THE CANYON

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PREFACE

"The Canyon" is a master thesis by Thomas Dam Lauritsen and Peter Stie Hansen, 10th semester, Architecture, Design and Media Technology, Aalborg University.

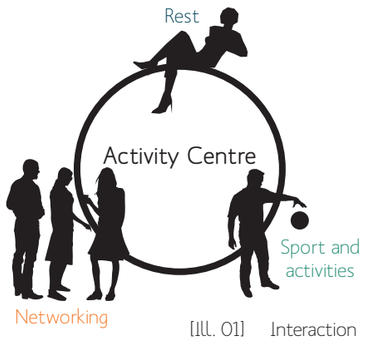
This project is based on a brief from an open international architecture competition arranged by Walltopia and coordinated together with the Chamber of Architects in Bulgaria and the Union of Architects in Bulgaria. The purpose of the competition was to receive proposals for a new activity centre in Sofia, Bulgaria.

The competition ask for a proposal for a activity centre of 7000 m2, with a mixed programme focusing on climbing. The winning entry will be build in an area, which in the future will develop as a commercial district in Mladost in Sofia, the capital of Bulgaria.

INTRODUCTION

One of challenges in this project, is to create a social network that reaches further than only involving participants from the same sport. An activity centre that makes people interact through the composition and architecture of the centre. This project presents a belief in architecture through its materials and composition can contribute to social interaction. Therefore, the tactile qualities of the materials will play an important role when they are utilized in the centre within different spatial senses. The project is developed with climbing as the main attraction, with point of departure in the brief from the International Open Competition "Collider Activity Center".

The project is developed through an integrated design process, with focus on a healthy relationship between aesthetics, construction and material. Sustainability will be implemented both socially through the interaction between people, and environmentally through the orientation of the building, indoor climate and daylight conditions.



[Ill. 01] Interaction

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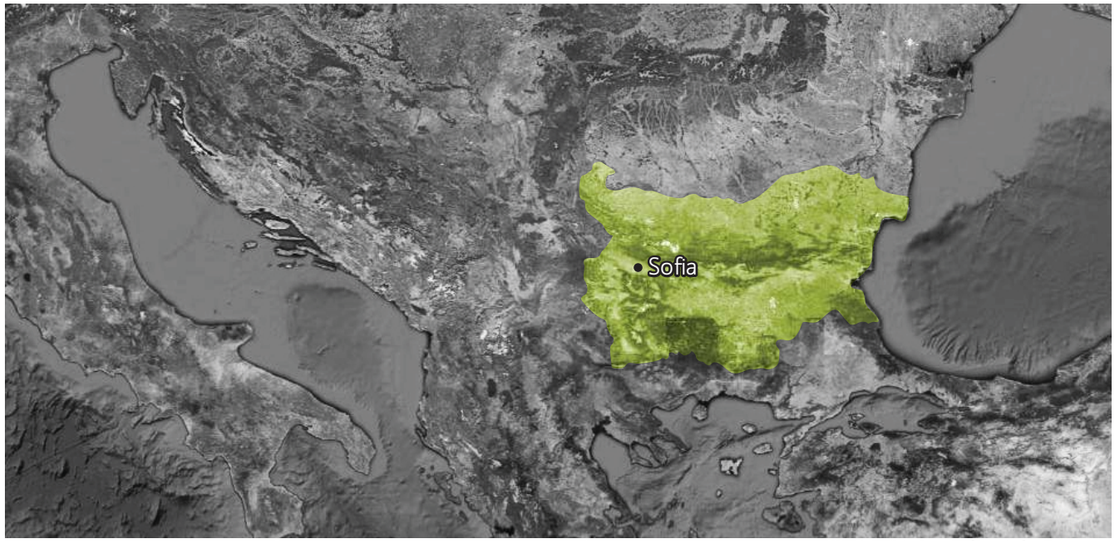
LOCATION

Bulgaria

Many Western European citizens have difficulties defining Bulgarian culture and trades, which is understandable when reviewing their history. From 1396 - 1908 Bulgaria was a Turkish colony, and the ottoman rule for five centuries has made a great stamp on the cities and civilisation. Bulgaria became independent again in 1908, but the independence only lasted 38 years. The country was occupied by the Soviet Union from 1944 until 1989, which meant a new time with influence from other cultures. The Soviets brought communism, and only after the Soviets left, the country could start living in harmony with their own culture and history [02]. Sofia represents the confusing history with roots from Roman times and cathedrals mixed with the Muslims mosques.

Bulgaria entered the European Union in 2007, and some might say that it is not until now, Bulgaria has found the right track back to their European history. However the influence from Europe is still lacking in the everyday life of an average Bulgarian citizen, a high unemployment and underpayment is normal, but the new generations experience a life with educational opportunities and independence. However, some older Bulgarians will remember the communistic regime as a time with jobs for everyone and order in the society.

Geographically, Bulgaria has great areas of mountains. The Balkan mountains dominate most of the mountainous area, with several branches reaching out in different areas of Bulgaria.



[Ill. 02] Bulgaria

[Ill. 03] Balkan mountains, Bulgaria

Sofia, Mladost

Sofia is far ahead in terms of quality of life compared to the rest of Bulgaria, because the city that has experienced great influence from the European Union. The city is in many ways not different from any other capital in Europe. It has everything, and everything is possible if you have the money [04]. Great class distinction is still present, but when new educational opportunities, restaurants, clubs, cafes, and bars pop up everywhere, it is hard to neglect the country is going towards positive times [03]. It is located at the bank of the Vitosha Mountains 500 meters above sea level, which give the citizens the opportunity to experience the beautiful nature in the great natural park in the Vitosha Area.

Especially, the district around the competition site experiences a flourishing development. The area is called Mladost and is situated in the south-eastern end of Sofia, with an estimated population of 110,000. The area is fast growing, and is the second most popular neighbourhood in Sofia. [02]

[Ill. 04] Sofia

[Ill. 05] Site

[Ill. 06] Site

METHODOLOGY

Architectural Approach

A clear definition of architectural quality is due to the complex profession, diffuse and unclear. However, this project group will with point of departure in thoughts formulated by Kenneth Frampton and Gottfried Semper prove the architectural quality in the form-finding and form developing processes. Frampton's formulation, is due to its emerging in the 1990s, modern and relevant. He describes three important factors in the form-finding process; typology, topology, and tectonic. [05]
His definition of tectonic is in many ways similar to earlier formulations. The importance is given to the essence of a building (construction, materials and joints) [05]. The project will intentionally express cosmic order through the trinity between these keywords. The constructional logic will be assisted by well-articulated details and material choice. Furthermore the spacious qualities will be developed through a carefully consideration of the division set up by Frampton - tactility, telluric, tectonic [05].

Because of The Activity Centre's function as a building full of energetic people, a great significance will be addressed to the tactility of the materials. The material's appearance has great importance when people choose one or another space to practice their sport. This is especially true in a climbing context, where people will have a close relation to the materials when climbing and feeling the texture of the materials.

When giving attention to these things, the project will additionally strive for a close relation to the site - not only as an integration into the surrounding landscape, but the project will be conceived as a landscape. In that way, the aesthetics of the project will not only be in a tectonic manner. A relationship between the construction, detail, and material choice, will be assisted by a clear integration of the surroundings.

To determine topology and typology of the areas, and analyse the potentials and issues in the area, Kevin Lynch's division into edges, districts, landmarks, nodes, and path will be used [08].

The Integrated Design Process (IDP)

The Integrated Design Process formulated by Mary-Ann Knudstrup will be used to organise the process of this project.

This method works as a design method with focus on the architectural, technical, and the functional solutions, from the beginning and throughout the whole design process. Working with these different parts simultaneously, defines the principle of the integrated design process. The method is divided into five phases; problem formulation, sketching, synthesis, and presentation.
The different phases are not to be seen as individual parts which is performed step by step. An important thing concerning the method, is the possibility to go back in the phases and modify parameters, which affects all other phases. To reach a successful sketching phase, the architectural and engineerical demands have to be fulfilled and merged together. [07]

The following paragraph lists the use of tools in the different phases, and describes how the i.Integrated design process has been approached.

Phase	Description	Tools/Approach
Problem formulation	- Research accumulation, discussion	
Analysis	- Site analysis (Kevin Lynch mapping method) - Climate analysis - Case Studies - Analysis of topology and typology - User group (User demands and logistics) - Volume studies	- Autodesk Ecotect and Vasari - Structural analysis - Adobe CS5
Sketching	- Solar studies - Wind studies - Organization strategies (Daylight, Flow, Functional) - Structural strategies - Daylight analysis - Constructional strategies	- Spreadsheets - Velux Daylight Vizualiser - Autodesk Ecotect and Vasari - Autodesk Robot Structural Analysis - Autodesk AutoCad - Google Sketchup - Physical modelling - Hand sketches - Workshops
Synthesis	- Site plans, floor plans, section - Organization principles (Daylight, Flow, Functional) - Materials (Tactility) - Details development - Construction principles - Context integration principles	- Autodesk Ecotect and Vasari - Google SketchUp - Autodesk AutoCad - Autodesk Robot Structural Analysis
Presentation	- Report - Drawings (Plans, section, elevations, facades) - 3D visualizations and physical models - Diagrams - Final calculations - Final details	- Adobe CS5 - Autodesk AutoCad - Google SketchUp - Rhino (VRay) - Physical models

[Ill. 07] Integrated Design Process, phases

MAPPING

BRIDGES

RELIGION

CULTURE

OTHER

Lion's Bridge

Central Market Hall,

Synagogue, Sofia

Alexander Nevsky Cath.

Banya Bashi Mosque

Central Military Club

Central Bath

National Assembly of Bulgaria

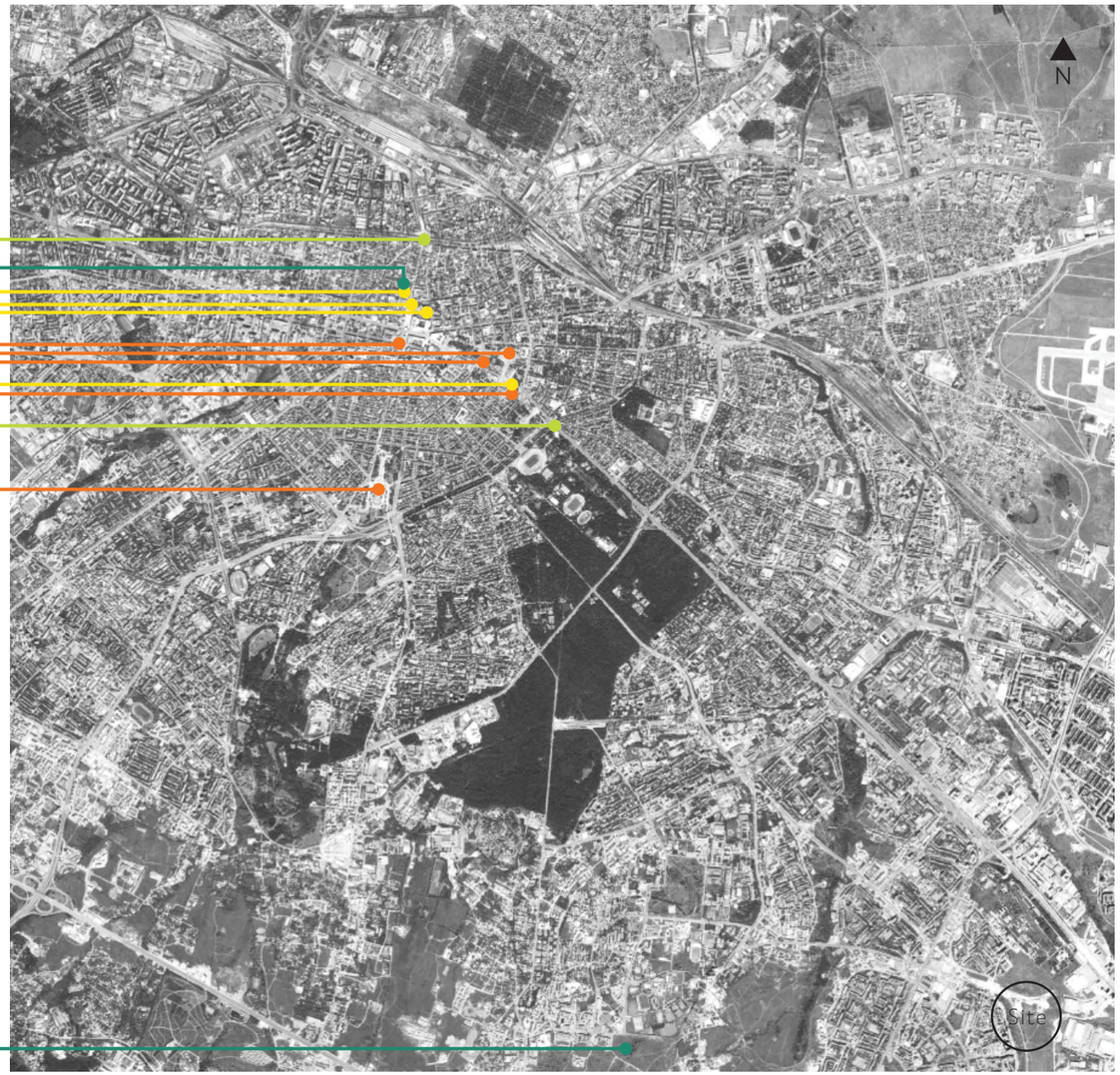
The Yablansky house

St. Nedelya Church

Eagles bridge

National Palace of Culture

Borisova Gradina TV Tower



[Ill. 08] City Map, Sofia

Landmarks

The competition site in Mladost is located seven kilometres away from the city centre, and has a suburban atmosphere. When looking at the main attractions and landmarks, these are primarily located in the centre, and they all show relation to the complex history of Bulgaria. Roman ruins illustrate their ancient origin, byzantine cathedrals the orthodox Christian religion, and the mosques exemplifies the long period under Turkish rule, but all together, they highlight a long and exciting history.

[Ill. 09] Centrail Military Club

[Ill. 10] Alexander Nevsky Cathedral

[Ill. 10] Alexander Nevsky Cathedral

[Ill. 11] National Palace of Justice

Future development

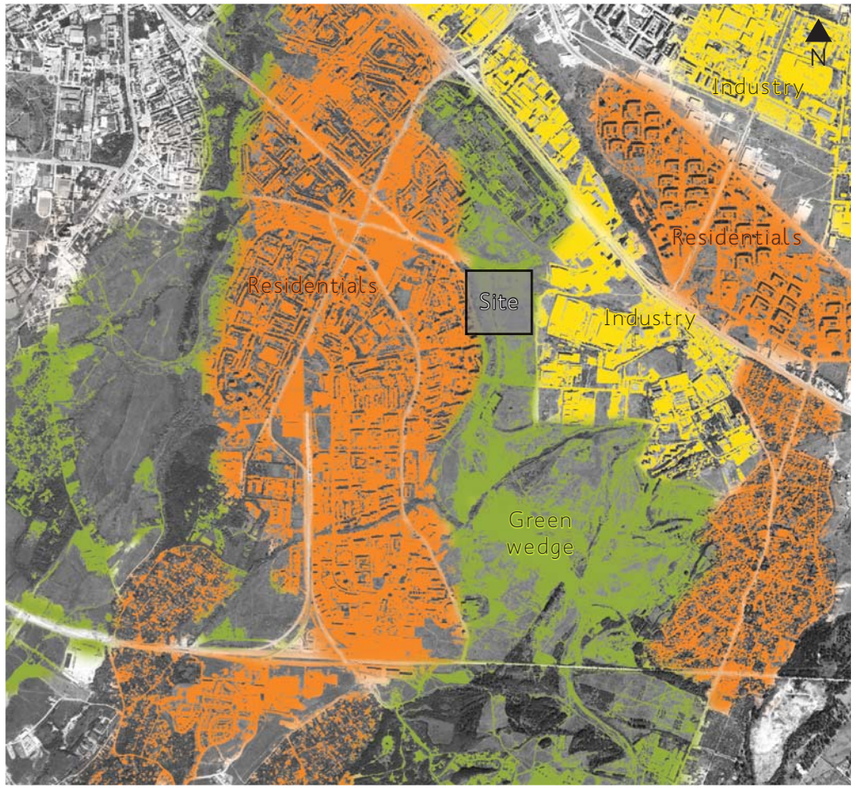
The existing development plan for the area around the competition site proposes a large commercial area. A supermarket and a TV-Studio are already planned. The white buildings on the mapping are only indications.

[Ill. 12] Site

[Ill. 13] Nodes and Paths

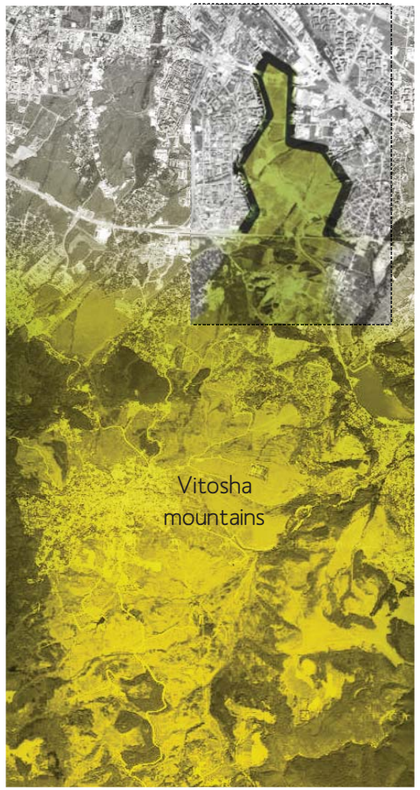
Districts

Residences, industry and a green wedge are already located around the new area. The new activity centre will together with the future development of the commercial area, bring a new typology to the location. The new typologies will bring diversity and new life to the area.
The view to the Vitosha Mountains is highlighted by the topographic arrangement of the site. Long views is blocked by the industrial area to the east and by residences to the west, but in the southern direction, nothing blocks the view, and a great green wedge guides one's eyes directly to the mountains.
The site has a unique starting point in terms of recreational development, and a clash between nature and city can bring an exciting gesture to the area, and encourage the inhabitants in the area to use the green wedge.



[Ill. 14] Map, Mladost, Sofia

[Ill. 15] Edge



[Ill. 16] Vitosha Mountains

CONTEXTUAL POTENTIALS

View to Vitosha Mountains
The unique view to Vitosha Mountains must be taken into consideration.

Incorporation of the Green Wedge
The great green wedge coming from the base of the Vitosha Mountains dominates the area.
There is a great potential in conceiving the project as a part of the green wedge, to retain the recreational qualities for the residents in the area.

Close Related User Group
Large residential areas are located around the building site, which give a close related user group.

Connection to the Underground Station
The recently built underground station, north of the area, is located 200 metres above the building site, and is connected directly to the centre of Sofia. If it is possible to incorporate and make a good connection from the underground station to the building site, the user group can be expanded and involve users of public transportation.

[Ill. 17] Contextual potentials

Inital idea

To make a good integration of the underground station, this project wishes a direct connection from the commercial area to the underground by incorporating the transit area in the design. There is potential in organising the future development around a transit area to the underground station.

[Ill. 18] Initial arrangement

POTENTIALS FROM BULGARIAN BUILDING TRADITIONS

Bulgaria has, despite the many years of occupation by other countries, rich building traditions. These traditions are described in this paragraph, to pinpoint if they possess potential.

[Ill. 19] Tradtional stone house

[Ill. 20] Courtyard enclosed by stone walls

Stone House

Bulgarians have a long tradition in using stone for buildings. This unique tradition is due to the available raw materials. The roofs are covered with stone tiles and exterior walls painted white. The first floor is often build from stone, while the second floor is build from wood and often has more windows. The first floor is more closed for privacy reasons. Inside, the supporting timber beams are exposed. These materials give a characteristic cosy atmosphere with a beautiful collaboration between stone and wood. Other traditional features are the chimneys, also build from natural stone, balconies called "chardaks", and small courtyards enclosed by thick stone walls. [09]

Bulgarian Gneiss stone

Natural stone is a part of traditional Bulgarian building tradition, and is used to many different purposes, like roof tiling, chimneys, walls and flooring. The Bulgarian gneiss stone is a metamorphic rock with high solidity. The surface is harsh and non-slip, which give the stone its unique look. The colour of the stone is a result of the minerals that it contains, and can be white, grey, yellow, green, brown etc.
[10]

Chardak

The chardak is often a part of Bulgarian houses, offering outdoor space. They are mainly built from wood; while the rest of the house is built in another material.

[Ill. 21] The typical building materials, stone and wood

[Ill. 22] Bulgarian Gneiss Stone

[Ill. 23] Chardak

[Ill. 24] Alley

The potentials from the bulgarians own culture is seen as an important factor to incorporate in the new activiy center. The project believes in a close relation to culture and traditions that people understand and can relate to. It can be in terms of new modern interpretations, which can give an interesting reference to the history but at the same time highlights, that the building is moving forward an belong to modern times.

VISION

On the basis of the adjacent green wedge, the vision is to strive for a project conceived as a landscape. To create an exciting environment which will make people interact through different sports, activities, and rest areas is a part of the vision. This vision is based on the belief that architecture can contribute to social interaction through its material and composition. And inspiring atmosphere and indoor climate is created through use of materials with tactile qualities, daylight and different spaces.

Problem statement

"How to develop an activity centre conceived as a landscape based on the adjacent green wedge, focusing on social interaction between the users of the different activities, with an architectural expression of harmony between function, daylight, material, construction, and detail?"

[Ill. 25] Climber

DESIGN CRITERIAS

Aesthetics and functions

- Incorporation of interesting views to the mountains and nature.

- Harmonious relationship between material, daylight, and form, which stimulating the users of the centre.

- Creation of an attractive environment, which has great value for the citizens of the Mladost area.

- Interaction between the different facilities in the centre, but at the same time development of secondary space connected to a specific function.

- Creation of a relation to the Bulgarian culture through integration of their landscape and use easily accessible building materials.

Technical

- Organisation of building's programme in relation to the different functions' requirements of natural and artificial lighting, to create a harmonious indoor climate by carefully incorporating daylight.

CONCEPT

Climbing associations

Mountains
Adventure
Danger
Risk
Drama
Rocks
Nature

→ Where does nature express these assocation?

↓

Grand Canyon

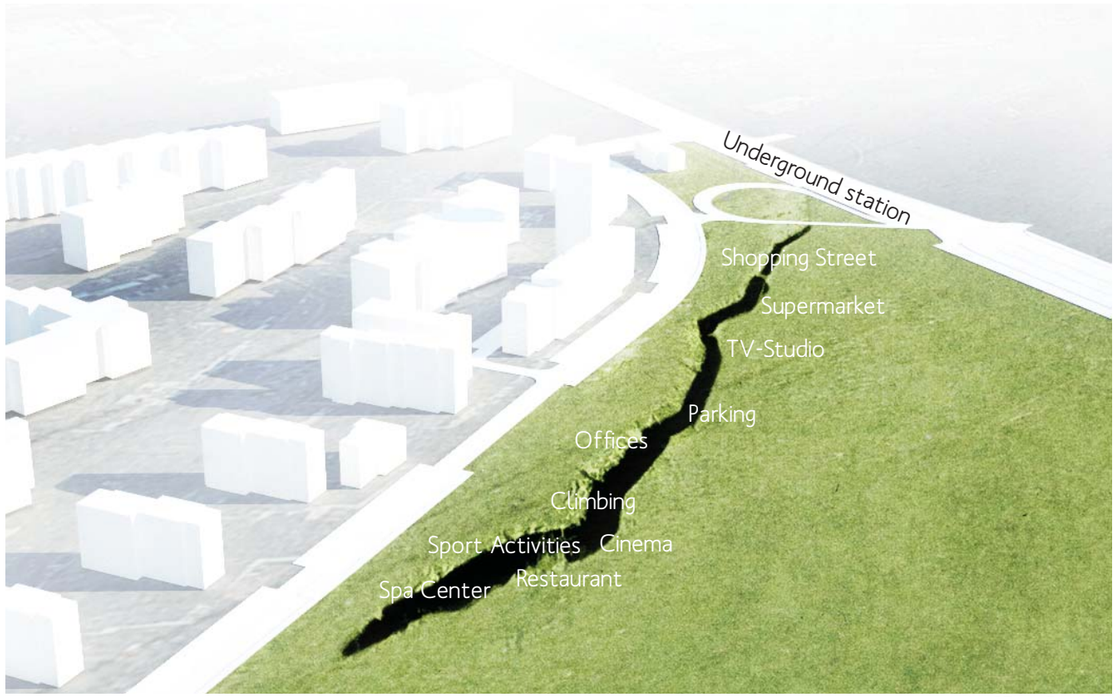
[Ill. 26] Grand Canyon

Grand Canyon

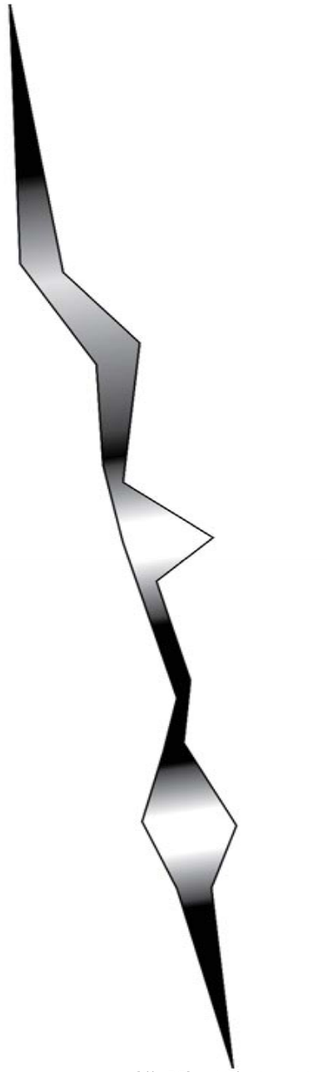
The canyon concept is inspired by Grand Canyon, Arizona, USA. Experiencing Grand Canyon is dramatic. Standing on the canyon edge, one will be impressed by the striking and surprising forces of nature. The human is taken by surprise by the overwhelming scale.

