INTERNATIONAAL PROJECT NO FOOTPRINT HOUSE COSTA RICA

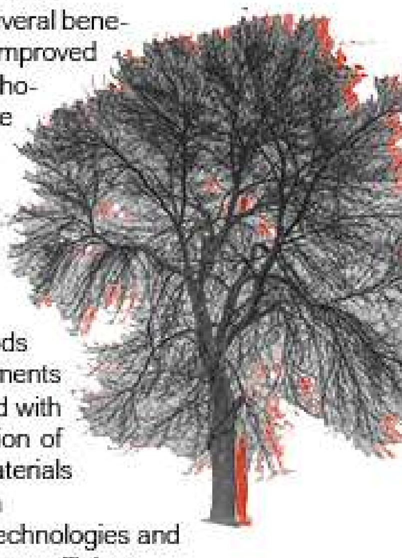
MATERIALIZATION/SUSTAINABLE

Sustainablitly
A "no footprint" house aims to minimize or eliminate the negative environmental impact of construction and building lifecycle. It involves resource efficiency, energy conservation, water management, waste reduction, and ecological integration. The No Footprint House in Costa Rica utilizes renewable energy sources and locally sourced materials, while the "Roadmap 2025" project can guide the creation of a No Footprint House in Europe.

The current materialization of the No Footprint House in Costa Rica showcases sustainable and environmentally conscious architecture. It incorporates locally sourced materials like bamboo and reclaimed wood, reducing transportation emissions and supporting the local economy. The house utilizes passive design strategies for energy efficiency, optimizing natural light, ventilation, and solar gain. Renewable energy systems, such as solar panels and battery storage, provide clean and reliable electricity. Water conservation measures, including rainwater harvesting and greywater recycling, minimize water waste. Waste management practices, like composting toilets and recycling systems, promote responsible waste handling. The landscape design focuses on restoring and enhancing the surrounding ecosystem, with native plants and green spaces. Smart home technologies enable monitoring and optimization of energy and resource consumption. Overall, the No Footprint House demonstrates the potential of sustainable architecture and serves as an inspiration for eco-conscious building projects worldwide.

Incorporating native plants, implementing graywater recycling systems, and embracing recycling and waste separation practices are key elements in future materialization and sustainable applications, helping to create environmentally conscious buildings and promote responsible resource management.

In future materialization and sustainable applications, incorporating smart home technologies, energy monitoring systems, and automated controls brings several benefits. These include increased energy efficiency, cost savings, convenience, improved security, sustainability, and integration. Smart home technologies enable homeowners to have better control over their energy consumption, optimize energy usage, and create a comfortable and secure living environment.



Using locally sourced materials in the construction of environmentally friendly homes in the Netherlands offers sustainable and eco-friendly options. Timber sourced from sustainably managed forests, clay and earth-based materials, locally sourced insulation materials like sheep's wool or flax, Dutch brick or locally quarried stone for exterior cladding, locally sourced woods such as Dutch oak or beech, and bamboo grown in controlled environments are all viable choices. These materials reduce carbon emissions associated with transportation, support local economies, and contribute to the preservation of traditional craftsmanship. Additionally, utilizing recycled or salvaged materials from nearby construction sites or salvage yards further reduces the carbon footprint and adds uniqueness to the home.By incorporating smart home technologies and using locally sourced materials, future sustainable building projects can create efficient, environmentally friendly, and aesthetically appealing homes that promote responsible resource management and minimize the ecological footprint.

TYPOLOGY AND LOCATION

In the process of selecting the appropriate typology for the adaptation of the NFH in Costa Rica to the context of Rotterdam, several factors need to be considered. These factors include the common practices in the construction industry in the Netherlands/Rotterdam, the demand in Rotterdam, and the vision of the city/municipality.

Starting with the city's vision, Rotterdam emphasizes the need for urban densification rather than expansion to preserve the green areas surrounding the city. This opens up possibilities for different approaches to urban densification, such as infill development, rooftop extensions, and building on water.

Regarding typologies, infill development between existing houses often involves apartment buildings or duplexes. These typologies could be considered for the adaptation. However, it's important to note that the NFH in Costa Rica is a detached building, which may not align with the urban vision of Rotterdam. Therefore, it becomes necessary to adapt the valuable elements of the NFH into a different typology that suits the Rotterdam context.

TYPOLOGY AND LOCATION

To determine the suitable typology, further research and analysis are needed,
taking into account the specific requirements and constraints of the Rotterdam context. This analysis should consider factors such as the market demand, building regulations, spatial constraints, and the potential for innovative and sustainable solutions.
Ultimately, the goal is to identify a typology that combines the valuable elements of the NFH with the principles of urban densification and meets the vision and needs of Rotterdam.

Infill Development
For the location of our adaptation of the NFH, we have been given a lot of freedom as long as the building is in Rotterdam. As mentioned, we found infill development to be an interesting solution for urban densification. This concept of infill development is also encouraged by Rotterdam's vision, and it is something that is increasingly being seen in the city.
The municipality of Rotterdam promotes infill development through the "Small but Fine" initiative, which encourages this approach.
However, infill development is not our only option, which is why we will also conduct research on our other possibilities.

Roof Extension:
Roof extension, involves adding a new structure on top of an existing building, essentially "topping off" the existing structure.
This is a widely practiced method in Rotterdam and is truly an innovative approach to urban densification. Let's take a building in the city center as an example. The key to this extreme form of roof extension lies in the lightweight construction, which is something we can definitely leverage. Our construction will also be lightweight, utilizing materials such as wood or steel. By using light prefab elements, this approach becomes feasible.
However, we want to mention that roof extension is not our first choice, and this is due to the following reasons. It also brings consequences and disadvantages.
For instance, the surrounding environment needs to be suitable, considering factors like sun exposure for neighboring buildings. The existing building and its surroundings should accommodate the necessary amenities, such as parking spaces and elevators.
These drawbacks can be mitigated when opting for a smaller-scale roof extension. However, this would result in a highly specific solution, whereas we aim for our building to be adaptable with minor adjustments to its dimensions, making it applicable in various locations.

Building on Water:
Building on water is also an idea we briefly wanted to explore, as it aligns well with the character of the city. However, we believe that constructing on water still involves too many risks and complexities. It requires extensive knowledge of buoyancy and water flow dynamics.
We feel that dedicating a significant amount of time to address these challenges would compromise our design.
Moreover, floating a building is a specific undertaking that would require substantial research if we were to consider implementing it in a different location.

We aim to determine what and where we want to build. We want to focus on the core strength of the NFH design in Costa Rica, which lies in its adaptability and dismantlability. This allows for quick construction in various locations, particularly through the concept of inbreeding. By maintaining a fixed core size and adaptable surrounding spaces, the NFH can be easily adjusted to fit different gaps in the city. While we choose a location based on the "Klein & Fijn" map, we also design the building to be applicable throughout the city, thanks to its dismantlable nature and versatile facade.

CLIMATE AND CULTURE

The No Footprint House (NFH) is originally designed for a warm and humid climate, specifically for Costa Rica. It is designed to accommodate the lifestyle of Costa Ricans, who value community, family gatherings, and a sense of pride in their homes. The original design features an open and inviting layout with no walls or windows, emphasizing ventilation and a connection with nature.

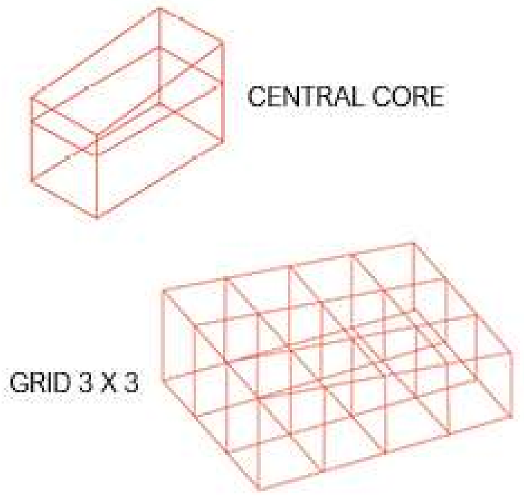
To transform the original design for an urban setting in Rotterdam, which has a temperate oceanic climate, several modifications are necessary. Firstly, insulated walls and windows should be incorporated to provide privacy, security, and maintain comfortable indoor temperatures. The addition of these elements would address the cooler temperatures and occasional snowfall experienced in Rotterdam's winters.

