

IPRO-315:

Design of a Large Scale Structure

IPRO Faculty Advisors

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IPRO Team Members

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Cervantes, Jesus
Cheung, Kwong

Conley, Kaitlyn
Crowley, Brian
Ekstrand, Carl
Ezell, Garrett
Jurasits, Joseph
Kozys, Karolis
Kucher, Rostislav
Lollino, Luca

Nizich, Adam
Newman, Adam
O'Neil, Benjamin
Park, Shin Young
Roubeni, Sacha
Witek, Andrew
Zarazua, Gustavo

1.0 Team Information

Name	Major	New knowledge/ skills to develop	Strengths	Overall expectations
Corina Abrudan	Civil Engineering	Project presentation	Hardworking, reliable, very organized	To try and make everyone work as a team.
Christopher Adams	Civil Engineering	Develop AutoCAD Skills	PowerPoint and presentation, public speaking	I expect to learn from my peers and do what is expected of me to complete and present the project
Fabian Aguillar	Architectural Engineering	Develop structural design skills and foster teamwork	AutoCAD drawing and architectural development	Succeed with the project and meet the owners expectations
Rodrigo Aihara	Mechanical Engineering	Learn how to work in a large group and be able to communicate with other group members	Very detailed and hardworking	Be able to complete our team's objectives
Algirdas Bielskus	Mechanical Engineering	Learn more about HVAC and how to correctly size furnaces and Air Conditioners for hotels.	Able to apply theory presented in coursework to real world examples	Produce a plan for the hotel that incorporates sustainability not only in terms of concern for the environment but also concerning cost-effectiveness
Adnan Bhat	Mechanical Engineering	Better drawing skills	HVAC, mechanical skills	To be part of a great team
Jesus Cervantes	Mechanical Engineering	Be a better team player, learn how design HVAC and plumbing systems	Good troubleshooter, strong work ethic	Do a great job on the project and make the design close to real as possible.
Kaitlyn Conley	Civil Engineering	Better design aspects and better integration with other majors	Dedicated, persistent, efficient	Strengthen design skills and develop better understanding about the structural aspects
Kwong Cheung	Civil Engineering	Better communication with each member in the team	Auto Cad drawing	to get more experience with large scale buildings
Brian Crowley	Civil Engineering	Work better in groups, communicate better, work as better team member.	Hardworking, dedicated to the project, good with structural analysis calculations	To have everyone work together doing equal amounts of work to complete and exceed the expectations of the professors when finishing the building.
Carl Ekstrand	Civil Engineering	Improve my design skills	Problem solver, hardworking	To complete a project from ground up
Garrett Ezell	Mechanical Engineering	Improve my design and HVAC skills	Project-related organizational, problem solving, and multi-tasking skills	Work efficiently with a large group of people
Joseph Jurastis	Civil Engineering	Improve my team work	Modeling, SAP, AutoCAD	Learn to design an entire project

Karolis Kozys	Civil Engineering	Work as a part of a team,	Good problem solver, team work	To get close to real work experience, and get the job done on schedule
Rostislav Kucher	Civil Engineering	Have decent knowledge of building code, especially steel Manual	I have plenty of construction experience	Expect to learn to collaborate better with fellow peers.
Luca Lollino	Civil Engineering	Have a better understanding of the process of building a large scale structure	Experience in finite element modeling, SAP and ADINA	Expect to learn a great deal about other aspects of building a large scale structure
Adam Newman	Architecture	Develop mechanical and structural skills	I have some knowledge into systems and drawing conventions.	To get the job done in time
Adam Nizich	Civil Engineering	Design building skills	Arc View, management skills	To design a building
Ben O'Neil	Environmental Engineering	Get more experience in leadership and organization of large-scale projects	Structural modeling, SAP, MathCAD, communication, and multi-tasking.	Learning new software packages and research into rooftop gardens and building design for run off management.
Shin Young Park	Architecture	Learn to build what I design	Drawing	Finish the project on time
Sacha Roubeni	Architecture	Be a good team member	AutoCAD drawing	Get more experience with engineers from different fields
Andrew Witek	Civil Engineering	Work efficiently in a large group. Increase my AutoCAD skills while working on the project's drawings	Motivated, hard working, and very detailed with my work.	To work efficiently as an entire group to complete the project objectives.
Gustavo Zarazua	Mechanical Engineering	Gain more experience in calculating heating/cooling loads and determining the equipment that is to be used.	Experience in calculating heating/cooling loads as well as duct work sizing	Expect this to be a somewhat challenging project, there are many design considerations for constructing large scale buildings

2.0 Team Purpose and Objectives

The purpose of this IPRO is to design a 22 story hotel located in the western suburbs of Oakbrook, IL. The group will use their skills in Architectural, Structural, and Mechanical engineering to efficiently design this structure.

