TEAM PACIFIC
The team

Joe
MEP

Antonio
CM

Jan
SE

Pernille
MEP

Camilla
A

Chanel
CM

Siddharth
SE
Norms, Protocols, software and tools

Communication

Coordination

Collaboration

Slack

Facebook

Nureva Span

Google Drive

GoToMeeting

TERF

Google Calendar
The climate - Marine climate

Zone 3
- Marine climate

Relative humidity [%]
- High RH in mornings due to fog

Temperatures [°F]
- Moderate climate

Wind [knots]
- Prevailing wind from SW

Precipitation [in]
- Low precipitation

Sun availability
- About 3000 annual hours of sunlight
Surroundings and Flow

LAKE VIEW

PARKING

WIND

STUDENT HOUSING
Distance from closest fault
(San Andreas): 2.5mi = 4km
Seismic data

USGS Design Maps Summary Report

User-Specified Input

Building Code Reference Document: ASCE 7-10 Standard

Site Coordinates: 37.72077°N, 122.47716°W

Site Soil Classification: Site Class D - "Stiff Soil"

Risk Category: IV (e.g., essential facilities)

USGS-Provided Output

\[ S_a = 2.182 \text{ g} \]
\[ S_{MS} = 2.182 \text{ g} \]
\[ S_{DS} = 1.455 \text{ g} \]
\[ S_1 = 1.040 \text{ g} \]
\[ S_{M1} = 1.560 \text{ g} \]
\[ S_{D1} = 1.040 \text{ g} \]
Soil data

- **Soil Condition**
  - Well sorted fine to medium sand
  - Bearing capacity: 3500 psf
  - Not in liquefaction zone
  - Water table: 14 ft below grade
<table>
<thead>
<tr>
<th>Room Function</th>
<th>Total Area (sq.ft.)</th>
<th>Minimum Live Load (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty Lounge</td>
<td>1000</td>
<td>100</td>
</tr>
<tr>
<td>Faculty Offices</td>
<td>3600</td>
<td>50</td>
</tr>
<tr>
<td>Student Offices</td>
<td>1200</td>
<td>50</td>
</tr>
<tr>
<td>Classrooms</td>
<td>3600</td>
<td>40</td>
</tr>
<tr>
<td>Storage Rooms</td>
<td>1000</td>
<td>150</td>
</tr>
</tbody>
</table>
Shape and Program approach

Decreasing the program space to have open collaboration spaces and learning spaces
Orientation

Shading
Equinox, winter solstice, summer solstice

Wind speed (knots)
Radial scale is % if time

Wind frequency (hrs)
## Structural System

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gravity System</strong></td>
<td><strong>Tension Columns</strong> - Fiberglass (Glass FRP)</td>
</tr>
<tr>
<td></td>
<td>[18F17 Flanged Tube]</td>
</tr>
<tr>
<td></td>
<td><strong>Compression Columns</strong> - Timber [18”x18”]</td>
</tr>
<tr>
<td></td>
<td><strong>Cables</strong> - Steel [Nominal Diameter- 1.5”]</td>
</tr>
<tr>
<td><strong>Lateral System</strong></td>
<td><strong>Concrete Shear Wall (Core/Spine)</strong></td>
</tr>
<tr>
<td></td>
<td>Outer Diameter- 13’ Inner Diameter- 10.5’</td>
</tr>
<tr>
<td></td>
<td>Thickness- 15”</td>
</tr>
<tr>
<td></td>
<td><strong>Timber Shear Walls</strong></td>
</tr>
<tr>
<td></td>
<td>Thickness- 8”</td>
</tr>
<tr>
<td><strong>Floor System</strong></td>
<td><strong>Cross-Laminated Timber Slab with Glulam Beams</strong></td>
</tr>
<tr>
<td></td>
<td>Slab Depth- 6”</td>
</tr>
<tr>
<td></td>
<td>Beam Depth- 12”</td>
</tr>
</tbody>
</table>
Structural floor plans

Basement

Level 1

Timber Columns 18”x18”

Timber Shear Wall 8”
Structural floor plans

- **Level 2**
- **Level 3**

- Timber 18”x18”
- Fiberglass 18F17
- Timber Shear Wall 8”
- Cable Connection to Core (Level 4)
- Concentrically Braced Frame L8x8x7/8
Structural system layout

Top View - Cable Layout

3D View

- Timber 18"x18"
- Fiberglass 18F17
- Concrete Core
- Cables

N

- 60 ft
- 40 ft
- 28 ft
- 16 ft
18F17 Flanged Tube

W = 16.75 lb/ft
A = 22.47 in²
Ixx = 1197.3 in⁴
Iyy = 279.7 in⁴
E = 3,967,000 psi
G = 425,000 psi
M = 2,000,000 lb-in
r = 3.53 in
Bf/Bt = 20.8
K = 1

