Ridges with the RIDGE

kristian
maryanne
annemarie
bedriye
milos
RidgeRS and global teamwork
With Lauren Scammell and Gitte Sørensen as owners.

Bedriye (MEP)
Kristian (A)
Annemarie (SE)
Milos (CM)
Maryanne (SE)
Where is The Ridge?

There is some existing slope, but not much.

„We‘re RidgeRS, so let‘s make some slope!“
## Soil Profile

<table>
<thead>
<tr>
<th>Depth of Excavation</th>
<th>Soil Type</th>
<th>Thickness</th>
<th>Bearing Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade at 5,580 ft. Elevation</td>
<td>Stony Sandy Loam and Heavy Loam</td>
<td>19 inches (1.58 ft.)</td>
<td>1,500 psf.</td>
</tr>
<tr>
<td>19 inches (1.58 ft.)</td>
<td>Sandy Clay Loam</td>
<td>10 inches (0.83 ft.)</td>
<td>1,500 psf.</td>
</tr>
<tr>
<td>29 inches (2.42 ft.)</td>
<td>Clay and Clay Loam</td>
<td>27 inches (2.25 ft.)</td>
<td>1,500 psf</td>
</tr>
<tr>
<td>48 inches (4.0 ft.)</td>
<td>Very Gravelly Sandy Loam and Very Gravelly Loam</td>
<td>28 inches (2.33 ft.)</td>
<td>5,000 psf</td>
</tr>
<tr>
<td>56 inches (4.67 ft.)</td>
<td>Volcanic Rock</td>
<td>Unknown</td>
<td>8,000 psf</td>
</tr>
<tr>
<td>84 inches (7 ft.)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Grade at 5,580 ft. Elevation
- Water Table
- Pre-draining (-)
- Retaining walls (-)
- Higher building (+)
LOCAL HAZARD

- Highly seismic area
- Large fluctuation in temperatures (daily and seasonly)
- High desert winds – average windspeed 60mph
- "Rain shadow"
## The Decision Matrix

<table>
<thead>
<tr>
<th>Discipline Based</th>
<th>Pine Cone</th>
<th>Hardscape</th>
<th>Pine Cone</th>
<th>Hardscape</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Concrete</td>
<td>Steel</td>
<td>Concrete</td>
<td>Steel</td>
</tr>
<tr>
<td>building concept clarity</td>
<td>4.8</td>
<td>5.0</td>
<td>3.0</td>
<td>3.2</td>
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<tr>
<td>perceived value &amp; aesthetics</td>
<td>4.2</td>
<td>4.2</td>
<td>3.8</td>
<td>3.8</td>
</tr>
<tr>
<td>exposed structure as aesthetics</td>
<td>2.8</td>
<td>2.8</td>
<td>4.0</td>
<td>4.0</td>
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<td>constructability</td>
<td>3.4</td>
<td>3.4</td>
<td>4.4</td>
<td>5.0</td>
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<tr>
<td>prefabrication &amp; shorter schedule</td>
<td>3.6</td>
<td>3.8</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Biomimicry Challenge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>biomimetical form innovation</td>
<td>4.2</td>
<td>4.2</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>possibilities for new biomimetical technologies integrations</td>
<td>3.4</td>
<td>3.4</td>
<td>3.6</td>
<td>3.6</td>
</tr>
<tr>
<td>TVD Challenge - Local &amp; Natural Factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>local community/environment interaction</td>
<td>3.8</td>
<td>3.6</td>
<td>4.4</td>
<td>4.2</td>
</tr>
<tr>
<td>water collection and reuse</td>
<td>4.2</td>
<td>4.2</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>renewable on-site energy production</td>
<td>3.8</td>
<td>3.4</td>
<td>3.8</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td><strong>38.2</strong></td>
<td><strong>38.0</strong></td>
<td><strong>37.0</strong></td>
<td><strong>37.2</strong></td>
</tr>
</tbody>
</table>
TARGET VALUE DESIGN

