IPRO It takes a team INTERPROFESSIONAL PROJECTS PROGRAM

IPRO 339 MIDTERM REPORT

Designing Affordable Housing out of Shipping Containers for Ciudad Juarez, Mexico

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Man Leung
Michael Lynn
Luke McGuire
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Brett Monroe
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Jacqueline Schaefer
Yihan Su
Jaquelin Tijerina
Maciej Tusz
Theresa Zappala

IPRO Sponsor
Mr. Brian McCarthy, President: Por Fin Nuestra Casa

1.0 Objectives.

IPRO 339 is focused on providing an affordable housing option for the working poor in Juarez, Mexico. This semester we will research the technologies involved in reusing shipping containers for this housing. We will design a prototype housing unit which will relate to other units in an overall community, with services such as commerce, open spaces for activity, and community centers to support them. We wish to design a housing community that embodies the ideals of humanity, affordability, functionality, opportunity, sustainability, durability, safety, culture, and neighborhood. In order to do this, our team for the Spring Semester has set forth the following objectives:

- Research and understand the users of our product by looking at the social, economic, and physical factors in Juarez, Mexico and in the Maquiladoras where they work.
- Research the most cost efficient and sustainable ways of incorporating plumbing, HVAC, and electricity into the homes.
- Research the structural aspects of building this community.
- Develop a potential site plan and floor plans and sections for the housing units.
- Using our research and designs, develop a proposal for our sponsor, considering the client at hand.

2.0 Results to Date.

1. We had three initial subgroups which consisted of Sociology/Marketing, Design Team, and an Engineering team. When we divided into these subgroups we completed initial research to get a better understanding of what would be required when converting shipping containers into livable spaces. These subgroups yielded initial design ideas that we were able to use in our first design Development Study. This Development Study One had the constraints of using a 100 meter by 100 meter site on either side of a theoretical factory. These two studies produced respective densities of 130 dwelling units and 111 dwelling units.

2. After we complete Development Study One we met with our sponsor Mr. Brian McCarthy, the president of Por Fin Nuestra Casa. We presented both of our solutions and discussed other possible ideas to make each development solution better. After we presented our initial ideas he presented PFNC's business plan and explained his efforts in developing housing from recycled shipping containers.

3. Our most recent development study is named Development Study Two. Two sub groups, each consisting of half the total project team completed a separate high density study on a theoretical 100 meter by 100 meter site adjacent to a Maquiladora (a factory which imports materials and equipment for assembly and then re-exports them). These subgroups were named "North Subgroup" and "South Subgroup". The results of the "North" subgroup yielded 512 dwelling units and the "South" subgroup yielded 352 dwelling units on each 100 meter by 100 meter site.

