Architectural portfolio

Hooman Parhizkar

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content

1 Indoor Arena

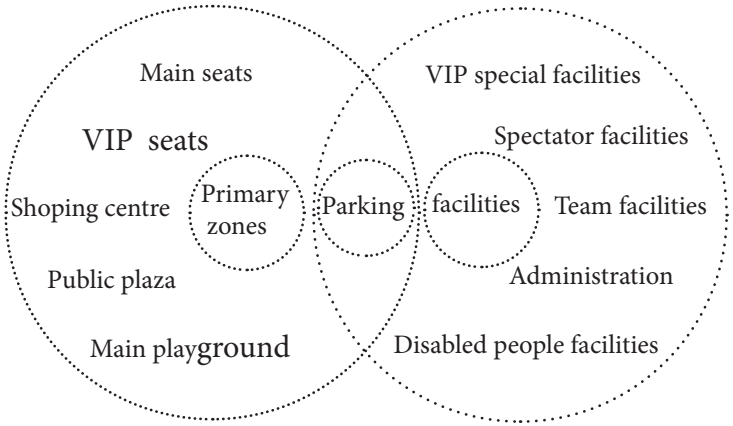
Architectural Technology Design |

Master's design studio

Prof: Dr.Hafezi, Dr.Azarmi, Eng.Shahsavari

Designed by Hooman Parhizkar, June 2016

Instructive Plan / facilities Primary Design Attitudes



Outdoor parking
Indoor parking
Bus drop off
Referee drop off
Teams drop off
Teams' buses parking
Guest parking
Disabled people parking
Emergency parking
Welfare parking

VIP special facilities

- Reception
- Catering hall
- Guest rooms
- Kitchen
- Conference room
- Toilet
- Meeting room
- Safe room
- Washing room

Spectator facilities

- Check in area
- Secondary ticket check in area
- Control room
- Emergency room
- Safe room
- Spectator buffet
- Restaurant
- Kitchen
- Toilet
- Disabled people toilet
- Praying room

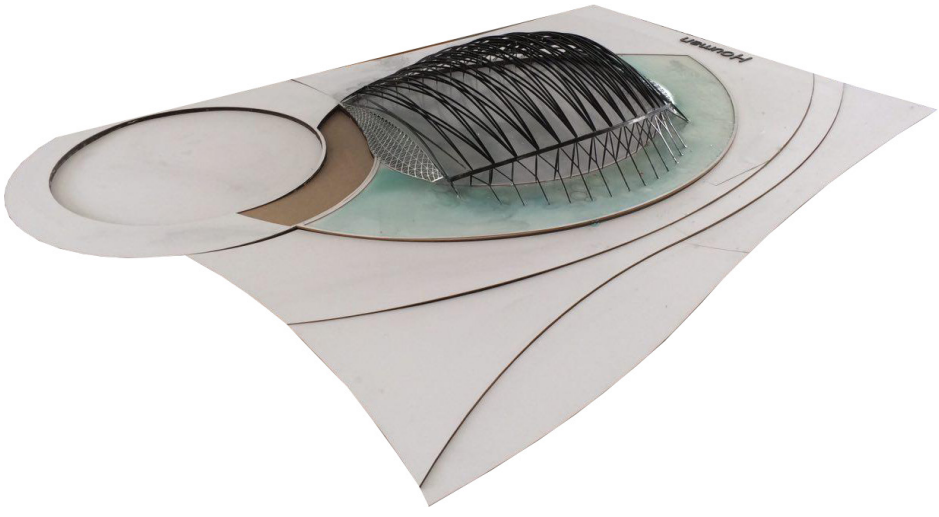
Team facilities

- Changing rooms
- Individual shower, Jacuzzi
- Massage room
- Training area
- Doping room
- Referee room
- Initial emergency room
- Observer rooms
- Players dining hall
- Equipment room
- Couch rooms

Media facilities

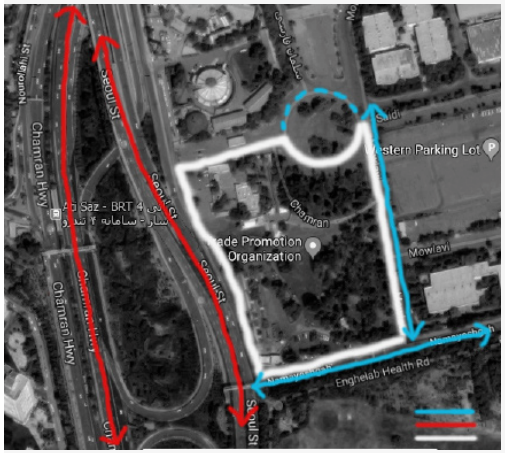
- Reporters zone
- Photographer zones
- Conference room
- Television studio
- Media centers
- Quick interview room
- Mutual area
- Communication center
- Toilet

The project is planned to provide space for 6000 spectators who are gathering to watch their popular team match including miscellaneous sports such as basketball, volley-ball, handball and futsal. It also afford sufficient service areas serving them not only during match games, but also as an urban plaza, shopping center, restaurant and cafes. According to its site which is located in one of the sumptuous regions of Teh-ran-District 2- it should serve more than a functional arena, addressing an es-sential role in the term of its architecture and design to serve as a city sign. **"Logical architecture"** is the term which was mentioned by our professor- Dr. Hafezi, who has also designed Milad tower of Tehran (The tallest tower in Iran)- encouraged us to practice architecture and structure, not only as separated elements, but also as a thoroughly combined items in order to reach a prosperous design procedure. So that we tried to merge architecture and structure as the two primary phases of design. Merging different structural avenues to decrease in amount of waste material consumption was another considered aspect which will be presented in relevant section. Nowadays, however we face dominant problems regarding to our environment and energy issues, architecture could possibly overcome most variety of them by its performance. Therefore we practiced different solutions to provide **natural light, natural ventilation** and also **low-carbon material** usage by admitting appropriate material. Basically, more we move toward sustainability, more our future could be.



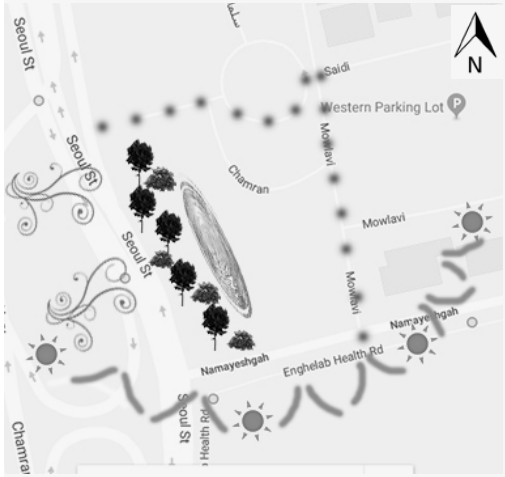
Initial site analysis & Primary diagram

With respect in the site location which had been submitted to be designed in, I firstly, evaluated different aspect of environment settings in order to approach a sustainable avenue. Simultaneously, different possibilities to specify convenient entrance for either of on foot and riding applicants were studied. Coming these all together, accompanying the concept of outdoor, semi-indoor and indoor spaces and also the most impressive views and perspectives to the city, the initial location laid out.

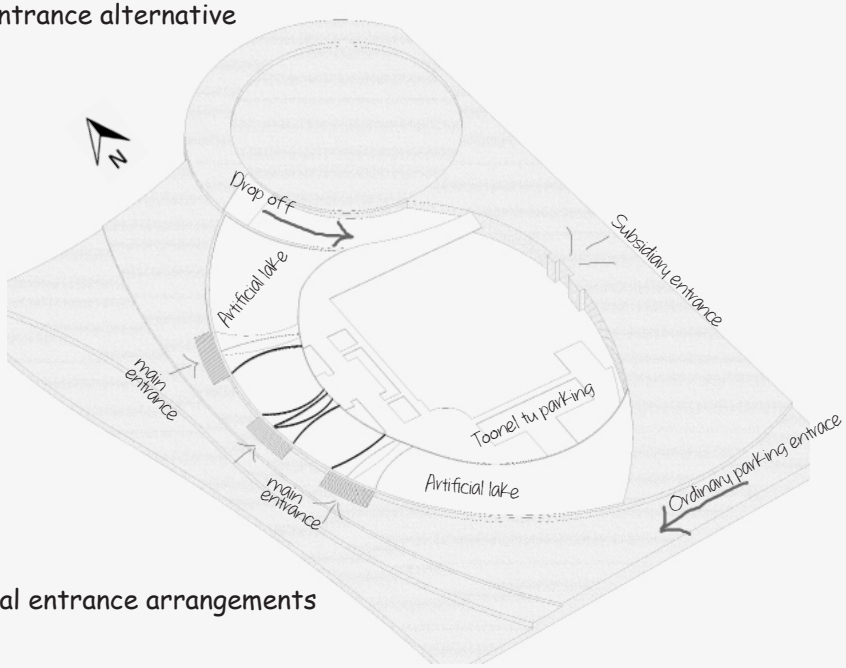


Site adjacency to nearby highways/ streets

Entrance alternative



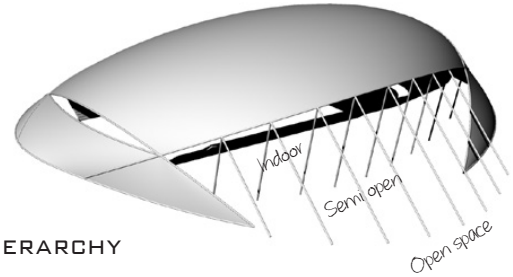
Current environmental situation reflecting possibilites of sustainable approach



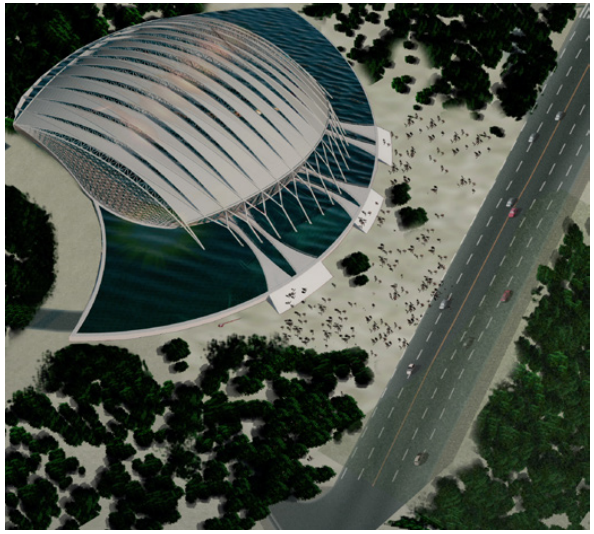
Final entrance arrangements

Circulation Hierarchy

The hierarchy in which spectators enter the arena is based on a general statement; we arrange the circulation with 3 main spaces: 1- Open space, 2- Semi Open space, 3- indoor space. This is the concept which has been frequently seen in Iran's historic buildings. So that, not only this concept could remind that ancient concept of Iranian architecture, but also it persuade people to pass through a deliberate plan in which prepares them from a 100% outdoor space into the indoor.



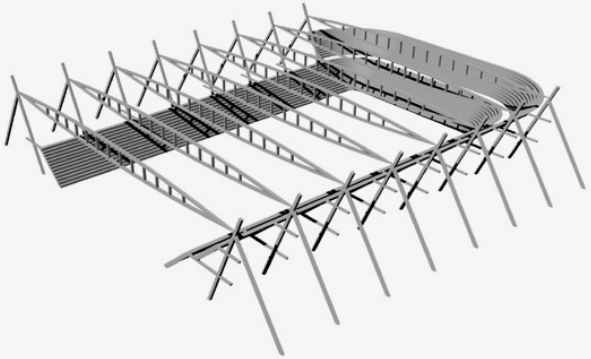
Hierarchy



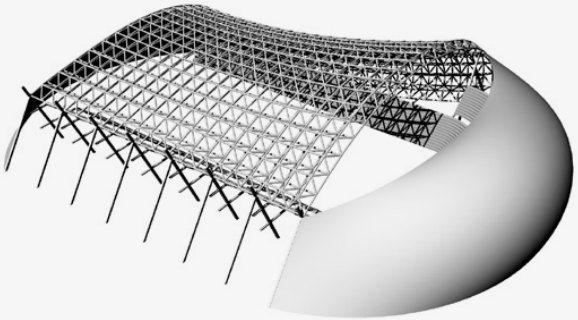
Periphery of 3 addressed spaces from top view

Form finding process

1 - Adding spectator seats accompanying an ordinary truss to cover the space



2 - Adding an open space to the south façade in order to provide natural light for indoor space, thus practicing space grid as an alternative roof structure



