PACIFIC TEAM

A - Young Kim
E - Elina Wetterblad
    Therese Karlsson
    Elyse Wong
C - Carolyn Galayda
    Chris Hall
    Ladislav Klinć
The Team

Owners:
Hans Verhay
& Eric Borchers

Time difference:
Palo Alto 11 am
Georgia 2 pm
Ljubljana 7 pm
Stockholm 7 pm
### Winter Quarter Decision Matrix

<table>
<thead>
<tr>
<th></th>
<th>A1-BRBF</th>
<th>A1-MRF</th>
<th>A2-MRF</th>
<th>A2-Concrete</th>
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<td><strong>TOTAL</strong></td>
<td>78</td>
<td>76</td>
<td>80</td>
<td>81</td>
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| **Floor Plan**  | 20       | 20     | 10     | 10          |
| **TOTAL**       | **98**   | **96** | **90** | **91**      |

Arch Concept 1 – Double Diamond (Moment/Brace Frame)  
Arch Concept 2 - Square (Moment Frame/Concrete)
• Site
• Concept
• Site plan + Floor plan + Section plan
• Facade design + Daylight design concept
• Sun Shade
• 3D views
Project Site-SFSU
Existing Conditions
Proposed Access
Spatial Affinities
Architectural Concept

- Become a local community anchor

- Reflect San Francisco’s cultural identity
Architectural Concept

Mass Concept

Program Layout
First Floor Plan
Third Floor Plan

Pacific Team
Section Plan

North-South section
Facade Design Concept

FACADE DESIGN CONCEPT - Inspirations

MACON à BORDEAUX, France, Bordeaux, 1995, Renzo Piano

Villa VERDI, Utrecht, Netherlands, UNStudio

BBC Music Center, UK

FACADE DESIGN CONCEPT - Diagrams
Daylight Design Concept

- Give west and south windows shading priority. Morning sun is usually not a serious heat gain problem.
- Use a vertical form on west windows
Daylight Design Concept

South Side

Alt. Angle Winter, Noon: 30°
Alt. Angle Summer, Noon: 75°
Selected a critical month and time for shading:
- south windows use September noon,
- east use September 10am,
- west use September 3 pm
Sun Shade-Interior Views

Lobby

Central Space

Student Office
3D views
Exterior views

North side view

East side view

West side view

South side view
Interior Views

Lobby view

Atrium View
Process
ENGINEERING

- Loading
- Floor Layouts
- Lateral Systems
- Pushover Analysis
- Foundation
Gravity Loading

per ASCE 7-05

Dead Load

<table>
<thead>
<tr>
<th>Component</th>
<th>Load (psf)</th>
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<tr>
<td>MEP</td>
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<td>Partitions</td>
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<td>Composite Floor Deck</td>
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Live Load (per room type)

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<td>Offices</td>
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<td>Assembly area- fixed seats</td>
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<tr>
<td>Classrooms</td>
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<tr>
<td>Access floor systems</td>
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<td>Stairs and exit ways</td>
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<td>Corridors</td>
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<tr>
<td>Green Roof</td>
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</tr>
<tr>
<td>Restrooms</td>
<td>50</td>
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</tbody>
</table>

Load Combinations

- \(1.2D + 1.6L\)
- \(1.2D + 0.5L + 1.6W\)
- \((1.2 + 0.2 S_{DS})D + 0.5L + 1.0E\)
- \(0.9D + 1.0E\)

\[\Rightarrow 1.47D + 0.5L + 1.0E\]
Lateral Loading

Importance Factor = 1.0
Occupancy Category II

Wind

Exposure C
Wind Velocity = 85 mph
Velocity pressure,
\[ q_z = (0.00256V^2)K_zK_{zt}K_{d1} \]
Design Wind pressure,
\[ p = q_z(GC_p) \]

Earthquake ⇒ Controls!!

