IPRO It takes a team INTERPROFESSIONAL PROJECTS PROGRAM

IPRO 339 B FINAL REPORT

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

IPRO Faculty Advisors
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1.0 Abstract

IPRO 339 is an investigation using shipping containers as an alternative affordable housing solution for under-paid and exploited working populations. Specifically, IPRO 339 focused on creating affordable home-ownership opportunities for the thousands of displaced workers from Mexico's rural regions who were forced to relocate to urban slums of Juarez – one of the fastest growing cities in Mexico due to globalization.

Currently there are several countries throughout the world that have a large need for affordable housing. Our IPRO is currently dealing with solutions for Juarez, Mexico and Chicago, Illinois. These two places are very different in climate, culture, as well as economy. Our IPRO this semester will focus on applying the prototype from last semester to these two regions, while making adjustments as needed. We will continue the research into systems which will be advantageous to each situation and develop them accordingly. Once we get a better understanding as to how we can apply our prototype to these situations we will be better able to apply the prototype to various other countries throughout the world.

2.0 Background

The sponsor for IPRO 339 is Mr. Brian McCarthy, President of PFNC Global Communities in Corrales, New Mexico. His company strives to create affordable housing for those areas in the world where there is none or not an adequate amount for the working population. Workers of Maquiladoras factories in Juarez, Mexico face daily struggles with wages of less than two dollars an hour. Owning even a very basic home with no electricity or plumbing is out of reach for most people. If they do wish to purchase one, they must go in with several other families for one home. Workers therefore have little choice but to create squatter settlements. They construct the homes themselves out of wooden palettes, and boxes. Sometimes there is a makeshift foundation or metal roof. The majority of these settlements do not have running water, sewage systems, or electricity for heating and air conditioning. Because the job turnover at the factories is sometimes over one hundred percent a year, the communities are often transient as well. By providing homes that are affordable for their income and which they can own themselves, we hope that people will be able to stay longer and feel a better sense of entitlement to the land and community there. The slums of Juarez face many social problems as well. There is a huge problem with gangs and violence, and there have been hundreds of murders and rapes of young women in the last couple of years. In Chicago much of the government provided housing has failed over the years and now is in such a state of disrepair that many of them are being closed and people are left homeless. There are very little affordable housing solutions left in the city of Chicago therefore a need for this type of

housing is incredibly great. In order to ensure that our solution does not fail like previous attempts at social housing we must design it to fit into the typical Chicago lot and so that it resembles the architecture and character of homes around it.

The situation calls to mind previous attempts at public housing, which have often led to social problems in regards to crime, isolation from the rest of the community, and dependency on the government for income. In Chicago alone there are many examples of failed government provided housing developments which today are being torn down at a rapid rate, and many people are being displaced with no where to go. In order to not repeat previous mistakes we must integrate the housing into communities that are already successful so that the community is a mix of retail, high, medium, and affordable housing solutions. Affordable housing should not cost more than thirty percent of a household's gross income. Reusing shipping containers for another occupiable use has been done many times before. Portakabin is one example, in which the units can be moved as well. They have been successfully converted into youth centers, classrooms, office space, artists' studios, live / work space, nurseries and retail space. Often these are more trendy projects, however, rather than basic housing like our project. We are therefore working on ways to make these containers still inviting and a place to call home. Habitech is another company which manufactures affordable housing technologies. Homes can be assembled in anywhere from one day or one week and cost about thirty to fifty percent less. But overall, there is not enough affordable housing for many areas of the world.

Last semester IPRO 339 produced a prototype for a generic site in Juarez, Mexico. This included floor plans, elevations, sections, and 3d renderings of what a community in Juarez could look like. The IPRO tackled this by dividing into subgroups and creating several design development studies which eventually became one final design development that was presented at IPRO day. Various amounts of research was also done to determine what a community like this would need. The culture is very different from ours therefore there was a need to understand what exactly was needed in everyday life, as well as basic cultural needs that needed to be implemented into the design. All of these things went into the final development study.

In investigating the problem at hand, the team must be careful of any assumptions they make with the way people live and what resources they need or want. Just because they are from a poorer area than us, we must not forget that they have similar goals and desires for the way they live. We need to therefore provide them with appropriate resources. We also should not be blinded by the fact that there is violence and social problems; our solutions need to be appropriate and not stifling or worse than what is there now. Ethically we are obligated to be sensitive to each situation in which we are implementing our prototype. If needed the prototype should be adapted to meet each condition in a unique way so that it is beneficial to the people using it.

2.0 Objectives

A. • 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.
- To provide a safe and healthy community for the workers in Cuidad Juarez, Mexico.
- Provide a variety of unit types to meet the varying needs of the workers in Juarez.
- To encourage and promote a sense of community, so that the sense of community currently in place is enhanced
- Research solutions to make the shipping container prototype resemble Chicago vernacular housing.
- To provide a housing solution that is affordable for the workers, while still greatly increasing their standard of living
- Research the most cost efficient and sustainable ways of incorporating plumbing, HVAC, and electricity into the homes.
- Research the structural aspects of building these homes with the structural cointainer.
- Develop additional site plans, floor plans, and sections as different solutions and options to the previous semester.
- Using our research and previous designs to continue to develop multiple solutions for our sponsor, considering the client at hand.
- Using our prototypes to implement our solution to other places around the world.

B. IPRO 339 is focused on providing an affordable housing option for the working poor in Juarez, Mexico as well as low income families in Chicago, Illinois. This semester we will continue to research the technologies involved in reusing shipping containers for this housing. We will continue to 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.

