Six Cultures

Mike

Ana

Sebastian

Amy - MEP

Albert - Ap

Bjorn - A

Tim - LCFM

Olga - CM

Chris - SE

Sophia - SE
Five Disciplines

Mike

Ana

Sebastian

Amy - MEP
Albert - Ap
Bjorn - A
Tim - LCFM
Olga - CM
Chris - SE
Sophia - SE
Three Time Zones
TEAM CENTRAL

Mike
Ana
Sebastian

Amy - MEP
Albert - Ap
Bjorn - A
Tim - LCFM
Olga - CM
Chris - SE
Sophia - SE
Public Private Partnership

Conventional
- Design
- Bid
- Build

Innovative
- Design
- Build
- Finance
- Operate

Risk allocation

Know how
Project success
LOCAL HAZARDS:
EARTHQUAKES
• 1994 - Northridge EQ – M6.7
• 2014 – La Habra EQ – M5.1

CLIMATE:
TEMPERATURE
• Avg. High 67°F - 83°F
• Avg. Low 47°F - 64°F

RAINFALL
• 15” Annual - LOW

HIGH SOLAR AVAILABILITY
Site Analysis - Nolly Map
Site Circulation
# Decision Matrix

<table>
<thead>
<tr>
<th>Point skala</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>terrible</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>poor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>very good</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>excellent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>AVG. WEIGHT</th>
<th>L-Shape Concrete</th>
<th>L-Shape Steel</th>
<th>DD-Shape Timber</th>
<th>DD-Shape (B) Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 POINTS</td>
<td>WEIGHTED POINTS</td>
<td>POINTS</td>
<td>WEIGHTED POINTS</td>
<td>POINTS</td>
</tr>
<tr>
<td>1</td>
<td>Building program</td>
<td>13</td>
<td>4</td>
<td>52</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Funkonality &amp; Flexibility</td>
<td>8,5</td>
<td>2</td>
<td>17</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Building quality</td>
<td>13</td>
<td>4</td>
<td>52</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Construction</td>
<td>7</td>
<td>3</td>
<td>21</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Operation</td>
<td>6</td>
<td>4</td>
<td>24</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Ecologic</td>
<td>11,5</td>
<td>1</td>
<td>11,5</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Sustainability goals</td>
<td>9,5</td>
<td>4</td>
<td>38</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Earthquake safety</td>
<td>13,5</td>
<td>2</td>
<td>27</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>Big idea</td>
<td>5</td>
<td>4</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>Building design</td>
<td>13</td>
<td>3</td>
<td>39</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>REACHED POINTS</th>
<th>MAXIMUM POINTS</th>
<th>RATIO TO MAX POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-Shape Concrete</td>
<td>31</td>
<td>50</td>
<td>60%</td>
</tr>
<tr>
<td>L-Shape Steel</td>
<td>41</td>
<td>50</td>
<td>82%</td>
</tr>
<tr>
<td>DD-Shape Timber</td>
<td>37</td>
<td>50</td>
<td>73%</td>
</tr>
<tr>
<td>DD-Shape (B) Steel</td>
<td>37</td>
<td>50</td>
<td>75%</td>
</tr>
<tr>
<td>Construction Cost</td>
<td>MIO. $</td>
<td>7</td>
<td>MIO. $</td>
</tr>
<tr>
<td>Value for Costs</td>
<td>POINTS</td>
<td>43</td>
<td>POINTS</td>
</tr>
</tbody>
</table>
Big Idea
Programming
### Benefits of Space Efficiency

#### Lower O&M costs

- **Less waste**

#### LOWER RENT

**VALUE FOR THE OWNER**

<table>
<thead>
<tr>
<th>Building Program Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignable Sqft</td>
</tr>
<tr>
<td>Total Sqft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Building Program L-Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignable Sqft</td>
</tr>
<tr>
<td>Total Sqft</td>
</tr>
</tbody>
</table>
Basement: -13ft

- Circulation
- Large Class Room
- MEP Room
- Student Open Work Space
- Server Room
- Storage
- Technical Support
1st Floor: -6ft
Ground Level: 0ft

- Circulation
- Small Class Room
- Storage
3rd Floor Faculty Lounge
Elevation and Section South
Elevation and Section North
Green Façade for Shading Southeast
Building Structure

