TEAM RIDGE

OWNERS: MARIA SELK, DONATA TROST, ZUZANNA KOLTOWSKA

ANDREW SANG

ERIK LINDSTROM
SATEJ DESAI

RAYMOND PIERSON

SE

CM
CM

MEP

MEP

A

SE

KATARZYNA ALASZEWSKA

SEBASTIAN RAU

PERNILLE BERG
Site analysis

General conditions

Campus placed in concavity between arms of a Sierra Nevada mountain range, which can be seen from 2+ level in the buildings
Site Constraints

- Summer: hot days / cold nights
- Winter: Cold, Snowfall
- Sunshine hours a year: 3650
- Very dry desert climate
- Santana winds - dust / heat

Climate data

- Precipitation inches x10
- Snowfall inches x10
- Record high °F
- Average high °F
- Average temp °F
Site Constraints

- Slightly sloped terrain
- Heavy Earthquakes

Probabilities for the next 50 years:
> 95% magnitude 5.0
~ 20% Magnitude 7.0

Reno, NV Earthquake Report

The USGS database shows that there is a 94.55% chance of a major earthquake within 50km of Reno, NV within the next 50 years. The largest earthquake within 30 miles of Reno, NV was a 6.10 magnitude in 1994.

Probability of earthquakes within the next 50 years
WITHIN 31 MILES / 50KM ABOVE MAGNITUDE

http://www.usgs.gov/earthquakes/research/website-county/reno.html
Site analysis
Characteristics of the campus
BIG IDEA: MOUNTAIN CLIMB EXPERIENCE

Learning is about making progress

And is like climbing a mountain

To reach the highest peak
Double-diamond footprint inspirations
Double diamond footprint Position on the site
Double diamond
Levels
0 and -0.5
Double diamond
Levels
2 and 1,5
Double diamond
Levels
3 and 2.5
Section a-a
Zen zones
Healthy building – Healthy People
**Double Diamond Loads**

### Gravity:

<table>
<thead>
<tr>
<th>Roof Level - Steel Option:</th>
<th>Roof Level - Concrete Option:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead Load</td>
<td>Dead Load</td>
</tr>
<tr>
<td>80 psf</td>
<td>125 psf</td>
</tr>
<tr>
<td>Live Load</td>
<td>Live Load</td>
</tr>
<tr>
<td>30-100 psf</td>
<td>30-100 psf</td>
</tr>
<tr>
<td>Snow Load</td>
<td>Snow Load</td>
</tr>
<tr>
<td>15 psf</td>
<td>15 psf</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Levels - Steel Option:</th>
<th>Other Levels - Concrete Option:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead Load</td>
<td>Dead Load</td>
</tr>
<tr>
<td>70 psf</td>
<td>115 psf</td>
</tr>
<tr>
<td>Live Load</td>
<td>Live Load</td>
</tr>
<tr>
<td>40-100 psf</td>
<td>40-100 psf</td>
</tr>
</tbody>
</table>

### Lateral:

<table>
<thead>
<tr>
<th>Wind Estimates:</th>
<th>Earthquake Estimates:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Wind Speed</td>
<td>Site Class B</td>
</tr>
<tr>
<td>100 mph</td>
<td>Steel Base Shear</td>
</tr>
<tr>
<td>Wind Base Shear</td>
<td>516 k</td>
</tr>
<tr>
<td>89 k</td>
<td>Concrete Base Shear</td>
</tr>
<tr>
<td></td>
<td>999 k</td>
</tr>
</tbody>
</table>
Dual Building Interaction Scheme

**Option 1:**
Two halves of the building slide and connections are detailed to allow slippage during earthquake.

**Option 2:**
Rigidly connect the two halves of the building together. The building will react as one unit now.

**Option 3:**
Stiffen both halves of the building so that there is very little deflection. This prevents the two buildings from damaging each other as well as non-structural components.
Slipping Building Concept: Split Floor Ramp System

Two halves of the building slide and connections are detailed to allow slippage during earthquake.

ASCE 7-10 Chapter 12.12.3

Building designed for 2% Story Drift
Top of building Seismic Expansion Joint

→ Requires 1’ Joint Minimum.