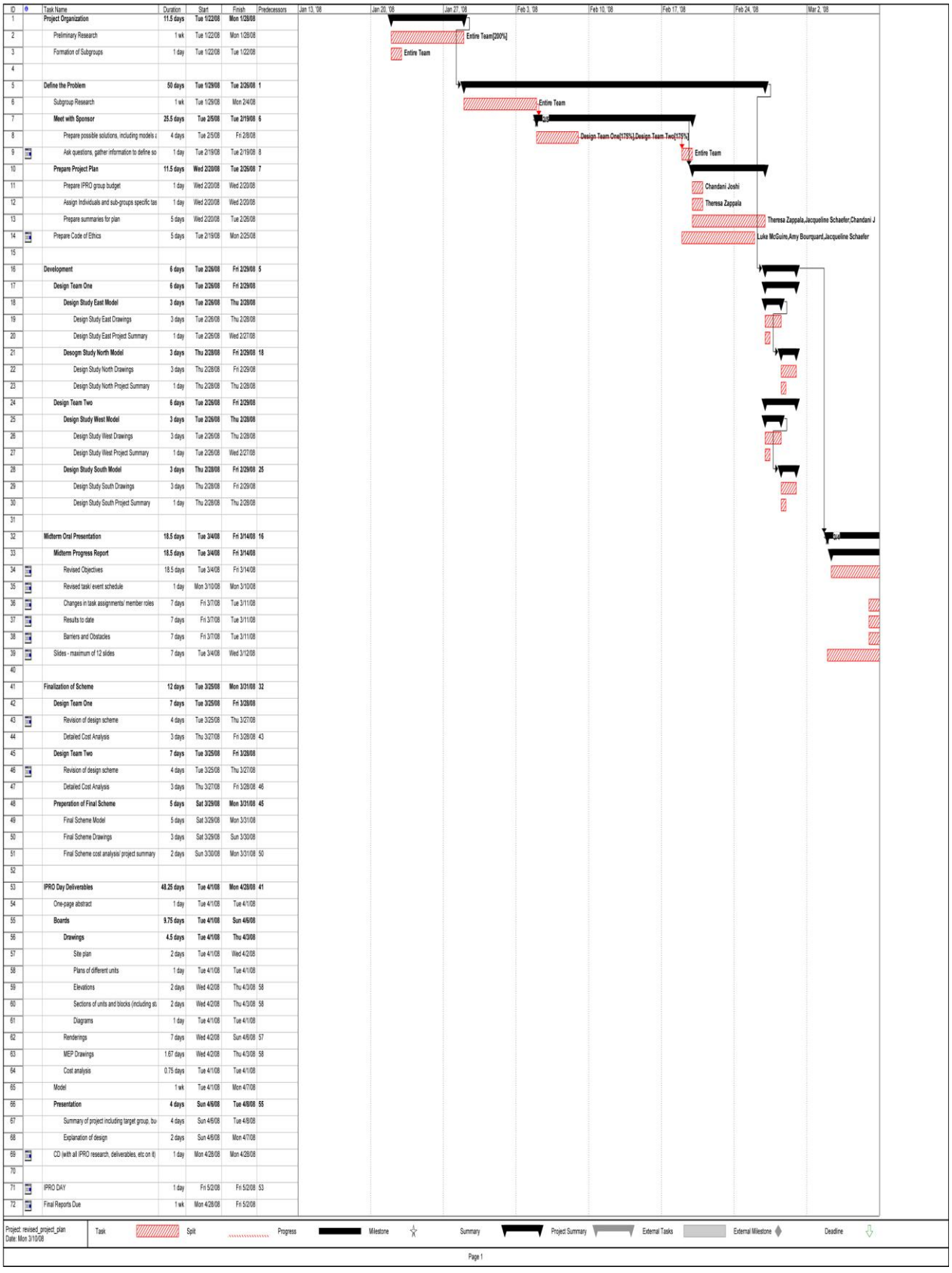
4. Our work so far has yielded the possibility of applying our solution not only to our site in Juarez, Mexico but sites around the world which have a need for employee, volunteer, or relief housing solutions. Research and refinement of our working models are resulting in low cost attractive housing solutions for poor or displaced people in need of quality housing.

5. We have produced two sets of working drawings that include site plans, floor plans, and model configurations, as well as a physical model of each subgroup development solution. In each of our solutions we also have preliminary cost analysis studies with cost projections for single units as well as the entire development. Both hard and soft costs for our site in Juarez Mexico are part of each analysis.