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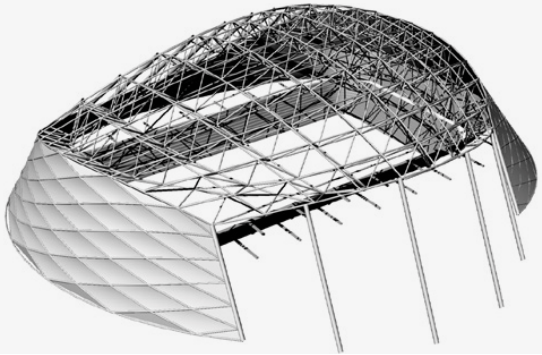
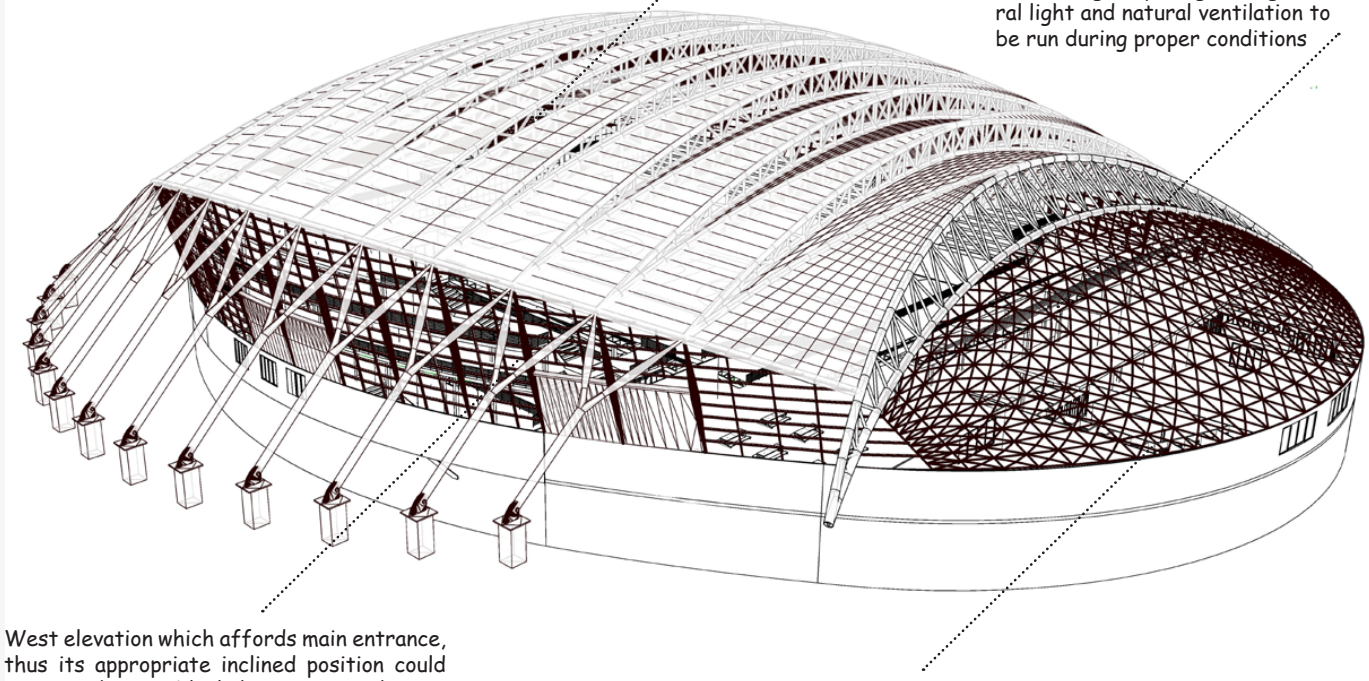


Form follows function

Indoor arena was supposed to be an active space which should precipitate its environment activity as an impressive focal point. Its dynamic form represent the sharpness and active function. There are two main hollow envelopes in south and north of the façade which let the appropriate natural light to be entered into indoor zones in which either spectators or players may be benefited. There is also a widespread glass façade in west elevation which was inclined to earth surface in order to prevent unpleasant light, thus presenting the main entrance. There is a parking tunnel in south elevation to connect the main parking to the arena by shopping centers located just below the south façade. By contrast, north façade covers the drop-off which is the way to enter the teams and particular viewers to the arena.

Roof sunlight opening letting natural light and natural ventilation to be run during proper conditions

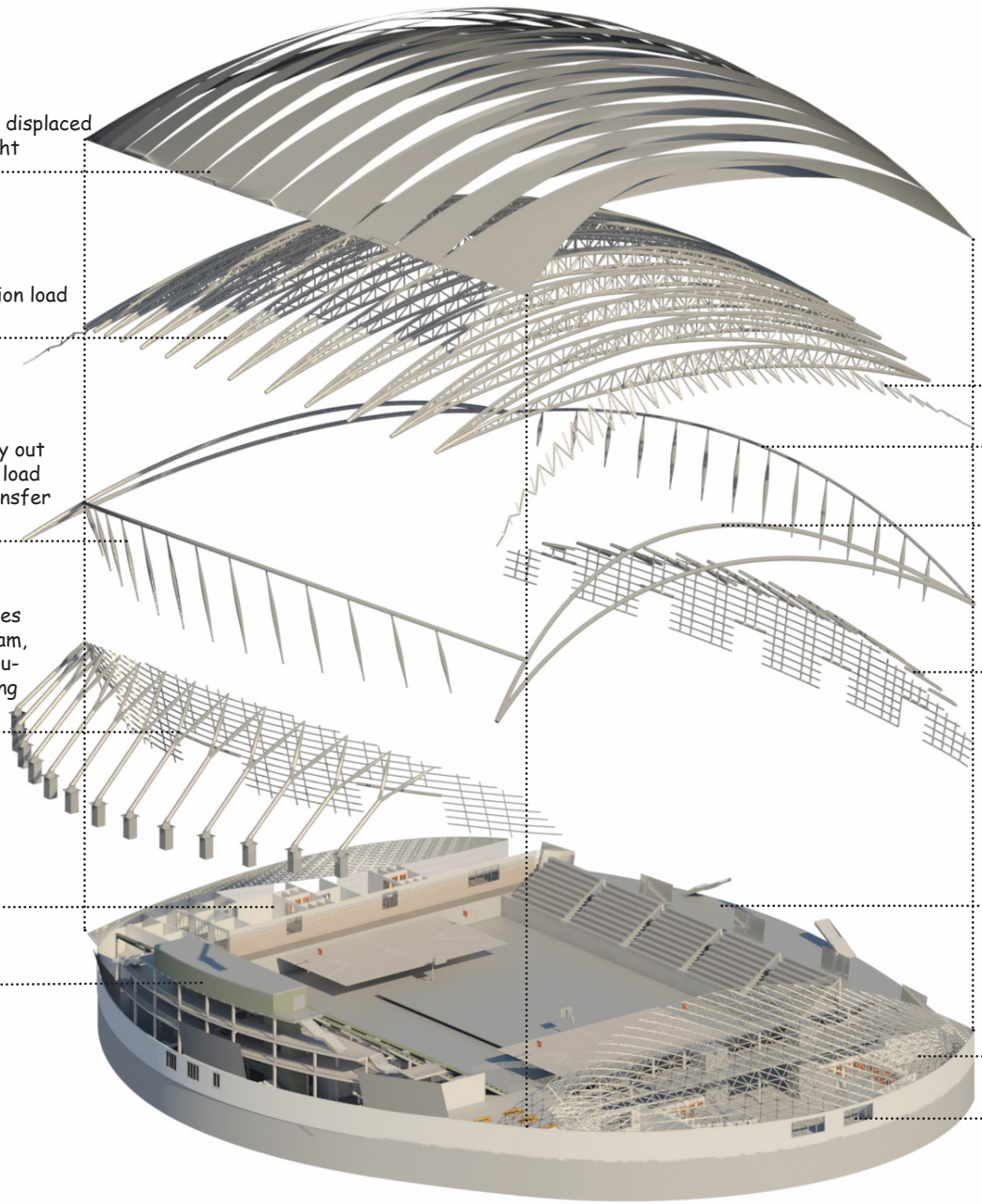
Roof sunlight opening letting natural light and natural ventilation to be run during proper conditions



West elevation which affords main entrance, thus its appropriate inclined position could prevent dispensable light to enter the entrance zone

South façade elevation and its possibility to provide south light for shopping centers and part of playground and spectator seats.

Configuration expansion



Final aluminum covering shell which has been displaced every other one to provide indoor natural light

X shape trusses which provide either direction load bearing by its multi direction placement

Subsidiary columns which shape a triangle lay out with outdoor ones, affording multi direction load bearing opportunity, thus contributing in transfer of trusses loads to basement

Outdoor columns, representing triangle shapes in the connection point to the main curve beam, providing multi direction load bearing opportunity, thus providing complexity to load bearing system which contribute to more usage of

Teams changing room connected to the main drop-off zone

Media zone providing relevant facilities to cover live shows

South edge sunscreen providing light for shopping center and part of main playground

The eastern main ring transferring truss loads to columns and ground

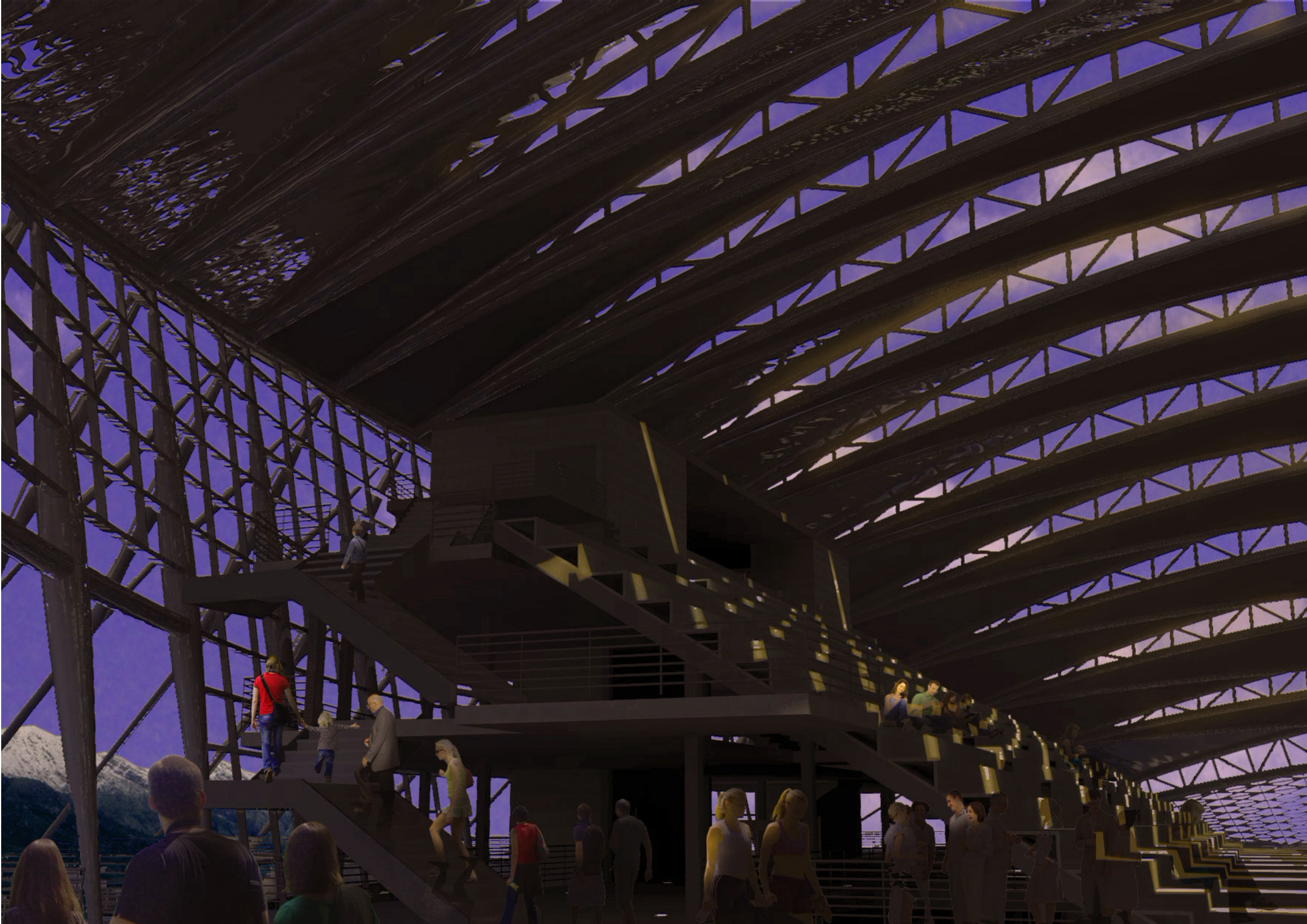
Southern truss structure system, transferring part of total load and its attached glass panels to the basement

Eastern entrance, supposed to be a subsidiary one, providing part of the entrance and also eastern natural light for indoor spaces

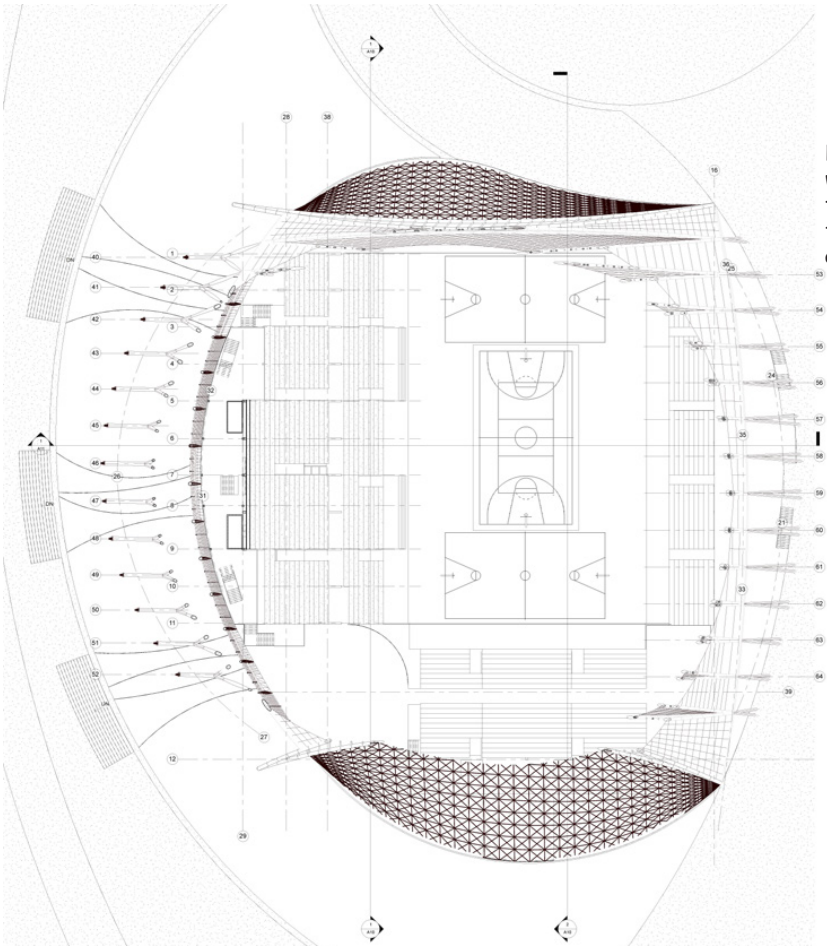
Eastern entrance zone, providing services for eastern spectators

