Pacific 2015
A-E-C-MEP
SITE CONTEXT
CLIMATE

**Climate Summary**

- **Annual Sunshine:** 2950 hours/year
- **Humidity (due to fog):**
  - Daily average high = 84%
  - Daily average low = 60%
- **Annual Rainfall:**
  - 68 days/year
  - Total 23.64 in
- **Temperature:**
  - 50F - 65F average
- **Wind:**
  - 15 mph (max 40mph)

**Building Site**

[Diagram of building site with the climate information superimposed.]
LOCAL CONSIDERATIONS

USGS Provided Output:
\[ S_{DS} = 1.459 \text{ g}, \quad S_{D1} = 1.043 \text{ g} \]

Seismic Zone

Slope
SKETCHES, INSPIRATIONS
EVOLUTION OF BIG IDEA

1/18 Kick off

1/30 1st Delivery

2/13 Peer Review

2/20 Crit Session
FOOTPRINT ORIENTATION

ADDITIONAL ENTRANCE - ROOF

LAKE/FOREST

TREES/SPORT FACILITIES

SCHOOL DORMS AROUND TREES

VIEWS

Team Pacific
SURROUNDINGS

- SNACK SPACE
- COLLABORATION SPACE
- FOCUS SPACE
- INSPIRATION SPACE
- BEAUTIFUL VIEWS
- RECREATION SPACE

NORTH

PEOPLE

Team Pacific

A  E  C  MEP
REFERENCE PHOTOS

Open Space

Stairs

Atrium
SECTION 1

GREEN ROOF

- Plants (e.g. Grass, Sedum)
- Growing Medium,
- Oldroyd Tp Filter Fleece
- Oldroyd Xv20GreenXtra (Drainage Layer)
- Safeguard Root Barrier
- Suitable Waterproofing Membrane
- Concrete Slab

BLGD SUPPORTS THE SLOPE
SOIL FROM EXCAVATION
USED FOR ATTACHING

Team Pacific A E C MEP
VIEW FROM SOUTH-EAST

ENTRANCE

NORTH
ORIGAMI HYDRO FAÇADE PANELS

BUD | FLOURISHING | OPENING | OPENED

GLASS

MESH

HYDRO

2 x WOOD VENEER

FOG HARVESTING MESH

WOOD STRETCHES

MESH STRETCHES

WOOD SHRINKS
VIEW FROM SOUTH-WEST

TEAM PACIFIC AECMEP
<table>
<thead>
<tr>
<th>Room Function Type</th>
<th>Total Area [sf]</th>
<th>Minimum LL [psf]</th>
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</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>
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Reference: California Building Code
## LATERAL LOADS

<table>
<thead>
<tr>
<th>Design Concept</th>
<th>Lateral System</th>
<th>Force [kips]</th>
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</thead>
<tbody>
<tr>
<td>Iceplant I</td>
<td>BRBF</td>
<td>2142</td>
</tr>
<tr>
<td>Iceplant II</td>
<td>Shear Wall</td>
<td>3637</td>
</tr>
<tr>
<td>Water I</td>
<td>Diagrid</td>
<td>1071</td>
</tr>
<tr>
<td>Water II</td>
<td>EBF</td>
<td>1008</td>
</tr>
</tbody>
</table>
SOIL PROFILE

- Soil Condition
  - Well sorted fine to medium sand
  - Bearing capacity: 3500 psf
  - Not in liquefaction zone
  - Water table: 14 ft below grade
Evolution of chosen concept:

**Crit Session Mentorship**
- Cost
- Additional need to detach building from slope/ground
- Maintenance

Kick off Meetings /First Phase
1/19 - 2/15

Second Phase /Current Design
2/15 - 3/13
# Structural Systems

<table>
<thead>
<tr>
<th>Structural System</th>
<th>Steel</th>
<th>Timber Composite</th>
</tr>
</thead>
</table>
| **Gravity System** | Beam: W Section  
Girder: W Section  
Column: W Section | Beam: Timber Rectangular  
Girder: W Section  
Column: W Section |
| **Lateral System** | Buckling Restrained Braced Frame (BRBF) | Concrete core and shear wall system |
3D STEEL STRUCTURE

136 ft
142 ft
44 ft
Column: W14×90
Beam: W16×31
Girder: W16×31
Green Roof Load
Live Load

Column: W14×90
Beam: W24×55
Girder: W24×55
Truss: W24×55
Truss: W16×31
Cantilever

- Green Roof Load
- Live Load
• Line footing 1’x3’x1’
• Spread footing 2’x2’x1’
LATERAL SYSTEM

- BRBF (8’’)^2
- Retaining Wall 10’’

Basement

Level 1

Level 2

atrium

NORTH
LOAD PATH - GRAVITY

Location
MEP Solution for ICE PLANT/STEEL:

General:
- VAV w/ Reheat

Auditorium:
- Underfloor Air Distribution (UFAD)

