

Strategies for sustainable social housing in Colombia

Politecnico di Torino

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Abstract

The housing deficit in Colombia is a reality being faced from a lot of generations now, this deficit accounts for quantity and quality, being quantity the main focus of the construction sector, having an specific economic interest over a social interest or even in the environmental issues; this housing deficit is being handled trough the development of a large proportion of accessible social housing that presents low quality and disregards the negative impact on the environment.

In a concerned world for climate change and social inequality, Colombia moves slowly towards sustainability and in response to the vast number of construction projects being created, it has attempted to encourage sustainability practices with regulations and initiatives such as guides for sustainable design; this strategies fall short as there is a lack of incentives for the implementation of sustainable development strategies, an absence in definition of sustainable criteria for buildings of all uses including social housing (which for the existent regulations, sustainable criteria is not mandatory); this creates an even bigger distance between social housing and sustainability; the dissociation of both of this elements contributes to a social, economic and environmental negative impact; that way, thinking social housing from a sustainable perspective is a crucial component to tackle housing deficit and an environmental crisis.

In that sense, the question focuses in how social housing meets sustainability. This work will implement the Sustainable Development Goals (SDGs) as a framework that supports the encounter between social housing and sustainability, this will be done by understanding the interactions of social housing that is referred to in target 11.1 with other targets, in order to create mutual advance and avoid negative impacts.

The thesis is divided in six chapters, in which the first one regards the context of Colombia, housing and environmental issues and the need for sustainable social housing.

The second chapter introduces the Sustainable Development Goals as the framework of the thesis, the dimensions and complexity of its implementation and the importance of its understanding and use.

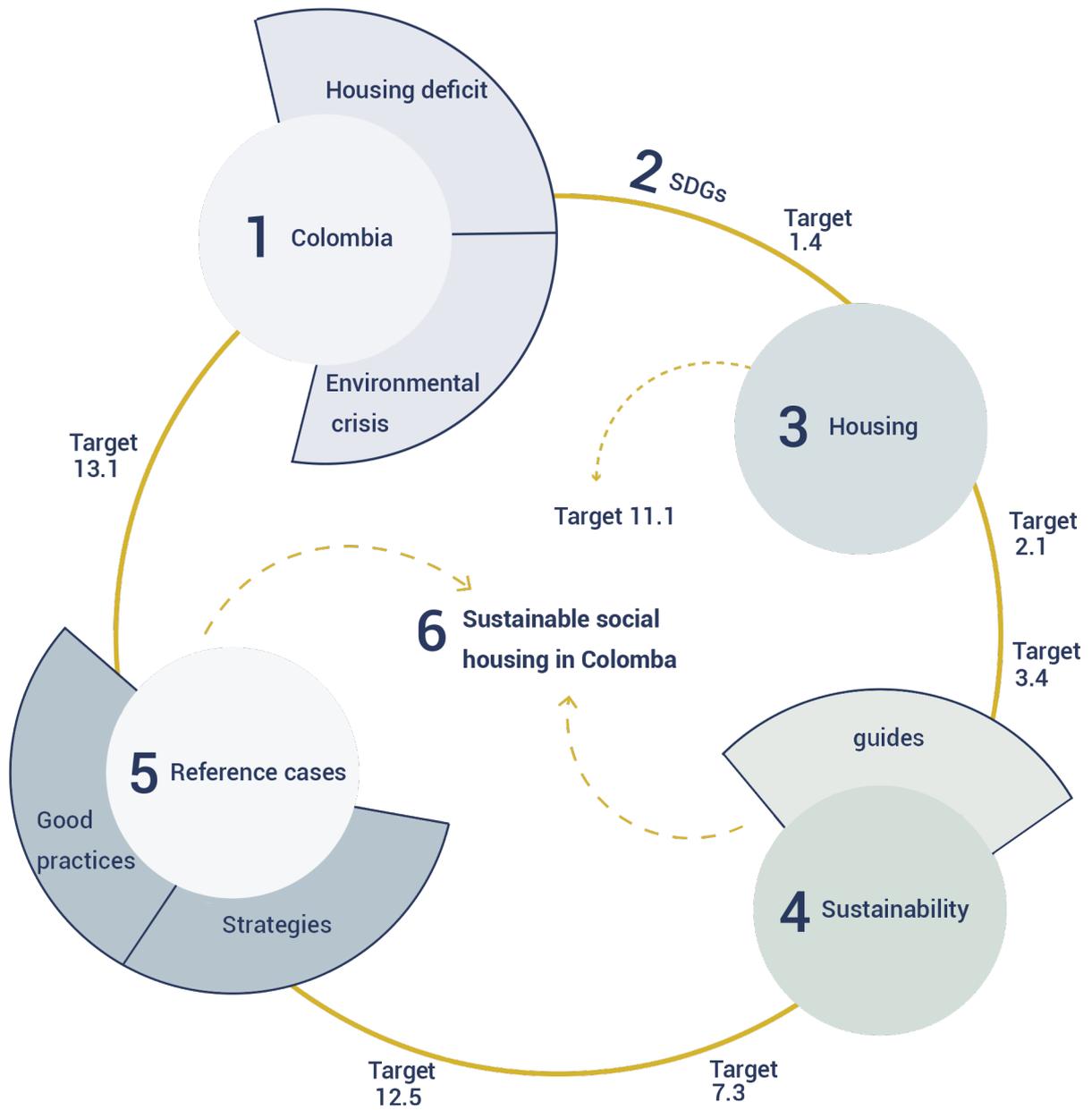
The third chapter describes the social housing system in the country and its development from a critical point of view, arriving to the conclusion that is a failing housing system that is not approached from the correct point of view.

The fourth chapter regards sustainability in Colombia and the related regulations in the construction and architecture sector, in this chapter the guides for sustainable design are analyzed in order to choose the more complete for further implementation.

In the fifth chapter are analyzed the reference projects at a national and international level in order to identify the lessons learned and the strategies that can be applicable for a sustainable housing project, the chapter closes with a graphic summary of all the strategies and good practices to implement.

In the final chapter the proposed project is developed with specific focus on the positive interactions of target 11.1 with other six related targets from the SDGs. The project is explained and design according to the topics suggested by the Colombian guide for sustainable buildings and the strategies extracted from the reference cases.

The aim is to compile a series of strategies and good practices that should be implemented when creating social housing projects in order to have quality outcomes that respond to the social needs without compromising the environment; these strategies are presented in a conceptual project proposed for Ibagué, a city in Colombia; this project can provide future developments a frame of reference that may facilitate reaching quality and sustainable outcomes. This work seeks to address the lack of consideration regarding environmental, and social matters in the growing construction sector.



Resumen

El déficit habitacional en Colombia es una realidad que se enfrenta desde hace muchas generaciones, este déficit representa cantidad y calidad, siendo la cantidad el principal foco del sector de la construcción, teniendo un mayor interés económico sobre un interés social y sobre las cuestiones ambientales; este déficit de vivienda se está manejando a través del desarrollo de una gran proporción de viviendas sociales accesibles que presenta baja calidad y no tiene en cuenta su impacto negativo sobre el medio ambiente.

En un mundo preocupado por el cambio climático y la desigualdad social, Colombia avanza lentamente hacia la sostenibilidad y en respuesta al gran número de proyectos de construcción que se están creando, ha intentado fomentar prácticas de sostenibilidad con regulaciones e iniciativas como guías para el diseño sostenible; estas estrategias se quedan cortas debido a la falta de incentivos para la implementación de estrategias de construcción sostenible, la falta de definición de criterios sostenibles para los edificios de todos los usos, incluida la vivienda social (que en las normativas existentes, estos criterios sostenibles no son obligatorios); esto crea una distancia aún mayor entre la vivienda social y la sostenibilidad; la disociación de ambos elementos contribuye a un impacto negativo social, económico y ambiental; de esta manera, pensar la vivienda social desde una perspectiva sostenible es un componente crucial para enfrentar el déficit de vivienda y la crisis ambiental.

En ese sentido, la pregunta se centra en cómo la vivienda social se encuentra con la sostenibilidad. Este trabajo implementará los Objetivos de Desarrollo Sostenible (ODS) como un marco que apoya el encuentro entre la vivienda social y la sostenibilidad, esto se hará mediante el entendimiento de las interacciones de la vivienda social que se menciona en la meta 11.1 con otras metas, con el fin de crear un avance mutuo y evitar impactos negativos.

La tesis se divide en seis capítulos, en los que el primero se refiere al contexto de Colombia, la vivienda y las problemáticas ambientales y la necesidad de la vivienda social sostenible.

El segundo capítulo presenta los Objetivos de Desarrollo Sostenible como el marco estructural de la tesis, las dimensiones y complejidad de su implementación y la importancia de su comprensión y uso.

El tercer capítulo describe el sistema de vivienda social en el país y su desarrollo desde un punto de vista crítico, llegando a la conclusión de que es un sistema de vivienda fallido que no se abarca desde una perspectiva correcta.

El cuarto capítulo se refiere a la sostenibilidad en Colombia y las regulaciones relacionadas en el sector de la construcción y la arquitectura, en este capítulo se analizan las guías para el diseño sostenible en el país con el fin de elegir la más completa para su posterior implementación.

En el quinto capítulo se analizan los proyectos referentes a nivel nacional e internacional con el fin de identificar las lecciones aprendidas y las estrategias que pueden ser aplicables para un proyecto de vivienda social sostenible, el capítulo cierra con un resumen gráfico de todas las estrategias y buenas prácticas a implementar.

En el capítulo final, el proyecto propuesto se desarrolla con un enfoque específico en las interacciones positivas de la meta 11.1 con otras seis metas relacionadas de los ODS. El proyecto se explica y diseña de acuerdo con los temas sugeridos por la guía colombiana para edificios sostenibles y las estrategias extraídas de los casos de referencia.

El objetivo es compilar una serie de estrategias y buenas prácticas que deben implementarse al crear proyectos de vivienda social para obtener resultados de calidad que respondan a las necesidades sociales sin comprometer el medio ambiente; estas estrategias se presentan en un proyecto conceptual propuesto para Ibagué, una ciudad de Colombia; este proyecto puede proporcionar a desarrollos futuros un marco de referencia que puede facilitar el logro de resultados de calidad y sostenibilidad. Este trabajo busca abordar la falta de consideración sobre temas ambientales y sociales en el creciente sector de la construcción.

Introduction

The impact of construction in the environment is an issue that cannot be ignored. “The construction sector is one of the most polluting industries today, and it can be estimated that 40% of pollution is directly or indirectly linked to construction activities” (García, Quito, Perdomo, 2019). In Colombia, construction growth is increasing substantially, specifically, the major growing sector in 2019 was social housing, and is expected to keep growing rapidly (Martínez, 2020). In Ibagué, this situation does not change as this construction type has increased 16,2% from 2018 to 2019 compared to normal housing, with an increase of only 3.3% (CIMPP, 2020).

In that sense, an understanding of how social housing is being developed in Colombia is of great importance. By analyzing this type of construction in the last few years, it is possible to conclude that economic interests are greater than the interest of the well-being of people, as well as the interest of environmental issues. The latter has led to projects that fail to fulfill the high demand, that lack in quality and that are harming the environment with every square meter being built.

Some efforts are being made towards more sustainable buildings; Colombia is the country with the highest number of EDGE certificated projects in the world, meaning major savings in water and energy (Dominguez, 2020). Sustainable social interest housing or VISS by its initials in Spanish, is being developed in some regions of the country, and some sustainable certifications have been granted; however, challenges still remain in the country, the gap between conventional social housing VIS and Sustainable social housing VISS is significant. This issue arises from various perspectives; the lack of knowledge regarding sustainability in the field of architecture leads to the conception that sustainability comes with high costs and complex technologies; in the other hand, there is a lack of regulations in the country that support and enhance sustainable practices in social housing. This way, construction methods are being kept the same and the architecture field is not implementing resources to move towards a more sustainable approach.

According to the previous mentioned issues, it is of urgent need to break the barrier between the current housing system and sustainability. In order to accomplish this aim, it is pertinent to specify the strategies for developing sustainable social housing so it is applied in the field for this type of building; this will be done by presenting a set of strategies, crucial for the design process and all stages of a project that are complementary to the sustainable design strategies proposed by the Colombian guide for sustainability in building design (2015).

01 Context

Colombia

Biodiversity

Population

Housing and environment

Social housing and sustainability

Colombia

Extension: 1,142 million km²

53% of forest area

Capital city: Bogotá

Population: 50'882.884 habitants by 2021 (Banco Mundial, 2020)

Number of species: 63.303 registered species by 2020 of fauna and flora (SiB Colombia, 2020)

Language: Spanish
69 indigenous languages
2 creole languages



Colombia in the South American continent

Cultural diversity /

Colombia is a diverse country due to its ethnic multiplicity, the constant mixture of the cultures have created a multicultural country that is reflected in music, dance, gastronomy and in the virtues and expressions of the people.

After the Spanish Conquest a mixture of three cultures was created; for the most part, Spanish, then Native Americans, Europeans and Africans. From this mixture emerged the mestizos (descendants of American Indians and whites), mulattos (descendants of blacks and whites) and zambo (descendants of American Indians and blacks). In smaller amounts Arabs, and Gypsies also arrived (Colombia, n.d.).

Climate and weather /

Colombia is located in the equatorial zone, this means that the hours in which the sun rises or falls at night only change slightly, and the seasons are not the same as in other countries of the world, instead, they consist in dry and rainy seasons; these characteristics are given by the geographic conditions including the altitude (As, 2021)

According to the classification of thermal levels, warm weather goes from 0 masl to 1.000, mild from 1.000 to 2.000 masl; cold to 3.000 masl, the páramo to 4.200 masl and the perpetual snow from 4.200 meters onwards (Catorce 6, 2019)



Jamaica

Dominican Republic

Puerto Rico

Caribbean

ua

a Rica

Curaçao

Panama

Venezuela

Colombia

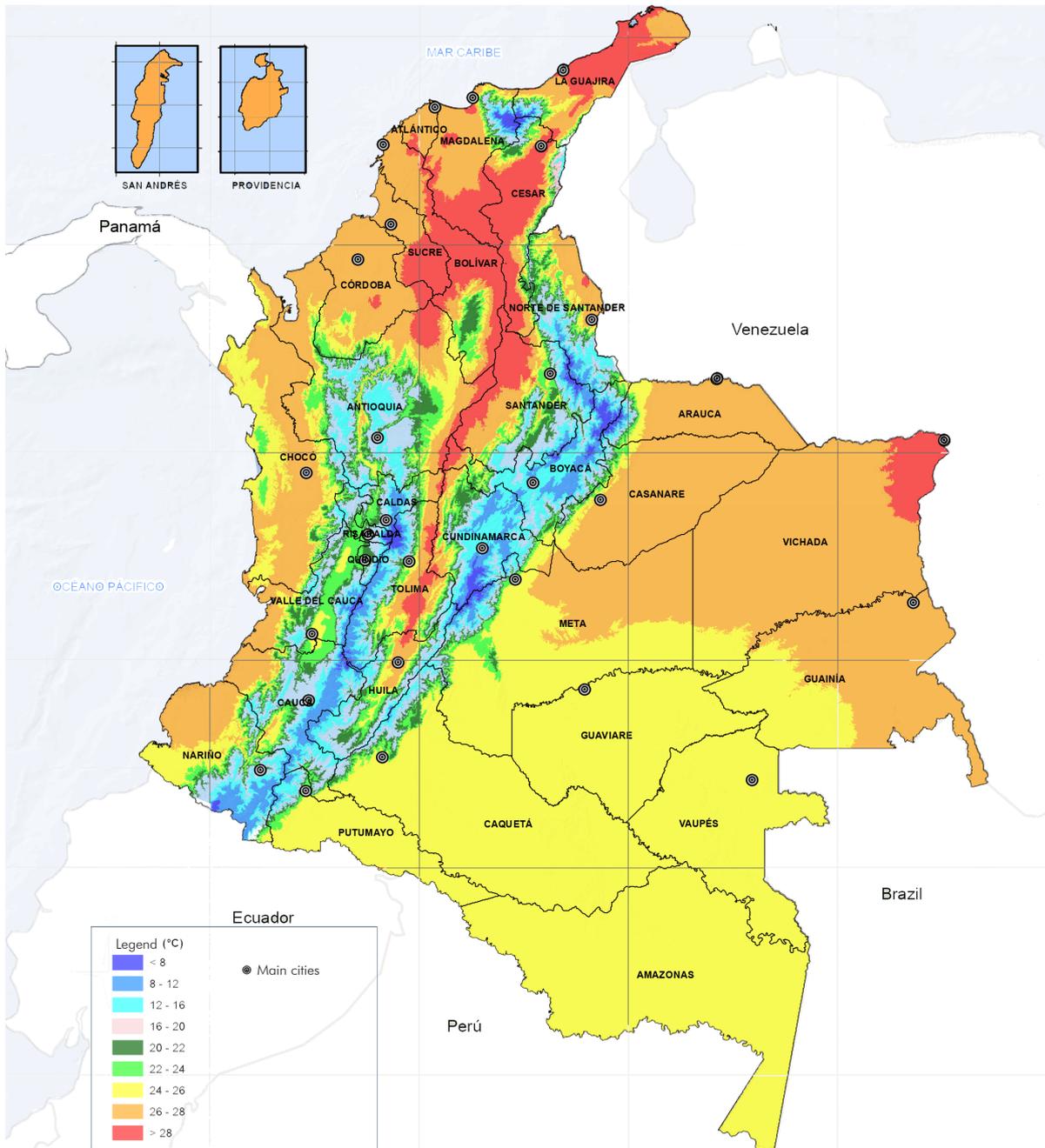
Ecuador

Pacific ocean

Peru

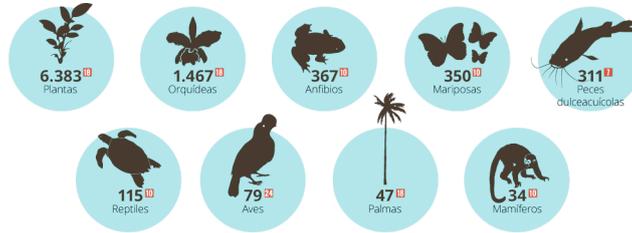
AMAZONAS

Average annual temperature



01 Colombia, average annual temperature
IDEAM, 2014

Biodiversity

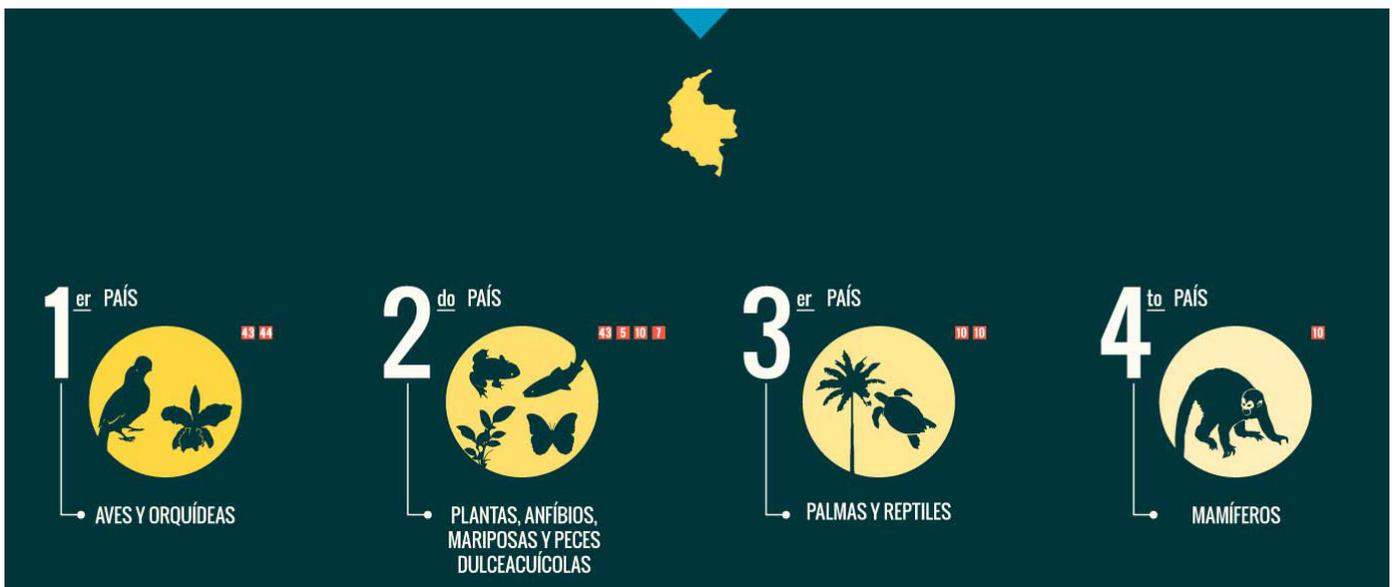


02 Endemic species of Colombia

Instituto Humbold, 2017

Colombia currently ranks second in biodiversity and is among the 12 most mega-diverse nations on the planet (Colciencias, 2016). This unique quality of the country is one of the pillars of Colombians identity; for this reason, it must be protected and preserved. Studies have shown an average decrease of 18% of the biodiversity; the greatest

threat is in the loss of natural habitats, usually related to agriculture and expansive livestock; among other factors are also, urban, and industrial expansion. This issue cannot be ignored as there are approximately 1200 species under threat of extinction in the country (Instituto Humboldt, 2017).

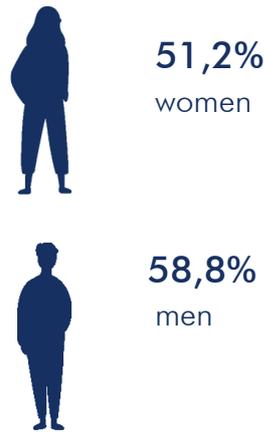


03 Worldwide ranking for number of species. Instituto Humbold, 2017

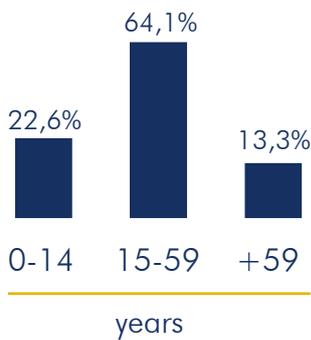
Population



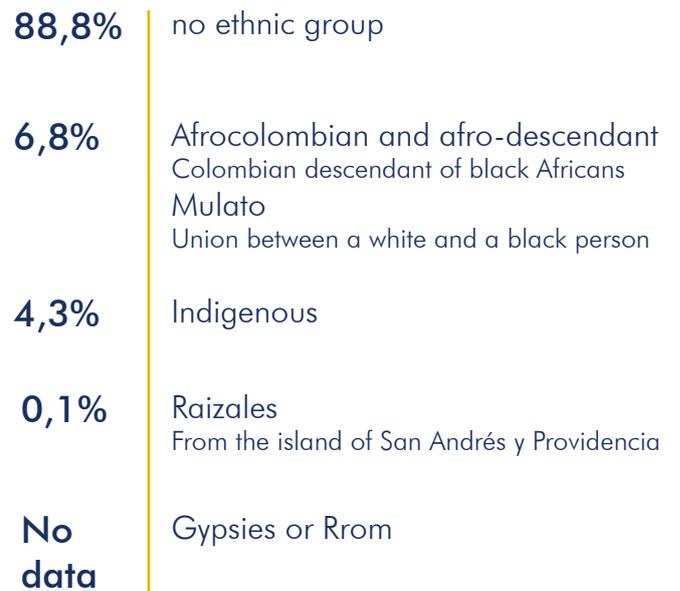
50.882.884
(Banco Mundial, 2020)



Population by age



Ethnic population



Territorial distribution



municipal capitals

76,8%



populated centres and scattered rural areas

22,5%

(DANE, 2018)

Family composition

According to the Population and Housing Register of 2018, in Colombia, almost half of the families are mainly conformed by two parents and one or more children; it is followed by 18% of individual homes; 14,56% are one parent with children, It is important to highlight that in this type of family the female leadership predominates in an 86%; in a smaller proportion, Colombian households are two parents, children, and another member of the family, 9.66%, one parent, children, and another member of the family (6.89%) and families without a nucleus 55.3 % (DNP, 2020).

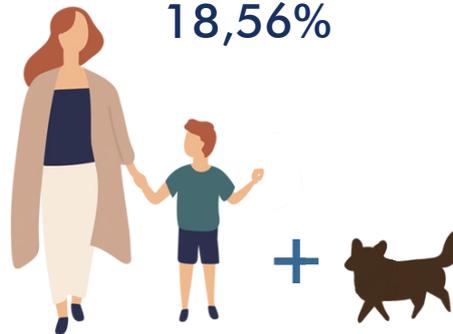
This data confirms that even when the typical Colombian family of parents and children is still the most common, the second most common is a single person who is considered as a "family", giving this term another interpretation, accepting the transformation of the family type.



Two-parent nucleus
42,11%



One person
18,56%



One parent nucleus
14,56%



Extensive two-parent
9,66%

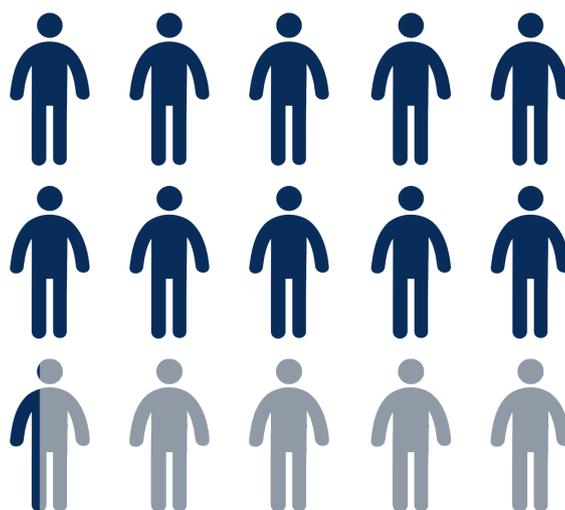
A two dimensional issue

Housing deficit approached from a quantity perspective

In Colombia there is a housing deficit of 31,4% (DANE, 2020), this estimate considers quantity and quality, and is equivalent to the difference between households and the number of housing units which is 1,5 million; this numbers are concerning since the population growth significantly exceeds the growth of new housing production, which reaches 2 units per 100,000 inhabitants (Universidad del Rosario, 2007), this population growth is higher in the main cities due to forced displacement from the rural areas as a result from violent disputes regarding political, economic and social interests, making the civilian population a target (Defensoría del Pueblo, n.d.) which are left with no other option than to move to the city where the lack of opportunities will then lead to low quality living conditions. This group of population in quality housing deficit belongs to the 73% of habitants with less than 4 legal current minimum monthly wage (887,34€) per household.

The effects of housing deficit have a high impact on quality of life, each element of housing such as, sanitary, structural and comfort, can cause a direct or indirect consequence on physical and mental health and well-being, in the immediate and longer term (Eurofound, 2016). In addition, families can experience increased housing uncertainty or are pushed into homelessness, which is then reflected in the formation of informal settlements (Up For Growth, 2018).

The government's respond to this matter is to enhance the construction of accessible housing by private construction companies and the grand of subsidies for people with low income. As the solution to this issue is being pursued from a quantity perspective the result is a low quality housing that is detached from social and environmental interests.



In Colombia there is a housing deficit of 31,4% (Altamar, 2021)

An environmental crisis

Colombia has been included in the list of the eleven countries with higher vulnerability against the effects from the climate crisis, according to the report submitted by the US government there is a big concern, since these countries will not be able to face the growing effects of climate change and will not manage to adapt to these changes (Agencia EFE, 2021).

The challenges in advancing towards solutions for the environmental issues still remain, among the sectors with a high impact in the environment is the construction industry, as it is a large consumer of resources and generator of waste. The consumption of land represents a 10% in a global scale (UNEP-SBCI, 2006), designated for construction are 3 billion tons per year of the world's

raw materials, which is a 40%, in the same way, the consumption of drinking water represents a 17%, and 25% of the cultivated wood (WorldGBC, 2008), this value amounts to 70% if it is considered the total wood resources (Edwards, 2001).

The construction sector is also responsible for more than a third of the world's energy consumption, mostly during the occupation period. 20% of the energy is consumed during the construction process, materials processing and demolition of the construction works (UNEP-SBCI, 2009, as cited in Acevedo et al., 2012). The approach of the construction industry must shift to an environmental focus to stop contributing to the current environmental crisis.



04 Floods in Colombia
WFP, 2010

Social housing and sustainability

Social housing is the way to provide all people the right to a decent home, the definition of social housing varies between countries according to their social and economic status; from a global perspective, in Europe for instance, some countries like Austria offer social housing for all, while in most of the other European countries social housing is strictly available for people who cannot access housing as there is a growing demand and a long waiting list; other countries as Ireland offer lower prices compared to the market on this type of housing (Whitehead et al., 2007). The strategies for social housing change around the world but the aim of provid-

ing people with safe housing is a common goal. Social housing in Colombia is currently focused on solving a lack of housing, this approach occurs at the project and urban scale, and carries with it the lack of quality in housing and the inadequate development of the city. This the result of providing spaces that do not meet people's needs, do not enhance community creation or reinforce sustainable development and do not present adaptability towards future changes. Moreover, while failing to fulfill peoples needs, the construction industry is being responsible for many negative impacts on the environment.

Social housing



The approach Colombia implements when facing the housing issue is creating environmental problems instead of working towards better practices that not only can be environmentally friendly but that can improve its conditions. Addressing housing shortage, its lack of quality and the environmental crisis should be carried out contemporaneously and not as two separate matters.

In that sense, housing deficit should be faced from a sustainable point of view through understanding the impact that social housing has on the environmental, social and economic fields

and implementing the right strategies to mitigate these impacts and at the same time tackle other issues that social housing is able to face.

This project seeks to address housing deficit from a sustainable perspective of social housing (using the Sustainable Development Goals as a framework) as well as addressing other related issues faced worldwide that can be impacted in a positive way by a sustainable-based housing project. Bringing together social housing and sustainability is the right response to significantly create environmental, social and economic benefits for the society (UNEP, n.d.).



Sustainability

02 Sustainable Development Goals

UN Sustainable development goals

The 2030 Agenda

How is Colombia advancing?

Goal 11

Target 11.1 and its interlinkages

UN Sustainable Development Goals

The 17 Sustainable Development Goals (SDGs) are part of the 2030 Agenda for Sustainable Development assumed by all state members of the United Nations in 2015, with the aim of setting a plan for peace and prosperity for people and the planet, now and into the future; the goals are a call for action by all countries in a global effort (United Nations, n.d.a).

By 2030 the Agenda seeks for a balance between the economic, social and environmental dimensions of sustainability, at an international level all countries are called to contribute to give solutions to the world's changes.

The SDGs are a structured frame of reference, each of the goals have a set of targets for a total of 169, and for some targets a set of indicators to help measuring the achievement of each Goal.

These Goals are being pursued around the world and the progress varies from one country to the other according to their capacity and development, monitoring these advances help us know how each goal is being reached around the globe.

Equality and non-discrimination are the core of the efforts of the 2030 Agenda, this principles are part of the universal values that guide us to respond to discrimination and inequality, the SDGs must advocate for these values in conformity with international human rights to assure gender equality and to leave no one behind. The human rights-based approach allows United Nations to help some people meet their obligations and some others to meet their rights, for this aim it requires human rights principles including universality, indivisibility, equality and non-discrimination, participation, and accountability.

SUSTAINABLE DEVELOPMENT GOALS



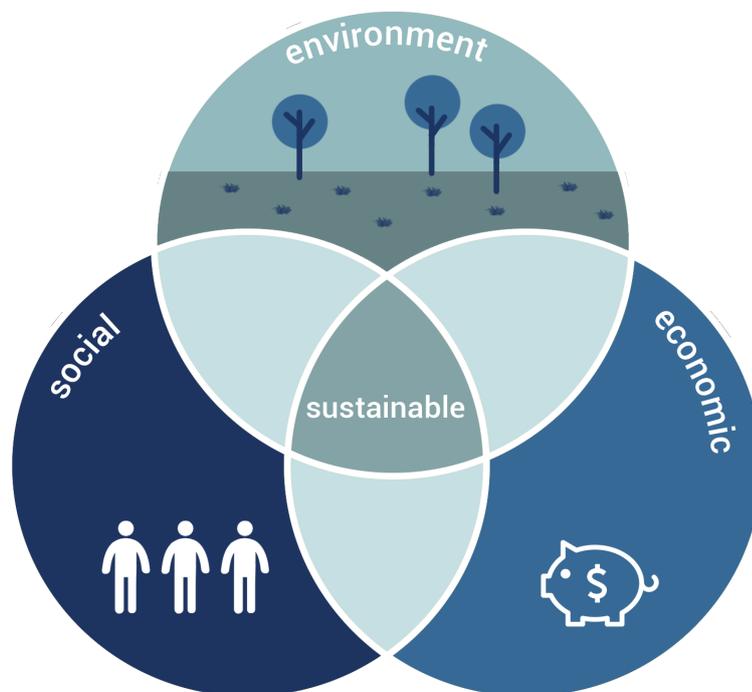
05 United Nations

These mentioned rights are often frustrated for some people as a result from laws that lead to discrimination, and policies that leave some population far behind compared to others, being on an unequal condition scenario. Knowing what people is being left behind and the reasons is an important step to fight this issue from the root. In this matter, gender can be one more reason for inequality, gender has an impact on how people experience life, opportunities are different as well as limitations and barriers, gender equality must be achieved in order to have real progress towards a sustainable world.

In that sense, sustainable development is a worldwide priority to create an equal world, and the way this is achieved is by the three pillars that work as a unifying platform; economic, social and environmental

(UNSDG, n.d.). achieving economic and social balance as well as a protected environment is the key for sustainable development.

Architecture as a multidisciplinary field contributes in a great way to reaching the SDGs, well-design built environment creates positive change. Architecture addresses directly Goal 11, which is to “Make cities and human settlements inclusive, safe, resilient and sustainable.” This goal aims for a wide range of targets including access to affordable housing, urban space, protection of cultural and natural heritage; in addition, architecture interacts with all the other goals and some projects meet different goals at the same time.



06 Three pillars of sustainability

Implementation of the agenda 2030

The Sustainable Development Goals of the Agenda 2030 are a “universal call to action to end poverty, protect the planet and improve the lives and prospects of everyone, everywhere” (United Nations, n.d.b). Worldwide many places are making progress but in overall the Goals are not being achieved as fast as needed to reach the Goals at only 8 years away from the set target year 2030.

The progress made worldwide in moving towards reaching the SDGs is not as significant, as there is an inadequate understanding of the goals and the interactions between different targets of the Agenda 2030.

There is a lack of comprehension on how targets interact and influence one another, determining unfavorable interactions (trade-offs) is key to alleviate and mitigate negative impacts as well as determining positive interactions (synergies) for strengthening all targets. The efforts towards achieving the SDGs must have at its core the understanding of synergies that can reinforce each target and of trade-offs that can set them back.

Interaction between targets can be positive if there is consistency in policies as proposed in target 17.14, regarding policy coherence to elude conflicts between targets. According to the principle of the Agenda 2030 to leave no one behind, policies must acknowledge different interests and opinions from stakeholders and decision makers.

The 2030 Agenda has an invisible nature due to its complexity; the advance towards reaching the SDGs and implementing the Agenda depends on the application of a systemic approach that focuses on interlinkages between goals and targets. It is necessary as a first step to translate the Agenda to a national context according to the development of the country in terms of sustainable advance to set specific strategies, then priority targets must be identified according to their urgency (Breu et al., 2020).

Efforts to accomplish the targets must be made by all. In the 2019 SDG summit, world leaders made a call for action denominated Decade of Action in which all sectors of society are called to act on a global,

local, and people action to create a movement that unify efforts for the urgent changes. People’s actions include young, civilians, private sector, media, unions, academia and other stakeholders; meaning that achieving the Agenda 2030 is in the hands of all people around the world (United Nations, n.d.b).



07 Global action towards Sustainable Development Goals

Adapted from European Commission, n.d.

How is Colombia advancing?

Colombia has an index score of 70,6, this index is the percentage on achievement of the goals, being 100 the completion of all of them, the development towards the goals shows progress in meeting the SDGs since their adoption in 2015; however, if it maintains the rate of annual progress, the achievement of the 17 Goals would take more than 50 years. In general, only Goal 7 has been achieved, Goal 12 have remaining challenges, 7 goals have significant challenges remaining, 8 more Goals experience major challenges and regarding progress, there is 1 Goal maintaining the road to achievement, 9 Goals with a moderately improving (meaning having over a 50% of expected progress but under the trajectory to achieve the goals by 2030), 6 Goals standing (stable or moving towards less than 50% of progress), and one lacking on information of its progress. Among the decreasing indicators within the Goals, the report of 2019 from Latin American and Caribbean countries in respect of Goal 15 of Life on

Land, shows a widespread decline by about half of the countries in the region in meeting SDG 15. This situation is due to the accelerated loss of biodiversity in 20 of 24 countries, Colombia is currently steady in the advancement of this Goal. The country's Spillover score is of 95.2, meaning a higher positive impact over a negative impact in other country's ability to achieve the SDGs. In 2020 the global average SDG Index score decreased from the previous year for the first time since 2015 due to the COVID-19 pandemic a decline driven to a large extent by unemployment and increased poverty rates. (Sustainable Development Report, 2021).

This project specifically will address Goal 11 (Sustainable cities and communities), as it will meet directly target 11.1; some other indicators will be address as a secondary focus such as targets from Goal 1, 2, 3, 7, 12 and 13, this targets are interlinked to the target 11.1 according to the mapping of synergies between indicators.



08 Indicator of progress of the SDGs in Colombia Sustainable Development Report, 2021

Goal 11/

Make sustainable cities and communities



Make cities and human settlements inclusive, safe, resilient and sustainable.

