IPRO 335

DESIGN OF THE STADIUM

FALL 2006
Key tasks accomplished:
- design lobby/ security/ entrance areas of the stadium
- redesign seating and access to seating on all floors
- redesign all circulation of the building (stairs, elevators)
- design basement plan with loading dock and vip entrance and program the space
- design floor program of vip /scoring/conference rooms
- design bathrooms and concession areas of the building
- developed first floor programming with restaurants and museum
- design fourth access level
- design fourth level tier
- implement all structural members into building
- redesign sections and elevations
- developed and design ramps
BASEMENT FLOOR PLAN

AREAS ON THE FLOOR PLAN

- ENTRY FOR PLAYERS
- LOCKER ROOMS
- GYM
- MEDIA ROOM
- SECURITY AREA
- MECHANICAL ROOMS
- MEINTENANCE
- STORAGE
- CAFETERIA
- BATHROOMS
SECOND FLOOR PLAN
THIRD FLOOR PLAN
FOURTH FLOOR PLAN
FIRST FLOOR SECURITY

Security Policies
To ensure the best possible guest experience during this event, please observe the following:
Glass, plastic, and metal containers, weapons and illegal substances prohibited
Bags subject to search
Disruptions may result in ejection
No re-entry
Your Cooperation is appreciated.

PROHIBITED ITEMS:
Metal, plastic, glass containers of any kind
Backpacks and large bags
Large flags and banners, without approval
Poles and staffs (metal, plastic, or wooden)
Weapons and Illegal substances
Food and beverages
ELEVATIONS

FRONT ELEVATION

SIDE ELEVATION
CONCLUSION

- Key findings
  - fourth floor plan was inaccurate with section
  - designed stairways were not enough for the building
  - there was no entrance/lobby space designed
  - there was no loading dock
  - there was no entrance for vip’s and players
  - access to seating areas was shown incorrectly

- Conclusions
  - all levels were provided with accurate access to seating
  - all entrances and exits were incorporate into plans
  - develop of loading dock and entrance for vip/players
  - circulation of the building developed
Structural Design

- Gravity Loads
  - Dead load
  - Live load
  - Snow load

- Lateral Loads
  - Wind Load
  - Seismic Load
Frame Design

- Gravity Loading Requirements
- Deflection Requirements
- Seismic Requirements
Frame Analysis

- Hand Calculations
- Software
  - SAP
    - Push Over
    - Time History Analysis
Analysis Results

- Deflections
- Bending Moments and Axial Forces
Lighting Fixtures

- Arena
- Office and Hallways
- Restaurants and Museum
Arena Lighting

- Duraglow Luminaire
- 1000 W Metal Halide Lamp
- 146 Lamps
Zonal Cavity Method

- Determining the number of lights
  - Initial Lamp Lumens
  - Light Loss Factor (LLF)
  - Room Cavity Ratio (RCR)
  - Coefficient of Utilization (CU)

\[
\text{# of Fixtures} = \frac{\text{Footcandles \times Area}}{\text{Lumen \times CU \times LLF}}
\]
Electrical Load Equations

- Total Load = Lighting + A/V + HVAC + Concessions + Elevators + Security System + Miscellaneous

- Total Lighting Load
  - Approximately 6000 lighting fixtures
  - Approximately 335 kW
Video System Design

- Energy Efficiency
- Video quality
- LED display for main screens
- Network based video transmission
Audio System

- Reverberation a major problem
- Obstacle: interior design limited
- Analysis moved to next semester
Site & Landscape Plan
Site Diagram & Map
Green Lot Section

- Plan of the pavers
- Pavers and earth infill
- Fine gravel
- Medium gravel
- Coarse gravel
- Sub-grade
Rain Garden Section

- Indented area of dense landscaping
- 12-18” Compost/rich soil
- 2’ Sand
- Deep and extensive root system
The objective was to create a HVAC system for the underground parking garage while considering energy saving concerns as well as maintaining EPA guidelines for CO concentrations.
Mechanical: HVAC System

Some Considerations

- Amount of time spent in the garage
- Car emission rate
- Noise in HVAC system
- Flow jet properties of air
- Energy Savings
- Duct Sizing
- Outlet locations
- Ventilation control
Mechanical: HVAC System

Ventilation Control
There are 3 types of ventilation control

- **Constant volume**
  Ventilation is always on. Uses high amounts of energy to constantly run fans systems.