Site Class D
Seismic Design Category D
\[ S_s = 2.02, \quad S_1 = 1.083 \]
R = 8 (Buckling Restraining Brace Frame)

Seismic Base Shear:
\[ C_s = S_{DS} / (R/I) \]
\[ V = C_sW \]

Lateral Load Distribution:
\[ C_{vx} = \left( w_x h_x^{k} \right) / \sum (w_i h_i^{k}) \]
\[ F_x = C_{vx}V \]
Structural Approach

1. Lateral System and Column Locations
2. Member Sizes

2nd Floor

3rd Floor and Roof
Structural Approach

1. Lateral system and columns positions
2. Typical Member Sizes

Gravity System

- Transfer Girder: W24x492
- Beam W14x22
- Column W10x49

Lateral System

- Beam W18x76
- Column W14x99

2nd Floor
Structural approach

1. Lateral system and columns positions
2. Typical Member Sizes: Lateral System

- View from East
  \[ A_{sc,3} = 6 \text{ in}^2 \]
  \[ A_{sc,2} = 7 \text{ in}^2 \]
  \[ A_{sc,1} = 10 \text{ in}^2 \]
  2- 1¼” Ø Dywidag Bars

- View from North
  \[ A_{sc,3} = 7 \text{ in}^2 \]
  \[ A_{sc,2} = 10 \text{ in}^2 \]
  \[ A_{sc,1} = 14 \text{ in}^2 \]
  2- 1¼” Ø Dywidag Bars
Composite Floor Deck

Vulcraft 3VLI20

- 3 ¼” concrete + 3” metal deck
  = 6 ¼” total depth
- Lightweight Concrete (115 pcf)
- 46 psf
- 3-span
- Max sheet length 42’
Load Path

3VLI20 Vulcraft Composite Floor Deck

Base shear $V = 808 \text{ K}$

Load Path:
- 19 ft to 76 ft
- 16 ft
- 90 ft

Diagram showing the load path through the structure.
Typical Connections

BRBF Connection

3-Way Joint Connection
Krawinkler, 2009.

Beam-to-Column: Shear Connection

Krawinkler, 2009.
Story Drift: X- Direction

![Graph showing story drift ratio and actual drift](image)

- Allowable Drift
- Actual Drift

- $\Delta_{\text{roof}} = 1.33$ in
- $\Delta_3 = 0.94$ in
- $\Delta_2 = 0.48$ in
Story Drift: Y-Direction

\[ \Delta_{\text{roof}} = 0.76 \text{ in} \]
\[ \Delta_3 = 0.51 \text{ in} \]
\[ \Delta_2 = 0.24 \text{ in} \]
Mode Shapes

Mode 1
T = 0.52 sec

Mode 2
T = 0.36 sec

Mode 3
T = 0.26 sec
Pushover Analysis

Pushover Curve: Mode 1, T1=0.52 sec

Base Shear / Weight (V/W) vs. Roof Drift
Soil Information

Colma Formation

SP-SM

Bearing Capacity: 3500 psf

No Liquefaction Zone

Water Table: 14.5 ft

Liquefaction

Earthquake - Induced Landslides
Structural Model
CONSTRUCTION MANAGEMENT

- HVAC Overview
- Cost Estimate
- Schedule
- Logistics/Methods
- LEED Checklist
HVAC – Active Chilled Beams

- Uses water for energy transfer
- Energy efficient
- Smaller overall height
- Chilled beams coupled with ventilation unit
- Requires lower floor-to-floor height
HVAC

1st Floor

2nd Floor

3rd Floor

Air Flow - no chilled beams

Active Chilled Beams
Structural & MEP Impact on Excavation Depth: Arch Concept 1 - BRB System:

- Deck: 6.25"
- MEP: 12"
- Green Roof: 8"

Levels:
- 1st Flr. Beams: 22.7"
- 2nd Flr. Beams: 18.5"
- 3rd Flr. Beams: 16.5"

Spaces:
- Auditorium: ≈15’
- Green Roof: 8”
- Excavation: 12’

Excavate
Using active chilled beams for all the rooms except the auditorium and lobby (and maybe for 2 large classrooms). In these rooms we would only use air distribution, where we would pump air into the space along one or 2 walls (ducts would go from ceiling down to the floor where air distribution unit would be located. (we would like to ensure that air is distributed as low as possible).
Natural Ventilation: The Beddington Zero Energy Development

Operable windows allow air in one side of the building and out through the roof making use of the “Venturi effect”
Natural Ventilation: Venturi Effect in Central Corridor

West-East Section

Ceiling Vents

Prevalent Winds From West

HALLWAY

STAIRS

1st Floor

2nd Floor

3rd Floor

North Winds

Prevalent Winds
BMS controls exterior operable windows and interior clear-story louvers
eQuest Energy Model