Is it possible to implement the canyon phenomenon into the architecture and urban spaces, connecting it with the city and surroundings?

By expanding the existing competition programme and implementing the future development plans for the whole area, a great variety of functions will generate a connected urban life. A street starting from the underground station will be the pulsating vein, which leads the flow the whole way through the canyon.
The user will experience diversity in light intensity, when walking in the canyon, which generates a variety of experiences. The widest areas will gather people in open spaces as natural locations for public squares. The darker narrower areas will function as transit areas, where people can discover and experience the flow of the canyon before entering the next open space.



[Ill. 27] Concept



[Ill. 28] Light intensity

[Ill. 29] Grand Canyon

Architectural Interpretation of a Canyon

When looking at the spaces inside a canyon, they illustrate a beautiful collaboration between various elements of nature. The elements described below, tell the story of how the canyon emerged.

1) Cliffs on both sides, made from rock, which was connected before the crevice arose

2) Small pieces of rock fallen of the cliffs

3) Water, which has carved the canyon wider and wider

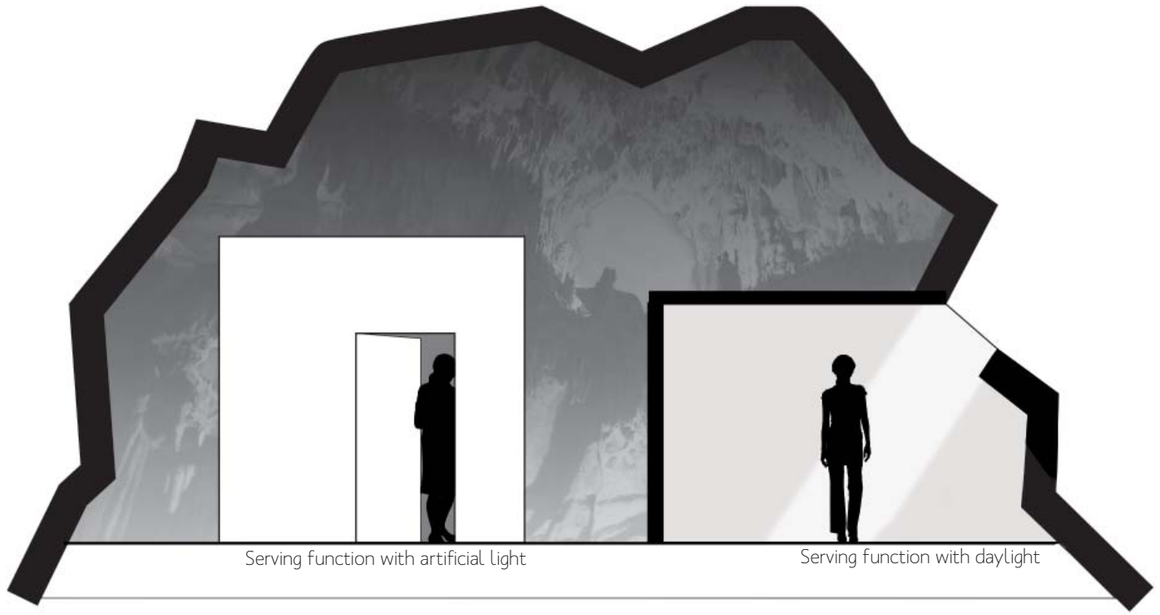
4) Areas of vegetation, which has developed because of the water

This project wants to introduce these elements in an architectural interpretation of the canyon. However, the human scale is where the interpretation differs from a real canyon, with the integration of useable outer spaces, transit areas, interior functions and objects such as railing, benches, and stairs.

Canyon Caves

The interior spaces are an interpretation of the caves, which sometimes can be found along a canyon.
Inside these interpreted caves, are the secondary functions implemented as rectangular spaces within the cave cavity. The rectangular spaces offer a great contrast to the complex expression of the cave, provide relation to the human scale, and are very functional at the same time.

Functions, which need daylight are integrated in the canyon wall, and express a clash between the canyon and human scale.
Functions, with no need of daylight, have no connection with the outer wall.



[Ill. 30] Canyon Cave principle

MODULE PRINCIPLE

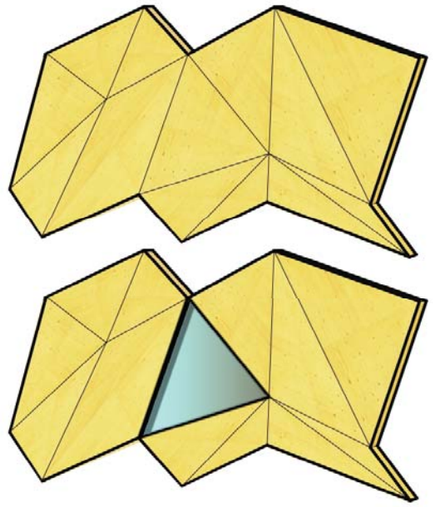
The canyon wall is made by modules, which has similar ends, and fit together in different ways.

Module 1: 8000x16000mm
Module 2: 8000x16000mm
Module 3: 8000x16000mm
Module 4: 8000x16000mm
Module 5: 4000x8000mm
Module 6: 4000x8000mm
Module 7: 4000x8000mm
Module 8: 4000x8000mm

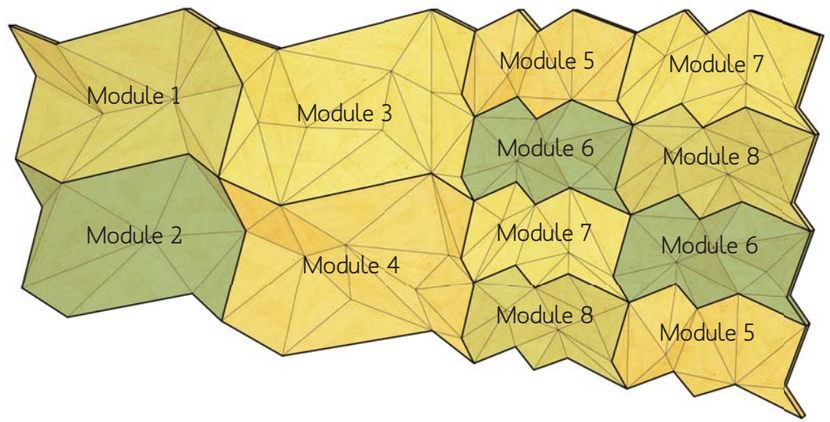
The modules make a complex expression by a simple system. However, ends and corners are made by unique modules.
Triangular plywood panels are supported by a steel structure, which make the wall a part of the overall bearing structural system.

Windows

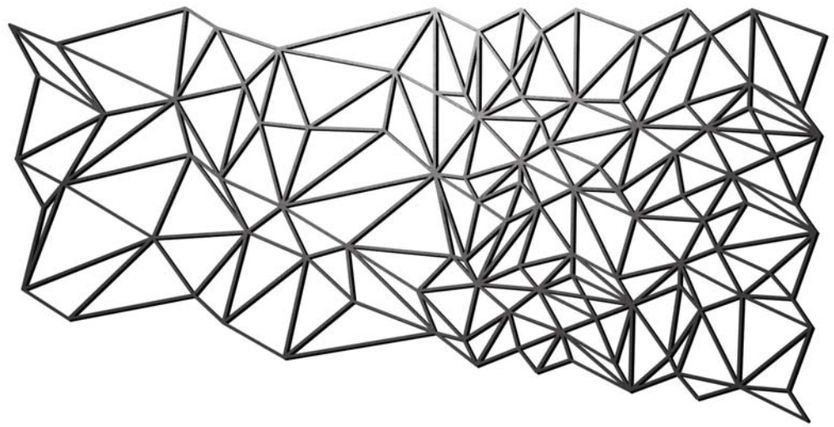
To get daylight into the caves behind the canyon wall, windows are integrated in the same system, by placing a triangular window instead of one of the plywood triangles.



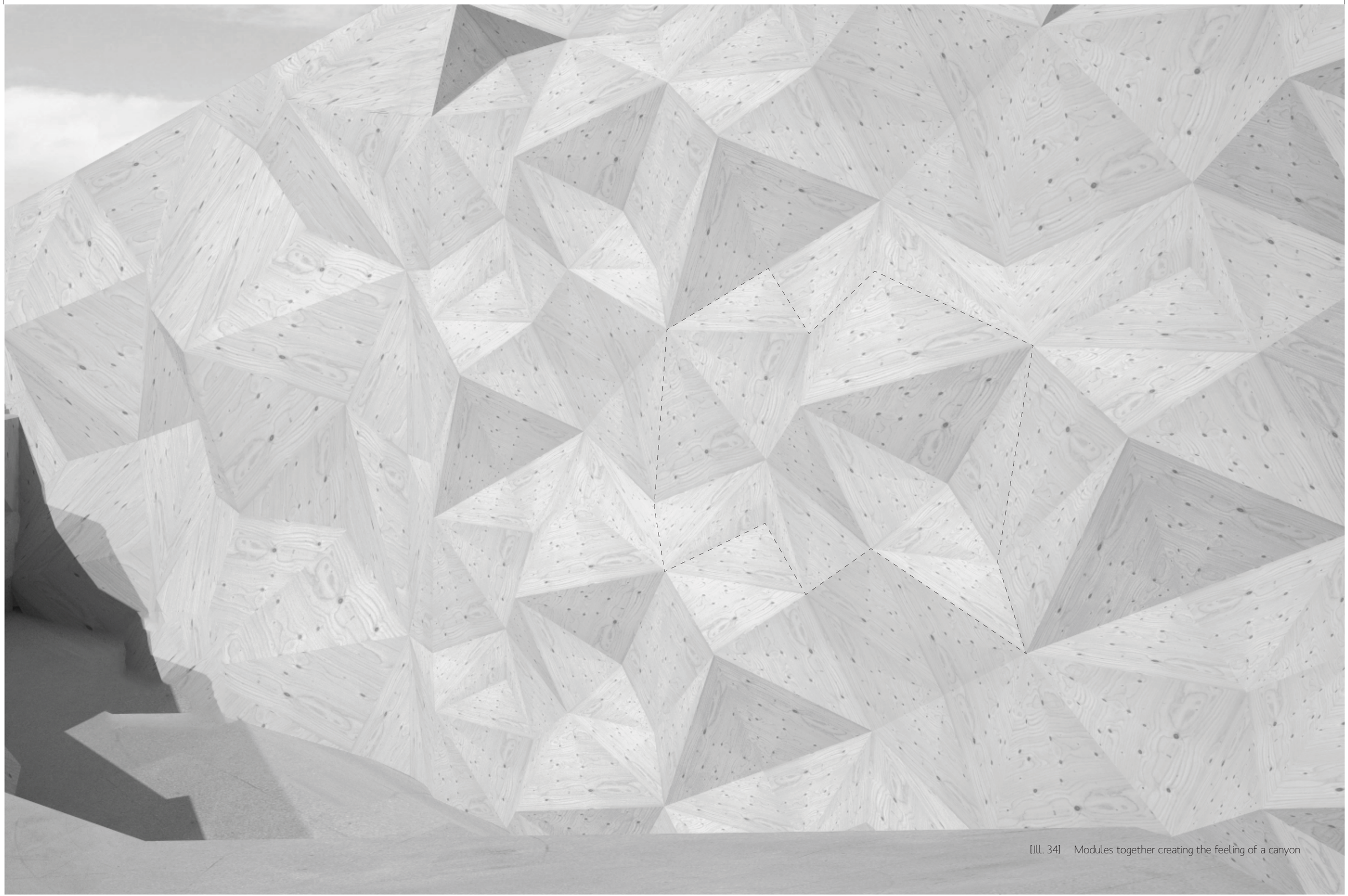
[Ill. 32] Window principle



[Ill. 31] Module principle



[Ill. 33] Steel structure



[Ill. 34] Modules together creating the feeling of a canyon

FUNCTIONS

The activity centre unites different functions in one place.

The centre has besides activity spaces for climbing and sport, also spaces for networking and relaxing - all spaces are for people to interact.

In the table, every function is listed with the respective number of square meters. The activity centre has function areas of around 10,000-12,000 square metres. Additional square metres are added for internal connections and walls.

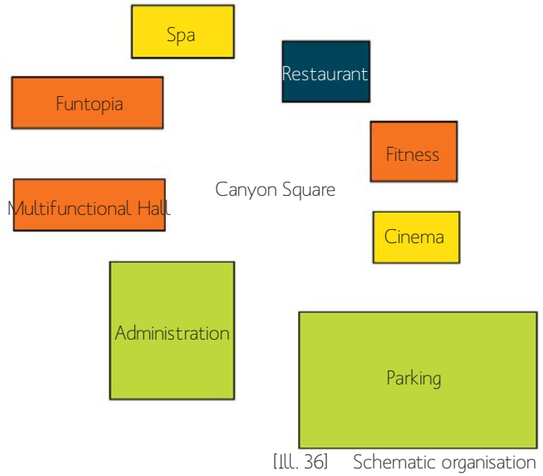
For further insight in the functions, a detailed room programme can be found in appendix C.

Climbing area	750-1000 m2
Funtopia	800 m2
Fitness	700 m2
Multifunctional Hall	800 m2
Spa Center	600 m2
Rest rooms and lockers	
Restaurant	500-700 m2
Coffe Shop	150-225 m2
Administration	2000 m2
Cinema	1200 m2

[Ill. 35] Program

Schematic Organisation

The activity centre provides many choices of different activities, which are located around the central square, Canyon Square.
The square functions as the main gathering point, where people can interact before entering one of the functions. The facades defining the central square are used by climbers, being the centre of attention when staying in the square.

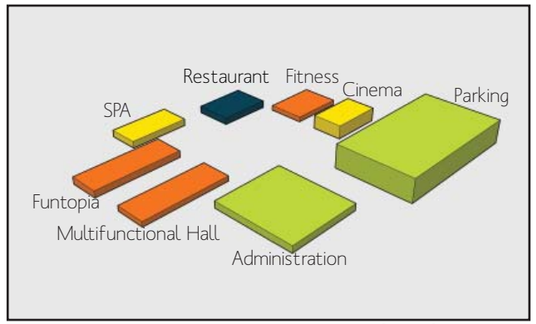


[Ill. 36] Schematic organisation

CONCEPT DEVELOPMENT

Volumes

The diagram illustrates the schematic organisation of the functions according to the demands of the competition brief [01]. The volumes are all in one storey except the cinema and parking. Due to the size of the cinema screen and to compromise the footprint of the parking, additional storeys are necessary for these two functions. This creates a multi storey car park for the whole area. All functions are in correlation with the Canyon Square

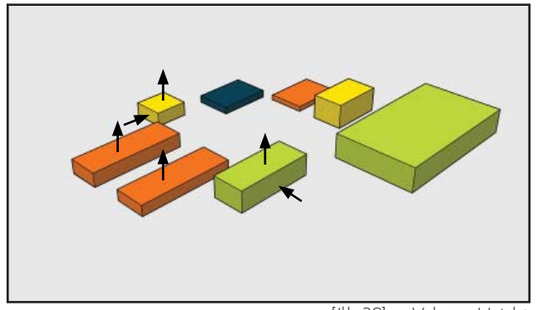


[Ill. 37] Volumes

Volume Height

The volumes are modified to create good spatial qualities to the different functions. Funtopia and the Multifunctional hall have double storey room height because of the activity level and the spatial feeling in these rooms, which have a large floor plan. The spa is also modified to a cramped floor plan with two storeys; this creates a more intimate, relaxing, and enjoyable atmosphere, which have a close connection to the different functions in the Spa area.

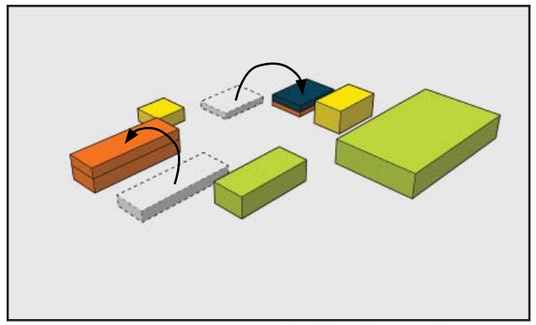
The administration is a three storey volume, making each floor plan narrow. This modification lets more daylight into each floor plan, which gives a good and light working environment.



[Ill. 38] Volume Height

Vertical Connection

There is a high level of activity in both Funtopia and the Multifunctional hall. They too have large floor plans. To give extra spatial qualities to these large rooms the multifunctional hall is placed above Funtopia, which creates a visual and physical connection between the functions.
These two double story volumes provide a four storey climbing wall on the facade.



[Ill. 39] Vertical Connections

Daylight and Organisation

Daylight and flow are parameters influencing the organisation of each volume. where some of the volumes are placed under ground level, which will be explained later. Administration, Funtopia, Multifunctional Hall and Spa are facing the street and can incorporate undisturbed daylight. The parking and cinema is placed away from the street, because these function has no requirement of daylight. Fitness and the restaurant are located in between these volumes to have an average level of daylight.

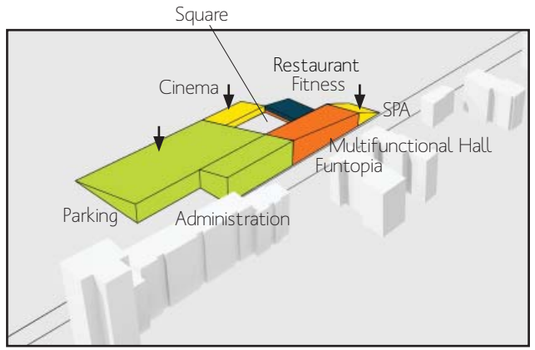
The volume constitutes a square, which have a close connection to all functions except the Spa area, which have a more private location away from the centre square. This square is the centre of this project and called Canyon Square.

Light from two Directions

The functions, which require most light (Funtopia, Multifunctional hall, Administration, and Spa), are located in the volumes receiving light from two directions. Funtopia and the Multifunctional hall are dynamic functions and their spaces need to have much natural lighting, not only for practical reasons but also to motivate and inspire people in bright surroundings.

Light from one Direction

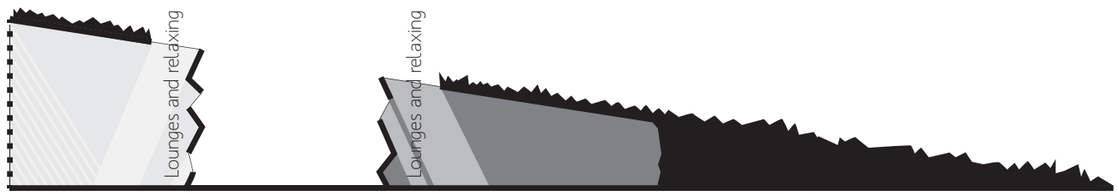
Parking, cinema and restaurant are located in the volumes, which only receive light from one direction. However, these volumes are organised in two zones - one zone with artificial light and one zone with natural light from facade windows and roof light. In the cinema, a lounge area is located in the zone with natural light, while the cinema halls and service rooms have artificial light. In the restaurant, the dining area and kitchen have natural light, while the service rooms have artificial light.



[Ill. 40] Organisation according to daylight

Landscape

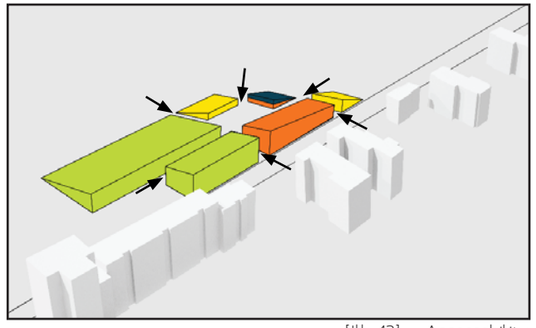
The canyon concept is correlated to the landscape. To create a canyon expression and atmosphere, the volume is forced down to the existent ground level in the end of the volumes. The landscape is transformed into parts of each volume, giving the canyon expression. The low slope will give a dramatic and unexpected canyon feeling.



[Ill. 41] Organisation according to daylight

Accessibility

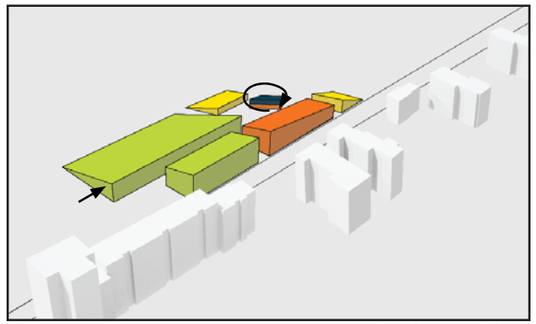
Accessibility to the Canyon Square is important to create an interesting square with a variety of open and closed spaces, where the canyon concept will be expressed by this accessibility. Only few openings exist to generate curiosity to the Canyon Square. The Canyon Square is an open outdoor space.



[Ill. 42] Accessability

Wind Flow

The sides of the volume will arise some problems according to the wind. The project development is analysed in a digital wind tunnel (appendix B). This diagram shows the modifications controlling the wind flow. The multi storey car park is moved forward to change the wind flow. The restaurant and fitness volume are rotated to control the wind and to design some varying and interesting spaces in the Canyon Square.

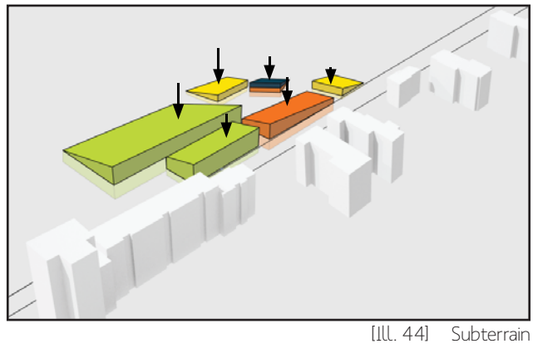


[Ill. 43] Wind flow

CONCEPT DEVELOPMENT

Subterranean Volumes

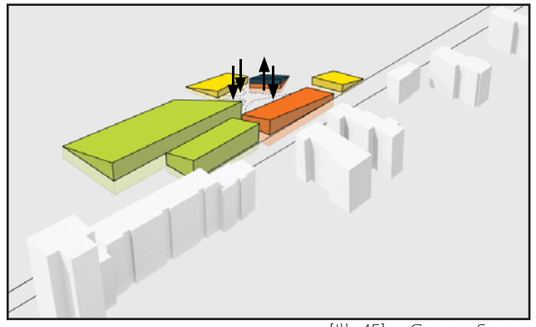
All volume is pushed down into the earth to create a canyon feeling experience. Each volume is forced more or less into the earth to create activities in different levels by an atmosphere that is interesting and inspiring. The length of the arrows symbolise how much the volumes are forced down into the earth.