The objectives of this IPRO are to design the structure to include:

For the Architectural portion:

- A. A front desk and lobby area at the first floor.
- B. A kitchen and formal restaurant with capacity for 150 people.
- C. A kitchen and cafeteria with capacity for 100 people.
- D. An exercise room and spa area.
- E. One floor for hotel administrative offices.
- F. A ballroom.
- G. A green roof and an outdoor area at the top floor.

For the Structural portion:

- A. Concrete spread footings and caissons for the foundation.
- B. Reinforced concrete shear walls forming the core of the building, designed to resist gravity and lateral loads imposed on the structure.
- C. Steel columns and composite steel beams forming the exterior structure designed to resist gravity loads only.
- D. Elevated floors constructed using normal weight concrete slabs on a metal deck.

For the Mechanical portion:

- A. Heating Ventilation and Air Conditioning system (HVAC).
- B. Mechanical Electrical and Plumbing systems (MEP).
- C. Electrical equipment and accessories.

3.0 Background

- 3.1 Sponsor Information: IPRO 315 Design Group is a multidisciplinary design firm specialized in residential and hotel building projects. IPRO 315 Design Group is composed of three main divisions: Architectural, Structural, and Mechanical. IPRO 315 Design Group is divided in three groups forming each of the divisions of the company.
- 3.2 Addressed Problems: As stated in the paragraph above, the aim of IPRO 315 is to design a 22 story hotel equipped with almost the same substance as a typical big city hotel. IPRO 315 is focusing on getting design project documents done for bid purposes by completing them in accordance with

the 2006 International Building Code IBC-2006 and other relevant code references as required by the city of Oakbrook.

- 3.3. Technology Involved: SAP (Structural Analysis Program) is used to analyze the integrity and strength of the structure. AutoCAD is also utilized to draw out all elements of the structure which include architectural, structural, and mechanical components. Technical report writing is used to effectively explain the results of the project.
- 3.4. Previous Attempts to Solve the Problem: This is the first attempt by IPRO 315 at solving the problem.
- 3.5. Ethical Issues: IPRO 315 will strictly abide by all codes as required by the city of Oakbrook as to not compromise the safety of those residing in the hotel.
- 3.6. Societal Costs: The designing of a hotel will benefit society by providing the potential to create jobs in this rough economic period.
- 3.7. Implementation Outline: The team is broken into three groups with each specializing in Architectural, Structural, and Mechanical engineering. Each group is chosen a team leader which will be responsible for having specific deadlines met. Aside from the specialized groups, sub-teams made up of assorted majors will take on IPRO deliverables and presentations.
- 3.8. Research literature: Research from educational textbooks, literature, and journals pertaining to strength of materials, heat and mass transfer, fluid mechanics, and other relevant design information available will be used.
- 3.9. Supporting Documents: A document provided to us from our preliminary briefing for the project is attached as Addenda A.

4.0. Team Values Statement

This semester's IPRO - 315 team recognizes that the success of the project, and the individual's capacity for learning, rests on the fluidity of the group's dynamics. Therefore, the team collectively will adhere to certain values that would support successful projects in business environment. These 'ethically tolerated' values include, but are not limited to the following:

- 4.1 Regular attendance and punctuality to group and sub-group meetings.
- 4.2 Participation and contributions to group discussions and sub-group objectives.

- 4.3 Close attention to the timeline of objectives set forth in the Project Plan must be paid by the sub-groups.
- 4.4 Clear and timely communication with team member's regarding project objectives, including IPRO Deliverables.

The above values will be regimented by the sub-group leaders; should group members disregard the values, the advisors will be notified. These objectives will be made more fluent through iGroups online discussions and detailed online time reporting, regular sub-group meetings, clearly defined sub-group goals, and frequent communications between sub-group leaders.

5.0. Methodology / Brainstorm / Work Breakdown Structure

The IPRO team will develop the architectural and engineering design for an engineer's estimate concerning the development of a mid-rise hotel in Oakbrook, IL. per the request of the sponsor. The breakdown of work is as follows.