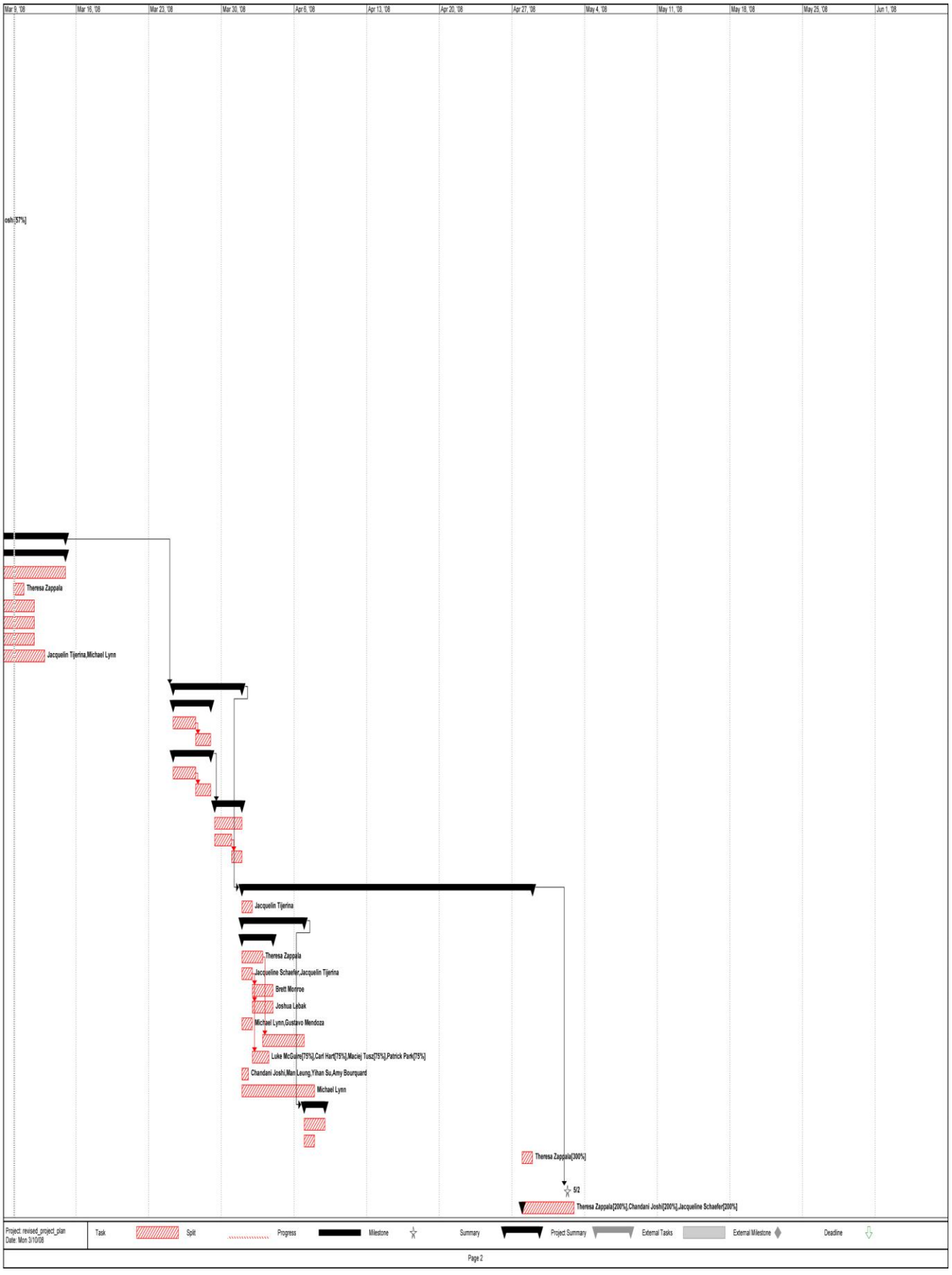
6. We continue to have communications with our valued sponsor Mr. Brian McCarthy PFNC President. His visit to IIT to review our Development Study One reports was useful to our team in outlining guidelines and constraints for our most recent Development Study Two. In depth cost analysis became a key component of the overall development process. He then asked us to examine in depth the cost per unit for our development and to use his constraint of eight thousand dollars per unit to drive our solution.

7. Our current developmental study results will guide the decisions we make in the future by giving us an idea of how to approach problems we still have yet to solve. The results we have now will be taken and then analyzed further to achieve all of our goals of affordable housing from recycled shipping containers. Many of our current successful design decisions will be apparent in our final Development Study.