[Ill. 44] Subterrain

Canyon Square

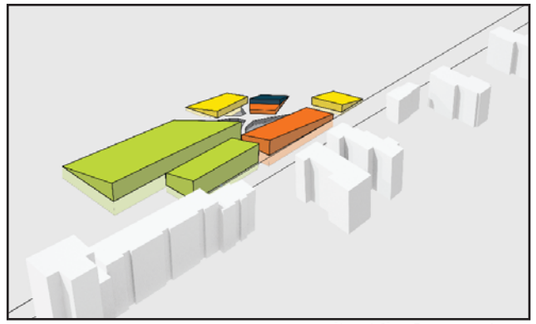
The Canyon Square is the space connecting all functions and is a interesting and inspiring environment. The Canyon Square is dividing into two areas. The selected areas are calm spaces, which invite to relaxation, enjoyment, and breaks. The area in the middle creates a plaza and transit area with accessibility to all functions. This is a more windy area, but yet acceptable because of the modifications, documented by the digital tunnel study (Appendix B).



[Ill. 45] Canyon Square

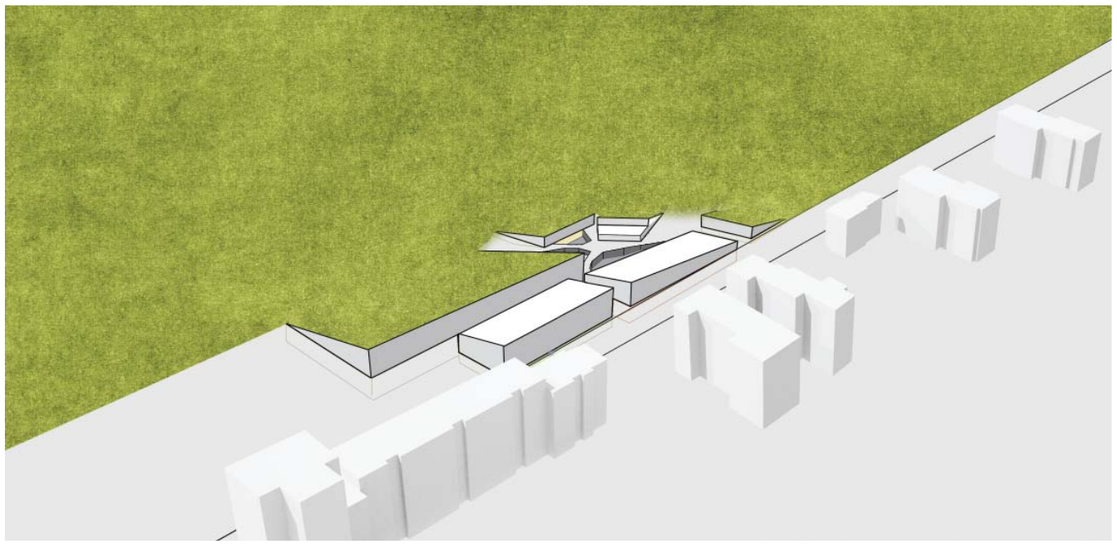
Calm and Relaxing Areas

The digital wind tunnel study verifies calm areas in the Canyon Square (Appendix B). These areas are forced down to the lowest level creating more private spaces for relaxation and enjoyment. This creates a high climbing wall from the lowest level to the highest point, resulting in a unique feeling and space in the Canyon Square. Pulling the fitness area forward creates a plateau for the restaurant, which will establish an outdoor service restaurant area in the Canyon Square.

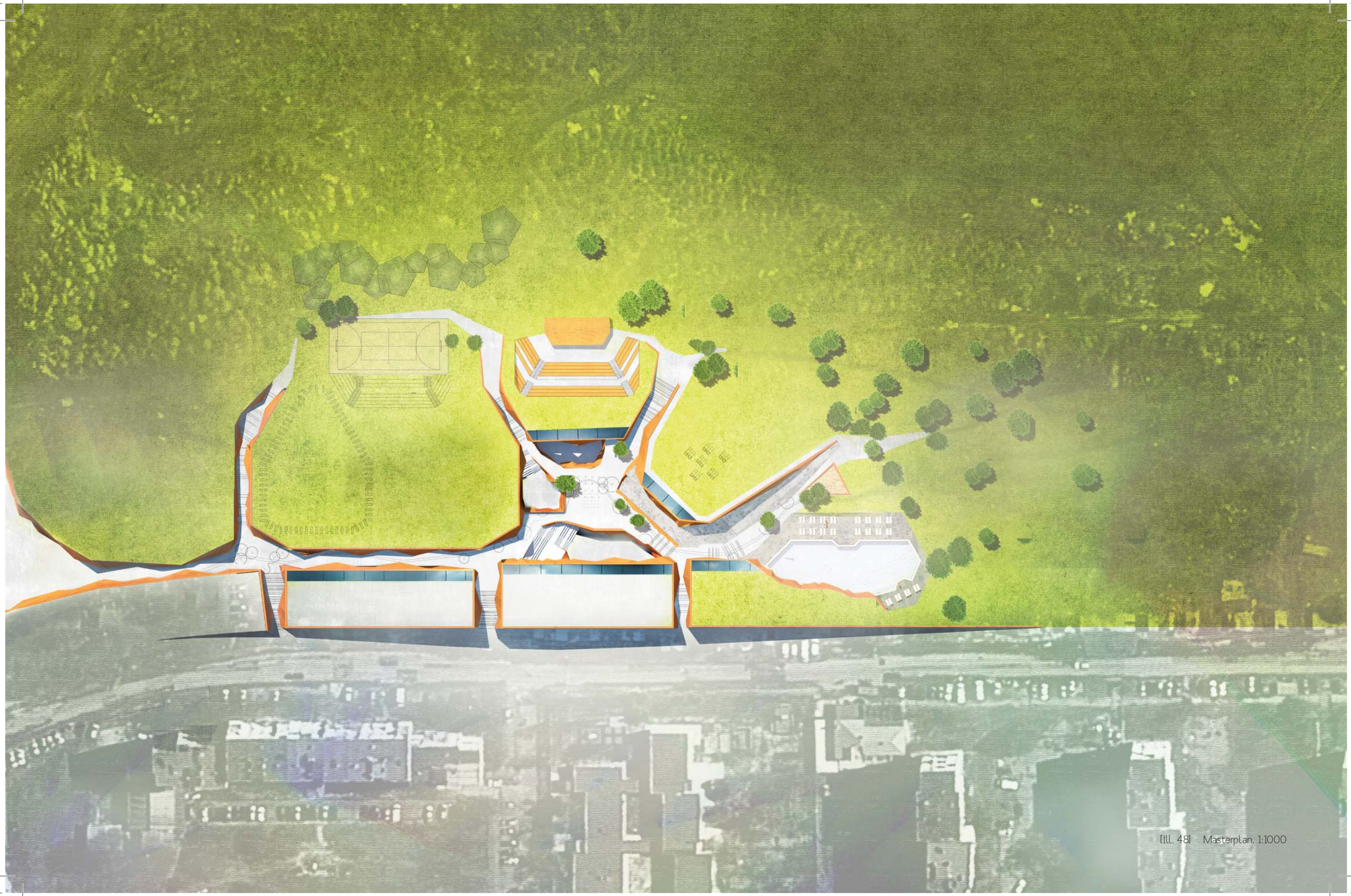


[Ill. 46] Relaxing Areas

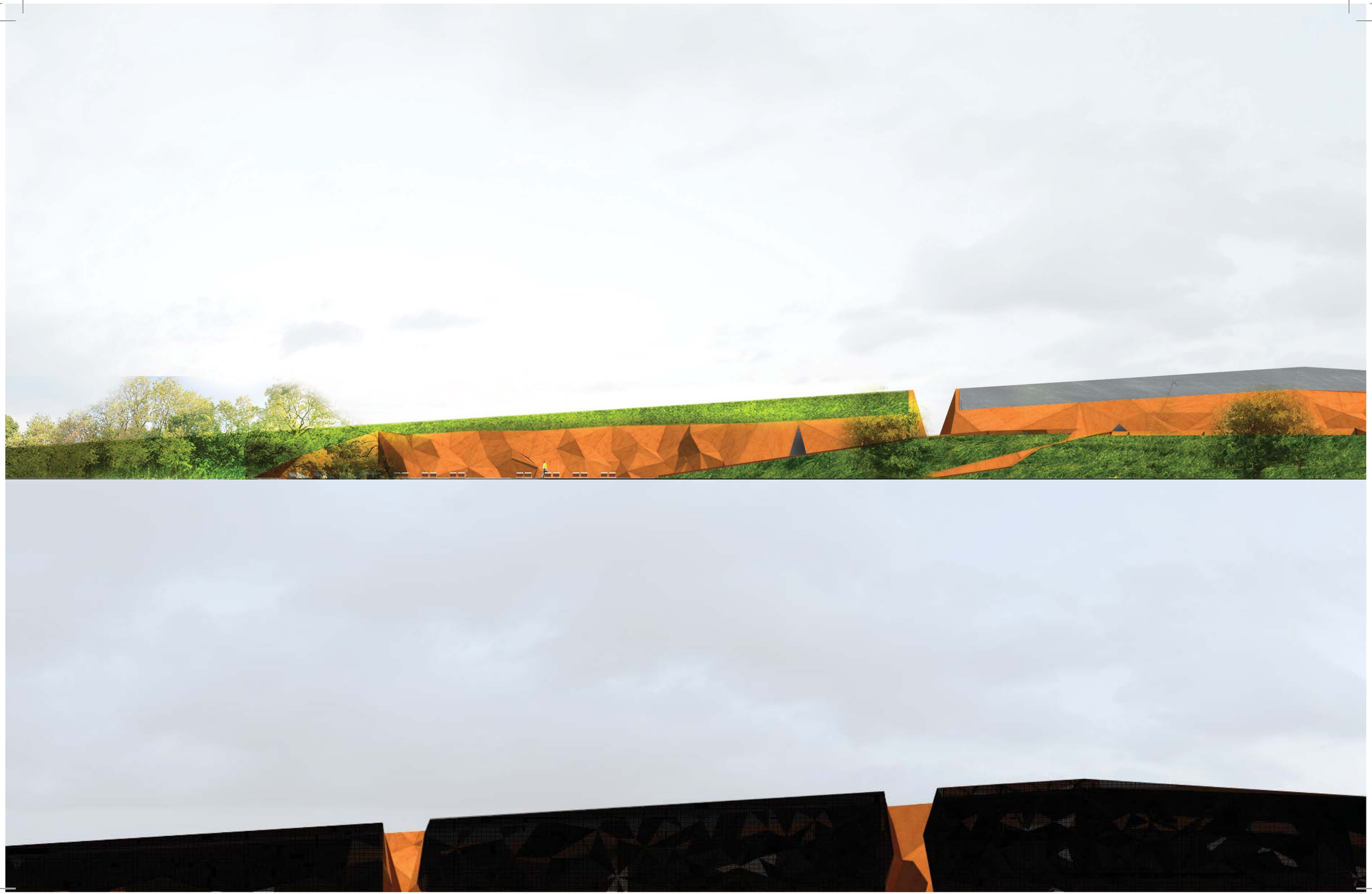
The composition and organisation of each volume and function is visualised and argued through the previous steps. The canyon expression is the main idea of this project. The prospectively development of the concept will be based on a close relation to the previous steps



[Ill. 47] Integration of Landscape and City



[Ill. 48] Masterplan, 1:1000

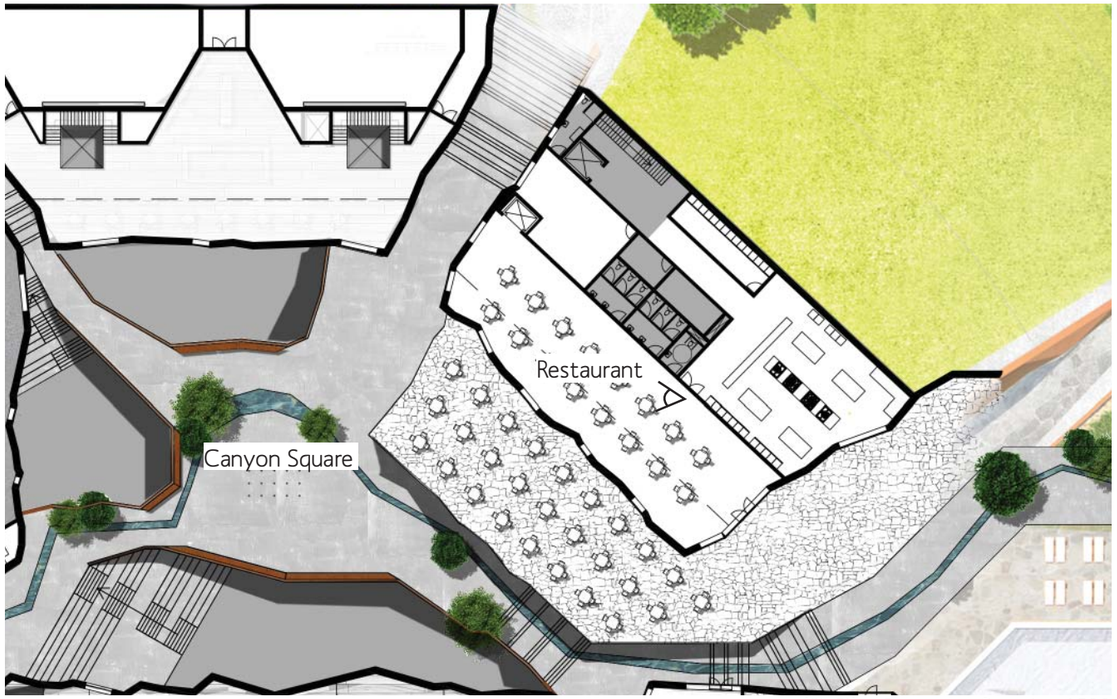


[Ill. 49] Elevation east

[Ill. 50] Elevation West

RESTAURANT

The restaurant offers a break in the intense activity centre as a relaxing space to enjoy a meal while looking out at the climbers on the climbing walls or people in the Canyon Square.
The lightest area in the restaurant, under the roof light and close to the canyon wall, is where the dining area is located.

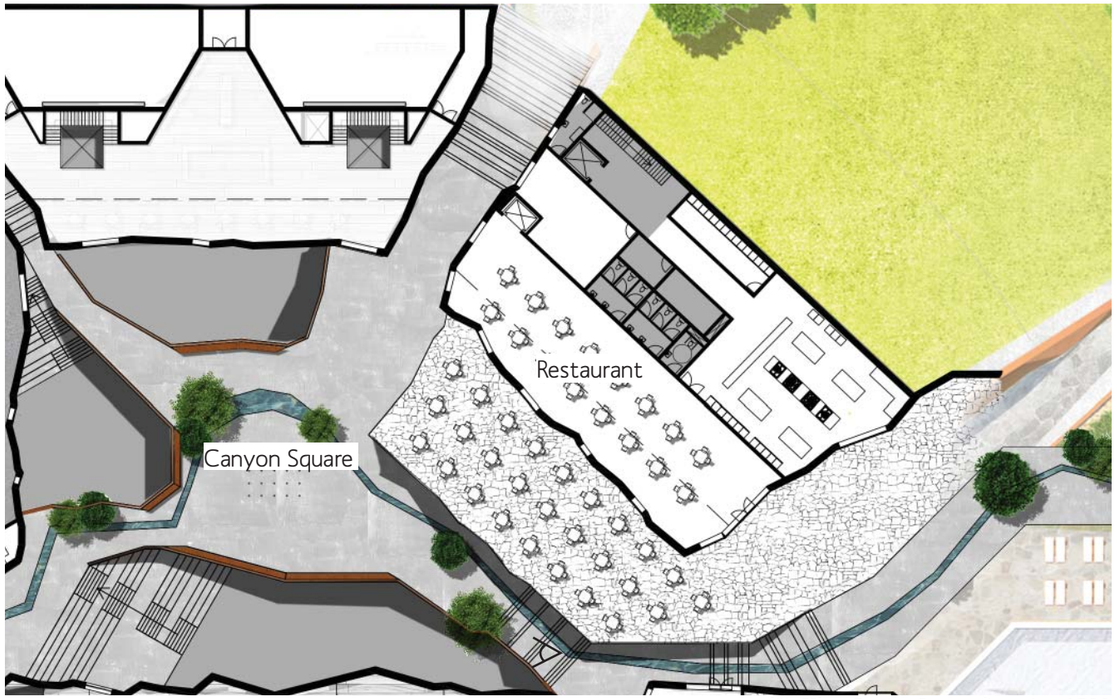


[Ill. 51] Restaurant, floorplan, 1:500

[Ill. 52] Interior, restaurant

CANYON SQUARE

The Canyon Square gathers people from the different functions around the square, and people taking a walk in the area.

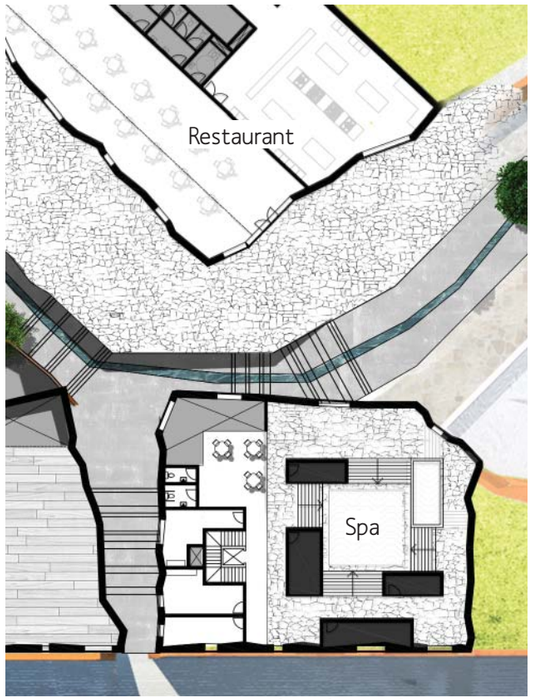


[Ill. 53] Canyon Square, floorplan, 1:500

[Ill. 54] Canyon Square, winter

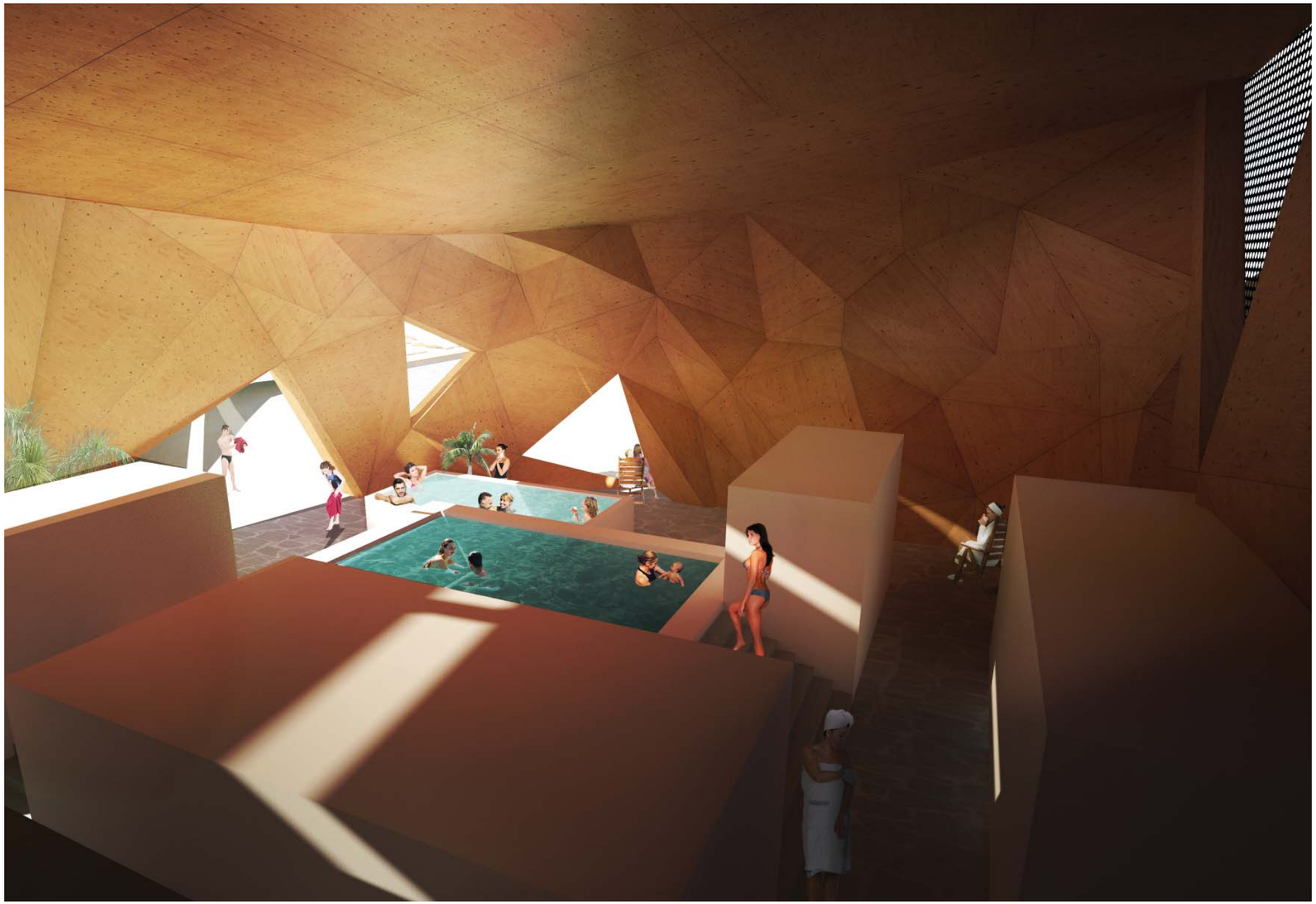
[Ill. 55] Canyon Square

SPA



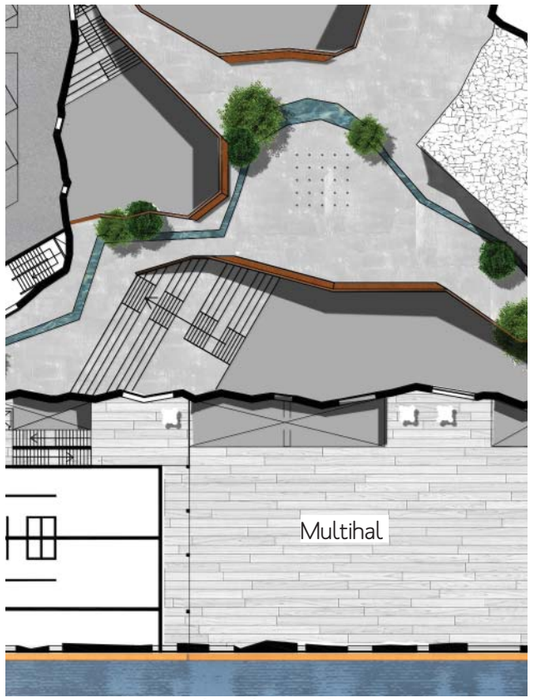
[Ill. 56] Spa, floorplan, 1:500

The interior rectangular spaces of the spa create a contrast to the surrounding plywood walls. The feeling of a secret sanctuary is highlighted by the white rectangular spaces with baths, saunas, and massage rooms inside.