QR Codes on elements there links to element information's
# Load Table

<table>
<thead>
<tr>
<th></th>
<th>Live (psf)</th>
<th>Dead (psf)</th>
<th>Earthquake (kips)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof</td>
<td>20</td>
<td>5</td>
<td>519</td>
</tr>
<tr>
<td>2\textsuperscript{nd} Level Ceiling</td>
<td>60</td>
<td>90</td>
<td>750</td>
</tr>
<tr>
<td>1\textsuperscript{st} Level Ceiling</td>
<td>60</td>
<td>90</td>
<td>808</td>
</tr>
<tr>
<td>Corridors</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Load Combination:
- \(1.2D+1.6L\)
- \(1.2D+1.0L+1.0E\)
Load Path

Dimensions:
- 18' 0"
- 12' 0"
- 29' 6"
- 16' 8"
- 10' 11"
- 32' 0"
- 26' 0"
- 25' 6"
Floor Plan 1st Level

- Column W14x109
- Beam W16x31
- Girder W24x104
- Bracing HSS 8x8x5/8
- Bracing HSS 10x10x5/8
- Bearing Wall
Floor Plan 2nd Level

- **Column W14x53**
- **Beam W16x31**
- **Girder W18x40**
- **Bracing HSS 8x8x5/8**
- **Bracing HSS 10x10x5/8**
- **Bearing Wall**
Floor Plan 3rd Level

- Column W14x53
- Beam W16x31
- Girder W18x40
- Bracing HSS 8x8x5/8
- Bracing HSS 10x10x5/8
- Bearing Wall
- Steel Joist 36LH07
Based on ASCE 7

If \[ A_x = \frac{\delta_{\text{max}}}{1.2\delta_{\text{avg}}} < 1.0 \] No Torsional irregularity

\[ \delta_{\text{max}} = \text{the maximum displacement at Level x computed assuming } A_x = 1 \text{ (in)} \]

\[ \delta_{\text{avg}} = \text{the average of the displacements at the extreme points of the structure at Level x computed assuming } A_x = 1 \text{ (in)} \]

\[ = 0.895 < 1.0 \]
Fully Composite Slab system

- 2VLI19 slab
  3.25” LWC + 2” steel deck
total deck depth = 5.25”

- W16x31 beam
  with 1.25” camber &
  54 shear studs

- W18x40 Girder
  with 1.5” camber &
  64 shear studs
8” concrete slab  
Friction Pendulum Base Isolation  
Spread Footing 8’x8’x15”
Retaining Wall

- $M_{\text{resist}}/M_{\text{mover}} = 2.74 > 2.0$ ✔
- Bearing Stress = 2.36 ksf < 5.0 ksf ✔
Simple Connections

Moment Connection
Close to San Andreas Fault

In the next 30 years:
6.7 Magnitude: 99.7%
7.5 Magnitude: 46%

Northridge Earthquake
January 17th, 1994
Mw=6.7 Peak Sa=1.8g
- Structural Material Saving
- Life Cycle Saving

<table>
<thead>
<tr>
<th></th>
<th>Floor Shear [kip]</th>
<th>Total Weight of Steel Used in Beams and Columns [tons]</th>
<th>Building Damage [% of the building value]</th>
<th>Down Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Base Isolator</td>
<td>638.5</td>
<td>210</td>
<td>40%-60%</td>
<td>Several Months</td>
</tr>
<tr>
<td></td>
<td>1064.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1277.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With Base Isolator</td>
<td>519.6</td>
<td>154 (save 26%)</td>
<td>5%</td>
<td>Several Days</td>
</tr>
<tr>
<td></td>
<td>750.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>808.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Site Class D
15 ft of Sandy Soil (Suitable for Base Isolator)
Importance Category II
Design for MCE (Maximum Considered Earthquake)
Reduction Factor 2 for Superstructure
Reduction Factor 1 for Substructure (Foundation)

Preliminary Size governed by the vertical load it takes: 459 kip
Base Isolation - Properties

\[ k_{\text{eff}} = \frac{|F^+| + |F^-|}{|\Delta^+| + |\Delta^-|} \]

- \( k_{\text{eff}} \): 52kip/in
- \( T_n \): 2.1s
- \( \zeta_{\text{eff}} \): 35%
- Displacement including accidental eccentricity: 2ft

