Title Page

4th semeter Master
Institute of Architecture & Design
Aalborg Univerity

Title
Dance Center in Beirut

Theme
Daylight, Acoustics

Project period
1st February - 16th June 2009

Group
AD10-ARK29

Main Supervisor
Claus Bonderup

Technical Supervisor
Poul Henning Kirkegaard

Pages : 86
Subjoined : CD ,Drawing folder

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Efstathios Kanios

Foreword

This report is the result of a 4th semester architectural project developed at the department of Architecture & Design in the Master Programme.

The purpose for the project is the design of a Dance and Performing Arts Center in Beirut, Lebanon The focus is to design a building complex of significant architectural qualities that integrates acoustic and daylight solutions while considering the culture ,the climate and it's users.

ill.1 perpective of building

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Introduction

Objective

A multicultural place such as Lebanon requires a special arts centre. The Center of Dance (the Lebanese Omani Centre) will be a space for cultural and artistic production, for exchange and interaction between the Lebanese and especially the youth. It will be an independent space with the aim to contribute to social communication and cultural expansion and to promote creativity in the Performing Arts .

To achieve this goal, the Center should be a free space of artistic expression with no boundaries. Its functions and agenda, multiple but equilibrated, should be open to dance and encourage interactivity between artists and their public, conferences, workshops, free initiatives, etc.

Daylight and Acoustics

Due to the nature and the location of the project ,the design emphasis will be given on the natural daylight conditions inside the building. The program Dialux is utilised as a simple tool for testing both the quantitative and the qualitative daylight by calculating the Lux levels.

The program CattAcoustic will be used to ensure that the acoustics of the Performance hall comply to international standards

Tools

Sketching,physical models,Relux,CattAcoustics,Autocad,Sketch up,Illustrator,Indesign,Photoshop,3DSmax.

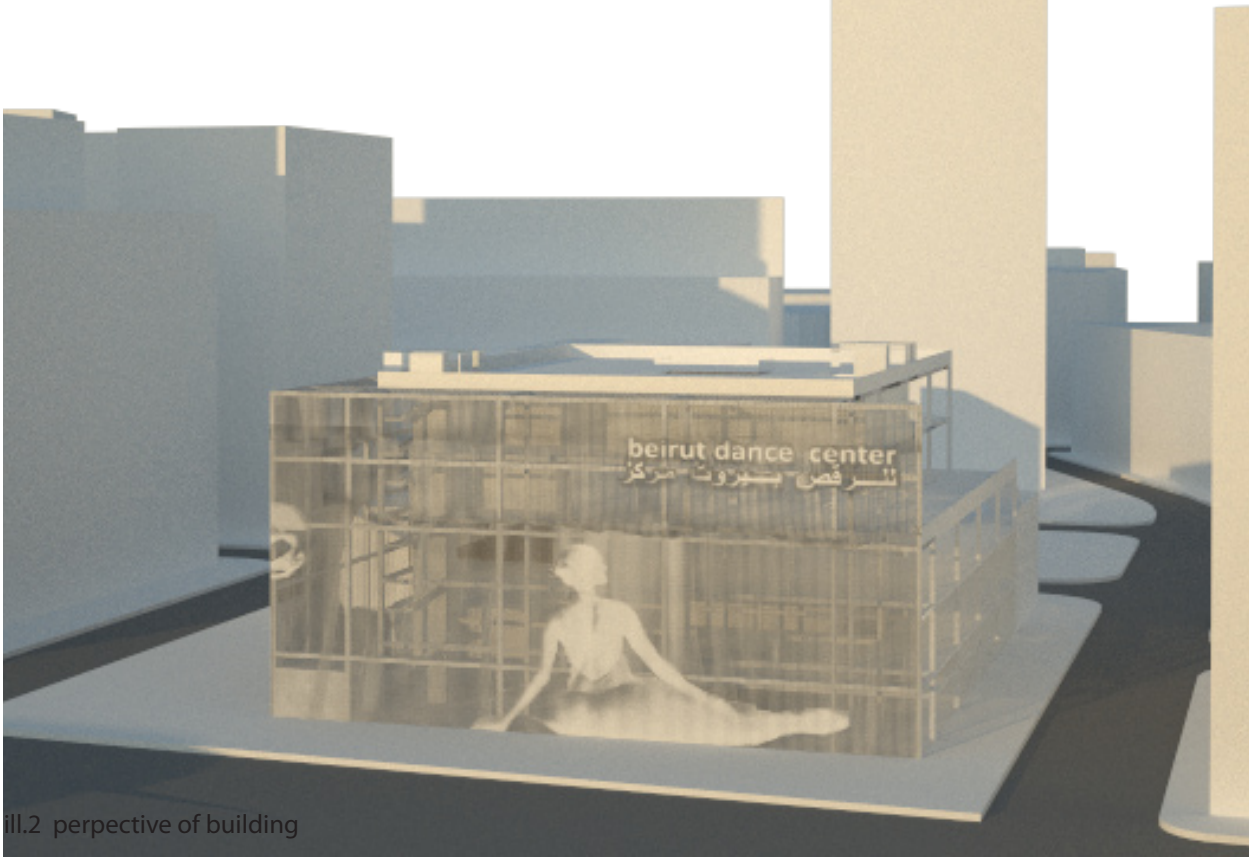
Key words

transparency ,fluidity,context

"Architecture is a kind of urban ballet,architects have often felt that their buildings catch the essential rhythms of people's lives. One of the central conceits of architecture is that it is a translation – in stone and concrete – of the human body in its proportions and its very elements, and that it's halfway between the human body and the bigger world." Aaron Betsky

Problem formulation

How do we design a dance centre focusing on dance educations while taking into consideration acoustics , daylight and being accessible to the residents of the area and respecting the context of the surrounding area?



ill.2 perpective of building

Context Analysis

The initial phase of the analysis begins by getting an understanding of the city of Beirut and the building site.

Beirut
Beirut is positioned on a peninsula extending westward into the Mediterranean Sea,about 94 km north of the Lebanon-Israel border. The city is flanked by the Lebanon mountains, it has taken on a triangular shape, largely influenced by its situation between and atop two hills. The Beirut Governorate area is of 18 square kilometres, and the city's metropolitan area is of 67 square kilometres . Beirut's coast is rather diverse; rocky beaches, sandy shores, and cliffs are situated beside one another.It is the capital and largest city with over 2.1 million as of 2007.

Artistic creativity has always been a major component of life in Beirut. A buoyant city sitting on the Eastern shores of the Mediterranean, Beirut is at the same time an Arab and a European city. In this sense, it is similar to many other Mediterranean harbours that have served as links between countries and cultures. But Beirut has been more and it remains so. It is the gate to the Orient and to the West. For the European, it is the 'easy Orient' and for the Oriental, it is the 'easy West' . It offers a space of transition and, in this space, it offers freedom of thought and an intellectual arena that has shaped the thinking of the Near and Middle-East.

ill.3 geographic location Lebanon

ill.4 geographic location Beirut

The Beirut Central Discrit is becoming both the main address location for successful businesses and the major magnet of entairtainment for the public at large , through a public space that displays an amalgam of highly modern and well preserved historic buildings ,live pedestrian spines and refined landscaping of open spaces.

In summary this success can be seen as an outcome of a sincere search of the city for an identity that hovers between a history with visible traces on the archeological sites, street patterns and buildings ,and the modern aspirations to occupy a stand among renowned cities around the globe. In retrospect the aphorism that was launched at the begining of the master plan as Berut is an authentic city for the future continues to represent and guide the development process of the city.

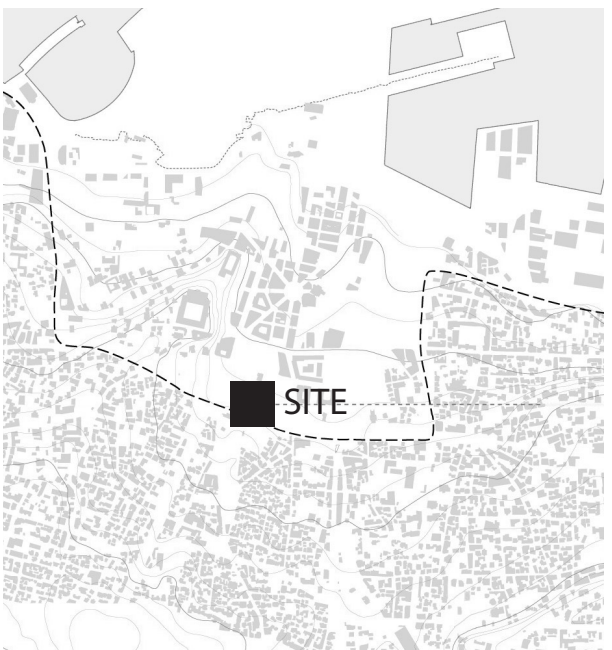
The Dance Center is located in the heart of Beirut Central Discrit ten minutes away from the international airport.The aspirations of the project is to develop a distinguished state of the art structure.

Building site

The site, lot 128-4, of an area of 3.785m2, is situated in the zone of Solidere. The height of the façades adjoining the main streets on the three sides of the building is only 32 metres. The total height of the building could reach 40 metres.

Standing at an angle, the exploitation factor of the plot is of 20%. The authorized total built up area above floor level is then 22,710m2. The authorized foot print area at ground level is 2,712m2 being 70% of the total area of the plot.

The site of the project is located in a full expansion district, in what is left of the
old Ghalghoul situated on the heights of the reconstructed downtown.



ill.5 geographic location site

Adjacent Buildings

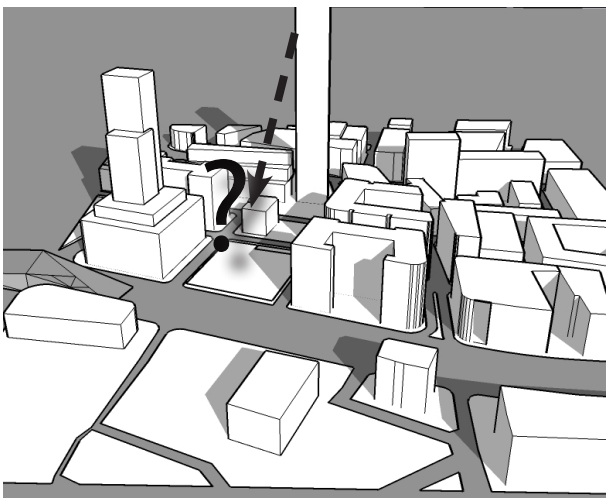
In the north part of Beirut , towards the sea, the business districts, the banks street,the Parliament and the Municipality of Beirut are situated. Towards the south, the commercial area around the new part of Beirut: a project run by Rafael Moneo. To the east, there is the axis of the Martyr's square sloping towards the sea along the archaeological zones between the Damascus Road and Bechara el Khoury Street.

Bordered in the north by Ghalghoul Street and Riad el Solh Square, the centre is encircled by several projects under construction ,as well as many existing outstanding buildings.

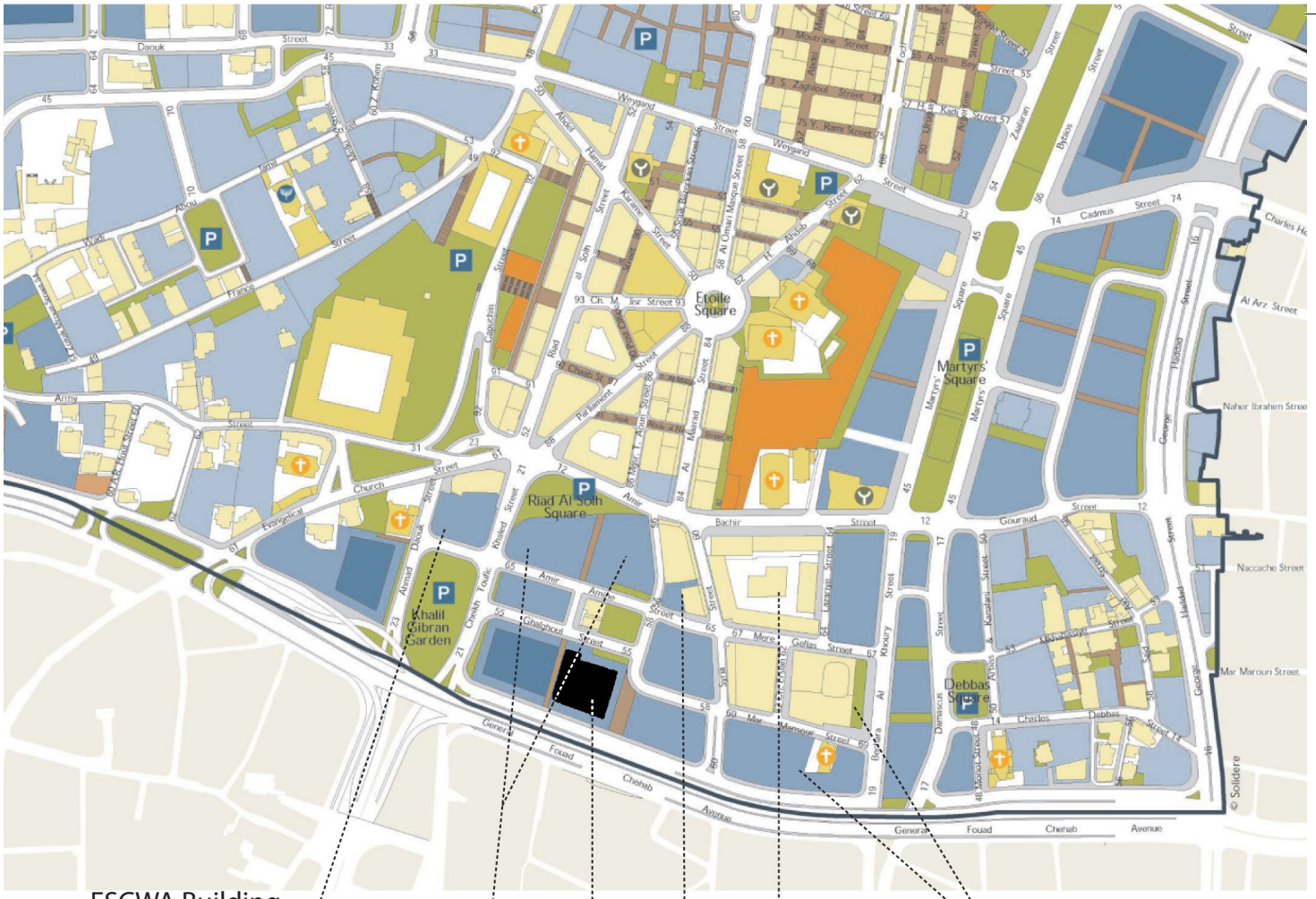
Along Emir Amine Street and facing the site of the project, from the other side of the square, the « Landmark » project by Jean Nouvel is under study: the complex comprises commercial spaces, cinemas, a hotel with luxury apartments and consists of 2 buildings. A "campanile" and a residential monolith constitute ,an internal street in the urban layout of Downtown Beirut.

On its right side, the Grand Theater of Beirut facing Emir Amine Street and located between Syria Street and Emir Bechir Street is under rehabilitation and transformation by Architecture Studio. A luxury hotel accommodating 90 rooms is planned on the 11,000 m2 area of the building. A group of towers of 80 to 140m high will emerge behind the Grand Theater, on three independent plots facing the Azarieh Building (office building dating back to the 50's). In an area of 86,900m2, Christian de Portzamparc will build a high rising tower of overlooking small towers laid on hanging gardens including 70 % of apartments.

On the west, still on Emir Amine Street, there is a building designed by the reputed Lebanese architect Pierre el Khoury, which houses the United Nations Economic and Social Commission for Western Asia (ESCWA). This building is situated at the beginning of the banks street and on the axis of one of the main exits roads towards the south and the airport.



ill.6 site with future development in the area



ESCWA Building
Pierre El kurry

Gibran Khalil Gibran garden

Lot 128-4
Project Site

Azaryiadh Building

Beirut Gate Project
Ch de Portzamparc

Landmark Project,
Ateliers Jean Nouvel

Grand Theater Project,
Architecture Studio

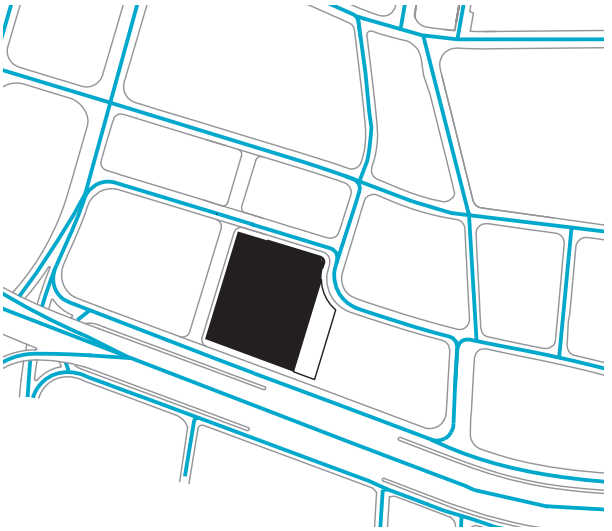
ill.7 future development in the area

Traffic and Urban relation with area

The site is situated in an area characterized by a very flat terrain with open spaces around until the new buildings are completed. The landscape is artificial , next to a central road of the city with a lot of traffic on the south side .

Located right up against the "Ring", the high-speed road that surrounds Downtown Beirut, the plot is adjacent to an intermediary road that separates it from the high speed road and enables its access.

Lot 128-4 has access from cars as well as pedestrians all around it while there is heavy traffic directly on the southern side.It would be better to have the car parking and entrance on the southern part while having a second entrance for pedestrians on the northern part would have to be considered during the design process.



ill.8 car traffic

ill.9 bicycle and pedestrian circulation

ill.10 aerial view of the site

ill.11 aerial view of the site

-- Prewar shorelines
New development- low density
New development- medium density
New development- high density
Development below corniche level
Restored building

Public or religious buildings
Public open space
Private open space
Archeological site
Pedestrian site / link
Utilities
Lot 128-4

Includes proposed modifications to the New Waterfront District sector plan

ill.12 urban settings of the area

photo 1

photo 2

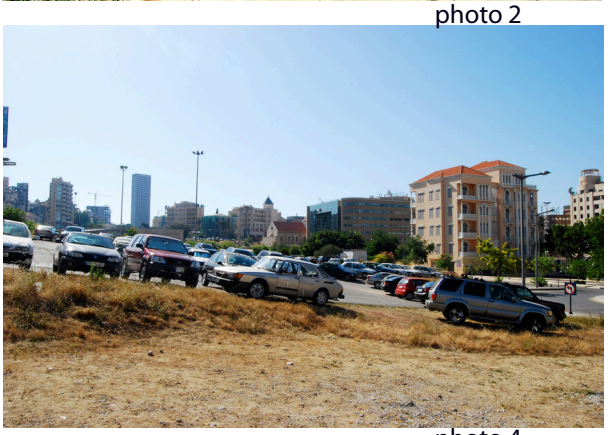
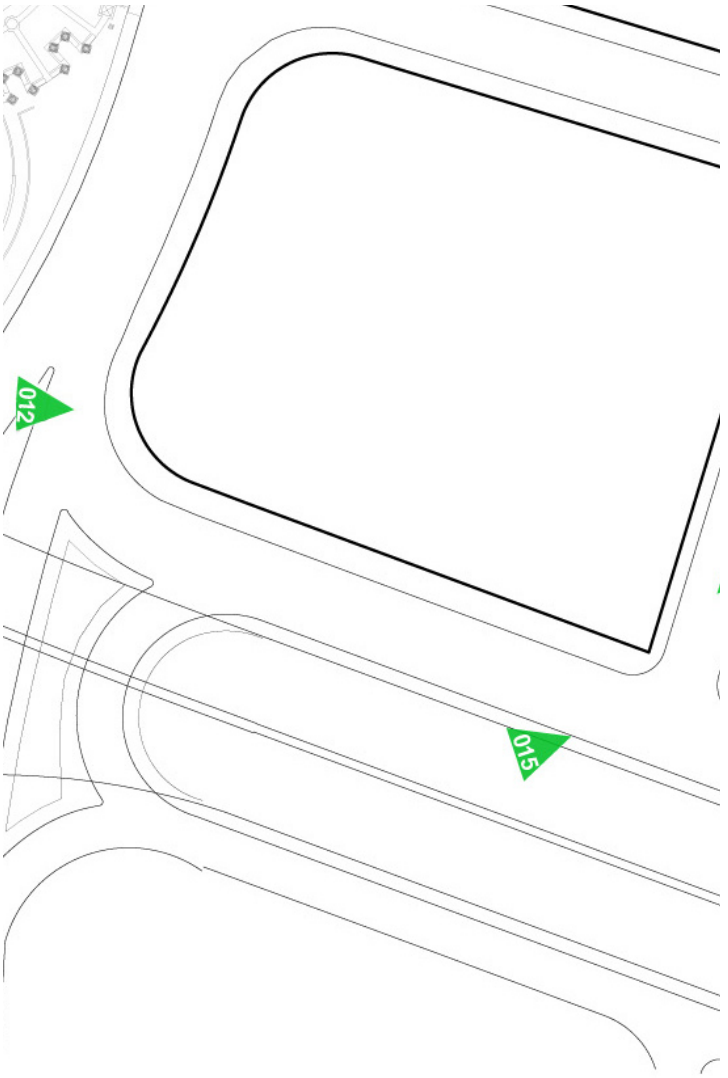


photo 4

photo 5

ill.13 Photos of the site and the area that surrounds it.



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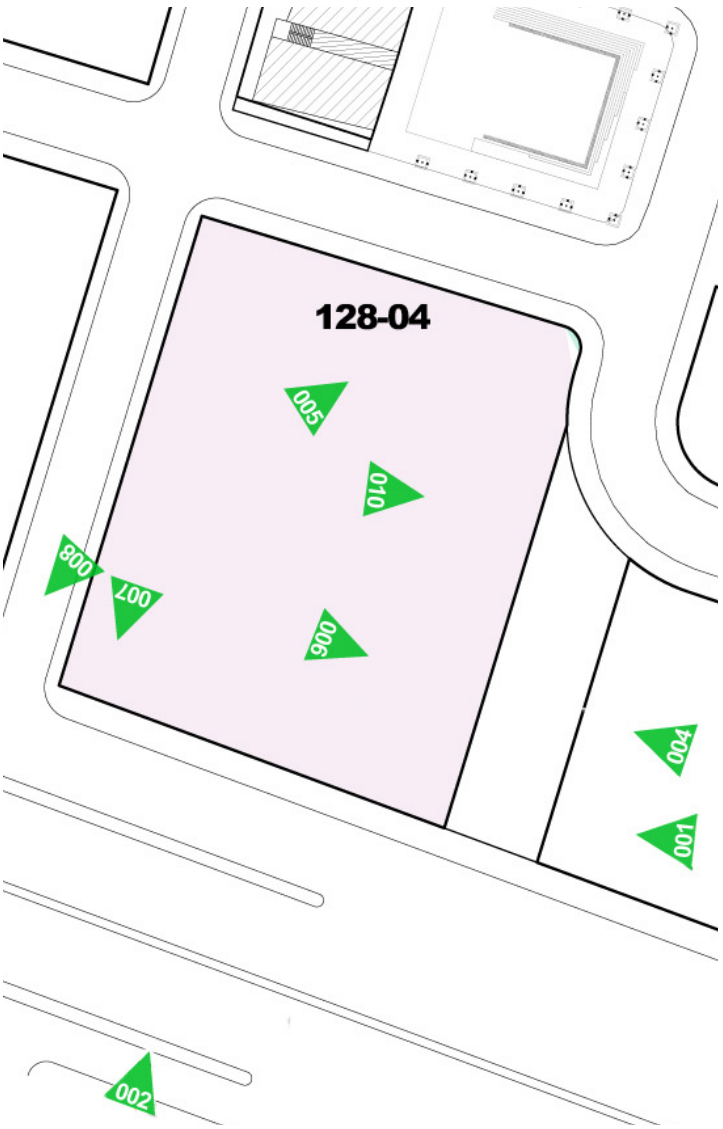


photo 15

photo 12

photo 10

photo 7

photo 8

Building Programme

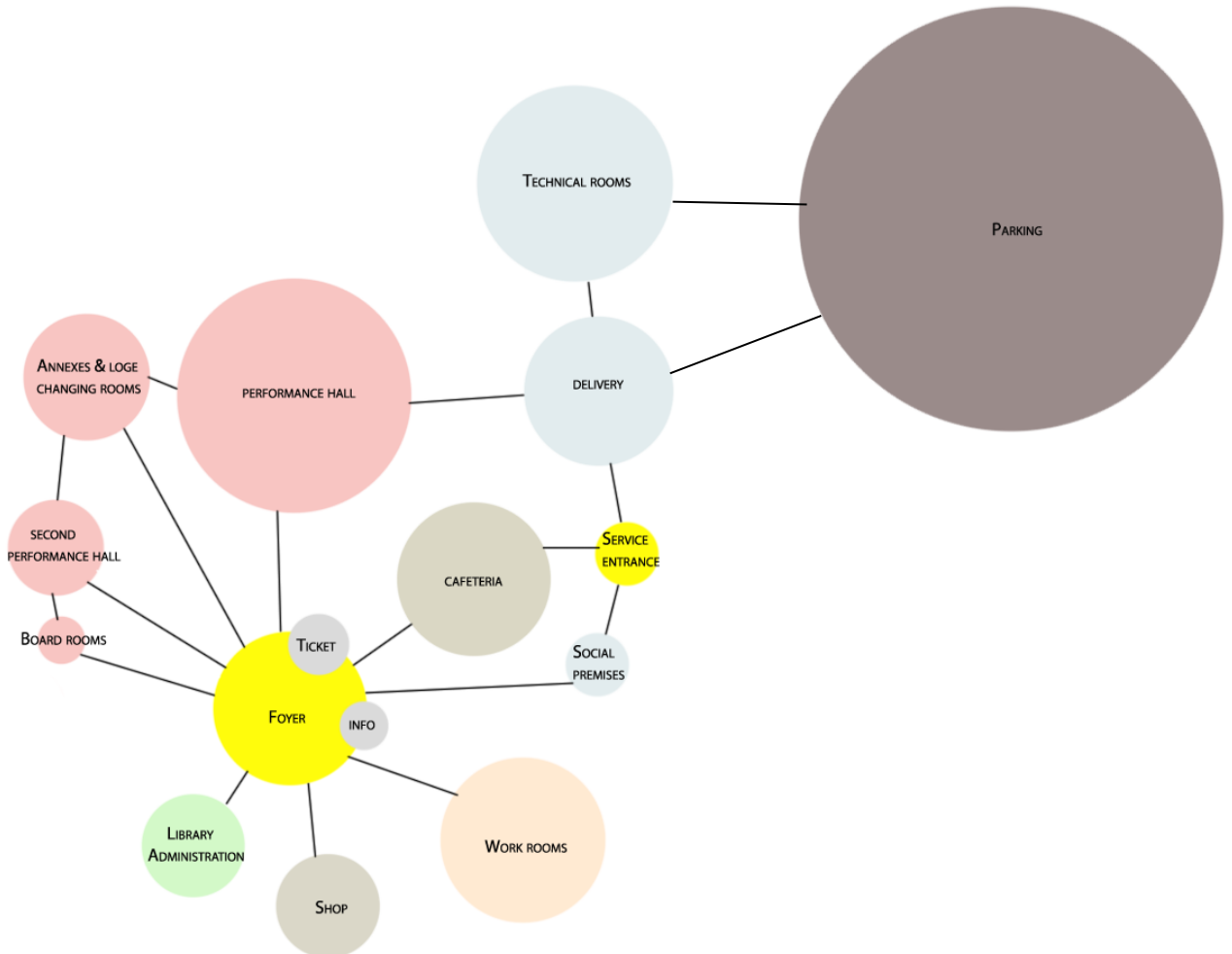
FUNCTION		m2
A. RECEPTION & INFORMATION		375
A1 . Reception Hall		300
A2. Ticket offices		25
A3. Information desk		25
A4. Security room		20
B. PERFORMANCE & CONFERENCE HALL		1,710
B1. Hall		300
B2. Butlery		15
B3. Public restrooms		40
B4. Large Performance and Conference Hall		
Hall 350 Places		400
Lighting control room		8
Sound control room		8
B5. Small Performance Hall		
Hall 200 places		250
		8
B6. Adjoining Rooms To Halls		
Individual dressing rooms	2 X 15 m2	30
Individual dressing rooms	3 X 10 m2	30
Double dressing rooms	3 X 10 m2	30
Collective dressing rooms for men		40
Collective dressing rooms for women		40
Restrooms and showers	2 X 25 m2	50
Foyer for the artists		30
B7. Meeting Room		
Small meeting room 30 persons		40
C. WORKSHOPS & TRAINING ROOMS		
C1. Workshops		
Computer rooms	2 X 30 m2	60
Printing room		30
Theatre and music Workshop	3 X 50 m2	150
Dance studios 20 persons	6X100m2	600
Dance studios 10 persons	3X 60m2	180
Dance studios 30 persons	3X160m2	480
Arts workshop	2 X 50 m2	100
Classrooms	3 X 30 m2	90
Gym		100
C2. Restrooms & Showers		50

D. COMMERCIAL SPACES		510
D1. Cafeteria		
Restaurant 100 places		200
Kitchen and related areas		100
Public restrooms		30
D2. Shops & Boutiques		
Bookshop,DVDs sale, posters, souvenirs		150
Boutiques stock		30
E. ADMINISTRATION		379
E1. Director Office		30
E2. General Secretary Office		24
E3. Waiting Room		15
E4. Meeting Rooms		40
E5. Private Restrooms		8
E6. Administrator Office		24
E7. Offices for Teachers	6 X 12 m2	72
E8. Offices for Manager		32
E9. Administrative staff	4 X 16 m2	64
E10. Secretariat Pool		12
E11. Kitchennete		8
E12. Staff Restrooms		15
E13. Area for Reprography		15
E14. Archives		20
F. LIBRARY		456
F1. reception		15
F2. shelves		300
F3. storage		50
F4. reading room		30
F5. WC		25
F6. Offices	3 X 12 m2	36
G. MISCELLANEOUS SPACES		300
G1. storeroom		60
G2. workshop		50
G3. storage		60
G4. archives		60
G5. waste storage		20
G6. staff room		20
G7.lockers and restrooms		20
G8. Infirmary		10
H. TECHNICAL ROOMS		300
H1. technical areas		300
H. PARKING AND DELIVERY		4.900
H1. underground parking 192 Cars		3.300
H2. delivery area		173
H3. Miscelaneus Space		30
H4. WC		25

Summary of Surface Areas

SPACE	AREAS	PROGRAMME
A. Reception, Information	395	musical,theatrical events,conferences
B. Performance and Conference hall	1,710	studios and classes for the students
C. Workshops and Traning rooms	1840	shop and caffeteria
D. Cafeteria and commercial spaces	510	management and functions
E. Administration	379	storage ,social rooms
F. Library	456	
G. Miscellaneous Spaces	300	heating, electricity, air-conditioning
H. Technical rooms	300	
I . Parking and delivery	3,600	atleast 100 cars
Horizontal and vertical circulation	400	connection between functions
TOTAL USEFUL SURFACE	9,434	

In order to get an idea of the layout of the program and which functions are needed in the building a room diagram is set up to express the functional connection of the rooms as well as the area relations .



