

# **IPRO 315 – Capstone Design – Parking Garage Fall 2007 Final Report**

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## Members:

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Elijah Stine  
Seth Thomas  
David Williams  
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## **REVISED OBJECTIVES**

The plan for this IPRO is to develop a design for a large scale parking garage that can accommodate about 500 cars and will be located on IIT's main campus. The objective of this project is to develop a design that is applicable to today's lifestyles, yet goes beyond the standard parking systems currently used. Features including quick handling of incoming and outgoing cars, efficiency in storage, and aesthetics are all considered in design. Basically, the aim is to develop an innovative and economical concept for parking a car.

The building will be completely self-sufficient and will incorporate the architecture of the various buildings on campus. An automated parking system has been chosen for the design. An automated system will include a vehicle lifting and maneuvering device to move and park the vehicle so the driver does not have to. The structure will be built with steel with reinforced concrete floors. The architectural integrity will combine the appearance of building on campus with a futuristic innovative addition.

## **RESULTS TO DATE**

The IPRO team in general has performed an extensive amount of work for this project. From research, to drawings, to analysis, it is certain that this project is well underway for certain completion by the end of the course.

## **BARRIERS AND OBSTACLES**

To date, there have been a few substantial barriers and obstacles.

## **REVISED TASK/EVENT SCHEDULE**

- Week 1:* Introduction of the project and identification of the tasks.
- Week 2:* Development of architectural design.
  - Selection of structure types.
  - Approval by the client.
- Week 3:* Building envelope design.
  - Start of structural analysis and design.
- Week 4:* Continued building envelope design.
  - Continued structural design.
- Week 5:* Continued mechanical system design.
- Week 6:* Continued mechanical system design.
  - Continued structural design.
- Week 7:* Continued mechanical system design.
- Week 8:* Progress report presentation.
  - Finalized mechanical system design.
  - Finalized structural design.
- Week 9:* Traffic flow study started.
- Week 10:* Building serviceability reviews.
- Week 11:* Structural foundation design.
- Week 12:* Traffic flow study completed.
- Week 13:* Cost estimating and bill of materials.
- Week 14:* Begin preparation of presentation materials.
- Week 15:* Finalized architectural, structural, and mechanical design and drawings.
  - Final report and presentation.

## **UPDATED ASSIGNMENTS**

For the IPRO, three separate groups were created, based on student major and specialty. The Design Team is responsible for the design of the structure while the Structural Team is responsible for the analysis of the structure/design of structural components and the Mechanical Team is responsible for the mechanics (namely, the design of the lift utilized in the project). Each group has made performed a substantial amount of work in contribution to the project. As of right now, everything is preliminary. Revised objectives, results to date, revised task/event schedule, and updated assignments for each group are specified below.

## Design Team

### Members:

Marek Dominikowski  
John Kapecki  
Nicholas Palladino  
Saagar Patel

### Team Objectives

The architectural group has been responsible for creating and revising plans, sections, elevations, and a site plan for this project. The Design Team is responsible for implementing architectural details and perspectives for the client. They will be putting together the presentation boards and coordinating all efforts that will be involved with this.

### Results to Date

So far, the team has drawn up preliminary plans and elevation drawings. For a typical floor plan, see Figure 1 in the Appendix. Research is on-going for a glass curtain wall.

### Team Task/Event Schedule

<i>Week of October 23rd:</i>	Continued design and drawings of plans and elevations.
<i>Week of October 30th:</i>	Continued design and drawings of sections and details.
<i>Week of November 5th:</i>	Continued design and drawings of sections and details.
<i>Week of November 12th:</i>	Continued design and drawings of sections and details, including elevation details, roof details, and attachment of façade panels to structure.
<i>Week of November 19th:</i>	Finalized architectural design and drawings. Poster boards and presentation materials finalized.

### Barriers and Obstacles

The main obstacle in the progression of the design has been dramatic changes and alterations to initial proposal throughout the course of the project thus far. This has required extra work and effort from the Design Team.

## Structural Team

### Members:

Lukas Janulis  
Piotr Sawulski  
David Williams

### Team Objectives

The objective of the structural team is to design a system that adequately supports the building and all its contents according to codes and methods used by today's structural engineers. This team will work together with the Design Team to make the systems work together.

**Results to Date**

As of right now, dead and live loads have been calculated. Due to the unique shape of the building, wind loads have not been calculated. There has been plans to utilize the on-campus wind tunnel to see if it is possible to calculate in this fashion, however if that is not done, 20 psf is the assumed wind load for the Chicago area.

Based on the loadings, columns and beams have been designed. The pallets are to be pre-fabricated while the columns and beams are to be cast in place, to make a rigid connection. For design of the columns and beams, see Figure 2 in the Appendix.

Structural connections still need to be designed, as do more exact numbers on the size of the beam/column (depending on wind load).

**Team Task/Event Schedule**

<i>Week of October 23rd:</i>	Finalized sizes and specifications for structural members to be submitted to Design Team.
<i>Week of October 30th:</i>	Continued structural design, including concrete reinforcement design for columns, beams, and pre-fabricated slabs.
<i>Week of November 5th:</i>	Continued structural design, including preliminary foundation design. Structural information to be used on poster boards to be submitted to Design Team.
<i>Week of November 12th:</i>	Finalized structural design and drawings. Preliminary traffic flow study.
<i>Week of November 19th:</i>	Preliminary cost estimation.

