LET
THE JOURNEY
BEGIN
TEAM
CENTRAL 2018
TEAM CENTRAL 2018
AEC Global Teamwork: The Journey Continues
1993-2017-2018
WINTER CONCEPT 1: TREASURE
Feed Back Loop

Concept → Design → Construction → Users

Survey from UCLA Students
## Decision Matrix

<table>
<thead>
<tr>
<th>Factors</th>
<th>Weight</th>
<th>Treasure Steel</th>
<th>Treasure Timber</th>
<th>Synergy Steel</th>
<th>Synergy Timber</th>
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<td>0.5</td>
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<td>Water consumption</td>
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<td>Carbon footprint</td>
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<td>Energy efficiency</td>
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<td>Replacement of components</td>
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<td>Prefabration</td>
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<td>Constructability</td>
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<td>0.9</td>
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<td>Interior</td>
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<td>Air Quality</td>
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<td>0.9</td>
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<td>1.0</td>
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<td>Innovation</td>
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<td>User Comfort</td>
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<td>Exterior</td>
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<tr>
<td>Appeal/urban design</td>
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<td>0.5</td>
<td>0.4</td>
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<td>Neighbourhood integration</td>
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<td>0.8</td>
<td>0.9</td>
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<td>Impact on surroundings</td>
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<td>Functionality</td>
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<td>0.5</td>
<td>0.4</td>
<td>0.4</td>
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<td>Earthquake resilience</td>
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<td>0.9</td>
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<td>Consistence of big idea</td>
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<tr>
<td>Survey Feedback UCLA</td>
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<tr>
<td>Total</td>
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<td>17.3</td>
<td>20.0</td>
<td>15.4</td>
<td>17.1</td>
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</table>
BIG IDEA 1.0

TREASURE = KNOWLEDGE

TECHNOLOGY
A JOURNEY FROM KNOWLEDGE TO WISDOM

"Technology as a means and not an end in itself"

KNOWLEDGE VIA TECHNOLOGY WISDOM
BIG IDEA 2.0

TREASURE = WISDOM

MAKE PEOPLE ACT VIA HUMAN - TECHNOLOGY INTERACTION

Where human meets technology
WHAT HAPPENS WHEN HUMAN MEETS TECHNOLOGY?

HUMAN AND TECHNOLOGY

TEAM CENTRAL

i- Building

- NET ZERO
- LESS M&O
- CHANGE HUMANS BEHAVIOR

i- Team

- HUMAN + ARTIFICIAL INTELLIGENCE
- REAL TIME CLASH DETECTION
- PREDICTIVE DESIGN SOLUTIONS
“Data driven approach to complete the sustainability puzzle”
SUSTAINABILITY GOALS

- **AI + HUMAN**
- **SENSORS IN BUILDING**
- **PARAMETRIC DESIGN**
- **FUTURE CLIMATE**
- **LEED CERTIFICATE**
- **SOLAR PANEL**
- **NEIGHBORHOOD**
- **SUSTAINABLE MATERIAL**
- **DAYLIGHT ANALYSIS**
- **SAFE SITE**
- **PREFABRICATION**
- **RISK REDUCTION**

- Changing Human Behaviour
- Integration with future
- Integration with present
- Integration with operations
DESIGN EVOLUTION

1st floor: Closed box (Double Diamond)

2nd floor: Half-opened box

3rd floor: Completely opened box
Double-diamond on site
ADD EXTRA SPACE TO FLOOR PLANS

Design 3 floors separately
Synchronize 3 floors together

Final design with slanted walls
PROJECT LOCATION

34°03'49.2"N 118°26'52.9"W

UCLA
SURROUNDING CONDITIONS

- Rectangular buildings
- Visible structure
- Shadings
- Bright facade material
- Visible structure
Precipitation Amounts

Jan: 83.8 mm
Feb: 110.5 mm
Mar: 57.6 mm
Apr: 20.2 mm
May: 6.4 mm
Jun: 1.2 mm
Jul: 0.8 mm
Aug: 0.4 mm
Sep: 2.5 mm
Oct: 14.9 mm
Nov: 17.3 mm
Dec: 62.8 mm

