

I PRO 339 PROJECT PLAN

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

**I PRO Faculty Advisors**

Michael Glynn  
 Blake Davis

**I PRO Team Members**

Shreyas Dole  
 Haim Eliyahu  
 Jeremy Moore  
 Ben O’Neil  
 Heather Olson  
 Joe Peroni

SUBGROUPS:

ENERGY	INFRASTRUCTURE	EXTERIOR ENVELOPE	HOUSING DESIGN
Jeremy Moore	Joe Peroni	Shreyas Dole Haim Eliyahu	Ben O’Neil Heather Olson

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1.0 Abstract

Currently there are several countries throughout the world that have a large need for affordable housing. Our I PRO 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 I PRO team this semester will focus on applying the prototype from last two semesters to Juarez, Mexico, 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 Juarez situation we

will be better able to apply the prototype to various other countries throughout the world.

**Comment [D1]:** What about: “we will develop a versatile prototype for Juarez Mexico that can be applied to communities in need everywhere”?

## 2.0 Background

- A. 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.
- B. 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-. 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.
- C. 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

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needs that needed to be implemented into the design. All of these things went into the final development study.

- D. 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.

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### 3.0 Objectives

A.

- -Develop solutions to make the shipping container prototype resemble Juarez vernacular housing.
  - Research the most cost efficient and sustainable ways of incorporating plumbing, HVAC, and electricity into the homes.
  - Develop additional site plans, floor plans, and sections as different solutions and options to the previous semester by developing design solutions to the problem of solar gain minimization, water collection, optimizing site orientation, and enhancing thermal zones.
  - Using our research and previous designs to continue to develop multiple solutions considering the client at hand.
  - Using our prototypes to implement -and focus our solution for Juarez, Mexico but keep in mind to generalize it enough to make it easier to expand our research to other places around the world.
  - Research a viable and cost effective energy solution
  - Make the housing compliant with Juarez, Mexico fire code guidelines and investigate the ethical responsibilities of further Fire Protection.
  - Ensure civic and handicap accessibility for the housing.
  - Investigate the climatic needs of the region, and change site layout
  - Ethically observe the cultural needs of the region through cultural understanding and design solutions.

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B.

IPRO 339 is focused on providing an affordable housing option for the working poor in Juarez, Mexico. 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,

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functionality, opportunity, sustainability, durability, safety, culture, and neighborhood.

Prioritization will focus on first revamping the design to incorporate the Juarez Fire Safety Code, solar gain minimization, site orientation, and insulative solutions. We will concurrently develop cost effective construction solutions to the various modules that make up the homes and continue research on the exterior envelope and insulation options.

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.

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**Comment [D3]:** It's not new to the semester, and our group will not be focusing on it.

#### 4.0. Methodology

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

Level 1: Affordable Shipping container housing

Level 2:

- 1.1- Energy
- 1.2- Infrastructure
- 1.3- Exterior Envelope
- 1.4- Housing Design

Level 3:

- 1.1- Energy
  - 1.10- Gather all climate data [3]
  - 1.11- Do initial solar studies [4]
  - 1.12- Make energy model for last semester's design and test [6]
  - 1.13- Energy Analysis [8]
  - 1.14- Solar Heat, Cooling, Electricity [9]
  - 1.15- Zero Energy [9]
  - 1.16- Local Energy [9]
  - 1.17- Call representatives of Honda about energy ideas [6]
  - 1.18- Research feasibility of investigations [10]

1.2- Infrastructure

- 1.20- Electrical [4]
- 1.21- Plumbing [6]
- 1.22- System Sizing [6]
- 1.23- Infrastructure Components [6]

- 1.24- Passive Systems [8]
- 1.25- Modular Equipment & Visit RV installation plant [8]
- 1.26-Research how to lift the containers into place [8]
- 1.27-Research how to lock down/connect the containers [9]
- 1.28-Create mock-ups of radiant flooring system [10]
  
- 1.3- Exterior Envelope
  - 1.30- Foundation [4]
  - 1.31- Skirting [5]
  - 1.32- Fire Safety (talks with fire department) [5]
  - 1.33- Insulation and Infiltration Control [8]
  - 1.34- Cladding Systems [8]
  - 1.35-Researching different strategies [8]
  - 1.36-Researching insulation [10]
  - 1.37-Calculate cost [10]
  
- 1.4- Housing Design
  - 1.40- Ventilation [6]
  - 1.41- Roofing Systems [8]
  - 1.42- Visual Appeal [8]
  - 1.43- Painting Options [9]
  - 1.44- Floor Plan Arrangements [7]
  - 1.45- Solar Gain [5]
  - 1.46-Research shading types and sun angles [6]
  - 1.47-Rearrange floor plans to create efficiency and comply with fire safety regulations [6]

The last two weeks of the semester would be dedicated towards finishing minor tasks and getting ready for IPRO day and other exams.

### 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
I PRO day	\$250.00	1	\$250.00	Poster and presentation materials (Including models)
Food	n/a	n/a	\$100.00	Pizza Party
<b>Total:</b>			<b>\$450.00</b>	

### 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, Exterior Envelope sub-group member and a member of the Juarez Design Team. Returning member of I PRO 339.

Name: Haim Eliyahu  
 Year: 3<sup>rd</sup> year  
 Major: Mechanical Engineer/MSE  
 Experience, Skills, Strengths: leadership, problem solving, organization, member of the Material Advantage group, Titanium powder research.  
 Roles: Preliminary research, Juarez group, Exterior Envelope sub-group.

Name: Jeremy Moore  
 Year: 5<sup>th</sup> year  
 Major: Architecture  
 Experience, Skills, Strengths: programming, conceptual design for health care

organization, AutoCAD, 3D modeling, 3D animation, interest in housing design, experience in urban planning  
Roles: Preliminary research, Juarez group, Energy sub-group

Name: Ben O'Neil  
Year: 4<sup>th</sup> year  
Major: Civil-Environmental Engineering  
Experience, Skills, Strengths: Structural analysis, SAP2000, MathCAD, Maple, Structural Design, Adobe creative suite, Microsoft Office Suite, Water resource engineering, internship for Chicago LEED council, communication, and research.  
Roles: Juarez group, Housing Design sub-group

Name: Heather Olson  
Year: 5<sup>th</sup> year  
Major: Architecture  
Experience, Skills, Strengths: Internship at architecture firm, photoshop, model making, problem solving, communication  
Roles: Juarez group, Housing sub-group, preliminary research

Name: Joe Peroni  
Year: 4<sup>th</sup> year  
Major: Architecture  
Experience, Skills, Strengths: Experience in design and typical construction methods, model making, problem solving, AutoCAD, photoshop  
Roles: Preliminary research, member of infrastructure sub-group, Juarez group