"As far as i am concerned, life is a dance, and life is creativity. Like Kuafu, the legendary Chinese figure who chased after the sun, we should never stop or hesitate." liu feng-xue

Target group

Proffesionals
Future professional performers aged 18-26 with high artistic potential from a wide range of artistic disciplines, cultural origins and economic backgrounds. These will have the maximum subsequent impact on performing arts as practised in their own countries and disciplines.

Summer school or workshop participants will be performing artists of all disciplines with the creative ability to make meaningful contributions to the project they are engaged to execute.

Amateurs
Besides the educated professionals there is going to be a need to provide a place for aspiring amateurs who dance as a hobby such as children and their parents that want to have fun with physical activities .They will need a space to practise as well as perfrom. Therefore it is nesecary to have two halls minimum in the premises of the complex.

Audience
Of course the artists need to show their art. Therefore people will come to admire the shows o, to relax and socialise in the cafeteria, or just to admire the architecture.


ill.16 audience in a performance

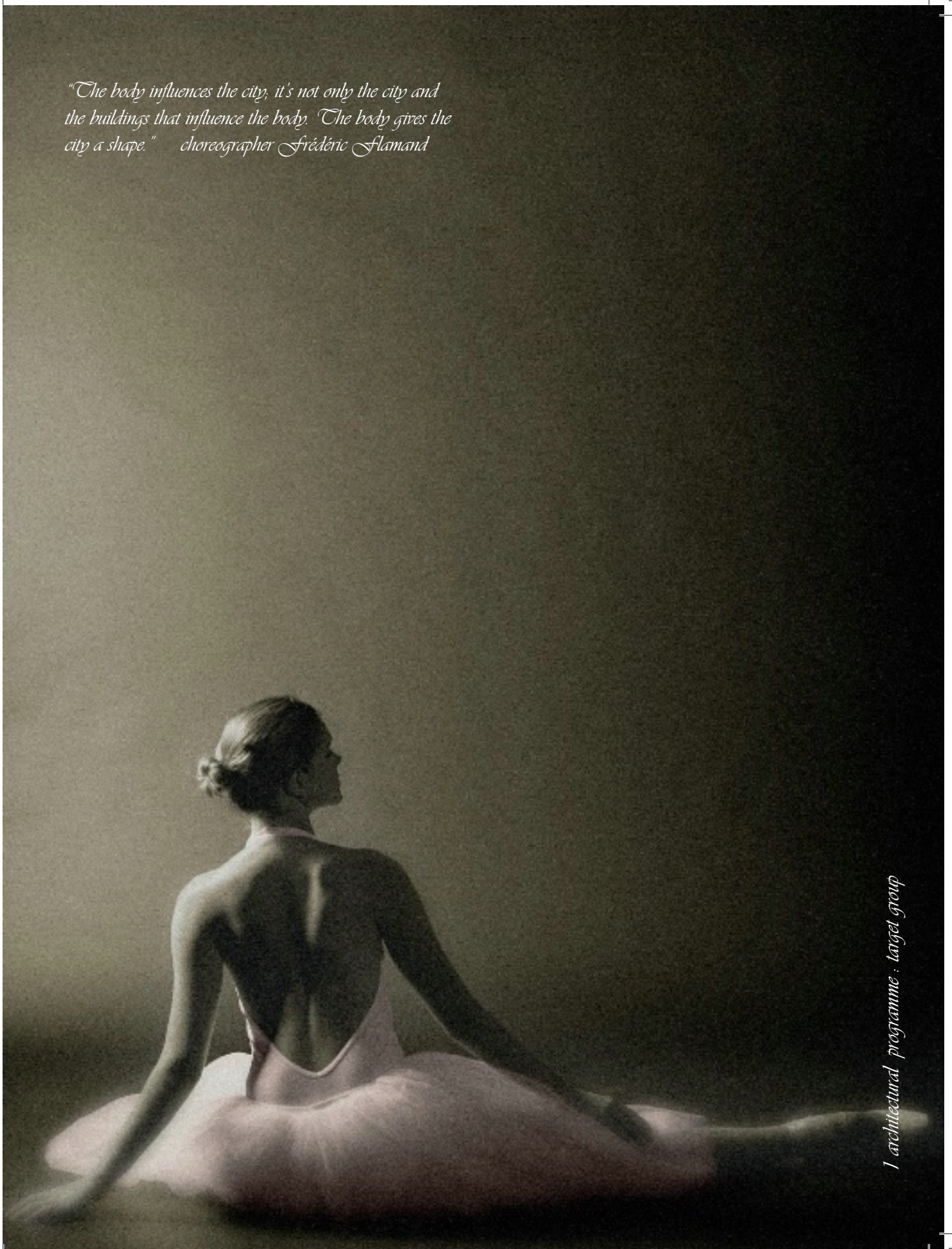

ill.14 dancing on professional level


ill.15 dancing for fun

Conclusion
It is needed to propose a building involved in the everyday life of the people due to its proximity to major roads.It should be accesible to the inhabitants of the area, besides the students and employees of the facility.The other issue is to provide qualitative and easy access for the minor and major needs.

The building should be extrovert to the visitors but also provide the students and staff the ability to focus on their daily work without distraction.The need to design the building with an open and welcoming space for social activities and a more private space for the usual users in evident in the research.

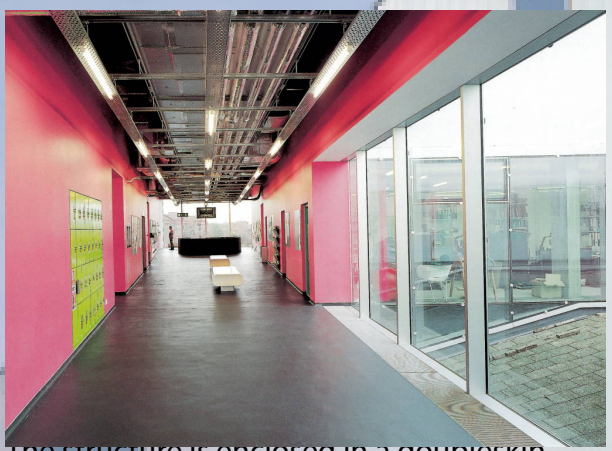
"The body influences the city, it's not only the city and the buildings that influence the body. The body gives the city a shape." *choreographer Frédéric Flamand*



1 architectural programme : target group

CASE STUDY
Laban Dance Center Herzog & de Meuron

The Laban Centre is one of the largest institutions for modern dance in Europe. Named after Rudolf Laban,it is situated among warehouses and workshops on a tributary of the Thames in Deptford, southeast London. The large volume of the building is well integrated into its surroundings, although the somewhat unreal, floating quality lent by the **shimmering facades** distinguishes the centre from the neighbouring developments.



The structure is enclosed in a doubleskin facade with a 60 cm ventilated cavity between the two layers. The outer skin, which provides thermal insulation and acts as a visual screen. The coloured coating was applied to the rear face of the inner layer of sheeting, which lends this skin a pastel-like, three-dimensional effect. The inner skin consists largely of translucent double glazing.
Movement and communication, two central aspects of the dance centre, are also themes of the architecture. The interior and exterior of the building **suggests a state of movement**. Ramps and circulation routes lead between the complex layout of rooms and broaden into open spaces. Light wells allow daylight to penetrate into the deep volume of the building and establish visual links through the centre.

ill.17 sketch of the first floor plan

The **transparent and translucent** walls have more of an articulating than a separating function. Within this open "cityscape", the colours form a visual aid to orientation. Walls and inbuilt fittings in the corridors are coloured bright turquoise, green and magenta.
In contrast, the dance studios have a restrained design. Here, the panes of obscured glass filter the incoming light. A single room-height window in each studio space allows a **view out** to the surroundings.

ill.18 photos of the interior

The double-skin facade creates a subtle reciprocity between inside and outside: the colours of the facade panels shimmer internally, while externally, one sees the shadowy forms of the dancers in the evening.

ill.19 of transparent or partially coloured polycarbonate sheeting

Lincoln Dance Center Diller + Scofidio

Lincoln Center (LCPA) is the new "Street of the Arts" spanning West 65th Street between Broadway and Amsterdam Avenue. After $360 million of renovations ,it embraces the spirit of the original 1960s architecture, while incorporating elements of transparency and fluidity to create a new language celebrating the vitality of the cultural complex today.

LCPA provides a wide range of activities such as offering art-related symposia; family programming; accessibility; and other community initiatives. The now solid travertine base of the school will be opened up with a **transparent new facade** offering substantial street visibility and establishing an **unmistakable presence** on Broadway.

A three-story wall of sheer glass reveals the pre-concert hubbub in the lobby at Tully, a 1,087-seat recital hall. Looking up, one sees the dance students working out in a studio that is suspended inside the **transparent lobby** of Alice Hall in a distinctive wedge shape.

A new campus green would provide an **oasis** for students and the public to gather day and night. The lyrical design features a gently sloping paraboloid public green oriented toward the reflecting pool.

The opening up of the theater to pedestrians and drivers passing by serves to increase the visibility of the building and provide a new "front door."

The design encourages the interaction of thousands of visitors and more than 5,000 artists, teachers, and students who work and practice every day in the 81 practice and 80 rehearsal rooms, 13 dance studios, and 13 stages and concert halls that border West 65th Street.

LCPA serves three primary roles: presenter of superb artistic programming, national leader in arts and education and community relations, and manager of the Lincoln Center campus.

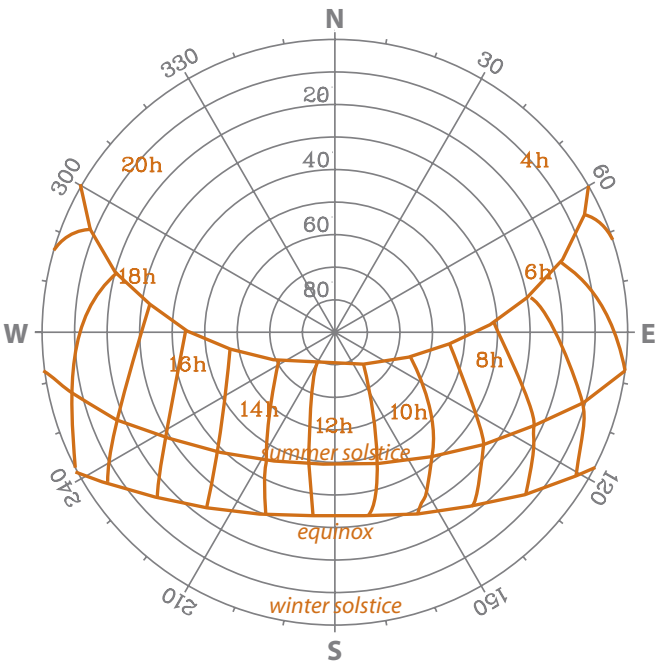
ill.20 interior photos of the dance center

Climatic Analysis

Beirut has a Mediterranean climate characterized by a hot and humid summer, pleasant fall and spring, with cool,rainy winter. August is the hottest month of the year with a monthly aver. high temperature of 29 °C, while January and February are the coldest months with a monthly average low temperature of 10 °C (50 °F). During the afternoon and evening the prevailing wind direction is from the west, i.e., onshore, or inland from the Mediterranean Sea; at night the wind direction reverses to offshore, i.e., blowing from the land out to the sea.

Winter is the rainy season, with major precipitation falling after December. The average annual rainfall is 860 millimetres; the rainfall is concentrated during scattered days in winter falling in heavy cloudbursts. Snow is extremely rare and usually occurs without accumulation.

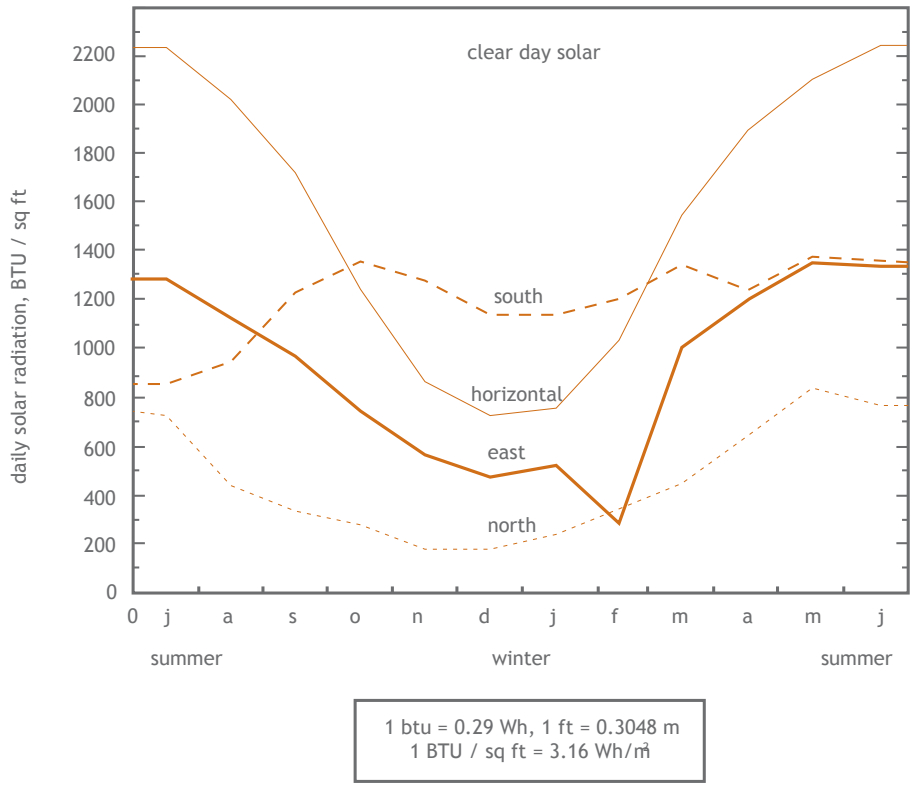
Sun



ill.21 sunpath diagram for Beirut

Due to the geographic position and the surrounding buildings the site is exposed to the sun most part of the year.There is a need to avoid excess sunlight and overheating of the structure ,especially since its focused for people that exercize.Natural daylight is very important inside the building for the well being of its inhabitants and to lower energy use when feasible.

Solar radiation



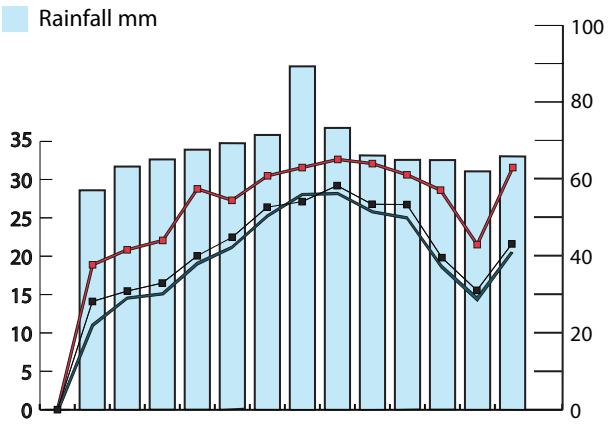
ill.22 solar radiation diagram for beirut

Solar radiation and related parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Daily Total Horizontal Solar	2387.6	3195.8	4898.1	6012.0	6837.0	7192.0	7010.4	6343.7	5374.6	3873.5	2757.2	2273.4
Daily Total Vertical Solar Azimut N	735.7	996.5	1480.0	1961.2	2562.6	2398.0	2227.4	1408.4	1000.6	925.6	585.9	598.2
Avg. Daily Total Vertical Solar Azimut E	1620.0	2137.2	3166.2	3819.9	4325.1	4184.5	4104.4	3577.7	3123.0	2452.9	1776.7	1513.1
Avg. Daily Total Vertical Solar Azimut S	3526.6	3798.2	4346.3	3871.3	3461.4	2623.1	2732.9	2995.6	3908.2	4193.6	4061.5	3736.0
Avg. Daily Total Vertical Solar Azimut W	1612.1	2148.2	3164.3	3831.0	4324.8	4155.2	4074.4	3626.3	3114.8	2443.4	1777.4	1509.3
Average Daily Direct Normal Solar (Wh/m2)	2981.7	3364.5	4587.2	4761.0	4829.7	6740.1	6586.6	7240.3	6960.9	4959.0	4514.7	3529.8

Research has been made on how much solar radiation is transmitted through the windows. The sun path is smaller in winter while in summer east and west facades are taking a large amount of solar radiation.A suggestion would be to avoid window areas on the south to avoid overheating the structure.Designing a shading system that would protect during those hours could be another solution.

Temperature and humidity

On the basis of the high temperatures all year round natural ventilation should be utilisised to avoid overheating the building and to provide fresh air for indoor climate.



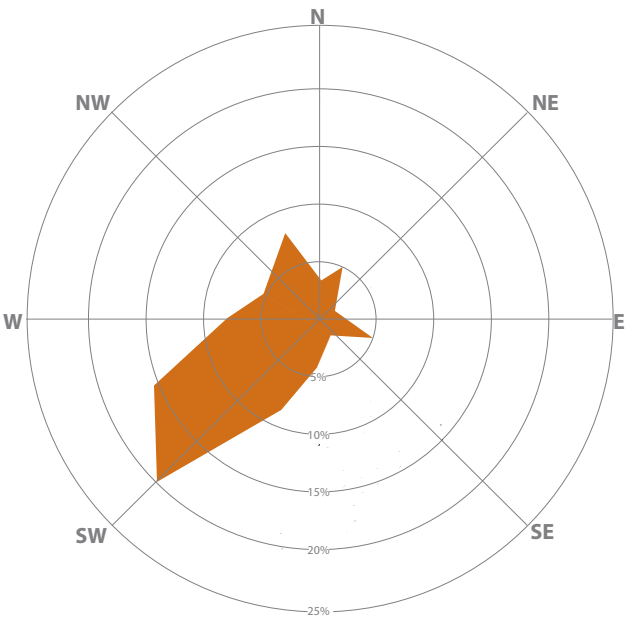
Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yea
Day Temp	14,1	15,4	16,5	20,1	22,5	26,4	27,1	29,2	26,8	26,7	19,8	15,5	21,6
NightTemp	11,9	13,3	14,8	17,5	20,7	24,3	26,5	27,4	24,8	22,7	17,8	13,8	19,7
Max temp	19,4	20,6	21,1	29,4	27,2	30,0	31,1	32,8	31,7	28,3	28,9	20,0	32,6
Humidity	58,1	63,8	65,4	68,3	69,7	71,1	89,1	72,7	66,9	64,9	64,8	62,0	66,6

ill.23 diagram of average climate data from Beirut

Wind

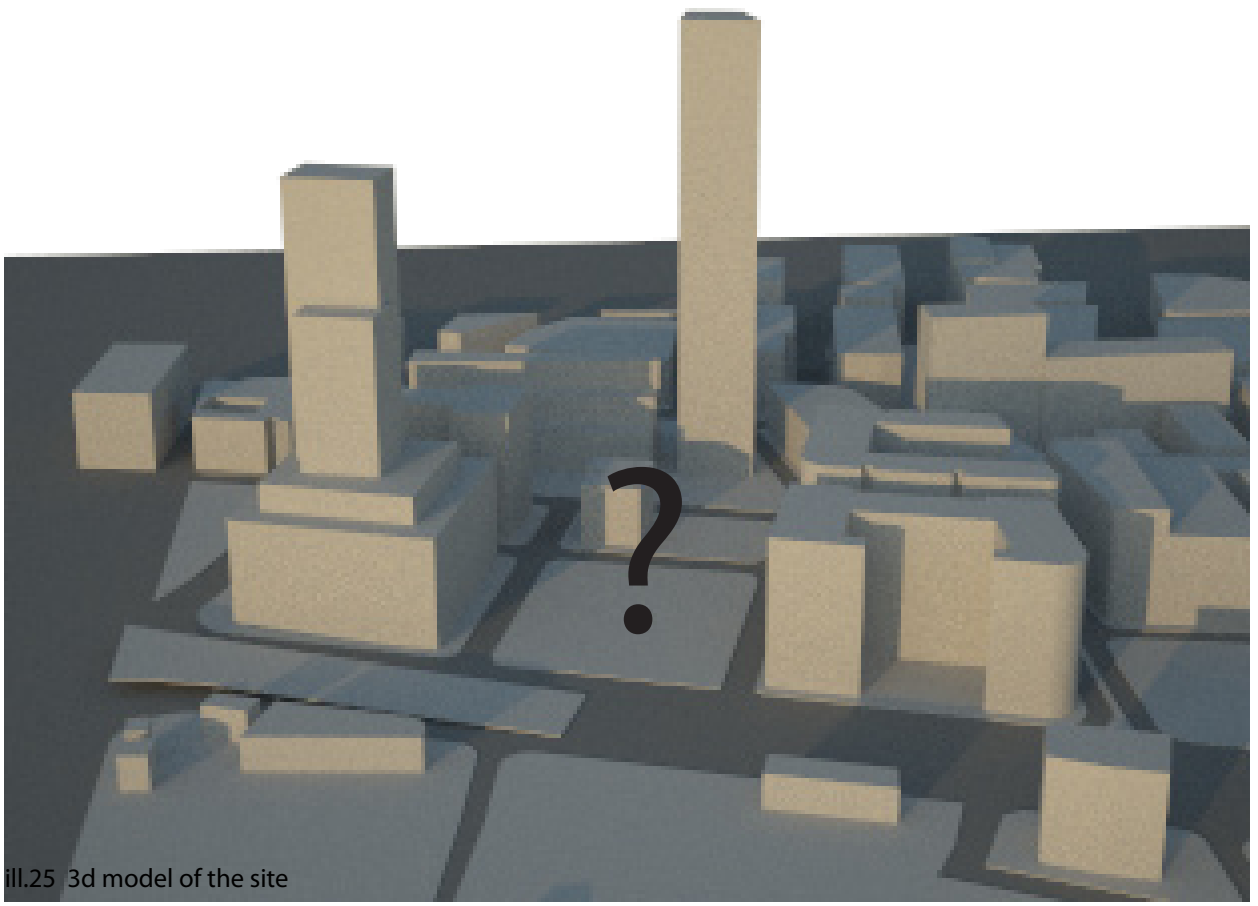
The largest amount of air comes from the south western direction and the mainland. Due to the site's proximity with the sea and the change of direction of the wind depending on the time of the year the air in the area is of good quality.

Since there is a big road in the southern part it would be better to avoid big openings on that side in order to avoid dust and noise from ongoing traffic.On the other hand by having openings protected from particles , efficient natural ventilation in the building would be achieved by positioning the openings in the opposing pressure zone.



ill.24 wind diagram of Beirut

A good solution would be to shelter the openings with an artificial obstacle or even better vegetation and trees to filter the air from the polluted and noisy road .

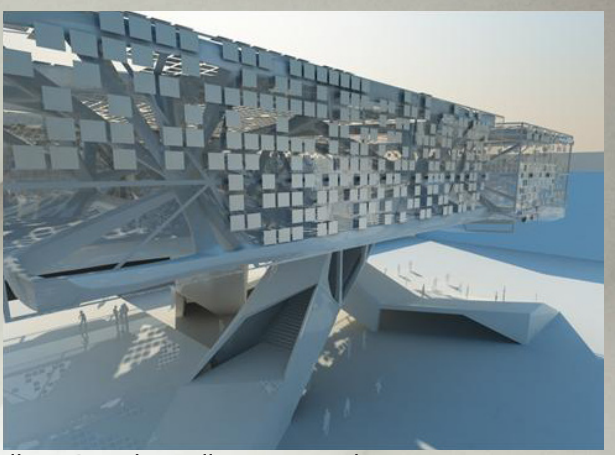


ill.25 3d model of the site

Architectural Qualities

Besides the usual architectural qualities implemented on projects such as the shape ,construction ,view , the room programme and spatial diversity for example in this project there is a need to study other aspects more in depth.

Due to the nature of the building ,education facility and performing hall, and taking under consideration its inhabitants the major attributes that should be investigated during the design process would be the acoustic quality and natural daylight



ill.26 Danish pavillion mapt architects

ill.27 Dhaka

"No space, architecturally, is a space unless it has natural light." Louis Kahn

ill.28 scan from office

Daylight

Architecture exists because of the light: to see it, to experience it, to enjoy it. Light and space are inseparable , because light is the only material capable of giving the feeling of space. It influences the way we percieve ,materials and their surface.Daylight can divide space in zones and illuminate areas according to specific requirements.

This fact has always represented a big challenge for architects and it allowed the growth of a critical attitude to emphasize light effects and to exploit natural light sources. It's not only shape and color that characterize the space, but especially the light that penetrates, its diffusion and the relation that it creates with the outside and the landscape. The problem is then how to solve the need for natural light, according to architectural issues like orientation, openings and light diffusion.

Since ancient architecture, the movement of the sun has been a source of inspiration, influencing not only the shape of a building, but also the orientation and layout of rooms and openings.

Building orientation is one of the oldest principles to reach a good level of natural light, the positioning of the structure should consider the environmental conditions such as topography and area as well as overshadowing from trees or other buildings.

The amount of daylight can be calculated by various methods. A daylight factor of 4% is preferable for ensuring a good amount of daylight for working conditions,or 2% for a school with rarely need of artificial light during daytime [Rob March, 2005 p. 67].

With software such as Dialux it's possible to determine the amount and quality of the daylight and artificial light through a photometric model of the rooms by means of the amount and quality will be determined.

ill.29 Zlatko Ugljen, White Mosque , Bosnia Dhaka

Daylight conditions

Visual comfort is important in order to avoid general discomfort and damaging the vision of any occupants.Following are listed a few of the strategic objectives to ensure comfort when working with artificial light and daylighting:

1 The design should ensure that all workplaces are daylit for the majority of the hours of daylight.

2 Sufficient illumination must be provided to enable the occupants to carry out their particular task in comfort.

3 Large areas of vertical glazing for deep penetration will need careful detailed design, possibly including shading or redirecting elements such as light shelves, to avoid glare from direct sunlight and bright diffuse sky.

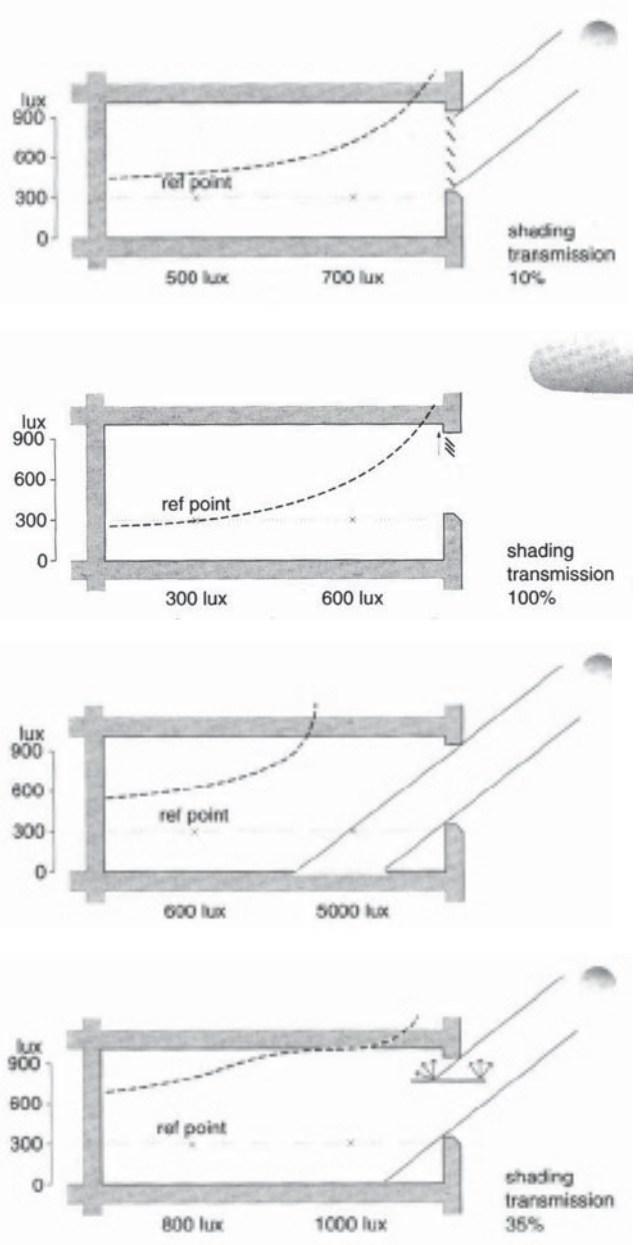
4 Consider the positioning and reflectance of surfaces both inside and outside the building to minimize the risk of glare.

5 Artificial illumination should be low in glare and of good colour rendering, especially in areas where occupants spend long periods.

6 Both daylighting and artificial lighting should be designed with recognition of the task carried out and atmospheres wanted in the space.

[Baker, 2000]

One of the primary functions of the window is to let in daylight in the building. However, to avoid glaring sunlight and overheating, it can be necessary to add solar shading to regulate the contribution of light and heat.



ill.30 varying daylight conditions according to shading

Conclusion.

Solar shading can prevent direct sunlight when it is needed and reduce glare from the windows. At the same time it can be used to make an interesting play between direct sunlight and shadows in interior rooms. Solar shading should not shut out so much daylight, that makes it necessary to use artificial light.

Shading

Regardless of construction method shading is essential to obtain a satisfying thermal indoor climate. In winter direct sun may be considered comfortable and desirable in a living zone, while in summer it will be uncomfortable and cause overheating. Shading is also necessary to avoid excess temperatures caused by external and internal solar gains. The following methods are used to reduce external solar gains when available:

1 Shade external building surfaces, particularly roof, east and west walls. This could be done by other buildings or by vegetation.

2 Use light-coloured external finishes, e.g. paint or chipping, to reflect radiation.

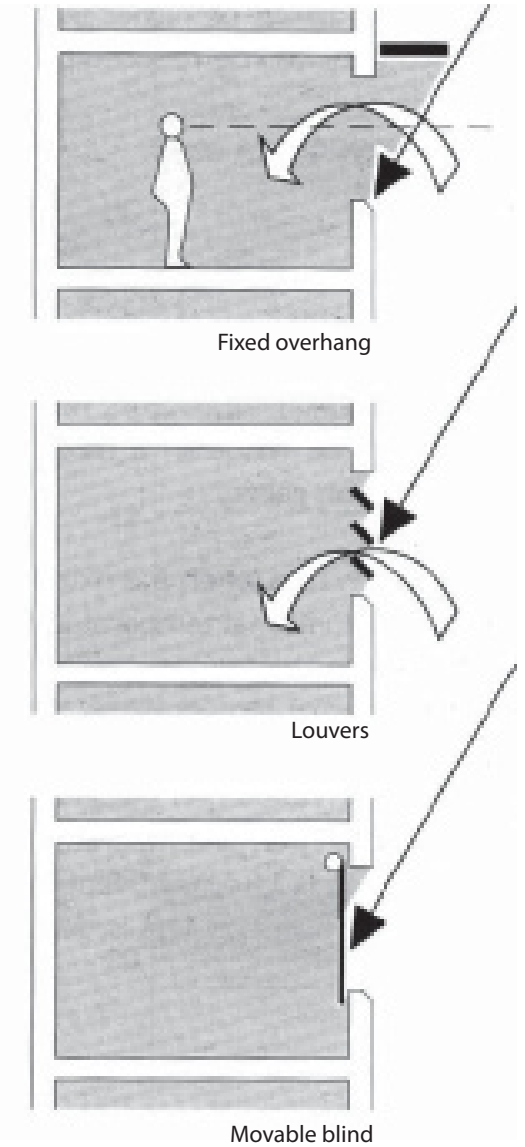
3 Ventilate cavities.