This semester our IPRO is also focusing on producing an affordable solution for people located in the Chicago land area. In doing this we must examine what makes affordable housing successful and then implement this into our design. We must also be respectful to what people believe is an actual home; therefore we must make our solution resemble typical Chicago housing.

Our team plans to have a large base on information on the user we are aiming our houses at and take their specific social, economical, and physical

needs into account with our design. We will look at the climate and geography of the area and use this to influence the design of our HVAC and structural systems. By the end of the semester, we will integrate all these spatial, cultural and physical investigations to create a suitable housing unit. We will come up with a marketing plan focused on the companies in Juarez, who will then be able to sell them to their workers at very affordable prices.

4.0. Methodology

WBS Level 1: Affordable Shipping container housing
WBS Level 2:

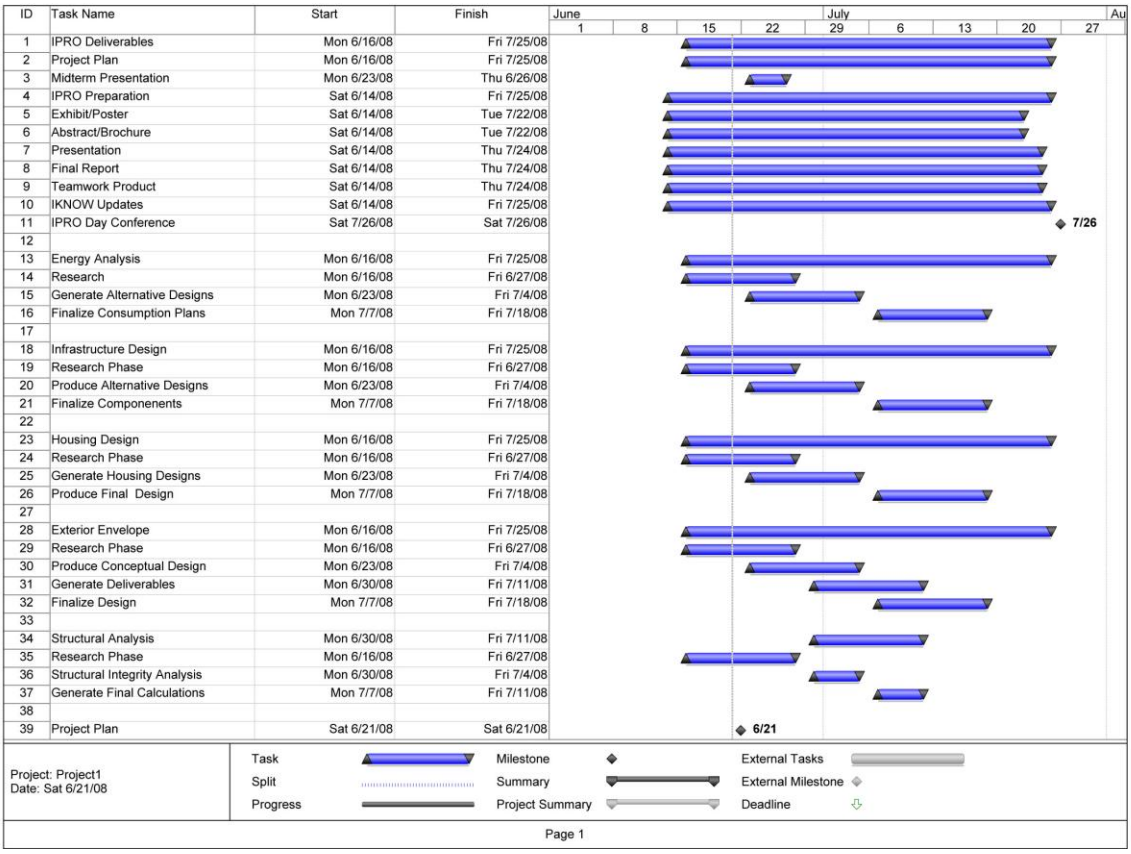
- 1.1- Energy (20)
- 1.2- Infrastructure (22)
- 1.3- Exterior Envelope (20)
- 1.4- Structural Design (15)
- 1.5- Housing Design (23)

WBS Level 3:

