TEAM ISLAND
Team

California:
- Andrew - MEP
- Thomas - Structures
- Arianna - Apprentice

Puerto Rico:
- Ana V. - Architect
- Stephanie - Architect

Denmark:
- Hussain - Construction

Germany:
- Chris - LCFM

Slovenia:
- Ana K. - Structures
Owners

Maryland:
Sarah

Puerto Rico:
Bianca

Germany:
Felix

Slovenia:
Jure
Architecture
Structure
Construction
Life Cycle

Color coding
Location

Puerto Rico

San Juan
Location
Wind Conditions

Wind Flow Site Simulation

East Flow

North East Flow
There is a 65% average chance it will rain at some point during a given day.

Roof Catchment potential:

56 inches per year
927,000 gallons per year
Solar Conditions

- **Morning**
- **Noon**
- **Afternoon**

### Summer Solstice
- Morning diagram
- Noon diagram
- Afternoon diagram

### Winter Solstice
- Morning diagram
- Noon diagram
- Afternoon diagram
Hazard Conditions

Based on ACSE 7 - 2010 Ed.

Earthquake
0.2 SRA = 1.0g
1.0 SRA = 0.4g
TL = 12s

Hurricane
High wind from NE
Basic wind velocity
v = 160/170 mph

Avg wind velocity on site
### Structural Conditions

**Based on California Building Code**

#### Live loads (psf)
- Offices: 50
- Lounge: 80
- Classroom & seminar: 40
- Auditorium: 100
- Lab: 100
- Common space: 60-80
- Corridor: 80-100
- Storage: 150-250
- Mech/elec. room: 100
- Stairs: 100
- Roof: 40

#### Soil Profile
- Bearing Capacity: 5000 psf
- Soil Type: Medium to Very Stiff Clayey Soil
- Water Table: 8'
- Excavation Line: 17'
- Medium to Very Stiff Clayey Soil: 17'
- Water Table: 18'

![Soil Profile Diagram]
## Decision Matrix

<table>
<thead>
<tr>
<th></th>
<th>CONCRETE</th>
<th>STEEL</th>
<th>CONCRETE</th>
<th>STEEL</th>
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<td>6</td>
<td>8.30</td>
<td>4</td>
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<td>9</td>
<td>7.70</td>
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<td>4</td>
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<td><strong>O&amp;M cost</strong></td>
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<td>10</td>
<td>7.53</td>
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<td>11</td>
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<td><strong>Consistence big ideas</strong></td>
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<td>12</td>
<td>8.93</td>
<td>4</td>
<td>2</td>
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<td><strong>Merging disciplines</strong></td>
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<td><strong>Average reached Points</strong></td>
<td>3.25</td>
<td>2.67</td>
<td>3.33</td>
<td>2.42</td>
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<td><strong>283</strong></td>
<td><strong>183</strong></td>
<td><strong>287</strong></td>
<td><strong>206</strong></td>
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</table>
Team objectives

solar  water  realistic
community  local  flow
living  visible  welcoming
gathering  focal point
connecting  multi-cultural  integrated
in  square  in
inspiring  breathing
efficient
Big idea

Create a living Focal Point

Bird of Paradise Flower
Design process

From Outside IN
Pedestrian Flow Conditions

Pedestrian Flow  New Pathways
Concept Diagram
South Entrance
North Entrance
Southwest Elevation
Building access
Acoustic design

- Diffusion panels
- Absorption panels
- Reflecting panels
Wall Section

A

Gravel
Water proof membrane
Drainage

B
Wall Section

A
- Soil
- Gravel
- Insulation
- Water proof membrane
- Bubble slab

B
- Absortive transparent material
- Glass panel
- Aluminium wood finish blade
- Track operable louvers
- Metal Structure
- Glass panel
Auditorium Structure

HVAC Integration

Connections

Clash Detection
Auditorium Structure

Steel truss
HSS 7x0.5

Steel deck
1in thick

SAP2000 analysis model
HVAC - Middle Floors
HVAC - Auditorium
Vertical Circulation

