Folsom Lake California 2011
WATER IS A GLOBAL CHALLENGE

Folsom Lake California 2015
WATER IS A GLOBAL CHALLENGE

Swiss Alps
WATER IS A GLOBAL CHALLENGE

Slovenia

China

United Kingdom

Eritrea
TEAM MISSION

TEAM Express
We Push The World Toward A More Sustainable Future
DESIGN CONCEPT

Inspired by Water …

Our building exists to Educate the Community on Water
Process (Latency) → Water Innovations
TEAM PROCESS

SE

CM

A

MEP

SE

CM

APP
COMMUNICATION CHANNELS

**Good for:**
- Collaboration
- Planning Workflow

**Used for:**
- Weekly Meetings
- Owner Meetings
- Subgroup Meetings

**Good for:**
- Sharing Designs
- Co-editing Deliverables

**Used for:**
- Mentor Meetings
- Subgroup Meetings

**Good for:**
- Planning Workflow

**Used for:**
- One-on-One
- Subgroup Meetings
DOCUMENT MANAGEMENT

**Good for:**
- Sharing Work
- Simultaneous Design

**Used for:**
- Revit
- Excel
- Navisworks

**Good for:**
- Storing files
- Saving Backups

**Used for:**
- Storing completed presentations and documents

**Good for:**
- Co-editing presentations and documents

**Used for:**
- Document and presentation creation
<table>
<thead>
<tr>
<th>Name</th>
<th>Note</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Han Chew</td>
<td>flushing toilet with less water than in a beer can</td>
<td>United States</td>
</tr>
<tr>
<td>Geffen Oren</td>
<td>water catchment system that collects water on the roof, runs it down into a collection tank through a pipe. This pipe has a turbine in it that spins when water runs through it. The turbine is connected to a turbine that spins a generator and creates electricity</td>
<td>United States</td>
</tr>
<tr>
<td>Stavros Moirantas</td>
<td>smart systems control the water usage</td>
<td>Denmark</td>
</tr>
<tr>
<td>Sio Cheng</td>
<td>reclaimed water</td>
<td>United States</td>
</tr>
<tr>
<td>Geffen Oren</td>
<td>use excess water collected by the building to water the surround farm</td>
<td>United States</td>
</tr>
<tr>
<td>Kaira Alias</td>
<td>over 70 % of our body is water ----&gt; use that idea to take this into our building, over 70 % water should be reused</td>
<td>United States</td>
</tr>
<tr>
<td>Han Chew</td>
<td>rainwater catchment</td>
<td>United States</td>
</tr>
<tr>
<td>Geffen Oren</td>
<td>green roof/ green facade to mitigate run off</td>
<td>United States</td>
</tr>
<tr>
<td>Geffen Oren</td>
<td>placing the collection tank inside the building so that people see how much water is being caught</td>
<td>United States</td>
</tr>
</tbody>
</table>
Agile Team Process

Subgroup Meetings
Set Deadlines
WHAT IS LATENCY?

Latency:
Time Spent Waiting

Delay:
Time spent waiting for something to be completed

Rework:
Time spent on something that can’t advance the project

Multitasking:
Time spent doing something else
**Value for Time Survey Reminder**

Geffen Oren <goren@stanford.edu>

Apr 13

Please fill this out about today's meeting and last week's work:

https://docs.google.com/forms/d/14t5aAqk_wfUo4Py3ER5k99vMrIFtLXCqiaRYM1AHFM/viewform?usp=send_form

---

Geffen Oren <goren@stanford.edu>

Apr 20

---

Geffen Oren <goren@stanford.edu>

Apr 27 (10 days ago)
**Rework:** How many hours of rework did you encounter this week?

**Delay:**
- Did you have to wait this week for something to be delivered before you were able to move forward with your work?
- If so, how much time?

**Multitasking:** Did you multitask during the meeting?
REDUCING LATENCY

Strategies

- Communicating effectively
- Asking for help

- Communicating effectively
- Setting hard deadlines

- Call out people’s names
- Holding yourself accountable

Reduce
Rework

Minimize
Delay

Discourage
Multitasking
MULTITASKING

Co-location!!