Considering the lifestyle and preferences of Rotterdam inhabitants, who are more focused on their careers and socialize outside their homes, a large common space is no longer essential. Instead, a small office space would be beneficial, catering to the needs of students and workers. Additionally, since space is often limited in urban environments, adding more floors to the NFH design could maximize living space without expanding the footprint.

To adapt the original NFH design to the urban setting and oceanic climate of Rotterdam, the modifications should include insulated walls and windows for privacy and temperature control, a small office space, and the incorporation of multiple floors to optimize space utilization. These changes would align the design with the cultural and climatic aspects of Rotterdam while maintaining the sustainable and eco-friendly principles of the No Footprint House concept.

CONCEPT FEATURES, BUILDING REGULATIONS

Concept features
The No Footprint House (NFH) in Costa Rica showcases an impressive sustainable design that responds to its surrounding environment. Key features include slanted wooden louvers for natural light and ventilation, passive climate control, motorized screens for shading, and connection to local water and electricity networks. The NFH emphasizes sustainability, energy efficiency, and comfort, utilizing smart strategies to optimize natural elements and reduce reliance on external energy sources. When adapting a similar concept in the Netherlands, elements such as a central core, a 3x3 grid, sustainability measures, and the use of prefab elements can be incorporated. These adaptations offer benefits such as efficient layout, cost savings, rapid assembly, and reduced ecological footprint. The NFH serves as inspiration for designing sustainable and modular homes in the Netherlands, taking into account the country's specific context and requirements.



CONCEPT FEATURES, BUILDING REGULATIONS

Building regulations
the construction regulations in Costa Rica differ from those in the Netherlands. While the Netherlands has a comprehensive system of building regulations, Costa Rica's regulations may vary by region and are potentially less standardized. In the Netherlands, the Building Decree serves as a standard reference, while in Costa Rica, various entities such as the Ministry of Housing and Urban Development, the College of Architects of Costa Rica, and the Costa Rican Chamber of Construction are responsible for establishing and enforcing building regulations.

Key aspects of Costa Rica's building regulations include zoning and land use planning, maximum building height and area, minimum distance to property boundaries, structural and foundation requirements, environmentally friendly construction practices, and sanitary and safety regulations. However, it's important to note that specific building regulations can vary by region and location.

Differences between the Netherlands and Costa Rica include the extent of legislation and regulations, the scope of application (which encompasses all types of buildings in the Netherlands), emphasis on sustainability (with the Netherlands placing a strong focus on energy efficiency), safety requirements, and enforcement and compliance mechanisms.

In conclusion, while the Netherlands has a standardized and comprehensive system of building regulations, Costa Rica's regulations can vary by region and are overseen by different authorities. It's crucial to consult local authorities, professional organizations, and experts in the construction industry for up-to-date and location-specific information on building regulations in both countries.

LOGISTICS AND BUILDING METHOD

Logistics
Various sustainable methods are applied for the logistics process of the No Footprint House in Rotterdam. Transport takes place using electric vehicles from the workshop/factory where the modules are prefabricated. Efforts are made to minimize transport distances and the use of transportation vehicles. An electric crane is used on-site to lift the modules to the appropriate location.
In case of limited parking options for workers during busy periods, a meeting point can be created just outside the city where workers can gather before being transported to the construction site. Construction hubs are not necessary since the modules arrive prefabricated on-site.
For further deliveries of materials from different suppliers, one electric truck is utilized to transport everything to the location in one go.
Efficiency and sustainability are prioritized in the logistics process of the No Footprint House in Rotterdam. This includes the use of electric vehicles, an electric crane, shared transportation for workers and materials, and minimizing transport movements.

Building methods
There are various construction methods used in the building industry, ranging from traditional approaches to modern and innovative techniques. Here are some common construction methods:

Traditional Construction: This is the most common method that has been employed for centuries. It involves constructing a structure on-site using traditional materials such as bricks, concrete, wood, and steel. Most of the work, including foundation, masonry, carpentry, and finishing, is carried out at the construction site.

Prefabrication: In this construction method, building components and modules are produced off-site in a factory or workshop and then transported to the construction site. Prefabrication can involve walls, floors, roofs, complete modules, or even entire buildings. The advantage of prefabrication is that it can reduce construction time, improve quality, and minimize waste.

Modular Construction: This method utilizes prefabricated modules that are manufactured in a factory and then assembled on-site to form a complete structure. Modular construction is particularly popular for residential buildings, hotels, and student housing. It offers benefits such as speed, cost savings, and flexibility.

Concrete Construction: Concrete construction involves the use of concrete as the primary building material. It can be applied in both traditional ways, using on-site formwork and concrete pouring, or by utilizing prefabricated concrete components. Concrete provides durability, fire resistance, and structural stability.

Timber Frame Construction: In this method, a structure is built using a wooden frame consisting of timber beams and studs that form a framework. Timber frame construction is popular due to its fast construction time, energy efficiency, and the environmental sustainability of wood as a renewable building material.

Green Building: Green building, also known as sustainable building, focuses on minimizing environmental impact during the construction process and throughout the building's lifecycle. It involves the use of sustainable materials, energy-efficient designs, water conservation, recycling of construction waste, and green technologies.

LOGISTICS AND BUILDING METHOD

For the No Footprint House in Rotterdam, the chosen construction method is modular construction. This technique involves manufacturing large portions of the housing in a factory and assembling complete modules on-site, incorporating plumbing, electrical work, and other necessary elements specific to the building. Modular construction goes beyond prefab construction, as it involves assembling complete modules to form a single building.
Modular construction leads to a 50% reduction in CO2 emissions per project and emphasizes smarter, faster, and cleaner construction processes.
In Costa Rica, the construction method involves a steel core for structural stability, with the rest of the building constructed around it using a steel framework and incorporating wood as much as possible. The prefab structure of the house consists of an elevated steel grid measuring 12 by 9 meters, supported by concrete foundations and columns that form a second layer within the sloping exterior walls. The interior features an open living space with a living and dining area, two bathrooms, two bedrooms, and a terrace arranged around the central service core. Additional features such as storage space and bed frames are designed to fit between structural columns.

Construction
The construction of the house in Costa Rica involves the following elements:
Foundation: The foundation consists of prefabricated concrete piers and beams.
Floor: The floor is made of wooden floor panels that are laid around the core of the building.
Construction: The main structural elements of the building are made of steel. This includes the framework for the sloping walls, providing stability, and supporting the roof.

For the construction of the residential building in the Netherlands, the plan is to replicate the same concept as the building in Costa Rica, with a variable-sized central core and modular and demountable construction. This will allow for easy installation and dismantling of the building when needed. Additionally, the aim is to create a concept that can be replicated in other cities, thereby establishing a unique typology.

Regarding the foundation of the modular house in the Netherlands:
Piers: Piers are reinforced concrete columns or blocks used to transfer loads from a structure to the foundation. Piers are typically placed at the corners or strategic points of a building to provide stability and support.
Footplate: A footplate, also known as a base plate or foundation plate, is a flat piece of concrete placed beneath the pier. It serves as an extension of the foundation to create a stable base and evenly distribute the loads to the underlying soil.

In the modular construction using Cross-Laminated Timber (CLT), multiple layers of wooden panels are glued and cross-laminated, usually perpendicular to each other. This creates a strong and stable construction material that can be used for floors, walls, and roofs.

