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Conversion of abandoned industrial buildings into productive purposes without negative impacts on the environment - Treska factory, Skopje

Vladimir Arsovski b.sc.civ.eng, prof. d-r. Vangel Dunovski
[1](*Architecture student, MIT University, North Macedonia)*
[2](*Dean of the Faculty, MIT University, North Macedonia)*

ABSTRACT: *Architecture as a living matter changed depending on the location and time for the needs of human and his development and adaptation, undergoes drastic changes. Due to the human awareness of the progress of humanity, the Industry appears in response to the hitherto expensive and slow processes for the production of goods that were the main mover of the socio-economic status of a nation - society. The word industry means a form of production of goods by machine processing of raw materials and mass production. The benefits of the emergence of industry led to global changes in socio-economic status, initially in European and North American countries where the Industrial Revolution began, with the transformation of the then feudal economies.*

Due to the awareness of the negative impacts of industrial buildings in urban areas and their abandonment, while creating landscapes in decay. The need for their conversion and proper integration in space is necessary. A world trend where neglected parts of the city, occupied by decaying buildings grow into cultural - social places.

KEYWORDS *- Awareness, Conversion, Industry, Society, Space.*

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I. INTRODUCTION

The urban revolution identifies a long historical change, from the agricultural to the industrial to the urban modern world, but also captures the change in the inner territorial formation of the city, from the original political city to the industrial, to the present day, a harbinger of a certain globalization of urban life.

Architecture over time is subject to changes resulting from the influences of various events in history. From the complex sequence of classical buildings to the simple use of vertical and horizontal lines, the art of design has sparked revolutionary changes in an attempt to respond to the social and technological development of mankind. One of these revolutions led to a complete redesign of how architecture behaves in space, the Industrial Revolution.

Subject of research

The subject of the research covers the urban transformation of abandoned industrial complexes situated in the downtown area. Which, as polluters and pests of the environment turn into a positive movement of socio-economic and economic growth and development of the population with positive impacts on the environment.

Purpose of the research

The aim of the research is the revitalization of these industrial complexes that would enable the creation of a new urban transformation of the abandoned parts of the city, a new representation of the existing entities and their integration into the architectural landscape, while creating new city sights.

Research methodology

Reinterpretation of existing sites, transformation of abandoned industrial complexes, while revealing the reasons that led to such degradation of a space through the Case Study method.

A case study is a research methodology that explores contemporary phenomena in a real-life context, and especially in cases where the boundaries between the research question and the context cannot be clearly defined. The case study provides more depth, in terms of the breadth of the research. Allows enrichment of the theory, but not confirmation (testing) of it.

Expected results

To find a solution to the problems that arise from such locations, without disturbing their industrial culture, as well as to pay attention to their environment and the history they convey.

II. Conversion of industrial buildings

The increase of the population and the expansion of the city, marks the spatial organization of the abandoned industry in the city, as abandoned and closed spaces for the public. Industrial architecture has a significant role in creating new memorabilia - forms of space identification.

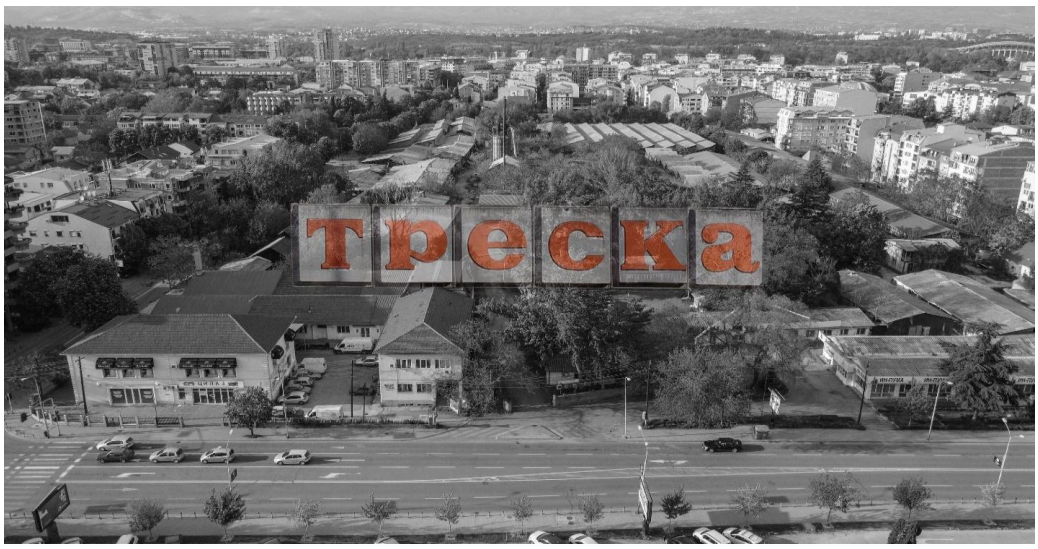
The conversion of industrial buildings into urban areas is the most significant environmental innovation developed in the last decade - an innovation used by countries in response to surreal spatial-urban policies that actually encourage people to leave polluted and overcrowded areas. The conversion of abandoned industrial buildings into productive ones without negative environmental impacts not only has social benefits, but also economic ones. By encouraging commercial activities to be located on the old industrial sites in the cities, the conversion of abandoned industrial buildings influences the factor that contributes to the reduction of population density and contributes to the appearance of open space and architectural landscape.

III. Case study, factory "TRESKA"

3.1. Factory " Treska "

The joint stock company "Treska" was founded in 1924 and is located next to the former railway line Skopje - Kosovska Mitrovica near the central city area. The company "TRESKA MEBEL" from Skopje was established as a production and processing capacity - sawmill. It has been operating as an organization with expanded capacities and activities since September 1946, which was established by a decision of the Government of the Republic of Macedonia. From 1946 until today, the company is going through several stages of status changes. From 1960-1965 it begins to develop with greater cooperative cooperation with similar companies in the wood industry in R. Macedonia. From 1965-1969. This cooperation shows high results, in which period there are initiatives for integration into larger working organizations. In 1973. In accordance with the legal regulations, "Treska mebel" is organized as a joint wood industry and forestry with 17 working organizations, which also includes "Treska", which has a leading position. With the entry into force of the Law on Enterprises in 1989. the complex organization "Treska" is disintegrating, and the working organizations, ie the basic organizations of its composition are transformed into separate enterprises.

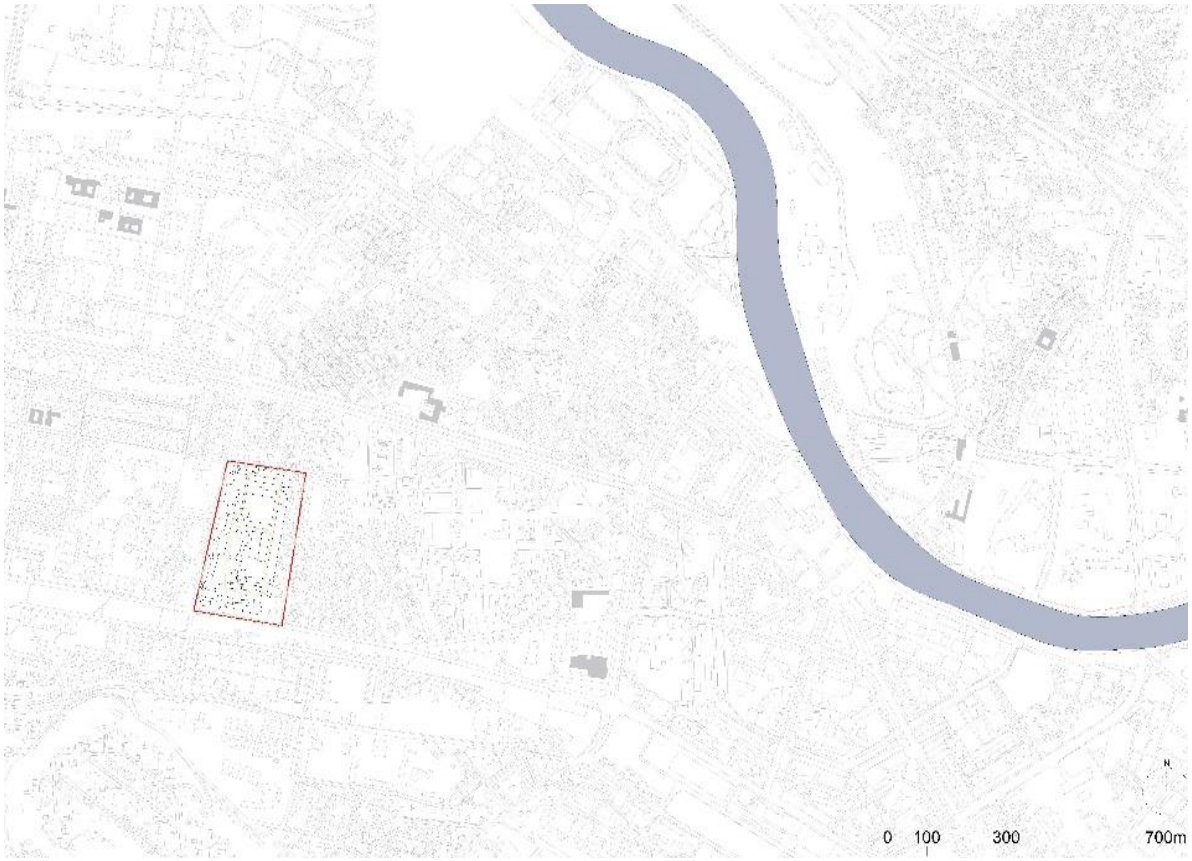
The main processing and production facilities of the company located in Skopje between the streets "Teodosij Gologanov Blvd.", "Franklin Roosevelt" and "Vladimir Polezanovski", were mainly built after the Second World War, ie after 1950. Residential and other buildings built on the site exist along Franklin Roosevelt and Vladimir Polezanoski Streets. The existing location is practically in the center of the city and covers an area of 66,500 m2, of which 53% is land under the building, and has imposed the need for dislocation in whole or in certain parts. The company received a location for dislocation in the western industrial zone of the city with an area of 48 ha. After several attempts for dislocation and lack of funds, "Treska Mebel" remains in an unchanged location. This excludes any expansion of capacity, except in the field of quality, and a series of smaller investments at the existing location. Today, the facilities at this location are used by certain companies as warehouses, but left as such are slowly becoming construction waste.