+ Economizer option
+ Simple zoning
+ Common, inexpensive

- Wasted reheat energy
- More ductwork
- Open plenum reduces privacy
<table>
<thead>
<tr>
<th>Structural System</th>
<th>Steel</th>
<th>Timber Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravity System</td>
<td>Beam: W Section</td>
<td>Beam: Timber Rectangular</td>
</tr>
<tr>
<td></td>
<td>Girder: W Section</td>
<td>Girder: W Section</td>
</tr>
<tr>
<td></td>
<td>Column: W Section</td>
<td>Column: W Section</td>
</tr>
<tr>
<td>Lateral System</td>
<td>Buckling Restrained Braced Frame (BRBF)</td>
<td>Concrete core and shear wall system</td>
</tr>
</tbody>
</table>
- Column: W12x170
- Column: W14x311
- Beam: W16x31
- Beam: W18x76
- PT Timber: 8.5"x26"
- Framing: SP 5.25"x14"/4'
- Framing: SP 3.25"x9"/4'
- Retaining wall 10"
- Core wall 10"
- Shear wall 10"
- 3" Concrete slab
LEVEL 2

- Column: W12x170
- Column: W14x311
- Beam: W16x31
- Beam: W18x76
- PT Timber: 8.5"x26"
- Framing: SP 5.25"x14"/4'
- Framing: SP 3.25"x9"/4'
- Retaining wall 10"
- Core wall 10"
- Shear wall 10"
- 3" Concrete slab
LATERAL SYSTEM

- Retaining wall 10"
- Core wall 10"
- Shear wall 10"
- Lateral bracing
  - Moment resisting
Line footing 1’x3’x1’

Spread footing 2’x2’x1’
AUDITORIUM SPAN

Post-Tensioned Timber beam:
- Larger span
- More shallow beam
- Damage control design
RADIANT HEATING & COOLING

MEP - ICE PLANT - COMPOSITE:

General:
- Radiant Heating & Cooling
- DOAS
- Forced Air System for peaks

Auditorium:
- Displacement Ventilation

+ Use of reclaimed water
+ Efficient hydronics
+ Heats occupants directly

- Low capacity
- High cost
- Difficult maintenance
WATER CHALLENGE - ICE PLANT

HYGRO

Pervious Pavers

Recycled Water

Water Feature

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Key Goals
1. Safety
2. Latency
3. Reduce construction site footprint
BIG IDEA – WATER FLOW
FOOTPRINT ORIENTATION

Evolution of chosen footprint
LAKE MERCED & FOREST

OUR BUILDING

NORTH
INSPIRATIONS
SUMMER SOLSTICE

WINTER SOLSTICE

Increased Solar Gains

Self-Shading
EXAMPLE 3D VIEW (ELEVATION)

ENTRANCE

PANEL IDEA
SURROUNDINGS

- SNACK SPACE
- COLLABORATION SPACE
- FOCUS SPACE
- INSPIRATION SPACE
- BEAUTIFUL VIEWS
- RECREATION SPACE

PATH

AUDITORIUM EGRESS

NORTH
EFTE panels
<table>
<thead>
<tr>
<th></th>
<th>Diagrid</th>
<th>Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>3D View</td>
<td><img src="image1.png" alt="Diagrid 3D View" /></td>
<td><img src="image2.png" alt="Steel Frame" /></td>
</tr>
<tr>
<td>Gravity System</td>
<td>Column: W Section</td>
<td>Girder: W Section</td>
</tr>
<tr>
<td></td>
<td>Floor: Bubble Deck + PT Slab</td>
<td>Column: W Section</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Floor: Bubble Deck</td>
</tr>
<tr>
<td>Lateral System</td>
<td>Exterior Diagrid Systems</td>
<td>Eccentrically Braced Frame</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(EBF)</td>
</tr>
</tbody>
</table>
Post Tensioning + Bubbledeck = Spans up to 50 times slab height!

1ft deck = 50 ft span
3D - DIAGRID

130 ft

45 ft
Diagrid serves as lateral resistance systems

Column: W14×90
Diagrid System
HSS 10x0.312

12” Bubble Deck slab with Post Tensioning
Column: W14×90
Diagrid System
HSS 10x0.312
12” Bubble Deck slab with Post Tensioning
Column: W14 x 90

Diagrid System

HSS 10 x 0.312

12” Bubble Deck slab
with Post Tensioning
• Spread footing: 3’x4’x1’

Line footing: 3’x1’x1’
LOAD PATH—LATERAL

Location

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MEP SOLUTION FOR DIAGRID:

General:
- Underfloor Air Distribution

Auditorium:
- Ventilation Seats

+ User flexibility and control
+ Minimal ductwork
+ Easier discipline coordination

- Dirt/dust in floor plenum
- High cost
- Potential air leakage
LEVEL 2

MEP Shafts

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79
## Structural Systems

<table>
<thead>
<tr>
<th></th>
<th>Diagrid</th>
<th>Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3D View</strong></td>
<td><img src="image1" alt="Diagrid 3D View" /></td>
<td><img src="image2" alt="Steel 3D View" /></td>
</tr>
</tbody>
</table>
| **Gravity System** | Girder: W Section  
Column: W Section  
Floor: Bubble Deck + PT Slab | Girder: W Section  
Column: W Section  
Floor: Bubble Deck |
| **Lateral System** | Exterior Diagrid Systems                      | Eccentrically Braced Frame (EBF)              |
Column: W14×90
Girder: W16×31
Curved Column: W14×90