Target 11.1

By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums

Indicator 11.1.1

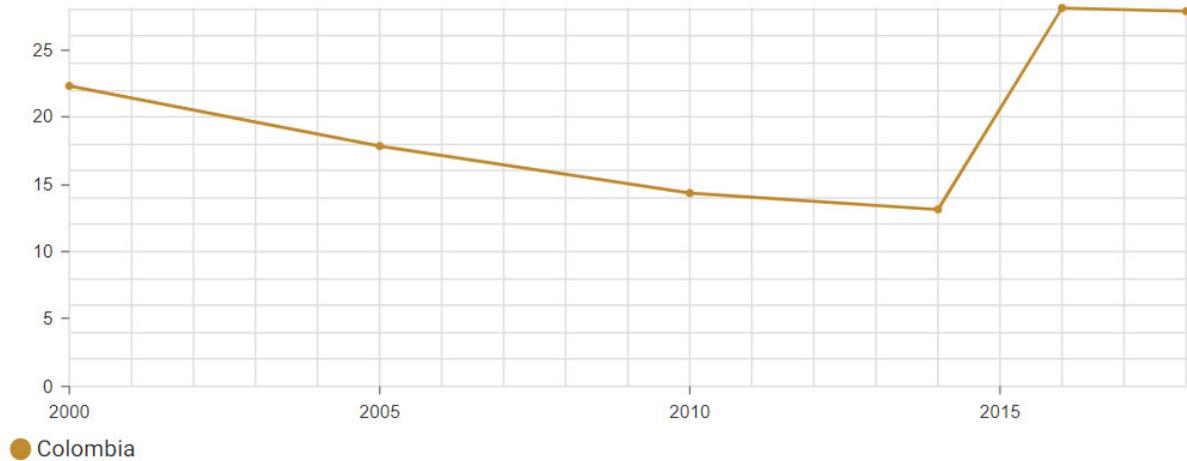
Proportion of urban population living in slums, informal settlements or inadequate housing

(United Nations, n.d.a)



09 Informal settlements in Altos de la Estancia, Bogotá
Melgarejo César, 2020

Proportion of urban population living in slums %



G.01 From 2000 to 2018 it had an increase of 5.50%

UN Habitat, 2021

Informal settlements /

In 2017, the capital of Colombia Bogotá had 20.819 Informal settlements and 21% of the urban land in the same year had its origins from this type of settlements. (Semana, 2017)

Around 10 informal settlements of more than 100 families are registered around the city of Ibagué, in some of these areas, the occupation has taken place for almost 2 years. (El Tiempo, 2022)

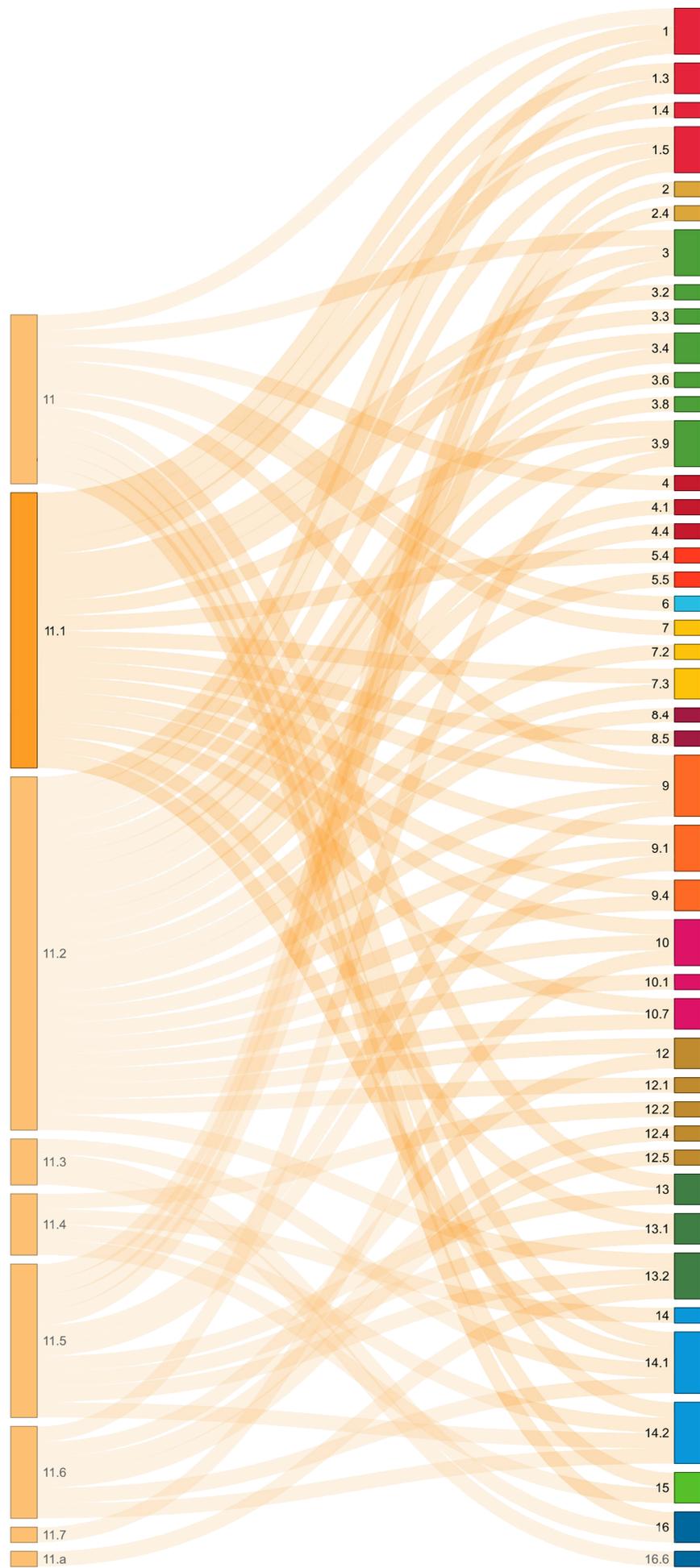
11.1 Proportion of urban population living in slums

Development of the indicator /

↓ Decreasing

● Major challenges remain

By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums



G. 02 Interlinkages of Goal 11, Synergies / Interlinkages visualization tool European commission, n.d.

Synergies and Trade-offs

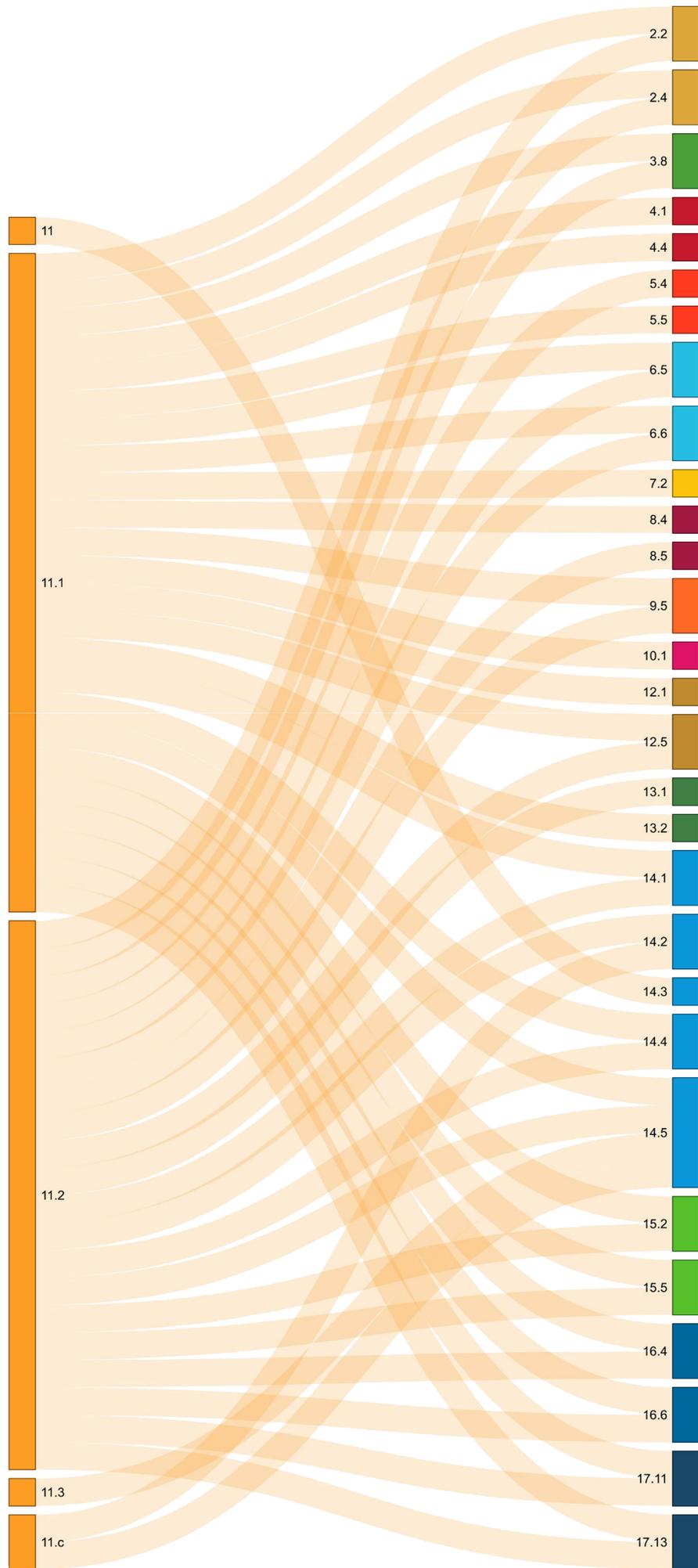
The implementation of the SDGs from science to reality is a complex process that carries a set of interactions between goals that can be positive or negative, comprehension of this linkages is crucial to fulfill the achievement of the agenda as it guarantees that the advance of one goal does not interfere with the others and vice versa.

Synergies among goals are a positive interaction between goals as one goal can enable or reinforce the other one; trade-offs instead, are constraints and incompatibilities between goals. An example of a trade-off can be seen between Goal 14 of conservation of the oceans, and Goal 11 regarding sustainable cities and communities; in this case, conflicts can be presented with cities and urban areas located in coasts, the ocean conservation can be challenged by the environmental pressure of the city, and the conservation of the coast and ocean can limit the development of infrastructure, housing and transportation.

From the synergies perspective, there is a positive interaction between Goal 3 regarding good health and wellbeing and Goal 11, as cities have a great impact on mental and physical health, their sustainable planning and the availability of affordable housing reinforce mental health, increases the access to health care and decreases environmental impacts (International Council for Science, 2017).

In this case, target 11.1 is the target with more trade-offs from Goal 11, meaning that its development should be performed very carefully as it may intervene other targets from other Goals; the achievement of a target must maximize its synergies and minimize the trade-offs with other targets.

G. 03 Interlinkages of Goal 11, Trade-offs / Interlinkages visualization tool European commission, n.d.



Target 11.1 and its trade-offs

Achieving target 11.1 comes with several interlinkages where the majority of them are trade-offs or negative impacts with other targets. Reaching target 11.1 that is to ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums, represents a challenge as if it is not pursued with consciousness having a sustainable approach it can impact other targets severely.

Consumption of non renewable natural resources such as water, energy and raw materials as well as the production of waste are some of the aspects from the construction field that sets back the achievement of other goals, it is important to understand that reaching one target must integrate and consider other targets instead of compromising their chances of achievement.

03 Housing

Latin America

Accessible housing in Colombia

Social interest housing

Addressing housing deficit in Latin America

The housing deficit in Latin-American is addressed primarily with a public financing mechanism, the “housing subsidy”, this system proposed by Chile in the 90’s has been widely disseminated in Latin countries such as Ecuador, Guatemala, Perú, Colombia, Honduras, Venezuela and many more; this model combines savings, subsidy and credit (Salas, J., 2022). Policies regarding efforts to address informality in form of prevention are promoting the construction of social housing by private companies and programs for improvement and formalization of informality. This model implemented from almost 20 years in some of the countries, have not fulfilled the housing need and, according to Calderón (2015) is due to the disengagement between the purposes of the public policy and the behavior of real estate and land markets and a government that “gives solutions to private initiative and reduces the state to a facilitating role”, according to the author, the state must play a more active role in the production of social housing and not restrict its intervention to the granting of subsidies.

In Chile from 1980 to 2006, a success was considered when the housing deficit was addressed with the construction of a massive number of social housing; in the following year, quality issues and location problems were presented, as well as a widely criticized maintenance and management systems.

According to Santoro (2019) In Colombia,

“The policy of giving subsidies and increasing the financing capacity for affordable housing beneficiaries, has contributed to the inflation of land prices, deepening socio-spatial inequalities, and is a factor in the continuity of producing large scale housing projects on the peripheries of cities”

this policy of ownership does not address social and inequality issues faced by the people in poverty and therefore should be complemented with other policies and regulations taking as reference successful cases from around the world.

Affordable housing system in Colombia/

The housing system can be understood by referring to the main subsidy program of the government Mi Casa Ya (My House Now) that helps people access new housing through subsidies by being in certain conditions; the aim of the housing model is for people to own a home through the subsidy, a bank credit and own savings.

The model consist in the synergy between private construction companies and the governments subsidy. The construction companies are in charge of delivering the building according to the regulations for social housing and price range stipulated by the law; people can access this type of housing with the subsidy, savings and bank financial credits that would cover the remaining amount.

Accessing affordable housing/

Subsidy from government
+
Bank credit
+
Own savings

Building affordable housing/

Private companies
+
Government subsidy

Accessible housing in Colombia

In Colombia there is a housing policy to facilitate access to housing and to address the housing deficit of the sector of population in poverty and has no access to decent housing (Minvivienda, n.d.). These policies revolve around two types of dwelling, Social Interest Housing (VIS) and Priority Interest Housing (VIP); according to the Ministry of Housing, City and Territory of Colombia, VIS is the one that gathers the elements that assure its habitability, standards of quality in urban design, architectural and construction whose maximum value is one hundred and thirty-five legal current minimum monthly wage (135 MW). In 2022 the minimum wage was set to one million pesos, approximately 225,23 €, meaning that the value of a housing unit is 30.406 € or less.

The population which benefits from this type of housing are households constituted of one or more people that earn less than 4 MW (887,34 €) (Forbes,

2021) this represents the middle class together with people in vulnerable conditions in Colombia, that earn less than the current minimum monthly wage, specifically less than 145 € (Minvivienda, n.d.). Instead, for people in poverty there is a more accessible option of housing, which is VIP, that is defined as the social housing with maximum value of 70 legal current minimum monthly wage (70 MW). Which is 15.766 € or less per housing unit. In response to the housing deficit issue, the government has set the goal to decrease the deficit by 2,47% in 2022 (Altamar, 2021); for this aim, other than promoting the construction of social and priority housing, the government implements subsidy programs, which are defined as a state contribution in money to facilitate housing purchase, this subsidy can be awarded by Compensation Funds or by the Government (Minvivienda, n.d.); there are currently three main programs.



10 Social housing in Cali, Colombia
Fondo Adaptación, n.d.

National housing relocation and reconstruction program.

The Fondo Adaptación (Adaptation Fund) was created to address the areas affected by the phenomenon La Niña 2010-2011, the effect of La Niña in our country is characterized by a considerable increase in rainfall and a decrease in temperatures (IDEAM, n.d.), the winter wave of 2010-2011 associated with the Phenomenon has been classified as one of the worst natural disasters in the history of Colombia causing considerable civil and economic losses (Sánchez, n.d.). One of the programs responds to households that are victims or located in areas of high risk that cannot be mitigated; through this program, the Fund provides housing solutions to affected population.

Beneficiaries: People in state of vulnerability.

Conditions /

Being affected population (registered in the Single Register of Gathered Victims), owners of destroyed homes or improvement of wasteland with affected homes and those communities located in high-risk areas that cannot be mitigated (Fondo Adaptación, n.d.).

Another subsidy program released in 2022 will apply for Colombians with incomes less than two legal minimum monthly wages, affiliated to a family Compensation Fund, the household will receive up to 50 MW for the purchase of their home, representing fifty million pesos (11.035,81 €), this is only for major cities and urban agglomerations with more than one million inhabitants which are Barranquilla, Cali, Medellín and Bogotá (Minvivienda, 2022).

Mi Casa Ya. (My House Now)

Mi Casa Ya is the program of the National Government that facilitates the purchase of new urban housing in Colombia. It is aimed for families with incomes of up to four minimum wages and consists of granting a subsidy to the down payment and coverage at the interest rate. This will be reflected in a low monthly fee for the first seven years, in addition, the coverage at the interest rate will be between 4 and 5 percentage points.

Beneficiaries /

-Families with income of 2 MW (\$2'000.000 COP) (441,50 €) will have a subsidy of 30 MW (\$30,000,000 COP) (6.621,48 €)

-Families with income from 2 to 4 MW (\$2'000.000 to \$4'000.000 COP) (441,50 €962,39 €) will have a subsidy of MW (\$20'000.000)- (4.414,32 €)



< 2 MW (441,59 €)
< 2-4 MW
(441,59€-962,39 €)

Conditions /

- Have a total income less than 4 MW. (962,39 €)
- Not owning a home.
- Have not been a beneficiary of any Family Housing Subsidy granted by the compensation fund.
- Not having received a subsidy from the national Government.
- Not have been beneficiary of any title of the hedges at the interest rate.
- Have an approved housing credit, or have a housing lease approval letter, issued by a financial institution or the National Savings Fund. (Fondo Nacional del Ahorro, n.d.)

Social interest housing

Vivienda de interés social

Social Interest Housing acquisition is significantly growing every year (Minvivienda, 2021), it is therefore a question if the thousands of sold housing units in the past years can be considered as quality housing. The regulations for Social Interest Housing ignore the importance of quality housing which should be of extreme significance as is directly related to the quality of life. The concept of quality housing has been studied and applied to understand habitability. It is defined by the Architect Haramoto Nishikimoto as:

“Quality housing (or residential) depends on the attributes and properties of the housing object on one hand and the demands and valuations that the subjects make on these. While it is true that a certain intrinsic (implicit) quality that comes from the attributes proper to the object can be recognized, on the other hand the recognition of the necessity and the appreciation of those attributes on the side of the subject is required.” (Nishikimoto,1994, as cited in Instituto de Vivienda, n.d.).

The latter, means that quality applied to housing is both a set of components of the unit and the understanding of the user necessities, these aspects are to be acknowledge in a specific context, considering social, cultural, economic, and politic variables (Nishikimoto,1994, as cited in Instituto de Vivienda, n.d.). The environmental context is implied, as is part of all the above-mentioned variables. It is clear now that these aspects are not applied to VIS in Colombia, as confirmed by Concha: “Evaluations of different approaches of private and academic public interest, made to housing in Colombia, currently show that there is a quality deficit neglected by the public sector in the provision of social interest in the country, as both the legislation on the subject, as the ability of public entities to exercise control over the product being offered, are very limited” (Concha, 2012, pag. 28).

The conclusion is reached by the author as according to several studies applied to existing housing projects in Bogotá, the result of the quality studies would always showcase unsatisfactory conclusions. In one of the studies mentioned, the result was that: “the general design and the architectonic aspect become a matter relegated by the economic rationality” (Doris Tarchópulos, 2003, as cited in Concha, 2014), this economic focus prevails over any other matter, the main target is then a design to fit as much housing units as possible, in a homogenous block high in density and occupation.

Quality Vs. Quantity

The quality of housing goes from the private unit to the urban context where is located, an integration of natural environment and the neighborhood are equally important for a housing complex (Nishikimoto, 2002); this conclusion is also reached by Concha through a survey to the residents of VIS housing units, relating user and product in order to understand the quality of housing from the users' vision (Concha, 2014).

“The design of a complex is definitive for the quality of life of the residents because it can positively or negatively affect the coexistence between neighbors as evidenced in the interviews in the four projects. The design of the unit defines how each member of the family can carry out their basic activities comfortably and safely. The quality of housing should be addressed in a more comprehensive way and not only as a problem of unity.” (Concha, 2012, pag. 111).

The lack of quality in many aspects of the VIS is evident and goes from the unit to the entire complex and its location; in specific, from the survey studied previously it can be concluded that the residents consider the communal spaces and the organization of the units as very valuable and important since the wrong configuration creates conflicts between neighbors and affects community relations, as it does not recognize the diversity of people and the age groups; this implies the need for dedicated spaces for each group and a thought design for the complex. Another important aspect in quality housing is the sustainable approach, this factor was recognized by the users in mentioning orientation, natural ventilation and lighting and the importance of energy savings and management of resources (Concha, 2012).



11 Arboleda campestre, VIS project in Ibagué
Prodesa, 2021



12 Terraverde, VIS project in Ibagué
Inacar, 2021

04 Sustainability

Sustainable approach

Regulations

Certifications

Guides for sustainable design

Sustainability in architecture

In terms of sustainability, some concepts are not yet defined by the Colombian government, for example, Sustainable Social interest Housing VISS and Sustainable Priority Housing VIPES, these concepts are often mentioned in academic papers and articles since 2006 by scholars in the architecture field (Bedoya, 2011) referring to the sustainable development in these type of housing in Colombia.

From a wider perspective, a true sustainable architecture is the one that meets the needs of its occupants, at any time and in any place, without endangering the well-being and development of future generations. Sustainable architecture therefore implies an honest commitment to human development and social stability, using architectural strategies to optimize resources and materials; reduce energy consumption; promote renewable energy; minimize waste and emissions; minimize the maintenance, functionality, and price of buildings; and improve the quality of life of occupants (De Garrido, 2010).

Sustainability can be achieved in architecture by implementing a wide range of strategies or approaches from the early stages of a project. From the design stage for instances, bioclimatic design can be implemented, this type of design strategy aims to create a building considering the climate of

the place, the purpose is to achieve thermal comfort and healthy spaces by using the intrinsic natural resources of the location and respecting the environment. Bioclimatic design takes into account:

- Orientation
- Size and shape of the building
- Materials and isolation
- Ventilation systems
- Water and vegetation
- Thermal accumulators
- Thermal bridges
- Hydrothermal comfort

(Iberdrola, n.d.)

Sustainable initiatives that are being carried out in Colombia are implemented mainly for non-social interest housing due to the conception of high costs related to sustainability, and lack of regulations relating practices in architecture and construction for more environmentally aware solutions in projects. Despite these limitations, there are regulations, certifications, guides, and other strategies to encourage sustainable practices in the construction sector, this initiatives are a contribution in the search for reaching sustainability in social housing.



13 Sustainable and productive rural housing in Colombia
Espacio Colectivo Arquitectos + Estación Espacial Arquitectos, 2019

Regulations

There are a few public policies regarding sustainability in construction, one of the first regulations introduced in the country was the **Resolution 0549 of 2015** that establishes the minimum percentages and measures of savings in water and energy for new buildings, these measures are voluntary for VIS and VIP.

In 2018 due to the important role of the growing construction sector, it was created a series of documents that generate a framework of reference for the different policies, initiatives, and regulations of the country. There are seven CONPES documents that contribute to the development of sustainability in the construction sector, the one directly related to the field is the **National Policy of Sustainable Buildings** which aims to:

-Promote the inclusion of sustainability criteria for all uses and within all stages of the life cycle of buildings through regulatory adjustments.

-The development of monitoring mechanisms and promotion of economic incentives, which contribute to mitigating the negative effects of the building activity on the environment, improve living conditions and generate employment and innovation opportunities.

This document is of great relevance since the previous existing regulations in Colombia such as Resolution 0549 of 2015, issued by the Ministry of Housing, City and Territory, and the Colombian Technical Standard (NTC) 6112 of 2016, under the Colombian Environmental Seal (SAC), are focused on new buildings and a group of buildings of different uses not including VIS and VIP, due to potential impact on cost caps, which the CONPES includes (CONPES 3919, 2018).

% Water and Energy

CONPES 3919

Resolution 0549 of 2015

NTC 6112 of 2016

NTC 1500 de 2014

+

Recommendations for Sustainable buildings

In regards of financial initiatives, the Ministry of Environment developed initiatives for sustainable buildings with a national or international certification in the design phase; these are:

-Tax exemption (Decree 2205 of 2017, Resolution 0367 that adds the Resolution 1988 of 2017)

-Exclusion of IVA (Value Added Tax) (Decree 1564 of 2017, Resolution 1988 of 2017 y Resolution UPME 585 de 2017) (MinAmbiente, n.d.).



Colombian Council of Sustainable Construction (CCCS)

CCCS is a private non-profit organization founded in 2008 committed to raising the level of sustainability of all uses of new and existing buildings, and cities, in Colombia, is the only association that offers programs, trainings and applied research to demonstrate and disseminate the advantages and economic feasibility of designing under integral sustainable criteria (CCCS, n.d.).

Among the strategies created by the organization are:

-The CASA certification

- LEED Certification ally, facilitating the process.
-Organization of the annual International Forum and Expo Sustainable Design and Construction CONSTRUVERDE.

-Material, instruments, and training regarding sustainability in construction.

Initiatives

There are several private initiatives in different fields, in the financial area for example, banks play a significant role, banks such as Davivienda, Bancolombia and Bbva offer discounts of up to 100 basis points on the building credit rate for projects that meet sustainability criteria. (Núñez, 2021), this has a great impact since the major obstacle to implement sustainable strategies is the economic aspect.

Another initiative in the construction field is Ar-

gos, the major concrete and cement producer in Colombia, their initiative Green Solutions bring new systems in a variety of areas, including green concrete, green cement, and non-conventional construction systems such as of-site modular construction; in addition, the company has a program for collecting the bags where the material is transported for its recycling. It is worth mentioning that some of the green solutions at the moment are only present in some regions of the country.



14 Collected bags of cement
Argos

Certifications

Certificates for sustainable construction provide the possibility to measure and guide the sustainable outcomes of a project, it evaluates the building performance by using a set of quantifiable criteria in sustainability, considering the balance between environmental, economic, and social dimensions (GXN, 2018).

There are currently approximately 600 certification systems around the world, in Colombia are mainly implemented five certification labels, including one national; the most popular and the one with more certificated projects in the country is LEED certification system (Rubio, 2020), the second most widely implemented is EDGE, and lastly, the national created certification CASA.

LEED

(Leadership in Energy and Environmental Design)

IFC innovation, it measures through comparing savings versus a baseline, consist in a free-to-use software that helps design green buildings.

- Base energy performance and water savings
- 3 types of level (20% savings, 40% savings and zero carbon emissions)
- Fee for lower level of certification from 440,05€



BREEM

(Building Research Establishment Environmental Assessment Method)

British created system, with multi-indicator certification, the main sustainable aspects considered by the system are resources, environmental impact, and health.

- 6 levels of rating
- Fee from 1,100 to 4,500€



EDGE

(Excellence in Design for Great Efficiencies)

IFC innovation, it measures through comparing savings versus a baseline, consist in a free-to-use software that helps design green buildings.

- Base energy performance and water savings
- 3 types of level (20% savings, 40% savings and zero carbon emissions)
- Fee for lower level of certification from 440,05€

HQE

(Haute Qualité Environnementale)

French system with primarily consideration on the social dimension of sustainability.

- Focus on quality of life
- 5 levels of rating
- Fee from 1,850€ to 42,250€

CASA Colombia

The aim of this tool is to promote the incorporation of sustainable criteria at a national level, facilitating the cost-efficient structuring of new projects, providing solutions in compliance with current regulations and with focus not only in the efficient use of resources but also on health and well-being. The special focus in a VIS dedicate certification creates an opportunity of implementation for VIS projects, along with a simplified access being a national based system.

- Integral approach
- VIS focus certification
- Fee from 1518,14€



Guides for sustainable design

In search for a sustainable future, architecture has a great responsibility and a big role in contributing towards this goal; the field of sustainable architecture is constantly developing and changing, and its strategies depend on the time and place, at the same time, some general rules can be applied in a worldwide perspective. This general aspects and strategies have been compiled around the world in forms of guides for an easy understanding and

their future application, this guides are developed as well by municipalities and governments in Colombia, focusing on their specific conditions to enhance sustainable practices in the architecture and construction discipline, this guides are a great support and a useful tool in the field. Three guides will be analyzed in order to have a complete overview of the contents and the focus of each guide.

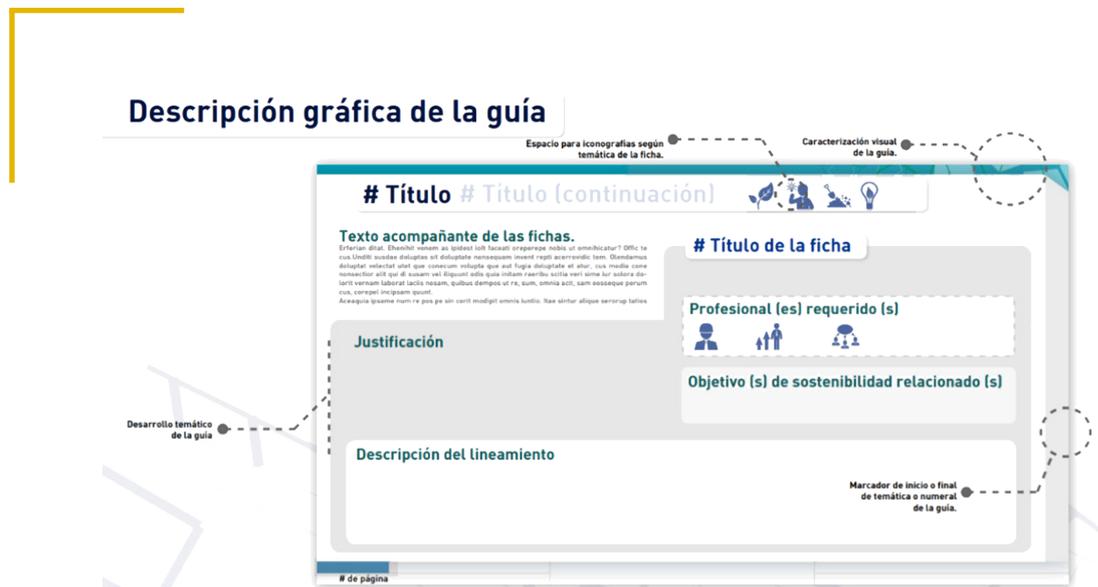
Colombian guides for Sustainable design

1. Guide for the Design of Sustainable Buildings, Valle de Aburrá
2. Sustainable Construction Guide for Saving Water and Energy in Buildings
3. Guide for Sustainable Recommendations for the Building Field in Bogotá D.C.

Guide for the Design of Sustainable Buildings from 2015 of Valle de Aburrá

The Guide for the Design of Sustainable Buildings from 2015, that was part of the Metropolitan Agreement of 2014 of Valle de Aburrá, Antioquia, it was set as a goal the creation of a Sustainable Construction Policy in which 4 guides were created as technical tools for the implementation of the principles and criteria established in the policy, this guide is the

fourth one and it focuses on buildings. This guide creates a system of data sheets including visual and graphic representation to help the user read the guide in an easier way, the data sheet includes for each topic, an icon for easier identification, specifies the personal needed in the type of strategy, a description, sustainable objective and a justification.



16 Graphic description of the guide

Valle de Aburrá (2015). pag. 6

Regarding the information presented in the guide, it is detailed and complete regarding the topics treated; habitability, energy, water, materials, and solid waste are the main topics explained; in addition, feasibility of the strategies are explained in order

for the user to know the possibilities of application, it provides data for related policies and regulations at national level that must be considered, and in some cases provides additional guides for technical details and specific information for each strategy.

Positive elements /

- + Addresses mainly climate change
- + Wide range of topics
- + Specific and detailed information
- + Referral to normative and regulations
- + Referral to detailed technical drawings

7 AFFORDABLE AND
CLEAN ENERGY



6 CLEAN WATER
AND SANITATION



13 CLIMATE
ACTION



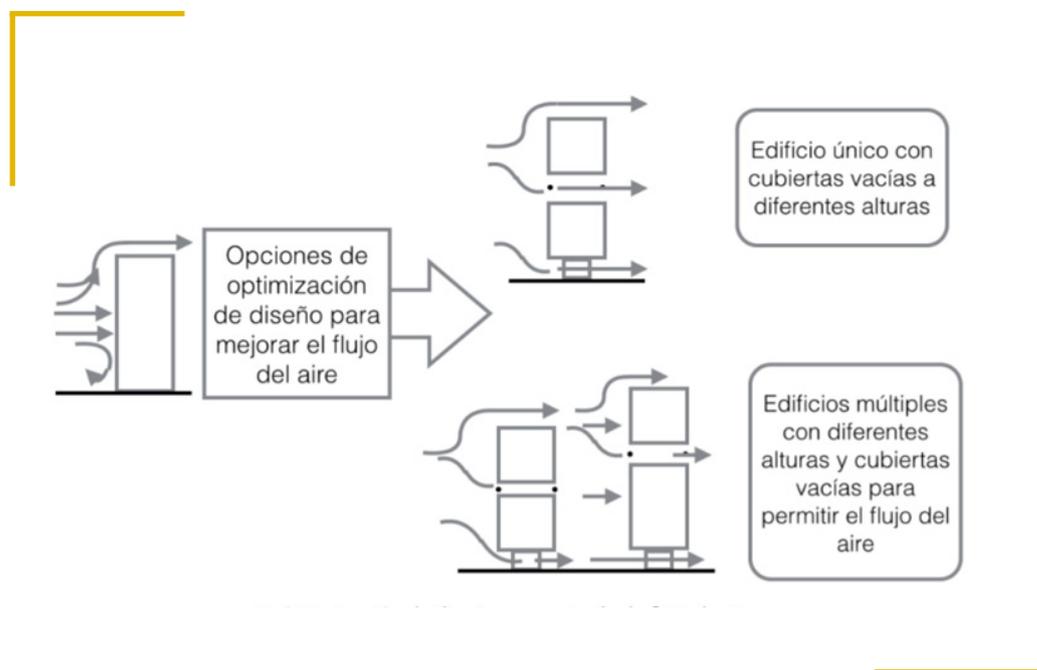
Negative elements /

- Focus on all types of buildings
- Insufficient graphic representation
- Incomplete information regarding sustainable certifications
- Lack of social focus

Sustainable Construction Guide for Saving Water and Energy in Buildings.

The second guide to be analyzed is the Sustainable Construction Guide for Saving Water and Energy in Buildings (Alcaldía mayor de Bogotá, 2015), this document was a project requested by the Colombian government through the Ministry of Housing, City and Territory and is a regulatory framework to reduce water and energy consumption in new buildings; it aims to lead the design of sustainable build-

ings with recommended guidelines and strategies for different climates and types of use, the topics treated in the guide are habitability, energy, water, sustainable materiality, urban solid waste, and feasibility for each one the previous mentioned; it explains background, recommendations, and proposes some general strategies for each use and climate.



17 Graphic of optimization of design for wind flow

Alcaldía mayor de Bogotá. (2015). Pag. 76

The guide explains every topic in detail in a theoretical way, however, as this guide is tight to the regulations, while navigating through it, the strategies regarding social housing in most of the cases are marked that for some of them it is not necessary or not applicable, while for other uses

like public buildings it is, this is strictly linked to the legislation, that for the moment does not impose sustainable courses of action for this type of housing. The guide communicates that for social housing some strategies are not necessary giving a misconception for the users of the guide.

Positive elements /

- + Addresses water and energy
- + Strategies organized by weather and type of use including VIS
- + Specific and detailed information
- + Clear recommendations for each topic
- + Technical information

7 AFFORDABLE AND
CLEAN ENERGY



6 CLEAN WATER
AND SANITATION



Negative elements /

- It implies that for VIS some strategies are not required
- Lack of social focus

Guide for Sustainable Recommendations for the Building Field in Bogotá D.C

The last guide studied from Colombia is, the Guide for Sustainable Recommendations for the Building Field in Bogotá D.C (Alcaldía mayor de Bogotá, 2015). According to the guide, the purpose is to “introduce the reader in the technical development of strategies, general and specific actions for sustainability efficiency of natural resources, seeking to promote the environmental performance of projects, modify the design pro-

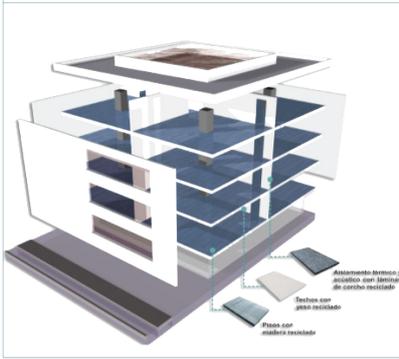
cess, and behavior of residents and users.” The guide is focused on water, energy, materials, waste, comfort and habitability; for each topic it briefly explains a general action, specific action, the phase where it should be implemented, the importance of implementation together with some examples, and an image of a 3D model of a building where the actions and strategies are pointed out.



Mc. A. Promover el uso de materiales sostenibles y durables a lo largo del ciclo de vida de la construcción.

Acción general
Utilizar materiales con contenido de reciclado.

Acciones específicas
Seleccionar materiales con contenido de reciclado cumpliendo con los requerimientos Icontec y NSR-10. incorporar elementos provenientes de residuos de construcción y demolición en nuevos proyectos.



Fuente imagen: Elaboración propia

| Fases del proyecto | | |
|--------------------|--------------|-----------|
| Diseño | Construcción | Operación |
| x | x | |

¿Para qué se hace?

Mc. 3. Disminuir los impactos ambientales asociados a la producción de materiales de construcción y extracción de agregados de origen natural.

Mc. 1. Reducir la generación de residuos, Gases Efecto Invernadero -GEI-, contaminación y consumo de recursos.

Ejemplos de aplicación

Muro cortina fabricado con botellas PET
Arthur Huang
MINIWIZ



1

Loseta de caucho reciclado



2

Fuente imágenes:
 1. admin.masisvecologica.com/Sitefiles/masec/contenido/medios44_Paredes-EcoARK-2.jpg
 2. www.suelosdecaucho.com/loseta-de-caucho.jpg

18 Strategies for sustainable materials

Guía de lineamientos sostenibles para el ámbito edificatorio (2015) Pag. 31

This guide is the simplest of all the analyzed guides, in terms of the information provided; for the representation it uses mostly graphic content, contrary to the other two that mainly use text, it also comple-

ments the data with a resume table for each topic where more strategies are listed together with the related normative and referenced documents such as guides or technical sheets that are more detailed.

Positive elements /

- + Focus in energy, water, materials, waste, and habitability and comfort
- + Reference to normative and regulations
- + Reference to detailed technical drawings
- + Use of a reference building
- + Summary table for each topic with listed strategies

7 AFFORDABLE AND
CLEAN ENERGY



6 CLEAN WATER
AND SANITATION



13 CLIMATE
ACTION



Negative elements /

- Focus on all types of buildings
- Lack of use of real life reference cases
- No information regarding sustainable certifications
- Is not specific for each type of weather
- Does not mention important subjects such as design for deconstruction
- Lack of social focus

As a summary from the guides studied, it can be concluded that for some of the guides the information presented for every topic is detailed and complete, in addition, the topics are often linked to a list of regulations and normative regarding the subject and in some cases technical documents with details and drawings by the government or from external sources.

Nevertheless, in the guides there is an absence of focus in social aspects, community creation and the involvement of people in the projects, both at the beginning and the end of the project, this aspects are not mentioned and they are essential for a sustainable housing project, keeping in mind social, economic and environmental aspects that are the pillars of sustainability, and it seems that the guides only focus in the last two. On the other hand, social housing is not a fo-

cal point in the guides as is not mandatory for this type of housing by the Colombian regulation.

In the guides sustainable certifications are mentioned briefly, and these are a general guidance for sustainability itself, even though in order to create sustainable architecture is not a mandatory aspect, it is a useful tool for measuring the sustainable outcomes and the strategies that can be use.

In the table ahead a comparison between the guides from Colombia is made through the main elements that create a quality sustainable guide according to the previous analysis; points are given to the guide if it meets the aspect and then summed up to evaluate their quality and to be able to recognize the most complete guide from the three.

Guides

| Aspects | Guide for sustainable recommendations for the building field (2015) | Sustainable construction guide for saving of water and energy in buildings (2015) | Guide for the Design of Sustainable Buildings (2015) |
|----------------------------|---|---|--|
| Consideration of VIS | 0 | 5 | 2.5 |
| Reference projects | 3 | 0 | 0 |
| Social approach | 0 | 0 | 0 |
| Sustainable certifications | 0 | 0 | 4.5 |
| Information and topics | 3 | 3 | 5 |
| Total | 6 | 8 | 12 |

G. 04. Comparison between guides for sustainability in the building context

Evaluation of the guides / Elements for a comparative analysis

1. Consideration of VIS: Since the existent guides are not focus on social housing but some of the strategies mentioned can be applied to VIS, it is important to evaluate if the guides link these strategies to the type of housing and if the application of some of them is possible or not.