Seismic Expansion Joint
http://mmsystemscorp.com/ejp/

Stanford University - Center for Clinical Science Research
Slipping Building Concept: Split Floor Ramp System

Bottoms of ramps detailed with teflon and polished steel sliders for relative movement.

Short shear columns will be avoided especially in the lower floors.

Roof detailing requires one end of the atrium roof to be able to slide. Flashing detailing and slider detailing will be necessary.

Roof seismic motion-absorbing gap cover

http://www.freepatentsonline.com/6675539.html
1st Alternative: Post-Tensioned Flat Slab

2-Way Post tensioned Slab

Tendons: bundled at column strip
Uniform Direction

<table>
<thead>
<tr>
<th>PT Slab</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bay size</td>
<td>22' x 23'</td>
</tr>
<tr>
<td>Slab Thickness</td>
<td>7&quot;</td>
</tr>
<tr>
<td>Max. Sag</td>
<td>2.25&quot;</td>
</tr>
<tr>
<td>Typical Strand Size</td>
<td>0.5&quot;</td>
</tr>
<tr>
<td>PT force</td>
<td>170 kips</td>
</tr>
<tr>
<td>GR270 Monostrand</td>
<td></td>
</tr>
</tbody>
</table>
DD PT Flat Slab: Auditorium 1-Way Slab

### PT Slab
<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bay size</td>
<td>37' x 19'</td>
</tr>
<tr>
<td>Slab Thickness</td>
<td>9''</td>
</tr>
<tr>
<td>Max. Sag</td>
<td>3.25''</td>
</tr>
<tr>
<td>Typical Strand Size</td>
<td>0.5''</td>
</tr>
<tr>
<td></td>
<td>GR270 Monostrand</td>
</tr>
</tbody>
</table>

### PT Girder
<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Span</td>
<td>37'</td>
</tr>
<tr>
<td>Dimensions</td>
<td>30'' x 12''</td>
</tr>
<tr>
<td>PT Force</td>
<td>620 kips</td>
</tr>
<tr>
<td>Excentricity</td>
<td>24''</td>
</tr>
</tbody>
</table>
DD PT Flat Slab: 2ND Floor/1.5TH Floor Framing Plan

- Column 12" x 12"
- Slanted column
- Auditorium PT girder 30"x12"
- Slanted moment frame
- Load bearing wall gravity 8'
- Level chance
- Slab opening
- Footprint
DD PT Flat Slab: 3rd Floor Floor Framing Plan

- column 12" x 12"
- slanted column
- Auditorium PT girder 30" x 12"
- slanted moment frame
- load bearing wall gravity 8'
- level chance
- slab opening
- PT girder 20" x 12"
- footprint

Cantilever
DD PT Flat Slab: Lateral System

- Slanted Moment Frames

→ Slabs: additional axial force transfer load to core or balancing cantilever

Same lateral system for the steel composite alternative!
DD Steel Composite: 1st Floor/Basement Framing Plan

Deck Direction
Note: Columns go UP

Typical Column:
HSS16x16x.625

Slanted Columns:
W14x211

Lateral Girder:
W14x154

Typical Girder:
W10x45 72 Ø0.75” Studs
0.75” Camber

Typical Beam:
W10x30 52 Ø0.75” Studs

Auditorium Truss

Special Beams

Vulcraft 2VLI20
3.25” Light Weight Concrete
DD Steel Composite: 2\textsuperscript{nd} Floor/1.5\textsuperscript{th} Floor Framing Plan