3.0 Revised Task / Event Schedule.



ID	Task Name	Duration	Start	Finish	Predecessors
1	**Project Organization**	**11.5 days**	**Tue 1/22/08**	**Mon 1/28/08**	
2	Preliminary Research	1 wk	Tue 1/22/08	Mon 1/28/08	
3	Formation of Subgroups	1 day	Tue 1/22/08	Tue 1/22/08	
4					
5	**Define the Problem**	**50 days**	**Tue 1/29/08**	**Tue 3/26/08**	1
6	Subgroup Research	1 wk	Tue 1/29/08	Mon 2/4/08	
7	**Meet with Sponsor**	**25.5 days**	**Tue 2/5/08**	**Tue 3/19/08**	6
8	Prepare possible solutions, including models a	4 days	Tue 2/5/08	Fri 2/8/08	
9	Ask questions, gather information to define so	1 day	Tue 2/19/08	Tue 2/19/08	8
10	**Prepare Project Plan**	**11.5 days**	**Wed 2/20/08**	**Tue 3/26/08**	7
11	Prepare IPRO group budget	1 day	Wed 2/20/08	Wed 2/20/08	
12	Assign Individuals and sub-groups specific tas	1 day	Wed 2/20/08	Wed 2/20/08	
13	Prepare summaries for plan	5 days	Wed 2/20/08	Tue 2/26/08	
14	Prepare Code of Ethics	5 days	Tue 2/19/08	Mon 2/25/08	
15					
16	**Development**	**6 days**	**Tue 2/26/08**	**Fri 2/29/08**	5
17	**Design Team One**	**6 days**	**Tue 2/26/08**	**Fri 2/29/08**	
18	**Design Study East Model**	**3 days**	**Tue 2/26/08**	**Thu 2/28/08**	
19	Design Study East Drawings	3 days	Tue 2/26/08	Thu 2/28/08	
20	Design Study East Project Summary	1 day	Tue 2/26/08	Wed 2/27/08	
21	**Desogm Study North Model**	**3 days**	**Thu 2/28/08**	**Fri 2/29/08**	18
22	Design Study North Drawings	3 days	Thu 2/28/08	Fri 2/29/08	
23	Design Study North Project Summary	1 day	Thu 2/28/08	Thu 2/28/08	
24	**Design Team Two**	**6 days**	**Tue 2/26/08**	**Fri 2/29/08**	
25	**Design Study West Model**	**3 days**	**Tue 2/26/08**	**Thu 2/28/08**	
26	Design Study West Drawings	3 days	Tue 2/26/08	Thu 2/28/08	
27	Design Study West Project Summary	1 day	Tue 2/26/08	Wed 2/27/08	
28	**Design Study South Model**	**3 days**	**Thu 2/28/08**	**Fri 2/29/08**	25
29	Design Study South Drawings	3 days	Thu 2/28/08	Fri 2/29/08	
30	Design Study South Project Summary	1 day	Thu 2/28/08	Thu 2/28/08	
31					
32	**Midterm Oral Presentation**	**18.5 days**	**Tue 3/4/08**	**Fri 3/14/08**	16
33	**Midterm Progress Report**	**18.5 days**	**Tue 3/4/08**	**Fri 3/14/08**	
34	Revised Objectives	18.5 days	Tue 3/4/08	Fri 3/14/08	
35	Revised task/ event schedule	1 day	Mon 3/10/08	Mon 3/10/08	
36	Changes in task assignments/ member roles	7 days	Fri 3/7/08	Tue 3/11/08	
37	Results to date	7 days	Fri 3/7/08	Tue 3/11/08	