Total: 378.4 mm/year
DAILY SOLAR CONDITION

12:30 PM

Sunset

Sunrise
MONTHLY SOLAR CONDITION

June

December

12:30 PM

12:30 PM
SURROUNDING SHADING ANALYSIS

<table>
<thead>
<tr>
<th>TIME</th>
<th>WINTER SOLSTICE</th>
<th>EQUINOX</th>
<th>SUMMER SOLSTICE</th>
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<tr>
<td>8 AM</td>
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<tr>
<td>12PM</td>
<td><img src="image4" alt="Image" /></td>
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<tr>
<td>5 PM</td>
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<td><img src="image8" alt="Image" /></td>
<td><img src="image9" alt="Image" /></td>
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</tbody>
</table>
SITE CHALLENGES

Air Pollution
- Wildfires
- Car exhaust gasses

Weather
- Sun low on horizon
- Daylight 14 hours
- No shading

Neighbourhood
- Bright facade materials
- Messy architecture

Fire
- Nearby wildfire zone
- High risk of fire
- Dry Climate

Heavy traffic
- Street corner
- Rush hour traffic

Earthquake
- Seismic active area
- Increasing size of earthquakes
VIEW FROM NORTH - WEST

east  north  west  south
SECTION TOWARDS NORTH

- auditorium
- classrooms
- seminar
- student offices
- faculty offices
- administration
- department chair's office
- faculty lounge
- student lounge
- cafe
- restrooms
SECTION TOWARDS WEST

- auditorium
- classrooms
- seminar
- student offices
- faculty offices
- administration
- department chair’s office
- faculty lounge
- student lounge
- cafe
- restrooms
HOLOGRAM IN ATRIUM
“We believe that it is data and its digital technology that is going to lead the transformation” - TEAM CENTRAL
STRUCTURAL
ENGINEERING
Soil Conditions
- Shallow / Deep water table
- 5000 SF Bearing

Earthquake Risk Category
- Risk Category: II
# Loads

## Live Loads

<table>
<thead>
<tr>
<th>Type of Room</th>
<th>Uniform [psf]</th>
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<tbody>
<tr>
<td>Student &amp; Faculty offices</td>
<td>50</td>
</tr>
<tr>
<td>Classrooms</td>
<td>40</td>
</tr>
<tr>
<td>Stairs</td>
<td>100</td>
</tr>
<tr>
<td>Roof</td>
<td>40</td>
</tr>
<tr>
<td>Auditorium</td>
<td>100</td>
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</tbody>
</table>

## Earthquake Loads

- 251.7 kips
- 255.8 kips
- 196.6 kips
- 101.2 kips

**Total Base Shear = 805.3 kips**
VERTICAL LOAD PATH

- TENSION
- COMPRESSION
HORIZONTAL LOAD PATH

TENSION

COMPRESSION
22.5” x 22.5”
Glulam Column

12” x 16.5”
Primary Timber Beam

4” x 9”
Secondary Timber Beam

1-ft Shear Walls
22.5”x22.5”
Glulam Column

12”x16.5”
Primary Timber Beam

4”x9”
Secondary Timber Beam

1-ft Shear Walls
22.5”x22.5” Glulam Column

12”x16.5” Primary Timber Beam

4”x9” Secondary Timber Beam

1-ft Shear/Retaining Walls

Waffle Slab
LATERAL LOAD RESISTING SYSTEM

Shear walls

Diaphragms

Basement walls
Natural Frequency for slab

\[
f = \frac{2.188}{2 \cdot l^2} \cdot \sqrt{\frac{EI_{\text{app}}}{\rho \cdot A_{\text{eff}}}} = 10.173 \text{ Hz} \geq 9 \text{ Hz}
\]
Seismic Response:

Scale Factor = 300

From USGS:
S_s = 2.246 g
S_1 = 0.822 g
**1st Modal Response:**

Scale Factor = 300  
Modal Participation Ratio = 31%
2nd Modal Response:

Scale Factor = 300
Modal Participation Ratio = 18%
Max Story Disp:

Roof:
UX_max = 0.053 in
UY_max = 0.045 in

3rd floor:
UX_max = 0.027 in
UY_max = 0.023 in

Allowable Story Disp:
Roof: 1.05 in
3rd floor: 0.75 in
First iteration

- 11.5-ft deep soil
- Need to prevent the wall from:
  - Sliding
  - Overturning
Improved solution:

Attach a **6.75-ft keyway** to the bottom of the wall foundation.
Backfill Side

11.5’

Simply Supported Wall

17.5’

1’

#4 @ 12 in O.C.