Southern glass façade, presenting a dynamic form and providing natural light for shopping centers, restaurants and entrance tunnel as well

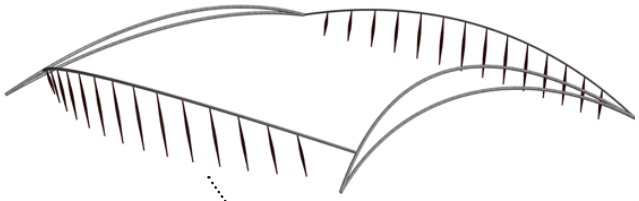
The tunnel connecting main parking and indoor space

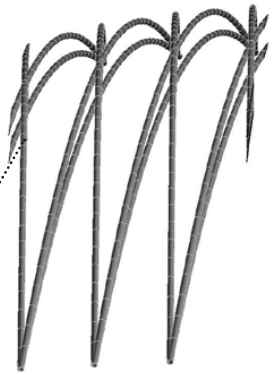


Structural procedure

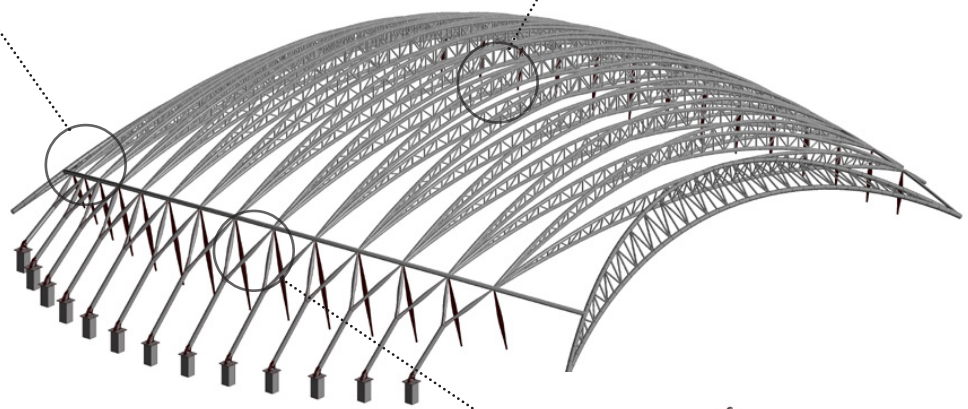


Firstly, the main dead load including aluminum panels and extra items such as snow loads, will be transferred by these trusses. Although they are 2D trusses, but their intersection has changed their performance into a 3D structure behavior. Not only they transfer gravity loads, but also their complex directions contribute in transferring lateral loads as well. It means that intersected trusses, serve as a kind of horizontal bracing system



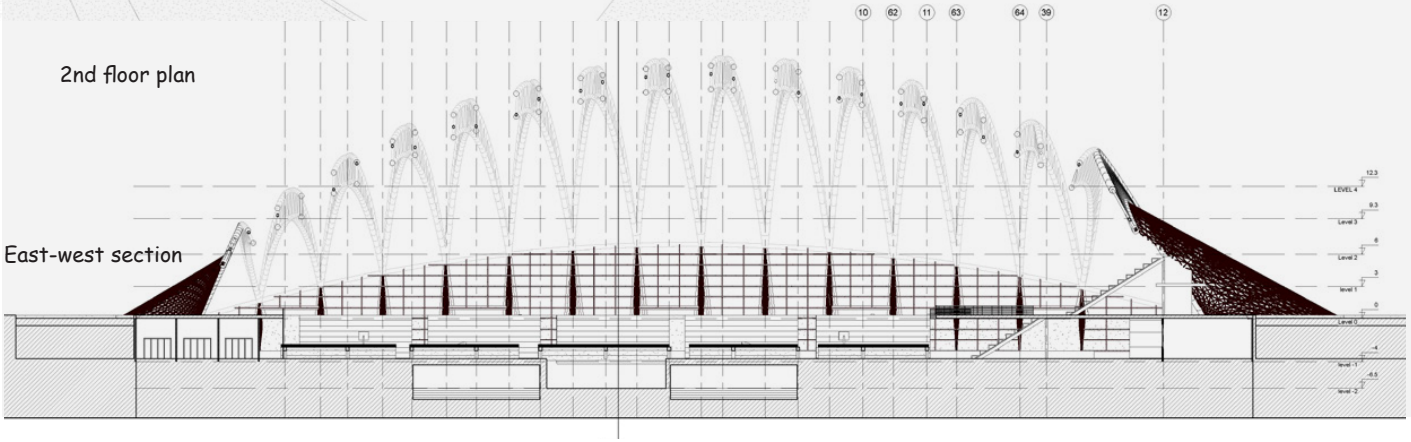


In the second process, there is a perimeter framing system which is aimed to transfer intersected trusses loads, partially, to the basement and eventually ground. It is assumed to be partial, because there are 2 sets of columns which are also responsible for transferring lateral and gravity loads

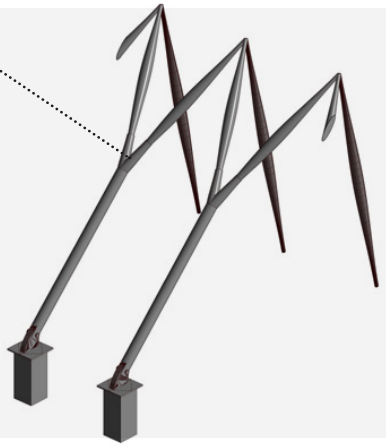


2nd floor plan

East-west section



Finally, there is a combination of 3D triangle shape columns which makes them potent about any lateral loads – since triangle is the most sustain form in nature – thus, instructing a complex way of load transferring from roof is another aspect made by this shape



2 Kinetic shading

Digital Fabrication Class

Master's design science course

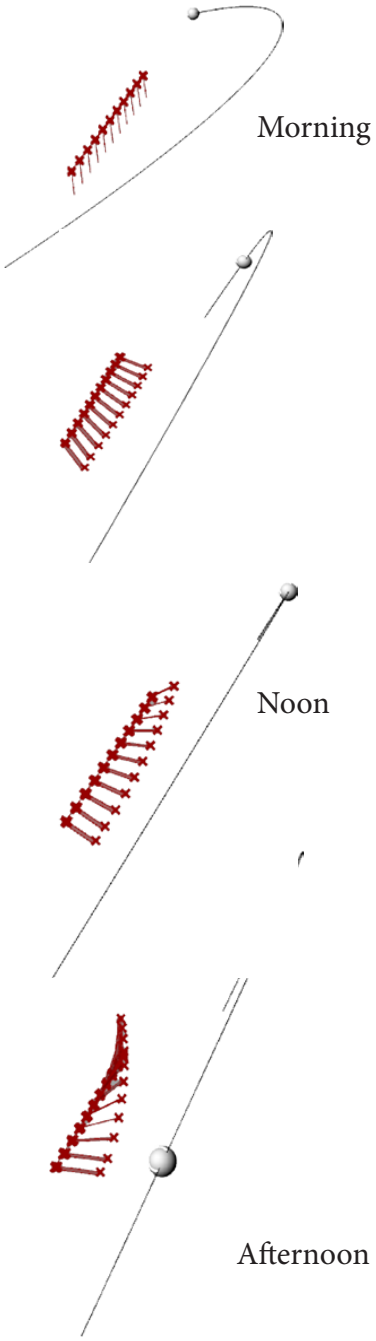
Prof: Eng. Faridani

Designed by Group teamwork, May 2016

Concept & Attitudes

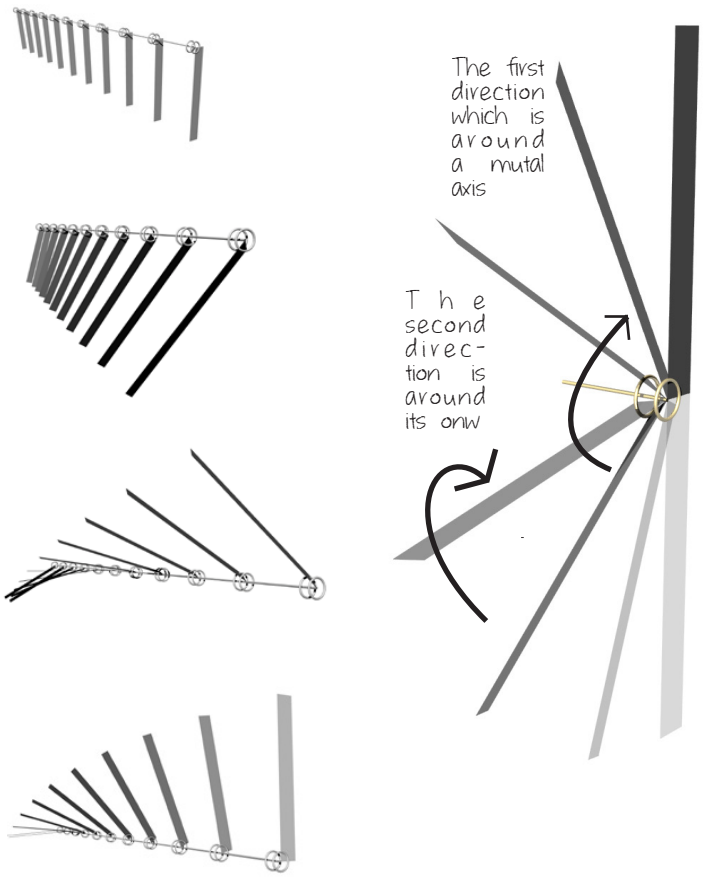
There are several reasons why we should control light intensity to be entered into indoor zones. Zones with high temperature would become cool by absorbing light and its relevant energy, while, affording additional energy for colder places could be important incentives to develop shadings.
The primary concept was to design a kinetic shading which could either be used as wall and façade. Not only this movement could bring form attraction, but also it may control light intensity in different time of a day.

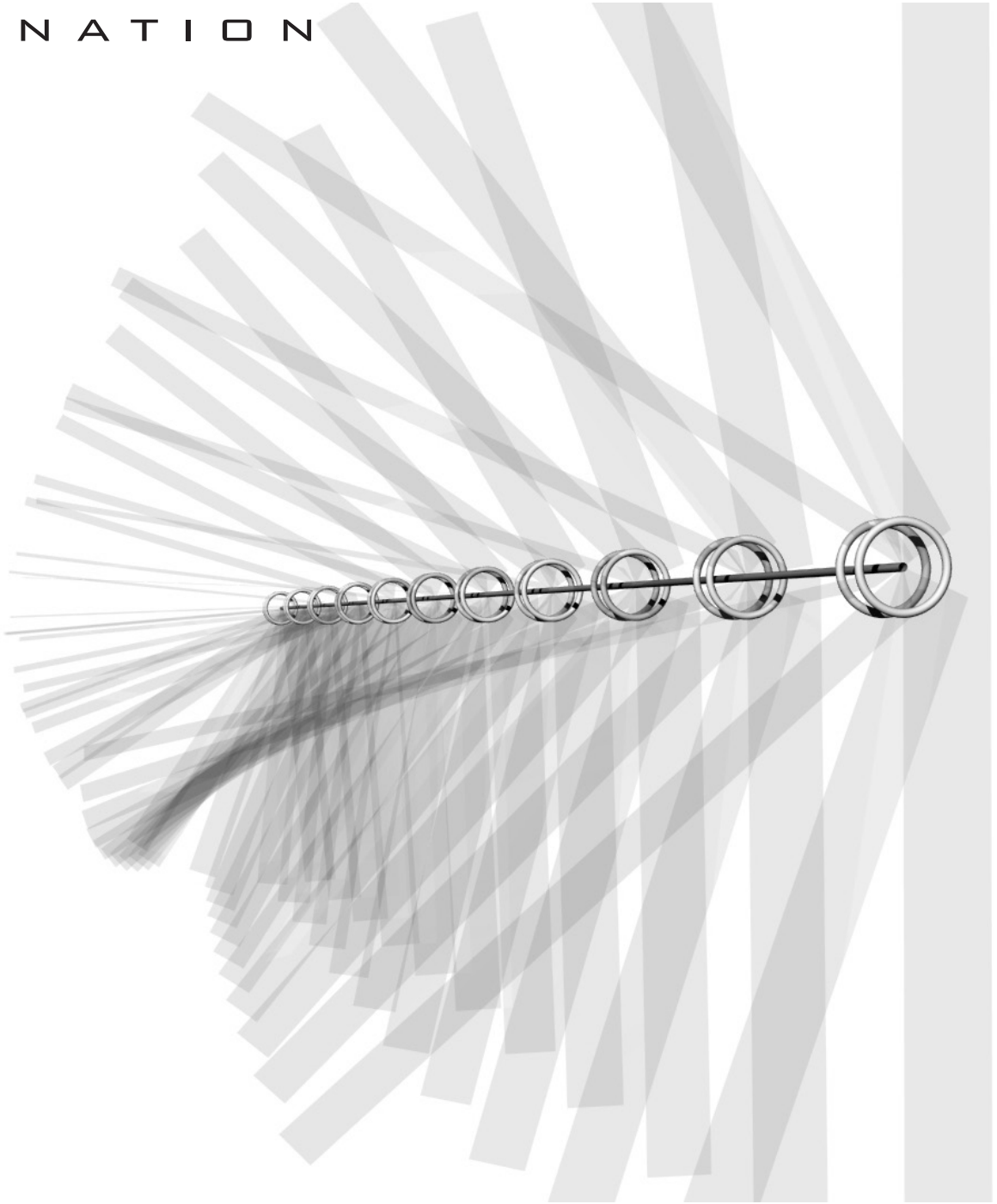
Right side diagrams show suns movement from morning to afternoon and represent the concepts principal idea of providing appropriate shading regarding to sun's position and its light direction. At morning, when there is no sunlight disturbance, every shadings are in their "wall" position. By approaching to noon, initial shadings start to move to provide shadow versus east light. At afternoon, an opposite side of the shading work, simultaneously, the initial part starts to pack up. This movement represent a sinus pattern in which we aimed to afford it for through the design process.