2. Reference projects or case study: The use of these resources is a key element in the understanding of the information provided as it presents an example on the applied theory.



3. Social aspect: The sense of creating community with design, having optimal social relations between users, the role of the inhabitants in the design process, and the behavior that the building enhance.



4. Sustainable certifications: This aspect evaluates if the guides present certifications for sustainability in construction and their possible use in the projects.



5. Information and topics: This aspect evaluates how wide is the variety of topics according to the broad area of sustainability in construction and architecture; in addition, if the topics treated in the guides are complete and explained in detail.



According to the results, the most complete guide is the "Guide for the Design of Sustainable Buildings" of 2015. Since the guide meets most of the aspects expect for "Reference projects or case studies"; "Social aspect" and it can be better in "Considering VIS", it is concluded that an ideal guide would include these elements as well as the improvement of the other aspects.

In conclusion, in order to have a complete guide portraying the strategies that can be implemented for a sustainable social housing project it is necessary to complement the subjects presented by the guide, this project would present the strategies lacking in the Colombian Guide for the Design of Sustainable Buildings according to this study and it will complement the strategies given by the guide.

05 Reference cases

Colombian cases

International cases

Synthesis

Proyecto El Paraíso / Valparaíso, Antioquia, Colombia

2018

Construction company: Syma

Type of housing: VIS

150 housing units

Certification: CASA

8 blocks / 5 floors

Apartments: 54,38m²

Price: Housing below 120 COL million pesos (28.466€)

- ✓ Innovation
- ✓ Social approach
- ✓ Role of biodiversity
- ✗ Flexibility and adaptation
- ✗ Low embodied carbon materials
- ✓ Wide range of strategies for sustainability
- ✓ Environmental services
- ✗ Life cycle analysis of the building
- ✓ Partnerships
- ✓ Certification

7/10 Total score

The holistic approach of the project results in a housing complex that promotes sustainable actions. One of the first things that is evident when analyzing the project is the lack of fences, the project creates public spaces for the municipality by avoiding the usual closure of the housing complex for privatization purposes; in this sense, the project proposes 83% of the project area for common spaces, green areas, a theatre, and an orchard with a compost space. The bioclimatic design saves around 30% of energy and by collecting rainwater it saves around 20% of water, relieving monthly household expenses by about 10%. Along the mentioned strategies, the social aspect was present since the early stages of the project were in a series of workshops

it was discussed with the community their necessities, wants and ideas, that were later implemented in the design process; in the next step, people were assisted with financial information in order for them to implement the resources and help given by the government to purchase the housing units; after people were living in the project a culturalization program was implemented to promote good community interactions as well as giving recommendations on the use of the urban orchard, the compost and to recycle in the correct way. Along these strategies, during the construction process, there was a saving of 141 cubic meters of water and the use of more than 13 tons of construction waste was achieved (Escobar, 2020).

Good practices /

- Community involvement from early stages to after occupation
- Construction waste and resource management
- Large public spaces and cultural areas
- Respect for the existent in the site



19 El Paraíso project
Syma, 2020

Location: Valparaíso Antioquia, Colombia

Weather: 19 °C to 27 °C

Design description: The apartment blocks consist in 5 floors of one type of apartment replicated 4 times mirrored with no shared walls for privacy and a central circulation consisting in stairs and hallway.

Apartment description: 54,38 m² apartment with 3 bedrooms and 2 bathrooms distributed in one side, and social area (living and dining room) and service area (kitchen and laundry room), in the other side.

Structure type: Masonry with cement blocks

Materials: Cement blocks, concrete and perforated bricks

El Paraíso complex:

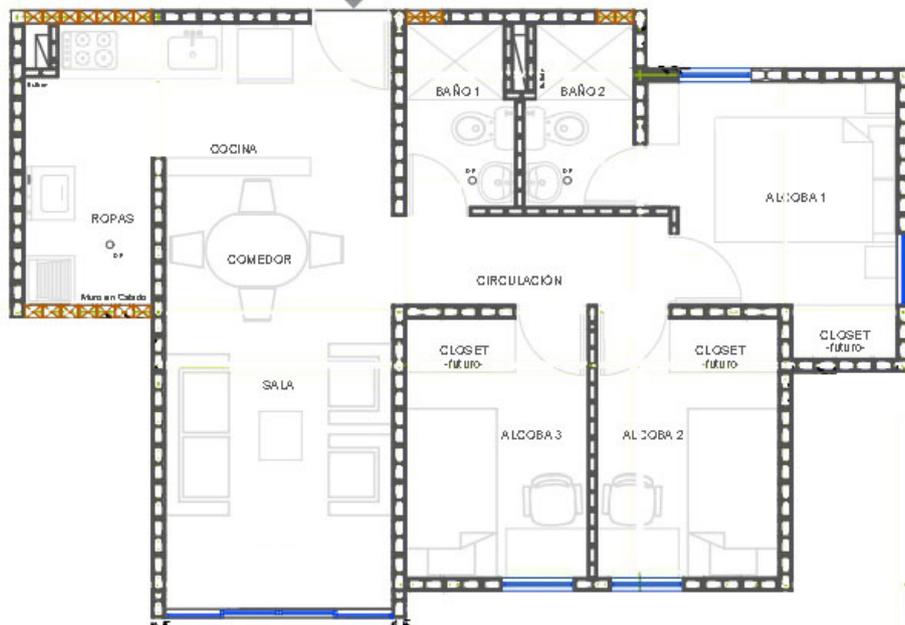
- 7,5 blocks (half a block was built to respect an existing tree)
- Open-air theatre
- Orchard
- Compost area
- Communal space
- Playground
- Green areas
- Recreational paths

Sustainable strategies:

- Social approach before and after construction
- Social spaces for the community
- Responsibility in construction phase
- Material recycling
- Water and energy savings
- Bioclimatic design
- Food production



Perforated brick
for ventilation



Apartment 54,38 m²

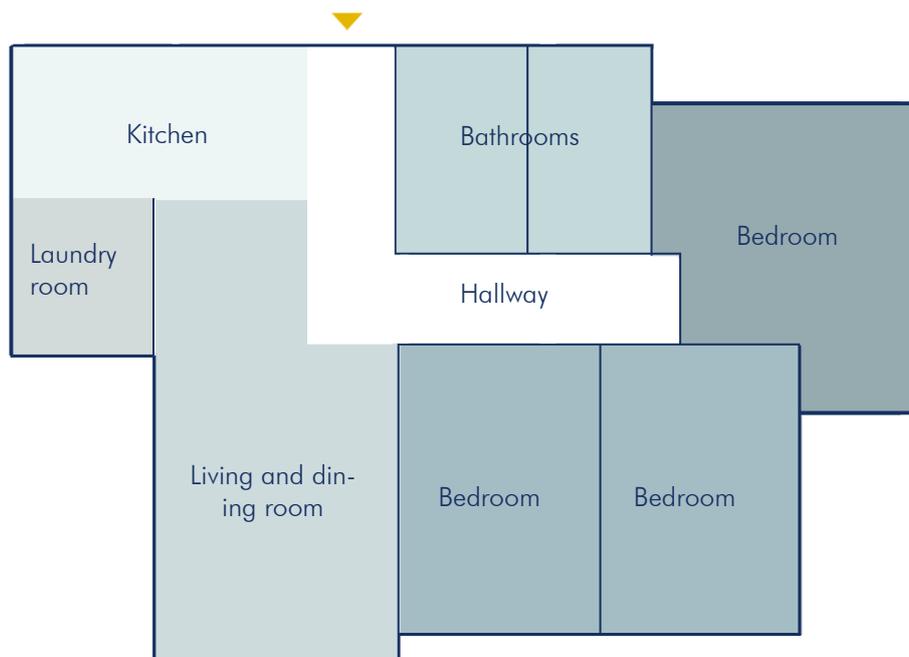
21 Syma, 2021

3 bedrooms

2 bathrooms

Social area / living and dining room

Service area / Kitchen and laundry room



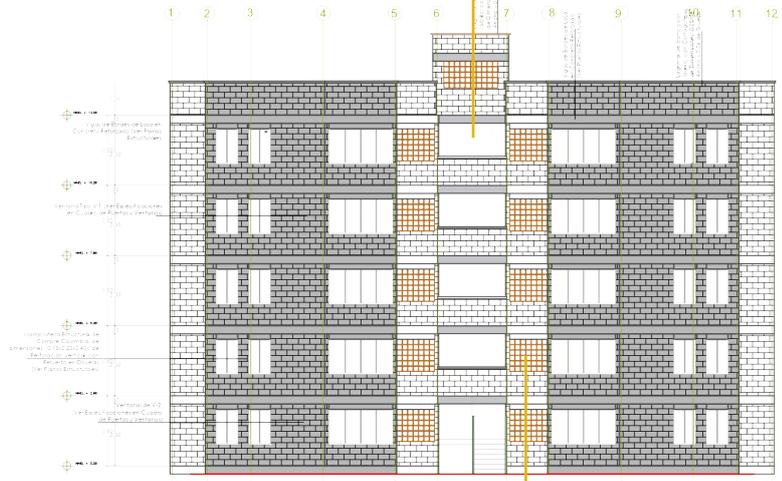


22 Construction phase
Syma, 2020



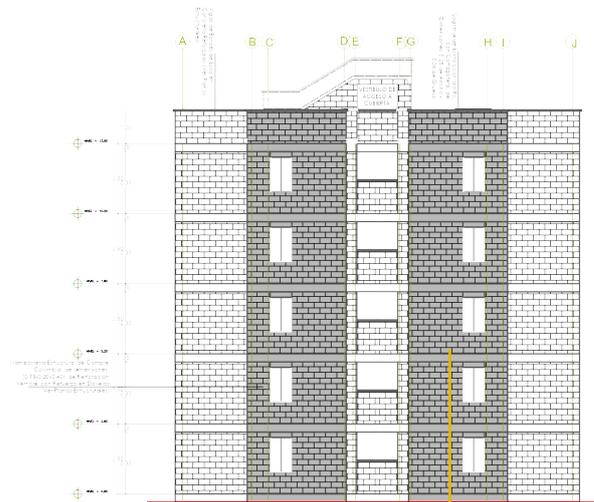
23 Construction phase
Syma 2020

Central openings for ventilation and lighting



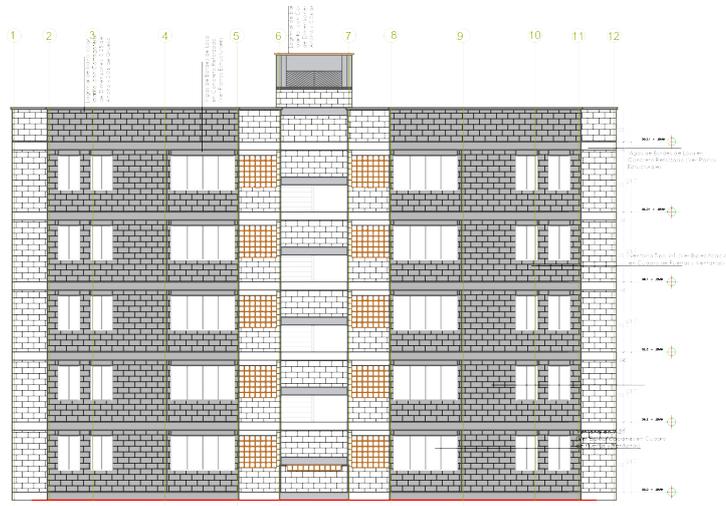
Front façade

Perforated bricks for ventilation and lighting located in kitchen, laundry room and bathrooms



Left lateral façade

Uniformity in façade, finishes with variation of three different colors



Back façade



Right lateral façade

24 Syma, 2021

Sayab habitational complex / Cali, Colombia

2006-2015

Architect: Luis de Garrido

Area: 38.942 m²

Awarded in 2011 as Colombia's most sustainable residential complex by Fundación América Sostenible (Sustainable America Foundation)

Apartments: 51,41- 85,59 m²

345 industrialized and prefabricated apartment units.

4 blocks / 8 floors

- ✓ Innovation
- ✓ Social approach
- ✓ Role of biodiversity
- ✓ Flexibility and adaptation
- ✗ Low embodied carbon materials
- ✓ Wide range of strategies for sustainability
- ✓ Environmental services
- ✓ Life cycle analysis
- ✓ Partnerships
- ✗ Certification

Total score 8/10

The project aim was to design without the need of technology as a characteristic element to obtain sustainable outcomes, this was approached with bioclimatic and passive strategies such as the orientation for solar incidence advantage as well as the use of the wind through the ventilation system to cool down the building in a natural way. The project has an integral approach to sustainability as it considers natural resources, increases the green area with a

green roof, reaching double the area of occupation of the building, and innovates in materials and structure as it is design with modular prefabricated elements; moreover, it involves the community with an integrated waste management program where habitants are part of a training to raise awareness and learn to separate the solid waste and make proper management and use of this waste (Casiopea, n.d.)

Good practices /

- Innovation in materials and structural design
- Community involvement
- Large green areas
- Flexibility in apartment distribution
- Bioclimatic approach
- Design for disassembly



25 Sayab building
Argos

Location: Cali, Valle del Cauca, Colombia

Weather: 19 °C to 29 °C

Design description: The two building blocks consist in 8 floors of different types of apartments organized in two sides of an internal courtyard with distribution points on each end, the apartments are accessed through small passages and bridges, creating a small circulation area; the opened center allows natural ventilation and lighting.

Apartment description:

70 m² apartment /

Distributed in social-service and private area:

| | |
|--|---|
| Social area / Living and dinning room Service area / kitchen and laundry room | Private area / 3 bedrooms 2 bathrooms |
|--|---|

Every apartment varies in balcony dimension, creating variations in the facade.

100 m² apartment / Duplex 2 levels

Distributed in private and social-service area:

| | |
|---|---|
| First level/ 3 bedrooms 2 bathrooms Free space | Second level / Living and dinning room kitchen and laundry room |
|---|---|

Structure type: Modular prefabricated elements

Materials: Reinforced concrete plates, water-repellent plasterboard, 5 cm hemp insulation, 3 cm ventilated air chamber and vegetable paints.



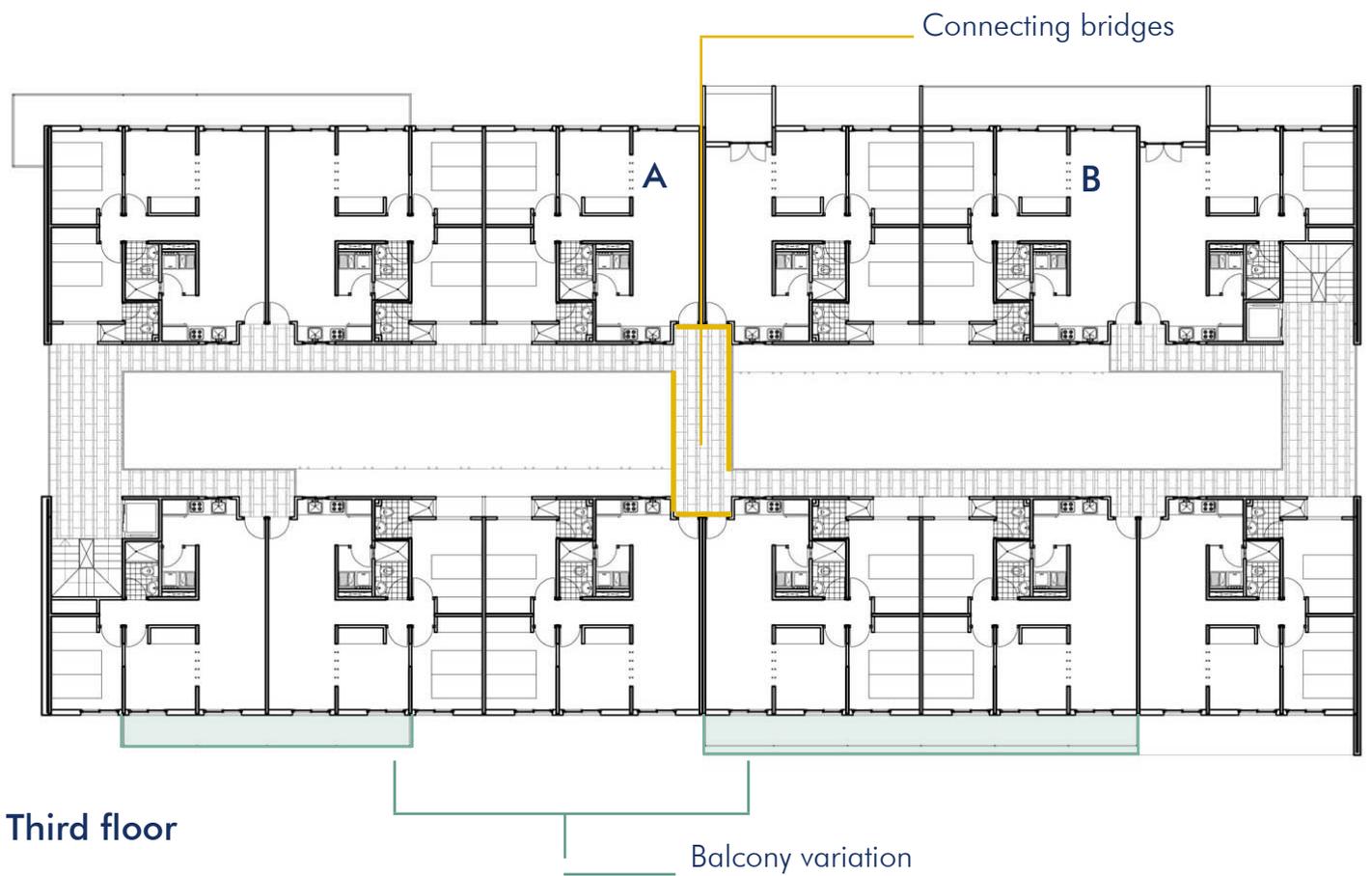
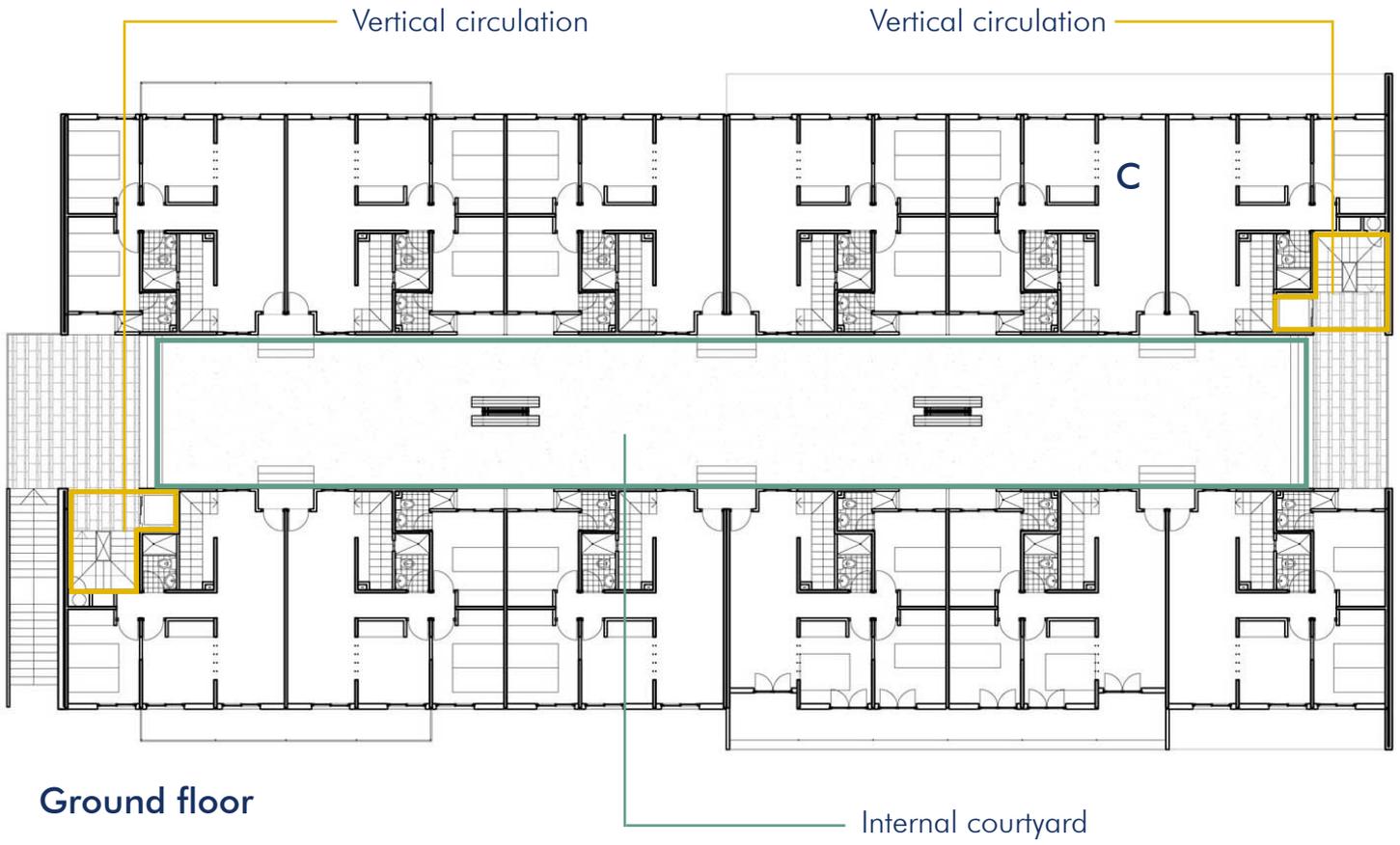
Complex:

- Playground
- Green areas
- Recreational paths
- Underground parking
- 2 blocks
- Pool
- Green roofs
- Communal space

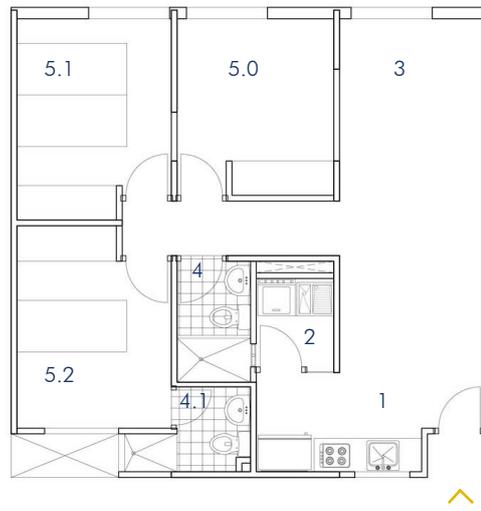
Sustainable strategies:

- Social responsibility after construction
- Social spaces for the community
- Low environmental impact materials
- Water and energy savings
- Bioclimatic design
- Large infiltration areas
- Design for deconstruction

Plan view

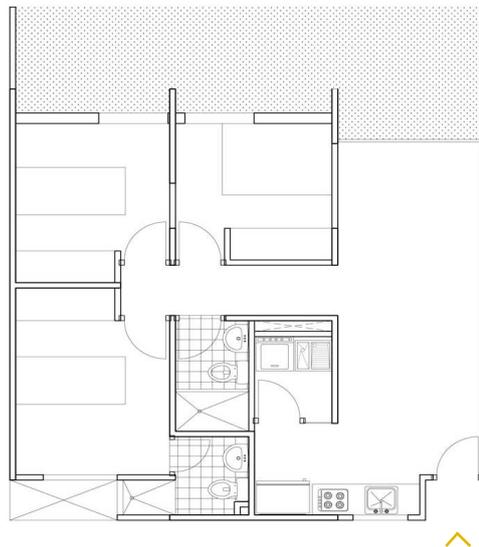


Apartment typologies



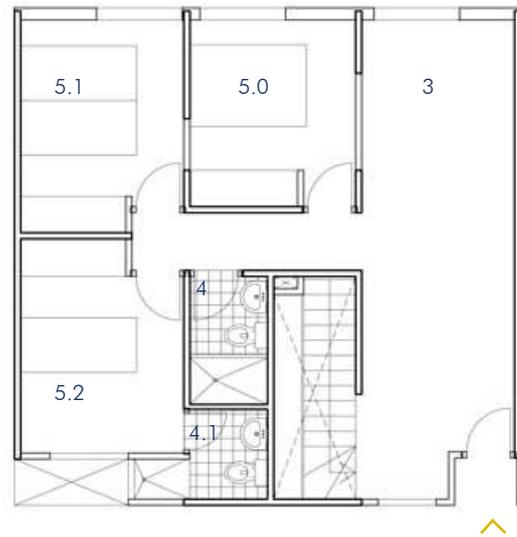
- 1. Kitchen
- 2. Laundry room
- 3. Living and dining room
- 4.0. Bathroom
- 4.1. Main bathroom
- 5.0. Bedroom
- 5.1. Bedroom
- 5.2. Main bedroom

A. Three room apartment
70m²



B. Three room apartment with balcony
70m²

27 Luis de Garrido



- 1. Kitchen
- 2. Laundry room
- 3. Living and dining room
- 4.0. Bathroom
- 4.1. Main bathroom
- 4.2. Bathroom
- 5.0. Bedroom
- 5.1. Bedroom
- 5.2. Main bedroom
- 6. Studio

1th floor



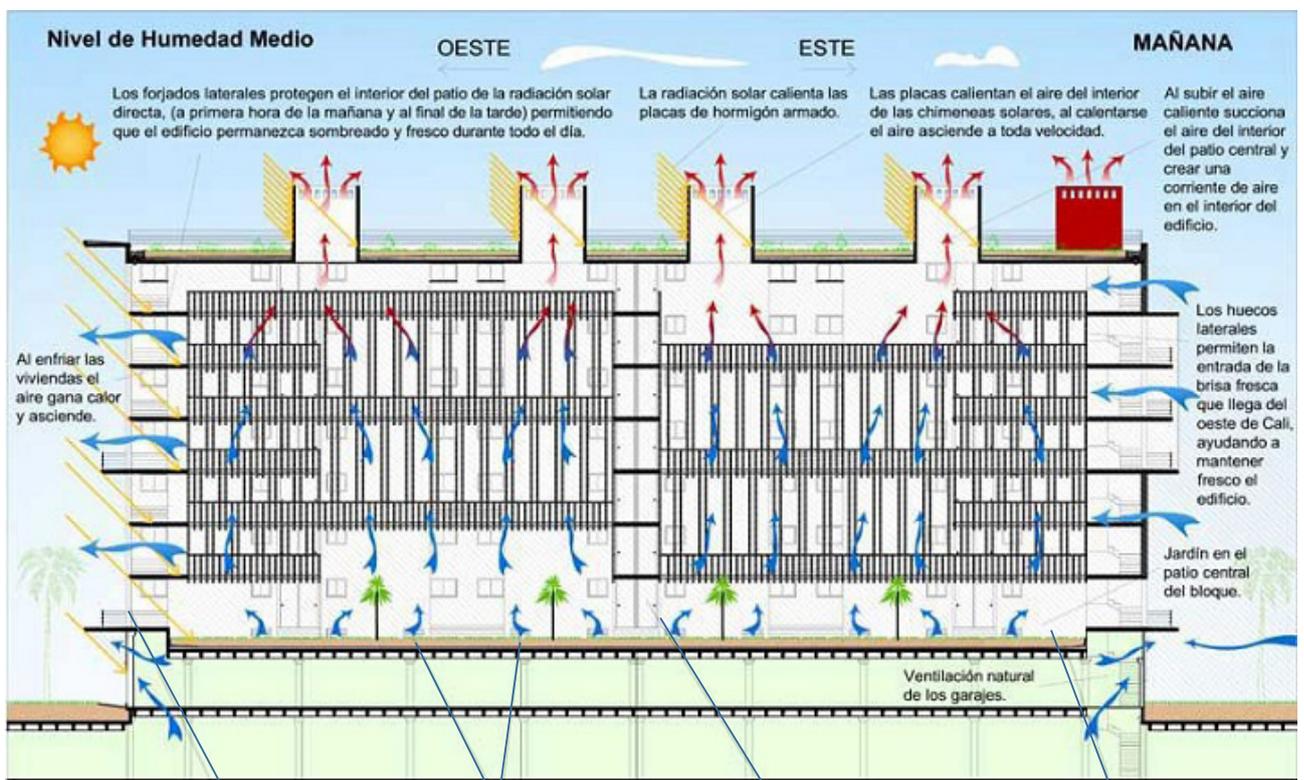
2th floor

C. Duplex apartment / 2 levels
 Three room apartment
 100m²

Bioclimatic strategies

Medium humidity levels

Morning

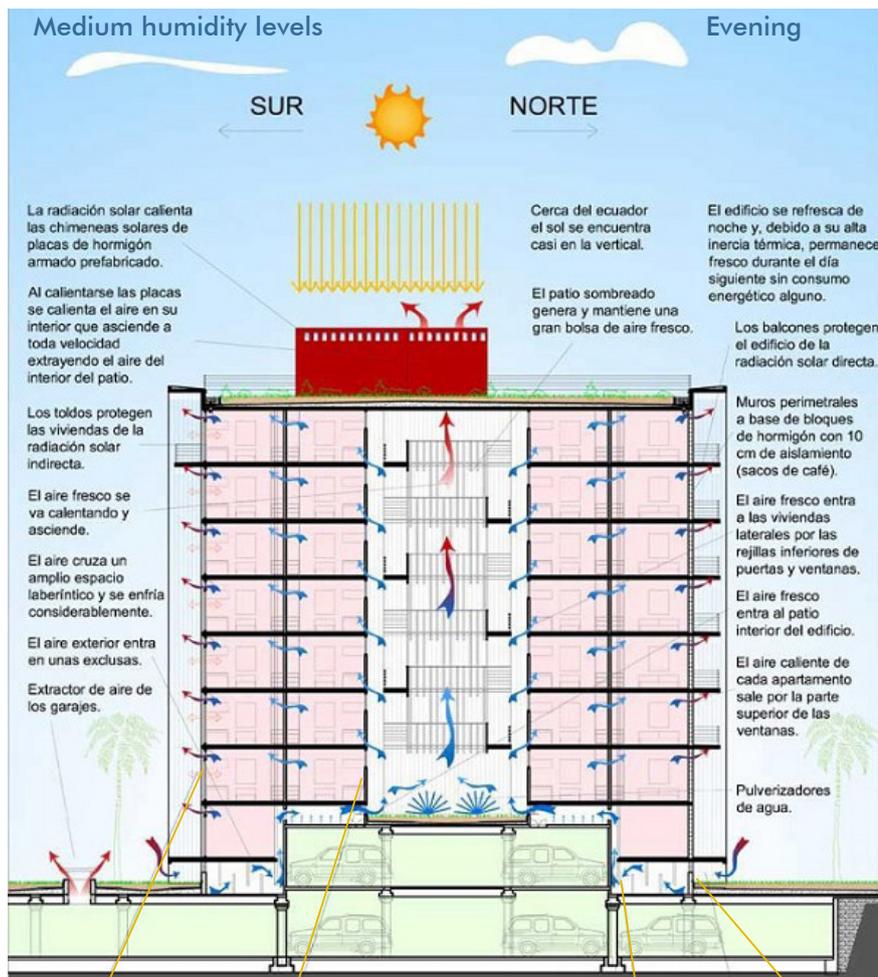


The metal mesh protects the lateral walkways and the central patio from direct solar radiation.

Fresh air slides from the architectural galleries of air refreshment.

In the central courtyard a huge bag of fresh air is generated that will refresh all the adjoining houses.

Internal court with green roof.



Due to the materials chosen, the walls transpire naturally and continuously, allowing natural ventilation, without energy loss.

The whole building has been built on prefabricated reinforced concrete plates of 8cm, which provides a great thermal inertia to the whole.

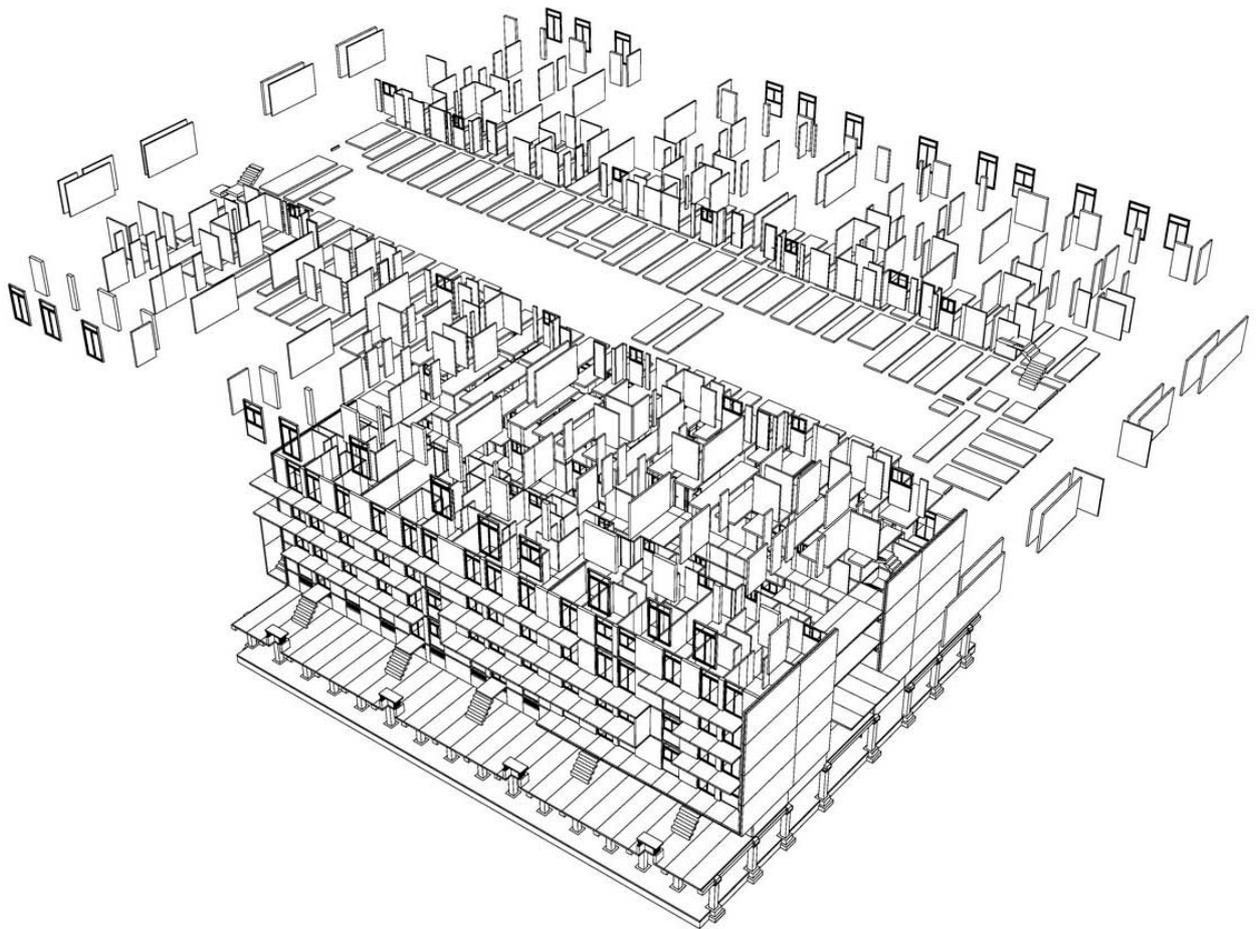
Overhangs protect the building from direct solar radiation and create fresh air pockets on the sides of the building.

The fresh air runs through a set of semi-buried galleries and cools at least 5°C respect to the fresh air outside.

Outside air enters a system of locks located between the ground floor and the basement floor.



29 Internal courtyard
Argos



**Exploded view 1,2,3 and 4th floor/
30 Prefabricated concrete elements**

Luis de Garrido

The resource rows / Copenhagen, Denmark

2015-2019

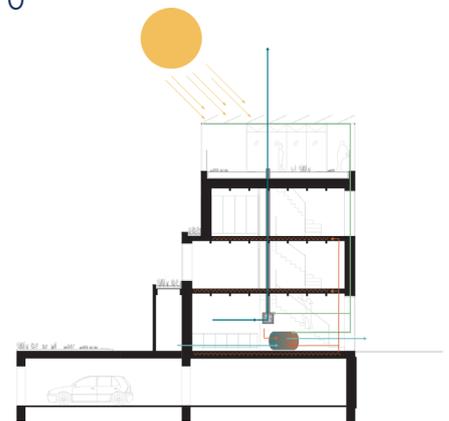
Architect: Lendager Group

Area: 9.148 m²

The project was based on five different focus areas: materials, energy, water, social and biodiversity. The soul of the project is the facades that keep history alive as its composed by reused brick walls that were recovered from old buildings and brought to a new life in the project. In regards of energy efficiency, the project lowers the energy consumption by implementing good practices in the envelope of the building and designing for natural lighting; for water savings, the building recovers rainwater for non-potable uses and landscape irrigation. The building gives back the lost green space taken by the construction by creating roof gardens, vertical gardens with a compost area and internal green courtyards.

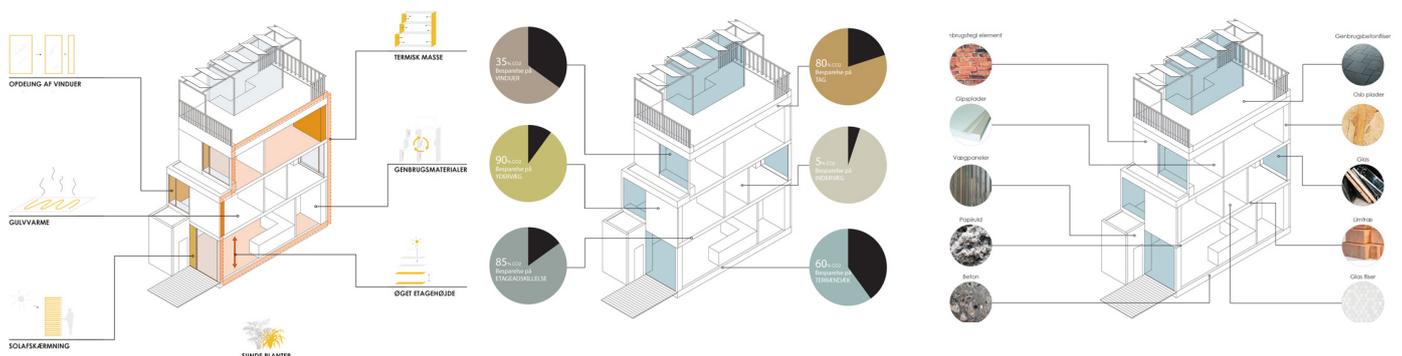
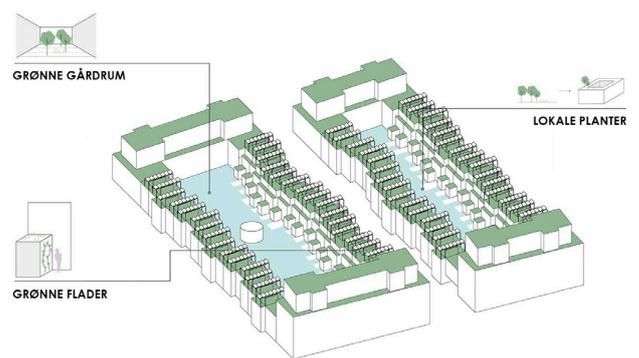
- ✓ Innovation
- ✓ Social approach
- ✓ Role of biodiversity
- ✗ Flexibility and adaptation
- ✓ Low embodied carbon materials
- ✓ Wide range of strategies for sustainability
- ✓ Environmental services
 - Life cycle analysis
- ✓ Partnerships
- ✗ Certification

Total score 7/10



Good practices /

- Use of recycled materials
- Communal spaces
- Implementation of gardens and greenhouses
- Water and energy management





31 The Resource Rows
Lendager Group

UN17 Village / Copenhagen, Denmark

2018-2023

Architects: Lendager Group and
Årstiderne Arkitekter

Area: 35,000 m²

Certifications: Requested,
DGNB Platinum and Gold,
DGNB Heart, Well. 100% elec-
tricity from renewable energy

Apartments: 40-100 m²
380 housing units

- ✓ Innovation
- ✓ Social approach
- ✓ Role of biodiversity
- ✗ Flexibility and adaptation
- ✓ Low embodied carbon materials
- ✓ Wide range of strategies for sustainability
- ✓ Environmental services
- ✓ Life cycle analysis
- ✓ Partnerships
- ✓ Certification

Total score 9/10

The proposal creates “the first building project in the world” to address all of the 17 UN’s Sustainable Development Goals (SDGs), more than creating a sustainable building, the aim is to enhance a sustainable lifestyle, focusing on health and quality of life. The project is developed by using recycled materials such as concrete, glass and wood; in terms of savings, the project recycle up to 1.5 million liters of water every year, all the energy is from sustainable sources, and encourages biodiversity with a gar-

den located in the rooftop of each housing block. In terms of the social approach, the project proposes 37 different housing typologies considering diversity in family conformation; along this proposal, the project creates co-living spaces, senior accommodation, communal spaces for public use, and conference center, it contributes to health and food waste as it introduces greenhouses, food-sharing facilities, and an organic restaurant.