#4 @ 8 in O.C.
RETEAINING WALL DESIGN

17.5’

#4 rebar

6"

6"
VENTILATION CONCEPT

Intake air  Exhaust air  Intake air  Exhaust air

AHU  AHU

Mechanical Room 1  Mechanical Room 2
# VENTILATION OPTIONS

<table>
<thead>
<tr>
<th>Component</th>
<th>Efficiency</th>
<th>Price</th>
<th>Downdraft</th>
<th>Space need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceiling diffusers</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
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<tr>
<td>Displacement ventilation</td>
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<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Diffuse ceiling ventilation</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Natural ventilation</td>
<td>● High air pollution&lt;br&gt;● High humidity + cooling devices&lt;br&gt;→ bad air quality&lt;br&gt;→ condensation problems</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Seasons:**
- **WINTER**
- **SPRING**

**Notes:**
- Change to diffuse ceiling ventilation.
DIFFUSE CEILING CONCEPT

low air velocities

Exhaust grill with silencer
VENTILATION DIAGRAM

- Inlet
- Exhaust
- Supply
- Return

Symbols:
- Damper
- Filter
- Cooling coil
- Heating coil
- Rotary heat exchanger
- Fan
Real-Time Clash Detection

Live Clash Detection in Revit
HVAC ROUTING - FLOOR 1

- Supply Air
- Return Air
- Shaft
- Mech Room
- AHU

Ducts 24"
Underfloor HVAC

Displacement Ventilation
Supply Air: 30mm insulation

Return Air: No insulation
HVAC ROUTING - FLOOR 3

Supply Air: 30mm insulation
Return Air: No insulation

Ducts:
- 12"x9"
- 8"x6"
Winter Quarter Proposal

- Glare issues
- Cooling needed was very high

Spring Quarter - Next Iteration

- Less glare issues
- Cooling reduced but still high
PARAMETRIC DESIGN OPTIMISATION
EXPLORING ALTERNATIVES

270 different alternatives

Parametric Design Optimisation
- Energy Balance: 90 kWh/m²
FINAL DESIGN

- Good daylight factor
- Minimized glare issues
- Energy Balance = 66.5 kWh/m²
FUTURE TEMPERATURE PREDICTION

http://weathershift.com/

ARUP WEATHERSHIFT™

http://weathershift.com/
FUTURE TEMPERATURE PREDICTION

http://weathershift.com/

ARUP weathershift

http://weathershift.com/
## ENERGY BALANCE

### Present

<table>
<thead>
<tr>
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<th>Purchased energy</th>
<th>Peak demand</th>
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<td>Total, Facility fuel*</td>
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<td>District heating</td>
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<td>Total</td>
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<td>Grand total</td>
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### 2065

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<td>HVAC aux</td>
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<td>Total, Facility electric</td>
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<td>Domestic hot water</td>
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<tr>
<td>Grand total</td>
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60.1 kWh/m² → 66.5 kWh/m²
## Cooling Options

<table>
<thead>
<tr>
<th>Component</th>
<th>Efficiency</th>
<th>Price</th>
<th>Downdraft</th>
<th>Space need</th>
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<tbody>
<tr>
<td>Chilled ceiling</td>
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<td></td>
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<tr>
<td>Fan coils</td>
<td>1st</td>
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</tr>
<tr>
<td>Active chilled beams</td>
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<td></td>
<td></td>
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<tr>
<td>Thermal active building slabs</td>
<td></td>
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</tr>
<tr>
<td>Cooling by ventilation</td>
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</tr>
</tbody>
</table>
Challenge: Student offices in northern part of atrium
- Triple-Layer Window
- Visible Transmittance 60%
- Shading Structure
SOLAR ANALYSIS IN STUDENT OFFICES