- Basement
- First Level
- Intermediate Level
- Second Level
- Third Level
Main Features:
Slanted columns regularly distributed
Concrete floors / steel roof
Internal core with tension ring
Thickened plate
under columns 11’x8’x19”
under walls 8’x19”

Retaining walls
thickness 8”
Vertical structural elements

- Round columns 24”
- Shear walls 12”
- Slanted columns:
  - Changing section
  - Bottom → 8’x1.5’
  - Top → 2’x1.5’
Horizontal structural elements

Bubble slab
- Last floor thickness 15”
- Other floors thickness 11”

Benefits
- 35% less concrete
- Fast to build
- Minimise operation, health and safety risks
- Less deflection for longer spans
Main entrance
Entrance truss

Compression

Tension

Steel elements
HSS 10x10x0.5

Connection detail

ETABS Model Rendering
Displacements

**Entrance cantilever**
Max of $\frac{1}{4}$ inch

**Long span**
Max of $\frac{3}{4}$ inch
Main Feature:
4 equally distributed shear wall cores
Earthquake data

Site conditions:
0.2 SRA = 1.0g
1.0 SRA = 0.4g
$T_L = 12s$
Soil category: C

Base shear: 1070 kips
Etabs animation
Torsion resistance

Added walls
Increased torsion resistance
Load paths
Earthquake risk

<table>
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<tr>
<th>Probability</th>
<th>10 %</th>
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<td>$2,434,000</td>
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<td>Risk Cost</td>
<td>$243,000</td>
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<td>Insurance</td>
<td>$34,500</td>
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Annual Risk Charge: $14,195
Hurricane protection

Net structure

Patent presented at the 2015 National Hurricane Conference - Austin, TX

Shutters
Steel shutters

Distribution at Level 3

Inventory

<table>
<thead>
<tr>
<th>Size</th>
<th>Numbers</th>
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<tbody>
<tr>
<td>20’x18’</td>
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<tr>
<td>20’x12’</td>
<td>9</td>
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<tr>
<td>15’x12’</td>
<td>2</td>
</tr>
<tr>
<td>10’x12’</td>
<td>1</td>
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</table>
Net anchorage

- **Roof Anchorage**
  - Net rolled-in
  - Fixed to steel girders
  - Max. load of 30 kips

- **Ground Anchorage**
  - 240 Anchor points
  - Max. load 22 kips
Net behavior

Without net

With net

Net specifications
- Angle of 30°
- Total of 60 units
- Unit size 10’x48’
- Unit weight 53 lbs

Net benefits
- roof pressure
- debris collision
- by 85% wind load
Net material

Textile - Valmex TF 400
Light-weight & high-performing
Produced out of recycled materials
Durable & recyclable
## Impact on LC & Risk

<table>
<thead>
<tr>
<th>Risk</th>
<th>Treatment</th>
<th>Risk Cost</th>
<th>Risk Reduction</th>
<th>Treatment Cost</th>
<th>New Risk Cost</th>
<th>Delta/Savings</th>
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<td>Hurricane</td>
<td>Hurripro</td>
<td>$2,774,000</td>
<td>65%</td>
<td>$108,000</td>
<td>$971,000</td>
<td>$1,695,000</td>
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![Graph showing the impact of treatment on risk cost over time. The blue line represents risk cost without treatment, while the red line represents risk cost with treatment. The graph shows a significant reduction in risk cost after treatment.]
Wind Conditions

Wind Flow Site Simulation

East Flow

North East Flow
HVAC Layout
Ventilation Analysis
Low Window - Too Windy
High Window - Limited Mixing, Accessibility Problems
CFD Simulations

Mid Level - Good Mixing, No Desk Gusts
Return Air Tradeoff

HVAC Energy vs System Types

- Enclosed Atrium
- Split System w/ WSHP
- No Return Air
- No 3F Air Distribution

Annual Cooling + Ventilation Energy (MWh)