Manufacturer - Enduro Composites
Load Transfer Through Tension

Gravity Load Flow
CLT Slab - 6”
Glue lam beam 8”
Steel plates - depth = 1/2”, width = 4”, every 2 feet
Lateral system

I= 1.5
Sds= 1.455

R= 5  (Ordinary Reinforced Concrete Shear Wall)
Base Shear= 1145kips
Outer Diameter= 13’
Inner Diameter= 10.5’

R= 6.5
Base Shear= 880kips
Thickness= 8”
Soil Bearing Capacity = 3500 psf

Large footing due to high overturning moments

Alternative - Piles (Expensive)
Daylight Conditions

Solar analysis
Cumulative insolation [kWh/m²]

Daylight
Fall Equinox 3PM [lux]
Daylight Control

- Solar film
- Shading trees
- Internal manual shading
- Daylight controlled artificial lighting

West
Administration

Atrium

Lounge, hallway

East

14' - 8"

22' - 10"

3rd floor
Utilizing Wind

Large potential
Prevailing wind direction
Large solar heat gain
Minimum change in internal load
SM = Small classrooms
SE = Seminar rooms
B = Big classrooms

Smaller potential
Large and changing internal loads
Need for mechanical ventilation
SM = Small classrooms
L = Labs.
T = Toilets
SE = Seminar rooms

No or limited need
Shafts, elevators, stairs, etc.

Wind frequency (hrs)
Radial scale is % if time
- 720+
- 576 - 648
- 504 - 576
- 432 - 504
- 360 - 432
- 288 - 360
- 216 - 288
- 144 - 216
- 72 - 144
- 1 - 72

Wind speed (knots)
- 34+
- 26 - 30
- 21 - 26
- 17 - 21
- 13 - 17
- 9 - 13
- 4 - 9
- 0 - 4
Utilizing Wind

- Smoke exhaust fans
- Self-regulating axial fans
- Automatically controlled windows
- Operable windows
- Trickle vent

Windward side
Leeward side
Atrium
11'-10"
3rd floor
14'-8"
22'-10"
Shaft and Mechanical Room

<table>
<thead>
<tr>
<th></th>
<th>Main Duct</th>
<th>Main Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAV</td>
<td>18-27&quot;</td>
<td>36&quot;</td>
</tr>
<tr>
<td>Radiant</td>
<td>12-16&quot;</td>
<td>20&quot;</td>
</tr>
</tbody>
</table>
HVAC option - VAV with reheat

Floor section, 3rd floor
HVAC option - Radiant ceiling & DOAS

HVAC schematic

Floor section, 3rd floor
SIMPPLICITY
Orientation

Shading
Equinox, winter solstice, summer solstice

Wind speed (knots)
Radial scale is % if time

Wind frequency (hrs)

- 720+ hours
- 576 - 648 hours
- 504 - 576 hours
- 432 - 504 hours
- 360 - 432 hours
- 288 - 360 hours
- 216 - 288 hours
- 144 - 216 hours
- 72 - 144 hours
- 1 - 72 hours
Elevations

North Elevation

East Elevation

South Elevation

West Elevation
Structural system - Alternative 1

Architectural

Structural
<table>
<thead>
<tr>
<th>Structural System</th>
<th>Gravity System</th>
<th>Lateral System</th>
<th>Floor System</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Columns</strong> - concrete [18” x 18”]</td>
<td><strong>Shear walls</strong> - concrete [thickness 10”]</td>
<td><strong>Composite slab</strong> - 14”</td>
</tr>
<tr>
<td></td>
<td><strong>Truss</strong> - steel - (auditorium) [height 4’]</td>
<td><strong>Moment frame</strong> - concrete [columns [18” x 18”], beam [15”]]</td>
<td><strong>Concrete Slab Depth</strong> - 6”</td>
</tr>
<tr>
<td></td>
<td><strong>Deep Beam</strong> - concrete (auditorium) [12’]</td>
<td></td>
<td><strong>Beam Depth</strong> - 8”</td>
</tr>
</tbody>
</table>
Lateral system

Entire system

North

Auditorium

Main Building

FORCE

Shear wall activity during earthquake - direction 1

Shear wall and moment frame activity during earthquake - direction 2
Connecting Architecture and Structure

Main building

Auditorium
1.) Composite slab (14”)
2.) Steel truss beam (4’)

Deep beam (2 x 12’)
- works as cantilever
- supports truss beam
- truss beam supports inclined slab
Concrete columns (18” x 18”)
Concrete beams (6” x 10”)
Concrete walls (10”)

Composite slab
14” = 8” steel + 6” concrete
Floor Plans - Alternative 1

Level 3
- SHEAR WALL
- COLUMNS
- TRUSS BEAM
- WALL

Level 4
## Structural System (West Wing)