Deck Direction
Note: Columns go UP

Typical Column:
HSS16\times16\times0.625

Slanted Columns:
W14\times211

Lateral Girder:
W14\times154

Typical Girder:
W10\times45 72 Ø0.75" Studs
0.75" Camber

Typical Beam:
W10\times30 52 Ø0.75" Studs
0.75" Camber

Auditorium Truss
Special Beams
Vulcraft 2VLI20
3.25" Light Weight Concrete

Cantilever
DD Steel Composite: 3rd Floor Floor Framing Plan

Note: Columns go UP

Typical Column:
HSS16x16x.625

Slanted Columns:
W14x211

Lateral Girder:
W14x154

Typical Girder:
W10x45 72 Ø0.75” Studs
0.75” Camber

Typical Beam:
W10x30 52 Ø0.75” Studs

Auditorium Truss
Special Beams
Vulcraft 2VLI20
3.25” Light Weight Concrete

Cantilever
Typical Column:
HSS16x16x.625

Slanted Columns:
W14x211

Lateral Girder:
W14x154

Typical Girder:
W10x45 72 Ø0.75” Studs
0.75” Camber

Typical Beam:
W10x30 52 Ø0.75” Studs

Auditorium Truss
Special Beams
Vulcraft 2VLI20
3.25” Light Weight Concrete

Deck Direction
Note: Columns go UP

Cantilever
DD Steel Composite: Lateral System Moment Frame

Girders W14x145
Columns W14x211
Reduced Beam Section detailing for ductility.

Deck Direction
Note: Columns go UP

Cantilever
**DD Steel Composite: Auditorium Truss**

- **Maximum Chord Force:** 1000k
- **Maximum Strut Force:** 200k

**Chords:**
- HSS 20x12x0.625

**Strut:**
- HSS 20x4x0.375

**Deck Direction**
- Note: Columns go UP
DD Foundation

<table>
<thead>
<tr>
<th>Depth</th>
<th>Soil Type</th>
<th>Thickness</th>
<th>Bearing Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.58 ft</td>
<td>Stony Sandy Loam and Heavy Loam</td>
<td>19 in</td>
<td>1,500 psf</td>
</tr>
<tr>
<td>2.42 ft</td>
<td>Sandy Clay Loam</td>
<td>10 in</td>
<td>1,500 psf</td>
</tr>
<tr>
<td>4.67 ft</td>
<td>Clay and Clay Loam</td>
<td>27 in</td>
<td>1,500 psf</td>
</tr>
<tr>
<td>7.00 ft</td>
<td>Very gravelly Sandy Loam and Very Gravelly Loam</td>
<td>28 in</td>
<td>5,000 psf</td>
</tr>
<tr>
<td></td>
<td>Vulcanic Rock</td>
<td>unknown</td>
<td>8,000 psf</td>
</tr>
</tbody>
</table>

Foundation challenges:
- 3 different levels of the foundation
- Different soil types (hard / soft)
- Slanted moment frames on exterior

Solution:
- Slab on grade (6") under auditorium + spread footings for columns
- Mat foundation (20") on soft soil
- Grade beam around exterior
L-shape footprint inspirations
L-shape footprint Position on the site
L-SHAPE

LEVELS

1 AND -0,5
L-shape
Levels
2 and 1,5
L-shape
Level 3
L-shape
Section 2
**GRAVITY:**

<table>
<thead>
<tr>
<th></th>
<th>Roof Level - Steel Option:</th>
<th>Roof Level - Concrete Option:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead Load</td>
<td>80 psf</td>
<td>125 psf</td>
</tr>
<tr>
<td>Live Load</td>
<td>30 psf</td>
<td>30 psf</td>
</tr>
<tr>
<td>Snow Load</td>
<td>15 psf</td>
<td>15 psf</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Other Levels - Steel Option:</th>
<th>Other Levels - Concrete Option:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead Load</td>
<td>70 psf</td>
<td>115 psf</td>
</tr>
<tr>
<td>Live Load</td>
<td>40-100 psf</td>
<td>40-100 psf</td>
</tr>
</tbody>
</table>

**LATERAL:**

<table>
<thead>
<tr>
<th></th>
<th>Wind Estimates:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Wind Speed</td>
<td>100 mph</td>
</tr>
<tr>
<td>Wind Base Shear</td>
<td>89 k</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Earthquake Estimates:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Class B</td>
<td></td>
</tr>
<tr>
<td>Steel Base Shear</td>
<td>410 k</td>
</tr>
<tr>
<td>Concrete Base Shear</td>
<td>768 k</td>
</tr>
</tbody>
</table>
1st Alternative: Post-Tensioned Flat Slab