[Ill. 57] Spa

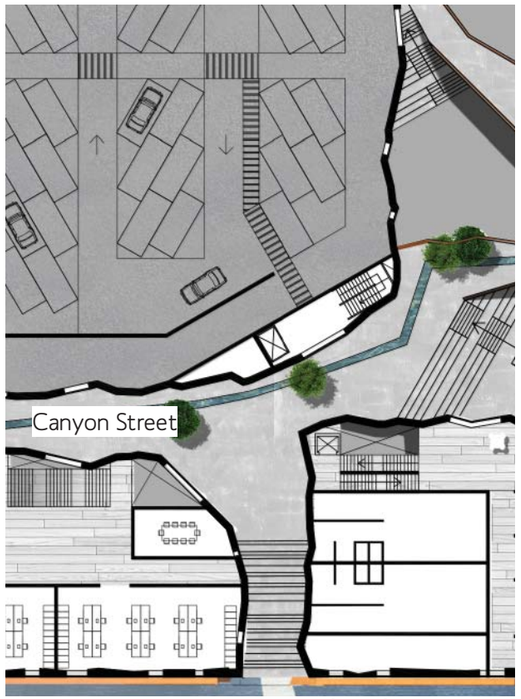
MULTIHALL



[Ill. 58] Multifunctional Hal, floorplan

[Ill. 59] Multifunctional Hal

CANYON STREET



[Ill. 60] Canyon Street

[Ill. 61] Canyon Street

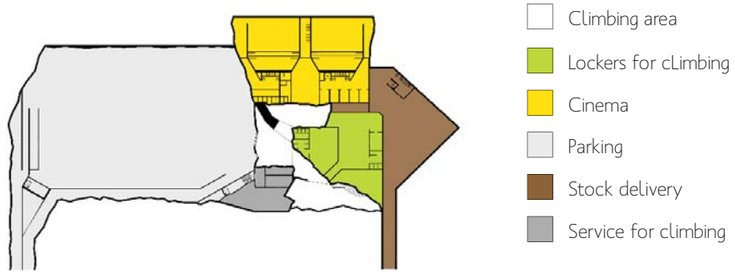
LEVEL -4 - 8000

This level is the lowest floor of the activity centre. The floor plan contains the climbing area, where the athlete can use the high climb walls, which stretches from the bottom to the roof.
The climbing and boulder areas have a small division underneath the Canyon Square, which separate but yet still link these functions.

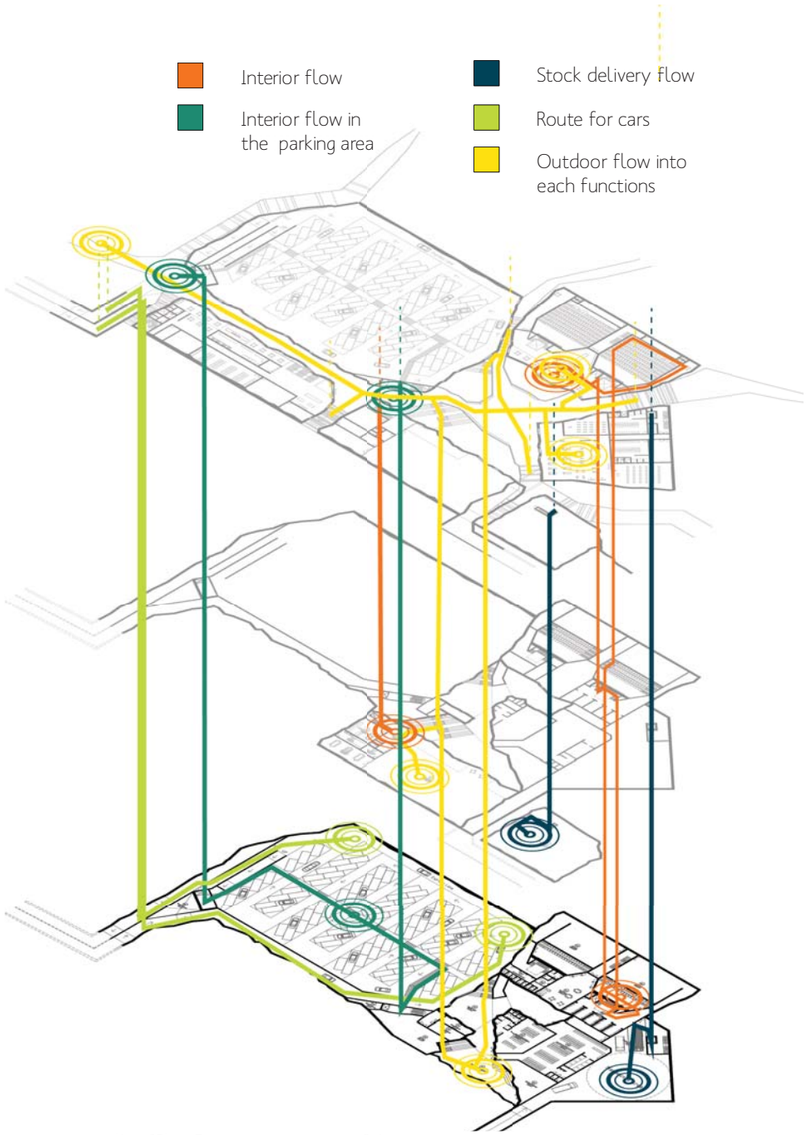
Providing an easy access to the climbing area, the locker rooms are located underneath the Canyon Square.
The two wide stair cases give access to the climbing area from the roads and the green wedge. These wide stair cases can also be used for small breaks or short stays.

The cinema is placed in the lowest level to achieve large spatial qualities when watching a movie. On this level, the cinema area has restrooms and wardrobes for the users, and the employees have their own working and relaxation spaces.

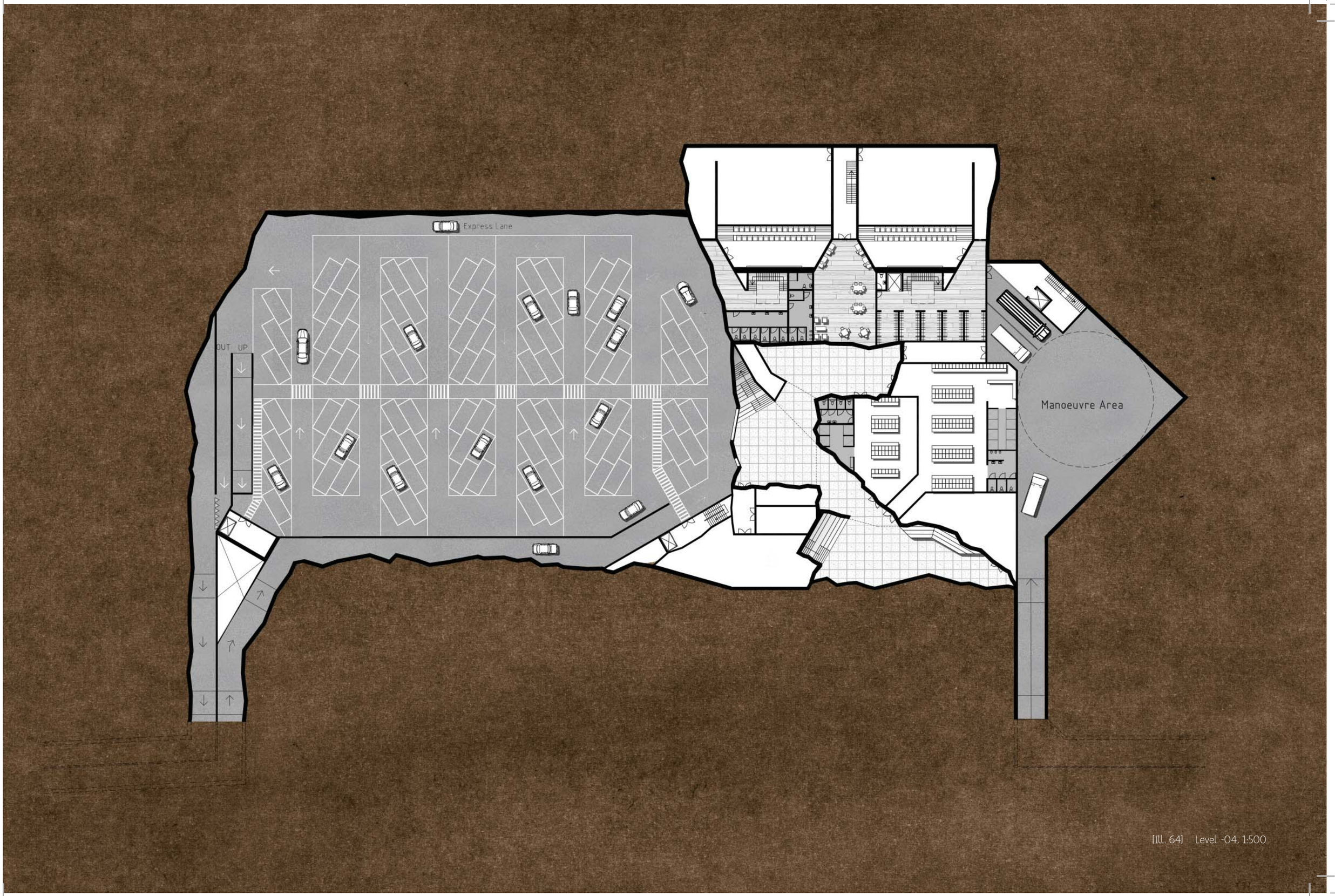
Access for cars and stock delivery is gained from ramps passing underneath the canyon street, dividing the heavy traffic from the people in the canyon street.



[Ill. 62] Function diagram, level -04



[Ill. 63] Flow diagram, level -04



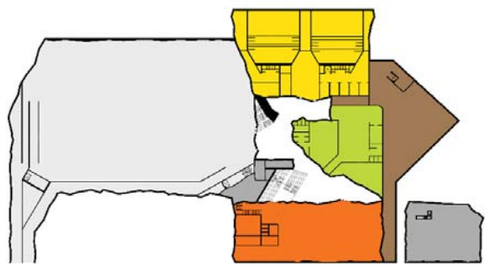
[Ill. 64] Level -04, 1:500

LEVEL -3 - 6000

This floor plan contains the access to Funtopia from the wide stair cases, which are located near the lobby area. Inside Funtopia, there is a vertical connection to the coffee shop above the locker rooms. This connection continues to the Multifunctional hall.

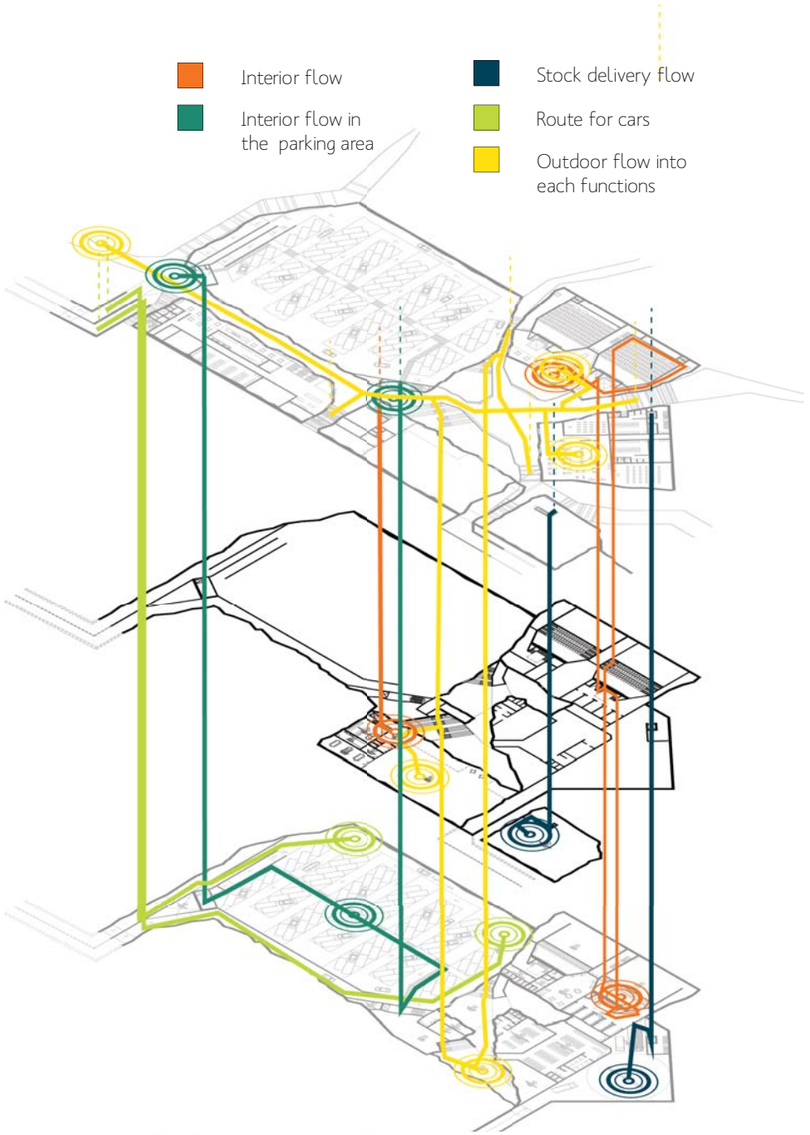
The party room in Funtopia has an internal vertical connection to the kitchen area in the coffee shop, for providing services to the party room.

The technical area provides services for the spa area, which requires easy access from underneath to each bath.

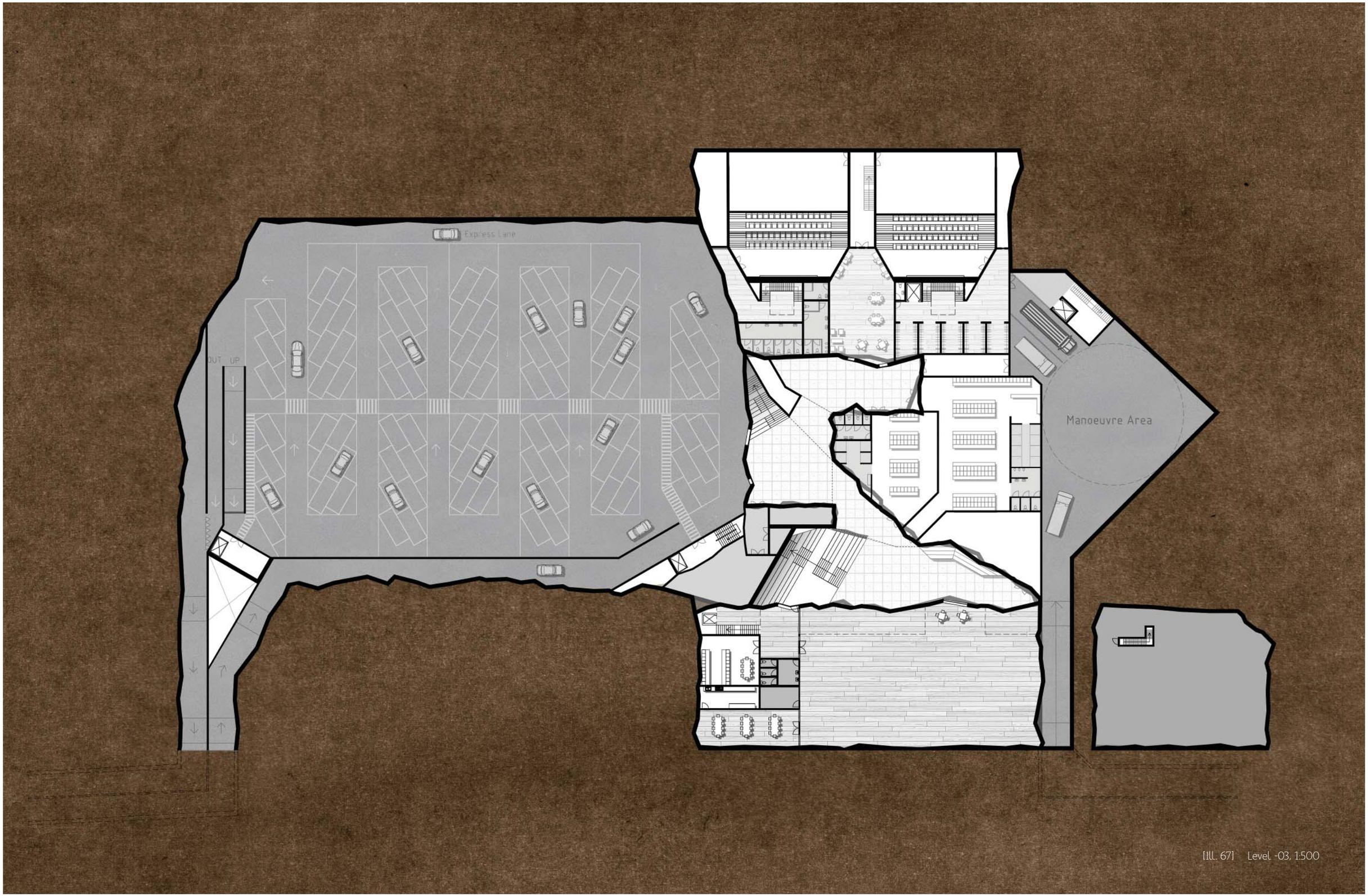


Climbing area
Lockers for cLimbing
Cinema
Parking
Stock delivery
Service for climbing and SPA
Funtopia

[Ill. 66] Functions, Level -03



[Ill. 65] Flow diagram, level -03



[Ill. 67] Level -03, 1:500

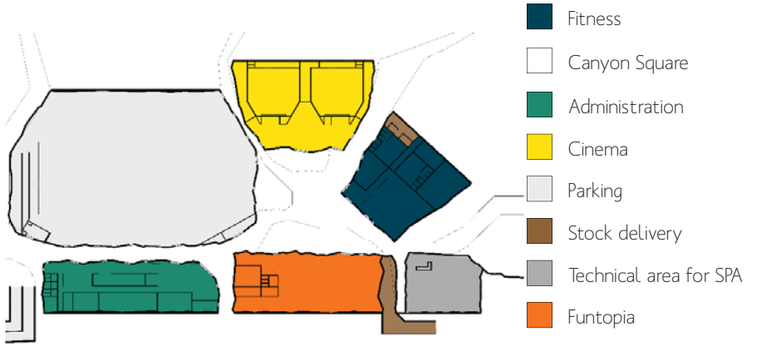
LEVEL -2 - 4000

The Canyon Square is placed on this floor, which is connected to almost all functions such as administration, cinema, fitness and the parking area.

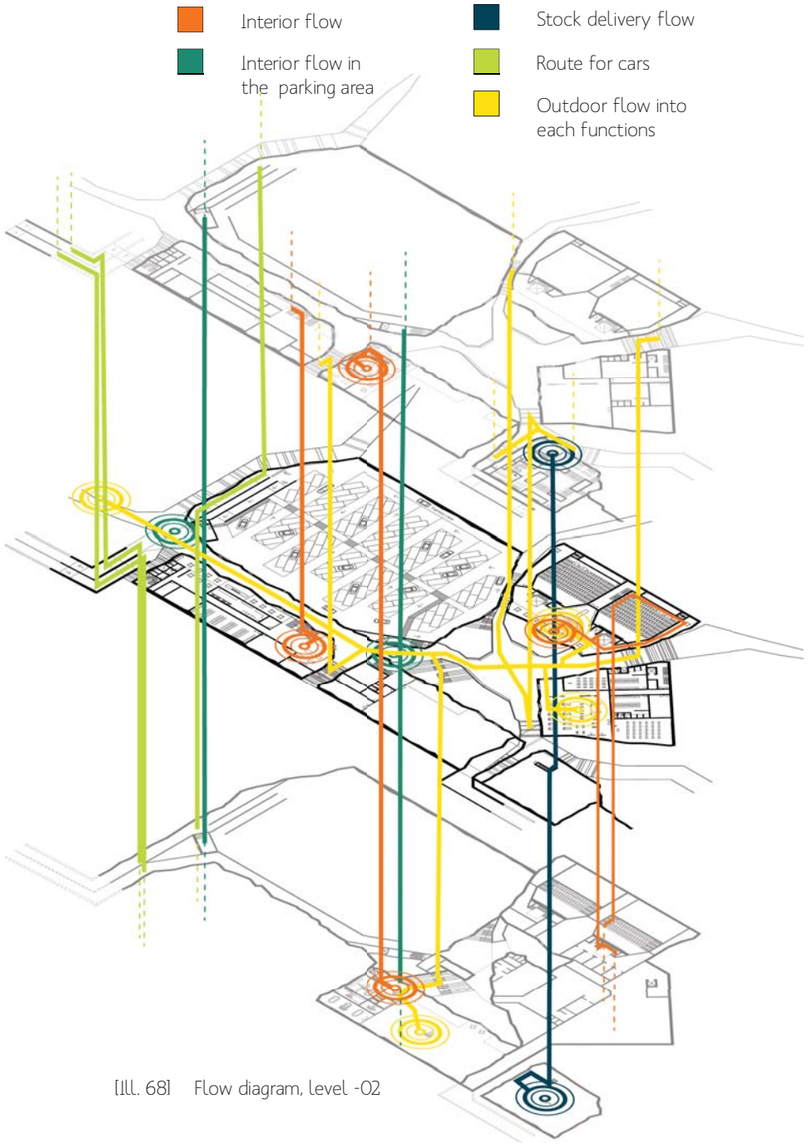
The fitness area is one storey level, having a visual and a direct connection to the Canyon Square.

The administration is placed as the first function you meet, when arriving from the underground station, here the lobby area faces the Canyon Square.
The lounge area in the cinema has free level access for the wheelchair user to get easy entree to the cinema.

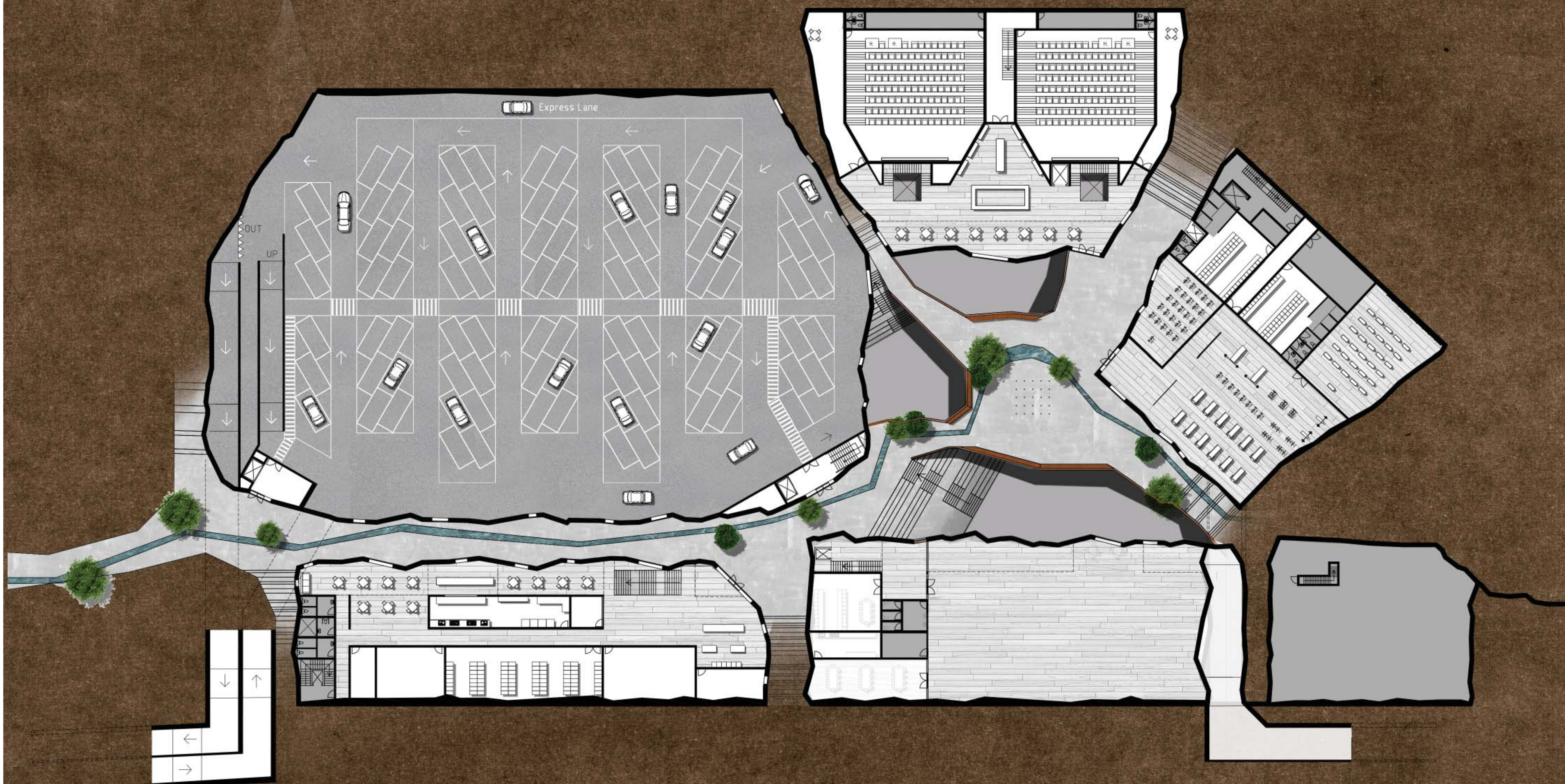
On level -2 the parking area has a direct access to the canyon street from the parking area.



