Greetings from
TEAM CENTRAL
CALIFORNIA
Project Members

Team

THOMAS [SE]
UNIVERSITY OF WISCONSIN-MADISON USA

MO’EMEN [SE]
BAUHAUS-UNIVERSITY WEIMAR GERMANY

WENIE [CM]
STANFORD UNIVERSITY USA

ANDERS [MEP]
TECHNICAL UNIVERSITY OF DENMARK

KILIAN [ARCH]
BAUHAUS-UNIVERSITY WEIMAR GERMANY

MADELEINE [CM]
KTH ROYAL INSTITUTE OF TECHNOLOGY SWEDEN
Behind The Scenes
Team Process
Working Towards A Shared Goal

Concept Development - The Journey

Two Concepts

January

Focus & Struggles

Early February

New Concept

Mid-February

High Identification

Winter
Concept Development - The Outcome

The Concepts: A Team Product

“I identify with the **First** Concept & Implementation.”

“I identify with the **Second** Concept & Implementation.”

- **50%** Agree
- **50%** Strongly Agree

- **83%** Agree
- **17%** Strongly Agree
From Silos to Teamwork

The Working Process

We are strong in …

… Creating (100%)  
“Do things first, have breakthrough ideas”

We are less successful in …

… Controlling (50.0 %)  
… Collaborating (33.3 %)  
… Competing (16.7 %)
From Silos to Teamwork

The Challenges

- Turning **Concepts into Results**
- **Communication** with Team Mates
- Handling the **Amount of Data**
- I struggled the most with ... **Data Requests of Team Members**
- **Time Management**
- **Transparency** & Quick Information Exchange on Design Changes
From Silos to Teamwork

The Future Steps

**Owner**
- Communication
- Inclusiveness of Disciplines
- Team Dynamics
- Use of MeetinVR

"In Spring I Want to Improve ..."

**Work Speed and Transparency**
- More Efficient Team Meetings

**Work Structure**
- More Frequent Sub-Meetings

**Deadline Management**
- Time Spent on Class

---

8
Team Process

Learning and Fun along the Way

Adjusting Own Thinking
Respecting Different Temperaments
Explaining Key Discipline Points in Understandable Ways
Understanding Information Needs
Using Virtual Collaboration Software

I enjoyed the most ...

Doing VR Walkthroughs
Exploring Ideas with the Team
Self-Learning New Skills
Making Joint Design Decisions

I learned the most about ...

I enjoyed the most ...

Doing VR Walkthroughs
Exploring Ideas with the Team
Self-Learning New Skills
Making Joint Design Decisions

I learned the most about ...
Team Process

Learning and Fun along the Way

“You guys are a great pleasure to work with, I feel like I learn something new from you everyday!”

“I will miss the Turtle GIFs in our chats!”

“It is really exciting to see how every concept becomes real in all disciplines!”

“You guys rule and I love working with you all!”

“Proud of our work”
Tools Supporting Interaction

Technology for Teamwork

Coordination
- BIM 360 Glue
- Revit/Dynamo
- Asana

Communication
- Zoom
- Facebook

Prospect
- MeetinVR

Collaboration
- Slack
- Google Drive
The Benefits of VR

Tools Supporting Interaction

1-2 per Day
Design Evaluation User Experience

 MEP

1-2 per Week
User Experience Shading Evaluation Critical Height Clash Detection

MEP

3-4 per Week
User Experience Critical Height Clash Detection

SE

1-2 per Week
User Experience

 CM

Bi-Weekly
User Experience

 Owner
The Script

Project Overview
A New Faculty Building for UCLA
Project Overview

Project Goals

Prefabication
Interoperability
Resilience
Owner Expectations
The Set

Project Location and Site
Los Angeles, California

Macro Location

"Mediterranean climate" (Dry subtropical climate)

Year-round mild/hot
Mostly dry
Los Angeles, California

Temperature & Precipitation

3,254 hours sunshine
Los Angeles, California

Wind and Natural Hazards

**Wind Direction**

**Natural Hazards**

Earthquake Risk Category 3
Assuming >500 total occupants

Wind Speed, Snow Loads not limiting factors in design
Wildfire Risk
Westwood, L.A.

Micro Location
Westwood, L.A.

Traffic and Soil Conditions

TRAFFIC

SOIL AND WATER TABLE

dense sandy soil 5000 psf, deep water table 15ft
UCLA Campus

Central Site Location
Site View - South West

Entrance to UCLA Campus
Neighbourhood View - North West

Traffic and Concrete Views
# SWOT Analysis

## Project Implications

<table>
<thead>
<tr>
<th>Internal</th>
<th>STRENGTHS - Exploit</th>
<th>WEAKNESSES - Minimize</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exposure to public - <strong>A</strong></td>
<td>Building height limit (permit) - <strong>A</strong></td>
</tr>
<tr>
<td></td>
<td>Proximity to highway - <strong>CM</strong></td>
<td>Low site attractivity - <strong>A</strong></td>
</tr>
<tr>
<td></td>
<td>Central location - <strong>CM</strong></td>
<td>Concrete-dominated architecture - <strong>A</strong></td>
</tr>
<tr>
<td></td>
<td>Dense soil, deep water table - <strong>SE</strong></td>
<td>Limited construction hours due to neighboring site uses (hospital, university, residential area) - <strong>CM</strong></td>
</tr>
<tr>
<td></td>
<td>Good daylight - <strong>MEP</strong></td>
<td>Lot of sunlight - <strong>MEP</strong></td>
</tr>
<tr>
<td></td>
<td>High heat gain - <strong>MEP</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External</th>
<th>OPPORTUNITIES - Anticipate</th>
<th>THREATS - Mitigate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chance to stand out with design - <strong>A</strong></td>
<td>Noise &amp; air pollution - <strong>MEP</strong></td>
</tr>
<tr>
<td></td>
<td>Good accessibility - <strong>CM</strong></td>
<td>Lack of water resources - <strong>MEP</strong></td>
</tr>
<tr>
<td></td>
<td>Skilled workforce, big labour pool - <strong>CM</strong></td>
<td>Natural hazards - <strong>SE, CM</strong></td>
</tr>
<tr>
<td></td>
<td>Regulations favor ZNE building - <strong>MEP</strong></td>
<td>Intense traffic and events affecting schedule - <strong>CM</strong></td>
</tr>
<tr>
<td></td>
<td>Demand for well-being focus - <strong>MEP</strong></td>
<td>Material costs - <strong>CM</strong></td>
</tr>
</tbody>
</table>