- Cooling Energy (MWh)
- Vent Energy (MWh)
Pedestrian Flow Conditions

Pedestrian Flow

New Pathways
Big idea

Create a living Focal Point

Bird of Paradise Flower
Design process

From Outside IN
Vertical Circulation

Third Level

Second Level

Intermediate Level

First Level

Basement
Team objectives

- Solar
- Water
- Realistic
- Community
- Local
- Welcoming
- Flow
- Living
- Visible
- Gathering
- Focal point
- Connecting
- Inspiring
- Breathing
- Efficient
- Multi-cultural
- Integrated
- Square
- In
- Efficient
Atrium iteration

1 Conceptual Idea

- Inspiring Circulation Novel
- Value Cost Efficiency
- Discipline Integration

[Diagram with architectural design elements]
Atrium iteration

Work in progress
Iterating 2 → 3

Material Choice

Breaks the fluidity

Lack of integration

Multi-functional columns

Give Purpose

Less but Together

Hydroponics
Final Decision

University of Baltimore, Law Building
Integrate community with the University

Now:
There is a barrier between the community and the University

Proposal:
Eliminate the barrier between the community and University
Aquaponic Loop
Plants with high solar need

- Lettuce
- Tomato
- Pepper

Plants with low solar need

- Fern plant
### Impact on Life Cycle Cost

<p>| | |</p>
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<td><strong>Initial Cost</strong></td>
<td><strong>$ 9,000</strong></td>
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<td><strong>Annual Cost</strong></td>
<td><strong>$ 16,000</strong></td>
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<td><strong>Annual Income (20% Buffer)</strong></td>
<td><strong>$ 54,000</strong></td>
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<td><strong>Annual Cash Flow</strong></td>
<td><strong>$ 38,000</strong></td>
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Additional Income over Life Cycle = $ 1,300,000

Reduce Rent for the University
Rooftop Garden
Rooftop Garden

1600 sq. ft of garden
Shallow - up to 9” of soil.

Passive water filtration
Rainwater fed
→ slows down stormwater.

Draining water from garden and patio delivers extra gray water to the system, helps make up the gap in greywater needs.
Water Use - System Diagram
Water Use - System Diagram
Predicting Water Use

Baseline Daily Use

- Landscaping: 52.6%
- Toilets & Urinals: 13.3%
- Cooling: 29.5%
- Kitchens: 4%

Predicted Daily Use

Domestic Water Reduction: 54%

(potable water demand reduction, through conservation and reuse)

1. Eliminate landscaping and cooling water loads.
2. Low flow fixtures in toilets and urinals.
3. Reuse water from faucets for flushing.
Predicting Water Supply

Roof Catchment potential: 927,000 gallons per year

Predicted building use:
- 49,000 gallons per month
- 2,000 gallons per day

Solution
- 4 x 10,000 gallon potable water storage tanks

To make up the difference:
→ 36,000 gallon reserve
Filtering for Drinking Water

All components are *commercially available*, with standard fixtures, warranties and predictable maintenance cycles.

- **Suspended Solids: Pre Filter**
  - Volume Filter VF6, by 3P Technik

- **Bacteria: Post-Filter**
  - RainFlo Carbon Filter 32 GPM to 5 microns

- **Viruses: UV Filter**
  - UV Pure Upstream™ NC 30-50 UV Sterilizer

- **Pure Water**
Short term:

Rooftop storage tanks can be used as-is. Up to 1000 gallons clean water immediately available, Gravity fed and already filtered

Medium Term:

Underground storage tanks can be used directly, with UV treatment. May provide water for up to 3 weeks for 250 occupants.
Solar Panels
Building Loads vs Solar