38	Barriers and Obstacles	7 days	Fri 3/7/08	Tue 3/11/08	
39	Slides - maximum of 12 slides	7 days	Tue 3/4/08	Wed 3/12/08	
40					
41	**Finalization of Scheme**	**12 days**	**Tue 3/25/08**	**Mon 3/31/08**	32
42	**Design Team One**	**7 days**	**Tue 3/25/08**	**Fri 3/28/08**	
43	Revision of design scheme	4 days	Tue 3/25/08	Thu 3/27/08	
44	Detailed Cost Analysis	3 days	Thu 3/27/08	Fri 3/28/08	43
45	**Design Team Two**	**7 days**	**Tue 3/25/08**	**Fri 3/28/08**	
46	Revision of design scheme	4 days	Tue 3/25/08	Thu 3/27/08	
47	Detailed Cost Analysis	3 days	Thu 3/27/08	Fri 3/28/08	46
48	**Preperation of Final Scheme**	**5 days**	**Sat 3/29/08**	**Mon 3/31/08**	45
49	Final Scheme Model	5 days	Sat 3/29/08	Mon 3/31/08	
50	Final Scheme Drawings	3 days	Sat 3/29/08	Sun 3/30/08	
51	Final Scheme cost analysis/ project summary	2 days	Sun 3/30/08	Mon 3/31/08	50
52					
53	**IPRO Day Deliverables**	**48.25 days**	**Tue 4/1/08**	**Mon 4/28/08**	41
54	One-page abstract	1 day	Tue 4/1/08	Tue 4/1/08	
55	**Boards**	**9.75 days**	**Tue 4/1/08**	**Sun 4/6/08**	
56	**Drawings**	**4.5 days**	**Tue 4/1/08**	**Thu 4/3/08**	
57	Site plan	2 days	Tue 4/1/08	Wed 4/2/08	
58	Plans of different units	1 day	Tue 4/1/08	Tue 4/1/08	
59	Elevations	2 days	Wed 4/2/08	Thu 4/3/08	58
60	Sections of units and blocks (including st	2 days	Wed 4/2/08	Thu 4/3/08	58
61	Diagrams	1 day	Tue 4/1/08	Tue 4/1/08	
62	Renderings	7 days	Wed 4/2/08	Sun 4/6/08	57
63	MEP Drawings	1.67 days	Wed 4/2/08	Thu 4/3/08	58
64	Cost analysis	0.75 days	Tue 4/1/08	Tue 4/1/08	
65	Model	1 wk	Tue 4/1/08	Mon 4/7/08	
66	**Presentation**	**4 days**	**Sun 4/6/08**	**Tue 4/8/08**	55
67	Summary of project including target group, bu	4 days	Sun 4/6/08	Tue 4/8/08	
68	Explanation of design	2 days	Sun 4/6/08	Mon 4/7/08	
69	CD (with all IPRO research, deliverables, etc on it)	1 day	Mon 4/28/08	Mon 4/28/08	
70					
71	IPRO DAY	1 day	Fri 5/2/08	Fri 5/2/08	53
72	Final Reports Due	1 wk	Mon 4/28/08	Fri 5/2/08	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Brett Monroe
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Michael Lynn,Gustavo Mendoza
Luke McGuire[75%],Carl Hart[75%],Maciej Tusz[75%],Patrick Park[75%]
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Michael Lynn
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Theresa Zappala[200%],Chandani Joshi[200%],Jacqueline Schaefer[200%]
Project: revised_project_plan
Date: Mon 3/10/08
Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