4 Internal solar gains are gains through windows and are likely to have the greatest impact on the thermal indoor climate.

The main methods to reduce internal solar gains are:

1 Prevent direct solar radiation by shading; external shading is more effective than internal shading. Louvers between panes of double or triple glazing have a shading performance approaching that of external louvers, but at lower cost. Movable shades give better response to varying sky conditions than
fixed overhangs, which respond to seasonal solar elevation only.Fixed shades often compromise daylighting during times of lower sky luminance.

2 The use of tinted and reflective glass is not recommended as a shading strategy. Most of these materials reduce the daylight by a similar or greater factor than their thermal coefficient. [Baker, 2000]



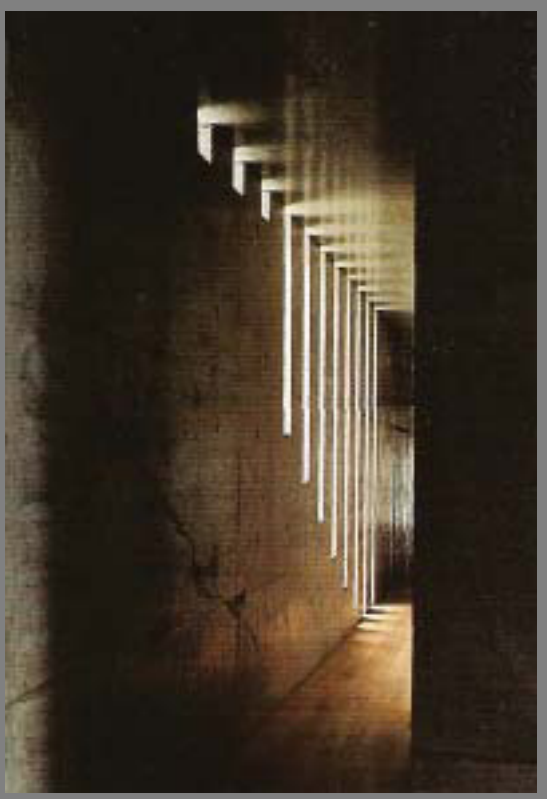
ill.31 shading devices with effects on view and ventilation

Case Study inspiration light and shadow

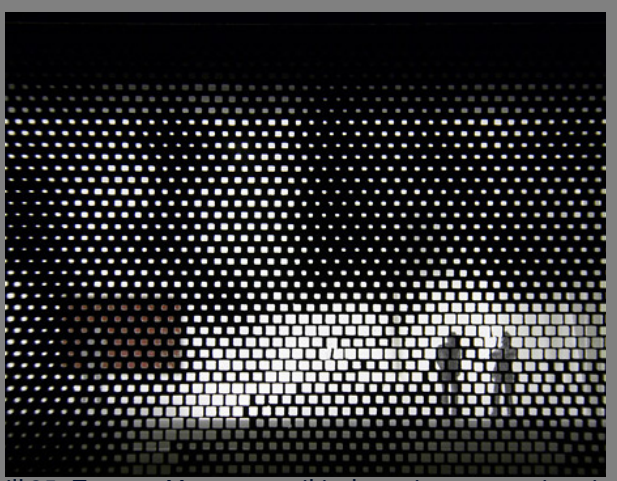
ill.32 Riddle Copboard, Steven Holl

By using perforated plates and gaps between the concrete walls or the ceilings we allow natural light to enter the interior and creating a play between shadows and light. The rooms change in character during the day and the plates can be used as a solar shading to prevent the glare from bright sunshine, as well as to avoid overheating in the summer months.

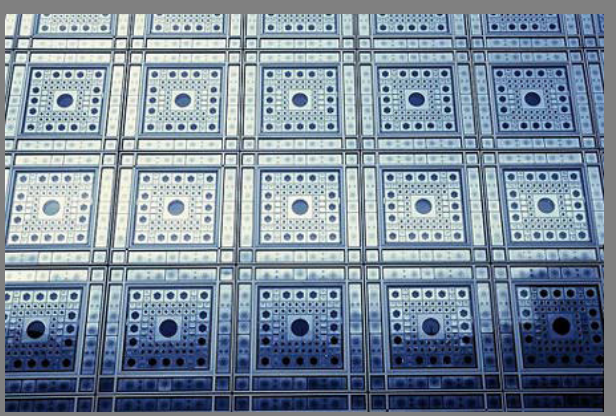
ill.33 Koshino House, Japan, Tadao Ando



ill.34 Johanniskirche, Saarbrücken ,Wandel Hoefer Lorch

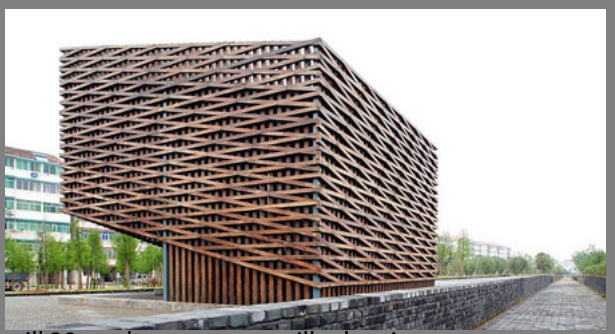


ill.35 Tamayo Museum, rojkind arquitectos,mexico city

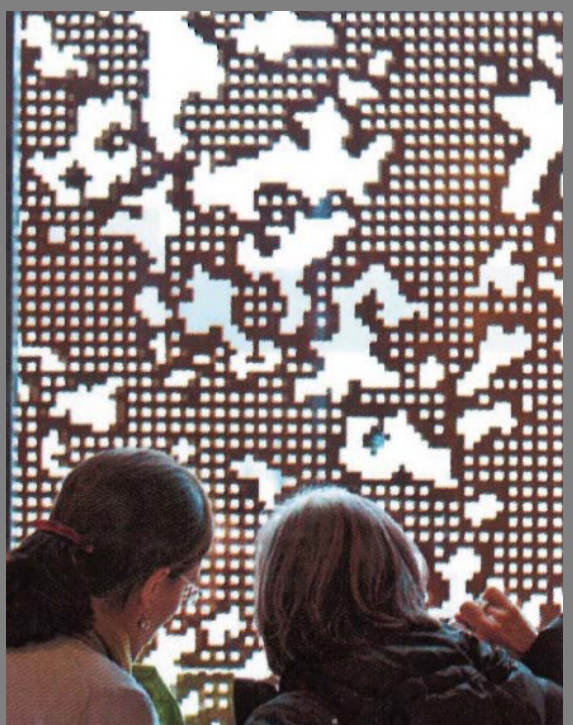


ill.36 Arab World institute Jean Nouvel, Paris

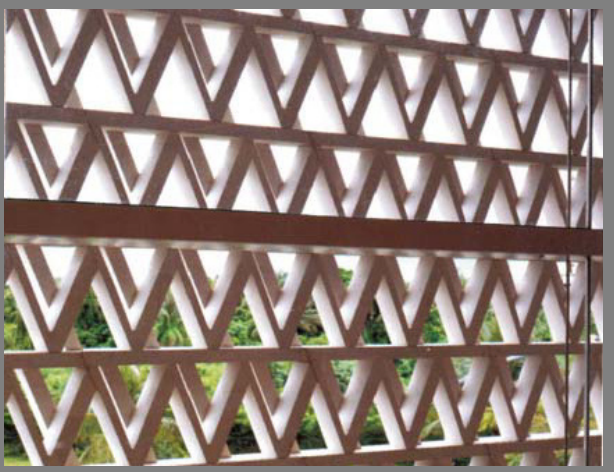
ill.37 Apartments and Studios, Tokio Studio M,



ill.38 welcome center , till schweizer

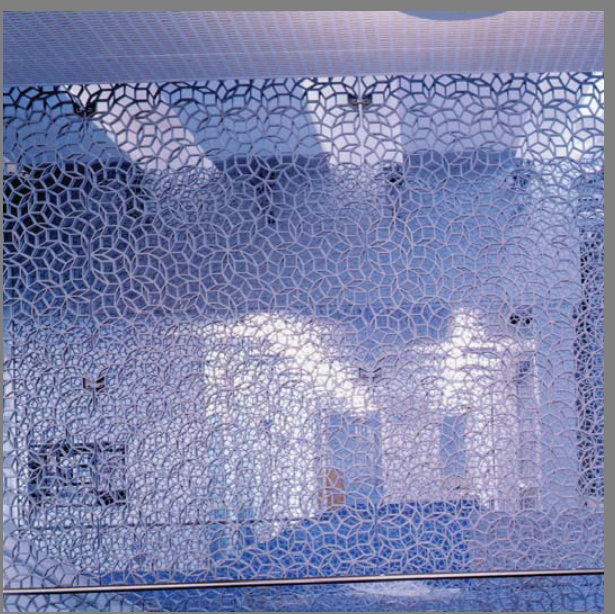


ill.39 CaixaForum, Madrid , Herzog & de Meuron



ill.42 Louis Vuitton Flagship Store, Guam Barthélémy & Grino

ill.41 perforated sheet facade Herzog & de Meuron



ill.40 Liberal Arts College,Doha Kensuke Watanabe

Acoustic comfort

Protection against noise is an essential requirement of building design to ensure that work or rest is not disturbed.

The major sources of noise that should be eliminated are:

1. Noise from equipment
2 .Airborne noise from outdoors
3. Airborne noise between enclosed spaces
4. Impact noise

There is a lot of evidence showing that people are comfortable in environments where conditions fall well outside the strict comfort limits specified. This is especially true in summer conditions. There is also considerable evidence that even in highly controlled environments, poor levels of user satisfaction still persist.

Comfort in buildings should be considered as the absence of long-term extreme values of environmental comfort parameters, rather than the maintenance of precise and close limits. The over all satisfaction of the occupants will be influenced by the building's own climate-modifying performance, the occupant's ability to adapt the building by means of control, such as shading, ventilation, space heating etc. [Baker, 2000].

A very common source of noise can be mechanical ventilation when we consider equipment noise.These type of nuisanses should be minimized to at least 35 db.

Airborne noise from outdoors is quite significant since our site is close to oncoming traffic.By increasing the insulation we might insulate more than the outside noise from the building.

Airborne noise between enclosed spaces: non-load-bearing interior walls often have poor acoustic insulation and airborne noise between enclosed spaces is a significant problem. The design initiatives for improving the energy consumption of a building do not improve the acoustics, unless increased insulation is used for interior walls and decks. [Kirkegaard, 2000].

Impact noise can be solved by creating a floating floor, where flooring and loadbearing construction is fully separated. Impact noise can be minimized by adding a soft mat under any wooden flooring, suspending the ceiling under the deck and increase the insulation. [Larsen, 2006].

In this section the important terms for the acoustic quality of a room will be discussed.

Reverberation time
Is the time before the decay of the reflected sound .Inside a classroom it is prefered to have an interval of 0,5s-1,2s while on the hall a time of 2 s would be efficient. The reverberation time must be high enough for the sound not to die out too quickly. To heighten the reverberation time highly reflective materials should be used. On the other hand the reverberation time should be low enough for the sound to stop. This can be achieved with absorbing materials.

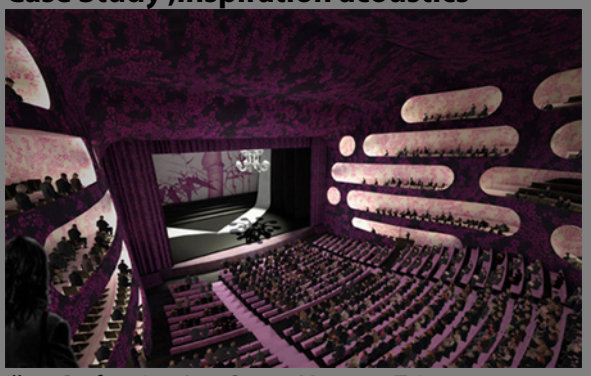
Geometry
The geometry of the room is important to control the angles of the reflected sound.
- The plane sound wave reflection can bring the sound far into a room, especially if a little angle is added, to project the sound even further.
- The concave shape creates sound "hot-spots" which is not desired in rooms where good acoustics is needed.
- The convex reflection diffuses the sound in different directions, which creates a more evenly distributed sound.
- The diffusion panels also distributes the sound in different directions.
-The shoebox is the most simple and succesful shape for a room.

Echo
The human ear will not perceive a reflected sound as an echo if the sound arrives less than 50 ms after the direct sound. To make sure the echo is below 50 ms ,the reflected sound-path should be a maximum of 17 meters longer than the direct sound-path. To achieve this it is important to eliminate flutter echo that can be created when sound travels back and forth between two hard surfaces.

Dead zones
The opposite problem of the echo is the dead zones. It is zones where people are screened of from both direct and reflected sound. This can be avoided by a controlled reflection of the sound by different angles of reflecting panels. [Kirkegaard, 2007]

Reflection, diffusion and diffraction
Reflection is the return of a sound wave from a surface.A plane sound wave which hits a plane surface will make a plane outgoing sound wave - angle of incoming and outgoing sound wave will be the same.
Diffusion is the scattering or random redistribution of a sound wave from a surface. Diff usion does not "break up or absorb sound, direction of the incident sound wave is changed as it strikes a sound-diff using material. This happens when the surface depth of the plane, hard-surface elements are similar to the lengths of the sound wave the outgoing angle is scattered.
Diffraction is the bending or "fl owing" of a sound wave around an object or through an opening. It is important to design the acoustic panels with correct surface area (length and width)

Case Study ,inspiration acoustics

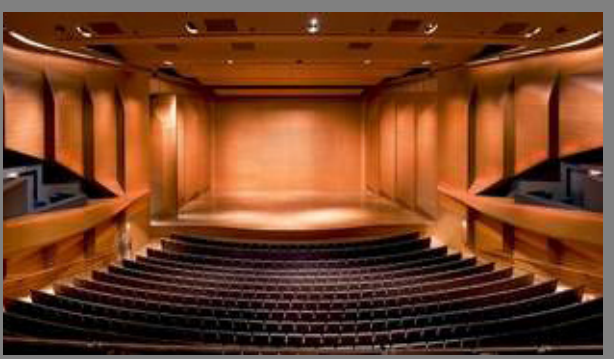


ill.43 Performing Arts Center Mecanoo Taiwan

ill.44 Snohetta oslo opera house

ill.45 Music Building ,3XN, Amsterdam

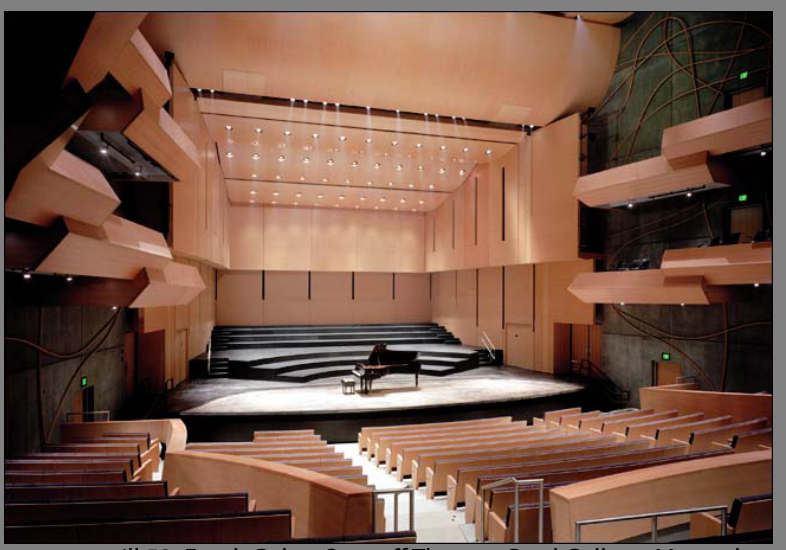
ill.46 Concert Hall in Raiding Atelier Kempe Thill



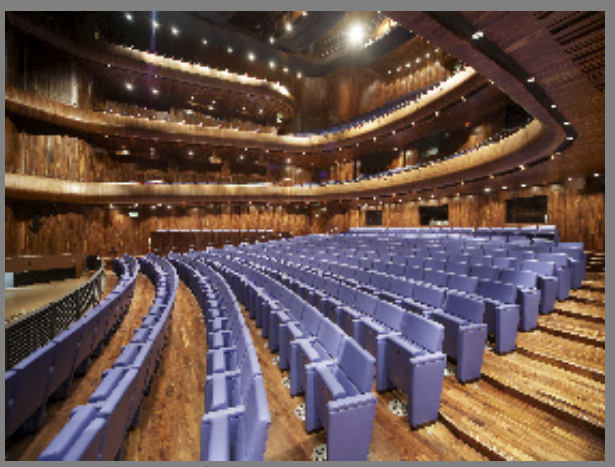
ill.47 Starr Theater auditorium Diller + Scofidio,Broadway

ill.48 Villa Vittoria,Florence

ill.49 Snohetta oslo opera house



ill.52 Frank Gehry Sosnoff Theater ,Bard College Massachu-



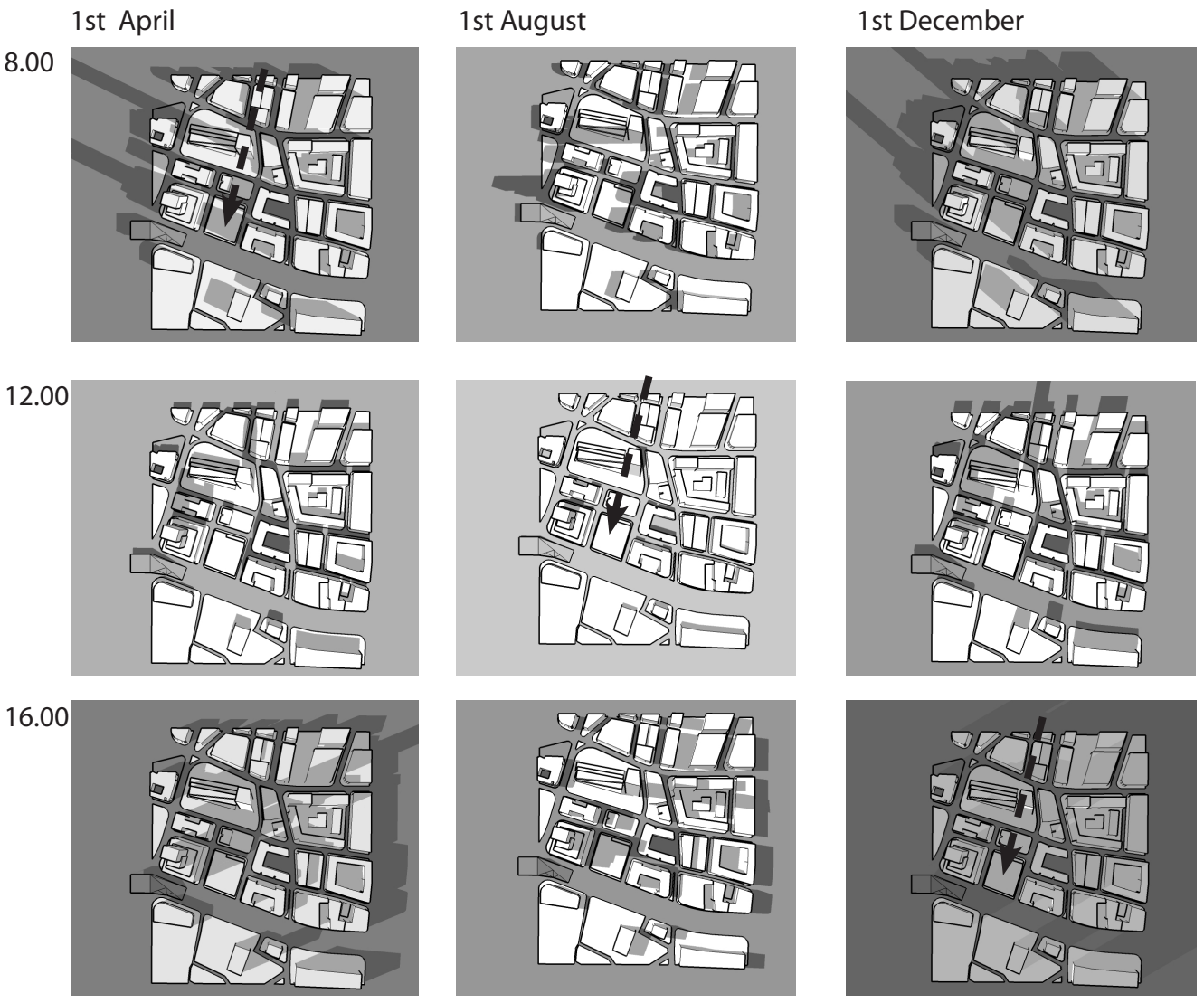
ill.50 Wexford Opera House OPW

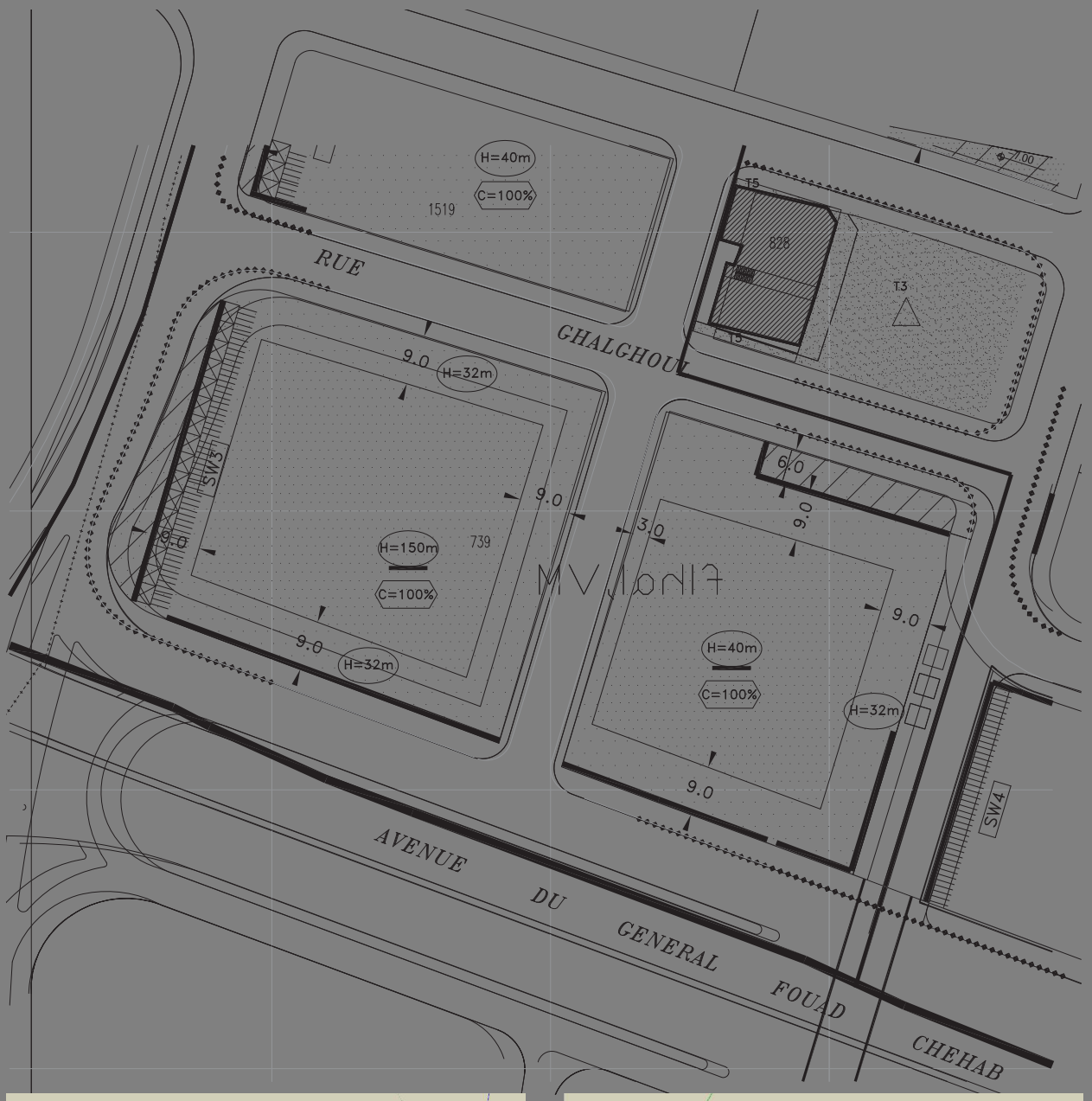
ill.51 Parsons ,School for Design ,New York City

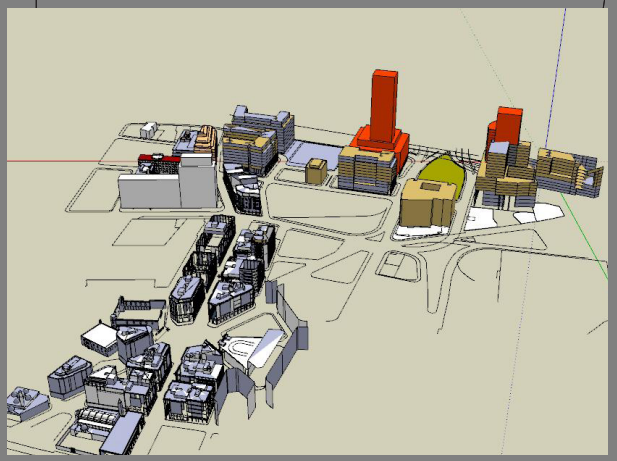
ill.53 Sydney opera house Jorn Utzon Sydney

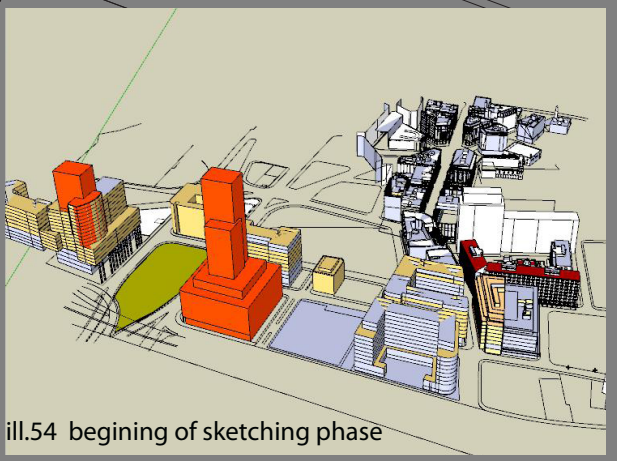
Shadow Study

Investigation of shadows in the Ghalghoul district
The area on the left and right of the building site is estimated to have two buildings of 100 and 36 meters respectively, that are taken into account during the shadow study.
The outcome of the study ,which was completed in Sketch Up, shows that the South facade is always taking the sun while the north and east is most of the time shaded by the surounding buildings.The west facade is shaded after 16.00 which means that it still needs to be protected from the sun to avoid glare and overheating.The same relates to the south facade.









ill.54 begining of sketching phase

Sketching process

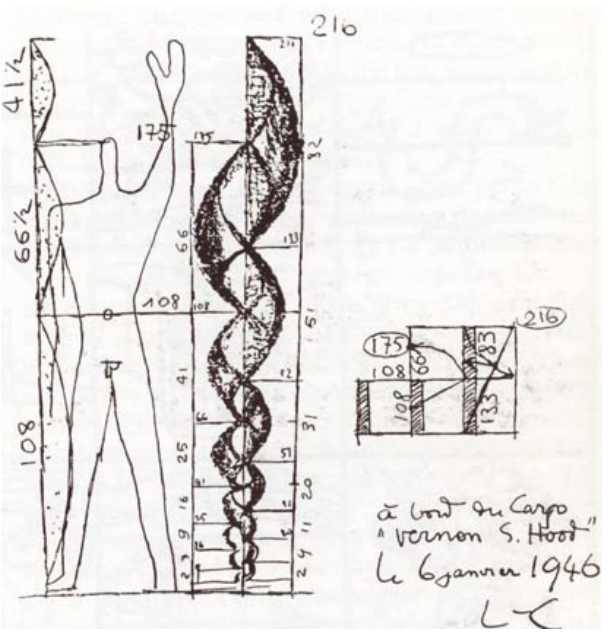
The sketching process is arranged as chronological as possible. Different aspects of the buildings are set up with icons, including; overall concept, plan and section, program, exterior shape, interior, structural system, acoustics and comments.

The first phase focuses on different studies previous to the actual sketching.

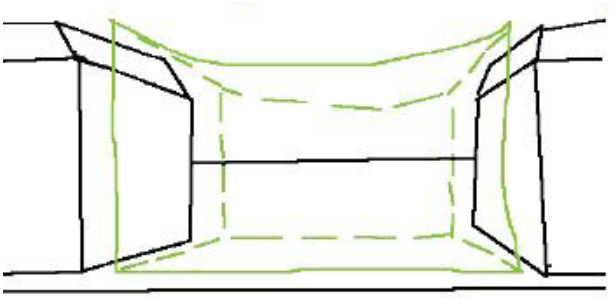
Plan : different typologies for filling up the building site are made.The size of the desired square meters is placed in a scale model of the context to give an idea of how much room the building actually requires.

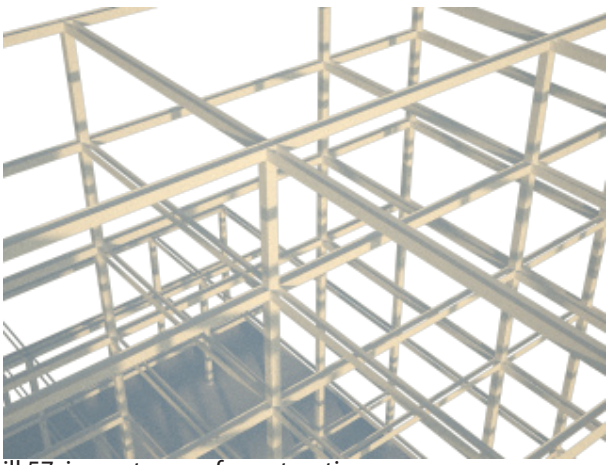
Program: studies in different ways of arranging the rooms are made.Both case studies are in terms of desired connections between the rooms and possible floors.