Movement combination

The concept which had been derived from environmental analysis was based on an overall statement: We were to combine 2 different movement, in which either had its own specific direction and the crucial point was that we wanted to run either of movements, **with just one directional orbit.**

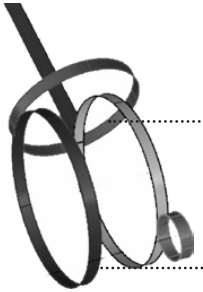




From Concept to Reality

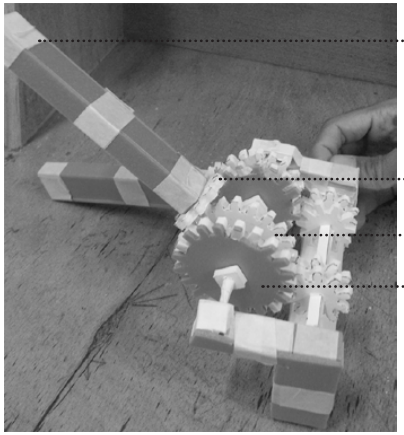
Following the previous explanation about the concept, we got into one mind to use gears as one of the options to connect 2 different directional movement into each other

Not only could this decision brought us "the changing direction, but also by fixing one of those two gears and letting the other one to move on it, we could afford both directions by only one side orbit



Moving gear

Fixed gear



Moving element

Moving gear

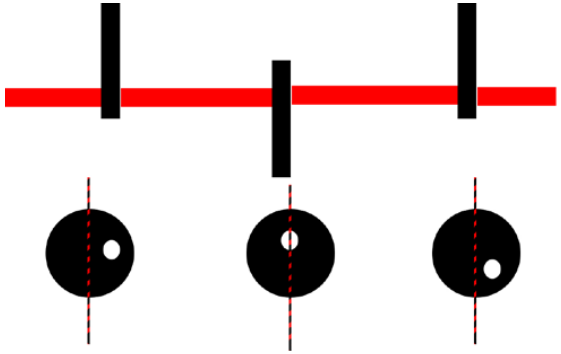
Fixed gear

Moving gear and pipe- shaped instrument

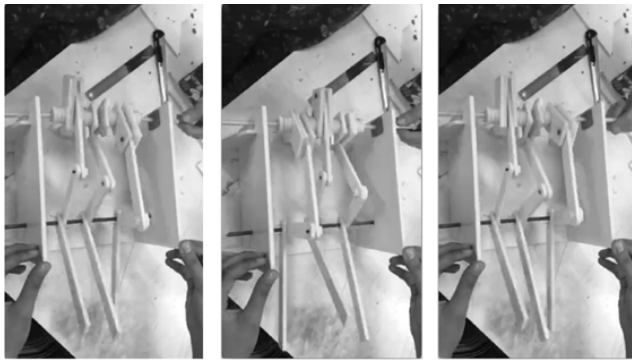
We built a test model in order to check the performance of movement and also to evaluate necessary details to develop the real model. In this model, the bigger gear was considered fix, while the smaller one orbited throw the mutual axis, afforded by the perpendicular pipe-shape instrument

How to produce sinus wave?

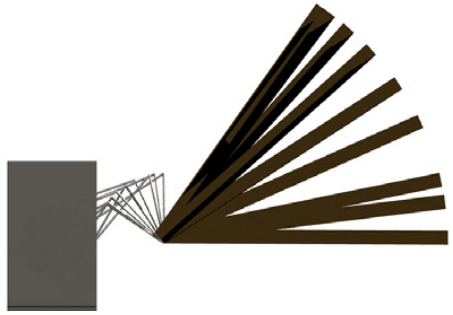
In order to create the Sinus waves, we followed an approach in which one of the mechanisms of automobile engines got in to gear. The crankshaft is a part in every car which handles the movement of pistons. The main point is that we could cre-



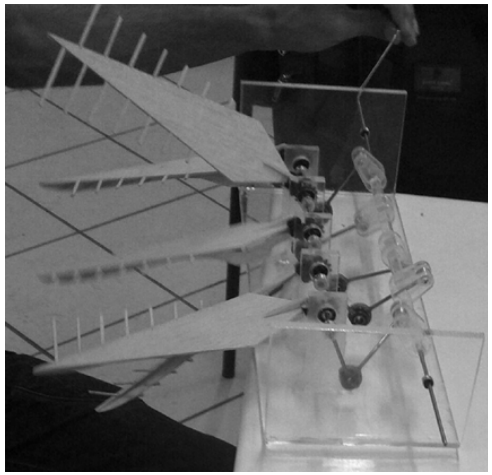
Phase difference could be created by increase or decreasing the space between the circles centers and shafts' axis

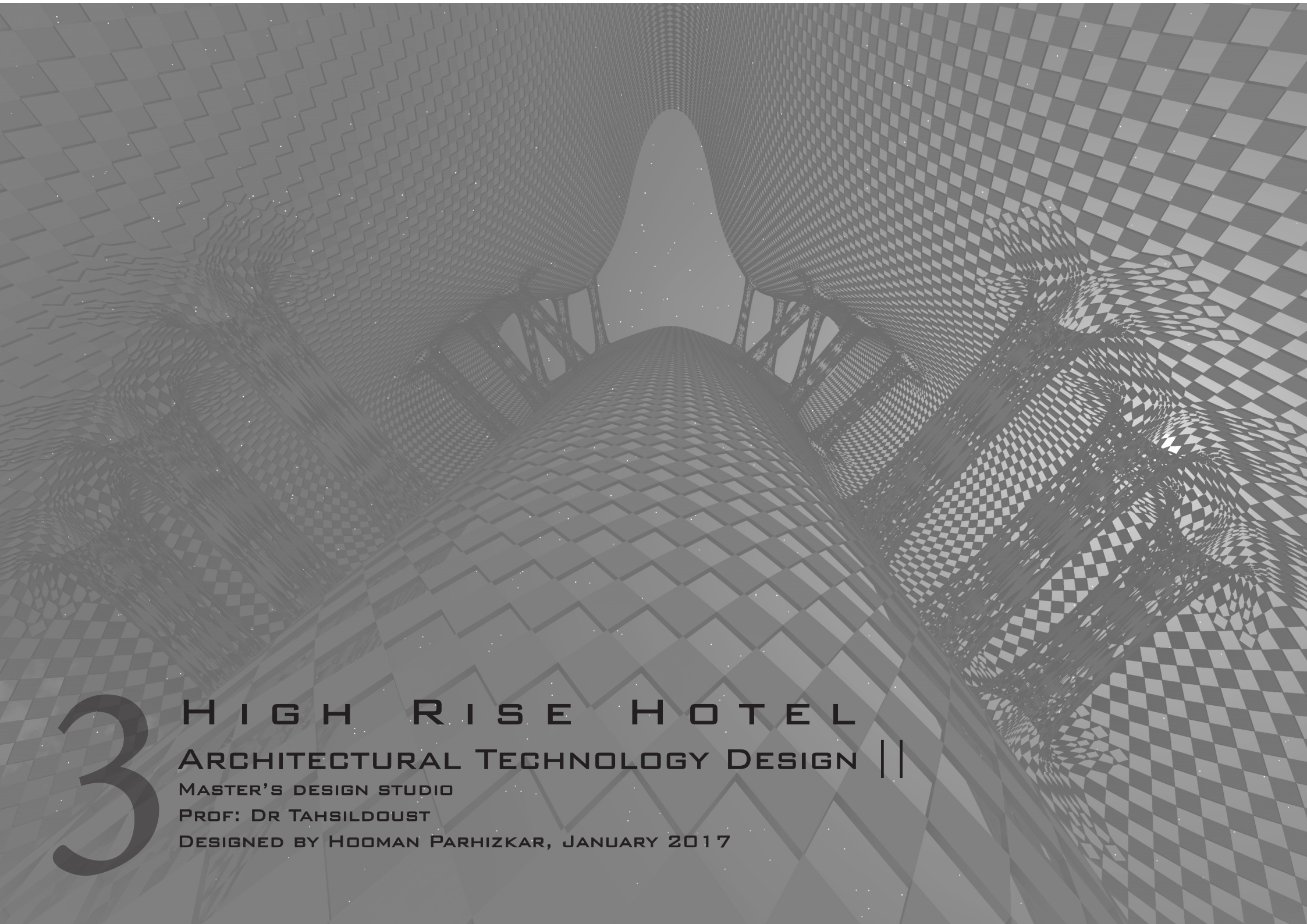


Before importing the model in grasshopper for additional analysis, we built an initial test model in order to check its performance in real situation



The grasshopper model which confirmed the idea's performance





3 High Rise Hotel

Architectural Technology Design ||

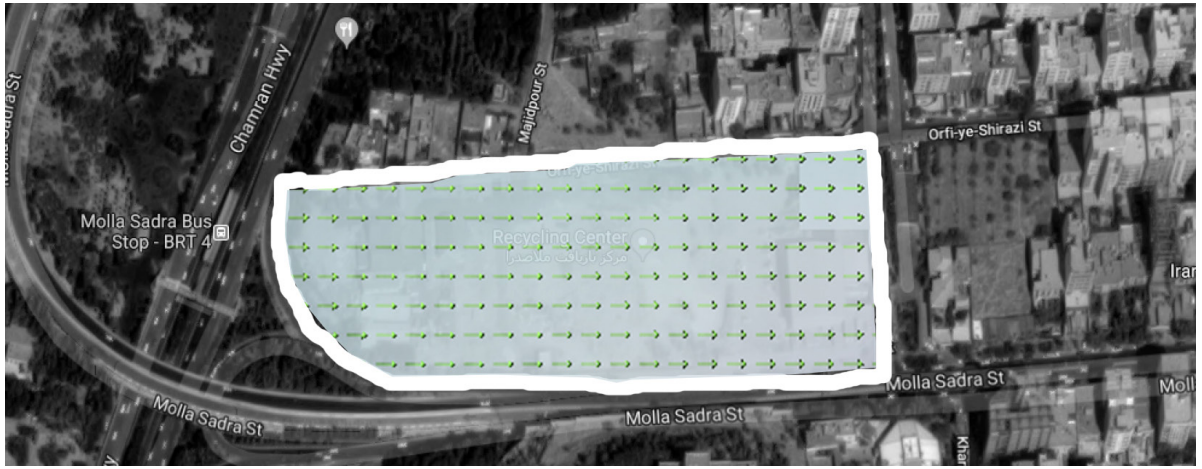
Master's design studio

Prof: Dr Tahsildoust

Designed by Hooman Parhizkar, January 2017

Design principles & attitudes

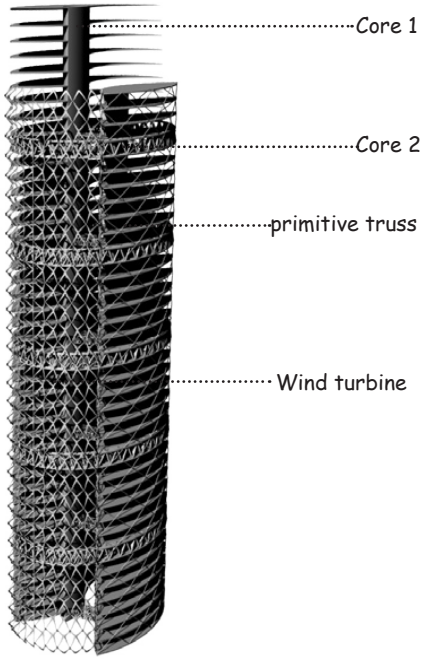
The design subject was the "48 story high rise tower" to provide Tehran's international hotel as well as facilities for the primary concept of the design was to hold up international conference, restaurants and wedding ceremony halls. We also had been encouraged to follow up a sustainable approach in which the tower could possibly provide part of its energy demand by natural sources. The site is located in of the wealthiest regions of Tehran in which its location afford an appropriate possibility for the design, to become "the city sign". As long as we were about to adopt various codes in the term of "tower design" such as fire, vertical circulation and hotel specific requirements, we were also obligated to take those fundamental codes in our design procedure. The primary concept of the design was the application of the most natural source, wind, to produce some part of the tower's energy consumption. Decision was based on the local environment condition in which it possessed potent wind flow around the site adjacency, hence, the site was extended in east- west axis in which we had the most flow velocity. In addition to the sites dimensions, it is the truism to say that by increasing in height, we could obtain more wind velocity which was one another possibility that the high rise tower provided. There were free forms development toward the wind direction accompanying wind flow analysis to declare the most efficient form for further developments:

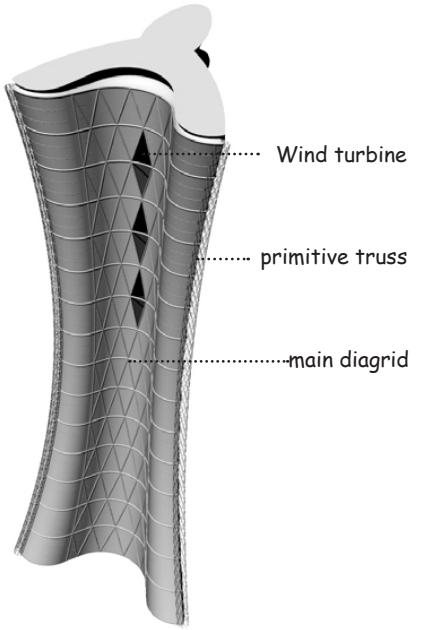


The site location and the wind direction in which specifies the main velocity direction

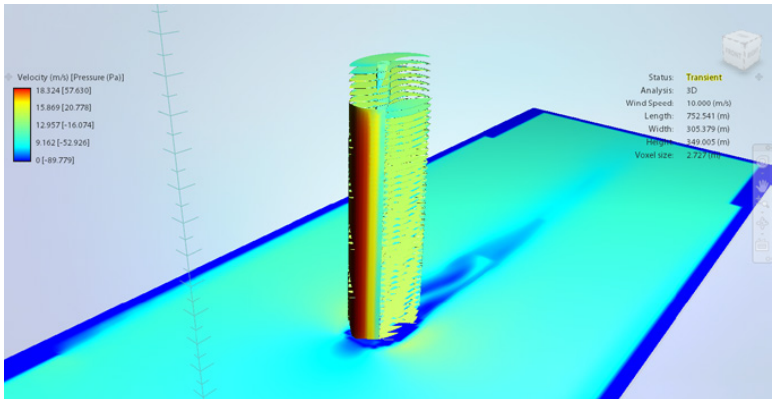
I started to practice some aerodynamic forms in which the tower's main façade faces the west- As the main wind direction is on east-west axis, simultaneously providing different hollow forms to provide the needed space to accommodate wind turbines.

