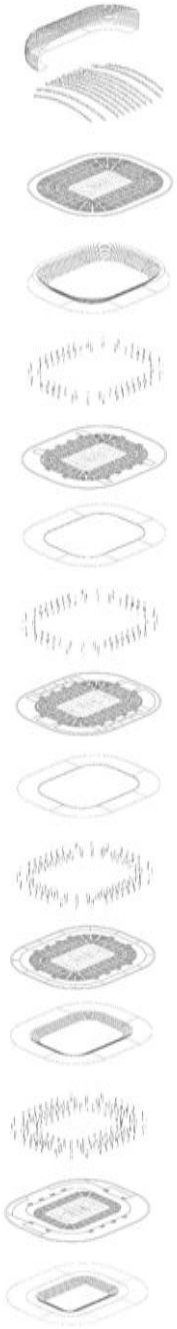
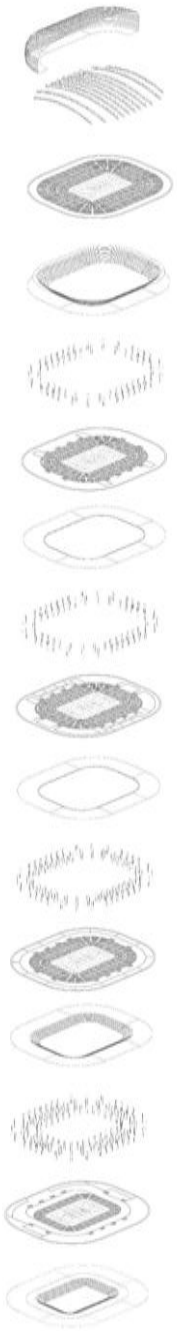


NEW UNITED CENTER ARENA

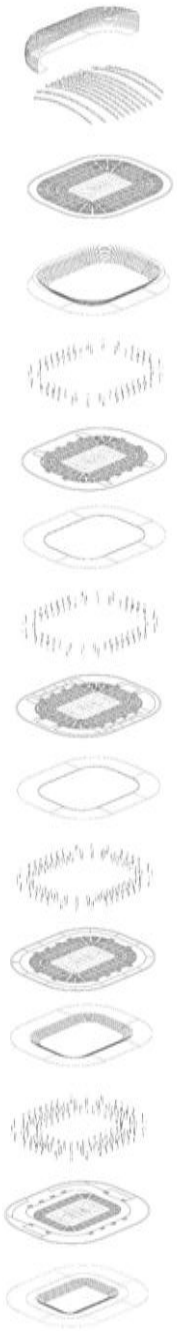
Capstone Design

CAPSTONE DESIGN. IPRO 335



Design

- New arena for hockey and basketball:
  - Structure
    - Sitting area
    - Arena
  - Parking
    - Underground
    - Above level
    - On the ground
  - M.E.P design
    - HVAC
    - Lighting
    - Acoustics



ARCHITECTURAL CONCEPT

- Indoor arena and Outdoor arena
  - Different activities can be performed in the different arenas. (Outdoor concerts in summer, Soccer games on the grass…)
  - Flexibility: area for other sports, exhibitions or any other activity in the future.
  - Permanent use of the building. Sport museum, conference rooms, games area as exhibition area…
  - Games grass area can be outside
- Improvement of the surroundings of the arena.
  - The arena is surrounded by gardens instead of concrete parking lots only used when there are games.
- Landscape + Parking
  - Improve the large area of parking around the United center and convert it into landscape parking design

First ideas

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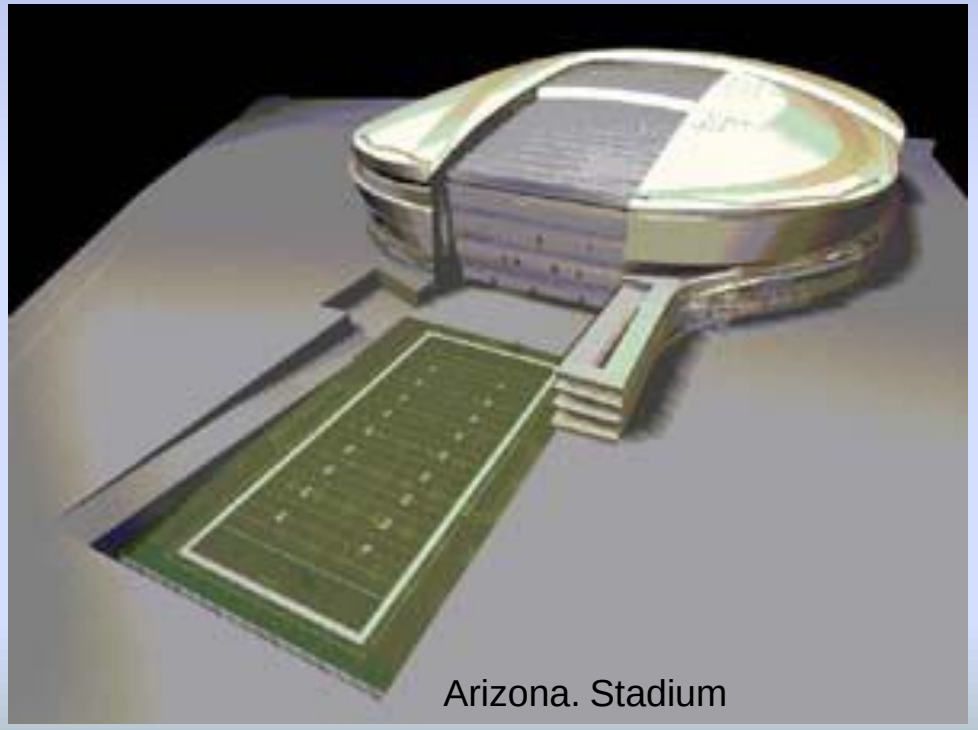
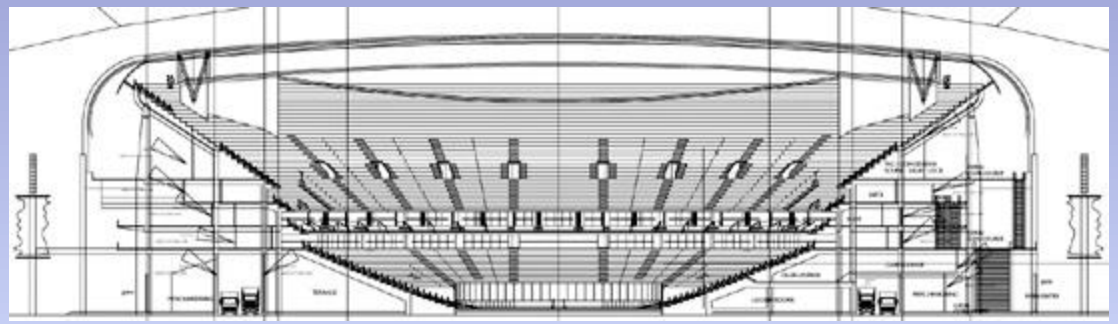
Munich. Soccer Stadium