Picture 1, TRESKA factory complex.

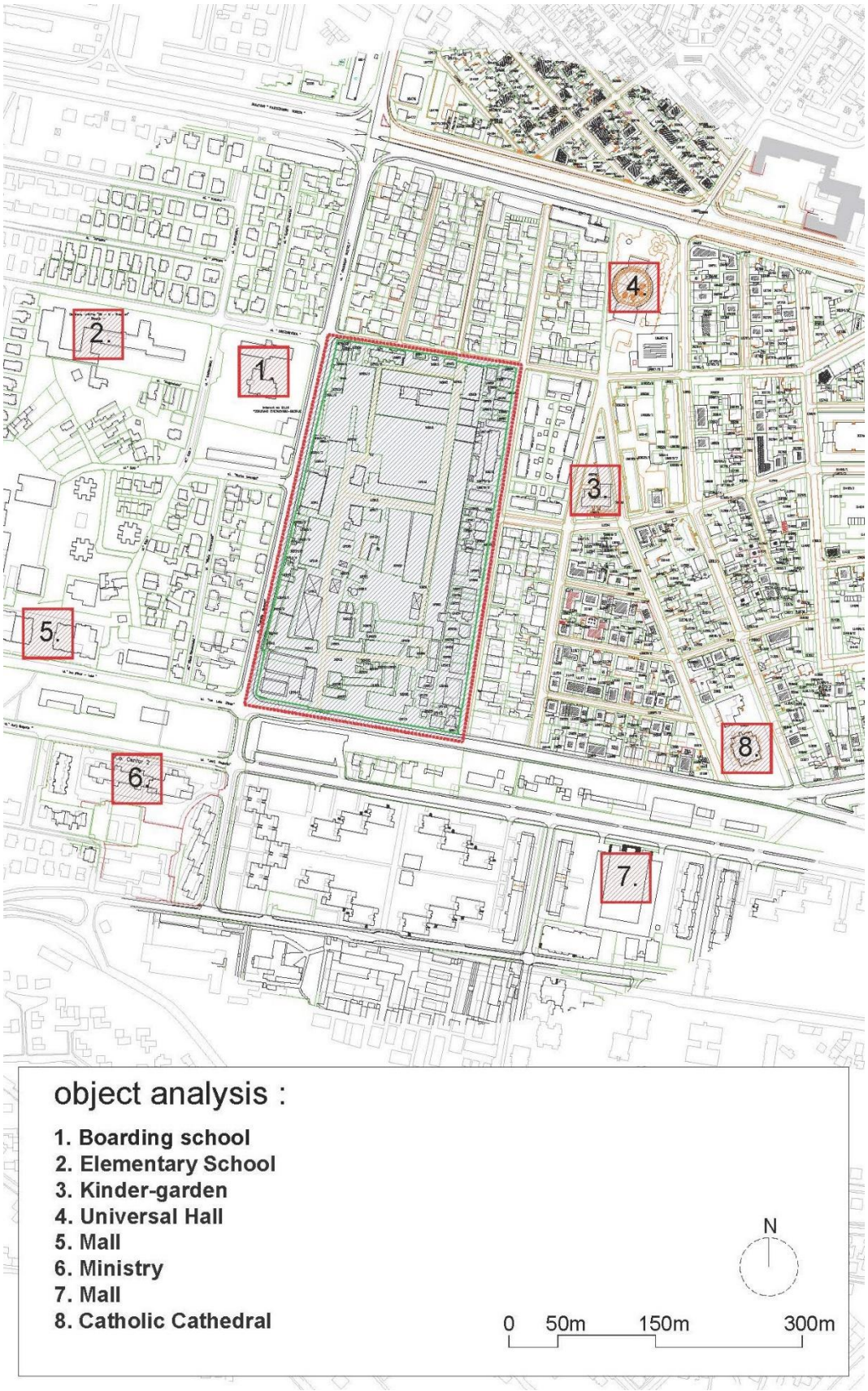
3.2. Analysis of the location (block) in space (city of Skopje)

Through the analysis of the location in the area, actualy the wider area or the city of Skopje, the shortcomings that this location will try to compensate in terms of spatial organization and evaluation of the planned contents and facilities will be identified.



Picture 2, city map


land purpose classes :
residental
residental and comercial
comercial and business
education and science
public institutions
greenery
N
0
50m
150m
300m


1.
2.
3.
4.
5.
6.
7.
8.
object analysis :
1. Boarding school
2. Elementary School
3. Kinder-garden
4. Universal Hall
5. Mall
6. Ministry
7. Mall
8. Catholic Cathedral
N
0 50m 150m 300m

3.3. Isolation - existing condition

The selected location that is subject to analysis and development is defined on three sides with the streets: Blvd. Theodosius Gologanov, Franklin Roosevelt Street and Vladimir Polezanoski and from the east side along the location it is branched with residential buildings. They are newly built residential buildings, apartment buildings. Because these are facilities that meet the basic needs for quality of life, they are excluded from the intervention in question by forming a new block with regulatory lines. The surroundings of the subject location consist of zones with different purposes:

- zone of buildings with residential purpose (residential houses)
- zone of buildings with business and commercial purpose

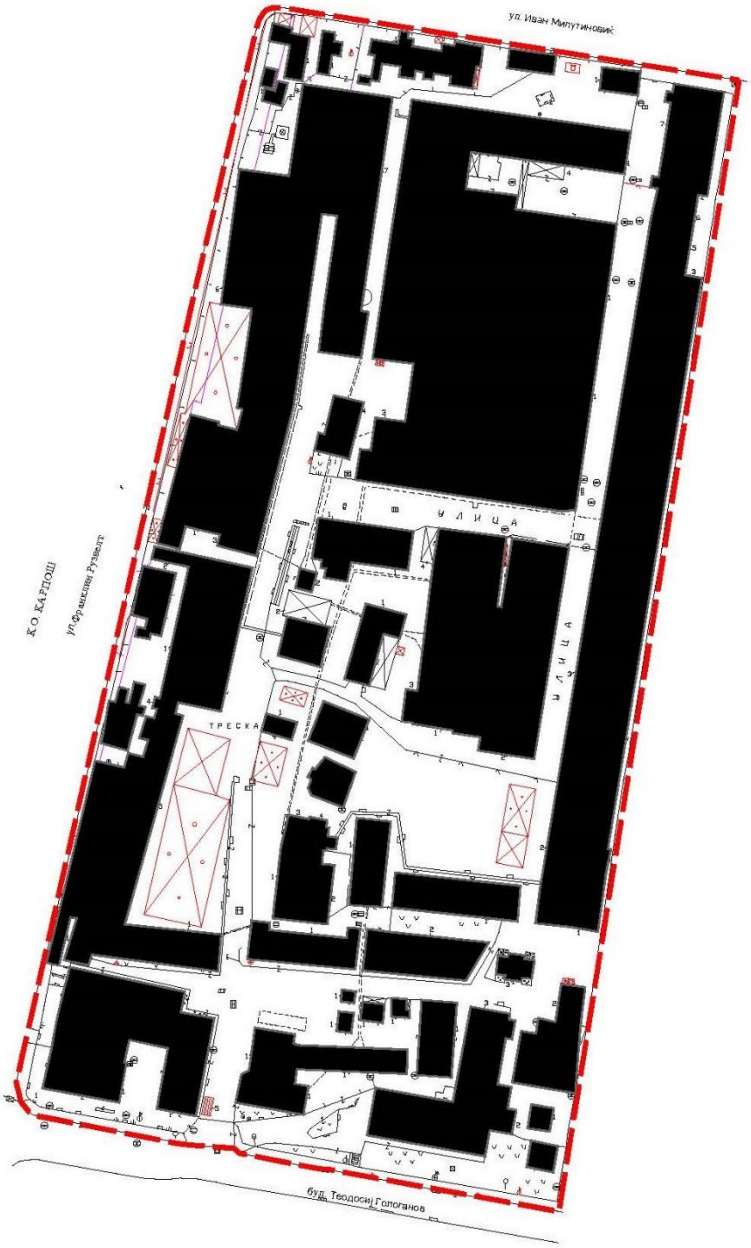
The objects at the subject location are in poor condition and in a state of decay. An impressive object on the site is the sawdust silo with all its infrastructure that extends to the location. A metal cone that dominates in height and is visually impressive on the site. The infrastructure is composed of overhead line facilities that aim to conduct sawdust in silo from the facilities on the site that during the wood processing process create the same, the transmission is enabled by vacuum technology, which contributes to the unique and recognizable appearance of the silo.

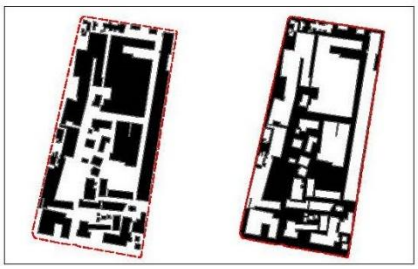
Picture 3, Silos for sawdust, Treska factory complex.

Picture 4, Silos for sawdust, Treska factory complex.

Regarding the traffic network - on the south side there is a city street, Blvd. Teodosij Gologanov with access to the location. On the west side is located st. Franklin Roosevelt, which has a narrow sidewalk along the street and it is non-functional, the same is repeated on st. Vladimir Polezanoski from the north side. There is no pedestrian traffic around the site.
The greenery is present on the location but it is wild and leaves the impression of a messy space.