Videos Turned On
WHAT IS LATENCY, REALLY?

Latency:
- Rework
- Multitasking
- Delay

Value for Time®
Feedback: Anything in particular you liked / disliked during the meeting?

Value per Activity:
-Which of the following activities were / were not valuable during the meeting?
(Brainstorming, Creating Deliverables, Updating, Resolving Coordination Issues, Developing Ideas, Planning Workflow, Special Activities)

Value: What percentage of the time during the meeting did you think was valuable?
FEEDBACK RESULTS

Liked:
1. Short Updates from each discipline
2. BrainMerge
3. Set up Subgroup Meetings
4. Seeing People Over Video

Disliked:
1. Planning Workflow

Feedback:
1. Say relevant things
2. Less comments and feedback time
3. Need to plan future work
4. Need to work on “process”

Value for Time®
RESULT DRIVEN MEETINGS

Input and Improvements

What We Liked/Disliked

KPI Statistics
Targeted Work Strategies

Continuous Reflection Process

Time

Legend

- Value
- Time

\[ M_i \]

\[ M_{i+1} \]

\[ M_{i+2} \]
VALUE FOR TIME PER MEMBER

Team Members

- Geffen
- Han Wei
- Klara
- Robert
- Sio Chong
- Stavros
- Xi Liu
VALUE FOR TIME PER ACTIVITY

Dry Run #1

1st Walkthrough in TERF
VALUE FOR TIME
WATER NETWORK

EUROPE

SLOVENIA

LJUBLJANA

BASIN
OCEANIC CLIMATE
EARTHQUAKES
YEARLY FLOODING
FOG - 60 DAYS/YEAR
Average Rainfall (mm)

Average Temperature (°F)
ORIENTATION

18_Mar_08:00am

07_May_08:00am

26_Jun_08:00am

15_Aug_08:00am

04_Oct_08:00am

03_Dec_08:00am
WHAT IS MISSING?

HILL ROZNIK
RELAX

FACULTY / STUDENTS

CITY / LAY PUBLIC

FACULTY / STUDENTS
GATES OF LJUBLJANA

PROJECT SITE

HILL ROZNIK

CASTLE HILL

RIVER

FLOW

CITY

ALPS
WATER = LIFE
● PREHISTORIC PILE DWELLINGS - LJUBLJANA MARSH
● STRUCTURAL GRID SYSTEM
● VERTICAL WALL/SUNSHADE VS. HORIZONT/WATER
● GREEN ROOF- NATURAL INSULATION
● LOCAL MATERIALS
● FLOODS
• DYNAMIC BUILDING
• SPACE ORGANISATION
• FLUIDITY / FLOW
SITE PLACING
waver
WAVE STRUCTURE
<table>
<thead>
<tr>
<th>Load Type</th>
<th>Occupancy or Use</th>
<th>Uniform Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uniform Live Load</td>
<td>Classroom</td>
<td>40 psf</td>
</tr>
<tr>
<td></td>
<td>Office</td>
<td>50 psf</td>
</tr>
<tr>
<td></td>
<td>Computer Lab</td>
<td>100 psf</td>
</tr>
<tr>
<td></td>
<td>Auditorium</td>
<td>150 psf</td>
</tr>
<tr>
<td></td>
<td>Corridor</td>
<td>80 psf</td>
</tr>
<tr>
<td></td>
<td>Green Roof</td>
<td>60 psf</td>
</tr>
<tr>
<td>Concentrated Live Load</td>
<td>Mechanical Room Grating (on area of 4 in2)</td>
<td>300 lb</td>
</tr>
<tr>
<td>Uniform Dead Load</td>
<td>Concrete Self Weight</td>
<td>150 pcf</td>
</tr>
<tr>
<td></td>
<td>MEP System Allowance</td>
<td>10 psf</td>
</tr>
<tr>
<td>Wind Load</td>
<td>All Level</td>
<td>8.6 psf</td>
</tr>
<tr>
<td>Earthquake Load</td>
<td>All Level</td>
<td>Time History</td>
</tr>
</tbody>
</table>
Earthquake Time History Data at Trebnje, Slovenia

