Project Site
Site Conditions

- **Latitude**: 18°30’ N
- **Prevailing Winds**: North-East Trade Winds
- **Basic design wind speed**: 145 mph
- **Seismic**: Site Classification D
- **Average Temp**: 86°F - Max, 66.9°F - Min
- **Average Sunlight**: 8hrs per day, 1,466 BTU/sq.ft/per day
- **Precipitation**: 60-90” annual

Project Site

- Existing slope: 1:12 (aprox.)
- High traffic pedestrian corner
- Lush vegetation
- Vast green lawn
Concept A
Concept A - the Beehive

- Collaboration
- Centrally focused
- Connectivity
- Permeability
- A&E Integration
Design Iterations - Process

A Visualization

$800 more per ton of steel

C Input

E Development

A Concept
1. Entrance
2. Large Class
3. Auditorium
Façade Development

- Structure = brisoleils
- Curtain Wall = transparency, opacity, translucency
- Structure + curtain wall = tectonic
Volumetric Development
Volumetric Development
Loading Assumption

- **Dead load**
  - Self weight
  - MEP/ ceiling/ flooring/ cladding
    - chillers 250 psf - air exchange unit 100 psf

- **Live load (According to ASCE 7.2)**
  - Corridor: 80-100psf; Classroom: 40-80psf; Auditorium: 60psf;
  - Library/ file room: 150psf

- **Wind Load (ASCE)**
  - Windward: 22 psf
  - Leeward: 14 psf
  - Total: 35 psf

- **Earthquake Load (USGS)**
  - $S_s (g) = 1$
  - $S_1 (g) = 0.4$

*Based on Square footage

(*Assume Reduction factor 8
R=8 for Moment frame)

312.5kips
Concrete Structure

- Gravity Column (20ft – 25ft spacing)
  - 12” x 12” or 14” X 14” (p=1.5%)

- Post-tension Slab and Flat Slab
  - First Floor
    - PT Slab at Auditorium (12 in, Cable @1.5ft)
    - Flat Slab (10 in)
  - Second Floor/Roof
    - Flat Slab (10in)
  - Material specification
    - LW concrete (f’c=5ksi)
    - Steel tendon 7-wire strands
      - (fs=270ksi, effective stress= 0.6fs)
Concrete Structure - Challenges

- **12ft cantilever along the north side**
  - 24”x 12” (p=2%)

**Alternative:**
- Waffle Slab 1.8 ft thk.

- **50 ft Auditorium Beam (@ 10ft)**
  - 24”X24” Post-tension Beam

**MF Deflection**
\[
\Delta = \sum V_{col} \left(\frac{h}{2}\right)^2 \left(\frac{1}{K_{beam}} + \frac{1}{\sum V_{col} \left(\frac{h}{2}\right)^3 / 3E_{col}}\right)
\]

Preliminary sizing:
- according to 1.2 DL + 0.2S(DL) +1.6 LL
- Cantilever column: **28X14 (p=2%)**
- Interior column: **24X14 (p=2%)**

Continuous Girder: **28x14 (p=2.2%)**

Estimated deflection under live load: **0.512 in (L/510)**
Steel Structure

- Gravity Column
  - W14 X 48 W12 X 50

- Gravity Beam (full composite)
  - Interior girder (W18x 55)
  - Exterior girder (W16X31)
  - Filler beam (W12X26)

- Composite floor system
  - 2 hr fire rating
  - 4 inches LW concrete
  - 2VLI17 (Ip/In =0.633in4) or equivalent

Column Plan
Steel Structure Challenges

12ft cantilever along the north side
Back span cantilever beam W21X48

50 ft Auditorium Beam (@10ft)
CB 36X104 (root beam W24X104)
18 in openings

Preliminary sizing:
according to 1.2 DL + 0.2S(DL) + 1.6 LL
Girder: W14x82
Brace: W14x74

-Typical connection details
Lateral resistance system

- Shear wall at peripheral/ one side of mechanical shafts/ auditorium wall
- SMF peripheral
  - 100 ft
  - 10 in thickness shear wall
  - SMF Column 24X18 Beam 20 X 18

