PLACES ARE FOR PEOPLE
TEAM PACIFIC
WINTER PRESENTATION AEC 2020
TEAM

Piero CM
Stanford University

Mek SE
University of Wisconsin Madison

Mary CM
Loughborough University

Adrian LCFM
Bauhaus University Weimar

Dimitris SE
Technical University of Denmark DTU

Łukasz MEP
Silesian University of Technology

Ada A
Warsaw University of Technology
OWNERS

Renate

Sebastian

Konstantinos

Eeshan

Karolina

Tobias
GOALS

PRODUCT/PROCESS
- Prefabrication
- Energy efficiency

PEOPLE
- Work & learn
- User-oriented space

PLACE
- Sustainability
- Well-being

INTEGRATED TEAMWORK
SITE CONTEXT

San Francisco State University Engineering Department

San Francisco University Campus

Lake Merced

Sports facilities

Shopping center

San Francisco University Campus

Lake Merced & Golf fields
What did we discover?

- No connection from Winston Dr
- Accessible only N State Dr
- Potential in opening the building to the lake view
SITE CONTEXT

Height difference

Winston Dr

N state Dr

Road access

Existing retaining wall

Restricted site area

Road access

Library – student center

Road access

Road access
SITE CONTEXT - ENVIRONMENTAL

Temperature - San Francisco, CA

Cooling time

Heating time

WIND

TEMPERATURE
SITE CONTEXT - ENVIRONMENTAL

Rainfall
average rainfall in inches

- On average, January is the most humid.
- On average, October is the least humid month.
- The average annual percentage of humidity is 75.0%.

Fog collection
SITE CONTEXT - ENVIRONMENTAL

Our district - seven
SITE CONTEXT - SOIL PROFILE

Soil Conditions

Well sorted fine to medium sand

Bearing Capacity: 3500 psf

Not in Liquefaction Zone

Water Table: 14' below grade
SITE CONTEXT – RISKS & HAZARDS

**Earthquake**

Risk Category: III

**ASCE7-16**: "Building and other structures, the failure of which could pose a substantial risk to human life."

**Seismic Loads > Wind Loads**

Seismic design and detailing requirements are more restrictive than wind requirements.

**Wind**
CONNECTION

BIG IDEA

NATURE
• Use of natural resources on site
• Wind, sun, fog

INSIDE & OUTSIDE
• Walkway connection
• Experience path
• Staircase + lake view

PROCESS
• Prefabricated structure
• Teamwork
• Information connection

PEOPLE
• Work & study
• User-oriented space
• Shared spaces
CONNECTION

ORIENTATION ON THE SITE

- Public plaza
- Pedestrian access from Winston Dr
- Pedestrian access from campus
- Main access to the plaza
- Lake view axis

From Winston Dr:
- Pedestrian access

From campus:
- Pedestrian access
ORIENTATION ON THE SITE

ORIENTATION/AMOUNT OF PV

SUN IN ATRIUM
ORIENTATION ON THE SITE – SHADING ANALYSIS

20th of March

9:00 am

3:00 pm

21st of June
ORIENTATION ON THE SITE – SHADING ANALYSIS

22nd of September

9:00 am

3:00 pm

21st of December
CONNECTION

DEVELOPMENT OF DESIGN

1. CONNECTING THE DOTS
   Analysis of given requirements

2. CONNECTING THE STREETS
   Connecting the levels of the streets
   Creating access to the building from both streets
   Creating experience path around the building as a viewing spot
3 CONNECTING BUILDING WITH NATURE

Using wind to produce power with kinetic facade

Rotating aerodynamical panels
**CONNECTION**

**DEVELOPMENT OF DESIGN**

<table>
<thead>
<tr>
<th>Area</th>
<th>m²</th>
<th>139.08</th>
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</thead>
<tbody>
<tr>
<td>Power</td>
<td>N</td>
<td>1272.87</td>
</tr>
<tr>
<td>Movement</td>
<td>m</td>
<td>0.01</td>
</tr>
<tr>
<td>Energy</td>
<td>Nm/J</td>
<td>16.17</td>
</tr>
<tr>
<td>Mass</td>
<td>kg</td>
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</tr>
<tr>
<td>G</td>
<td>m/s²</td>
<td>9.81</td>
</tr>
<tr>
<td>H</td>
<td>m</td>
<td>4.00</td>
</tr>
<tr>
<td>Ep</td>
<td>J</td>
<td>58.17</td>
</tr>
<tr>
<td>kWh per year</td>
<td>kWh</td>
<td>0.000016159</td>
</tr>
<tr>
<td>Efficient</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td>kWh</td>
<td>0.03</td>
</tr>
</tbody>
</table>

From one wall we can get about 0.03 kWh per year (from PV on the roof we produce about 138 000 kWh per year).