A prefab wooden roof element refers to a pre-manufactured wooden component specifically designed for use in roofs. It is commonly used in the construction industry to accelerate the building process and increase efficiency. Prefab wooden roof elements are typically custom-made in a factory or workshop and then transported to the construction site for installation. They consist of various pre-assembled components such as wooden beams, trusses, panels, and insulation materials.
The concept includes incorporating the central core, louvers, green roof, solar panels, water systems, etc.

Planning
During the construction project, an overall planning is implemented to provide information to all stakeholders. This planning includes the schedule for executing specific tasks and the allotted time for each task. The planning document typically lists the tasks on the left side and the weeks and days on the top.

The planning in Costa Rica and the Netherlands may differ due to weather conditions. Unfavorable weather conditions such as snow or rain occur more frequently in the Netherlands compared to Costa Rica. However, these adverse weather conditions only affect the on-site assembly process, as the prefabrication of the house in the production facility is not impacted by weather conditions.

Costs
The costs of a construction project are calculated through a cost estimation process. This involves determining the required materials and their prices, calculating the labor hours, including the general on-site construction costs (ABK), and considering the costs for subcontractors.

Next, a cost breakdown is performed, which includes insurance costs, general overhead costs (AK), profit and risk (W&R), and finally, the value-added tax (BTW). The costs in the cost breakdown are calculated using percentages.

To make a rough estimate of the overall cost of a construction project in advance, an estimation is made based on the square meters (m2) or cubic meters (m3) of the project. The average cost per cubic meter for a new-build villa is approximately €550/m3, and the square meter price is around €3,300/m2 in the Netherlands. These costs exclude land costs

RS

REQUIREMENT SPECIFICATION

1. Project Description
The project involves the development of a No Footprint House. The original concept, which was designed for the climate and culture of Costa Rica, will be adapted for implementation in Rotterdam, the Netherlands. The existing residential building will be acquired and transformed according to the specifications outlined in this RS, taking into account the climate, culture and requirements of the Netherlands.

2. Scope
The building will be transformed while preserving the core concept and the 3x3m grid pattern. The design should include multiple residential levels and utilize local materials. The residential building will be designed and installed in a modular fashion.

3. Functional Requirements
The complex should include two bedrooms and an outdoor space must be integrated. The complex should have a smart home system for automated functions and energy efficiency.

4. Technical Requirements
The design should utilize local materials to promote sustainability and minimize environmental impact. A graywater system should be implemented for efficient water usage.

5. Performance Criteria
The design must comply with building and safety regulations. The smart home system should enhance the building's energy efficiency. The graywater system should facilitate water reuse and conservation.

6. User Requirements
The smart home system should provide peace of mind for the residents. The louvers in the building should be preserved and adjustable for sun shading and privacy.

7. Data Management
A sufficient area in square meters should be allocated to various functions:

Kitchen	10 m2
Bathroom	10 m2
Bedroom 1	18 m2
Bedroom 2	12 m2
Living room	24 m2
Dining room	10 m2
Office	9 m2

8. Target Audience
The aim of our research is to create a living environment that is flexible and capable of meeting the needs of different types of people. We understand that traditional households are evolving, and there is an increasing diversity in household compositions. Therefore, we want to develop a residential building that accommodates various combinations of residents, such as families, couples, friends, or even pets.