Concrete system
- Dual System - Shear Wall + Perimeter RC SMF
  - 10 in thickness shear wall
  - SMF Column 24X18 Beam 20 X 18

Steel system
- Dual System - Shear Wall + Steel SMF
  - 12 in thickness Shear Wall
  - SMF Column W14 x 145 Beam W18 x 106
  - Reduce Steel RC connection
Lateral resisting system

- Decision of choosing Dual system
- Tuning of length and rigidity (CR) of the shear wall
- The use of flat slab/PT slab in combination to peripheral SMF

<table>
<thead>
<tr>
<th></th>
<th>Shear Wall + Peripheral SMF</th>
<th>Shear wall + Ordinary MF</th>
<th>Shear wall + SMF</th>
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<tbody>
<tr>
<td>Cost /complexity</td>
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<td>✓</td>
<td>✓</td>
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<tr>
<td>Lateral Load Resistance</td>
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<tr>
<td>Internal gravity system</td>
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<tr>
<td>Overall performance</td>
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# Foundation

<table>
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<tr>
<th>Type</th>
<th>Qty</th>
<th>Length (ft)</th>
<th>Width (ft)</th>
<th>Depth (ft)</th>
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<tbody>
<tr>
<td>Square</td>
<td>11</td>
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<td>6</td>
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<tr>
<td>Aud Strip</td>
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<td>3.5</td>
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<tr>
<td>Class Strip</td>
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<td>2.5</td>
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<tr>
<td>Aud Beam</td>
<td>2</td>
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<td>Class Beam</td>
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<table>
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<tr>
<th>Slab on Grade</th>
<th>Area (ft^2)</th>
<th>Thickness (in)</th>
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<tr>
<td>Auditorium</td>
<td>50x70</td>
<td>8</td>
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<tr>
<td>Classroom</td>
<td>35x53</td>
<td>6</td>
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</table>
Sunken Box Structure

<table>
<thead>
<tr>
<th>Kips per unit width</th>
<th>Length</th>
<th>Height</th>
<th>Width</th>
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</thead>
<tbody>
<tr>
<td>43</td>
<td>67ft</td>
<td>12ft</td>
<td>8in</td>
</tr>
<tr>
<td>77</td>
<td>120ft</td>
<td>16ft</td>
<td>10in</td>
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</table>

Volume of Concrete
2140 ft³
MEP Rationale

Forced Air Ventilation

Natural Ventilation

Active Chilled Beams

Raised Flooring for Third Floor
Floor Level Section

Composite Deck = 6"

Beam = 1'

1st Floor

16.5'

2nd Floor

10'

Composite Deck = 6"

MEP = 2'

Beam = 1'

3rd Floor

8.5'

MEP = 1'
Delivery Times

- Besides Hwy Pr-27, route has low traffic conflict
- Schedule delivery times outside of rush-hour times

Heavy Traffic Routes
Critical Site Areas

Site Access
- Road west of site is a non-traffic road
- Minimal construction of site access road
- Local vegetation would go unharmed

Concrete Truck Waiting Area
- Waiting area would not obstruct traffic
- Existing Areas already used as loading zones
Jobsite Logistics/Placement

Staging and on-site fabrication:
- Reachable by crane
- Used for building components that require on-site fabrication
- Formwork assembly and storage
- Rebar assembly
- Storage of components too heavy for forklift operations
Jobsite Crane

- Grove RT9130E
- Max load of 73 tons from AHU
- Crane on site for 34 weeks
- $4500/week
- Proximity of max load and crane reach-ability reduces risk due to wind loads
## Concrete Structure Estimate