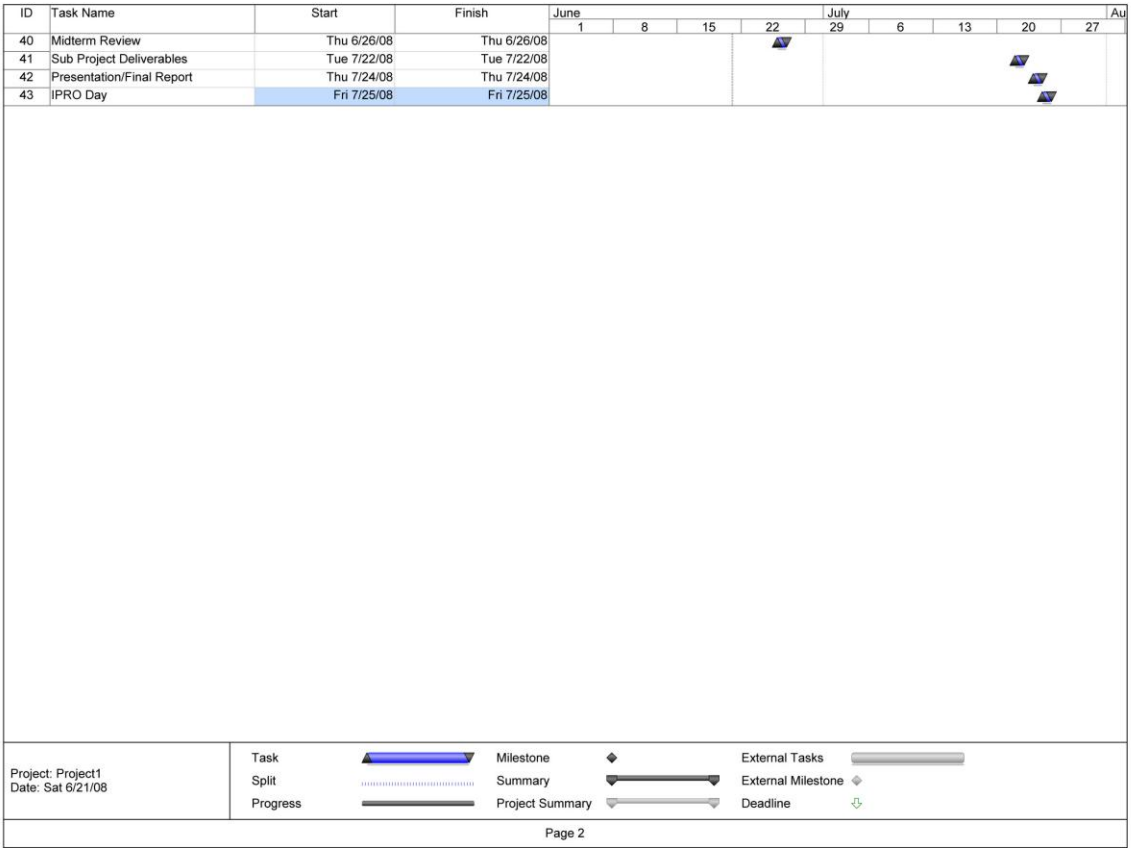
- 1.1- Energy
  - 1.10- Solar Power (4)
  - 1.11- Zero Energy (4)
  - 1.12- Hybrid Systems (4)
  - 1.13- Cost Analysis (4)
  - 1.14- LEED Certification (4)
- 1.2- Infrastructure
  - 1.20- Electrical (4)
  - 1.21- Plumbing (4)
  - 1.22- System Sizing (3)
  - 1.23- Infrastructure Components (5)
  - 1.24- Passive Systems (4)
  - 1.25- Solar Heating (2)
- 1.3- Exterior Envelope
  - 1.30- Foundation (6)
  - 1.31- Skirting (4)
  - 1.32- Crawl Space (3)
  - 1.33- Insulation and Infiltration Control (5)
  - 1.34- Cladding Systems (2)
- 1.4- Structural Design
  - 1.40- Structural Strength (3)
  - 1.41- Strengthening Alternatives (4)
  - 1.42- Connection Sizing (3)
  - 1.43- Cutting Methods (3)
  - 1.44- Process for obtaining Containers (2)
- 1.5- Housing Design
  - 1.50- Vernacular Housing in Chicago (4)
  - 1.51- External Appearances, Arrangements, and Dimensions (5)

1.52- Roofing Systems (6)
1.53- Visual Appeal (4)
1.54- Painting Options (4)

Gantt Chart



ID	Task Name	Start	Finish
1	IPRO Deliverables	Mon 6/16/08	Fri 7/25/08
2	Project Plan	Mon 6/16/08	Fri 7/25/08
3	Midterm Presentation	Mon 6/23/08	Thu 6/26/08
4	IPRO Preparation	Sat 6/14/08	Fri 7/25/08
5	Exhibit/Poster	Sat 6/14/08	Tue 7/22/08
6	Abstract/Brochure	Sat 6/14/08	Tue 7/22/08
7	Presentation	Sat 6/14/08	Thu 7/24/08
8	Final Report	Sat 6/14/08	Thu 7/24/08
9	Teamwork Product	Sat 6/14/08	Thu 7/24/08
10	IKNOW Updates	Sat 6/14/08	Fri 7/25/08
11	IPRO Day Conference	Sat 7/26/08	Sat 7/26/08
12			
13	Energy Analysis	Mon 6/16/08	Fri 7/25/08
14	Research	Mon 6/16/08	Fri 6/27/08
15	Generate Alternative Designs	Mon 6/23/08	Fri 7/4/08
16	Finalize Consumption Plans	Mon 7/7/08	Fri 7/18/08
17			
18	Infrastructure Design	Mon 6/16/08	Fri 7/25/08
19	Research Phase	Mon 6/16/08	Fri 6/27/08
20	Produce Alternative Designs	Mon 6/23/08	Fri 7/4/08
21	Finalize Componenents	Mon 7/7/08	Fri 7/18/08
22			
23	Housing Design	Mon 6/16/08	Fri 7/25/08
24	Research Phase	Mon 6/16/08	Fri 6/27/08
25	Generate Housing Designs	Mon 6/23/08	Fri 7/4/08
26	Produce Final Design	Mon 7/7/08	Fri 7/18/08
27			
28	Exterior Envelope	Mon 6/16/08	Fri 7/25/08
29	Research Phase	Mon 6/16/08	Fri 6/27/08
30	Produce Conceptual Design	Mon 6/23/08	Fri 7/4/08
31	Generate Deliverables	Mon 6/30/08	Fri 7/11/08
32	Finalize Design	Mon 7/7/08	Fri 7/18/08
33			
34	Structural Analysis	Mon 6/30/08	Fri 7/11/08
35	Research Phase	Mon 6/16/08	Fri 6/27/08
36	Structural Integrity Analysis	Mon 6/30/08	Fri 7/4/08
37	Generate Final Calculations	Mon 7/7/08	Fri 7/11/08
38			
39	Project Plan	Sat 6/21/08	Sat 6/21/08