Using wind to produce power with kinetic facade

**Decision matrix:** not enough electricity gain to spend such a big budget on kinetic facade
CONNECTION

DEVELOPMENT OF DESIGN

CONNECTING THE NATURE WITH THE BUILDING

Using wind to gain water

Fog collection

Using typical shape of nets to design the facade
CONNECTION - FOG CATCHER
CONNECTION - FOG CATCHER

Façade development

- Adjusted to the structural façade system
- Arc shape to accommodate to the wind flow
- Diagonal pipes to fasten the water harvest

Inspiration
- typical fog catching net

See-through nets
Letting light into the atrium

Emphasizing the atrium in the shape of the building
Meeting spot in front of the entrance
CONNECTION

Passage
CONNECTION

Façade from crossroad

Façade from adjacent plot

Façade from N State Dr

Façade from Winston Dr
CONNECTION

LEVEL 0  CONNECTIONS WITHIN THE BUILDING

Horizontal communication
Entrances
Vertical communication
Experience path

Auditorium
FLOORPLAN LEVEL -1

Level -1
- Auditorium
- Large classrooms
- Storage
- Mechanical room
LEVEL -1 CONNECTIONS WITHIN THE BUILDING

Horizontal communication
- Entrances
- Vertical communication
- Experience path

Staircase from Level 0 to -1
LEVEL 0  CONNECTIONS WITHIN THE BUILDING

Horizontal communication

Entrances

Vertical communication

Experience path

Main meeting space
CONNECTION

WORK
STUDY
MEET

Auditorium
Small classrooms
Student offices
Café
Faculty lounge
Department Chair's office
Senior Administration office
Administrative Assistants
Level +1
- Small classrooms
- Instructional labs
- Seminar rooms
- Student offices
- Toilets
- Server room
- Storage room
- Outdoor terraces
LEVEL +1  CONNECTIONS WITHIN THE BUILDING

Horizontal communication
Entrances
Vertical communication
Experience path

Experience path through the staircase
CONNECTION

FLOORPLAN LEVEL +2

Level +2
- Faculty lounge
- Faculty offices
- Department Chair’s office
- Senior Administration office
- Administrative Assistants
- Toilets
- Storage room
- Outdoor terrace
LEVEL +2 CONNECTIONS WITHIN THE BUILDING

Horizontal communication
- Entrances
- Vertical communication
- Experience path

Office open to the atrium
Timber Scheme

Superstructure:
Gravity:
- Glulam columns & beams
- Composite CLT / concrete slab
Lateral:
- CLT rocking walls

Substructure: Concrete

Foundations: Isolated and combined footings

Steel Scheme

Superstructure:
Gravity:
- HSS columns & W-shaped beams
- Composite metal deck
Lateral:
- ConXtech XL 300

Substructure: Concrete & Steel

Foundations: Isolated and combined footings
STRUCTURAL SOLUTIONS

Timber advantages

- Sustainable material
- Reduced labor costs
- Lightweight & Strong
- Good sound absorption

Steel advantages

- Faster construction schedule
- Design for disassembly
- High strength & Durability
- Construction Safety
TYPICAL LIVE LOAD

Typical Live Load (psf)

<table>
<thead>
<tr>
<th>Space</th>
<th>Load (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Classroom</td>
<td>40</td>
</tr>
<tr>
<td>Office</td>
<td>50</td>
</tr>
<tr>
<td>Auditorium</td>
<td>60</td>
</tr>
<tr>
<td>Corridor above 1st floor</td>
<td>80</td>
</tr>
<tr>
<td>Large Classroom</td>
<td>100</td>
</tr>
<tr>
<td>Corridor 1st floor</td>
<td>100</td>
</tr>
<tr>
<td>Staircase</td>
<td>100</td>
</tr>
<tr>
<td>Mechanical &amp; storage</td>
<td>125</td>
</tr>
</tbody>
</table>

Source: ASCE 7-16
Typical Elements

- **Glulam column**: 12”x12”
- **Post-tensioned glulam girder**: 5 1/8" x 27"
- **Glulam girder**: 5 1/8" x 13.5"
- **Glulam flitch girder**: 6 3/4" x 22.5"
- **CLT rocking walls**: 8" x 8’-8"
POST-TENSIONED GLULAM BEAMS

Flitch beam

Auditorium
TIMBER – LEVEL 1

Typical Elements

- **Glulam column**: 12"x12"
- **Glulam girder**: 5 1/8" x 13,5"
- **Glulam flitch girder**: 6 3/4" x 22,5"
- **CLT rocking walls**: 8" x 8’-8"
TIMBER – LEVEL 2

Typical Elements

- Glulam column: 12"x12"
- Glulam girder: 5 1/8" x 13.5"
- Glulam flitch girder: 6 3/4" x 22.5"
- CLT rocking walls: 8" x 8'-8"
Typical Elements

<table>
<thead>
<tr>
<th>Element</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete column</td>
<td>18&quot;x18&quot;</td>
</tr>
<tr>
<td>Concrete shear wall</td>
<td>10'x12&quot;</td>
</tr>
<tr>
<td>Concrete beam</td>
<td>12&quot;x24&quot;</td>
</tr>
<tr>
<td>Retaining wall</td>
<td>12&quot;</td>
</tr>
<tr>
<td>Isolated footing</td>
<td>7'x7'x2'</td>
</tr>
<tr>
<td>Combined footing</td>
<td>26'x6'x2'</td>
</tr>
<tr>
<td>Concrete beam</td>
<td>12&quot;x24&quot;</td>
</tr>
</tbody>
</table>
TIMBER - 3D SECTION CUTS

Floor -1&0

Floor 1

Floor 2
Structural beams are incorporated in the solid wooden panels of curtain wall.
ROCKING WALL LATERAL SYSTEM

- Post-tensioned steel rods
- Krawinkler fuses – replaceable structural elements
  ✓ Serviceable structure after a seismic event
  ✓ Resilience
GRAVITY LOAD PATH

- Gravity load
- Transfer load
- Compression
- Tension
LATERAL LOAD PATH

- **Gravity load**
- **Transfer load**
- **Compression**
- **Tension**
"Lower and locking"