- Max Ground Acceleration at EW = 0.261 m/s²
- Max Ground Acceleration at NS = 0.229 m/s²

Ref: Ambraseys N., P Simt, R. Sigbjomsson, P. Suhadolc, B. Margris (2001)
Use a simplified format based on the provisions of the ASCE Standard

\[ Wind \ Pressure \ P = 0.00256V^2IK_zK_{zt}K_dGC_p = 8.6 \text{ psf} \]

- Assume basic wind speed \( V = 85 \text{ mph} \) (same with CA).
- School -> Occupancy Level 3 -> \( I = 1.15 \);
- Exposure Category B & Low-rise Building -> \( K_z = 0.7 \) for all levels;
- Building on ground level -> \( K_{zt} = 1.0 \);
- Main Lateral-Resisting System -> \( K_d = 0.85 \);
- Rigid Structure -> \( G = 0.85 \);
- Windward Wall -> \( C_p = 0.8 \).
Floor Plan (Winter Presentation)

Problems:
1. Off-grid Columns
2. Shear Wall on Curtain Wall

Solutions:
1. Relocate the columns
2. Move the shear wall
Floor Plan (Winter Presentation)

Problem:
1. MEP Ducts cannot penetrate beams
2. Too Large a span

Solution:
1. Flat Floor without beams.
2. Change the grid.
ROOF FLOORPLAN

18"x18" Rectangular Column
12" Concrete Shear Wall
12" Circular Column
W14"x20" Curve Steel Girder
W12"x18" Steel Beam
12"x24" PT Girder
PT SLAB

Tendon @ 1 ft
Tendon @ 2.5 ft

PT Slab Property

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tendon Diameter</td>
<td>0.6 inch</td>
</tr>
<tr>
<td>Initial Prestress</td>
<td>162 ksi</td>
</tr>
<tr>
<td>Concrete Strength</td>
<td>5000 psi</td>
</tr>
<tr>
<td>Slab Thickness</td>
<td>10 inch</td>
</tr>
<tr>
<td>Clear Cover</td>
<td>0.75 inch</td>
</tr>
</tbody>
</table>
Values for Users:
1. Flat floor
2. Long spans and less columns
3. More open spaces
PT SLAB CONNECTION

Typical PT Slab to Column Connection

Ref: Slab-Column Frames, John Wallace, UCLA
GEOPOLYMER CONCRETE
## Geopolymer Concrete

<table>
<thead>
<tr>
<th>Cubic Yard of Concrete</th>
<th>Geopolymer Concrete</th>
<th>Portland Cement Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement (lbs)</td>
<td>0</td>
<td>560</td>
</tr>
<tr>
<td>Fly Ash (lbs)</td>
<td>667</td>
<td>0</td>
</tr>
<tr>
<td>Coarse Aggregates (lbs)</td>
<td>1,863</td>
<td>1,760</td>
</tr>
<tr>
<td>Fine Aggregates (lbs)</td>
<td>1,193</td>
<td>1,100</td>
</tr>
<tr>
<td>Admixtures (lbs)</td>
<td>0</td>
<td>1.4</td>
</tr>
<tr>
<td>Water (lbs)</td>
<td>0</td>
<td>290</td>
</tr>
<tr>
<td>8 mol. NaOH solution (lbs)</td>
<td>300</td>
<td>-</td>
</tr>
</tbody>
</table>

Values of Geopolymer Concrete

**Consumes 47% less Water**

during the material manufacturing phase than portland cement concrete.
Other Facts about Geopolymer Concrete

1. **68%** less Greenhouse Gas Emissions than Portland Cement Concrete.

2. Geopolymer Concrete develops strength through Geopolymerization of fly ash, which is a by-product of coal combustion in power plants.