- 5.1 This is an inter-disciplinary team and the work breakdown will affix the major design groups required in the design of the building. Group members will be mentioned in a subsequent section, but the groups are defined as follows:
 - 5.1.1 Architecture Group – Involved in the design of the building, including frame, layout, aesthetic design, et al. The group will also be responsible for the building models, code accommodation, and green roof design.
 - 5.1.2 Structural Group – The group will be responsible for the structural design, engineering related computer modeling, relevant code compliance, and foundation design.
 - 5.1.3 Mechanical Group – Accountable for the design of the mechanical systems involved in the building, including HVAC, plumbing, and fire protection.
- 5.2 Relevant models will be constructed in various software. Models will be developed and presented to all teams, to assure compliance with engineering procedure and code.
- 5.3 Required analyses will be documented within each group, to be held accountable by the group leader, and posted on iGroups to ensure transparency of results.
- 5.4 The order of work breakdown, and expected task completion which corresponds to required development will be defined in section 8.0.
- 5.5 IPRO deliverables are the responsibility of the four group leaders, who will assign tasks as necessary, but have the overall liability in constructing the deliverables. Other members are responsible in accordance with the team values mentioned in section 4.0.

6.0. Expected Results

This project will give the IPRO team an opportunity to incorporate the materials that have been studied through the course of their education giving them an opportunity to apply their studies on actual design procedures and processes. The individuals involved will be able to work as a team in order to determine the solutions to the design of a large scale project and attain the skills necessary to prepare them for the following steps of their professional careers.

- 6.1 The team will need to work together on the design of a large scale project and will need to coordinate with other members of their groups in order to accomplish the overall design.
- 6.2 The team will be producing various design drawings representative of the project and operation of the building.
 - 6.2.1 Architectural drawings will provide the general details of the building design and function.
 - 6.2.2 Structural drawings will provide the support structure of the building.
 - 6.2.3 MEP drawings will provide the mechanical (HVAC), plumbing/fire protection, and basic electrical requirements and locations of the building.
- 6.3 The team will expect to face challenges over the design of such a large scale project and will need to make assumptions based on those challenges.
 - 6.3.1 Architectural will need to overcome challenges based on the relative space available in order to incorporate all of the desired building requirements put forth by the building owner. They will need to overcome challenges such as ceiling and floor heights as well as efficient use of the available spaces of the building.
 - 6.3.2 Structural will need to overcome challenges such as accounting for the varying load conditions that a building such as this can be subject to. They will need to overcome design challenges incorporated in properly supporting a structure.
 - 6.3.3 MEP will need to face the challenges of the supply of air and water services to the building inhabitants. They will need to work closely with architectural in their designs in order to provide the most efficient MEP system for the building occupants and owner.

7.0. Project Budget

Presentation:	Total Estimate:	\$100
Posters		
Printing		
Misc. Supplies		
Team Party:	Total Estimate:	\$100
Food/Pizza		
Drinks/Misc.		
Snacks		
Model:	Total Estimate:	\$300
Construction Supplies		
Glue/Nails		
Misc. Supplies		
	Grand Total:	\$500

8.0. Schedule of Tasks and Milestone Events

The following schedule of tasks reflects the required, yet ideal sequence in designing the structure, as certain groups must complete tasks for other groups to continue in the development of the building.

NOTE: The numbers in the brackets below represent by what week the work should be done.

8.1. Architecture Group

- 8.1.1. Research on relevant codes [3]
- 8.1.2. Research possible sites [3]
- 8.1.3. Brainstorm conceptual design and framing [3]
- 8.1.4. Initial conceptual design and framing for submittal to groups [4]
- 8.1.5. Confer with groups and begin floor programming and layout [4]
- 8.1.6. Anticipated revisions required from other groups [5]
- 8.1.7. Framing, programming, and layout finalized [6]
- 8.1.8. Begin design on green roof landscape [7]
- 8.1.9. Incorporate further aesthetic appeal and ornamentation [7]
- 8.1.10. Begin modeling of structure, including research on software to incorporate 3D, animated, and laser-cut models. [8]

8.2. Structural Group

- 8.2.1. Begin SAP and CAD modeling [3]
- 8.2.2. Research foundation sites [3]
- 8.2.3. Research load combinations and building codes [3]
- 8.2.4. Confer with ARCH group about designs for the CAD model [4]

- 8.2.5. Finish SAP Model (frame) [5]
- 8.2.6. Apply load cases to the first floors [5]
- 8.2.7. Revise model per group requests [5]
- 8.2.8. Test load combinations on the first floors of the building [6]
- 8.2.9. Foundation/Earthwork calculations finalized [6]
- 8.2.10. CAD Model finalized [8]
- 8.2.11. SAP Model finalized [9]