[Ill. 69] Functions, level -02



[Ill. 68] Flow diagram, level -02



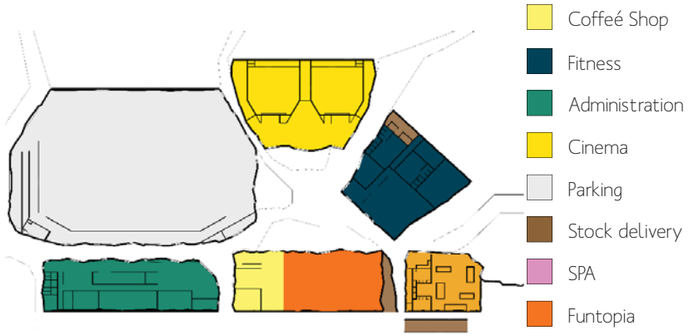
[Ill. 70] Level -02, 1:500

LEVEL -1 - 2000

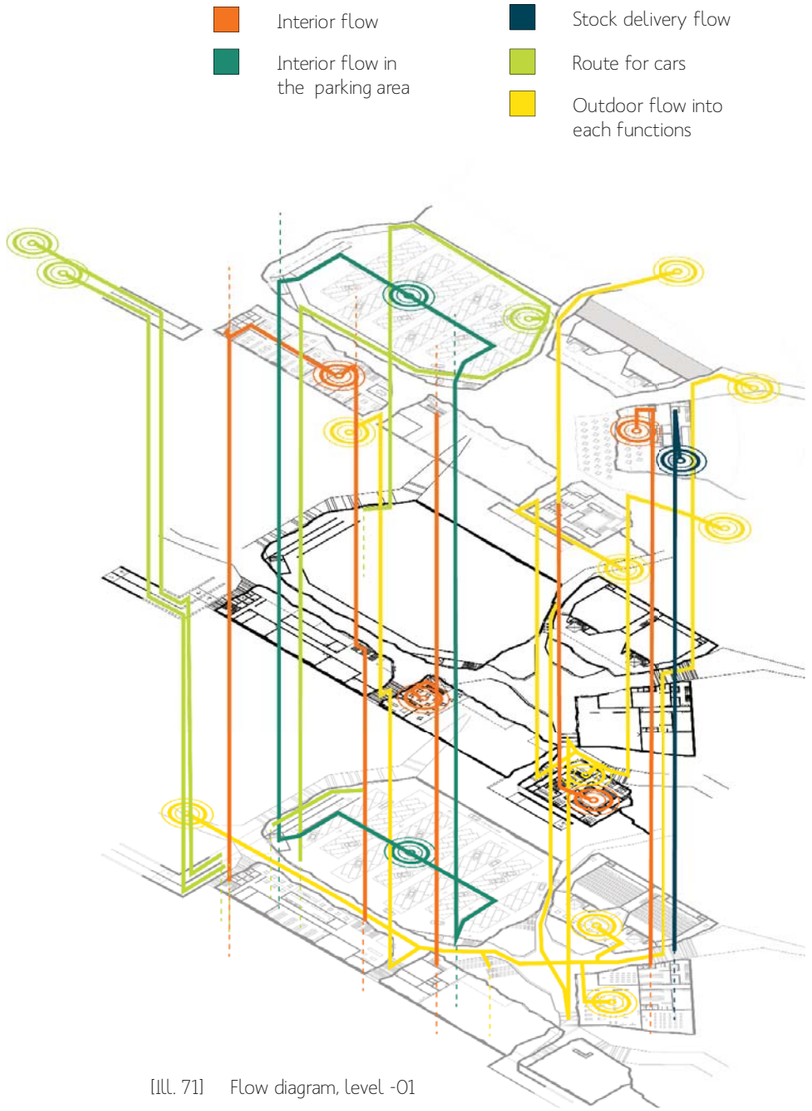
The spa area is placed a little away, but still with a visual connection to the Canyon Square. The spa has a more private atmosphere and different level of activity, which explains the location. The pool area located in relation to the spa has the Vitosha Mountains in the background.

The coffee shop is placed in an activity filled environment, with a location above the locker rooms of Funtopia. This location provides quality for Funtopia and the coffee shop, giving parents an opportunity to relax and enjoy a cup of coffee, while the children are playing around.

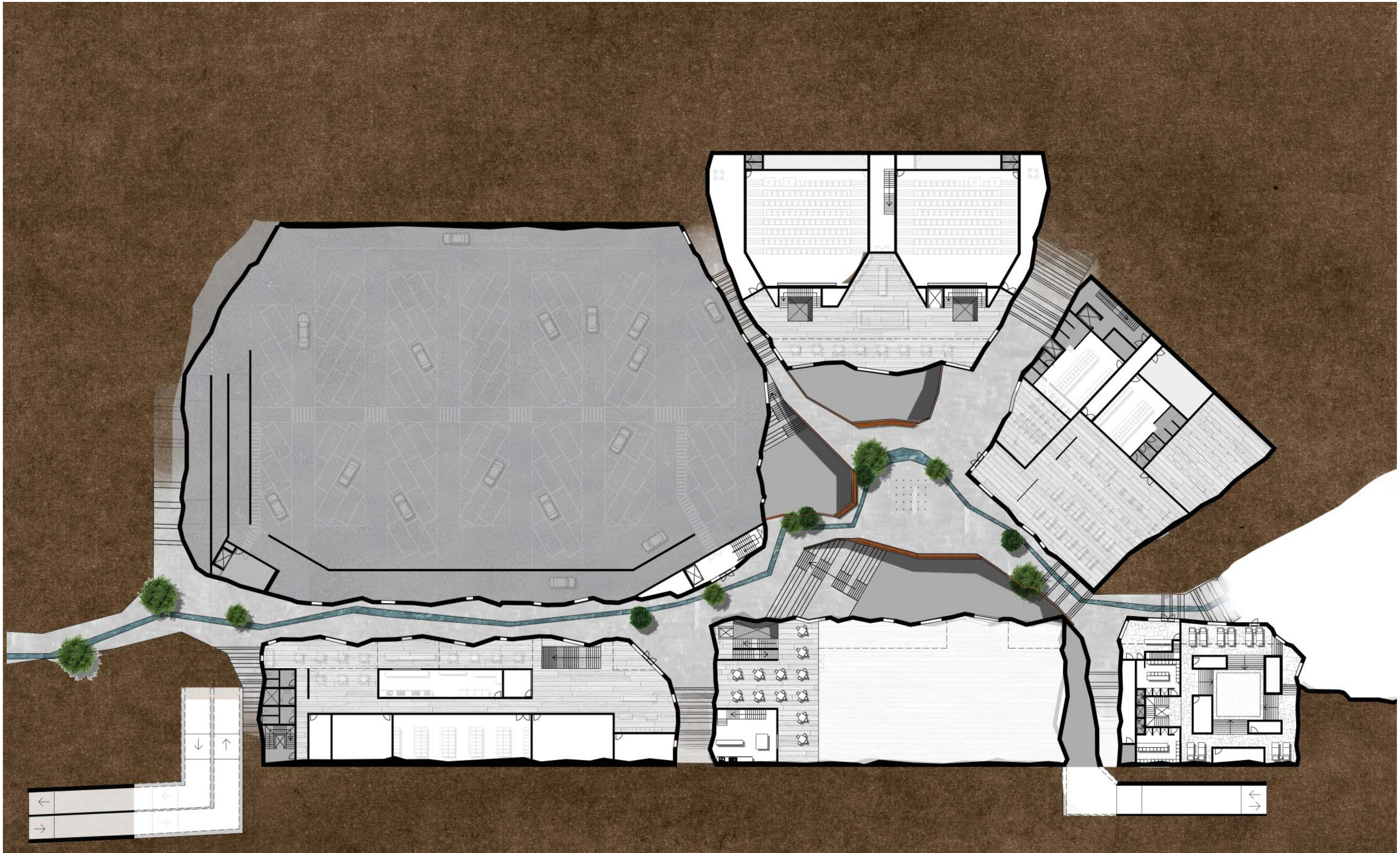
Administration has two separate exits, according to fire issues and easy accessibility to the different working spaces.



[Ill. 72] Functions, level -01



[Ill. 71] Flow diagram, level -01



[Ill. 73] Level -01, 1:500

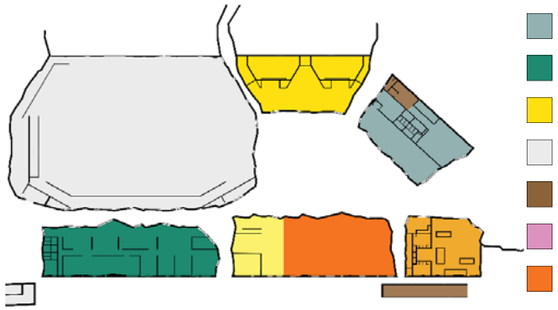
LEVEL 0 0000mm

This floor plan provides access to the green wedge and the city through the stairs in the edge of Canyon Square.

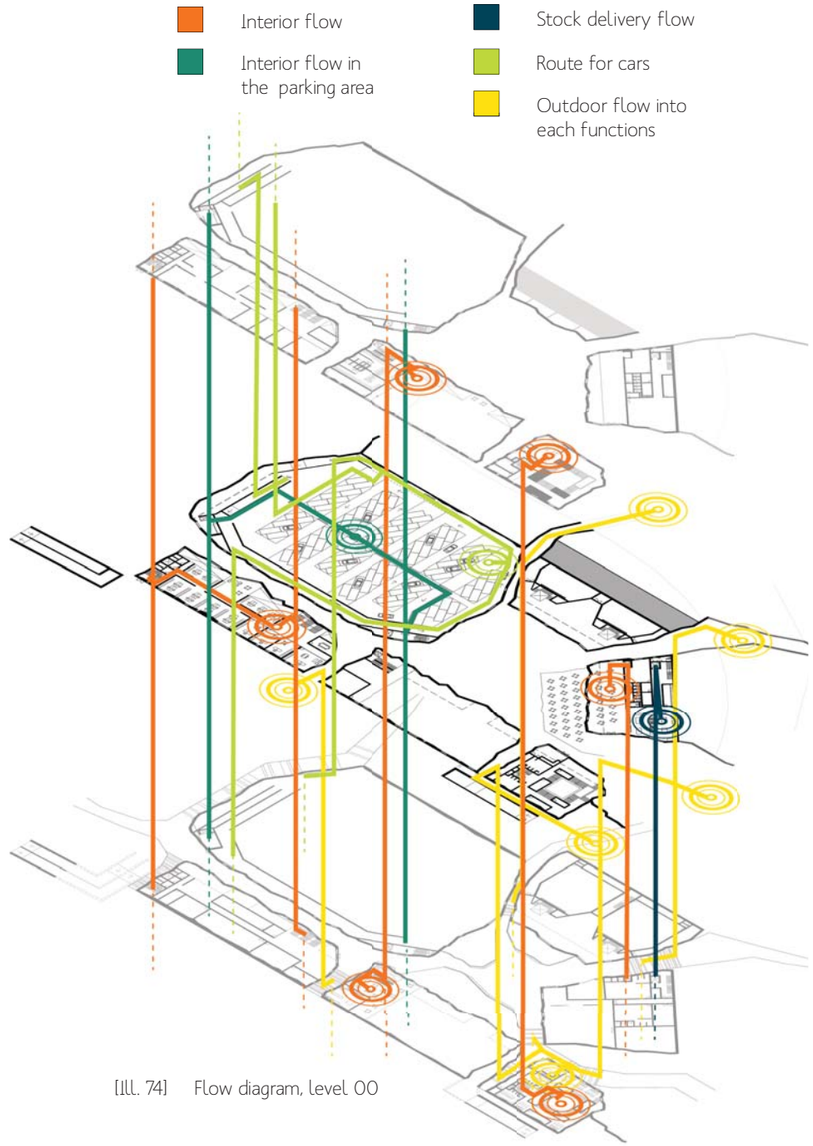
The restaurant is located on this level. Because the restaurant is located higher than Canyon Square, activity is created in several levels. The wheelchair user can get access to the restaurant by using the elevator located near the cinema from the Canyon Square.

The parking floor uses the vertical connection to access the canyon street.

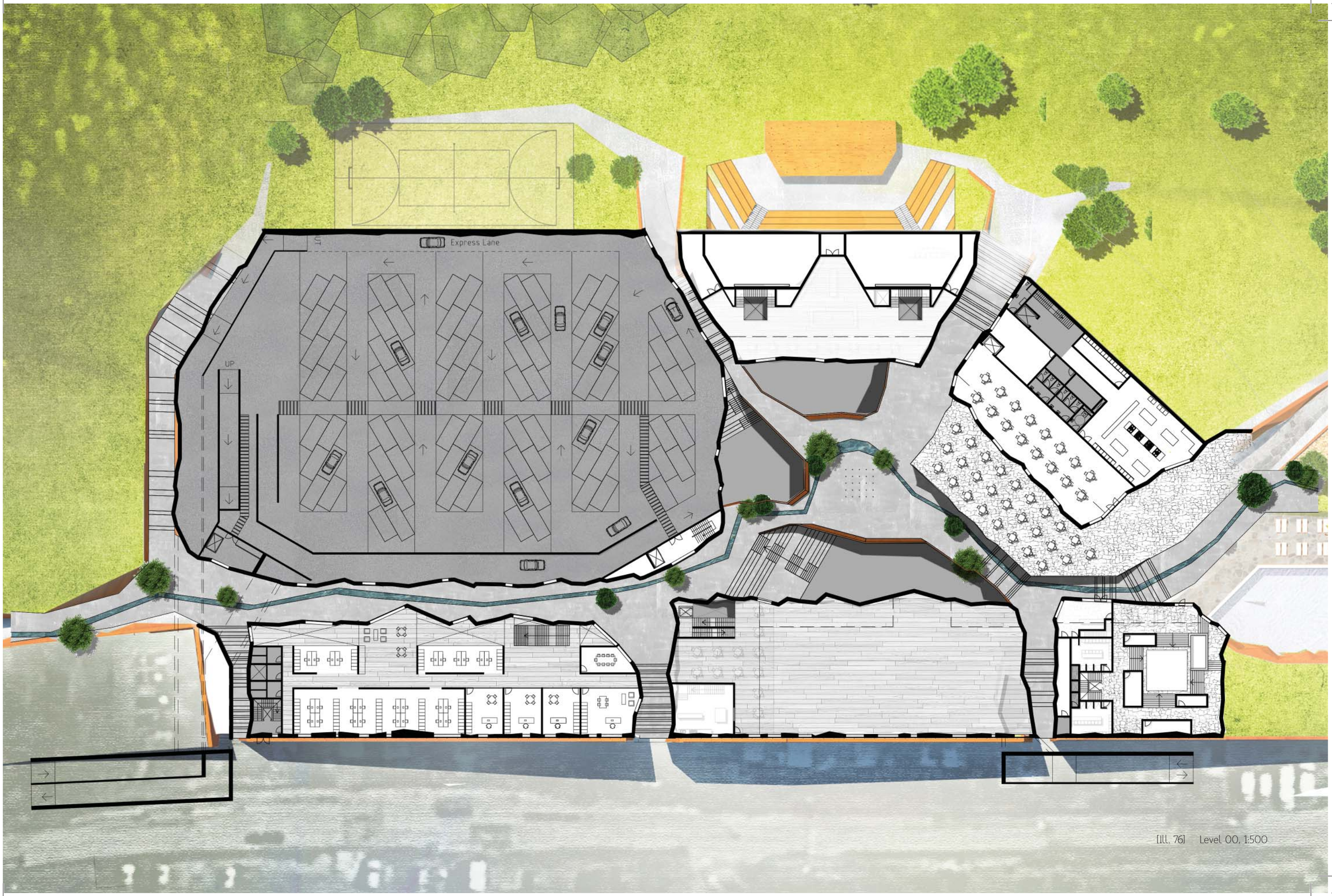
The spa area is in two storeys, having an internal vertical connection that generates an interesting environment with life and experiences in two levels.



[Ill. 75] Functions, Level 00



[Ill. 74] Flow diagram, level 00



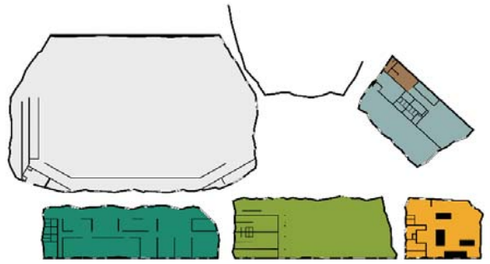
[Ill. 76] Level 00, 1:500

LEVEL 1 +2000mm

This floor plan has connections to the Multifunctional hall by the vertical connections from Funtopia.

The Multifunctional hall has visual connection with Funtopia, which also provides daylight down to Funtopia.

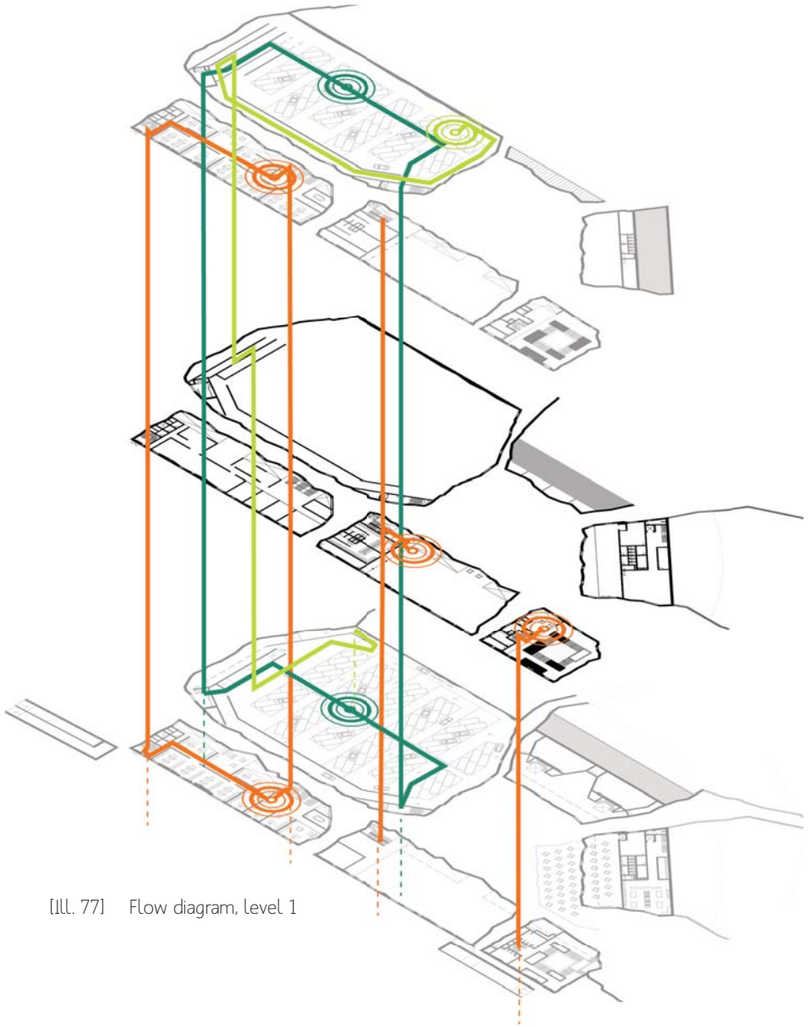
The spa area has a balcony that connects the massage room to the spa, but also gives an overview to the different levels.



Restaurant
Administration
Parking
Stock delivery
SPA
Funtopia

[Ill. 78] Functions, Level 1

Interior flow
Interior flow in the parking area
Stock delivery flow
Route for cars
Outdoor flow into each functions

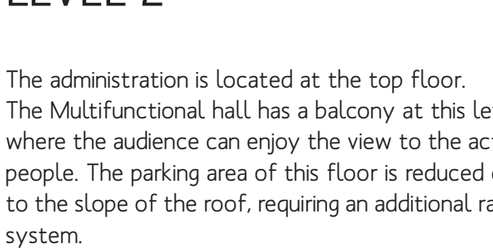


[Ill. 77] Flow diagram, level 1

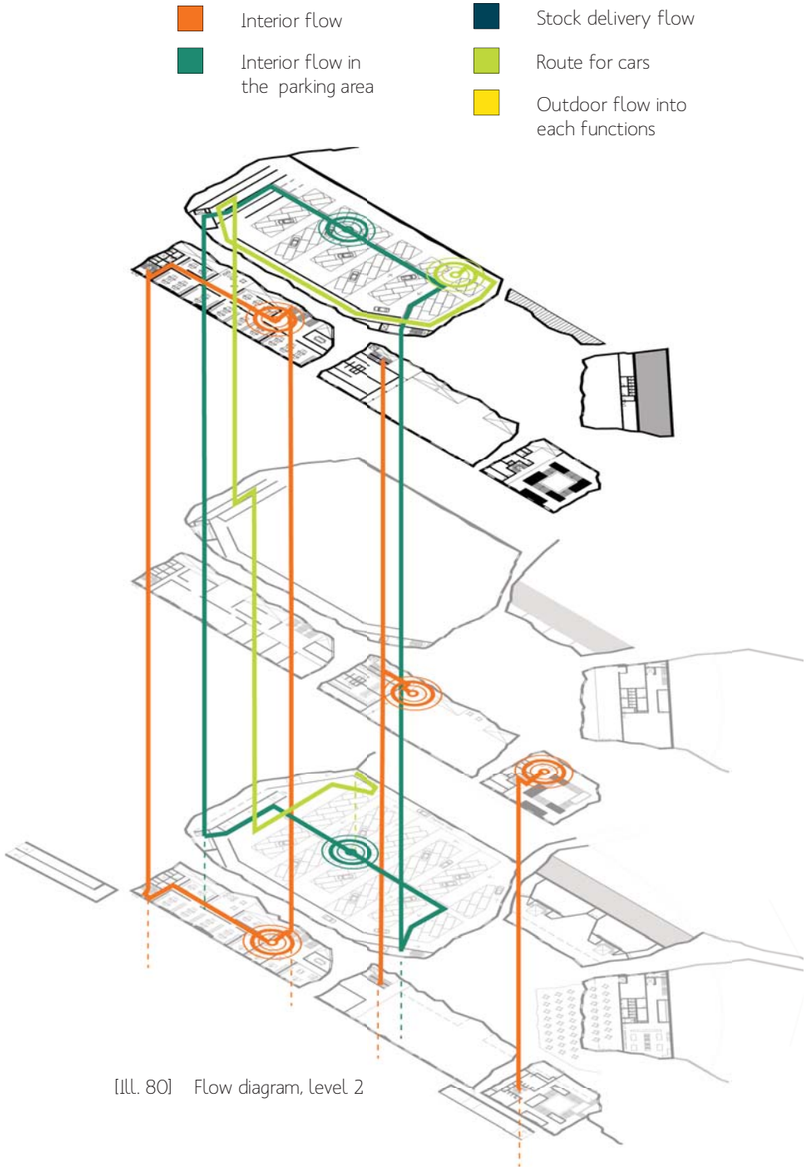
[Ill. 79] Level 01 1:500

LEVEL 2 +4000mm

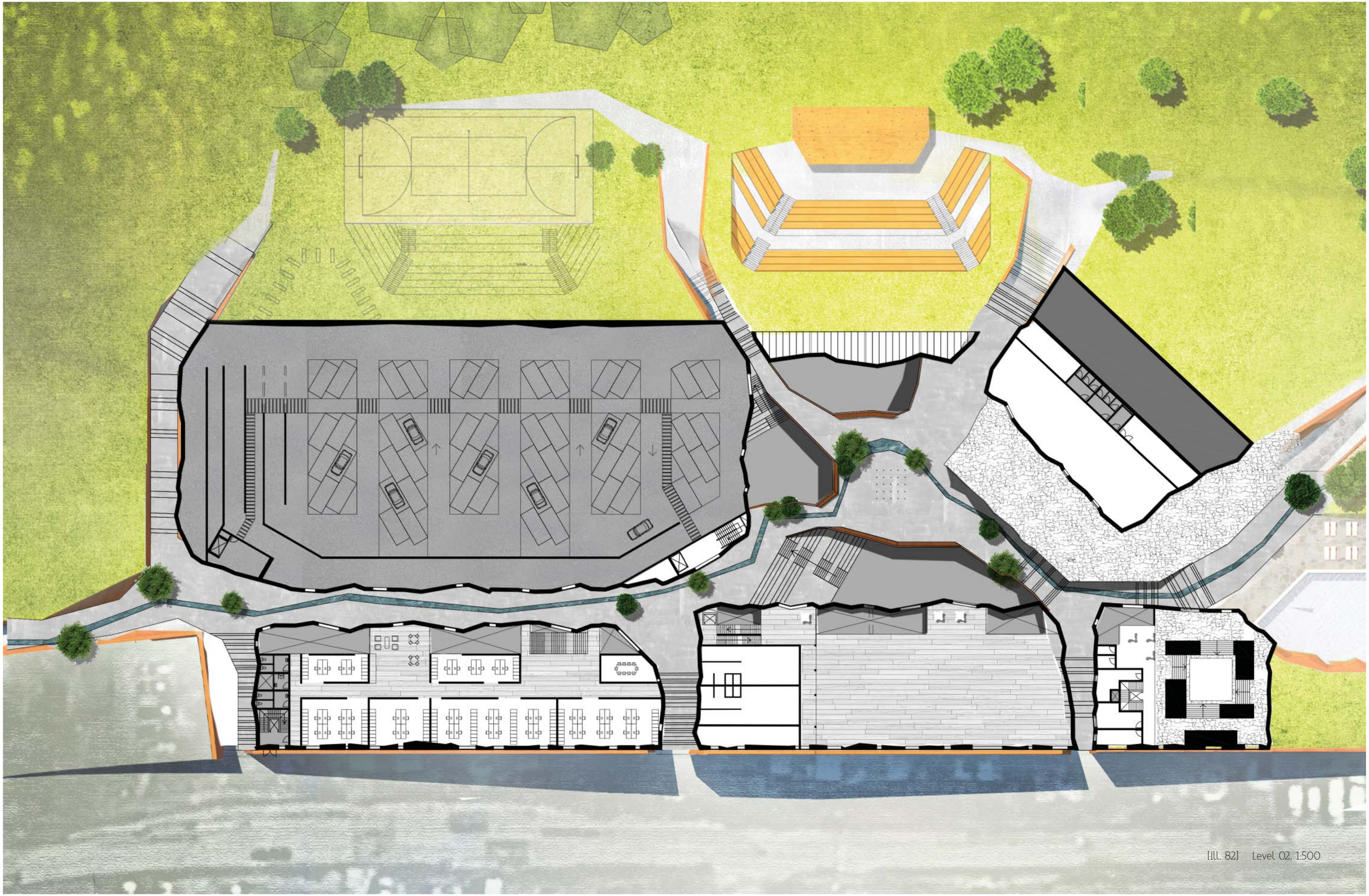
The administration is located at the top floor.
The Multifunctional hall has a balcony at this level, where the audience can enjoy the view to the active people. The parking area of this floor is reduced due to the slope of the roof, requiring an additional ramp system.