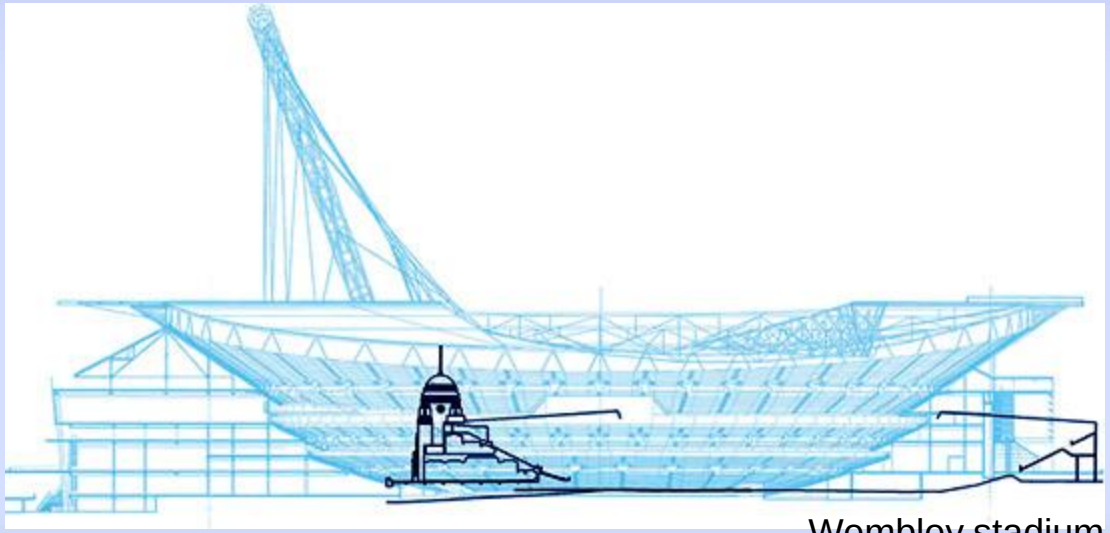
Arizona. Stadium

CAPSTONE DESIGN. IPRO 335

Other references: sections of stadiums

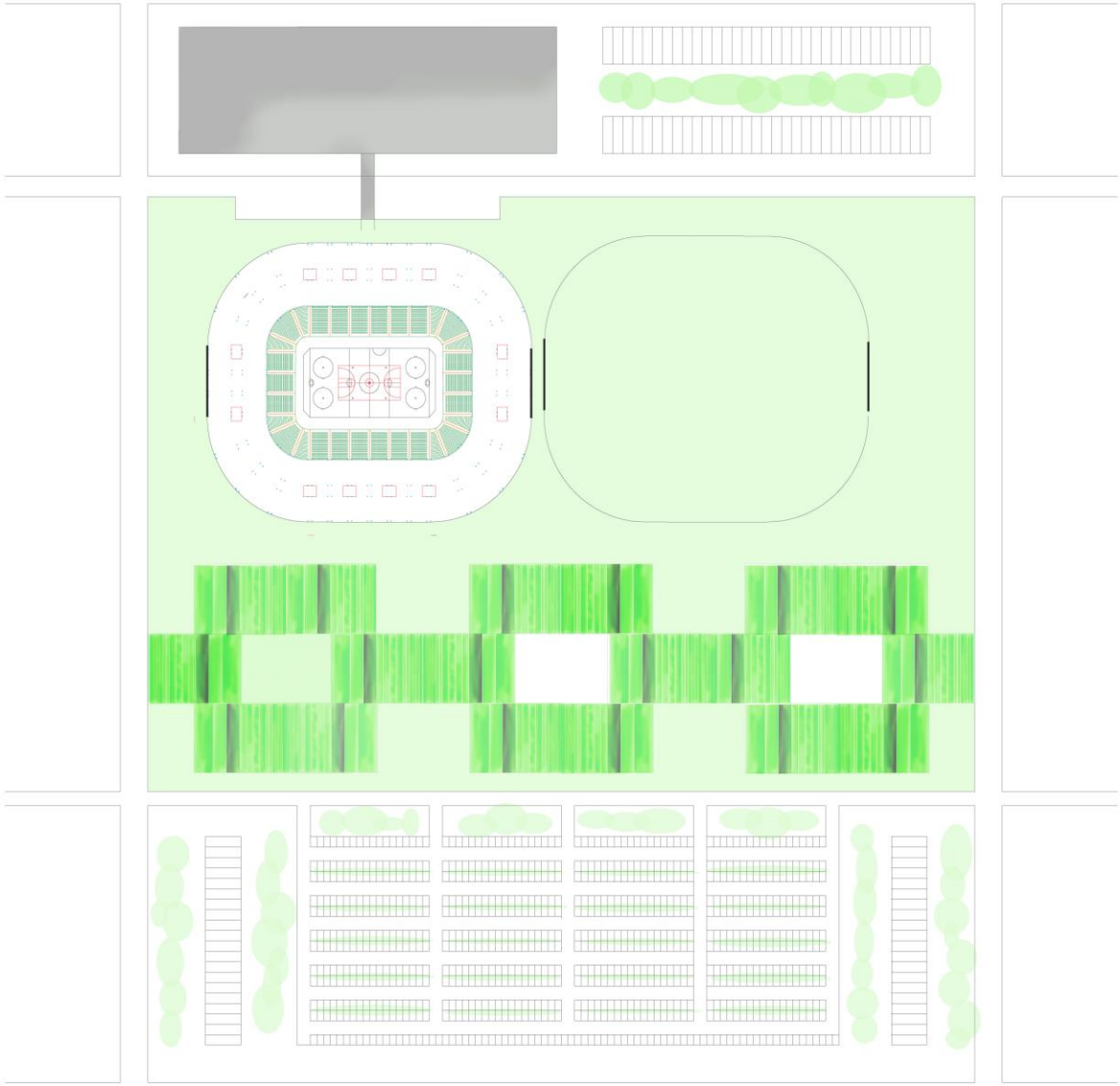


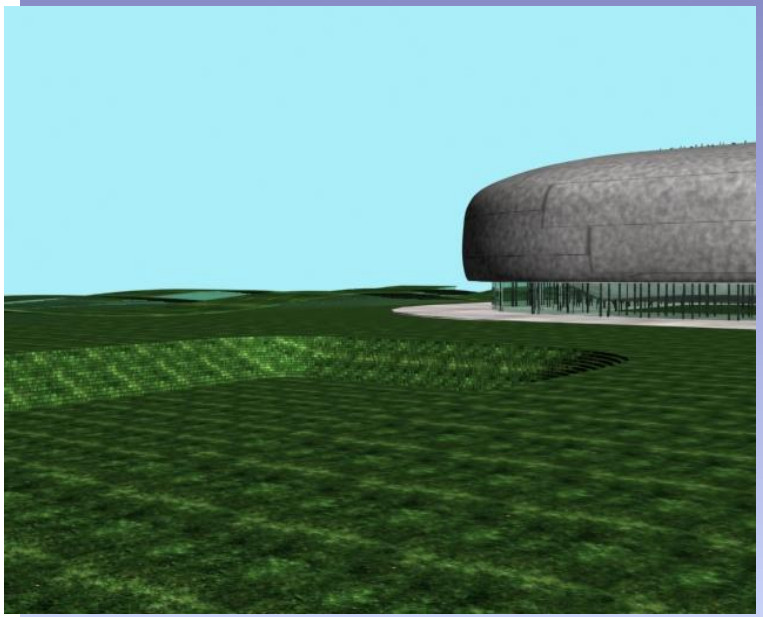
Millenium dome

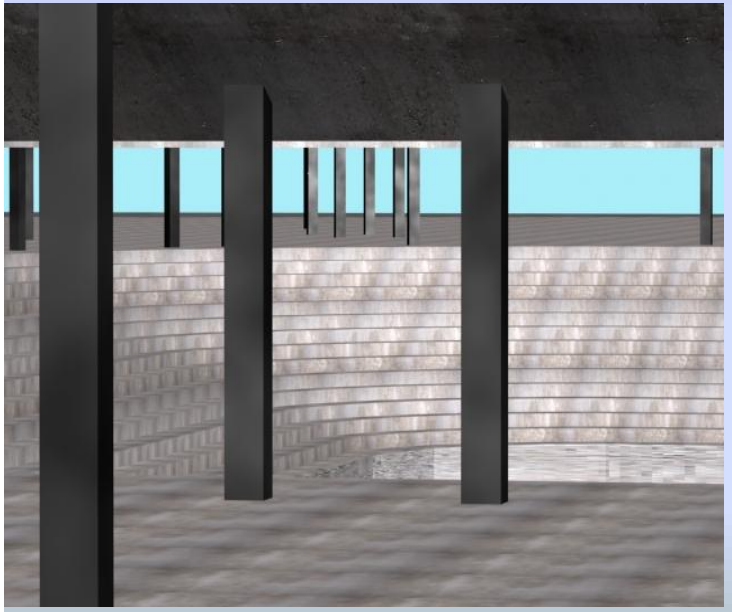


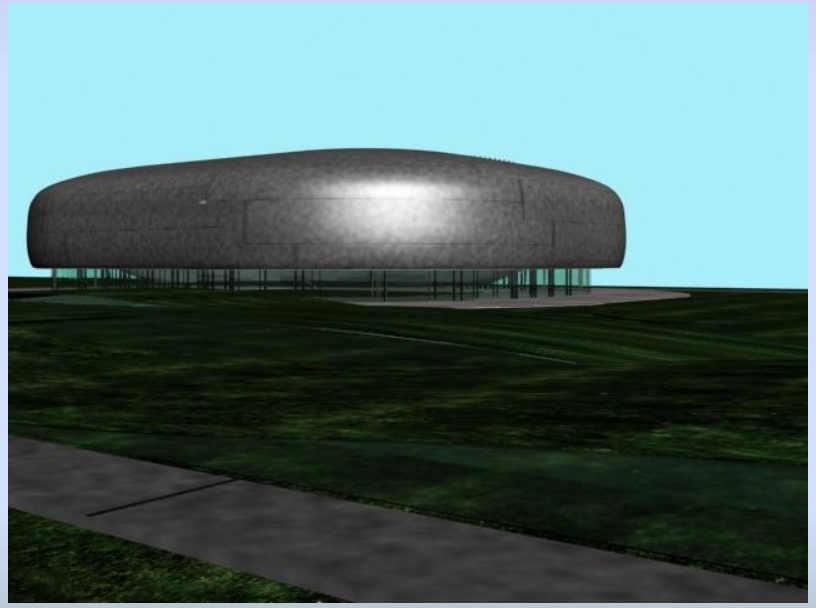
Wembley stadium

Arenas and parking layout

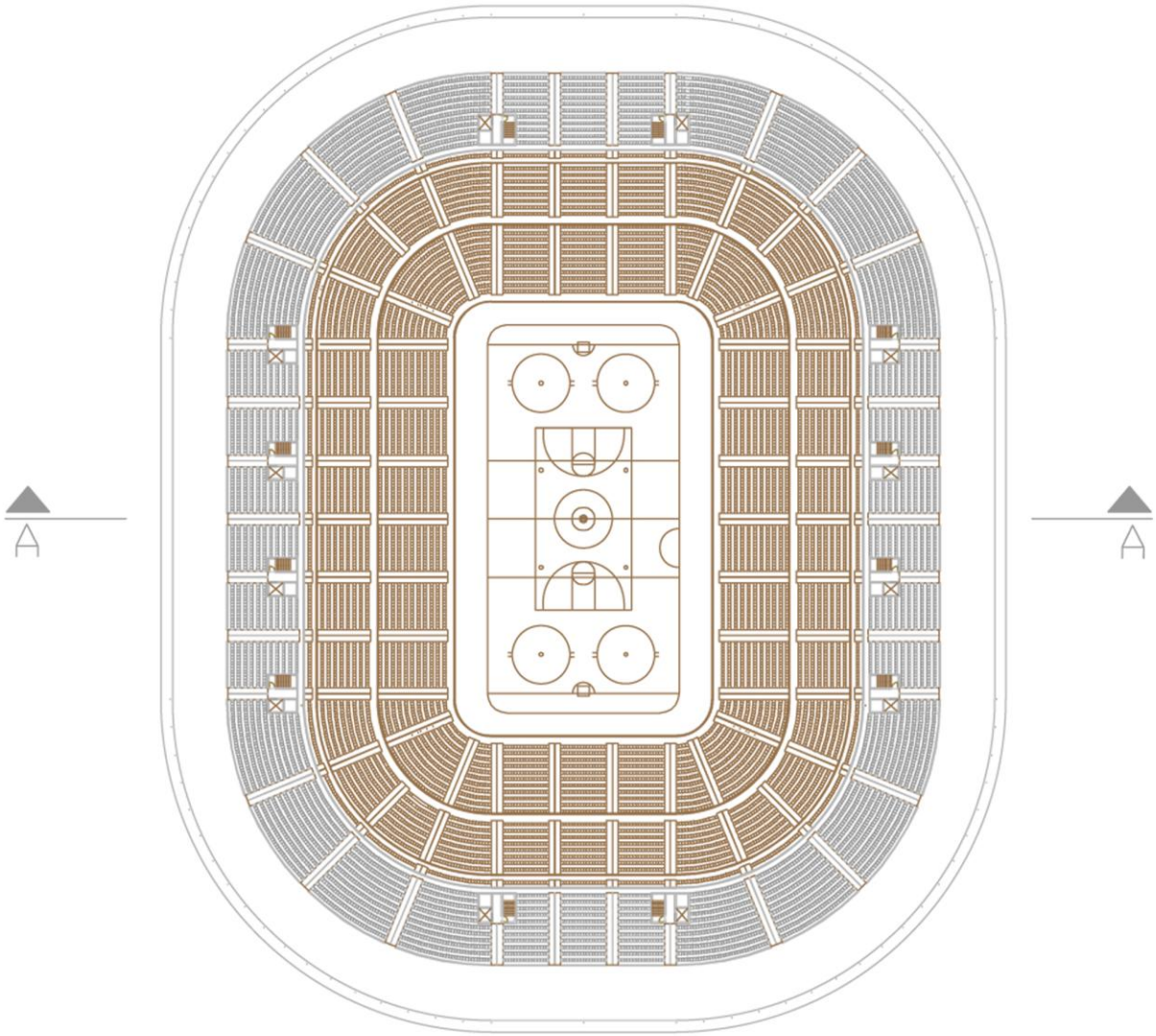






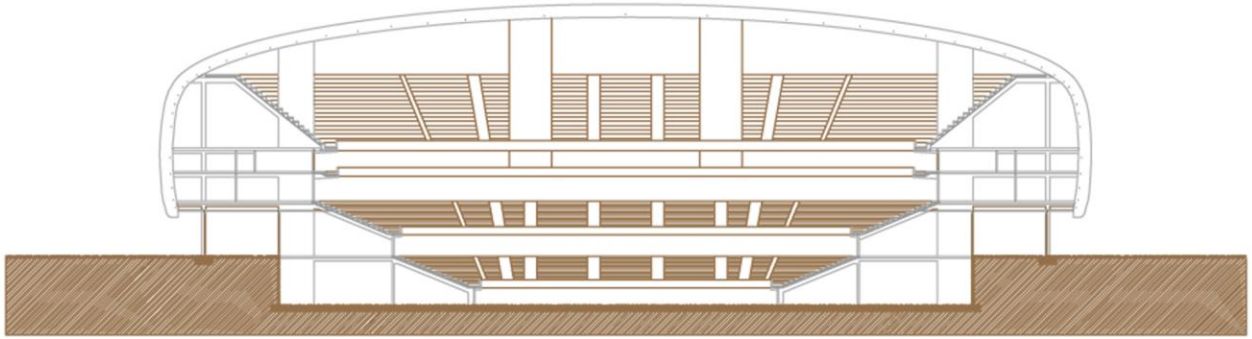


CAPSTONE DESIGN. IPRO 335



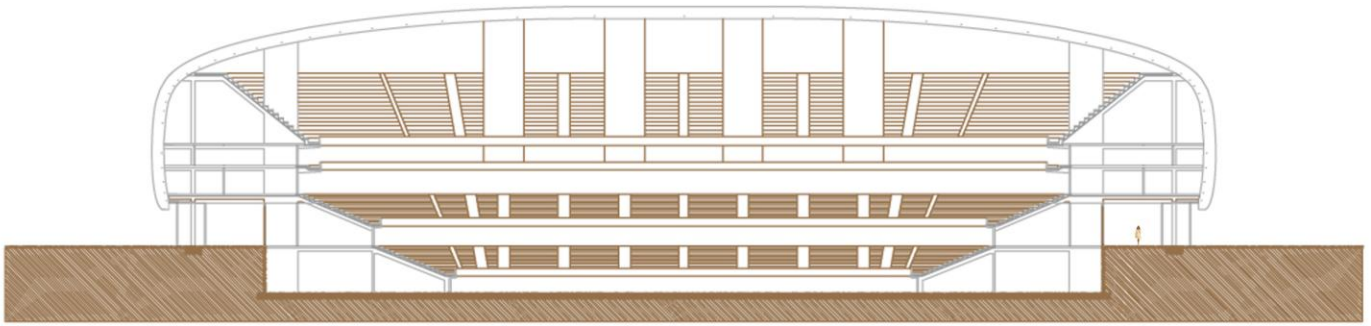
Floor plan

CAPSTONE DESIGN. IPRO 335



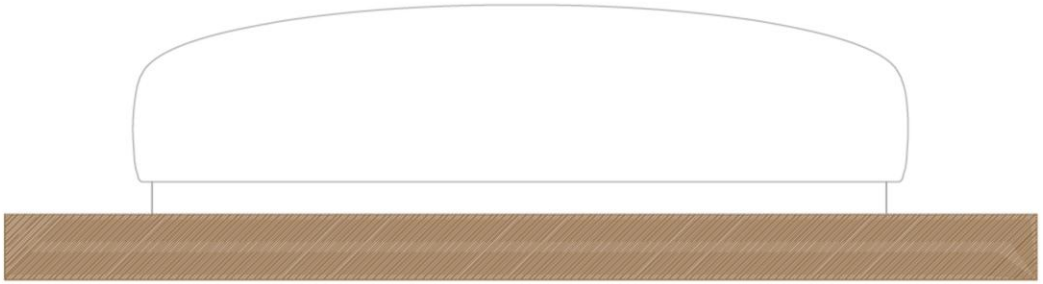
Section A-A

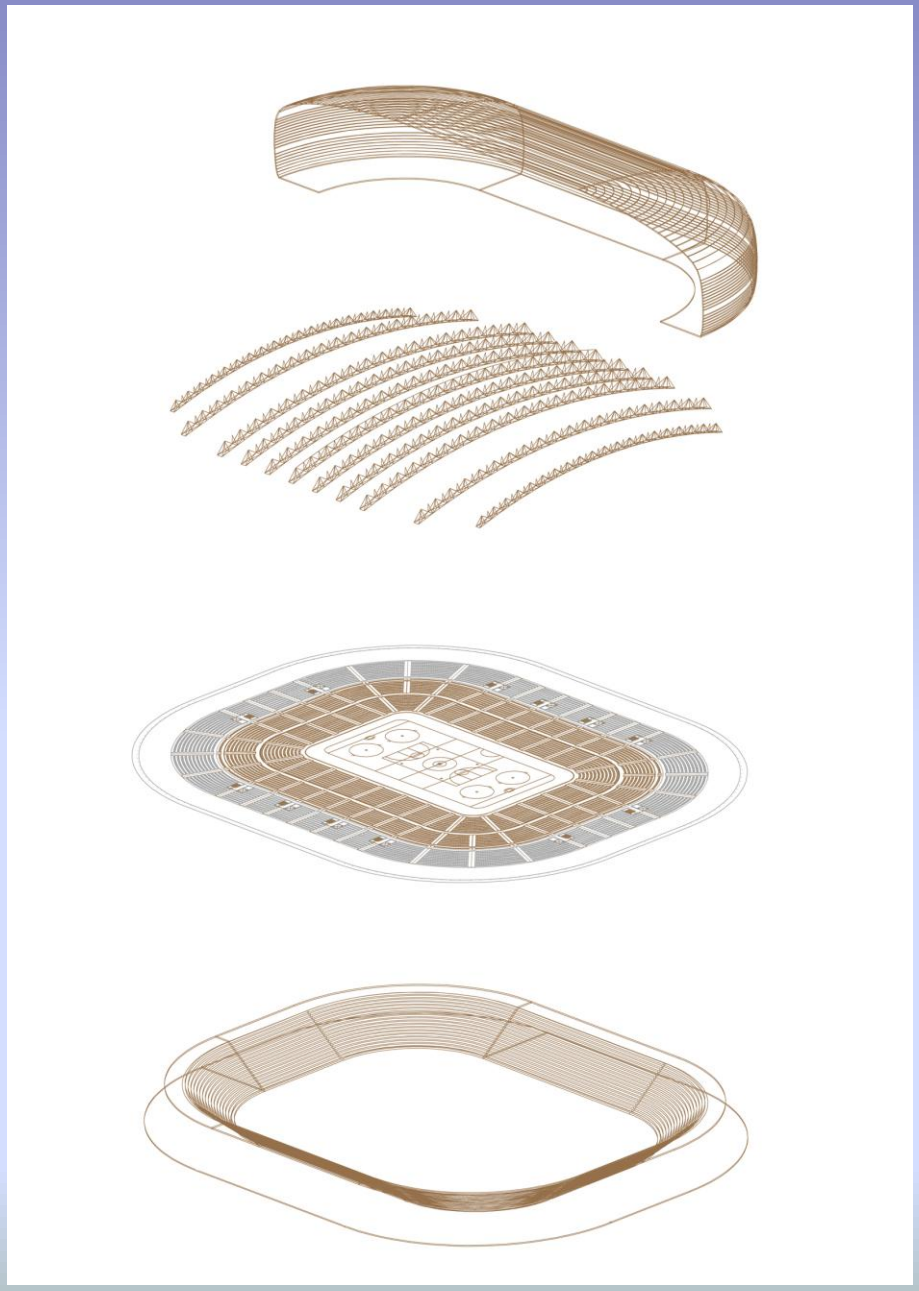
CAPSTONE DESIGN. IPRO 335



Section longitudinal

Facades: longitudinal and transversal





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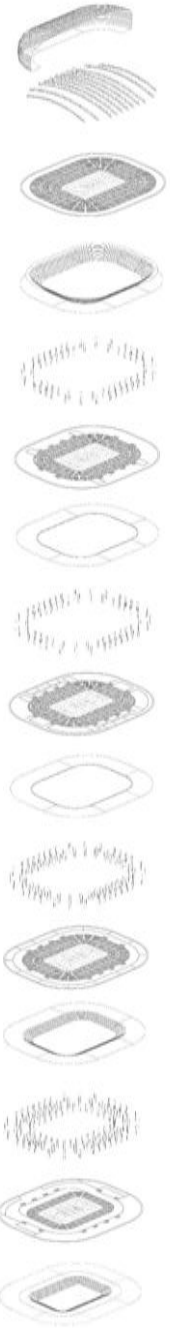

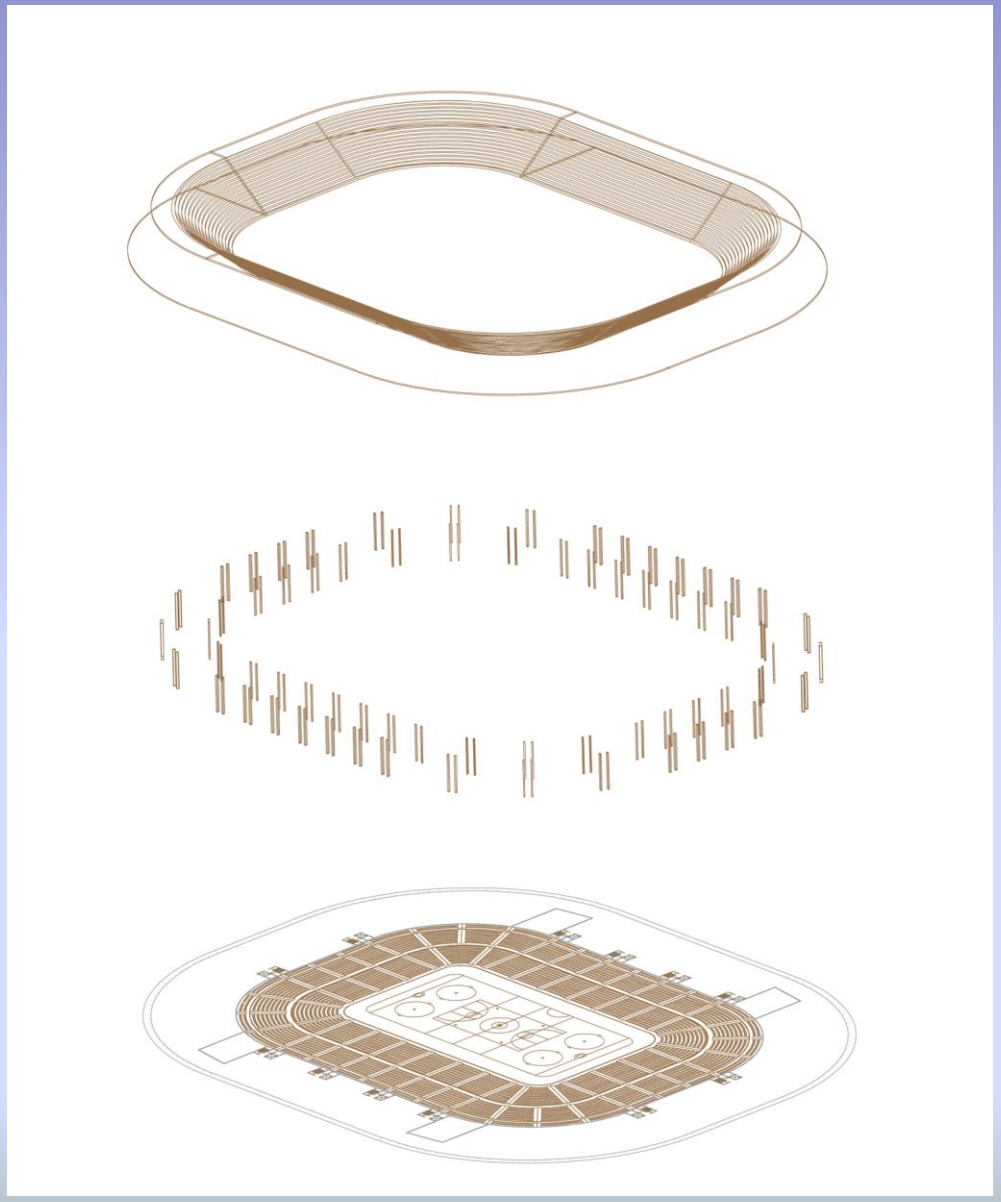

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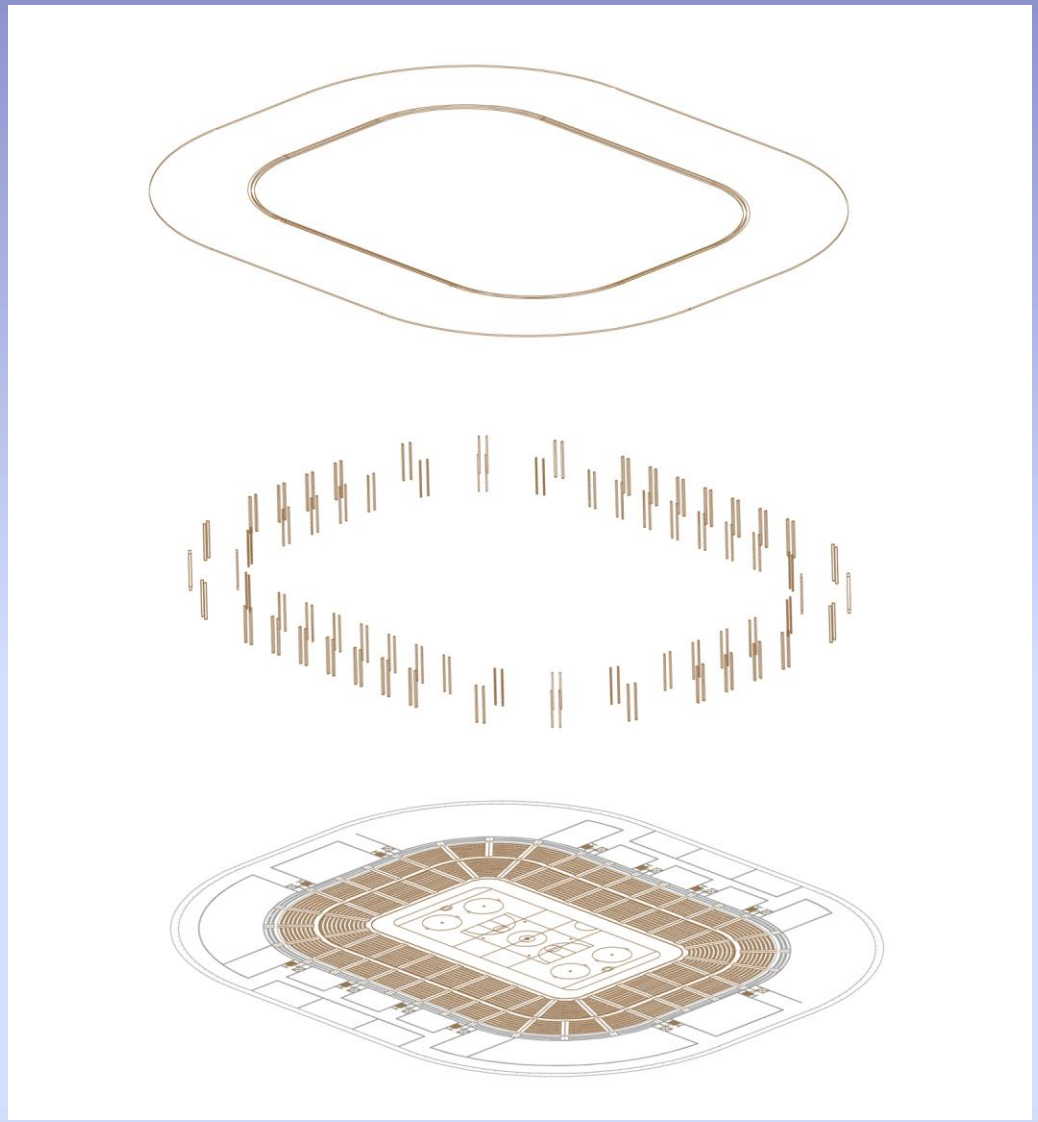

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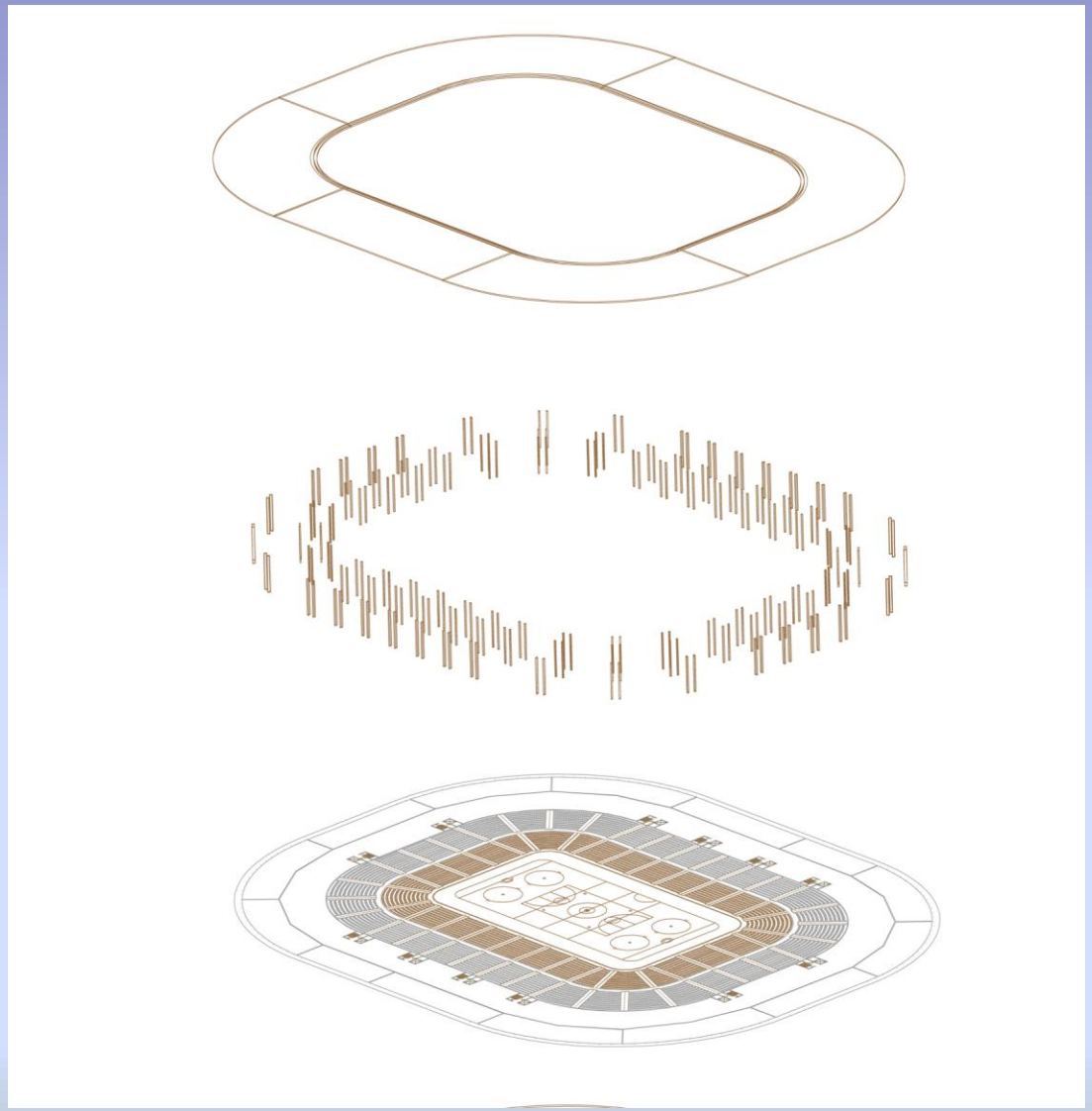