Construction : a way of seperating the building in sectors for easier preperation or prefabrication was considered although the main building method in the area is in-situ casting.



ill.55 Modulor 1946, Le Corbusier.The architect's measuring system.


ill.56 scale and position of surounding


ill.57 importance of construction

In search of the form

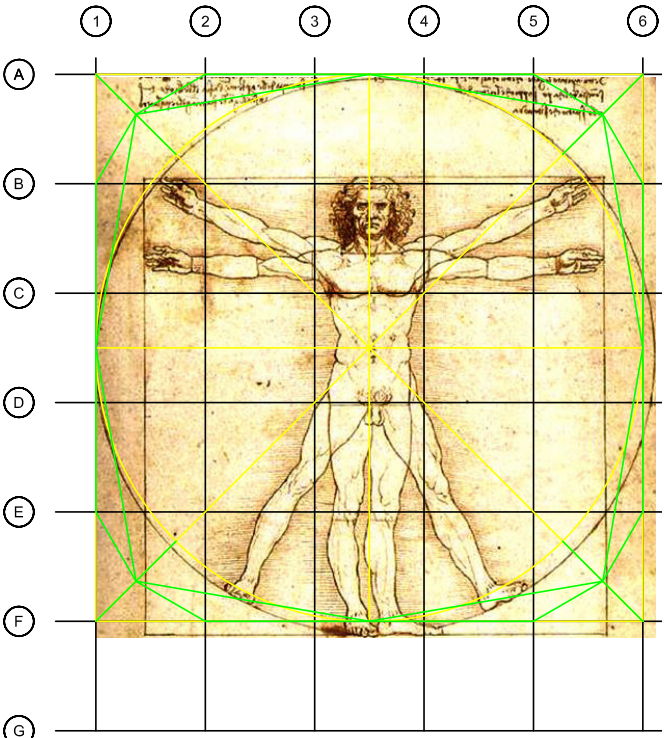
While trying to arrange the different functions and parts of the programe it was realized that there was a need for a more compact building in comparison to a very tall one that would be more difficult for its users to work.The choices that were discovered would be either to have a very compact and low structure or a complex of many buildings connected to each other , which were investigated later.

Begining

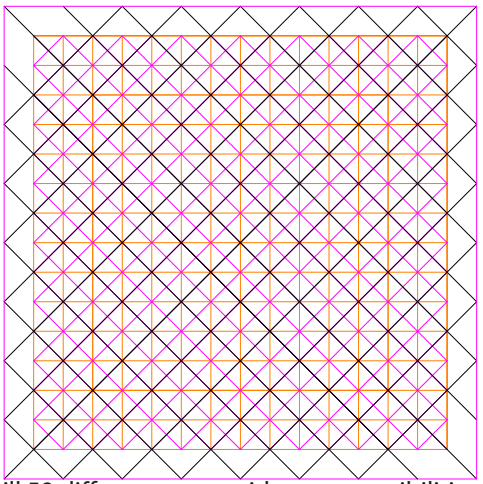
The site was later divided in a raster of 5 meters in order to make the design and positioning of the different functions an easier task.

Vitruvius man was used as an inspiration to use simple geometric forms like polygons, ,squares and circles in order to see the comparison of the shapes with the human body and analogy with the site.The man is divided in five palms according to classical metric system and the system was then used as a raster of 10 m in a search of some intresting results.

Further attempts were made with the golden mean proportions and fibonacci numbers but without success to retrieve a usefull result.

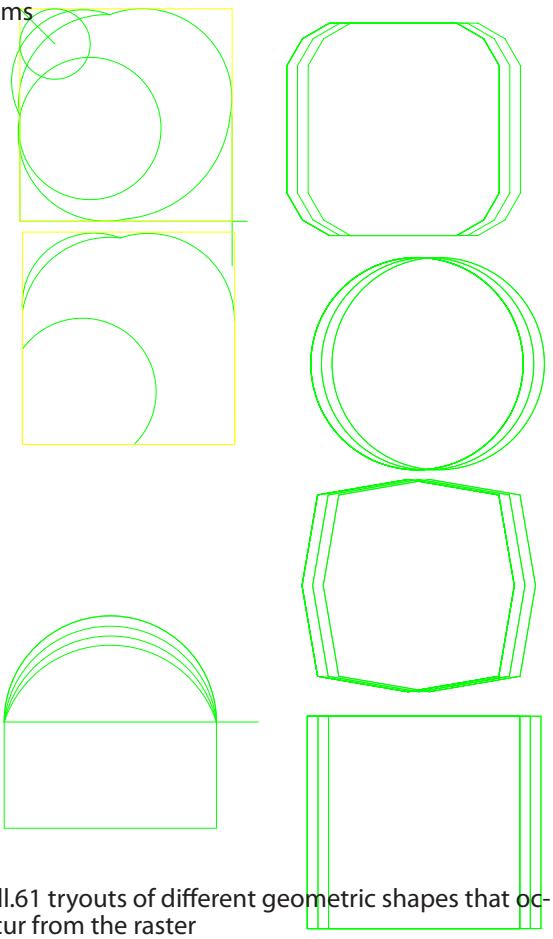


ill.58 vitruvious man with the raster of 5 palms

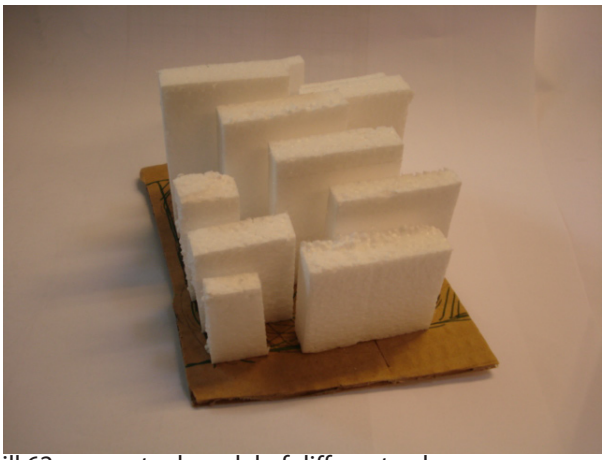


ill.59 different raster with more possibilities for the position of functions and rooms in the building

ill.60 romanesco brocoli basic idea for fractal and fibonacci utilization.



ill.61 tryouts of different geometric shapes that occur from the raster

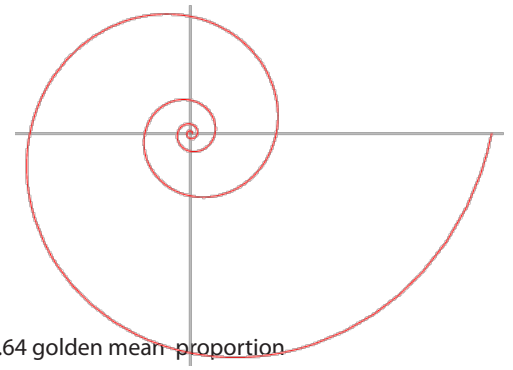


ill.62 conceptual model of different volumes

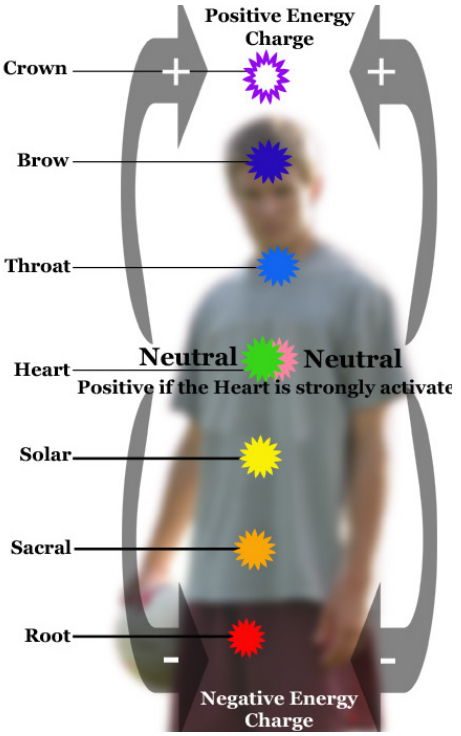
In search for a concept or ways to differenciate the building ,finding the position of the functions in the floors (different levels), time was spent on hinduist and hebrew religion (chacras and sephiroths) and classic theories (golden mean proportion).The reason was to see how they position energy in the human body trying to find a comparison between the building and a person.

The outcome was the positioning of the functions in four floors and two basements .

ill.63 volumes rotated 45 degrees for orientation .



ill.64 golden mean proportion



ill.65 chacras from hinduist

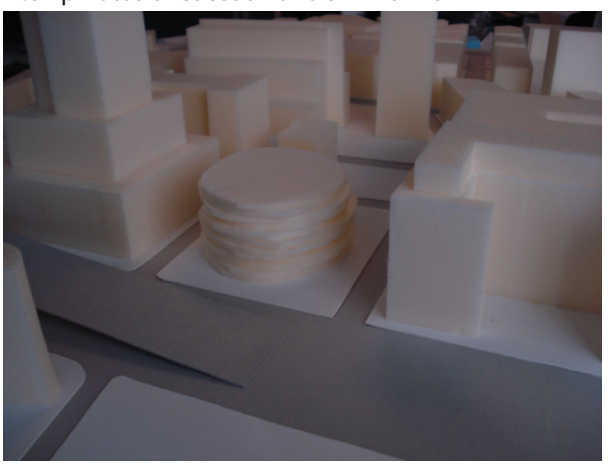
ill.66 possible floor distribution

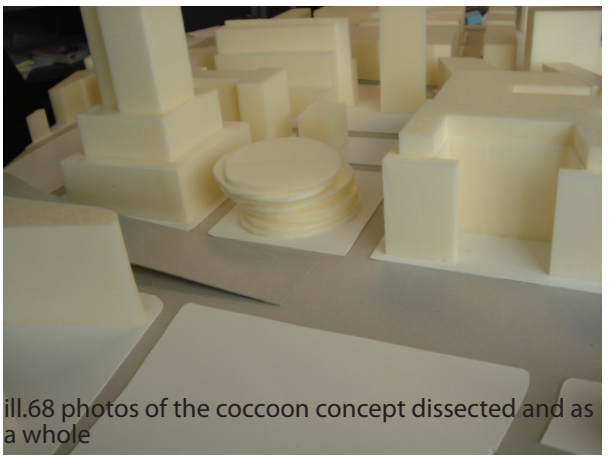
Cocoon

One of Beiruts key exports is silk so the idea could be utilised in ways such as ,having a cocoon or skin on top of the actual building or just having the building follow a cylindrical shape. That would mean the building would be with more stories(either above or underground) which might make it less functional and compact.It could become a landmark in the urban landscape, but having the functions as close to each other would be a better choice.

The concept was that the building would act as the coccoon for the transformation of the students through knowledge.
After making the cylindrical shape the idea was to subdivide it in pieces protecting from the sun and air.

ill.67 p hotos of coccoon and silk worms





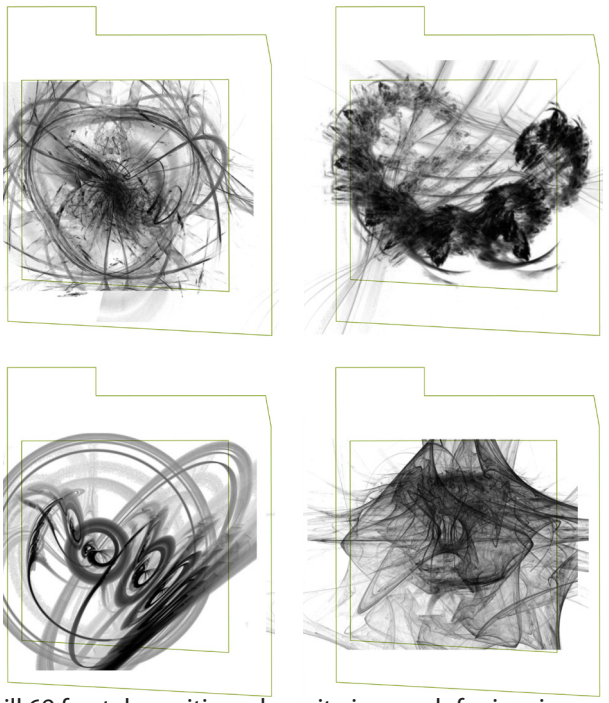
ill.68 photos of the coccoon concept dissected and as a whole

Organic approach , fractal

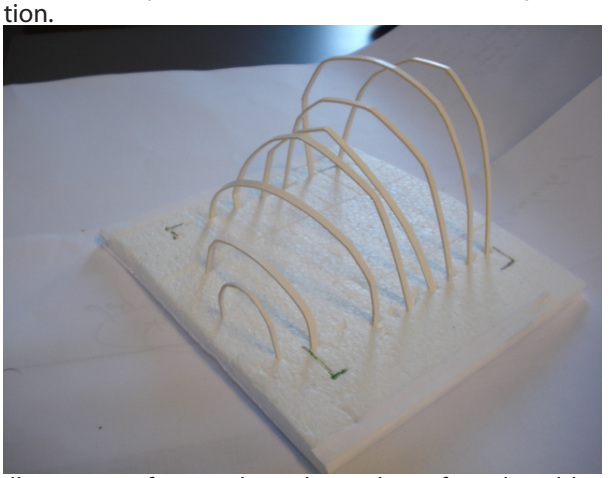
The software apophysis 2.0 was used to design fractals for sketching.Due to the small size of the site and the need for a more compact building the idea was not further developed . Given that the site is almost square gave the idea of continuing with a more minimal and rectangular approach .

In terms of a plan the space can be going in different directions depending on the chosen outcomes from the software

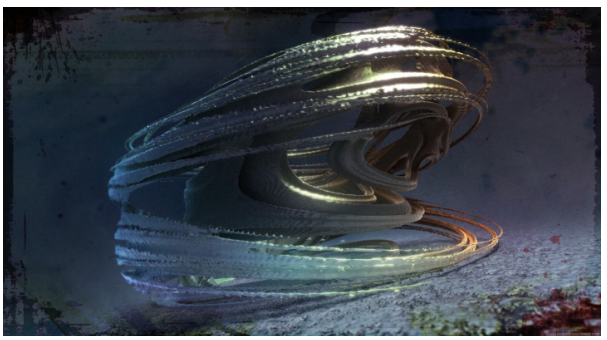
To place the functions inside the structure could be difficult and might not be the best in terms of function and being user friendly.

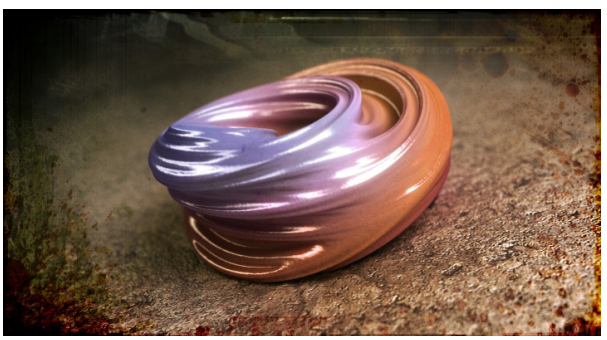


ill.69 fractals positioned on site in search for inspiration.

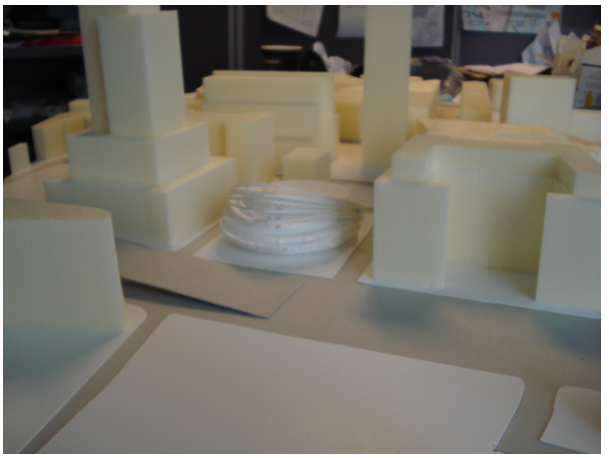


ill.70 tryouts for visualising how a basic fractal could look like in reality

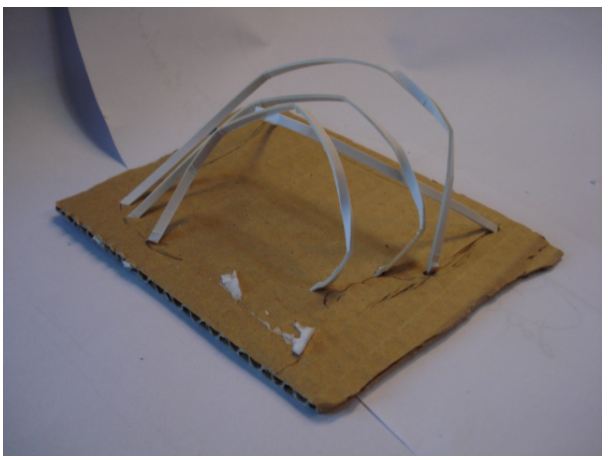


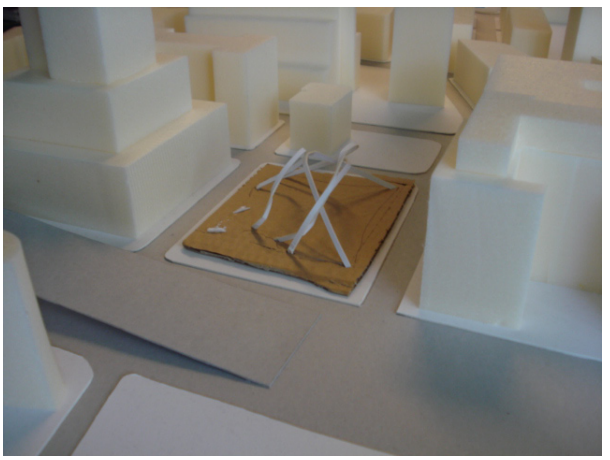


ill.71 3d fractal examples designed with the software xeno dream

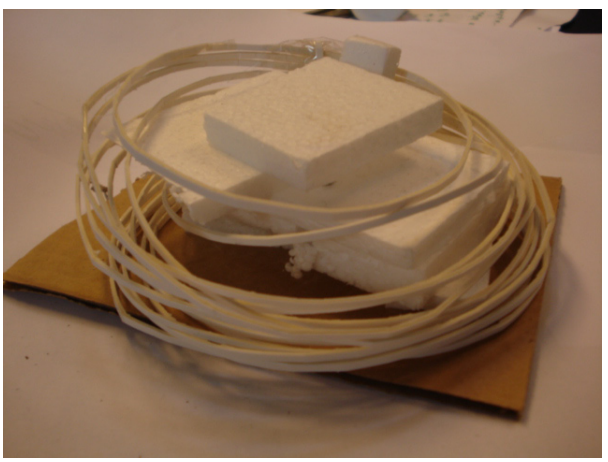


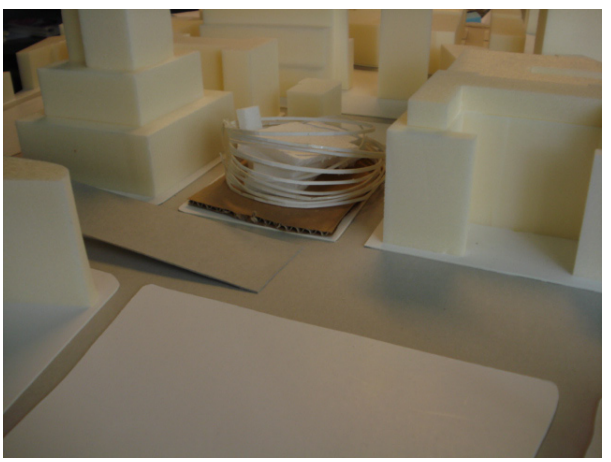
This model is following the idea of the dissected coccon with the added sunshaders on top of the southern part of the building. It was made to look similar with one of the fractals designed with xenodream.





This model is visualising an other idea for the exterior shape of the building taken from the fractals realised with the software apophysis.

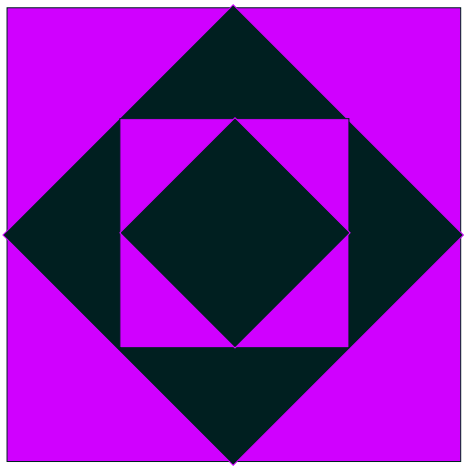




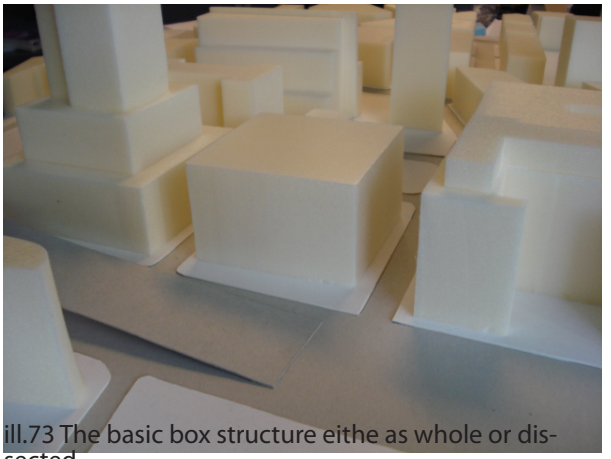
The concept of this model is merging the different functions together , having a skin or facade around the building uniting the various spaces to create an indoor enviroment .

Square within square

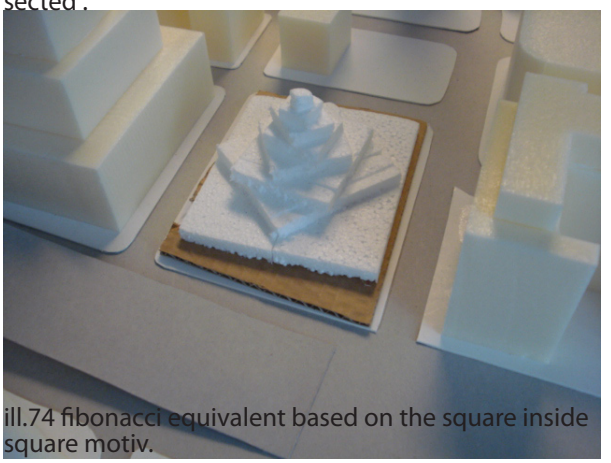
A typical symbol of muslims is the square within a square (rotated 45 degrees and 75% smaller) that can be used for inspiration during the design either for the building or the facade. It is similar to the fibonacci numerical system giving an effect equivalent to the romanesco broccoli.The end result looked similar to a zigurat from mesopotamian architecture.



ill.72 Testing different geometric shapes .



ill.73 The basic box structure eithe as whole or dissected .



ill.74 fibonacci equivalent based on the square inside square motiv.

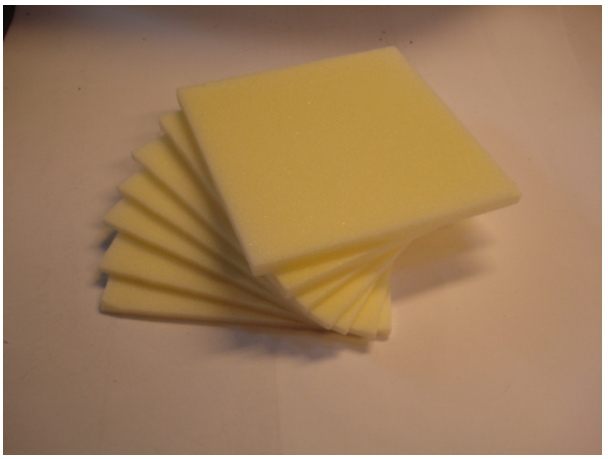
Box

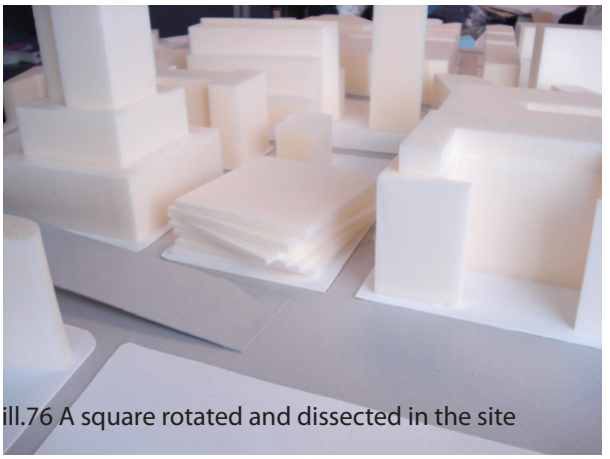
Continuing the search for a simple , preferably geometric form every architectural student eventually comes across the box .

Such an approach can give a very compact building, or a complex of more than one , according to the categories and the functions inside it can have different sizes o

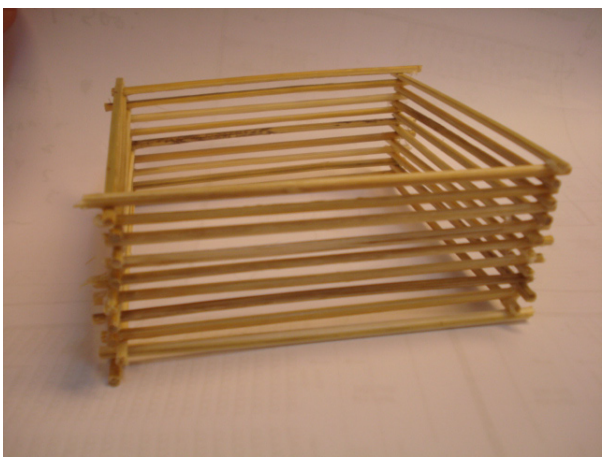
Form the cocoon concept , taking the idea of dissecting the structure and positioning it according to the sun and wind direction gives another form that could produce intresting results and be efficient for the users .

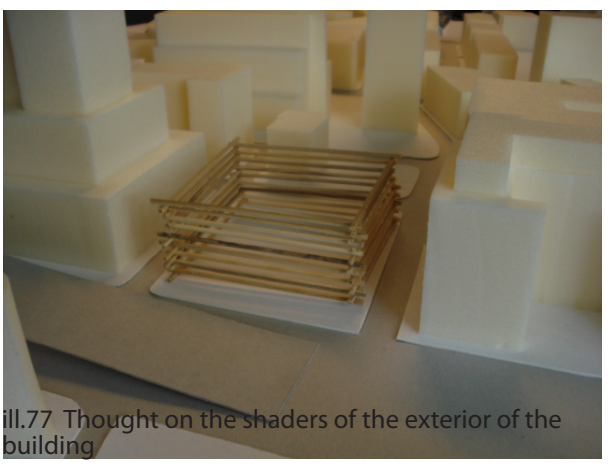
ill.75 Smithsonian American Art Museum,Norman Foster





ill.76 A square rotated and dissected in the site



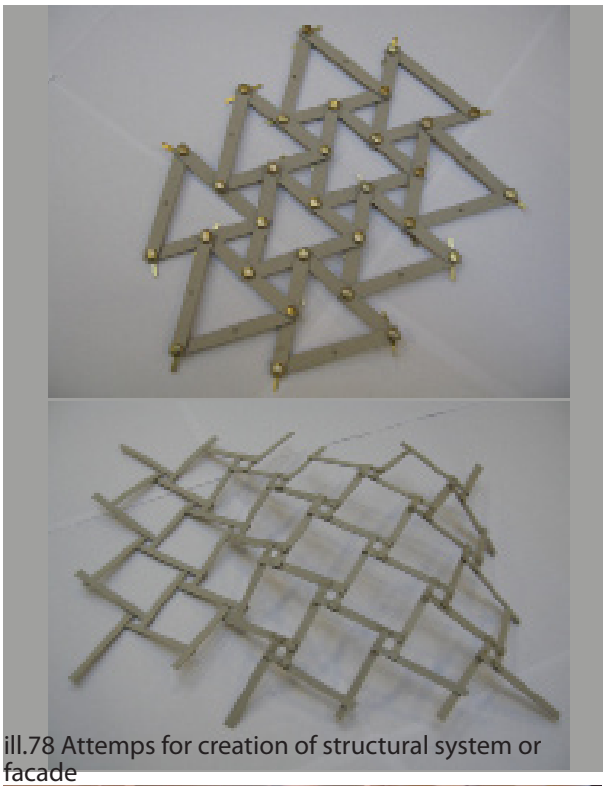


ill.77 Thought on the shaders of the exterior of the building

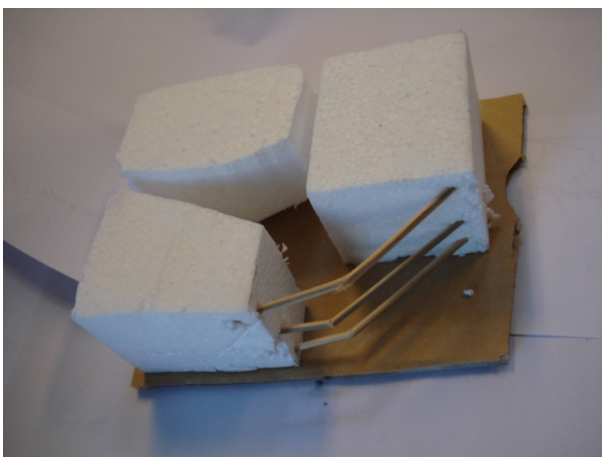
Structural system

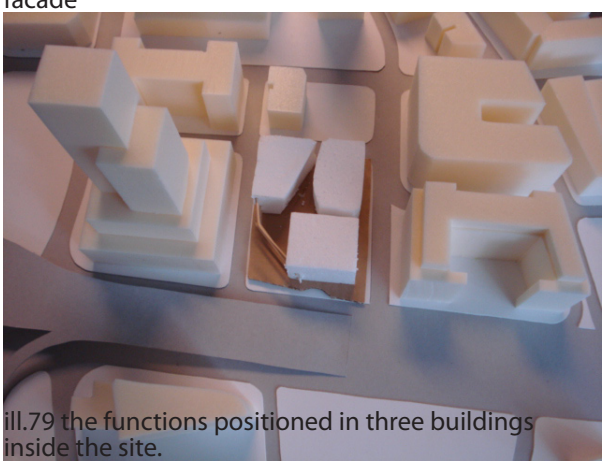
The models in this page continue with the idea of positioning the functions in different buildings on the site and perharps having an external skin to create an atrium as a gathering place for people.

The integration between structure and shape can be used as an inspiration for the form of the building. The models on the right are attempts on ways of creating a skin for the building or the atrium.

