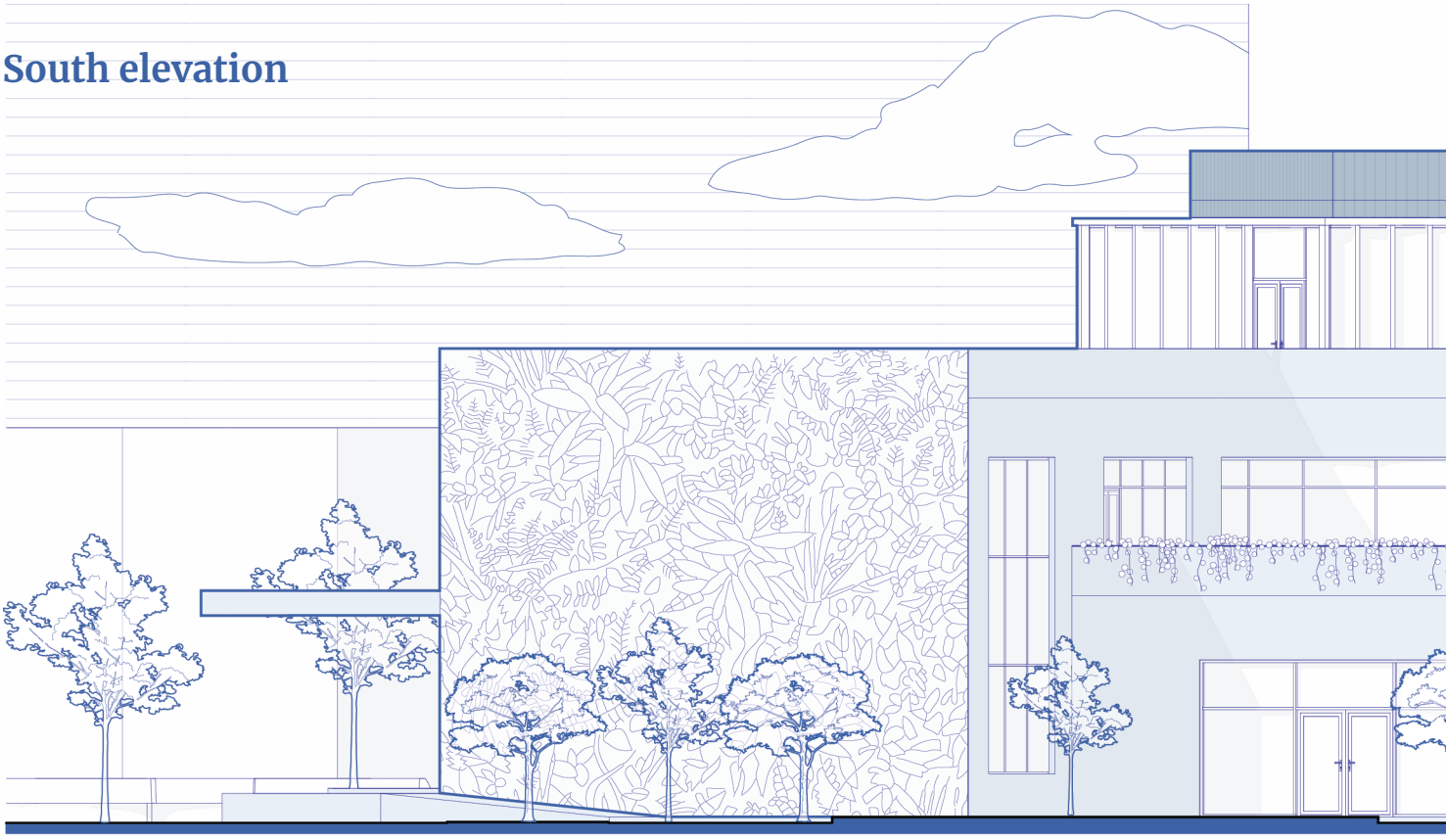


Fig. 97: Perspective section A-A. Made by the author.