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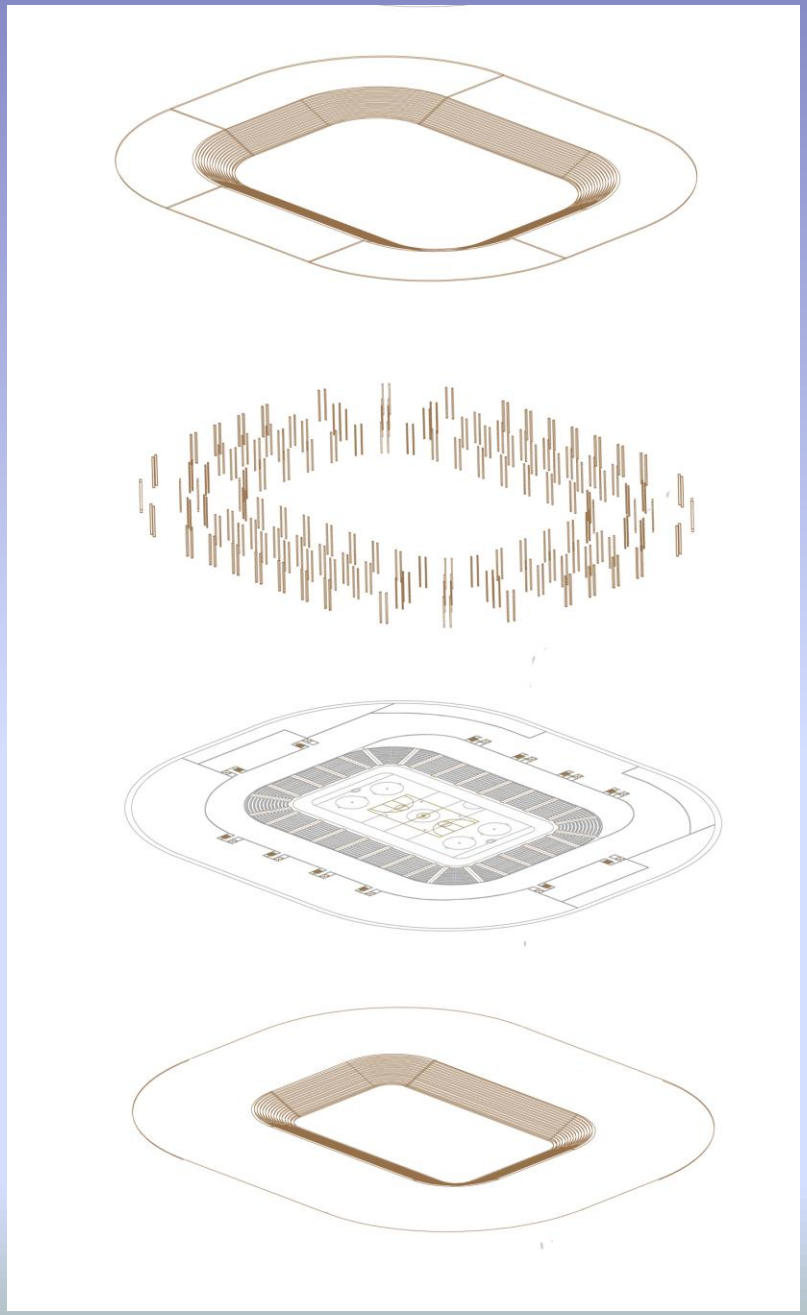

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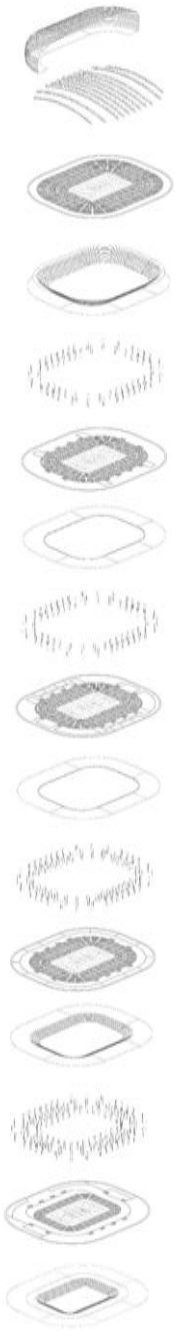
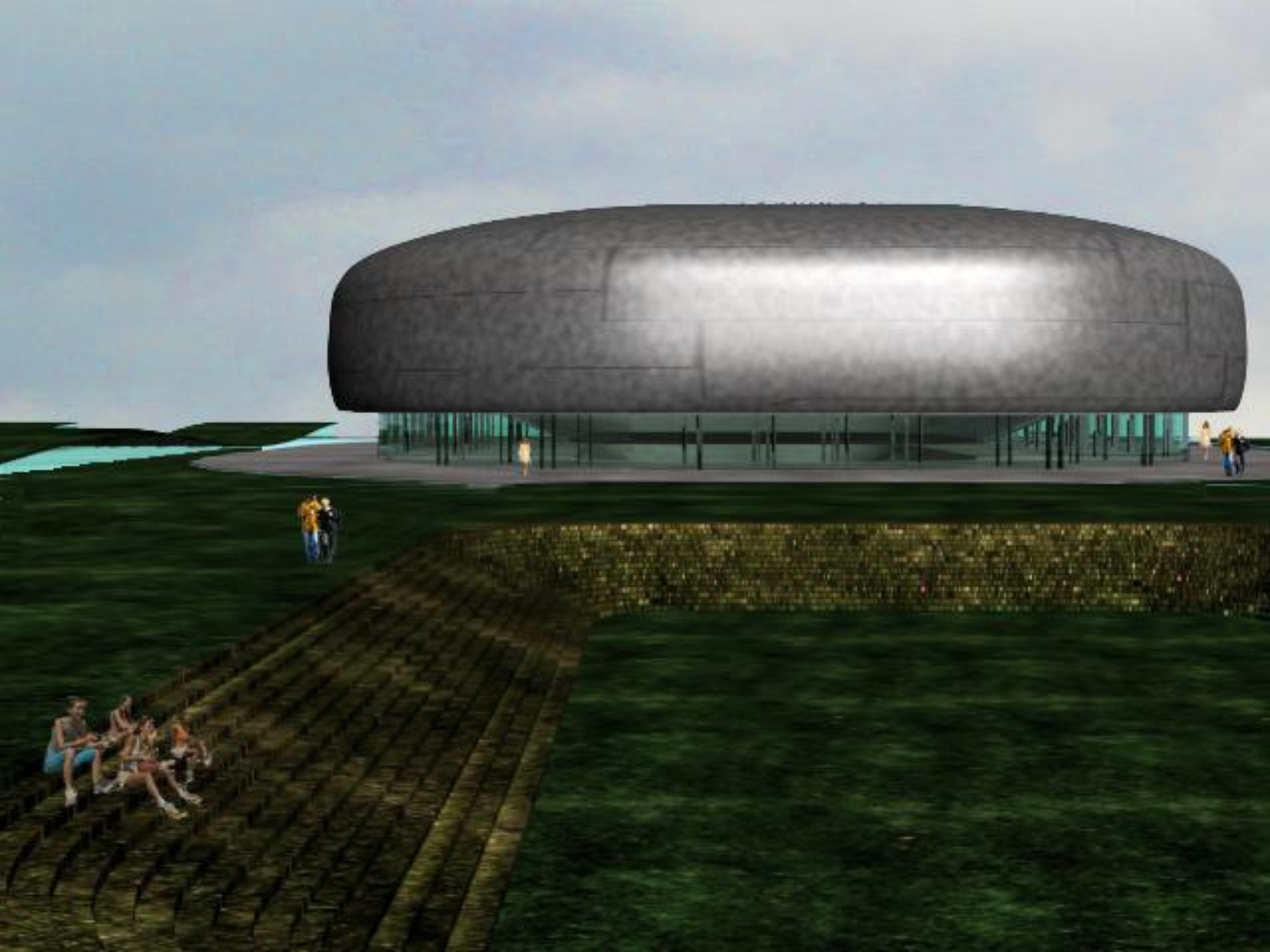


Exterior

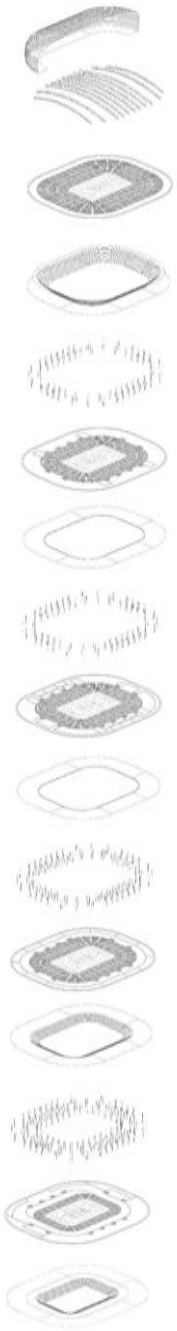
- Structure limit: the glass
  - Roof like floating above the glass
- Metal
  - Lightness and shiny point that catch the attention of the coming public
- Round shape
  - The roof as the cover of the space.
  - Higher in the game area.



Roof material

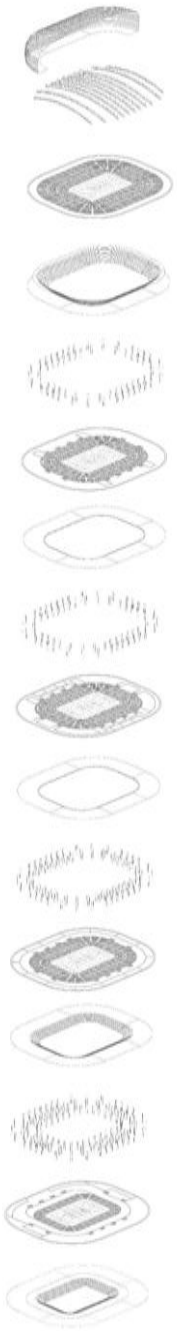
Insulation sandwiched between two layers of metal.

We use metal because it is impermeable and very light.



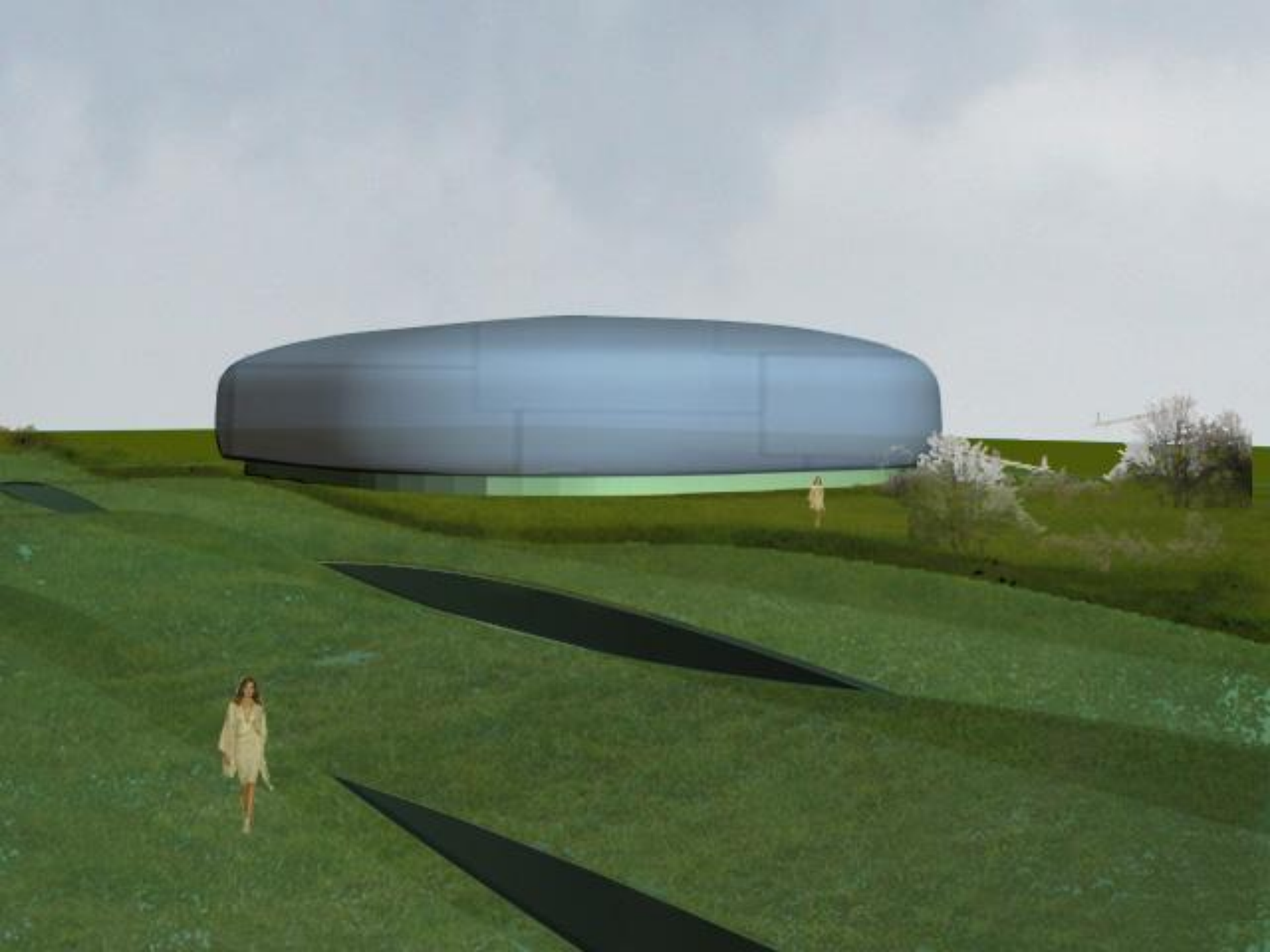
Interior

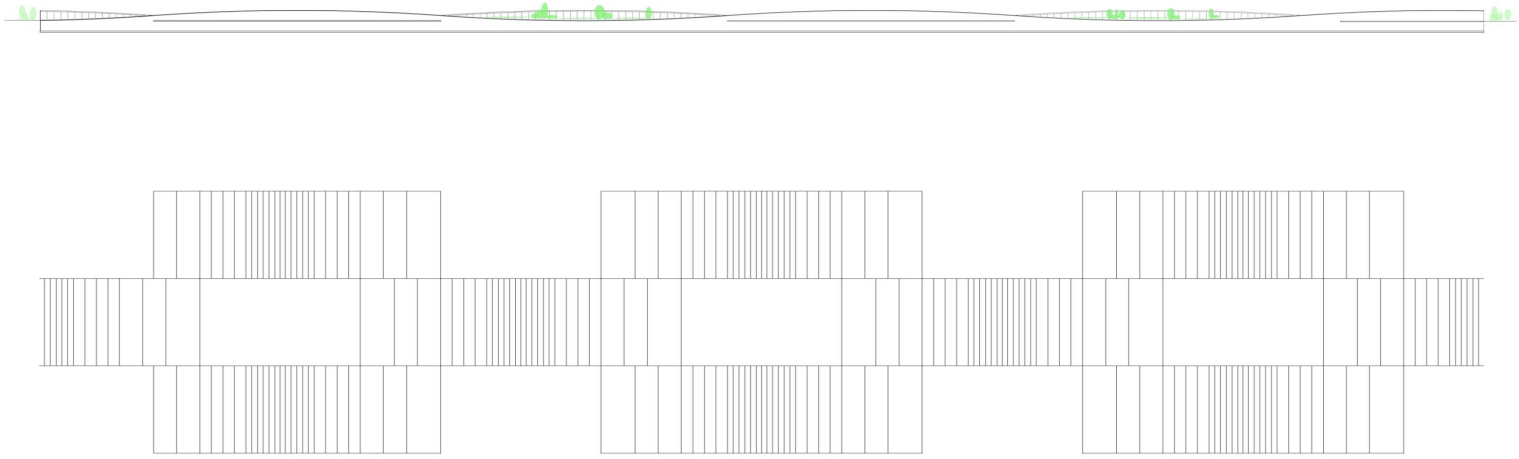
- Structure away from the sitting area
  - Not interrupted visibility
- Trusses
  - Light structure that permits to see the large roof
- Steepness of the sitting area
  - Enable to see from every point of the sitting area



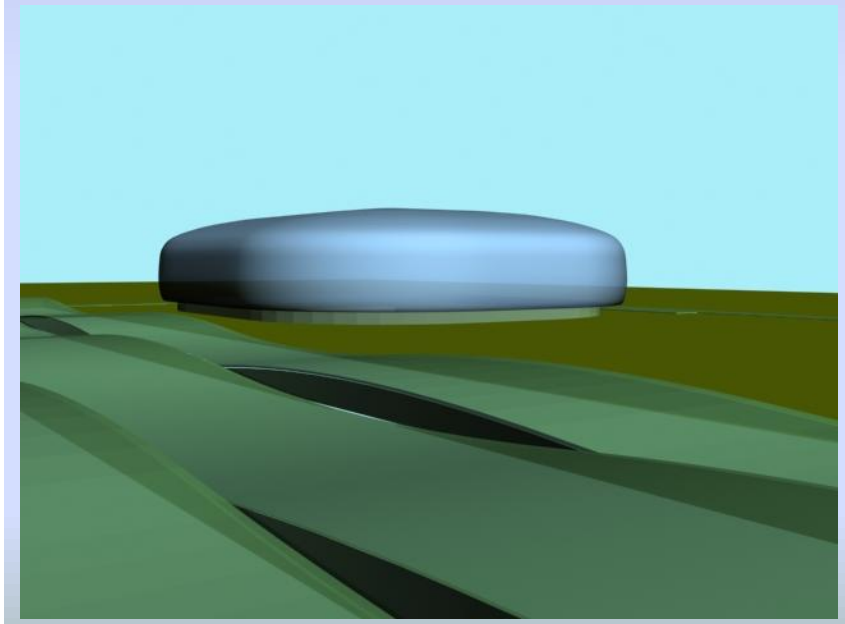
Landscape parking

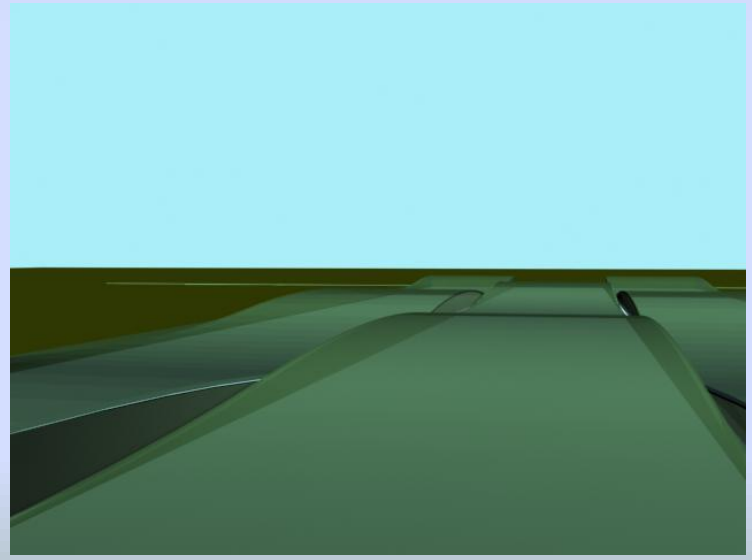
- Green roof
  - Better thermal performance
- Natural Light and Ventilation
  - Cleaner air and better light
- Parking as a garden
  - Integrated solution



