Smart Rainwater Harvesting

Capstone Design Class
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GZG Water Solutions
December 1, 2017
Sponsors

- Client: Mr. Pablo Marvin, Director of the Hacienda Santa Clara in San Miguel de Allende, Guanajuato Mexico
- Sponsors:
  - Mr. Luis Cifuentes, Special Assistant to the President Texas A&M Corpus Christi
  - Ms. Cynthia Lyle, Senior Research Development Officer Texas A&M Corpus Christi
- Faculty Advisor: Dr. Fouad Jaber, Associate Professor and Extension Agricultural Engineering Specialist - Texas A&M AgriLife Research & Extension (Dallas)
- Project Manager: Dr. Maria King
Project Scope

- As water shortages are becoming an issue worldwide, solutions to meet water demand in a sustainable way are much needed. In Mexico, around half of the population live in rural areas surrounding big cities. San Miguel de Allende is an example.
- The goal is to design a smart rainwater harvesting system to provide water to the area around the hacienda for a variety of uses.
- Constraints:
  - Design must be easy to maintain and economically efficient
  - All materials must be locally available
Location: Hacienda Santa Clara
Detailed Deliverables

- Design Solution
  - Solidworks Model
- System Maintenance Manual
- Cost Benefit Economic Analysis
- Design Notebook
Design Literature

Design Approach

- What is Rainwater Harvesting RWH?
  - Rainwater harvesting (RWH) is a system to collect and store runoff from rainfall, either for immediate use, or to be used at a later time
  - Types of Systems
    - Simple - distribute water immediate
      - gutters, sloped sidewalk, catchment systems (cannot be water permeable)
    - Complex - store some to all for later use
      - Conveying system + storage containers

- System able to switch from a large scale to a small scale system using a complex RWH system that has two separate outlets
  - One outlet for potable water (small scale)
  - One outlet for irrigation water (large scale)
Method and Materials

- Research/Data Needed
  - Rainfall estimate for 2017- to take into consideration natural disasters that have occurred in the past year due to climate change
  - Data from 2016: Average rainfall per year in San Miguel de Allende is about 27.5 in.
    - Dry Periods: November - April
    - Wet Periods: May - October (account for over harvesting of water)
  - Existing systems currently used in rural areas near the Hacienda
    - EWB has already worked with IRRA Mexico to deliver potable water for families/clinics/schools
    - Contact Gabriela Lagunes - lead engineer on team that did maintenance and replaced systems
  - Existing systems used to purify and move varying amounts of water
    - Will be examining existing systems at the Texas A&M AgriLife Extension center
Design Alternatives: Storage Containers

- **Placement**
  - Rooftop
  - Underground

- **Contamination**
  - ROV inspections that occur every year (not prevention)
  - Screen Filters
    - Remove debris/insect

- **Materials**
  - Fiberglass
  - Polyethylene (least expensive and most common)
  - Wood
  - Metal
  - Concrete

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<th>Transportability</th>
<th>Maint. Requirement</th>
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-- Low/No    + High/Yes
Design Alternatives: Water Purification

- Ultraviolet Light
  - Light goes through cell wall of organism, disrupting cell genetic makeup, which ceases the reproduction of microorganism
- Membrane Filtration
  - Pushes water through a layer of material
- Distillation
  - Provides purest form of water, but most expensive and complicated
  - Requires boiling water in an enclosed container
- Chlorine Dioxide Tablets
  - Modern solution to distillation
  - Kill all microorganisms in water
  - Portable and easy to store
Roadmap and Timeline

Smart Rainwater Harvesting

- Memorandums
- Research
  - General Research
  - Literature Review
  - Materials Research
- Decisions
  - Initial Design Approach
  - Materials
- Travel
  - RCN CE3SRAR meeting - Corpus Christi
  - Texas A&M AgriLife Extension - Dallas
  - Hacienda Santa Clara - Mexico
- Deliverables
  - Project Roadmap Report
  - Design Solution
  - Design Notebook
  - Economic Analysis
  - Final Report
- Presentations
  - Corpus Christi Presentation Preparation
  - Corpus Christi Presentation
  - Project Roadmap Preparation
  - Final Roadmap Preparation
  - Final Presentation
Communication

• Bi-weekly memorandums sent to client, sponsors, faculty advisor, and project manager.
• Monthly WebEx Meetings
• Other emails sent and meetings held as needed
Any Questions?