FTP Manufacturer
http://www.earthquakeprotection.com/triple_vs_single_pendulum.html
• ELF was used to select the preliminary size of elements (Equally distributed force)

• Two Point Link elements were used to model the base isolator
Moat Area: 2.5ft

Solution for the Entrance:
- Moat Cover: Expansion Joint
- Slider underneath the Ramp
### Base Isolation – Modal Analysis

<table>
<thead>
<tr>
<th></th>
<th>w/o Base Isolation</th>
<th>w/ Base Isolation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period [s]</td>
<td>0.35</td>
<td>2.1</td>
</tr>
</tbody>
</table>
Response Spectrum Analysis

<table>
<thead>
<tr>
<th></th>
<th>Max Demand</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moment [kip*ft]</td>
<td>550</td>
<td>675</td>
</tr>
<tr>
<td>Shear [kip]</td>
<td>160</td>
<td>207</td>
</tr>
<tr>
<td>Axial Force [kip]</td>
<td>459</td>
<td>1440</td>
</tr>
<tr>
<td>Deflection [in]</td>
<td>0.85</td>
<td>1.3</td>
</tr>
<tr>
<td>Interstory Drift Ratio [%]</td>
<td>0.34%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Response History Analysis: Uplift of the isolator units and p-delta effects on the isolated structure can be analyzed
Base Isolator – Connection Details

- Column
- Stiffened Base Plate
- Base Isolator
- Foundation

Moment Connection

- Bolt
- (milled) heavy plate
- Nut
- Bolt or threaded rod into coupler
- Grout

Base Plate

Foundation

Column
Earthquake damage calculation – Base Isolation

Mean Value earthquake damage

$885,000
Earthquake damage calculation – No Base Isolation

Mean Value earthquake damage
$4,965,000
Insurance comparison

Base Isola Aon

Non-Base Isola Aon

Benefit in PPP period
$ 170,000

Next 5 yrs
$ 500,000
Base Isolation and Insurance

- No Earthquake safety
- Insurance without BI
- Insurance with BI

<table>
<thead>
<tr>
<th>Price Range</th>
<th>No Earthquake safety</th>
<th>Insurance without BI</th>
<th>Insurance with BI</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1,000,000</td>
<td>$4,965,000</td>
<td>$2,755,000</td>
<td>$2,585,000</td>
</tr>
<tr>
<td>$2,000,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$3,000,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$4,000,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$5,000,000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• Ducts had to be a maximum of 10” x 39” in order to penetrate ducts
• Max depth of 2.6’ \(\rightarrow\) raises our clear height to 9’3”
• Exposed structure adds 18” to clear height between beams
<table>
<thead>
<tr>
<th>Heating</th>
<th>Cooling</th>
<th>Ventilation</th>
<th>Supply</th>
<th>Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditioning of DOAS supply Heating Coil</td>
<td>Conditioning of DOAS supply Cooling Coil</td>
<td>DOAS</td>
<td>Plenum</td>
<td>Ducted</td>
</tr>
</tbody>
</table>
Floor Plans

1st Floor

2nd Floor

3rd Floor
1. Optimize the Envelope

2. Optimize the Systems

3. Optimize the People
Green Façade for Shading

Self shading
CWS (45F) and HWS (212F) from UCLA Cogeneration Plant

Filters Remove Pollutants

Cooling Coil SAT = 65F
Heating Coil SAT = 75F

Return Air

Cooling Set Point = 75F
Heating Set Point = 67F

Fans Provide Space Conditioning
Energy Monitor

Renate’s Profile

Energy Monitor

Your Weekly Summary Week of Nov 22

Breakdown by Time of Day, Week of Nov 22

Weekly Energy Tip:
Reduce energy use by using tasklighting instead of overhead lights

Current Energy Use Benchmark

Projected

Last Week
This Week

Congratulations!
You have won a **FREE** coffee in the Café for meeting your WEEKLY ENERGY BENCHMARK!
Energy Flows – Final Solution

UCLA Cogeneration Plant  
On-Site PV Generation  
Grid Electricity

18,266 kWh/yr  
60,026 kWh/yr  
20,203 kWh/yr  
88,184 kWh/yr

Space Cooling  
Space Heating  
Fans  
Lighting  
Plug Loads
Use Phase – Water Reductions