Wind Simulation & Developments

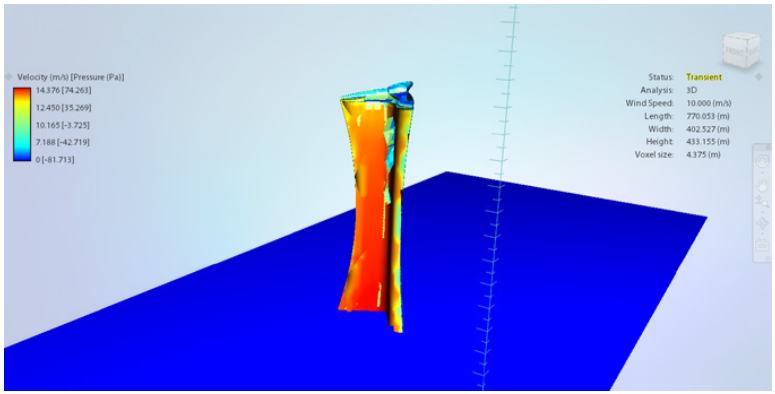




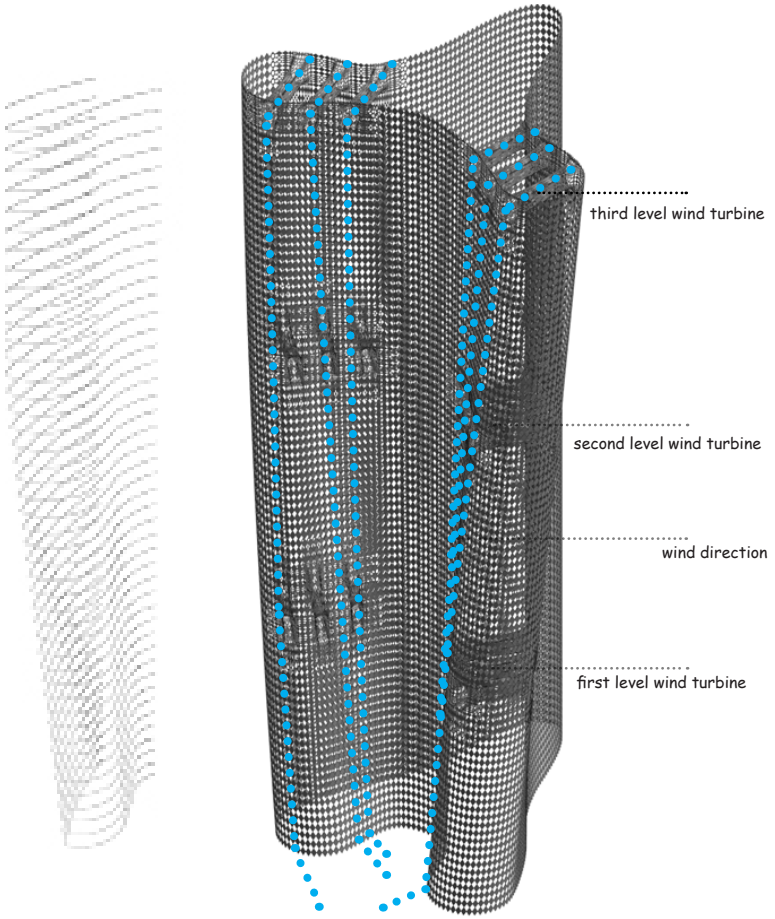
The basic purpose of this approach was to evaluate two primitive category of forms facing the west façade in which we had the most velocity intensity; Concave forms and Convex. Two different forms which represent the two concepts were modeled in rhino + grasshopper and had been put under wind tunnel experiment to estimate their relevant west façade wind velocity in which we aimed to design the wind turbines. Results demonstrated that the concave had more velocity around its surface and the approach chose to be followed in further developments.



Analysis of the convex form in wind tunnel and its relevant velocity index on west façade



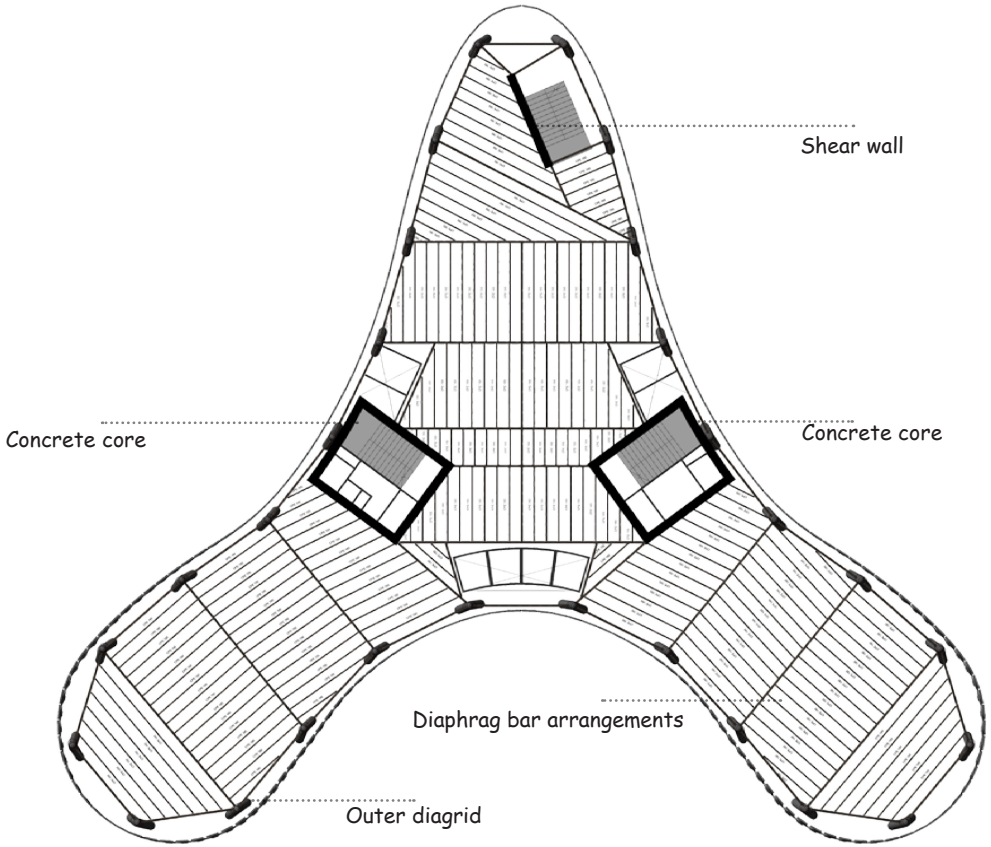
Analysis of the concave form in wind tunnel and its relevant velocity index on west façade



The solution to absorb more velocity to the turbine tunnels was to open up more space by the form procedure. As the height increases, the floor slabs as well as the elevation extended in width, allowing much velocity to enter the

Structure design

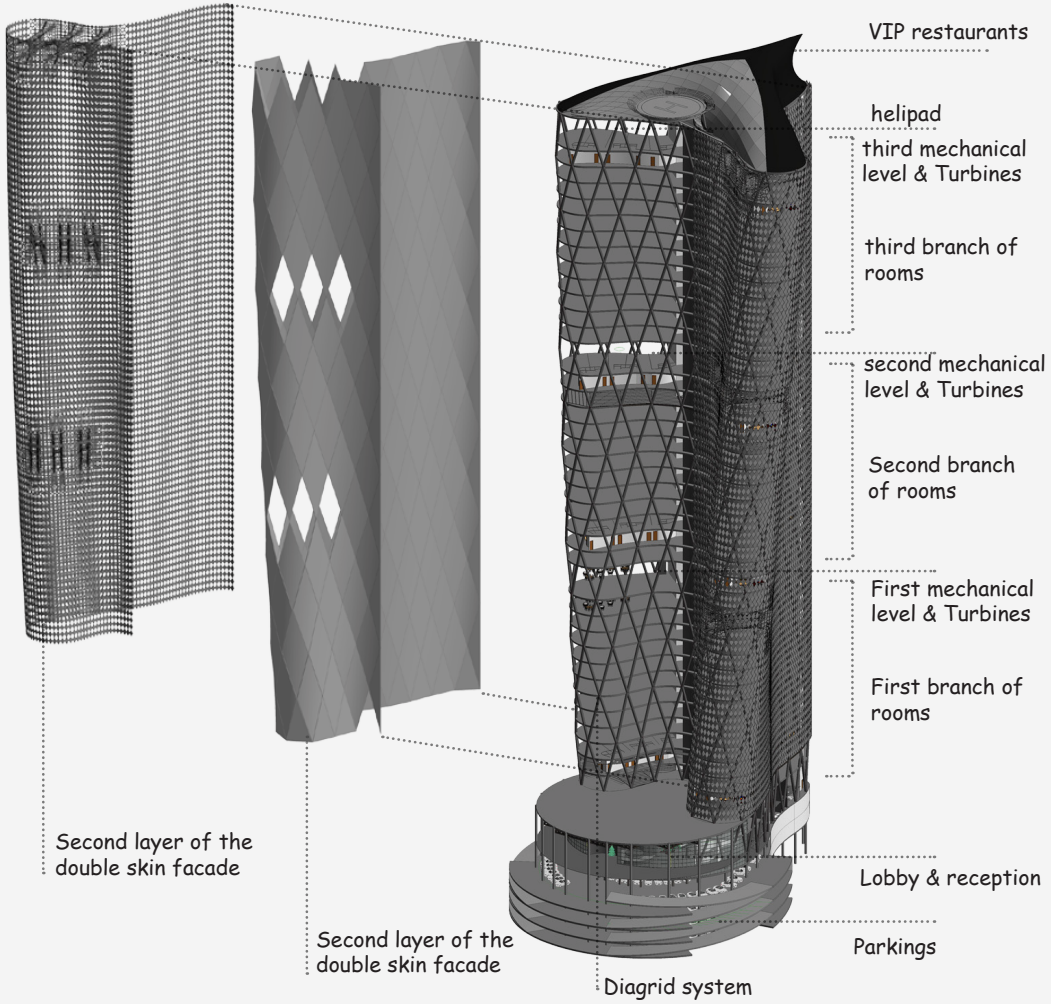
The main structure is formed by 3 main parts: 1- primary concrete cores, 2- primitive diagrid core,3- concrete slabs as the diaphragms as well as a concrete shear wall at the bottom of the form. The diagrid were about to contribute in horizontal and vertical loads either, however, concrete cores must strengthen the unity of the structure by connecting the concrete slabs as the diaphragms to the diagrid structure.