3. A university building in Australia made with Geopolymer Concrete
Four 12” Shear Walls + Rigid Diaphragm in Each Direction
Max IDR at Y direction = 0.8% < 2%
Max Displacement at Y direction = 1.0 inch
Max IDR at X direction = 0.7% < 2%
Max Displacement at Y direction = 0.9 inch
CANTILEVER ANALYSIS

Revit Model

ETABS Model
GRAVITY SYSTEM ANALYSIS

Moment Diagram

Deflection Z

[Inch]
FLOODED

Flood Event
2010.09.18-20

Site Location
FLOODING PROTECTION

FloodStop

Performance
SOIL PROFILE

A: Human Soil - Non Bearing
B: Clay with Pebbles CU/GC, $Q_u = 100$ kPa
C: Stiff Compact Sedimentary River Gravel GW/GP, $Q_u = 290$ kPa

Surface
Water Table
- Excavate for 0.5m to remove the non-bearing human soil.
- 4” slightly R.C. Slab-on-grade at 0.5m below ground level.
- Isolated Footing at 1.5m below ground level.

Diagram:
- Original Surface
- Excavate 0.5m from Surface
- Slab-on-grade
- 1m-thick
- Isolated Footing
- 8m-thick
- Stiff Compact Sedimentary River Gravel GW/GP, Q_u = 290 kPa
- Water Table
<table>
<thead>
<tr>
<th>Primary Systems</th>
<th>Secondary Systems</th>
<th>Terminal Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Plant</td>
<td>Supply Ducts</td>
<td>Return Grilles</td>
</tr>
<tr>
<td>Hot water</td>
<td>Radiant Heating</td>
<td>Controls</td>
</tr>
<tr>
<td>Chilled water</td>
<td></td>
<td>VAV boxes</td>
</tr>
</tbody>
</table>
Auditorium
Underfloor Air Distribution
FLOOR SANDWICH

Supply Grilles

Supply Duct

Return Grilles
BUILDING ENVELOPE OVERVIEW

- External blinds control the Daylight
- Direct/Indirect, energy efficient luminaires
- Low-e triple glazing
- Low U-value insulation
- Reuse of greywater
- Water efficient plumbing fixtures
- Rainwater Harvesting
- Water Tank Collector
- Acoustic Ceiling Panels
- Controlled Ventilation
- Green Roof filters the rainwater and reduce roof temperature
REDUCING THE ENERGY CONSUMPTION

-21989 kWh
-60408 kWh
-26672 kWh
**ENERGY ANALYSIS**

<table>
<thead>
<tr>
<th>Delivered energy</th>
<th>kWh</th>
<th>kWh/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting, facility</td>
<td>20306</td>
<td>7.0</td>
</tr>
<tr>
<td>Electric cooling</td>
<td>18543</td>
<td>6.4</td>
</tr>
<tr>
<td>HVAC aux</td>
<td>12085</td>
<td>4.1</td>
</tr>
<tr>
<td>Domestic hot water</td>
<td>6231</td>
<td>2.1</td>
</tr>
<tr>
<td>District heating</td>
<td>58403</td>
<td>20.0</td>
</tr>
<tr>
<td>Equipment, tenant</td>
<td>32248</td>
<td>11.1</td>
</tr>
<tr>
<td>Grand total</td>
<td>147816</td>
<td>50.7</td>
</tr>
</tbody>
</table>

Heating Setpoints: 69.8°F

Cooling Setpoints: 77°F
INDOOR AIR QUALITY

Room: Large Classroom
Monthly Average

Thermal environment: category II
Total occupant hours of dissatisfaction < 10%
Room: Large Classroom
Daily Occupancy Hours (08:00 - 17:00)
CO2 (ppm)
INDOOR AIR QUALITY

Room: Large Classroom
Daily Occupancy Hours (08:00 - 17:00)

Relative Humidity (%)
INDOOR AIR QUALITY

Room: Large Classroom
Daily Occupancy Hours (08:00 - 17:00)

Air Age Rate (h)

Air Age Rate

Occupancy hours

(h)

0 0,5 1 1,5 2 2,5 3

8:00 8:10 8:20 8:30 8:40 8:50 9:00 9:10 9:20 9:30 9:40 9:50 10:00 10:10 10:20 10:30 10:40 10:50 11:00 11:10 11:20 11:30 11:40 11:50 12:00 12:10 12:20 12:30 12:40 12:50 13:00 13:10 13:20 13:30 13:40 13:50 14:00 14:10 14:20 14:30 14:40 14:50 15:00 15:10 15:20 15:30 15:40 15:50 16:00 16:10 16:20 16:30 16:40 16:50 17:00 17:10 17:20 17:30 17:40 17:50 18:00
WATER INNOVATION