Glare analysis

Daylight factor

Factor 2-3%
200-300 Lux
CONSTRUCTION
MANAGEMENT
CONSTRUCTION SITE ACCESS

CONSTRUCTION SITE

HEAVY TRAFFIC

RUSH HO UR: 7AM - 9AM
5PM - 7.30PM
CONSTRUCTION SITE ACCESS

405

CONSTRUCTION SITE

HEAVY TRAFFIC

RUSH HOUR:
7AM - 9AM
5PM - 7.30PM
CONSTRUCTION SITE ACCESS

**Entrance Trucks**

**Exit Trucks**

**Emergency Area**
CONSTRUCTION SITE LOGISTICS

1. EXIT/ENTRANCE EMPLOYEES
2. SITE OFFICES
3. RESTROOMS
4. SHADED AREA
5. LOADING AREA
6. MATERIAL LAYDOWN AREA
7. RECYCLING AREA
8. EMERGENCY AREA
9. FIRST AID KIT STATION
10. TRUCK WASH
SECTION TOWER CRANE

139 FT

16 FT
Specifications

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<th>Specification</th>
<th>Value</th>
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<tr>
<td>Liebherr 85 EC-B 5 FR.tronic</td>
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<td>Max radius</td>
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<tr>
<td>Max capacity</td>
<td>11,023 lbs</td>
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<tr>
<td>Lifting capacity at max radius</td>
<td>2,866 lbs</td>
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<tr>
<td>Equipment name</td>
<td>Capacity</td>
</tr>
<tr>
<td>----------------</td>
<td>----------</td>
</tr>
<tr>
<td>Excavator</td>
<td>3-4 cy</td>
</tr>
<tr>
<td>Dump Truck</td>
<td>12 cy</td>
</tr>
<tr>
<td>Compactor</td>
<td>1</td>
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</tbody>
</table>
Compulsory to use safety equipment

Hospital map

First aid kit stations

Fall protection

Prohibited to pass the truck route
Earthquake

Evacuation plan - Evacuation Area

Warning signal!
Fire

Fire alarm!

Fire points

FIRE HYDRANTS MAP

CONSTRUCTION SITE
BEAT THE HEAT

Portable fans

Report heart symptoms!

Fresh and pure water tanks

Shadowed area for rest
Radius distance from construction site
- 10 MILES
- 20 MILES
- 40 MILES

HVAC supplier
Steel supplier
Concrete supplier
Lumber supplier Glulam
Construction site equipment
Construction workwear and safety gear
Mass timber supplier CLT

Oregon department of forestry

M

KATERRA

400 miles

350 miles
**LOCAL VENDOR SUPPLIER**

**T** Tower crane

![Tower crane image]

![Map with LIEBHERR OFFICE and distance indicated]

**345 miles**
CONSTRUCTABILITY

- PRECAST WAFFLE SLAB
- CLT SLAB/GLULAM BEAMS
- STRUCTURAL CONNECTIONS
- PREFAB CONCRETE WALLS
- CURTAIN WALLS
- FACADE

SMOOTH CONSTRUCTION
### Overall Budget and Target

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
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<tbody>
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<td>Construction Grant from Donor</td>
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<tr>
<td>Grant Year</td>
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<td>Construction Year</td>
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<tr>
<td>Expected Inflation</td>
<td>3.00%</td>
</tr>
<tr>
<td>Return on Investment</td>
<td>2.00%</td>
</tr>
<tr>
<td><strong>BUDGET</strong></td>
<td><strong>$9,414,801</strong></td>
</tr>
<tr>
<td><strong>TARGET</strong></td>
<td><strong>$8,500,000</strong></td>
</tr>
</tbody>
</table>
## Cluster Targets (%)

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Based on RS Means SF Estimate</th>
<th>Based on Previous Projects (1)</th>
<th>Based on Previous Projects (2)</th>
<th>TARGETS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Substructure</td>
<td>10%</td>
<td>6%</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>B Shell</td>
<td>30%</td>
<td>27%</td>
<td>35%</td>
<td>30%</td>
</tr>
<tr>
<td>C Interiors</td>
<td>12%</td>
<td>12%</td>
<td>14%</td>
<td>18%</td>
</tr>
<tr>
<td>D Services</td>
<td>35%</td>
<td>24%</td>
<td>28%</td>
<td>27%</td>
</tr>
<tr>
<td>E Equipment and Furnishings</td>
<td>5%</td>
<td>9%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>F Specialty Construction</td>
<td>5%</td>
<td>3%</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>G Building Sitework</td>
<td>1%</td>
<td>5%</td>
<td>6%</td>
<td>5%</td>
</tr>
<tr>
<td>H General Conditions</td>
<td>2%</td>
<td>14%</td>
<td>9%</td>
<td>10%</td>
</tr>
</tbody>
</table>

| SUM              | 100%                          | 100%                           | 102%                           | 100%    |