[Ill. 81] Functions, Level 2



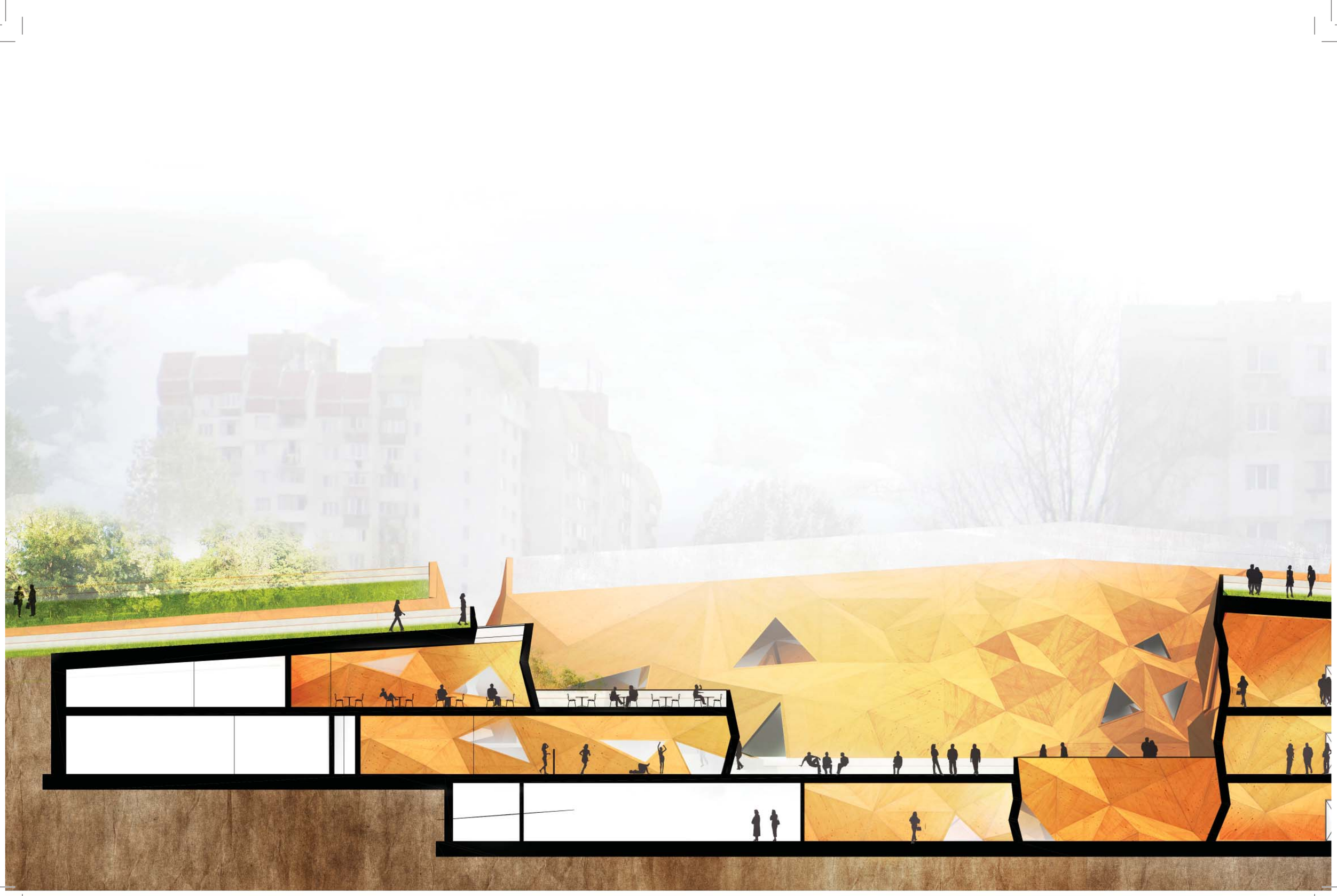
[Ill. 80] Flow diagram, level 2



[Ill. 82] Level 02, 1:500

[Ill. 83] Section CC

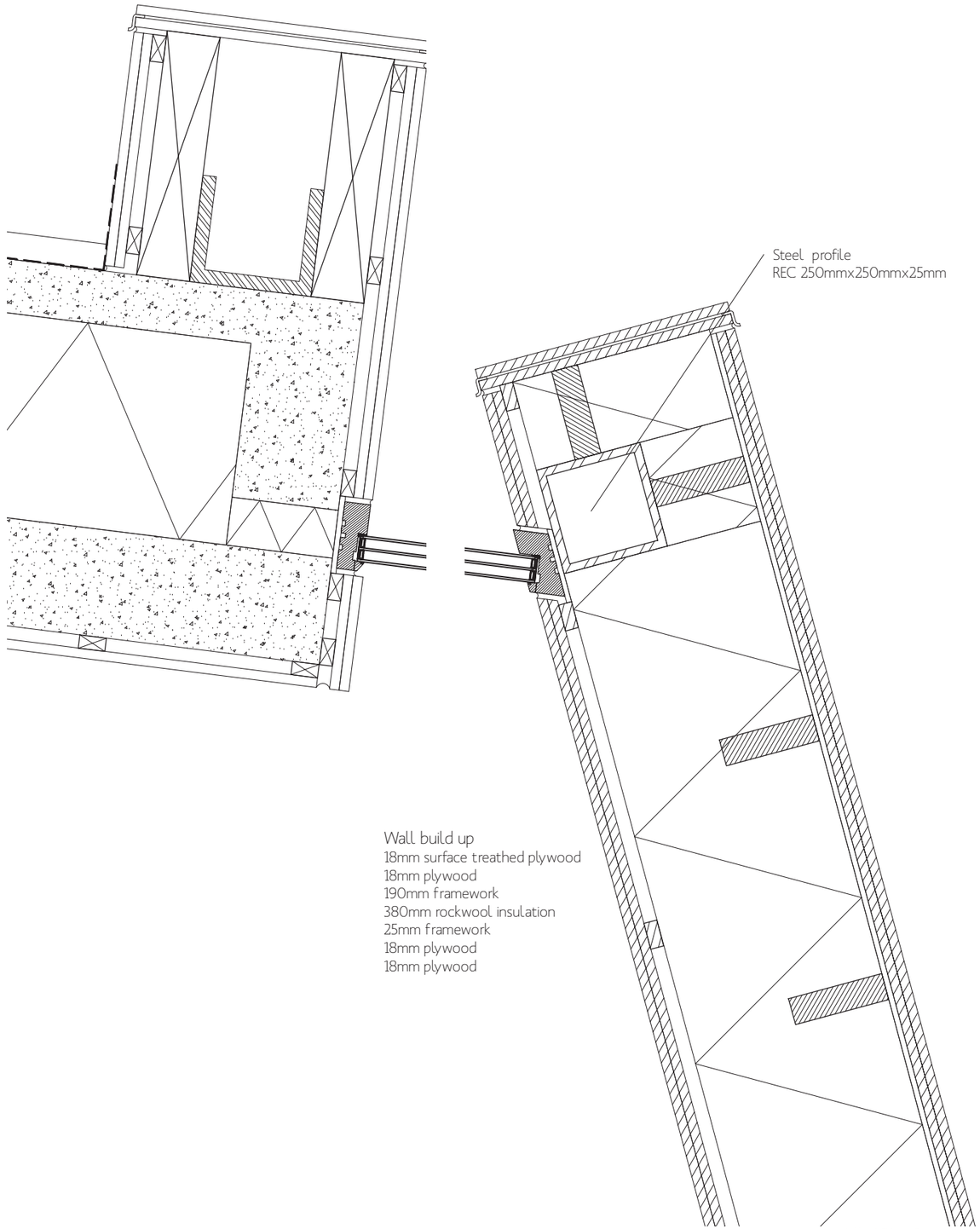
[Ill. 84] Section BB



[Ill. 85] Section BB

DETAIL A
WALL / ROOFLIGHT

[Ill. 86] Rooflight

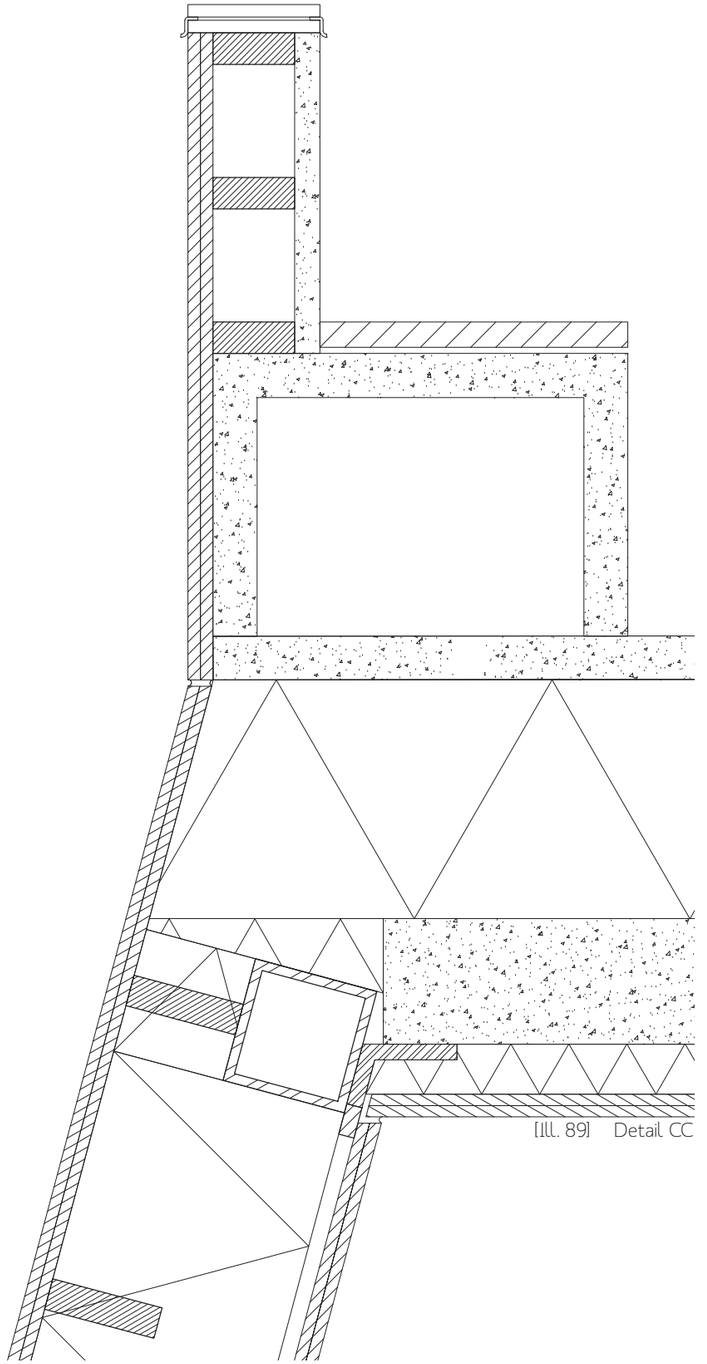


Wall build up
18mm surface treathed plywood
18mm plywood
190mm framework
380mm rockwool insulation
25mm framework
18mm plywood
18mm plywood

[Ill. 87] Detail A

DETAIL C
RAILING AND BENCH

[Ill. 88] Railing and bench



Floor build up
70mm concrete
380mm rockwool insulation
200mm concrete
25mm framework
18mm plywood

[Ill. 89] Detail CC

CONCLUSION

The project set out to create an activity centre conceived as a landscape. With climbing as the main activity of the centre, associations to the phenomenon of a canyon arose. The canyon concept was included through design, material choice and composition, creating an inspiring atmosphere for people to interact through sports and different activities. Material choice was of great importance to encourage interaction, which is why materials, that are nice to stay in and touch, were chosen. Technical studies, early in the process, have contributed in the development of the project.

The activity centre was located in an area with a growing population. The use of the canyon concept in this project by creating floors into the ground provides perspectives on exploiting the subsoil in cities with growing populations.

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ILLUSTRATIONS

[Ill. 01] Interaction
Own illustration

[Ill. 03] Balkan mountains, Bulgaria
Balkan mountains
http://wallpapers.free-review.net/42 _ ~ _ Balkan _ Mountains.htm
Assessed 28/02/2013

[Ill. 02] Bulgaria
Own illustration
based on http://maps.google.com

[Ill. 05] Site
Own illustration
based on http://maps.google.com

[Ill. 04] Sofia
Own illustration
based on http://maps.google.com

[Ill. 06] Site
Own illustration
based on http://maps.google.com

[Ill. 07] Integrated Design Process, phases
Own illustration

[Ill. 08] City Map, Sofia
Own illustration
based on http://maps.google.com

[Ill. 09] Centrail Military Club
Central Military Club
http://www.sofia-guide.com/attraction/central-military-club/
Assessed 06/02/2013

[Ill. 10] Alexander Nevsky Cathedral
Alexander Nevsky Cathedral
http://www.ahitravel.com/content/images/programs/DANUBE13A/AlexanderNevskyCathedralSofia _ SS160656974.jpg
Assessed 05/01/2013
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[Ill. 11] National Palace of Justice
Bulgaria's National Palace of Culture
http://www.novinite.com/view _ news.php?id=127922
Assessed 06/02/2013

[Ill. 12] Site
Own illustration
based on http://maps.google.com

[Ill. 13] Nodes and Paths
Own illustration
based on http://maps.google.com

[Ill. 14] Map, Mladost, Sofia
Own illustration
based on http://maps.google.com

[Ill. 15] Edge
Own illustration
based on http://maps.google.com

[Ill. 16] Vitosha Mountains
Own illustration
based on http://maps.google.com

[Ill. 17] Contextual potentials
Own illustration
based on http://maps.google.com

[Ill. 18] Initial arrangement
Own illustration
based on http://maps.google.com

[Ill. 20] Courtyard enclosed by stone walls
Empty courtyard restaurant in Bulgaria in the winter
http://www.colourbox.com/image/empty-courtyard-restaurant-in-bulgaria-in-the-winter-image-1667796
Assessed 14/02/2013

[Ill. 19] Traditional stone house
Stone house
http://blog.bestbgproperties.com/bulgaria _ news/264
Assessed 14/02/2013

[Ill. 21] The typical building materials, stone and wood
Places of interest
http://www.incomingbulgaria.com/i.php/places_of_interest/Zheravna/index.html
Assessed 14/02/2013

[Ill. 23] Chardak
Chardak
http://www.pochivki.com/BG _ hoteli/view.html?hid=1466319
Assessed 14/02/2013

[Ill. 22] Bulgarian Gneiss Stone
Gneiss Bulgaria, natural stone
http://realni.net/details.php?id=1206
Located 14/02/2013
Gneiss Gloria Polygonal stones
http://www.archello.com/en/product/gneiss-gloria-polygonal-stones/image-6
Located 14/02/2013

[Ill. 24] Alley
Shiroka Laka
http://fromanotherangle-bb.blogspot.dk/2010/04/shiroka-laka.html
Assessed 22/02/2013

[Ill. 25] Climber
HD Wallpaper Pics
http://cdn.hdwallpaperspics.com/uploads/2012/12/climbing_ by_jeneliza-beth-d36na6d.jpg
Assessed 14/02/2013
(kilde)

[Ill. 26] Grand Canyon
The Big Crack
http://www.creationscience.com/online-book/GrandCanyon5.html
Assessed 20/02/2013

[Ill. 27] Concept
Own illustration
based on http://www.creationscience.com/onlinebook/GrandCanyon5.html

[Ill. 28] Light intensity
Own illustration

[Ill. 29]	Grand Canyon	Travel Guide to Grand Canyon http://paradiseintheworld.com/travel-guide-to-grand-canyon/ Assessed 19/05/2013
[Ill. 30]	Canyon Cave principle	Own illustration
[Ill. 31]	Module principle	Own illustration
[Ill. 32]	Window principle	Own illustration
[Ill. 33]	Steel structure	Own illustration
[Ill. 34]	Modules	Own illustration
[Ill. 35]	Program	Own illustration
[Ill. 36]	Schematic organisation	Own illustration
[Ill. 39]	Vertical Connections	Own illustration
[Ill. 37]	Volumes	Own illustration
[Ill. 38]	Volume Height	Own illustration
[Ill. 40]	Organisation according to daylight	Own illustration
[Ill. 41]	Organisation according to daylight	Own illustration
[Ill. 42]	Accessability	Own illustration
[Ill. 43]	Wind flow	Own illustration
[Ill. 44]	Subterrain	Own illustration
[Ill. 45]	Canyon Square	Own illustration
[Ill. 46]	Relaxing Areas	Own illustration
[Ill. 48]	Integration of Landscape and City	Own illustration
[Ill. 49]	Landscape	Own illustration
[Ill. 50]	Masterplan, 1:1000	Own illustration
[Ill. 51]	Elevation east	Own illustration
[Ill. 52]	Elevation West	Own illustration
[Ill. 53]	Bird 's eye view	Own illustration
[Ill. 54]	Restaurant, floorplan, 1:500	Own illustration
[Ill. 55]	Interior, restaurant	Own illustration
[Ill. 56]	Canyon Square, floorplan, 1:500	Own illustration
[Ill. 57]	Canyon Square, winter	Own illustration
[Ill. 58]	Canyon Square	Own illustration
[Ill. 59]	Spa, floorplan, 1:500	Own illustration
[Ill. 60]	Spa	Own illustration
[Ill. 61]	Multifunctional Hal, floorplan	Own illustration
[Ill. 62]	Multifunctional Hal	Own illustration
[Ill. 63]	Canyon Street	Own illustration
[Ill. 64]	Canyon Street	Own illustration
[Ill. 65]	Function diagram, level -04	Own illustration
[Ill. 66]	Flow diagram, level -04	Own illustration
[Ill. 67]	Level -04, 1:500	Own illustration
[Ill. 69]	Functions, Level -03	Own illustration
[Ill. 68]	Flow diagram, level -03	Own illustration
[Ill. 70]	Level -03, 1:500	Own illustration
[Ill. 72]	Functions, level -02	Own illustration
[Ill. 71]	Flow diagram, level -02	Own illustration
[Ill. 73]	Level -02, 1:500	Own illustration
[Ill. 75]	Functions, level -01	Own illustration
[Ill. 74]	Flow diagram, level -01	Own illustration
[Ill. 76]	Level -01, 1:500	Own illustration
[Ill. 78]	Functions, Level 00	Own illustration
[Ill. 77]	Flow diagram, level 00	Own illustration
[Ill. 79]	Level 00, 1:500	Own illustration
[Ill. 81]	Functions, Level 1	Own illustration
[Ill. 80]	Flow diagram, level 1	Own illustration
[Ill. 82]	Level 01 1:500	Own illustration
[Ill. 84]	Functions, Level 2	Own illustration
[Ill. 83]	Flow diagram, level 2	Own illustration
[Ill. 85]	Level 02, 1:500	Own illustration
[Ill. 86]	Section CC	Own illustration
[Ill. 87]	Section BB	Own illustration
[Ill. 88]	Section BB	Own illustration
[Ill. 89]	Rooflight	Own illustration
[Ill. 90]	Detail A	Own illustration
[Ill. 91]	Railing and bench	Own illustration
[Ill. 92]	Detail CC	Own illustration
[Ill. 93]	Windrose, Sofia	Wind diagram Sofia, bulgarien http://www.windfinder.com/windstats/wind-statistic _ sofia-vrazhdebna.htm Assessed 10/02/2013
[Ill. 94]	Climate table	Sun Paths - Bulgarien, sofia http://www.gaisma.com/en/location/sofia.html Assessed 10/02/2013
[Ill. 95]	Main wind directions	Own illustration
[Ill. 96]	Sun angle 9:00	Own illustration
[Ill. 97]	Sun angle 13:00	Own illustration
[Ill. 98]	Sun angle 16:00	Own illustration
[Ill. 99]	One Cube	Own illustration based on Autodesk Vasari
[Ill. 100]	Two cubes - 30 Meter	Own illustration based on Autodesk Vasari
[Ill. 101]	Two cubes - 20 Meter	Own illustration based on Autodesk Vasari
[Ill. 102]	Two cubes - 10 Meter	Own illustration

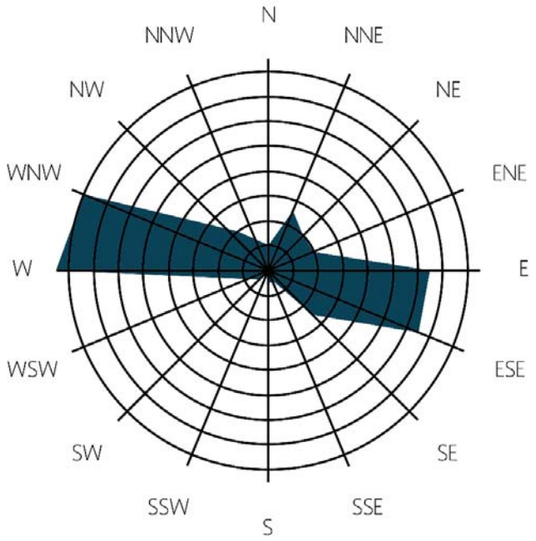
based on Autodesk Vasari
[Ill. 103] Two cubes - 5 Meter Own illustration
based on Autodesk Vasari
[Ill. 104] Two cubes - 2 Meter Own illustration
based on Autodesk Vasari
[Ill. 105] Two cubes - 5 Meter Own illustration
based on Autodesk Vasari
[Ill. 106] Tree cubes - 5 Meter Own illustration
based on Autodesk Vasari
[Ill. 107] Own illustration
[Ill. 108] Own illustration
[Ill. 109] Own illustration
[Ill. 110] Own illustration
[Ill. 111] Own illustration
[Ill. 112] Own illustration
[Ill. 113] Own illustration
[Ill. 114] Own illustration
[Ill. 116] Own illustration
[Ill. 115] Own illustration
[Ill. 117] Room Programme Own illustration
[Ill. 118] Structural principle Robot Structural Analysis
[Ill. 119] Load calculation Robot Structural Analysis
[Ill. 120] Static system Robot Structural Analysis
[Ill. 121] Structural analysis Robot Structural Analysis
[Ill. 122] Forces Robot Structural Analysis
[Ill. 123] Forces, table Robot Structural Analysis
[Ill. 124] Stresses Robot Structural Analysis
[Ill. 125] Stresses, table Robot Structural Analysis
[Ill. 126] Deformation Robot Structural Analysis
[Ill. 127] Deformation, table Robot Structural Analysis
[Ill. 128] Daylight analysis Robot Structural Analysis
Velux Daylight Visualizor

APPENDIX A
CLIMATE

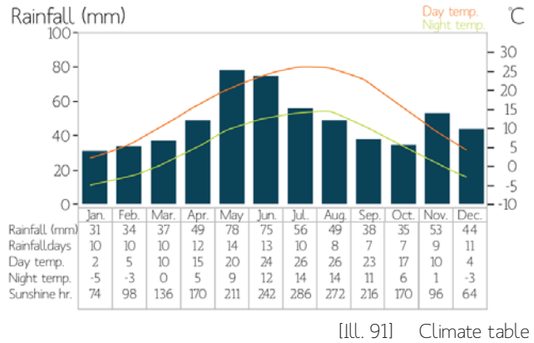
Climate

The investigation is divided into two topics; wind direction and sun relation.
Bulgaria lies within the temperate climate zone in the northern hemisphere, with continental climate of long, cold winters and warm, dry summers.
Bulgaria is located on the edge of the subtropical cli¬mate zone which gives an average temperature in the summer months just below 30 degrees. In the sum¬mer season, buildings with large glass areas facing south risk overheating. The primary wind direction is west, while the secondary wind direction is east. Wind coming from south is very rare.
Potentials and Issues

The competition asks for an outer area to the east, but the area will be windy, which can be appreciated in the summer season. However, the winter, spring and fall season will call for an enclosed area that blocks the wind from west and east, respectively.