- **On-Off Control**
  Fans start and stop based on input from CO sensors. Saves some energy based on constant volume due to the fans being either on or off.

- **Variable Air Volume Control**
  Fans speeds adjusted depending on CO level in garage based from CO sensors. Saves most amount of energy due to the ability to change system fan speeds.

![Savings and Average Conc. For Control Systems](image)
Mechanical: HVAC System
Duct Design
Why is duct design important?

- Minimize work done by the fan to save energy
- Minimize frictional losses due to fittings of ducts and fans
- Minimize noise from the system due to health reasons

Steps to designing ducts

- Find pressure losses in system (due to change in height, velocity, etc)
- Divide system into sections depending on changing flow, size, or shape changes
- Size ducts using figures given in ASHRAE handbook
Mechanical: HVAC System

Results

- Variable air volume control used
- Main duct dimensions are: 1.5m x 0.60m
- Branch duct dimensions are: 0.80m x 0.40m
- Minimal air exchange per hour was calculated to be around 4 (but 6 used in order to comply with ASHRAE standards)
- Rounded joints for the ducts used to minimize the frictional losses
- Outlet grills for incoming air located on horizontal walls to maximize air mixing
Mechanical: HVAC System

Next Steps

- Selection of commercial fan with the pressure conditions calculated for the ducts
- Placement of the ducts in the garage
- Placement of the inlet and outlet areas for the air
- Placement of fan units inside the garage
The objective was to reduce water consumption in the stadium by at least 50%, adding to the “green” design of the building.
Mechanical: Plumbing
Considerations

- Maximum consumption rate of fixtures
- Retention pond usage
- Following International Plumbing Codes
Mechanical: Plumbing

Fixtures

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Model</th>
<th>% water saved</th>
<th>weighted % savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Closet</td>
<td>Kohler 4405 L</td>
<td>20</td>
<td>13.9</td>
</tr>
<tr>
<td>Urinal</td>
<td>Kohler K-4915</td>
<td>50</td>
<td>9.8</td>
</tr>
<tr>
<td>Drinking Fountain</td>
<td>Haws 1011HPSMS w/ Filter Model 6426</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Showerhead</td>
<td>Ecotech Low Flow Showerhead</td>
<td>60</td>
<td>1.2</td>
</tr>
<tr>
<td>Lavatory</td>
<td>Geberit Electronic Faucet 115.736.21.1 w/ 5 gpm aerator</td>
<td>75</td>
<td>5.4</td>
</tr>
<tr>
<td><strong>Total Savings</strong></td>
<td></td>
<td><strong>30.1</strong></td>
<td></td>
</tr>
</tbody>
</table>

- The percent water saved derives from the difference between gallons per minute or gallons per flush for the fixtures selected, and IPC recommended values. Total savings may be considerably higher if compared to outdated plumbing systems not complying to IPC standards.
- Weighted values are from the relative water load previously calculated in the spring of 2006.
- Cost was not given heavy consideration when selecting each piece of hardware.
# Mechanical: Plumbing

## Fixtures

<table>
<thead>
<tr>
<th>Types of fixtures</th>
<th>Standard Model</th>
<th>Efficient Model</th>
<th>Percent Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>toilets (gpf)</td>
<td>1.6</td>
<td>1.28</td>
<td>20</td>
</tr>
<tr>
<td>urinals (gpf)</td>
<td>1</td>
<td>0.5</td>
<td>50</td>
</tr>
<tr>
<td>drinking fountains (gpm)</td>
<td>0.5</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>showerheads (gpm)</td>
<td>2.5</td>
<td>1</td>
<td>60</td>
</tr>
<tr>
<td>lavatories (gpm)</td>
<td>2</td>
<td>0.5</td>
<td>75</td>
</tr>
</tbody>
</table>
Mechanical: Plumbing

Next Steps

- Consult calculations done by this year’s drainage team
- Integrate storm water retention pond into plumbing system
- Selecting pumps and water filtration for storm water
- Examine possibility of using Uniform Plumbing Code instead of International Plumbing Code
Mechanical Team

Resources

- Environmental Design and Construction: The 2006 Green Book
- www.kohler.com
- www.chicagofaucets.com
- www.hawsco.com
- http://www.ecotechwater.com/Products/products.asp
Civil Design

- Drainage design
  - 100 year 24 hr storm
  - Volume of Water
Piping Design

- Layout and Material Selection