<table>
<thead>
<tr>
<th>Major Group Element</th>
<th>Cost</th>
<th>Cost per SF</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A SUBSTRUCTURE</td>
<td>$196,370</td>
<td>$6</td>
<td>3%</td>
</tr>
<tr>
<td>B SHELL</td>
<td>$1,605,833</td>
<td>$45</td>
<td>27%</td>
</tr>
<tr>
<td>C INTERIORS</td>
<td>$518,784</td>
<td>$15</td>
<td>9%</td>
</tr>
<tr>
<td>D SERVICES</td>
<td>$1,663,606</td>
<td>$47</td>
<td>28%</td>
</tr>
<tr>
<td>E EQUIPMENT &amp; FURNISHINGS</td>
<td>$191,018</td>
<td>$5</td>
<td>3%</td>
</tr>
<tr>
<td>F SPECIAL CONSTRUCTION &amp; DEMOLITION</td>
<td>$177,120</td>
<td>$5</td>
<td>3%</td>
</tr>
<tr>
<td>G BUILDING SITEWORK</td>
<td>$304,234</td>
<td>$9</td>
<td>5%</td>
</tr>
<tr>
<td>JOB SUBTOTAL</td>
<td>$4,656,965</td>
<td>$132</td>
<td>77%</td>
</tr>
<tr>
<td>Z1010 Administration (Overhead and Profit, 15%)</td>
<td>$698,545</td>
<td>$20</td>
<td>12%</td>
</tr>
<tr>
<td>Z1050 Permit, insurance and bonds (2%)</td>
<td>$195,584</td>
<td>$6</td>
<td>3%</td>
</tr>
<tr>
<td>Z2010 Design Contingencies (5%)</td>
<td>$232,848</td>
<td>$7</td>
<td>4%</td>
</tr>
<tr>
<td>Z2030 Construction Contingencies (5%)</td>
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</tr>
<tr>
<td>Total Project Cost</td>
<td>$6,016,791</td>
<td>$170</td>
<td>100%</td>
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</tbody>
</table>

### Major Group Elements

- **A SUBSTRUCTURE** 3%
- **B SHELL** 27%
- **C INTERIORS** 9%
- **D SERVICES** 28%
- **E EQUIPMENT & FURNISHINGS** 3%
- **F SPECIAL CONSTRUCTION & DEMOLITION** 3%
- **G BUILDING SITEWORK** 5%
- **Z GENERAL** 22%
Our Project in Other Cities
Concept 1 Concrete Structure

<table>
<thead>
<tr>
<th>Project Location</th>
<th>Base</th>
<th>Overhead and Profit (15%)</th>
<th>Contingency (10%)</th>
<th>Permits, Bond, and Insurance (2%)</th>
<th>Total</th>
<th>Cost per SF</th>
<th>Labor</th>
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<tbody>
<tr>
<td>Reno, Nevada</td>
<td>$6,013,473</td>
<td>$902,021</td>
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<td>$642,822</td>
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<td>$8,275,136</td>
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<td>$227,530</td>
<td>$7,646,051</td>
<td>$255</td>
<td>Open Shop</td>
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<tr>
<td>Madison, Wisconsin</td>
<td>$6,349,482</td>
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<td>$241,578</td>
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<td>Los Angeles, California</td>
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<td>$700,862</td>
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<td>$9,015,153</td>
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<td>$224,925</td>
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<tr>
<td>Albuquerque, New Mexico</td>
<td>$7,555,801</td>
<td>$1,133,370</td>
<td>$755,580</td>
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<td>$9,712,806</td>
<td>$324</td>
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<tr>
<td>San Fransisco, California</td>
<td>$8,185,175</td>
<td>$1,227,776</td>
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## Steel Structure Estimate