Good practices /

- Targeting all 17 SDGs
- Use of recycled materials
- Communal spaces
- Implementation of gardens and greenhouses
- Water and energy management



32 UN17 Village
TMRW Visualizations. 2018

L'Inesto, Milano, Italy

2018-on going

Architect: Barreca & LA Varra

Environmental expert: Arup Italia

Area: 21.000m²

700 tenants

- ✓ Innovation
- ✓ Social approach
- ✓ Role of biodiversity
- ✗ Flexibility and adaptation
- ✓ Low embodied carbon materials
- ✓ Wide range of strategies for sustainability
- ✓ Environmental services
- ✓ Life cycle analysis
- ✓ Partnerships

Total score 9/10

The project is described as Italy's first zero carbon social housing project, it was the winner of the competition "C40 Reinventing Cities" an international contest that encourages the innovation in the field of urban space with zero carbon design strategies. (Arup n.d.). It will be developed in a former railway area in the northeast part of Milan, in the Greco-Pirelli station, the location is strategic as it will connect two important neighborhoods that currently are separated by the space taken by the railways, it will also become a key node, due to its proximity to the station providing transport connections with Monza, a city close to Milan.

The main strategy towards sustainable outcomes is the energy from renewal resources, and an urban wastewater heat-recovery system, along these strategies, regarding building structure, it is de-

signed for disassembly with pre-assembled construction technology. In addition, as a social focused design, some activities complement the project to create community and social interaction with a Circular Economy District, Community Food Hub an Energy Showroom, a Zero Waste Store, a 'Residents' Handbook', and a district App. The area will have 70% of green space, vegetable gardens, a garden nursery, green seeded roofs, and 'edible' landscapes will create an agricultural heart.

Among the key contributions are design and planning that secure affordable, accessible and healthy housing, access to sanitation, as well as buildings, public spaces and infrastructure which help to reduce the spread of diseases through design.

Good practices /

-Communal spaces

-Implementation of gardens and greenhouses

-Water and energy management

-Enhancing sustainable behaviour

-Use of technology for users knowledge

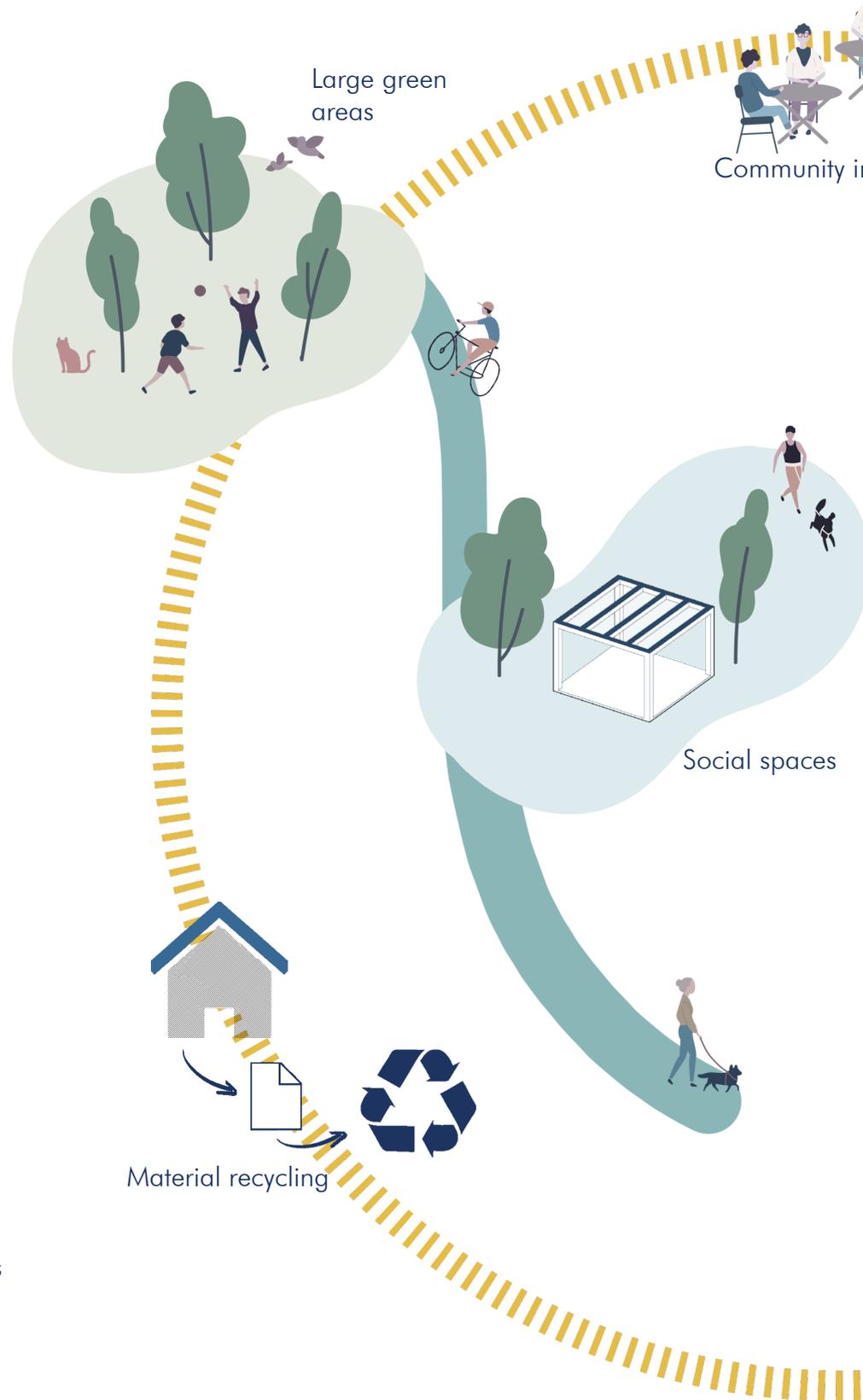


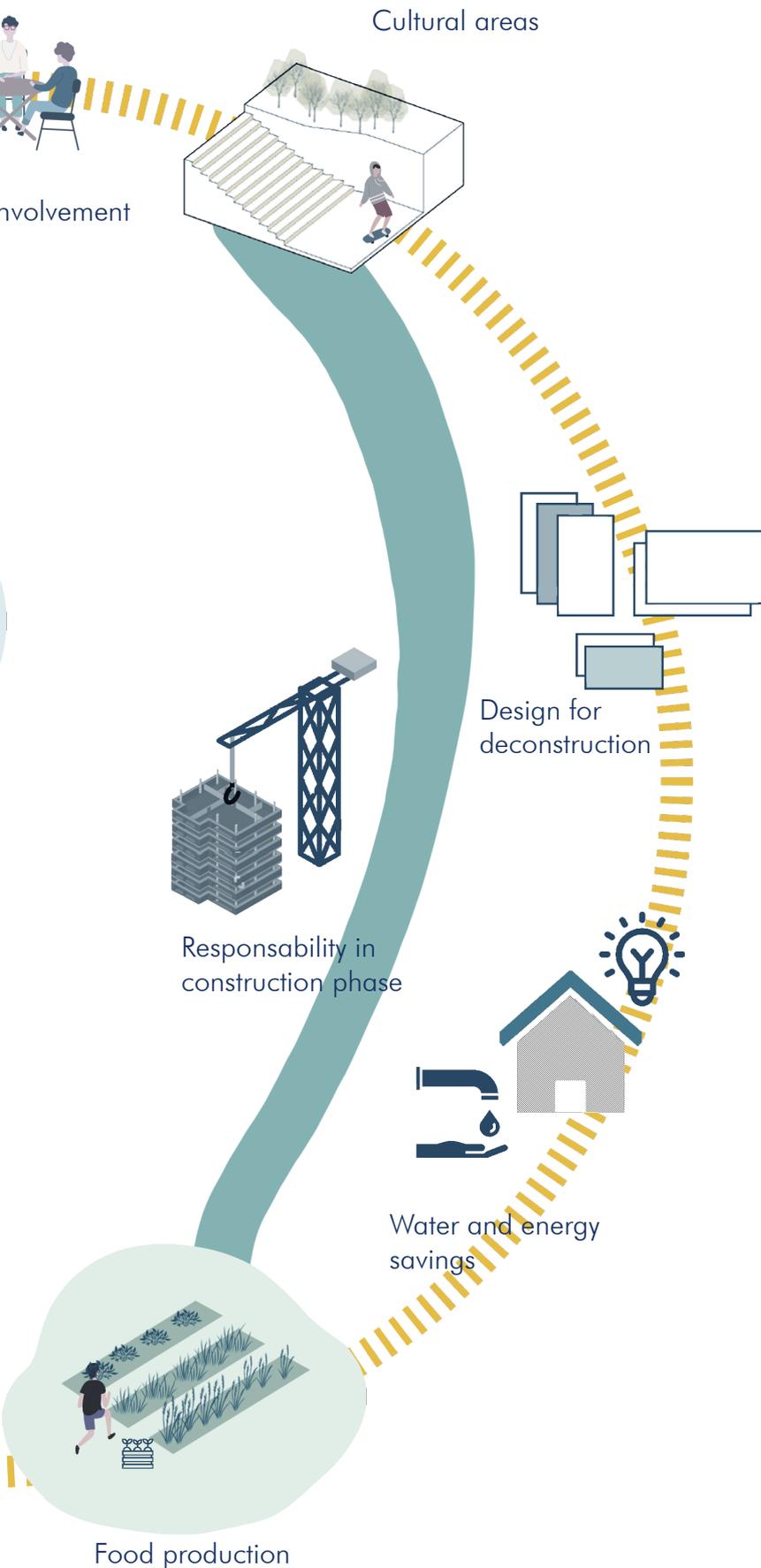


Lessons learned from the case studies

Sustainable strategies/

- Social approach before and after construction
- Social spaces for the community
- Responsibility in construction phase
- Material recycling
- Use of recycled materials
- Water and energy savings
- Bioclimatic design
- Food production
- Low environmental impact materials
- Water and energy savings
- Bioclimatic design
- Large infiltration areas
- Design for deconstruction





Good practices /

- Community involvement from early stages to after occupation
- Construction waste and resource management
- Large public spaces and cultural areas
- Respect for the existent in the site
- Innovation in materials and structural design
- Large green areas
- Flexibility in apartment and space distribution
- Use of technology for users knowledge
- Enhancing sustainable behaviour

Additional sustainable social housing initiatives

Access to housing is a right for all and it should be addressed contemplating its complexity and challenges by implementing a sustainable approach, the housing deficit is treated in different ways in every country; lessons learned from countries that have applied successful models or policies related to social housing can be studied in order to find a solution on ideal elements to implement to affordable housing in Latin-American countries.

In a European context, it can be highlighted the case of Vienna, where the municipality promotes the developers to invest with benefits in taxation and construction; in addition, it requires to assign to social housing a 30% of every new building (De Luca et al., 2009), this strategy would address many of the issues occurring in the Latin countries, such as segregation due to the location in the periphery of the city, low quality housing and exclusion of population with low income.

Another initiative on social housing implemented in the Netherlands is the sustainable bonds by NWB Bank, the SDG Housing Bond finances affordable and sustainable social housing, promoting with this the linkage between sustainability and social housing (UN, 2021), which in Lat-

in-America is still a remaining challenge.

In Belgium The Community Land Trust, creates the possibility for co-ownership housing by offering dwellings with a ground lease contract of 50 years with the option of renewal, the price of the housing is established according to the buyer's income, being detached from the market value and ensuring long lasting affordable housing.

In Barcelona, an example on partnerships between public entities and third parties is the relation of the Housing and Rehabilitation Institute with the Council for Social Housing that involves residents in delivering their own housing needs through activities, such as debates and meetings to formulate proposals for housing-related strategies. From these meetings, the results are presented as reports, that reflect the experience of residents, and the benefits of consulting them to come up with improved housing policies. (UN, 2021). This strategy would improve the quality of housing and would solve issues related to post occupancy dissatisfaction with the housing units, as seen in the case of Chile, where the issue moved from being a No roof problem to a With roof problem (Rodriguez and Sugranyes, 2011).



Strategies for quality sustainable social housing

Social participation /

The course of action when starting a project, is involving people from the earliest stages, this is an essential step, as it will allow developers to understand peoples needs, as well as shaping the project by integrating their ideas and thoughts, according to Broom (2005), residents should not only be participants, but should “control the major decisions”. Participatory processes are of great significance, as they will create ownership in the future project.

It is crucial to consider the participation of the user, as is in fact an active rather than passive agent and participates in shaping his experience and his response to the architecture he encounters (Parikh, A. and Parikh, 2017).

According to De Carlo, there are three phases of participation; finding out needs; formulation of hypotheses and actual use, not only in this specific order but in a cyclical dynamic where it can go back and re formulate what it was previously established (Blundell Jones, et al., 2005).

Mixed-income housing /

The mixed-income housing is created to generate social benefits for inhabitants. The relation between a household with higher income is related to increased social capital for low-income residents; role model of social norms in behaviour in a direct or indirect way; safer communities and benefits for the community through enhanced engagement of political and market forces (Joseph et al., 2007).

The city of Vienna implements mixed-income housing, opening social housing to middle class and low income households; as mentioned by Senior Housing Researcher of the City, Bauer, “a member of parliament can live in the same building as an unemployed person, a student or a retired person.” as she explains, this is a way of addressing the issue of gentrification and segregation. This strategy as well as spreading subsidized housings in different parts of the city helps preventing gentrification (Maschaykh, 2017).

Technologies in social housing /

The ICT in social housing can be an strategy for community engagement trough online dynamics, people can access community services trough a neighborhood App, for booking spaces, car sharing services, or community library use; this technologies can also be implemented for security, or health purposes; in terms of the building, technologies are engaged from earlier stages of the project, from the design and planning with analysis of proposals or in the construction phase for management; in addition, in the occupancy phase it can be implemented for monitoring consumption, building maintenance and home automatization. (Trane et al., 2022)

District Apps as proposed in the project L'inesto in Milano, can also contribute to sustainable behavior; the app for this project is aimed to create a sustainable community and to be part of the change that residents are seeking when involving in this carbon-neutral based project.

Post occupancy evaluation /

Is a process that takes place after a building has been delivered to the users for a period of time, this evaluation is implemented in order to analyze the building performance and identify negative or positive outcomes from the design.

The results from this analysis are crucial for future projects with the learned experience, it can also help to identify and share best practices for people related to the field to follow.

In some cases the retrofit from the evaluation can lead to modifications for the improvement of the existing building, therefore, creating better user experiences (HMC, 2020).

06 Proposal

Project concept

Targets addressed

Strategies for a sustainable outcome

Project development

Project concept

The aim of the project is to create a sustainable habitat with a social focus that contributes to facing housing deficit, poverty, hunger, and climate change, in addition to promoting well-being, affordable clean energy use, and responsible consumption and production.

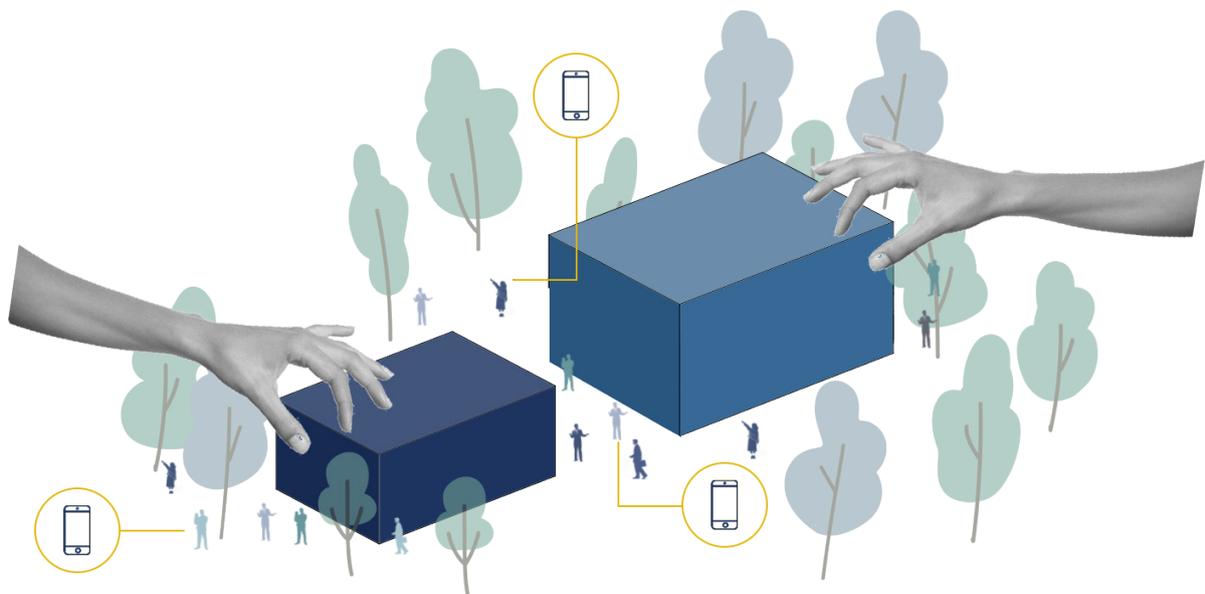
The project proposes a mixture of Social interest housing (VIS), Priority interest housing (VIP) and normal housing, all of these for sale and renting to create a diverse space amplifying the offer in housing to a wider range of people in different social and financial status to reduce inequality, contributing to achieving target 1.4 to ensure that all men and women, in particular the poor and the vulnerable, have equal rights to access to basic services, ownership and control over land.

In order to create a social based project that enhance community creation, it is proposed to involve the community trough all the stages of the project including initial stages to allow participatory design that enhance ownership and sense of belonging.

An urban agriculture space is proposed in order to create links between the community, contributing to food security improvement as stated in target 2.1, enhance neighbor interaction, and promote well-being (Target 3.4).

The implementation of technologies is proposed for a facilitated user experience and management of the project during occupancy and in all the stages of the project.

The project aims to enhance sustainable actions to help tackle climate change by the residents such as recycling, cultivating, saving water and energy, and adopt a more sustainable way of living. For this aim the project proposes spaces adapted for these practices to take place, as well as water harvesting and cleaning systems and solar panels. These strategies are in line with target 7.3 to improve energy efficiency, target 12.5 to reduce waste generation through prevention, reduction, recycling and reuse, and 13.1 to create adaptive capacity to climate-related hazards.



Project concept
Mix housing, community engagement,
urban orchard and technology use.

Social approach /

1. Before project proposal/

1.2. Analysis of people living in the area and possible users of the project to understand their needs and identify the population.

2. Project proposal/

2.1. Develop spaces for the people, their needs and cultural characteristics.

3. During project construction/

3.1. Presentation on advance of the building to involve community in the process

3.2. Involvement of the community in the stage of plantation in the green areas and the orchard to create acknowledgment on the importances of this areas and the care and use.

Urban agriculture /

The project proposes spaces of cultivation for the community, not only for food production but to promote well-being, community bonding and sustainable practices. This spaces will be design to be gathering points to socialize, barbecue and cultivate.

The cultivation areas are to be handled by residents and gardeners if needed according to the participation of people; the products originated in the gardens can be distributed to the people contributing to the gardening activities for free, and people not participating from the activities can purchase weekly a box with products, contributing to the financing of necessary elements for the garden, new seeds and payment of any gardeners or workers.

The volunteer based system and purchase of boxes for own financing is a common scheme implemented in nordic countries. Urban farming is considered a social activity more than a food production system (Liverino, 2021)

4. On project delivery/

4.1. Briefing on the building with presentation of the spaces with their functionality and respective use.

4.2. Workshop on reduce, reuse and recycle to present recycling system of the project and workshop of urban cultivation in the areas of the project.

5. Post occupancy/

5.1. Post occupancy evaluation after 6 months or 1 year after project delivery.

Technologies /

The project proposes the use of community Apps in order to have a correct and efficient management of the building by the inhabitants and administrators.

Currently available in Colombia there are some Apps with this purpose, they compile all administrative management information and integrates accounting services, payments, reservation of common areas, customer service, communication and virtual assemblies of the horizontal property, through web site or mobile application (Mosquera, n.d.). Some other Apps connects residents with electricians, plumbers, constructors and other services.

In terms of sustainable solutions, there are other apps that help the user locate recycling points for waste such as batteries, electronics and other special waste; other apps collect the recyclable material directly to the building (Vitia, n.d).

Interlinked targets to Goal 11 to be addressed by the project

Goal 1/ End poverty in all its forms everywhere

Equal rights to ownership, basic services, technology and economic resources.

Target 1.4/ By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including micro finance.



1.4

Goal 2 / End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Universal access to safe and nutritious food.

Target 2.1/ By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round



2.1

Goal 3/ Ensure healthy lives and promote well-being for all at all ages

Target 3.4 / By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being



3.4



7.3

Goal 7/ Ensure access to affordable, reliable, sustainable and modern energy for all

Target 7.3 /

By 2030, double the global rate of improvement in energy efficiency



12.5

Goal 12/ Ensure sustainable consumption and production patterns

Target 12.5 /

By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse



13.1

Goal 13 / Take urgent action to combat climate change and its impacts

Target 13.1/

Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

United Nations, n.d.

The chosen strategies for a sustainable outcome

In order to have a complete framework for achieving sustainable social housing, the Colombian guide for the Design of Sustainable Buildings of Valle de Aburrá was chosen as the most complete regarding the topics proposed, this topics will be taken into account by the project in order to achieve a sustainable outcome that achieves the Targets selected . There are six proposed topics of the guide for which it presents strategies and good practices in the design and construction of buildings.

In addition to the proposed topics of the guide, complementary subjects are proposed in order to have a complete guide towards sustainable social housing, these additional matters were found

to be important in the studied reference cases of projects and policies implemented in different countries to address social housing from sustainable principles and tackle housing deficit.

The diagram in the next page represents which target is being addressed by each of the topics; taking these aspects into account is crucial for achieving sustainable social housing and to contribute to reaching several targets on different Goals.

In the following section the project concept will be explained followed by the development of the project according to the 10 topics proposed.

Contents of the guide

Habitability

Energy

Water

Sustainable materials

Waste management

Feasibility

+

Additional subjects

Site

Social approach

Urban agriculture

Certifications



01 Site

02 Social approach

03 Habitability

04 Energy

05 Water

06 Urban agriculture

07 Sustainable materials

08 Waste management

09 Feasibility

10 Certifications



Design concept / Diversity

“Diversity means variety.
Diversity refers to difference.”

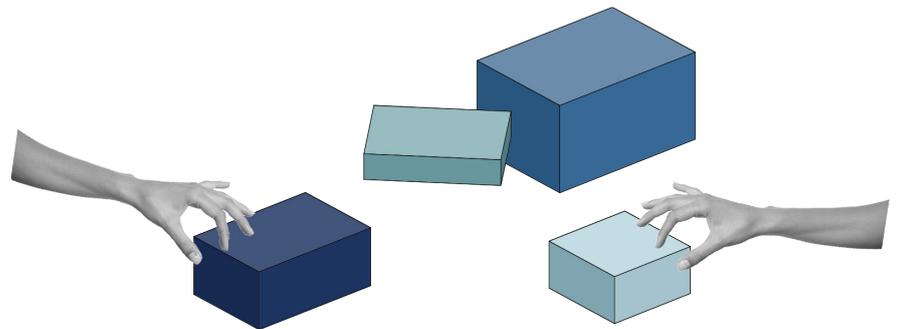
-UN, 2017

“Diversity is embodied in the uniqueness and plurality of the identities of the groups and societies making up humankind. As a source of exchange, innovation and creativity, cultural diversity is as necessary for humankind as biodiversity is for nature”- UN, 2001



Diverse

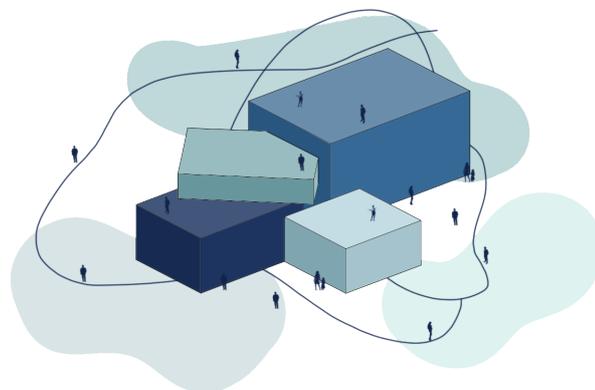
Diversity from the architecture perspective is the preservation of cultural identity which is crucial to humanity (Martin, T., and Casault, A. 2005). Architecture understands everyone's differences and needs to portray them into inclusive spaces for all, this spaces are adaptive and flexible to change and are the scenario where interaction takes place resulting in social cohesion and community engagement.



Inclusive

Social housing is /

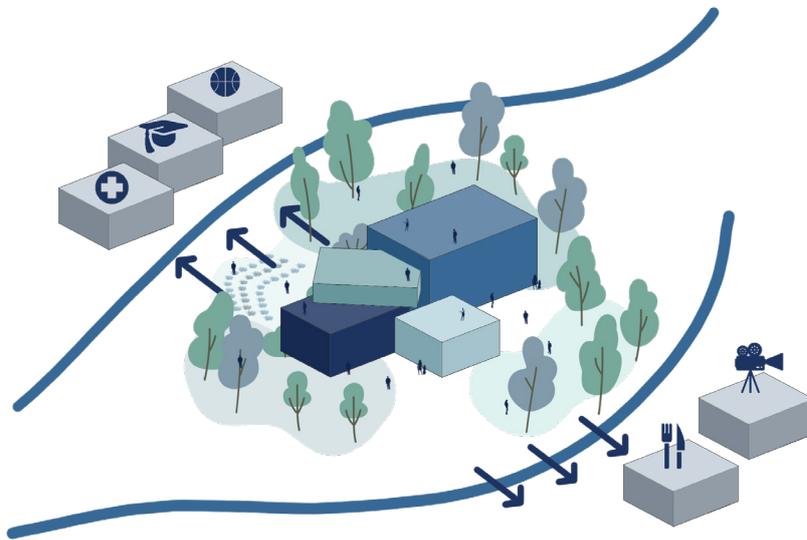
- | | |
|-------------------|--------------------|
| Diverse | Safe |
| Inclusive | Sustainable |
| Affordable | Accessible |
| Adequate | Resilient |



Adequate and safe



Environmentally Sustainable



Accessible and affordable



Resilient

01/ Site

A detailed analysis of the place where the project is going to be built will determine its unique characteristics and it will help to identify the conditionals for the design and the relation that the project will have with its surroundings, this analysis takes into account preexistent elements that can be physical, like the constructed surroundings, green areas and vegetation, characteristics

of the terrain and other non physical conditions such as weather and views. This specific features of the place in addition to guiding the design of the project, helps to preserve and protect the existent in the site as well as identifying other needs. The site analysis also identifies the building within the city and recognizes its role.

Elements of analysis

1. Characterization
2. Weather conditions
3. Biodiversity
4. Housing context
5. Immediate context
6. Determinants

Ibagué

Department: Tolima
Extension: 1.439 km²
Hight: 1.285 masl
Population: 529.635 (2018)
Average temperature: 23.2 °C / mild climate
Max. temperature: 28 y 30°C /
Min. temperature: 19 y 20°C

Ibagué is the capital of the department of Tolima, located in the central part of Colombia, being strategically well connected to the capital and other main cities; the city characterizes for its music, dance, festivals, and natural landscape. The area is distributed in the mountain area that is part of the Central Mountain range of Colombia and the flat area known as “meseta” or plateau, the city is crossed by several rivers, two of them, the river Combeima and Coello supply the city by an 80%.

Weather

Ibagué has a mild climate, meaning that is between warm and cold temperature, and goes above 18 °C; the average annual total rainfall is 1691 mm. During the year the rains are distributed in two dry seasons and two rainy seasons. The months of July and August are the driest seasons, and there is a second dry season in January and February. The rainy seasons extend from late March to early June and from late September to early December. In the dry months, it rains from 6 to 10 days/month; in the months of heaviest rains can rain about 20 days/month (IDEAM, n.d.).



Department of Tolima in Colombia

Economic development

20% People in poor conditions

13,2% Unemployment rate

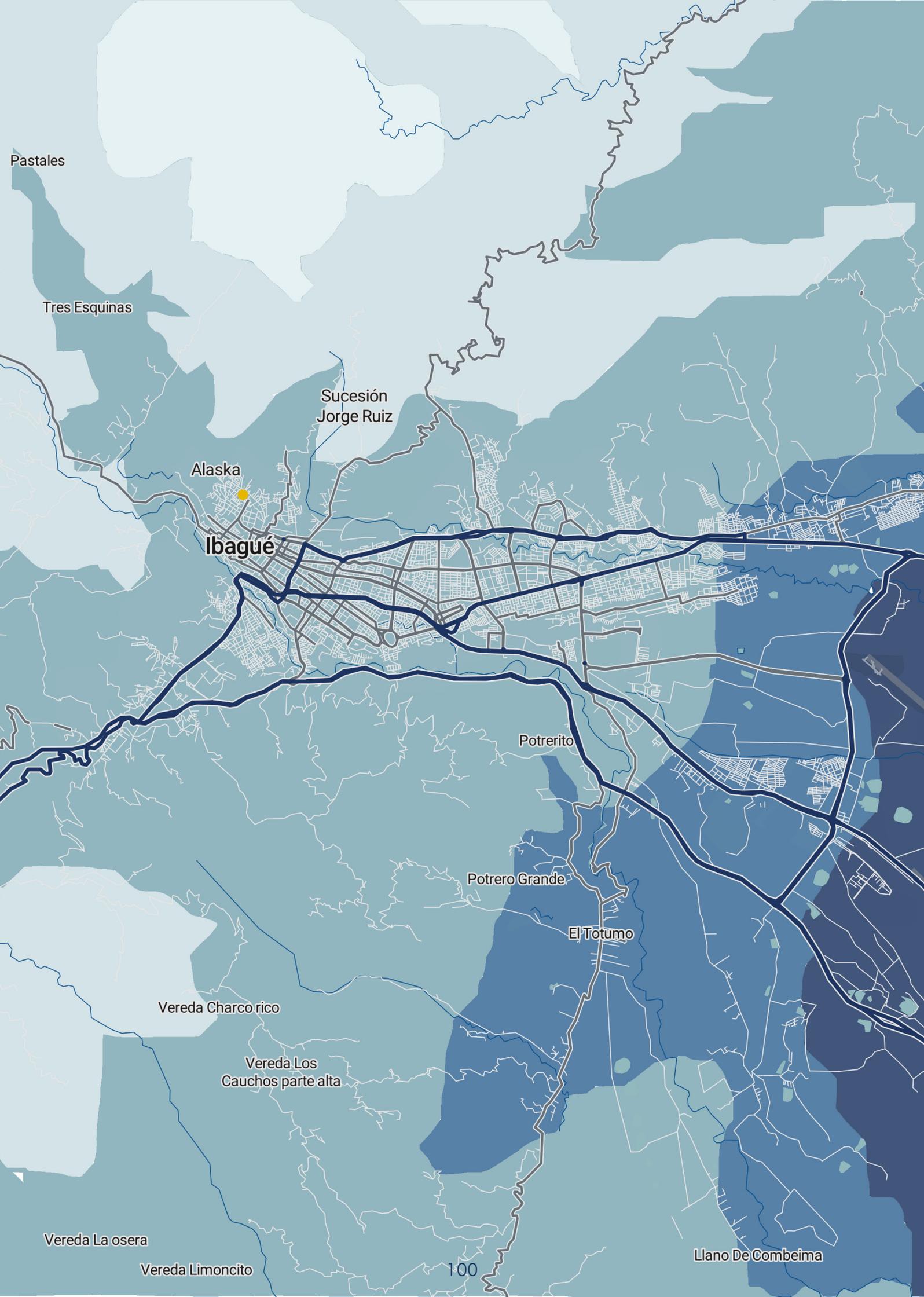
Business structure

96,1% Micro enterprises

83% Tertiary sector (trade)

15,6% Secondary sector (industry)

15% Primary sector (agriculture)



Pastales

Tres Esquinas

Sucesión
Jorge Ruiz

Alaska

Ibagué

Potrerito

Potrero Grande

El Totumo

Vereda Charco rico

Vereda Los
Cauchos parte alta

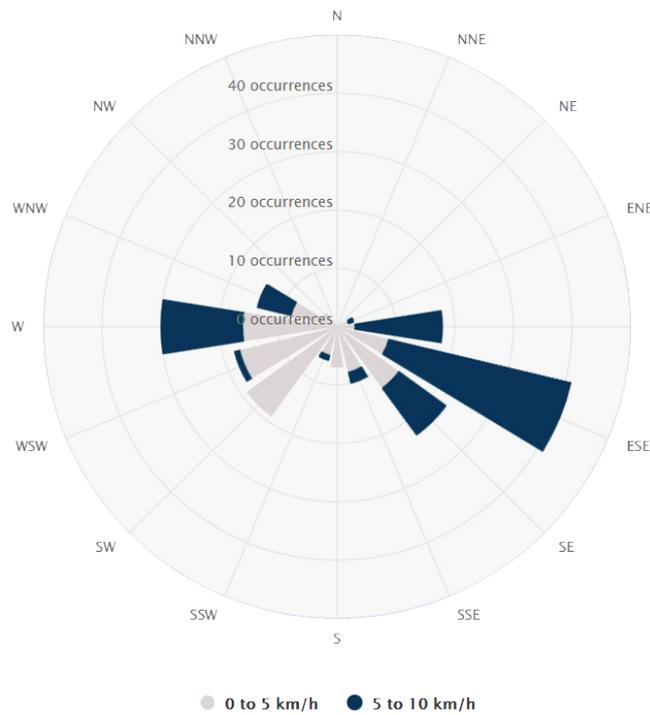
Vereda La osera

Vereda Limoncito

100

Llano De Combeima

Semi-humid mild temperature



Wind rose of Ibagué
Meteoblu, 2022

Temperature in Ibagué

- Super-humid very cold
- Super-moist cold
- Semi-humid mild
- Semi-moist heat
- Semi-arid heat

Adapted from IDEAM, 2014

Biodiversity

In Ibagué, the lack of trees in some streets in the city center is very evident, this affects negatively the thermal comfort and environmental quality. The city has a large amount of native species that provide valuable environmental and ecological services, such as *Saman Samanea saman*, the *Ceiba Ceiba pentandra* or the *Cámbulo Erythrina poeppigiana*.

One the most obvious problems in the urban arborization of Ibagué is the conflict between trees, and the power and telephone lines. This situation occurs in many of the sectors with trees of the city and it is for their plantation under the power lines that consist in cables at 5 or 6 meters high, medium and large species which exceed 15 meters in height, such as the *Ocobos Tabebuia rosea*. This shows the lack of clear criteria for species selection for the urban tree by the administration of the city (Molina, 2008).

In that sense, is of high relevance to know the species that can be planted and that are recommended for their good environmental services and their appropriate relation with the constructed environment.

Species recommended for strengthening the Main Ecological Structure of Ibagué.



Acacia forrajera



Cámbulo



Guadua



Balso



Carbonero



Guayabo



Cachimbo



Ceiba

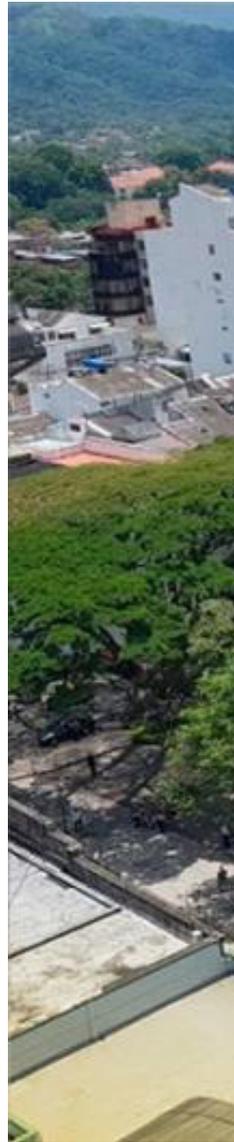


Guayacán amarillo

Plaza de Bolivar /

36 Main square in the city center with blossomed Ocobo, distinctive tree of the city.

El Nuevo Día, 2021





Iguá



Ocobo



Samán



Mamoncillo



Palo de cruz



Totumo



Mango



Payandé



Yarumo

VIS Housing in Ibagué

In 2018 the housing deficit was of 17.346 housing units, one of the reasons for this issue is that Ibagué is the urban center of the department of Tolima, and it receives the migration of the rural areas and bigger cities of the rest of the country, as people move to intermediate cities such as Ibagué for the quality of life; these factors lead to increasing population and higher housing request (ICV, 2018).

VIS housing construction in Ibagué has been rising in the last few years, in March 2020, the growth was of 179% (El Nuevo Día, 2021). This growth will continue to be positive according to the new master plan that contemplates new areas destined for VIS.