West elevation



South elevation



0 1 2 5m

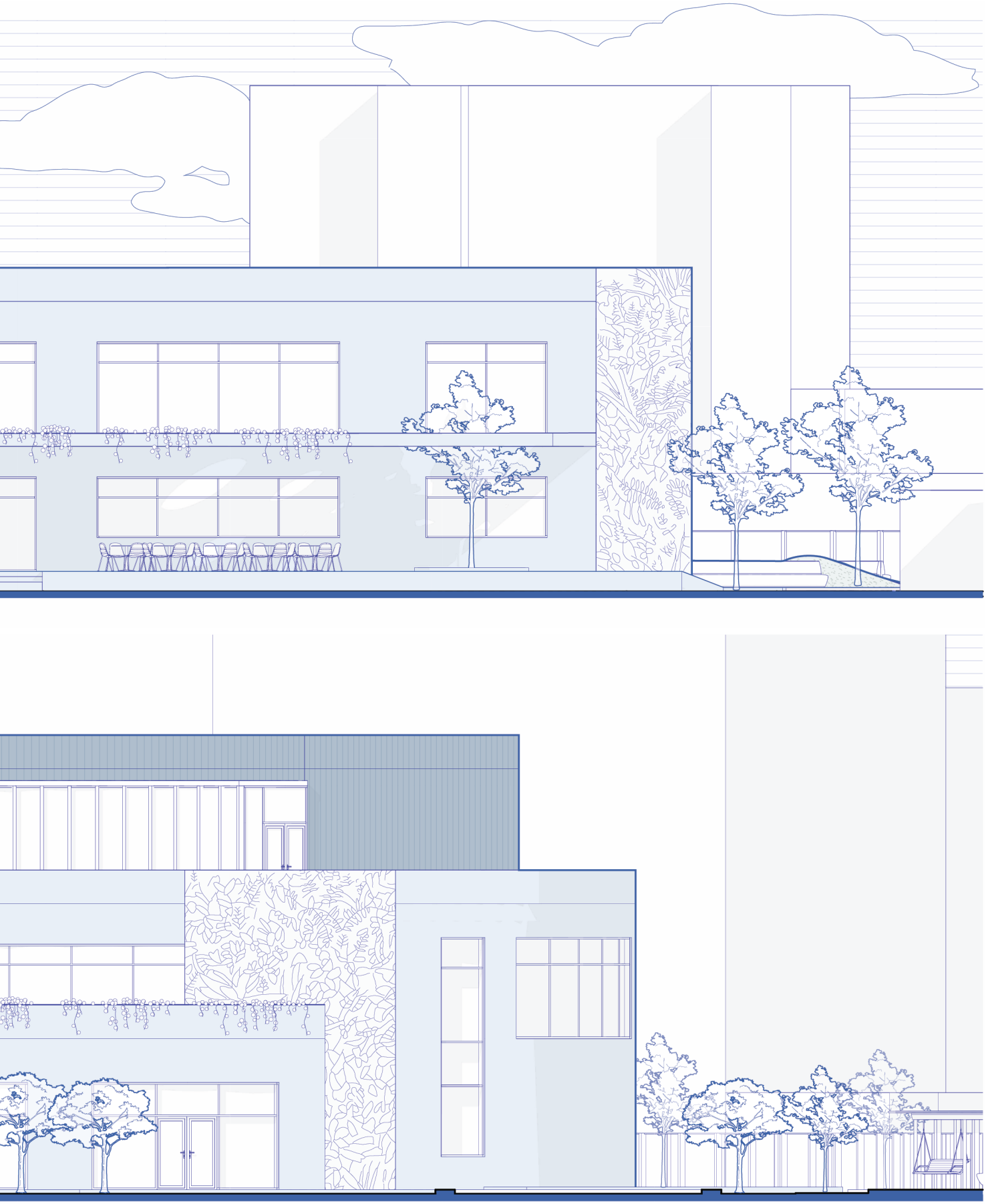
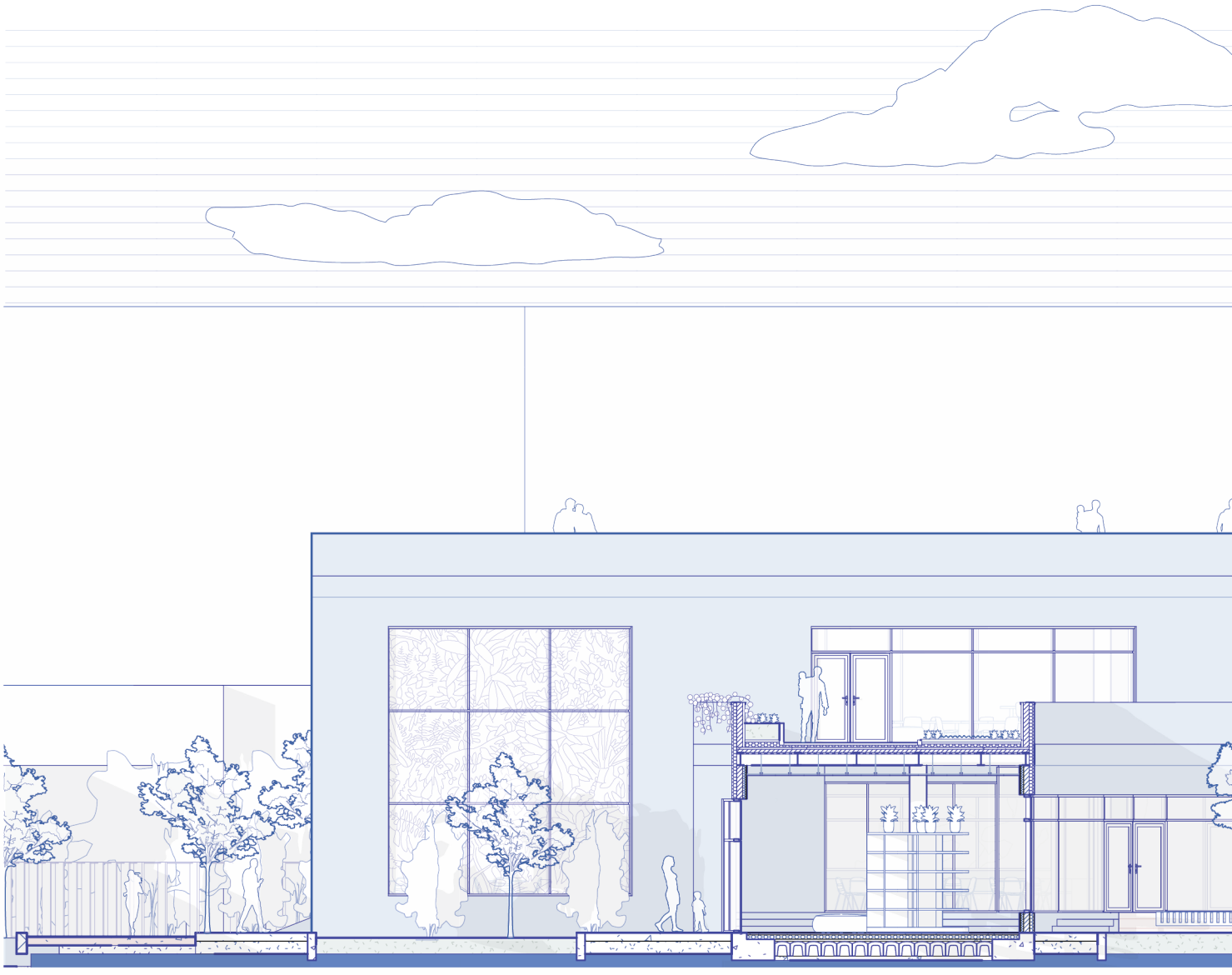