**A** = Advantage, **CM** = Concern, **SE** = Strength, **MEP** = Moderate External Pressure
The Palm Tree

The Storyline - Part 1
Concept Background

Big Idea - The Palm Tree

FEELING OF L.A.
DIVERSITY
RESILIENCE

Boardwalks Venice Beach

Habitat for Different Species
How can our building be a local center for its global occupants and visitors?
## Architecture Implications

### SWOT

<table>
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<th>Internal</th>
<th>Strengths - Exploit</th>
<th>Weaknesses - Minimize</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure to Public</td>
<td><strong>A</strong></td>
<td>Low Site Attractivity - <strong>A</strong></td>
</tr>
<tr>
<td>High Footfall</td>
<td><strong>A</strong></td>
<td>Concrete-dominated Architecture - <strong>A</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External</th>
<th>Opportunities - Anticipate</th>
<th>Threats - Mitigate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chance for Unique Design</td>
<td><strong>A</strong></td>
<td>Lack of Connectivity to University - <strong>A</strong></td>
</tr>
</tbody>
</table>
Shielding and Opening
Concept Development

Shielding and Opening
Excavation to frame Plaza
Instigating Boulevards
Extruding Cantilevers
Introversion - South Facade
Extroversion - North Plaza
The Palm
Section View
Ground Floor - Entrance Boulevard
First Floor - Intersection of Boulevards
Second Floor - Boulevard Looking South
A Natural Facade

Concept Illustration

Accoya Wood Cladding

Wooden Louver - Shading System

Prefabricated Rammed Earth Panels
Structural Engineering
## Site Characteristics

<table>
<thead>
<tr>
<th>Internal</th>
<th>Strengths - Exploit</th>
<th>Weaknesses - Minimize</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dense Soil</td>
<td>SE</td>
<td></td>
</tr>
<tr>
<td>Deep Water Table</td>
<td>SE</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External</th>
<th>Opportunities - Anticipate</th>
<th>Threats - Mitigate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seismic Activity</td>
<td>SE</td>
<td></td>
</tr>
</tbody>
</table>
Engineering Implications

Seismic Parameters

Address: Los Angeles, CA, USA
Coordinates: 34.0522342, -118.2436849
Elevation: 285 ft
Hazard Type: Seismic
Reference Document: ASCE7-16
Risk Category: III
Site Class: C

SDC D  Seismic design category
F_a 1.2  Site amplification factor at 0.2s
F_v 1.4  Site amplification factor at 1.0s
Typical Loads - Gravity

Live Load Distribution

- **125 psf**: MEP Room, Storage Rooms, Kitchen
- **100 psf**: Stairs, Lobbys, GF Corridors
- **80 psf**: Corridors above Ground Floor
- **60 psf**: Auditoriums, Large Classrooms
- **50 psf**: Offices, Small Classrooms
Lateral Load Distribution

Typical Loads - Lateral

532 KIP

486 KIP

260 KIP

56 KIP

Base shear = 1333 KIP
Visualization

Structural System 1

Gravity System
BONE Steel Frame with Composite Deck

Lateral System
Yielding Brace System (YBS)
we shall provide floor system type
something like the attached photo
central 2020, 3/11/2020
Visualization

Architecture Coordination
Cast Connex Scorpion Yielding Connectors

- Flexural yielding of highly ductile fingers
- Frame remains elastic
- Easily replaceable
- Post-yield stiffness prevents soft story
YBS Configuration

HSS 8x8x1/2 Concentric Braces with Scorpion Yielding Connectors

3rd Floor
Structural System 1

Gravity Load Path

- Compression
- Beam Transfer

Levels:
-5 ft
-10 ft
+7 ft
+18 ft
+30 ft
Structural System 1

Lateral Load Path

Red: Compression  
Blue: Tension  

Uplift
System 1 - Floor 2

- W18x86 Column
- W14x132 Beam
- W14x68 Beam
- W14x48 Beam
- W14x34 Beam
- 3” LW Concrete on 2” Composite deck
same as timber
central 2020, 3/11/2020
System 1 - Floor 1

- **W 18x130 Column**
- **W 14x132 Beam**
- **W 14x68 Beam**
- **W 14x48 Beam**
- **3” LW Concrete on 2” Composite deck**
5' x 6' Isolated Footing
7' x 18" Strip Footing
12" Concrete Retaining Wall
6" Slab on grade
12" x 18" Grade beams

Auditorium excavated 10 ft below ground level, waterproofing for retaining wall

Drain Mat
Asphalt Based Foundation Sealer
Crushed Rock
Edge Drain
Filter Sock
Drain Tile
Structural System 1

