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Spring 2009
   Preliminary Design. Analysis found structural deficiencies.

Fall 2009
   IPRO 315 focused on designing a 22 story "Phantasy Hotel" located in the western suburbs of Oakbrook, IL. The 315 design group was comprised of Architects & Engineers, working together to create architectural plans that the engineers could make possible through calculations. As a continuing IPRO from the spring 2009, the team was able to efficiently design the structure and fix the torsion problems of the previous years.
IPRO 315
DESIGN OF A LARGE SCALE STRUCTURE

PROBLEM ORGANIZATION

STRUCTURAL

Phase 1
- FLOOR PROGRAM
- FLOOR PLANS
- FINALIZE DESIGN

Phase 2
- FINALIZE LOADS
- FINALIZE MODEL
- DESIGN STEEL
- FOUNDATION

Phase 3
- FINALIZE SCHEDULE
- FINALIZE PLANS

ARCHITECTURAL

Phase 1
- FLOOR PROGRAM
- FLOOR PLANS
- FINALIZE DESIGN

Phase 2
- GREEN ROOF DESIGN
- FAÇADE DESIGN
- AESTHETIC DESIGN
- FINALIZE SCHEDULE

Phase 3
- SCALE MODEL
<table>
<thead>
<tr>
<th>IDEAS</th>
<th>CHALLENGES</th>
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<tbody>
<tr>
<td>• MAKE MORE EFFICIENT</td>
<td>• FIX TORSION (TWISTING) PROBLEMS</td>
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<tr>
<td>• DETAILED PLANS</td>
<td>• NO EXACT SITE</td>
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<tr>
<td>• DETAILED SECTIONS</td>
<td>• GIVEN LAYOUT WAS HARD TO WORK WITH</td>
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<tr>
<td>• GREEN ROOF</td>
<td>• BATHROOMS</td>
</tr>
<tr>
<td>• MOVE THE CORE</td>
<td></td>
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<tr>
<td>• ADD MORE BATHROOMS</td>
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Phantasy Hotel Layout

**Floor Heights:**
- Typ. Suite Floor: 8'
- Lobby: 13'
- Offices: 13'
- Restaurant: 10'
- Ballroom: 13'
- Café: 10'
- Conference: 10'
- SPA: 10'
- Mechanical: 13'

Total Building Height: 297'

**Hotel:**
- Suites Per Floor: 10
- Number of suite floors: 14
- Total number of suites: 140
First Floor Lobby
IPRO 315
DESIGN OF A LARGE SCALE STRUCTURE

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First Floor Lobby
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Typical Guest Floor Layout with Elevator/Stair Shafts and Bedrooms

Efficiency:
- Area of typ. floor: 5,183 sq ft
- Area of suites per floor: 3,672 sq ft
- 71% Efficiency ratio
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Typical Guest Suite
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Green Roof
BENEFITS

- Grow fruits, vegetables, and flowers
- Reduce heating loads on a building
- Reduce cooling loads on a building
- Reduce the city's average temperatures during the summer
- Increase roof life span
- Reduce stormwater run off
- Filter pollutants and carbon dioxide out of the air
- Help to insulate a building for sound.
- Filter pollutants and heavy metals out of rainwater
- Increase wildlife habitat in built-up areas
TYPE
- Intensive Flat Green Roof

PURPOSE
- Create special recreation space to refresh people with fascinated view and nature

SYSTEM
- Built-in Place system
- 4” soil depth
- 1/4 : 12 slop
- 4 main drains and 6 emergency drains
- 3441.83 sf green roof area
- 60 pounds per square foot for plants and trees
- Roof Load Total 137673.2 lbs/sf
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Green Roof
I. Procedure

1. Calculations Using Matcad
   Girder → Beam → Column
   (Load is assigned by AISC-7)

2. Based on calculations, steel members for the framework of the building are designed

3. SAP Modeling used for the Load Cases to determine Governing Load.

4. CAD Drawings of each floor details is added
II. Detail

1. Deck: Composite floor deck is used (Vulcraft 3VLI)

2. Economical Design:
   Based on Load cases calculation,
   Safe & Economical design
III. Steel Design

1. Structural calculations using MathCad were done to design a composite beam system
2. Girder and beam design using the Allowable stress Design Method (ASD)
3. Design of a typical Column section using the ASD method
4. Lateral Load Resisting System
Shear wall
What is SAP 2000?

- Integrated software for structural analysis and design.
- Provides linear and nonlinear, static and dynamic analysis and design of three-dimensional structures.
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DESIGN OF A LARGE SCALE STRUCTURE

Modeling

• SAP 2000 Modeling
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Modeling

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Modeling

• SAP 2000 Modeling
 Modeling

• SAP 2000 Modeling
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DESIGN OF A LARGE SCALE STRUCTURE

Foundation Group

95' Deep
45° Bell Angle
6'-17' Dia. Bases
#4 Ties at 18” O.C.
#10, #14, #18 Vert. Bars
Supports Gradebeams
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45° Bell Angle
6'-17' Dia. Bases
#4 Ties at 18” O.C.
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CONCLUSION

• Importance of clear communication between disciplines
• Necessity of clear planning
• Importance of flexibility to accommodate possible changes
• Balance between delegation and cooperation
• “Big picture” view of individual design elements
• Experience with demands of real-world design projects