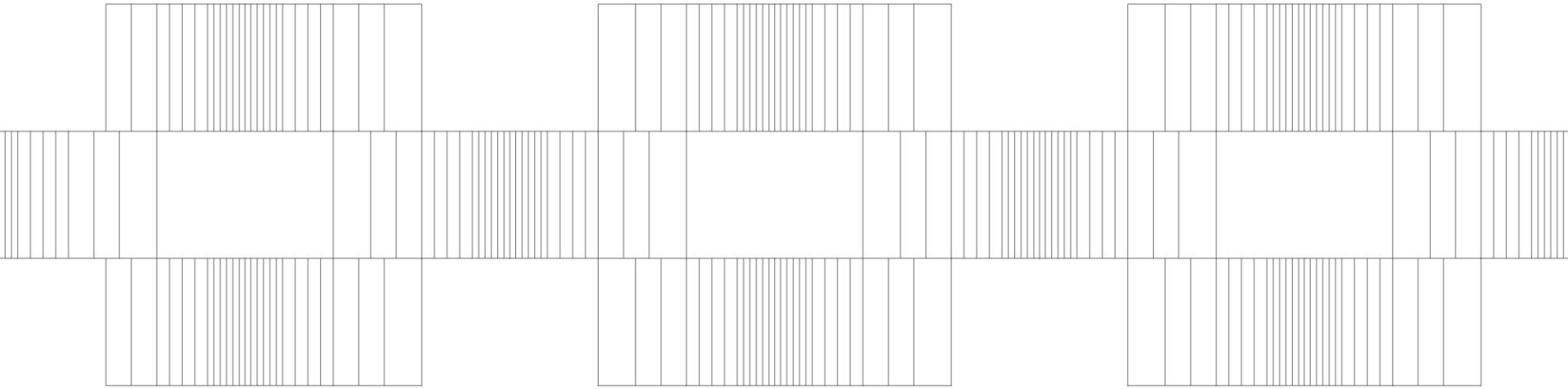


Shape of the parking. Waves



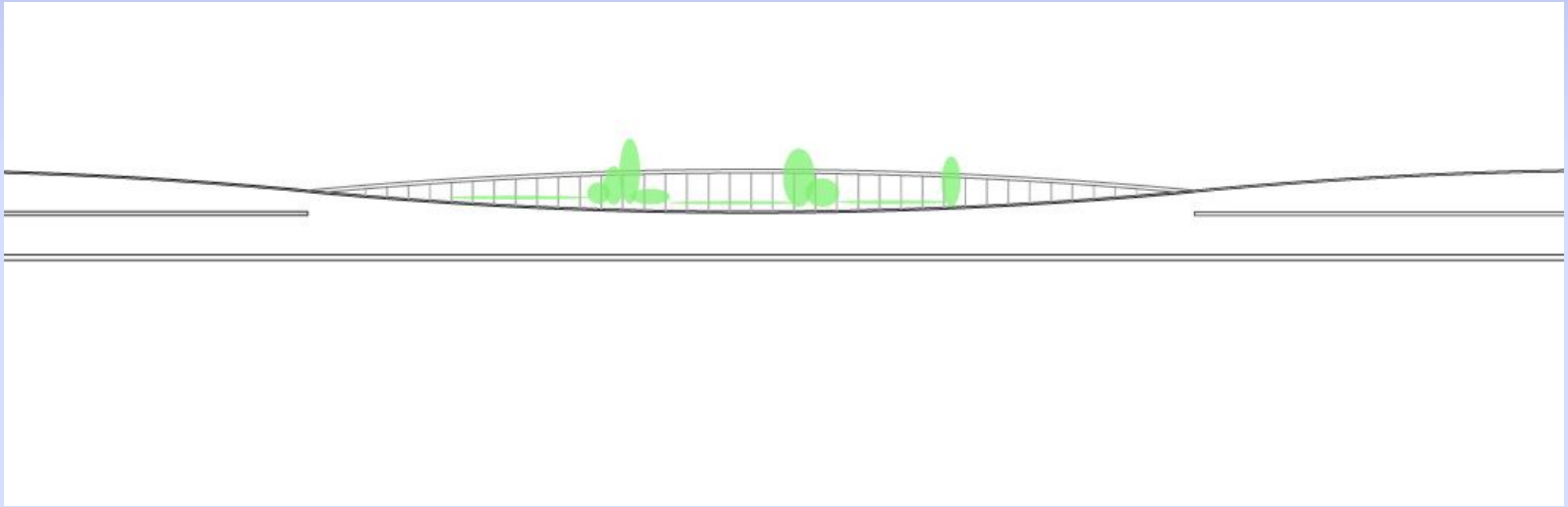


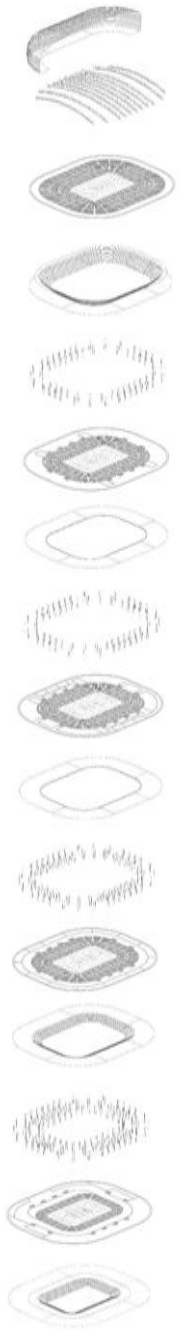
CAPSTONE DESIGN. IPRO 335



THE LANDSCAPE PARKING

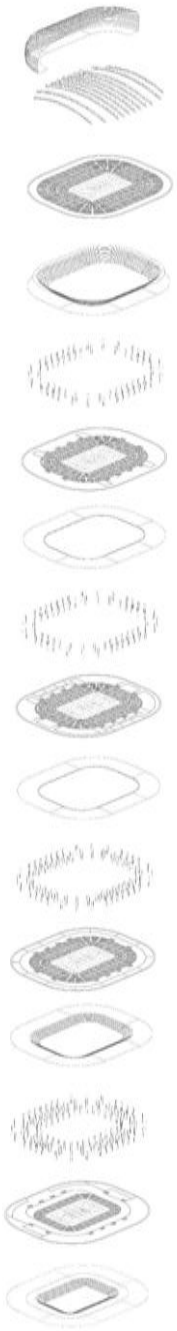
The parking garage was envisioned like gardens with glass entrances. The waves have a phase so they permit to open entrances to the parking





ARENA STRUCTURE

CAPSTONE DESIGN. IPRO 335

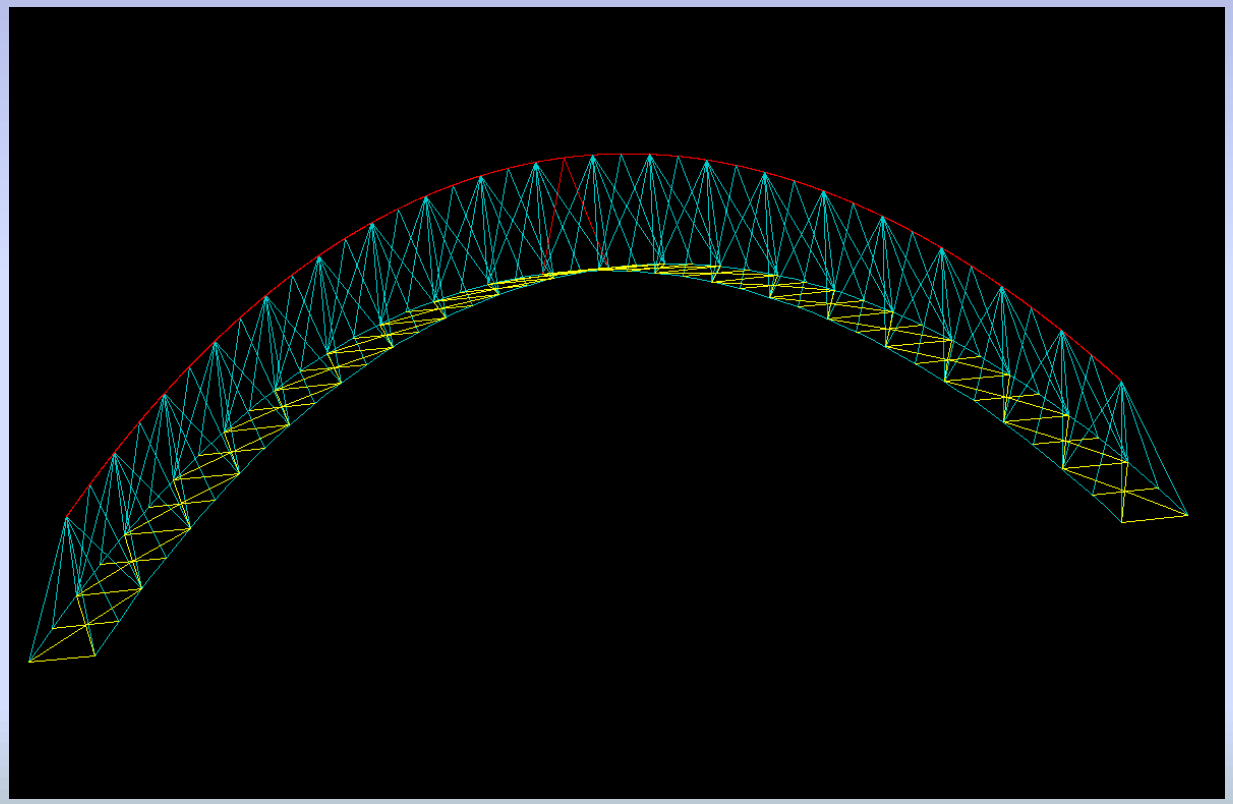


Arena Structure

- Roof Truss
  - A 3-dimensional triangular truss
  - Made of structural steel that includes W-sections and HSS pipes
  - Truss spans approximately 380 feet
  - Trusses take load from prefabricated steel roof joists
  - Middle truss supports the 56,000 pound Jumbotron

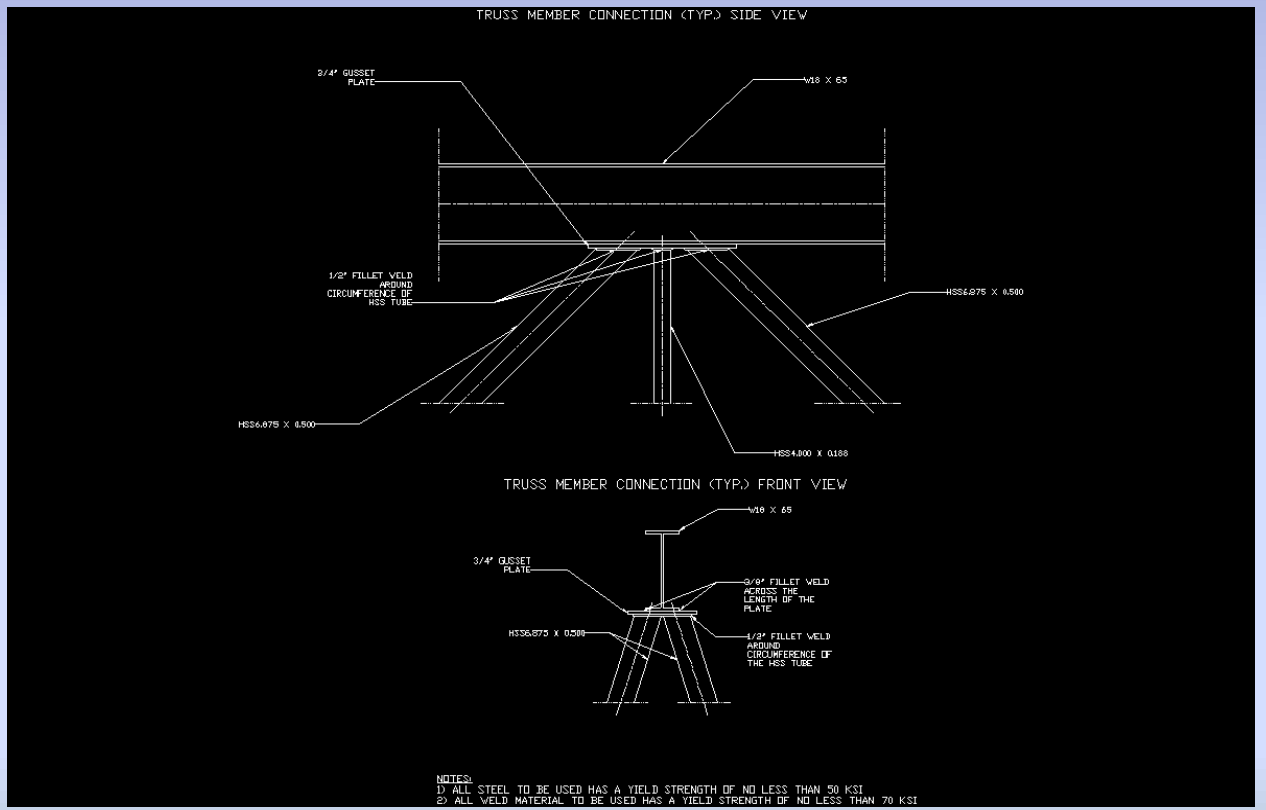
Arena Structure, ctd…

- An isometric view of the truss



Arena Structure, ctd…

- A typical connection detail

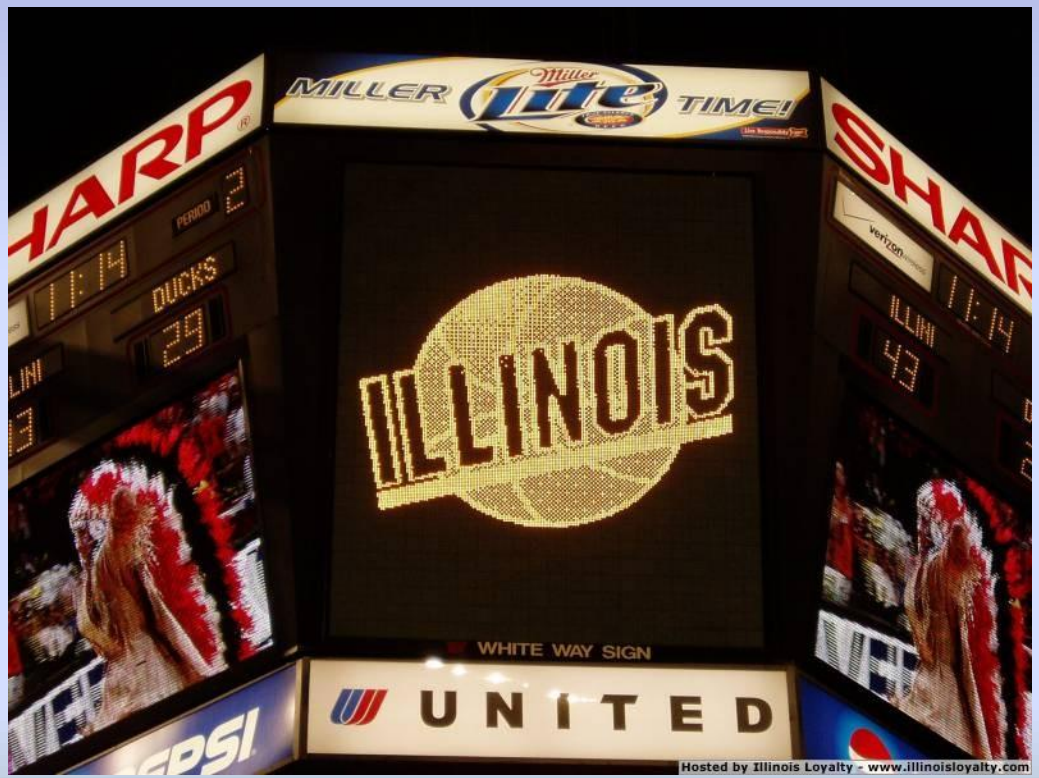


Arena Structure, ctd…

- An illustration of steel roof joists

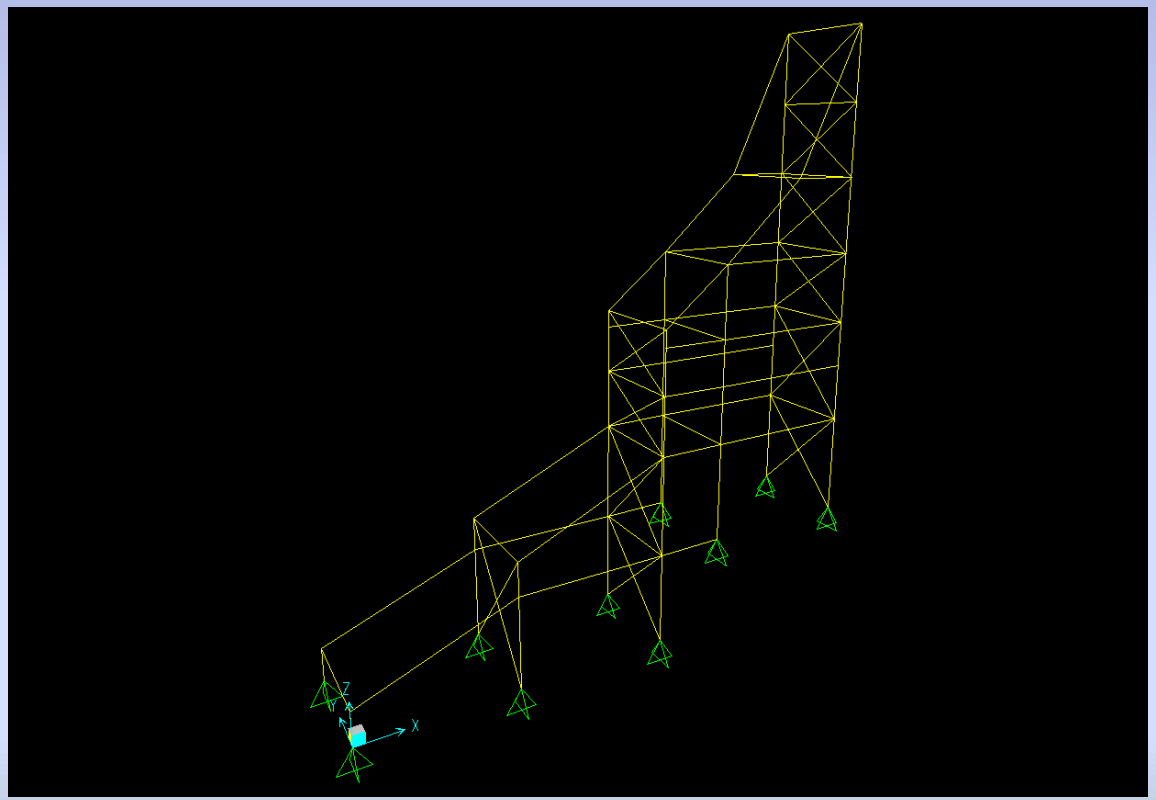
Arena Structure, ctd…

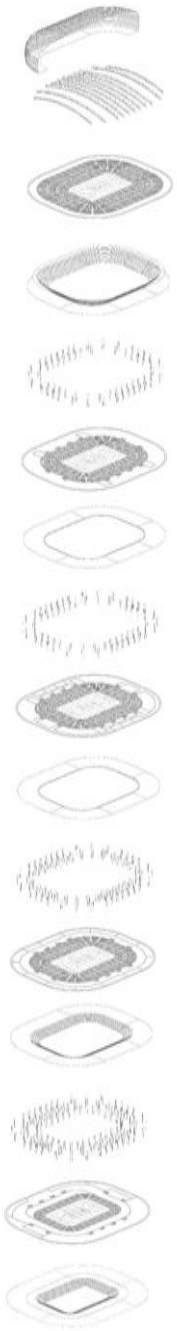
- The United Center Jumbotron



Arena Structure, ctd…

- Isometric view of seating area structure





Arena Structure, ctd…

- Seating Area
  - Frames are constructed out of steel W-sections
  - Moment resisting frame is used in the radial direction to resist lateral loads due to occupants
  - Braced frame is used in the tangential direction to resist lateral loads due to occupants
  - Outer seating area columns support the roof system
  - Seats are supported on prestressed, prefabricated, hollow core concrete slabs
  - Concrete slabs are supported on rakers belonging to the supporting girder
  - Wind loads are transferred to shear walls which house the elevators and the stairs

Arena Structure, ctd…

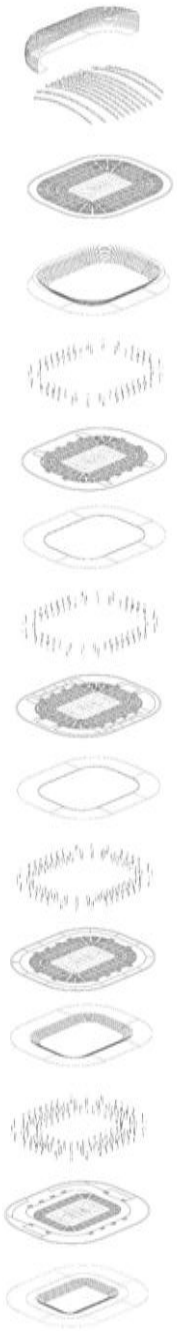
- An illustration of steel rakers

Arena Structure, ctd…

- An illustration of pre-cast, pre-stressed hollow core beams

Arena Structure, ctd…

- An illustration of a shear wall. Note the connection of the structure to the wall