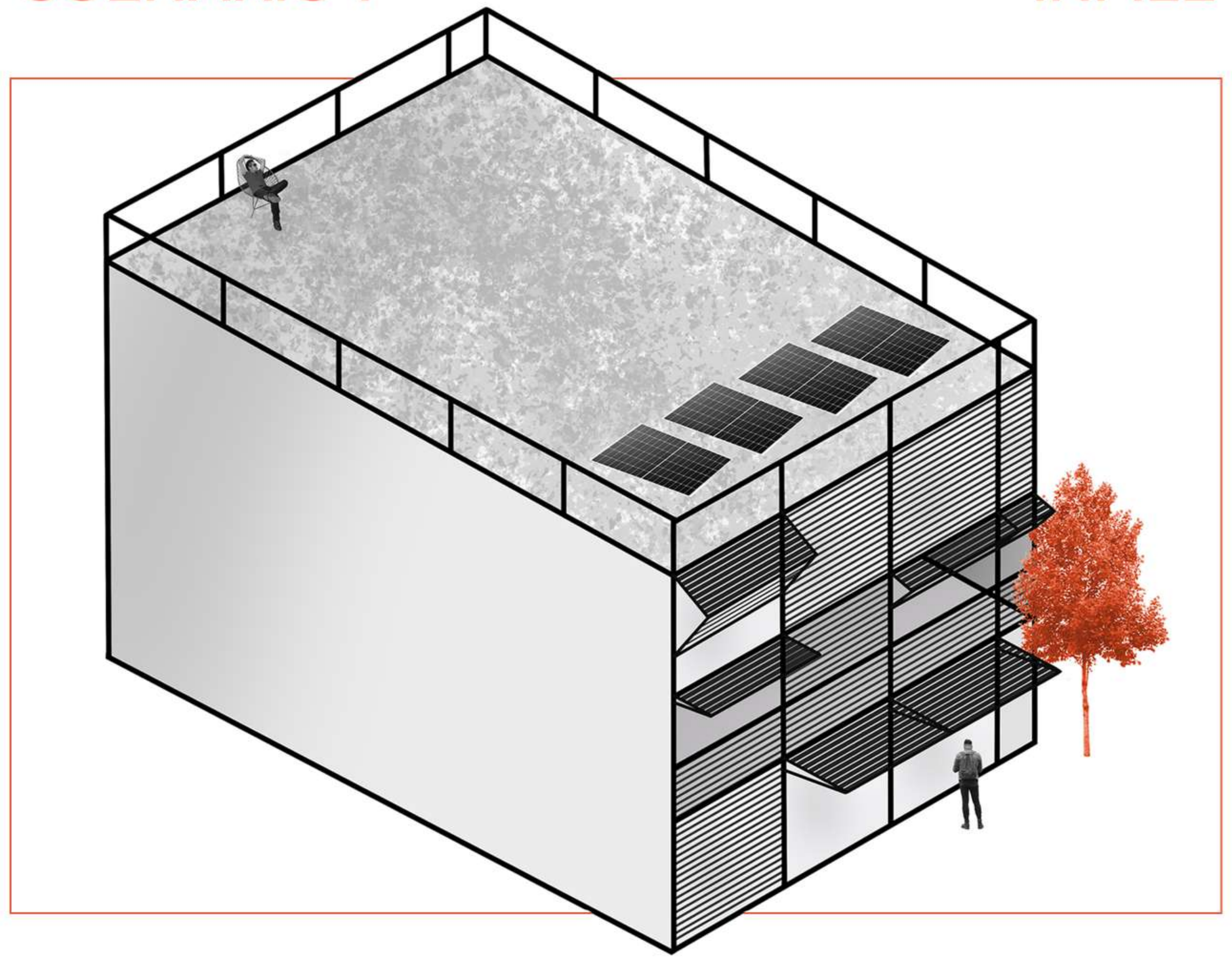
friends couples with child couples

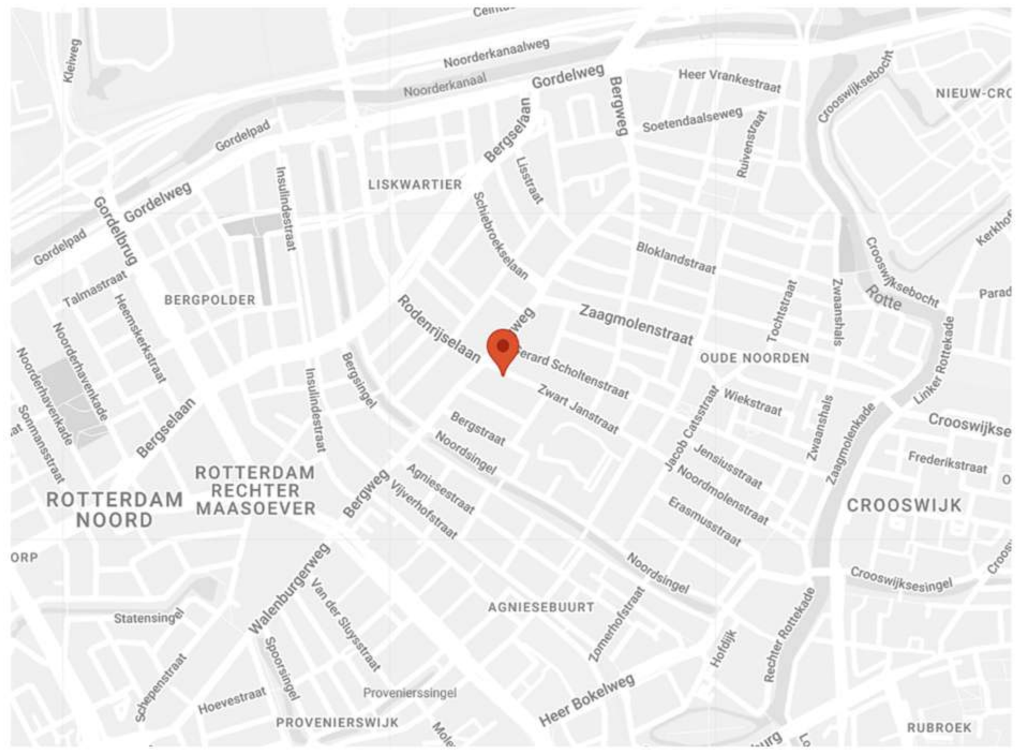
Through careful design, we strive to create homes that are suitable for diverse lifestyles. Each dwelling in the building will provide sufficient space and privacy, with attention to comfort and functionality. We want to ensure that residents can enjoy their own personal space while also benefiting from shared amenities that promote interaction and the social aspect of cohabitation.

9. Testing and Acceptance Criteria
The residential building must fulfill the required functionalities and technical specifications as described in this RS.