5.0. Project Budget

Item	Price	QTY	Price	Purpose
Models	$25.00	2	$50.00	Developing prototypes of our designs for review and further study.
Printing	$5.00	10	$50.00	Printing of renderings, floor plans, site plans for in class presentations
IPRO day	$250.00	1	$250.00	Poster and Presentation materials (Including models)
TOTAL:			**$350.00**	

6.0. Team Structure and Assignments

Name: Shreyas Shrikar Dole
Year: 4th year
Major: Mechanical Engineering
Experience, Skills, Strengths: Problem Solving, experience in thermodynamics and designing machine parts.
Roles: preliminary research, worked in initial Exterior Envelope sub-group and a member of the Juarez Design Team.

Name: Ruth Droescher
Year: 4th year
Major: Architecture
Experience, Skills, Strengths: Experience in design, knowledge of energy and environmental policies, experience in space planning.
Roles: preliminary research, member of Energy research sub-group, member of Juarez/Third world design team.

Name: Harry Michael
Year: 4th year
Major: Mechanical Engineering
Experience, Skills, Strengths: Experience with working in a team environment and knowledge of renewable efficient energy
Roles: preliminary research, member of Energy research sub-group, member of Juarez/Third world design team.

Name: Brett Monroe
Year: 5th year
Major: Architecture
Experience, Skills, Strengths: Experience in design, space planning, and problem solving, has worked in an architectural firm.
Roles: preliminary research, worked in initial infrastructure research sub-group, and is a member of the Juarez infrastructure sub-group.

Name: Sumayya Nikhat
Year: 4^{th} year
Major: Electrical Engineering
Experience, Skills, Strengths: IPRO Blind swimmer project. Build a sonar active and passive device)
Roles: Group A- Energy

Name: Maribel Valdez
Year: 4th year
Major: Mechanical Engineering
Experience, Skills, Strengths: Experience in process selection engineering for large-scale energy production plant design. Experience in mathematical optimization of theoretical engineering design. Experience in user interface and controller development using lab view software. Experience in aero elasticity theory applied to military aircraft design.
Roles: Juarez sub-group and part of the energy sub-group

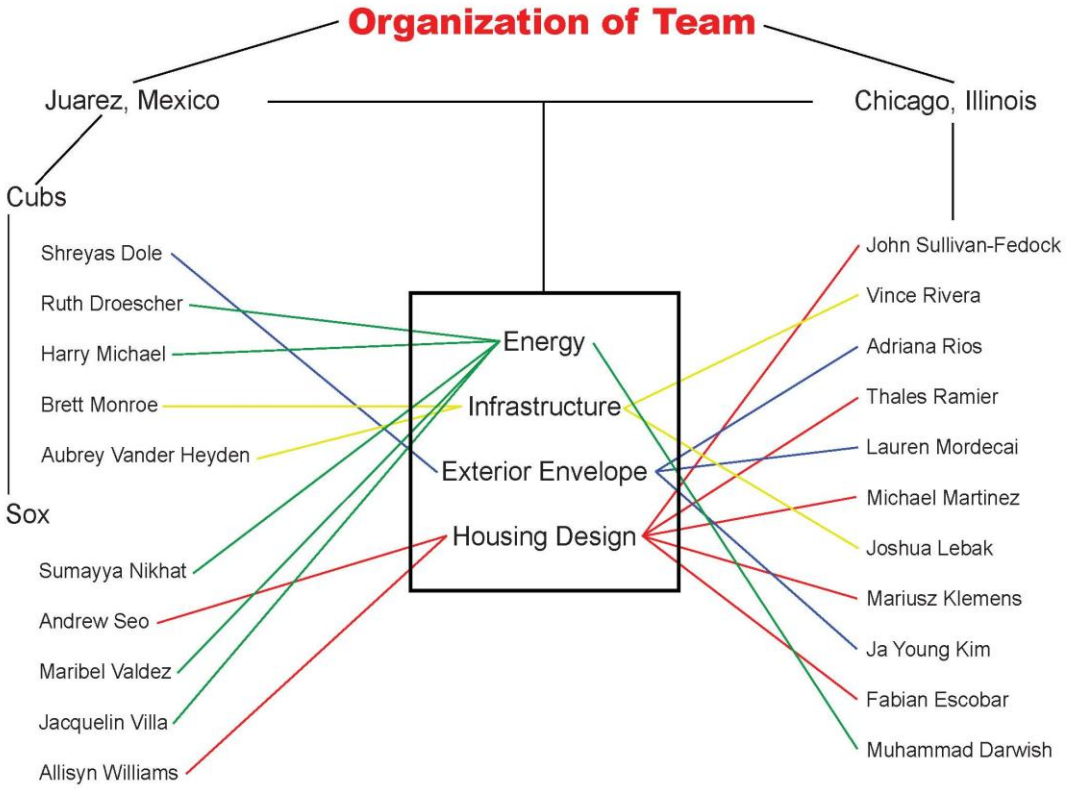
Name: Jacqueline Villa
Year: 5th year
Major: Architecture
Experience, Skills, Strengths: Experience with marketing and web design.
Roles: Juarez sub-group and energy sub-group