- **BASELINE**
- **IMPROVED FIXTURES**
- **BLACKWATER TREATMENT**

Use Phase – Water Reductions

- Annual Water Consumption (kGal/yr)
- Reductions:
  - 37% Reduction
  - 73% Reduction

Categories:
- Toilets
- Urinal
- WC sink
- Kitchen sink
- Irrigation (from EPA Watersense Tool)
Water Flows – Final Solution

Toilets (432 kGal/yr)
Urinals (85 kGal/yr)
Lavatory Sinks (337 kGal/yr)

PV Cleaning (2 kGal/yr)
Irrigation (25 kGal/yr)

Living Machine Treatment

Total Reuse Used: 881 kGal/yr

Potable Water (337 kGal/yr)
• How can we streamline O&M costs?
  – MEP changes energy model → has to tell LCFM = LATENCY
Which floor finish?
## STV – LCC Integration

### Concrete:

<table>
<thead>
<tr>
<th>GWP (kgCO2e)</th>
<th>Energy (MJ)</th>
<th>Water (kg)</th>
<th>ODP (kgCFC11e)</th>
<th>$ First Cost</th>
<th>$/yr Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,207</td>
<td>67,065</td>
<td>135,039</td>
<td>2.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>32,893</td>
<td>451,719</td>
<td>350,036</td>
<td>9.3E-05</td>
<td>72,437</td>
<td>3,779</td>
</tr>
<tr>
<td>253,937</td>
<td>2,263,654</td>
<td>3,211,264</td>
<td>6.4E-03</td>
<td>349,481</td>
<td>12,177</td>
</tr>
</tbody>
</table>

### Reclaimed Wood:

<table>
<thead>
<tr>
<th>GWP (kgCO2e)</th>
<th>Energy (MJ)</th>
<th>Water (kg)</th>
<th>ODP (kgCFC11e)</th>
<th>$ First Cost</th>
<th>$/yr Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,207</td>
<td>67,065</td>
<td>135,039</td>
<td>2.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>32,893</td>
<td>451,719</td>
<td>350,036</td>
<td>9.3E-05</td>
<td>72,437</td>
<td>3,779</td>
</tr>
<tr>
<td>169,664</td>
<td>2,329,995</td>
<td>1,805,505</td>
<td>4.8E-04</td>
<td>373,635</td>
<td>19,495</td>
</tr>
</tbody>
</table>

### Carpet:

<table>
<thead>
<tr>
<th>GWP (kgCO2e)</th>
<th>Energy (MJ)</th>
<th>Water (kg)</th>
<th>ODP (kgCFC11e)</th>
<th>$ First Cost</th>
<th>$/yr Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,207</td>
<td>67,065</td>
<td>135,039</td>
<td>2.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>32,893</td>
<td>451,719</td>
<td>350,036</td>
<td>9.3E-05</td>
<td>72,437</td>
<td>3,779</td>
</tr>
<tr>
<td>41,658</td>
<td>703,415</td>
<td>61,068</td>
<td>7.9E-04</td>
<td>322,968</td>
<td>13,806</td>
</tr>
</tbody>
</table>
Concrete is cheaper, but more environmentally impactful.

Wood provides our owners with more **VALUE for MONEY**.
Building Health
# Building Monitoring

## Structural Monitoring System

<table>
<thead>
<tr>
<th>Number</th>
<th>Element</th>
<th>Tag</th>
<th>Floor</th>
<th>Deflection</th>
<th>OK?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 Column</td>
<td>1</td>
<td>1</td>
<td>0.000023</td>
<td>OK</td>
</tr>
<tr>
<td>2</td>
<td>2 Column</td>
<td>2</td>
<td>1</td>
<td>0.000021</td>
<td>OK</td>
</tr>
<tr>
<td>3</td>
<td>3 Column</td>
<td>3</td>
<td>1</td>
<td>0.00002</td>
<td>OK</td>
</tr>
<tr>
<td>4</td>
<td>4 Connection</td>
<td>1</td>
<td>1</td>
<td>0.00012</td>
<td>OK</td>
</tr>
<tr>
<td>5</td>
<td>5 Bracing</td>
<td>1</td>
<td>2</td>
<td>0.000037</td>
<td>OK</td>
</tr>
<tr>
<td>6</td>
<td>6 Bracing</td>
<td>2</td>
<td>2</td>
<td>0.000039</td>
<td>OK</td>
</tr>
<tr>
<td>7</td>
<td>7 Girder</td>
<td>1</td>
<td>3</td>
<td>0.00071</td>
<td>OK</td>
</tr>
<tr>
<td>8</td>
<td>8 Girder</td>
<td>2</td>
<td>3</td>
<td>0.00065</td>
<td>OK</td>
</tr>
</tbody>
</table>
• Safety after seismic events
• Energy reductions
Construction Site Access