Fig. 98: West and South elevation. Scale: 1:150. Made by the author.

Section B-B



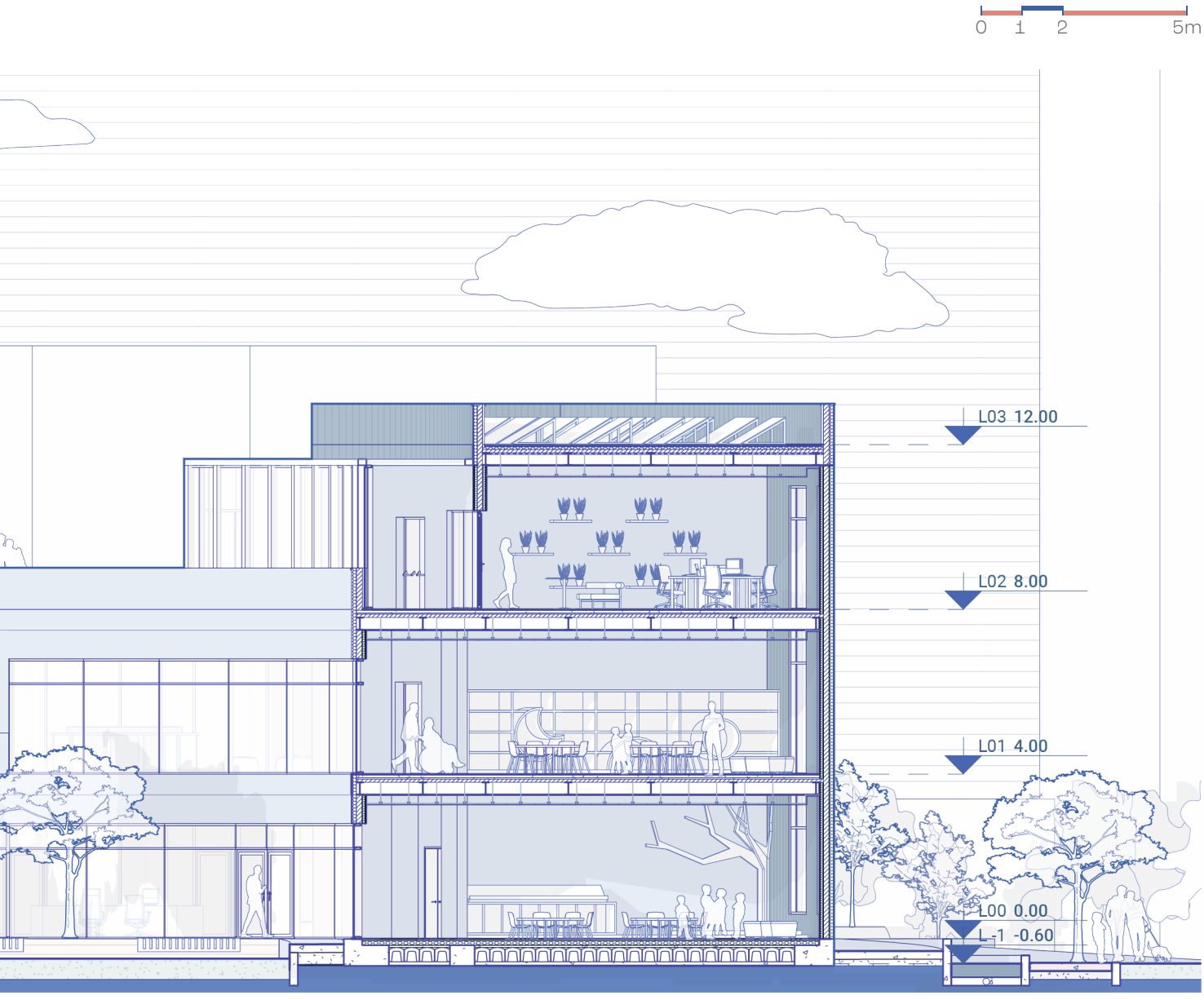


Fig. 99: Section B - B. Scale: 1:150. Made by the author.


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Fig. 100: Main access perspective. Made by the author.

Fig. 101: Playground and building perspective. Made by the author.

06| Conclusions

This thesis explores the children's urban landscapes and the benefits of having a child-friendly city seeking to explain the need to include more opportunities to enhance the connection with nature. To achieve this goal it adopts nature-based design, focusing especially on the importance of biophilic design. With this approach, the urban environment will be safer, it will increase the health of the population and their general well-being. In addition, it will help build sustainable environments. Biophilic design is a strategy for obtaining sustainable development with a human-centered viewpoint, and combined with the power of playing spaces, reinforce their affinity with the natural environment, their sensory exploration, and the capacity of increasing social interaction.