Name: Allisyn Williams
Year: 5th year
Major: Architecture
Experience, Skills, Strengths: architecture intern summer 2006, strengths in research and planning
Role: Research, Juarez, Mexico group and the Design sub-group

Name: Aubrey Vander Heyden
Year: 3th year
Major: Architectural Engineering
Experience, Skills, Strengths: architecture intern summer 2006, strengths in research and planning
Role: Research, Infrastructure Sub-Group, Juarez Sub-Group

Sub-group Name	**Juarez, Mexico**	**Chicago, Illinois**
Group Members	Shreyas Dole	John Sullivan-Fedock
	Ruth Droescher	Vince Rivera
	Harry Michael	Adriana Rios
	Brett Monroe	Thales Ramier
	Sumayya Nikhat	Lauren Mordecai
	Andrew Seo	Michael Martinez
	Maribel Valdez	Joshua Lebak
	Aubrey Vander Heyden	Mariusz Klemens
	Jacquelin Villa	Ja Young Kim
	Allisyn Williams	Fabian Escobar
	Michael Glynn (Prof)	Muhammad Darwish
		Blake Davis (Prof)

Sub-group Name	Energy	Infrastructure	Exterior Envelope	Structural Considerations	Housing Design
Sub-group Leader					
Group Members	Harry Michael	Aubrey Vander Heyden	Adie Rios	Thales Ramier	Allisyn Williams
	Ruth Droescher	Brett Monroe	Lauren Mordecai		Fabian Escobar
	Muhammad Darwish	Vince Rivera	Jayoung Kim		Mariusz Klemens
	Sumayya Nikhat	Josh Lebak	Shreyas Shrikar Dole		Michael Martinez
	Maribel Valdez				Andrew Seo
	Jacqueline Villa				John Sullivan-Fedok



0.7 Results:

Shipping containers were proposed as a solution to the affordable housing need because they are structurally very strong; they are also readily available and a less expensive source of steel. Using the standard container size of 40ft x 8ft x 8.5ft (height) as our basic unit size, we developed 5 unit layouts, including two single units (using a single container), a single unit with a shared kitchen (using two containers), and two double units (each using two containers).By providing a variety of unit types and layouts, we hoped to meet the needs of a variety of users. The individual units were combined to form two different building types: the u-plan and the cross plan. Both building plans feature more private courtyards and attempt to maintain a relationship to the ground by not building more than three stories tall. The overall site plan features wide walkways and strips of greenspace between the units. A large green space was also included in the site planning to provide the occupants with a space for outdoor sports and recreation, and market activites. Space was designated for multi-purpose buildings also built using shipping containers.In order to reduce the heat gain on the buildings, a green roof was incorporated into the two buildings. The green roof would not only serve as insulation, but also provide space for gardens where tenants can grow their produce. Heat gain in the units was also reduced by using a straw bale insulation on the exterior walls. A grey water collection systems was implemented to reduce the fresh water demand of the complex. The other heating and cooling needs will be met by individual HVAC systems in each living unit.

0.8 Obstacles:

There were various obstacles faced through out the semester. One of the main obstacles was lack of communication or meetings, because the course met officially only Saturdays it was hard to keep track of the progress. Due to the commitment of all the teammates this obstacle was over come, we had meetings through out the week to update other teammates our progress and prepare a presentation for the following Saturday. The team also actively communicating through email and iGroups. Due to the shear size of the initial team it would have been hard to manage the whole group. Members of the class were distributed into four research sub-groups: Energy, Exterior Envelope, Chicago Housing Design and Structural, and Infrastructure. In addition, all members were split into two larger design subgroups. Half joined the Juarez design team, and the second half joined the Chicago design team. The idea behind this was to create design teams that would separately address the issues of each of the proposed sites: Ciudad Juarez, Mexico and Chicago, IL. The Juarez design subgroup was broken into two sections. Each section came up with a distinct apartment complex design: cross-shape and u-shape apartment building designs. From this the two sections within the Juarez design sub-group joined together and composed a final site development solution equipped with details regarding

plumbing, electrical and mechanical systems, insulation, and exterior envelope. The research presented within each of the four research sub-groups aided the Juarez design subgroup in designing and adapting research ideas into their site development solution.

0.9 Recommendations:

IPRO 339 attempted to address most issues to develop a sustainable container community. Our Findings primarily addressed site development, container densities, and unit layouts. Further development of our recommended findings will be necessary to optimize the potential of a container development. Recommendations to explore should consist of, but not be limited to; further exploration of passive heating and cooling options, true modularity of internal components to be pre-fabricated. Also, we recommend further exploration of efficient methods to increase densities. We also recommend developing a marketing plan focused on the companies in Juarez, who will be able to sell the units to their workers at prices they can afford.