Monthly Energy Consumption vs Solar Production

- **Jan**: Misc. Equip. (10), Space Cool (20), Area Lights (5), Vent. Fans (3)
- **Feb**: Misc. Equip. (11), Space Cool (18), Area Lights (6), Vent. Fans (4)
- **Mar**: Misc. Equip. (12), Space Cool (17), Area Lights (7), Vent. Fans (5)
- **Apr**: Misc. Equip. (13), Space Cool (16), Area Lights (8), Vent. Fans (6)
- **May**: Misc. Equip. (14), Space Cool (15), Area Lights (9), Vent. Fans (7)
- **Jun**: Misc. Equip. (15), Space Cool (14), Area Lights (10), Vent. Fans (8)
- **Jul**: Misc. Equip. (16), Space Cool (13), Area Lights (11), Vent. Fans (9)
- **Aug**: Misc. Equip. (17), Space Cool (12), Area Lights (12), Vent. Fans (10)
- **Sep**: Misc. Equip. (18), Space Cool (11), Area Lights (13), Vent. Fans (11)
- **Oct**: Misc. Equip. (19), Space Cool (10), Area Lights (14), Vent. Fans (12)
- **Nov**: Misc. Equip. (20), Space Cool (9), Area Lights (15), Vent. Fans (13)
- **Dec**: Misc. Equip. (21), Space Cool (8), Area Lights (16), Vent. Fans (14)

- **Solar Production (MWh)**: Overall decrease from January to December

Legend:
- **Green**: Misc. Equip.
- **Blue**: Space Cool
- **Yellow**: Area Lights
- **Purple**: Vent. Fans
- **Orange**: Ext. Usage
- **Black**: Solar
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<th>Solution</th>
<th>Advantage</th>
<th>Disadvantage</th>
<th>Annual Cost</th>
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<td>Live-Drive</td>
<td>Cloud System</td>
<td>Not flexible to expansive</td>
<td>$189,000 (0% Energy Cost included)</td>
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<td>No Maintenance</td>
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<td></td>
<td>No Energy</td>
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<td></td>
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<tr>
<td>On-site Storage</td>
<td>Control about your Data</td>
<td>Maintenance High Energy</td>
<td>$31,500 (62% Energy Cost included)</td>
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<td>Amazon Web Services</td>
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<td>Low Energy</td>
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<td>Cheapest</td>
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# Tradeoff Solar Panels

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<tr>
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<th>Total Cost Without</th>
<th>Total Cost With Sun Panels</th>
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<td><strong>Initial Cost</strong></td>
<td>$ 0.00</td>
<td>$ 884,000</td>
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<tr>
<td><strong>Energy Cost</strong></td>
<td>$ 2,425,000</td>
<td>$ 355,000</td>
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<td><strong>Maintenance</strong></td>
<td>$ 0.00</td>
<td>$ 220,000</td>
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<td><strong>Cleaning</strong></td>
<td>$ 0.00</td>
<td>$ 6,000</td>
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<tr>
<td><strong>SUM</strong></td>
<td>$ 2,425,000</td>
<td>$ 1,465,000</td>
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**Life Cycle Savings**: $ 960,000
Daily Net Power Consumption

Net Power Consumed (kWh)

-800 -600 -400 -200 0 200 400 600 800 1000

Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec

Weekend  Weekday
Learning: Occupant Behavior

Digital monitoring for water and solar collection

Encourage & raise awareness of the occupants

Meet KoKee!

The common coqui treefrog is a **Puerto Rico symbol**
A sympathetic interactive reason to save energy

**Plus, he’s just so cute!**
Your building is HEALTHY!

Energy Made > Energy Used
Water Collected > Water Used
Your building is UNHEALTHY!
Energy Made < Energy Used
Water Collected < Water Used
Roof structure

Tension ring

WWF14x177

Secondary steel elements

W8x10
Roof panels

Colourcoat HPS200 Ultra
100% recyclable
Low carbon footprint
Corrosion resistance
UV resistance
Allows water harvesting
Fast construction (kit-up)
25 years performance guarantee
Why do we need an open Atrium/Roof?