RidgeRS
LOCAL & NATURAL – biomimicry & materials

BRISTLECONE PINE – Nevada state tree
LOCAL – community & labor

One of the mottos of the University of Nevada Reno:
„A Nevada education stresses conceptual, hands-on learning.“
LOCAL – social aspect

More than just a studying and working place …
TEAM PROCESS

The power of team workflow and using new technologies for achieving higher standards in building design.
Architectural Target Values

- Biomimicry
- Sustainability
- Social/Collaborative Space
- Local/Community Atmosphere
- Functional Exterior and Warm Interior
PINE CONE CONCEPT EVOLUTION
BIOMIMICRY CONCEPT EVOLUTION

Initial Pine Cone Idea – Combine local TVD with Sustainable TVD

Utilization of Pine Cone Forms

- Solar Shading
- Diffused Natural Lighting

TVD: NATURAL    TVD: LOCAL    TVD: SUSTAINABLE
Concept Evolution – Pine Cone Form Integrated into Design Language
Pine Cone Water Collection/Reuse

Concept Evolution – Onsite Water Collection

**TVD: SUSTAINABLE**

- Collected Rain Water
- Gray Water brought into building

Cistern and filter buried in terrain adjacent to main plumbing core
Rainwater collection to reuse
The flushing of toilets with rainwater collected from roofs makes a significant saving in the use of potable water.
Pine Cone Biomimicry – Natural Ventilation

Concept Evolution – Mixed Mode: Adaptive System w/ Stack Ventilation

TVD: SUSTAINABLE

- Automated
- Operable
**ENERGY CONCEPT**

**Ventilation**
- Combined natural and mechanical ventilation
- Natural ventilation only at night – night cooling
- Thermal mass of concrete – better for cooling

**Daylight**
Power consumption for daylight is minimized due to:
- Efficient use of daylight
- Electric lighting controlled by monitoring daylight
- Workstations located close to the windows

**Solar control**
- By exterior shadings and cantilever
- Power consumption for cooling is minimised

**TVD: SUSTAINABLE**
Seed Arrangement
CONTEXT AND ORIENTATION

Circulation Flow to Main Entry and Social Plaza

Student Union & Events Center Primary Adjacency

Direct Path for foot traffic from parking structure
## ORIENTATIONS

<table>
<thead>
<tr>
<th></th>
<th>1st orientation</th>
<th>2nd orientation</th>
<th>3rd orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electricity</strong></td>
<td>454,028 kWh</td>
<td>449,479 kWh</td>
<td>447,070 kWh</td>
</tr>
<tr>
<td><strong>Fuel</strong></td>
<td>16,968 therms</td>
<td>17,027 therms</td>
<td>16,097 therms</td>
</tr>
<tr>
<td><strong>CO2 – conc.</strong></td>
<td>92 tons/yr</td>
<td>84 tons/yr</td>
<td>78 tons/yr</td>
</tr>
<tr>
<td><strong>HVAC, Lightning, Equipment</strong></td>
<td>449,152 kWh</td>
<td>444,605 kWh</td>
<td>442,196 kWh</td>
</tr>
</tbody>
</table>

1st orientation → Good
2nd orientation → Good
3rd orientation → Best

3rd orientation has low el, fuel and HVAC consumption and also low CO₂ emission than the other two orientations.
3rd orientation – Pine Cone
Revit analysis – cut/fill reports:

„Using existing soil is a feasible idea.“
1st STAGE – EXCAVATION AND LANDSCAPING

Establish sloped landscaping

TVD: LOCAL

TVD: NATURAL

Retaining walls
RETAINING WALL

Full Height Retaining Wall ~ 15’

15’ Gravity Retaining Wall

Full basement height (15’)

18”

15’

8’
BASEMENT LEVEL

Auditorium: 3,000 SF
Sm. Classrooms: 1,000 SF
Cafe: 3,000 SF
Lab: 1,000 SF
Server/IT: 900 SF
Storage: 400 SF
Vert. Circ. & WC: 570 SF
Mechanical: 400 SF
Collaboration Space: 2,800 SF
GROUND LEVEL