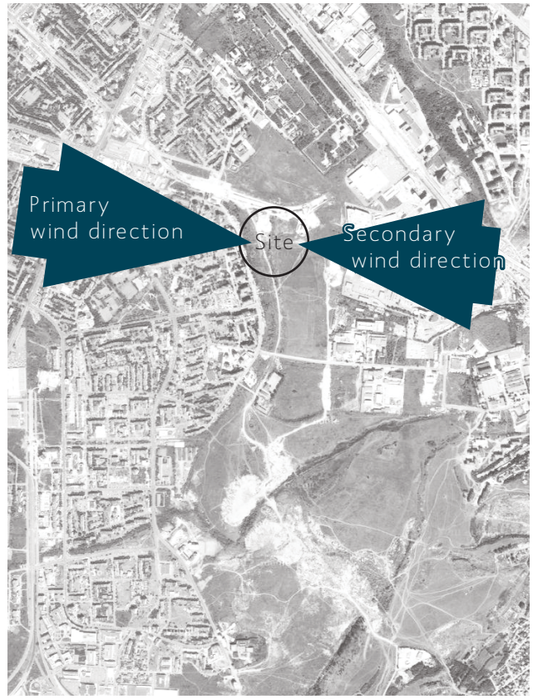


[Ill. 90] Windrose, Sofia



	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Rainfall (mm)	31	34	37	49	78	75	56	49	38	35	53	44
Rainfall.days	10	10	10	12	14	13	10	8	7	7	9	11
Day temp.	2	5	10	15	20	24	26	26	23	17	10	4
Night temp.	-5	-3	0	5	9	12	14	14	11	6	1	-3
Sunshine hr.	74	98	136	170	211	242	286	272	216	170	96	64

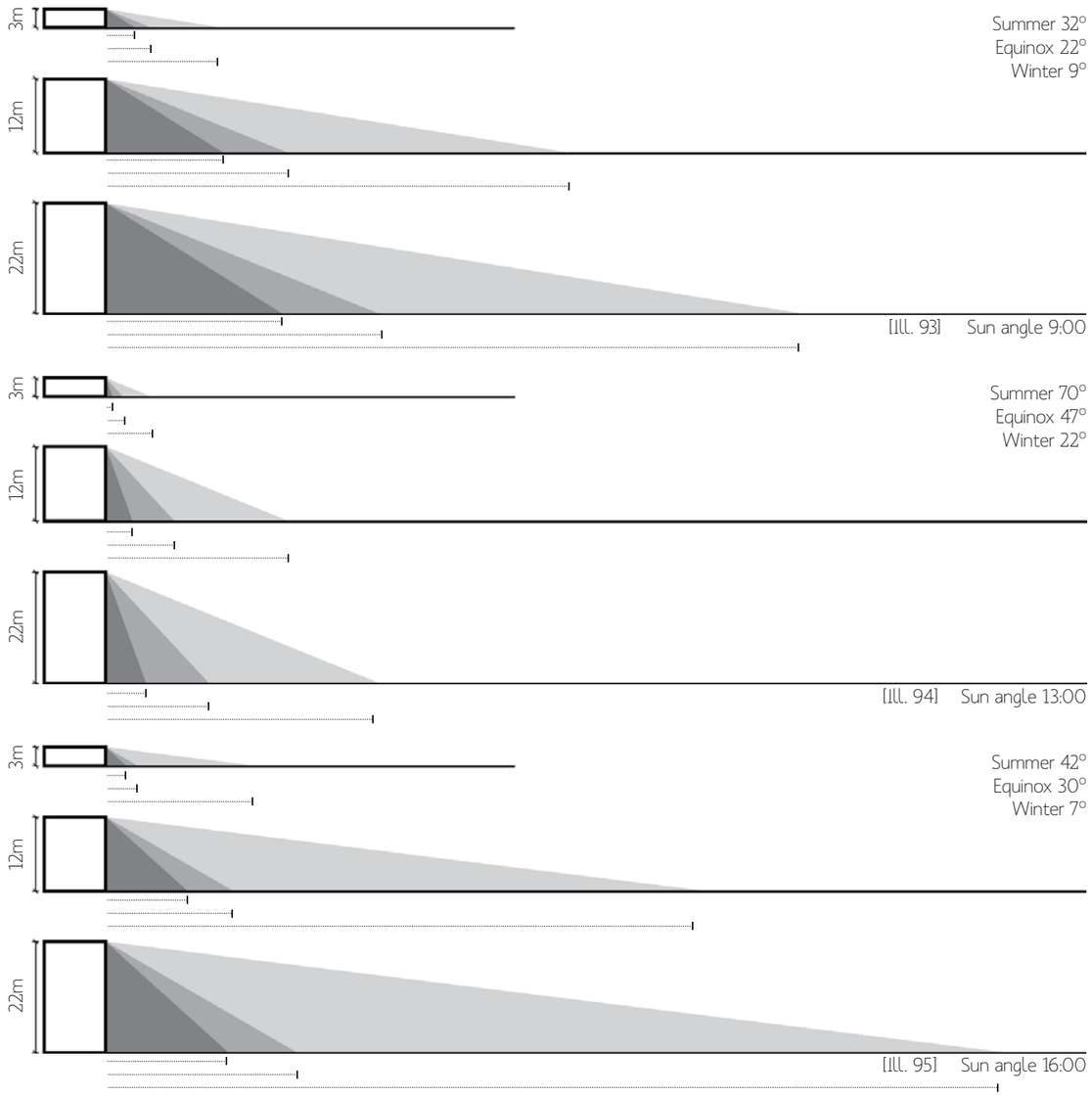
[Ill. 91] Climate table



[Ill. 92] Main wind directions

Sun Paths

The shadow diagrams visualises the length of the shadows in different scenarios.
It is a static investigation that analyses different parameters, such as height of the building, the lowest sun position, the highest sun position and equinox.
Building shadows are investigated at three different times of the day.
The greatest difference from northern Europe is the position of the sun, which is higher in the summertime resulting in shorter shadows casted from the buildings in Bulgaria.
The different length of the shadows compared to northern Europe will be considered during the design process.



[Ill. 93] Sun angle 9:00

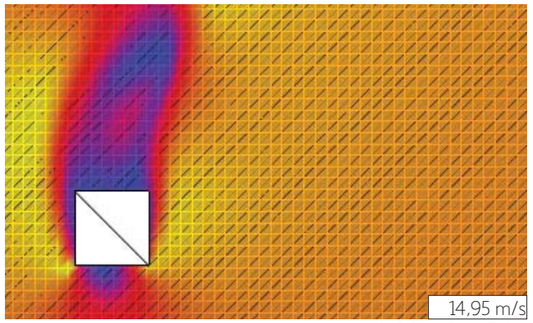
[Ill. 94] Sun angle 13:00

[Ill. 95] Sun angle 16:00

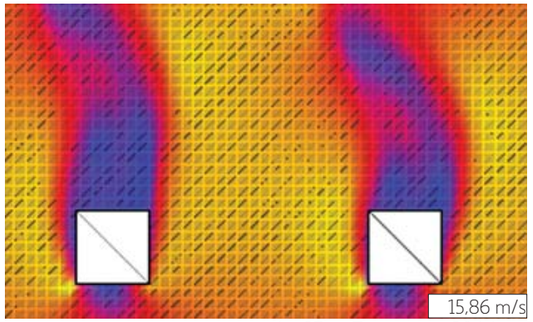
APPENDIX B
WIND STUDY

In Bulgaria, the wind direction is primary west, secondary east [Ill. 92]. This initial wind investigation provides basic knowledge of wind behaviour, when the wind strikes two volumes with varying distance. The investigation is based on a virtual wind tunnel using the software Vasari. The wind blows from west with a speed of 10 m/s. The red colour is the middle value, the blue represents a calm area, and the yellow is the high speed wind area. The value of the yellow area is different during the investigation. The highest value is described in the picture.
The first picture illustrates wind behaviour, when affecting one single volume. The wind is forced around it, and then the wind speed accelerates to 14.95 m/s, and decreases around the volume with some turbulence area on the back side of the volume.
The next pictures are investigating wind behaviour, when affecting two volumes with varying distances. The distance starts at 30 metre and decreases to 2 metre. The last investigation documents the behaviour, when the volume rotates.

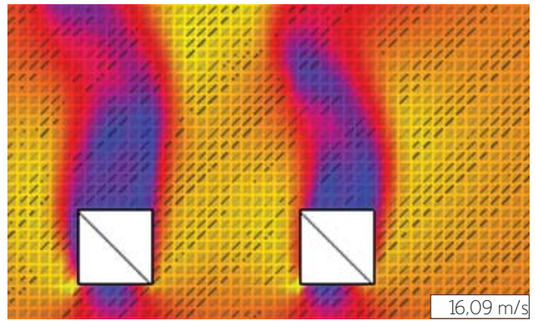
The wind speed is accelerating significantly, when two volumes move closer together. With a distance of 10 metres, the wind speed is twice as fast. A two metre distance gives a fast wind speed pressure, with a factor four - not a comfortable, relaxing and enjoyable space.
The last two pictures document that these volumes have a huge impact on the wind speed and direction,



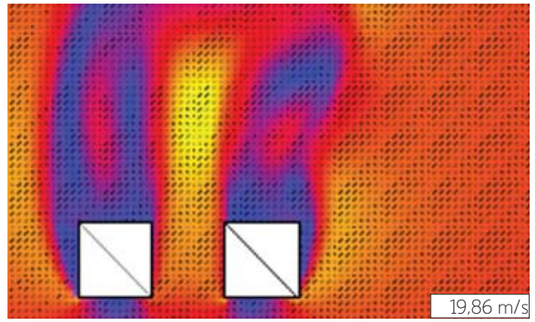
[Ill. 96] One Cube



[Ill. 97] Two cubes - 30 Meter

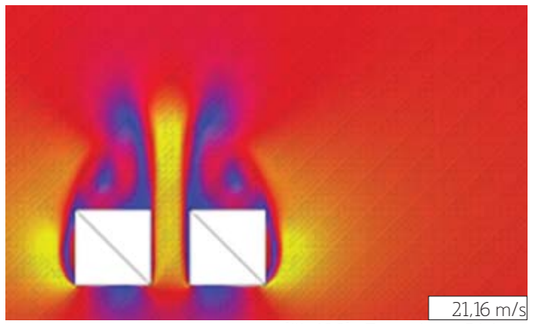


[Ill. 98] Two cubes - 20 Meter

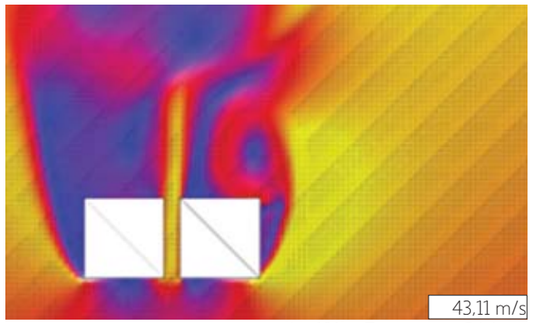


[Ill. 99] Two cubes - 10 Meter

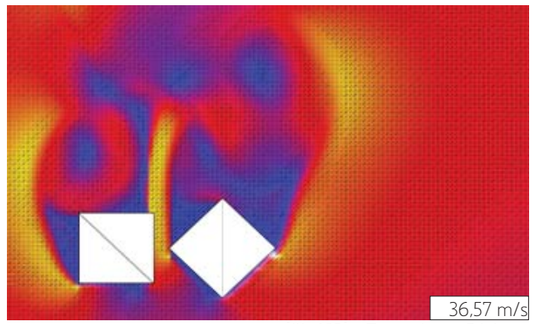
meaning that it is possible to influence and create wind flow. This is something, the project group will be aware of during the project design.



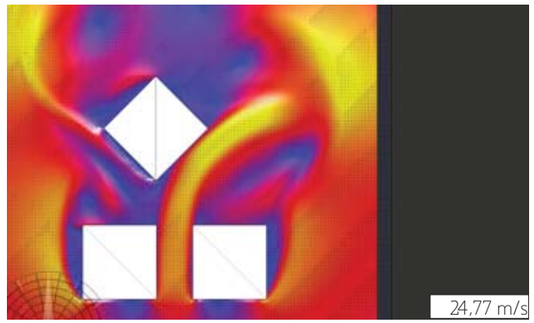
[Ill. 100] Two cubes - 5 Meter



[Ill. 101] Two cubes - 2 Meter



[Ill. 102] Two cubes - 5 Meter



[Ill. 103] Tree cubes - 5 Meter

Development According to Wind Flow

Earlier in this rapport wind behaviour was explained in theoretical terms. This study is project based investigation of wind behaviour step by step to create calm areas, where you can relax, eat, or enjoy the outdoor space in the canyon street.

The first picture visualises wind acceleration between the three volumes. [Ill. 106] shows the parking volume, forcing the wind south. The restaurant is placed in the clam area, so it is possible to eat and enjoy a nice comfortable area.

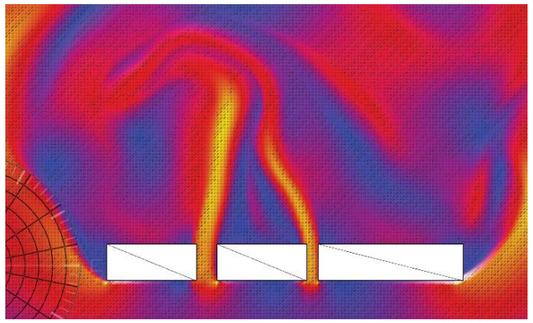
A volume is placed to enclose the outdoor space, but this arises some problems according to the wind pressure.

Evaluation

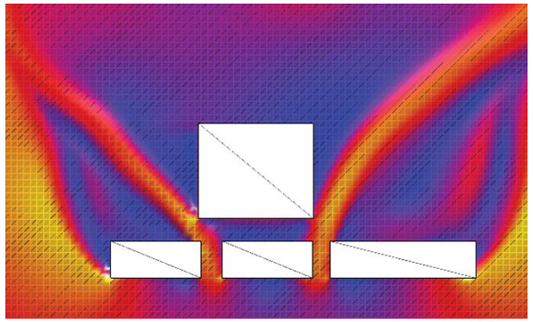
There are no calm areas near the cinema and parking area, and when the wind direction is changed to east, there is a great wind tunnel effect along the parking area.

The problem from the previous study of wind flow was creation of a wind tunnel. This investigation will document the redesign improvement of the wind flow to create more calm area.

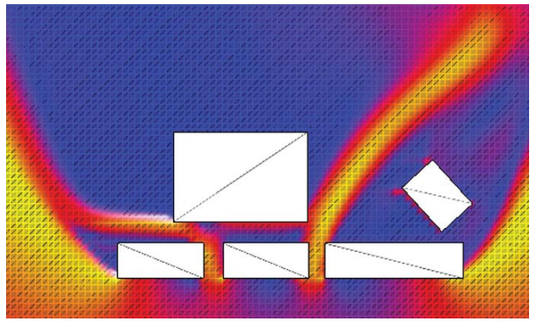
According to the theoretical investigation, the volume location has huge influence on the wind flow and pressure. This investigation's main change is moving the parking volume more south, to block the wind tunnel along the parking area. [Ill. 107] documents that this also gives calm areas in different places in



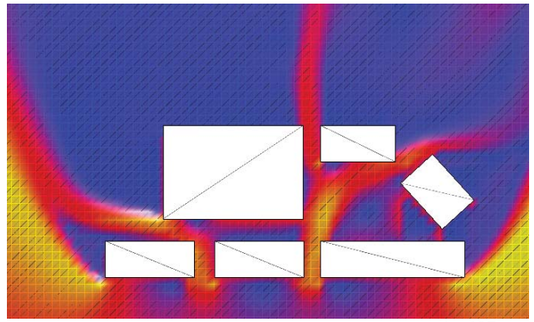
[Ill. 104]



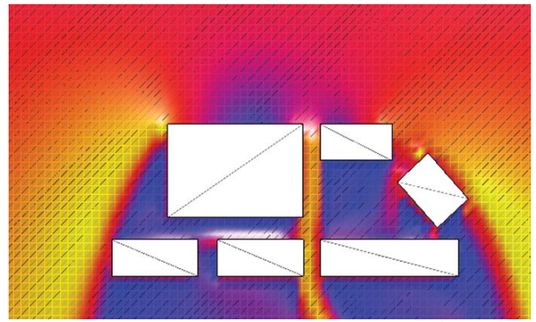
[Ill. 105]



[Ill. 106]



[Ill. 107]

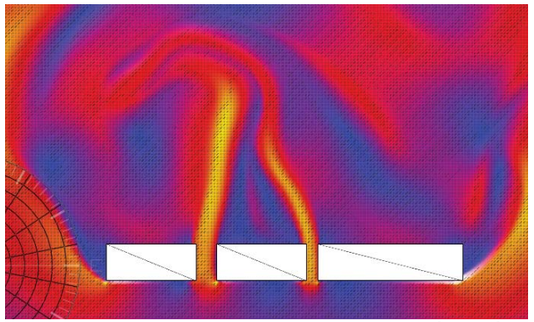


[Ill. 108]

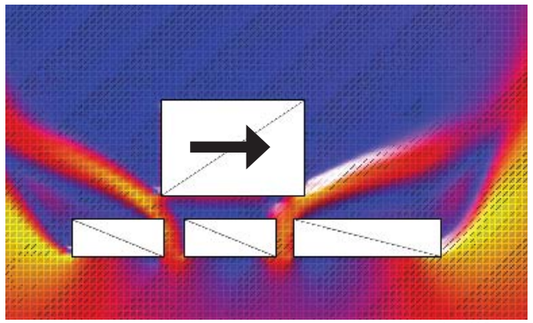
the large outdoor spaces.

Wind Flow Conclusion

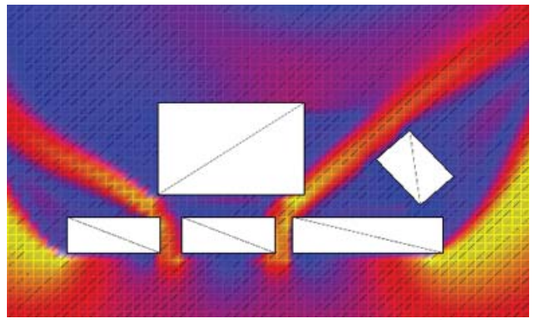
The change, by moving the parking volume, nicely influences the wind flow and pressure, making the transit area an area containing wind flow. There are still small issues when wind is changed to the east, which will be solved by changing the opening to the east.



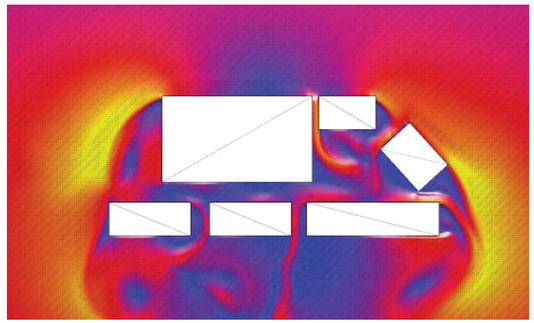
[Ill. 109]



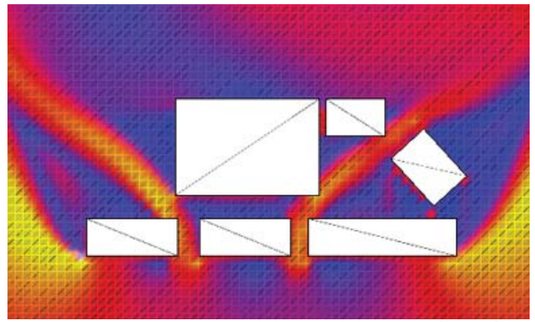
[Ill. 110]



[Ill. 111]



[Ill. 113]



[Ill. 112]

APPENDIX C
FUNCTIONS

Functions in the Activity Center, with guiding amount of squaremeters.

Function	Sq. meters	Light
Climbing area	750-1000 m2	
Hall for high climbing walls		Daylight
Boulder Hall		Daylight
Room for boomlift		Artifical light
Storage		Artifical light
Cleaning room		Artificial light
Funtopia	600 m2	
Hall		Daylight
Briefing room and lockers		Daylight
Buffer zone		Daylight
Party Room		Daylight
Kitchen for the party room		Daylight / Artifical light
Fitness	700 m2	
Fitness Hall		Daylight
Storage		Artifical light
Multifunctional Hall	800 m2	
Hall for dancing		Daylight
Item storage		Artifical light
Spa Center	600 m2	
Spa		Daylight
Sauna and Infrared sauna		Artificial light
Cold room		Artifical light
Showers		Artifical light
Rest rooms - 2 toilets and 2 sinks		Artifical light
Leisure room		Daylight
Two massage rooms		Artificial light
Front desk and Storage for the front desk		Daylight / Artifical light
Rest rooms and lockers	150-225 m2	
Climbing Hall		Artifical light
Fitness		Artifical light
Multifunctional Hall		Artifical light
Spa		Artifical light
Restaurant	1250-1350 m2	
Restaurant Hall with tables for 120 people		Daylight
Kitchen		Artifical light / Daylight
Rest room for clients		Artifical light
Tables for 80 people outside next to the swimming pool		

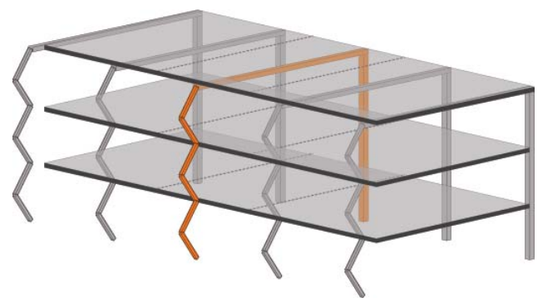
Function	Sq. meters	Light
Storage		Artifical light
Administration offices for 140-150 people	2000 m2	Daylight
Offices		Daylight
Meeting rooms		Daylight
Kitchen		Artificial light
Leisure rooms		Artificial light
Pay room		Artificial light
Security room		Artificial light
IT server room		Artificial light
Archive		Artficial light
Storage		Artificial light
Rest rooms,		Artificial light

[Ill. 114] Room Programme

APPENDIX D
STRUCTURAL ANALYSIS

The triangle shaped facade facing the Canyon Square is simplified to create a structural analysis, which will document the forces, stresses, and the deformation.