Picture 5, Linear infrastructure overgrown with greenery, Treska factory complex.





percentage of construction in the block
area of design scope = 66 488,3 m²
l.u.b. = 35 670,48 m² (53.6%)
u.l. = 30 817,82 m² (46.4%)

N

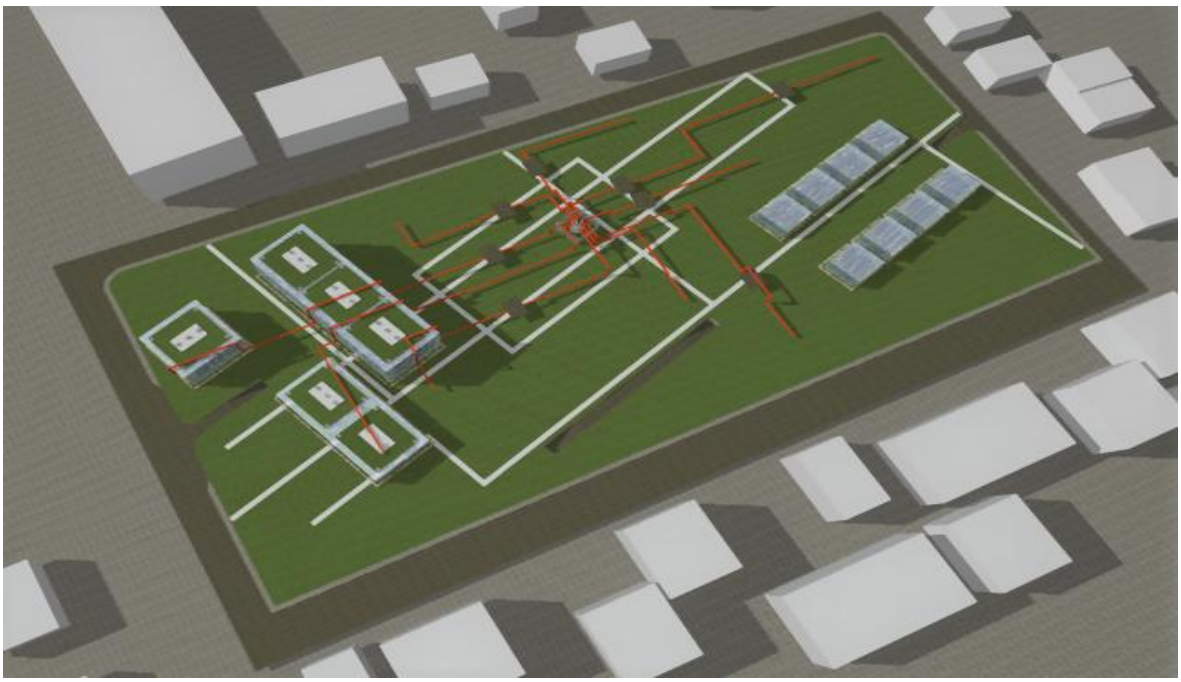
0 10 50 100 m.

3.4. Intervention - project solution

Access to the location for road traffic is provided from two sides, main entrance from Teodosij Gologanovo Blvd. (south) and side entrance from Vladimir Polezanoski St. (north). Due to leaving the location and its contents, the former functional traffic solution is in non-functional condition, ie due to the accumulation of construction waste and the continuous decay of the buildings, the traffic jams are inaccessible.

The planned primary traffic infrastructure is planned as an underground road and it provides the car access to the facilities from the underground level, which maintains continuity and space of green areas on the ground level. But a pedestrian street appears on the ground, as a communication between Teodosij Gologanovo Blvd. (south) and Vladimir Polezanoski St. (north). It is necessary to provide access to fire protection vehicles and an ambulance. Next to the pedestrian street there is a buffer space, in the form of sound insulation composed of high and low greenery, in response to the unfavorable impact of public space on residential structures.

Through the intervention which primarily envisages connecting the location with the environment through the creation of green landscapes and memorials - landmarks forms of identification of the space.



Picture 6, Project solution - Situation, Treska factory complex.

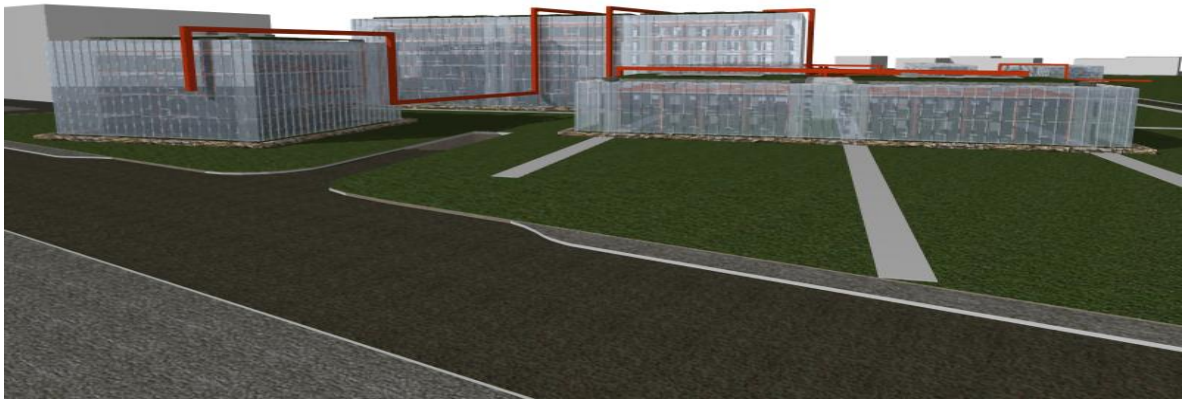
The envisaged program respects the existing represented class of purpose, so within the location is foreseen the placement of buildings of residential and commercial - business purpose. The post is supplemented with facilities for cultural socialization and education. As there is no adequate pedestrian and bicycle traffic along the location, the facilities and the overall functional solution are subject to restructuring of the contents by purpose, with the appearance of green spaces.

All program contents will be intertwined with park greenery that allows the programs to function as a coherent whole.

The intervention first envisages expansion of the road infrastructure, ie expansion of the sidewalks by adding a bicycle path and opening of pedestrian accesses and paths throughout the location. Due to the unsatisfactory condition of the existing facilities, they are subject to removal. Due to the awareness of the newly created construction waste, its recycling is envisaged. Selection of construction waste that is subject to recycling processes for processing and its integration as material for construction of pedestrian paths throughout the site.

As an object that is preserved is the sawdust silo with all its infrastructure that extends to the location. A metal cone that dominates in height and is visually impressive on the site. The infrastructure is composed of overhead line facilities that aim to conduct sawdust in silo from the facilities on the site that during the wood processing process create the same, the transmission is enabled by vacuum technology, which contributes to the unique and recognizable appearance of the silo. The above-ground line buildings will serve as a construction for the installation of park lighting, which is characterized by disobedience and disrespect to the newly planned buildings, ie tells a story from another time. With the preservation of some historical artifacts, the park becomes an "architectural landscape". Infrastructure line facilities will serve as a construction for the installation of photovoltaic panels and they serve as protection from rain in certain places for visitors during adverse weather conditions. In the center of the location, a park is formed where the silo for sawdust is preserved and at the same

time it is converted into a static sculpture. A representative building from the rest of the industrial past that stands out in the landscape. The sawdust silo is becoming a landmark, connecting the park with its wider surroundings.



Picture 7, Project solution - south view, Treska factory complex.

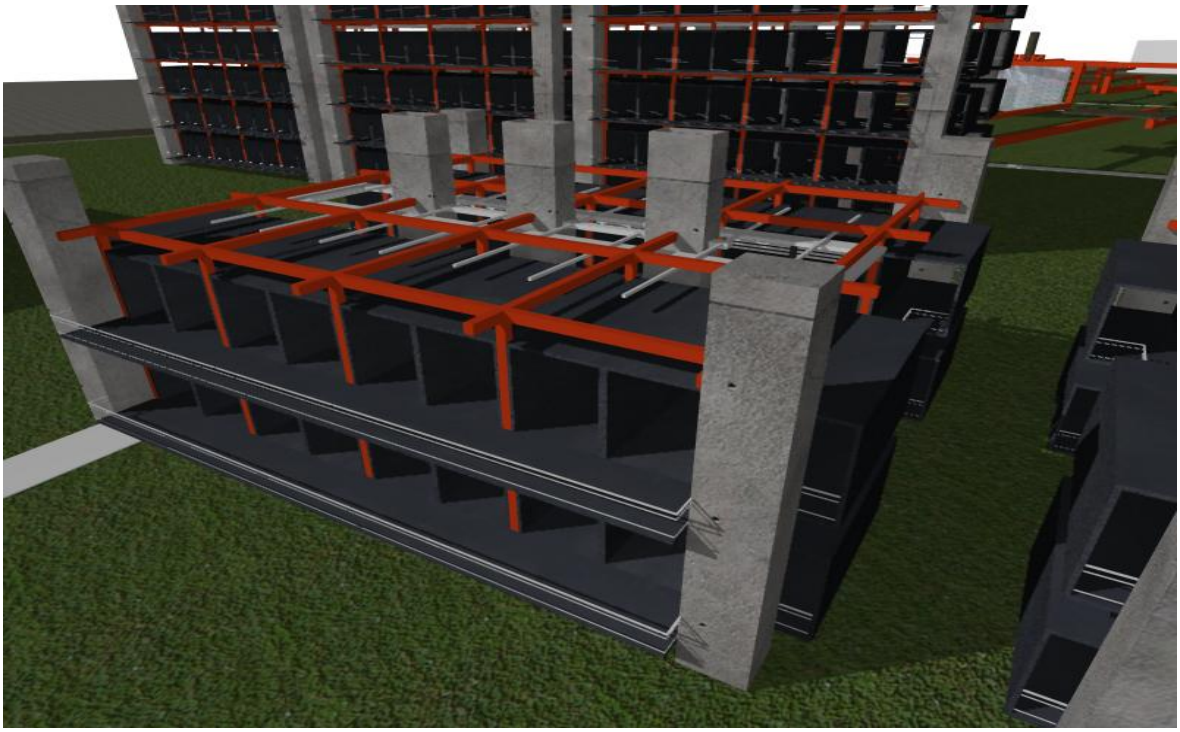
Developing physical ties with existing economic areas in the neighborhood is also important to enable economic development of the site. Through context analysis, there should be green corridors on the site that connect different spaces. Pedestrian traffic is intertwined throughout the location, but at the same time the movement on the grassy areas is not prohibited, the formed pedestrian paths serve as signposts to the buildings and throughout the location.

It is planned to place three objects on the location, similar in shape but different in character. The idea is to form a modular unit that meets multiple needs and is easily adaptable to form different spaces. The answer to this basic need is the transport container, it is closely related to industry, ie a transport container is a freight container for sea or river transport, land transport (road or rail) and multimodal transport. These are sealed units that protect the goods from the weather and are manufactured in accordance with ISO regulations.

With the advent of the shipping container in the 1950s, it revolutionized the transportation industry. The implementation of transport containers in architecture is also growing into a revolution in the construction industry. They are convenient, efficient and structurally sound. These same qualities make transport containers ideal building materials.

The containers are mostly made of steel, but there is also aluminum and a bit of plywood reinforced with fiberglass. In most cases, the floor is made of wood, although there is already bamboo. Inside they have a special layer against humidity, to avoid moisture during the trip.