Increased architectural freedom

✓ AISC 358-16 Prequalified Connection for Special and intermediate Steel Moment Frames for Seismic Applications
STEEL - LEVEL 0

Typical Elements

Steel column

- HSS 12”x12”

Steel girders / beams

- W10x33
- W16x57
- W24x84
STEEL - LEVEL 1

Typical Elements

Steel column
- HSS 12”x12”

Steel girders / beams
- W10x33
- W16x57
- W24x84
STEEL - LEVEL 2

Typical Elements

Steel column
- HSS 12"x12"

Steel girders / beams
- W10x33
- W16x57
- W24x84
STEEL - LEVEL -1 & FOUNDATION

<table>
<thead>
<tr>
<th>Typical Elements</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel column</td>
<td>HSS 12”x12”</td>
</tr>
<tr>
<td>Steel beam</td>
<td>W10x33</td>
</tr>
<tr>
<td></td>
<td>W24x84</td>
</tr>
<tr>
<td>Retaining wall</td>
<td>12”</td>
</tr>
<tr>
<td>Isolated footing</td>
<td>7’x7’x2’</td>
</tr>
<tr>
<td>Combined footing</td>
<td>16’-6”x7’x2’</td>
</tr>
<tr>
<td>Concrete column</td>
<td>12”x12”</td>
</tr>
<tr>
<td>Concrete beam</td>
<td>12”x24”</td>
</tr>
<tr>
<td></td>
<td>18”x24”</td>
</tr>
</tbody>
</table>
STEELE - 3D SECTION CUTS

Floor - 1&0

Floor 1

Floor 2
GRAVITY LOAD PATH

Gravity load
Transfer load
Compression
LATERAL LOAD PATH

Gravity load
Transfer load
Compression
SOLAR ENERGY – PV PANELS' ANALYSIS

Area of PV: 4301 ft²
Power: 83.25 kW
SOLAR ENERGY – SUN ANALYSIS

View from South West

View from South East

View from North West

View from North East
MEP OPTION 1

Option 1

Primary system
- Ground Heat Pump
- Chiller
- VAV system with heat/cool recuperation

Secondary system
- Displacement ventilation in Auditorium and
- Fan coils/chilled beam
- Radiant ceiling in Atrium
Primary system
- Reverse Air Heat Pump

Secondary system
- VAV system with heat/cool recuperation
- Displacement ventilation in Auditorium and large classes
- Fan coils/chilled beam
- Radiant floor in Atrium
MEP OPTIONS - DIAGRAMS

OPTION 1

OPTION 2
TIMBER FLOOR SANDWICH

Typical

- Floor Finish
- CLT Floor Panel w/ lightweight topping
- Glulam Beam
- MEP
- Ceiling Finish

Auditorium

- Floor Finish
- CLT Floor Panel w/ lightweight topping
- Post-tensioned flitch beam
- MEP
- Ceiling Finish
- Floor Finish
- Concrete slab on grade
CIRCULATION

BIG IDEA

NATURE

Circulation of air
Sustainable ventilation

"CIRCLElation"

Distribution of spaces
Coordinated solutions

INTEGRATED TEAMWORK

Circulation of people
Work & study environment

USER-ORIENTED DESIGN

CIRCULATION of people
Work & study environment

Distribution of spaces
Coordinated solutions

INTEGRATED TEAMWORK

CIRCULATION of air
Sustainable ventilation

"CIRCLElation"
CIRCULATION

DEVELOPMENT OF DESIGN

1. Circulation of information
   Analysis of given requirements and lessons learned while doing first concept

2. Circulation of air and spaces
   Natural ventilation vs distribution of spaces and communication

3. Green workspaces
   Activation of the corridors
   Creating user-experience
CIRCULATION
CIRCULATION

ORIENTATION ON THE SITE

- Pedestrian access from Winston Dr
- Meeting spot in front of the entrance
- Main access to the plaza
CIRCULATION

ORIENTATION ON THE SITE

NATURAL VENTILATION – CROSS VENTILATION
Corridor as buffer
- Prevents from direct wind in the classrooms or offices
- Air gets warmed up in the glazed corridor
CIRCULATION

VENTILATION SHAFT WITH GREENERY

Auditorium
CIRCULATION

FACADE

1. MODULE

- Louvers with PV panels

2. MODULE

- Glass

3. MODULE

- Greenery to collect CO2

+ PV to create electricity for plug load

Façade detail
CIRCULATION

LIVING WALL PANELS

Generating electricity for plug load

Green workspaces
CIRCULATION

- Façade from crossroad
- Façade from N State Dr
- Façade from adjacent plot
- Façade from Winston Dr
CIRCULATION

SECTION

WORK

STUDY

MEET

Faculty lounge
Faculty offices
Small classrooms
Instructional Lab
Auditorium
Large classrooms
CIRCULATION

FLOOR PLAN LEVEL 0

Level 0
- Auditorium
- Large classrooms
- Rentable space- café
- Mechanical room
- Toilets
CIRCULATION

LEVEL 0

CIRCULATION WITHIN THE BUILDING

Horizontal communication
Vertical communication
Entrances
Green workspaces

Entrance area
CIRCULATION

FLOORPLAN LEVEL -1

Level -1
- Auditorium
- Large classrooms
- Storage
CIRCULATION

FLOOR PLAN LEVEL +1

Level +1
- Small classrooms
- Instructional labs
- Seminar rooms
- Student offices
- Toilets
- Storage
- Technical room & server room
- Green open workspaces
CIRCULATION