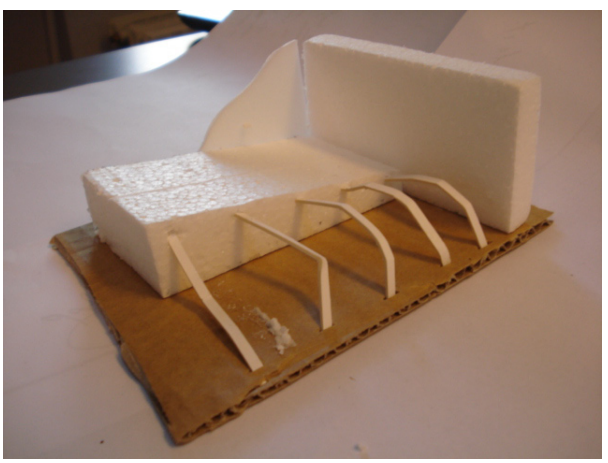


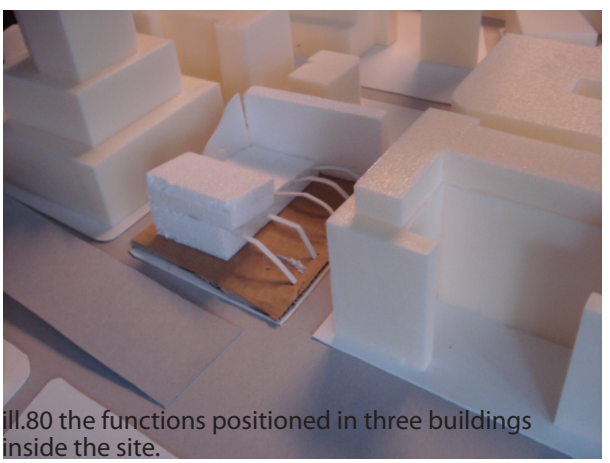
ill.78 Attemps for creation of structural system or facade



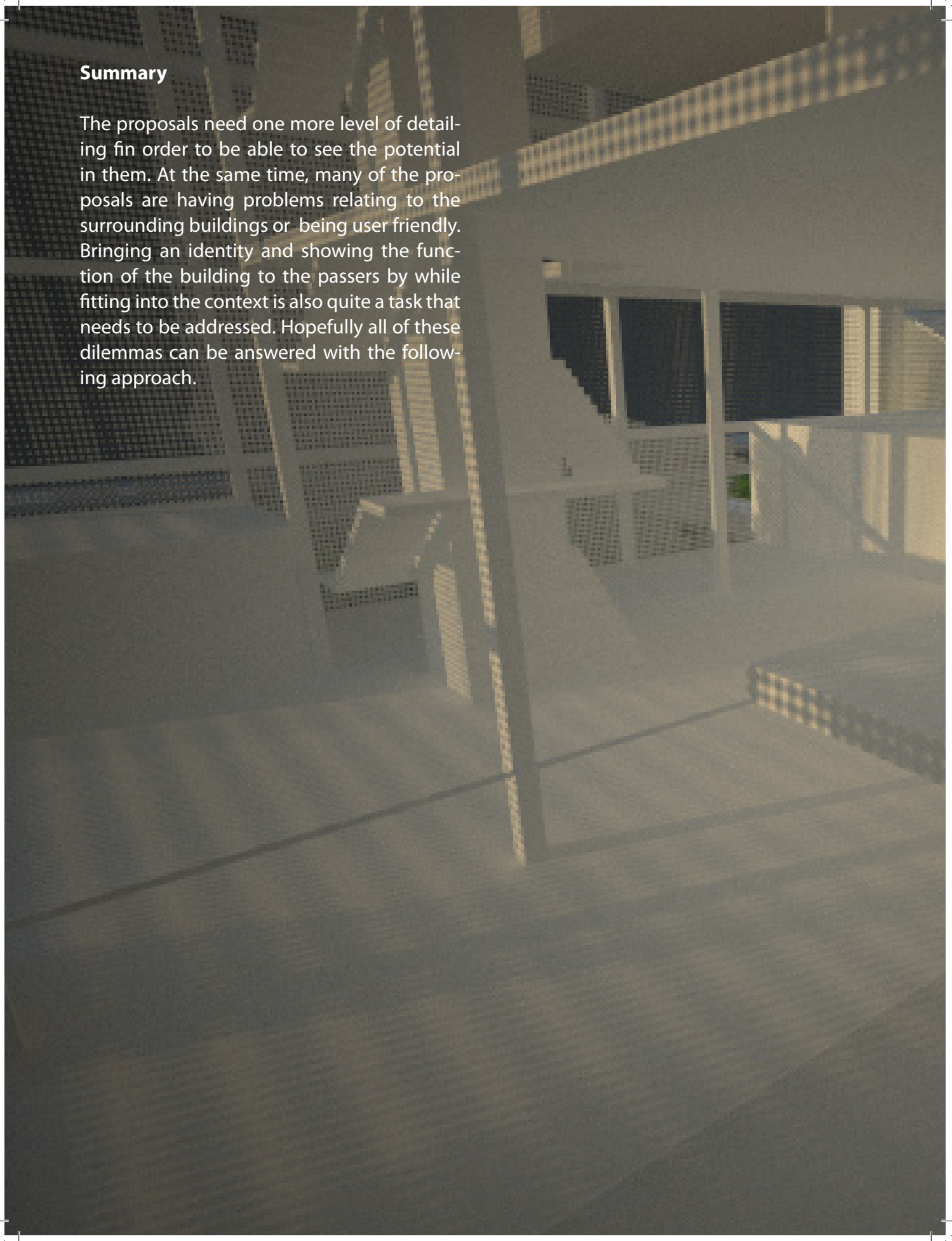


ill.79 the functions positioned in three buildings inside the site.





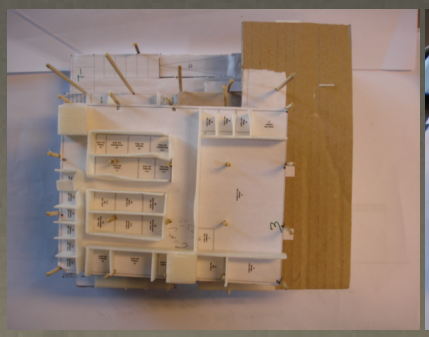
ill.80 the functions positioned in three buildings inside the site.



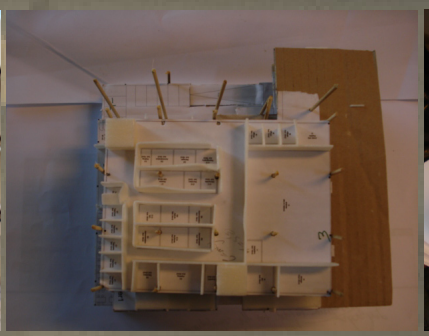
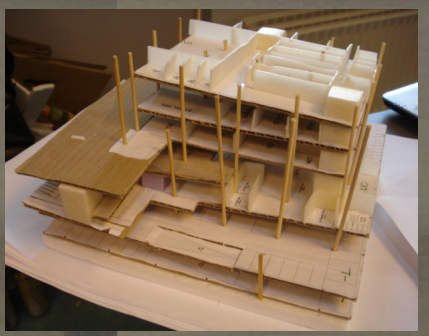
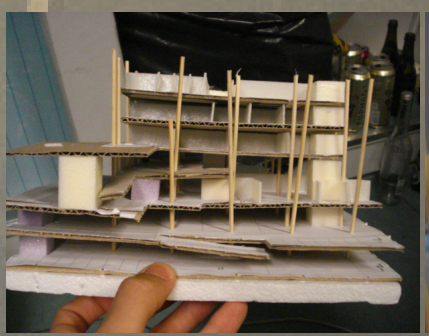
Summary

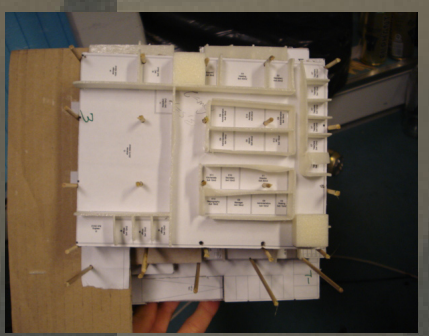
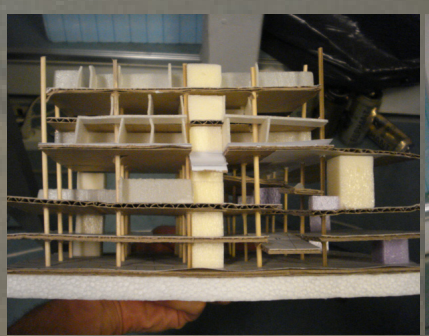
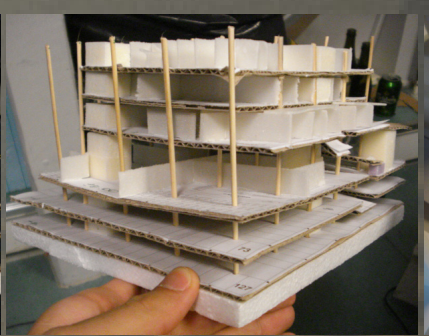
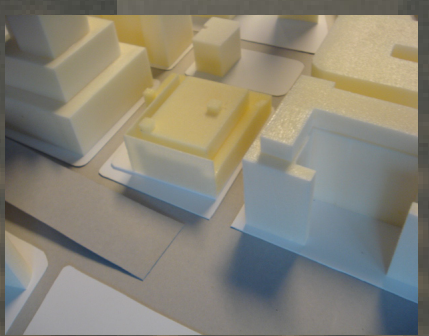
The proposals need one more level of detailing fin order to be able to see the potential in them. At the same time, many of the proposals are having problems relating to the surrounding buildings or being user friendly. Bringing an identity and showing the function of the building to the passers by while fitting into the context is also quite a task that needs to be addressed. Hopefully all of these dilemmas can be answered with the following approach.

ill preliminary models of the final solution.





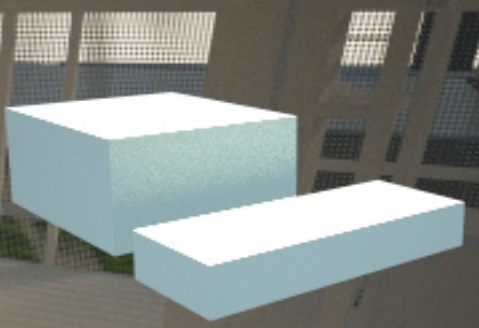





ill preliminary solution in context to the site



End Result

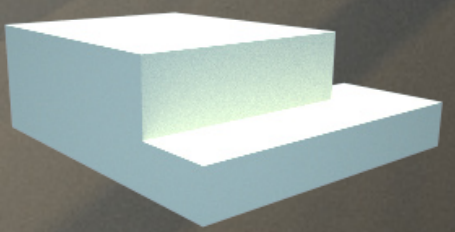
Concept
The programme is according to its qualities .By dividing the functions in two categories according to their requirements on interaction and height we obtain two volumes:
a tall box and a low plinth.Inside the plinth the two performing halls are placed and on top we position a plaza in order to connect the exterior ,city, with the building and its users.In the tall box we place all the other functions of the programme that require vertical circulation.Therefore form follows function.



ill.81 big box and low

The box on the ground and first floor can host different event configurations ,from dance evenings and lectures to markets and fairs giving flexibility and openess to different needs.

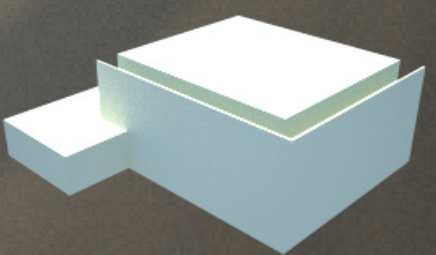
The big and small performance halls are independent from each other allowing for maximum interaction of the functions inside and the urban relation with the exterior..



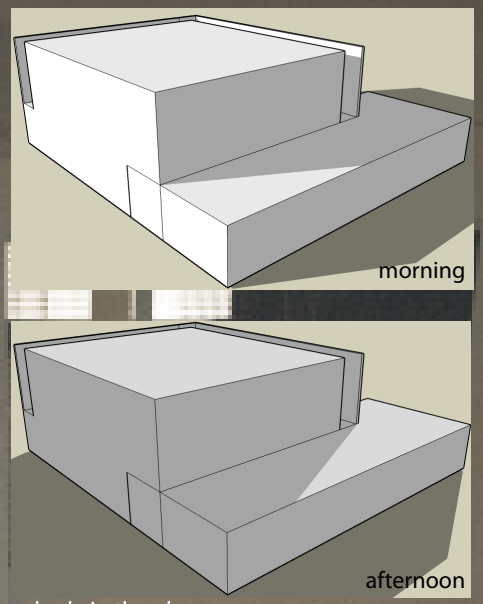
ill.82 big box and low plinth connected

Position of the building
The big box ,facing the central avenue of general Fouad Chebab, is placed on top of the low plinth ,facing the Ghalghoul street.The closed facade ,shaded from the perforated metal plates ,protects from the noise and dust of ongoing traffic .The free space created on top of the plinth is an elevated plaza for the users and pedestrians in front of the square on the north.

Urban context
The southern facade is viewed from a long distance ,being visible from thousands of cars and pedestrians ,so the facade had to portray the identity of the building and its users.



ill.83 facade for protection and atrium crea-



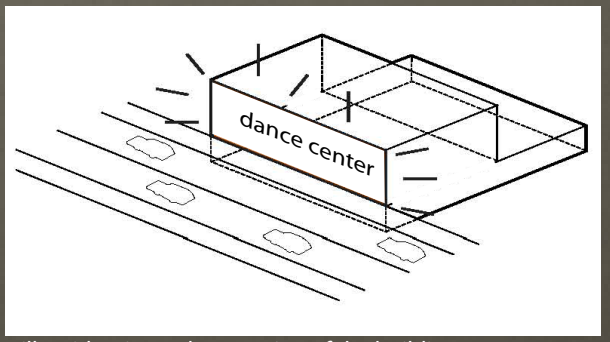
ill.84 sunshade in the plaza

The main entrance for the building is on the west like the staircase for the plaza., that is located 8 meters above ground.
The east part has the entrance for the underground garage and a secondary entrance for the staff and students.

In order to avoid mono-functional spaces, the distribution of the programe could be extented into the next .
-in the ground floor the restaurant cafe is connected with the reception and can be enlarged for a big banquet
- in the first floor the exhibition hall can be combined with the waiting hall .
- in the second floor the three dance studios can open their doors and have access to the plaza.

Access
The building's ,main entrance is on the west part with a secondary one and the garage on the east.There is another one on the west from the staircase of the plaza and the doors on the north side on top of the plaza.Last exit is on the third floor from the staircase.

Presence in the area
Taking into account the buildings that are estimated to be finished in the area ranging from 32 to 170 m height around the dance center its is obvious that we can not compete on the height of the structure.There is a need to establish a strong presence , a recognisable character without becoming a rigid and static icon that will eventully fuse with everyday routine.
The architecture of the center should not impose ,restrict or limit the potential of creativity by allowing flexibility and imposing an active and vibrant image.



ill.85 identity and promotion of the building

In search of the facade.

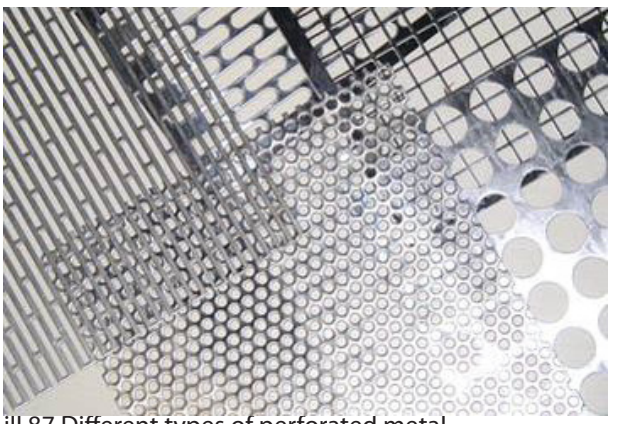
Due to the nature of the structure ,the geografic location and the need to protect from overheating there needed to be a way to differenciate the building from its enviroment while thhinking of the region and taking inspiration from the past.

One of the ways that this could be achieved was by the use of shading devices on the south and west facade.Arabic architecture and modern architecture use different patterns ,geometric shapes or even just a normal mesh as shading devices that also provide an itricate play of light inside the structure depending on the day and time giving us a different experience of space and time

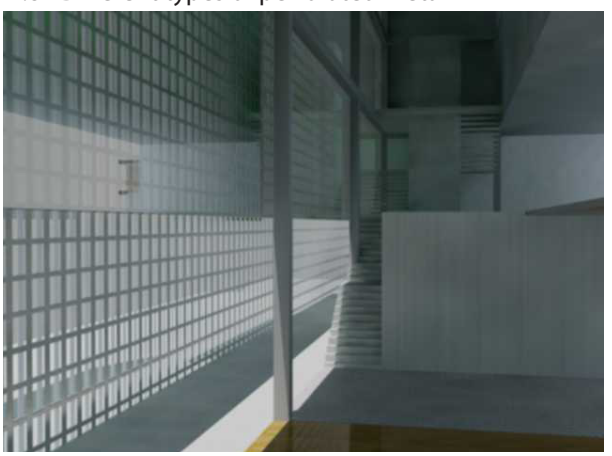
The first stage of experimentation was by using a simple rectangular perforator to experience the interior light.

The perforators used were making the interior light very dim which would not suffice in real life for an educational facility and also didnt give any architectural interest in the building either exterior or interior.The renders were made with the software 3dsmax and Vray .

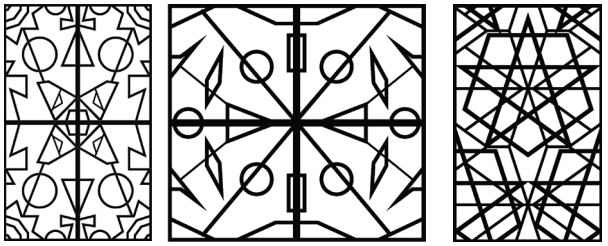
ill.86 Art Center College of Design, Pasadena,



ill.87 Different types of perforated metal



ill.88 render testing with simple perfora-

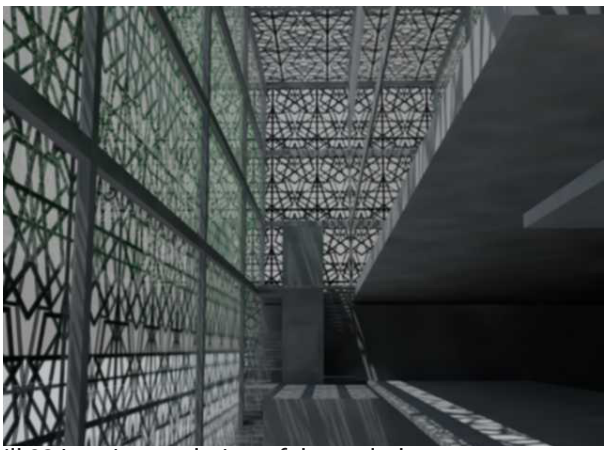


ill.89 arabic symbols turned into facade patterns

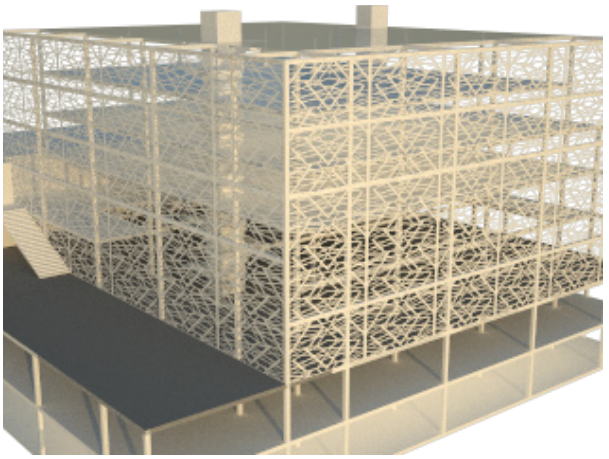
ill.91 Interior rendering of the first pentagrams

For the second stage different patterns were made from arabic symbols and tested by rendering in the software 3dsmax ,and later Rhino, with the renderer Vray.The last one was giving a more intricate light effect and was selected for further testing.

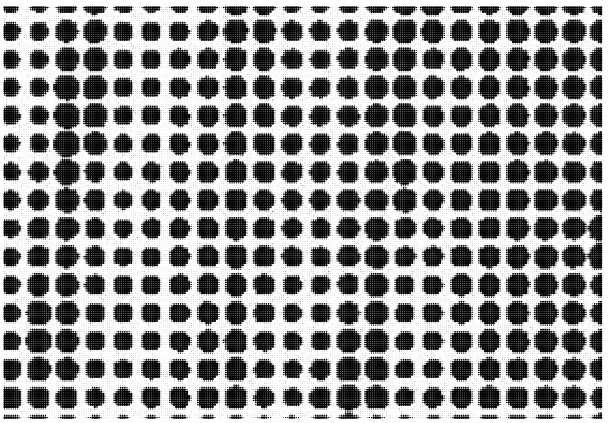
The scale of the openings needed to be changed to provide enough lighting to the interior and although it was giving a satisfying result the feeling of the space and the facade were not showing the identity of the structure as a dance center.



ill.92 Interior rendering of the scaled pentagrams



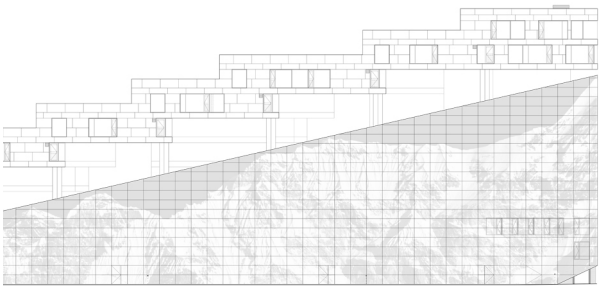
ill.90 exterior rendering of the pentagram



ill.93 perforated metal sheet 1.50m x 1.00

The third and final stage consisted of changing the pattern of the plates and getting inspiration from dancers and the movement of the human form .

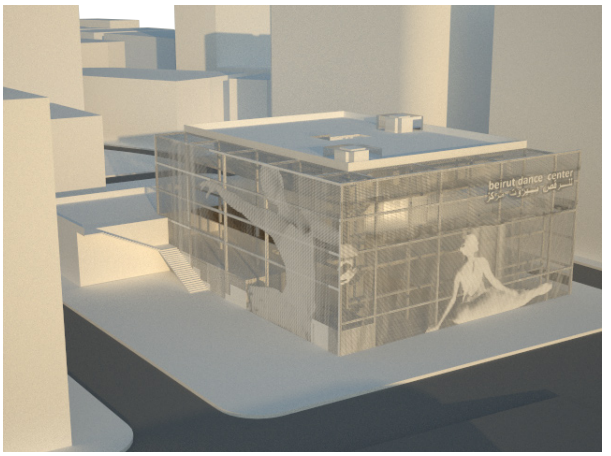
Different photgraphs and collages of dancers were put together and the one that showed more elegance ,and didnt look like an advertisment, were the pictures of two ballarinas with ,stage curtains on the background .
Different scaling of the pictures and the perforators on the metal gave the end result.

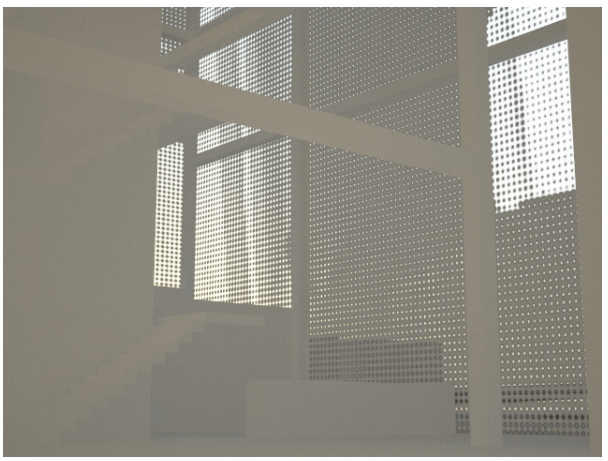


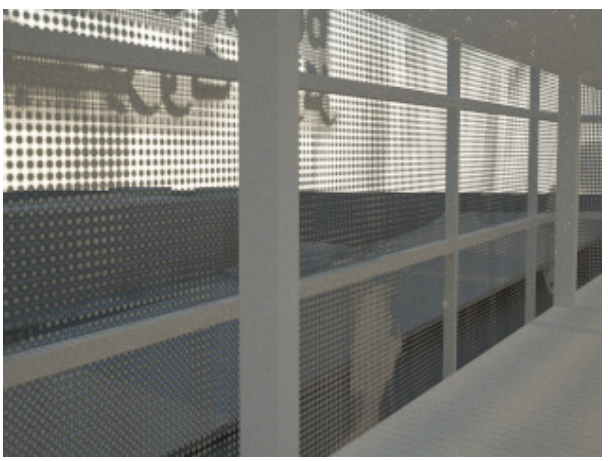
ill.94 Cad drawing of mountain facade ,BIG ,copenha-

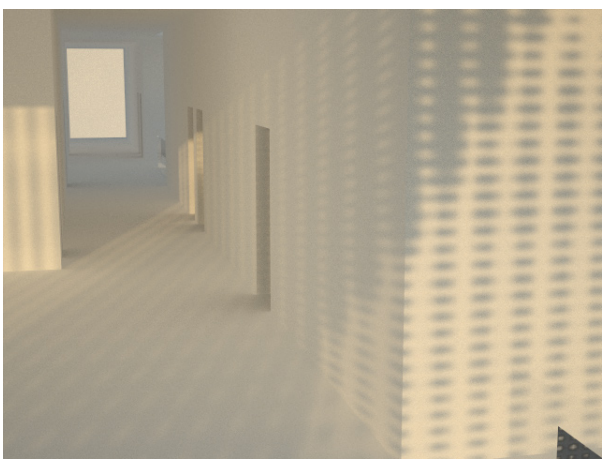
ill.95 facade options

The end result gives a very playfull an calming feeling inside the structure ,while protecting from the sun, and giving enough illumination for the building to be pleaant for the users.
The identity of the structure is recognisable from the hundreds of pedetrians and cars making it stand out from the context without overshadowing it. Following are different renders of the interior giving a sense of the space and light.









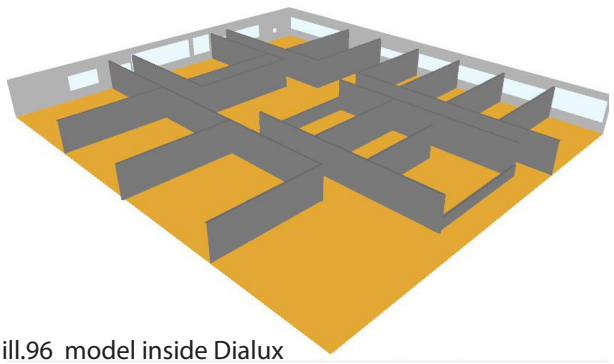
Daylight investigation

The program Dialux is utilised as a simple tool for testing both the qualitative and quantitative light inside the building.

It calculates the Lux level in the modeled second floor of the building that contains dance,classrooms and theater studios.

The presented results are calculated in the 21st of March with the reference plane 50 cm above floor level. According to the software Dial Europe the nesecary illumination level for a classroom is 300 lux.

The results affect the layout of the windows in the facades if there will be a shading device needed for the west and south walls, and explains one of the reasons of the atrium in the design.



ill.96 model inside Dialux

Test 1

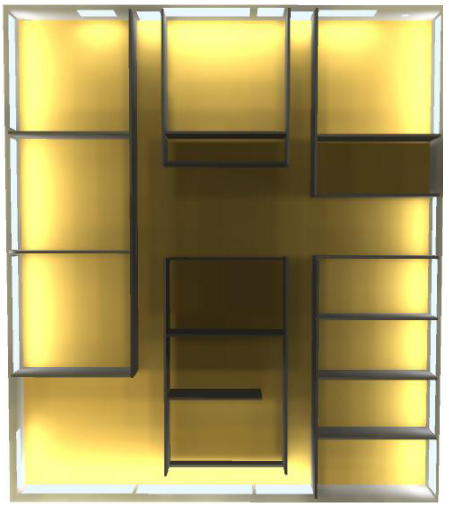
The initial part of the lighting calculation came expecting that most parts of the facade are glazed with the openings having a height of 3.70 m.
This would be very energy demanding and produce interior glare, but its a starting point to see the illumination levels and continue with the design.

Test 2

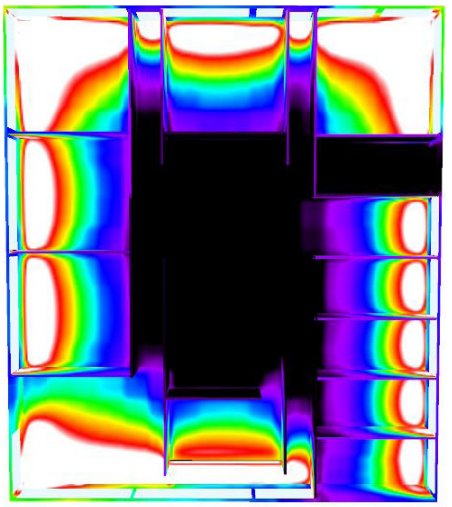
Due to the insuffieciency of the light in the core of the building an atrium was introduced for further study.Because the glazing is too big in order to minimize energy losses and reduce glare in the interior the windows became 2m high covering most part of the fasade.

Test 3

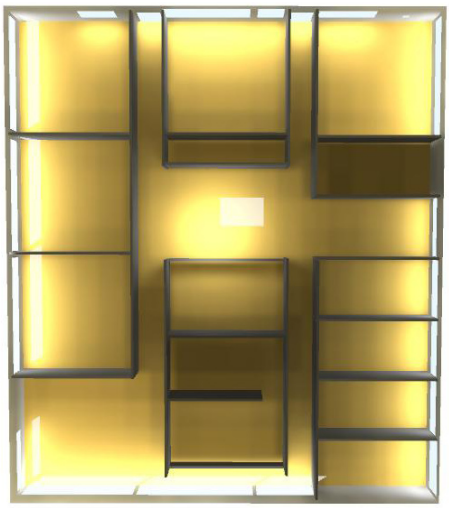
The use of perforated metal sheets in the facade helped to reduce the glare and by reducing the height of the windows to 1.5 m it gives a better result. The problem that continues is that the rooms in the center of the floor ,where even after using glass in the walls don't have sufficient daylight. The position of the classrooms, in the center ,are taking the place of the theater studios,rooms on the right,changing the floor plan for the rooms to have the necessary light.