They are robust, durable, economical, easily portable, adaptable and sustainable.

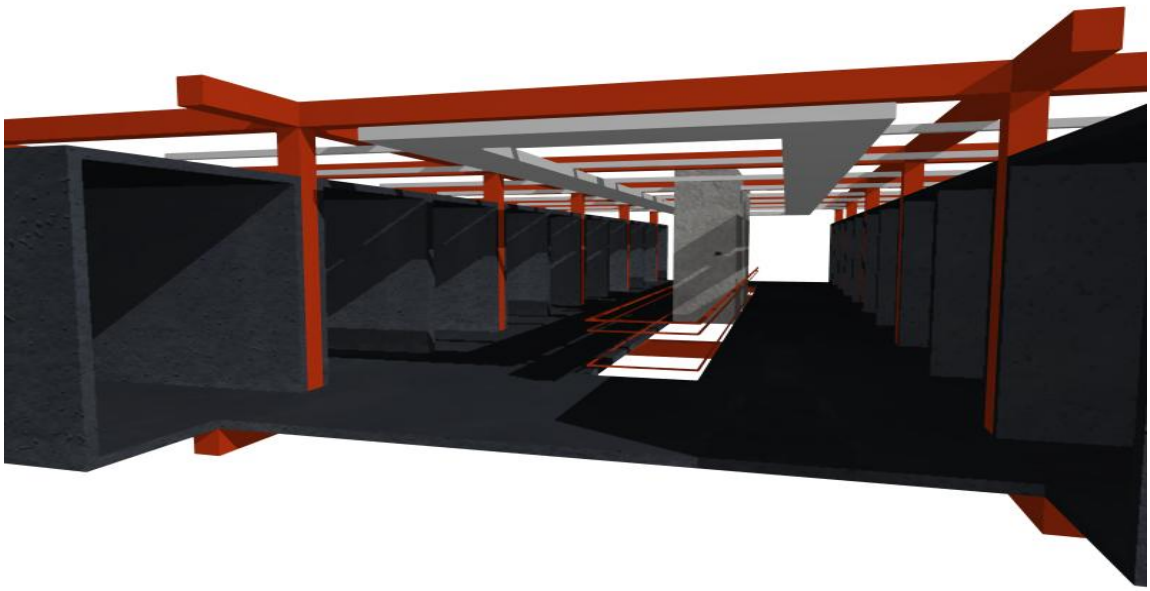


Picture 8, Project solution - modular architecture, Treska factory complex.

Modular architecture

The modular unit is the container itself, with almost 15 square meters of indoor space. Using this system saves a lot of money, time and energy compared to traditional construction methods. Its durability and structural design facilitate both its foundation and its spatial configuration. Their diversity makes them adaptable to the most diverse scales and needs, individual and collective homes, shopping malls, offices, schools, hotels, restaurants, shelters, laboratories and works of temporary architecture. In this case, those containers are used that are generally accepted for widespread use, but also those that are most common in the waste. Due to minor damages, they lose the high criteria for transport of goods and usually end up in waste. The transport containers that are accepted in this project have the following dimensions: width 2.40 m, height 2.70 m and length 5.90 m. They favor the environment due to the process of recycling the transport container. They are strong and safe, much less dangerous for the environment than traditional construction because they do not create permanent changes in the land. That is, the transport containers are placed on a steel skeleton structure with a mezzanine empty space for natural ventilation.

Container architecture is a method of construction for solutions for housing, cultural - educational and commercial - business spaces, which is a new trend in construction, with new forms of use and increasingly bold designs. In addition, they represent an advancement in the concept of recycling and sustainability. Constructive method based on assembling modular elements. The peculiarity is that these modular units are really containers for freight transport. They are well-known "containers" used in maritime and rail transport for the safe storage and transport of all kinds of products.



Picture 9, Project solution - modular architecture, Treska factory complex.

The construction procedure

First, a reinforced concrete foundation or steel structure must be made, on which the containers will later rest. With the help of appropriate cranes, the containers are lifted and joined. All this, according to the previously established design. For this, the presence of additional fasteners are fastened in each of the corners of the container. In certain situations it is necessary to make some reinforcement of the container based on the forces arising from the calculation of the joint structure.

Although container houses have a significant increase in followers, in recent years there has been a tendency towards acceptance and focus on the construction of buildings made of containers, mainly due to the low cost and speed of construction.

There are many examples of coherent design and use, but there stands out a neighborhood in the city of Amsterdam, the neighborhood of Keetwonen, dedicated to students and composed of buildings with these recycled structures.

Transport containers are integrated into the construction of commercial - commercial and residential buildings in Europe and Asia. In crowded Amsterdam, for example, these once orphans and abundant containers provided much-needed housing for low-income citizens and students. From emergency shelters for soldiers to housing for densely populated cities, container architecture has helped meet the urgent need for affordable, sustainable structures.

Aesthetics

The growing importance of transport container architecture can be attributed to the growing popularity of industrial aesthetics in architecture and design. For example, real estate or office space upgraded from an old factory may receive a higher purchase or rental price due to the positive effects on the environment. This aesthetic combined with the innate strength and durability of the transport container structure, increases the popular appeal of buildings created from transport containers.

Sustainability

Because the basis of transport container architecture is the conversion of existing material, it is by nature a viable alternative. This is especially true given the reduced carbon footprint of avoiding melting / destroying these large transport containers.

Popular Uses

Often used for permanent structures such as retail malls and residential homes, shipping containers are also widely used for events, exhibits and trade fairs. Due to their inherent versatility and portability, the architecture of delivery containers meets many criteria, but most importantly, it offers unique, environmentally sustainable solutions to many space and housing challenges.

Facade

Facade is a word of French origin meaning front face. The use of glass in the exterior facades provided more light and a good ambience for the occupants of the building which led to increased use of glass. The glass covering on the outside of the building is called the glass facade. In cities, whether residential or commercial, they tend to glamorize through the owner's stylish choice. One of the most desirable ways to instantly improve the stylistic quotient of a tall building is the glass facade. Apart from giving a modern but open look to the modern building, it also offers sound and heat insulation, which makes them a favorite choice. Modern building designs and constructions use a large amount of glass facades due to the simplicity of the materials and a wide range of designs is possible due to the availability of different design options. The curtain wall is designed to withstand and deal with all the loads imposed on it, as well as to prevent air and water from entering the building. The loads imposed on the glass curtain wall are transferred to the building structure through the load-bearing structural elements that fasten the foundations of the building. The glass curtain is intended for both dead load and wind load.

Advantages of glass facades

The materials used in glass facades are extremely strong and durable. They are designed to withstand major weather events, including strong winds, rain, etc. A unique transparent material that allows light to pass through it, so that the objects behind the glass are clearly visible. It has a smooth shiny surface, so it is resistant to dust and can be cleaned effectively. Unlike other materials, it is easy to maintain. Available in a wide range of colors, and when we combine the glass sheet in laminated or insulated units, it changes color and appearance. The glass is UV stable because it is not exposed to ultraviolet radiation and hence will not appear cracks, discoloration or decay. Glass is an excellent insulator and does not conduct electricity easily, glass is resistant to corrosion and only under certain conditions is glass chemically attacked. It can withstand the effects of wind, rain or sun and can maintain its appearance and integrity in most given conditions. It can transmit 75% -80% of natural light in both directions, something no other substitute does. Glass does not rust, so it is better than iron and does not succumb to the weather. It reduces the weight of the building foundations and makes the building lighter compared to the walls. In addition to all the functional benefits of a glass facade, one of the biggest advantages is the Appearance.

Glass facade curtains

Non-load-bearing structures similar to curtains are attached to the floor of the building in which the facade is to be installed. Such facades should support only their weight and not the dead weight of the load imposed by the building. There are connections between the curtain wall and the pillars and floors of the building so that the weight of the wind can be transferred from the facade.

United curtain glass wall

Consisting of large units that are pre-assembled and glazed at the factory before being sent to the construction site for installation. With the combined curtain walls that form the basic component of the building's exterior, thermal efficiency, sound transmission and fire safety become key criteria for system performance. In this case, the vertical cladding is attached to the floorboards first, and the horizontal cladding is attached to the vertical cladding to make it look like a lattice.

Art of first impression

The glass facade of a commercial building or retail shop should provide the best possible performance in combination with the most attractive aesthetics. The variety of glass available for facades controls every aspect of performance, from thermal and solar control to safety, color and overall building design.

Reduction of heating

Roof gardens reduce heating. The roofs on which the roof gardens are placed are with 1-4 ° degrees lower temperature, compared to the conventional roofs. They can also reduce the ambient temperature by up to 5 °. The average maximum surface temperature of green roofs does not exceed 30 ° C, while in conventional gardens, it can reach more than 59 ° C.

Green roof plants use the rain immediately. In summer, roof gardens can hold up to 80% of the rainfall. And in winter up to 40% of the rains. After utilization, water returns to the atmosphere through transpiration and evaporation.

Cost reduction

Researchers at Lawrence Berkeley National Laboratory conducted a life cycle cost analysis of green roofs, cold roofs and conventional roofs.

Research shows that while green roofs are initially more expensive to build, they provide significantly higher relative benefits per square meter over a 50-year life cycle. (eg saving energy costs, avoiding emissions ...). Compared to conventional roofs, the benefits of wide green roofs provide savings of MKD 800 per square meter.

Energy efficiency

Insulation of buildings with roof gardens lasts almost twice as long as conventional buildings, whose roofs require more frequent replacement or repair. One model shows that the average lifespan of conventional roofs is 20 years, while in well-placed roof gardens it can be up to 40 years, twice as long.

Increasing the value of buildings

Green buildings realize 5.7% more rent than conventional buildings nationwide. Implementing green space in an urban environment adds aesthetic value to nearby properties. Proximity to green space, especially views of parks or buildings with roof gardens, can increase the value of the building by up to 15%. A study also showed that installing 5 million square feet of roof gardens would reduce water costs by about 435 million gallons, or 19% each year. That is, plants and soil are a natural filter of toxins and heavy metals in the rain. In the underground levels of the buildings, it is planned to install rainwater tanks that are collected from the roof surfaces for later use as sanitary water, in the toilets of the toilets and for self-irrigation of the roof plants in the period of drought.

Roof gardens are a novelty that is constantly proving to be a great solution. The city of Stuttgart in Germany, for example, has more than 10 million square meters of extensive gardens. It is estimated that more than 12% of all flat roofs in Germany are roof gardens. The trend of roof gardens around the world is constantly growing.