Connection Details

- BONE Structure typical connections
- Laser cut in shop
- Prefabrication opportunity
- No onsite welding

![Connection Details Image]
Structural System 1

Connection Details

- Scorpion Connector Typical Connections
- HSS 10x10x1/2 Braces

Bolted connection to gusset plate
Visualization

Structural System 2

Gravity System
Glulam frame with CLT deck

Lateral System
CLT Shear W all Cores
Visualization

Coordination State

SE vs Arch: Minor Clashes

SE vs MEP: Minor clashes
Core Configuration

12” CLT Shear Wall

1st Floor

2nd Floor

3rd Floor
Structural System 2

Gravity Load Path

- Compression
- Beam Transfer

-5 ft
-10 ft

+30 ft
+18 ft
+7 ft
Structural System 2

Lateral Load Path

- Compression
- Tension

Uplift

Bending deformation
Shear deformation
Translation deformation
Rotation deformation
System 2 - Floor 2

- Glulam 10.75”x15” Column
- Glulam 10.75”x13” Beam
- Glulam 12”x28” Beam
- Glulam 12”x32” Beam
- 12” CLT Shear Wall
- 12” CLT Deck
6'x6'x18" Isolated Footing
7'x18" Strip Footing
12" CLT Shear Wall
6" Slab on grade
12"x18" Grade beams

Auditorium excavated 10 ft below ground level, waterproofing for retaining wall
Structural System 2

Timber Connections

- Glulam Columns
- CLT Panels
- Self Tapping Screws
- Glulam Beams
Structural System 2

CLT Shear Wall Connections

Hold-Down

Anchor Bolt

Steel Bracket

CLT Floor panel with CLT wall

Steel bracket

STS
# Structural Solutions

## Overview

<table>
<thead>
<tr>
<th>Option 1: Steel</th>
<th>Option 2: Timber</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key Characteristics</strong></td>
<td>Replaceable maintain post-yield stiffness</td>
</tr>
<tr>
<td><strong>Resilience</strong></td>
<td>Replaceable yielding connectors → prevent building closure</td>
</tr>
<tr>
<td><strong>Prefab Options</strong></td>
<td>Yielding finger connectors</td>
</tr>
<tr>
<td><strong>Impact on Costs</strong></td>
<td>Reduced costs after seismic events</td>
</tr>
<tr>
<td><strong>Impact on Schedule</strong></td>
<td>Shorter construction time (ca. 5 weeks)</td>
</tr>
</tbody>
</table>
## Site Characteristics

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<tr>
<th>Internal</th>
<th>Strengths - Exploit</th>
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<tr>
<td></td>
<td>Plenty of Daylight - <strong>MEP</strong></td>
<td>Lot of Sunlight - <strong>MEP</strong></td>
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<td>High Heat Gain - <strong>MEP</strong></td>
<td>Lack of Water Resources - <strong>MEP</strong></td>
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<td>Noise &amp; Air Pollution - <strong>MEP</strong></td>
</tr>
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<td></td>
<td>Well-Being in Focus - <strong>MEP</strong></td>
<td></td>
</tr>
</tbody>
</table>
Central Energy Production

Primary System 1

UCLA cogeneration plant

- Heating
- Cooling
- Electricity
- Heat Exchanger
- Inlet
- Exhaust
- AHU
- MEP room
Indoor Climate Zones

Ground floor:
- Zone 1: Continuous use - Offices & lounges
- Zone 3: Temporal use, heavy load - Auditorium

1st floor:
- Zone 2: Variable use - Café, study areas, labs and classrooms

2nd floor:
- Zone 4: Exhaust air zones - Kitchens, cleaning storage and toilets
Floor Sandwich A

Dedicated Outdoor Air System -
Slim ductwork only for air ventilation
Cooling/heating radiant pipes in ceiling plates.
High ceiling
System 2

Floor Sandwich B

Multiple Zone - VAV with flexibility for Natural ventilation

Intelligent room sensors provide air where people are.

Lower ceiling height.
System Integration
Second Floor
Green Infrastructure for Water Resilience

Rainwater Harvesting

Water from roof is guided by pipes to underground water storage.

Permeable climate tiles collect water into storage.
Water consumption

<50% water saving from Hydroloop

Water consumption: 20k gal/month

40K water storage provide water from rainfall for 7 out of 12 months

Making building water independent the red box needs to be mitigated. Lowering consumption, increasing supply or both.
Occupant Well-Being

WELL Certification

Initial Estimate: WELL Gold
Project Goal: WELL Platinum

More Exploration and System Integration in Spring Quarter
### Overview

**HVAC Solution for Palm**

<table>
<thead>
<tr>
<th>Key Characteristics</th>
<th>Radiant Ceiling</th>
<th>Conditioned/Natural Ventilation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterborne w. DOAS</td>
<td>Low energy consumption</td>
<td>Multi-zone VAV system w. Option for Natural ventilation</td>
</tr>
<tr>
<td>Need low humidity</td>
<td>High Initial cost, lower in use</td>
<td>More flexibility for users</td>
</tr>
<tr>
<td>Resilience</td>
<td>High energy efficiency, good thermal environment. Needs dry climate</td>
<td>Lower initial cost, higher in use</td>
</tr>
<tr>
<td>Impact on Costs</td>
<td>Easy to turn of when not needed.</td>
<td>Decent energy efficiency</td>
</tr>
<tr>
<td>Sustainability</td>
<td>Best energy consumption</td>
<td>Best for flexibility and direct air</td>
</tr>
<tr>
<td>Building Performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommendation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Site Characteristics