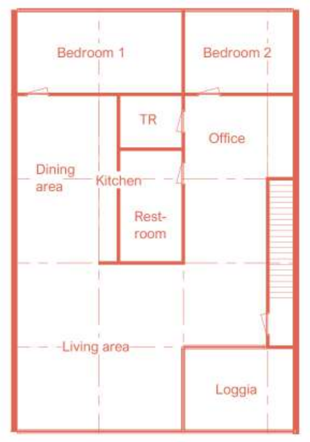
SCENARIOS

SCENARIO 1 INFILL

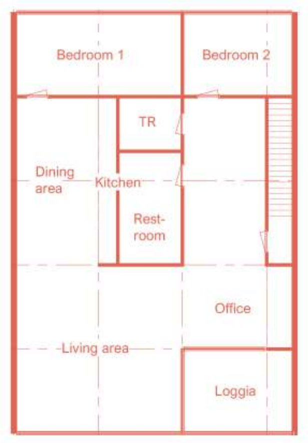




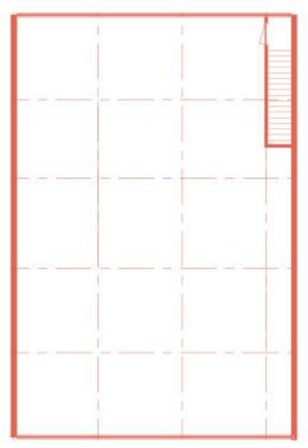
ground floor



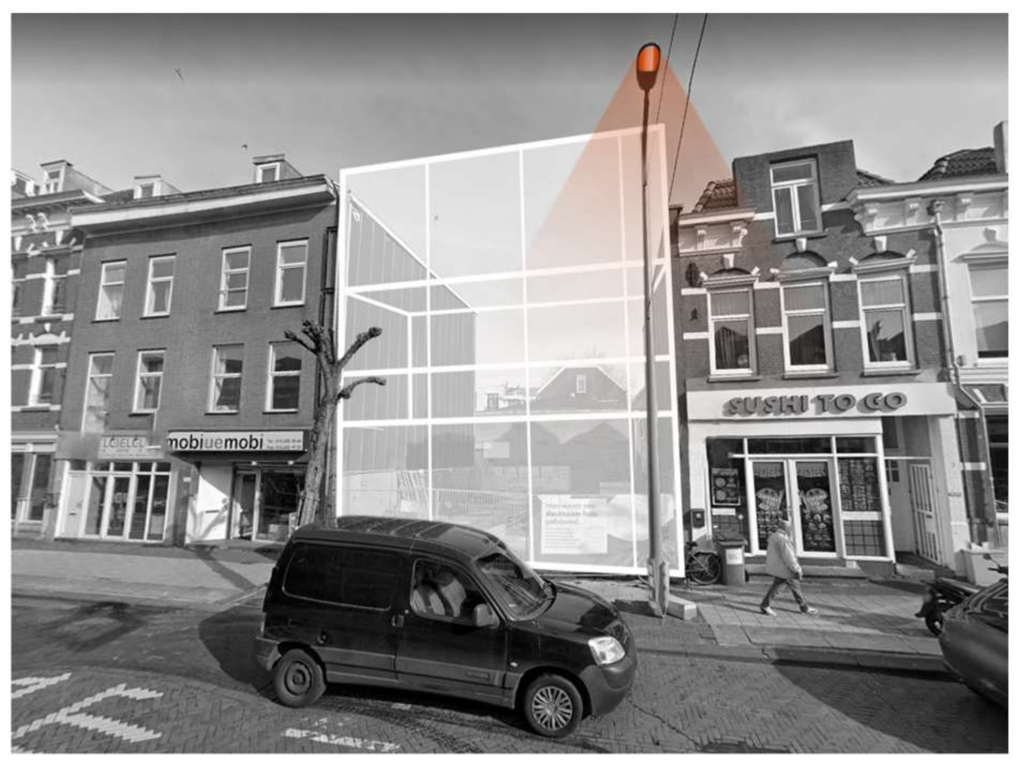
first floor



second floor



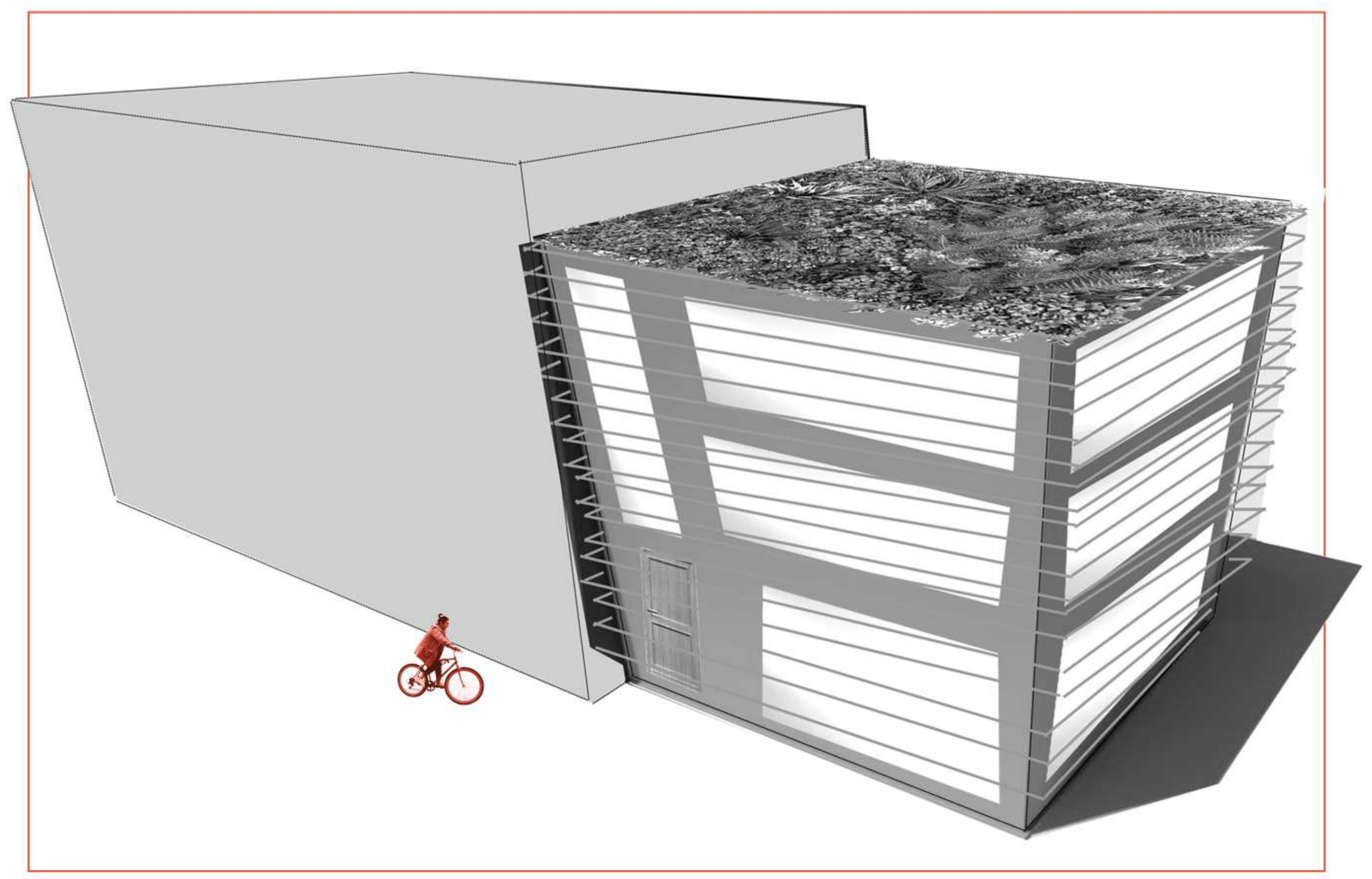
roof

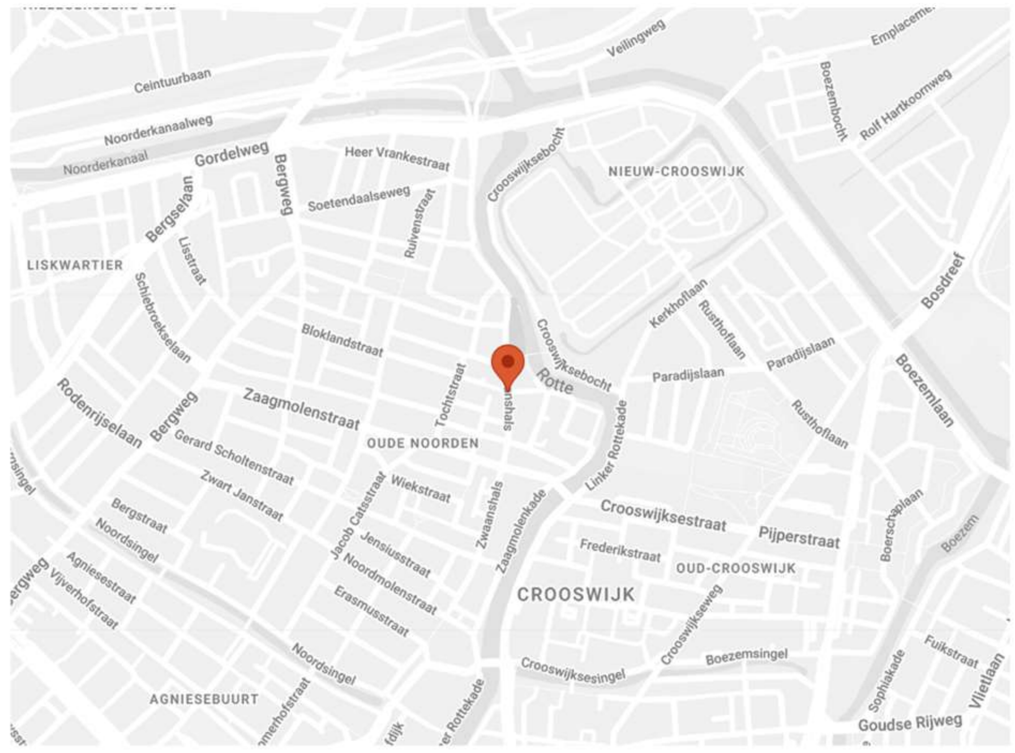


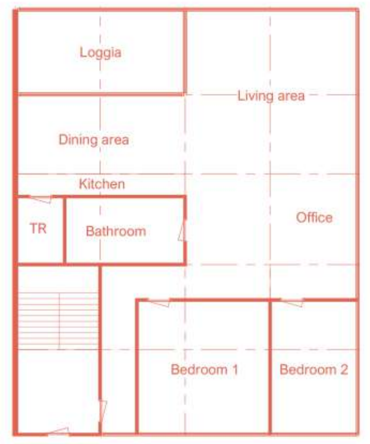
Zwarte Janstraat, Rotterdam Noord
As our first scenario, we are considering transforming the original No Footprint House into a typology that is suitable for infill. We would like to redesign the original concept into a modular multilevel system that integrates well with the Dutch climate and urban culture. By developing this typology, we hope to create a concept that is applicable to various locations, but for now, our specific focus will be on the Zwarte Janstraat.

In this area, we plan to construct a three-level building based on a 3 by 3 grid system. The ground floor will have a different function compared to the rest of the street. The apartments located above the ground floor will each have an outdoor space, and the rooftop will accommodate multiple solar panels.