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gravity System</strong></td>
<td></td>
</tr>
<tr>
<td>Columns</td>
<td>Concrete (18”x18”)</td>
</tr>
<tr>
<td>Columns Surrounding Atrium</td>
<td>Concrete (14”x14”)</td>
</tr>
<tr>
<td><strong>Lateral System</strong></td>
<td></td>
</tr>
<tr>
<td>Shear Wall</td>
<td>Concrete (12”)</td>
</tr>
<tr>
<td>Concentric Braced Frame</td>
<td>Steel/Concrete</td>
</tr>
<tr>
<td></td>
<td>Brace- L8x8x7/8</td>
</tr>
<tr>
<td></td>
<td>Beam- Conc. 9”x12”)</td>
</tr>
<tr>
<td><strong>Floor System</strong></td>
<td></td>
</tr>
<tr>
<td>Prestressed Concrete</td>
<td>10” with 0.6” diameter strands</td>
</tr>
<tr>
<td></td>
<td>spaced at 2” c/c</td>
</tr>
</tbody>
</table>
### Structural System (East Wing)

#### Gravity System
- **Columns**: Steel (W14x82)
- **Beams**: W21x48 (Exterior)  
  W24x62 (Interior)

#### Lateral System
- **Concentric Braced Frame**: Steel  
  (Brace- L8x8x7/8  
  Beam- W21x48)

#### Floor System
- **Concrete with Steel Deck**: 2” steel deck with 4.5” Normal Weight Concrete  
  (2Hr Fire Rating)
Floor plans

Level 1

20' (typ.)

10' (typ.)

Concrete 18” x18”

W14x82

W21x48

W24x62

10’ (typ.)

6” Concrete Shear Wall

Concentrically Braced Frame

Level 2
Floor plans

Level 3

Concrete 18” x18”

W14x82

W21x48

W24x62

6” Concrete Shear Wall

Concentrically Braced Frame

Level 4
Structural system - 3D view

West Wing

East Wing
Gravity load path - auditorium
Gravity load path - east wing

- Compression
- Tension
- Horizontal Load Transfer
I = 1.5
R = 5 (Ordinary Reinforced Concrete Shear Wall)
R = 6 (Steel Special Concentrically Braced Frame)
Sds = 1.455

**Base Shear** = 1746 kips (Shear Wall)
   = 1455 kips (Concentrically Braced Frame)
Daylight Conditions

Solar analysis
Cumulative insolation [kWh/m²]

Daylight
Fall Equinox 3PM [lux]

North
West
East
Southern

4th floor
4rd floor
Daylight Control

- Solar film
- Shading trees
- External overhangs
- Internal manual shading
- Daylight controlled artificial lighting

Daylight controlled artificial lighting
Wind Conditions

Wind speed (knots)
Radial scale is % if time
- 34+
- 26 - 30
- 21 - 26
- 17 - 21
- 13 - 17
- 9 - 13
- 4 - 9
- 0 - 4

Wind frequency (hrs)
- 720+
- 576 - 648
- 504 - 576
- 432 - 504
- 360 - 432
- 288 - 360
- 216 - 288
- 144 - 216
- 72 - 144
- 1 - 72
Large potential
- Prevailing wind direction
- Large solar heat gain
- Minimum change in internal load

AD = administration offices
C = Chair
F = Faculty offices
L = Lounge

Smaller potential
- Large and changing internal loads
- Need for mechanical ventilation

T = Toilet
S = Server room
LA = Lab.

No or limited need
- Shafts, elevators, stairs, etc.
Utilizing wind conditions

- Trickle vent
- Self-regulating axial fans
- Automatically controlled windows
- Operable windows
- Return grill

Legend:
- Windward side
- Administration
- Hallway
- Leeward side

Measurements:
- 27’ - 3”
- 31” - 9’
HVAC - VAV with Reheat

HVAC schematic

Floor section, 3rd floor
HVAC - Fan Coil

HVAC schematic

Floor section, 3rd floor
Shafts and Mechanical Room

<table>
<thead>
<tr>
<th>Main Duct</th>
<th>Main Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-27&quot;</td>
<td>36&quot;</td>
</tr>
</tbody>
</table>
Nature - Sustainable Target Value