Urban landscapes for children should aim to provide equal opportunities for all children in order to promote their social inclusion and equitable engagement in society. Moreover, including people with disabilities, who should have access to quality environments that meet their individual needs. Architecture should also care about broadening their sensory experience and improving their interpersonal abilities, particularly if a child presents certain difficulties. Considering that the natural environment is the primary source of sensory stimulation, having the flexibility to connect with nature at multiple moments and places is indispensable for children's healthy growth and for developing their ability to adapt to the world and use their senses to interact with it. I identified that there's a need for achieving Biophilic Child- Friendly Cities and Buildings. In this scenario, through biophilic design and enhancing the human-nature connections, the sensory exploration will increase, creating spaces more inclusive and sustainable, better places to live.

Libraries create an environment that provides opportunities for new discoveries, learning, and greater social relationships, fostering a sense of community. Is a space to exchange ideas and gain collective insights, rather than a book repository. Combining them with a Biophilic design approach these spaces generate an environment of relaxation that increases their learning capabilities, while we will be tackling the aforementioned contemporary world problems. With the proposal of the project "i giardini dei libri" library, the biophilic solutions were included in its design to achieve the goals explained in this thesis. The project aims to contribute a greater social integration among the childrens of the city of Turin, while creating a healthy and active community with the increasing connection with nature, the sensory exploration and the playing opportunities, while straightening the nature-human relationship.

To highlight, my contribution could be summarized as:

- State-of-the-art analysis on biophilia, children-nature inner connection, children city landscapes, Child-Friendly cities, the biophilic design attributes and patterns and its contributions with children's health and wellbeing, Children's social inclusion, interactions, and struggles, and the economic evaluation as a tool for estimating the relevance of green spaces on urban landscapes.

- Evaluation and analysis of Study cases, and how they integrate the biophilic concept into architectural solutions.

- Reasoning on the aforementioned findings and consideration of the lessons learned, identify the need for Biophilic Child- Friendly Cities.

- Findings of an intrinsic relationship between biophilic attributes and human senses.

- Linking the human-nature relationship to particular experiences bounding the library spaces to these relationships.

- Exploring architectural solutions using biophilic elements through its stimuli and user experiences to include them in the design of children's urban landscapes,

- Analyzing the city of Turin and developing a proposal of a Biophilic Child-friendly building, a library in an abandoned area of the city of Turin.

07| Appendices

Appendix 1. Biophobia:

Biophobia is the aversion to nature. The term covers a wide variety of emotions, including discomfort in natural environments and rejection of everything that is not artificial, controlled, or air-conditioned. The potential for this aversive response (irrational fears and disgust responses) to manifest may be increased if children's intrinsic affinity for the natural world is constrained during their developmental years (Russo and Andreucci, 2023).

Appendix 2. Children's Urban Landscapes:

For the purposes of the research presented here, an urban landscape is defined as a complex combination of natural and human-made elements that includes buildings and urban open spaces; and the children's urban landscapes as urban landscapes with a focus on children, that prioritize their perspectives and are safer, more exciting, and more active (Balogh et al., 2020).

Appendix 3. Child-Friendly cities:

A Child-Friendly city is a city that adopts safety, healthy, lively and sustainability as main developmental principles. Developers must consider the perspectives of children when developing urban environments, on aspects such as colors, forms, scales, textures, balance, interactivity, and creativity (Balogh et al., 2020). This thesis highlights that Child-friendly cities should be designed to provide children with access to nature and green spaces, as well as opportunities to encourage social interaction among children and play (Balogh et al., 2020). Those cities create an environment that benefits children's development, health, and access to opportunities, and create inclusive and healthy communities (Jansson et al., 2022; Arup, 2017). Therefore urban planning and design that prioritizes children will result in the creation of a more liveable, sustainable, secure city and more inclusive society. This approach will not only benefit children, but will also have positive impacts for the entire population (Balogh et al., 2020; Arup, 2017).

This approach will not only benefit children, but will also have positive impacts for the entire population (Balogh et al., 2020; Arup, 2017).