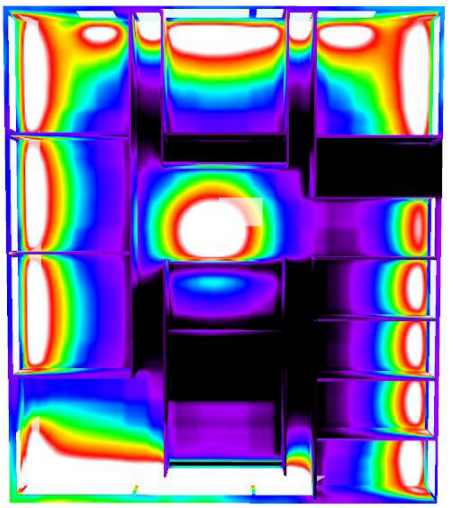


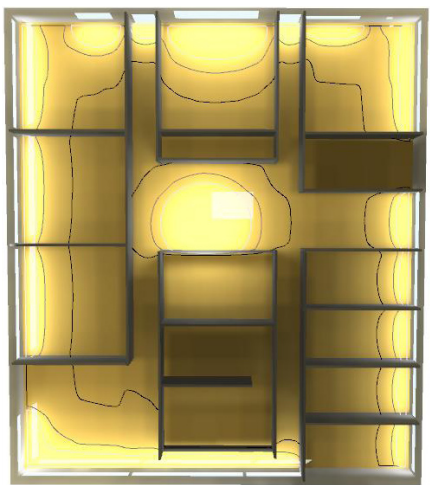
photorealist model



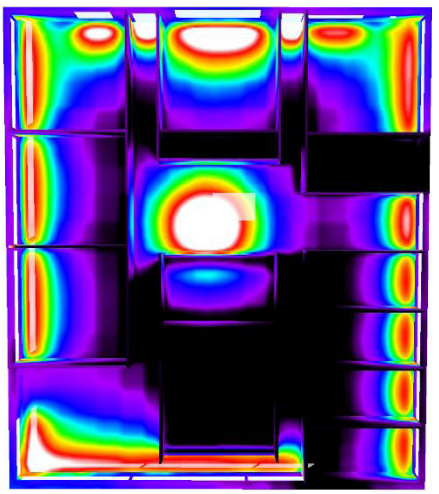
lux estimation







1000 lux
800 lux
600 lux
500 lux
400 lux
300 lux
200 lux
100 lux
50 lux



Acoustic investigation

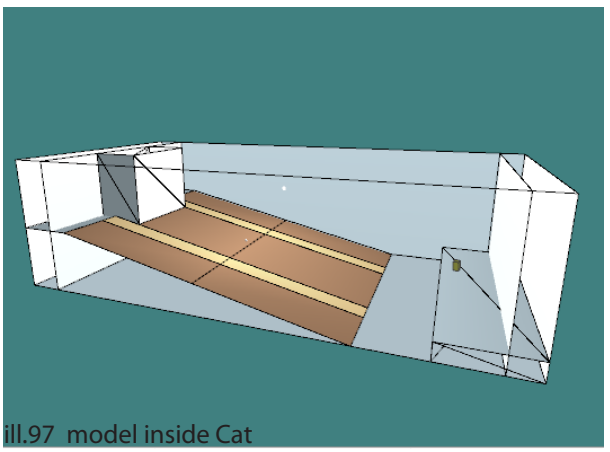
CATT-Acoustic is software for room acoustics simulation which allows the simulation of variable surfaces and sound sources, and calculates several acoustic parameters including echo, clarity ratio, and reverberation time.

The program is included in the process of designing the big performing hall, 500 m2 to investigate the acoustic possibilities of the shape

The tests made were using different materials in the surfaces and either having diffusers on the ceiling or not.

Criteria for acoustic quality
T-30: 0.5 sec < R < 1.2 seconds (Reverberation time)
D-50: Acceptable > 50% (Clarity of speach)
Echo at speech should be avoided (<50ms)

The roof should provide qualitative sound propagation and architectural intrest.By positioning a diffusor would give some merit to the interior expirience of the viewer. The outcome of the testing shows that a combination of wood and fibre rigid backing would give the best acoustic results.



ill.97 model inside Cat

Test 1

For the first part of testing for the interior of the performing hall is covered with wood on the walls and thick carpet on the floor considering where the audience is placed.

D-50 = 57.7 %
T-30 = 1.42 s

Test 2

For the second part we keep the same attributes in the interior with the exception of putting a diffuser on the ceiling

D-50 = 61.5 %
T-30 = 1.16 s

Test 3

In this option we place fibre against rigid backing on the walls and ceiling in order to improve clarity of the sound an remove some echoes.

D-50 = 99.5 %
T-30 = 0.32 s

Test 4

The final option to choose from is keeping the fibre rigid backing on the walls of the technical rooms,place wood in the interior surfaces and positioning a diffusor on the ceiling.

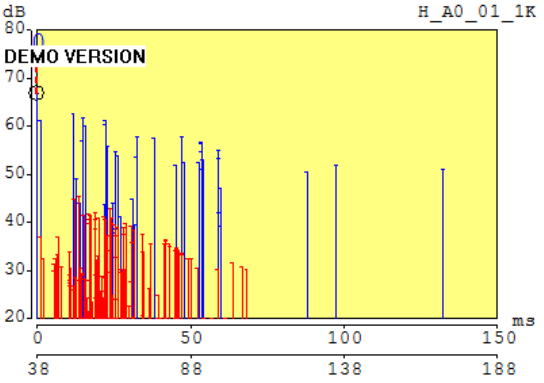
D-50 = 83.8 %
T-30 = 0.61 s

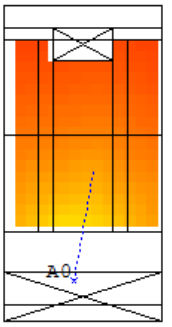
Reverbaration and clarity

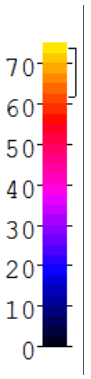
Echogram

Sound pressure level

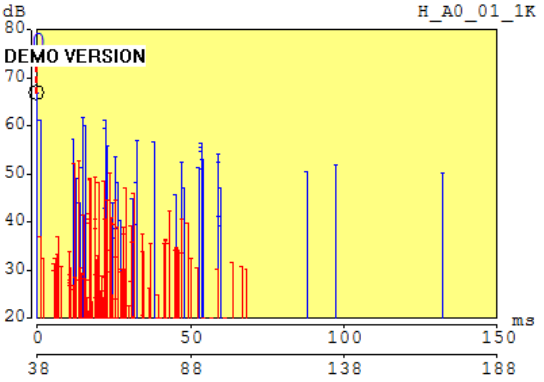
EDT	1.19	s
T-DEMO VERSION	3	s
T-30	1.42	s
D-50	57.7	%
C-80	3.7	dB
LFC	33.7	%
LF	24.5	%
Ts	66.5	ms
SPL	74.9	dB
G	9.7	dB

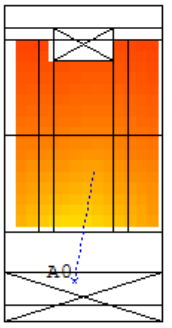


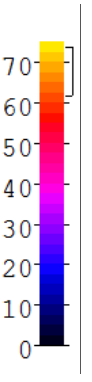




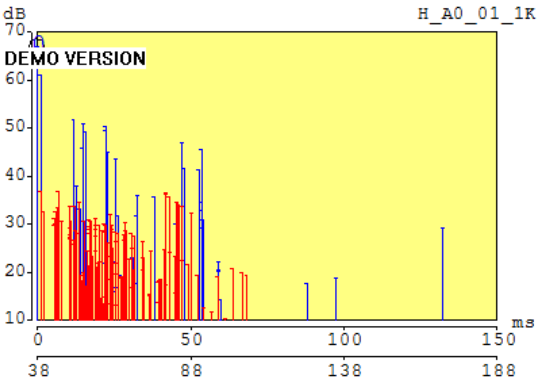
EDT	0.93	s
T-DEMO VERSION	9	s
T-30	1.16	s
D-50	61.5	%
C-80	5.4	dB
LFC	37.6	%
LF	27.1	%
Ts	53.8	ms
SPL	74.1	dB
G	8.9	dB

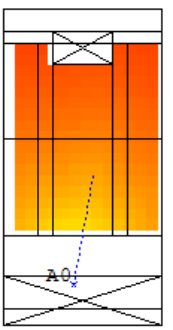


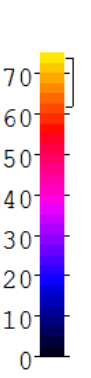




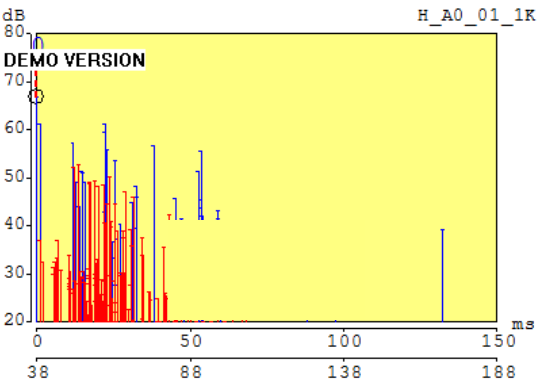
EDT	0.19	s
T-DEMO VERSION	2	s
T-30	0.32	s
D-50	99.5	%
C-80	28.0	dB
LFC	4.9	%
LF	3.6	%
Ts	2.8	ms
SPL	68.5	dB
G	3.3	dB

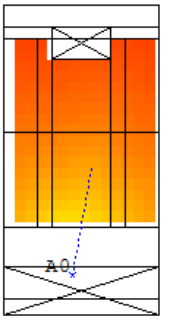


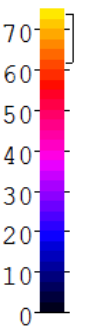




EDT	0.46	s
T-DEMO VERSION	3	s
T-30	0.61	s
D-50	83.8	%
C-80	11.1	dB
LFC	27.7	%
LF	19.4	%
Ts	26.3	ms
SPL	71.8	dB
G	6.6	dB







Ventilation /Heating strategies

Educational facilities use energy for several tasks such as heating water for showers, cooling or heating and ventilating the rooms and lighting requires large amounts of energy.

Due to the geographic location of the site temperatures vary from 10 C to 30 C depending on the time of the year with a lot of sunlight every part of the year.

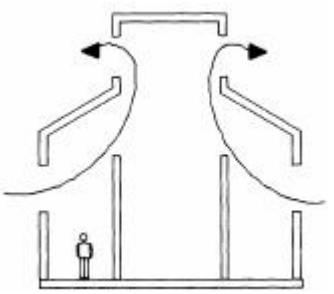
In order to keep the prefered indoor temperature for an educational facility ,from 20 C to 26 C ,there are two attached atriums on the south and west facade of the building to provide ventilation due to the stack effect.

A core atrium in the center of the building provides nesecary light and the flow of air horizontally in the building due to cross ventilation effect.

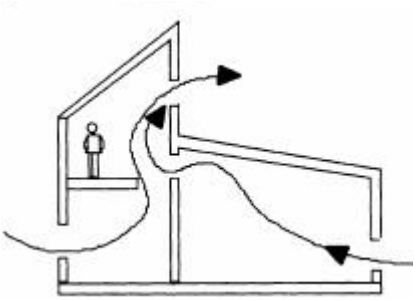
A green roof and plants in the entrance and on top of the auditorium stabilize the humidity in the air and circulation of fresh air inside the building.

A part of the energy demands can be covered by solar panels on the roof facing the south. The amount and effect of these are not calculated here but an effective system should be able to supply heat for utility purposes.

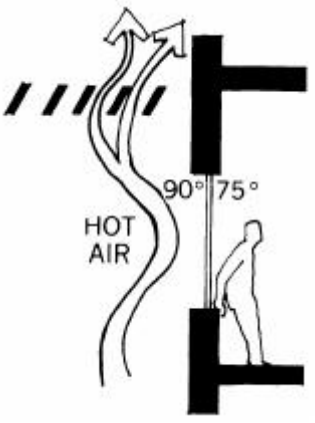
The fasade made from perforated metal sheet is responsible for the building not to overheat and provide the nesecary lighting conditions by avoiding glare from overexposure to the sun.



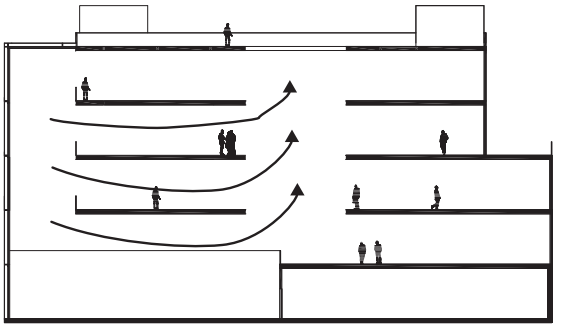
ill.98 stack ventilation effect



ill.99 cross ventilation effect



ill.100 hot air through the perforators



ill.101 ventilation on the building

Sustainability

Sustainability is sustained through an enviromentally friendly strategy and the possibility of adaption to new parameters so the Center doesn't become obsolete and inadequate.

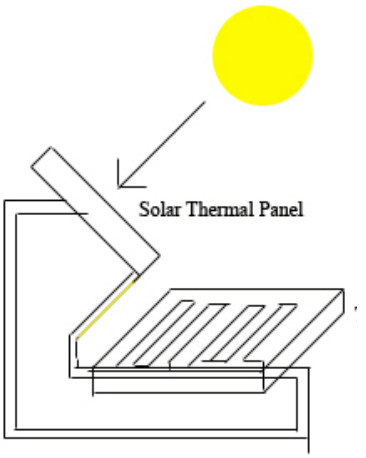
Materials
The center uses ecologicaly certified and natural materials.
The non-fixed interior partitions are made of recyclable materials such as reinforced cardboard allowing for easy transportation and fixing.The surfaces of the plaza and the exterior of the performing halls reuse shells ,broken tiles and spolia .
The vegetation in the building is autochthon to minimize water needs

Low energy consumption
Sun protected south and west facade and open east and north sides.
Part of the soil from the excavation will be layered on the roofs to stregthen the isolation of the building and prevent CO2 emission from transportation
Double glazing in the north facade will reduce the loss of heating in winter.

Bioclimatic systems
The glass facade on the south acts as a chimney where the hot air from all the floors will escape through the top perforations.In winter when these openings are closed the air will remain inside.
The air will flow horizontally through the many openings allowing for a quick and complete ventilation of the building and comfortable feeling.This will be given special attention in rooms where most heat is produced (dance and theater workshops)

In order to keep the prefered indoor temperature for an educational facility from 20 C to 26 C there is one atrium each on the south and west facade and one in the center of the building to provide ventilation due to the cross ventilation and stack effect.

A green roof and plants ,in the entrance and on the plaza stabilize the humidity in the air and circulation of fresh air inside the building .



ill.102 solar panel for warm water


ill.103 attached atrium


ill.104 green roof

Material Analysis

In order to get an idea of the abilities of materials which could be of interest for the project, they are set up to be studied in terms of structural abilities, perception, light and acoustics. Material is an essential aspect of architecture as it is the physical connection to ones perception of a building and the foundation for the strength of the structure.

Concrete
- Structural abilities: Concrete has its big advantage in the ability of taking large compression forces. It's weak in tension but can be strengthened with reinforcement.
- Perception: Somewhat a more cold and raw expression that gives a feeling of an industrial material. But the wide range of surface texture in the concrete makes it possible to change the experience of the material.
- Light: Regular concrete has a medium light reflection of around 30-45% whereas white concrete is slightly higher. A white painted surface has an even higher reflection of 75-85%.
- Acoustic: Not a very good acoustic material in terms of sound absorption, but changing the concrete into curved shapes can improve this.


ill.105 Tenerife Concert Hall - Santiago Calatrava

Metal
- Structural abilities: In general a very strong material in terms of load bearing both in tension and compression
- Perception: The range of metal can give a different perception from very bright and cold to dark and more alive though it has an industrial expression.
- Light: In general a very high reflection of light around 70-90%
- Acoustic: Not a particularly good material in terms of acoustics.


ill.106 Casa da Musica - Porto, OMA

Glass
- Structural abilities: Not suitable as a construction material.
- Perception: A light and transparent material that can also seem somewhat cold. The visual passageway between inside and outside because of its transparency.
- Light: The material of choice to get the maximum natural light because of its transparency.
- Acoustic: Lets sound pass through

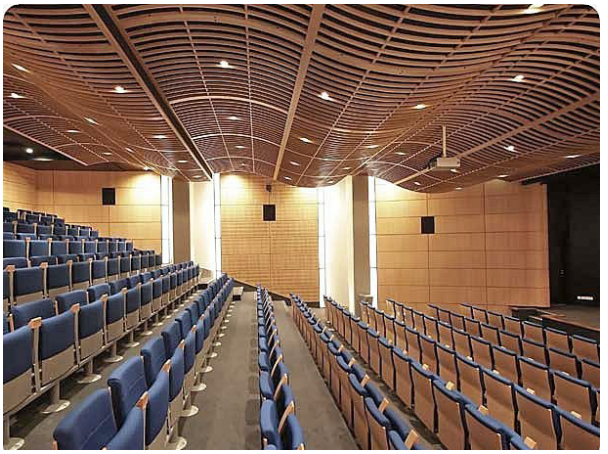
Wood
- Structural abilities: In general a very strong material in terms of load bearing both in tension and compression
- Perception: A very warm material that gives a different perception from very bright and drak and more alive and it has a natural expression.
- Light: In general a medium reflection of light around depending on the colour.
- Acoustic: A good material in terms of acoustics.


ill.107 St Henry's Ecumenical Art Chapel

Tiles
- Structural abilities: In general a very strong material prefered for covering outdoor or sanitary areas.
- Perception: A relatively cold material .
- Light: reflection of light varies with the type and colour.
- Acoustic: A very reflective material not good for acoustics.

The interior of the performing halls will be entirely made from wood with diffusers on the ceiling and thick carpet on the ground. .These are two examples of diffusors that could be used as tiles.


ill.108 wooden diffuser tile figurations


ill.109 random broken tile figuration.

Construction

The construction of the building is a simple beam and column structure with concrete slabs resting on top .The selected width of the slabs is 32 cm ,according to spaencom.dk .This format is chosen since its the most popular way of building in the area and it would be easier and feasible to build .

This size was chosen since the largest distance from one column to the other is 9.70 m while there are a lot of vibrations from the movement of the people and the music and in order to avoid synchronization of the freequencies that was the most suitable size.

The beams and colums carry the slabs and control the outcome of the exterior shape. They are responsible for distribution of the horizontal forces . There was a problem regarding the vertical ones during for example an earthquick or strong winds.

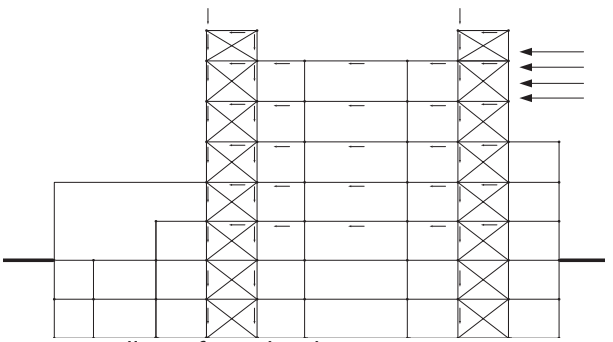
Lebanon has a history of major earthquakes that have leveled Beirut over the centuries. Most buildings and structures in Lebanon are built without any consideration for Earthquakes. A major Earthquake (6.0+) could easily level 25% of Beirut.While there were two earthquakes 5.1R in February 2008 and May 2009 that startled the population.

In order to address this situation the two staircases are reiforced with concrete and steel to act as stabilizers for the vertical forces chanelling them horizontally to the ground.

ill.110 concrete slab

Armering		Spændvidde	10,2
egv i kN excl. fugebeton		Pr. plade	49,9
8 L9,3	M_{Rd}	172,06 kNm	6,7
	V_{Rd}	106,96 kN	13,1
	MmBS60	141,80 kNm	4,7
	MmAbnFak0,02	100,80 kNm	2,1
	MmÅbnFak0,04	122,40 kNm	3,5
	MmÅbnFak0,06	140,69 kNm	4,7
	V_{vBrand}	80,22 kN	8,7
	MmBS120	47,90 kNm	-
	Mrev	163,99 kNm	6,1
	Mbal	74,66 kNm	0,4
	flev i mm		9,0
	fe1 i mm		2,4
	Egensvingning	Hz	9

ill.111 table with slab characteristics

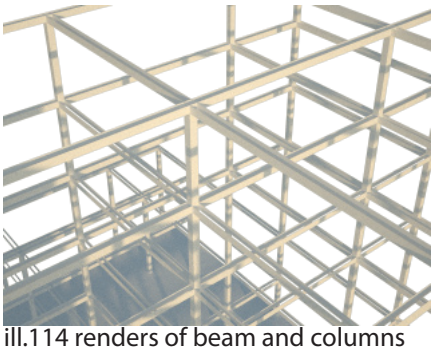


ill.112 force distribution on a section

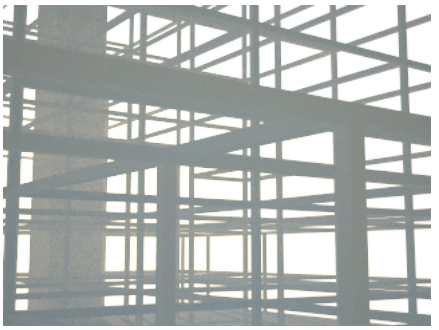
The intitial sketching came from keeping a 5m grid but the final outcome doesnt keep this grid entirely giving different distances from one column and beam to the other.

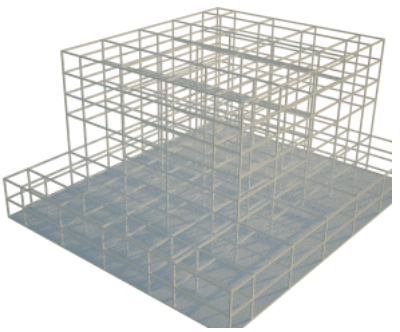
The finished building would be painted white with fireproof paint to protect the reinforcement form high temperatures.The distance from the beams to the ceiling would be covered with gypsum boards that would hide the ventilation ,electric ,mechanical systems and would put the free height of the room to 3.70 m.

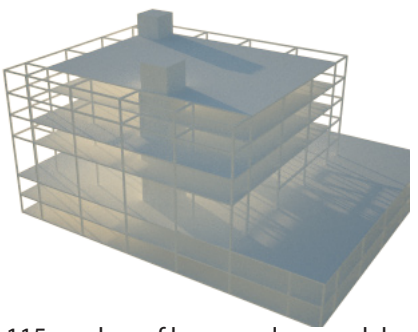
The estimated measurement of the columns and beams is 0.3 mx 0.3m and are chosen for the structural purpose to carry the structure.



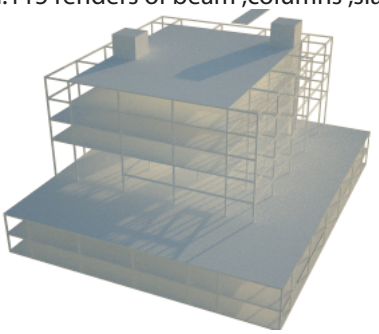
ill.114 renders of beam and columns

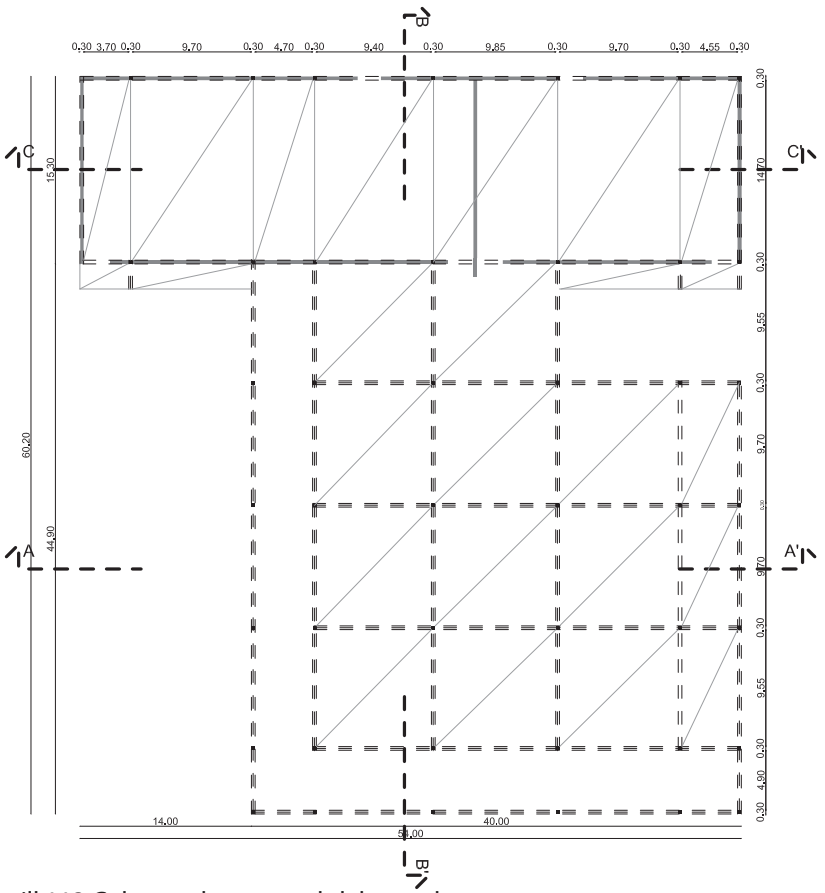






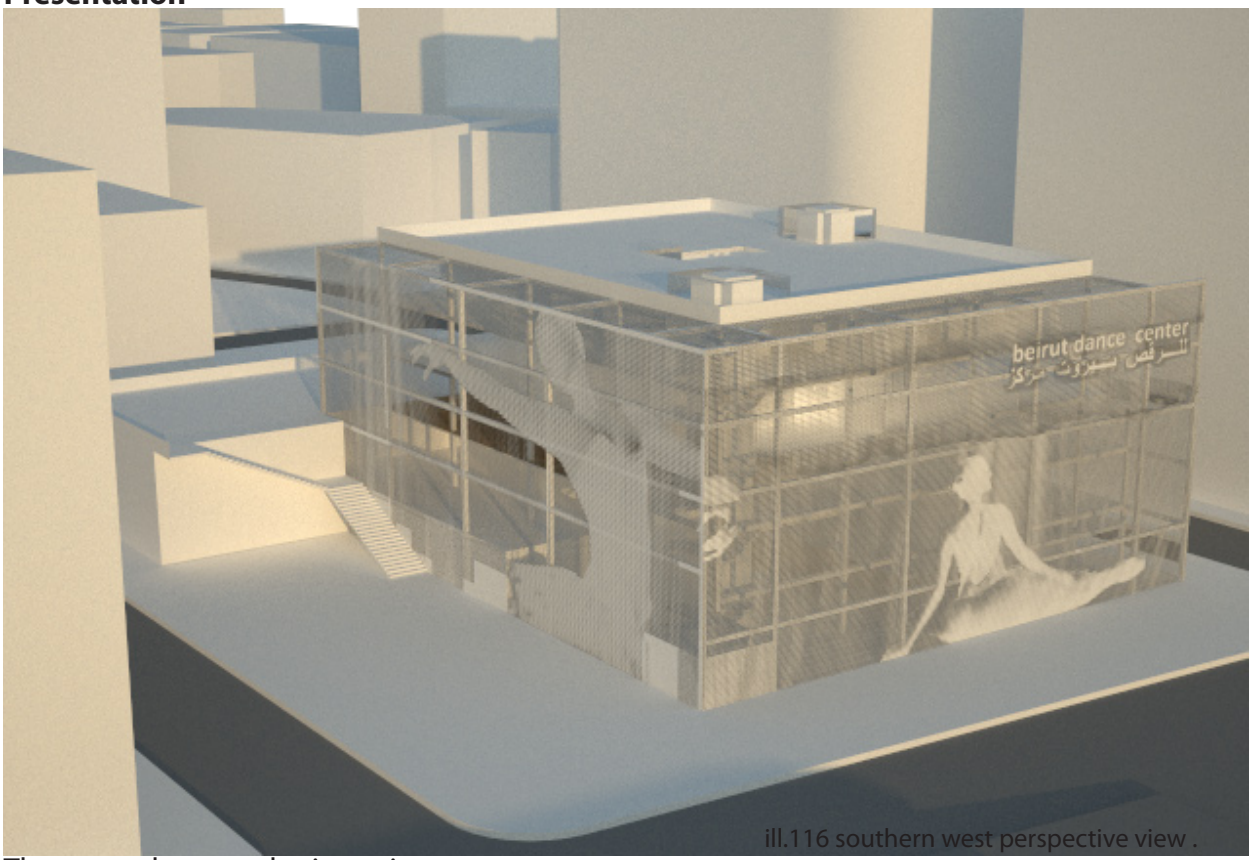
ill.115 renders of beam ,columns ,slabs





ill.113 Columns, beams and slabs on the

Presentation

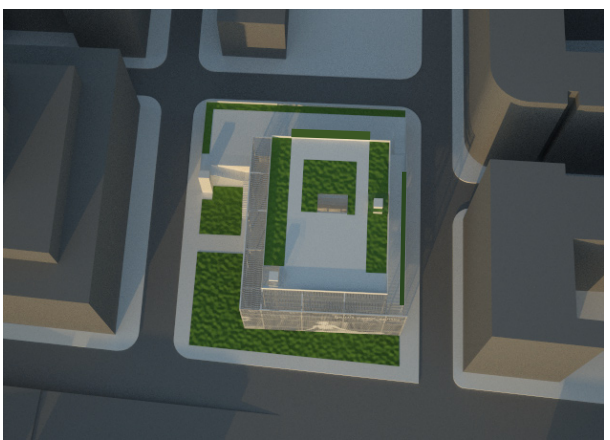


ill.116 southern west perspective view .

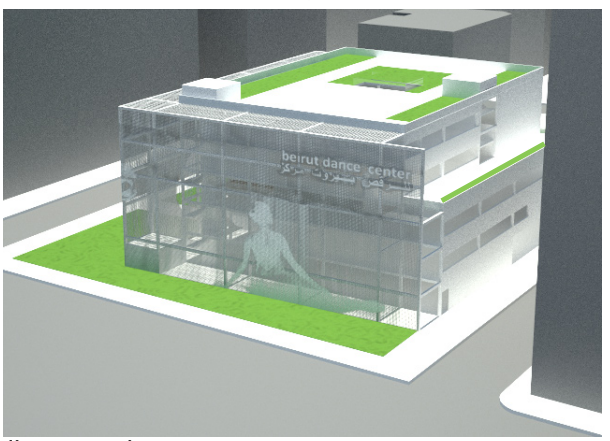
The outer shape and orientation

The position and shape of the building is following the rectangular site with the impulse to protect the interior from the noise and sun while providing a view to the north from the top of the performing halls and the east on the balcony of the third floor.

The building itself has a clear geometric outline of the plan which is also projected on the outside from the exterior shape.The south and west facade are from perforated metal sheet both to protect the interior, give a play of light common to arabic architecture and portrays the identity of the building with the elegant ballet dancers being a contrast to the strict rectangular forms in the plan.The main entrance is on the west part with a secondary on the east.



ill.117 building with vegetation



ill.118 southeast perspective

Plaza

The main plaza is positioned on top of the two performing halls with view to the small park on the northern side.There is also small vegetation on the ground floor on the main entrance and people have the possibility to walk up the stairs to the third floor.

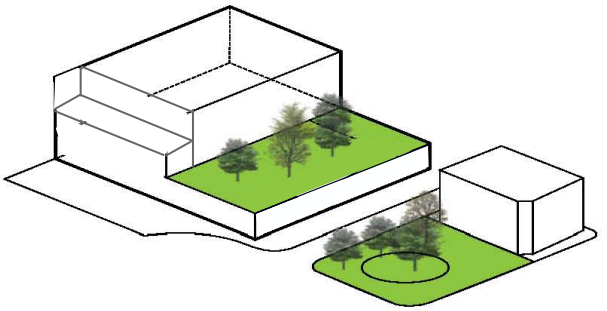
The layout of the plaza is defined through the shape and position of the building and from the dimensions of the site and is divided in three areas.Each part has its own function and connection to the Center although they interact as one public space.