**Water progress**
- Project: \( \text{kg H}_2\text{O} \)
- Target: \( \text{kg H}_2\text{O} \)

**CO2 progress**
- Project: \( \text{kg CO}_2\text{-eq} \)
- Target: \( \text{kg CO}_2\text{-eq} \)

**Energy progress**
- Project: \( \text{MJ} \)
- Target: \( \text{MJ} \)
Sustainable Target Value

Nature

3.3 kg-CO₂ eqv.  
88%

526 kg H₂O  
718 %

Simplicity

4.0 kg-CO₂ eqv.  
108%

531 kg H₂O  
725 %

85 MJ  
71%

94 MJ  
79%
SITE PLANNING, EQUIPMENT AND MATERIALS
<table>
<thead>
<tr>
<th>Construction will impact</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air quality</td>
<td>Minimize environmental disruption</td>
</tr>
<tr>
<td>Traffic levels on roads</td>
<td>Plan and schedule to minimize disturbance</td>
</tr>
<tr>
<td>Water</td>
<td>Water cleaning and recycling program, Stormwater pollution prevention</td>
</tr>
<tr>
<td>Safety</td>
<td>Zero tolerance</td>
</tr>
<tr>
<td>Keeping time, budget and quality</td>
<td>Communication Platforms &amp; Software</td>
</tr>
</tbody>
</table>
Air quality challenge

1. Spray water on the surface of dusty material before, during and after excavation
2. Use dump truck equipped with mechanical cover for transportation of dusty material
3. Wash vehicle to remove any dusty materials before leaving a site
4. Keep the haul road wet by water sprinkler or water bowser
5. Low energy emitting air dust control sprinkler for particle capture, with noise barrier
The safety of our worksites is one of our most important issues. We believe that all accidents can be prevented.
Equipment and materials

- Mobile crane (100 ton)
- Radius 140 feet, capacity 11 000 lbs
- Rent locally from nationaltrailer.ca
- Construction workers pleasure
Site Conditions

Overview

Elevation

Scale
Site Logistics

- Building Footprint with path
- Air Quality Control
- BBQ Area & Progression Display Board
- Waste & Recycling
- Staff Office
- Rain Water Tank
- Staff Parking
- Mobile Crane – Radius 140 foot
- Construction Hoist
- Lay Down Areas
- Equipment Parking
- Water Cleaning Area
- Washing Zone

Major Goals: Air Quality, Easy Access, Safety
COSTING AND SCHEDULE
Target Value Design

1) Donation value in 2019: $10 Million
2) Target Value:
3) Uniformat Structure

Owner’s Definition of Value

DPR Estimating Sheet + RS Means
General Costing Considerations

1) California Prevailing Wages Premium of $8/SF
2) CEQA & LEED Premium of $250 k.
3) Environmental Activism Premium of $50 k

- Wash Areas - Recycling Areas
- DBEs
- SWPPP, IAQ During Construction
- Driver
### Example for C. Interiors estimating sheet

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>LINE ITEM DESCRIPTION</th>
<th>COST DATA</th>
<th>QUANTITY</th>
<th>ESTIMATE RELIABILITY</th>
<th>ESTIMATE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C. INTERIORS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Materials</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wall Finishes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Door &amp; Window</strong></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>Floor Finishes</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>Ceiling Finishes</strong></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>C: Quantity Reliability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C: Cost Data Reliability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C: Overall Reliability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The right level of detail
Nature - Cost Estimate

Total Cost: $8,790,123
Occusable Area: 24,545 SF

Cost per SF: $305/SF
Simplicity - Cost Estimate

Total Cost: $9,409,655
Occupiable Area: 31,402 SF
Cost per SF: $288/SF
Simplicity - Cost Breakdown

TVD - TARGETS BY CLUSTER

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

- TARGET VALUE
- ESTIMATED VALUE
- VALUE DELTA

Risky

TVD Exterior Finishes.

Prevailing wage premium.
Scheduling Zoning and Strategy

Nature

Simplicity

Building Divided into two Zones

Billboarding

Allows early lab commissioning.
Value for money, challenges, and sensitivity

Nature

Cost per SF: $305/SF

Early tenants in labs: Likely

Main challenges:
- Curtain wall escalation: $200,000
- Structure Escalation: $200,000
- Structural cables complexities.

Constructability challenge: Medium

$100k - $150k savings if switch to timber.

Simplicity

Cost per SF: $288/SF

Early tenants in labs: Very likely.

Main challenges:
- Tight budget
- Finishes escalation: $200,000
- Auditorium Escalation $100,000

Constructability challenge: Fair
COMPARISON
## Comparison

<table>
<thead>
<tr>
<th>Nature</th>
<th>Simplicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber Glass + Timber + VAV w. Reheat</td>
<td>Steel + Radiant and DOAS</td>
</tr>
<tr>
<td>Concrete + VAV w. Reheat</td>
<td>Concrete + Steel + Fan Coil</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feature</th>
<th>Fiber Glass + Timber + VAV w. Reheat</th>
<th>Steel + Radiant and DOAS</th>
<th>Concrete + VAV w. Reheat</th>
<th>Concrete + Steel + Fan Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program layout</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Navigability</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Indoor climate initiatives</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Structural efficiency</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Innovative</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Value</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>
TEAM PACIFIC

THE END
Thank you!