0.10 References:

1. http://networkearth.org

2. http://www.nationmaster.com/encyclopedia/Third-world-country

3. http://www.eere.energy.gov/buildings/energyplus/cfm/weather_data.cfm

4. http://www.eere.energy.gov/buildings/tools_directory/subjects.cfm/pagename=subjects/pagename_menu=materials_components/pagename_submenu=envelope_systems

5. http://greenhomebuilding.com/QandA/cob/uses.htm

6. http://www.cobprojects.info

7. http://www.cobcottage.com

8. http://www.weather.com/outlook/travel/businesstraveler/wxclimatology/monthly/graph/MXCA0026?from=tenDay_bottomnav_business

9. http://books.google.com/books?id=pRfakcj5ONIC&pg=PA353&lpg=PA353&dq=Juarez++hot+and+dry&source=web&ots=1et7n9wRrK&sig=ZYmKaVapLkBBwfDyPX8wQ8KTt0c&hl=en&sa=X&oi=book_result&resnum=2&ct=result

10. http://en.wikipedia.org/wiki/Heat_capacity#Heat_capacity

0.11 Resources :

Team Member	Total Time Spent
Maribel Valdez	58
Allisyn Williams	65
Harry Michael	62.5
Sumayya Nikhat	61
Shreyas Dole	20
Brett Monroe	48
Ruth Droescher	59
Aubrey Vander Heyden	40
Jacqueline Villa	64
Total	**477.5**

Time Sheet for each individual team member is given below: -

Timesheet Report for Maribel Valdez
Completed Tasks

Date	Hours Spent	Task
06/12/2008	3.0	Research regarding internal combustion engines...hazards associated with them and potential

		fuels. Alternative sustainable energy methods. Primarily piezoelectric transducers and pendulum-systems implementing evaporative-cooling cycles to generate mechanical energy.
06/18/2008	2.0	Floor Plans
06/18/2008	3.5	Research regarding cladding and green roofs.
06/19/2008	5.0	Floor Plan Preliminary Research. Exterior Insulation
06/19/2008	6.0	Energy Analysis - ECOTECT Software and via Energy Engineering book. Contacted Honda engine manufacturer. Received a quote.(1.04 gal/ hr). Does not come with inverter. Contacted engine-inverter-generator unit sold in the vicinity at ENGINE CENTER. Awaiting response.
07/01/2008	5.0	Engine Sizing for Zero-Energy Home Chicago Project
07/03/2008	3.0	Thermal Analysis Procedure investigation. Used book that I obtained from Galvin Library: Energy Engineering. Will create an excel sheet and apply procedure to Ciudad Juarez, Mexico using the 'cross' apartment complex concept.
07/04/2008	6.0	Sox Group: Research on affordable water heating solutions in Ciudad Juarez--Tank less Heater. Sized and selected model. Determined load. Research on efficient cooling systems--swamp cooler. Sized and selected model. Determined load. Energy Presentation: see energy systems.ppt
07/04/2008	9.0	Worked on thermal analysis calculations by hand for Ciudad Juarez, Mexico using the cross apartment complex concept. Created an Excel sheet. See thermalmodel.xls file. Studied envelope solutions. Suggested an aluminum base paint for internal insulation. Using piezoelectric transducers for courtyard space. See energy solutions.ppt
07/08/2008	8.0	Contacted whole house generator supplier. Made a list of questions for Harry to ask E85 vendors. Made a list of manufacturers for him to call. Got EES software for use on engine rating. Research Envelope ideas. Updated thermal load and helped Muhammad for the Chicago site. Met Juarez group.

07/10/2008	6.0	Plumbing system layout. Research efficient methods of layout. Research quotes. Worked on .ppt for Saturday's Juarez presentation.
07/18/2008	1.5	Plumbing cost u-shape, cross-shape, and single unit designs.

Total Hours Spent: 58.0

Timesheet Report for Allisyn Williams

Completed Tasks

Date	Hours Spent	Task
06/09/2008	1.0	Questionnaire for visit to Wheeler
06/10/2008	2.0	Visit to Wheeler
06/11/2008	4.0	Research-Cladding systems for Sox Proposal
06/12/2008	3.0	Prepare slides for Wheeler and research and prepare slide for personal research
06/13/2008	2.0	prepare presentation with design group
06/15/2008	4.0	Plan Schemes
06/17/2008	1.5	Plan Schemes
06/19/2008	2.5	Research for Team A Solar, Roof and Crawl Space
06/19/2008	5.0	Sox team meeting and Detail cladding system
06/20/2008	2.0	Design Team Meeting
06/20/2008	7.0	Sox Team Presentation -Site Plan, Elevations and cladding
06/22/2008	4.0	Floor Plan-SOX Presentation
07/03/2008	5.0	revise elevation drawings
07/04/2008	5.0	Elevation Final Drawings (Illustrator) 3 schemes
07/08/2008	5.0	Juarez group meeting and rough draft site proposal
07/09/2008	3.0	Finalize rough draft site proposal
07/10/2008	2.0	Revise Site proposal and finalize
07/15/2008	4.0	revised cross plan and Juarez group team meeting
07/17/2008	1.0	revised site plan scheme
07/21/2008	2.0	Revise Elevations