434 kWh/year

311 MBtu/year

Total Annual Bill Across All Rates: $65,250 VS Average Cost = $74,800

14.6% Decrease

Note: Does Not Take Natural Ventilation Into Account
**Cost Estimate**

San Francisco State University  
- School Building  
Team Pacific  

DATED 05/08/2009

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<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Sub Total</th>
<th>Cost/SF</th>
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<td>01</td>
<td>FOUNDATION</td>
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<td>02</td>
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**INDIRECT COST**  
- Overhead: 15%  
  - Subtotal: $920,145  
  - Cost/SF: $28.56
- Fee: 10%  
  - Subtotal: $613,430  
  - Cost/SF: $19.04
- Contingency: 10%  
  - Subtotal: $613,430  
  - Cost/SF: $19.04

**2009 TOTAL COST**  
- $8,281,301  
- Cost/SF: $271.00

**2015 TOTAL COST**  
- $10,020,374  
- Cost/SF: $311.00

**MEP ~ 32.7%**  
**Superstructure ~ 19.7%**  
**Exterior Closure ~ 20.3%**  

2009 Costs = $8,281,000  
2015 Costs = $10,020,000
Cost Index Forecast

Source: http://www.docstoc.com/docs/4912172/Cost-Index-Forecast
Model based scheduling

Quantities from the model exported to scheduling software
Scheduling

• 3 zones per each floor
• 2 zones for excavation
• Using Vico Control and Flowline view
• Detecting clashes in flowline view
**Schedule**

Duration:
- 291 calendar days
- 41 weeks
- 9 months and 16 days

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<th>WBS</th>
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<th>Weeks</th>
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<td>Interior work</td>
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<td>10.8</td>
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<tr>
<td>Punchlist and final cleanup</td>
<td>49</td>
<td>7</td>
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</table>
4D Model
Site Approach

- Requires travel through low-height tunnel under mall
- Fence & Slope Along North Side Prevent Access
- Median Prevents Turn From North
- Not a Through Street

North
324D L Hydraulic Excavator –
Boom: 19 ft
Stick: 8 ft

Heavy Duty Bucket - intended for use in abrasive applications such as mixed dirt, clay, and rock

Ditch Cleaning Buckets - sloping, grading and other finishing work.

HC 80 Hydraulic Crawler Crane -
With 47HI offset tip boom; 58,100 Pound Counterweight

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<thead>
<tr>
<th>Radius (Feet)</th>
<th>Boom Angle (Degrees)</th>
<th>Side Frames (Pounds)</th>
<th>From Boom Pt. to Ground (Feet)</th>
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<td>69.8</td>
<td>14,640</td>
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<td>150</td>
<td>39.8</td>
<td>3,930</td>
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</table>

W24 x 492 – 1st Floor Beam

W14 x 33 – 3 Story Columns; Typ.

W18 x 35 – 3rd Floor Girder
South Face

36 Flat Conc. Panels: 6' x 6'
6 panels cut down to 4' wide

11 Small Curve Conc. Panels: 2' x 20'

9 Large Curve Conc. Panels: 10' x 10'

9 Flat Conc. Panels: 14' x 10'
All W/ Standardized Window Openings

9 Flat Conc. Panels: 4' x 10'
North Face

27 Exterior Panels: 4' x 12'
(Custom cut windows)

6 Flat Conc. Panels: 6' x 6'

8 Flat Conc. Panels: 14' x 10'
16 Flat Conc. Panels: 4' x 10'
With Standardized Window Openings

14 Small Curve Conc. Panels: 2' x 20'
## Prefab Concrete Panels

### Flat Concrete Panels

<table>
<thead>
<tr>
<th>QTY</th>
<th>Size (w x h)</th>
<th>Window Pattern</th>
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<td>6' x 6'</td>
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<tr>
<td>9</td>
<td>10' x 14'</td>
<td>(2) 24” D</td>
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<tr>
<td>4</td>
<td>10' x 14'</td>
<td>(1) 24” D</td>
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<td>4</td>
<td>10' x 14'</td>
<td>(1) 36”; (1) 60” D</td>
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<td>(2) 36” D</td>
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<td>27</td>
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### Concrete Curved Panels

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<td>25</td>
<td>2' x 20'</td>
</tr>
<tr>
<td>9</td>
<td>10' x 10'</td>
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North Elevation Window/Brace Pattern
Prefab PaperStone Panels