**Higher Interiors costs**
TOTAL COST: $8.52 M
<table>
<thead>
<tr>
<th>Task</th>
<th>Duration</th>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation</td>
<td>5 days</td>
<td>Fri 8/30/24</td>
<td>Thu 9/5/24</td>
</tr>
<tr>
<td>Tower crane installed</td>
<td>0 days</td>
<td>Fri 9/6/24</td>
<td>Fri 9/6/24</td>
</tr>
<tr>
<td>Auditorium stair outside</td>
<td>3 days</td>
<td>Fri 9/6/24</td>
<td>Tue 9/10/24</td>
</tr>
<tr>
<td>Foundation</td>
<td>19 days</td>
<td>Wed 9/11/24</td>
<td>Mon 10/7/24</td>
</tr>
<tr>
<td>Superstructure</td>
<td>64 days</td>
<td>Tue 10/8/24</td>
<td>Fri 1/3/25</td>
</tr>
<tr>
<td>Roof</td>
<td>18 days</td>
<td>Tue 12/31/24</td>
<td>Thu 1/23/25</td>
</tr>
<tr>
<td>Exterior closure</td>
<td>30 days</td>
<td>Fri 1/24/25</td>
<td>Thu 3/6/25</td>
</tr>
<tr>
<td>MEP</td>
<td>63 days</td>
<td>Tue 1/28/25</td>
<td>Thu 4/24/25</td>
</tr>
<tr>
<td>Interior</td>
<td>63 days</td>
<td>Thu 1/30/25</td>
<td>Mon 4/28/25</td>
</tr>
</tbody>
</table>
HUMAN INTELLIGENCE ENCLOSED SCHEDULE

COMPLETION 28TH APRIL
ALICE Technologies

3 MILLION ITERATIONS

$3.2 MILLION
210 days

Human Intelligence Schedule in ALICE
Human Schedule Prediction = Superstructure in 104 days

v/s

AI Schedule simulation = Superstructure in 210 days

UNLIMITED?
- **Crane and Carpenter crew - Critical Factors**
- Most optimized duration with 1 crane = 204 days
- Cost = 3.2m $

2 Mobile cranes on site

Night Construction

15% premium to labourers
Mobile Crane

1 Side of road open in night
**Artificial Intelligence**

110 days  
2.98m $

**Human Intelligence**

104 days  
2.7m $

**Insight:**
- 2 mobile cranes
- Crew Utilization
So why do we need CM’s from now?

- Most optimum AI Solution not constructible
- Construction Constraints
- Crew and Equipment Selection

Human + Artificial Intelligence

117 days

3.01m $
ANIMATION
ANIMATION
“Technology as a means and not an end in itself”
CROSS DISCIPLINE INTEGRATION

INFORMATION TAKEOFF

<table>
<thead>
<tr>
<th>Building Element Type</th>
<th>Type</th>
<th>Net Area</th>
<th>Length</th>
<th>Volume</th>
<th>Count</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beams</td>
<td>12'' x 18''</td>
<td></td>
<td>1,504 8 7/8''</td>
<td>50.76 cu yd</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Beams</td>
<td>12x16.5 2</td>
<td></td>
<td>3,103 4''</td>
<td>101.74 cu yd</td>
<td>199</td>
<td></td>
</tr>
<tr>
<td>Beams</td>
<td>4'' x 9''</td>
<td></td>
<td>7,051 6 9/16''</td>
<td>62.93 cu yd</td>
<td>594</td>
<td></td>
</tr>
<tr>
<td>Beams</td>
<td>44x302</td>
<td></td>
<td>895 10 9/16''</td>
<td>4.40 cu yd</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Columns</td>
<td>14'' x 14''</td>
<td></td>
<td>395</td>
<td>18.55 cu yd</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Columns</td>
<td>22.5'' x 22.5''</td>
<td></td>
<td>786 7 9/16''</td>
<td>101.47 cu yd</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>External Walls</td>
<td>5'' x 10''</td>
<td></td>
<td>2,035.91 sq ft</td>
<td>230 8 1/2''</td>
<td>47.47 cu yd</td>
<td>6</td>
</tr>
</tbody>
</table>
1. Site Sensors: To monitor temperature, noise, pollution etc. for workers safety.