## Construction Implications

<table>
<thead>
<tr>
<th>Internal</th>
<th>Strengths - Exploit</th>
<th>Weaknesses - Minimize</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highway Proximity - <strong>CM</strong></td>
<td>Limited Construction Hours - <strong>CM</strong></td>
</tr>
<tr>
<td></td>
<td>Central Location - <strong>CM</strong></td>
<td>Surrounding Buildings - <strong>CM</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small Site - <strong>CM</strong></td>
</tr>
<tr>
<td>External</td>
<td>Opportunities - Anticipate</td>
<td>Threats - Mitigate</td>
</tr>
<tr>
<td></td>
<td>Good Accessibility - <strong>CM</strong></td>
<td>Natural Hazards - <strong>CM</strong></td>
</tr>
<tr>
<td></td>
<td>Skilled Workforce - <strong>CM</strong></td>
<td>Intense Traffic - <strong>CM</strong></td>
</tr>
<tr>
<td></td>
<td>Big Labour Pool - <strong>CM</strong></td>
<td>Material Costs - <strong>CM</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Illegal Workers - <strong>CM</strong></td>
</tr>
</tbody>
</table>
Site Characteristics

Construction Implications

West View of Site

South View of Site
Construction Implications

Site Characteristics

Site Access from South

East View of Site
Risk Management

Construction Implications

Identify Hazards & Consequences
Classify Risk Types & Impacts
Rank Impact & Probability
Prevent Strategy & Monitoring

Risk Matrix
Construction Implications

Health and Safety

Risk Matrix
Construction Implications

Health and Safety

Risk Matrix

Prefabrication
Junior/ Senior Staffing
Site Logistics
Construction Implications

Site Protection

Tree Inspection & Protection Strategy

Noise Blocking Walls
Prefabrication and Procurement

Construction Methods

- Precast RE Panels
- Prefab Steel System
Prefabrication and Procurement

Construction Methods

Underground Water Tank
Hydro Loop Water Recycling
Air Handling Unit on Roof
# Palm Tree - Steel

## Project Schedule

| Project Duration (Weeks) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
|--------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Calendary Week            | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
| Month                     | October | November | December | January | February | March | April | May | June |
| Earliest Start of Construction  |          |          |          |          |          |          |          |          |          |
| Site Preparation          |          |          |          |          |          |          |          |          |          |
| Excavation                |          |          |          |          |          |          |          |          |          |
| Water Tank Installation   |          |          |          |          |          |          |          |          |          |
| Substructure              |          |          |          |          |          |          |          |          |          |
| Superstructure            |          |          |          |          |          |          |          |          |          |
| Christmas/NYE Week        |          |          |          |          |          |          |          |          |          |
| MEP                       |          |          |          |          |          |          |          |          |          |
| Exterior Envelope Installation |      |          |          |          |          |          |          |          |          |
| Interior Construction & Finishing |  |          |          |          |          |          |          |          |          |
| Landscaping               |          |          |          |          |          |          |          |          |          |
| Computer Installations    |          |          |          |          |          |          |          |          |          |
| Contingency               |          |          |          |          |          |          |          |          |          |
| Close out                 |          |          |          |          |          |          |          |          |          |
| Faster Superstructure Construction |  |          |          |          |          |          |          |          |          |

**Santa Ana Winds: Wildfire Risk**

37 weeks
184 days
Palm Tree - Timber

Project Schedule

Longer Superstructure Construction

Santa Ana Winds: Wildfire Risk

39 weeks
193 days
Construction Phase

Site Plan & Access
Site Logistics

Fuzor VDC VR Animation
# Construction Equipment

## Crane Selection

<table>
<thead>
<tr>
<th>Components</th>
<th>Crane Solution</th>
<th>Key Features</th>
<th>Building Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structural Elements</strong></td>
<td>Mobile Crane LTM 1040 2.1</td>
<td>Max. capacity: 45 USt&lt;br&gt;Boom length: 115 ft&lt;br&gt;Max. radius: 125 ft&lt;br&gt;Max. hoist height: 144 ft</td>
<td>2 Air Handling Unit on the roof&lt;br&gt;Weight: 1.1 USt&lt;br&gt;Radius: 115 feet</td>
</tr>
<tr>
<td><strong>Exterior Elements</strong></td>
<td>Spider Crane UNIC URW -376</td>
<td>Max. capacity: 14.9 USt&lt;br&gt;Boom length: 50 ft&lt;br&gt;Max. tip height: 50 ft</td>
<td>Exterior Facade Panels</td>
</tr>
</tbody>
</table>
Construction Equipment

Crane for Structural Elements

LTM 2 Axle 1040
Option for Remote Control
Construction Equipment

Crane for Exterior Elements

URW 376
Option for Remote Control
Emission Free Option for Indoor Works
Construction Equipment

Excavator

Mitigate Noise Impacts on Hospital

**VOLVO ECR25 ELECTRIC**

- **Runtime**: Up to 8 hours
- **Off-board fast charging**: 80% recharge in 1 hour
- **On-board 230 VAC charger**: 6 hour recharge

**MAIN SPECIFICATIONS**

- **Weight**: 2.5 t
- **Breakout force**: 20.2 kN
- **Max. digging depth**: 2.76 m
- **Max. dump height**: 3.07 m

**VOLVO L25 ELECTRIC**

- **Runtime**: Up to 8 hours
- **Off-board fast charging**: 80% recharge in 2 hours
- **On-board 230 VAC charger**: 12 hour recharge