Easy access, 1.7 miles from 405 freeway

Hospital next to the site

Available Parking Space for Workers

Bus stop next to the site 2/302
## Material suppliers

<table>
<thead>
<tr>
<th>Company</th>
<th>Distance (Driving)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Rentals</td>
<td>18.8 mi</td>
<td>28 min</td>
</tr>
<tr>
<td>American Rentals Inc.</td>
<td>24.9 mi</td>
<td>31 min</td>
</tr>
<tr>
<td>Reliance Steel &amp; Aluminum Co</td>
<td>14.7 mi</td>
<td>24 min</td>
</tr>
<tr>
<td>CEMEX</td>
<td>9.7 mi</td>
<td>16 min</td>
</tr>
<tr>
<td>Nucor</td>
<td>46.4 mi</td>
<td>53 min</td>
</tr>
</tbody>
</table>
Erection Sequence - Excavation
Erection Sequence – Column Installation
Erection Sequence – Final Stage
Equipment Selection

**Dump truck:** 16 ton, 12 C.Y. payload, 400 H.P.
**Type:** Various manufacturers
**Monthly rate:** $2,900 per month or per load if owner-operated

**Pump Size:** 32-38 m boom
**Rate charged:** $160.00 per hour
**Cub meter pumped:** $7.00 per cubic m
**Main advantages** | **Flexibility, mobilization**
---|---
**Max. lifting capacity** | 352,700 lbs at 10 ft radius
**Telescopic boom** | 43ft - 203ft
**Monthly Rate** | $29,250
Excavator & Mini-Excavator
Bucket Capacity: 1-1/2 C.Y.
Fuel Type: Diesel, 325 HP
Monthly Rate: $8,175

Capacity: 2,600 lbs
Bucket size: 1 C.Y.
Net engine power: 85 hp
Monthly Rate: $2,500

Max Lift Capacity: 30k lbs
Fuel Type: Diesel
Options: 30k lbs / 17'-19' Dig
Monthly Rate: $4,733
Temporary Structure

Supplier: PERI USA
Type: Aluminium/Steel/Wood
Slab/Wall Formwork System: Maximo or Trio
Scaffolding System: Up
Column System: Vario or Trio
Monthly Rental Rate: $TBD
Distribution: Rental / Truck
Follow local mandates (Example: Los Angeles)
On site PM has many stakeholders present, but also needs to include safety and Safe-BIM

- Use 3D safety plans
- Create sophisticated, modernized site safety plans to enhance construction safety
- Promote collaboration, between property owners, architects, engineers
The entire team endorses safety

**Owner +Architect / Engineer:** Safety at the project front-end eliminates hazards already in the design phase

**Sub Contractor:** Early involvement in safety and safe construction planning ensure safe project execution

**Facility Manager:** Safety and decision making in the early phases of a project decide on the “safety outcome” during the O&M phase
Safety Framework

FUTURE ENHANCEMENTS
- Real-Time Location Services (RTLS)
- Visual and Auditory Alerts (Vandalism Alarm, Safety Beacon, Job Site Notifications)
- Motion Sensing and Charging

COLOR CODED ROLE IDENTIFICATION
- Visitor
- Developer
- Apprentice
- Journeyman
- Foreman
You have been working for 3 hours. Take a water break.
2nd Floor Axonometric

CM – A – SE – MEP
3rd Floor Axonometric

Architecture

MEP

Structure

CM – A – SE – MEP
• Beams exposed in outside stairwell
• Beams blocking the stairwell
- Beams penetrating the MEP Shaft
BIM Coordination