**Paperstone:** 100% post-consumer waste, recycled paper and proprietary, petroleum-free, phenolic resins & organic pigments

<table>
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<th>QTY</th>
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<td>42</td>
<td>4' x 12'</td>
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<td>6</td>
<td>2' x 12'</td>
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</table>
Curtain Wall Panels

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<td>9' x 6'</td>
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<td>34</td>
<td>8' x 10'</td>
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<tr>
<td>17</td>
<td>8' x 6'</td>
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<tr>
<td>4</td>
<td>2' x 6' (edge)</td>
</tr>
<tr>
<td>4</td>
<td>2' x 8' (edge)</td>
</tr>
<tr>
<td>4</td>
<td>2' x 9' (edge)</td>
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<tr>
<td>6</td>
<td>2' x 10' (edge)</td>
</tr>
<tr>
<td></td>
<td>+ custom curves</td>
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LEED-NC Version 2.2 Registered Project Checklist-Updated by GA/Real Estate Services for:

NEW PARKS AND RECREATION COMMISSION HEADQUARTERS FACILITY

<< San Francisco, CA, San Francisco State University School of Engineering Facility>>

<table>
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<th>P - Preferred Project Elements</th>
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<td>Innovation &amp; Design Process</td>
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**Project Totals (pre-certification estimates)**

| 34 | 21 | 14 | 69 Points |

Certified 26-32 points  Silver 33-38 points  Gold 39-51 points  Platinum 52-69 points  June 7, 2007
TEAM PROCESS

- Process & Progress
Synchronous Communication

**Skype** – Audio and some textual

**Netmeeting & Recall** – Graphic visual & audio recording

**Vsee** - Video during Friday meetings

**QWAQ** – Team building

* **DabbleBoard** – for real time graphic visual discussions during discipline specific meetings when netmeeting was unavailable
Asynchronous Communication

**Google Group:**
- Tracks all communication: *530 threads (thousands of posts)*
- Consolidates longer discussion threads and informal chatting in one spot
- Includes Calendar
- Easily allows Google Doc sharing

**Google Docs:**
- Allows multiple parties to view an edit
- Used for:
  - developing meeting agendas
  - tracking task list
  - sharing developing information and notes

**Oslo:**
- for sharing finalized information and files

**New ftp site:**
- used after Oslo ftp crashed; set up in Slovenia by Ladi
Norms/ Rules

- **Standardized Methods of:**
  - Weekly meeting role assignments
  - Agenda organization
  - Documentation naming and sharing for Oslo & Google docs
  - Sharing of all meeting minutes
  - Slide show development

- **Task List:** update weekly (Google Docs)
  (when, who, what, status, notes log includes links to further documentation)

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<td>- building frame systems- pro &amp; cons</td>
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<td></td>
<td>- elevator: what type and where - structural preferences of location of required rooms</td>
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<td>- Soil research. USGS visit w/ Carolyn 1/23/09.</td>
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<td>In Progress</td>
<td>Chris</td>
<td>Research Work Hrs/Arch &amp; Design Restrictions</td>
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<td>In Progress</td>
<td>Chris</td>
<td>Research Inflation (yr 2015)</td>
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Define Specific Tasks

Set Realistically Ambitious Time Frames

Weekly Assessment: Where are we vs. Where we need to be
Software

AutoCad: preliminary floor plans

Sketchup: preliminary 3D views

Revit: Final 3D model (architectural & Structural)
Etabs: Structural Analysis (imported from Revit)
Robot: Structural Analysis (foundation)
MathCad: Hand calculations

Archicad/Constructor: Arch. And Struc. Models redrawn in Archicad to drive schedule, cost estimate, and 4D model
*importing from Revit to Archicad via .ifc files did not work

Control: Schedule - driven by Constructor model

Vico Cost Manager: Estimate driven by Constructor model

eQuest: Energy modeling
Pacific Team saw improved productivity from taking these measures.

1) Increased Communications – with Owners and Renate

2) Increase Formalization

Pacific Team saw *improved productivity* from taking these measures.
Lessons Learned

COMMUNICATION and notification!!

The “ball” is always in your court because everyone’s on the same team.

Start with simple calcs, they will change a lot…

Make decisions synchronically

Check compatibility between softwares

You CAN do it!!
Thank You!!!

Special thanks to...

Renate Fruchter

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