**MAIN SPECIFICATIONS**

- **Weight**: 4.9 t
- **Tipping load**: 3.35 t full-turn tipping load
- **Bucket size**: 0.9 m³ standard bucket
- **Fork**: 2 t payload fork
- **Breakout force**: 49 kN
- **Dump height**: 2.5 m
Construction Cost

Target Value Distribution

Overall Budget and Target

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Construction Grant from Donor</td>
<td>$12,000,000</td>
</tr>
<tr>
<td>Grant Date</td>
<td>1/31/2020</td>
</tr>
<tr>
<td>Construction Start</td>
<td>10/1/2024</td>
</tr>
<tr>
<td>Expected Inflation (p.a.)</td>
<td>2.25%</td>
</tr>
<tr>
<td>Return on Investment</td>
<td>3.00%</td>
</tr>
<tr>
<td>BUDGET</td>
<td>$12,426,238</td>
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<tr>
<td>TARGET</td>
<td>$12,000,000</td>
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</tbody>
</table>

TARGETS DISTRIBUTION

- Substructure: 26%
- Shell: 17%
- Interiors: 17%
- Services: 10%
- Equipment and Furnishings: 8%
- Specialty Construction: 6%
- Building Sitework: 6%
- General Conditions: 5%
- Others: 4%
### Inclusion of Owner Preferences

#### Construction Cost

<table>
<thead>
<tr>
<th>OWNER'S VALUES</th>
<th>Description</th>
<th>Owner's Value (Owner 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Substructure</td>
<td>Avoidance of Partial Closure after Earthquake</td>
<td>10</td>
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<tr>
<td></td>
<td>Avoidance of Complete Closure after Earthquake</td>
<td>6</td>
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<tr>
<td></td>
<td>Iconic Building</td>
<td>10</td>
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<tr>
<td></td>
<td>Sustainability of Structure</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Open Space Floor Design</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Flexibility of Room Sizes</td>
<td>8</td>
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<tr>
<td></td>
<td>Reduction of Building Footprint</td>
<td>4</td>
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<tr>
<td></td>
<td>Roof - Use for Occupants, e.g. Roof Terrace</td>
<td>7</td>
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<tr>
<td></td>
<td>Roof - Use for Energy/Water Generation</td>
<td>7</td>
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<tr>
<td></td>
<td>Hidden (Integrated) Shading</td>
<td>10</td>
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<tr>
<td>B Shell</td>
<td>Quality of Finishes (Durability)</td>
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<td></td>
<td>Sustainability of Finishes</td>
<td>8</td>
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<td></td>
<td>Elegance of Finishes</td>
<td>7</td>
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<tr>
<td></td>
<td>Energy Efficiency</td>
<td>8</td>
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<tr>
<td></td>
<td>Indoor Air Quality</td>
<td>8</td>
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<tr>
<td></td>
<td>Acoustic Insulation</td>
<td>8</td>
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<tr>
<td></td>
<td>Water Self-Supply</td>
<td>7</td>
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<tr>
<td></td>
<td>User Controllability of Lighting (Artificial)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>User Controllability of Lighting (Natural)</td>
<td>7</td>
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</tbody>
</table>

| D Services     | User Controllability of Lighting (Natural)  | 7                       |
|                | User Controllability of Room Temperature   | 6                       |
|                | Building Certifications (LEED, WELL)       | 7                       |
|                | Communication Connectivity to Other Facilities/Universities/Online-Conferences | 7                       |
|                | Electrical Services (Power Outlets, ...)    | 7                       |
| E Equipment and Furnishing | Flexibility of Auditorium | 5                       |
|                | Flexibility of Class Rooms                 | 8                       |
|                | Flexibility of Office Spaces               | 8                       |
|                | Areas for Informal Interaction and Meetings | 7                       |
|                | Areas for Public Events/Interaction (e.g. Cafe) | 7                       |
|                | Moveability of Furniture in Open Spaces    | 7                       |
| F Specialty Construction | Integration of App/User Interface for Building Performance and Operations (e.g. consumption visualization, room booking) | 10                      |
|                | Art Elements                               | 8                       |
|                | Automated Building (e.g. Robotics)         | 10                      |
|                | Water Storage                              | 8                       |
|                | Reuse of Materials                          | 8                       |
| G Building Site | Avoidance of Construction Waste            | 9                       |
|                | Avoidance of Construction Noise             | 9                       |
|                | Preserving of Trees on site                | 9                       |
|                | Short Construction Phase on site           | 9                       |
|                | Provision of Outdoor Spaces                | 9                       |
|                | Bike Rental and Storage on Site            | 7                       |
| H General Conditions | Risk Buffer | 7                       |
## Construction Cost

