CREATING AFFORDABLE HOUSING USING SHIPPING CONTAINERS IPRO 339-B

IN CUIDAD JUAREZ, MEXICO

GOALS AND OBJECTIVES

- To provide a safe and healthy community for the workers in Cuidad Juarez, Mex.
- 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 current living conditions are enhanced
- To provide a housing solution that is affordable for the workers, while still increasing their standard of living
- To create prototypes that could be applied to other third world sites

METHODOLOGY

- Members of IPRO 339 were first divided into research sub-groups: energy, exterior envelope, design, and infrastructure.
- These groups were responsible for researching and recommending solutions for the housing design.
- In addition to these research groups, the whole IPRO was then divided between team A (Chicago) and team B (Juarez).
- The Juarez team was divided into two sub groups each responsible for designing individual units, and later larger multi-unit structures. These sub-groups made recommendations about the systems necessary to the project, including exterior cladding, and electrical, plumbing and HVAC systems.
- These two sub-groups later combined to develop a final site plan that included both building layouts designed by the sub-groups.

PROBLEMS FACED

Finding a cheap and easily constructed exterior cladding.

Something cheap and locally available with a high insulation value.

Finding a cheap and sustainable roofing material.

Choosing between the labor and cost of a green roof, and the cheap but lesser quality of a membrane flat roof

Finding meeting time outside of Saturday

Since most of us work full time, that being one of the reasons the students were able to take the Saturday class to begin

CONCLUSION

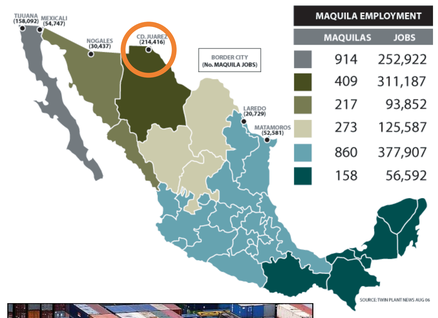
The climate in Cuidad Juarez, Mexico presented a difficult problem because of the extreme heat gain, the limited rainfall, and sparse wind flow.

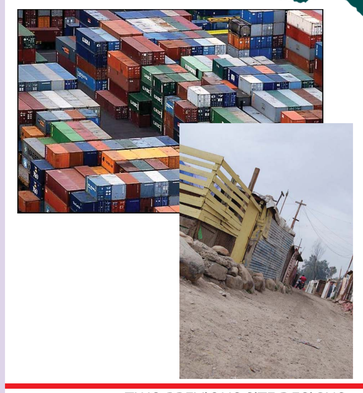
The green roof and straw bale insulation will help to greatly reduce the heat gain; the straw bale insulation will be a relatively inexpensive insulation solution because it is possible to find near the site. The structural strength of the shipping container allowed us to greatly reduce the building cost and provides us with an opportunity to prefabricate many of the features in the unit, making the installation and construction process very short.

TEAM MEMBERS (Juarez)

Allisyn Williams, Jacqueline Villa, Aubrey Vander Heyden, Maribel Valdez, Sumayya Nikhat, Brett Monroe, Harry Michael, Ruth Droescher, Shreyas Dole

FACULTY ADVISORS
Michael Glynn, Blake Davis





THE PROBLEM

There are over 3000 factories known as Maquiladoras in Mexico, the thousands of employees in these factories work for an average of $1.00-$2.15 an hour. The addition of a cent in pay will get them to change the factory they work for. The Maquiladoras need a way to keep their workers. The workers themselves, due to pay, live in run down shacks with no running water or electricity. The communities that these shacks form also experience a very high rate of crime. They need better housing and living conditions in general.

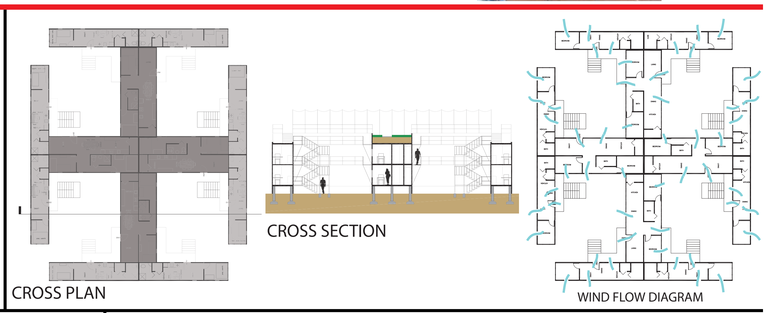
There is a surplus of shipping containers around the world. They are made in places such as China, shipped to their location, and usually kept there, sometimes going into reuse but mostly going into storage or scrap. These containers are taking up a lot of space, and their good structural qualities are going unused.

- Maquiladoras need a way to keep their workers.
- The workers need improved living conditions, in a safe, sound, and sustainable community
- Shipping containers need to be used in a sustainable manner.