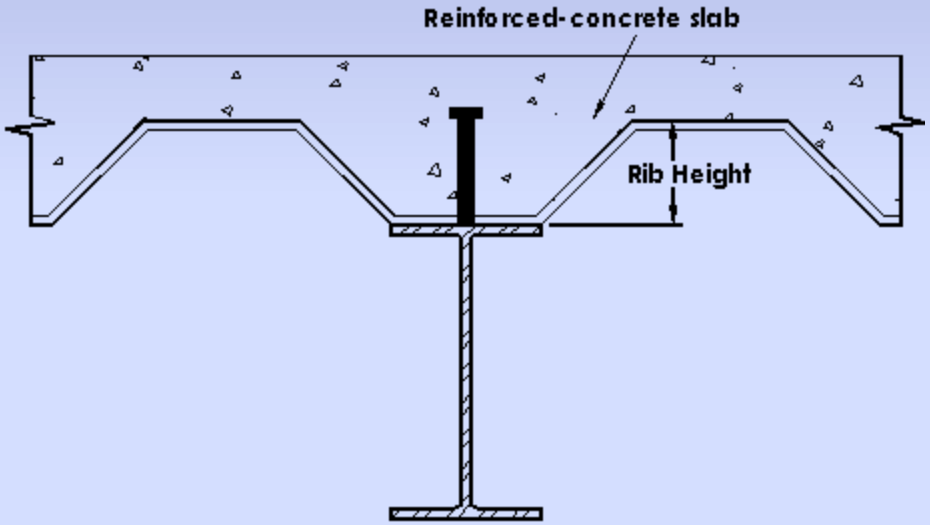


Arena Structure, ctd…

- Foundation and Floors
  - The stadium playing floor is cast-in-place reinforced concrete
  - The floors for the walking area are reinforced concrete on metal decking making a composite beam effect with the W-sections.
  - The foundation will be a series of isolated spread footings

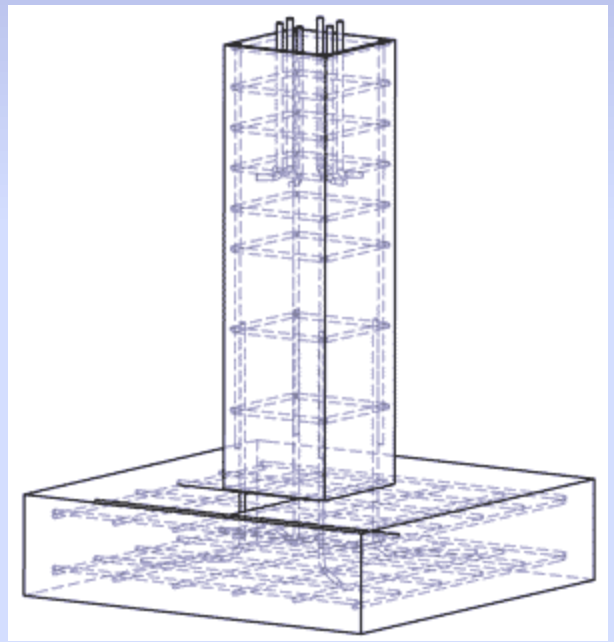
Arena Structure, ctd…

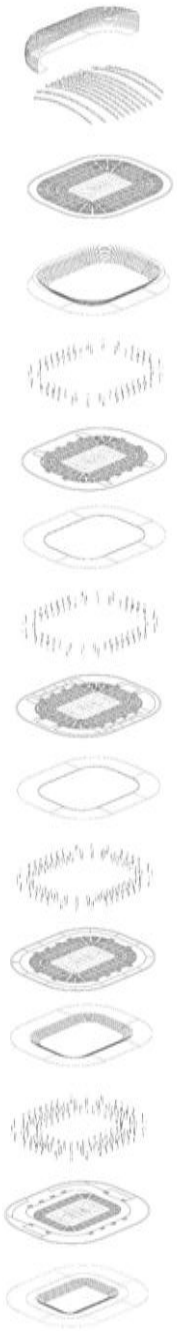
- An illustration of composite beam



Arena Structure, ctd…

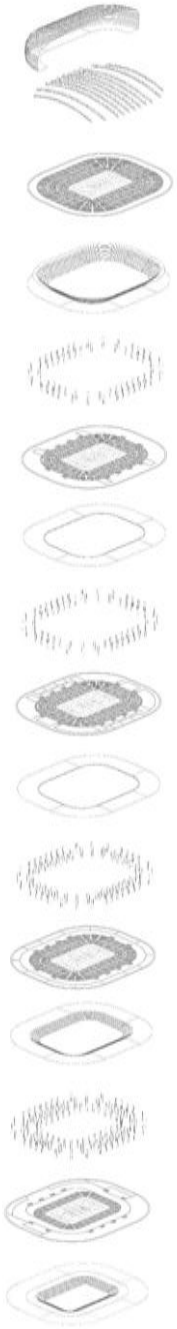
- An illustration of spread footings





Arena Structure, ctd…

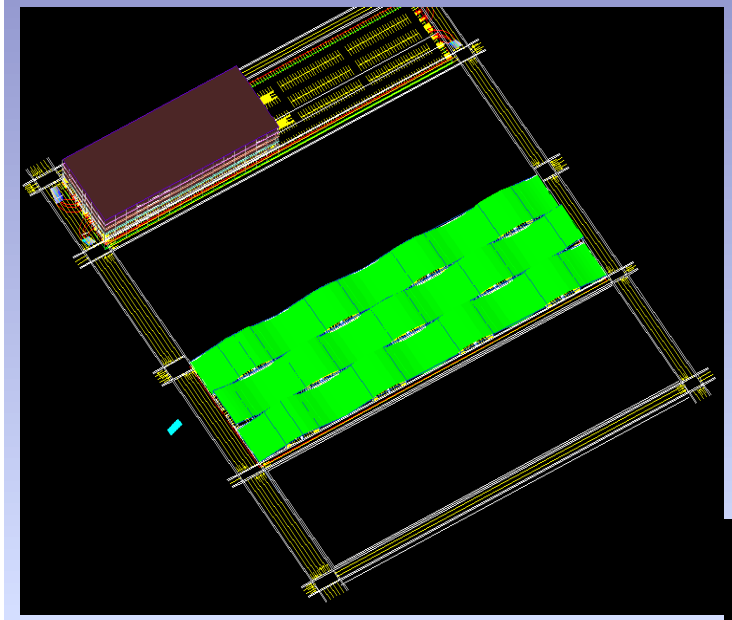
- Miscellaneous
  - The structure was drawn up in AutoCAD 2006 and transferred to SAP2000 for load analysis
  - ASCE 7-02 was used for determining the loads acting on the structure
  - The triangular roof truss is not the most efficient design but is aesthetically pleasing to the viewer



PARKING DESIGN

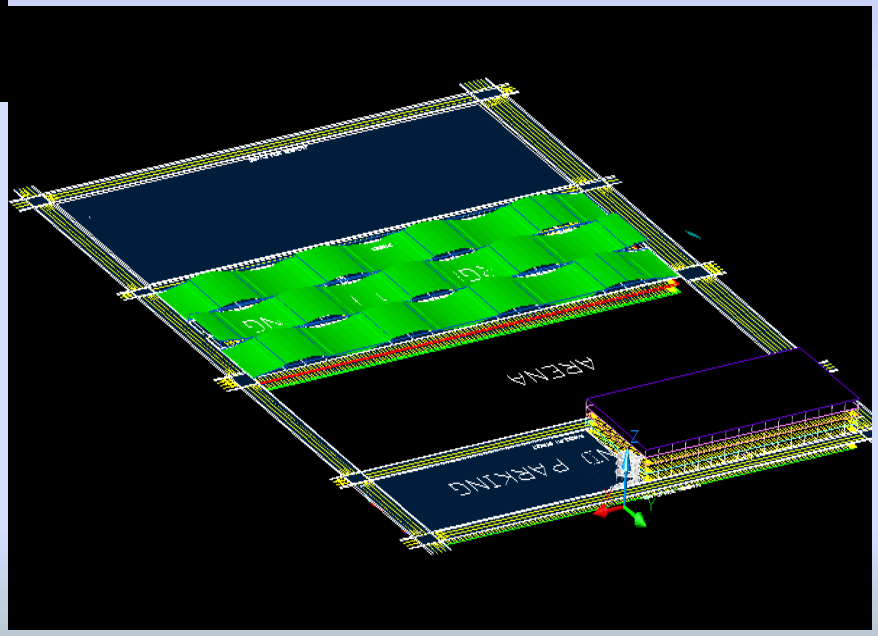
CAPSTONE DESIGN. IPRO 335

Design

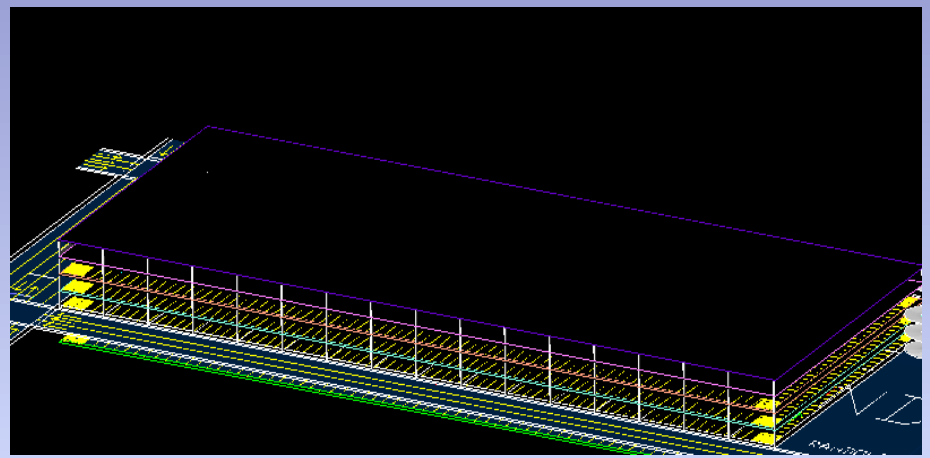


•Front view of the parking structure

•Rear view of the parking structure

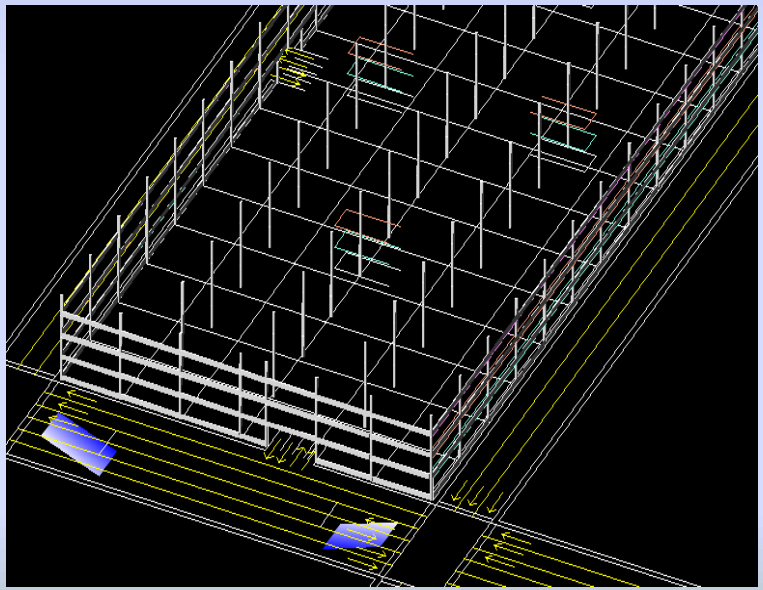


ABOVE GROUND

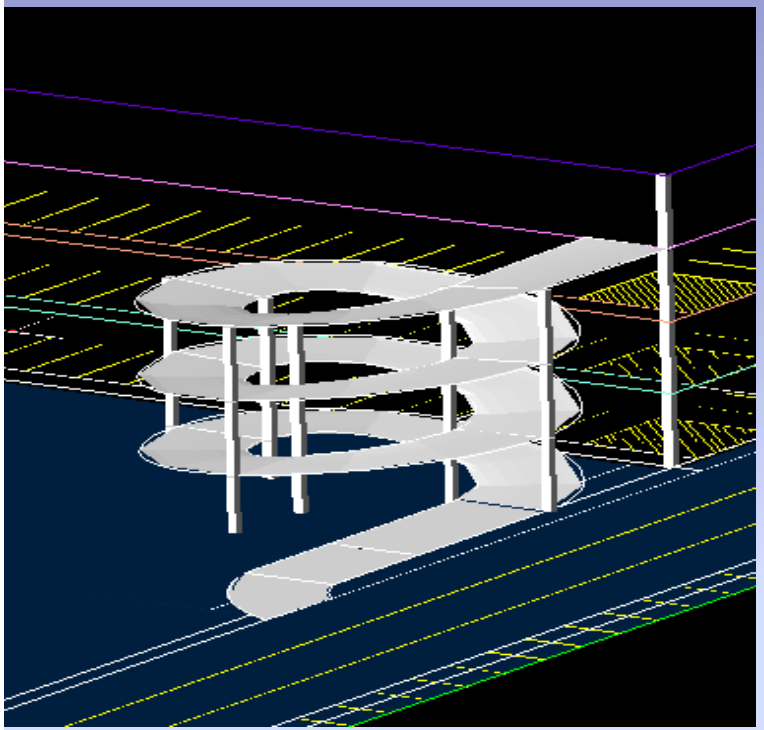


- Above ground parking.
- 4 levels
- Top most parking is VIP
- First three levels have 500 parking spots each.
- Top level 300 spots.

- Internal supports every 5 spaces
- On the exterior barriers to hold cars back
- Skeleton of the ramps

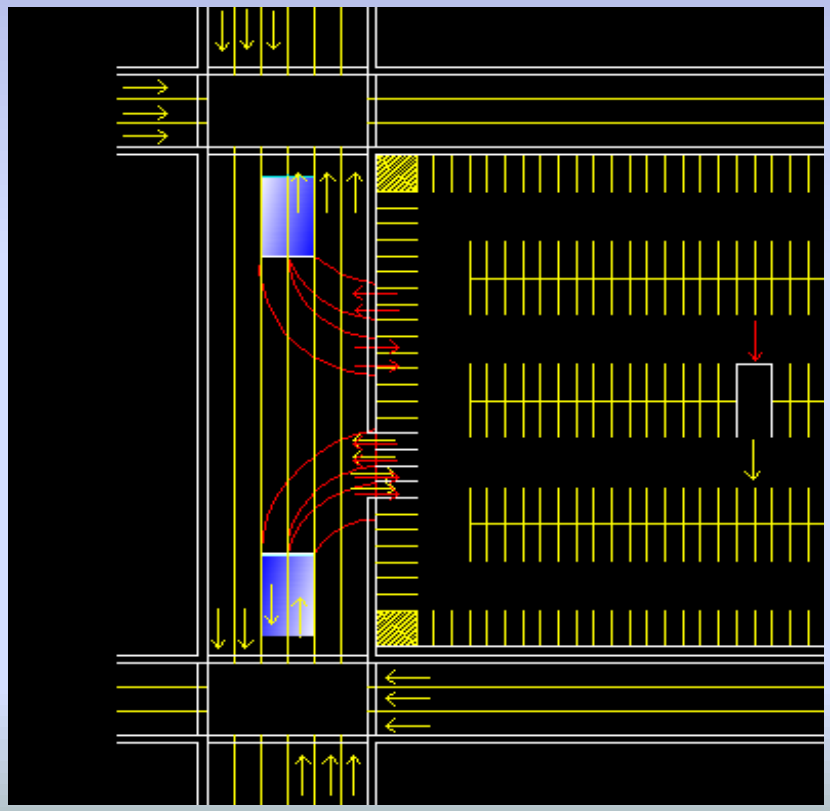


ABOVE GROUND

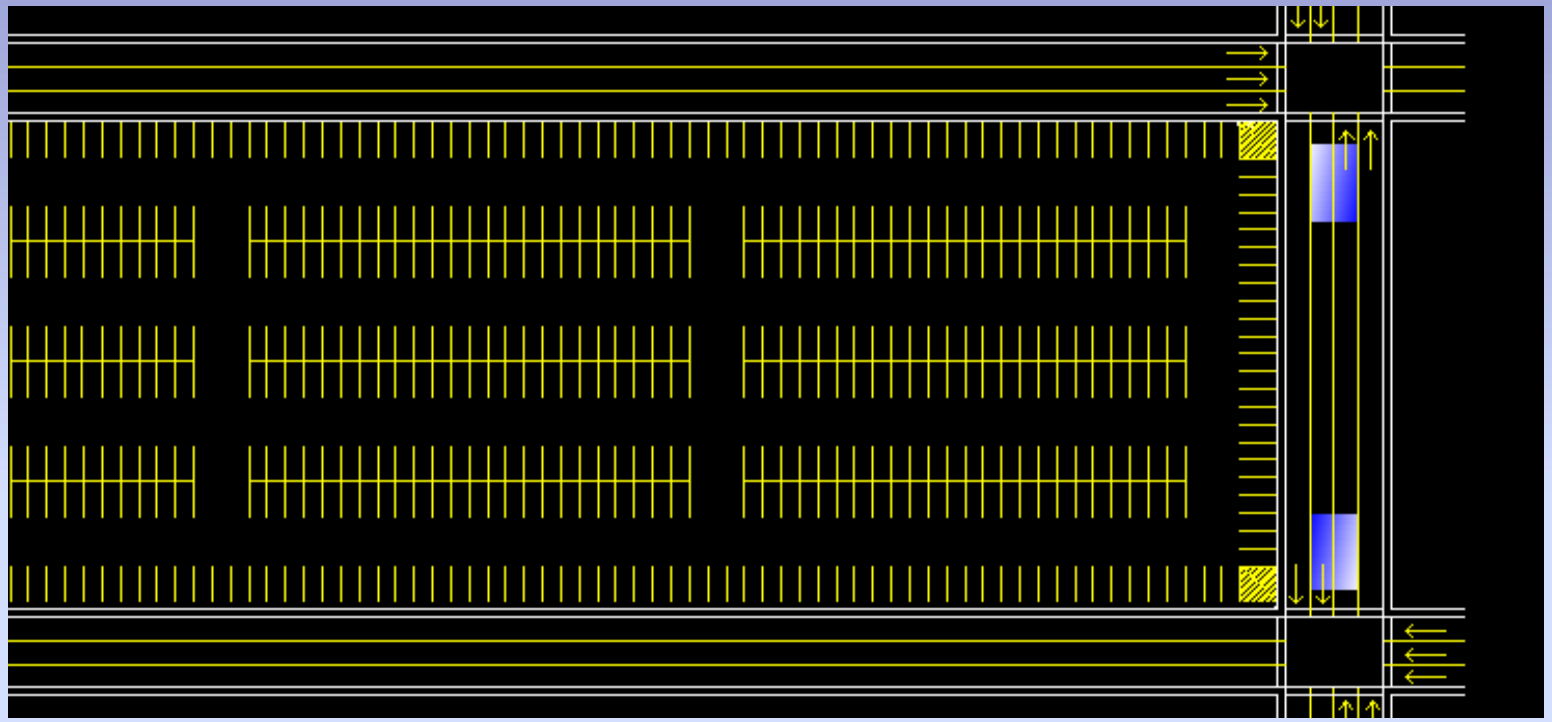


•VIP exit from the fourth floor.
•Accessibility only by VIP ticket holders

•Entrance and exit to the first floor of parking structure.