2-Way Post tensioned Slab

<table>
<thead>
<tr>
<th>PT Slab</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bay size</td>
<td>20' x 20'</td>
<td></td>
</tr>
<tr>
<td>Slab Thickness</td>
<td>7''</td>
<td></td>
</tr>
<tr>
<td>Max. Sag</td>
<td>2.25''</td>
<td></td>
</tr>
<tr>
<td>Typical Strand Size</td>
<td>0.5''</td>
<td>GR270 Monostrand</td>
</tr>
<tr>
<td>PT force</td>
<td>170 kips</td>
<td></td>
</tr>
</tbody>
</table>

Tendons: banded in one Direction (Column strip) Uniform 1 Direct.
LL PT Flat Slab: 1st Floor/Basement Framing Plan

- footprint
- shear wall 12"
- auditorium girder PT 36" x 12"
- lab girder - PT 25" x 12"
- slab opening
- columns 12" x 12"
LL PT Flat Slab: 2nd Floor Framing Plan

- footprint
- shear wall 12"
- auditorium girder PT 36" x 12"
- lab girder - PT 25" x 12"
- slab opening
- columns 12" x 12"
- cantilever columns 10" x 10"
- special girder 10" x 10"
- compression struts
LL PT Flat Slab: 3rd Floor Framing Plan

footprint
shear wall 12"
auditorium girder PT 36" x 12"
lab girder - PT 25" x 12"
slab opening
columns 12" x 12"
cantilever columns 10" x 10"
special girder 10" x 10"
compression struts
LL Steel Composite: 1st Floor Framing Plan

Deck Direction
Note: Columns go UP

Typical Column:
HSS16x16x.625

Slanted Columns:
W14x211

Lateral Girder:
W14x154

Typical Girder:
W10x45 78 Ø0.75" Studs
0.75" Camber

Typical Beam:
WBx21 38 Ø0.75" Studs

Auditorium Truss
Special Beams
Vulcraft 2VLI20
3.25" Light Weight Concrete
LL Steel Composite: 2nd Floor Framing Plan

Deck Direction
Note: Columns go UP

Typical Column:
HSS16x16x.625

Slanted Columns:
W14x211

Lateral Girder:
W14x154

Typical Girder:
W10x45 78 Ø0.75” Studs 0.75” Camber

Typical Beam:
WBx21 38 Ø0.75” Studs

Auditorium Truss
Special Beams
Vulcraft 2VLI20
3.25” Light Weight Concrete

Cantilever
LL Steel Composite: 3rd Floor Framing Plan

Deck Direction
Note: Columns go UP

Typical Column: HSS16x16x.625
Slanted Columns: W14x211
Lateral Girder: W14x154
Typical Girder: W10x45 78 Ø0.75” Studs
0.75” Camber
Typical Beam: WBx21 38 Ø0.75” Studs
Auditorium Truss
Special Beams
Vulcraft 2VL120
3.25” Light Weight Concrete

Cantilever
LL Steel Composite: Roof Floor Framing Plan

Deck Direction
Note: Columns go UP

Typical Column:
HSS16x16x.625

Slanted Columns:
W14x211

Lateral Girder:
W14x154

Typical Girder:
W10x45 78 Ø0.75” Studs
0.75” Camber

Typical Beam:
WBx21 38 Ø0.75” Studs

Auditorium Truss
Special Beams
Vulcraft 2VLI20
3.25” Light Weight Concrete

Cantilever
LL Steel Composite: Lateral System Moment Frame

Girders W14x145
Columns W14x211
Reduced Beam Section detailing for ductility.
LL Steel Composite: Auditorium Truss

Deck Direction
Note: Columns go UP

Maximum Chord Force: 1000k
Maximum Strut Force: 135k

Chords:
HSS 20x12x0.625
Strut:
HSS 20x4x0.3133
LL Steel Composite: Floor Diaphragm Truss

Deck Direction
Note: Columns go UP

Truss between floors used to tie building floor slabs together.
L Shape Cantilever Solution

Steel 12’-16’ Cantilever Solution
• Brace system is very stiff
• Hidden in Partition Walls

Concrete 12’-16’ Cantilever Solution
• Brace system is very stiff
• Hidden in Partition Walls
### L-Shape Foundation