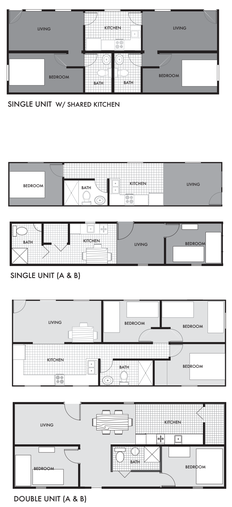
TWO PREVIOUS SITE DESIGNS (100 sq. m)

2.47 acres total units = 194 Density = 78 d.u/acre total occ. = 466

2.47 acres total units = 224 Density = 90 d.u/acre total occ. = 560

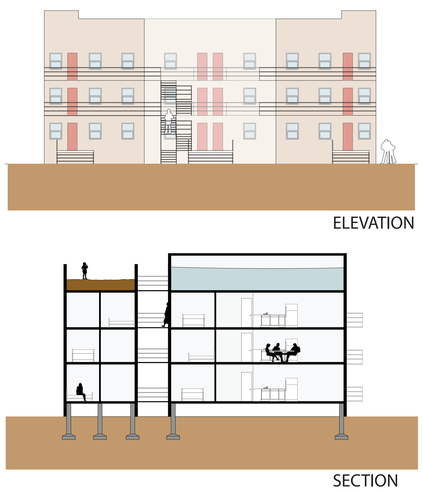


INDIVIDUAL UNIT PLANS
U-PLAN AND CROSS



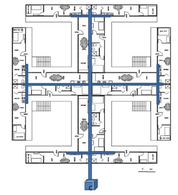
CROSS PLAN
U-PLAN: 22 UNITS 54 OCCUPANTS
CROSS: 24 UNITS 64 OCCUPANTS

U-PLAN, ELEVATION AND SHORT SECTION

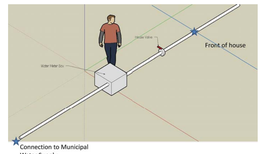


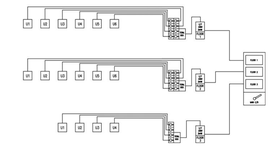
SOLUTIONS:

PLUMBING



The water distribution lines were mapped out individually for each of the proposed buildings: cross-shape apartment, u-shape apartment, and a single-unit dwelling. The preliminary figures presented attempt to show how distribution lines will be mapped out.
DWV lines should be designed such that stack lines are minimized to reduce piping costs. Using the piping supplier recommended, Charlotte Pipes, a PVC and cast iron plumbing combination for the DWV plumbing lines will not only provide a building that reduces noise yet, it will also provide a building that meets LEED standards, because the company uses 100% recycled cast iron.
The passive water heating equipment sized to each of the 3 building types implements solar collectors mounted on the roof, through which cold water lines are heated via the sun, and it is also equipped with an 80-gallon solar water tank, which is placed adjacent to the building such that the required water pressure is achieved via gravity and buoyancy, essentially a thermosiphon water system. About 65-95% of water heating will come from the sun and the rest will be supplied via an electrical heating element within the tank that will function as a back-up heating source. Further work will include using the information and supplier recommendations presented here to create detailed drawings that address all connections and set-up details for each of the three building types mentioned here.





ELECTRICAL

After an analysis of the electrical needs of these sites, we chose to go with a system compatible with the needs of the Juarez people. The system that was most compatible was an electrical configuration that gave each unit control over their own power. This type of system protects from power surges affecting each individual unit in a site plan. An 8-12 pole load bank is sufficient for a single unit. These load banks are then connected to a circuit transformer. There is one circuit transformer per floor which allocates 6 load banks per floor. Wired to each transformer are hot sequence meter stacks. These stacks give us the ability to meter the power usage per unit as opposed to per site, which ultimately causes less problems with billing issues in the future. These circuit transformers (three per U-plan and four per Cross-plan) are then wired to the main circuit breaker which is supplied with the main power service. The power distribution lines were mapped out for each plan specifying service sizes, wire sizes, and wiring configurations.

EXTERIOR

The Exterior Envelope consists of the external wall, internal insulation, sound-proofing and foundation for building. While doing research we tried to use a lot of materials that were cheap and yet at the same time very effective insulators and strong foundations. After effective research was done, materials were compared for outer walls insulation and inner wall insulation and sound proofing. The material chosen for external wall was Straw bale which provides R-30 insulation value with only 1 foot thickness. It is also easily available in and around Juarez, Mexico. The material used to hold the straw bale together and against the wall is stucco. The total compilation comes to be about $2.00 per sq. ft. For the inner wall insulation and sound proofing Blown cellulose insulation will be used. This technology basically uses recycling paper which is sprayed on the wall to form a foamy yet hard substance which can have an R-value of up to R-48. The cost for this would come out to be $1.20 per sq. ft. As for the foundation, pier foundation was chosen as it is the most conducive method and cheap at the same time.