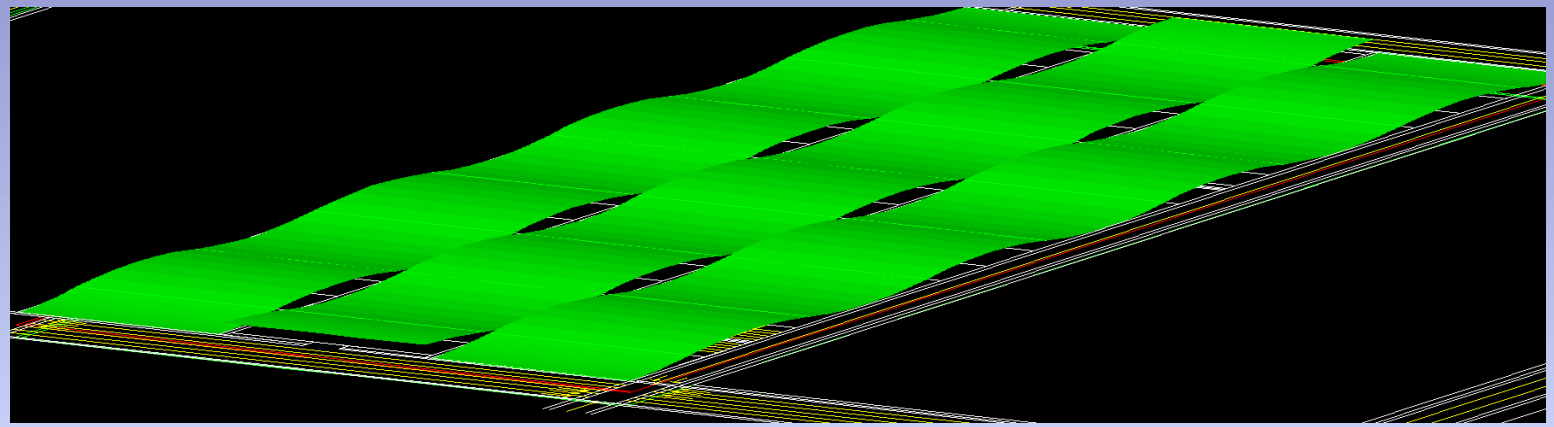


TAXI and BUSSES

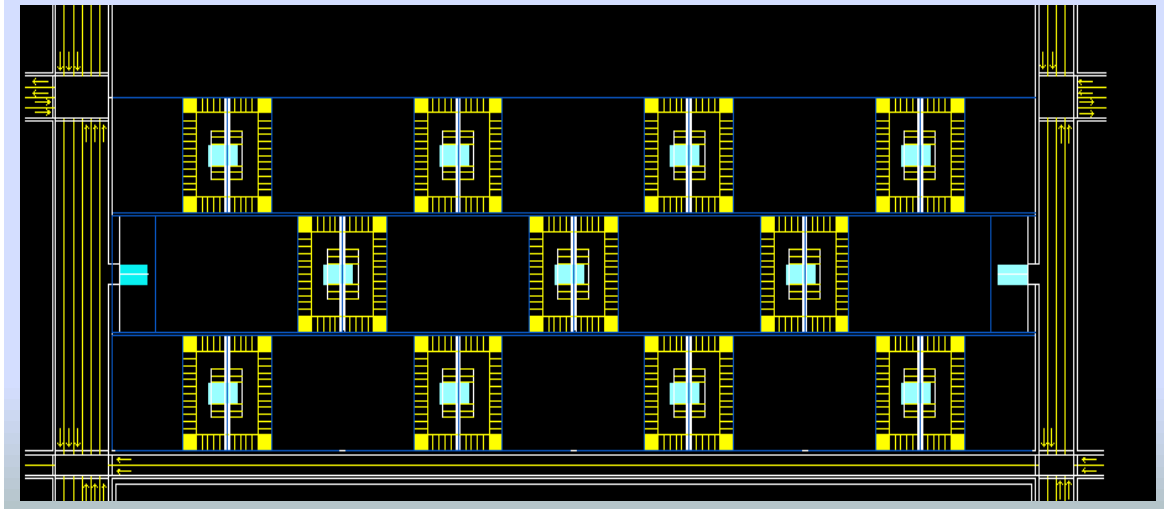


- Parking for busses and taxis
- Roof member
- Above ground
- Busses Space

GREEN ROOF

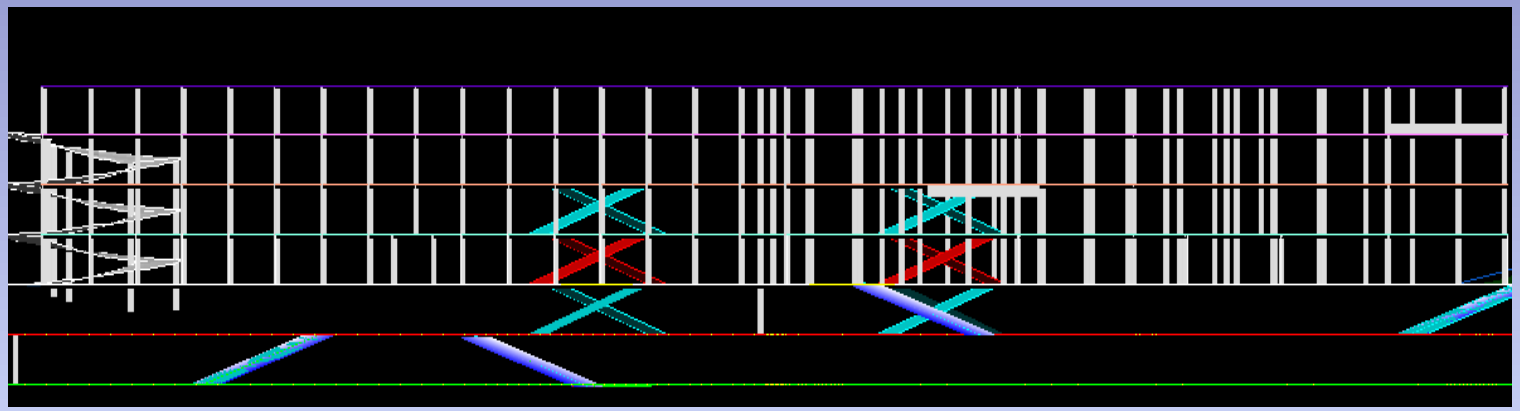


- Roof on top of a under ground parking
- Promoting green roof effect



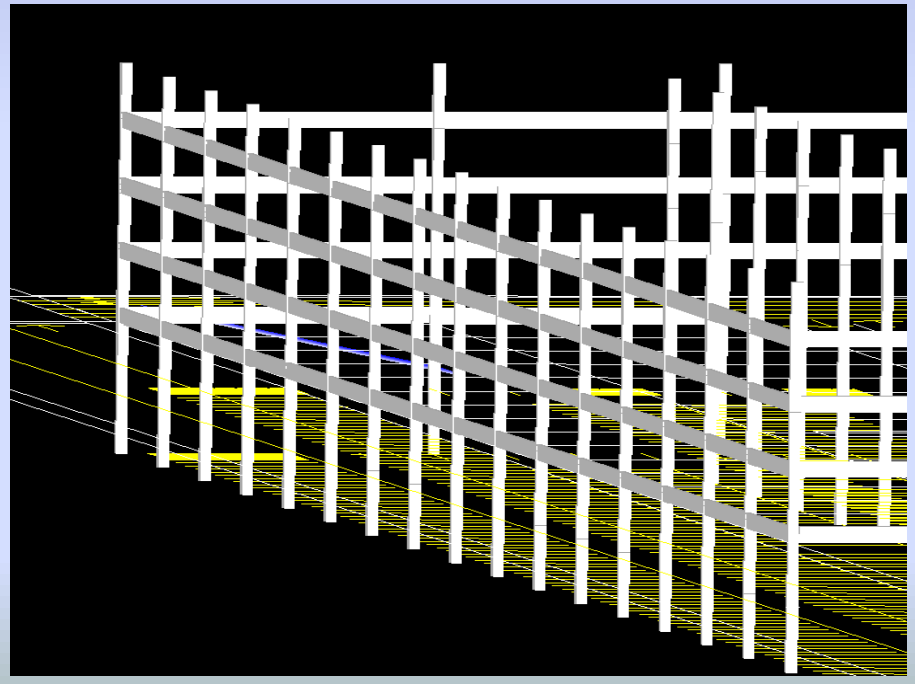
- Top view of the parking under each wave
- 44 parking spots each
- Entrances on the side and underground

UNDERGROUND PARKING



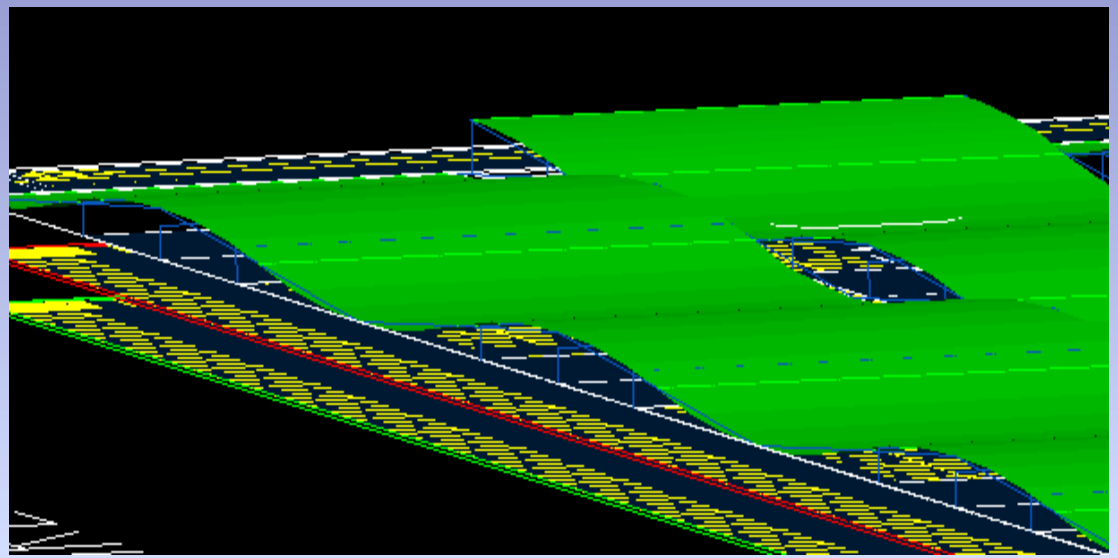
- Side view of underground.
- Ramps going down and up

- View of parking under ground
- Beam supports going down
- Walls for underground



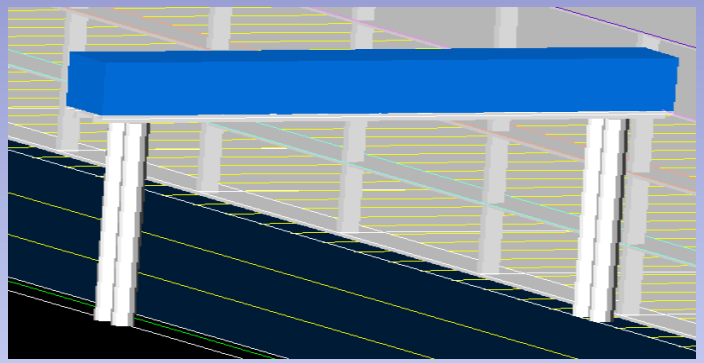
UNDERGROUND PARKING

- Under ground parking
- Better view of green roof parking

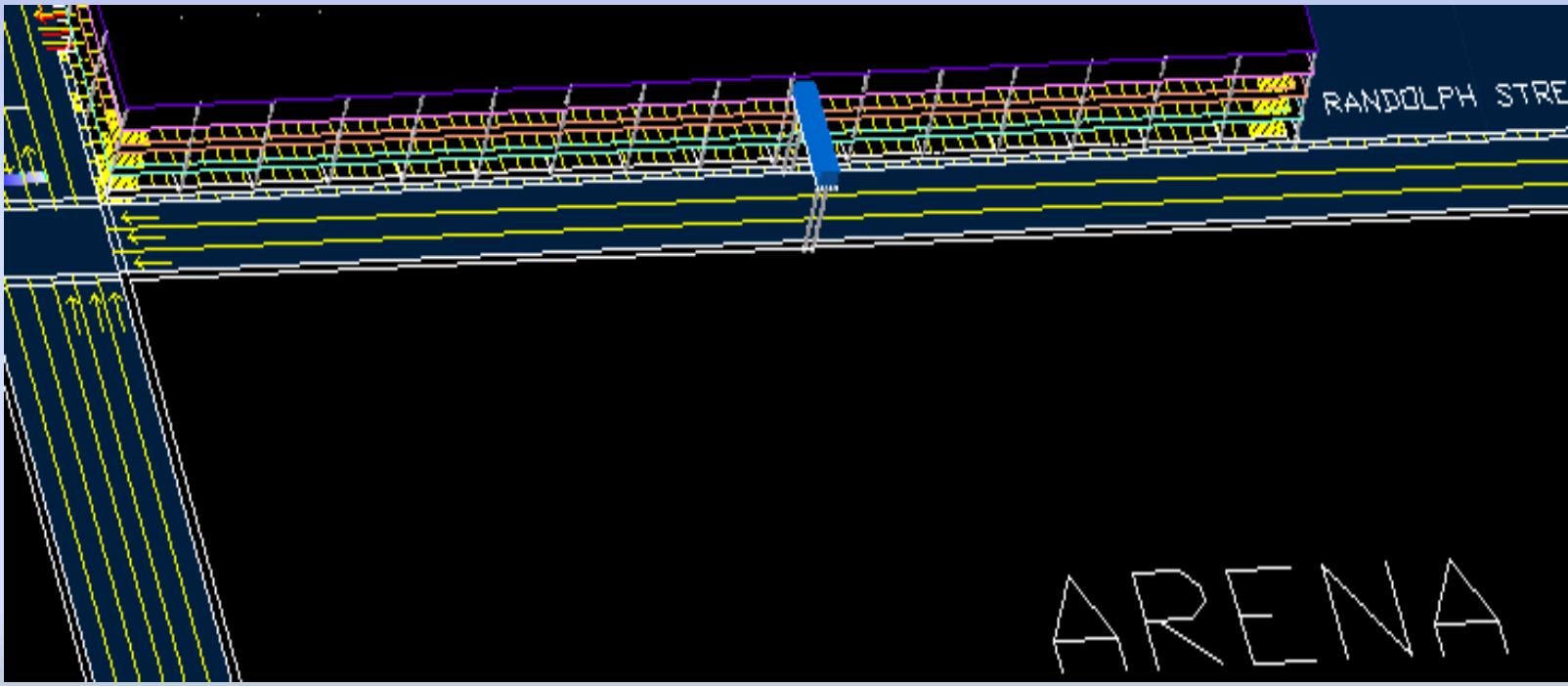


- Steel Metals on the back wall
- Concrete between ridges
- More lighting

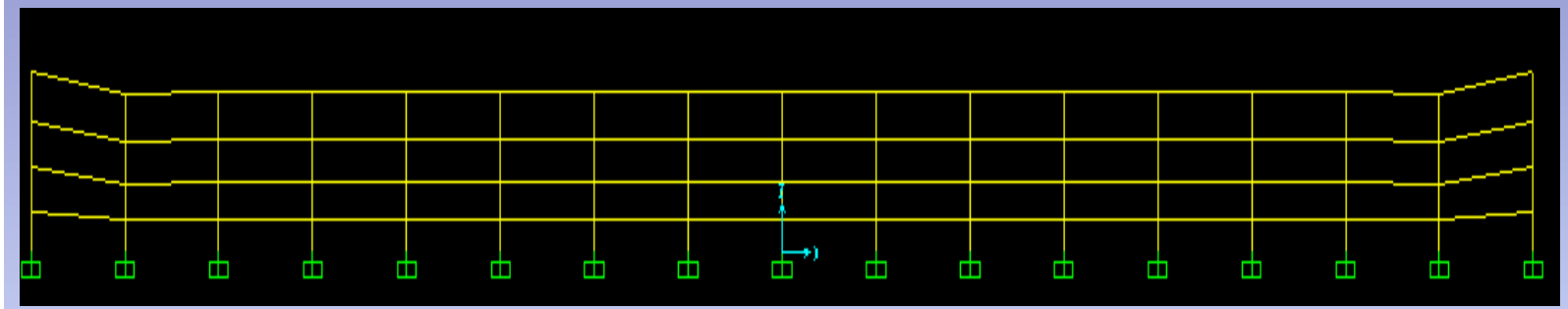
BRIDGE

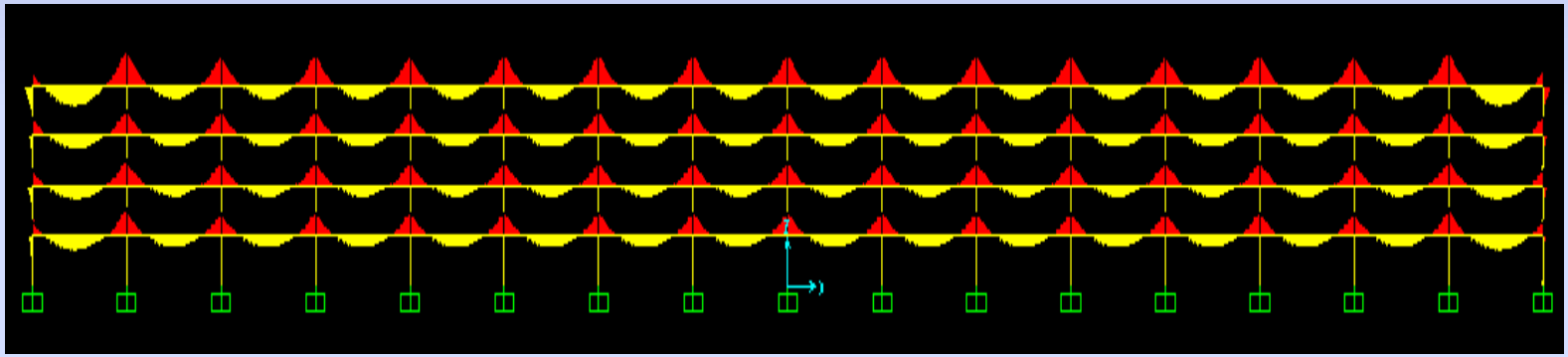


- Bridge from forth floor parking into the arena
- Strictly VIP ticked holders
- Supported from each side of the road



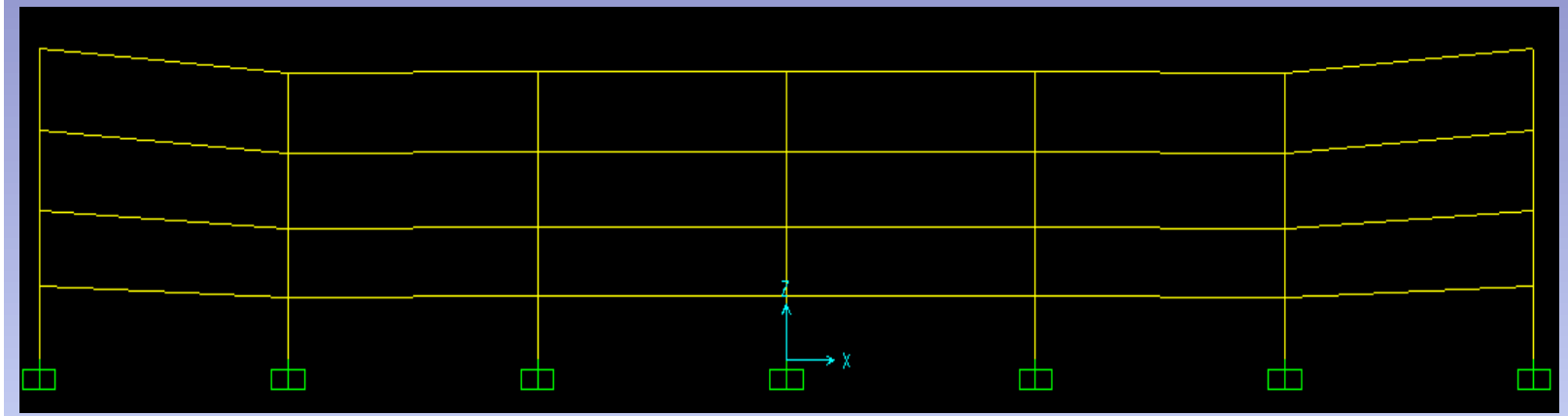
BRIDGE DIAGRAM (LONG)