Total Hours Spent: 65.0

Timesheet Report for Harry Michael

Completed Tasks

Date	Hours Spent	Task
06/07/2008	3.0	Researching Hybrid engines to provide the housing units with electricity.
06/11/2008	2.0	Researched other sources of renewable energy. for example solar panels, wind energy etc.
06/17/2008	2.0	Floor Plans for double and single units.
06/19/2008	4.0	Research how feasible it would be to use different sources of renewable energy at different locations.
06/20/2008	2.0	Meeting with the group for discussing our progress.
06/23/2008	2.0	Coming up with a site plan for 32 units.
06/25/2008	2.0	Cubs group meeting
06/26/2008	0.5	Meeting minutes from 06/21/08
06/26/2008	4.0	Researching on Thermal masses suitable for juarez after looking at the climate there. Also coming up with ideas for a Solar Water heater.
06/27/2008	2.0	Energy group meeting. regarding the presentation on Saturday
06/27/2008	1.0	Slides for the Cubs team (Thermal Masses and Solar water heater)
07/03/2008	0.5	Meeting minutes from 06/28/08
07/03/2008	2.0	some density calculations
07/04/2008	2.0	Mass Calculation for the water containers.
07/10/2008	6.0	A combination♣Passive cooling. of natural ventilation, thermal mass on the exterior of the unit and evaporative cooling
07/11/2008	2.0	Slides of the Saturday Presentation.
07/11/2008	0.5	Meeting Minutes
07/11/2008	6.0	Research and calling people to gather as much information for e 85 engines.
07/16/2008	2.0	fixing the meeting minutes format and summiting them to iknow.
07/17/2008	3.0	Final Presentation Seminar
07/24/2008	3.0	Research on the People of Juarez.
07/24/2008	2.0	Putting together the Problem, Conclusion and question Slides.
07/24/2008	9.0	Final Report

Total Hours Spent: 62.5

Timesheet Report for Sumayya Nikhat

Completed Tasks

Date	Hours Spent	Task
06/14/2008	0.0	Joined IPRO 339 this day!
06/18/2008	4.0	Searched information about the automobile engines and looked into how to set up a meter to utilize power, also found out information about different kinds of inverters and the electrical load required.
06/19/2008	1.5	Double and Single unit floor plans submitted.
06/20/2008	3.5	Searched for information about the exterior walls and solar gain required - Envelope Definition.
06/20/2008	2.0	Meeting with group
06/24/2008	4.5	Did some research on car engines and electrical loads and figured out the electrical load required per unit.
06/26/2008	3.0	Created PowerPoint slide for Energy- Electrical requirements.
06/26/2008	2.0	Sox group meeting.
06/27/2008	4.0	Meeting the Group and discussing about the presentation and progress, Research.
07/04/2008	2.0	Research on electrical diagrams.
07/04/2008	4.0	Slides for the sox team and the energy team.
07/11/2008	5.5	Research, slides for Saturday's presentation.
07/16/2008	3.0	Cost analysis research
07/17/2008	3.0	Ipro presentation seminar
07/18/2008	4.0	Research and presentation slides
07/21/2008	2.0	Research
07/22/2008	6.0	Working on the Final Report.
07/23/2008	7.0	Working on the Final Report

Timesheet Report for Shreyas Dole

Completed Tasks

Date	Hours Spent	Task
06/11/2008	2.0	Research
06/13/2008	3.0	made presentation for exterior env. group
06/17/2008	2.0	Research
06/18/2008	0.5	Ext. Env. meeting
06/19/2008	1.5	Ext. Env. Meeting...
06/22/2008	3.0	Research on Insulation

06/24/2008	2.0	Team A Cubs Meeting
06/26/2008	1.0	Ext. Env. Meeting
06/27/2008	5.0	Research on Insulation, work on midterm presentation explanation, work on passive cooling.

Total Hours Spent: 20.0

Timesheet Report for Brett Monroe

Completed Tasks

Date	Hours Spent	Task
06/07/2008	3.0	Research
06/10/2008	1.0	Research
06/17/2008	2.0	Envelope research
06/17/2008	3.0	Floor plans
06/18/2008	2.0	Research
06/18/2008	1.5	Final touch up on floor plans
06/24/2008	2.0	Research
06/25/2008	1.5	Roof details
06/26/2008	1.5	MEP
06/26/2008	3.5	Plumbing model
07/02/2008	1.0	passive cooling research
07/04/2008	3.0	infrastructure presentation
07/08/2008	2.0	site planning
07/08/2008	2.0	juarez presentation
07/09/2008	2.0	site planning
07/11/2008	5.0	presentation
07/16/2008	4.0	model
07/17/2008	4.0	model/presentation
07/18/2008	4.0	presentation

Total Hours Spent: 48.0

Timesheet Report for Ruth Droescher

Completed Tasks

Date	Hours Spent	Task
06/10/2008	3.0	LEED Research
06/13/2008	4.0	Researched sustainability: concepts, methods
06/16/2008	3.0	Research

06/17/2008	5.0	Unit designs
06/20/2008	4.0	Research
06/22/2008	3.0	Unit layouts, site layout for juarez
06/24/2008	2.0	Cubs group meeting; development of 32 unit layout
06/25/2008	3.0	Worked on presentation for Juarez design proposal.
06/26/2008	2.0	Cubs group meeting; developed presentation drawings for Juarez proposal
06/27/2008	4.0	Finished presentation drawings: plans, section, elevations, passive cooling diagram.
06/27/2008	2.0	Energy group meeting
07/01/2008	1.5	Cubs group meeting
07/01/2008	3.0	Energy Research
07/02/2008	4.0	drawing revisions
07/02/2008	2.0	site planning
07/04/2008	2.0	prepared presentation
07/08/2008	1.0	attended LEED lecture
07/10/2008	2.0	Juarez group meeting
07/11/2008	2.0	Energy Group meeting; worked on energy presentation
07/15/2008	1.5	Juarez Team Meeting
07/17/2008	3.0	Preparing for final presentation
07/18/2008	2.0	Final presentation slides