Design Phase
Manufacturing Phase
Construction Phase
Use Phase
Education Function

Fixtures
Water Drop
Rainwater Harvesting

Water Efficiency
BUILDING ENVELOPE OVERVIEW

- External blinds control the Daylight
- Direct/Indirect, energy efficient luminaires
- Low-e triple glazing
- Low U-value insulation
- Reuse of greywater
- Water efficient plumbing fixtures
- Rainwater Harvesting
- Water Tank Collector
- Acoustic Ceiling Panels
- Controlled Ventilation
- Green Roof filters the rainwater and reduce roof temperature
WATER CONSUMPTION

Water Amounts (Gallons/Year)

Water Collected

Average Monthly Greywater Collection

Average Monthly Consumption
Life Cycle Assessment Results Overview
Total Life Cycle Impacts

Performance Relative to Life Cycle Impact Targets

<table>
<thead>
<tr>
<th>Impact</th>
<th>Target</th>
<th>Project</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon (kgCO2e)</td>
<td>4,664,724</td>
<td>3,627,006</td>
<td>78%</td>
</tr>
<tr>
<td>Energy (MJ)</td>
<td>183,196,824</td>
<td>76,757,323</td>
<td>47%</td>
</tr>
<tr>
<td>Water (kgH2O)</td>
<td>1,406,958,904</td>
<td>414,276,105</td>
<td>28%</td>
</tr>
<tr>
<td>Ozone (kgCFC11)</td>
<td>-</td>
<td>1,51E-01</td>
<td>-</td>
</tr>
</tbody>
</table>
WAVE MODEL
MATERIALS

For windows
M-Sora

For green roofs and green wall:
HUMKO

For facade
RIKO-HISE
Vehicle access
Parking area

Drop off area
Concrete mixer
### MAXIMUM LEGAL DIMENSIONS

#### PERMISSIBLE MAXIMUM DIMENSIONS OF TRUCKS IN EUROPE

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>HEIGHT</th>
<th>WIDTH</th>
<th>Lorry or Trailer</th>
<th>Road Train</th>
<th>Articulated Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLOVENIA</td>
<td>4.2</td>
<td>2.55m</td>
<td>12m</td>
<td>18.75m</td>
<td>16.50m</td>
</tr>
</tbody>
</table>

- **3.5 m**
- **4.2 m**
EQUIPMENT SELECTION

2 mobile cranes
Furthest (1800 kg) 36m

Flatdeck/extendable semi-trailers

Transporting long materials, steel and concrete

Excavator
2 CRANES VS. 1 - COMPARISONS

One Crane Vs. Two Crane Comparison

[Graph showing comparisons between one and two cranes for different categories such as Site, Substructure, Shell, Curved Façade, MEP, Interior, Exterior, Lab, Commissioning, and Site Work. The graph includes bars for Two Cranes, One Crane, and the number of days of difference.]
## OUTCOMES: 2 VS 1 CRANE

<table>
<thead>
<tr>
<th></th>
<th>Two</th>
<th>One</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commissioning</strong></td>
<td>Completed 8/26/2020</td>
<td>Completed 9/30/2020</td>
</tr>
<tr>
<td><strong>Lab Installation</strong></td>
<td>Done in time</td>
<td>Delays</td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td>Time = $</td>
<td>Limitations: movement of crane, mobilizing takes more time</td>
</tr>
</tbody>
</table>
What do we really know about water usage on construction sites?

Which are the processes that take a lot of water?
WATER USING PROCESSES

General site activities including tool washing

Commissioning and testing of building plants and service

Site trailers

Wheel washing, high pressure cleaning
**Value for money**
Unlikely that the introduction of expensive processes on temporary construction sites will be preferred by companies when procuring.