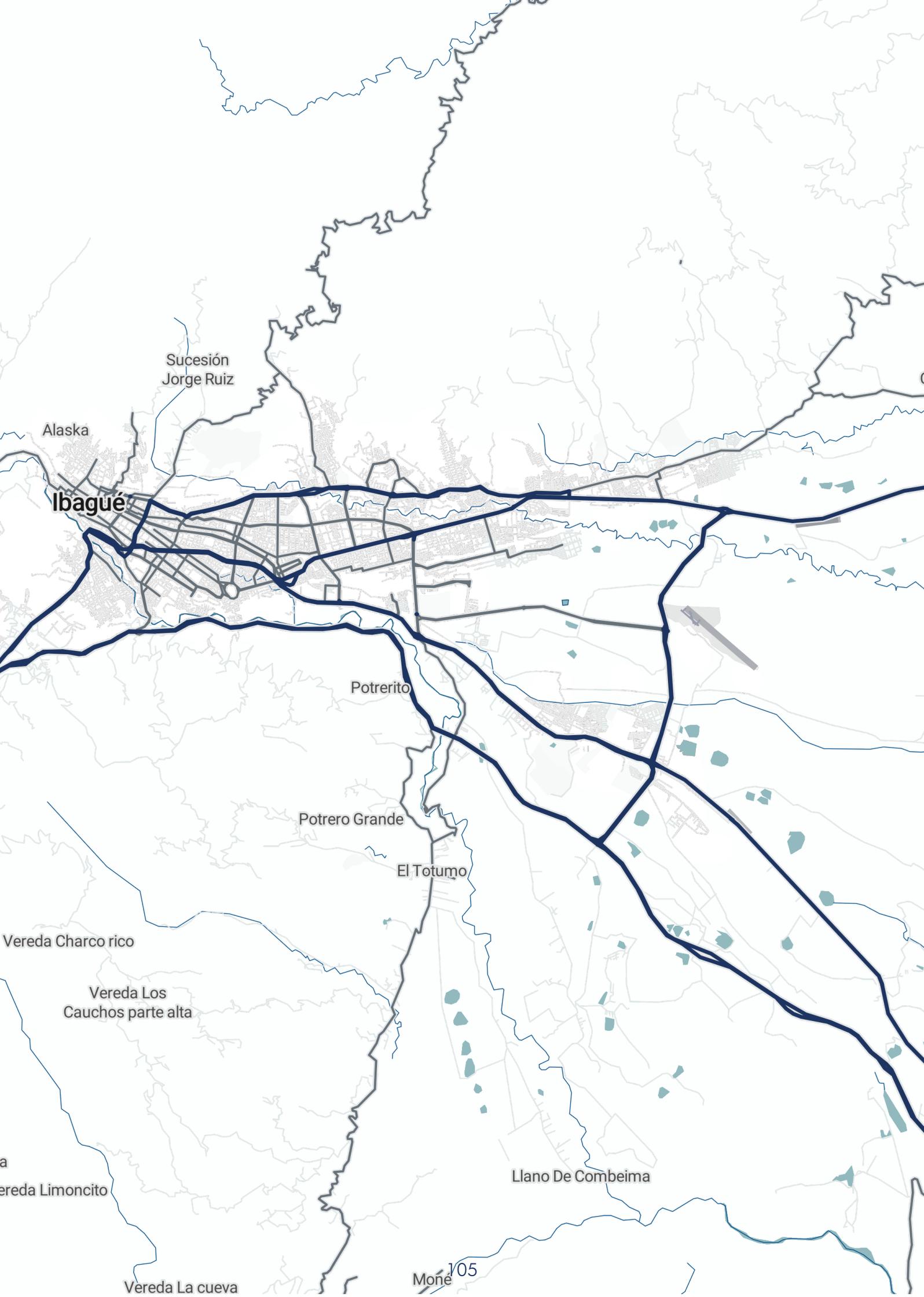
The city is growing in population, and this has led to its expansion to outside of the urban area, the new development, in response to the high housing request, is composed by housing buildings, and public infrastructure connected through a mobility system that creates cycle routes, pedestrian paths, and green corridors, this expansion takes over a large area of green space the the projects are not returning.



38 Ecodiudad La Riviera
Eco-city, expansion of the urban area in Ibagué
Prodesa, 2021



Map of the city of Ibagué
Mapbox



Sucesión
Jorge Ruiz

Alaska

Ibagué

Potrero

Potrero Grande

El Totumo

Vereda Charco rico

Vereda Los
Cauchos parte alta

Vereda Limoncito

Vereda La cueva

Llano De Combeima

Mone 105

Informal settlements in Ibagué

Population living in slums



women / men / children / elders

Considerable high number of population in working age

15-65 years

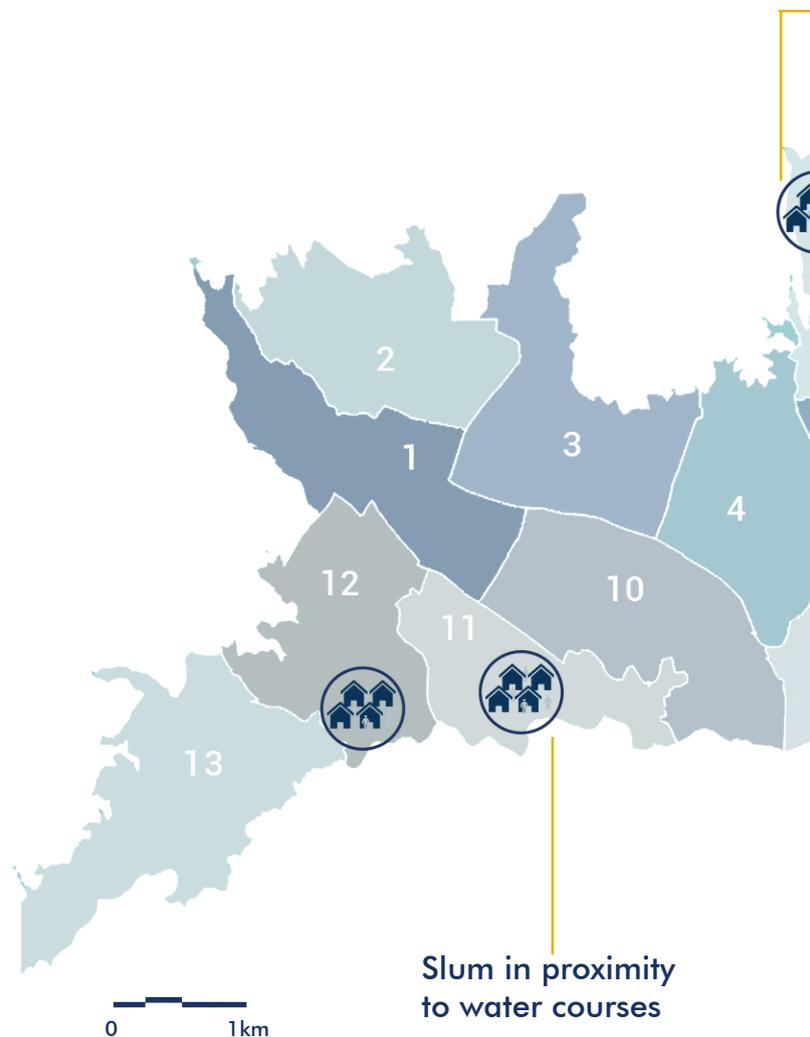
High number of children



Women in pregnancy



Settlements of 2 years of existence

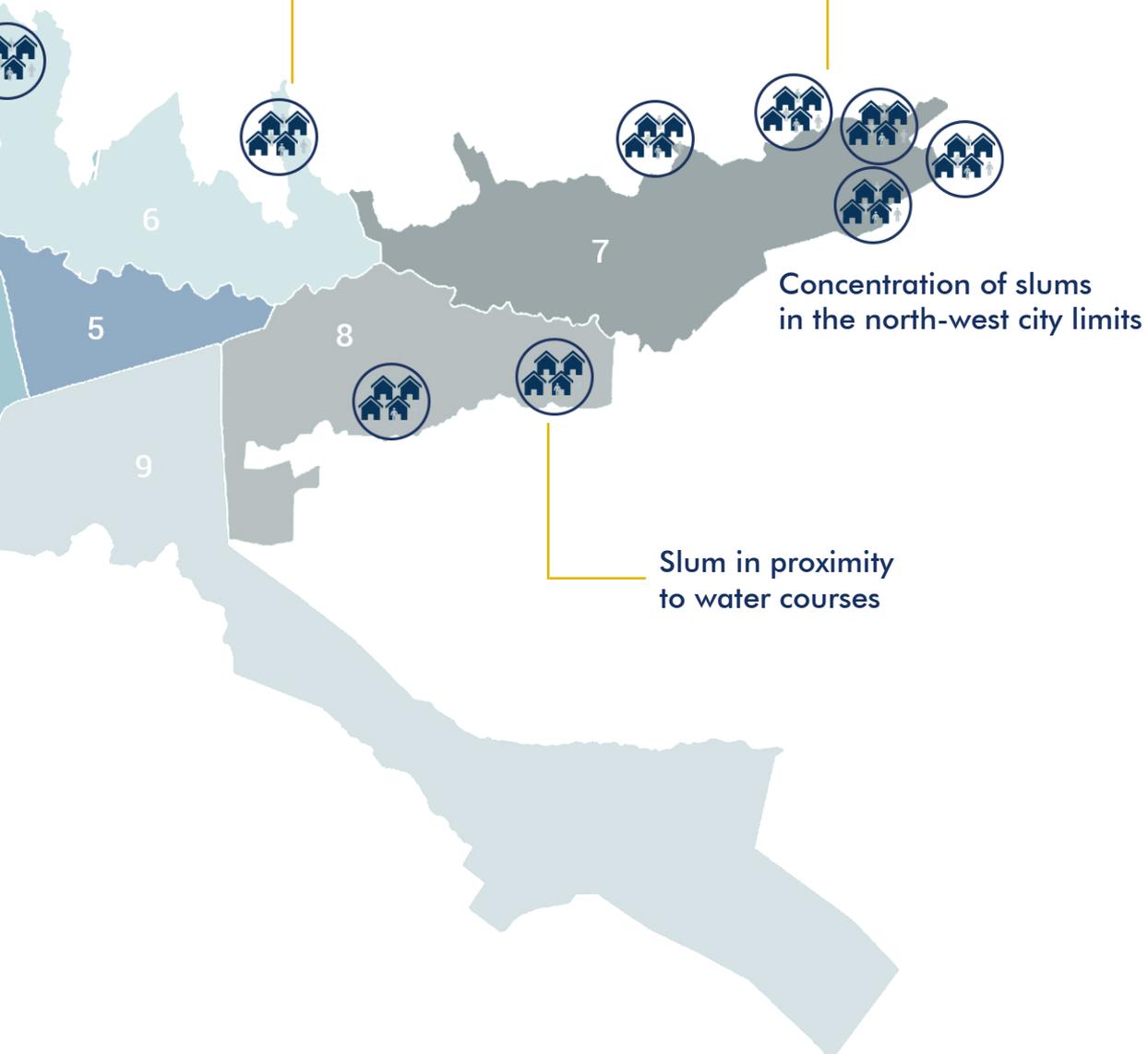


Informal settlements in Ibagué per comuna

39 Own elaboration with bases on El Nuevo Día, 2022

Located in danger areas
of earth remotion

100-270
families
per settlement

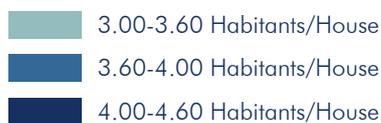
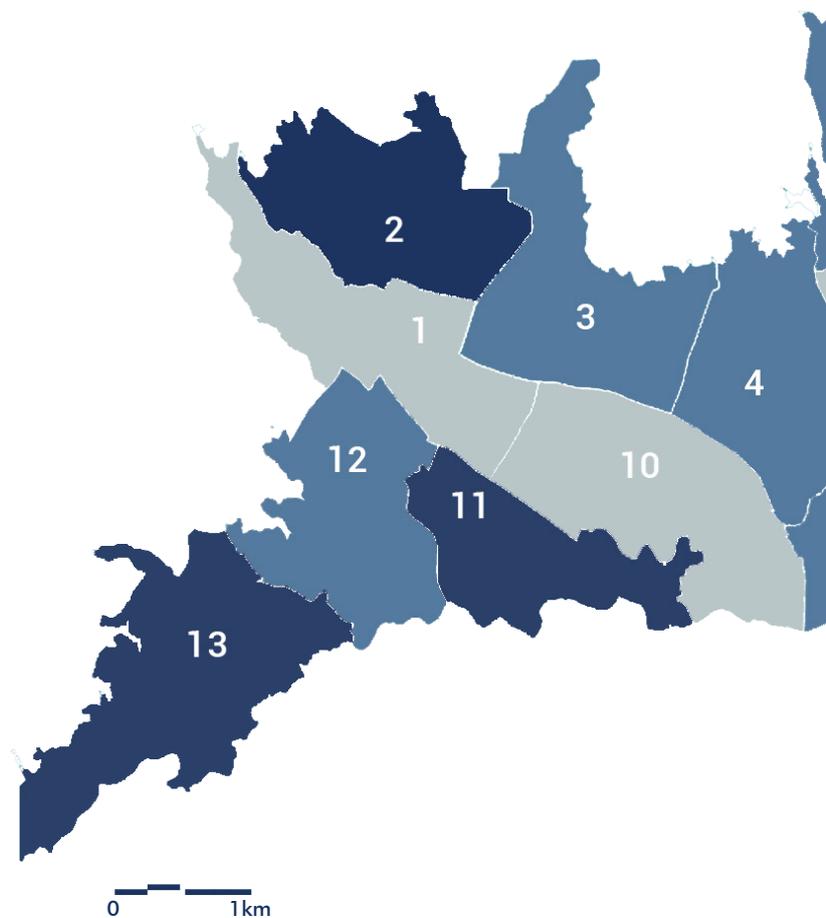


Housing deficit in Ibagué

Overcrowding in homes

Commune 2 has the highest value of 4.3 inhabitants per household, situation indicating that this territorial unit presents a situation of large families per household and dwelling, which are located in the status 1 and 2 and in dwellings less than 80 m², this can generate problems of overcrowding, since many of these homes share the common area with the bedroom.

It is important that the Land Management Plan (POT) creates new areas for housing of social interest and that it is supplied the need for housing for large families that are settled on illegal land (Consejo de Planeación, 2012)



Informal settlements in Ibagué per comuna

40 Own elaboration with bases on Consejo de Planeación, 2012



End poverty in all its forms everywhere



In 2019, 98.1% of households in Colombia had access to electricity



87.0% access to aqueduct



81.8% access to garbage collection



74.4% access to sewerage



64.5% access to natural gas

Inequality between municipalities and rural areas



Capital of municipalities

92.8%
Access to sewerage

80.6%
Natural gas



villages and rural areas

4.8%
Access to sewerage

12.3%
Natural gas

Inequality

Colombia is the most unequal country in Latin America in land tenure and distribution, most properties are concentrated in the hands of few people, 1% of the population occupies 81% of the land and 99% of population occupies only 19% (Cardona, 2018).

Peasant and indigenous who live from family agriculture, are owners of only 4% of land as a result from violence, as millions have been forced to leave their lands to escape the situation (Serrano, J. A., 2018).

Women only own 26% of the land in Colombia (Guereña, 2017) this is due to less land rights compared to men, in addition, their land rights depend on the male integrants of the family, being in danger of no longer having those rights if the relative migrates, they separate or if she becomes a widow (Velez, 2018).



41 Wilma Chen from Guatemala has been evicted from her land four times Vasquez, C. 2021

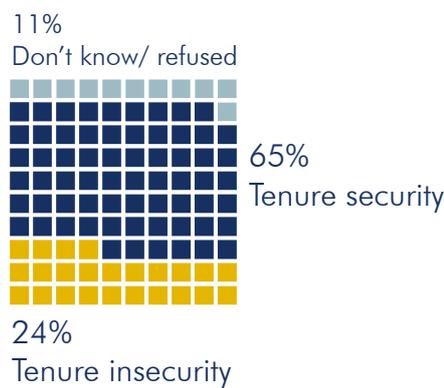
Tenure insecurity

1 NO POVERTY



Land right is crucial for the development of other rights such as the right to a decent standard of living, the right to housing, the right to food and the right to economic development; land is related to our cultural heritage and identity and having a home means more than having a roof over the head, a home is essential for the sense of dignity and wellbeing. Worldwide about 1 billion people are frightened of expulsion. This crisis related to land and housing is not allowing a proper development; women's empowerment and a contribution to climate change (Prindex, n.d)

Securing land rights allow people to focus the efforts in their livelihoods and their homes; tenure security also accounts for agricultural yields, and recognizing indigenous land rights are linked to decreased deforestation and increasing levels of carbon storage (Werhmann and Lange, 2019)



- Challenges remain
- ➔ Score stagnating or increasing at less than 50% of required rate

Target 1.4/ By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including micro finance.

Indicators /

1.4.1

Proportion of population living in households with access to basic services

1.4.2

Proportion of total adult population with secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure, by sex and by type of tenure (United Nations, n.d.).

Documentation

Property rights protection



perceive property rights in country to be protected

Knowledge of defending rights



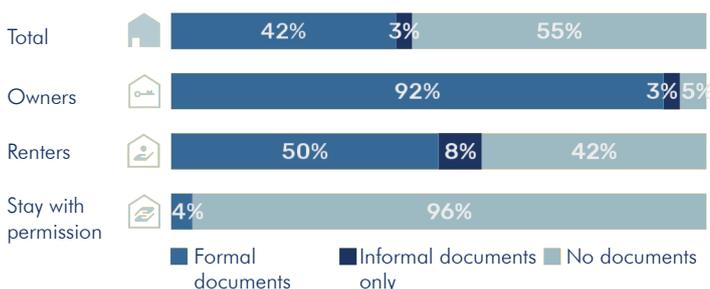
would know how to defend rights

Confidence in authorities' support



are confident of receiving support from authorities

Property rights



Tenure types



26% are owners



33% are renters



38% stay with permission

Food insecurity in Colombia

“Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Food security covers availability, access, utilization and stability issues, and -in its focus on individuals- also embraces their energy, protein and nutrient needs for life, activity, pregnancy, growth and long-term capabilities”- World Food Summit, 1996

Food insecurity exists in the insufficiency access to adequate, safe and nutritionally valuable food that supports an ideal growth, an energetic and healthy living. Some causes for food insecurity are the low availability of food and the lacking of resources to access food. Food insecurity can be measured implementing the Food Insecurity Experience Scale (FIES) as showed in the diagram (Food and Agriculture Organization of the United Nations, n.d.)

54.2%

Population In Colombia that lives in food insecurity



10 million tons food wasted annually

Food insecurity does not lie much in the scarcity of food, but in the impossibility of accessing it due to low income (ABACO, n.d.).

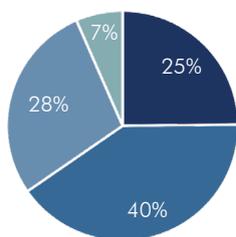
31%

Colombians that cannot eat three times a day. That is, three out of 10 households and around 16 million people (DANE, 2021).

FIES



Ibagué



Classification of household food security for children in displaced situation in Ibagué.

-The displaced condition increased risk of food insecurity (Quintero et al., 2020).

Low income of the population and low food production

In 2021, the rising unemployment and growing poverty after the pandemic was aligned with an approximately 8% of increased food, for some municipalities the percentage doubled (Red Cómo Vamos, 2021).

Colombia has low food production capacity that creates a dependency on imported food for higher prices (Razón Pública, 2022). At the same time, production and consumption areas are not articulated efficiently, causing externalities associated with the deterioration of products, losses and waste up to 50% in profits (FAO, n.d.).

Inequality and the access to food

There is a strong correlation between gender inequality and food and nutrition insecurity. Lower social status and lack of access to resources means that women and girls are most disadvantaged by the unequal global economic processes governing food systems and by global trends such as climate change (BRIDGE, 2014). At an international level women experience a 27% higher risk compared to men to face food insecurity (Un Women, 2020).



Families' food availability is correlated with their income levels. "Afro-Colombian households have an income per capita that is close to 20% lower than that of non-Afro Colombian households" UNDP, 2010, as cited in FAO, 2015 pg. 7. The same way, Afro-Colombians have a 5% higher unemployment rate.

This indicates a significant inequality gap and a lower capacity to access food.



2 ZERO HUNGER



- Challenges remain
- Moderately improving

Target 2.1/

By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round

Indicator

2.1.2

Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES) (United Nations, n.d.)



42 Tsiory Ny Aina Andriatso, 2021

Mental health and well-being

Well-being encapsulates quality of life and a positive experience by an individual or a society, is an essential element in every day life the same way health is. Well-being is determined by social, economic and environmental circumstances (World Health Organization, 2021).

The OECD understands well-being according to certain aspects that are crucial in material living conditions and quality of life, the index allow a comparison between countries and the recognition of the well-being situation in the country.

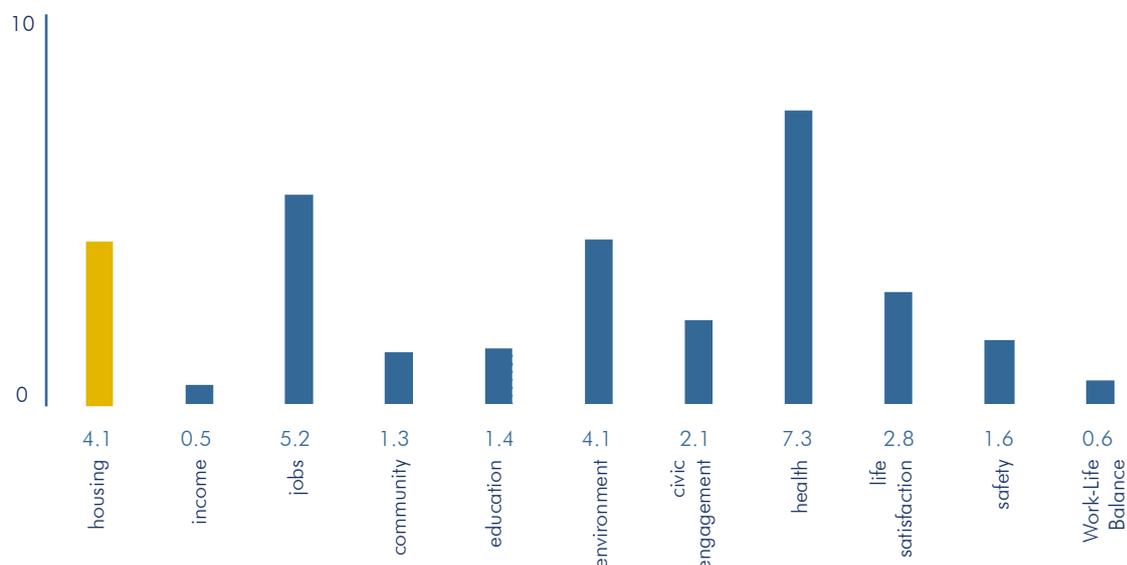
In addition, the Global Multidimensional Poverty Index (IPM Global in Spanish) is a measurement of poverty that reflects the multiple needs faced by poor people at the same time in areas such as education, child and youth conditions, work, health, public services and housing. This index can be implemented to evaluate general well-being.

18%

Multidimensional poverty in Colombia

16%

Multidimensional poverty in Tolima (DANE, 2022)



G. 06. Better Life Index, rating of topics for Colombia
(OECD Better Life Index, n.d.)

Well-being in Colombia can be seen through the OECD topics /

Housing/

23,5% of population have a qualitative deficit. The aspects evaluated are the number of people living in one home, conditions of the kitchen, availability of services and materials (DANE, 2021).

Income/

54,2 (Banco Mundial, 2020)

GINI index (measures the extent to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution.) zero represents perfect equality and 100, perfect inequality (OECD, 2006).

Jobs/

About 58% of people aged 15 to 64 in Colombia have a paid job, below the OECD employment average of 66%. 71% of men are in paid work, compared with 45% of women

Community/

80% of people believe that they know someone they could rely on in time of need

Education/

59% of adults aged 25-64 have completed upper secondary education, lower than the OECD average of 79%.



- Major challenges
- Moderately improving

Environment/

Level of atmospheric PM2.5 is 22.6 micrograms per cubic meter, the World Health Organization recommends not exceeding 10 micrograms per cubic meter yearly (Data Bank, 2017).

Civic engagement/

Voter turnout in Colombia was about 53% of those registered
 -the level of stakeholder engagement in developing regulations is 1.4 (on a scale between 0 and 4), this means a low public engagement in the decision-making.

Health/

Life expectancy at birth in Colombia is around 77 years
 80% of people in Colombia said they were in good health, more than the OECD average of 68%

Life Satisfaction/

General satisfaction with life was 5.7/10 on average

Safety

The rate of perceived insecurity is 44% for men and 45,5% for women (Redacción Colombia, 2021). The homicide rate is 23.1, one of the highest rates in the OECD, where the average is 2.6.

Work-Life Balance

Nearly 24% of employees work very long hours in paid work, well above the OECD average of 10%.

(OECD Better Life Index, n.d.)

Inequality

Target 3.4 /

By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being

Indicator

3.4.2

Suicide mortality rate (United Nations, n.d.)

Suicide mortality rate

52,4
 Attempted suicide rate in Colombia

5,07
 Suicide rate (cases for every 100.000 inhabitants) in Colombia

Age group from **15 to 19** followed by the age group of **20 to 24**

81% Masculine
19% Feminine

MinSalud, 2018

Ibagué

4.57
 Suicide rate

(Alcaldía de Ibagué, 2018)

Employment rate



Long working hours



Safety



Life satisfaction



G.07 (OECD Better Life Index, n.d.)

Energy efficiency in the architecture field in Colombia

An energy-efficient building is able to create comfortable conditions, consuming the smallest possible amount of energy and maximizing efficiency in use of resources (Gupta and Chakraborty, 2021).

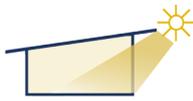
Passive strategies are the most implemented tool for energy efficiency in Colombia. The aim of passive design is to avoid completely the need for active mechanical systems as well as fossil fuel-based energy consumption and to maintain occupant comfort at all times (Bhatt, 2014). Active solutions on the contrary are strategies that either uses or produces electricity (Varming, 2018). These strategies can incorporate mechanical system components, automation processes, photo-voltaic panels, and high-efficiency appliances (Sustainable, n.d.).

Passive strategies

Elnagar and Köhler, 2020



Orientation



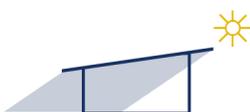
Daylight



Window to wall ratio



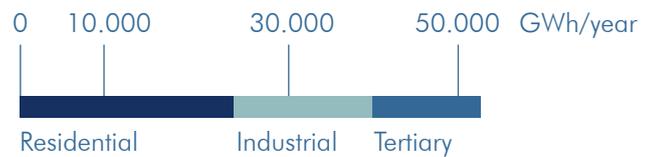
Natural and crossed ventilation



Shading

In Colombia there are 201 certified buildings with EDGE, which is granted for a 20% of energy savings for the Edge Certified level or a 40% of energy savings for Edge Advance, 138 (Mouthon, 2021) of this buildings are residential and none of them are social housing . In addition, there are 122 certified projects and 229 in the process from the certification LEED (Amarilo, 2021), that for the first level credits a 20% of energy savings.

Increasing energy saving strategies in the residential sector is crucial , as is the sector with highest electric energy consumption in Colombia (UPME, 2010).



Sectorial demand for electricity on 2009
UPME, 2010

Active strategies



Solar panels



High-efficiency appliances
/ Led light bulbs



Automatized lighting

Energy intensity measured in terms of primary energy and GDP

“The rate of global primary energy intensity improvement - defined as the percentage decrease in the ratio of global total energy supply per unit of gross domestic product (GDP) - is the indicator used to track progress on global energy efficiency”-UN stats, n.d., as cited in lea, n.d.

The global energy intensity has to decrease for a net zero scenario, and it should make an improvement of more than 4% per year from 2020 to 2030 to achieve Goal 7.3. The improvement on potential for energy intensity can come from a change to electric vehicles, improvements in efficiency in the industrial areas and more rigorous building energy regulations for new and existing buildings, that includes electrical heating systems. (IEA, n.d.)

GDP in Colombia: **3** (2019)

GDP in the world: **6** (2019)

The World Bank, n.d.

● SDG achieved

↑ On track or maintaining SDG achievement

7 AFFORDABLE AND CLEAN ENERGY



Target 7.3 /

By 2030, double the global rate of improvement in energy efficiency

Indicator

7.3.1

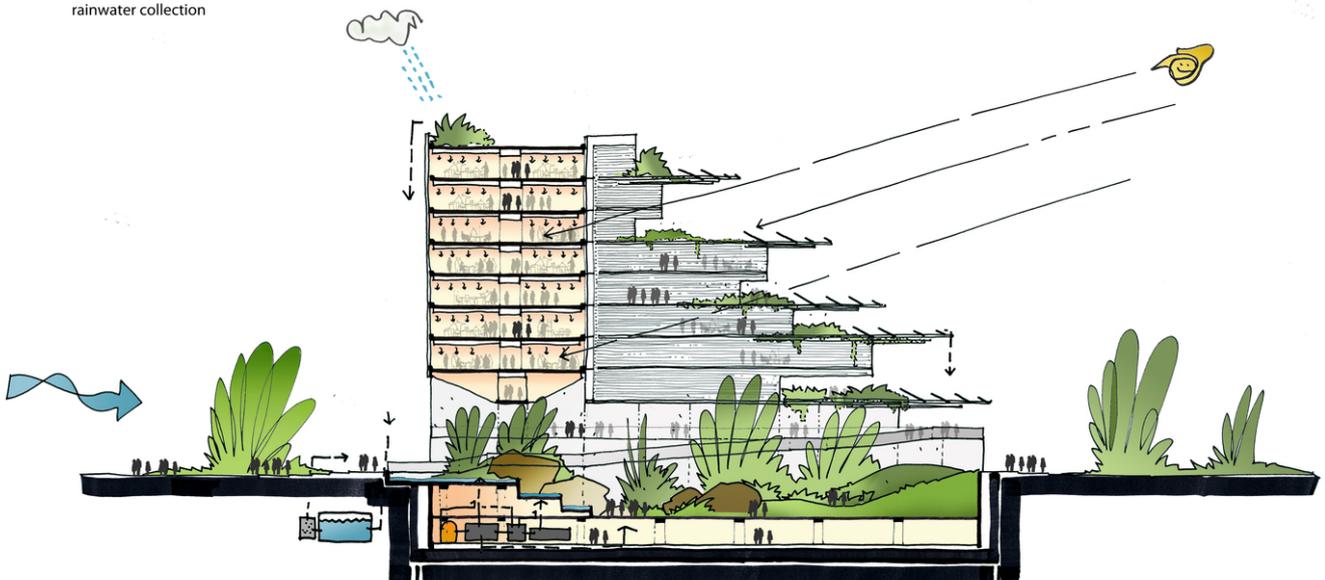
Energy intensity measured in terms of primary energy and GDP

(United Nations, n.d.)

environmental strategies

winter

- solar support
- high insulation wrap
- winter winds protection
- rainwater collection



performance energetica

standard building MCA building



-58% HVAC CO2
24 kg CO2 / mq y

heating 27 kWh / mq y
cooling 92 kWh / mq y

43 Sino-Italian Ecological and Energy Efficient Building

Mario Cucinella Architects, 2006

Winter diagram

Waste management and recycling

Solid waste management is essential for the sustainable cities but is often overlooked, from the magnitude of waste generated, its composition and the way in which it is managed, it is estimated that in 2016 the treatment and disposal of waste generated the emission of 1600 million tons of carbon dioxide equivalent, which accounts for about 5% of global emissions.

If urgent action is not taken, by 2050 global waste will grow by 70% over current levels (Banco Mundial, 2018)

Colombia



11.82% -
26,46 million tons 2019
National recycling rate
(DANE, 2021)



78%
of Colombian households
do not recycle (Semana,
2020)

The recycling system in Colombia

Recycling is carried out by recycling organizations where people's income is based on the quantity of material they collect, this sum is approximately 94 euros per month; in bigger cities like Bogotá, an additional sum equivalent to 24 euros is paid (France 24, 2021).

28.000

people linked to recycling
organizations in Colombia

Recyclers work most commonly with their relatives, and they carry out this activity the majority of times implementing a wooden plank with wheels that is moved by one person in the front, some others use a motorcycle with a carrying platform behind (moto-car) and in other cases a small truck.

This activity takes up many hours of the day and/or night and almost everyday of the week in order for them to cover large areas and collect certain weight that represents gaining a minimum income (Manos Verdes, n.d.).

87% of workers and families do it on a piece-rate basis and only 5% have a work contract (Superservicios and UNAL, 2017, as cited in Manos Verdes, n.d.).

Why people are not recycling?

The country today has the infrastructure and technical capacity to take advantage of waste such as plastic, glass, metal and cellulose derivatives (paper and cardboard); however, there is still a very short capacity for separation and collection at the source as people do not know how to do recycle properly or they are not willing to do it.

The current separation system implemented from 2021 in Colombia consists on 3 types of bag differentiated by color; white, black, and green; the white is for all the recyclable materials such as plastic, metal, paper, cardboard and glass, the black bag is for not usable waste, and the green bag is for all the organic waste (Uribe, 2019 as cited by Caicedo, 2019). Separation between the materials of the white bag occur in the collection center.



The low recycling rate begins with a lack of education regarding recycling and a lack of a recycling culture in the country, that summed with the non formalized recycle collection creates limitations for reducing waste and increase the recycling rates.

Impact of construction sector

In Colombia the construction industry is responsible for 40% of the waste.

Construction and Demolition Waste (CDW) rates can be mitigated by implementing this materials that can varies from raw materials such as mud, clay, wood, drywall, PVC and polystyrene, to dry or fresh concrete. In Colombia in the main cities, there is monitoring of construction sites in order to assure recycling of the 20% of the waste, and this materials recovered are implemented on site or are collected for transformation of for example, new resins using polystyrene (Economía y Negocios, 2019). In Bogotá in 2016, 30,34% of CDW was reused or implemented on site, this was a total of 2.339.085,99 Tons (OAB, n.d.).

This practices in the construction field are crucial for decreasing waste as is one of the industries with higher contribution . Globally the annual construction waste is expected to reach 2.2 billion tons for 2025 (Transparency Market Research, n.d.).

- Challenges remain
- Unavailable information



Target 12.5 /

By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.

Indicator

12.5.1

National recycling rate, tons of material recycled

(United Nations, n.d.)

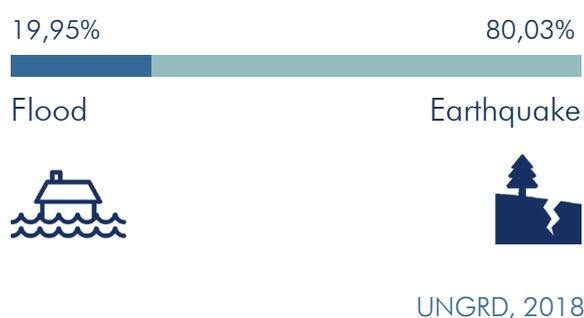


44 Recyclers in Bogotá
Malgarejo, C., 2020

| | Deaths | Affected persons |
|----------|--------|------------------|
| Tolima | 15 | 19 |
| Colombia | 7 | 25 |

Affected people and disasters on the country from 2006-2014 per 100,000 population (DNP, 2015).

Contribution per disaster in Tolima



Tolima is one of the departments with higher number of deaths for disaster; its geography, population density and concentration of productive activities generate high exposure to phenomena such as landslides and floods (Banco Mundial, 2012).

In Ibagué the threat of landslide was identified as the biggest risk according to the intensity, frequency and the importance in the urban development, this threat was followed by flooding and earthquake (GeoAlerta, n.d.).

Disasters produce due to climate and natural disasters in Colombia

Hydro-meteorological

- Floods
- Droughts
- Tropical cyclones
- Mass Movement

Geological

- Earthquakes
- Volcanic activity
- Landslide

Vulnerability towards natural phenomena

Currently **86%** of the Colombian population is located in areas of high and medium seismic threat.

Unplanned occupation of peripheral areas and the phenomenon of self-production of habitat represent a high risk (Banco Mundial, 2012).

2010 in Colombia

from hydro-meteorological and geological events:



60 destroyed houses



5.822 affected houses

(Corporación OSSO, 2011 as cited in Cardona, et al., 2004)

Inequality

Risk conditions are closely linked to poverty conditions, disasters in Colombia tend to have a wider relative impact on status 1 and 2, the risk levels are higher, due to the occupation of lands unsuitable for urbanization, the informality of settlements, non-compliance with constructive standards, and in general due to factors of social vulnerability (Banco Mundial, 2012).

Architecture's contribution to Climate Change

Architecture has an important role in tackling climate change, as this sector is one of the biggest contributors to global warming (Melton, n.d.); shifting its approach from the typical point of view to an environmental perspective can make a significant change.

A sustainable approach in architecture can contribute to mitigate the impact of climate change from early stages of planning, understanding climate change and its consequences should be a fundamental step on the design of built environment as this will produce strategies to create resilient and adaptive habitats that can put up with an ever changing world.

● Challenges remain

➔ Score stagnating or increasing at less than 50% of required rate

13 CLIMATE ACTION



Target 13.1/

Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

Indicators

13.1.1

Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population

13.1.2

Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030

13.1.3

Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies (United Nations, n.d.).



45 Several homes in Las Malvinas, Barranquilla are at risk of collapse by stream. El Heraldo, 2020

Comuna 2

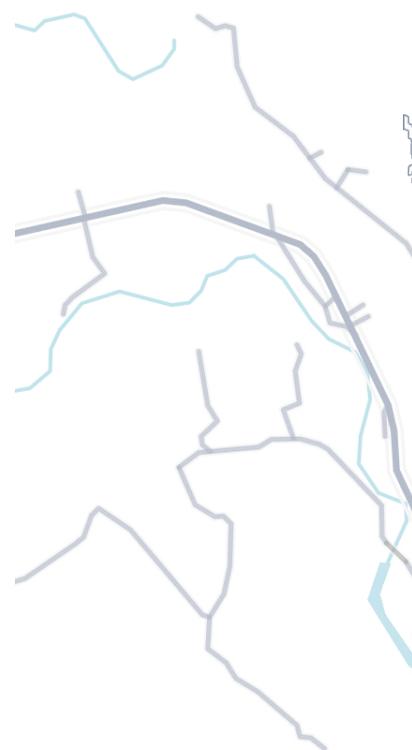
40% of the area is planned to be treated as integral improvement area.

The integral improvement is allocated to sectors of the city developed in a sub-normal way, in conditions that are deficient in terms of the provision of equipment, recreational areas and public services, among others. This treatment is aimed at promoting the integral legalization of properties and buildings, for the normalization of housing located in the extreme areas of the city, in areas where risk can be mitigated, susceptible to a process of recovery and consolidation, in order to raise the quality of life (POT, 2014).

The commune has a high deficit in public spaces with 0,35 m² per inhabitant, being 10m² the international recommendation.

This part of the city has a great connectivity to the center and the location in the west near the mountain provides a more favorable weather compared to the rest of the city.

Increasing the offer of new affordable housing in this area is necessary to solve the housing deficit and the inadequate living conditions (Plan de Desarrollo Comuna 2, 2012).