Lg. Classrooms
1,600 SF

Sm. Classrooms
1,040 SF

Seminar Rooms
800 SF

Lab
1,000 SF

Student Offices
1,050 SF

Storage
200 SF

Vert. Circ. & WC
570 SF

Mechanical
120 SF

Social Space
2,000 SF
PINE CONE ROOF FORMS
PINE CONE ROOF FORMS

Concept Evolution – Integration of Pine Cone Form as Design Language
ROOF SYSTEM

8” RC Slab:
Typ. Span 19’

#5s @ 6”

3” Steel Deck:
Typ. Span 10’
ROOF SYSTEM

**Loads – 3” Steel Deck**
- Dead Load: 30 psf
- Live Load: 20 psf
- Snow Load: 10.5 psf

**Loads – 8” Concrete Slab**
- Dead Load: 115 psf
- Live Load: 20 psf
- Snow Load: 10.5 psf

Steel Purlins –
W14x48 Typ. Span 20’

Dogleg Beams –
W14x48 Typ. Span 20’
Tension Rod Detail:
1 ¼” Square Steel Section
Placed in front of glazing
W10x33 Vertical Elements
ROOF SYSTEM DETAILS

LOAD PATHS

EQ
Connect steel beams to concrete column with HALFEN HUC or similar
ATRIUM
ENTRY FROM SOCIAL PLAZA  South East Side
FLOORPLANS

basement level

- columns 16”x16”
- gravity wall 16”
- beam typ. span 20’ 16”x18”
- typ. span 30’ 18”x24”

- collector beam 22”x28”
- RC slab 8”, typical span 19’

Diagram showing floor plans with designated areas for columns, gravity walls, beams, and slab.
FLOORPLAN

RC slab 8”, typical span 19’

gravity wall 16”

beam
typ. span 20’ 16”x18”
typ. span 30’ 18”x24”
collectors beam 22”x28”
FLOORPLAN

office level

- columns 16”x16”
- gravity wall 16”
- beam
typ. span 20’ 16”x18”
typ. span 30’ 18”x24”

RC slab 8”, typical span 19’
GRAVITY DESIGN

PT Beam
Prefab Beam
PT slab
RC slab
RC shear walls

Too much disciplines on site

What does really fit our requirements?

PT Beam
RC slab
RC shear walls
GR AVITY DESIGN  
slab – ground level

Deformation

-6.4 mm
-4.5 mm
-3.2 mm
-1.9 mm
-1.3 mm
-0.6 mm
0.0 mm

No column needed

overhang is feasible
GRAVITY DESIGN  
slab – ground level

Reinforcement bottom
- 0.00 – 1.15 cm²/m
- 1-15 - 2.30 cm²/m
- 2.30 - 3.45 cm²/m
- 3.45 – 4.6 cm²/m

constant rebar, strengthen in high stressed area

RC slab 8”, Uniaxial, Typ. Span 19’

Doublecheck results!
DESIGN DETAILS  slab – overhangs

Shear and punching reinforcement

3D- view

Position in floorplan

Section

slab

PT beam
GRAVITY DESIGN

RC vs. PT

19' Beam

Cross section PT beam

Tendon during

Calculation for RC beam

PT beam 16”x16”

RC beam 16”x18”
GRAVITY DESIGN 30' Beam

RC vs. PT

calculation for RC beam

Cross section PT beam  
Tendon during

PT beam 18"x26"
RC beam 24"x30"
Typical RC beam reinforcement

Typical connection from RC beam to RC column
Poured concrete
10" thick
DESIGN DETAILS

staircase

fire stair design

10 Stg. 24.4/30
Laufbreite = 140 cm
Glazing – Thermo glass

outside

5.00 mm Float glass
10.00 mm Air
5.00 mm Float glass
0.38 mm Foil
8.00 mm tempered safety glass

inside
stress check – max. utilization 32%
DESIGN DETAILS

Fixing detail

Reference building
GRAVITY DESIGN

Strip foundation
40" x 28"