General benefits

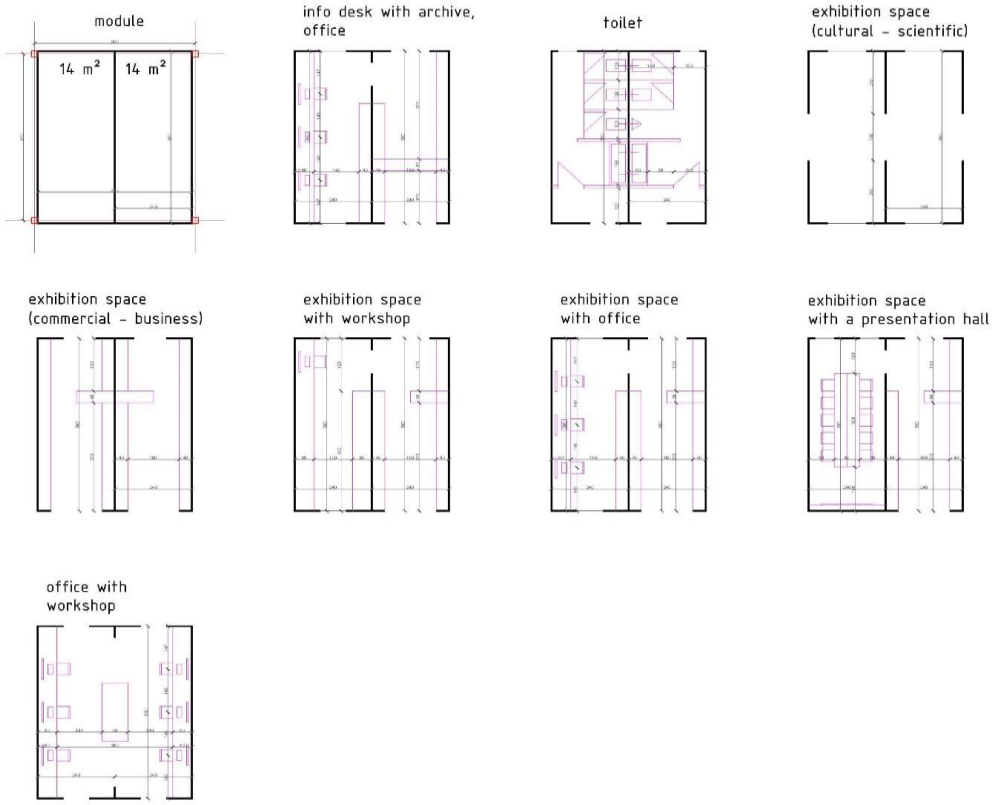
Flood reduction during heavy rains. The substrate used in roof gardens usually retains 30-60% of the water by volume. Also, plants used for roof gardening, such as laundry or species of the genus Sedum or Delosperma cooperii, retain a large amount of water, ie it is assumed that they are responsible for 40% of water use, while the remaining 60% are due to evaporation. Reduces the noise level on the roof.

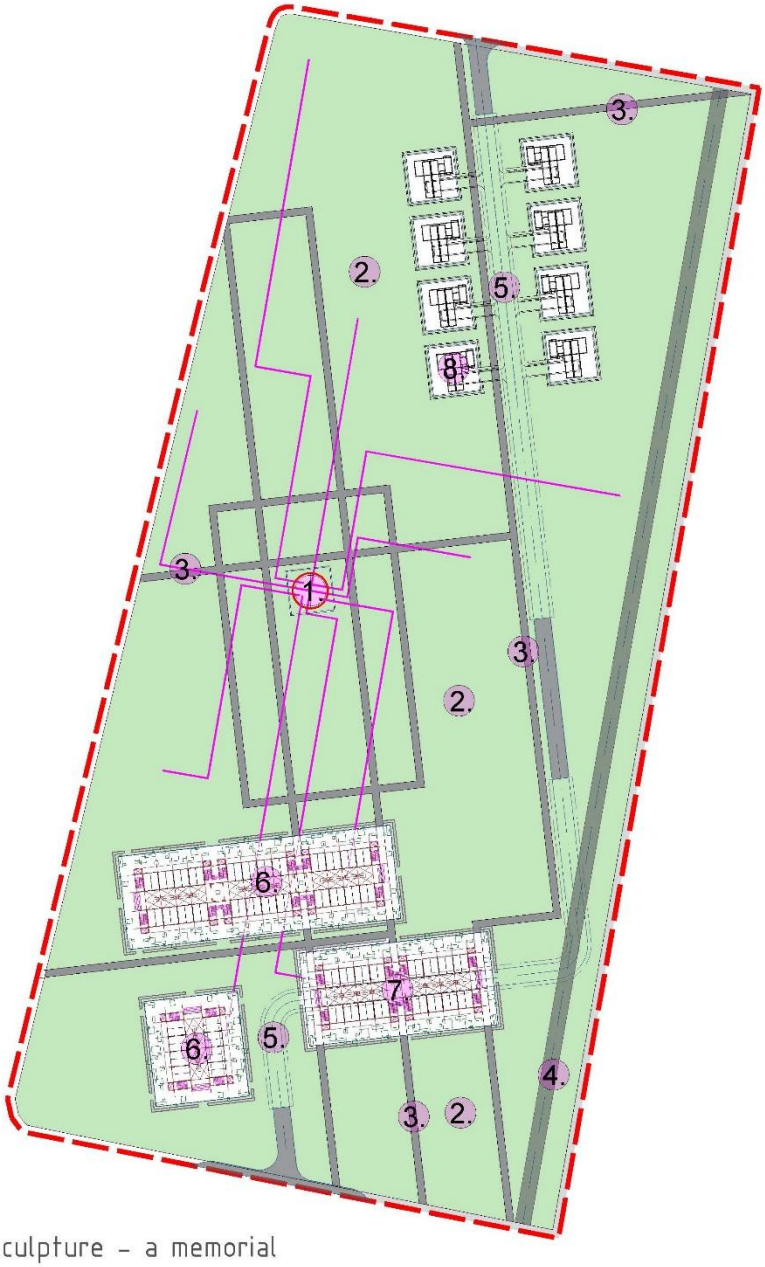
According to studies, roof gardens 5-15 cm thick have reduced roof noise levels by 8 decibels or more, depending on the water content of the growing substrate. The larger the part of the roof covered with greenery, the greater the reduction in sound pressure from the sounds traveling through the roof. Roof gardens have the potential to reduce both low frequency sounds (substrate blocked) and high frequency sounds (vegetation blocked).

The benefits of roof garden noise reduction also depend on the location of the building, with the greatest benefits coming from those near highways or high-traffic areas, and the potential reduction in noise mitigation costs.

The benefits are innumerable. A study shows that office workers are 2.9% more productive when the view from their office windows includes vegetation.

Container tipology



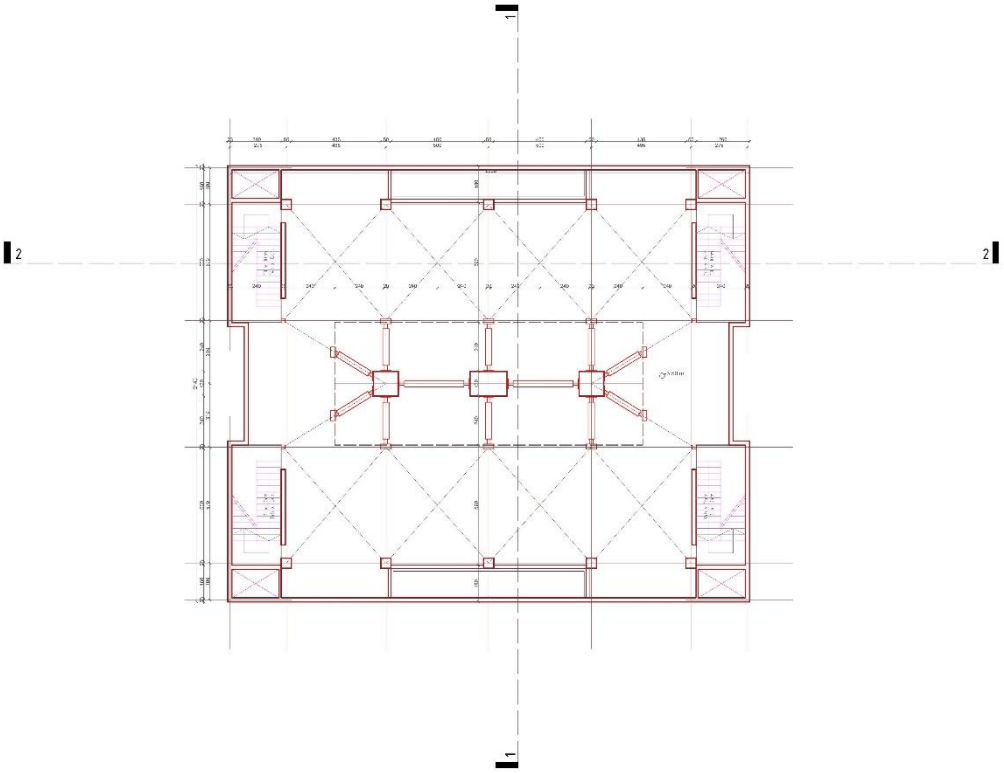


1. sculpture – a memorial
2. park greenery
3. pedestrian path
4. pedestrian street
5. underground street
6. building – (commercial – business)
7. building – (cultural – social)
8. building – (individual housing)