Total Hours Spent: 59.0

Timesheet Report for Aubrey Vander Heyden

Completed Tasks

Date	Hours Spent	Task
06/07/2008	3.0	research
06/11/2008	2.0	code and landscape research
06/17/2008	2.0	space planning
06/18/2008	2.0	research
06/19/2008	3.0	project plan
06/20/2008	2.0	project plan and research
06/21/2008	2.0	finalizing project plan
06/24/2008	2.0	Research MEP
06/25/2008	3.0	Electrical Configuration, Plumbing research
06/26/2008	3.0	White roof, PowerPoint outline
06/30/2008	2.0	Electrical design for Cubs sub group
07/01/2008	3.0	Electrical scheduling
07/02/2008	3.0	AutoCAD diagrams
07/03/2008	2.0	Polar power research and electrical write-up
07/07/2008	2.0	Solar powered public lighting systems
07/09/2008	3.0	Electrical diagrams and lighting research
07/10/2008	1.0	New kW calculations for utilities in sox and cubs team layouts

Total Hours Spent: 40.0

Timesheet Report for Jacqueline Villa

Completed Tasks

Date	Hours Spent	Task
07/29/2007	1.0	notes and e-mails
06/02/2008	2.0	floor plans for Glynn
06/09/2008	2.0	climate research
06/10/2008	2.0	finalizing floor plans and some research
06/13/2008	2.0	putting together the sheet with links for uploading
06/19/2008	2.5	finding software for environmental simulation, and or to design a zero energy building
06/20/2008	5.0	reformatting climate information and group meeting to discus overall findings

06/21/2008	2.0	scanning in and redrawing sketches from class, e-mailing to group
06/23/2008	4.0	sketch 3d model of complex, and climate research on insulation and other
06/24/2008	3.0	climate analysis research...cladding design for complex in sub group for team A
06/25/2008	2.0	climate info
06/26/2008	8.0	plans and research and presentation for sub group in team A design
06/27/2008	12.0	finalizing of section, plans, and sk of 3D, group meeting, put together ppts, and putting together slide for climate ppt
07/03/2008	6.0	re do dwgs, diagrams, e-mail group. put together presentation.
07/08/2008	2.0	meeting and some climate research
07/09/2008	1.5	site plan sketch for Juarez group
07/10/2008	2.0	revision of site plans for Juarez group and meeting
07/14/2008	2.0	UPDATING DWGS
07/21/2008	3.0	working on final board, and final dwgs

Total Hours Spent: 64.0

0.12 Acknowledgements:

We would like to thank our Professors Michael Glynn and Blake Davis for their expert opinions and suggestions throughout the project. We would also like to thank Mike Moran from Ford Motor Company for his cooperation in discussing E85 engines.

Appendix A: Cost Analysis for IPRO 339 B (Juarez Group)

IPRO 339B - Cost Analysis

22-Jul-08

PRELIMINARY

	Qty. / Unit	Material Cost	Unit Cost
Hard Cost			
Container	1	$1,400.00	$1,400.00
Window Unit Type A	1	$48.00	$48.00
Window Unit Type B	1	$52.00	$52.00
Entry Door & Window	1	$125.00	$125.00
Interior Door	1	$45.00	$45.00
Shower Unit	1	$200.00	$200.00
Shower Valve	1	$75.00	$75.00
Water Closet	1	$80.00	$80.00
Bath Sink & Faucet	1	$75.00	$75.00
Kitchen Sink	1	$25.00	$25.00
Kitchen Sink Faucett	1	$25.00	$25.00
Laminated Coutertop - Bath (by linear foot)	3	$15.00	$45.00
Laminated Coutertop - Kitchen (by linear foot)	10	$15.00	$150.00
Wire Shelving - Bedroom (by linear foot)	8	$1.21	$9.68
Wire Shelving - Storage (by linear foot)	24	$1.21	$29.04
Light Fixtures (per unit cost)	3	$32.00	$96.00
Refrigerator	1	$355.00	$355.00
Electric Cooktop & Range	1	$250.00	$250.00
Kitchen / Bath Exhaust Fans	2	$30.00	$60.00
HVAC Unit	1	$200.00	$200.00
Electrical Outlets / Switches (per unit cost)	10	$30.00	$300.00
Electrical Conduit (by linear foot)	70	$1.95	$136.50
Interior Walls (by linear foot)	30	$5.50	$165.00
Bathroom Subfloor	1	$65.00	$65.00
Plumbing - Rough In	1	$100.00	$100.00
Vinyl Flooring - Bathroom	1	$80.00	$80.00
Refinish Wood Flooring (by square foot)	320	$0.49	$156.80
Furniture	1	$1,176.00	$1,176.00
Insulation / Soundproofing	1	$1,224.00	$1,224.00
Strawbale /stucco			
Logistics and Labor			
Container - Shipping Cost	1	$500.00	$500.00
Crane Operation - Container Installation	1	$55.00	$55.00
Factory Labor	1	$550.00	$550.00
Onsite Labor	1	$210.00	$210.00
Shared Infrastructure & Land			

Costs

Concrete Footings / Foundations	0.0417	$1,750.00	$72.98
Domestic Water Heating Plant	0.0417	$4,250.00	$177.23
Electrical Distribution System	0.0417	$2,100.00	$87.57
Land Cost ($16,000 / acre)(60 d.u./ acre)	0.0417	$16,000.00	$667.20
Stairs, Landings & Railings	0.0417	$9,500.00	$396.15
Green Roofing / Single Ply Roofing	0.0417	$2,800.00	$116.76

Total Cost $9,580.90

Sales Price (Includes Total Cost + 15% Contingency) **$11,018.04**