Foundation slab
10" thick

Bearing Capacity:
300 kN/m³
Deformation

- 0.0 mm
- 2.5 mm
- 4.9 mm
- 5.8 mm
- 7.4 mm
- 8.2 mm
- 9.0 mm

Ground settlement: 9 mm < 20 mm
Initial Structural Design
- No cuts
- Too rigid
- Needed windows

Initial Architectural Design
- Maximum desired windows
- Not rigid enough
- Needed window reduction

Integrated Design
- Adequate rigidity
- Enough windows for all rooms
- Office level window maximization
Special RC Shear Wall Lateral System

- Designed using Equivalent Static Force Method (ASCE 7-10)

### Story Shears

<table>
<thead>
<tr>
<th>Floor</th>
<th>Shear</th>
</tr>
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<tbody>
<tr>
<td>Roof</td>
<td>729 k</td>
</tr>
<tr>
<td>2nd Floor</td>
<td>1216 k</td>
</tr>
<tr>
<td>1st Floor</td>
<td>1457 k</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>length [ft]</th>
<th>Mmax [k-ft]</th>
<th>Vmax [kips]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>39.0</td>
<td>17786</td>
<td>505</td>
</tr>
<tr>
<td>2</td>
<td>47.5</td>
<td>20491</td>
<td>579</td>
</tr>
<tr>
<td>3</td>
<td>10.0</td>
<td>808</td>
<td>22</td>
</tr>
<tr>
<td>4</td>
<td>22.8</td>
<td>5030</td>
<td>125</td>
</tr>
<tr>
<td>5</td>
<td>19.0</td>
<td>3521</td>
<td>88</td>
</tr>
<tr>
<td>6</td>
<td>38.0</td>
<td>11761</td>
<td>293</td>
</tr>
<tr>
<td>7</td>
<td>10.5</td>
<td>2225</td>
<td>43</td>
</tr>
<tr>
<td>8</td>
<td>10.5</td>
<td>1555</td>
<td>31</td>
</tr>
<tr>
<td>9</td>
<td>19.0</td>
<td>5550</td>
<td>113</td>
</tr>
<tr>
<td>10</td>
<td>19.0</td>
<td>4861</td>
<td>101</td>
</tr>
<tr>
<td>11</td>
<td>19.0</td>
<td>3724</td>
<td>95</td>
</tr>
<tr>
<td>12</td>
<td>38.0</td>
<td>12438</td>
<td>319</td>
</tr>
<tr>
<td>13</td>
<td>20.0</td>
<td>7732</td>
<td>152</td>
</tr>
<tr>
<td>14</td>
<td>38.0</td>
<td>13619</td>
<td>326</td>
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</tbody>
</table>
CANTILEVER SUPPORT – Office Level

Unreduced Loads

<table>
<thead>
<tr>
<th>Load Type</th>
<th>Load</th>
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<tbody>
<tr>
<td>Dead Load</td>
<td>120 psf</td>
</tr>
<tr>
<td>Live Load</td>
<td>50 psf</td>
</tr>
</tbody>
</table>

Example of Load Path – Adds additional load to shear wall system
**CANTILEVER SUPPORT – Roof**

**Unreduced Loads**

<table>
<thead>
<tr>
<th>Type</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead Load</td>
<td>115 psf</td>
</tr>
<tr>
<td>Live Load</td>
<td>20 psf</td>
</tr>
<tr>
<td>Snow Load</td>
<td>10.5 psf</td>
</tr>
</tbody>
</table>

Example of Load Path – Adds additional load to shear wall system
LATERAL SYSTEM – Shear Wall Design

12” thick (typ. 16” boundary elements)
2 #5s @ 12” Longitudinal Reinforcement
#5s @ 12” Transverse Reinforcement