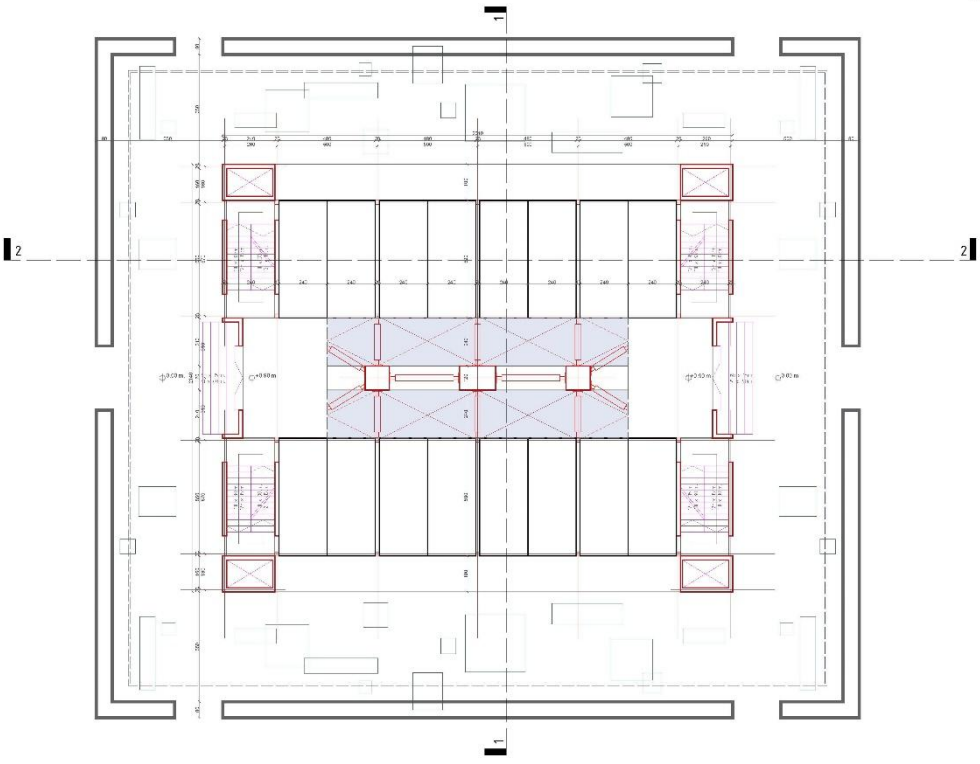
situation with open ground floor
area of design scope = 66 488,3 m^2