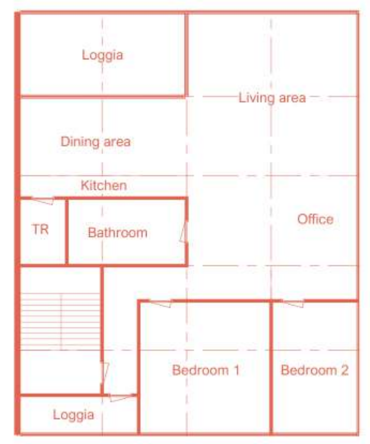
SCENARIO 2 EXPANSION



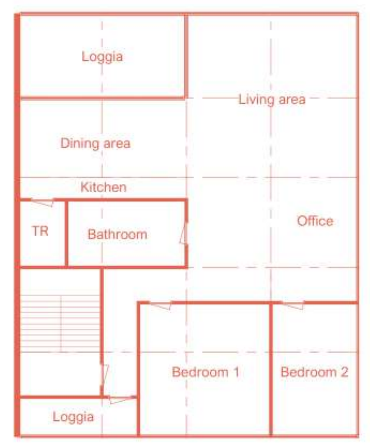




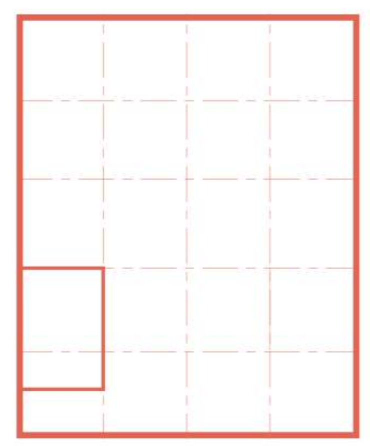
ground floor



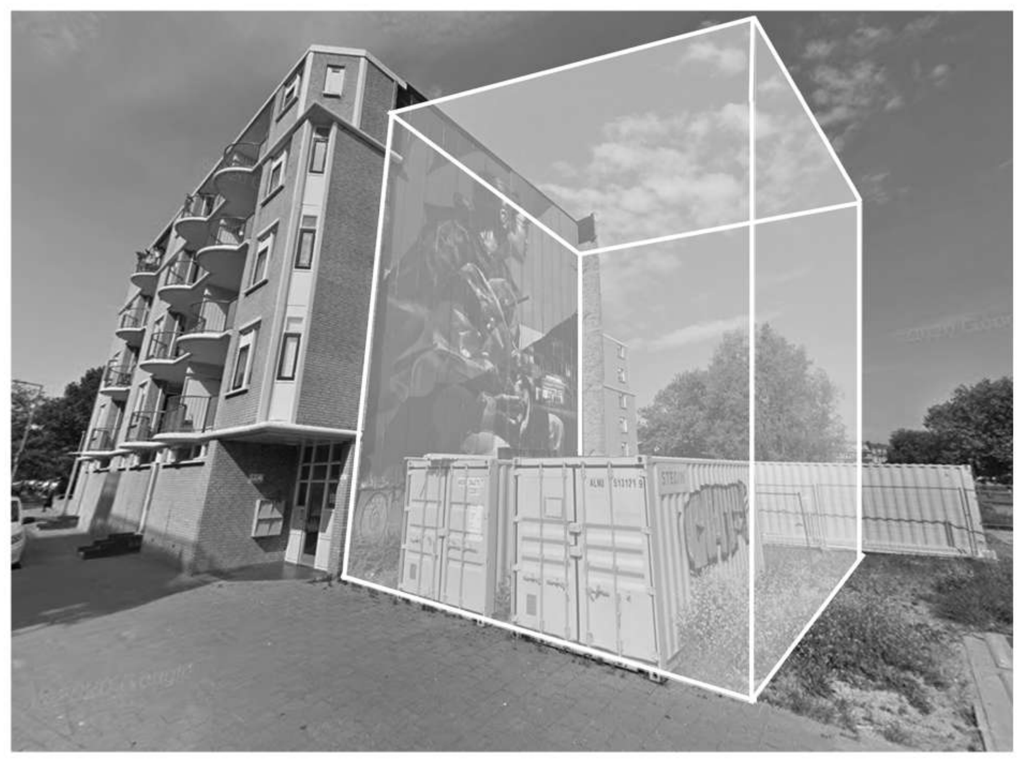
first floor



second floor



roof



Zwaanshals, Rotterdam Noord
As our second scenario, we are considering transforming the original No Footprint House into a typology that is suitable for expansion. This can be achieved by either enlarging an existing building or attaching it to another existing building. By focusing on this typology, we aim to assist the city in densification. For this scenario, we will specifically examine Zwaanhals.

Similar to the first scenario, this option will also involve multiple levels and will be built on a 3 by 3 grid system. However, in this case, the ground floor will also be an apartment. Another distinction is the size and floor plans, which will be different from the previous scenario.

ANALYSIS

SCENARIO 1

For our adaptation of the NFH, we have been given a lot of freedom in choosing the location, as long as the building is in Rotterdam. In our first scenario, we have looked at the possibility of infill development, an interesting solution for densification.

Infill development is being increasingly applied and is also encouraged by Rotterdam's vision. This is supported by the initiative "Small but Fine" by the Municipality of Rotterdam, which actively promotes infill development.

At the location of Reformhuis W. van Mastrigt, located on Zwart Janstraat, we see opportunities to apply this concept and contribute to the densification and strengthening of the urban environment in Rotterdam.

The design of the building adheres to a 3x3 grid and the essential core of the NFH concept. This structure forms the basis for the layout of the building. The grid allows for a flexible and adaptable spatial layout, with the core acting as a stable and central element. This enables the spaces around the core to be efficiently and versatilely adjusted to different needs. By adhering to this grid structure, the strength of the NFH concept is utilized, creating a building that is both functional and adaptive.

SCENARIO 2

The second scenario will explore the possibility of expansion, another interesting solution for densification.

In the second scenario, we will examine how the building can be expanded on the side. This approach offers an interesting solution for densification, where additional space is created by either enlarging the existing building or attaching a new building to it. By expanding on the side, the building can either gain more functional space and better meet the needs of the users or create an entirely new living space.

In this process, architectural and structural aspects are taken into account to achieve seamless integration of the expansion with the existing building while preserving its aesthetics and characteristics. The goal is to improve livability and functionality while maintaining the existing aesthetics and characteristics of the building.

At the location of Zwaanhals in Rotterdam, there is an opportunity to apply this concept.

By retaining the layout from the first scenario, a recognizable and consistent structure is maintained within the building while allowing for flexibility and adjustments to accommodate the users' needs.

COMPARISON

1. Urban integration
Scenario 1: In infill development, the integration of the NFH building into the existing environment of Reformhuis W. van Mastrigt in Rotterdam is considered.
Scenario 2: In expansion, the seamless integration of the side expansion with the existing building while preserving aesthetics and characteristics is examined.

2. Sustainability
Scenario 1: Sustainable design principles can be applied in infill development of the NFH building, such as energy efficiency and green spaces.
Scenario 2: The expansion can incorporate sustainable elements, such as energy-efficient systems and water management.

3. Functionality
Scenario 1: The grid structure and flexible spatial layout around the core allow for efficient use of space based on different needs.
Scenario 2: Through expansion on the side, the building can gain more functional space and better meet the users' needs.

4. Accessibility
Scenario 1: In infill development, accessibility considerations can include providing good accessibility and amenities for different user groups.
Scenario 2: The expansion can address accessibility aspects, such as creating step-free access and ensuring good connections to public transportation.

5. Aesthetics
Scenario 1: Retaining the grid structure and core of the NFH concept can result in a recognizable and consistent appearance of the building.
Scenario 2: The expansion aims for seamless architectural integration while preserving the existing aesthetics and characteristics.

6. Social value
Scenario 1: Infill development can contribute to social interaction and community building by creating communal spaces and amenities.
Scenario 2: The expansion can offer opportunities for new community spaces and amenities that benefit both residents and the surroundings.

7. Economic feasibility
Scenario 1: The costs and returns of infill development must be proportionate and enable a sustainable operation.
Scenario 2: The economic feasibility of the expansion needs to be assessed in terms of costs and expected returns.

OUR CHOICE

After comparing scenario 1, where the NFH building is infilled at the Reformhuis W. van Mastrigt location, with scenario 2, which considers expansion, **scenario 1** is found to be preferable.

Infill development aligns well with Rotterdam's vision and offers advantages in terms of urban integration, functionality, aesthetics, and social value. The grid structure and flexible spatial layout of the NFH concept enable efficient use of space while preserving the existing environment and characteristics. Additionally, sustainability principles can be applied, and there is room for communal spaces and amenities that foster social interaction and community building.

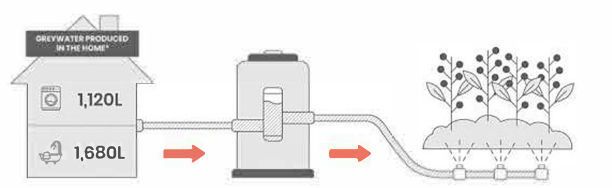
NFH ROTTERDAM

SUSTAINABLE APPLICATIONS

Smart technologies
Smart technologies can be applied in an urban house to achieve a minimal ecological footprint. Some examples include smart energy monitoring systems, smart thermostats, smart lighting systems, smart appliances, smart water monitoring systems, and solar systems with energy storage. These technologies help optimize energy consumption, reduce water usage, and promote sustainability. By integrating these smart technologies, an urban house can strive for a more efficient and environmentally friendly lifestyle.

Ventilation system: balanced ventilation - system D
This system extracts heat from the outgoing air and uses it to warm up the fresh incoming air. This saves energy and increases comfort in the house, resulting in a positive effect on energy efficiency.

Greywater system
A greywater system utilizes recycled household water streams, such as water from sinks, showers, and washing machines. This water is collected, treated, and reused for non-potable purposes such as toilet flushing, garden irrigation, and driveway cleaning. The greywater system can be connected to a storage tank where the recycled water is stored for use when needed.