**The work environment**
Technology is robust to stand up to the demands of construction sites.

**Habits**
Behaviour change is not a process that will happen overnight.
<table>
<thead>
<tr>
<th>Processes using water</th>
<th>Procedures</th>
<th>Behaviour</th>
<th>Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trailers</td>
<td>Toilets, washing</td>
<td>Monitor with meter reading. Rainwater collection and use</td>
<td>Site inspections for leaks, increase awareness</td>
</tr>
<tr>
<td>General site activities, cleaning</td>
<td>Tool washing</td>
<td>Site inspections, checking leaks</td>
<td>Use toolbox talks, make people understand. Use buckets to wash</td>
</tr>
<tr>
<td>Plants, commissioning and test</td>
<td>Building plants/services</td>
<td>Capture and reuse commissioning water</td>
<td>Site inspection to ensure water is off when not needed</td>
</tr>
</tbody>
</table>
WATER IN CONSTRUCTION SITES

Recycled Content Products

Composting Toilet

Reused Building Materials

<table>
<thead>
<tr>
<th></th>
<th>Green trailer</th>
<th>Typical trailer</th>
<th>Annual benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATER</td>
<td>0 gallons</td>
<td>1600 gallons</td>
<td>1600 gallons or $1020 annually</td>
</tr>
</tbody>
</table>
# COST ESTIMATE - TVD

## Winter Estimate:

**Large Delta Between Targets and Estimate**

## Spring Estimate:

**Smaller Delta Between Targets and Estimate**

### ESTIMATE AND TARGET VALUE - SUMMARY

<table>
<thead>
<tr>
<th></th>
<th>Estimated Value</th>
<th>Target Value</th>
<th>Value Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL</strong></td>
<td>$8,850,000</td>
<td>$9,000,000</td>
<td>$150,000</td>
</tr>
<tr>
<td>A Substructure</td>
<td>$140,000</td>
<td>$930,000</td>
<td>$790,000</td>
</tr>
<tr>
<td>B Shell</td>
<td>$1,860,000</td>
<td>$1,800,000</td>
<td>$60,000</td>
</tr>
<tr>
<td>C Interiors</td>
<td>$1,100,000</td>
<td>$1,370,000</td>
<td>$270,000</td>
</tr>
<tr>
<td>D Services</td>
<td>$3,700,000</td>
<td>$2,200,000</td>
<td>$(1,500,000)</td>
</tr>
<tr>
<td>E Equipment and Furnishing</td>
<td>$50,000</td>
<td>$700,000</td>
<td>$650,000</td>
</tr>
<tr>
<td>F Specialty Construction</td>
<td>$350,000</td>
<td>$580,000</td>
<td>$230,000</td>
</tr>
<tr>
<td>G Building Sitework</td>
<td>$350,000</td>
<td>$700,000</td>
<td>$350,000</td>
</tr>
<tr>
<td>H General Conditions</td>
<td>$1,300,000</td>
<td>$700,000</td>
<td>$(600,000)</td>
</tr>
</tbody>
</table>

### ESTIMATE AND TARGET VALUE - SUMMARY

<table>
<thead>
<tr>
<th></th>
<th>Estimated Value</th>
<th>Target Value</th>
<th>Value Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL</strong></td>
<td>$9,050,000</td>
<td>$9,000,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>A Substructure</td>
<td>$130,000</td>
<td>$250,000</td>
<td>$120,000</td>
</tr>
<tr>
<td>B Shell</td>
<td>$2,790,000</td>
<td>$2,500,000</td>
<td>$(290,000)</td>
</tr>
<tr>
<td>C Interiors</td>
<td>$1,350,000</td>
<td>$1,400,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>D Services</td>
<td>$3,350,000</td>
<td>$3,400,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>E Equipment and Furnishing</td>
<td>$30,000</td>
<td>$100,000</td>
<td>$70,000</td>
</tr>
<tr>
<td>F Specialty Construction</td>
<td>$300,000</td>
<td>$350,000</td>
<td>$(50,000)</td>
</tr>
<tr>
<td>G Building Sitework</td>
<td>$350,000</td>
<td>$300,000</td>
<td>$(50,000)</td>
</tr>
<tr>
<td>H General Conditions</td>
<td>$750,000</td>
<td>$700,000</td>
<td>$(50,000)</td>
</tr>
</tbody>
</table>
TVD TRACKING AND TRADE-OFFS