1. The first area is located on the west side of the building,it is the main entrance to the building and the staircase to the main plaza.

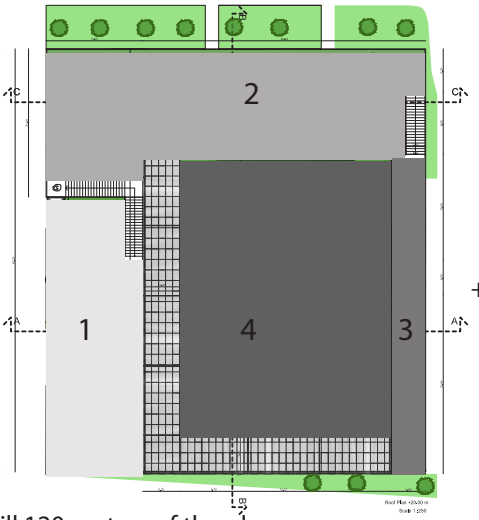
2.The second is the main square which is interacting with the second floor and the dance studios that could open up in special occasions.

3.The third is the eastern side of the third floor communicating with the dance studios there. People have the ability to see the view from the perforated sheet and the classes inside the dance studios.

4.The green roof is accessible only from the staircases inside the building and is there for people to experience the view from the top of the structure.



ill.119 plaza in connection to the north park



1. 517 m2
2. 837 m2
3. 218 m2
+4. 1.190m2
= 2.762 m2

ill.120 sectors of the plaza

Elements in the plaza

On these spaces there is only trees on the ground floor and minor vegetation on the higher levels.They represent the nature that is extended into the city and provide protection from the wind and noise.

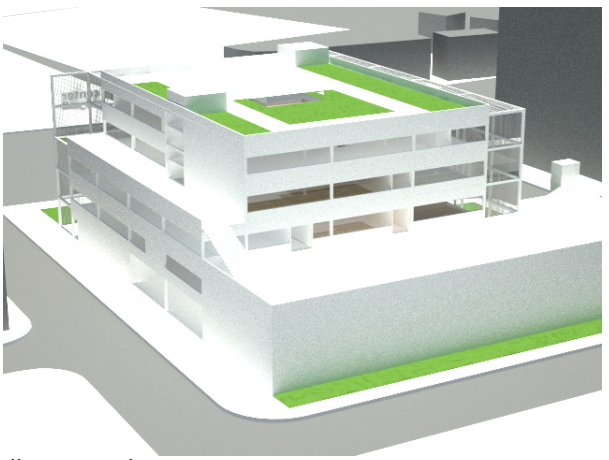
Wooden box benches have been positioned for the visitors and students to enjoy the warm weather and shading from the sun is provided in most part of the plaza and the side of the third floor.The size of the benches is 1m width and3 m lenght. The idea of using spolia and broken tiles on the surface could define each space in a different way.

Windows

The building has many windows of 1.5 meters height in the north and east facade but with the south and west covered with the perforated metal the interior openings are 2 meters high to allow enough light inside.This gives an indication of the programming of the interior and provides a definition of mass to contrast the concrete structure.

The southern atrium has a width of 5.2 meters and the western 5 meters till the interior of the building.The shading devices have different width of openess and make the facade vary in expression and to sheild from unwanted sunlight and overheating.

The first area inside the building in the ground floor that is the commercial and public area, with a double height till the first floor for illumination and a better sense of space.



ill.121 northeast perspective

The holes in the facade form a huge reproduction of two ballet dancers turning what would have been a standard shading device into a piece of art. At day the holes in the plates will appear black on the white metal , and the picture will resemble that of a rough rasterized photo. At night time the facade will be lit from the inside and appear as a photo negative in different colours as each floor has different use.

ill.122 first floor view to the commercial

Interior

The plan is shaped as a rectangular element positioned in the center of the site with respect to the souroundings. It loosely follows the initial grid of 5mx5m and the shape is according 'the form follows function logic'.In general the movement is free inside the building and emphasizes in the multifunctionality and extension of various areas in different levels according to the occasion.

Due to the constant play of music and noise from the students the walls have to be insulated making them 20cm in width.A key word besides fluidity is transparency and that is achieved with the facade ,that provides a dialogue with the site and the glass openings towards the atrium getting a general overview off the different areas .The glass panels start from one meter from floor height and continue till two and a half meters to provide enough illumination to the coridors and rooms on the center of the building.

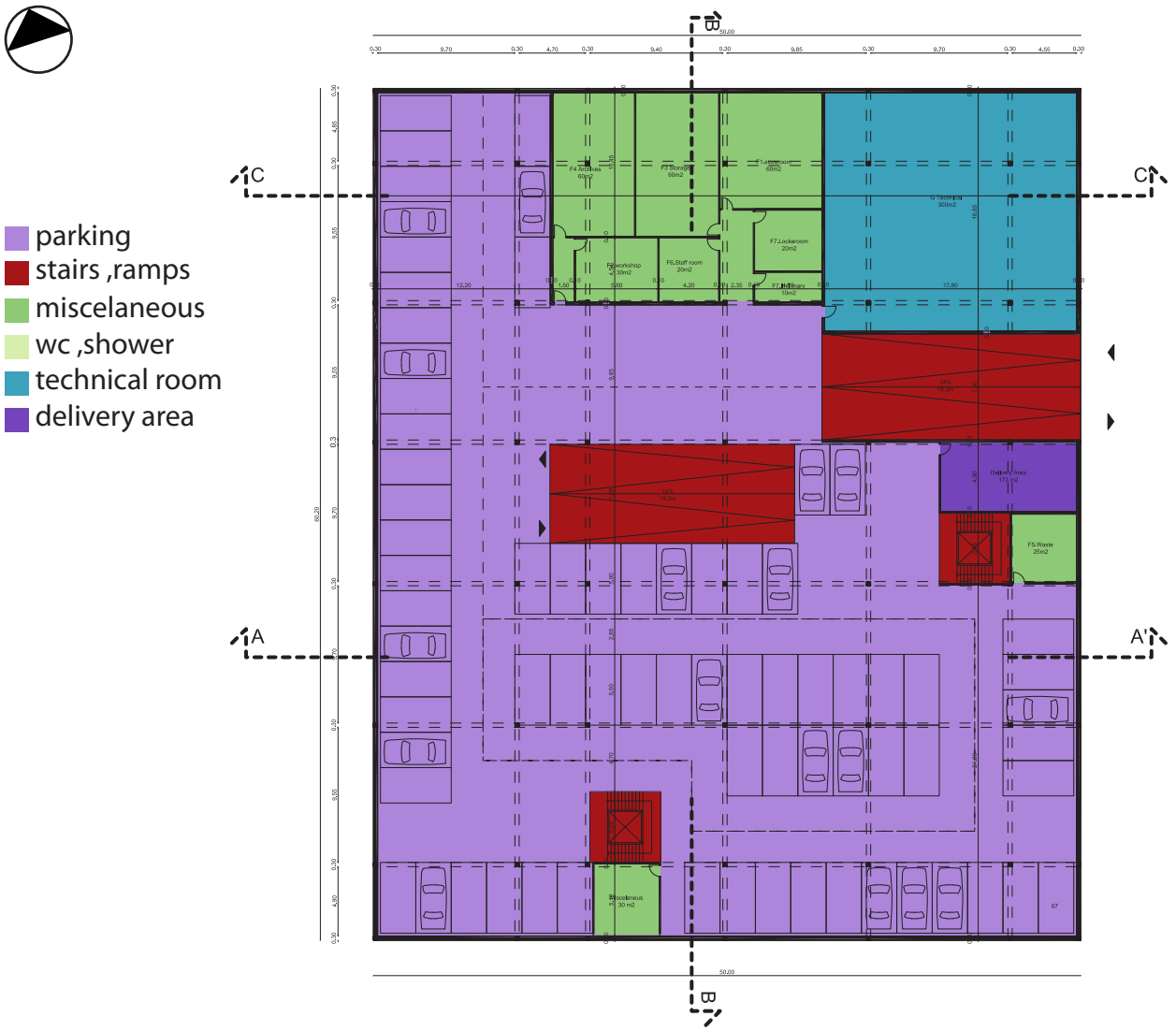
In general the building program can be divided in four chapters :

1st: The parking ,technical and private parts taking place on the basement.

2nd: The public sector that is mainly accomodated on the ground and first floor.

3rd: The educational facility that takes part in the second and third floor.

4th: The administration and library that are positioned on the fourth floor.

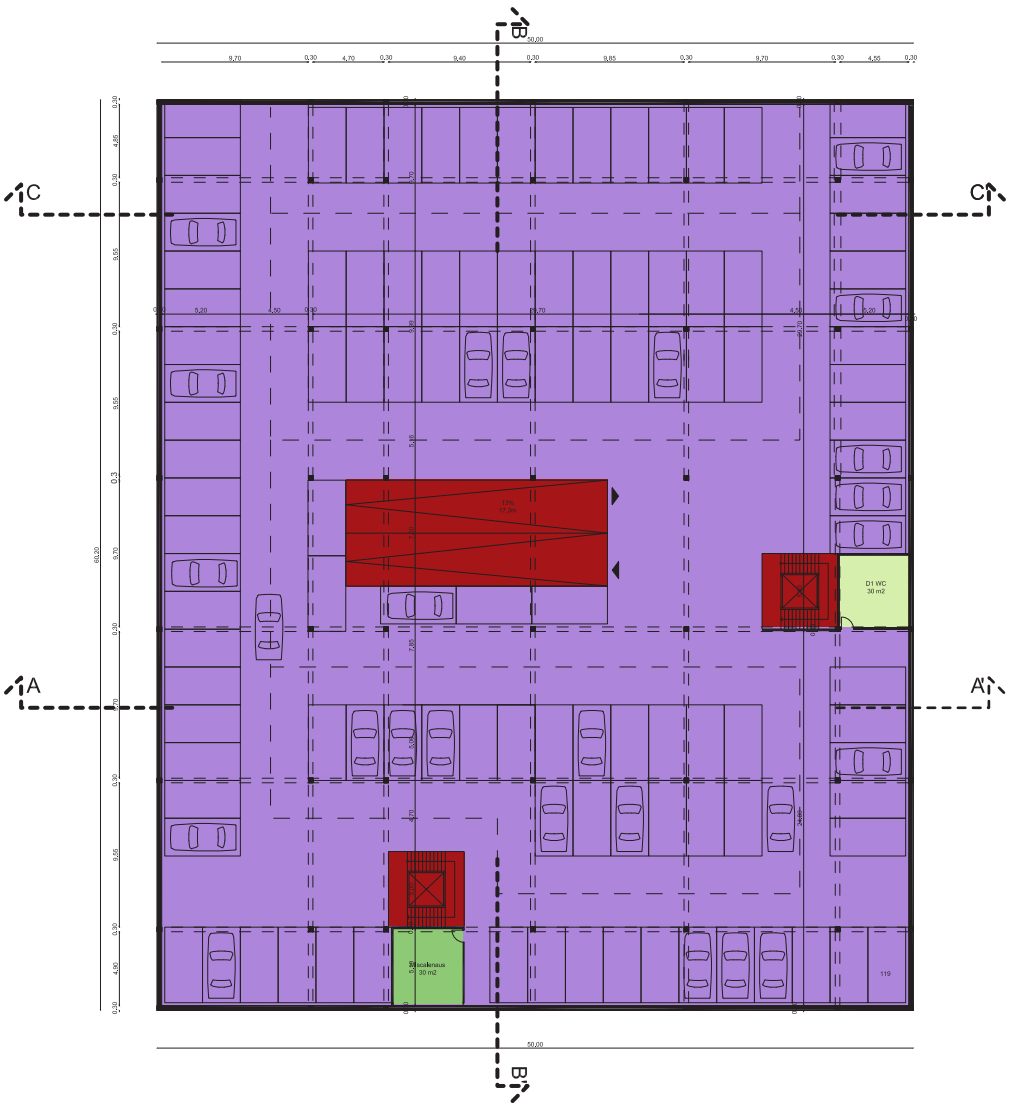


1st : The entrance to the parking is from the east side of the site and goes 4 meters underground.While descending the ramp on the right hand we find the technical rooms and the miscelaneous rooms .The miscalenaous functions are the infirmary ,the locker room, storage, store room,archives,workshop and staff room.

On the left side of the ramp there is the delivery area and the waste collection next to the staircase .The only other room in the floor is a multipurpose room next to the second staircase on the south side.Last on the center of the building there is a remp to descends to the second underground parking lot.

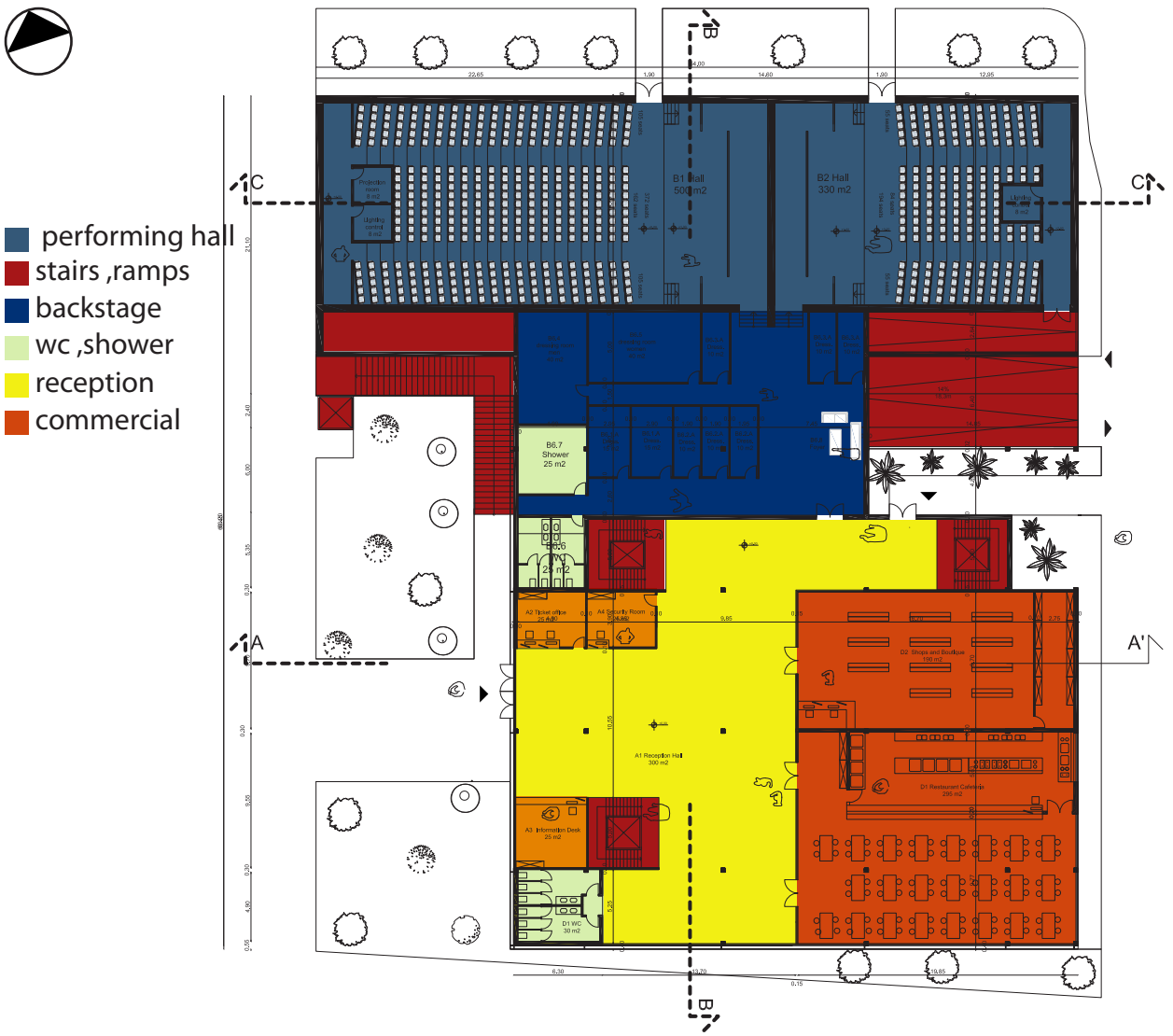
Parking -1 with beams and columns Miscalenaous Spaces and Technical rooms
Area 3.010 m2 Scale 1:500

parking
stairs ,ramps
miscelaneous
wc ,shower



The second parking lot is located eight meters underground and the only rooms it has are a bathroom in the eastern part next to the staircase and a multipurpose room on the south part next to the staircase there. It accomodates room for 119 parking spaces.The only ways to the surface is through the ramps or in order to enter the building through either flight of stairs.

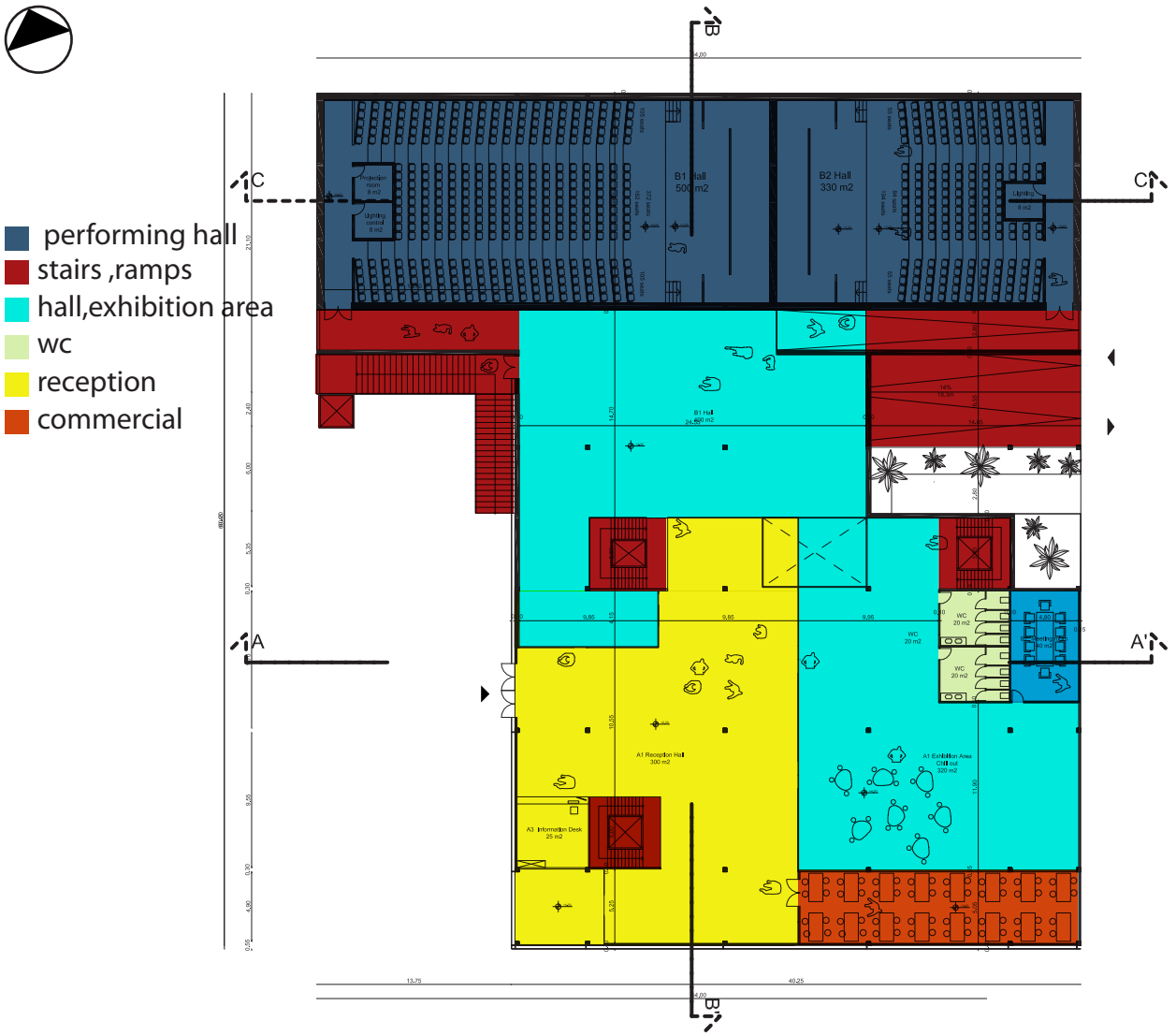
Parking -2 with estimated beams and columns
Area 3.010 m2 Scale 1:500



2nd : The entrance of the building is located in the west part.Upon entering the ticket office and the security room is on the left with the reception and information desk located on the right ,next to the staircase on the southern side.In front is the commercial space with the boutique and the restaurant cafeteria adjacent to the south atrium.

On the north part of the reception hall there are two staircases one ,both leading to the first floor the one on the left towards the reception halls while the other on the exhibition area and a small meeting room. Directly forwards is the door to the backstage of the two performing halls that contain a foyer ,ten dressing rooms ,showers and a bathroom.

Ground Floor reception, commercial ,performing halls and back stage
Area 2.425 m2 Scale 1:500



Getting on the second floor from the north,now 4 meters above ground, you are inside the waiting room of the two performing halls. There are two corridors one that leads to the big performance hall on the left and one for the smaller one on the right direction.

Continuing south and passing underneath the lighting well you come across the exhibition area with view to the reception hall and the restaurant thanks to the double height ceiling and the two adjacent atriums. Inside the exhibition area there are two bathrooms ,for the waiting room and the exhibition area and last a small meeting room.

Floor 1 reception, commercial ,performing halls and exhibition area
Area 2.425 m2 Scale 1:500

Performing Halls

Colleges and other theatre training programs usually employ the black box theatre because the space is versatile and easy to change. Many theatre training programs will have both a large proscenium theatre, as well as a black box theatre. This allows two productions to be mounted simultaneously, but they can also have a large extravagant production in the main stage while having a small experimental show in the black box.

There are two performing halls on the ground floor of the site ,connected via the entrance with the waiting hall and the backstage adjoining rooms of the artists.
Both have a height of 8m from the ground level and they have a fire exit on the northern side.

The entrance to the first is through a path directly from the hall in the first floor.It is the big one , 450 m2, with 372 seats. The stage is 64 m2 with a backstage of 40.7 m2 positioned both 1 m above ground.There is also a lighting control room and a projection room , 8m2 each, on the western part on top of the chairs.

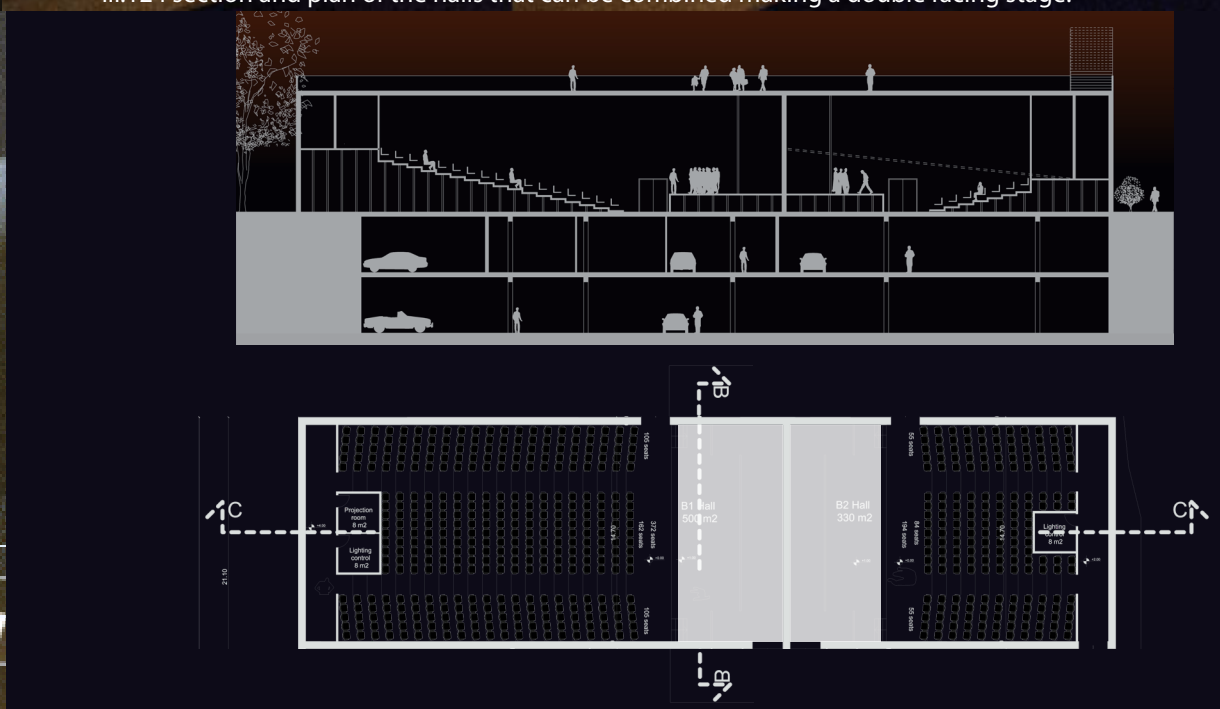
The entrance to the small one is by a declining path of 2.85mx15m ending 4m above ground .This hall is 300 m2 with 194 seats. The stage is 64 m2 and backstage of 40.7m2 on the same level of the big performing hall .There is also a lighting control room , 8m2 on the eastern part on top of the chairs.

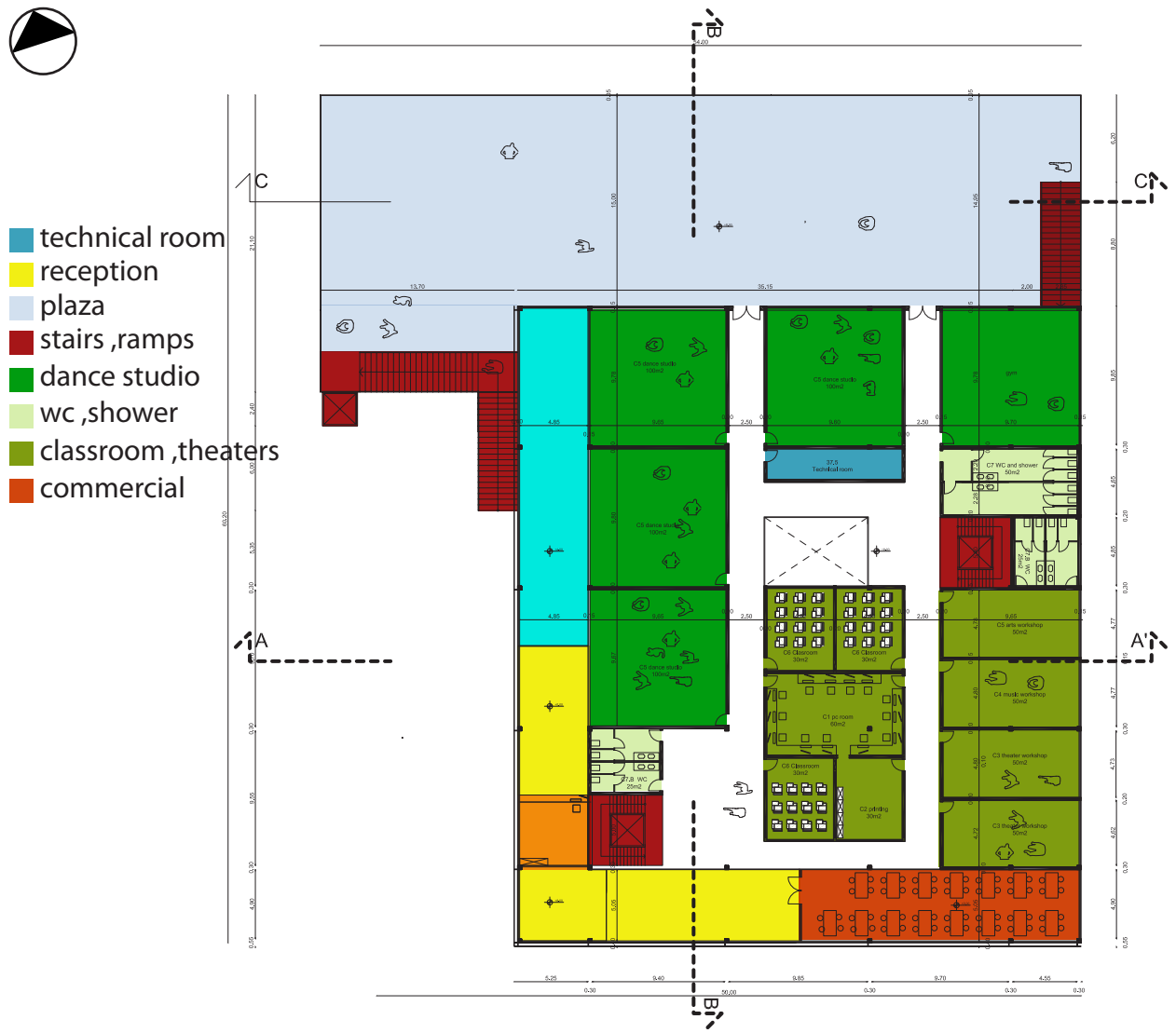
The concept of the two performing halls was that they could be used autonomously following the simple specifications of the black box idea and they could also be used together making a double facing stage of 566 seats when needed for larger events.

ill.123 renderings of the performing hall interiors.

"what's interesting about dance is that there isn't a single linear path through the stage," she said. "There's always overlap and interplay. If you look at the movement in dance, you see that dancers occupy the space differently at every single moment. They occupy the stage in different ways."
Zaha Hadid.

ill.124 section and plan of the halls that can be combined making a double facing stage.