LEVEL +1

CIRCULATION WITHIN THE BUILDING

- Green workspaces
- Horizontal communication
- Vertical communication
- Entrances
- Green workspaces
FLOOR PLAN LEVEL +2

- Faculty lounge
- Faculty offices
- Department Chair’s office
- Senior Administration office
- Administrative Assistants
- Toilets
- Outdoor terraces
CIRCULATION

LEVEL +2  CIRCULATION WITHIN THE BUILDING

- Faculty lounge & offices
- Horizontal communication
- Vertical communication
- Entrances
- Green workspaces
Steel Scheme

Superstructure:
Gravity:
  ▪ HSS columns & W-shaped beams
  ▪ Composite metal deck
Lateral:
  ▪ ConXtech XL 300

Substructure: Concrete & Steel
Foundations: Strip footings

Hybrid Concrete & Steel Scheme

Superstructure:
Gravity:
  ▪ Concrete moment frame
  ▪ Post-tensioned concrete deck
  ▪ Steel cantilevers
Lateral:
  ▪ Concrete Moment frames

Substructure: Concrete
Foundations: Strip footings
STEEL – LEVEL 0

Typical Elements

<table>
<thead>
<tr>
<th>Element</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Column</td>
<td>HSS 12x12x5/8</td>
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<tr>
<td>Girder</td>
<td>W12x50</td>
</tr>
<tr>
<td>Beam</td>
<td>W18x97</td>
</tr>
<tr>
<td>Tension ring</td>
<td>W21x93</td>
</tr>
</tbody>
</table>
CANTILEVER DETAIL

Double curvature

max 8' 2"

Shear tab connection
Shop assembly

Moment connections

ConXL Moment connections

max 22"

Shear tab connection
STEEL – LEVEL 1

Typical Elements

Column
- HSS 12x12x5/8

Girder
- W12x50
- W18x97

Beam
- W10x26

Tension ring
- W21x93
STEELE – LEVEL 2

Typical Elements

- **Column**: HSS 12x12x5/8
- **Girder**: W12x50
- **Beam**: W10x26
- **Tension ring**: W18x97
STEEL – LEVEL -1 & FOUNDATIONS

Typical Elements

<table>
<thead>
<tr>
<th>Element</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel column</td>
<td>12&quot;x12&quot;</td>
</tr>
<tr>
<td>Concrete retaining wall</td>
<td>12&quot;</td>
</tr>
<tr>
<td>Steel girder</td>
<td>W12x50</td>
</tr>
</tbody>
</table>
STEEL - 3D SECTION CUTS

Floor -1&0

Floor 1

Floor 2

Bridge to Winston Dr.
GRAVITY LOAD PATH

Challenge: floating columns on Level 2

Gravity load  Transfer load  Compression
LATERAL LOAD PATH

Transfer load
Compression
Gravity load
Tension
Tension ring

Gravity load
Transfer load
Compression
Tension

105'
22'
7'
CONCRETE - LEVEL 0

**Typical Elements**

- Concrete column: 12"x12"
- Concrete beam: 12"x24"
- Concrete shear wall: 8"
- Pour strip: 36"x24"
- Steel girders / beams: W12x50
- Steel column: HSS 8x8x3/8
CONCRETE – PT Tendon Layout

Challenge: shaft openings

Challenge: shaft openings

Pour Strip
CANTILEVER DETAIL

- Shear tab connection
- Shop assembly
- Moment connections
- Embedded plate w/ Moment connections
- Double curvature

max 8' 2"
max 22"
CONCRETE - LEVEL 1

Typical Elements

- Concrete column: 12"x12"
- Concrete beam: 12"x24"
- Concrete shear wall: 8"
- Pour strip: 36"x24"
- Steel girders / beams: W12x50
CONCRETE - LEVEL 2

Typical Elements

Concrete column  ➡  12"x12"
Concrete beam  ➡  12"x24"
Concrete shear wall  ➡  8"
CONCRETE - LEVEL -1 & FOUNDATIONS

Typical Elements

- Concrete column: 12"x12"
- Concrete shear wall: 8"
- Concrete retaining wall: 12"

Strip footing
CONCRETE - 3D SECTION CUTS

Floor -1&0

Challenge: long spanning columns

Floor 2

Floor 1

146'-0" 106'-0"

129'-0"

98'-0"

146'-0"

16'-0"
GRAVITY LOAD PATH

Challenge: floating columns on Level 2

Gravity load  Transfer load  Compression
LATERAL LOAD PATH

- Gravity load
- Transfer load
- Compression
- Tension

Dimensions:
- 105' length
- 22' width
- 7' height
SOLAR ENERGY
SOLAR ENERGY

View from South West

View from South East

View from North West

View from North East

Project location: 1000 Holloway Ave, San Francisco, CA 94132
Sun study start date time: 2010-01-01 00:00:00
Sun study end date time: 2010-12-31 23:59:00
Cumulative Irradiation
COLLECTING WATER

Collected Water

Step 1: Air
As air passes over the heated air source, water vapor is released from the air.

Step 2: Vapor
As the vapor exits, it condenses to water.

Step 3: Water
The water is collected in a collection area.