<table>
<thead>
<tr>
<th>Major Group Element</th>
<th>Cost</th>
<th>Cost per SF</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A SUBSTRUCTURE</td>
<td>$233,139</td>
<td>$7</td>
<td>4%</td>
</tr>
<tr>
<td>B SHELL</td>
<td>$2,033,162</td>
<td>$57</td>
<td>31%</td>
</tr>
<tr>
<td>C INTERIORS</td>
<td>$518,784</td>
<td>$15</td>
<td>8%</td>
</tr>
<tr>
<td>D SERVICES</td>
<td>$1,663,606</td>
<td>$47</td>
<td>25%</td>
</tr>
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<td>$5</td>
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<td>G BUILDING SITEWORK</td>
<td>$304,234</td>
<td>$9</td>
<td>5%</td>
</tr>
<tr>
<td>JOB SUBTOTAL</td>
<td>$5,121,063</td>
<td>$145</td>
<td>77%</td>
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<tr>
<td>Z1010 Administration (Overhead and Profit, 15%)</td>
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<td>Z1050 Permit, insurance and bonds (2%)</td>
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<td>Z2010 Design Contingencies (5%)</td>
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<td>Z2030 Construction Contingencies (5%)</td>
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<tr>
<td><strong>Total Project Cost</strong></td>
<td><strong>$6,608,516</strong></td>
<td><strong>$187</strong></td>
<td><strong>100%</strong></td>
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</tbody>
</table>

### Major Group Elements

- **A SUBSTRUCTURE**: 3%
- **B SHELL**: 31%
- **C INTERIORS**: 8%
- **D SERVICES**: 25%
- **E EQUIPMENT & FURNISHINGS**: 3%
- **F SPECIAL CONSTRUCTION & DEMOLITION**: 3%
- **G BUILDING SITEWORK**: 5%
- **Z GENERAL**: 22%
Sustainable Performance

- Passive Design Strategies (orientation, brisoileis, etc.)
- Natural Ventilation (corridors open to east / atrium is escape route)
- Energy Harvesting System on roof (sunpower pv panels à use of “State Sun Energy Program”)
- Flexible interior space
- Bicycle pkg.
- High efficiency windows and curtain wall

<table>
<thead>
<tr>
<th></th>
<th>Circulation area net foot area</th>
<th>Building volume gross floor area</th>
<th>Surface area building volume</th>
<th>Net floor area gross floor area</th>
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<tr>
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<td>3.0</td>
<td>&lt;0.25</td>
<td>&gt;0.60</td>
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</table>
Radiator

Site - What influences my site experience?
Initial ideas: volumetry/orientation sun path study
Floor Plans

Section AA

- Entrance
- Large Class
- Auditorium

First Floor
Volumetric Development

Section AA

Axonometrics
Sun Studies

April 21, 2015

October 21, 2015
Facades

East Facade

West Facade

North Facade

South Facade
Volumetric Development
North West
Volumetric Development
Concrete Structure

- **Gravity Column**
  - 12” x 12” or 14” X 14” (p=1.5%)

- **Post-tension Slab and Flat Slab**
  - **First Floor**
    - PT Slab at Auditorium (9 in, Cable @1.5ft)
    - Flat Slab (8 in)
  - **Second Floor/Roof**
    - Flat Slab (8in)
  - **Material specification**
    - LW concrete (f’c=5ksi)
    - Steel tendon 7-wire strands (fs=270ksi, effective stress= 0.6fs)

- **Central box structure**
  - Beam 18” X 12”
  - Column 12” X12”
Concrete Structure - Challenges

- **25ft cantilever at the east side**
  - Vierendeel Truss
  - Cantilever column: **28X14 (p=2%)**
  - Cantilever Girder: **28X18 (10 PT Tendons)**

- **40 ft Auditorium Beam (@10ft)**
- **24”X24”Post-tension Beam (9 PT)**

- **Post-tension Girder for Central Long Span Beam**
  - **28x18 (10 PT Tendons)**

- **Moment connection detail of the Truss**

- **Load from the column of the central box**
  - **15 in cable sag**

- **40 ft**
Steel Structure

- Gravity Column
  - W14 X 48 or W12 X 50

- Gravity Beam
  - Interior girder (W18x 55)
  - Exterior girder (W16X31)
  - Filler beam (W12X26)

- Composite floor system
  - 2 hr fire rating
  - 4 inches LW concrete
  - 2VLI17 (Ip/In =0.633in4) or equivalent

