IPRO-315:
Design of a Large Scale Structure

IPRO Faculty Advisors
Dr. Jeffrey Budiman
Dr. Jay Shen
Jorge Cobo

IPRO Team Member

Carmen Aguilar-Wedge
Oladipo Animashaun
Alex Baur
Michael Cullen
Shuaib Hadi
Namrata Hedge
Steve Kuo
Christopher Lee
Yongdoo Lee
Karol Rybaltowski
Dawveed Scully
Jie-Hua Shen
Shadi Yousef
Yoojee Kim

Executive Summary

IPRO 315 focused on designing a 22 story "Phantasy Hotel" located in the western suburbs of Oakbrook, IL. When designing the hotel the group viewed themselves as The IPRO 315 Design Group is a multidisciplinary design firm specializing in hotel building projects. 315 worked together to create architectural plans that the engineers could make possible through calculations. The group was comprised of Architects, Structural and Civil Engineers, and an Electrical Engineer. As a continuing IPRO from the spring 2009, the team was able to efficiently design the structure and fix the torsional problems of the previous years.

The Phantasy Hotel, a large scale structure, can now be constructed according to ASCE-7 (American Society of CIvil Engineers Minimum Design Loads for Buildings), IBC (International Building Code), and AISC (American Institute of Steel Construction), codes made up by professionals in the industry to insure building and design safety for the public.

Purpose and Objectives

IPRO 315 is an ongoing project. This semester the students were asked to use their skills as architects and engineers to modify a structure created by the previous semesters designers. The group was given a similar frame design from an existing hotel in Chicago, IL and from there a new architectural re-creation of the original Phantasy Hotel as well as a second computer analysis of the structure in order to select new materials for construction of the tower and foundation work was needed. The biggest problem that the 315 group encountered when reviewing the work of the previous semester were initial torsional problems due to wind or seismic loads on the building. Torsion is the twisting of an object due to an applied lateral load. We found that with the correct amount of wind at a specific angle the building would twist off of its foundation. It was critical that we found a solution to the given as the primary problem, so the team moved the "core" of the building, made up of four shear concrete walls that span the entire height of the

building, five feet toward the center so the center of mass was not off-set causing problems with its structural integrity.

A simulation of a real team from a design office, this IPRO was the first time that the students were asked to work on a "real life" project. It was also the first time that the Architects and Engineers were able to work together outside of the classroom environment toward a possible goal. It was important for both groups to be able to work together to achieve the goals ahead of them, so a big emphasis was put on management, ethics, teamwork, and leadership. Although no sponsors or clients were involved the IPRO went ahead and worked on the project seriously, and made no shortcuts.

Organization and Approach

The 315 Group was comprised of two main divisions: Architects and Engineers. A split between the disciplines created each division of the company, Team leaders came forth from the two groups and subsequent divisions took place. The team leaders also acted at liaisons amongst the teams so no duplication of work took place and that all of the needed information was shared from team-team. Since the group met bi-weekly each member was fully aware of each teams standings and what their next steps were. Once each part was completed it was uploaded to igroups so that each team member had access to all files. Upon completion of research and tasks all files were compiled and a clear project plan was made.

The engineers were divided int three sub-teams. This was done to ensure that each group was able to accomplish their individual group goals. The engineers were divided up into three teams: Computer Analysis, Steel Design, and Foundation Design.

The Architecture Group-Involved in the design of the building, including frame, effiient layouts, aesthetic design, etc. The group will also be responsible for the building models, renderings, code accomodation, and green roof design.

It was imperative that there was clear communication between both groups. Not only did we meet often but we communicated via email. Since most of the files we worked with were software based we were able to review and check eachothers work easily.

Analysis and Findings

The 315 group was asked to fix initial problems with the previous building given to them by its designers of the previous semesters. The major problem with the previous design was that it couldn't with stand any wind or seismic loads, these are loads that are perpendicular to the structure, causing it to twist off of its foundation. The 315 group saw this as an issue that couldn't be ignored. The initial design off-set the concrete core of the building so the lateral loads were not being placed at the centroid of the building. The 315 group moved this core about five feet toward to center and got rid of dead space inside the building so the integrity of the hotel suites were not compromised.

This change fixed the problem. The architects produced a set of plans from AutoCAD for each story of the hotel including, the lobby levels, the restaurants and ballroom, mechanical rooms, typical suite floor plan, spa, and green roof design. Also included in the set are numerous details and building sections to help better understand the building. The engineers were able to successfully create a 3D analysis of the building in SAP 2000 computer program. SAP 2000 (Structural Analysis Program) created at the University of Berkeley in California integrates physical laws and mathematics to study and predict the behavior of structures. Using SAP2000 the 315 group was able to find the service, axial, dead & live, loads on the individual members at each floor so a complete steel and foundation design could be performed while adhering to the relevant building code.

Once we applied loads to the building we were able to calculate the colums, beams, and girders using Mathcad and Matlab to help with the calculations. Once the building had been designed we moved on to foundation design where caisson foundations were used that went 95 feet below the ground surface.