8.3. Mechanical Group

- 8.3.1. Find strengths within team members and distribute work [2]
- 8.3.2. Research relevant buildings codes that are to be followed during the MEP design process[3]
- 8.3.3. Upload all relevant mechanical and plumbing codes [3]
- 8.3.4. Make preliminary load calculations [5]
- 8.3.5. Revise load calculations based on architectural design and indicate on plans locations of air supply/return/exhaust components and plumbing connections [6]
- 8.3.6. Begin modeling of equipment requirements [8]
- 8.3.7. Begin routing of MEP equipment: duct routing, plumbing routing, and electrical conduit and outlet locations as well as coordination of lighting with architectural. [8]

9.0 Individual Team Member Assignments

9.1 Architectural Group

- 9.1.1 Conceptual building design
- 9.1.2 Building programming
- 9.1.3 Floor Schematics for typical sections
- 9.1.4 Integration of sustainable design
- 9.1.5 Models & display

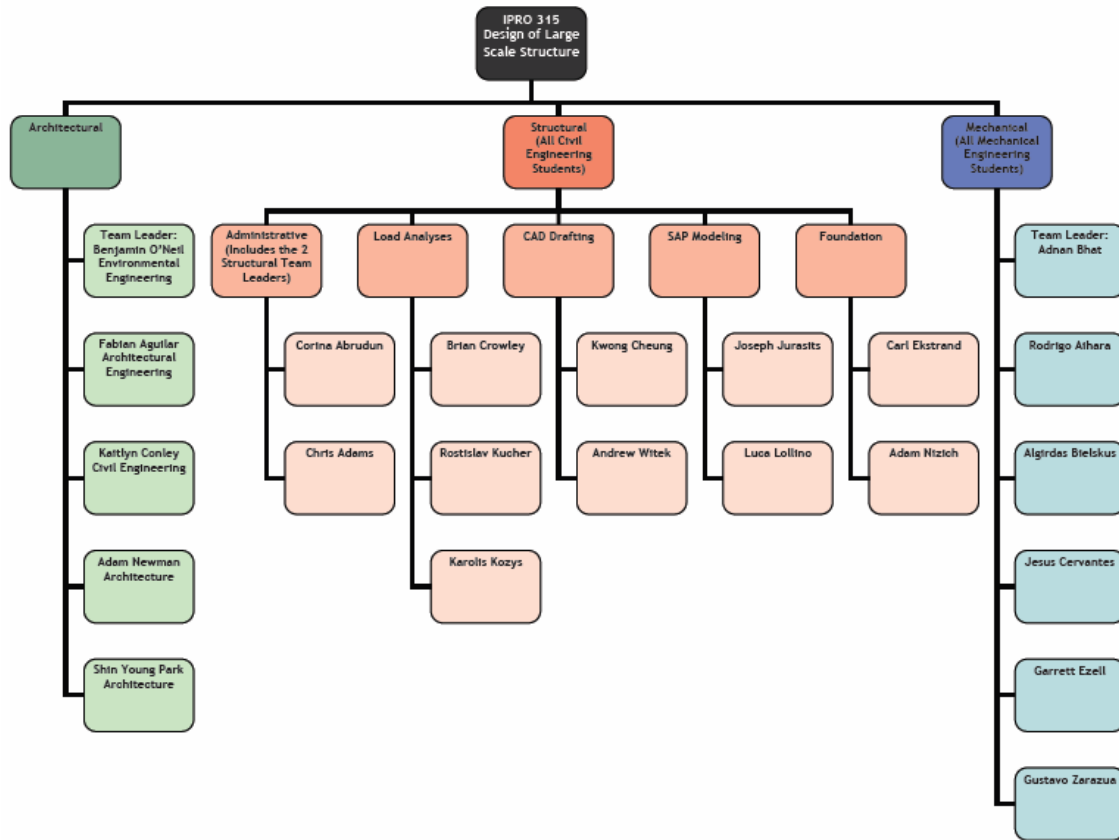
9.2 Structural Group

- 9.2.1 Administrative
 - 9.2.1.1 IPRO Deliverables
 - 9.2.1.2 Structural group oversight
 - 9.2.1.3 Communications
- 9.2.2 Load Analyses
- 9.2.3 CAD Drafting
- 9.2.4 SAP Modeling
- 9.2.5 Foundation Design

9.3 Mechanical Group

- 9.3.1 HVAC system design (Heating, Ventilation, Air Conditioning)
- 9.3.2 MEP system design (Mechanical, Electrical, Plumbing)

9.4 Team Schematic



10.0 Designation of Roles

Agenda Maker: Corina Abrudan
 Time Keeper: Rostislav Kucher
 Weekly Timesheet Collector: Corina Abrudan
 Master Schedule Maker: Corina Abrudan

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

Drawing	Scale From							Text Size	Paper space Scale
Scale	1/8	3/16	1/4	3/8	1/2	3/4	1		
	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