#### Foundation Challenges
- Different foundation levels
- Different soil types
- Building should act as one

#### Solution
- Slab on grade (6") under auditorium + spread footings for columns
- Mat foundation (20") on soft soil
- Tie slabs together with shear walls, staircase, and elevator core

---

![Diagram of L-Shape Foundation with labels for slabs, retaining wall, and connector walls.](image-url)
Climate Conditions: Reno, Nevada

Challenges:
- Summer: Hot Days / Cold Nights
- Winter: Cold, Snow
- Annual Sunshine Hours: 3650
- Dry, Desert Climate
- Santa Ana Winds – Carry Dust

Opportunities:
- Stacking Ventilation (night)
- Harvest Rainwater / Water Reuse
- Solar Energy
- District Heating and Cooling
- Ground Source Heat Pump

Climate data
Sustainable Target Value - Water

Living Machine

- 1500 SF outdoor treatment area
- Aspire to consume no fresh water for toilets or irrigation
District Heating & Cooling

- Solar PV-T

*Applies to Both Building Concepts
Ground Source Heat Pump

Solar PV- T

*Applies to Both Building Concepts
Solar PV-T Panels

SunPower® T10 Solar Roof Tiles
- Wind Resistant
- Modular Design
- No Roof Attachments
- Quick Installation

SunDrun® Solar Thermal Collectors
- Installed behind PV Panels
- Moderates PV Panel Temperature
Roof Layout

**Double Diamond**
- 179 Hybrid Panels
  - Capacity: 54.8 kW
  - Annual 97,000 kWh

**L-Shape**
- 196 Hybrid Panels
  - Capacity 60.0 kW
Double Diamond Source Energy Use Intensity (EUI)
### Effect of Glazing Treatments on Source EUI

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Double Diamond (kBtu/sf-yr)</th>
<th>L-Shape (kBtu/sf-yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Treatments (Baseline - 40%)</td>
<td>62.7</td>
<td>62.7</td>
</tr>
<tr>
<td>S Overhangs</td>
<td>62.0</td>
<td>62.0</td>
</tr>
<tr>
<td>S Fins</td>
<td>62.7</td>
<td>62.7</td>
</tr>
<tr>
<td>E Overhangs</td>
<td>62.2</td>
<td>62.0</td>
</tr>
<tr>
<td>E Fins</td>
<td>62.4</td>
<td>62.5</td>
</tr>
<tr>
<td>W Overhangs</td>
<td>62.1</td>
<td>62.1</td>
</tr>
<tr>
<td>W Fins</td>
<td>62.5</td>
<td>62.3</td>
</tr>
<tr>
<td>E/W/S Overhangs, E/W/S Fins</td>
<td><strong>60.2</strong></td>
<td><strong>60.2</strong></td>
</tr>
</tbody>
</table>
Double Diamond Energy Efficiency Measures

kBtu/sf-yr (EUI)

Floor-to-Ceiling 40% (Baseline) 64
Baseline Concrete Structure 62
Baseline w/ Shading 60
Low-e Triple Pane, Air 58
Triple Pane & Shading 56

RIDGE 2014 MEP
DD Mechanically-Assisted Natural Ventilation

- Inlet and filters remove dust

- Stacking effect cools atrium on summer nights

- Fans at inlet and on roof

Nighttime Wind

JUN-AUG

12AM-6AM
Vasari Shade Analysis – L-shape

JUN 21 - 10.00
JUN 21 - 12.00
JUN 21 - 14.00
SEP/MAR 21 - 10.00
SEP/MAR 21 - 12.00
SEP/MAR 21 - 14.00
DEC 21 - 10.00
DEC 21 - 12.00
DEC 21 - 14.00
HVAC options

General Rooms
- FLOOR HEATING AND COOLING + DIFFUSE CEILING VAVR

Auditoriums
- UFAD GRILLES
- UFAD PERSONAL VENTILATION
Floor Sandwich – DD

- Diffuse ceiling only PT concrete option
Floor Sandwich – DD

Dimensions:
- Height: 8' 3 3/4" (left), 7' 8 3/4" (right)
- Width: 10' (both)
- Length: 9' 4" (right), 10' (left)
Routing Plan – Alternative