4.0 Changes in Task Assignments and Designation of Roles and Team Organization.

A. Individual Members and Responsibilities.

1. Name: Amy Bourquard
   Year: 4th year
   Major: Materials Science and Engineering
   Experience, Skills, Strengths:
   Roles: Code of Ethics, preliminary research, participated in the Ethics workshop, worked in initial cost analysis, MEP, and Structural engineering subgroups, worked on Design study – East and North, and is a member of the development engineering sub-group.

2. Name: Carl Hart
   Year: 3rd year
   Major: Architectural Engineering
   Experience, Skills, Strengths: Architectural Intern, AutoCAD, HVAC Analysis/Design Software, Highly Analytical and Detailed
   Roles: iGroups manager, preliminary research, worked in initial MEP, Space planning, and sociology/marketing subgroups, worked on Design study – East and North, an is a member of the development engineering sub-group.

3. Name: Chandani Joshi
   Year: 3rd year
   Major: Molecular Biochemistry and Biophysics/ Pre-medicine
   Experience, Skills, Strengths: Organization, Management, Research
   Roles: Project management plan, minute taker, preliminary research on Juarez, worked in initial cost analysis, space planning, and sociology/ marketing sub-groups, worked on Design study – East and North, and is a member of the development sociology sub-group.

4. Name: Joshua Lebak
   Year: 4th year
   Major: Architecture
   Experience, Skills, Strengths: Urban planning, design, space planning, AutoCAD, 3d Studio Max, Adobe Creative Suite, Model Making, has worked for Lake Forest's planning office.
   Roles: preliminary research, worked in initial civil engineering, space planning, and site planning sub-groups, worked on Design study – West and South, and is a member of the development Design sub-group, Midterm Report.

5. Name: Man Leung
   Year: 5th year
   Major: Civil Engineering
   Experience, Skills, Strengths: Structural design/analysis to AISC/ASCE Steel Bridge Building Competition 2007, 2008; Non-linearized structural analysis using SAP2000
   Roles: preliminary research on pre-existing conditions in Juarez, worked in initial civil engineering, structural engineering, and cost analysis sub-groups, worked on Design study – West and South, and is a member of the development engineering sub-group.

6. Name: Michael Lynn
   Year: 5th year
   Major: Architecture
   Experience, Skills, Strengths: AutoCAD, adobe illustrator/Photoshop, 3d modeling, model making. Experience in construction and working at architectural firms. I have also worked at CNU, Congress for New Urbanism, doing site planning related research.
   Roles: preliminary research on Juarez, worked in initial site planning, sociology, and structural engineering sub-groups, worked on Design study – East and North, and is a member of the development Design sub-group.

7. Name: Luke McGuire
   Year: 3rd year
   Major: Architectural Engineering
   Experience, Skills, Strengths: IT manager for group of 7 medical clinics (Minnesota Oncology), Software developer for Parametric Technology Corporation, General manager campus radio station, Peer Leadership program developer and facilitator, AutoCAD, MathCAD, Pro/Engineer
   Roles: Code of Ethics, preliminary research, worked in initial Site planning, Space planning, and structural engineering subgroups, worked on Design study – West and South, and is a member of the development engineering sub-group.

8. Name: Gustavo Mendoza
   Year: 5th year
   Major: Architecture
   Experience, Skills, Strengths: AutoCAD, Adobe suite
   Roles: preliminary research, worked in initial structural engineering, site planning, and sociology sub-groups, worked on Design study – East and North, and is a member of the development Design sub-group.

9. Name: Brett Monroe
   Year: 4th year
   Major: Architecture
   Experience, Skills, Strengths: Problem solving, design, planning, Auto CAD, Adobe Photoshop and Illustrator, 3d Studio Max, Model Making, has worked in several architectural firms in the city of Chicago.
   Roles: preliminary research, worked in initial site planning, space planning, and MEP sub-groups, worked on Design study – West and South, and is a member of the development Design sub-group, Midterm Report.

10. Name: Patrick Park
    Year: 4th year
    Major: Electrical Engineer
    Experience, Skills, Strengths: AutoCAD, Adobe suite
    Roles: preliminary research, worked in initial sociology, MEP, and cost analysis sub-groups, worked on Design study – West, and is a member of the development Design sub-group.

11. Name: Jacqueline Schaefer
    Year: 3rd year
    Major: Architecture
    Experience, Skills, Strengths: have worked in 2 architecture offices, cad and some 3dmax skills
    Roles: project management plan, code of ethics, preliminary research, worked in initial site planning, space planning, and MEP sub-groups, worked on Design study – West, and is a member of the development Design sub-group.

12. Name: Yihan Su
    Year: 3rd year
    Major: Applied Mathematics, physics minor
    Experience, Skills, Strengths: Matlab, a little C++ computer language,
    2 languages (Chinese and English), has worked as an accountant in a shipping company.
    Roles: preliminary research, worked in initial Civil engineering, cost analysis, and structural engineering sub-groups, worked on Design study – West, and is a member of the sociology/marketing sub-group.