The resolve of this analysis shall verify the dimension of the steel construction to the triangle shaped facade and be a part of the overall bearing system.
This analysis will take point of departure in one structural element, as shown in the diagram [Ill. 115]. Thestructural element shall be a part of the bearing system.
The analysis is made in Autodesk Robot Structural Analysis Software. The calculation is made in 2D sections, where Robot calculates the dead load of each structural element. The load of grass, drain etc. on the roof is 0.5 kN/m2
The live load of an outdoor activity area, with tribune, relaxation, sports etc. is 5.0 kN/m2 [13],
the same for each floor.
The snow load is 1.0 kN/m2; this is resolved from the calculations below.



[Ill. 115] Structural principle

Loads

Dead load		
Reinforce Concrete Beam 300x8000mm		Robot calculates the exact load
Reinforce concrete Column 450x450mm		Robot calculates the exact load
Rectangle steel construction 250x250x20mm		Robot calculates the exact load
Earth, grass and drain		0,5 kN/m2
Live load		
Exterior live load, C5		5.0 kN/m2 (Teknisk Ståbi, 2013 tab. 4,7)
Interior live load, C5		5.0 kN/m2 (Teknisk Ståbi, 2013 tab. 4,7)

Snow

$s = \mu_i \, C_e C_{tS_k}$ (Teknisk Ståbi, 2013, 4.1) $\quad \mu_i = 0{,}8 \quad C_{tS_k} = 1.0 \cdot 1{,}0 \; kN/m^2$

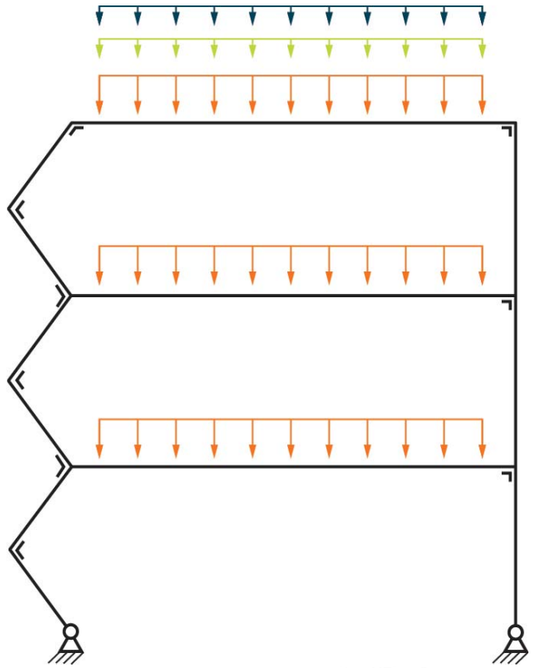
$C_e = C_{top} C_s \rightarrow C_{top} = 1.0 \;,\; C_s = 1{,}25 \rightarrow C_e = 1.0 \cdot 1{,}25 = 1{,}25$

$s = \mu_i \, C_e C_{tS_k} \rightarrow S = 0{,}8 \cdot 1{,}25 \cdot 1.0 \cdot 1{,}0 \frac{kN}{m^2} = 1{,}0 \frac{kN}{m^2}$

[Ill. 116] Load calculation

Static System

The structural element is converted to a static system, where the structural element is supported by pinned joints. The overall structural system is a column beam principle, where all joints are fixed. The triangle system is fixed on each floor and works like a column.
The load is added on each floor, excluding the dead load from the construction itself. The roof shall hold extra dead load, live load, and snow load.



[Ill. 117] Static system

Steel Section

The dimension of the steel in the triangle is the parameter which is changeable. The steel is a part of the overall bearing system. It is assumed that node 16 on [Ill. 118] is the most stressed and forced point. The steel profile is quadratic in form due to the profile which is taking loads from different angles and positions in this triangle facade.

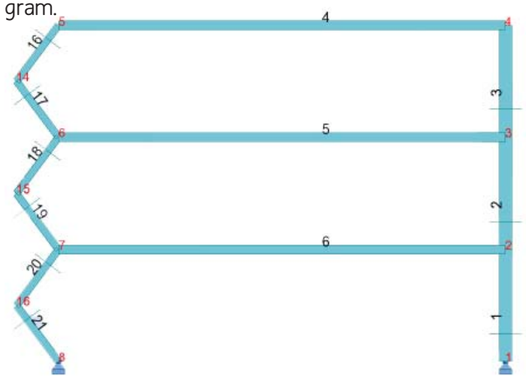
Load combination

The load combination is only calculated with the live load as the dominant factor, justifying the huge factor of the live load. This combination is added into the calculation of the structural element, where all analyses are made based on this combination.

$$1.0G_{kj,sup} + 1{,}5Q_{k,1} + 1{,}5 \cdot 0{,}3S_k$$

Robot Structural analysis

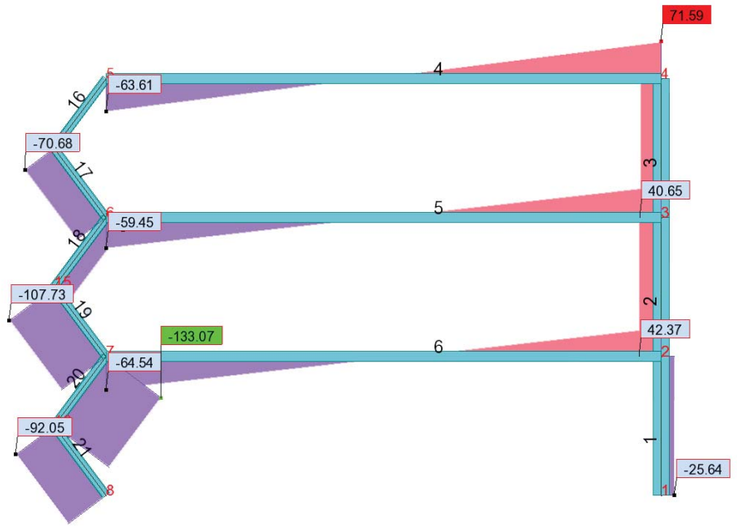
Robot is dividing the structural element into bars, nodes and columns, which is visualised in the diagram. The number represents all bars and nodes, which will be listed in the table, where all the calculation are listed. The focus in this calculation is node 16 as mentioned before.
Furthermore, all analyses and calculations are from this section and the values will be added to the diagram.



[Ill. 118] Structural analysis

APPENDIX E
STRUCTURAL ANALYSIS - FORCES

The forces are calculated through the structural element with the load combination as mentioned earlier. The bar 20 has the highest value with 133.07 kN. [Ill. 119] This diagram shows that the value of the load increases all the way through the structure.
Listed in the tableare all the exact values for all bars and nodes in the section [Ill. 120].



[Ill. 119] Forces

Forces (LiveLoad_Dominant)
Cases_4

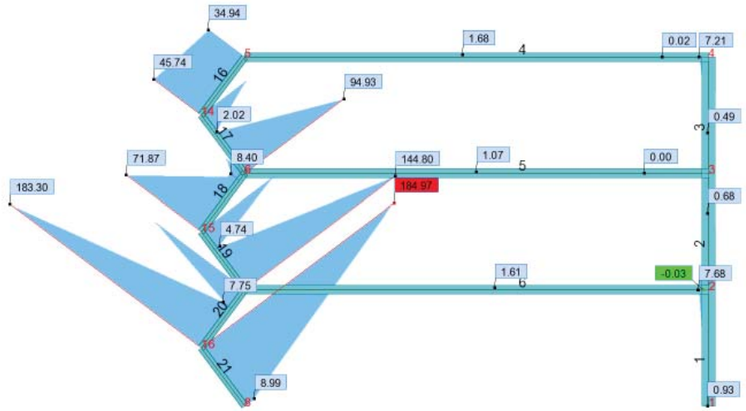
Filtering	Bar	Case
Full list	1to6 16to21	1to4
Selection	1to6 16to21	4
Total number	12	4
Selected number	12	1

Bar/Node/Case	FX (kN)	FZ (kN)	MY (kNm)
1/ 1/ 4 (C)	187,60	-25,64	0,00
1/ 2/ 4 (C)	187,60	-25,64	-102,57
2/ 2/ 4 (C)	132,14	42,37	-111,51
2/ 3/ 4 (C)	132,14	42,37	57,98
3/ 3/ 4 (C)	71,59	40,65	-58,42
3/ 4/ 4 (C)	71,59	40,65	104,17
4/ 4/ 4 (C)	40,65	71,59	-104,17
4/ 5/ 4 (C)	40,65	-63,61	-40,34
5/ 3/ 4 (C)	1,72	60,55	-116,41
5/ 6/ 4 (C)	1,72	-59,45	-107,58
6/ 2/ 4 (C)	-68,02	55,46	-8,93
6/ 7/ 4 (C)	-68,02	-64,54	-81,58
16/ 5/ 4 (C)	75,28	-5,65	-40,34
16/ 14/ 4 (C)	75,28	-5,65	-54,46
17/ 14/ 4 (C)	26,50	-70,68	54,46
17/ 6/ 4 (C)	26,50	-70,68	-122,25
18/ 6/ 4 (C)	123,87	-39,94	14,67
18/ 15/ 4 (C)	123,87	-39,94	-85,18
19/ 15/ 4 (C)	73,02	-107,73	85,18
19/ 7/ 4 (C)	73,02	-107,73	-184,16
20/ 7/ 4 (C)	134,69	-133,07	102,57
20/ 16/ 4 (C)	134,69	-133,07	-230,11
21/ 16/ 4 (C)	165,47	-92,05	230,11
21/ 8/ 4 (C)	165,47	-92,05	0,00

[Ill. 120] Forces, table

STRUCTURAL ANALYSIS - STRESS

The stress is important to see if the steel con¬struction can take the stress load from the whole construction. Here the nodes are calculated. Node 16 has the highest value of 184.97 MPa, which is acceptable for the steel construction. The steel construction can also carry more loads, which is an important feature according to the fact that this calculation is performed from a simply structural element.
Listed in the table are all the exact values for all nodes in the section [Ill. 122]



[Ill. 121] Stresses

Stress (LiveLoad_Dominant)
Cases_4

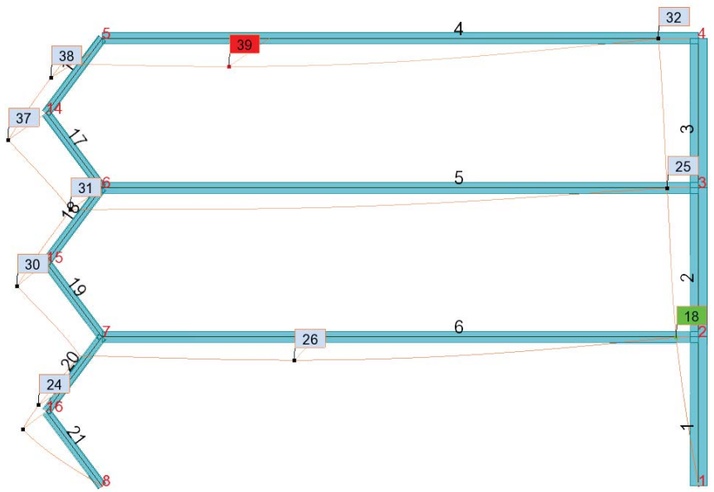
Filtering	Bar	Case
Full list	1to6 16to21	1to4
Selection	1to6 16to21	4
Total number	12	4
Selected number	12	1

Bar/Node/Case	S max (MPa)	S min (MPa)	S max(My) (MPa)	S min(My) (MPa)	Fx/Ax (MPa)
1/ 1/ 4 (C)	0,93	0,93	0,00	-0,00	0,93
1/ 2/ 4 (C)	7,68	-5,83	6,75	-6,75	0,93
2/ 2/ 4 (C)	7,99	-6,69	7,34	-7,34	0,65
2/ 3/ 4 (C)	4,47	-3,17	3,82	-3,82	0,65
3/ 3/ 4 (C)	4,20	-3,49	3,85	-3,85	0,35
3/ 4/ 4 (C)	7,21	-6,51	6,86	-6,86	0,35
4/ 4/ 4 (C)	0,88	-0,85	0,87	-0,87	0,02
4/ 5/ 4 (C)	0,35	-0,32	0,34	-0,34	0,02
5/ 3/ 4 (C)	0,97	-0,97	0,97	-0,97	0,00
5/ 6/ 4 (C)	0,90	-0,90	0,90	-0,90	0,00
6/ 2/ 4 (C)	0,05	-0,10	0,07	-0,07	-0,03
6/ 7/ 4 (C)	0,65	-0,71	0,68	-0,68	-0,03
16/ 5/ 4 (C)	34,94	-26,76	30,85	-30,85	4,09
16/ 14/ 4 (C)	45,74	-37,56	41,65	-41,65	4,09
17/ 14/ 4 (C)	43,09	-40,21	41,65	-41,65	1,44
17/ 6/ 4 (C)	94,93	-92,05	93,49	-93,49	1,44
18/ 6/ 4 (C)	17,95	-4,48	11,22	-11,22	6,73
18/ 15/ 4 (C)	71,87	-58,41	65,14	-65,14	6,73
19/ 15/ 4 (C)	69,11	-61,17	65,14	-65,14	3,97
19/ 7/ 4 (C)	144,80	-136,86	140,83	-140,83	3,97
20/ 7/ 4 (C)	85,76	-71,12	78,44	-78,44	7,32
20/ 16/ 4 (C)	183,30	-168,66	175,98	-175,98	7,32
21/ 16/ 4 (C)	184,97	-166,98	175,98	-175,98	8,99
21/ 8/ 4 (C)	8,99	8,99	0,00	-0,00	8,99

[Ill. 122] Stresses, table

STRUCTURAL ANALYSIS - DEFORMATION

The deformation is also calculated in the section. It is acceptable when the deformation is lower than 40mm, according to the length of the bars of 16000 mm. [Ill. 124].



[Ill. 123] Deformation

Displacements (LiveLoad_Dominant)
Cases_4

Filtering	Node	Case
Full list	1to8 14to16	1to4
Selection	1to8 14to16	4
Total number	11	4
Selected number	11	1

Node/Case	UX (mm)	UZ (mm)	RY (Rad)
1/ 4 (C)	0,0	0,0	-0,005
2/ 4 (C)	-18	-0	-0,003
3/ 4 (C)	-25	-0	-0,002
4/ 4 (C)	-32	-0	-0,003
5/ 4 (C)	-32	-20	0,001
6/ 4 (C)	-25	-18	-0,000
7/ 4 (C)	-18	-15	0,001
8/ 4 (C)	0,0	0,0	-0,012
14/ 4 (C)	-30	-22	-0,003
15/ 4 (C)	-23	-19	-0,003
16/ 4 (C)	-19	-14	-0,004

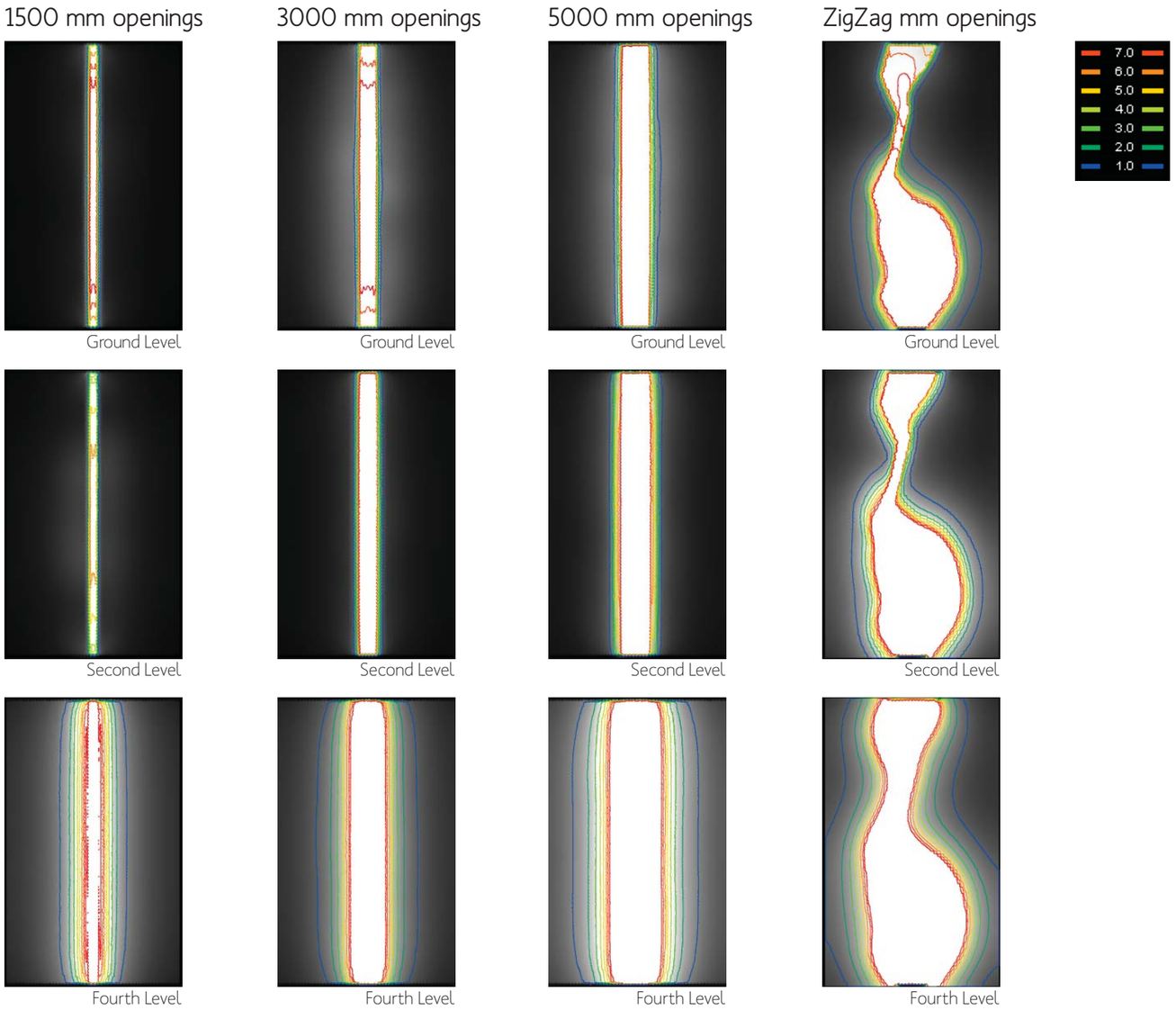
[Ill. 124] Deformation, table

APPENDIX F
DAYLIGHT ANALYSIS

The activity centre has different functions, with specific demands of the daylight level, especially the administration part (Appendix C). This analysis shall document the level of daylight that enters each floor, with different distances between volumes. The facade, facing out, is totally closed and the inside facing facade is fully covered with glass.
This analysis divides into four different situations, with a distance of 1500mm, 3000mm, 5000mm and a zigzag flow, where all before mentioned distances are incorporated. It is a four storey volume, with a storey height of 3500 mm. The daylight level is documented for three different heights; the ground level, second floor, and the fourth floor.
The ground level will not let in any daylight to the volume in all situations; just a little more light will enter the ground level with a distance of 5000 mm. The same scenario occurs on the second floor, where there is a small improvement of the daylight level. The fourth floor is the brightest, where plenty of daylight enters the floor level.

The zigzag situation will incorporate more daylight, also in these very narrow spaces due to the large openings.

Evaluation
There is problem letting in sufficient levels of daylight with this narrow space in the middle. The zigzag situation documents the possibility to let in more daylight to each floor. The canyon concept with a more closed facade expression will counteract the transparent facade. This will significantly reduce the level of daylight. The conclusion is to incorporate



[Ill. 125] Daylight analysis

another solution for entering daylight. The best solution is a roof light with opening all the way down to the lowest floor level. This will provide a nice level of daylight, but also a visual connection to the different floors, which will be a quality to the spacious expression. The zigzag will be incorporated in the project, because it can be a part of the canyon expression and at the same time providing more daylight into each volume.

APPENDIX G
INTERVIEW, THE CLIMBER GIOVANNI LAVANNA

The project group interviewed the experienced climb-er, Giovanni Lavanna, to achieve knowledge from a user's point of view. He has been a climber for 15 years, and is now an architectural student.

Output

- User group is very big. Many different kind of people choose to climb. As Lavanna says: "Where I climb there are women and men, children and elderly, businessmen and hippies. For sure you need to don't be afraid to try something a bit unconventional."

- Indoor climbing is a sport it itself, and is not neccessarely a first step before going outside on mountains.

- The atmosphere can be both competetive and more loose, depending on the climbing gym.

- Concentration is needed when climbing. Too many balconies or places for people to look at the climber at close hand, could be disturbing for some climbers.

1) How many years have you been a climber?
I started when I was 12 years old, so now 15 years.

2) Why did you start to climb?
My cousin invited me to climb and from the first day I found it so cool. I never stopped since then.

3) If practical reasons did not matter, where would you prefer to climb?
Well, actually yes, it matters. To have an appropriate gym in your city or a great rock nearby, it makes the difference. Your level can improve much faster and also your passion for the sport.

4) The climbing gym is a lot more acces¬sible than for example rocks or mountains outside. Is the gym seen as the first step before climbing outside, or is it just two different things?
I think more in the past was like you say; the gym was just a first step before climbing on the rock outside. Nowadays they are often two different things; there is much more just "urban climber" or "metropolitan climber". Anyway, also if now I'm living in the Netherlands, a country without mountains, I always prefer to climb outside on the real rock.

5) How is the atmosphere around climbers? For example in some sports the atmosphere is very intense and competitive. Is it the same in a climbing gym?
I often speak about it with friends. I think it depends a lot from gym to gym, from the spirit that is created between climbers. I have been climbing in extremely competitive gyms and in others that were completely relaxing and easy going. A bit of competition is always good to make you climb harder.

6) Do you have the feeling that a specific kind of person choose to climb? For example a specific sex, age or social status?
No. In my experience climbing is socially a very "horizontal" sport. Where I climb there are women and men, children and elderly, businessmen and hippies. For sure you need to don't be afraid to try something a bit unconventional. And if you go on the real rock, you need to love nature.

7) Could you see a quality in having other activities or sports represented in the same building as the climbing gym? If yes, which type of activities?
Yes I see a big quality in it. Climbing is an anaerobic sport, so any other sport that can compensate this, is an added value, as cycling, running, and swimming. But also sport or activities to relax and stretch your body are perfect to integrate your training, as yoga, meditation or a sauna.

8) If implementing balconies and/or windows in the climbing wall so people can look out from a space behind the walls, would you then feel exposed. Or do you think some people would feel exposed?
To train properly, personally I need a bit of concentration, so to not see people constantly walking behind the walls. But I love to have a lot of natural light. The perfect situation would be to have windows and places to look through with some natural filter on the ground level and more free on higher points. I also climbed in gyms with bars in the middle, it is quite funny but better when you climb with rope, because you go above so you can have your own concentration. For boulder I think it is better with a bit more distance.

9) Is there another way of climbing in a gym than using the grips? For example wall types that do not have the grips.
You can have big "volumes" modelled in a way that you don't need to add grips. There are fake rock walls that include spots to climb on or vertical cracks to train specific conditions. You can have thin wooden sticks to train with your hands or with the support of ice axes. There is the possibility to create artificial ice walls for ice climbing. Finally, you can also train with suspended horizontal wooden stairs; it is nice exercise for your arms.