<table>
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<th>Closed Atrium</th>
<th>Open Atrium</th>
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<tbody>
<tr>
<td>Energy Consumption</td>
<td>113,000 kWh/a</td>
<td>51,000 kWh/a</td>
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<td>Energy Cost</td>
<td>$ 780,000</td>
<td>$ 350,000</td>
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Life Cycle Savings
$ 430,000

But…….?
Design process

- ARCH
  - Open-ness
  - Esthetic

- LCFM
  - Robust
  - Cost-efficient
  - Maintenance

- SE
  - Light-weight
  - Operationality

- MEP
  - Brainstorm

- CM
  - Sustainability
  - Constructability

- CM
  - Objectives

- Solar Power
- Weather boundary
Design process

**Disciplines**

- ARCH
- SE
- MEP
- CM
- LCFM

**Product Features**

- Necessity of a **Retractable** Roof
- Material Choice
- Prefabricated & On-site assembly
- Aerodynamic Shape
- Solar Panel Envelope
- Manual Override
- Single Slide
Design process

**Iteration 1**
Aperture

- Novel
- Impressive
- Esthetic
- Expensive
- Complex

Team brainstorm and decision

**Iteration 5**
Single Slide

- Functional
- Low-cost
- Robust
- Reliable
- Common

125
**Benefit**

- **Polycarbonate skin**
  - 200 times stronger & 7 times lighter than glass

- **Stainless aluminium structure**
  - light-weight & corrosion resistant

- **Aerodynamic beck**
  - for smooth wind penetration & air capture

- **2 simple motor tracks**
  - with manual override

- **15° Slope** to optimize solar power catchment
Life Cycle Impact

Retractable Roof

Less cleaning costs

150,000 $

Savings

95,000 $

Less Interior Hurricane Damage
Distribution of materials

Construction Site
Concrete

Steel
Wood

Glass
Interior

Plastic

6 miles
4 miles
3 miles
2 miles

Off-site logistics
Reduce impact
Building site is sloped, could cause significant stability issues to a movable crane.

We will NOT demolish the older building to the west.
Equipment

**Excavators**
Rental from GT Rental 15 min drive from the site

**Power source:**
Diesel

**Cranes**
Rental from Esmo Grúas Hidráulicas 15 min drive from the site

**Power Source:**
Diesel

**Lifts**
Rental from GT Rental 15 min drive from the site

**Power source:**
Electricity
THINK SAFETY

No unauthorised entry

All visitors and delivery drivers must report to the site office

Safety helmets, safety footwear and high visibility clothing must be worn at all times on this site

You must be safety inducted to start work on this site

Wear eye, ear, hand and respiratory protection where appropriate

Danger of underground services

Check before you dig

CONSTRUCTION TRAFFIC MAXIMUM SPEED LIMIT 5 M.P.H.

CAUTION
CONSTRUCTION AREA
WATCH FOR MOVING EQUIPMENT
Safety course before access to the construction site
Safety Stations
- First Aid Kit
- Spill kit
- Eye wash kit
- Defibrillator kit
- Broom and Shovel
Construction schedule

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<th>Site Setup</th>
<th>16 days</th>
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<tr>
<td>Substructure</td>
<td>20 days</td>
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<tr>
<td>Shell</td>
<td>120 days</td>
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<td>Interior works and MEP</td>
<td>120 days</td>
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<tr>
<td>Cleaning</td>
<td>60 days</td>
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<tr>
<td>Inspection and handover</td>
<td>60 days</td>
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Hurricane Season

138
4D Movie
Steel props for supporting the slanted columns during construction
Steel props for supporting the cantilever during the construction
### TVD and cost estimation

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<thead>
<tr>
<th></th>
<th>Estimated Value</th>
<th>Target Value</th>
<th>Delta</th>
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<td><strong>Total</strong></td>
<td>$8,000,000</td>
<td>$9,150,000</td>
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<td>A Substructure</td>
<td>$417,678</td>
<td>$548,846</td>
<td>$131,168</td>
</tr>
<tr>
<td>B Shell</td>
<td>$1,977,589</td>
<td>$2,195,383</td>
<td>$217,793</td>
</tr>
<tr>
<td>C Interiors</td>
<td>$698,493</td>
<td>$823,269</td>
<td>$124,775</td>
</tr>
<tr>
<td>D Services</td>
<td>$2,794,179</td>
<td>$2,835,703</td>
<td>$41,524</td>
</tr>
<tr>
<td>E Equipment and Furnishings</td>
<td>$ -</td>
<td>$ -</td>
<td>$ -</td>
</tr>
<tr>
<td>F Specialty Construction</td>
<td>$753,498</td>
<td>$914,743</td>
<td>$161,244</td>
</tr>
<tr>
<td>G Building Sitework</td>
<td>$269,118</td>
<td>$457,371</td>
<td>$188,254</td>
</tr>
<tr>
<td>H General Conditions</td>
<td>$1,104,797</td>
<td>$1,372,114</td>
<td>$267,317</td>
</tr>
</tbody>
</table>