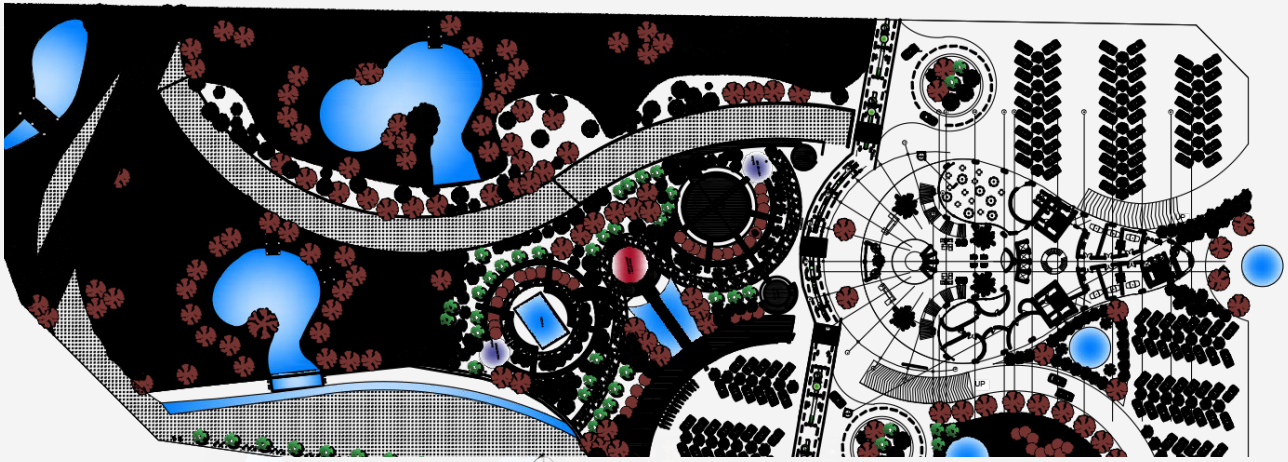
27 th floor structural plan

Configuration

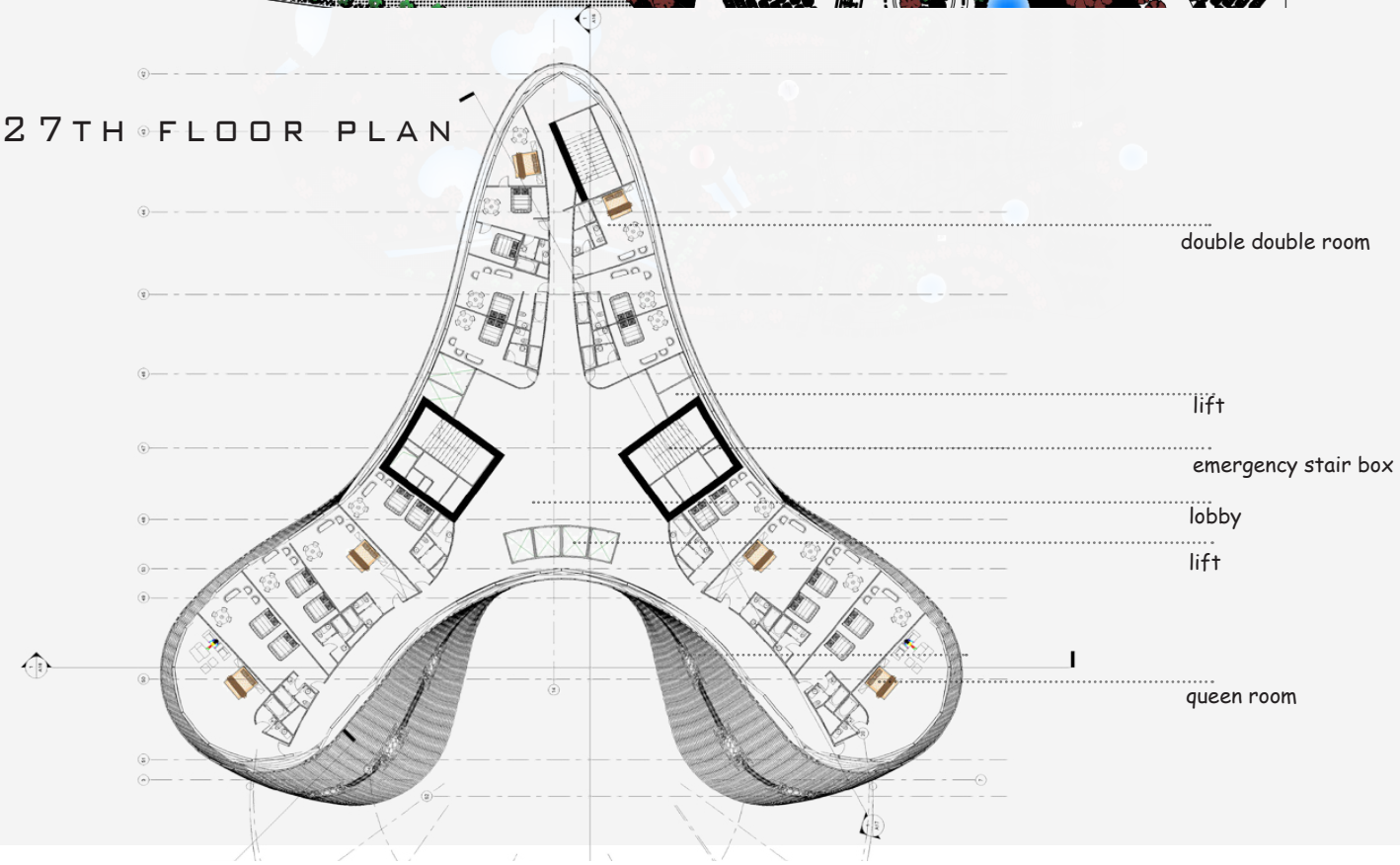
The façade consists of a double skin façade with the diagrid which is expose and has lightening features. 3 mechanical floors in which the wind turbines are installed as well, is shown below. The first layer of the double skin façade is covering indoor spaces, while the second layer is designed to shape the wind tunnels as well as natural ventilation for indoor spaces.



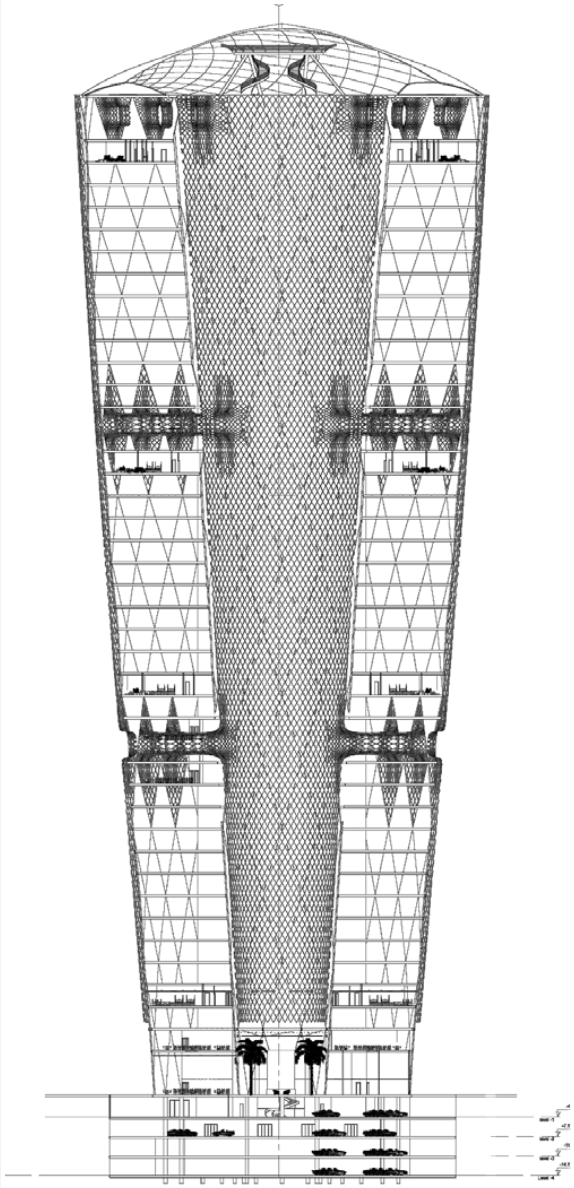
SITE PLAN



27TH FLOOR PLAN

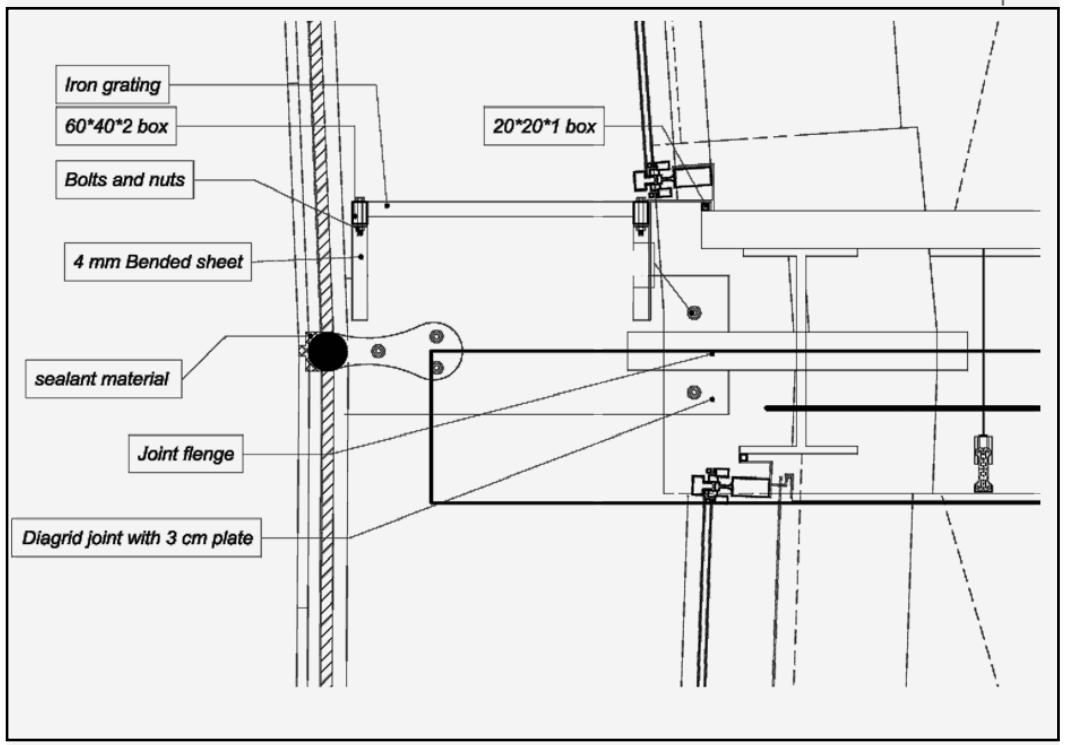


SECTION

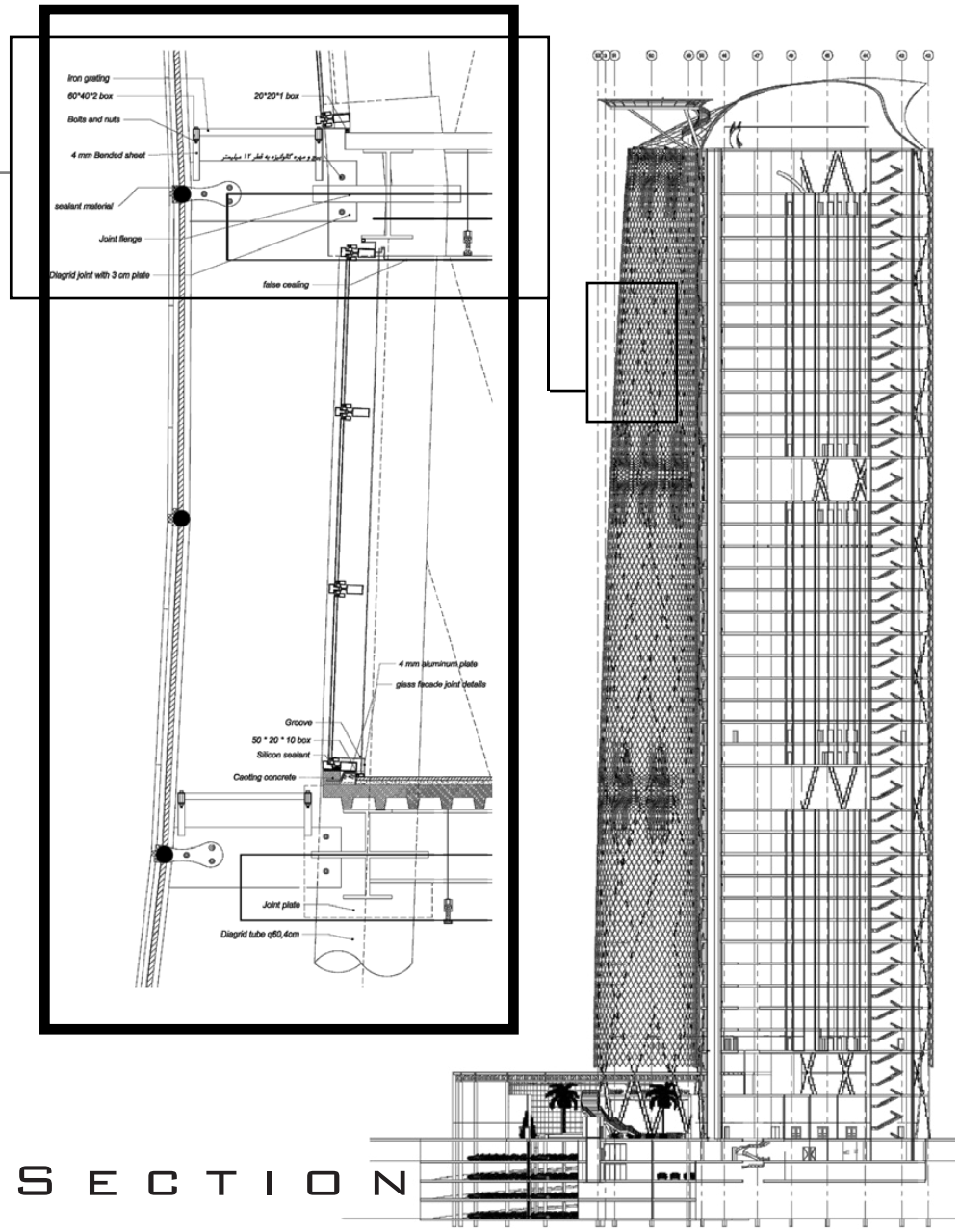


Detail

There are 3 main elements facing outer building's layout; the diagrid, Inner layer of the double skin façade and the outer one. The inner layer of the double skin façade is the designed to avoid heat loss with outside, simultaneously operate as operable windows to let the indoor spaces be ventilated by the cavity's moving air. The second layer is attached to the building by its special details and it was aimed to control air flow via wind tunnels. This is one of the designed wall section



Wall section



Section

4 TERRACOTTA PAVION

New technologies and material science

Master's design science course

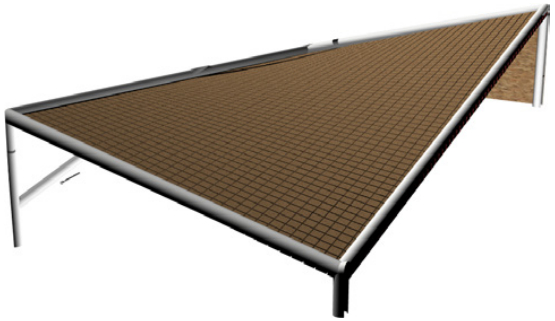
Prof: Dr. Afghani Khoraskani

Designed by Group teamwork, December, 2015

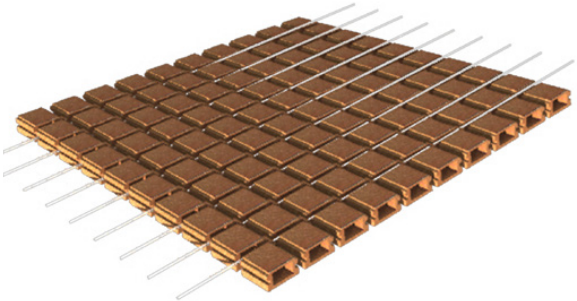
Note: This cover photo has been taken from ETH University fabrication Lab website
Photo by : Alessandra Bello

From Concept to Design

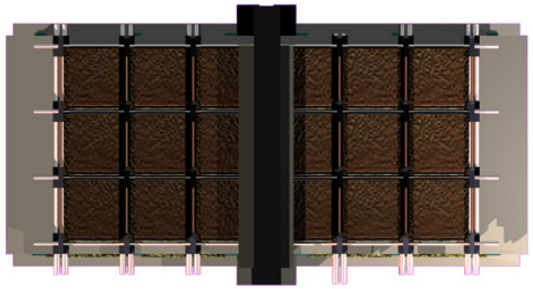
Following one of the obligatory courses in the master of architectural technology, my colleague and I decided to define this project for our "new technologies and materials of construction" course. It is an approach in which we practiced an avenue to develop "Terracotta" in a new construction method. For many years, brick masonries have established the primary architectural fabric of Iran, however, it has some restriction which does not allow it to be used in new constructions such as high rise buildings. These constraint mainly address the "brick" way of installation in which there is a high level of separation occurrence between the brick and its relevant mortar. This issue, has also been an obstacle to application of brick in such tall towers, not only the connection of material and the main structure is weak, but also, its heavy weight could not satisfy the national seismic codes. This statement – we must preserve our architectural fabric in current built environment – made us to develop the brick elevation, in a particular new method; "Installing them without any mortar"! This project aimed to install one of the specific forms of bricks, terracotta, in an arid avenue in two separated parts: 1- To use it as an elevation envelope in which terracotta would move back and forth in order to depict a specific shape 2- as the hyperbolic roof, covering a span. There had been structural and thermal analyses for either parts, which would be concisely mentioned further.