2nd Floor

- Vertical supply duct
- Vertical return duct
- Supply duct
- Return duct
- UFAD duct
- SUPPLY ATD/ACB
- SUPPLY DC
- UFAD GRILL
- UFAD CHAIR/PV
- RETURN ATD
- RETURN GRILL
Floor Sandwich – L-shape

- Supply duct
- Return duct
- UFAD duct
- Vertical supply duct
- Vertical return duct

SUPPLY ATD/ACB
SUPPLY DC
UFAD GRILL
UFAD CHAIR/PV
RETURN ATD
RETURN GRILL
Routing Plan – L-shape

1st Floor

2nd Floor

3rd Floor

- Vertical supply duct
- Vertical return duct
- Supply duct
- Return duct
- SUPPLY ATD/ACB
- SUPPLY DC
- SUPPLY UFAD
- UFAD GRILL
- UFAD CHAIR/PV
- RETURN ATD
- RETURN GRILL
- RETURN UFAD
Routing Plan – L-shape

3rd Floor

- Vertical supply duct
- Vertical return duct
- Supply duct
- Return duct
- SUPPLY ATD/ACB
- SUPPLY DC
- UFAD GRILL
- UFAD CHAIR/PV
- RETURN ATD
- RETURN GRILL

SUPPLY ATD/ACB
SUPPLY DC
UFAD GRILL
UFAD CHAIR/PV
RETURN ATD
RETURN GRILL
## HVAC Decision Matrix

<table>
<thead>
<tr>
<th></th>
<th>Comfort</th>
<th>Energy</th>
<th>Complexity</th>
<th>Ceiling height</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor heating</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>Wall hung radiators</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Floor Cooling</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Chilled Beam (ACB)</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>DOAS Chilled Beam (ACB)</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>VAVR Diffuse ceiling</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Displacement ventilation (Auditorium)</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Personalized ventilation (Auditorium)</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>16</td>
</tr>
</tbody>
</table>

1 = Poor  5 = Excellent
# HVAC Decision Matrix

1 = Poor  
5 = Excellent

<table>
<thead>
<tr>
<th>System</th>
<th>Comfort</th>
<th>Energy</th>
<th>Complexity</th>
<th>Ceiling height</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor heating</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>Wall hung radiators</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Floor Cooling</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Chilled Beam (ACB)</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>DOAS Chilled Beam (ACB)</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>VAVR Diffuse ceiling</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Displacement ventilation (Auditorium)</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Personalized ventilation (Auditorium)</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>16</td>
</tr>
</tbody>
</table>
Site Location: Reno, NV
NV University Campus

Coastline Equipment: Crane Rentals
Lindell's Painting Services: Interior Finishes
Nevada Cement Co: Concrete Supplier
Applied Mechanical: HVAC Sub
Nelson Electric Co: Electrical Sub
Local 169 Union Hall
Northern Nevada Rebar: Concrete Floor Systems
Custom Glass Co: Windows/Curtain Walls
Brussa Masonry: Exterior Finishes
Martin Steel Works: Structural Steel
MOBILE HYDRAULIC ALL TERRAIN 30 TON CRANE WITH 101’ BOOM

JOHN DEERE DIESEL POWERED EXCAVATOR. BUCKET CAPACITY 0.79 CY

JOHN DEERE DIESEL POWERED DOZER. BLADE CAPACITY 2.9 CY

JOHN DEERE DIESEL POWERED GRADER. BLADE PULL 28,990 LBS
KEY:

1) Shuttle & Vehicle Access
2) Accessible Route
3) Pedestrian Route from Parking Structure to Event Center
4) Closed Sidewalk
5) Construction Zone
6) Construction Entrance/Exit
7) Bus/Shuttle Stop
8) Security Fence
SITE LOGISTICS: WATER & EROSION