Solar panels combined with an electric boiler
Solar panels generate electricity from sunlight. This electricity can be used to heat a boiler. A solar boiler utilizes solar energy to heat water for household use, such as showering, dishwashing, and laundry. The water is heated by the solar heat captured by the solar panels, reducing the need for other energy sources like gas or electricity.

In addition to energy consumption, we also consider the energy yield of the solar panels. The amount of electricity the panels generate depends on various factors:
1. The wattage of your solar panels
2. The orientation of your roof
3. Shading on your roof
4. Available space on your roof

To estimate the number of panels needed for optimal utilization of your solar panels, we use panels with a power output of 400 watts peak and consider the average energy consumption of Dutch households. For a household of 3 people: 3500 kWh corresponds to approximately 12 panels.

By utilizing both solar panels with a boiler and a greywater system, you can make optimal use of sustainable energy and water-saving measures in your home. This can lead to lower energy costs, reduced water usage, and a decreased ecological impact. However, it is important to have qualified professionals handle the installation and maintenance of these systems to ensure they operate safely and efficiently.

Green roof
A green roof, also known as a sedum roof or vegetated roof, is a roof covered with living plants and vegetation. It offers various benefits such as insulation, rainwater retention, and reduction of ambient temperature.

Triple glazing
Triple glazing provides improved thermal insulation and sound insulation compared to HR++ glazing. It reduces heat loss, lowers energy costs, and creates a more comfortable indoor environment. It is a sustainable choice that contributes to reducing CO_2 emissions and energy consumption. Although triple glazing is more expensive and thicker, it can be particularly suitable for buildings where optimal insulation and soundproofing are nece

LOGISTICS

1. Accessibility of the construction site is important
2. Transportation using electric vehicles
3. Minimization of transportation to and from the construction site.
4. Joint transportation of construction materials to the construction site.
5. Exploring possibilities for water transport if the location is near water, and assessing its sustainability.
6. Utilization of a construction hub when necessary, especially when building in the city center.
7. Just-in-Time deliveries.
8. Minimization of crane usage and utilization of an electric mobile crane such as the SK487-AT3 eDrive City boy.

The accessibility of our chosen locations in Rotterdam is similar because the streets are narrow and located in the city center. Electric trucks are used to deliver materials and elements. Through the use of a hub, multiple transports can be consolidated, minimizing transportation movements within the city. The lifting operations should be performed using electric cranes such as the SK487-AT3 eDrive City boy. The logistical difference between Costa Rica and the Netherlands is that transportation distances are much larger in Costa Rica, and the transportation vehicles there all run on fossil fuels.

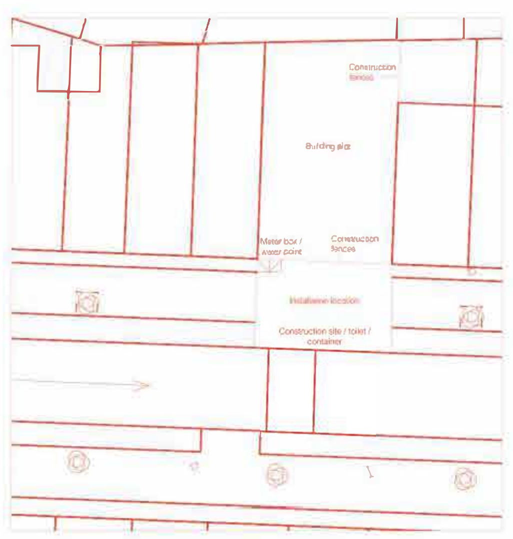
Access and transport routes
The access and transport routes will be via the A20 Rotterdam, leading to the construction site through the Gordelweg and Rodenrijselaan to reach Zwart Janstraat.

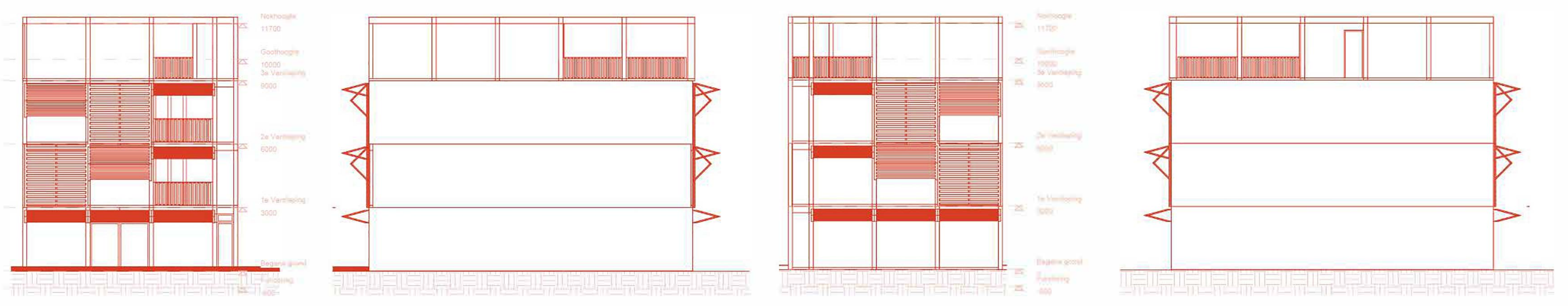
Transport
Transport will be conducted using electric vehicles from the workshop/factory where the modules are prefabricated and ready for transport. These modules will be produced as close as possible to the construction site and transported with minimal distance. All transportation will be bundled as much as possible to minimize transportation. On-site, an electric crane will be available to lift the modules to their designated locations.

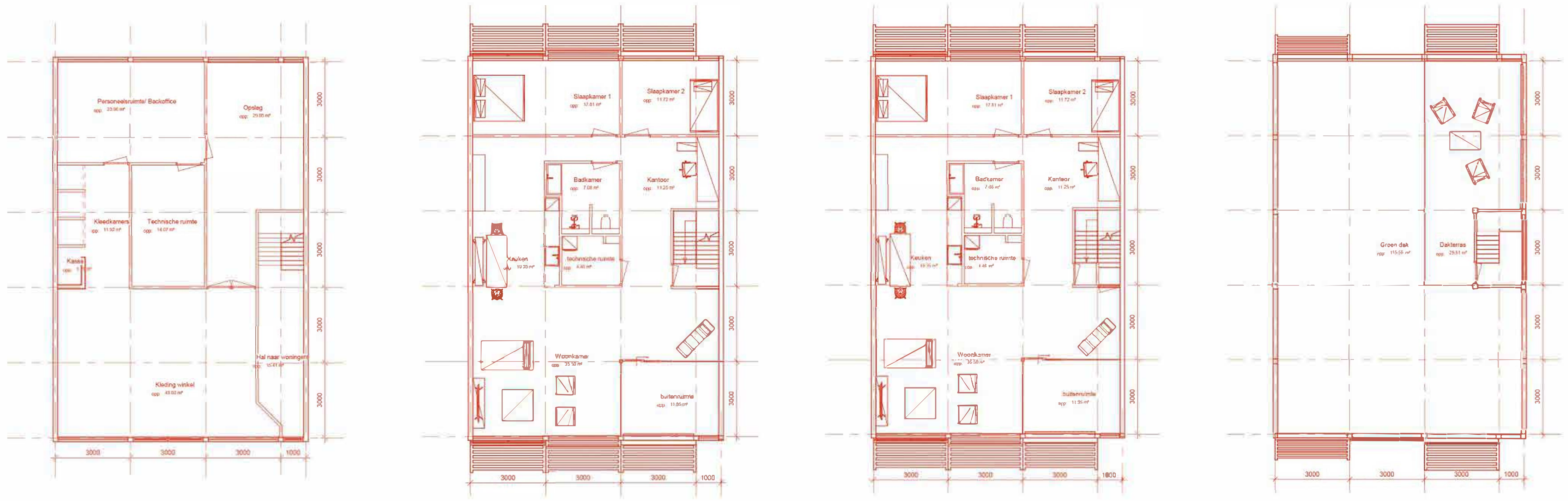
Consolidation
If construction occurs during a busy period, and there is limited space for workers and carpenters to park, for example, creating a meeting point just outside the city could be an option, allowing for collective transportation to the construction site. Further deliveries of materials from different suppliers will be picked up using one truck to ensure that everything arrives on-site in one trip. Deliveries will be made just in time.