Target Value Design - Tracking Over Time

- Architect
- Added
- Exterior Elements
- MEP
- Reduced
- Ductwork
## MODEL BASED QTO

![Selection Tree](Image)

<table>
<thead>
<tr>
<th>WBS</th>
<th>Group1</th>
<th>Floor</th>
<th>Element</th>
<th>Item</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.10.10.1.1.1.1</td>
<td>Shell</td>
<td>Level 2 - 1st Floor</td>
<td>Floors</td>
<td>10&quot; PT Hollow Core Slab</td>
<td>8,486.9 ft³</td>
</tr>
<tr>
<td>B.10.10.1.2.1.1</td>
<td>Shell</td>
<td>Level 2 - 1st Floor</td>
<td>Structural Columns</td>
<td>18 x 18</td>
<td>380.6 ft³</td>
</tr>
<tr>
<td>B.10.10.1.2.2.1</td>
<td>Shell</td>
<td>Level 2 - 1st Floor</td>
<td>Structural Columns</td>
<td>18&quot;</td>
<td>95.5 ft³</td>
</tr>
<tr>
<td>B.10.10.1.3.1.1</td>
<td>Shell</td>
<td>Level 2 - 1st Floor</td>
<td>Structural Framing</td>
<td>24(H) x 12(W) Prestressed</td>
<td>57.5 ft³</td>
</tr>
<tr>
<td>B.10.10.1.3.2.1</td>
<td>Shell</td>
<td>Level 2 - 1st Floor</td>
<td>Structural Framing</td>
<td>W14X20</td>
<td>6.5 ft³</td>
</tr>
<tr>
<td>B.10.10.1.3.2.2</td>
<td>Shell</td>
<td>Level 2 - 1st Floor</td>
<td>Structural Framing</td>
<td>W12X18 2</td>
<td>8.8 ft³</td>
</tr>
</tbody>
</table>
# Model Based QTOS

![Selection Tree](Image)

<table>
<thead>
<tr>
<th>WBS</th>
<th>Group1</th>
<th>Element ID</th>
<th>Element</th>
<th>Item</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.1.2.3.1.6</td>
<td>Interiors</td>
<td>Floors</td>
<td>Floor</td>
<td>floor slab auditorium 30</td>
<td>1,099.9 ft³</td>
</tr>
<tr>
<td>C.1.2.3.1.7</td>
<td>Interiors</td>
<td>Floors</td>
<td>Floor</td>
<td>floor slab auditorium 15</td>
<td>44.5 ft³</td>
</tr>
<tr>
<td>C.1.2.4.1.1</td>
<td>Interiors</td>
<td>Walls</td>
<td>Basic Wall</td>
<td>Wall_200</td>
<td>4,695.6 ft³</td>
</tr>
<tr>
<td>C.1.2.4.1.2</td>
<td>Interiors</td>
<td>Walls</td>
<td>Basic Wall</td>
<td>Wall_200</td>
<td>33.8 ft³</td>
</tr>
<tr>
<td>C.1.2.4.1.3</td>
<td>Interiors</td>
<td>Walls</td>
<td>Basic Wall</td>
<td>Wall_100</td>
<td>755.2 ft³</td>
</tr>
<tr>
<td>C.1.2.4.1.4</td>
<td>Interiors</td>
<td>Walls</td>
<td>Basic Wall</td>
<td>STUDYANDGO</td>
<td>911.9 ft³</td>
</tr>
</tbody>
</table>
Team Express - Targets By Cluster

- **TARGET VALUE**
- **ESTIMATED VALUE**
- **VALUE DELTA**

Cluster Details:
- A Substructure
- B Shell
- C Interiors
- D Services
- E Equipment and Furnishing
- F Specialty Construction
- G Building Sitework
- H General Conditions