Conclusions and Recommendations

This semester is the actual conclusion of The 315 group, for the project has been successfully finished. This simulation of a 'real life' project was very valuable to the 315 group. Although the time parameters seem unlikely, it was a good way to experience what exactly goes into a project of this magnitude. 315 Group was fortunate that most of the research was done in the previous IPRO so the design work could start immediately. The 315 group was able to make the best decisions based on the information given so the safest and most cost efficient building could be constructed.

When 315 started the project their initial goals were to incorporate the materials learned through out their IIT education and apply those studies in an actual design procedure and process. Teamwork and fluidity within the company was necessary in order to determine solutions to the problems that arose in the design of the large scale project. In conclusion and with success, the 315 group was able to attain the skills necessary to prepare them for the following steps of their professional careers.

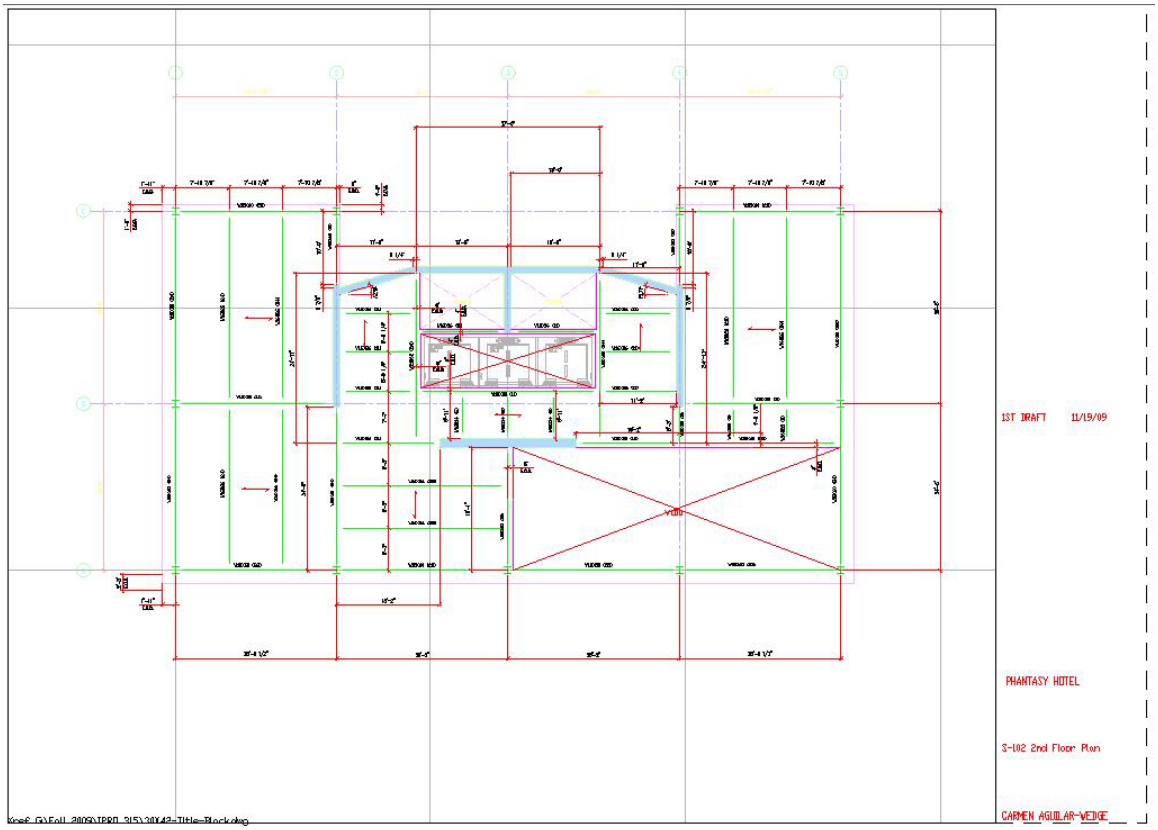
Appendices

Project Budget

Presentation: Posters Printing Misc. Supplies	Total Estimate:	$400
	Total:	$400

Addenda A

A.1. This is the existing building plan given to IPRO 315 that will be amended:



A.2. These are the CAD scaling standards to adhere to:

Drawing	Scale From							Text	Paper space
Scale	1/8	3/16	1/4	3/8	1/2	3/4	1	Size	Scale
	Scale Factors								1/#XP
1/8	1	1.5	1	3	4	6	8	12	96
3/16	0.6667	1	1.3333	2	2.6667	4	5.3333	8	64
1/4	0.5	0.75	1	1.5	2	3	4	6	48
3/8	0.3333	0.5	0.6667	1	1.3333	2	2.6667	4	32
1/2	0.25	0.375	0.5	0.75	1	1.5	2	3	24
3/4	1.6667	0.25	0.3333	0.5	0.6667	1	1.333	2	16
1	0.125	0.1875	0.25	0.375	0.5	0.75	1	1.5	12

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