13. Name: Jaquelin Tijerina
    Year: 5th year
    Major: Architecture, specialization in landscape architecture
    Experience, Skills, Strengths: AutoCAD, adobe illustrator/Photoshop, 3d modeling, model making, graphic design, bilingual in Spanish/ English, visited Mexico, and have worked as an architectural intern, where I have handled projects and dealt with consultants.
    Roles: preliminary research on Juarez, worked in initial space planning, site planning, and sociology/marking sub-groups, worked on Design study – East, and is a member of the development Design sub-group.

14. Name: Maciej Tusz
    Year: 5th year
    Major: Aerospace Engineering and Materials Science, Math minor
    Experience, Skills, Strengths: Worked at NASA for the summer, studied abroad, speak 3 languages, traveled to some poor neighborhoods in my life. Lived in communist Poland so understand the mentality of some of these projects, open mind
    Roles: time sheet collector/ summarizer, preliminary research on materials, worked in initial MEP, Structural, and cost analysis sub-groups, worked on Design study – East, and is a member of the development engineering sub-group.

15. Name: Theresa Zappala
    Year: 3rd
    Major: Architecture
    Experience, Skills, Strengths: Project leader, group leader, computer skills (Adobe suite, Microsoft Office suite, CAD, VIZ), on time, dedicated, able to see the whole picture and focus on many different parts of a project at once, worked as an intern for two different firms
    Roles: project management plan, preliminary research, worked in initial site planning, space planning, and sociology sub-groups, worked on Design study – West and South, and is a member of the development sociology / marketing sub-group.

B. Sub-groups.

1. **Sociology/Marketing:** Defining the economic scope of our project and our clients (both the corporation buying the project and the families buying the units). Defining the cultural needs of the clients, in order to work their habits into the design. Researching social patterns that affect design. Researching the best way to present the idea to a client. Preparation of building/construction cost analysis.
   Sub-group leader: Chandani Joshi
2. **Design Team:** Using the sponsor's initial requirements as a starting point, preparing individual unit floor plans and a site arrangement conducive to fostering a community atmosphere without drastically changing the cultural needs of the client.
   Sub-group leader: Jacquelin Tijerina
3. **Engineering Team:** Preparing an analysis of the best and most cost effective passive heating and cooling systems, any supplementary mechanical systems, plumbing systems, and any auxiliary structural systems needed to support the Design Team's plans.
   Sub-group leader: Luke McGuire
4. **Developmental Study Group One, East:** Preparing developmental studies which analyze a typical 100 meter by 100 meter site. Analyzing conditions and constraints that effect design decisions. Research topics which address design intents within the scope of the project. There are no designated sub-group leaders for the individual developmental studies.
5. **Developmental Study Group One, West:** Preparing developmental studies which analyze a typical 100 meter by 100 meter site. Analyzing conditions and constraints that effect design decisions. Research topics which address design intents within the scope of the project. There are no designated sub-group leaders for the individual developmental studies.
6. **Developmental Study Group Two, North:** Preparing developmental studies which analyze a typical 100 meter by 100 meter site with a high density solution (higher than development study one) which has a typical building height of four stories. Analyzing conditions and constraints that effect design decisions. Research topics which address design intents within the scope of the project. There are no designated sub-group leaders for the individual developmental studies.
7. **Developmental Study Group Two, South: :** Preparing developmental studies which analyze a typical 100 meter by 100 meter site with a high density solution (higher than development study one) which has a typical building height of three stories. Analyzing conditions and constraints that effect design decisions. Research topics which address design intents within the scope of the project. There are no designated sub-group leaders for the individual developmental studies.