Step 4: Water per unit
Water can be used in various ways, such as drinking, cooking, or cleaning.
MEP OPTION 1

Option 1

Primary system
- Reverse Heat Pump
- Natural ventilation in building

Secondary system
- VAV backup system with heat/cool recuperation
- Displacement ventilation in auditorium and large classes
- Fan coils/chilled beam
- Radiant ceiling in Atrium
MEP OPTION 2

Option 2

Primary system
- Reverse Heat Pump

Secondary system
- Natural ventilation in building
- Supply Ventilation as backup system
- Fan coils/chilled beam
- Radiant ceiling in Atrium
MEP OPTIONS

OPTION 1

OPTION 2
STV RESULTS

**Life Cycle Assessment Results Overview**

**Total Life Cycle Impacts**

<table>
<thead>
<tr>
<th>Impact</th>
<th>Target</th>
<th>Project</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon (kgCO2e)</td>
<td>3,714,897</td>
<td>2,148,011</td>
<td>57%</td>
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<tr>
<td>Energy (MJ)</td>
<td>120,002,807</td>
<td>230,419,311</td>
<td>19%</td>
</tr>
<tr>
<td>Water (kgH2O)</td>
<td>73,547,945</td>
<td>505,523,177</td>
<td>74%</td>
</tr>
<tr>
<td>Chrome (kgCo)</td>
<td>-</td>
<td>2.61E-01</td>
<td>-</td>
</tr>
</tbody>
</table>

**Performance Relative to Life Cycle Impact Targets**

- **Option 1**
- **Option 2**
STEEL FLOOR SANDWICH
Spring quarter: Reduce the height of floors.
CHALLENGES AND SOLUTIONS

Challenges

High labor cost
High construction costs
Restricted site access
Minimum nuisance to surrounding educational buildings (library, SAC)

Solutions

Just In Time
Prefabrication
Non-Peak hours Delivery
Real time tracking
## EQUIPMENT SELECTION

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Equipment Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>Crawler Crane LR 1110</td>
</tr>
<tr>
<td></td>
<td>Tower Crane NC-B-6-62</td>
</tr>
<tr>
<td>Telehandler</td>
<td>Telehandler Reach Forklift, 10,000 lbs., 44-55 ft.</td>
</tr>
<tr>
<td>Dump trucks</td>
<td>12 CY</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>CAT 320D Hydraulic Excavator</td>
</tr>
<tr>
<td>Telehandler</td>
<td>BRF 42.14 H (horizontal reach: 124 ft)</td>
</tr>
<tr>
<td>Concrete Mixer trucks</td>
<td>8 CY</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Equipment Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>CAT 320D Hydraulic Excavator</td>
</tr>
<tr>
<td>Telehandler</td>
<td>BRF 42.14 H (horizontal reach: 124 ft)</td>
</tr>
<tr>
<td>Concrete Mixer trucks</td>
<td>8 CY</td>
</tr>
</tbody>
</table>
CONSTRUCTION SITE PLAN

EXCAVATION/FOUNDATION PHASE – CONNECTION

Legend:
- Fence
- Excavated Area
- Excavator/Concrete Pump
- Waste area
- Dump Truck/Concrete Mixer Truck
- Material Laydown
- Parking area
- Site Office
- Toilet

North

3D View
CONSTRUCTION PHASE – CONNECTION

Legend:
- Fence
- Footprint
- Flatbed Truck
- Waste area
- Stairs
- Material Laydown
- Parking area
- Site Office
- Toilet
- Crane position
- Crane Radius

Tower Crane Option
- Winston Dr
- ZONE 3
- ZONE 2
- ZONE 1

Crawler Crane Option
- Winston Dr
- ZONE 3
- ZONE 2
- ZONE 1

North

N State Dr

MEP Equipment
CONSTRUCTION SITE PLAN

EXCAVATION/FOUNDATION PHASE – CIRCULATION

Legend
- Fence
- Excavated Area
- Excavator/Concrete Pump
- Waste area
- Dump Truck/Concrete Mixer Truck
- Material Laydown
- Parking area
- Site Office
- Toilet

3D View
CONSTRUCTION PHASE – CIRCULATION

Tower Crane Option

Crawler Crane Option

Legend
- Fence
- Footprint
- Flatbed Truck
- Waste area
- Stairs
- Material Laydown
- Parking area
- Site Office
- Toilet
- Crane position
- Crane Radius

North

Winston Dr

N State Dr

Zone 1

Zone 2

Zone 1

Zone 2
CONSTRUCTION PHASE – CIRCULATION

Tower Crane Option

Crawler Crane Option
Hydraulic lift crane

**LR 1110**

- **Main boom length:** 76'
- **Luffing jib length:** 123'

**Line** | **Description** | **Main boom angle** | **Luffing jib angle**
---|---|---|---
**Green** | Maximum Reach | 65° | 20°
**Blue** | MEP Equipment | 75° | 40°
**Red** | Minimum Reach | 88° | 78°

**Line** | **Description** | **Weight** | **Radius**
---|---|---|---
**Green** | Maximum Reach | 7 900 lb | 150'
**Blue** | MEP Equipment | 17 200 lb | 100'
**Red** | Minimum Reach | 42 300 lb | 40'