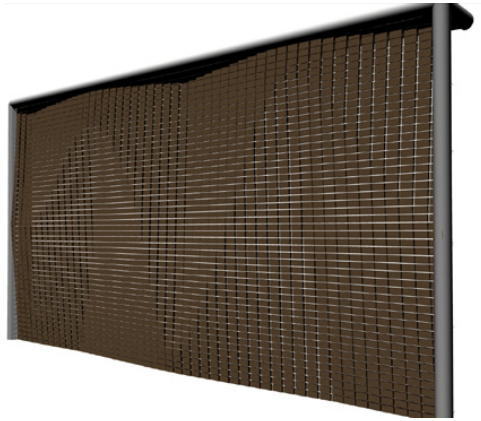
The roof was assumed to be hyperbolic shape in which bricks were about to cover the space. Thus a mechanism that its main target was to "use of cables to save the bricks". Therefore we decided to design its specific terracotta module in which the cable could be adjusted to terracotta bricks detail



This shape demonstrate the concept of terracotta and cables



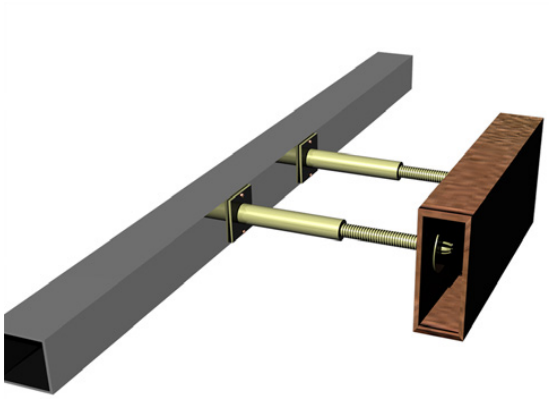
Terracotta panels' weight was departed into two different bearing system: the cable and the beams (expanded details will be presented soon)



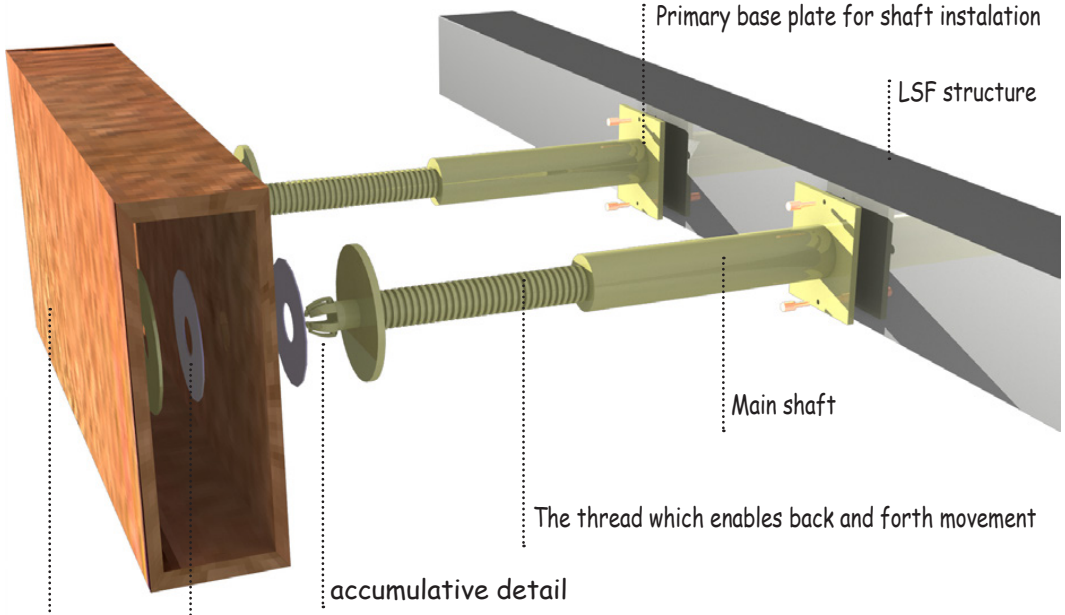
Before importing the model in grasshopper for additional analysis, we built an initial te The façade concept was about to depict a specific form by terracotta movement to back and forth. Its shape could be modeled in grasshopper, even shaping an actual picture (though in in this case we used the "focal curve" in which bricks became denser as they approached the curve and by contrast, became dispersed by as they got far from the curve st model in order to check its performance in real situation

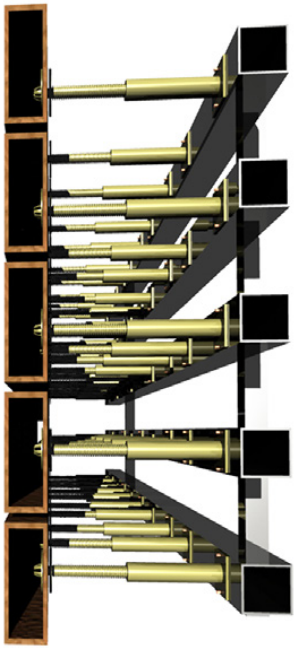
Terracotta panels were attached to a LSF aluminum web in which shaped the main holding structures (expanded details will be presented soon)

TERRACOTTA ARID FACADE

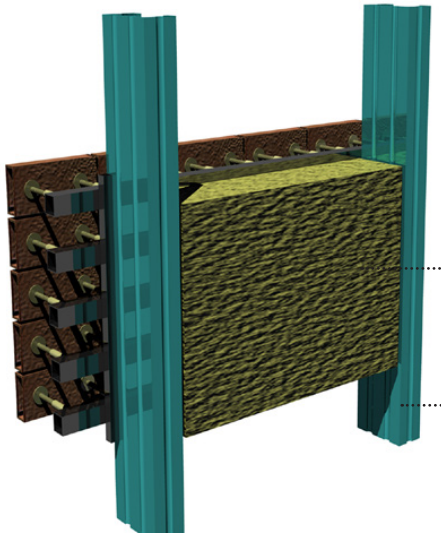


There were two pipe-shaped compacted plastic holder for each terracotta. Each panel needs two hollows in either of its sides to make the connection happen. Their connection to LSF structure is provided by bolts and nuts to facilitate the work at in-place installation.

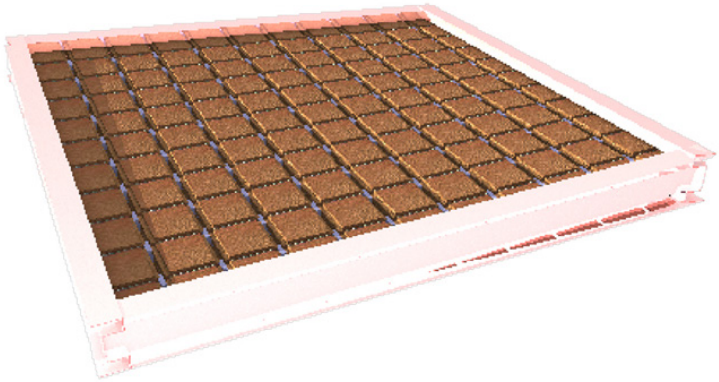




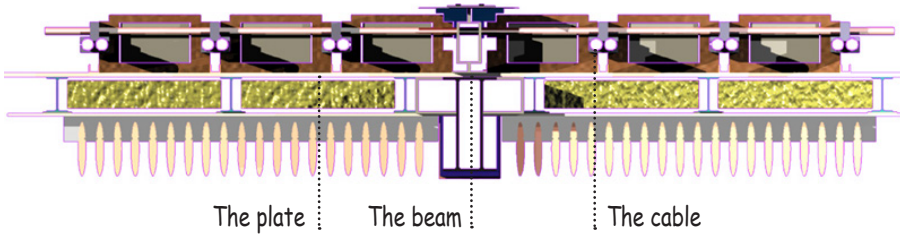
The accumulative detail is designed to enable the push-fit installation of terracotta panels which precipitate the construction speed, thus, avoiding probable damages to terracotta panels. Before the panels are installed, the appropriate length of the panel is adjusted by drills and eventually, the terracotta will be installed.



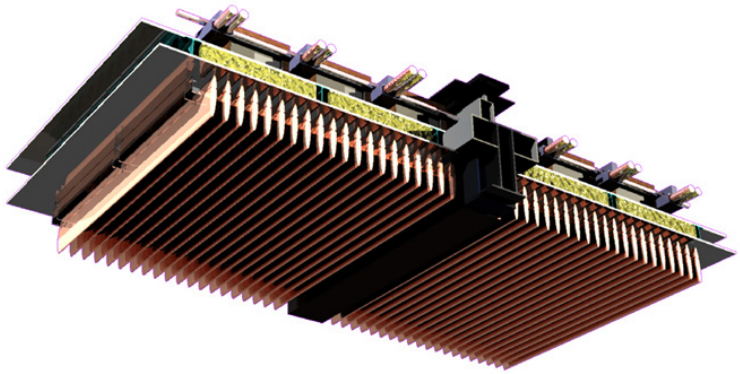
TERRACOTTA HYPERBOLIC ROOF

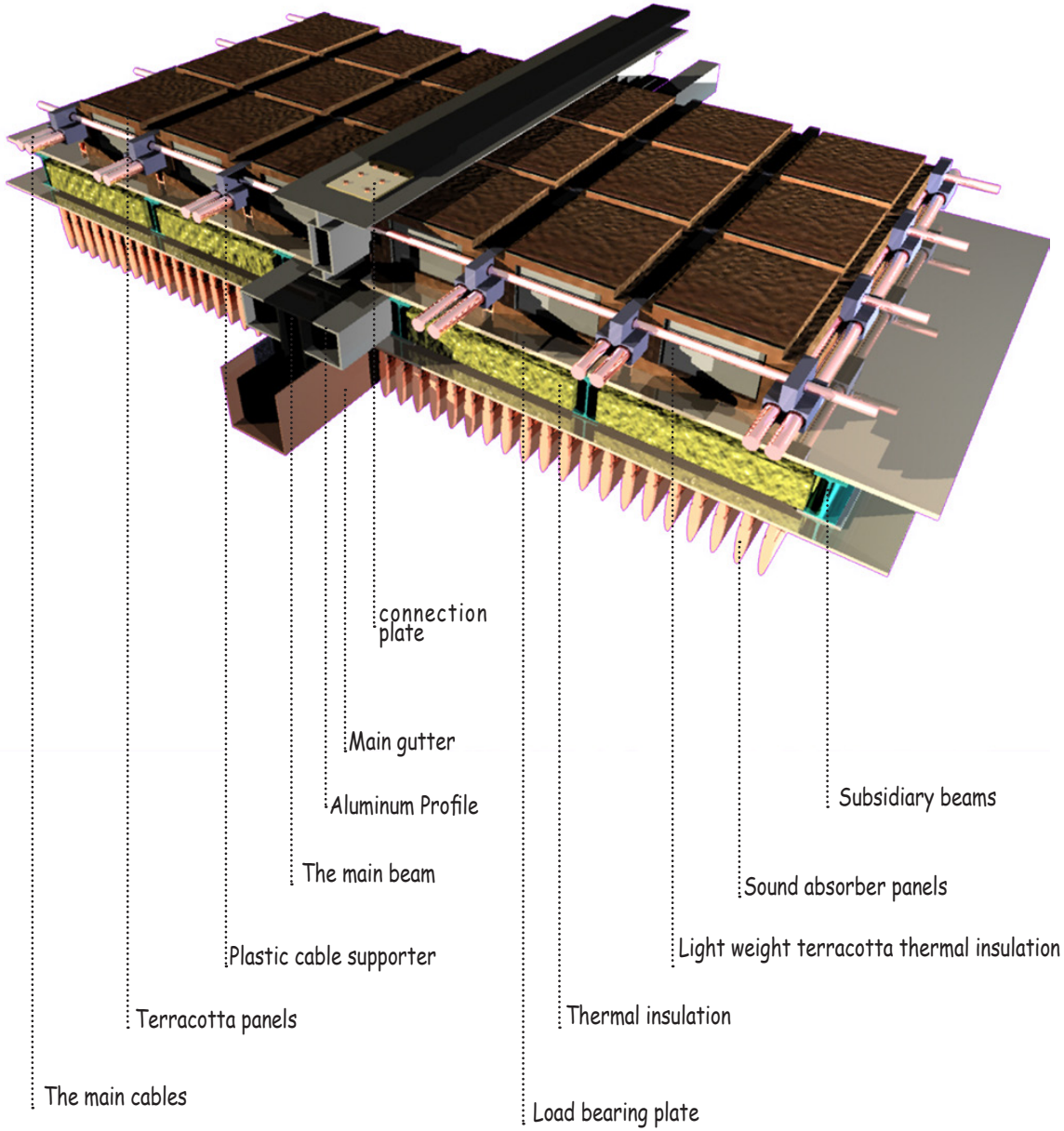


In order to cover the roof surface, we designed a particular terracotta panel in which cable and its elaborate details could serve as the bearing system