- Water truck flow throughout site in 2 hr intervals throughout dry months
- Sandbag barrier around storm drains
- Concrete Washout w/ non-permeable base layer, soil berm, and sandbag perimeter
- Pea-gravel 1/4" base
- Incoming direction of rainfall/snow melt on to site
- Silt Fencing lining outside of security fence
- Designed for Both Building Footprints
- Hillside
- Prevailing wind direction
- Entrance/Exit w/ temp cattle guard
- Silt Fencing lining inside of security fence
- Pea-gravel 1/4" base
- Spoils to be covered up w/ permeable covering when not in use
SITE LOGISTICS: FOOTPRINT COMPARISON

L-SHAPE SITE OVERALL SCORE = +10

DOUBLE DIAMOND SITE OVERALL SCORE = -5
## SCHEDULE MILESTONES

### Important Milestones DOUBLE DIAMOND

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Steel</th>
<th>Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 COMPLETION: EARTHWORK/FOUNDATION</td>
<td>8/1/2019</td>
<td>8/1/2019</td>
</tr>
<tr>
<td>4 PROJECT COMPLETION</td>
<td>4/9/2020</td>
<td>4/30/2020</td>
</tr>
</tbody>
</table>

### Important Milestones L-SHAPE

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Steel</th>
<th>Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 COMPLETION: EARTHWORK/FOUNDATION</td>
<td>8/1/2019</td>
<td>8/1/2019</td>
</tr>
<tr>
<td>2 COMPLETION: SHELL</td>
<td>11/14/2019</td>
<td>11/28/2019</td>
</tr>
<tr>
<td>3 COMPLETION: MEP SERVICES</td>
<td>3/20/2020</td>
<td>4/3/2020</td>
</tr>
<tr>
<td>4 PROJECT COMPLETION</td>
<td>4/23/2020</td>
<td>5/7/2020</td>
</tr>
</tbody>
</table>
+14 Cal. Days

+7 Cal. Days

Total +21 Days main contributors: formwork, curing, PT install, different finish installation requirements
GOAL: RENT LABS FOR ENTIRE CONSTRUCTION PERIOD

<table>
<thead>
<tr>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoids inconvenience to students</td>
<td>More expensive ($450 per day)</td>
</tr>
<tr>
<td>Allows for easier scheduling and faster</td>
<td></td>
</tr>
<tr>
<td>construction</td>
<td></td>
</tr>
</tbody>
</table>

$100,000 = 220 \text{ days} = 1.0\% \text{ of total project cost}$
ESTIMATING STRATEGY

RS Means Bare Estimate Cost $6,150,000

Assembly Cost From Initial Design Concepts

Estimates Comparison from Previous Teams

Perform Unit Cost Estimates from Revised Concepts

Modify Estimate Based on Owners & Team Feedback
<table>
<thead>
<tr>
<th></th>
<th>STEEL</th>
<th>CONCRETE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>L - SHAPE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Requirements</td>
<td>$900,724</td>
<td>$900,724</td>
</tr>
<tr>
<td>Concrete</td>
<td>$603,167</td>
<td>$1,346,647</td>
</tr>
<tr>
<td>Metals</td>
<td>$1,377,340</td>
<td>$509,910</td>
</tr>
<tr>
<td>Finishes</td>
<td>$794,341</td>
<td>$1,297,064</td>
</tr>
<tr>
<td>Plumbing/Mechanical/Electrical</td>
<td>$2,029,838</td>
<td>$2,029,838</td>
</tr>
<tr>
<td>Earthwork</td>
<td>$332,825</td>
<td>$332,825</td>
</tr>
<tr>
<td>Special Construction</td>
<td>$3,102,844</td>
<td>$2,785,969</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$9,340,000</td>
<td>$9,200,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DOUBLE DIAMOND</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Requirements</td>
<td>$900,724</td>
<td>$900,724</td>
</tr>
<tr>
<td>Concrete</td>
<td>$993,871</td>
<td>$1,565,004</td>
</tr>
<tr>
<td>Metals</td>
<td>$1,568,615</td>
<td>$411,725</td>
</tr>
<tr>
<td>Finishes</td>
<td>$776,711</td>
<td>$739,644</td>
</tr>
<tr>
<td>Plumbing/Mechanical/Electrical</td>
<td>$2,029,838</td>
<td>$2,029,838</td>
</tr>
<tr>
<td>Earthwork</td>
<td>$398,123</td>
<td>$398,123</td>
</tr>
<tr>
<td>Special Construction</td>
<td>$3,058,387</td>
<td>$3,185,551</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$9,530,000</td>
<td>$9,230,000</td>
</tr>
</tbody>
</table>
TARGET VALUE: $9,600,000