### Budget Allocation

<table>
<thead>
<tr>
<th>Cluster Targets (%)</th>
<th>Based on RS Means SF Estimate</th>
<th>Based on Previous Projects (1)</th>
<th>Based on Previous Projects (2)</th>
<th>Based on Previous Projects (3)</th>
<th>Based on Previous Projects (4)</th>
<th>Average of Previous 4</th>
<th>Based on Owner's Input</th>
<th>TARGETS</th>
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<tr>
<td>A Substructure</td>
<td>6%</td>
<td>10%</td>
<td>5%</td>
<td>4%</td>
<td>2%</td>
<td>5%</td>
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<tr>
<td>B Shell</td>
<td>28%</td>
<td>26%</td>
<td>23%</td>
<td>38%</td>
<td>27%</td>
<td>28%</td>
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<tr>
<td>C Interiors</td>
<td>20%</td>
<td>12%</td>
<td>21%</td>
<td>14%</td>
<td>19%</td>
<td>17%</td>
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<td>D Services</td>
<td>30%</td>
<td>29%</td>
<td>24%</td>
<td>21%</td>
<td>31%</td>
<td>27%</td>
<td>25%</td>
<td>26%</td>
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<tr>
<td>E Equipment and Furnishings</td>
<td>4%</td>
<td>6%</td>
<td>3%</td>
<td>1%</td>
<td>3%</td>
<td>3%</td>
<td>4%</td>
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<tr>
<td>F Specialty Construction</td>
<td>4%</td>
<td>7%</td>
<td>8%</td>
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<td>5%</td>
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<td>5%</td>
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<tr>
<td>G Building Sitework</td>
<td>3%</td>
<td>5%</td>
<td>5%</td>
<td>11%</td>
<td>5%</td>
<td>6%</td>
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<td>8%</td>
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<tr>
<td>H General Conditions</td>
<td>5%</td>
<td>5%</td>
<td>11%</td>
<td>9%</td>
<td>9%</td>
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<td><strong>SUM</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
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<table>
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<tr>
<th>Cluster Targets ($)</th>
<th>Based on RS Means SF Estimate</th>
<th>Based on Previous Projects (1)</th>
<th>Based on Previous Projects (2)</th>
<th>Based on Previous Projects (3)</th>
<th>Based on Previous Projects (4)</th>
<th>Average of Previous 4</th>
<th>Based on Owner's Input</th>
<th>TARGETS</th>
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<tbody>
<tr>
<td>A Substructure</td>
<td>$720,000</td>
<td>$1,200,000</td>
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<td>$480,000</td>
<td>$240,000</td>
<td>$648,000</td>
<td>$746,730</td>
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<td>$3,960,000</td>
<td>$3,120,000</td>
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<td>$1,680,000</td>
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<td>$3,056,939</td>
<td>$3,149,419</td>
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<td>E Equipment and Furnishings</td>
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<td>$720,000</td>
<td>$360,000</td>
<td>$120,000</td>
<td>$300,000</td>
<td>$408,000</td>
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<td>$459,353</td>
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<tr>
<td>F Specialty Construction</td>
<td>$480,000</td>
<td>$840,000</td>
<td>$960,000</td>
<td>$240,000</td>
<td>$480,000</td>
<td>$600,000</td>
<td>$685,508</td>
<td>$642,754</td>
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<tr>
<td>G Building Sitework</td>
<td>$360,000</td>
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<td>$600,000</td>
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<td><strong>12,000,000</strong></td>
<td><strong>12,000,000</strong></td>
<td><strong>11,981,320</strong></td>
<td><strong>11,934,650</strong></td>
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</tbody>
</table>
Palm Tree Steel

Cost Estimates

Target Value
$ 12.0M

Estimated Value
$ 11.6M

Square Foot Cost
$ 326/SF
Palm Tree Timber

Cost Estimates

Target Value
$12.0M

Estimated Value
$11.4M

Square Foot Cost
$320/SF
The Cradle
The Storyline - Part 2
The Big Idea

A Cradle for a New Way of Thinking

A Cradle for Innovation

A Cradle-to-Cradle Approach
How can we be a center of innovative resource re-use?
Subtracting Mass

Concept Development

People Flow
Subtracting Mass
Extruding Cantilevers
Framing through Excavation
An Introverted Iconoclast - South Facade
Playing with Masses - Atrium
Playing with Masses

The Atrium

Connectivity

Ventilation via Stack Effect

Show casing Recyclability

Productive Biophilia
The Cradle
Section View

- Faculty Office
- Student Office
- Large Classroom
- Small Classroom
- Auditorium
The Cradle
Section View

- Student Office
- Stair, Shaft, Restroom
The Breakout Spaces - First Floor
A Playful Facade

Schematic System

Structural Frame

THOMA 100 - Pre - Fab Panel

Textile - Anti-Nox Facade
An Early Morning - South Facade
Structural Engineering
Typical Loads - Gravity

Live Load Distribution

- 125 psf: MEP Room, Storage Rooms, Kitchen
- 100 psf: Stairs, Lobbys, 1st Floor Corridors
- 80 psf: Corridors above 1st Floor
- 60 psf: Auditoriums, Large Classrooms
- 50 psf: Offices, Small Classrooms
Can we indicate which rooms have the heaviest loads in the floorplans? Like on this slide, name the room with 125 psf - probably MEP?!

central 2020, 3/11/2020
Typical Lateral Loads

Lateral Load Distribution

874 KIP

795 KIP

440 KIP

105 KIP

Base shear = 2215 KIP
Visualization

Structural System 1

Gravity System
ConXtech Steel Frame with CLT Decks

Lateral System
Special Moment Frame (SMF)
Standardized interlocking connectors
CNC prefabricated
No onsite welding
Cradle to Cradle Certified Silver

Lateral System
ConXtech ConXL

“Lower and Lock” assembly
Structural System 1

Gravity Load Path

- Compression
- Tension
- Beam Transfer
Structural System 1

Lateral Load Path

- Compression
- Tension

Uplift
System 1 - Foundation

- 80"x80"x20" Isolated Footing
- 6" Slab on grade
- 12"x18" Grade beams
Connection Details

Structural System 1

ConXL Connections
Girders to Columns

ConX Gravity Connections
Joists to Girders
Visualization

Structural System 2

Gravity System
Glulam frame with CLT Deck

Lateral System
CLT Rocking Walls
Structural System 2
Rocking Wall Configuration

1st Floor

2nd Floor

3rd Floor

12” CLT Rocking Wall
Rocking Walls with Krawinkler Fuses

- Connections to frame with ductile Krawinkler fuse
- Deformation limited to replaceable fuses
Structural System 2