**Barriers and Obstacles**

As of now, the largest obstacle for the structural team has been the design change. With the change in design, loads were changed, as well as a few columns. The change in design also changed the affect of wind loads, which needs to be analyzed.

The other major obstacle is designing with pre-fabricated concrete, as no one on the structural team has experienced with pre-fabricated concrete.

## **Mechanical Team**

### Members:

Julian Beltran

Joe J. Carden

Viral Patel

Elijah Stine

Seth Thomas

### **Team Objectives**

The objective of the Mechanical Team is to come up with the design of a mechanical lift system for the garage and the backup systems needed in order to continue functionality in case of a power outage or other hazards. The primary task was to come up with the proper mechanical lift system and structural design components for the lift to operate.

### **Results to Date**

So far, the team has come up with several calculations in the hydraulic and pulley designs and has checked up with several companies and with campus faculty to confirm that progress is on the right track.

The support structure would be an I-beam structure with a pallet that would move up and down through the pulley system. The pallet would then have the system that would allow that forklift arm to move in and out of certain bays and attached to the forklift would be the hydraulic system that would carry the platform to its designated compartment and when prompted would be able to bring it back to the ground floor.

Our next step is to finalize the calculations and give the detailed dimensional analysis to the Structural and Architectural Teams so they can incorporate it in the design.

### **Team Task/Event Schedule**

- Week of October 23rd:* Finalized sizes and specifications for mechanical members to be submitted to Design Team.
- Week of October 30th:* Continued lifting system design, including support of the lift tower structure.
- Week of November 5th:* Continued lifting system design, including load and dynamic impact issues during operation.  
Mechanical information to be used on poster boards to be submitted to Design Team.
- Week of November 12th:* Continued mechanical design and drawings, including back-up power system needs.
- Week of November 19th:* Finalized mechanical design and drawings.

**Barriers and Obstacles**

The complications in the project are mainly due to lack of information on such high demand mechanical systems because its very new and not many companies have done any research on this and the ones that have been successful with the design are very reluctant to disclose any information even for a school project purpose.

**Transportation Team**Members:

Yousef Zaatar

**Team Objectives**

The objective of the Transportation Team is to come up with the street layouts and to see if there is any additional modification to the surroundings of the parking structure to accommodate for this structure. Furthermore a traffic flow study will be conducted to conclude what is the best location for the entrance/exit from this structure.

**Results to Date**

So far, the team has come up with several options for the layout of the streets surrounding the structure. The options are currently being studied to determine the best option. The team has been communicating with the parking services to get some data for the transportation study.

**Cost estimating Team**Members:

Mohamad Khudeira

**Team Objectives**

The objective of this team is to estimate the cost of the structure and the modification of the surrounding area. RSMEANS will be used to get the numbers for the estimate of materials.

**Results to Date**

The team is waiting on the final design to be completed to do the cost estimate of the structure.

## APPENDIX

Figure 1 – X-ray cut of structure

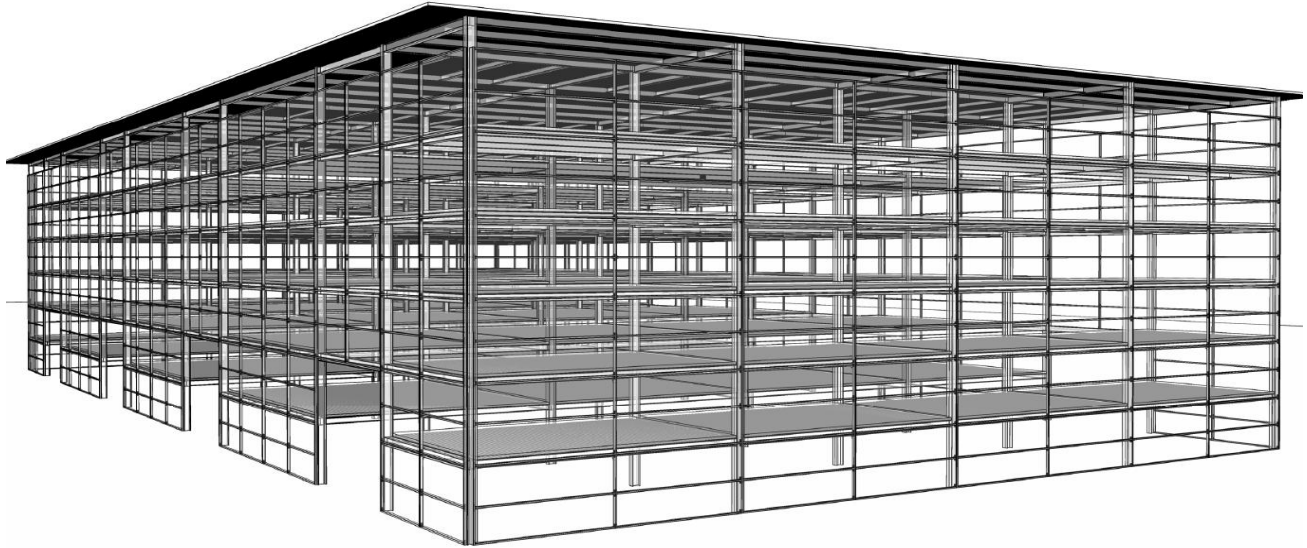


Figure 2 – Design of Typical composite deck