**MEP Equipment maximum weight:** 15 000 – 17 000 lb

**SE and A maximum weight:** 2 000 – 4 000 lb
**TOWER CRANE – NC-B 6-62**

**Tower Crane NC-B 6-62**

- **Main boom length**: 150’
- **Hoist Height**: 72 ft

<table>
<thead>
<tr>
<th>Line</th>
<th>Description</th>
<th>Weight</th>
<th>Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Maximum Reach</td>
<td>7100 lb</td>
<td>150’</td>
</tr>
<tr>
<td>Blue</td>
<td>MEP Equipment</td>
<td>11400 lb</td>
<td>100’</td>
</tr>
<tr>
<td>Red</td>
<td>Minimum Reach</td>
<td>13200 lb</td>
<td>20’</td>
</tr>
</tbody>
</table>

**MEP Equipment maximum weight**: 15 000 – 17 000 lb

**SE and A maximum weight**: 2 000 – 4 000 lb
CONNECTION - SCHEDULE

**CONNECTION - TIMBER**

- **Site Prep**: 2 w
- **Excavation**: 5 w
- **Substructure**: 4 w
- **Superstructure**: 10 w
- **MEP**: 6 w
- **Exterior**: 7 w
- **Interior**: 6 w
- **Landscaping & Commissioning**: 6 w

**Handover and Close out**: 3 w

**TOTAL DURATION**: 40 WEEKS

**2024**

- **Jun**: Week 1, 5, 9, 13, 17, 21, 25, 29, 33
- **Jul**: Week 1
- **Aug**: Week 1
- **Sep**: Week 1
- **Oct**: Week 1
- **Nov**: Week 1
- **Dec**: Week 1
- **Jan**: Week 1
- **Feb**: Week 1

**CONNECTION - STEEL**

- **Site Prep**: 2 w
- **Excavation**: 4 w
- **Substructure**: 4 w
- **Superstructure**: 6 w
- **MEP**: 7 w
- **Exterior**: 6 w
- **Interior**: 6 w
- **Landscaping & Commissioning**: 6 w

**Handover and Close out**: 3 w

**TOTAL DURATION**: 34 WEEKS

**2024**

- **Jun**: Week 1, 5, 9, 13, 17, 21, 25, 29, 33
- **Jul**: Week 1
- **Aug**: Week 1
- **Sep**: Week 1
- **Oct**: Week 1
- **Nov**: Week 1
- **Dec**: Week 1
- **Jan**: Week 1
- **Feb**: Week 1

**RAINY SEASON**

**Handover of IT office and Labs.**

**Finish of exterior work. Crane leaves site.**

**Finish of basement. Crane arrives to site.**

**Finish of exterior work. Crane leaves site.**

**Handover of IT office and Labs.**
CIRCULATION - SCHEDULE

TOTAL DURATION: 44 WEEKS

CIRCULATION - CONCRETE

- **Site Prep**: 2 w
- **Excavation**: 5 w
- **Substructure**: 5 w
- **Superstructure**: 11 w
- **MEP**: 7 w
- **Exterior**: 8 w
- **Interior**: 7 w
- **Landscaping & Commissioning**: 6 w
- **Handover and Close out**: 3 w

2024

<table>
<thead>
<tr>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21</td>
<td>25</td>
<td>29</td>
<td>33</td>
<td>37</td>
</tr>
</tbody>
</table>

2025

|     |     |     |     |     | 41  | 43  |

**TOTAL DURATION**: 40 WEEKS

CIRCULATION - STEEL

- **Site Prep**: 2 w
- **Excavation**: 5 w
- **Substructure**: 5 w
- **Superstructure**: 6 w
- **MEP**: 7 w
- **Exterior**: 8 w
- **Interior**: 7 w
- **Landscaping & Commissioning**: 6 w
- **Handover and Close out**: 3 w

2024

<table>
<thead>
<tr>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>9</td>
<td></td>
<td></td>
<td>17</td>
<td>21</td>
<td>25</td>
<td>29</td>
<td>33</td>
<td>37</td>
</tr>
</tbody>
</table>

**RAINY SEASON**

- **Finish of exterior work. Crane leaves site.**
- **Handover of IT office and Labs.**

2025

|     |     |     |     |     | 41  | 43  |

4 weeks

<table>
<thead>
<tr>
<th>Week 1</th>
<th>5</th>
<th>9</th>
<th>13</th>
<th>17</th>
<th>21</th>
<th>25</th>
<th>29</th>
<th>33</th>
<th>37</th>
<th>40</th>
<th>2025</th>
</tr>
</thead>
</table>

PACIFIC 2020
MODEL-BASED COST ESTIMATION

BIM MODEL

COST DATABASE

Quantity Take-Off

ESTIMATING

RSMeans data
from GORDIAN

PACIFIC 2020
CONSTRUCTION COST TRACKING

TVD - TRACKING TARGET OVER TIME

Model at 80% Cost estimation based on the model and some assumptions
Adding Green Living wall
Model at 100%
Reducing Green living wall area
Increased area of fog catcher facade
Wind turbine facade -> Fog catcher facade

Target
RS Means Original
16-Feb
23-Feb
02-Mar
09-Mar

$9,000,000
$9,500,000
$10,000,000
$10,500,000
$11,000,000
$11,500,000
$12,000,000

$9,000,000
$9,500,000
$10,000,000
$10,500,000
$11,000,000
$11,500,000
$12,000,000

TARGET
$11,900,000

$10,200,000
$10,800,000
$11,000,000
$11,100,000
$11,600,000

Connection - Timber
Connection - Steel
Circulation - Concrete
Circulation - Steel
CONSTRUCTION COST COMPARISON