Coordination

AUTODESK® BIM 360™ GLUE® (Global TeamWork) Clashes

Activities
- Olya Golovina: renamed merged model "Clash to A SE MEP" 1 minute ago
- Olya Golovina: deleted merged model A-M 1 minute ago
- Olya Golovina: renamed merged model "0428" to "SE MEP" 2 minutes ago
- Olya Golovina: created Clash Result Set "CL" 05/02/14 6:15 PM
- Olya Golovina: created merged file "A-M" 05/02/14 8:14 PM
- Olya Golovina: updated model "Architectural" to version 5 05/02/14 6:12 PM
- Olya Golovina: updated Clash Result Set "BIM MEP" 05/02/14 6:05 PM
- Olya Golovina: updated model "Mechanical" to version 15 05/02/14 6:05 PM
- Olya Golovina: updated Clash Result Set "SE MEP" 05/02/14 5:57 PM
- Olya Golovina: updated model "Mechanical" to version 14 05/02/14 5:55 PM
Model Integration in Autodesk 360 Glue
Clash Detection – A & MEP
## Schedule & Key Milestones

### Milestones

1. Dewatering completed
2. Shell completed
3. Early access to the lab completed
4. Project completed

**Total duration = 11 months**
Schedule – Early Access to Labs

Project

9/2

SITE PREPARATION

12/10

9/2

SUBSTRUCTURE

12/30

11/13

SHELL

12/24

3/10

Services

2/19

Interiors

5/5

3/25

1 Floor

6/12

3/25

Internal walls

4/28

3/25

Wall painting

4/7

4/21

4/8

Flooring

4/28

4/22

Tilling

4/24

3/11

Exteriors

4/21

3/25

Lansdscaping

7/14

6/3

Finalization

8/11

6/15
### STV – TVD Integration

#### STV Progress

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Material/Type</th>
<th>Amount</th>
<th>GWP (kgCO2e)</th>
<th>Energy (MJ)</th>
<th>Water (kg)</th>
<th>ODP (kgCFC11e)</th>
<th>CONSTRUCTION</th>
<th>LCC (per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>Novacem Mat and Pile (cc)</td>
<td>40</td>
<td>4,207</td>
<td>67,865</td>
<td>156,039</td>
<td>2.8E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Floor</td>
<td>Novacem Concrete (cc)</td>
<td>4,144</td>
<td>23,066</td>
<td>348,925</td>
<td>543,965</td>
<td>5.2E-04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Roof</td>
<td>Green Roof (sf)</td>
<td>11,362</td>
<td>52,277</td>
<td>795,399</td>
<td>243,544</td>
<td>2.3E-03</td>
<td>340,950</td>
<td>531</td>
</tr>
<tr>
<td>Exterior Wall</td>
<td>Brick on Metal Stud (sf)</td>
<td>19,301</td>
<td>486,382</td>
<td>6,473,319</td>
<td>5,219,204</td>
<td>1.8E-02</td>
<td>457,434</td>
<td></td>
</tr>
<tr>
<td>Interior Wall</td>
<td>Steel Studs and Painted Gypsum (sf)</td>
<td>19,785</td>
<td>391,413</td>
<td>5,038,920</td>
<td>4,683,133</td>
<td>1.4E-02</td>
<td>222,361</td>
<td></td>
</tr>
<tr>
<td>Interior Wall</td>
<td>Curtain Wall (sf)</td>
<td>478</td>
<td>6,624</td>
<td>90,545</td>
<td>91,782</td>
<td>1.1E-04</td>
<td>25,334</td>
<td></td>
</tr>
<tr>
<td>Floor</td>
<td>Wood System (sf)</td>
<td>21,375</td>
<td>169,664</td>
<td>2,329,995</td>
<td>1,805,505</td>
<td>4.8E-04</td>
<td>373,635</td>
<td></td>
</tr>
<tr>
<td>Roof</td>
<td>Green Roof (sf)</td>
<td>11,362</td>
<td>52,277</td>
<td>705,969</td>
<td>243,544</td>
<td>4.8E-04</td>
<td>340,860</td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>Photovoltaics (sf)</td>
<td>3,739</td>
<td>154,784</td>
<td>2,002,971</td>
<td>2,848,704</td>
<td>2.0E-03</td>
<td>218,000</td>
<td></td>
</tr>
<tr>
<td>Exterior Wall</td>
<td>EIFS on Metal Stud (sf)</td>
<td>19,301</td>
<td>483,559</td>
<td>7,044,754</td>
<td>5,293,339</td>
<td>2.3E-02</td>
<td>390,636</td>
<td></td>
</tr>
<tr>
<td>Interior Wall</td>
<td>Steel Studs and Painted Gypsum (sf)</td>
<td>19,785</td>
<td>391,413</td>
<td>5,038,920</td>
<td>4,683,133</td>
<td>1.4E-02</td>
<td>222,361</td>
<td></td>
</tr>
<tr>
<td>Interior Wall</td>
<td>Curtain Wall (sf)</td>
<td>478</td>
<td>6,624</td>
<td>90,545</td>
<td>91,782</td>
<td>1.1E-04</td>
<td>25,334</td>
<td></td>
</tr>
</tbody>
</table>