Sub-group Name	Sociology/Marketing	Design Team	Engineering Team
Sub-group Leader	Chandani Joshi	Jacquelin Tijerina	Luke McGuire
Group Members	Theresa Zappala	Jacqueline Schaefer	Carl Hart
	Yihan Su	Michael Lynn	Man Leung
	Patrick Park	Joshua Lebak	Maciej Tusz
	Michael Glynn (Prof)	Gustavo Mendoza	Amy Bourquard
	Blake Davis (Prof)	Brett Monroe	Michael Glynn (Prof)
		Michael Glynn (Prof)	Blake Davis (Prof)
		Blake Davis (Prof)	
Sub-group Name	**Development Study Group One East & Group Two North**	**Development Study Group One West & Group Two South**	
	Amy Bourqard	Joshua Lebak	
	Carl Hart	Man Leung	
	Chandani Joshi	Luke McGuire	
	Michael Lynn	Brett Monroe	
	Gustavo Mendoza	Patrick Park	
	Jaquelin Tijerina	Jaquelin Schaefer	
	Maciej Tusz	Yihan Su	
		Theresa Zappala	

C. Roles.
   1. Meeting Roles
      i. Minute Taker: Chandani Joshi
      ii. Agenda Maker: The professor is the agenda maker for this IPRO.
      iii. Time Keeper: The professor is time keeper for this IPRO.
   2. Status Roles
      i. Weekly Timesheet Collector/ Summarizer: Maciej Tusz
      ii. Master Schedule Maker: Chandani Joshi
      iii. iGROUPS: Carl Hart

D. Changes From Project Plan.

The major change from the Project Plan was the addition of two more sub-groups to develop higher density solutions simultaneously. These two sub-groups consisted of various members from each already established sub-group. The purpose of both developmental studies was to take a 100 meter by 100 meter site and come up with two solutions within the same constraints i.e. site configuration, floor plans, density, and amenities. Each group consists of members from each previous sub-groups so all disciplines are present to develop two complete ideas from varying backgrounds. The minor change involves one team member's

withdrawal from the IPRO, and therefore he has been removed from our sub-groups as well as task assignments.

5.0 Barriers and Obstacles.

A. **Obstacles Encountered.**

Obstacle One: The initial brainstorming of the project, which included site layout and plan design, was one of the biggest obstacles to resolve. A group member may have wanted their idea to ultimately be used over another member's idea because they may have thought it was the best plan for the application. There were many great ideas between group members, but unfortunately, not everything could be implemented.

Obstacle Two: The outcome and the overall reaction to the finished product. We asked ourselves a few question: How the residents in Ciudad Juarez would react to the shipping container as an environment for living and how the space would actually be inhabited.

B. **Obstacle Resolution.**

Obstacle One: In order to advance on final decisions, the group had to make a number of compromises. It was especially hard when one does not offer full support in someone else's idea. To aid in the process, we took in account input on the disliked and liked ideas. If their idea wasn't chosen, it wasn't completely disregarded or looked over. Their idea was either built upon or modified certain ways to create the best solution for the application.

Obstacle Two: To overcome this obstacle, we did some research of the current conditions in Ciudad Juarez that the workers are living in. They are living in some sort of shanty town by the factory. Their current living conditions don't have any permanent structure, only implemented scraps that could be considered garbage to us. We thought if any new type of innovative and affordable housing was introduced to the area, it would undoubtedly be an improvement over anything they have encountered.

C. **Remaining Barriers / Obstacles.**

Barrier One: A big barrier that we are facing is the ability to create an innovative, sustainable design to meet our client's budget per container. Some ideas wanted to stray away from a simple stacking, causing us to have to add more supports around the container. Along with abnormal layout, minimizing stairs in the overall site was a concern, in forms of accessibility and egress.

Obstacle One: Clashing of majors in the IPRO. Certain people may think they are in the IPRO to fulfill their one specialty duty. This greatly limits how the problem could be solved by having only one person working on separate problems.

D. **Team Plans Regarding Barriers / Obstacles.**

Proposed Plan-Barrier One: When thinking of the final design, we want to minimize the amount of additions, unnecessary components, and fabrication to the project in order to help keep costs down. Also, we can consider buying certain appliances or materials in bulk to help save costs and to keep under budget. We can research suppliers and compare prices on their products.

Proposed Plan-Obstacle One: Someone of a different specialization has a different outlook on the same problem. They can aid in the final decision by putting the problem in a different perspective. It makes problem solving easier to tackle it from multiple angles from multiple people than have one person have the same perception.