*Central Structure not shown for clarity*
Steel Structure Challenges

• 25ft cantilever at the east side
  • Girder: W14x82
  • Brace: W14x74

• 40 ft Auditorium Beam (@10ft)
  • CB 36X84 root beam W24X84

• 12ft cantilever at the south side
  • Brace: W14x74

• 40 ft Central Long Span Beam (@13ft)
  • W30X90

• Critical section on floor system

Allow openings

Allow openings
Lateral resisting system

- **Steel system**
  - Dual System - Shear Wall + Steel SMF
    - 10in thickness Shear Wall
    - Typical wall length 10ft, 15ft or 25 ft
    - Special Moment Frame
      - Column W14 x 159 Beam W18 x 119

- **Concrete system**
  - 8 no.s of Shear Wall
    - 12in thk

*Shear Wall*
Lateral resisting system – critical design details

- 8-10 no.s of shear walls
- Reduce shear walls by connector element
- Over-strength factor 2.5 (Shear wall system)
- Connection details may govern
  - connectors to shear wall
  - Check beam size or slab thickness

E-W earthquake

Typical axial/shear connection

Embed Section and Shear Studs
Foundation Structure interaction

- Steel Column to Square Foundation/ Strip footing
  - Part of the auditorium is sunk down by 18ft

- Column and Foundation Box Structure
  - Starter bar extending from substructure box to column
  - Clear auditorium height 20ft
  - Strip Footing
Sunken Box Structure

<table>
<thead>
<tr>
<th>Kips per unit width</th>
<th>Length</th>
<th>Height</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>24ft</td>
<td>60ft</td>
<td>9ft</td>
<td>5in</td>
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<tr>
<td>67ft</td>
<td>40ft</td>
<td>15ft</td>
<td>9in</td>
</tr>
<tr>
<td>97ft</td>
<td>114ft</td>
<td>18ft</td>
<td>11in</td>
</tr>
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</table>

Volume of Concrete
2556 ft^3
### Foundation

<table>
<thead>
<tr>
<th>Type</th>
<th>Qty</th>
<th>Length (ft)</th>
<th>Width (ft)</th>
<th>Depth (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square</td>
<td>26</td>
<td>6</td>
<td>6</td>
<td>1.5</td>
</tr>
<tr>
<td>Aud Strip</td>
<td>2</td>
<td>76</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Class Strip</td>
<td>2</td>
<td>30</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Aud Beam</td>
<td>2</td>
<td>38</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Class Beam</td>
<td>2</td>
<td>25</td>
<td>1</td>
<td>1</td>
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</table>

<table>
<thead>
<tr>
<th>Slab on Grade</th>
<th>Area (ft^2)</th>
<th>Thickness (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditorium</td>
<td>76x38</td>
<td>8</td>
</tr>
<tr>
<td>Classroom</td>
<td>30x25</td>
<td>6</td>
</tr>
</tbody>
</table>
Foundation Plans

Strip
Square
Beam on Grade
MEP Rationale

Passive Chilled Beam

Forced Air Ventilation

Active Chilled Beams

Natural Ventilation

Raised Flooring for Third Floor
First Floor
Second Floor
MEP 3D Model
## Concrete Structure Estimate