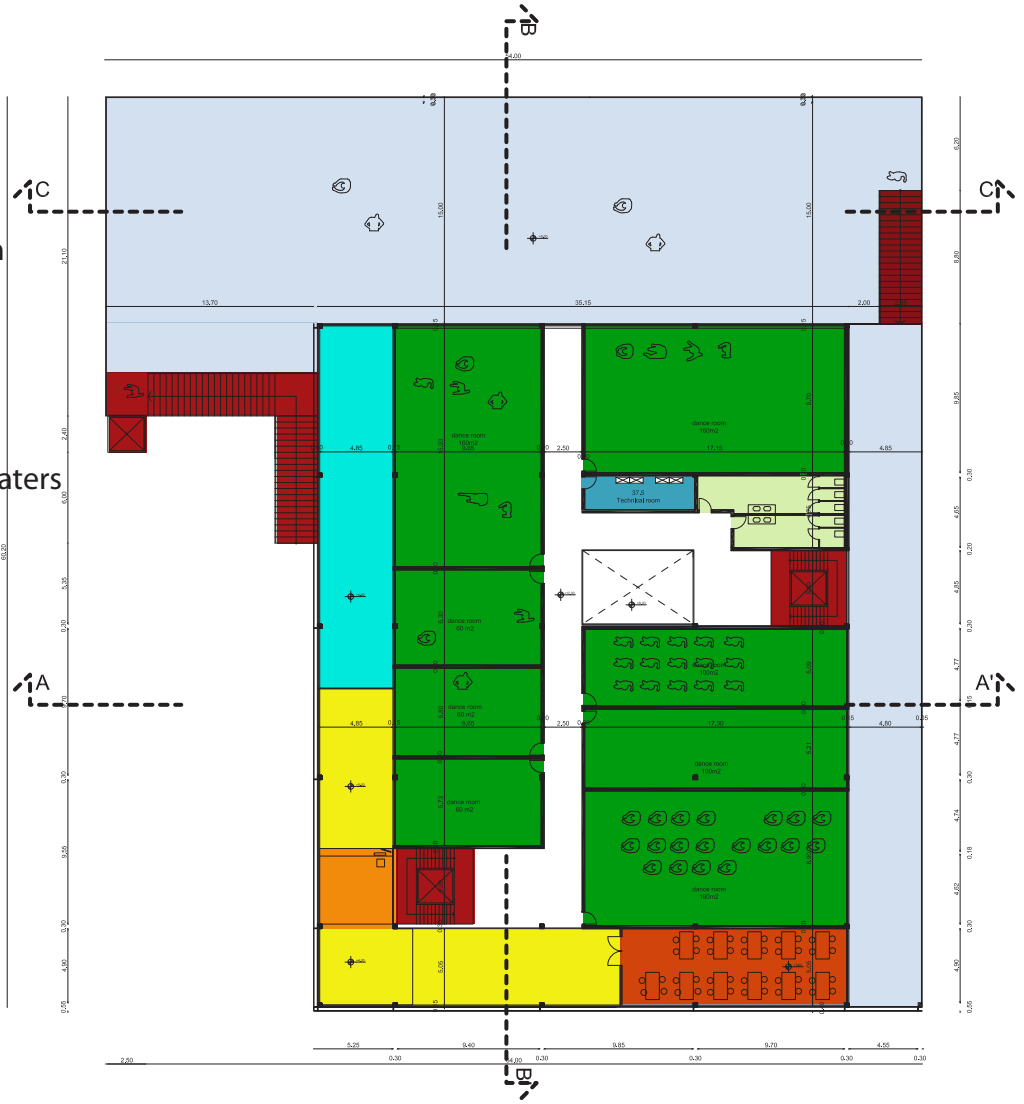


3rd : The second floor is the start of the educational facility being more private in comparison to the previous floors.Entering through the staircase on the south the visitor encounters 3 classrooms, a computer and printing room.

Circulation is made through two corridors that lets you pass to the theater and art studios on the east while continuing on the left hand there are three dance studios.In the center there is a lighting well with a technical room and a bathroom with showers next to the staircase on the east.

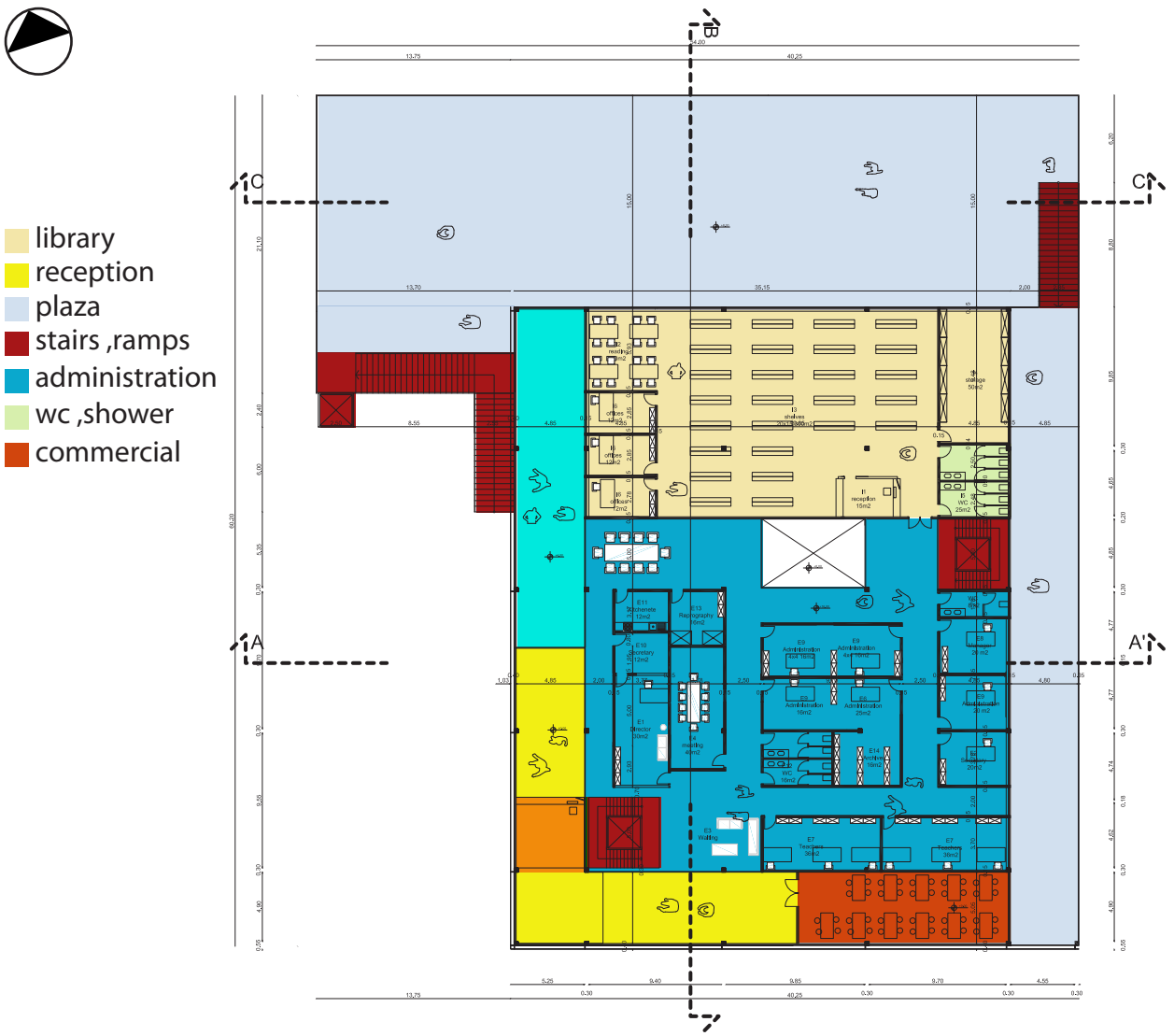
Floor 2 Dance studios and classrooms
Area 1.400 m2 Scale 1:500

technical room
reception
plaza
stairs ,ramps
dance studio
wc ,shower
classroom ,theaters
commercial



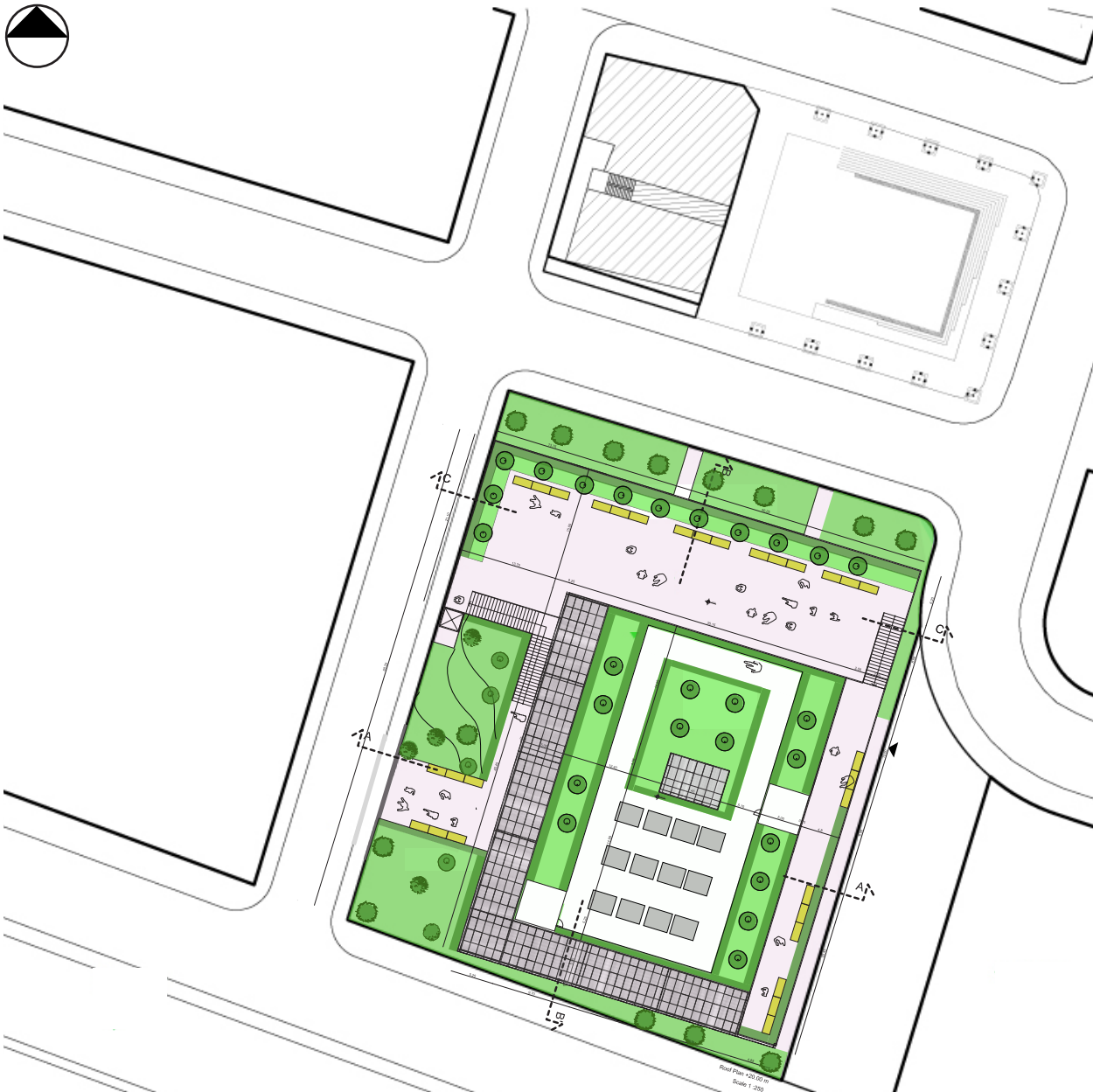
Floor number four is only occupied with dance studios ,eight in general ,with one corridor responsible for the circulation.There is also a technical room next to the lighting well and a bathroom with showers next to the escalator on the east.The dance studios on the east can open to the small terrace next to them.

Floor 3 Dance studios
Area 1.200 m2 Scale 1:500



4th : The fourth floor is the last one of the structure and is divided in two parts .On the north the library is situated with a reception ,a storage room ,three offices and a reading space .The other part of the floor belongs to the administration of the building.The sector is divided in four parts with a manager , administration stuff and secretary on the east ,room for six teachers and space for waiting next to the escalator on the south. In the center there is space for the administration and the archives and last on the west there is the office of the director ,the secretary ,copy room ,kitchenete and a meeting room.

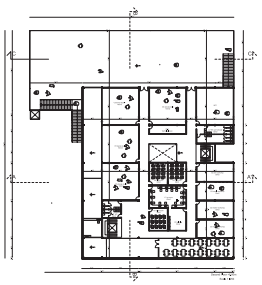
Floor 4 Administration and Library
Area 1.200 m2 Scale 1:500



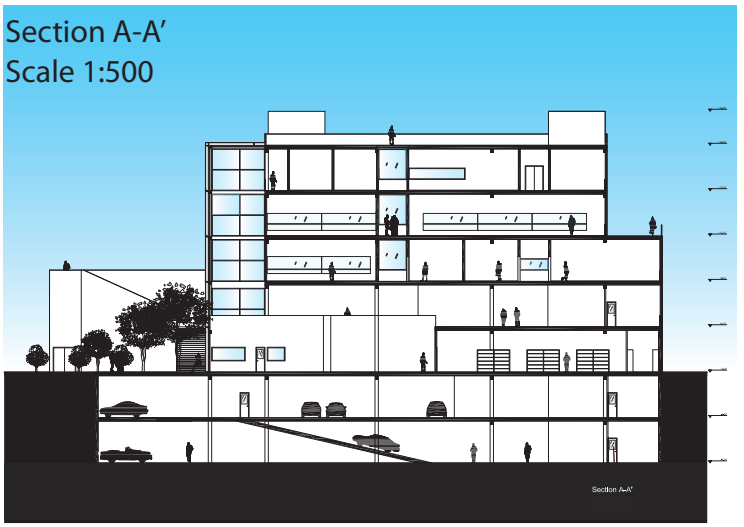
The roof is accesible from the two flights of stairs and is covered at a large extent with minor vegetation. There is also a number of solar panels facing the south to provide hot water forev-eryday use.

Roof plan
Scale 1:750

Sections



Section A-A'
Scale 1:500



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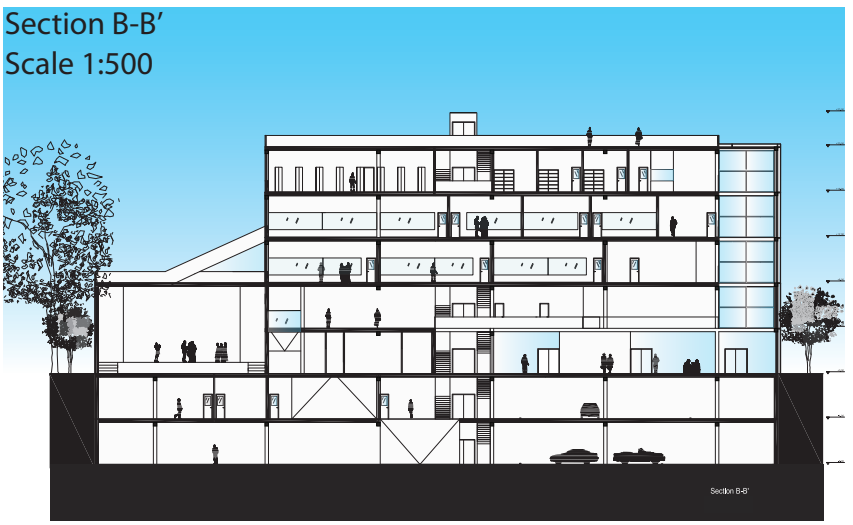
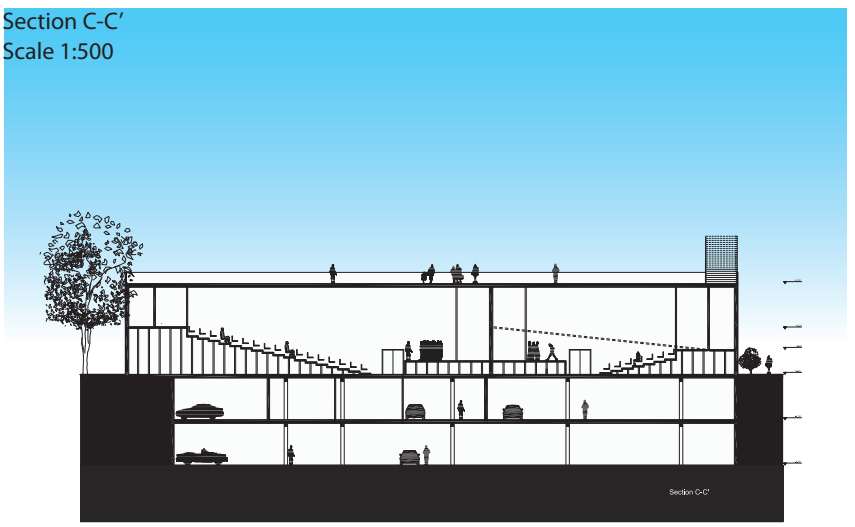
Scale 1:500

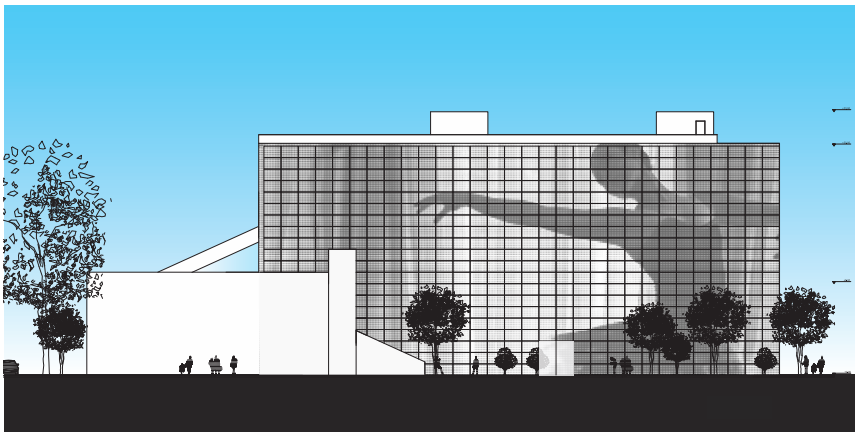


Section C-C'
Scale 1:500

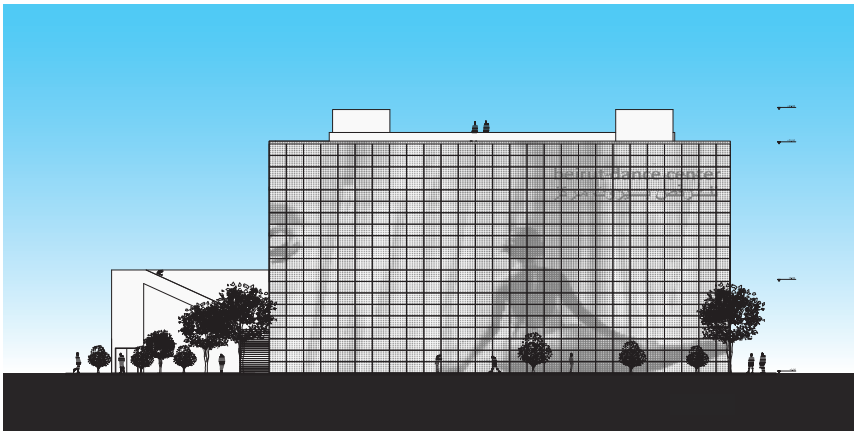


Elevations

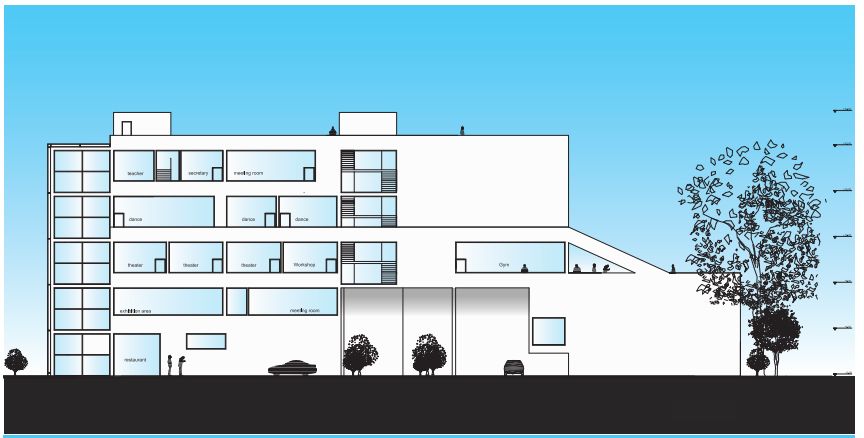
West Elevation



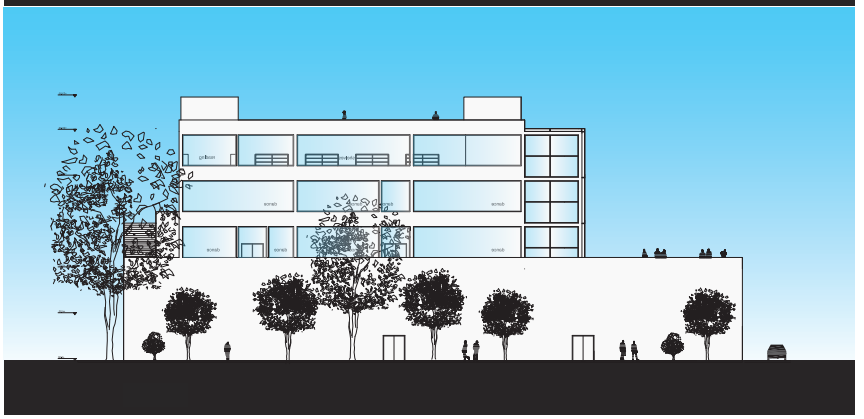
South Elevation



East Elevation



North Elevation



Conclusion

The building was designed as an educational facility ,with the idea that it would be open to everyday people besides students and staff and it would accomodate shows and exhibitions .The project aims to create a more open building where the community gets a meeting place either in the plaza or the commercial space inside either for dancing or socialising.The plan of the Center incites this connection by organising the functions aimed for large groups of people in the ground floor and the first floor while making the classrooms and dance studios more private even though they have access to the plaza and the balcony respectively. Again it is designed to serve the people of and in the district, and to supply their needs – whether regarding social ,educational or creative activity.

The connection from the old district to the Center is made easier with the plaza on the north part , where people informally get in contact with the building.
Although the Center canot be described as a landmark in the area compared to the buildings expected to be built its facade acts as a bill board of its identity on the estern and southern part were hundreds of pedestrians and cars pass every day making it stand out without looking out of context .The structure is made from reinforced concrete similar to the buildings on the area creating an easily readable structural system.The plain white and wooden colours make it friendly and inviting for the users.

The method of work during the conceptual phase is based on the physical models .This hands on media was the cradle of the actual product and further detailing was conducted inside the computer.Acoustic and lighing studies were taken into account during the end of the project that insured a satisfying incoporation of both although if these studies were made earlier in the process ,a different result would be a possibility.

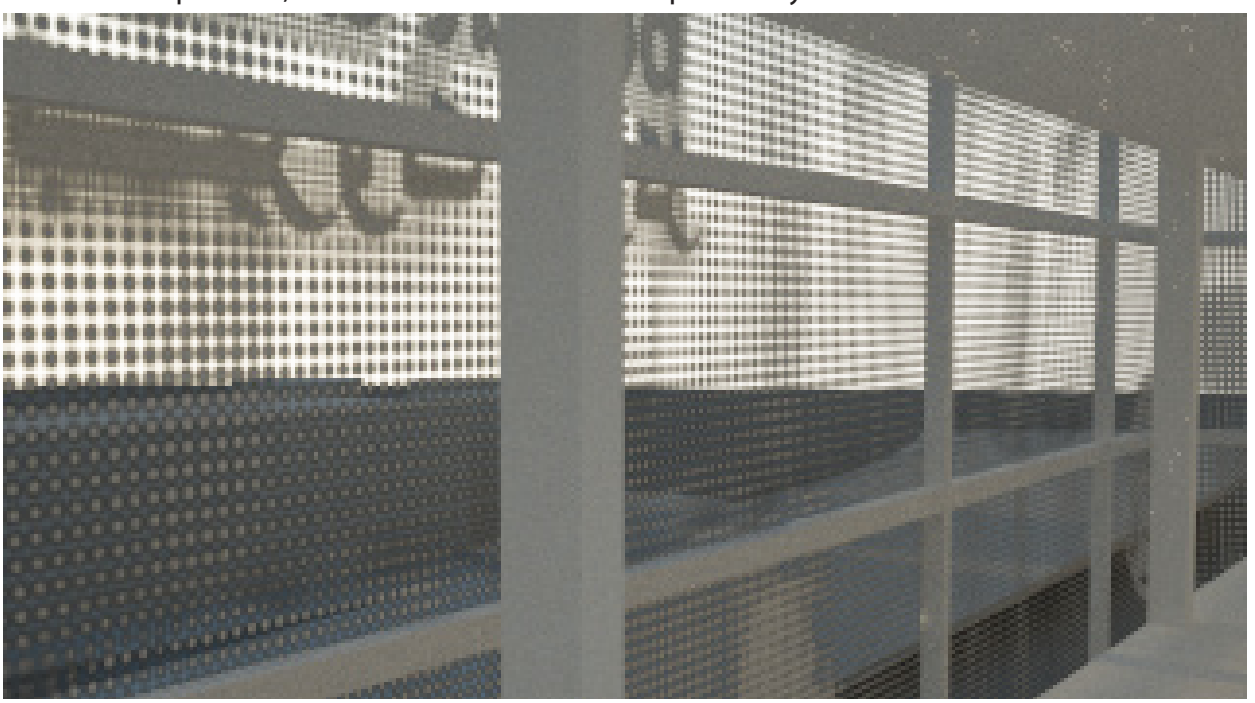


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Illustration list

ill.3-5 - www.darbayrut.org
ill.7 modified from www.darbayrut.org
ill.12 modified from www.darbayrut.org
ill.18 www.laban.org/
ill.20 www.lincolndancecenter.com
ill.21-24 personal illustrations
ill.26 http://www.mapt.dk/
ill.29 http://www.archnet.org/library/pubdownloader/pdf/9152/doc/DPC1230.pdf
ill.30-31 Baker, Nick et al (2000): "Energy and Environment in Architecture", E & FN Spoon
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ill.107 http://www.kolumbus.fi/sanaksenaho/web07.jpg
ill.109 http://4.bp.blogspot.com/_wXEBWu6h-p8/RyfC02CX-XI/AAAAAAAABg4/sTXbUI_fyiw/s400/P1010568.jpg

ill.124 first cover of the architectural program

Appendix

CATT acoustics

Surfaces	Materials	125 Hz	250 Hz	500 Hz	1Hz	2 Hz	4 Hz
	ABS default	0.10	0.10	0.10	0.10	0.10	0.10
Floor	Audience	0. 40	0.50	0.60	0.70	0.80	0.80
	Timberfloor	0.11	0.11	0.12	0.11	0.10	0.08
	Thick carpet	0.10	0.14	0.20	0.33	0.50	0.60
Ceiling	Diffusor	0.12	0.18	0.24	0.30	0.33	0.34
Walls	Glass	0.18	0.10	0.08	0.06	0.04	0.02
	Plywood	0.30	0.25	0.15	0.10	0.10	0.10
	Fibreglass board	0.80	0. 32	0.79	0.93	0.87	0.80
	Plaster ,gypsum	0.01	0.02	0.02	0.03	0.04	0.05

Dialux

Surfaces	Materials	Colour	Reflection factor
Floor	wood (light)	light brown	52%
Wall	standard wall	white	90%
Window	glass	white	6%
Ceiling	standard ceiling	light grey	90%

Concrete variables for construction

Bæreevner udover egenvægt i kN/m^2 ifl. DS 411-1999

Armering		Spændvidde		6,6	7,2	7,8	8,4	9,0	9,6	10,2	10,8	11,4	12,0
egv i kN excl. fugebeton		Pr. plade		32,3	35,2	38,1	41,1	44,0	47,0	49,9	52,8	55,8	58,7
8 L9,3	M_{Rd}	172,06 kNm	q_{rRd}	**22,0**	**17,8**	**14,5**	**11,9**	**9,8**	**8,1**	**6,7**	**5,5**	-	-
	V_{Rd}	106,96 kN	q_{rvRd}	22,7	20,4	18,5	16,9	15,4	14,2	13,1	12,1	-	-
	MmBS60	141,80 kNm	q_{mBS60}	17,3	**13,9**	**11,2**	**9,0**	**7,3**	**5,9**	**4,7**	**3,7**	-	-
	MmAbnFak0,02	100,80 kNm	$q_{mAbnFAk0,02}$	**11,1**	**8,6**	**6,7**	**5,2**	**3,9**	**2,9**	**2,1**	**1,4**	-	-
	MmAbnFak0,04	122,40 kNm	$q_{mAbnFAk0,04}$	**14,4**	**11,4**	**9,1**	**7,2**	**5,7**	**4,5**	**3,5**	**2,6**	-	-
	MmAbnFak0,06	140,69 kNm	$q_{mAbnFAk0,06}$	17,2	**13,7**	**11,1**	**8,9**	**7,2**	**5,8**	**4,7**	**3,7**	-	-
	VvBrand	80,22 kN	q_{vBrand}	15,9	14,2	12,8	11,6	10,5	9,6	8,7	8,0	-	-
	MmBS120	47,90 kNm	q_{mBS120}	**3,0**	**1,8**	-	-	-	-	-	-	-	-
	Mrev	163,99 kNm	q,rev	20,7	16,7	13,6	11,1	9,1	7,5	6,1	5,0	-	-
	Mbal	74,66 kNm	q,bal	7,1	5,2	3,8	2,7	1,8	1,0	0,4	-0,1	-	-
	flev i mm		f_{lev}	9,2	10,0	10,6	10,9	10,8	10,2	9,0	7,0	-	-
	fe1 i mm		f_{e1}	0,4	0,6	0,8	1,1	1,4	1,9	2,4	3,0	-	-
	Egensvingning	Hz	$f_{,1}$	16	15	13	12	11	10	9	8	-	-
7 L9,3+1 L12,5	M_{Rd}	185,27 kNm	q_{rRd}	24,0	**19,5**	**15,9**	**13,1**	**10,9**	**9,0**	**7,5**	**6,2**	**5,1**	-
	V_{Rd}	108,60 kN	q_{rvRd}	**23,1**	20,8	18,8	17,2	15,8	14,5	13,4	12,4	11,5	-
	MmBS60	157,78 kNm	q_{mBS60}	19,8	15,9	**12,9**	**10,5**	**8,6**	**7,1**	**5,8**	**4,7**	**3,7**	-
	MmAbnFak0,02	111,85 kNm	$q_{mAbnFAk0,02}$	**12,8**	**10,0**	**7,9**	**6,2**	**4,8**	**3,7**	**2,8**	**2,0**	**1,4**	-
	MmAbnFak0,04	135,79 kNm	$q_{mAbnFAk0,04}$	16,4	**13,1**	**10,5**	**8,5**	**6,8**	**5,5**	**4,3**	**3,4**	**2,6**	-
	MmAbnFak0,06	155,83 kNm	$q_{mAbnFAk0,06}$	19,5	15,7	**12,7**	**10,4**	**8,5**	**6,9**	**5,6**	**4,5**	**3,6**	-
	VvBrand	81,45 kN	q_{vBrand}	16,2	14,5	13,0	11,8	10,7	9,8	8,9	8,2	7,5	-
	MmBS120	54,90 kNm	q_{mBS120}	**4,0**	**2,7**	**1,7**	-	-	-	-	-	-	-
	Mrev	173,89 kNm	q,rev	22,3	18,0	14,7	12,1	10,0	8,2	6,8	5,6	4,6	-
	Mbal	81,77 kNm	q,bal	8,2	6,2	4,6	3,4	2,4	1,6	0,9	0,3	-0,2	-
	flev i mm		f_{lev}	10,2	11,2	12,1	12,6	12,7	12,4	11,4	9,8	7,4	-
	fe1 i mm		f_{e1}	0,4	0,6	0,8	1,1	1,4	1,9	2,4	3,0	3,7	-
	Egensvingning	Hz	$f_{,1}$	16	14	13	12	11	10	9	8	8	-

Views of the interior in the ground and first floor.