Value Ranges:
- $4,000,000
- $3,500,000
- $3,000,000
- $2,500,000
- $2,000,000
- $1,500,000
- $1,000,000
- $500,000
- $0
- $(500,000)
<table>
<thead>
<tr>
<th></th>
<th>ESTIMATED VALUE</th>
<th>TARGET VALUE</th>
<th>VALUE DELTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>$ 9,050,000</td>
<td>$ 9,000,000</td>
<td>$ (50,000)</td>
</tr>
<tr>
<td>A Substructure</td>
<td>$ 130,000</td>
<td>$ 250,000</td>
<td>$ 120,000</td>
</tr>
<tr>
<td>B Shell</td>
<td>$ 2,790,000</td>
<td>$ 2,500,000</td>
<td>$ (290,000)</td>
</tr>
<tr>
<td>C Interiors</td>
<td>$ 1,350,000</td>
<td>$ 1,400,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>D Services</td>
<td>$ 3,350,000</td>
<td>$ 3,400,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>E Equipment and Furnishing</td>
<td>$ 30,000</td>
<td>$ 100,000</td>
<td>$ 70,000</td>
</tr>
<tr>
<td>F Specialty Construction</td>
<td>$ 300,000</td>
<td>$ 350,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>G Building Sitework</td>
<td>$ 350,000</td>
<td>$ 300,000</td>
<td>$ (50,000)</td>
</tr>
<tr>
<td>H General Conditions</td>
<td>$ 750,000</td>
<td>$ 700,000</td>
<td>$ (50,000)</td>
</tr>
</tbody>
</table>
Find the leak!

Reduce your impact

Process of Design

Water Innovations

Water Cycle

Today’s Menu
Cloud Based Leak Detection

Provides real-time data about water flow in the building

Reports the leaks in the water fixtures immediately

Helps occupants identify the leaks and fix them as soon as possible
Explore these foods see how much water you can save by altering your diet.

- BEEF: 106 gal/oz
- LAMB: 85 gal/oz
- LENTILS: 71 gal/oz
- MANGOS: 28 gal/oz

You actually **save more water** by altering your diet than by taking shorter showers.
EDUCATION

Water Cycle

Water Use

WASTE WATER TREATMENT PLANT

WATER USE
HVAC Systems
Restrooms
Drinking fountain

WATER PURIFICATION AND FILTRATION
like Ahlstrom Disruptor®

WATER TANK

GREEN WALL

WATER FILTER

GREEN ROOF
Rainwater

CONTROL
Main Pump

DIRTY WATER

TECHNICAL WATER

DRINKING WATER

WET SEASON WATER OVERFLOW

DRY SEASON GREEN ROOF IRRIGATION

PLANTS IRRIGATION

AGRICULTURE

137
DROUGHT
TECH HELPS STRAWBERRY FARMERS CONSERVE DURING DROUGHT

THIS INDOOR FARM CAN BRING FRESH PRODUCE TO FOOD DESERTS
Make every **drop** count

Smart **Water** Saving Machin

*Originally invented by Express Team*
WASH STEP

1. Hand
2. Foam Soap
3. Water Clean
4. Dryer
Water-saving

Auto-sensing

Foam

High-speed dryers

Pore nozzle
Water Safe
LATENCY PREVIEW

Process (Latency)

Water Innovations
Latency:
- Rework
- Multitasking
- Delay

Value for Time®
WATER INNOVATION

Design Phase

Manufacturing Phase

Construction Phase

Use Phase

Education Function

Wave

Geopolymer Concrete

Recycle Material

Fixtures

Water Drop

Rainwater Harvesting

Waver App

Green Wall

Green Roof

Waver

Waver

Waver

Waver

Waver

Waver

Waver

Waver

Waver

Waver

Waver
ONE VALUE GAINED

Klara (CM) Iraq

“Best team ever”

Han (CM) Singapore

“Long distance relationship”

Geffen (App) USA

“Get to know your team well”
ONE VALUE GAINED

“Compassion”

“Work out the team process, then work out the project”

“Creative idea generation”

“Integrated design process”
THANK YOU!!

TEACHING TEAM:
Renate Fruchter
Flavia Grey
Maria Frank
Tongda Zhang

OWNERS:
Maria Selk
Ethan Landy
Anja Jutraz
Anirudh Rao

MENTORS:
Willem Kymell
David Bendet
Hollmen Saija
Justin Schwaiger
Greg Luth
Eduardo Miranda
Glenn Katz
Luis Rivera
Kyle Adams
John Nelson
Fernando Castillo
Cohen
Ken Rock
Fredrik Wincent