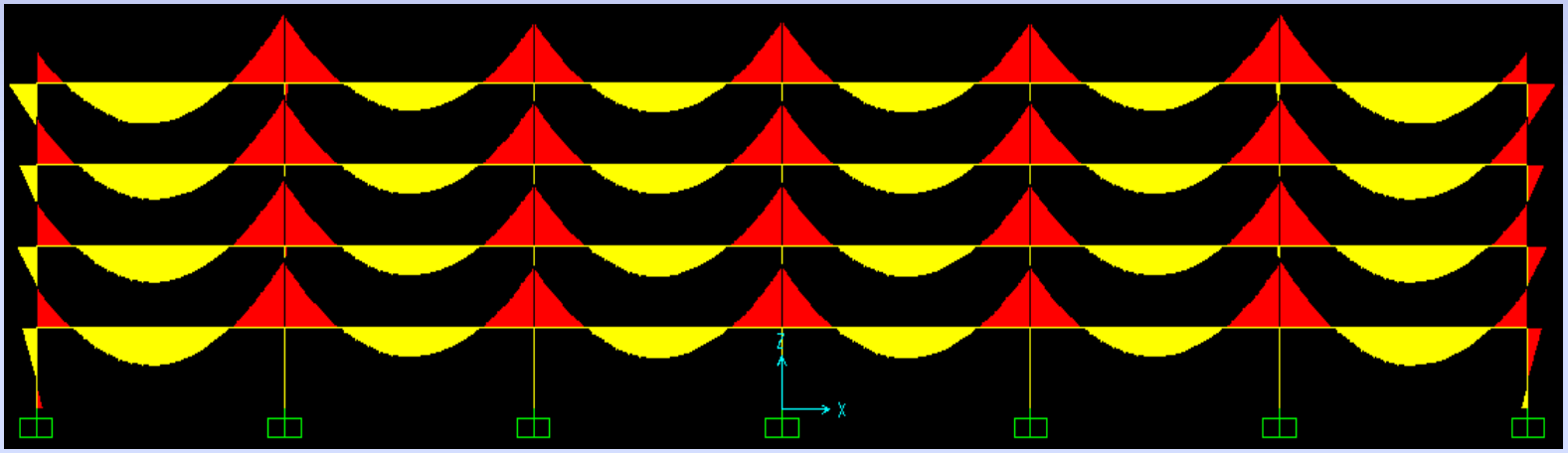




- Deformation of the bridge
- Analysis showing distributed loads

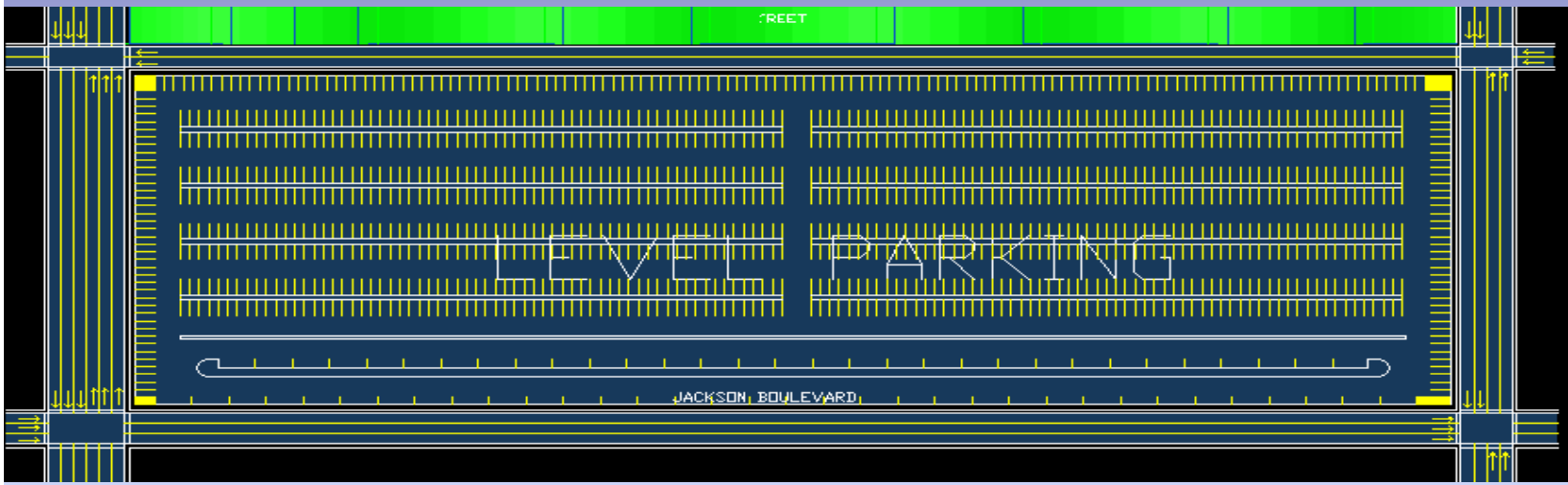
BRIDGE DIAGRAM (SHORT)



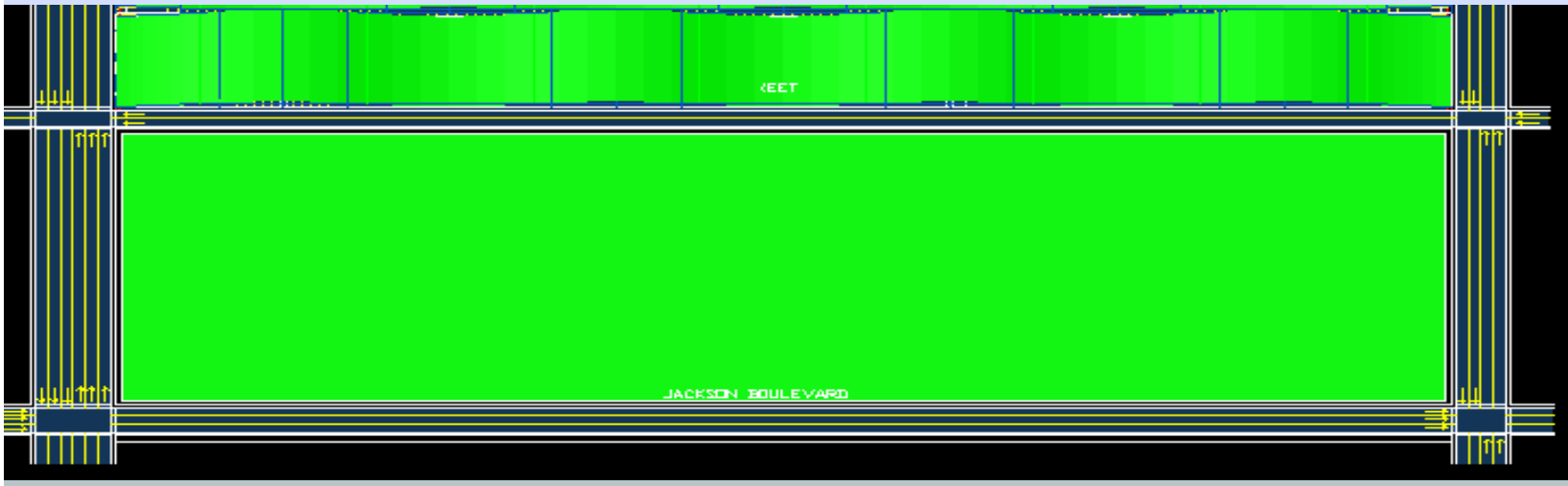


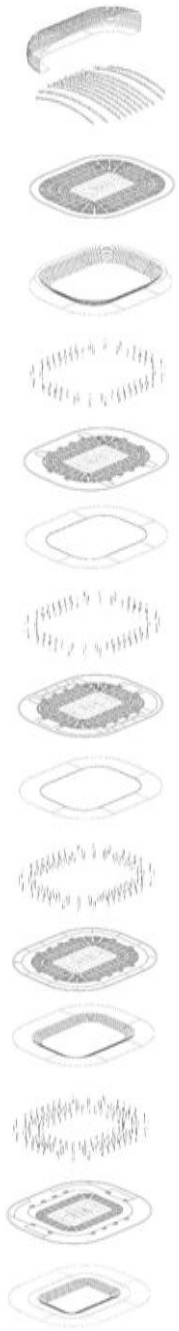
- Deformation of the bridge
- Analysis showing distributed loads
- Bridge calculation of 78.29 lb/ft^3

PROMOTING GREEN



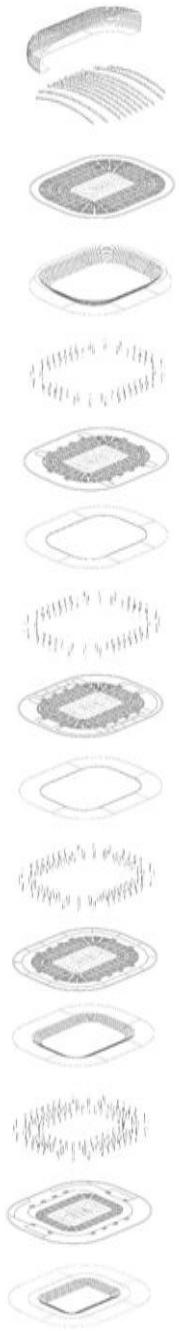
- Converting a parking lot.
- Helping improve the environment





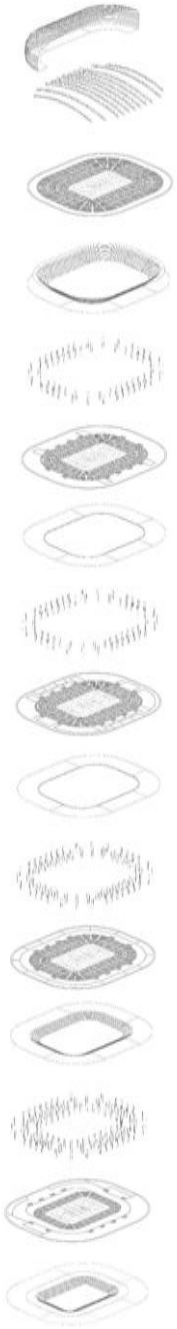
M.E.P DESIGN

CAPSTONE DESIGN. IPRO 335



Acoustics

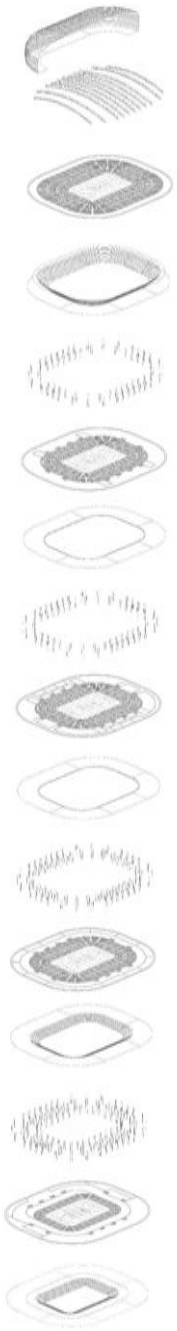
- Reverberation Time in Corridors
  - Perceived as the time for sound to die away
  - Shorter time = better
  - Result ranges from .3 to 1.38 sec.
  - Drop Acoustical Ceiling Tile

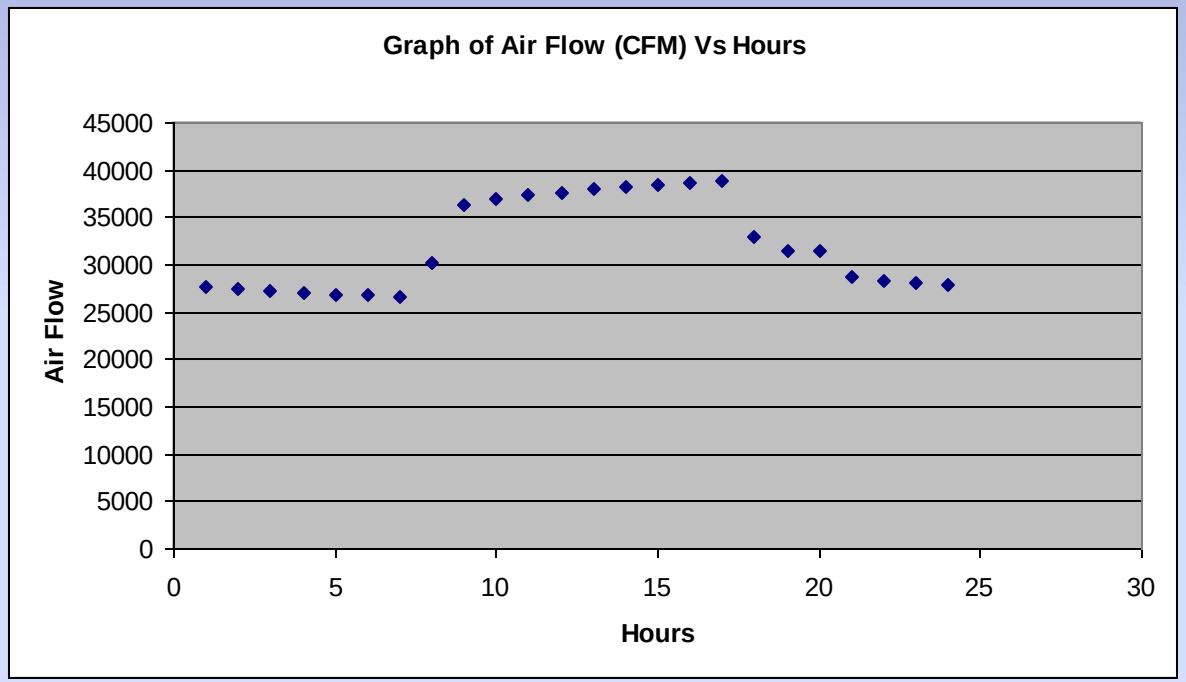


HVAC Graphs

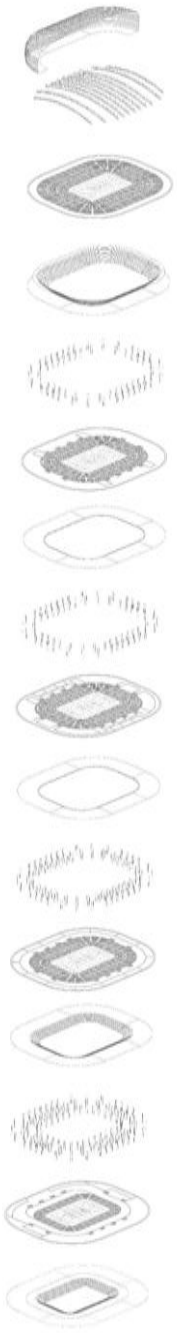
CAPSTONE DESIGN. IPRO 335

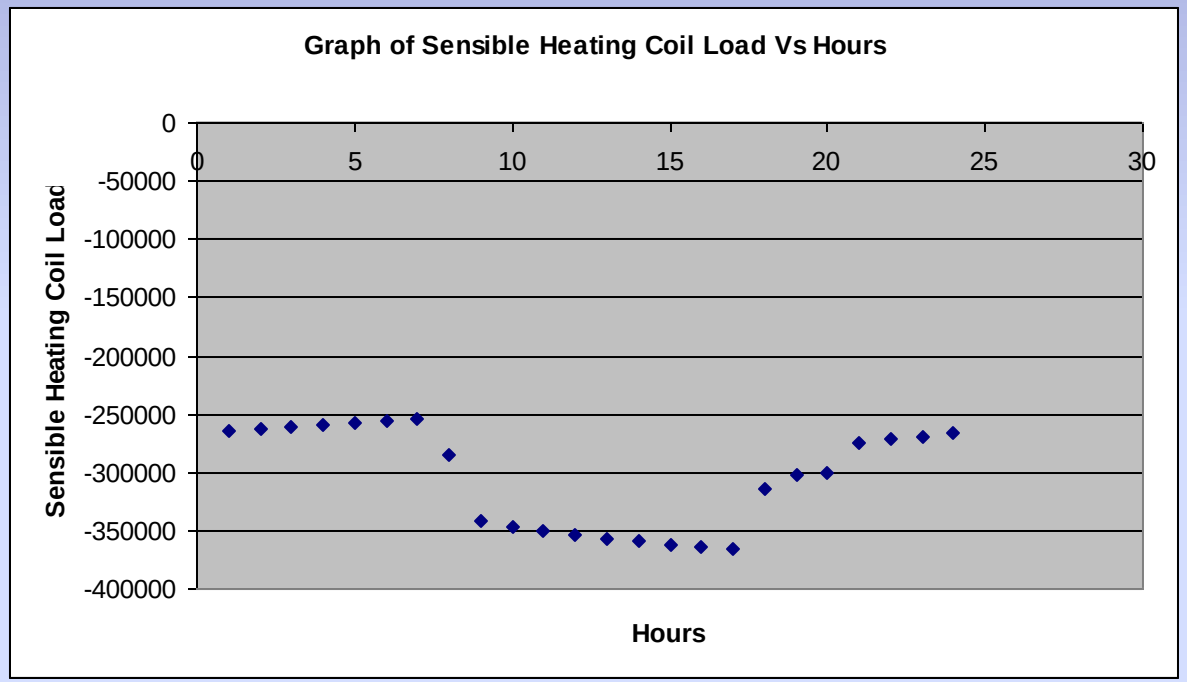
Third Floor



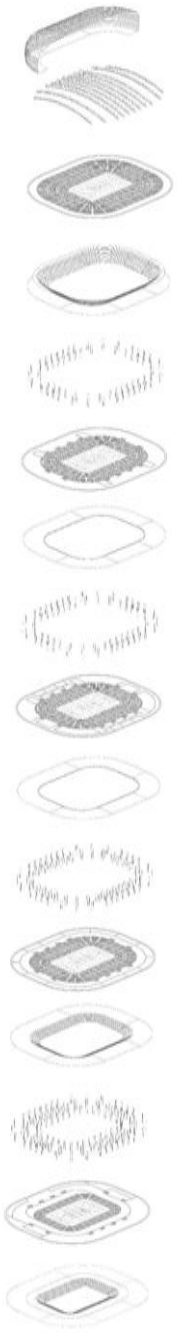

Graph of Air Flow (CFM) Vs Hours
Air Flow
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0
5
10
15
20
25
30
Hours

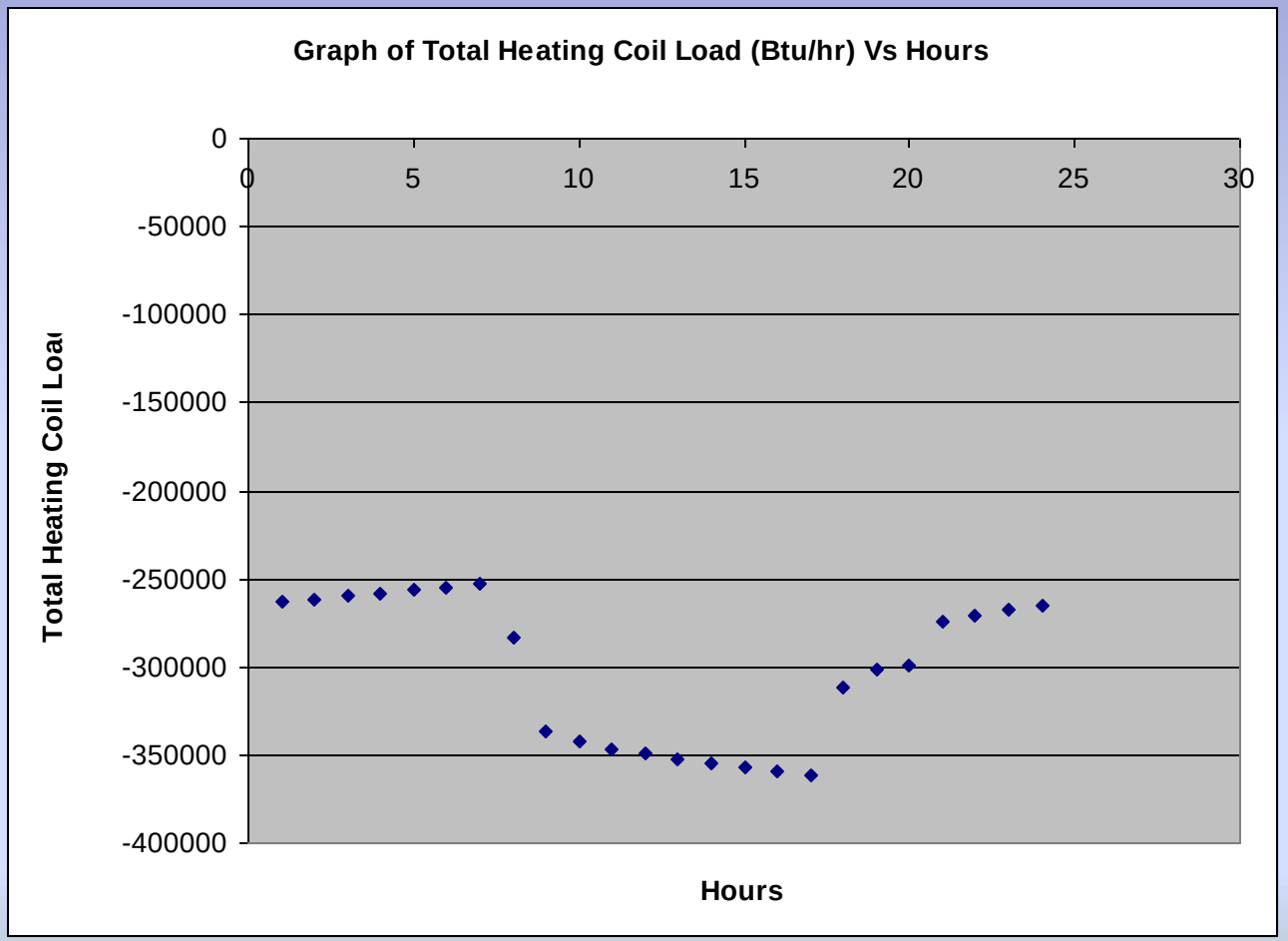
Third Floor



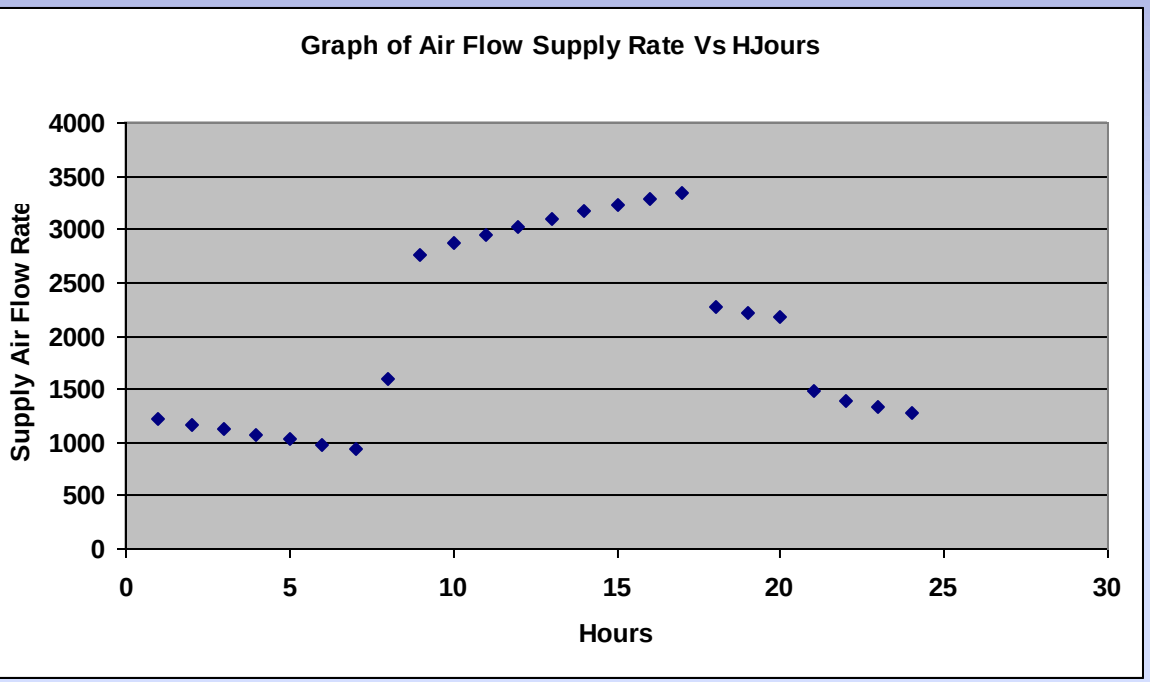

Graph of Sensible Heating Coil Load Vs Hours
Sensible Heating Coil Load
0
-50000
-100000
-150000
-200000
-250000
-300000
-350000
-400000
0
5
10
15
20
25
30
Hours