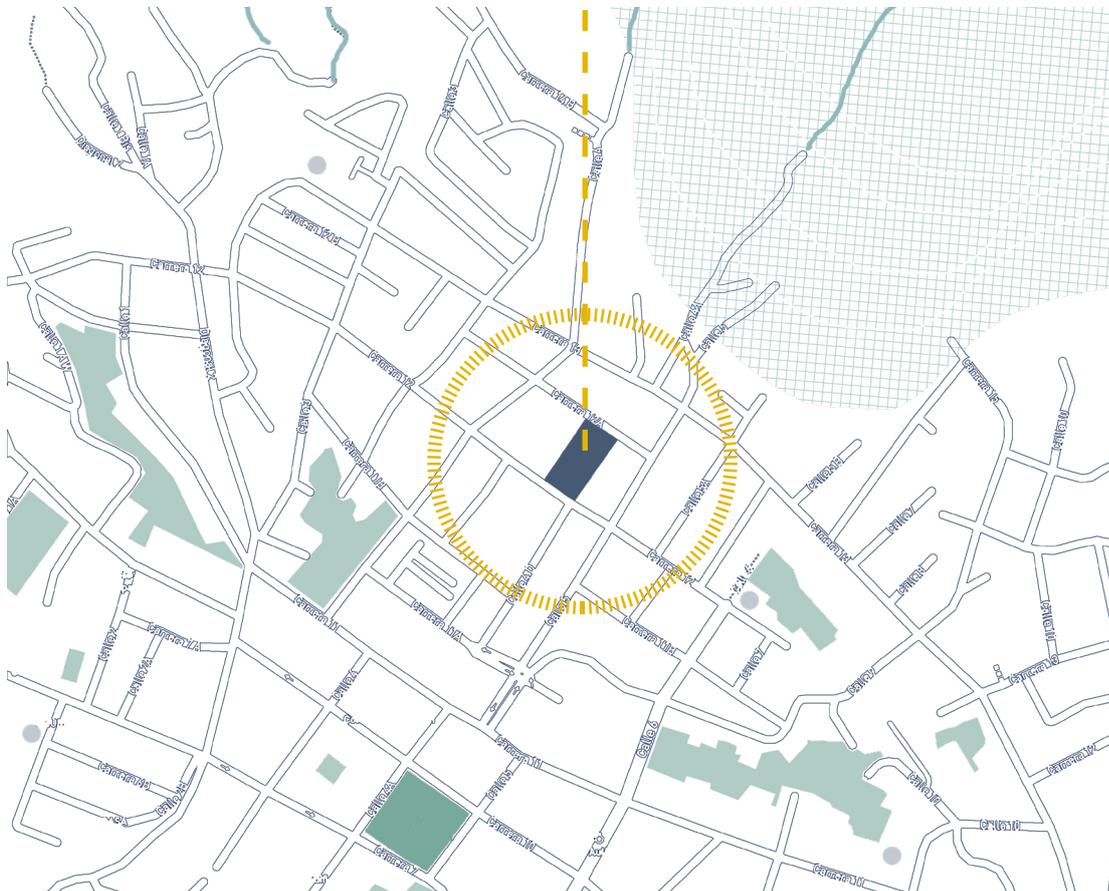


Location: Cra. 12 #4a-69 a 4a-1, Comuna 2

4.453573, -75.242827

Ibagué, Tolima, Colombia

Area: 2.145 m²



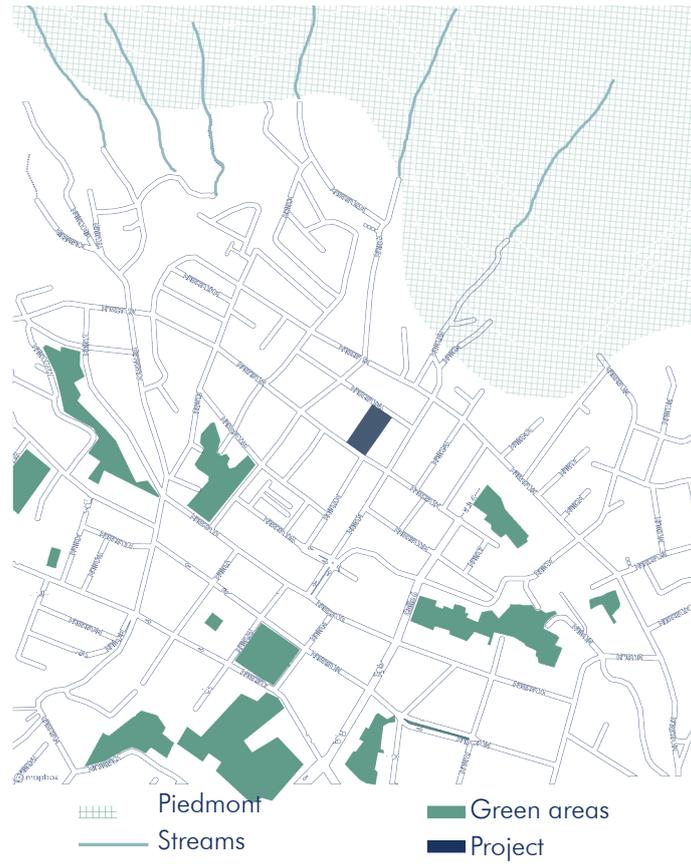


46 Park of Belén, nearby park from the site
2 POS

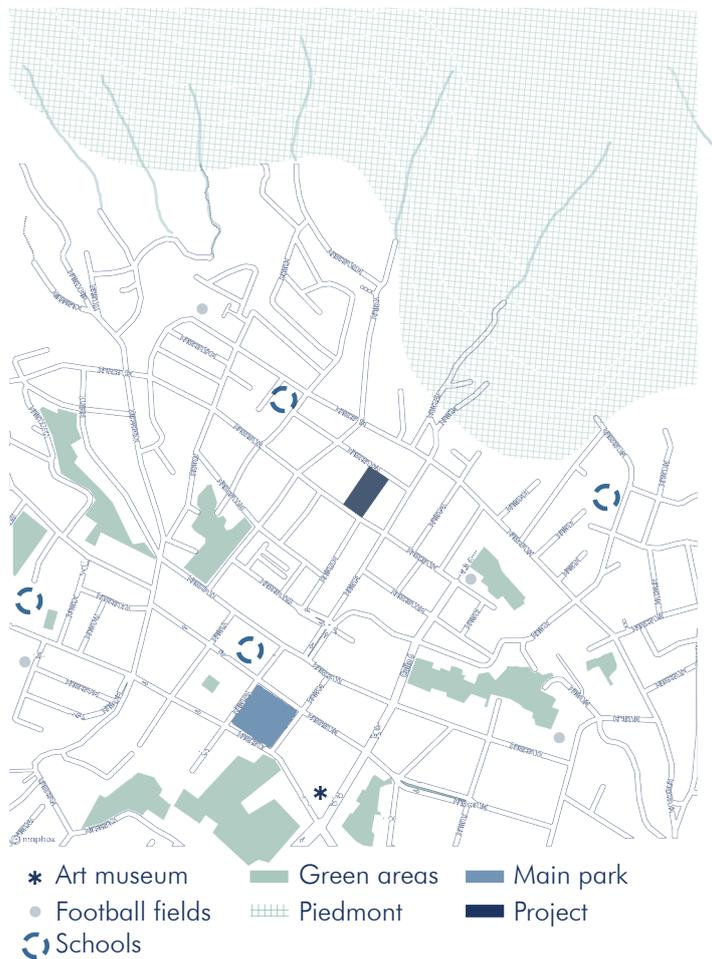
The project will be located in the north-west part of the city in the limit of the flat area of the city with the mountains, having a higher altitude compared to other parts of the city, this creates a higher thermal conform and the proximity to the mountain also contributes to the decrease in temperature in these areas. In addition, the location is privileged as it is 1,3 km from the city centre, more precisely,

from the central square Plaza de Bolívar. In its vicinity is the school Tolimense, one of the largest in the city, the art museum of Tolima and the recently inaugurated (2021) Panóptico of Ibagué, a work of restoration of the emblematic prison building with 100 years of construction that was transformed into a museum and cultural center.

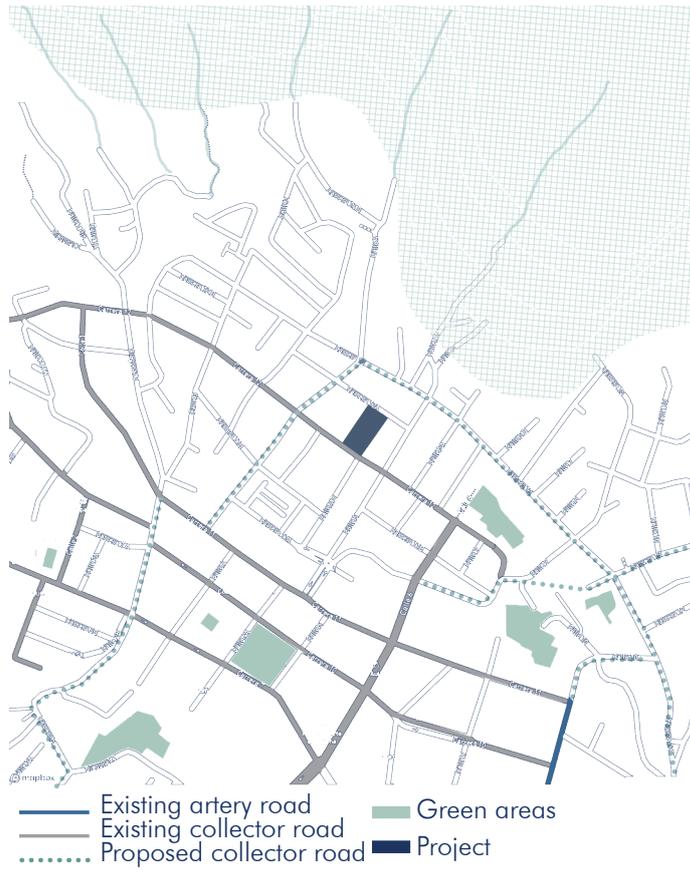
Ecological structure



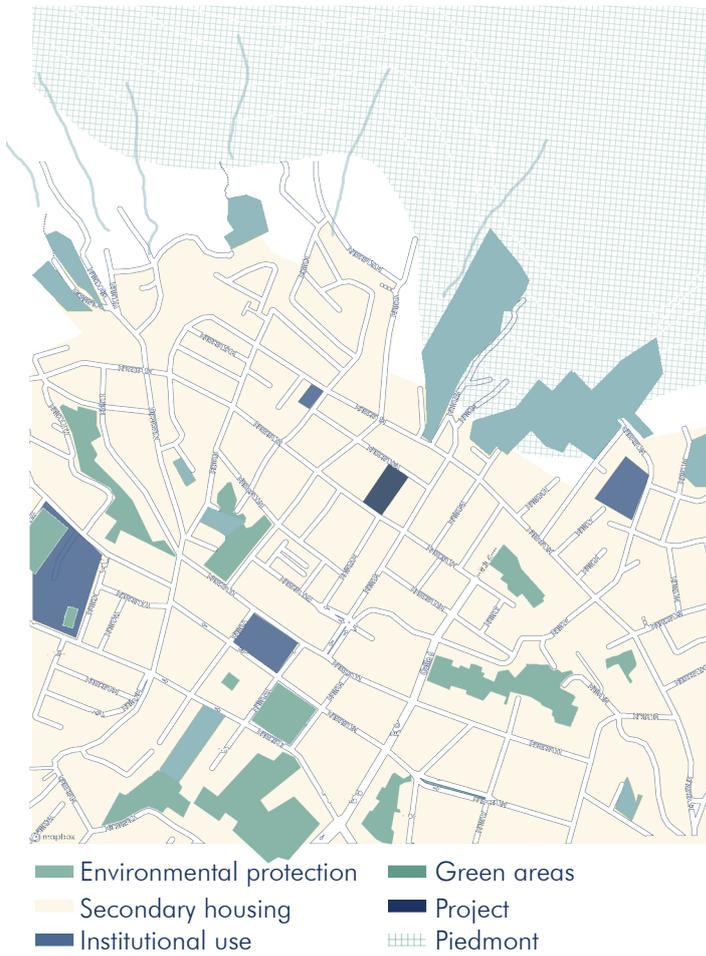
Public buildings



Mobility



Land use



Context



Satellite image

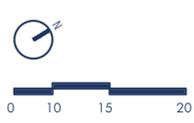


47 Google Maps

Santa Bárbara neighborhood

Context analysis

Street section



Housing typologies



1. One-storey house



2. Two-storey house



4. House with expansion



48 Google Maps

3. House with conventional style from the city center



5. House with front store

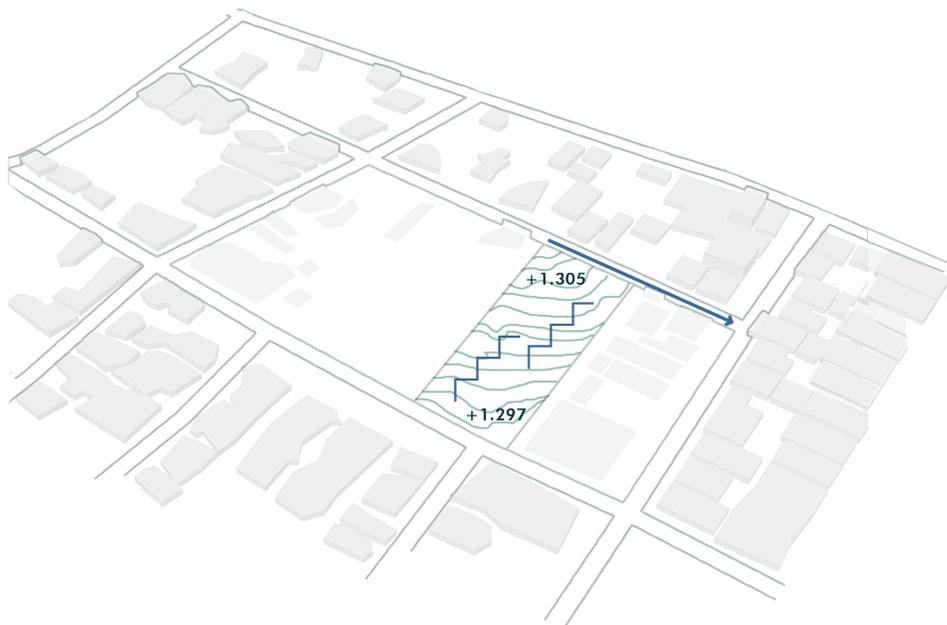
Determinants

Key elements of the site



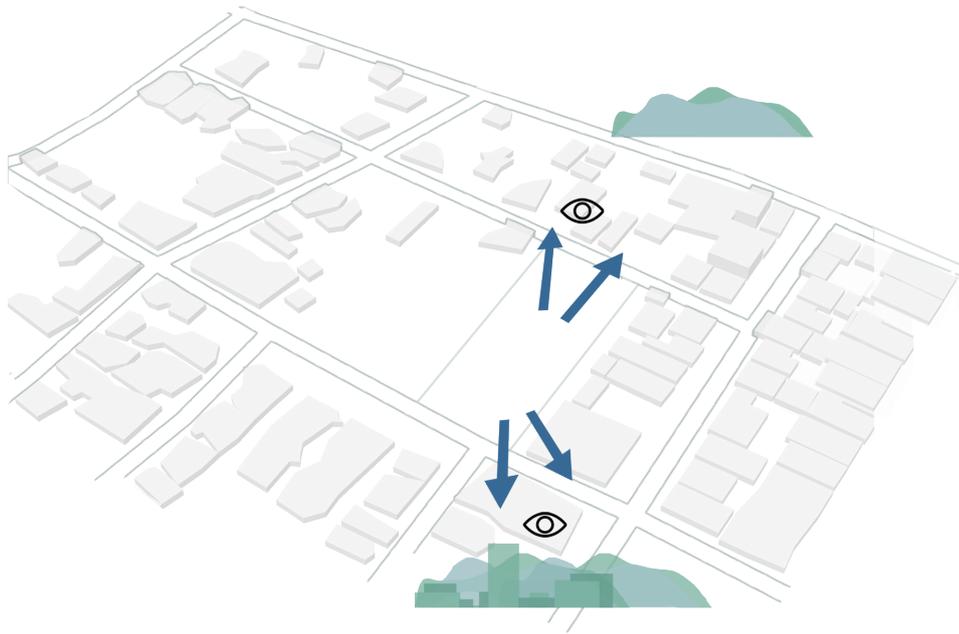
Orientation

Sun path and winds as one of the main aspects in the design stage taking into account the temperate of Ibagué.



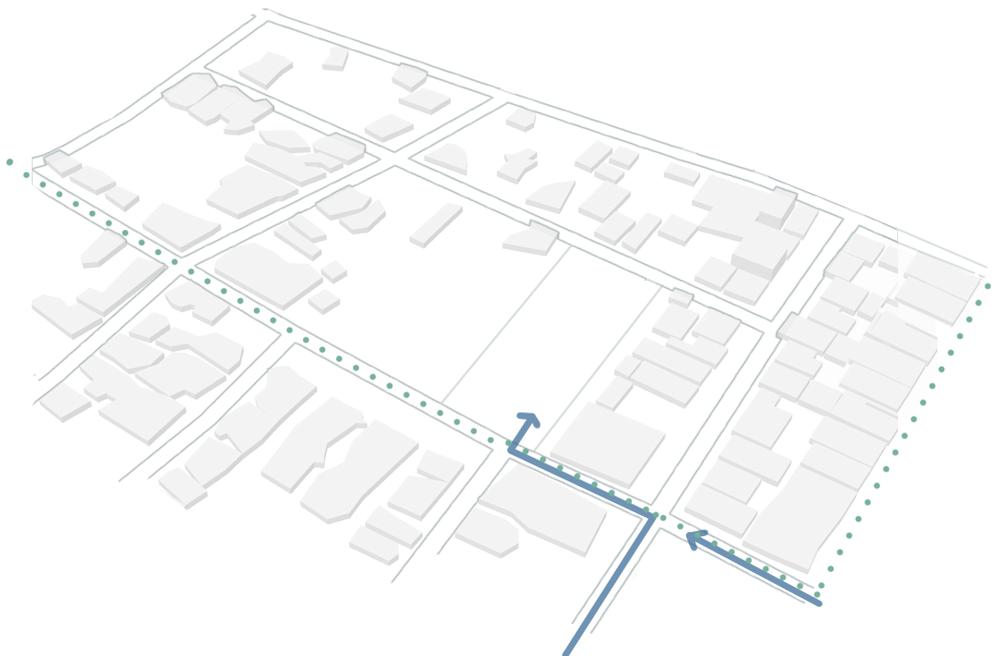
Terrain / slope

Gradient of 8 meters from the lowest point to the highest point.



Visuals

Strategic location with panoramic view of the city and the mountains.



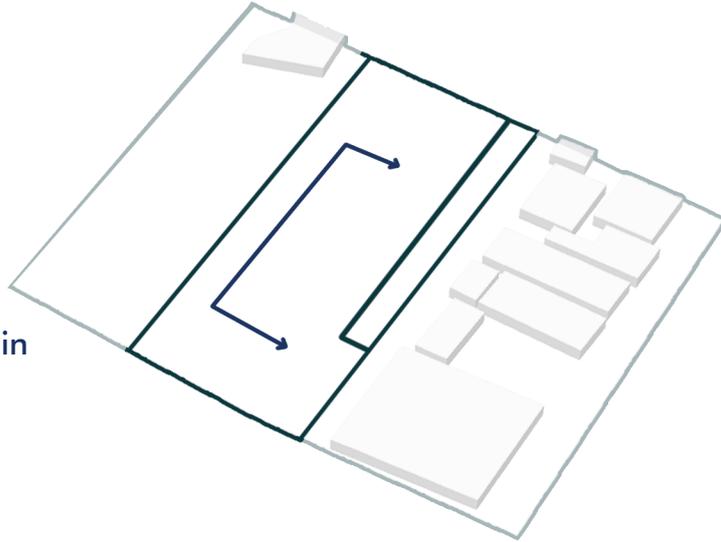
Access

Main roads that connect the project from the city center and public transportation route.

Volumetric analysis

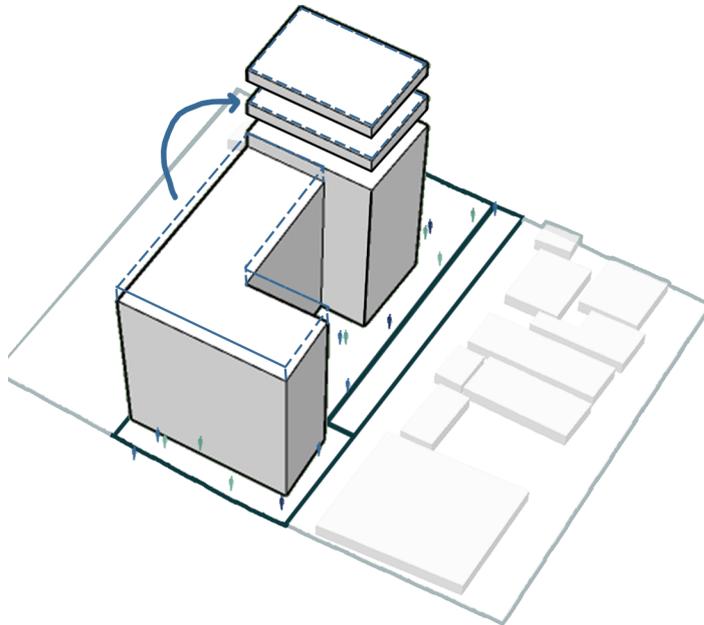
1

Sun / Visuals / Terrain



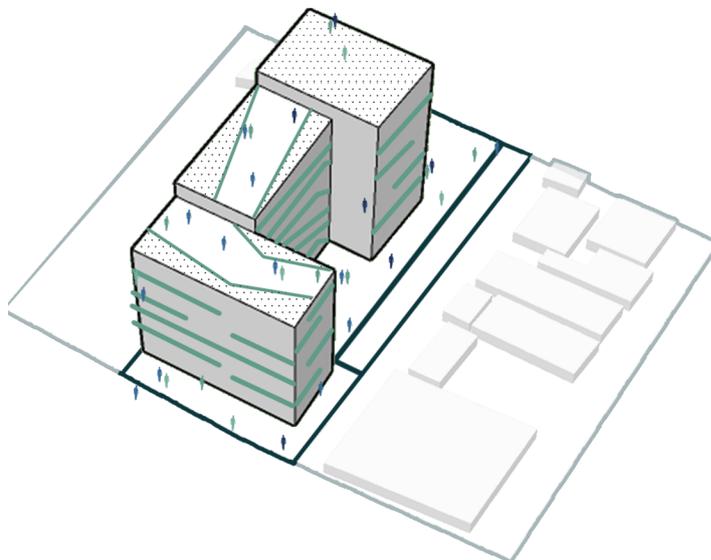
3

Visuals



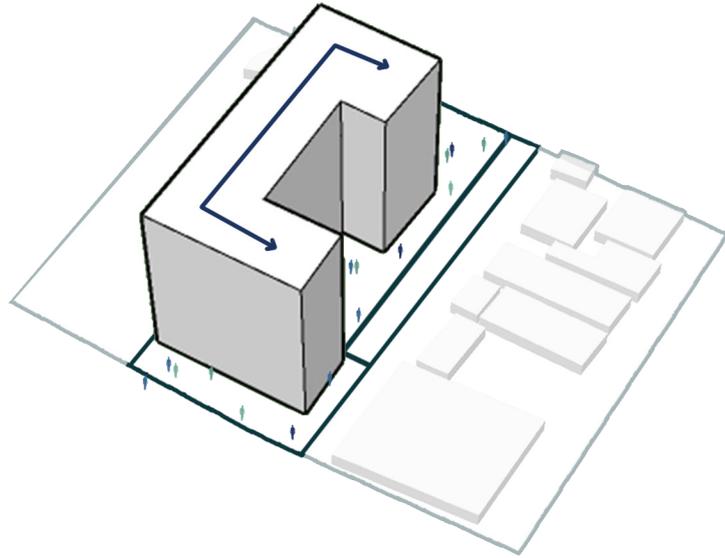
5

Green



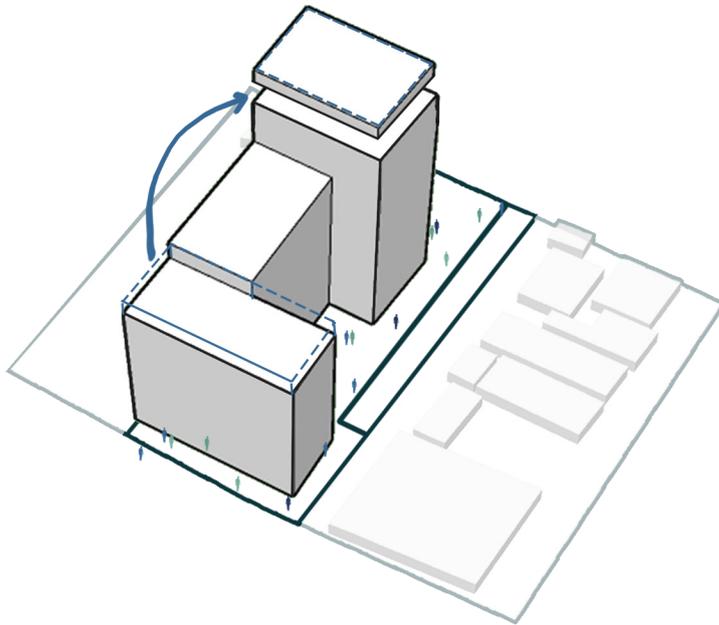
2

Height



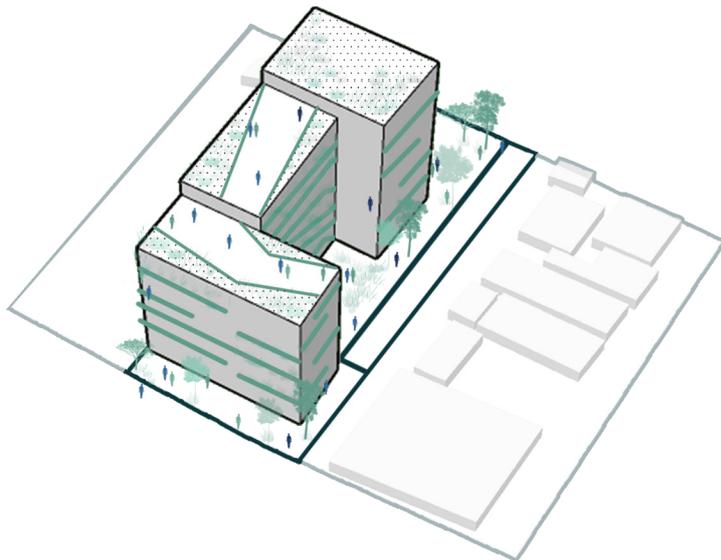
4

Terraces for communal space



6

Social and priority Housing



02 / Social approach

The social approach of a project has many stages in which is necessary to implement different strategies, from the lessons learned of the reference cases and policies, the following compilation of strategies for social involvement was made for different phases of a project. Social engagement in a housing project is crucial to understand peoples needs, creating sense of belonging and strengthening community.

1. Before project proposal/

1.1. Social analysis of the possible users of the project including age, family composition, necessities, common activities, culture and identity.

1.2. Involving people in design process

A social housing project in Pinotepa Nacional, Mexico, is a clear reference for participatory and community architecture as residents were interviewed and asked to draw their ideal home, providing an insight into their lifestyle and traditions. From there, the project focused on designing each house according to the needs of each family, local climate, and the characteristics of the terrain (HDA: Hector Delmar Arquitectura, M+N Diseño, 2020).

According to Delaqua (2021) engaging possible users in the project's first stages as the design process is an important step to have another view on the project by taking into account diverse points of views that can create smarter architecture.

Social involvement can add more adequate solutions for the context of the project by having diverse perspectives from people and creating the opportunity for the exchange of techniques from the place .

2. Project proposal/

Proposed criteria and key factors for social sustainability in architecture (Kefayati, et. al., 2015):

2.1. Social interaction / providing space that allow interaction between people.

2.2. Architectural identity / spaces that reflect culture and identity creates the sense of appropriation.

1. Before project proposal
2. Project proposal
3. During project construction
4. On project delivery
5. Post occupancy

2.3. Sense of security / Spaces that not only are safe but that transmit a protected place.

2.4. Flexibility / Creating spaces that can adapt to different users, needs and time.

(Lami, et al., 2020)

3. During project construction/

2.1. Informing on the advance of the building to involve community in the process.

2.2. Involvement of the community in the stage of plantation of species in the green areas to create acknowledgment on taking care of these areas.

4. On project delivery/

3.1. Briefing on the building with presentation of the spaces with their functionality and respective use.

3.2. Workshop on reduce, reuse and recycle to present recycling system of the project and introduce new information that may enhance sustainable practices in the user.

3.3. Workshop on urban farming to enhance the users to be part of the cultivating activities and their benefits.

5. Post occupancy/

4.1. Post occupancy evaluation implementing the RIBA guide (RIBA, 2019) to have feedback on the existent for future projects or improvements in the project.



49 Urban design students at the University of Western Australia apply their theoretical learning using the serious game interactive models.
Anthony Duckworth

“The physical construction of a building or a public space is only an excuse. In the end, what we want is to create citizens. The community is not only a protagonist because it engages volunteers, young misfits, or people with no opportunities in the construction, (but also because) they become involved in the design and building development. They start to debate, to think, and to visualize these spaces, the scale, and the colors. This is the beginning of a fundamental process: understanding that they are responsible for changing their own reality.”

- José Naza Rodríguez
as cited by Delaqua, 2021

03/ Habitability

Characterization of the target users is critical. In order to perform this characterization, in first instance, it should be defined the characteristics of the user as a group, which responds to circumstantial

conditions, defined largely by the typology of the building and its specific program. These features are the age group and necessary activities within the housing unit according to cultural elements.

“The main function of architecture is to ensure safe, comfortable and aesthetic values spaces for its inhabitants. When the human factors are unknown by age, gender, height, bodily reach, activities, special physical and psychological needs, dynamics mobility, permanent or temporary limitations, accessibility, growth and even aspects such as culture and idiosyncrasy, can be generated

projects that lack acceptance and ownership users, in many cases causing forced adaptations to situations, which generate conditions uncomfortable or uncomfortable for them, in the most extreme cases incurring temporary risks or chronic to their physical and mental health and safety.”

-Valle de Aburrá, 2015

Housing for whom?

Age range in Ibagué /



0 to 14 years

24,45%
Decreasing



15 to 64 years

66,07%
Stable



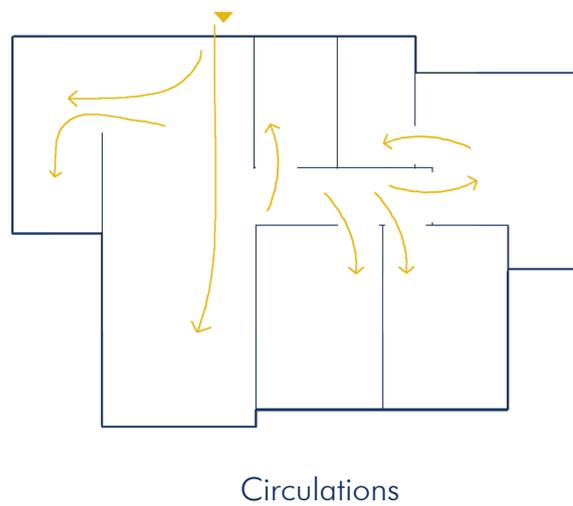
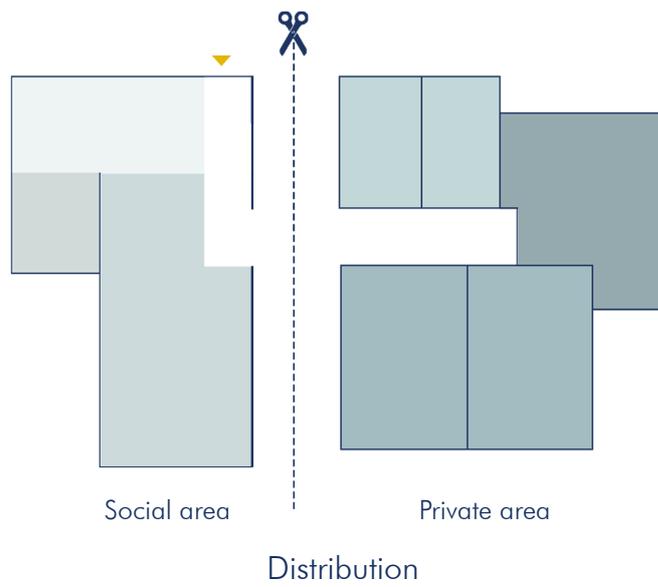
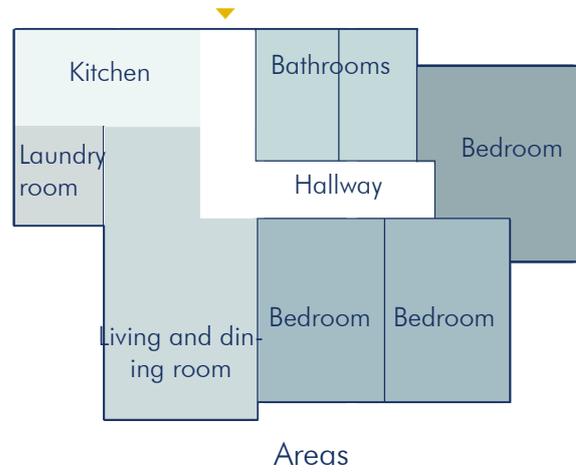
65 years and more

9,48%
Increasing

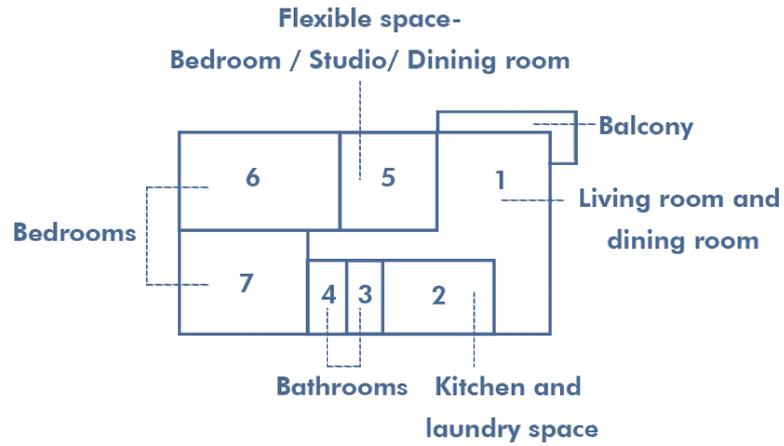
Necessary activities for the people

Typical Colombian typology of apartment

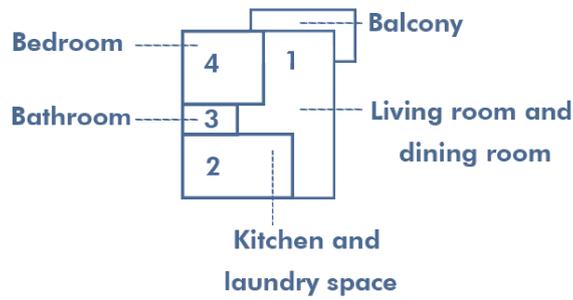
Apartment type in Cali of El Paraíso by Syma



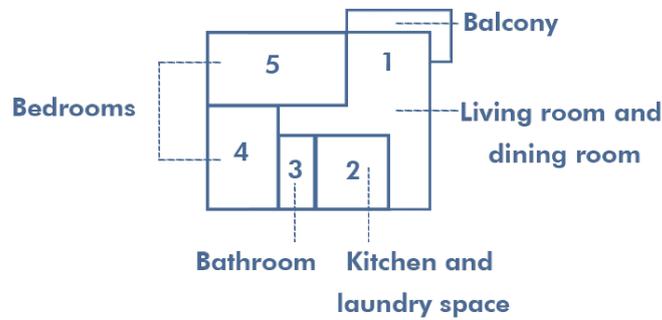
Housing typology per family type



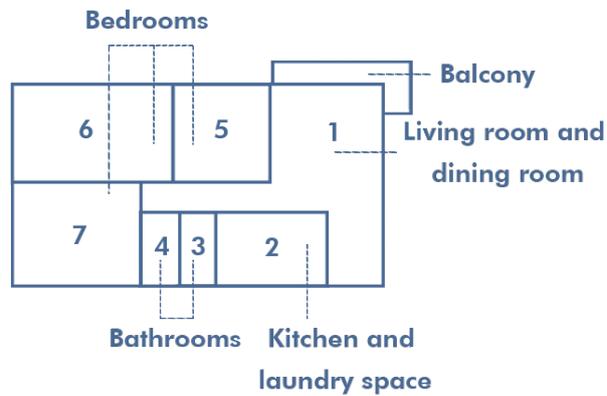
2 / 3 Bedrooms



1 Bedroom



2 Bedrooms



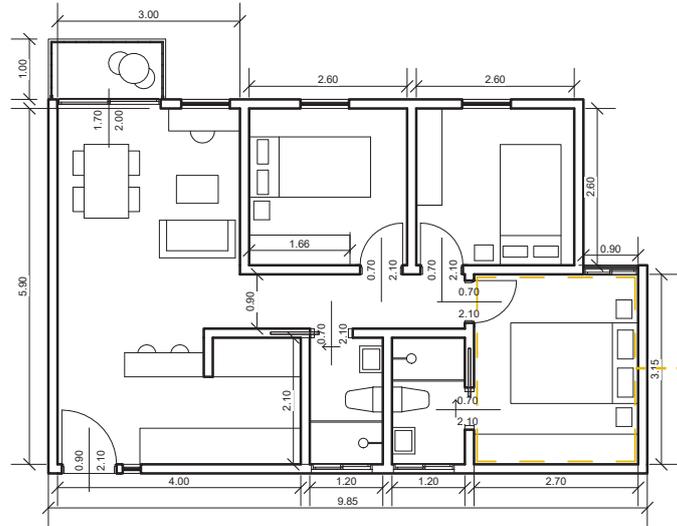
3 Bedrooms

Housing for all

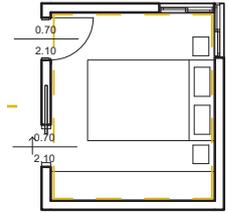


Type 1

60m²
3 Bedrooms
2 Bathrooms

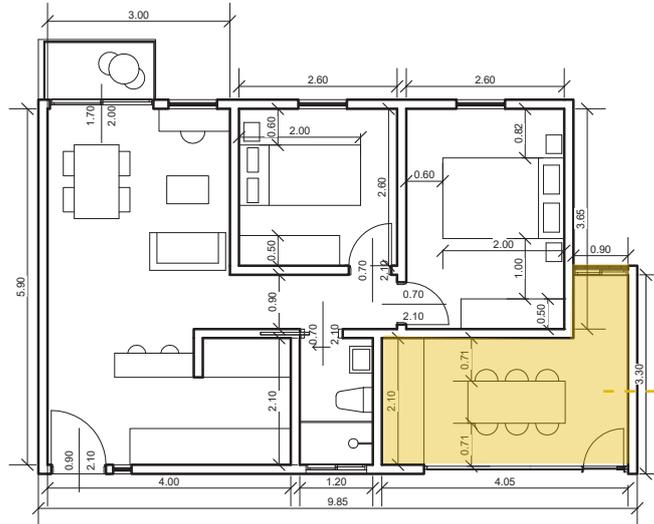


Variation
Corner apartment



Type 2

50 m²
2 Bedrooms
1 Bathroom

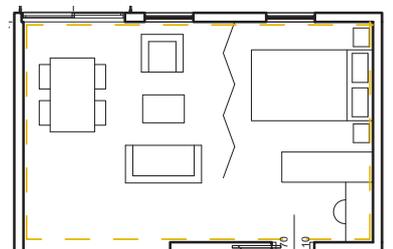
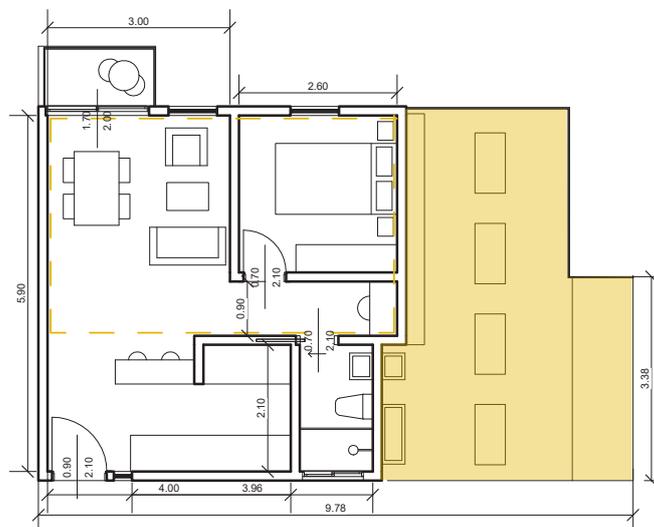