<table>
<thead>
<tr>
<th>Material</th>
<th>A Substructure</th>
<th>B Shell</th>
<th>C Interiors</th>
<th>D Services</th>
<th>E Equipment and Furnishing</th>
<th>F Specialty Construction</th>
<th>G Building Sitework</th>
<th>H General Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>4%</td>
<td>40%</td>
<td>18%</td>
<td>17%</td>
<td>2% 10% 3% 6%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete</td>
<td>5%</td>
<td>37%</td>
<td>19%</td>
<td>18%</td>
<td>2% 10% 3% 6%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel</td>
<td>4%</td>
<td>39%</td>
<td>17%</td>
<td>18%</td>
<td>2% 16% 3% 1%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timber</td>
<td>4%</td>
<td>37%</td>
<td>18%</td>
<td>19%</td>
<td>2% 17% 3% 1%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TARGET $11,900,000

- A Substructure: $11,600,000
- B Shell: $11,100,000
- C Interiors: $10,800,000
- D Services: $10,200,000
- E Equipment and Furnishing: $1,700,000
- F Specialty Construction: $1,100,000
- G Building Sitework: $800,000
- H General Conditions: $300,000

$1,100,000
$800,000
$300,000

PACIFIC 2020
ACCESS ROUTES - SUPPLIERS

<table>
<thead>
<tr>
<th>Site</th>
<th>Timber</th>
<th>Concrete</th>
<th>Steel</th>
<th>Precast</th>
<th>Equipment</th>
<th>Building Trades Council (Union labour)</th>
</tr>
</thead>
</table>

Map of access routes to suppliers in the San Francisco region.
CONSTRUCTION PROCESS – PT SLAB

Install Slab and side formwork

Lower + Anti-bursting + punching shear reinforcement placement

Bar Chairs + Tendons + extra top reinforcement placement

Concrete pouring

Side formwork removal + stressing of tendons + cut

Air pump for cleaning + grouting
IMPACT OF STV, TVD & DESIGN ON LCC

Fog Catcher and Photovoltaic Panels

Financial Structure and Capital Cost

Senior Loan (Interest rate = 4.0%); 10%
Equity: 10%

Junior Loan (Interest rate = 2.6%); 80%

Additional Rentable Areas

<table>
<thead>
<tr>
<th>KPI</th>
<th>Connection - Timber</th>
<th>Connection - Steel</th>
<th>Circulation - Concrete</th>
<th>Circulation - Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>STV (Water + Energy)</td>
<td>$120.000</td>
<td>$120.000</td>
<td>$160.000</td>
<td>$160.000</td>
</tr>
<tr>
<td>TVD</td>
<td>$10.200.000</td>
<td>$10.800.000</td>
<td>$11.100.000</td>
<td>$11.600.000</td>
</tr>
<tr>
<td>Interest (25 years)</td>
<td>$3.973.000</td>
<td>$4.207.000</td>
<td>$4.324.000</td>
<td>$4.519.000</td>
</tr>
<tr>
<td>Additional Rental Income p.a.</td>
<td>$150.000</td>
<td>$150.000</td>
<td>$96.000</td>
<td>$96.000</td>
</tr>
</tbody>
</table>
Sizes of the bubbles indicate risk value (= probability * severity)
### FINANCIAL SUMMARY (LCC, RENT & RISK)

<table>
<thead>
<tr>
<th>KPI</th>
<th>Connection - Timber</th>
<th>Connection - Steel</th>
<th>Circulation - Concrete</th>
<th>Circulation - Steel</th>
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</thead>
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<tr>
<td>STV (Water + Energy)</td>
<td>$ 120.000</td>
<td>$ 120.000</td>
<td>$ 160.000</td>
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<tr>
<td>TVD</td>
<td>$ 10.200.000</td>
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<td>$ 11.100.000</td>
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<td>$ 4.207.000</td>
<td>$ 4.324.000</td>
<td>$ 4.519.000</td>
</tr>
<tr>
<td>Additional Rental Income p.a.</td>
<td>$ 150.000</td>
<td>$ 150.000</td>
<td>$ 96.000</td>
<td>$ 96.000</td>
</tr>
<tr>
<td>Target Rent p.a. (Initial Year)</td>
<td>$ 900.000</td>
<td>$ 940.000</td>
<td>$ 1.000.000</td>
<td>$ 1.000.000</td>
</tr>
<tr>
<td>LCC (25 years)</td>
<td>$ 30.300.000</td>
<td>$ 31.100.000</td>
<td>$ 31.600.000</td>
<td>$ 32.200.000</td>
</tr>
<tr>
<td>NPV - After Financing and Tax</td>
<td>$ 2.600.000</td>
<td>$ 2.100.000</td>
<td>$ 700.000</td>
<td>$ 200.000</td>
</tr>
<tr>
<td>IRR - After Financing and Tax</td>
<td>10,00%</td>
<td>10,00%</td>
<td>6,86%</td>
<td>4,50%</td>
</tr>
</tbody>
</table>

**Maximum = $1 m**

**5% of profit = donation for student community**

Minimum Value for Target Value Search (not possible for Circulation concept)
# CONSTRUCTION COMPARISON

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Timber</th>
<th>Steel</th>
<th>Concrete</th>
<th>Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructability</td>
<td>🟢</td>
<td>🟢</td>
<td>🟥</td>
<td>🟢</td>
</tr>
<tr>
<td>Schedule</td>
<td>🟠</td>
<td>🟠</td>
<td>🟥</td>
<td>🟠</td>
</tr>
<tr>
<td>Cost</td>
<td>🟢</td>
<td>🟠</td>
<td>🟠</td>
<td>🴈</td>
</tr>
<tr>
<td>Prefabrication</td>
<td>🟠</td>
<td>🟠</td>
<td>🟠</td>
<td>🟠</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>11</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>
## TRADE OFF ANALYSIS - RANKING