N

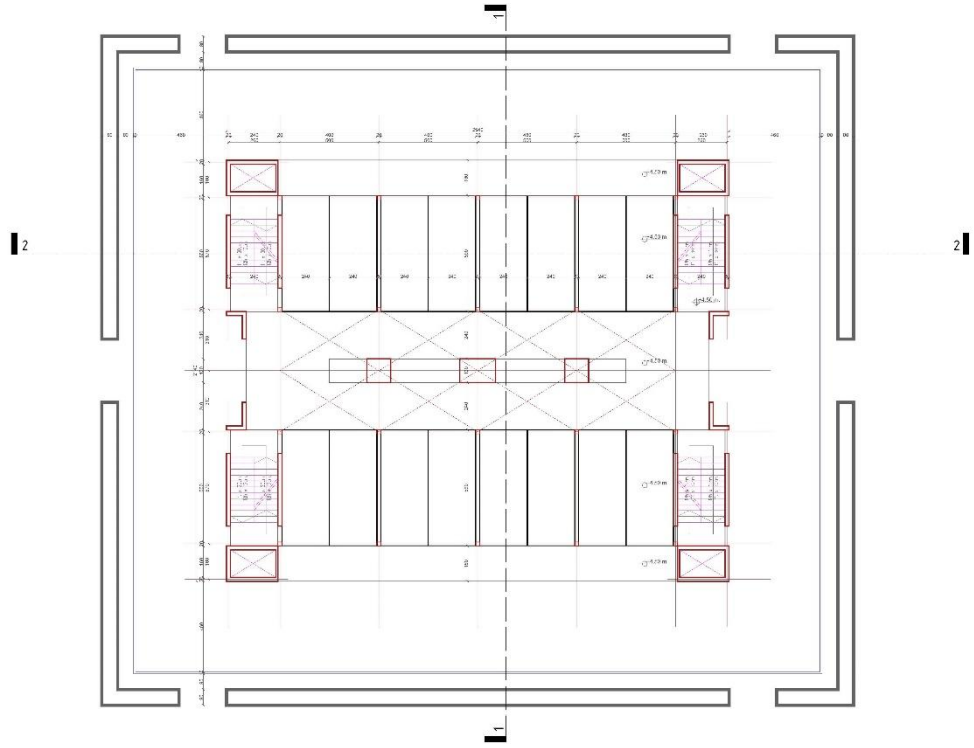
M=1:2000



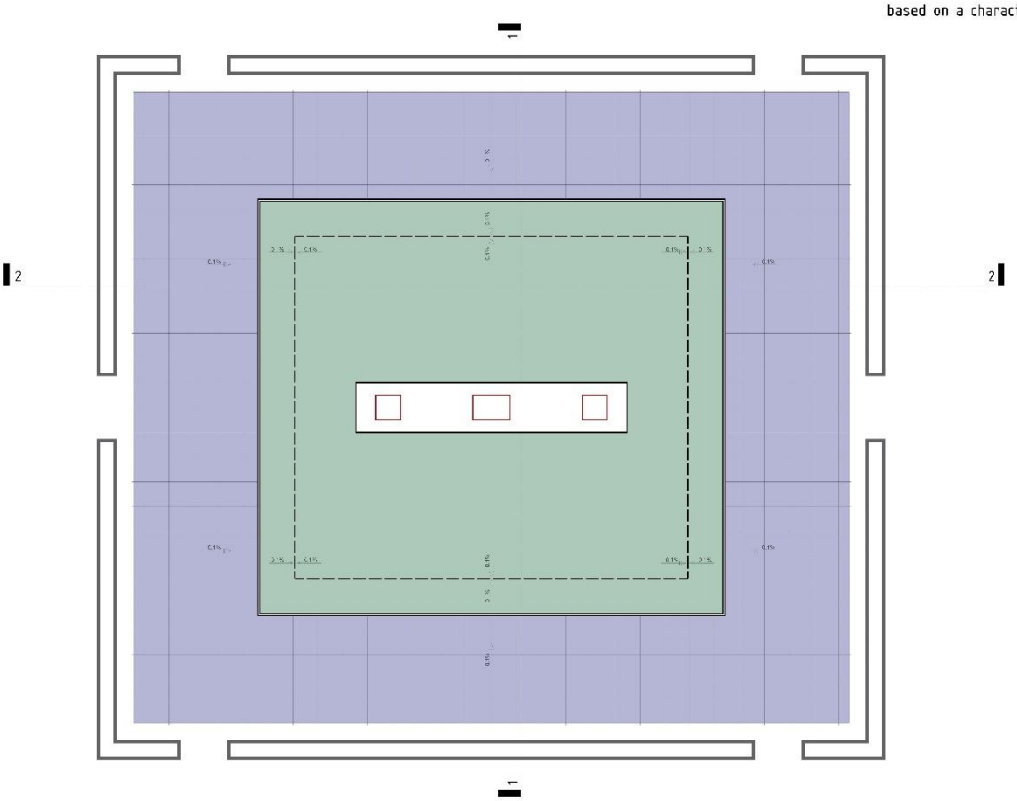
basement level



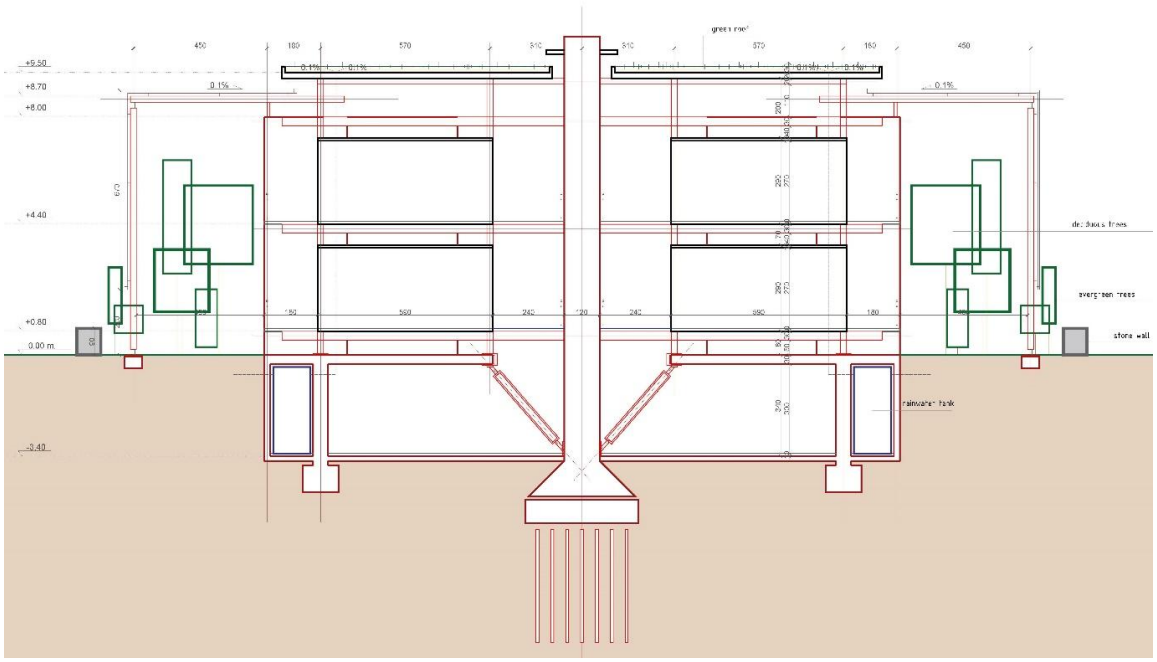
ground floor



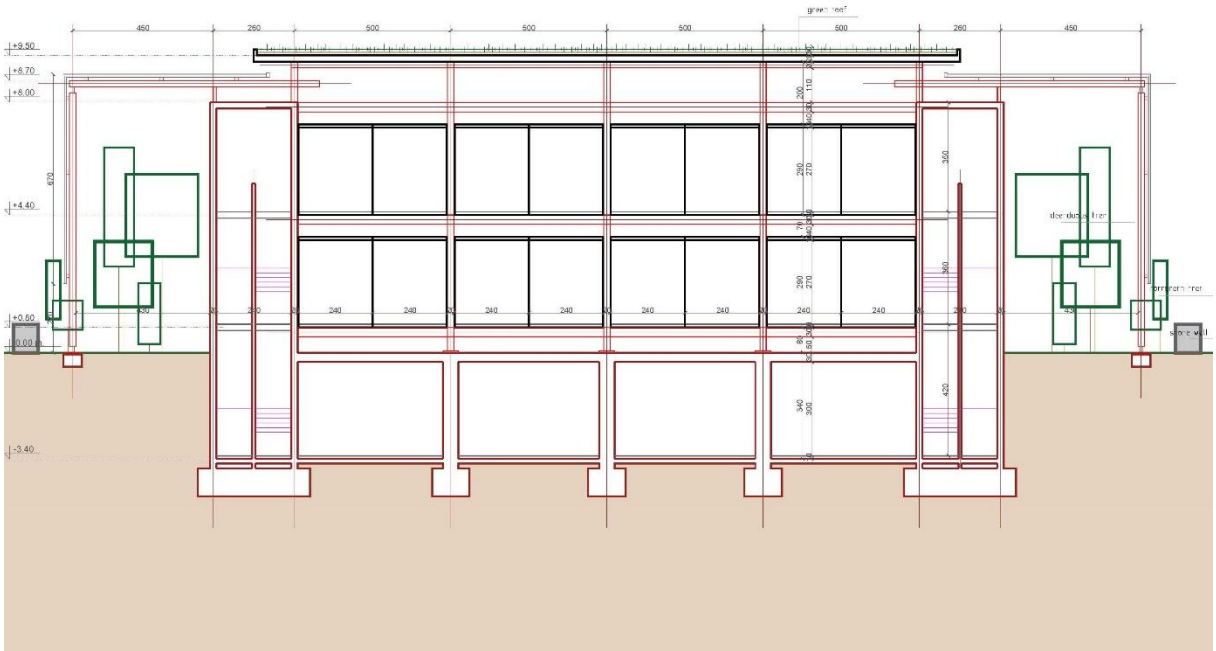
based on a characteristic floor



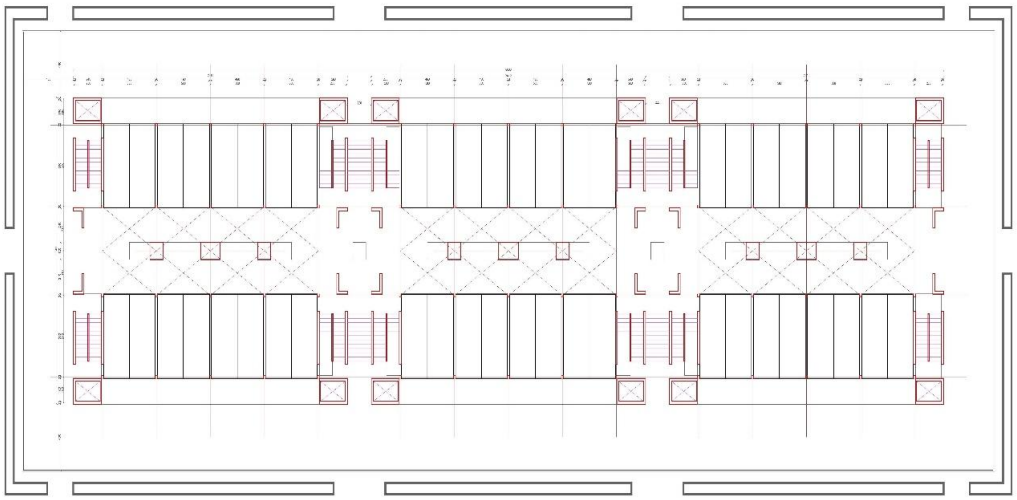
fifth facade



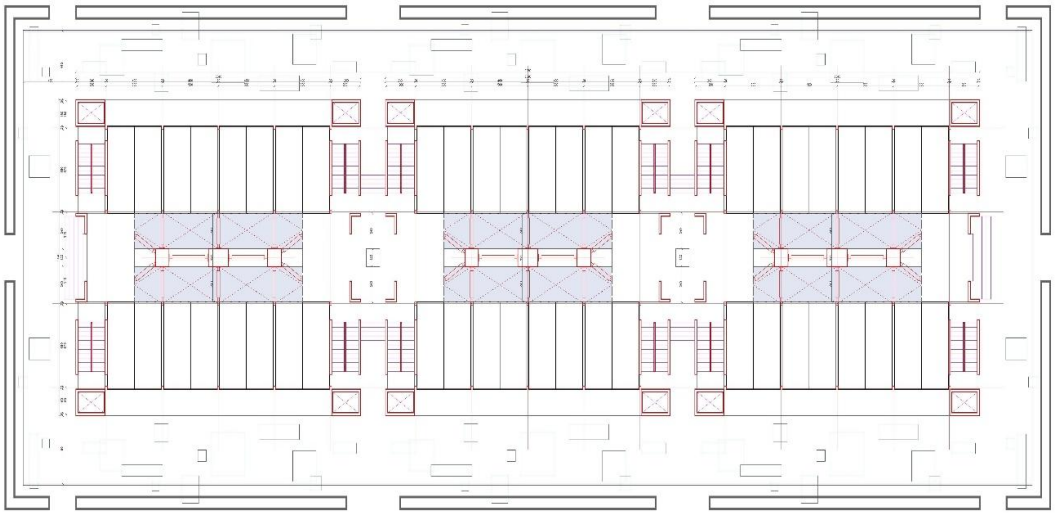
Section 1-1



Section 2-2



based on a characteristic floor



ground floor

3.5. Integration - adaptation to space (conclusion)

Recycling material in architecture is becoming increasingly valued in order to enable the creation of sustainable projects. Certainly, transport containers are one of the elements that have gained importance in recent years for the design of private and public buildings that respect the environment. In addition to being environmentally friendly, containers are a viable choice due to their speed and ease of assembly, the option of a cleaner construction site or even the various design solutions provided by this material. With their standardized sizes, it becomes possible to create a modular structure that provides endless possibilities for intervention to suit different purposes.

Residential purpose

The modulated container housing establishes a complete production system. This system brings some challenges, such as internal temperature control. To address this, it is important to study the terrain orientation and project implementation in order to take advantage of the local climate and to coat the interior layers with thermo-acoustic insulation to guarantee user comfort. However, there are advantages such as ease of assembly. In some cases, it takes about half an hour to lift each container. The structure of the box, doors, windows, roof, floor and walls can be completely prefabricated, which drastically reduces construction time.

Commercial and business purposes

Commercial and institutional uses can benefit from the rhythm of the modular structure to create movement. Additionally, the ease of transport of the containers is emphasized, which facilitates the transport and assembly of the same project for reuse in several places.

Botanical Garden

People have been trying to outsmart the seasons by growing plants in controlled environments since the Roman Empire. As the methods became more sophisticated and successful, the structures also became more complex and boasted of their place on the estates of the royal family and the nobility, such as l'Orangerie in the castle of Versailles.

Glass garden

A greenhouse can help increase plant growth and fruit production, and even allow you to grow plants that would not normally survive in your climate. Understanding how the process works is essential when extracting maximum potential from the greenhouse.

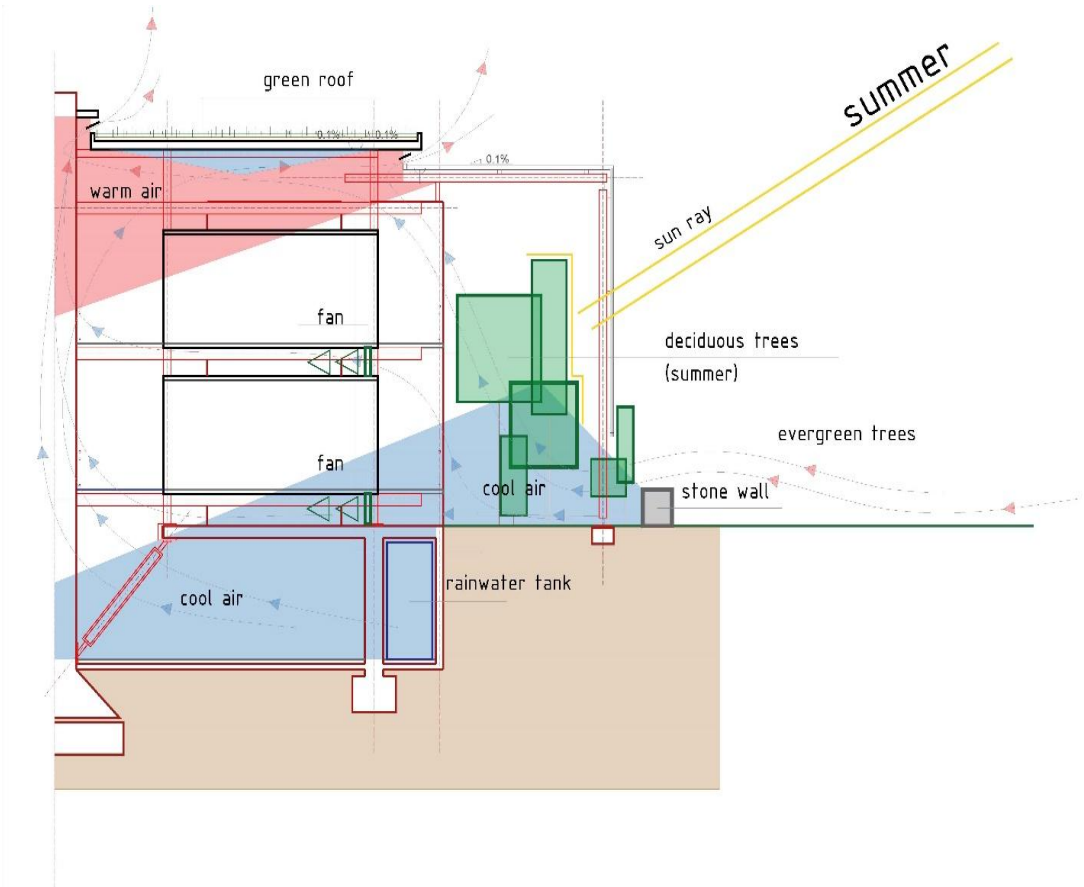
Heat is absorbed when light comes into the greenhouse glass walls, it is absorbed by plants, soil and everything else in the greenhouse, converting it into infrared energy (called heat) in the process. The darker the surface, the more energy it can absorb and convert into heat. This is why black asphalt gets really hot in summer, it absorbs a lot of heat.

Greenhouse effects

Storing heat during the day Different materials need different amounts of energy to heat themselves (it takes a long time for a stone to heat up), a feature known as heat mass. The higher the density of the material, or the more it is packed together, the more energy is needed to raise the temperature of that material. So, density materials can store a lot of heat. Examples of high density materials include:

- Stone
- Brick
- Water

Greenhouses are a great alternative to growing plants in the winter months or even in the summer. By capturing light and converting it into heat, these ingenious creations keep plants nourished and warm. Adding elements such as brick and stone along with water can help trap heat on cold nights. Comes with single glazing or double glazed. All glass in greenhouses should be tempered glass. This is a safety glass that will wrinkle when broken to protect people from being cut. During the winter all the plants bloom in the greenhouse. It is also planned to install polycarbonate in the roof while fully retaining the glass side walls - glass curtains. You get protection and insulation of the roof while the horizontal view remains clear and clean.