#### Sustainable Target Value

- **Construction and Materials**
- **Use Phase**
- **RESULTS**
- **Cogen Data**
- **LCA Data**
- **Lists**
- **COST DATA**
- **TVD Owners**
- **TVD**
Target Value Design
<table>
<thead>
<tr>
<th></th>
<th>ESTIMATED VALUE</th>
<th>TARGET VALUE</th>
<th>VALUE DELTA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>L-Shape Steel Winter Quarter</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>$7,500,000</td>
<td>$9,000,000</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>A Substructure</td>
<td>$300,000</td>
<td>$720,000</td>
<td>$420,000</td>
</tr>
<tr>
<td>B Shell</td>
<td>$2,800,000</td>
<td>$2,810,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>C Interiors</td>
<td>$1,000,000</td>
<td>$1,350,000</td>
<td>$350,000</td>
</tr>
<tr>
<td>D Services</td>
<td>$2,000,000</td>
<td>$2,520,000</td>
<td>$520,000</td>
</tr>
<tr>
<td>E Equipment and Furnishing</td>
<td>$60,000</td>
<td>$180,000</td>
<td>$120,000</td>
</tr>
<tr>
<td>F Specialty Construction</td>
<td>$340,000</td>
<td>$360,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>G Building Sitework</td>
<td>$400,000</td>
<td>$450,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>H General Conditions</td>
<td>$600,000</td>
<td>$630,000</td>
<td>$30,000</td>
</tr>
<tr>
<td><strong>L-Shape Steel Spring Quarter</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>$8,400,000</td>
<td>$9,000,000</td>
<td>$600,000</td>
</tr>
<tr>
<td>A Substructure</td>
<td>$1,805,000</td>
<td>$1,710,000</td>
<td>$(95,000)</td>
</tr>
<tr>
<td>B Shell</td>
<td>$1,780,000</td>
<td>$1,800,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>C Interiors</td>
<td>$1,050,000</td>
<td>$1,170,000</td>
<td>$120,000</td>
</tr>
<tr>
<td>D Services</td>
<td>$2,500,000</td>
<td>$2,790,000</td>
<td>$290,000</td>
</tr>
<tr>
<td>E Equipment and Furnishing</td>
<td>100,000</td>
<td>$90,000</td>
<td>$(10,000)</td>
</tr>
<tr>
<td>F Specialty Construction</td>
<td>250,000</td>
<td>$360,000</td>
<td>$110,000</td>
</tr>
<tr>
<td>G Building Sitework</td>
<td>$415,000</td>
<td>$450,000</td>
<td>$35,000</td>
</tr>
<tr>
<td>H General Conditions</td>
<td>$500,000</td>
<td>$630,000</td>
<td>$130,000</td>
</tr>
</tbody>
</table>
## Replacement Strategy

<table>
<thead>
<tr>
<th>Nr</th>
<th>Construction element</th>
<th>After start of operation phase</th>
<th>After expiration of contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Static construction</td>
<td>60</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Floor construction</td>
<td>60</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Roof construction</td>
<td>60</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Roof covering</td>
<td>40</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Facade</td>
<td>45</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Windows</td>
<td>40</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>Doors to the outside</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>Inner partitions, openings</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>Interior fittings</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>Ceilings</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>Doors inside</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>12</td>
<td>Fittings, fixtures</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>13</td>
<td>Sanitary equipment</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>14</td>
<td>Mechanical equipment</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>15</td>
<td>Electrical equipment</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>16</td>
<td>Monitoring system</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>17</td>
<td>Fire installations</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>18</td>
<td>Elevator</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>19</td>
<td>Dewatering system</td>
<td>60</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>PV Panels</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>Exterior</td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>