Construction Start Date: 25 June 2019

L-SHAPE
- Concrete: $9,200,000
- Steel: $9,340,000

DIAMOND
- Concrete: $9,230,000
- Steel: $9,530,000

L-Shape Concrete = Least expensive
Diamond Steel = Most expensive
SCHEDULE SUMMARY

L-Shape Concrete = SLOWEST
Diamond Steel = FASTEST
# Risk Consideration

## Risk Matrix

<table>
<thead>
<tr>
<th>Probability</th>
<th>Impact</th>
<th>Risk</th>
<th>Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>C5</td>
<td>C5, C9, C14</td>
<td>Order material and equipment early.</td>
</tr>
<tr>
<td>High</td>
<td>C6</td>
<td>C1, C10, C17</td>
<td>Limit construction time 7:00AM-6:00PM. Use noise reduction devices on equipment.</td>
</tr>
<tr>
<td>Medium</td>
<td>C16</td>
<td>C2, C3, C11, C12</td>
<td>In-depth site investigation prior to starting.</td>
</tr>
<tr>
<td>Low</td>
<td>C7</td>
<td>C7, C13, C15</td>
<td>Correct planning prior to construction. Proper storage and disposal at the end of the job.</td>
</tr>
<tr>
<td>Very Low</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>
BUILDING HEALTH CHALLENGE

GOAL & PROCESS
- Go beyond norms
- Inspire & invigorate
  - ‘Spiritual’ connection to natural environment

OUTCOME
- BIOPHILIC DESIGN: Connections that humans subconsciously seek with nature.
- 3 components: natural elements, natural attributes and spatial relationships
BUILDING HEALTH VS PROJECT HEALTH

- LEED Design
  - IAQ Focus
  - Occupant Comfort

- Biophilic Design
  - Zen Gardens
  - Outdoor Contact

- Building Responsiveness
  - Interactive
  - Adaptable

- Construction Safety
  - Guardrails
  - Protective Gear
  - Education
  - Correct Body Mechanics

Total Project Health
PROBLEM:
- Collaboration is proving difficult to achieve.

SOLUTION:
- BIM Manager.
- Learn from this quarter.
**BIM MANAGER ROLES**

- Prepare Revit project templates.
- Co-ordinate with other CM to work on model development during spring break.
- Prepare and INSTRUCT members on how to use templates.
- Establish sharing/linking of models.

**LEARN FROM EXPERIENCE**

- Better task tracking
- Minimize rework
- Intense focus on the process
<table>
<thead>
<tr>
<th>Category</th>
<th>Weighting Andrew</th>
<th>Weightning Erik</th>
<th>Weightning Pernille</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept and Design Clarity</td>
<td>20%</td>
<td>12%</td>
<td>10%</td>
</tr>
<tr>
<td>Structural design</td>
<td>20%</td>
<td>8%</td>
<td>10%</td>
</tr>
<tr>
<td>Constructibility</td>
<td>10%</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>Energy Consumption</td>
<td>10%</td>
<td>13%</td>
<td>10%</td>
</tr>
<tr>
<td>Sustainability</td>
<td>15%</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>Integration of the Challenges + Building Health</td>
<td>10%</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>Integration of the Big Idea</td>
<td>10%</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>Costs</td>
<td>5%</td>
<td>12%</td>
<td>15%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

**WINNER = DD CONCRETE**
<table>
<thead>
<tr>
<th>LEED POINTS SUMMARY</th>
<th>Yes</th>
<th>Maybe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location and Transportation</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Sustainable Sites</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Water Efficiency</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Energy &amp; Atmosphere</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>Materials &amp; Resources</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Indoor Environmental Quality</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Innovation &amp; Design Process</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Project Total</strong></td>
<td><strong>56</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

**Projected Value LEED Silver**