12 in. bubble deck
Column: W14×90
Curved Column: W14×90
Girder: W16×31
12 in bubble deck
Column: W14×90
Curved Column: W14×90
Girder: W16×31
12 in bubble deck
Foundation Layout

- Spread footing: 3’x1’x1’
- Line footing: 3’x3’x1’
LATERAL SYSTEM

EBF (7.5’’)²
LOAD PATH - GRAVITY
LOAD PATH LATERAL
MEP SOLUTION FOR STEEL:

General:
- Active Chilled Beams + DOAS

Auditorium:
- Underfloor Air Distribution

+ Efficient hydronic system
+ Minimal ductwork
+ Less fan and reheat energy

- Constant airflow required
- Less economizer benefit
- More piping than VAV
Team Pacific

Non-potable Water Sources

Water-Energy Nexus

Resource Efficiency

Metering and Display

Stormwater Filtration

WATER CHALLENGE - WATER FLOW
SUSTAINABLE TARGET VALUE

STEEL

TIMBER COMPOSITE

DIAGRID

STEEL

Iceplant

Water Flow
SITE LOGISTICS - Water Flow

Key Goals
1. Safety
2. Latency
3. Reduce constr. site footprint
## CRITICAL PATH & MILESTONES

<table>
<thead>
<tr>
<th>MILESTONES</th>
<th>CRITICAL PATH and MILESTONES</th>
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<tbody>
<tr>
<td></td>
<td>2019</td>
</tr>
<tr>
<td></td>
<td>Aug</td>
</tr>
<tr>
<td>Site mobilization</td>
<td></td>
</tr>
<tr>
<td>Foundation</td>
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<tr>
<td>M1: FOUNDATION</td>
<td>M1</td>
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<tr>
<td>Superstructure</td>
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<tr>
<td>Roofing</td>
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<td>M2: ROOFING</td>
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<tr>
<td>Finishes</td>
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<td>Start installation of labs</td>
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<td>M3: LAB INSTALLATION</td>
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<tr>
<td>Services</td>
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<td>Landscaping</td>
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<tr>
<td>Handing over</td>
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</table>

Team Pacific A E C MEP
TVD Cost Estimates

Building Concepts

- $8.3: Ice Plant, Steel, VAV
- $8.2: Ice Plant, Composite, Radiant
- $8.5: Water Flow, Diagrid, UFAD
- $9.4: Water Flow, Steel, Chilled Beams

Target Budget: $10.0 million

Estimated Cost (in Millions)
Concrete Structure (02-12-15): $900,000

Glulam Beams and Concrete Columns (02-25-15): $700,000

Glulam and Steel Columns (03-09-15): $1,000,000
<table>
<thead>
<tr>
<th>Building Concept</th>
<th>Excavation</th>
<th>Crane</th>
<th>Seismic Bracing</th>
<th>Exterior</th>
<th>Structural Systems</th>
<th>MEP Concept Implementation</th>
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<tbody>
<tr>
<td>Iceplant</td>
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</tr>
<tr>
<td>Steel /VAV</td>
<td>✗</td>
<td></td>
<td></td>
<td>✗</td>
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<tr>
<td>Composite /Radiant</td>
<td>✗</td>
<td></td>
<td></td>
<td>✗</td>
<td></td>
<td>✗</td>
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<tr>
<td>Water Flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagrid /UFAD</td>
<td>✗</td>
<td>✗</td>
<td></td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Steel /Chilled Beam</td>
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<td></td>
<td>✗</td>
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×: Constructability Challenge
DECISION MATRIX

Water Flow + Steel/Eccentricity Bracing + Chilled Beams

- Water Challenge Concept
- Big Idea Incorporation throughout building
- Aesthetics
- Structural Efficiency

- Costs
- Constructability
- STV Results
DECISION MATRIX OVERALL

ICEPLANT

WATER FLOW

BUILDING CONCEPT

- Ice Plant + Composite + Radiant
- Ice Plant + STEEL + VAV w/Reheat
- Water Flow + Diagrid + Bubbleddeck/PT + UFAD
- Water Flow + Steel/Eccentricity Bracing + Bubbleddeck/PT
MEETING PROTOCOLS

BrainMerge

Voting Room Title: Decision Matrix Topics

The brighter (orange) the ideas are, the more popular they are!
7 people contributed their ideas.
7 people voted.
Voting Finished!

Sort by Country | Sort by Ranking

Carte Markmeier | Water challenge | 100 | Sweden
Carte Markmeier | Latency | 79 | Sweden
Carte Markmeier | Energy Saving AND Producing | 69 | Sweden
Carte Markmeier | Prefabrication | 68 | Sweden
Carte Markmeier | Costs | 62 | Sweden

Brainstorming

Standup Meeting

Weekly Meeting
HEALTHY TEAM BALANCE
Leave comfort zone & learn!

Transparency

Cross-disciplinary

I & My → WE & OUR
Thank You for Your Attention!