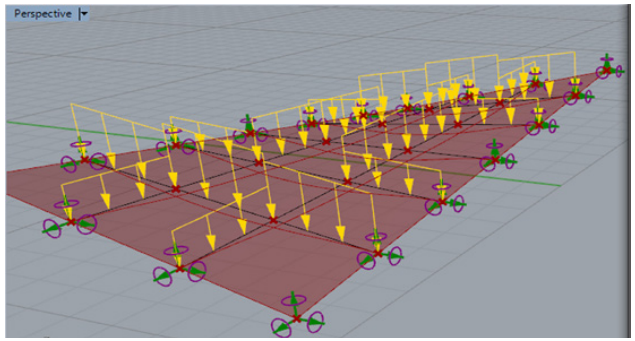
Moreover, a metal plates contributes the load bearing procedure by transferring additional loads to the main beams. This will ascertain the structure's properly performance, with a close cooperation between the cable system and the plate-beam system



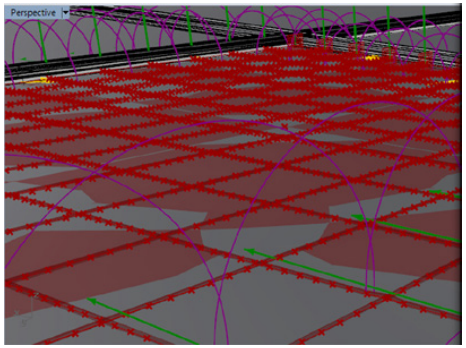


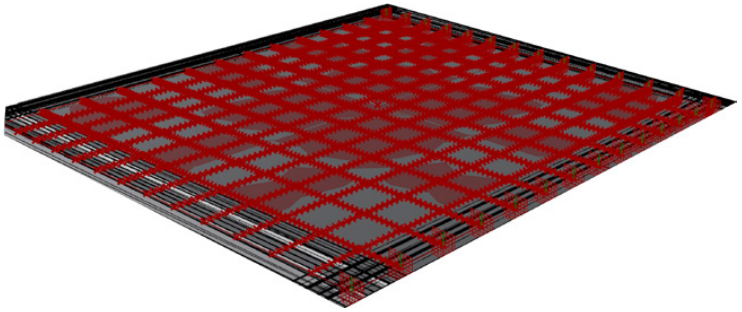
Structural & Thermal Analyses

In order to evaluate the system's structural behavior, we built a grasshopper model in which the analyses took place in Karamba (structural analyzer). The procedure was in two main phases:
1 – The analysis of the cables and 2- the plate load bearing analyze part



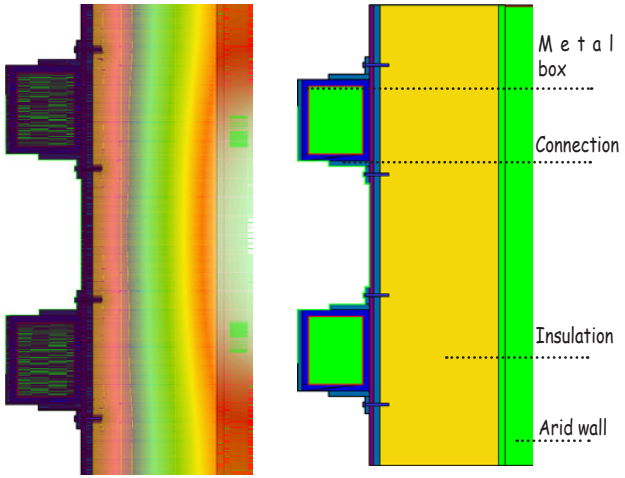
These pictures depict the steel web analyses done by karamba, in which every single beam modeled and its shape deformation calculated and then compared to national code in order to testify the estimated steel box sizes



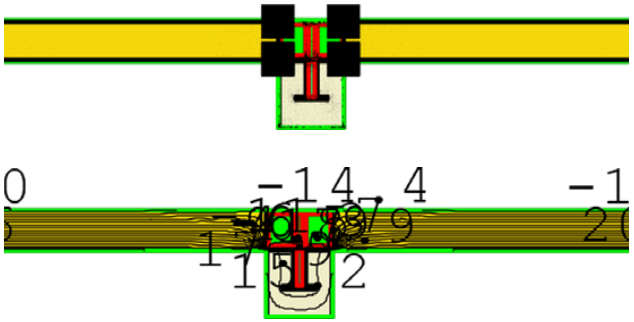


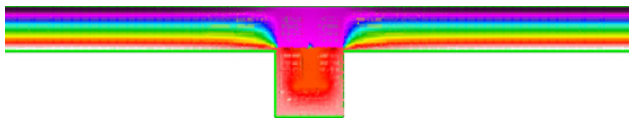
The second phase was to calculate the cables, by increasing the iteration of a single beam in Karamba in order to create a cable in that plug in. Therefore, the cable web was simulated and its largest deformation compared to national code for design of cable structures

Moreover, we analyzed the thermal behavior of the either systems to evaluate their energy loss by simulating in THERM, here are some concise depiction



The heat loss is shown in the left side pictiure in which heat transfer bridges are obvious too





5

Residental complex

Design 5 studio

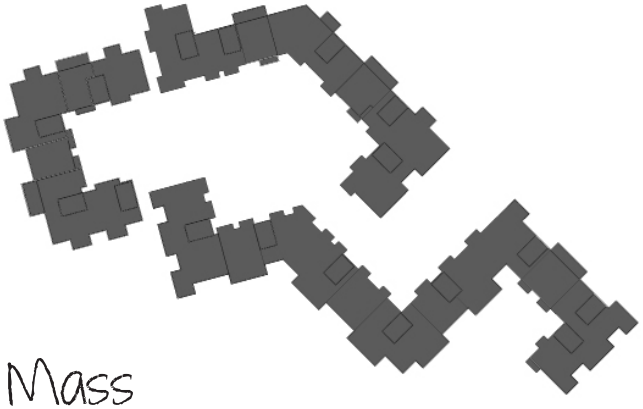
Undergraduate design studio course

Prof: Eng. Taleii

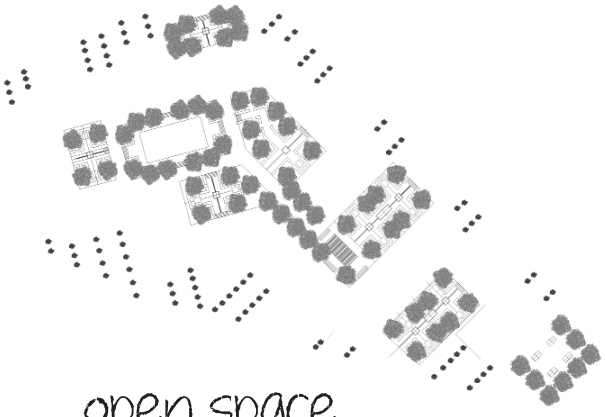
Individual design, May 2015

Site

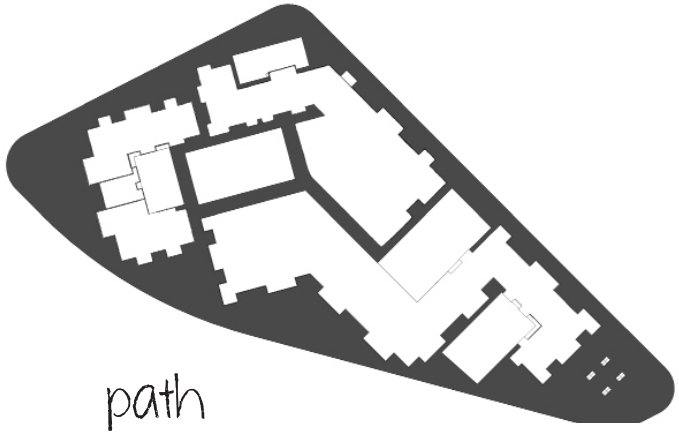
The site is located in Kashan, a city in the middle of a desert in which ones can find many magnificent pieces of architecture which completely adopt the geographical and cultural conditions of the city. As it is shown in the map, the site is near the main highway of Kashan - Isfahan and in the neighboring of Mehr residential com-plex. The challenge was to design 80 residential unite in a site with an utterly ir-regular shape in a way that Kashani people feel themselves at home in every sense of the world. I tried to put into use the merits of Kashan archi-tecture such as central garden, modular arch forms and form of baadgir in order to make a sense of familiarity for the settlers and of course to take advantage of their function.



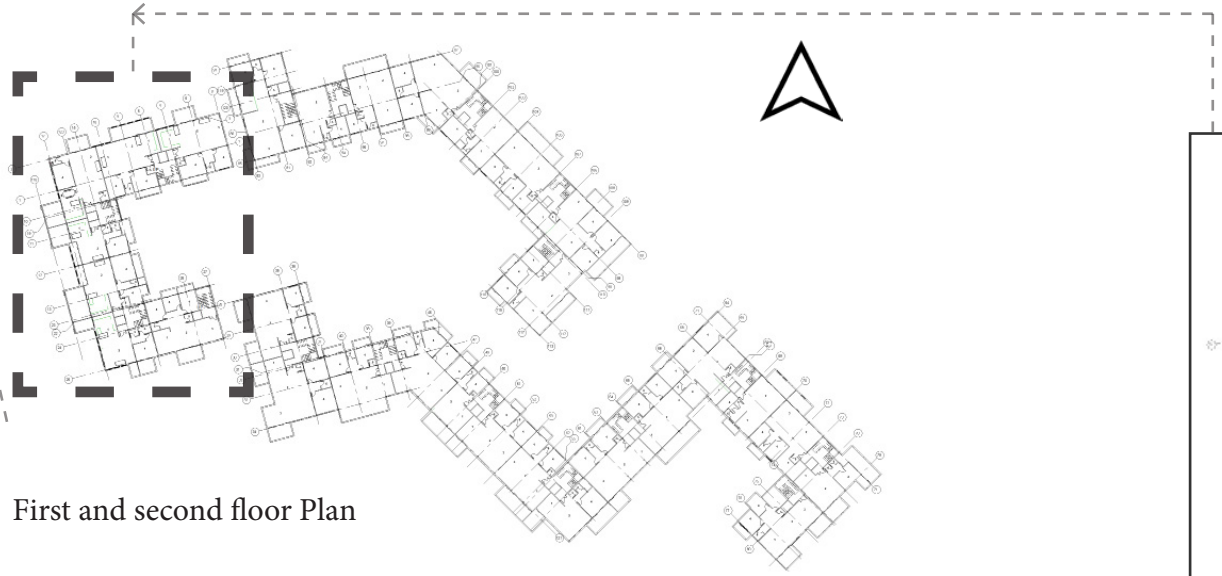
Mass



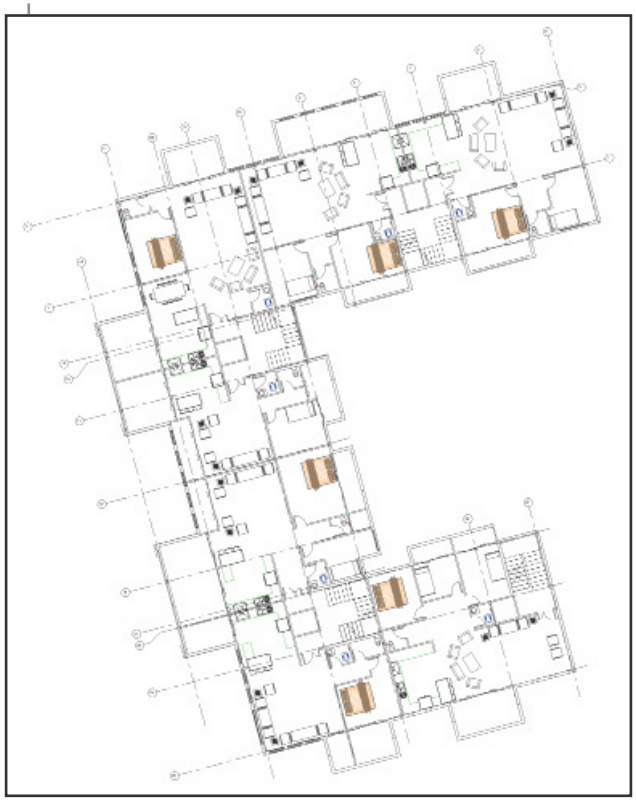
open space



path



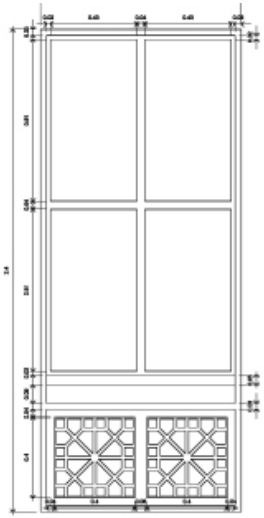
First and second floor Plan

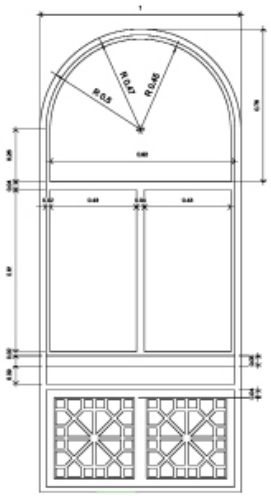


Magnified Plan

View

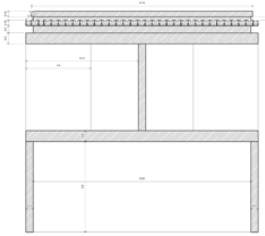
South Elevation



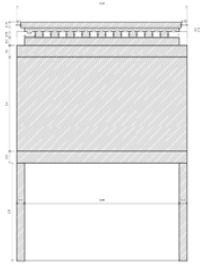


Pattern of windows

The mound
in the roof



Section of
the mound



Section of
the mound