Construction hubs and construction site
Construction hubs will not be necessary as the modules arrive prefabricated at the construction site. The construction site will not be heavily furnished as there is little need due to prefabrication. The construction site will be enclosed with construction fences, and there will be a construction trailer for the workers on-site, as well as possibly a container for storage of tools and materials. Construction waste will be separated on-site.

Safety
In terms of safety, it should be better than the conditions in Costa Rica. Everyone entering the construction site will be required to wear their personal protective equipment (PPE). The construction site will be off-limits to unauthorized personnel, and workers will need to report to the construction trailer. Additionally, the construction site will have designated walkways for safety purposes.







ground floor | first floor | second floor | roof

EXPLANATION OF THE MODULAR CONCEPT

The foundation of the concept
When establishing the foundation of our concept, we have retained several elements from the original concept in Costa Rica that form the basis of our design. The retained elements include the 3 x 3 grid, the central core housing all wet areas, sustainability measures, and prefab components. Additionally, we have added several core values to adapt the concept to the urban context of Rotterdam city.

To achieve this, we have applied a typology where the design is placed in open spaces within streets between existing buildings. This way, the design serves as an intervention for spaces that currently have no function. Furthermore, a green roof has been incorporated into the building design. This addition holds significant value in urban areas like Rotterdam, where heat stress is a concern. By introducing ample greenery, we can mitigate this issue. Moreover, cities often lack the capacity to store rainwater due to the prevalence of materials such as stone and steel that do not absorb it. By implementing green roofs, we can capture and even reuse rainwater.

What makes the concept modular
The design is a construction that is built using prefabricated modules or building components that are manufactured off-site and then assembled on the construction site. These modules are standardized and can be produced in a factory environment, enabling a more efficient and faster construction process.
The modular design offers flexibility and adaptability as the modules can be combined and reconfigured to create different structures and layouts. This allows for quick and easy construction, expansion, or modification of buildings, depending on the users' needs.

MATERIALISATION

CLT 1.
CLT stands for Cross Laminated Timber, which is a solid and strong type of wood. This is a different construction technique compared to timber frame construction and is a newer and more sustainable approach within the building industry. One requirement of the design is that the wood used for these walls, columns, and floors must come from the Benelux region, as it is more sustainable than wood sourced from distant countries. Longer distances result in higher CO_2 emissions.

Triple glazing 3.
High-efficiency triple glazing offers superior thermal insulation, reducing heat loss and energy consumption. It enhances indoor comfort by minimizing drafts and cold spots while providing excellent sound insulation. With its increased energy efficiency, it helps lower heating and cooling costs, making it an environmentally friendly and

Flax 5.
Flax is made from the remnants of the linen fabric, which in turn is derived from the flax plant. No chemical substances or artificial fertilizers are used during the cultivation of these plants, making the material truly natural. When the flax plant is used for linen production, certain fibers remain. These fibers are utilized to manufacture insulation material. Even during the processing of flax into insulation material,

Green roof 2.
This layer consists of a drainage layer, a water retention layer, and a substrate layer where the plants grow. On the roof, plants such as succulents, sedum plants, moss, and/or grass are grown, which is highly sustainable and provides cooling in the summer. The plants help to cool the photovoltaic (PV) panels that are installed on the roof, resulting in higher efficiency during the summer. Additionally, an extensive green roof is low-maintenance and requires minimal upkeep.

Concrete 4.
Concrete foundations are unparalleled in their strength and durability. They provide a stable and solid base for structures, ensuring long-term stability and withstanding heavy loads. Their ability to resist moisture and pests, coupled with their fire

CONSTRUCTION

The construction of our building is designed to be simple and adaptable. The load-bearing elements consist of the partition walls working in conjunction with the load-bearing columns and beams, all made of CLT (Cross-Laminated Timber). The stability is achieved through three core stability walls located in the core area as well as the staircase, which are also made of CLT, just like the rest of the structure.

This combination of walls and columns is not commonly seen in residential construction. We made a deliberate choice to utilize this system because it allows for flexibility in adjusting the width of the building without requiring a change in the structural principle.

Wall construction

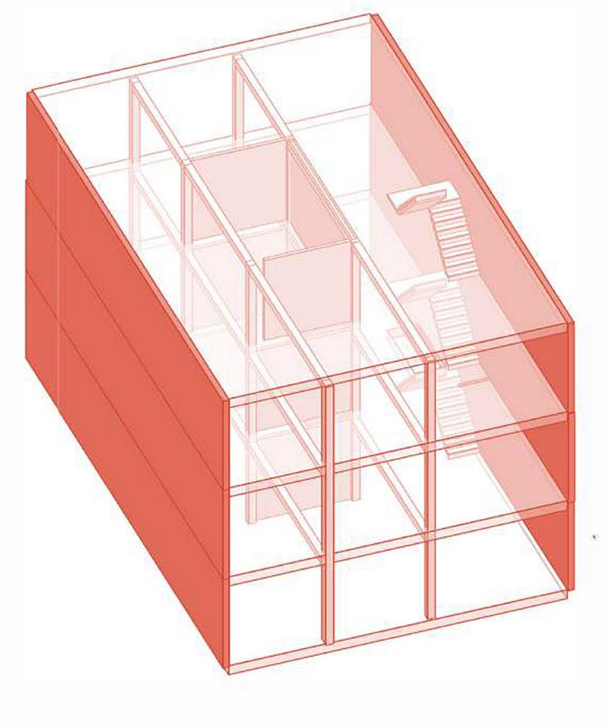
Interior finishing	10 mm
CLT inner panel	100 mm
Vapor barrier	
Flax insulation	140 mm
Wooden panel material	10 mm
Horizontal mounting battens	20 mm
Oak wood paneling	20 mm
Louvers	

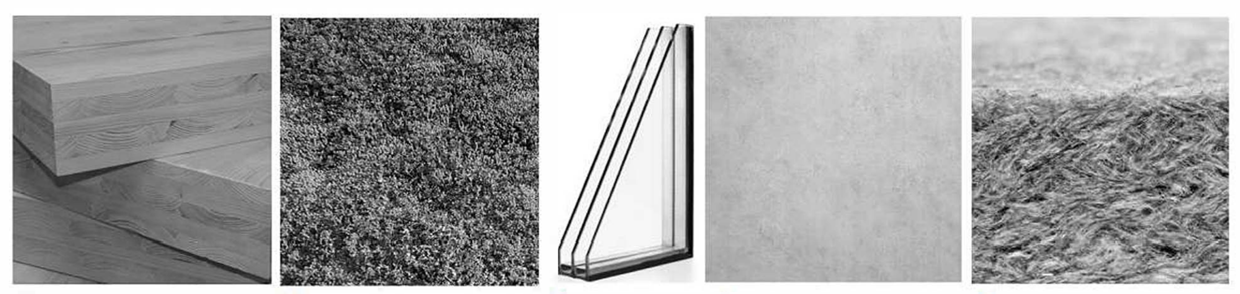
Roof construction

Wooden beam construction	150 mm
Underlayment roof sheathing	18 mm
Flax insulation material	160 mm
Roofing	2 mm
Drainage layer	20 mm
Filter fabric	
Substrate layer	50 mm
Sedum vegetation	
Solar panel	

Floor construction

Insulation of CLT floor	190 mm
CLT floor	180 mm
Cement screed	70 mm
Floor finishing	10 mm





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