Picture 10, Project solution - natural cooling and heating system (biomimicry), Treska factory complex.

The Treska factory is being converted into an office, cultural and social block in the center of Skopje. Designed to heat and cool with all-natural means, this facility is probably among the first buildings in the world to use natural cooling and heating to this level of sophistication.

Biomimicry

Biomimicry (bio-life; mimic-imitate) is a new branch of science that deals with the study of the best designs and conceptual solutions that can be found in nature. These ideas and procedures are then imitated and used to solve various problems in other branches of science (medicine, energy, etc.). Biomimicry can simply be described as a set of innovations inspired by nature. The basic idea behind biomimicry is that nature, resourceful when needed, has solved many of the problems facing modern society today. Animals, plants and microbes have found solutions that work and, most importantly, that are sustainable for the planet Earth. After 3.8 billion years of evolution, that is, research and development by trial and error, nature has come up with ingenious solutions that we find all around us. The task that humanity must learn from nature is the path to sustainable development. The name biomimicry appeared in 1982, and was popularized in 1997 with the publication of the book Biomimicry: Innovation Inspired by Nature by Janine Benyus.

Natural cooling - termites

Of course, biomimicry is not only used in architecture to design the structural system of buildings. Natural cooling systems for buildings in hot climates using termites. As termites build their nests in mud, they allow the nest to adapt to the warm weather conditions in their habitats thanks to the airways they create inside. Site facilities are designed this way. The airways created in the building provide natural ventilation and natural cooling of the warm air inside. Compared to traditional buildings, this system consumes only 10% of the energy used by a building of a similar volume. Hence, the building would save about $ 3.5 million in energy in 5 years.

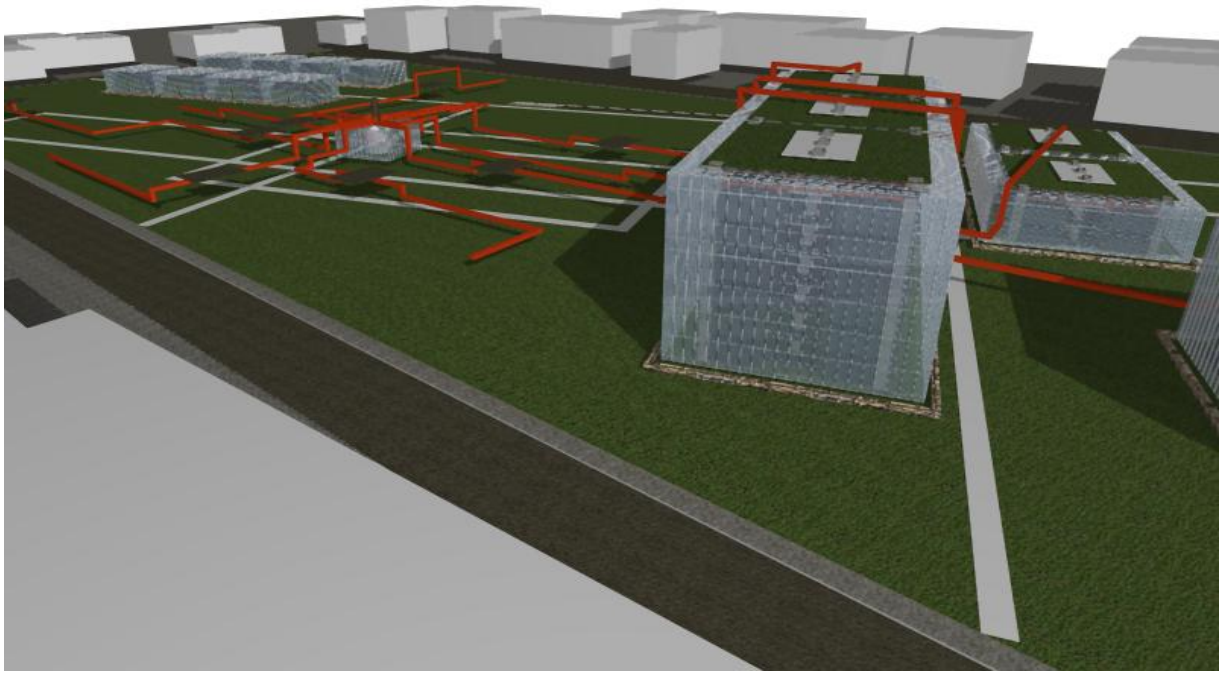
Care for the environment

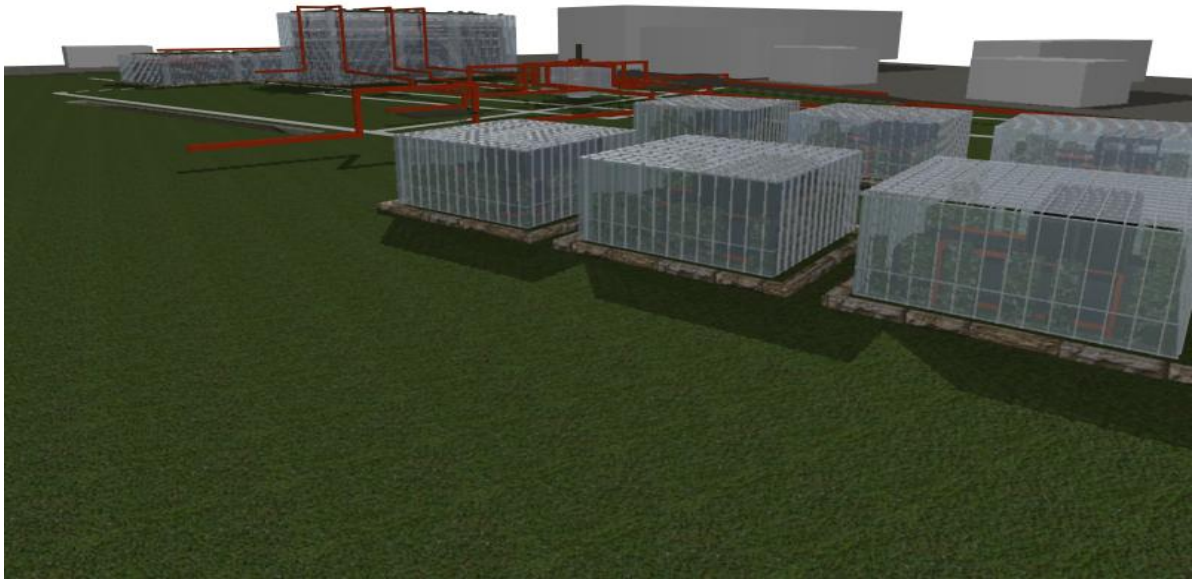
The surface that the buildings occupy or disturb the continuity of the greenery is a problem and inadequate access to the environment. Thus, from here the surface occupied by the land object is moved to the roof. That is, the functional greenery on the surface is not covered with an object, but it is transferred to a higher point than the previous one. Researchers estimate that a 100m2 roof garden can remove about 40 kilograms (PM) of airborne particles in a year, as well as produce oxygen and remove carbon dioxide (CO2) from the atmosphere.

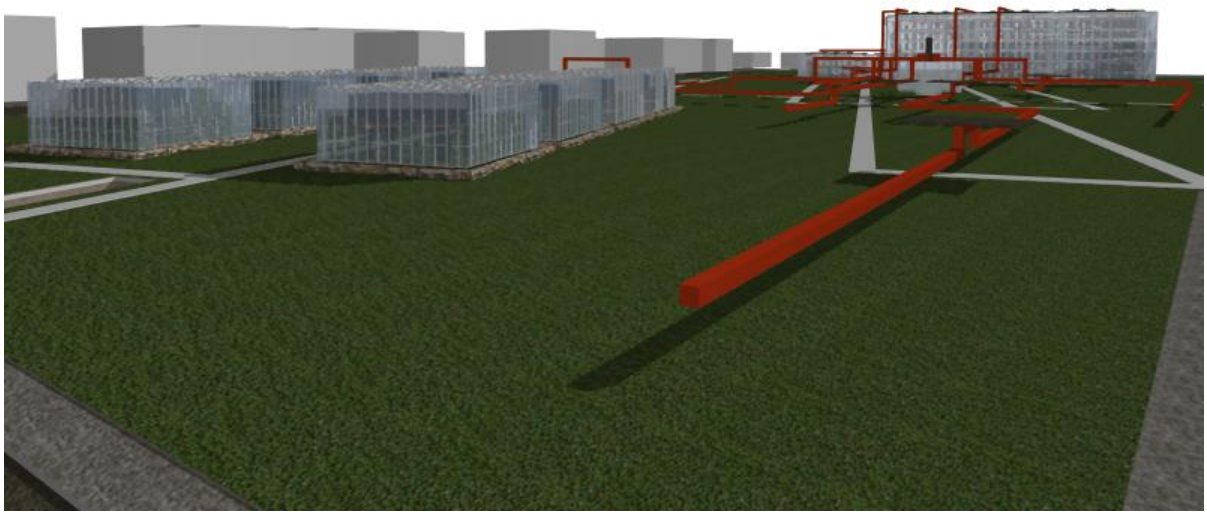
Forty kilograms (PM) of particles are approximately as much as 15 passenger vehicles will emit in one year of driving. In addition, some roofing plants used, such as Sedum album and Sedum spurium, are metal hyperacumulators, with unusually high levels of elemental metal intake and storage. A healthy environment is an irreversible resource, and we need to take care of it continuously. That is why there is no doubt for architects that roof gardens are necessary in urban areas, especially where there is a huge concentration of concrete, a lack of green space and a huge concentration of people and cars.

Improving air quality

The benefits of green roofs are supported by research conducted by the US Environmental Protection Agency. Which shows: The total coverage of roof gardens in Kansas, which is more than 2 ha, results in avoiding even:
17.5 kg - Nitric oxide (reduction of nitrogen oxide compounds with a green roof is estimated to be worth 0-30 denars per square meter with a roof garden)
33.5 kg - Sulfur dioxide
27 tons - Carbon dioxide







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