Gravity Load Path

- Compression
- Tension
- Beam Transfer

+30 ft

+19 ft

+7 ft

-5 ft

-10 ft
Structural System 2

Lateral Load Path

Compression

Tension

Uplift
System 2 - Floor 2

- Glulam 18” x 21” Column
- Glulam 10.75” x 24” Beam
- 12” CLT Deck
- CLT Rocking Walls
80”x80”x20” Isolated Footing
6” Slab on grade
18” Strip footing
12”x18” Grade beams
Structural System 2

Timber Connections

- CLT Panels
- Glulam Columns
- Self Tapping Screws
- Glulam Beams

Platform and balloon types for CLT construction
## Overview

### Structural Solutions

<table>
<thead>
<tr>
<th></th>
<th><strong>ConXtech Special Moment Frame</strong></th>
<th><strong>Glulam Frame with CLT Rocking Walls</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key Characteristics</strong></td>
<td>ConXL bi-axial connections that lower and lock into place</td>
<td>CLT rocking walls connected to frame through replaceable Krawinkler fuses</td>
</tr>
<tr>
<td><strong>Resilience</strong></td>
<td>ConXtech ConXL connections codified by AISC</td>
<td>Plastic activity limited to replaceable fuses, frame remains elastic</td>
</tr>
<tr>
<td><strong>Prefab Options</strong></td>
<td>ConXL connections are prefabricated with CNC</td>
<td>Krawinkler fuses and CLT decks can be prefabricated</td>
</tr>
<tr>
<td><strong>Impact on Schedule &amp; Costs</strong></td>
<td>Reduce construction time</td>
<td>Reduce costs after seismic events by preventing closure</td>
</tr>
</tbody>
</table>
Indoor Climate Zones

Ventilation

Ground floor

1st floor

2nd floor

Zone 1 - Continuous use - Offices & lounges

Zone 2 - Variable use - Café, study areas, labs and classrooms

Zone 3 - Temporal use, heavy load - Auditorium

Zone 4 - Exhaust air zones - Kitchens, cleaning storage and toilets
Energy-plus Building

Solar panels on roof: 240,000 kW h/yr

Calculated energy demand of building: 96,850 kW h/yr

= excess 140,000 kW h

Atrium windows open for natural ventilation

AHU on roof avoid pollution.
Sustainable Target Value

STV Development

1st - 2nd Value
Reduction of water flow in
Expansion of water storage to
40,000 Gal capacity

2nd - 3rd Value
Implementation of Solar panels
reduces grid electricity use

3rd - Future Values
Implementation of water cleaning
facility. Becoming Net Zero
Energy.
**HVAC Solutions**

<table>
<thead>
<tr>
<th>Key Characteristics</th>
<th>Radiant ceiling</th>
<th>Conditioned and natural ventilation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterborne w. DOAS</td>
<td>Tight envelope, low humidity</td>
<td>Multi-zone VAV system w. Option for Natural ventilation</td>
</tr>
<tr>
<td>Resilience</td>
<td>Low energy consumption</td>
<td>More flexibility for users</td>
</tr>
<tr>
<td>Impact on Costs</td>
<td>High Initial cost, lower in use</td>
<td>Lower initial cost, higher in use</td>
</tr>
<tr>
<td>Energy Sustainability &amp; Building Performance</td>
<td>High energy efficiency, good thermal environment. Require tight envelope</td>
<td>Decent energy efficiency Easy to turn off when not needed.</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Best energy consumption</td>
<td>Best for flexibility and direct air</td>
</tr>
</tbody>
</table>
Prefabrication and Procurement

Construction Methods

Wood 100 Walls

ConXTech Structural System
Prefabrication and Procurement

Construction Methods

Modular Pre-Tensioned Textile Facade

Hydro Loop Water Recycling

Air Handling Unit on Roof
Cradle - Steel

Project Schedule

- Faster Superstructure Construction
- Santa Ana Winds: Wildfire Risk

37 weeks
184 days
Cradle - Timber

Project Schedule

40 weeks 198 days
Construction Phase 1

Site Plan & Access
Construction Phase 2

Site Plan & Access
Site Logistics

Fuzor VDC VR Animation
## Crane Selection

<table>
<thead>
<tr>
<th>Components</th>
<th>Crane Solution</th>
<th>Key Features</th>
<th>Building Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural Elements</td>
<td>Mobile Crane LTM 1040 2.1</td>
<td>Max. capacity: 45 USt</td>
<td>Air Handling Units on Roof</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boom length: 115 ft</td>
<td>Weight: 1.1 USt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Max. radius: 125 ft</td>
<td>Radius: 115 feet</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Max. hoist height: 144 ft</td>
<td>Chiller in MEP Room</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Weight: 1.8 USt</td>
</tr>
<tr>
<td>Exterior Elements</td>
<td>Spider Crane UNIC URW - 376</td>
<td>Max. capacity: 14.9 USt</td>
<td>Exterior Facade Panels</td>
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<td></td>
<td></td>
<td>Boom length: 50 ft</td>
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<tr>
<td></td>
<td></td>
<td>Max. tip height: 50 ft</td>
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</table>
Construction Equipment

Crane for Structural Elements

LTM 2 Axle 1040
Option for Remote Control
Construction Equipment

Crane for Exterior Elements

URW 376
Option for Remote Control
Emission Free Option for Indoor Works
Construction Equipment