Communal space



Type 3

38,5m²
1 Bedroom
1 Bathroom

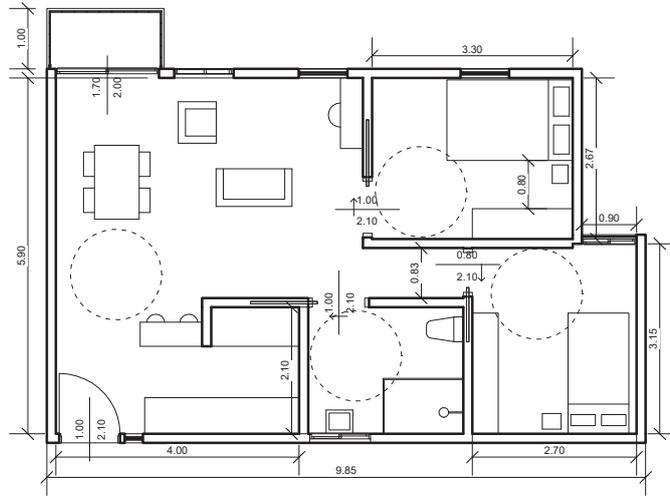


Variation
Open space



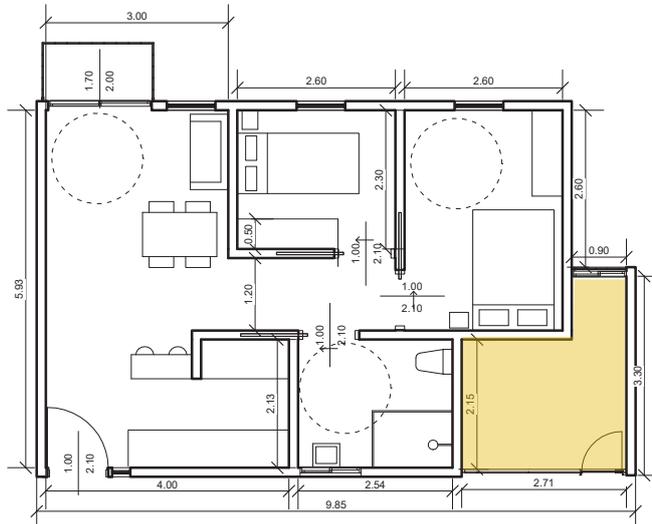
Type 1 /
Variation for accessibility

60m²
2 Bedrooms
2 Bathroom



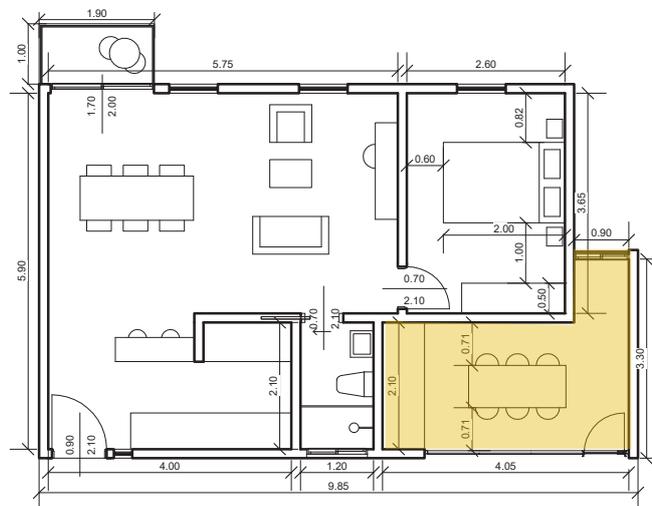
Type 2 /
Variation for accessibility

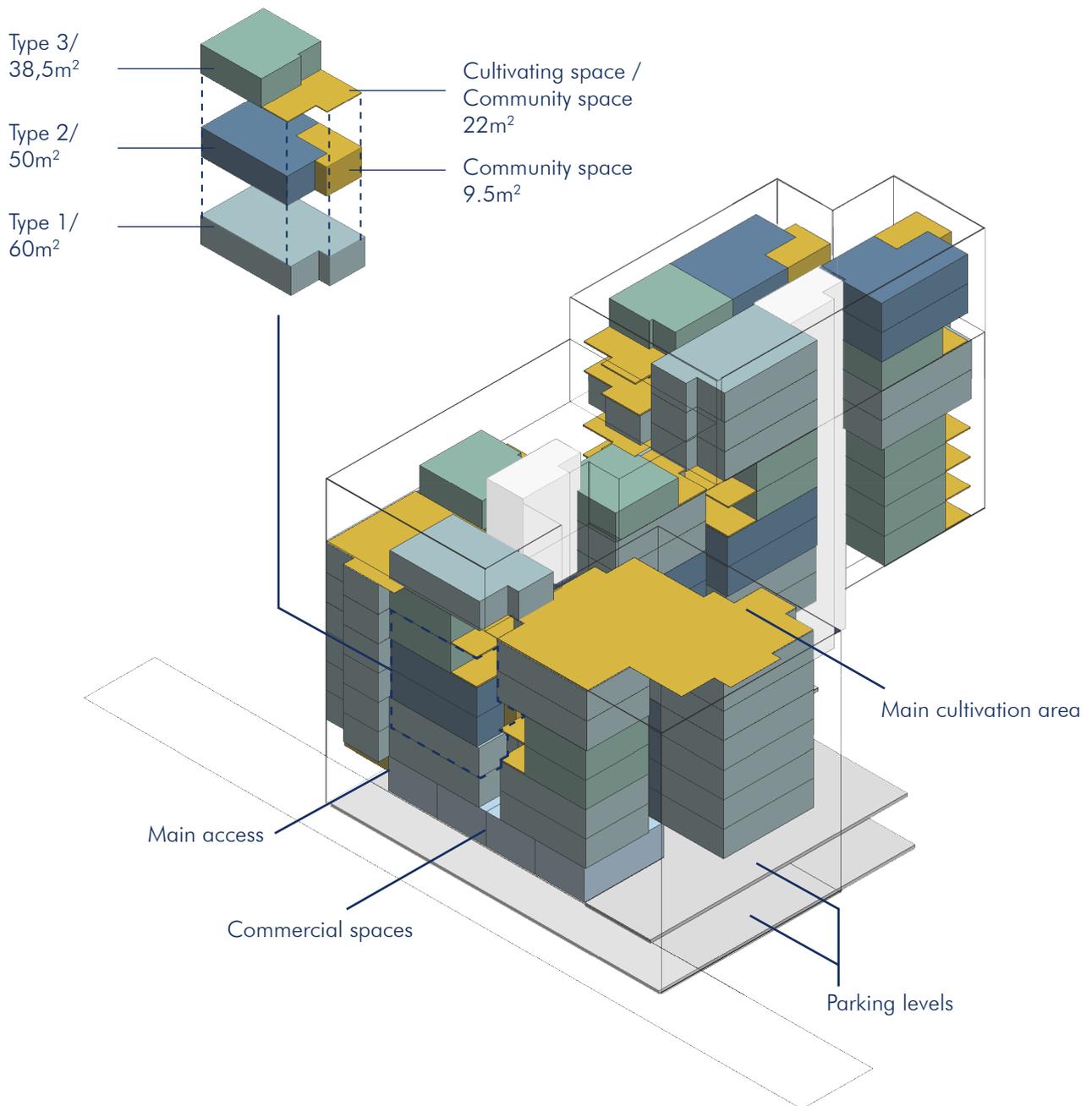
46m²
2 Bedroom
1 Bathroom



Type 1 /
Variation open space

60m²
2 Bedrooms
1 Bathroom





Program

8 levels /

816 m² on ground level/

81 apartments total / 251 people
 37 apartment of 60m² (148 people)
 19 apartment of 50 m² (57 people)
 23 apartments of 38,5m² (46 people)

Community spaces /

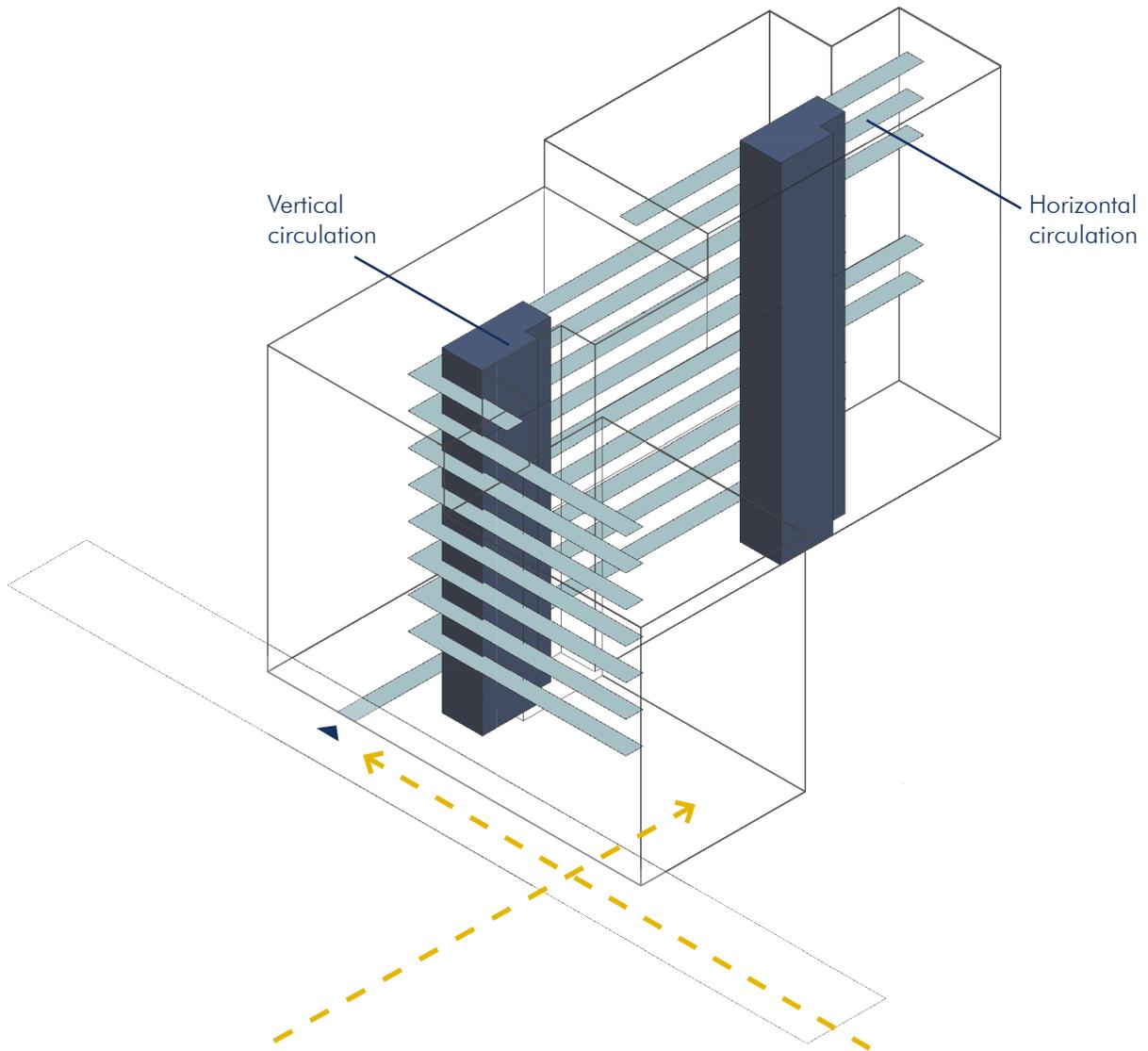
Cultivation areas /
412m²

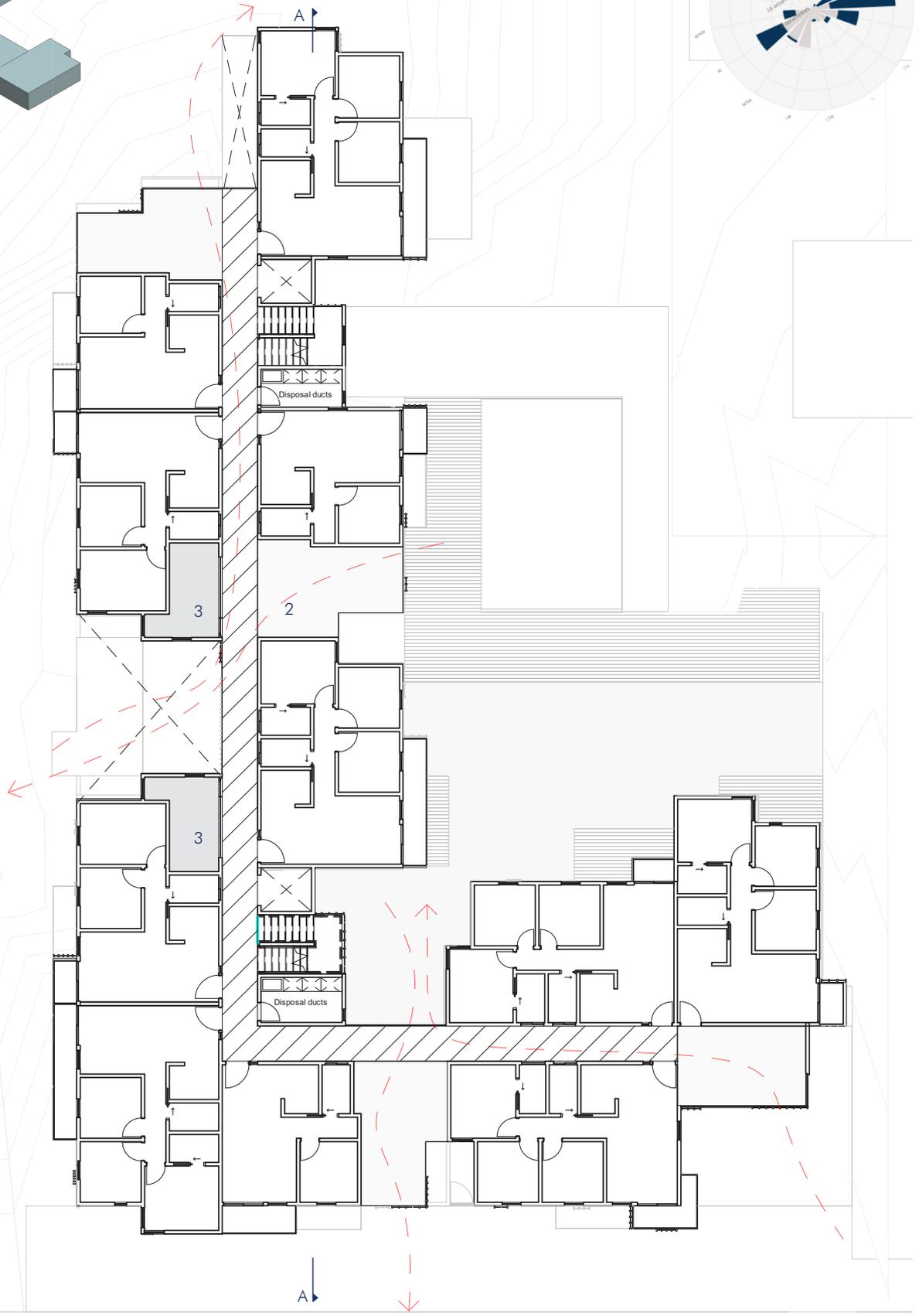
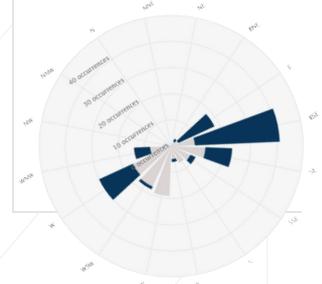
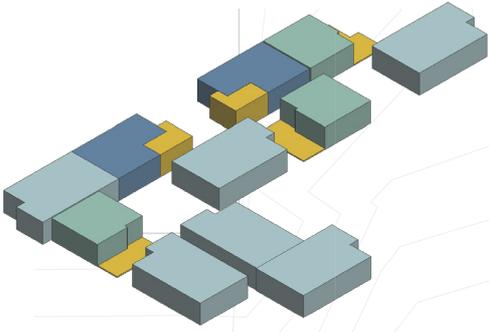
Flexible spaces /
Meeting and gathering
280m²

Ground floor /
260m²

2 parking levels /

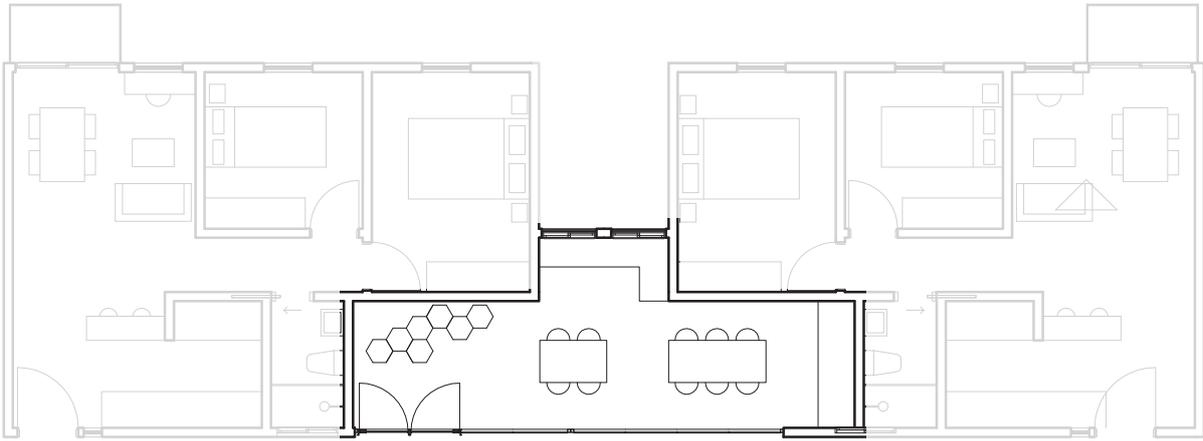
29 Bike parking spaces
 13 motorcycle spaces
 owners and visitors
 35 Car parking spaces
 owners and visitors



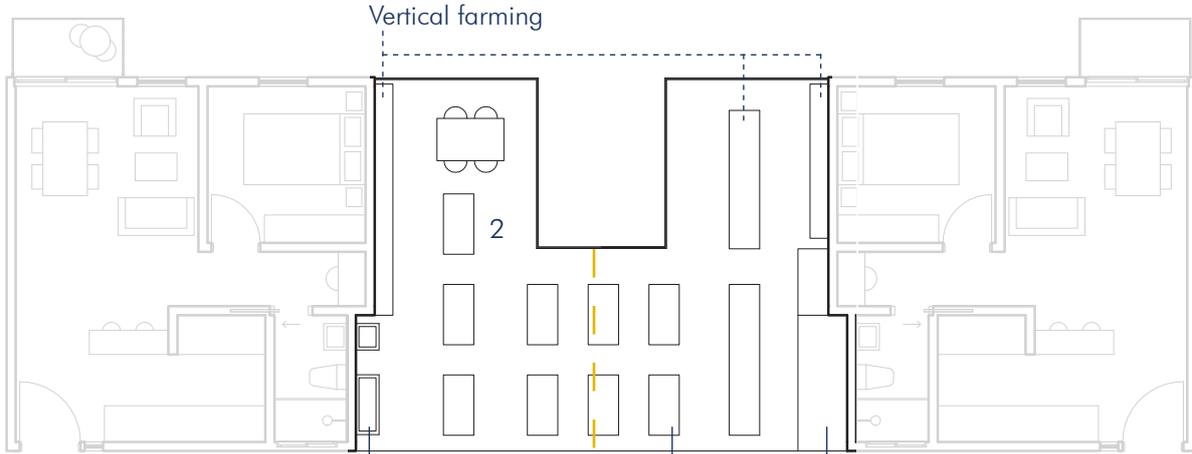


5th floor
Wind flow



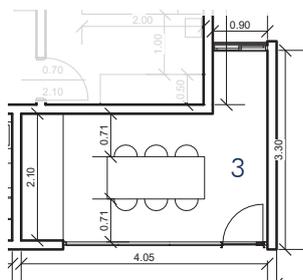


Gathering space /
two modules
20 m²



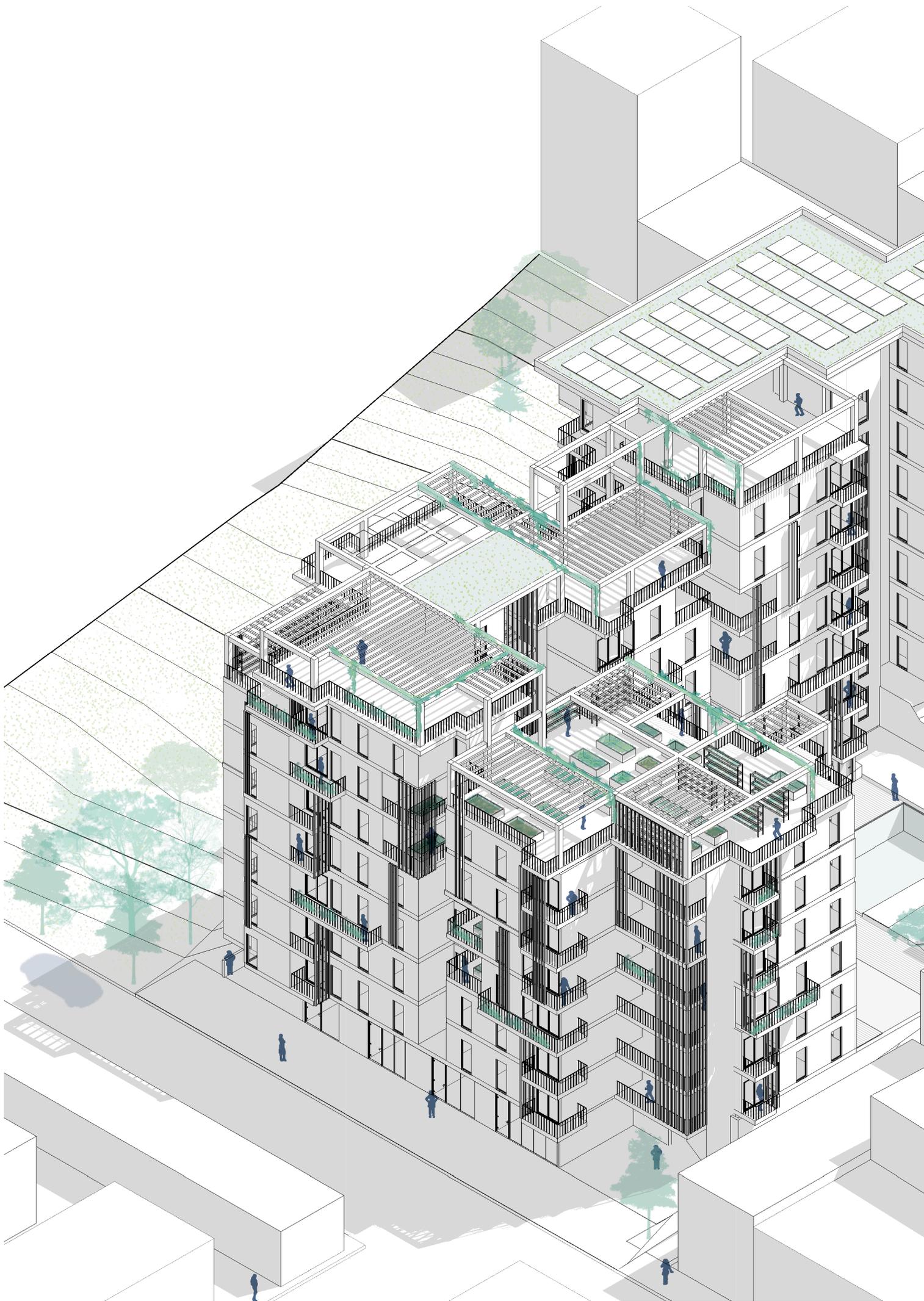
Cultivating space /
two modules
40 m²

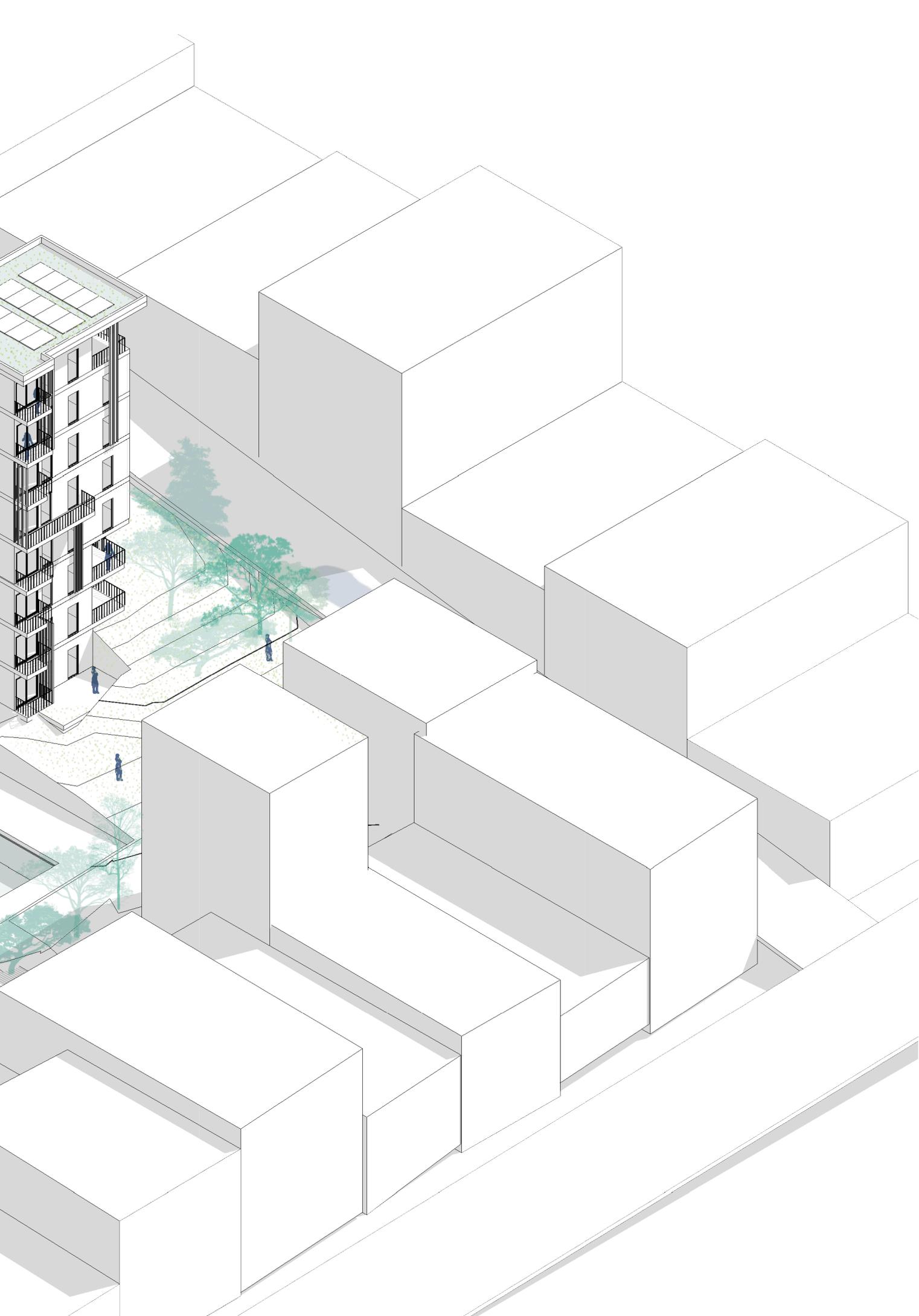
Sink and gardening sink Cultivating beds Desposit



Meeting space / one module
9.5 m²







04/ Energy

A sustainable management of energy, needs to implement a rigorous design of the envelope of the building that allow to manage the energy exchange between the interior space and its environment; architectural design can create energy savings and ensure a comfortable and healthy environment for the users.

In order to achieve a comfortable internal environment, passive strategies can be implemented, these strategies enhance climatic conditions by having an ideal orientation of the project in relation to the Sun and using the wind direction, these two are crucial as they can determine the thermal performance of the building and can imply a considerable decrease or gain of heat. In Colombia, due to its proximity to the Equatorial line there are not perceived great inclinations of the sun, the orientations with the highest incidence of the sun rays throughout the year are the East and West.

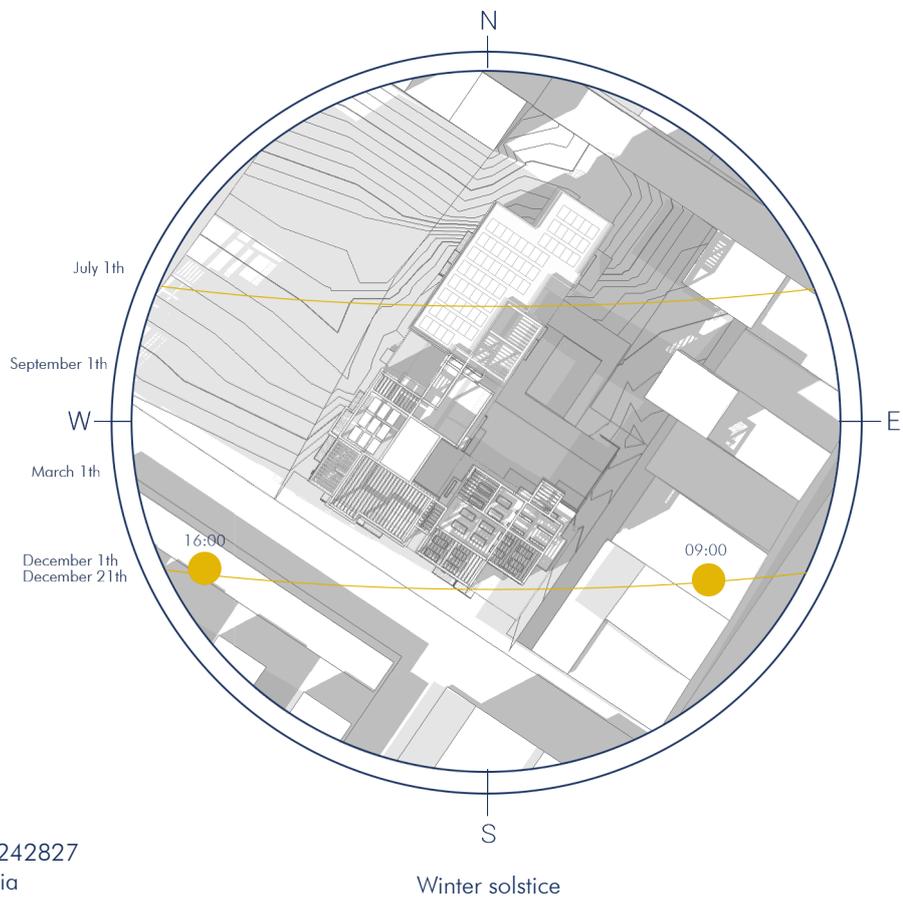
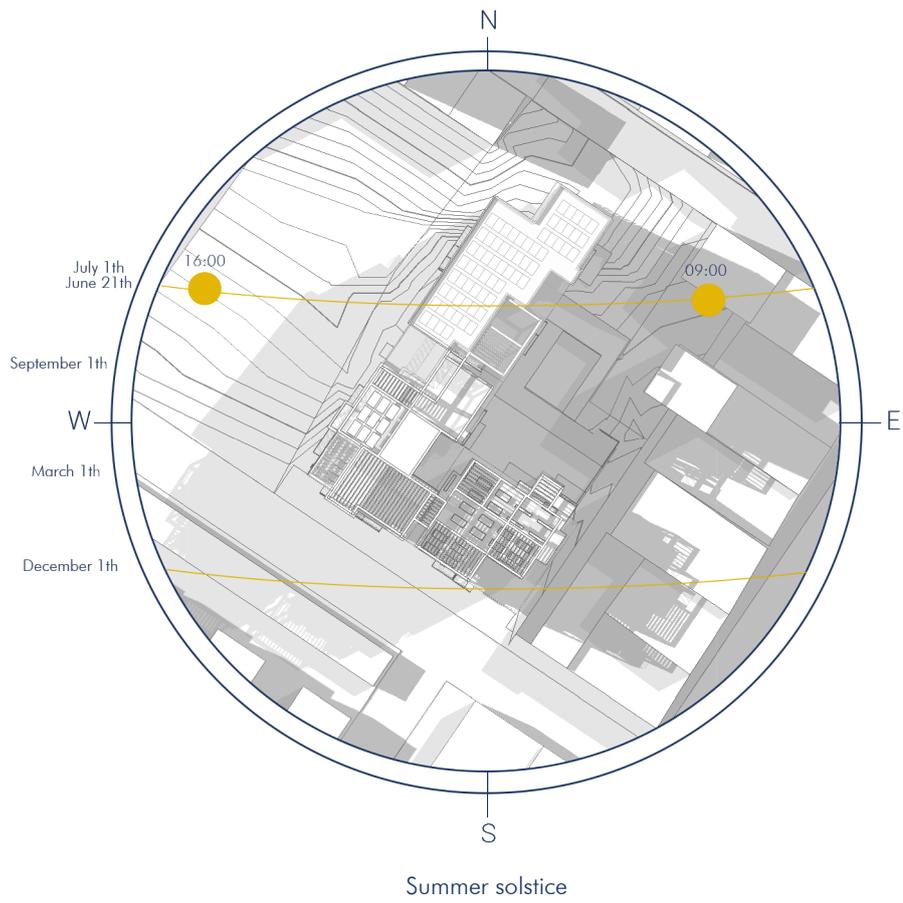
Proper natural lighting and ventilation also contribute to energy savings as the users would not need electronic devices to control temperature.

Alternatives to produce electric energy with the use of renewable resources such as solar panels contributes to mitigating the Carbon Footprint, and reduction of costs for the users (Valle de Aburrá, 2015).

Implementing the mentioned recommendations, the project is oriented to allow natural lighting as well as ventilation exploited by the morphology of the building that creates crossed ventilation.

Thermal comfort is reached by controlling the entrance of direct sunlight with vertical shadowing elements, and horizontal shading provided by overhanging balconies with different length; in addition, the project implements a ventilated façade that provides thermal insulation, creating comfortable interior conditions; these benefits are generated as well by the green roof, as it also acts as an insulator; the green roof can also improve external temperature as it remove heat from the air through the process of evapotranspiration.

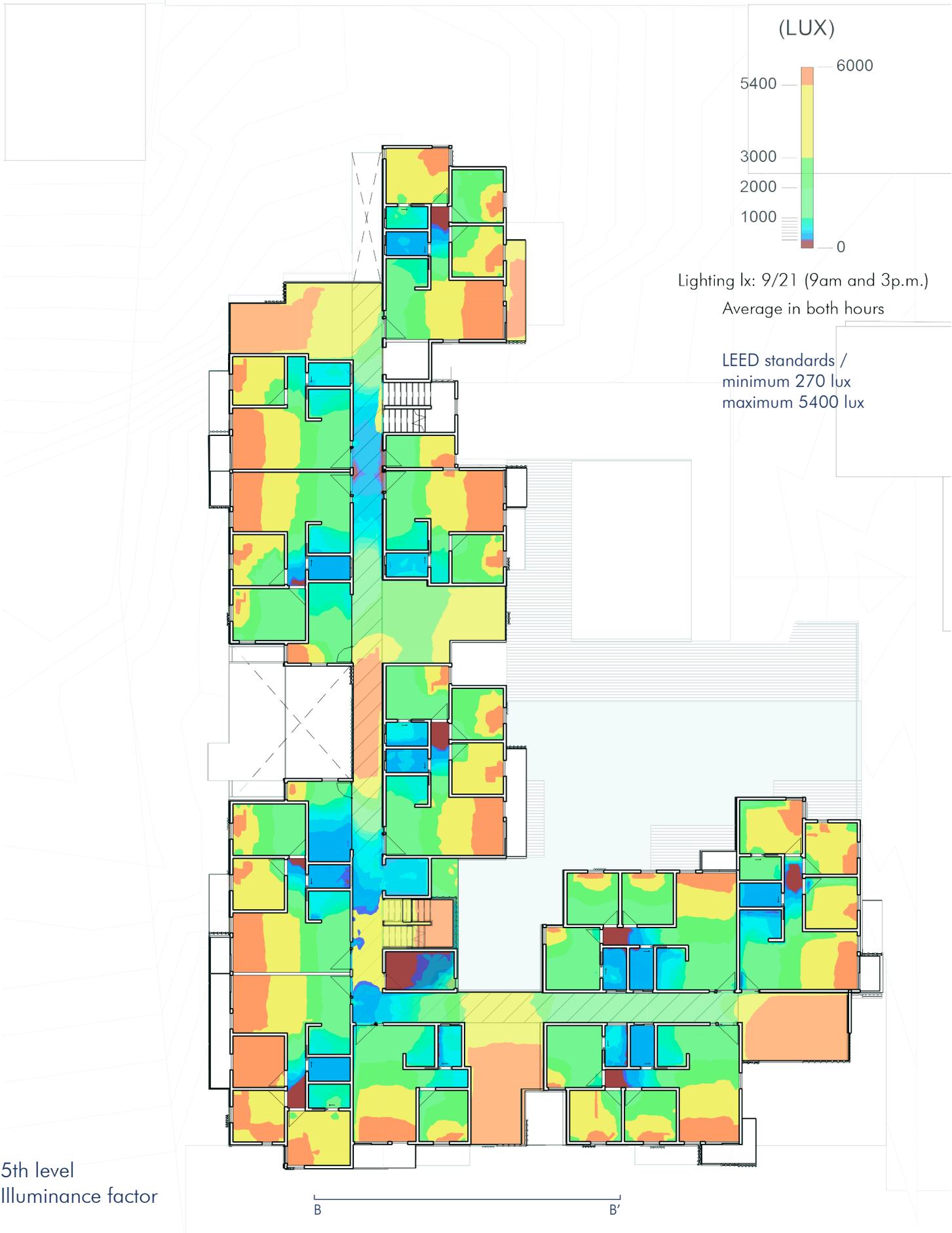
Solar panels are implemented in the project as they are a renewable energy source and create savings in bills for users.