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
<th>Industrialization / Prefabrication</th>
<th>Sustainability (kgCO2e)</th>
<th>Total points</th>
</tr>
</thead>
</table>
| Connection - Timber | $10,200,000 | • Modular construction  
                          • Easier prefabrication and transportation                                                              | 100%                     | 8           |
| Connection - Steel | $10,800,000 | • Modular construction  
                          • Easier prefabrication and transportation                                                              | +14%                     | 7           |
| Circulation - Steel | $11,600,000 | • Single structural material  
                          • Circular structure  
                          • ConXTech connections                                                                                 | +30%                     | 1           |
| Circulation - Concrete | $11,100,000 | • Hybrid structural materials  
                          • Circular structure                                                                                   | +61%                     | 2           |
COMPARISON OF RENEWABLE SOURCES

Energy

Energy from PV panels

- Connection
- Circulation

Water

Water collection

- Connection
- Circulation
COMPARISON OF RENEWABLE SOURCES

STV

Summary CO2e emission

Best option

Timber option

CO2e emission - construction
## COMPARISON OF MEP OPTIONS

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Ground heat pump</th>
<th>Reverse air heat pump</th>
<th>Supply air backup system</th>
<th>VAV backup system</th>
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</thead>
<tbody>
<tr>
<td>Energy from PV</td>
<td>🟢</td>
<td>🟢</td>
<td>🟢</td>
<td>🟢</td>
</tr>
<tr>
<td>Water collecting</td>
<td>🟢</td>
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<td>🟢</td>
<td>🟢</td>
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<tr>
<td>Investing cost</td>
<td>🟢</td>
<td>🟢</td>
<td>🟢</td>
<td>🟢</td>
</tr>
<tr>
<td>Using cost</td>
<td></td>
<td>🟢</td>
<td>🟢</td>
<td>🟢</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>12</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>
DECISION MATRIX - METHODOLOGY

1. Decision of Criteria
- Big Idea
- Usability / Design
- Constructability
- Sustainability
- Operability

2. Weighting Criteria
- Owners (33%)
- Team Pacific (33%)
- Users (33%)

- 4 = very good
- 3 = good
- 2 = ok
- 1 = bad
- 0 = really bad

3. Score Criteria

4. Identify Winner

Weighting of Criteria

Owners
Team Pacific
Users

Big Idea
40%

Operability
30%

Usability / Design
20%

Sustainability
10%

Constructability
0%
AND THE WINNER IS...
Connection Timber
DETECTION MATRIX - SUMMARY

Scoring of the Criteria
- Connection - Timber
- Connection - Steel
- Circulation - Concrete
- Circulation - Steel

4 = very good
3 = good
2 = ok
1 = bad
0 = really bad

<table>
<thead>
<tr>
<th>Role</th>
<th>Weighting</th>
<th>Connection - Timber</th>
<th>Connection - Steel</th>
<th>Circulation - Concrete</th>
<th>Circulation - Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owners</td>
<td>33%</td>
<td>3.6</td>
<td>3.1</td>
<td>2.9</td>
<td>3.0</td>
</tr>
<tr>
<td>Team Pacific</td>
<td>33%</td>
<td>3.5</td>
<td>3.5</td>
<td>2.3</td>
<td>2.5</td>
</tr>
<tr>
<td>Users</td>
<td>33%</td>
<td>3.6</td>
<td>3.5</td>
<td>2.5</td>
<td>2.6</td>
</tr>
<tr>
<td>Sum</td>
<td></td>
<td>10.8</td>
<td>10.1</td>
<td>7.7</td>
<td>8.1</td>
</tr>
</tbody>
</table>

Weighted Average Scores
CO-ORDINATION AND COLLABORATION

When2Meet
Group's Availability

BIM Glue – Clash Detection

IrisVR – Clash Detection/Troubleshooting

Excel – Voting Decision Matrix/Targets

Asana -> Excel
VR COORDINATION AND WALKTHROUGH

Architect is using VR everyday for the FINAL DESIGN!

# of times of using VR per week

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>VR Usage</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-Jan</td>
<td>Kick Off</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>07-Feb</td>
<td>First Concept</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>16-Feb</td>
<td>Two Concepts</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>23-Feb</td>
<td>Crit Session</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>02-Mar</td>
<td>Four Concept Options</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>09-Mar</td>
<td>Final models</td>
<td>2.5</td>
<td></td>
</tr>
</tbody>
</table>

Group: # of times using VR in a group
Individual: # of times using VR in an individual setting
LESSONS LEARNED

"Fail spectacularly!"

Remember to check AM or PM!

Check autocorrection! "DOG Catcher"

It's all about understanding and positive attitude!

Piero Urrutia 1:23 PM
Guys
Meeting tomorrow @ 8:00PM PST?
👍 3 😊

Adrian 10:27 PM
8pm is hard, would prefer 9pm

Mek 5:43 AM
I don't have class at 9:30 pm...?

Piero Urrutia 5:12 AM
GuYS
i up
It's 8:00 AM
@channel

Mek 20:20
That's pretty cool

Gonna be a nightmare for SE and CM maybe but I'm excited