<table>
<thead>
<tr>
<th>Major Group Element</th>
<th>Cost</th>
<th>Cost per SF</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A SUBSTRUCTURE</td>
<td>$ 212,389</td>
<td>$ 6</td>
<td>4%</td>
</tr>
<tr>
<td>B SHELL</td>
<td>$ 1,269,547</td>
<td>$ 36</td>
<td>22%</td>
</tr>
<tr>
<td>C INTERIORS</td>
<td>$ 752,721</td>
<td>$ 21</td>
<td>13%</td>
</tr>
<tr>
<td>D SERVICES</td>
<td>$ 1,531,754</td>
<td>$ 43</td>
<td>27%</td>
</tr>
<tr>
<td>E EQUIPMENT &amp; FURNISHINGS</td>
<td>$ 191,018</td>
<td>$ 5</td>
<td>3%</td>
</tr>
<tr>
<td>F SPECIAL CONSTRUCTION &amp; DEMOLITION</td>
<td>$ 177,120</td>
<td>$ 5</td>
<td>3%</td>
</tr>
<tr>
<td>G BUILDING SITEWORK</td>
<td>$ 304,234</td>
<td>$ 9</td>
<td>5%</td>
</tr>
<tr>
<td>JOB SUBTOTAL</td>
<td>$ 4,438,783</td>
<td>$ 125</td>
<td>77%</td>
</tr>
<tr>
<td>Z1010 Administration (Overhead and Profit, 15%)</td>
<td>$ 665,817</td>
<td>$ 19</td>
<td>12%</td>
</tr>
<tr>
<td>Z1050 Permit, insurance and bonds (2%)</td>
<td>$ 190,130</td>
<td>$ 5</td>
<td>3%</td>
</tr>
<tr>
<td>Z2010 Design Contingencies (5%)</td>
<td>$ 221,939</td>
<td>$ 6</td>
<td>4%</td>
</tr>
<tr>
<td>Z2030 Construction Contingencies (5%)</td>
<td>$ 221,939</td>
<td>$ 6</td>
<td>4%</td>
</tr>
<tr>
<td><strong>Total Project Cost</strong></td>
<td><strong>$ 5,738,609</strong></td>
<td><strong>$ 162</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

### Pie Chart

- **A SUBSTRUCTURE**: 4%
- **B SHELL**: 22%
- **C INTERIORS**: 13%
- **D SERVICES**: 27%
- **E EQUIPMENT & FURNISHINGS**: 3%
- **F SPECIAL CONSTRUCTION & DEMOLITION**: 3%
- **G BUILDING SITEWORK**: 5%
- **Z GENERAL**: 23%
# Steel Structure Estimate

<table>
<thead>
<tr>
<th>Major Group Element</th>
<th>Cost</th>
<th>Cost per SF</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A SUBSTRUCTURE</td>
<td>$201,753</td>
<td>$6</td>
<td>3%</td>
</tr>
<tr>
<td>B SHELL</td>
<td>$1,715,713</td>
<td>$48</td>
<td>28%</td>
</tr>
<tr>
<td>C INTERIORS</td>
<td>$752,721</td>
<td>$21</td>
<td>12%</td>
</tr>
<tr>
<td>D SERVICES</td>
<td>$1,524,796</td>
<td>$43</td>
<td>25%</td>
</tr>
<tr>
<td>E EQUIPMENT &amp; FURNISHINGS</td>
<td>$166,409</td>
<td>$5</td>
<td>3%</td>
</tr>
<tr>
<td>F SPECIAL CONSTRUCTION &amp; DEMOLITION</td>
<td>$85,228</td>
<td>$2</td>
<td>1%</td>
</tr>
<tr>
<td>G BUILDING SITEWORK</td>
<td>$310,049</td>
<td>$9</td>
<td>5%</td>
</tr>
<tr>
<td>JOB SUBTOTAL</td>
<td>$4,756,669</td>
<td>$134</td>
<td>77%</td>
</tr>
<tr>
<td>Z1010 Administration (Overhead and Profit, 15%)</td>
<td>$713,500</td>
<td>$20</td>
<td>12%</td>
</tr>
<tr>
<td>Z1050 Permit, insurance and bonds (2%)</td>
<td>$198,077</td>
<td>$6</td>
<td>3%</td>
</tr>
<tr>
<td>Z2010 Design Contingencies (5%)</td>
<td>$237,833</td>
<td>$7</td>
<td>4%</td>
</tr>
<tr>
<td>Z2030 Construction Contingencies (5%)</td>
<td>$237,833</td>
<td>$7</td>
<td>4%</td>
</tr>
<tr>
<td>Total Project Cost</td>
<td>$6,143,914</td>
<td>$174</td>
<td>100%</td>
</tr>
</tbody>
</table>

## Major Group Elements

- **A SUBSTRUCTURE**: 3%
- **B SHELL**: 28%
- **C INTERIORS**: 12%
- **D SERVICES**: 25%
- **E EQUIPMENT & FURNISHINGS**: 3%
- **F SPECIAL CONSTRUCTION & DEMOLITION**: 1%
- **G BUILDING SITEWORK**: 5%
- **Z GENERAL**: 23%
CM Estimate
- Project Option Comparisons