Excavator

Mitigate Noise Impacts on Hospital
# Construction Cost

## Budget Allocation

### Overall Budget and Target

<table>
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<tr>
<th>Description</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Construction Grant from Donor</td>
<td>$12,000,000</td>
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<tr>
<td>Grant Date</td>
<td>1/31/2020</td>
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<tr>
<td>Construction Start</td>
<td>10/1/2024</td>
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<tr>
<td>Expected Inflation (p.a.)</td>
<td>2.25%</td>
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<tr>
<td>Return on Investment</td>
<td>3.00%</td>
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<tr>
<td>BUDGET</td>
<td>$12,426,238</td>
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<tr>
<td>TARGET</td>
<td>$12,000,000</td>
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</table>

### Targets Distribution

- **Substructure**: 28%
- **Shell**: 17%
- **Interiors**: 17%
- **Services**: 12%
- **Equipment and Furnishings**: 9%
- **Specialty Construction**: 8%
- **Building Site Work**: 6%
- **General Conditions**: 5%
- **Other**: 4%
Cradle Steel

Cost Estimates

Target Value
$ 12.0M

Estimated Value
$ 11.7M

Square Foot Cost
$ 333/SF
Cradle Timber

Cost Estimates

Target Value
$ 12.0M

Estimated Value
$ 11.55M

Square Foot Cost
$ 329/SF
The Final Countdown

Concept Evaluation
<table>
<thead>
<tr>
<th>Concept Overview</th>
<th>Palm Tree</th>
<th>- Concept -</th>
<th>Cradle</th>
</tr>
</thead>
<tbody>
<tr>
<td>37 weeks (Steel)</td>
<td>GFA</td>
<td>35,130 sf</td>
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<tr>
<td>39 weeks (Timber)</td>
<td>Time</td>
<td>37 weeks (Steel)</td>
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<tr>
<td>11.6 Mio. $ (326 $/sf)</td>
<td>Cost</td>
<td>40 weeks (Timber)</td>
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<tr>
<td>11.4 Mio. $ (320 $/sf)</td>
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<td>11.7 Mio. $ (333 $/sf)</td>
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<tr>
<td></td>
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<td>11.55 Mio. $ (328 $/sf)</td>
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</tbody>
</table>
Overview

Turning Goals into Metrics

Project Goals

Overview

Categories

Concept
Architectural Design
Structural Design
Environmental Sustainability
Social Sustainability
Construction

Decision Metrics
Decision Matrix

Project Goal Implementation

<table>
<thead>
<tr>
<th>Project Goals</th>
<th>Palm Tree Steel</th>
<th>Palm Tree Timber</th>
<th>Cradle Steel</th>
<th>Cradle Timber</th>
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<tbody>
<tr>
<td>Interoperability</td>
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<td>Owner Needs</td>
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<td>3.3</td>
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<td>Resilience</td>
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<td>Grand Total</td>
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<td><strong>3.77</strong></td>
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## Decision Matrix

### Category Implementation

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<th>Palm Tree Timber</th>
<th>Cradle Steel</th>
<th>Cradle Timber</th>
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<tr>
<td>Architectural Design</td>
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<td>3.9</td>
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<td>Concept</td>
<td>3.9</td>
<td>4.0</td>
<td>3.9</td>
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<td>Construction</td>
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<td><strong>Grand Total</strong></td>
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<td><strong>3.8</strong></td>
<td><strong>3.6</strong></td>
<td><strong>3.7</strong></td>
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</table>
The Owner Perspective

Concept → Project

Weighted Votings

1 - Cradle Timber (3.96)
2 - Palm Tree Timber (3.87)
3 - Palm Tree Steel (3.81)
4 - Cradle Steel (3.78)

Owner Priorities

1. Idea Implementation (9.5 %)
2. Functional Resilience (9 %)
3. Aesthetics (8.5 %)
4. User Experience (8.1 %)
5. Iconic Building (7.6 %)
6. ...
A Joint Decision

Concept → Project

On Screen
May 8, 2020
Concept → Project

A Joint Decision

On Screen
May 8, 2020
# Project Overview

## Scope and Objectives

<table>
<thead>
<tr>
<th><strong>Project Name</strong></th>
<th>Central Project</th>
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<tbody>
<tr>
<td><strong>Project Location</strong></td>
<td>Westwood, Los Angeles, California, USA</td>
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</table>
| **Project Objectives** | New 3-story classroom and lab facility on UCLA campus  
Start of occupation latest September 30, 2025  
Home for innovative courses (collocated/online), collaborative PBL and research  
Part of a global network of facilities linked through Internet and Satellite Telecommunication |
| **Time Scope**         | 2020 (Start of Concept Development) – 2025 (End of Construction) |
| **Size**               | 30,000 square feet GFA                             |
| **Height**             | 30 feet above ground (floor slab 0.0 to roof slab) |
| **Budget**             | 12,000,000 $ (2020) - adjusted by inflation       |
The Working Process

- **Feedback**: 67% - “The feedback I get for my work is helpful”
- **Response Time**: 67% - “The response time is appropriate”
- **Transparency**: 67% - “The information I get from others is appropriate”

Agreement or Strong Agreement
## The Future Steps

### From Silos to Teamwork

#### Spring Strategy

<table>
<thead>
<tr>
<th></th>
<th>Efficient Enough</th>
<th>Frequent Enough</th>
<th>Spring Strategy</th>
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<tbody>
<tr>
<td><strong>Team Meetings</strong></td>
<td>67 %</td>
<td>100 %</td>
<td>Increase Efficiency</td>
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<tr>
<td><strong>Sub Meetings</strong></td>
<td>100 %</td>
<td>33 %</td>
<td>Increase Frequency</td>
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