2. Drones: Site surveying for safety and Information updates.
## Integration with Past

### 25th Year of AEC Global Teamwork

A stroll down **Memory Lane**

<table>
<thead>
<tr>
<th>Period</th>
<th>Projects</th>
</tr>
</thead>
</table>
| 2011-2012: Biomimicry| • Inspiration - Tree  
                        |   ○ External Shading  
                        |   ○ Enhance Solar PV Use  
                        |   ○ Embody carbon in timber structure |
| 2012-2013: Leapfrog  | • Changing human behavior with Hologram                                  |
| 2013-2014: Building Health | • Visual biophilia with timber                                          |
| 2014-2015: Water     | • Water measurement system                                              |
| 2015-2016: Air Quality | • Diffuse ceiling                                                       |
| 2016-2017: Space Efficiency | • Collaborative spaces                                                |
1. STUDENT OFFICE
2. HOLOGRAM
3. FLEXIBLE ATRIUM/CO-WORKING SPACES
4. VISUAL BIOPHILIA
5. DIFFUSE CEILING
6. PV PANELS
LIFE
CYCLE
FINANCIAL
MANAGEMENT
LCC - INTEGRATION

MARTA ARCH

MOA / ASHWIN CM

TEAM MEP

GARY / JACOB SE

TOBI LCFM

VALUE FOR MONEY

RENT

COST
LIFE CYCLE COSTS

OVERALL COSTS

= $19.4 Million

OPERATION
$ 4.6 MILLION

MAINTENANCE
$ 1.1 MILLION

Construction costs
M&O costs
Replacement costs
Risk
Interest
REPLACEMENT STRATEGY

PROVISIONS over 25 years

SAFE THE QUALITY

REPLACEMENT $1.2 MILLION

CONTROL THE BUDGET

YEAR 1: $45k
YEAR 10: $45k
YEAR 20: $45k
YEAR 25: $45k

...
RISK IDENTIFICATION & STRATEGY

- **RISK COST $2.1 Million**
- **RISK COST $1.5 Million**

![Graph showing risk costs with and without prevention for Construction Delay, Fire, Earthquake, Water consumption, and Vandalism.](image-url)
LCC - TVD - STV Evolution

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peer Review</td>
<td>02/09/2018</td>
</tr>
<tr>
<td>Crit</td>
<td>02/15/2018</td>
</tr>
<tr>
<td>Winter Presentation</td>
<td>03/16/2018</td>
</tr>
<tr>
<td>Fish - Bowl</td>
<td>04/05/2018</td>
</tr>
<tr>
<td>Final Presentation</td>
<td>05/04/2018</td>
</tr>
</tbody>
</table>

- STV
- TVD
- LCC

Graph showing trends over time.
ADDITIONAL RENT CAFÉ

<table>
<thead>
<tr>
<th>Costs per month</th>
<th>$ -4,500.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs p.a.</td>
<td>$ -54,000.00</td>
</tr>
<tr>
<td>costs for employees p.a.</td>
<td>$ -39,216.00</td>
</tr>
<tr>
<td>sales per day</td>
<td>$ 600.00</td>
</tr>
<tr>
<td>sales per month</td>
<td>$ 12,900.00</td>
</tr>
<tr>
<td>sales per year</td>
<td>$ 154,800.00</td>
</tr>
<tr>
<td>Overall income</td>
<td>$ 61,584.00</td>
</tr>
</tbody>
</table>
### Additional Rent Auditorium