Project Cost Criteria:
- Steel building 16% below national average
- Concrete building 19% below national average
- Concept 2 cheaper than Concept 1

CM Estimate Progression:
- RS Means SF Estimator
  - $4.95 million - $138/SF
- Building SF Comparison
  - $5.65 million - $160/SF
- Assembly Estimates Average
  - $6.13 million - $173/SF

<table>
<thead>
<tr>
<th>Project Options</th>
<th>Concept 1</th>
<th></th>
<th>Concept 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Concrete</td>
<td>Steel</td>
<td>Concrete</td>
<td>Steel</td>
</tr>
<tr>
<td>A SUBSTRUCTURE</td>
<td>$196,370</td>
<td>$233,139</td>
<td>$212,389</td>
<td>$201,753</td>
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<tr>
<td>B SHELL</td>
<td>$1,605,833</td>
<td>$2,033,162</td>
<td>$1,269,547</td>
<td>$1,715,713</td>
</tr>
<tr>
<td>C INTERIORS</td>
<td>$518,784</td>
<td>$518,784</td>
<td>$752,721</td>
<td>$752,721</td>
</tr>
<tr>
<td>D SERVICES</td>
<td>$1,663,606</td>
<td>$1,663,606</td>
<td>$1,531,754</td>
<td>$1,524,796</td>
</tr>
<tr>
<td>E EQUIPMENT &amp; FURNISHINGS</td>
<td>$191,018</td>
<td>$191,018</td>
<td>$191,018</td>
<td>$166,409</td>
</tr>
<tr>
<td>F SPECIAL CONSTRUCTION &amp; DEMOLITION</td>
<td>$177,120</td>
<td>$177,120</td>
<td>$177,120</td>
<td>$85,228</td>
</tr>
<tr>
<td>G BUILDING SITEWORK</td>
<td>$304,234</td>
<td>$304,234</td>
<td>$304,234</td>
<td>$310,049</td>
</tr>
<tr>
<td>JOB SUBTOTAL</td>
<td>$4,656,965</td>
<td>$5,121,063</td>
<td>$4,438,783</td>
<td>$4,756,669</td>
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<tr>
<td>Z1010 Administration (Overhead and Profit, 15%)</td>
<td>$698,545</td>
<td>$512,195</td>
<td>$666,817</td>
<td>$713,500</td>
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<tr>
<td>Z1050 Permit, insurance and bonds (2%)</td>
<td>$195,584</td>
<td>$207,187</td>
<td>$190,130</td>
<td>$198,077</td>
</tr>
<tr>
<td>Z2010 Design Contingencies (5%)</td>
<td>$232,848</td>
<td>$256,053</td>
<td>$221,939</td>
<td>$237,833</td>
</tr>
<tr>
<td>Z2030 Construction Contingencies (5%)</td>
<td>$232,848</td>
<td>$256,053</td>
<td>$221,939</td>
<td>$237,833</td>
</tr>
<tr>
<td>Total Project Cost</td>
<td>$6,016,791</td>
<td>$6,608,516</td>
<td>$5,738,609</td>
<td>$6,143,914</td>
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<tr>
<td>Cost Per Square Foot</td>
<td>$169.97</td>
<td>$186.68</td>
<td>$162.11</td>
<td>$173.56</td>
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</tbody>
</table>
Project Schedule – Milestone 1

- Start Date: August 17, 2015
- Crane On Site: October 7, 2015
- Milestone I (topping off): February 5, 2016
Project Schedule – Milestone 2

- Plumbing and Fire System Piping Finish: May 6, 2016
- Final Heavy Equipment Placement: May 27, 2016
Project Schedule – Milestone 3

- Interior Finishes Completion: July 14, 2016
- Milestone III (Substantial Completion): July 28, 2016
- Side Development Completion: August 3, 2016
- Building Closeout and Turnover: August 12, 2016
Cost Flow