**Pie Chart**

- **A Substructure**: 35%
- **B Shell**: 25%
- **C Interiors**: 9%
- **D Services**: 9%
- **F Specialty Construction**: 5%
- **G Building Sitework**: 14%
- **H General Conditions**: 3%
Risk Management

1. Hurricane

2. Construction schedule

3. Earthquake

4. Construction Cost

5. Vandalism

6. Additional Income

7. O&M Cost

Risks

A/SE/LCFM

CM/LCFM

SE/LCFM

CM/LCFM

CM/LCFM

ALL

ALL

ALL
## Risk Management

<table>
<thead>
<tr>
<th>Risk</th>
<th>Hurricane</th>
<th>Construction Schedule</th>
<th>Vandalism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Treatment</td>
<td>Hurripro</td>
<td>P-A Theory, More Supplier, Motivation Scheme</td>
<td>Security System</td>
</tr>
<tr>
<td>Risk Cost</td>
<td>$2,774,000</td>
<td>$385,000</td>
<td>$193,000</td>
</tr>
<tr>
<td>Risk Reduction</td>
<td>65%</td>
<td>31%</td>
<td>60%</td>
</tr>
<tr>
<td>Alternative Cost</td>
<td>$108,000</td>
<td>$79,000</td>
<td>$67,000</td>
</tr>
<tr>
<td>Risk Cost with Treatment</td>
<td>$971,000</td>
<td>$266,000</td>
<td>77,000</td>
</tr>
<tr>
<td>Delta/Savings</td>
<td>$1,695,000</td>
<td>$40,000</td>
<td>$49,000</td>
</tr>
</tbody>
</table>
## Risk Management

<table>
<thead>
<tr>
<th>Risk</th>
<th>Earthquake</th>
<th>Construction Cost</th>
<th>Wrong Income</th>
<th>O&amp;M Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC Cost</td>
<td>$ 313,000</td>
<td>$ 253,000</td>
<td>$ 88,000</td>
<td>$ 76,000</td>
</tr>
</tbody>
</table>

![Risk with Treatment](image1.png)

![Risk without Treatment](image2.png)
"We collect money over years, but what happens with it, if this RISKS don’t occur in the 25 years....?"

Replacement strategy:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Panels</td>
<td>$880,000</td>
</tr>
<tr>
<td>Roof Construction &amp; Covering (TATA)</td>
<td>$370,000</td>
</tr>
<tr>
<td>Retractable Roof</td>
<td>$320,000</td>
</tr>
<tr>
<td>Windows</td>
<td>$630,000</td>
</tr>
</tbody>
</table>
Financial Structure

Savings over LC: $890,000

Comparison Extra Repayment

- Interest without extra repayment
- Interest with extra repayment
Amount of Reduced Rent: $15,000
Additional Income

Rentable Spaces

$3,200,000

Aquaponic

$1,300,000
Additional Income

Cafeteria  
$1,600,000

Sale of Room Names  
$400,000

Wall Advertisement  
$500,000
Operation & Maintenance

Winter Presentation:
12,9 Mil. $

Water Collecting & Re-Use
→ Net Zero Water Savings of: 800,000$

12,1 Mil. $

Solar Panels: ($ 2,8 Mil.)
→ Reducing Energy Cost Savings: 2,5 Mil $

9,6 Mil. $
Operation & Maintenance

Replacement Cost
(2,4 Mil. $)
Savings: 1,1 Mil. $

Efficiency of Floor Plans
($ 3,3 Mil.)
→ Reduce O&M Cost
Savings: 2,0 Mil. $

Protonet
→ Reduces Energy Cost
Savings: 200,000 $

9,0 Mil. $
7,0 Mil. $
6,8 Mil. $
Cash Flow

Break Even Point
Weekly Process for BIM Integration:

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modelling</td>
<td>Modelling</td>
<td>Modelling</td>
<td>Verification and Sharing</td>
<td>Clash Detection</td>
<td>Reports and Coordination</td>
<td>Team Meeting</td>
</tr>
</tbody>
</table>
BIM Coordination

Revit DB Link

Microsoft Access Database

Sustainability Target Value (STV)
Cash Flow
Target Value Design (TVD)
Latency overview

LATENCY

INTRA

Meeting
Sync
Task

EXTRA

Tools
Hazards
Owners

KPI

Actual Task Time
Measured

Expected Task Time
Estimated

\[ \text{Actual Task Time} - \text{Expected Task Time} = \text{DELAY} + \text{TYPE} \]
<table>
<thead>
<tr>
<th>Team member</th>
<th>Estimated Work Hours</th>
<th>Updated Work Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCFM</td>
<td>181</td>
<td>210</td>
</tr>
<tr>
<td>ARCH</td>
<td>275</td>
<td>387</td>
</tr>
<tr>
<td>ENG</td>
<td>272</td>
<td>320</td>
</tr>
<tr>
<td>MEP</td>
<td>185</td>
<td>246</td>
</tr>
<tr>
<td>CM</td>
<td>233</td>
<td>252</td>
</tr>
</tbody>
</table>

**Work Distribution Chart**

- **ENG**: 22%
- **ARCH**: 18.1%
- **MEP**: 17.7%
- **CM**: 14.9%
- **LCFM**: 27.3%

**Project Completion Burn-Down**
Categorization of delays

Winter Quarter

- Laziness: 30.4%
- Waiting for Others: 17.4%
- Communication Mistakes: 10.9%
- Task Problems: 6.5%
- Technical Problems: 4.2%
- Other Work: 2.6%
- Personal Problems: 0.8%
- Freetime: 0.6%
- New Thoughts: 0.4%

Spring Quarter

- Laziness: 18.3%
- Waiting for Others: 14.7%
- Communication Mistakes: 10.9%
- Task Problems: 9.2%
- Technical Problems: 5.8%
- Other Work: 5.5%
- Personal Problems: 5.1%
- Freetime: 4.6%
- New Thoughts: 2.9%

Project

- Laziness: 21.9%
- Waiting for Others: 12.9%
- Communication Mistakes: 7.1%
- Task Problems: 5.8%
- Technical Problems: 23.9%
- Other Work: 12.9%
- Personal Problems: 7.1%
- Freetime: 5.5%
- Positive: 0%
- New Thoughts: 0%

- Laziness: 3
- Waiting for Others: 2
- Communication Mistakes: 1
- Task Problems: 0
<table>
<thead>
<tr>
<th>1. Delay</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay</td>
<td>3</td>
</tr>
<tr>
<td>No Delay</td>
<td>2</td>
</tr>
<tr>
<td>Faster</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Time of Delay</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0 hours</td>
<td>0</td>
</tr>
<tr>
<td>0 hours</td>
<td>1</td>
</tr>
<tr>
<td>0,3 hours</td>
<td>2</td>
</tr>
<tr>
<td>0,6 hours</td>
<td>3</td>
</tr>
<tr>
<td>0,9 hours</td>
<td>4</td>
</tr>
<tr>
<td>1,2</td>
<td>5</td>
</tr>
<tr>
<td>1,5</td>
<td>6</td>
</tr>
<tr>
<td>1,8</td>
<td>7</td>
</tr>
<tr>
<td>2,1</td>
<td>8</td>
</tr>
<tr>
<td>2,4</td>
<td>9</td>
</tr>
<tr>
<td>&gt;2,4</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max Value: 3x10x3 = 90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Value: 1x0x0. 9 = 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Reason Delay</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>green</td>
<td>0,9</td>
</tr>
<tr>
<td>yellow</td>
<td>1</td>
</tr>
<tr>
<td>orange</td>
<td>2</td>
</tr>
<tr>
<td>red</td>
<td>3</td>
</tr>
</tbody>
</table>