**Total:** $1,418,313.19
Replacement Strategy

Ceilings - $85,000
Doors - Inside - $80,000
Inner Par Aments - $140,000
Doors - Outside - $25,000
Elevator - $90,000

$500,000 – $1,000,000
1
3
5
7
9
11
13
15
17
19
21
23
25

During Replacement
Rent reduction – $250,000

$110,000
$1,170,000
$170,000
Rent Optimization

Design effects

Architectural design
Structural design
Mechanical design

Construction costs
Life cycle costs

Rent

Cost feedback

As low as possible
Rent: $725,000
Rent comparison

- Rent without optimization: $25,125,000
- Final rent: $21,000,000

$4.1M Saving
Expenses | Income

- Interest: $4,881,082
- Risk surcharge: $530,459
- O&M costs: $5,184,553
- Replacement costs: $1,427,380
- Initial costs: $8,381,311
- Rent Classrooms: $2,417,346
- Rent Cafe: $1,756,967
- Rent Owner: $20,648,125

Expenses | Income
Whole Life Cycle Costs

- Interest: 24%
- Initial costs: 41%
- O&M costs: 25%
- Replacement costs: 7%
- Risk surcharge: 3%

Initial costs
Replacement costs
O&M costs
Risk surcharge
Interest
Debt Service Cover Ratio

Credit status
DSCR
LLCR
DSCR Required

Equity: 20%  Debt: 80%
Project Cash Flow

Break even point: 19 yr

Total income
Total expenses
WLCC Cash flow

Required ROE
10%

-9,000,000
-7,000,000
-5,000,000
-3,000,000
-1,000,000
1,000,000
3,000,000
5,000,000

0 2 4 6 8 10 12 14 16 18 20 22 24

$-9,000,000 $-7,000,000 $-5,000,000 $-3,000,000 $-1,000,000 $1,000,000 $3,000,000 $5,000,000 $3,000,000

$5,000,000 $3,000,000 $1,000,000

Total income
Total expenses
WLCC Cash flow

Required ROE
10%
Building Health
Team process – Handover

Sub-group meeting

Jep, will work on it!
Team process – Stand Up Meetings

Monday
Stand up

<table>
<thead>
<tr>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.30 am</td>
</tr>
<tr>
<td>11.30 am</td>
</tr>
<tr>
<td>5.30 pm</td>
</tr>
</tbody>
</table>

Wednesday
Stand up

<table>
<thead>
<tr>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.30 am</td>
</tr>
<tr>
<td>11.30 am</td>
</tr>
<tr>
<td>5.30 pm</td>
</tr>
</tbody>
</table>

Saturday
Meeting

<table>
<thead>
<tr>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.30 pm</td>
</tr>
<tr>
<td>12.30 pm</td>
</tr>
<tr>
<td>6.30 pm</td>
</tr>
</tbody>
</table>

Looks good, thanks Bjorn,

Here is what changed
Team Process

Weekly Meetings
- Communication: 60%
- Coordination: 30%
- Collaboration: 10%

Stand Up Meetings
- Communication: 30%
- Coordination: 50%
- Collaboration: 20%

KICKOFF
- Communication: 60%
- Coordination: 30%
- Collaboration: 10%

WINTER PRESENTATION
- Communication: 30%
- Coordination: 50%
- Collaboration: 20%

FISHBOWL
- Communication: 60%
- Coordination: 30%
- Collaboration: 10%

SPRING PRESENTATION
Weekly Meetings 10%

Stand Up Meetings 20%

KICKOFF

WINTER PRESENTATION

FISHBOWL

SPRING PRESENTATION

Weekly Meetings 20%

Communication
Coordination
Collaboration
Chris: “Think more for others, better return you will receive.”

Amy: ”The key is patience and flexibility”

Bjørn: ”When you are thinking in 3D other might be thinking in 2D – meaning clashes!”

Olga: ”Can you hear me? Can you see my screen?”

Sophia: ”Project = Fun”

Albert: ”What are you sinking about?”

Tim: ”Don’t underestimate the importance of communication, collaboration and coordination.”
THANK YOU MENTORS


And our owners: Ana Sofia Cardona, Mike Muller, Sebastian Schönbach

AND special thanks to Renate Fruchter