Cost Flow Diagram

Number of Weeks

Total Cost
Weekly Cost
Total Costs

$600,000.00
$500,000.00
$400,000.00
$300,000.00
$200,000.00
$100,000.00
$-

$5,000,000.00
$4,000,000.00
$3,000,000.00
$2,000,000.00
$1,000,000.00
$0.00

$600,000.00
$500,000.00
$400,000.00
$300,000.00
$200,000.00
$100,000.00
$0.00

$500,000.00
$400,000.00
$300,000.00
$200,000.00
$100,000.00
$0.00

$400,000.00
$300,000.00
$200,000.00
$100,000.00
$0.00

$300,000.00
$200,000.00
$100,000.00
$0.00

$200,000.00
$100,000.00
$0.00

$100,000.00
$0.00

$0.00

$0.00
Sustainable Performance

- Passive Design Strategies (orientation study, climate responsive façade design)
- Natural Ventilation
- Green Roof
- Energy Harvesting System on roof (sunpower pv panels → use of “State Sun Energy Program”)
- Open interaction Courtyard
- Bicycle pkg.
- High efficiency windows and glass

<table>
<thead>
<tr>
<th>Table: Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circulation area net foot area</td>
</tr>
<tr>
<td>Building volume gross floor area</td>
</tr>
<tr>
<td>Surface area building volume</td>
</tr>
<tr>
<td>Net floor area gross floor area</td>
</tr>
</tbody>
</table>
Sustainable Performance
LEED Certification

MINIMUM SILVER LEED CERTIFICATION
(50 points or above)

1. Sustainable Sites → 12
2. Water Efficiency → 4
3. Energy and Atmosphere → 23
4. Materials and Resources → 5
5. Indoor Environmental Quality → 10
6. Innovation in Design → 3
7. Regional Priority → 3
Finance Model - PPP
(contractual relationships)
Finance Model - PPP
(payments flow)

- Investor
- UPR
- Bank
- Planner/Consultant
- Building contactor
- Operator

Flow of payments:
- Investor provides private equity for non-transferent expenditures.
- UPR provides loan to the Bank.
- Bank pays interest and repayment.
- Payment of building price is divided among the parties.
- Dividend is paid from the PC to the Investor.
- Fee is paid to the Operator.
O&M Cost Estimate

- $3,000,000.00
- $3,500,000.00
- $2,000,000.00
- $2,500,000.00
- $1,000,000.00
- $1,500,000.00
Five Goals

- Sustainability/Building performance
  - Strength of concept
  - Use of natural resources
  - Interior/exterior connection
  - Energy efficiency
  - Efficient use of space on site
  - Strength of concept

<table>
<thead>
<tr>
<th>Material</th>
<th>Steel</th>
<th>Concrete</th>
<th>Steel</th>
<th>Concrete</th>
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</thead>
<tbody>
<tr>
<td>Strength</td>
<td>6.1</td>
<td>6.3</td>
<td>8.5</td>
<td>8.7</td>
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<tr>
<td>User experience</td>
<td>6.8</td>
<td>7.0</td>
<td>7.8</td>
<td>8.0</td>
</tr>
<tr>
<td>Flexibility</td>
<td>8.7</td>
<td>8.3</td>
<td>7.5</td>
<td>7.3</td>
</tr>
<tr>
<td>Cost/Construction efficiency</td>
<td>6.5</td>
<td>7.3</td>
<td>6.5</td>
<td>6.8</td>
</tr>
<tr>
<td>Structural performance</td>
<td>8.4</td>
<td>7.9</td>
<td>7.8</td>
<td>7.4</td>
</tr>
</tbody>
</table>
Decision Matrix

**CHOICE: RADIATOR CONCRETE STRUCTURE**
What Works

- Notification Wave to alert when and where new uploads are located
- Good communication and accessibility
- High responsiveness
- Addressing the concerns of other disciplines
- Talk about things other than work!!!

How to Improve

- More Documentation of our process and our actions to address the IPD Challenge
- Keep track of deadlines so there is workflow back up
Thank You!