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of seats</td>
<td>183</td>
</tr>
<tr>
<td>Number of rented seats</td>
<td>83</td>
</tr>
<tr>
<td>Price per seat</td>
<td>$200.00</td>
</tr>
<tr>
<td>Renting Amount</td>
<td>$14,940.00</td>
</tr>
<tr>
<td>Overall renting amount</td>
<td>$80,676.00</td>
</tr>
<tr>
<td>Costs for Catering</td>
<td>-$3,500.00</td>
</tr>
<tr>
<td>Overall costs for catering</td>
<td>-$21,000.00</td>
</tr>
<tr>
<td>Overall income</td>
<td>$59,676.00</td>
</tr>
</tbody>
</table>
CASH FLOW

BREAK EVEN POINT in 2046

INFLOW
- Rent
- Café
- Auditorium

RENT $910,000 p.a.

OUTFLOW
- Construction costs
- M&O costs
- Replacement
- Risk
- Interest payment
ROOF + PV PANELS

VALUE FOR MONEY

Necessary roof area | 450 m²
Area per PV-Panel | 1.63 m²
Amount of panels | 276
sum of performance | 205,970 kW/h
Costs (PV-panels) | $208,587
TESLA POWERBACK

ACQUISITION COSTS
$75k
<table>
<thead>
<tr>
<th>Purchased Energy</th>
<th>kWh</th>
<th>kWh/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting, facility</td>
<td>8,396,0</td>
<td>3,1</td>
</tr>
<tr>
<td>Electric cooling</td>
<td>69,331,0</td>
<td>25,4</td>
</tr>
<tr>
<td>HVAC aux</td>
<td>19,396,0</td>
<td>7,1</td>
</tr>
<tr>
<td><strong>Total Facility electric</strong></td>
<td><strong>97,123,0</strong></td>
<td><strong>35,6</strong></td>
</tr>
<tr>
<td>Domestic hot water</td>
<td>28,937,0</td>
<td>10,6</td>
</tr>
<tr>
<td><strong>Total, facility fuel</strong></td>
<td><strong>28,937,0</strong></td>
<td><strong>10,6</strong></td>
</tr>
<tr>
<td>District heating</td>
<td>4,000,0</td>
<td>1,5</td>
</tr>
<tr>
<td><strong>Total, Facility district</strong></td>
<td><strong>4,000,0</strong></td>
<td><strong>1,5</strong></td>
</tr>
<tr>
<td><strong>Total overall</strong></td>
<td><strong>130,060,0</strong></td>
<td><strong>47,6</strong></td>
</tr>
<tr>
<td>Equipment tenant</td>
<td>51,594,0</td>
<td>8,9</td>
</tr>
<tr>
<td><strong>Total tenant electric</strong></td>
<td><strong>51,594,0</strong></td>
<td><strong>8,9</strong></td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td><strong>181,654,0</strong></td>
<td><strong>66,5</strong></td>
</tr>
</tbody>
</table>

| Roof Surface | 14,350 SF | 1,333 m² |

| Necessary roof area | 450 m² |
| Area per PV-Panel | 1,63 m² |
| **Amount of panels** | **276** |
| sum of performance | 205,970 kW/h |
| Costs (PV- Panels) | $208,587 |
TEAM CENTRAL

73 / 110 Points
LEED v4 - Schools

LOCATION & TRANSPORT 10/15
SUSTAINABLE SITES 7/12
WATER EFFICIENCY 8/12
ENERGY & ATMOSPHERE 21/31
MATERIALS & RESOURCES 9/13
INDOOR ENVIRONMENTAL QUALITY 14/16
INNOVATION 4/6
Inspiration: “Pro-active prevention is better than cure”

Definition:

“Ability to **detect** and **predict** the possibilities for ‘dropping the ball’”

“Team Engagement”
"Central Team's Hierarchy of Work"
- 6 Atrium Ideas
- 9 Facade Ideas

"We always have great concepts, but nothing to implement"

- Jacob (Struct. Eng., Team Central)

- 5-6 meetings in Spring Break

"Yet 5 out of 6 people felt we were least involved in the spring break"

- "How can you not have columns in a 60 ft timber span atrium?"
  - Fishbowl 2018
DPR - TRANSPARENCY CHALLENGE

ENGAGEMENT PROGRESS

Ball was dropped

“No Pull Planning”

SLACK ANALYTICS

Ball was dropped
DPR - TRANSPARENCY CHALLENGE

ENGAGEMENT PROGRESS

SUB-GROUP MEETINGS

MEETING INVOLVEMENT

Pro-active Prevention
What are our **BENEFITS?**

- **TRUST**
- **TRANSPARENCY**
- **DEDICATION**
- **JOY**

What are we **TAKING** with us?