Appendix 3. SDG:

The Sustainable Development Goals also known by its initials SDG are "the 17 global goals for development for all countries established by the United Nations through a participatory process and elaborated in the 2030 Agenda for Sustainable Development, including ending poverty and hunger; ensuring health and well-being, education, gender equality, clean water and energy, and decent work; building and ensuring resilient and sustainable

infrastructure, cities and consumption; reducing inequalities; protecting land and water ecosystems; promoting peace, justice and partnerships; and taking urgent action on climate change" (IPCC, 2022). A significant number of these targets are associated with children's development, and ensuring children's affinity with nature can effectively contribute to the achievement of numerous SDG goals (Russo and Andreucci, 2023).

Appendix 5. Sustainability, Sustainable Architecture and Environmental Sustainable Design:

Sustainability is "a dynamic process that guarantees the persistence of natural and human systems in an equitable manner" (IPCC, 2022).

"Sustainable architecture is frequently used to refer to a design that attempts to reduce its environmental impact through the use of sophisticated systems, conscious use of resources, efficient use of energy and water for operations" (Wijesooriya and Brambilla, 2021)

In general, environmentally sustainable design (EDS) "is the field of architecture and design that adheres to the principles of sustainability and energy efficiency, commonly known also as ecologically sustainable design. focuses on energy conservation and efficiency by improving the thermal performance of buildings and promoting the use of renewable sources" (Wijesooriya and Brambilla, 2020).

Appendix 6. Biophilia:

Biophilia is "the idea that humans possess a biological inclination to affiliate with natural systems and processes instrumental in their health and productivity. Originally proposed by the eminent biologist and one of the volume's authors, Edward O. Wilson, biophilia has been eloquently described by Wilson in this way: to explore and affiliate with life is a deep and complicated process in mental development." (Kellert, Heerwagen, and Mador, 2008)

"Biophilia is the understanding that people have an innate connection to nature and the living world that affects our well-being (Wilson, 1984)." (Pedersen Zari and Woodward, 2018)

Appendix 7. Biophilic design:

The term 'biophilic design' is inspired by the hypothesis of 'biophilia' proposed by Wilson in 1984, it advocates that people have an instinctive affinity with nature and the natural environment (Russo and Andreucci, 2023). Additionally, the concept of biophilic design is based on the premise that a connection with nature can positively impact human health and well-being. This connection, when

enhanced through the incorporation of natural elements into the built environment, can have a beneficial effect on both the occupants of the building and the surrounding ecosystem (Wijesooriya and Brambilla, 2021).

In general, it proposes diverse ways of increasing the bond with nature, through a direct or indirect experience of nature. The first one refers to the "relatively unstructured contact with self-sustaining features of the natural environment", such as daylight, plants, animals, natural habitats, and ecosystems. The indirect experience involves contact with nature that "requires ongoing human input to survive", such as potted plants, water fountains, or aquariums (Russo and Andreucci, 2023)

Appendix 8. Accessibility:

In "spatial" terms, accessibility refers to the capacity of a place to guarantee, regardless of age, gender, cultural background, physical and sensory abilities, and cognitive capabilities of someone to have an autonomous and self-sufficient life. According to our abilities, we experience, compare and determine if a space is accessible. It is, therefore, a subjective and incommensurable notion. The term is frequently used to refer to the right of those who are marginalized to exercise their rights, meet their physical and non-physical needs, and pursue their desires. Age, gender, health, culture, religious beliefs, economic circumstances, etc. are also possible causes of marginalization (Lauria and Montalti, 2015).

Appendix 9. Hedonic prices:

According to Rosen (1974) Hedonic prices are defined as the implicit prices of attributes. They are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics associated with them. The economic content of the relationship between observed prices and observed characteristics becomes evident once price differences among goods are recognized as equalizing differences for the alternative packages they embody.

Studies have demonstrated that with the presence of green areas and open spaces, the value of nearby properties will increase to match the benefits that property owners perceive they receive from the park. Economists use this method to determine how much a non-market resource, like a park, is worth by looking at the prices of goods traded in the marketplace, like surrounding residential properties (Crompton, 2001).

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