Key Performance Index: 2 x 5 x 2 = 20

Winter = 42
Spring = 30
Entire Project = 36
Sub-Group Meetings: Become much more INDEPENDENT over time
All-Group Meetings: Become more DECISIVE over time.
Sunday Meetings: Become *slightly* more efficient over time.
Owners latency

Always Overtime

Usually overtime *more* when presenting to owners. Tended to treat these as **mentoring** work-sessions, *not owner* interactions.
<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location &amp; Transportation</td>
<td>9</td>
</tr>
<tr>
<td>Sustainable Sites</td>
<td>5</td>
</tr>
<tr>
<td>Water Efficiency</td>
<td>8</td>
</tr>
<tr>
<td>Energy &amp; Atmosphere</td>
<td>20</td>
</tr>
<tr>
<td>Materials &amp; Resources</td>
<td>5</td>
</tr>
<tr>
<td>Indoor Environmental Quality</td>
<td>5</td>
</tr>
<tr>
<td>Innovation</td>
<td>5</td>
</tr>
<tr>
<td>Regional Priority</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>62</strong></td>
</tr>
</tbody>
</table>
Sustainability Target Values

- Carbon: 7,397,000 kgCO2e
- Water: 271,000,000 kgH2O
- Energy: 156,000,000 MJ

겼사과

Targets

Project
Life Cycle Cost

- Construction Cost: $10,000,000
- Interest Payment
- Operation & Maintenance Cost
- Risk Surcharge
- Replacement Cost

Costs range from $0 to $10,000,000.
Conclusion: Water

Water Challenge:

1. **Save**: Rainwater Collection and Reuse
   - → 54% Reduced Demand
   - → 100% Self Sufficient Supply

2. **Grow**: Aquaponics
   - → Visible living focal point

3. **Learn**: Interactive Visualization
   - → Storytelling for social change

4. **Return**: Disaster Response
   - → Filtered water post-event
Conclusion: Latency

Latency Challenge:

Save: Time and effort

Grow: Re-organize priorities, clarify the rules of the game and stick to it!
→ You’re late? Catch-up there’s a recording

Learn: Trial & Error
→ New team procedures: stand-up meeting
→ Foster sub-group meetings

Return: Enjoy saved time!
Conclusion: Building Goals

Project Challenge:

Constructible: Think outside in
→ Focus on Puerto Rico’s reality

Engaging: Solutions that excite all disciplines

Comfortable: Embrace the culture, the conditions and place
→ Focus on the user
→ Approach challenges from all side as a team

On Budget: Minimal possible rent
Conclusion: Team Goals

Team Challenge:

**Cooperate:** Accept differences in culture and personality, priorities. Make space for our differences.

**Grow:** Be more open minded. “Why Not?”

**Learn:** Get out of your comfort zone and embrace a new discipline’s contribution.

**Have Fun!** Remember it’s a class, make room for play

“What is your favorite ice cream?”
Team Takeaways

“I will sleep in summer”

“Sleep is for the weak”

“I hate you team! Yeah, actually maybe you’re right...”

“Everyone have different priorities. Divide the work.”

“Avoiding the use of email was surprisingly efficient”

“Keep it simple”

“I can’t wait to see each other again”

“What about money? Seriously guys...”
Thank you

PBL Team
Renate Frucrter
Flavia Grey
Maria Frank
Tongida Zhahg

Island 2015 Owners
Bianca Morell
Felix Bollwahn
Jure Česnik
Sarah Saxon

Mentors and members of the AEC industry
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Björn Wündsch
Claus Andersen
David Bentlett
Erik Kolderup
Forest Petersen
Franc Sinur
Glenn Katz
Greg Luth
Humberto Cavallin
Jorge Rofafort
 Justin Swaiger
Léon van Berlo
Matjaž Dolšek
Matthias Ehrlich
Morten Jensen
Nicklas Ostergaard
Noryar Badasian
Pedro García
Peter Rumsey
Sebastjan Bratina
Stig Brinck
Tim Tarek Fareign
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Tak
Hvala

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