- **FRIENDSHIP**
- **IMPROVED TEAMWORK**
- **KNOWLEDGE** as our **TREASURE**
## Technology Used

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptual Design</td>
<td>Sketch Up</td>
<td>Sketch Up</td>
<td>Sketch Up</td>
<td>Revit</td>
<td>Revit</td>
<td>Revit + Dynamo + Project Fractal</td>
</tr>
<tr>
<td>Detailed Model</td>
<td>Revit</td>
<td>Revit</td>
<td>Revit</td>
<td>Revit</td>
<td>Revit</td>
<td>Revit</td>
</tr>
<tr>
<td>Model Sharing</td>
<td>Central model everyone worked on</td>
<td>Discipline models linked by CM or Dropbox model server</td>
<td>Discipline models linked by CM or Dropbox model server</td>
<td>Dropbox with shared file path</td>
<td>A360-cloud shared central model</td>
<td>A360-cloud shared central model</td>
</tr>
<tr>
<td>Linking – Edit</td>
<td>Revit</td>
<td>Revit</td>
<td>Revit</td>
<td>Revit with local copy of central model</td>
<td>Revit with local copy of central model</td>
<td>Revit with local copy of central model</td>
</tr>
<tr>
<td>Integrating – Alternative exploration</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>BIM360 Glue</td>
<td>BIM360 Glue</td>
<td>BIM360 Glue Virtual Reality (HTC Vive)</td>
</tr>
<tr>
<td>Clash Detection</td>
<td>40 CAD/Navisworks (after 2006)</td>
<td>Navisworks</td>
<td>Navisworks</td>
<td>BIM360 Glue</td>
<td>BIM360 Glue</td>
<td>BIM360 Glue</td>
</tr>
<tr>
<td>Control</td>
<td>Individual discipline member</td>
<td>Individual discipline member</td>
<td>Individual discipline member</td>
<td>All team member</td>
<td>All team members</td>
<td>All team members</td>
</tr>
<tr>
<td>Integration Management</td>
<td>CM</td>
<td>CM</td>
<td>CM</td>
<td>Team/BIM Manager</td>
<td>Team/BIM Manager</td>
<td>Team/BIM Manager</td>
</tr>
</tbody>
</table>

Curtesy of : Fruchter, Katz, and Grey, 2016 – “Transforming the BIM Mindset”
TERF - MEETINGS

CONVENTENCE ROOM

WALKING IN THE MODEL IN TERF

3D - MODEL
THANK YOU SUPER OWNER RENATE, IT WAS AN AWESOME JOURNEY!

THANK YOU OWNERS FOR YOUR PRECIOUS TIME AND HELP!

THANK YOU ALL MENTORS FOR TEACHING, MENTORING AND HELPING US THROUGH THE JOURNEY!

SEE YOU SOON AEC-GLOBAL TEAMWORK FAMILY!!
THANK YOU!
Things end. But memories last forever.
LESSONS LEARNED

ASHWIN
USA
INDIA
CM

“"It's your responsibility if the team isn't performing well. No one else is to be blamed as you didn't interfere to stop the downfall.”

MOA
SWEDEN
CM

“Developing ideas and solving problems from different perspectives often results in innovative ideas and more interesting solutions.”

GARY
USA
CHINA
SE

“Talk, discuss, and argue with your teammates! The idea agreed by 6 people is usually more comprehensive than the one from your own.”
LESSONS LEARNED

MARTA
POLAND
A

“Design coordination does not exist when working in disciplinary silos. Breaking the silos and working together on ideas gives better solutions”

TOBIAS
GERMANY
LCFM

“Don’t stay in your comfort zone, but interact with everyone from the first second on.”

JACOB
DENMARK
SE

“Be open for other opinions and engage in a dialog to find the best solution. Answering “hmm”, “yes” or “okay, does not challenge the opinion”