Sun path

4.453573, -75.242827
Ibagué, Colombia

Mild semi-humid weather



Ideal lighting conditions produce energy savings and comfortable spaces.





South-west façade detail
B-B'



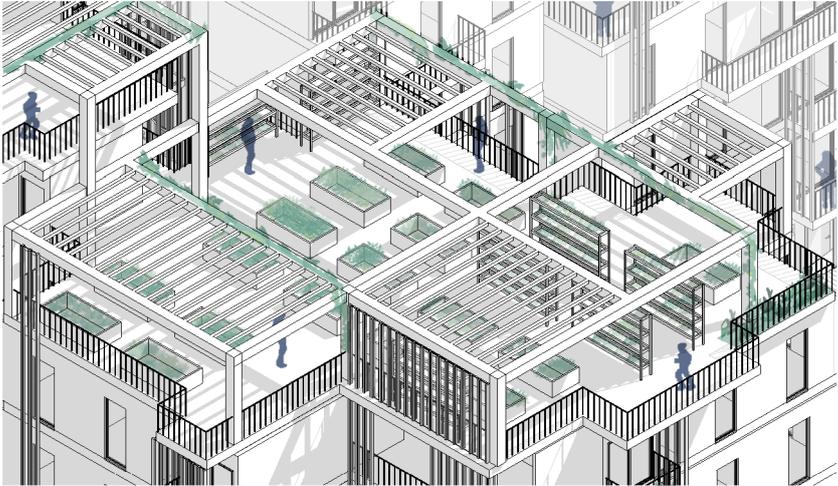
South-west façade



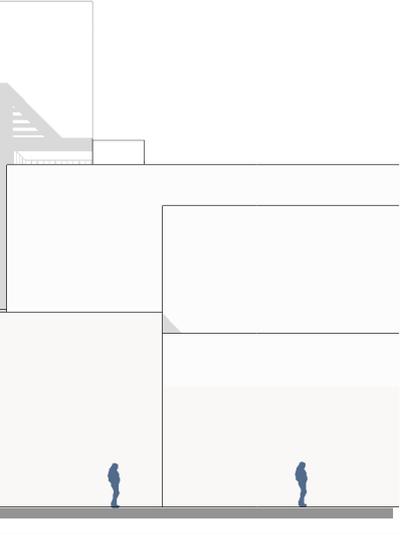
South-east façade



Pergolas



The terrace shadowing system allow the entrance of natural light and ventilation for the cultivation area while protecting people from direct sun given by the system itself and eventually the growing vegetation.



Ventilated façade / concrete cladding system

Vertical shading panels



The façade systems produce energy savings and creates ideal interior thermal conditions.



05/ Water

A more sustainable way to manage water in a project include using various water sources, those of natural origin and rainfall, this is in order to reduce the consume of potable water; for this aim, water recycling and treatment can be complementary strategies.

Rain water harvesting can be implemented in all types of buildings and it may be used for many uses inside or outside the building, different from human consumption. Water harvesting can be implemented with a collection system and a water storage such as a cistern or tank.

Grey water recycle needs for the building to have a double hydro-sanitary installation that allows the collection of grey water in a differentiated manner. The sewage will be conducted directly to the public sewerage system (Valle de Aburrá, 2015).

The project implements the mentioned strategies proposing water harvesting with a cistern tank of the capacity to storage 40.000 liters which is the consume of the building for a day according to an individual consume of 135 liters a day.

Grey water recycling is made trough a phyto-depuration system located in the green area of the project, the water collected can be used in non consumption activities and the irrigations of the cultivation and green areas.

Phyto-depuration system

Phyto-depuration is a natural purification system that takes advantage of the contribution of the purification capacity of different types of plants, as well as its high capacity to transfer oxygen to water.

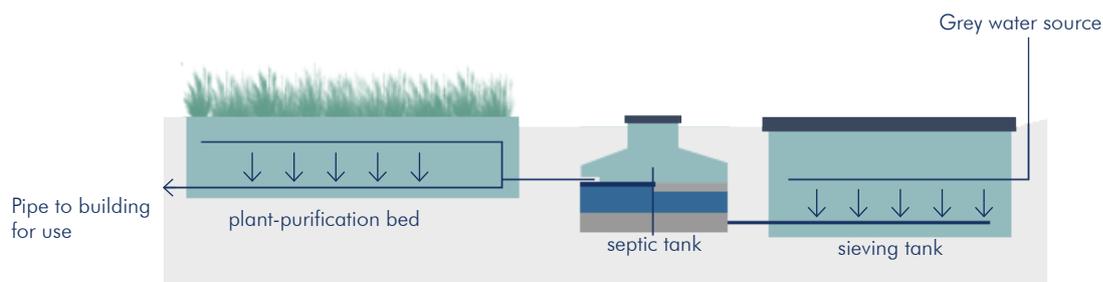
An ideal purification system for housing is the horizontal subsurface flow which is characterized by the absence of contact of water with air preventing the presence of odors and insects.

The system needs a first treatment that consists in the water flowing through a specific sieving tank to retain thick, non-biodegradable solids. The shape of the tank allows to retain fats, foams and floating solid substances.

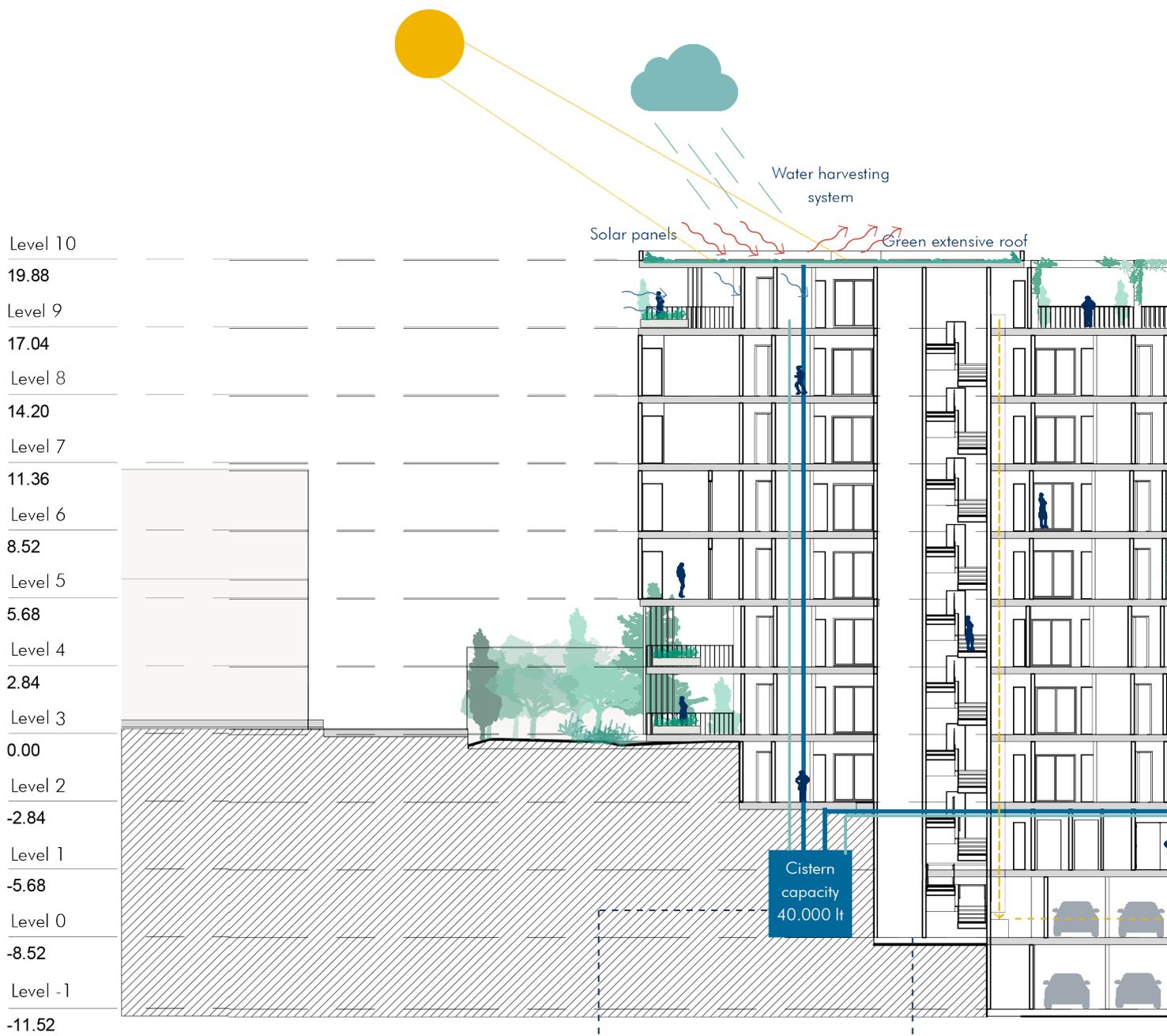
After this first treatment, an specific septic tank of two compartments, sedimentation and clarification, sediments most of the suspended solids present in the water in an approximately 80%, clarifying the outflow.

The plant-purification bed allows the purification of the generated waste water flow. It contains a filling filter bed of a filter medium that varies according to needs, location and budget from gravel to polypropylene bodies. On the surface of the raft specific and possibly plants from the area are planted to favor their acclimatization. A tank for regulating the water level inside the reservoir and sampling should serves as an outlet.

(Urbanarbolismo, n.d)



G08. Adapted from Nemor, n.d.

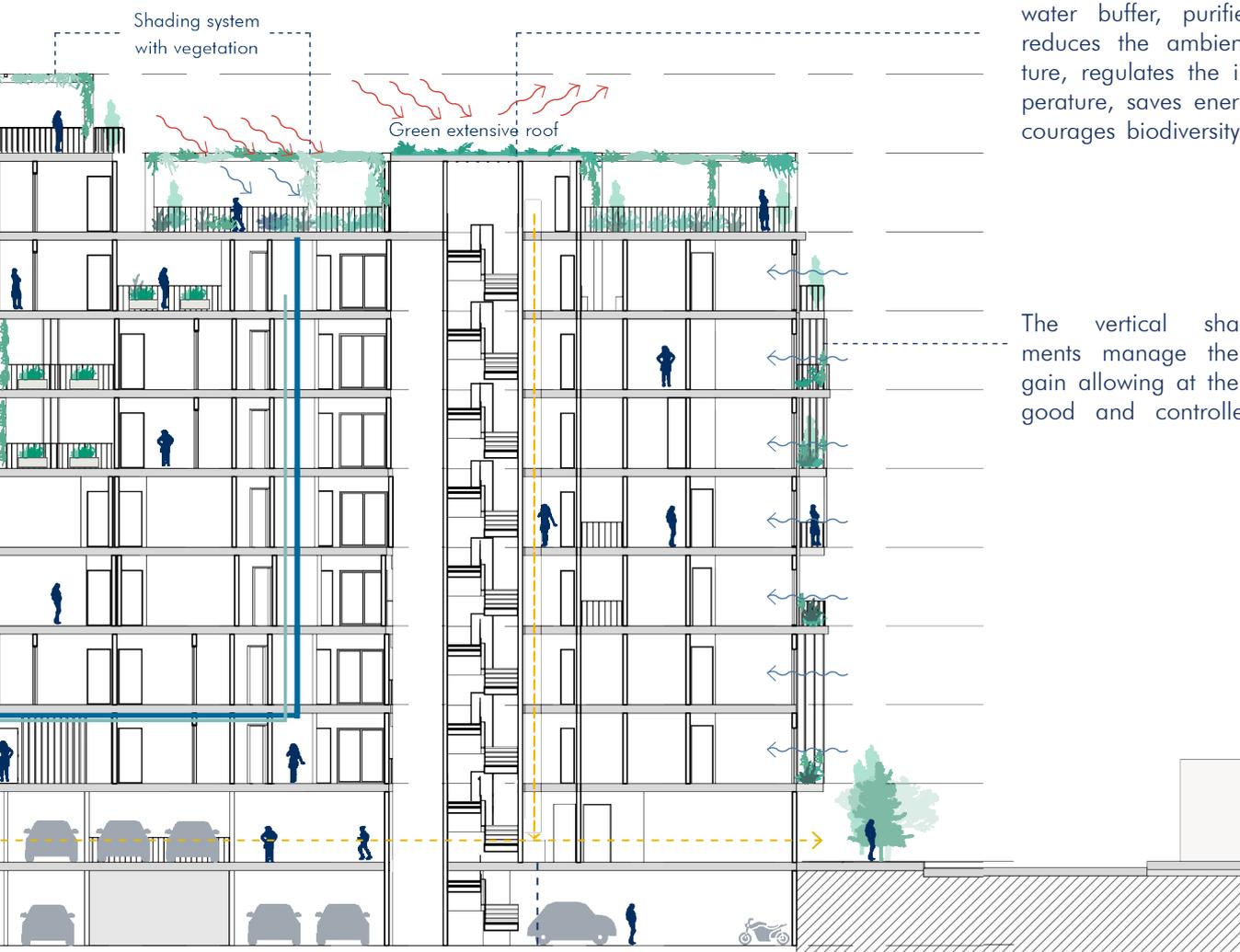


According to the liters consume by day per person (135L), the cistern has the capacity to storage water for all the building for the use of one day.

The project adapts to the land creating different levels according to the inclination of the terrain.

Section A-A
Environmental strategies

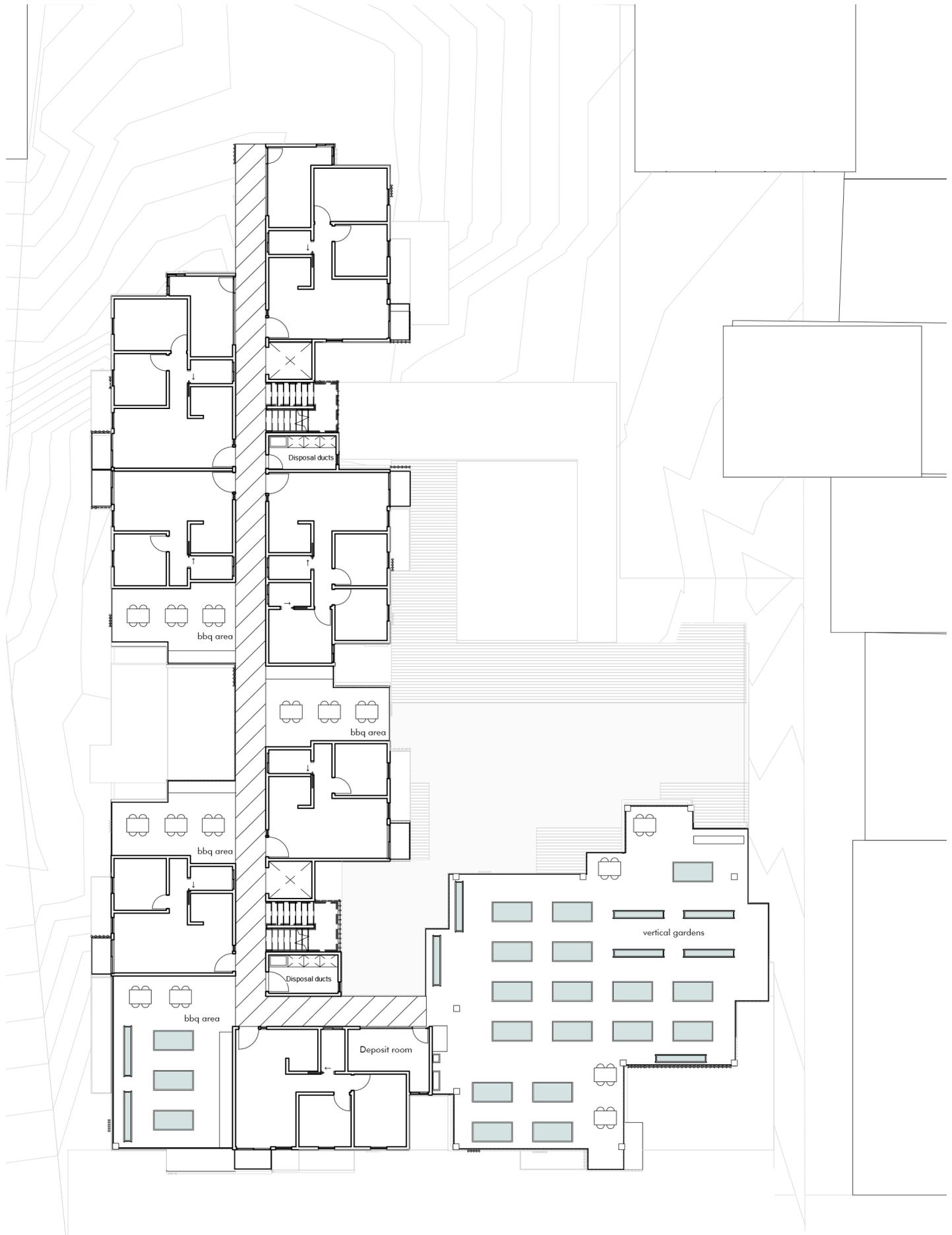




Green roofs provided a rain-water buffer, purifies the air, reduces the ambient temperature, regulates the indoor temperature, saves energy and encourages biodiversity in the city.

The vertical shading elements manage the sun heat gain allowing at the same time good and controlled lighting.

Three disposal ducts arrive to each floor and allow the separation according to the Colombian regulation in organic (green), undifferentiated (black) and recyclable (white) disposals. The ducts arrive to the bins at level zero to be easily moved out to the street.



Main cultivation area and terraces



06 / Urban agriculture

Urban agriculture is referred to the practice of cultivating in urban spaces, in the city or its surroundings and it can be done either in soft areas such as yards or patios or rigid areas such as rooftops or terraces. Cultivating in cities contributes in a positive way to food security, reinforces the social fabric, it supports natural resource conservation practices and valuation of biodiversity.

Urban agriculture promotes the cultivation of various species in spaces with different characteristics; an appropriate design must consider the conditions of space, the type of species to be planted and the needs of the family or community to formulate the production units. The circumstances of the space must meet aspects of lighting, ventilation, access to irrigation and proper space for maintenance and harvesting. For instance, in a small area of 4 m² a family can collect vegetables and small fruits with 230 plants of various species.

The orientation of the plants must be preferable located north-south to ensure constant luminosity, if plants are located east-west, higher plants like corn should be located in the west to avoid blocking sun light from the lower plants.

An accessible water supply is very important as young plants require frequent watering; air circulation is a priority to facilitate the breathing processes of the plants. It should be avoided, if possible, very strong drafts on the crop, thus decreasing tipping, broken leaves and stems, and dehydration.

The technical guide for urban agriculture of the Botanical Garden of Bogotá presents useful information when creating urban cultivation areas as it goes from starting a crop, the maintenance phase, harvest, post-harvest, the adequate plants to grow, includes nutritional information and suggests a dietary plan for a more healthy life, according to the harvest that can be taken from the crop.

It is highlighted the importance of urban agriculture for vulnerable people, as it reinforces the social fabric, recovers values that allow coexistence, as well as the affective and social reparation of communities.

Urban agriculture allows the identification of new social actors that interact through the contents and actions of the project, such as the leadership of the participants at local Urban Agriculture and/or Safety tables Food and Nutritional (Jardín Botánico de Bogotá, 2007).

Production capacity /



-1 person consumes 94.7 kg/year of vegetables, roots and others
-100 m² produces 480 kg/year (Peña, 2021)

Project/

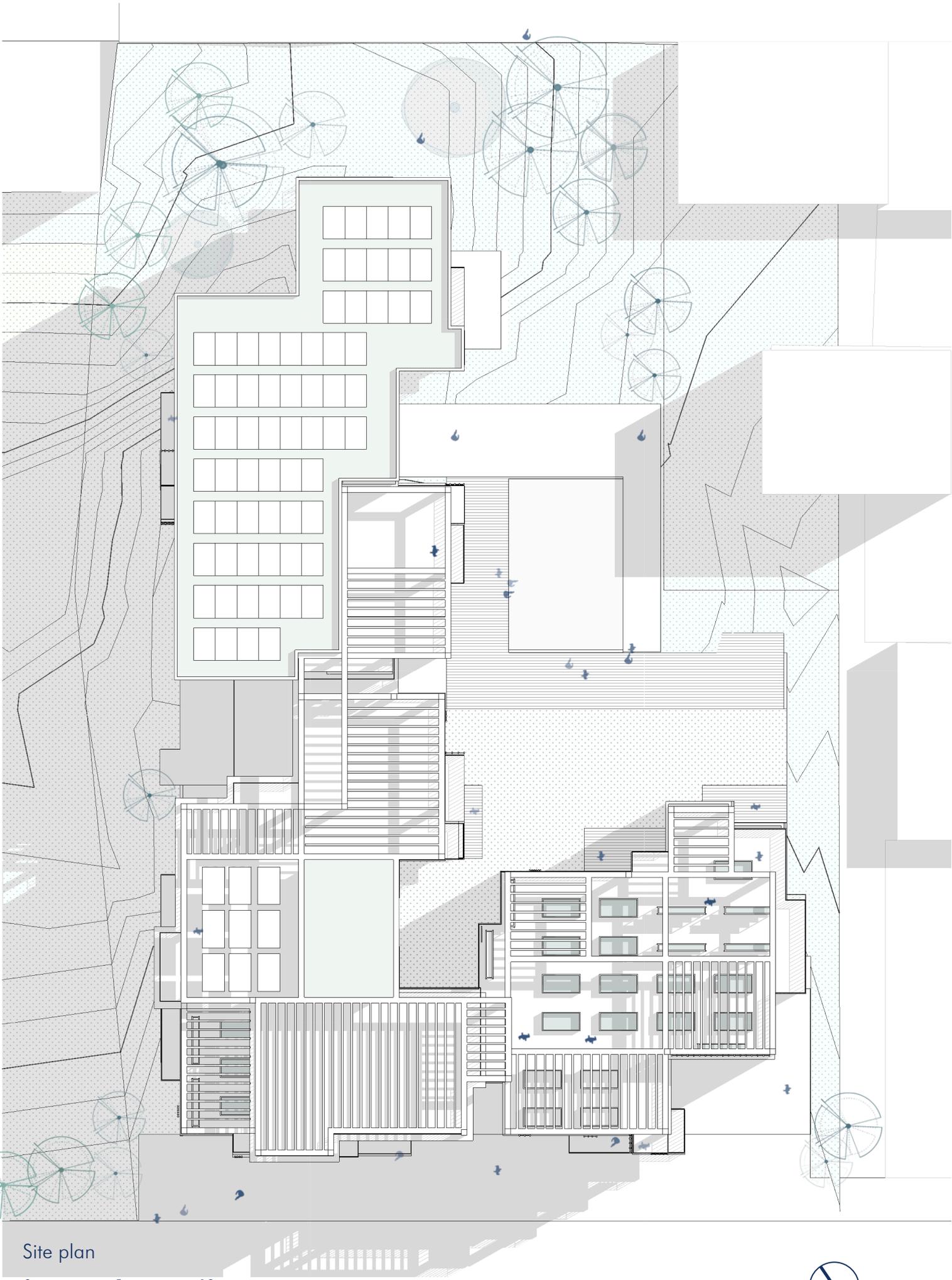
252 m² terrace + 160 m² other
=412 m²

1.920 kg/year
Building production capacity

251 residents consume 23.769 kg of vegetables and others per year



The building can produce 8% of the vegetables needed to fulfill peoples consume in the building in a year, this contributes to achieving target 2.1 to end hunger and ensure access by all people nutritious and sufficient food all year round and to reach target 3.4 to promote health and well-being.



Site plan

0 5 10

The project proposes a social housing solution that adapts to its context creating terraces that descent in the direction of inclination of the terrain. The terraces open to the city with a diversity of spaces for the community, including the cultivation areas.

The communal spaces in the upper levels are protected by a pergolated structure for shadowing and for vegetation to grow; this structure creates open spaces that allow good ventilation and lighting, ideal for the cultivation areas and comfortable spaces.

07/ Sustainable materials

A study of an existing social housing building of 6 levels in Soacha, Colombia, was able to analyze the Global Warming Potential of the three most commonly used construction systems in Colombia, structural masonry, confined masonry and industrialized systems; this analysis was made in order to determine the system that produce a milder environment impact.

Using BIM technologies, with the information of the parametric model, it was determined that Structural Masonry is the constructive system with lower carbon footprint for the construction of a multifamily social interest housing (VIS) in Soacha, Bogotá.

Within the parameters it was analyzed the energy use, type of material and quantities of each type of structure according to the structural design to the have a more detailed comparison as well as the impact of the system in the construction times and costs.

It was discovered that the structural masonry system was the construction system with less carbon footprint of the three systems for a VIS type of housing in the capital of Colombia, it was also concluded that the system was the most economic.

(López, et al., 2016)

The project proposes the implementation of a reinforced concrete structure as due to the height of the building is not possible to use structural masonry for a must sustainable solution as concluded by the mentioned research.

In Colombia green cement is a solution being presented for turning traditional concrete into a more sustainable material, this type of cement, has an addition of other cementitious materials, and is produced reducing energy consumption and CO₂ emissions (Argos, n.d.). In addition the availability of concrete in Ibagué is high, having low transportation emissions.

The ventilated façade is proposed as well in a concrete cladding system; this type of cladding offers durability and is an economic solution compared to other systems.

The ventilated façade provides thermal insulation ensuring energy savings and ideal interior climate conditions.

The façade vertical shading system proposed implements wood plastic composite (WPC) that is made with half recycled wood such as scraps of sawdust and parts that, if not recycled, would be wasted, and half recycled plastic, the slats have higher durability than wooden slaps with the exterior use, with resistance to humidity, degradation by fungi, and UV rays but keeping the aesthetic of wood (Arkos, n.d).

Alternative materials

Recycled plastic bricks are an alternative that has been used in Colombia in rural areas for one or two level houses, the first models were created by Conceptos Plásticos. The blocks are made by a process called extrusion where the plastic is melted with additives and poured into a mold (Royo, 2016). These blocks can be used in a bigger scale project for non bearing walls like division walls.

Compressed earth blocks (CEB) are another alternative solution for walls and partitions, this blocks are composed by soils, non-expansive clays, and aggregates to stabilize; this type of block can reintegrate to earth on the end of life of the building, and have lower embodied energy; in addition walls created with earth blocks can regulate the internal temperature, reduce heating and regulate humidity levels, improving the indoor air quality (Roberts, 2019).

08/ Waste management

The project proposes two disposal rooms for the building that receive the recycled, organic and undifferentiated disposals through three separated ducts that allow the users to deposit the elements from their floors; the rooms are located at a street level for an easy move; the system makes a simple way for separating waste.

In addition, is proposed a workshop for reduce, reuse and recycle in which these practices are taught to the new residents, this is proposed according to the lack of knowledge on recycling that was found to be existing and one of the reasons recycling was not being made.

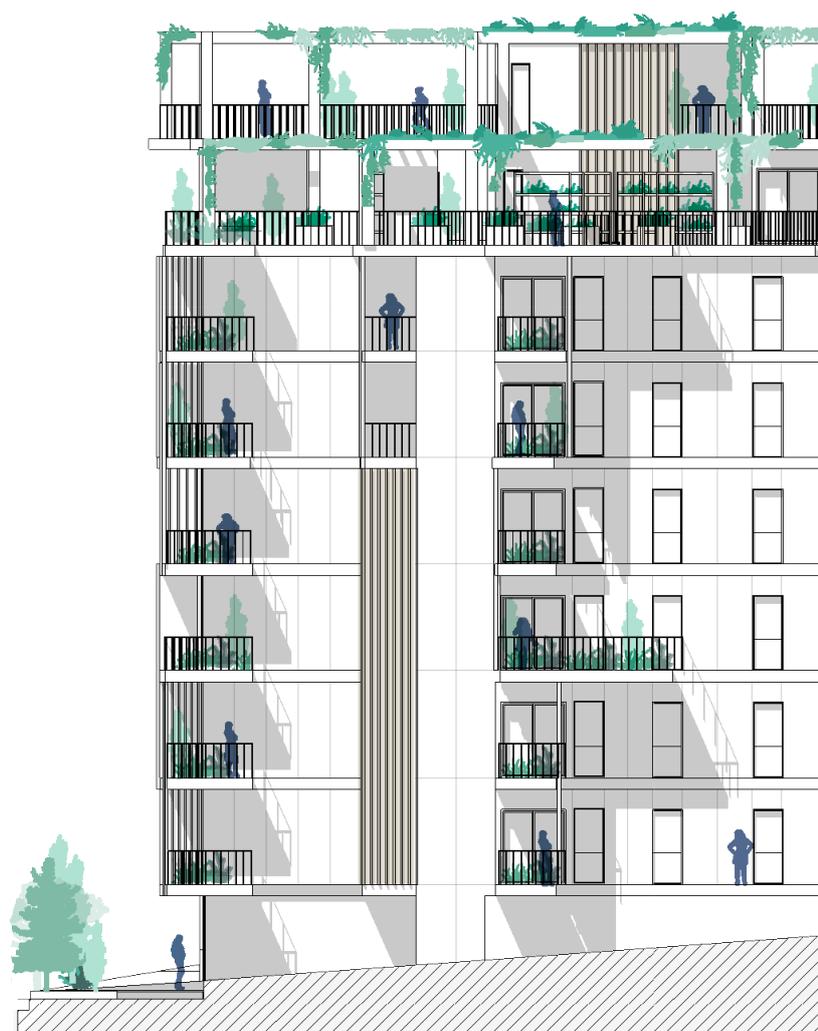
09/ Feasibility

Passive design and all related criteria with the characterization of the place and with the valuation of Landscape are strategies for sustainability that generate zero additional costs; more complex strategies such as water harvesting, water recycling and waste management system can generate additional costs that are recovered by the user in the operation phase and can be compensated to the investor with commercial benefits, higher prices or tax incentives such as tax exemption or increase of edificability (Valle de Aburrá, 2015).

10/ Certification

According to the research it was found that the national certification CASA was the most accurate certification to evaluate sustainable performance in a social housing project in Colombia.

The certification CASA evaluates and certifies specifically social housing, taking into account the economic limitations of social housing and the strategies that can be implemented, the price of the certification is based on number of housing units and typologies.



South-east façade detail



Solar panels /
45.600 kWh/year
Building energy consumption /
152.604 kWh/year

Supplies for 30%
of buildings consumption

Large permeable soil area



Extensive green roof

Terrace shading system

Cladding and shading systems
in façades



Arborization of areas with recommend-
ed species according to study including
fruit trees for harvesting



Waste management/
Disposal ducts to
recycling room



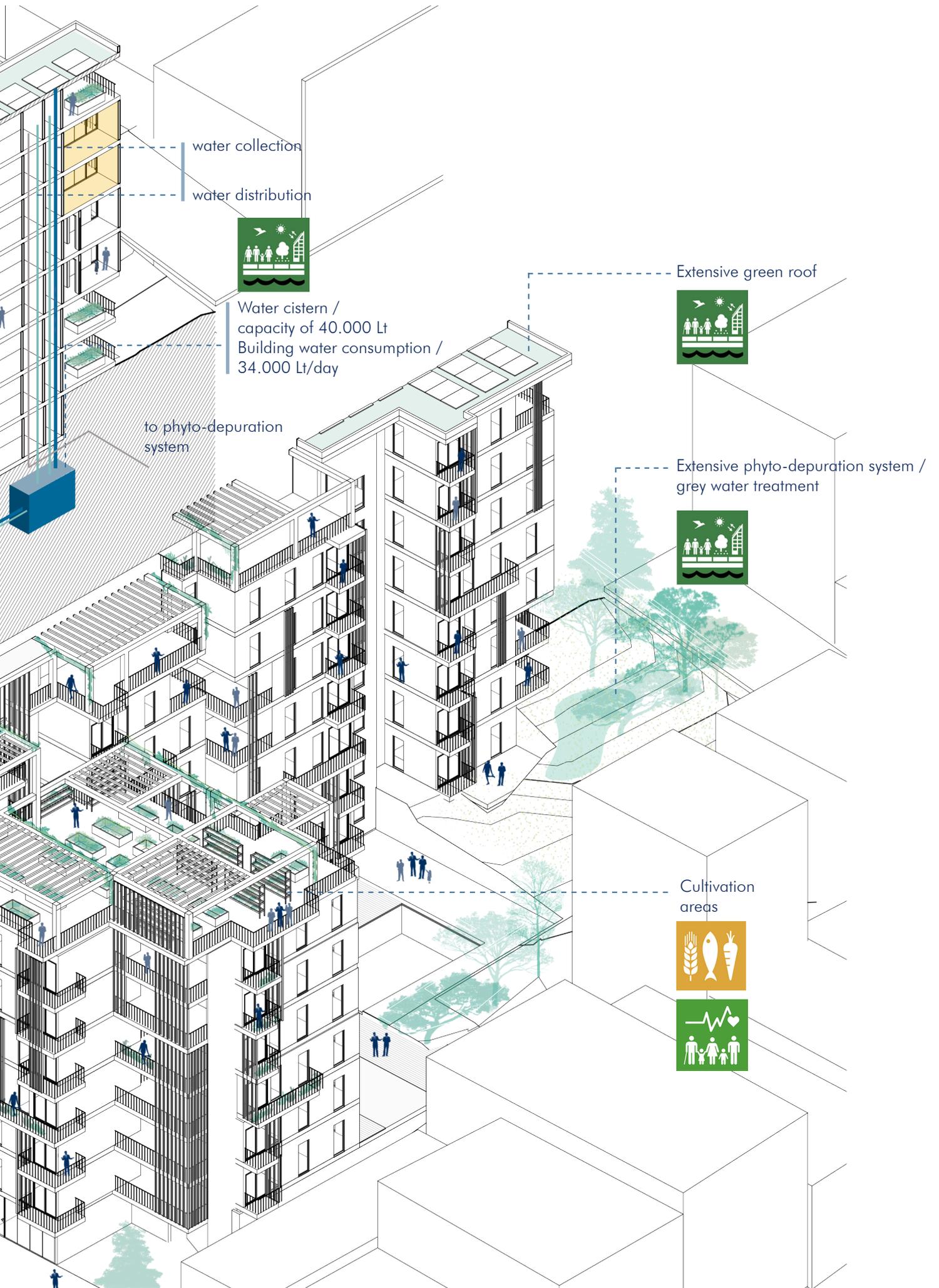
Housing for all



Spaces for the community



Targets achieved by the proposal



07 Final remarks

Limits and conclusions

References

Image references

Annex

Limits and conclusions

This thesis proposes a set of strategies and good practices for creating a sustainable social housing project with an particular focus on addressing specific targets of the SDGs; these strategies are reflected in an proposal of an architectural project designed for the city of Ibagué in Colombia.

The strategies explained in this study include in first instance social participation and community engagement from early stages of the project which can be applied in a real life case scenario; this project, by being a proposal, only lists and describes the steps to follow in order to achieve social participation but does not implement them in the process.

The importance of the economic aspect of a sustainable social housing project is clear. For this work, the proposal was created by analyzing existing social housing buildings in a national context in terms of areas, occupation, heights and density in order to achieve the feasibility of this type of project where budget is more limited than in other types of building. This proposal excludes an scrupulous economic analysis of feasibility.

Calculation on the carbon footprint of the building and its possible solutions or compensations are not studied in this work as the scope of the thesis is to identify the sustainable strategies and good practices that can be applied in a social housing project and not the specificity of the project itself.

The impact on the environment of construction industry relies in a large amount on the energy consumption of the materials implemented and the structural typology; in the city of Ibagué, traditional materials and structural typologies are still being used as regulations and new alternatives are only present in bigger cities. The project is limited to propose typical structural systems or materials; as researched, adopting alternatives manufactured in other cities can create bigger impacts for the environment.

The project contributes to Social Housing development in a sustainable way, implementing the Agenda 2030 as a framework. It contributes to the achievement of several targets of the SDGs as it reinforces the beneficial interactions between Target 11.1 and other Targets, as the project not only focuses on achieving social housing

but implements strategies to create social housing that aims to provide a home for all, fight hunger, promote well-being, implement clean energy, promote recycling and tackle climate change.

The aim is accomplished as this work compiles lessons learned at a national and international level of successful cases of sustainable social housing that can be implemented in the Colombian context; these lessons are implemented in the project together with the strategies presented by a national guide for sustainable buildings that provides guidelines for creating sustainable architecture.

The proposal creates a project that understands people's needs and diversity; this way, it provides home for all families, from different economic situations, and necessities, creating an inclusive space for all.

Cultural identity and community are acknowledge by proposing spaces for social interaction and community bonding. These community spaces are also part of the urban agriculture system that enhance the social interaction and contributes to food security, well-being, mental and physical health.

The environmental nature of the proposal lies in a balance between creating homes with and for the people, without compromising the well-being of the environment, but in fact, providing a space for natural life to develop and that enhance people's sustainable actions.

This work can be an alternative solution for the housing deficit in the country as it proposes a different perspective to approach social housing. It can be studied as a set of steps that can be followed when designing and developing social housing projects to improve quality and create more sustainable outcomes.

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Annex

Goal 11 /

Make cities and human settlements inclusive, safe, resilient and sustainable

Target 11.1:

By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums

Indicator 11.1.1: Proportion of urban population living in slums, informal settlements or inadequate housing

Target 11.2:

By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons

Indicator 11.2.1: Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities

Target 11.3:

By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries

Indicator 11.3.1: Ratio of land consumption rate to population growth rate

Indicator 11.3.2: Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically

Target 11.4:

Strengthen efforts to protect and safeguard the world's cultural and natural heritage
Indicator 11.4.1: Total per capita expenditure on the preservation, protection and conservation of all cultural and natural heritage, by source of funding (public, private), type of heritage (cultural, natural) and level of government (national, regional, and local/municipal)

Target 11.5:

By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations

Indicator 11.5.1: Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population

Indicator 11.5.2: Direct economic loss attributed to disasters in relation to global gross domestic product (GDP)

Indicator 11.5.3: (a) Damage to critical infrastructure and (b) number of disruptions to basic services, attributed to disasters

Target 11.6:

By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management

Indicator 11.6.1: Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal waste generated, by cities

Indicator 11.6.2: Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)

Target 11.7:

By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities

Indicator 11.7.1: Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities

Indicator 11.7.2: Proportion of persons victim of physical or sexual harassment, by sex, age, disability status and place of occurrence, in the previous 12 months

Target 11.a:

Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning

Indicator 11.a.1: Number of countries that have national urban policies or regional development plans that (a) respond to population dynamics; (b) ensure balanced territorial development; and (c) increase local fiscal space

Target 11.b:

By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management at all levels

Indicator 11.b.1: Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030

Indicator 11.b.2: Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies

Target 11.c:

Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials

Indicator 11.c.1:

No indicator is currently listed under 11.c. See E/CN.3/2020/2, paragraph 23.

(United Nations, n.d.a)