Third Floor

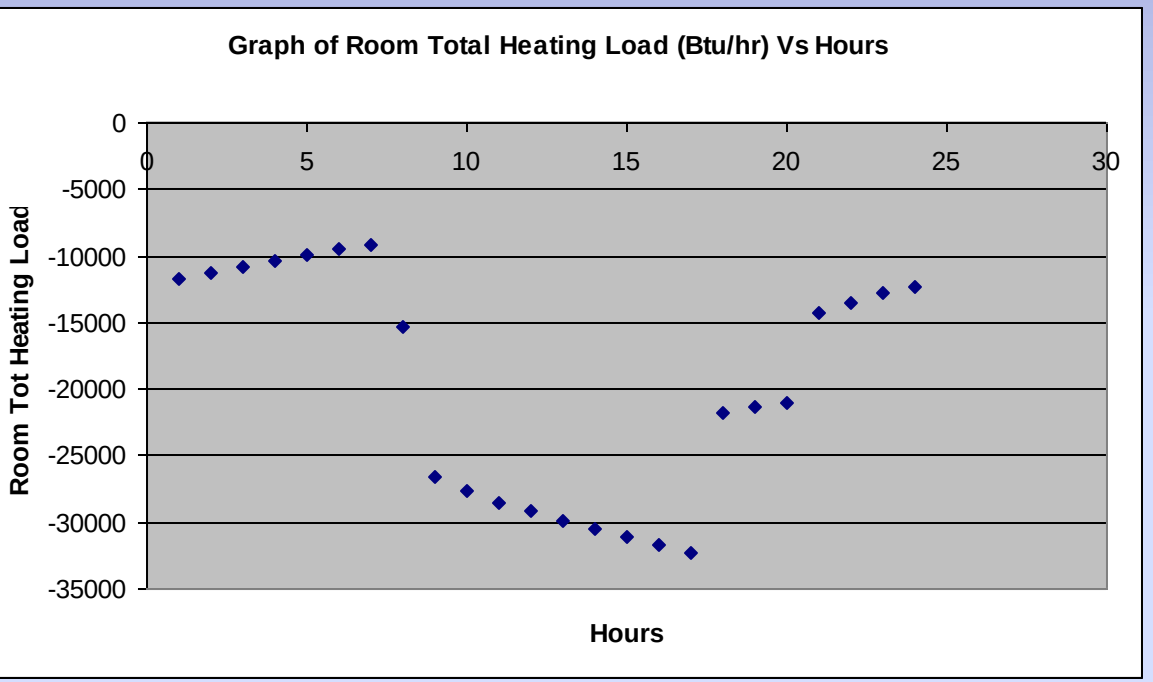



Graph of Total Heating Coil Load (Btu/hr) Vs Hours
Total Heating Coil Loa
0
-50000
-100000
-150000
-200000
-250000
-300000
-350000
-400000
0
5
10
15
20
25
30
Hours

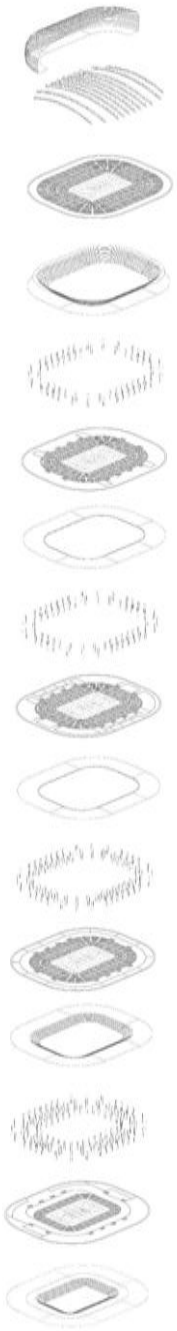
Conference Room

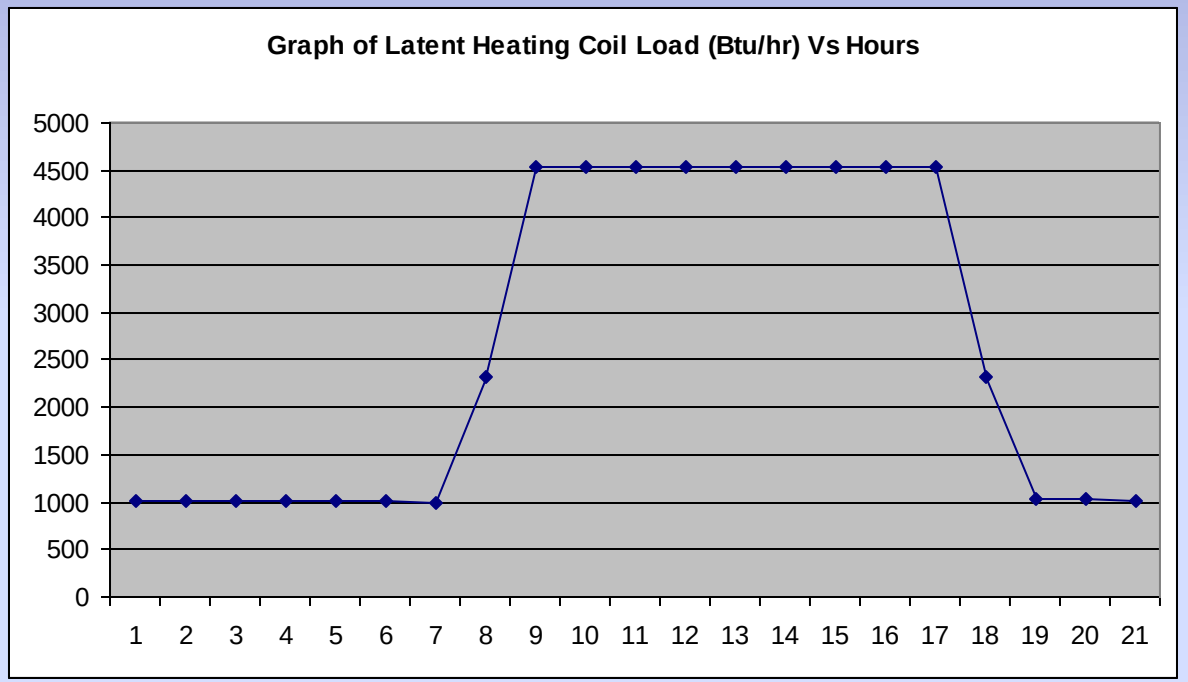


Conference Room

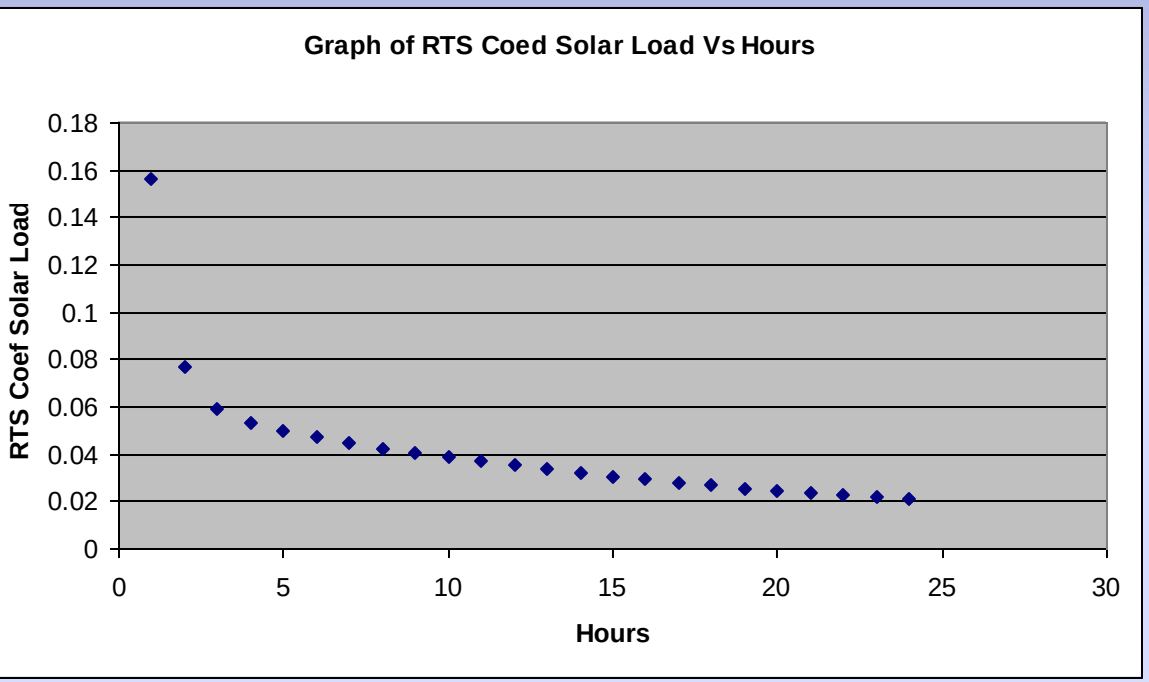


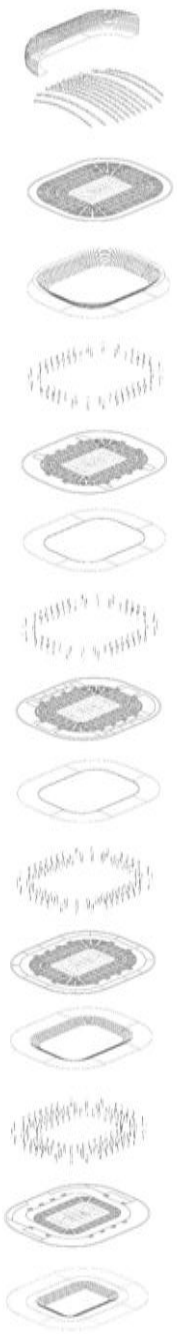
Third Floor




Graph of Latent Heating Coil Load (Btu/hr) Vs Hours
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Conference Room

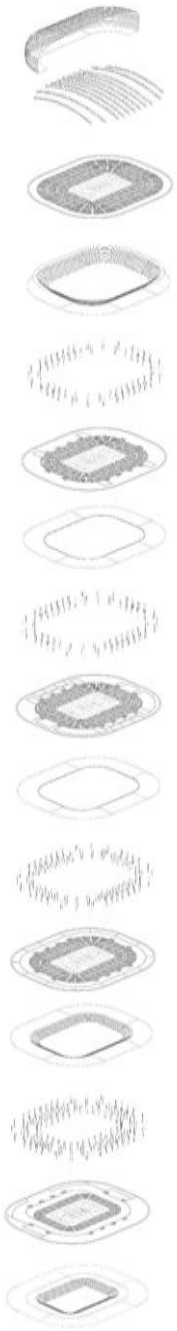




LIGHTING OBJECTIVE

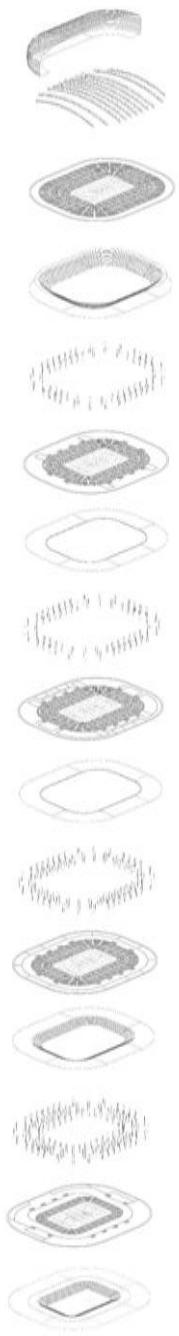
Arena Bowl Lighting

Control the brightness of an object verses the background such that the object will be visible regardless of its size, location, path and velocity, for any normal viewing position of spectator or player.



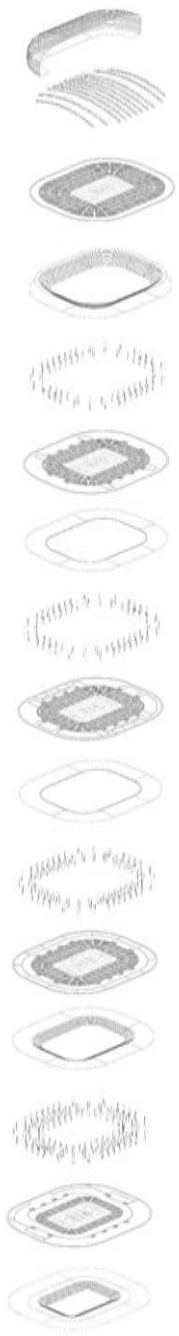
LIGHTING DESIGN SECTIONS

- **Arena Bowl Lighting**
- Specialty Rooms
  - Skyboxes
  - Suites
- Bathrooms and Player Locker Rooms
- Concession Stands
- Public Walkways



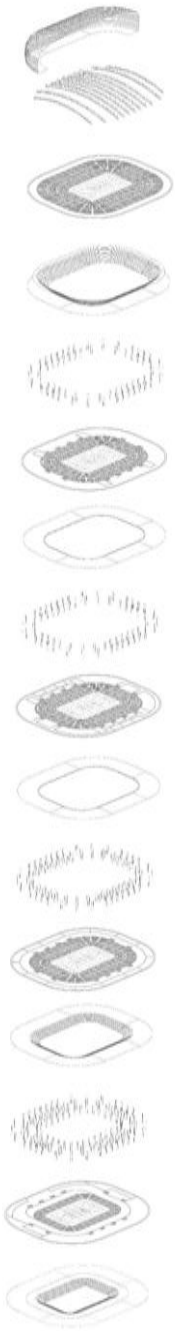
ARENA BOWL LIGHTING

- Event Lighting Systems
- House / Aisle / Emergency Lighting
- Theatrical Effects
- Scoreboard / Score cube
- Miscellaneous
  - Portable Spotlights
  - Still Camera Strobes
  - Catwalk



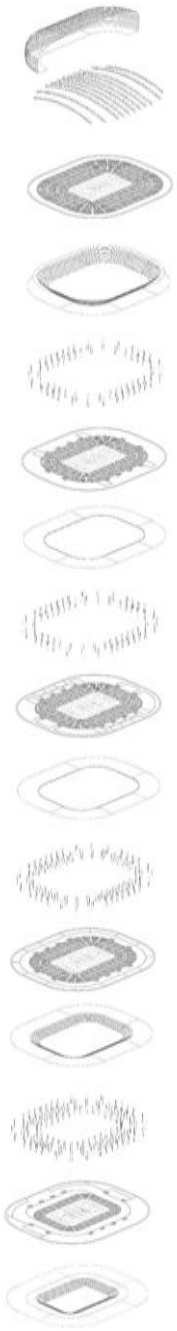
DESIGN CONSIDERATIONS

- Power Input Required
- Control Systems
- Event Lighting
  - Light Sources
  - Light Fixtures
  - Instant On / Off



DESIGN RESOURCES

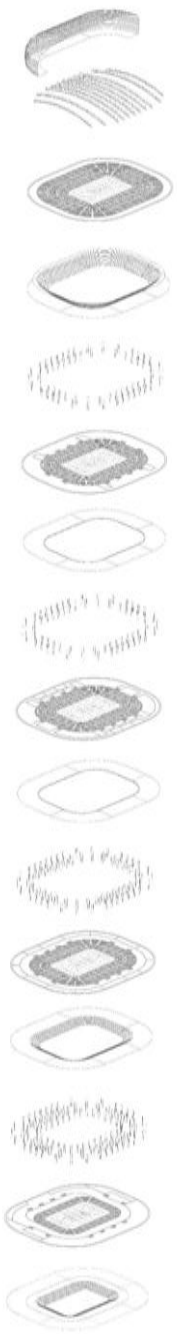
- Technical Magazines
- Professional Society Publications
  - Illumination Engineering Society of North America
  - International Commission on Illumination
- Internet
- Professional Consultants
- Manufacturing Representatives



DESIGN RESULTS

Event Lighting System

- GE Ultra Sport Quadrant System
  - 200 Total Lamps
  - 2000 / 1000 Watt
  - 0%-50%-100% Automatic Dimming
  - 200-footcandles on playing surface
- 400-Watt Retractable Twin Luminaire
  - 75-footcandles on playing surface



DESIGN RESULTS

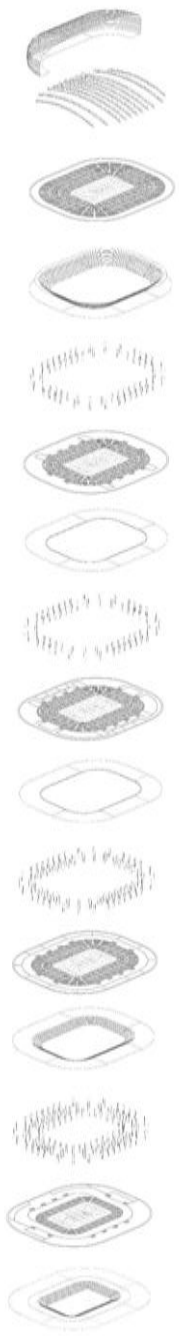
House / Aisle / Emergency

Instant on source of general illumination Within arena bowl. Alternately powered by emergency power generator

- 500 Watt Suspended Tungsten Halogen
  - 25-foot candle illumination.
- LED Aisle Lighting
- Full Brightness Emergency Lamps
  - Located at all exits

DESIGN RESULTS

- Specialty Rooms
  - Halogen ceiling lights with additional task lighting
  - Minimum illumination of 40-foot candles
- Public Room / Bathroom
  - Fluorescent lighting
  - Minimum illumination of 30-foot candles
- Recommend 4 spotlights with 12 optional locations



Plumbing

- Two taps from City Main
- Determine Flow Rate in GPM
- Size System
- Waste Stacks and Vents
- Follow Code