Moment Curvature of Wall 1

<table>
<thead>
<tr>
<th>Wall No.</th>
<th>$\phi M_n$ (k-ft)</th>
<th>$\Delta y$ (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30000</td>
<td>0.91</td>
</tr>
<tr>
<td>11</td>
<td>16000</td>
<td>1.42</td>
</tr>
</tbody>
</table>
A-A Slab to Wall Detail

Seismic hooks

Boundary Element

#6s @ 12"

24"

#5s @ 12"

#5s @ 12"

16"

#5s @ 12"

16"

#5s @ 12"

24"

#5s @ 12"

#5s @ 12"
ETABS ANALYSIS

Equivalent Static Force Method
Force Amplification due to Torsional Irregularity
Some simplifications made in modeling
Verification Of Shear Wall Design

\[ T_n = 0.1946 \text{ sec} \]
\[ \Delta_{\text{max drift}} = 0.000247 \]
Max elastic roof displacement = 0.28 in
CLIMATE CONDITIONS

Climate conditions

99% heating design
Temperature: 14.9F

1% cooling design
Temperature: 92.5F

Average humidity: 60%

Indoor design conditions

RH: 50% for comfort
Design temp setpoint for heating: 68F
Design temp setpoint for cooling: 74F
DUCT NETWORK | Basement level

Supply
Exhaust
DUCT NETWORK | Ground level
Main duct: 6 - 8 m/s

Distribution ducts in rooms: 3 - 4 m/s

Distribution ducts between rooms: 4 - 6 m/s
DAYLIGHT ANALYSIS | Basement level

January 21

July 21
DAYLIGHT ANALYSIS | Ground level

January 21

July 21
<table>
<thead>
<tr>
<th>Building type</th>
<th>University</th>
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<tbody>
<tr>
<td>Area</td>
<td>2814.6 m²</td>
</tr>
<tr>
<td>Volume</td>
<td>13508.9 m³</td>
</tr>
<tr>
<td>Heating setpoint</td>
<td>68F</td>
</tr>
<tr>
<td>Cooling setpoint</td>
<td>74F</td>
</tr>
<tr>
<td>Ventilation</td>
<td>VAV</td>
</tr>
<tr>
<td>Solar shading</td>
<td>External shading</td>
</tr>
<tr>
<td>Glazing</td>
<td>1.9 W/(K*m²)</td>
</tr>
<tr>
<td>Facade</td>
<td>0.5 W/(K*m²)</td>
</tr>
</tbody>
</table>
| Occupancy       | Weekdays: 7am – 6pm  
|                 | Weekends: 0     
|                 | July: Vacation  |
| Lighting        | Weekdays: 7am – 6pm  
|                 | Weekends: 0     
|                 | July: Vacation  |
| Equipment       | Weekdays: 7am – 6pm  
|                 | Weekends: 0     
<p>|                 | July: Vacation  |
| Heating system  | District heating |</p>
<table>
<thead>
<tr>
<th>Delivered energy</th>
<th>kWh</th>
<th>kWh/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting, facility</td>
<td>229301</td>
<td>82.8</td>
</tr>
<tr>
<td>Cooling</td>
<td>3641</td>
<td>1.3</td>
</tr>
<tr>
<td>HVAC aux</td>
<td>100276</td>
<td>36.2</td>
</tr>
<tr>
<td><strong>Total, Facility electric</strong></td>
<td><strong>333218</strong></td>
<td><strong>120.3</strong></td>
</tr>
<tr>
<td>Heating</td>
<td>115455</td>
<td>41.7</td>
</tr>
<tr>
<td>Domestic hot water</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Total, Facility district</strong></td>
<td><strong>115455</strong></td>
<td><strong>41.7</strong></td>
</tr>
<tr>
<td>Total</td>
<td>448673</td>
<td>162.0</td>
</tr>
<tr>
<td>Equipment, tenant</td>
<td>143656</td>
<td>51.9</td>
</tr>
<tr>
<td><strong>Total, Tenant electric</strong></td>
<td><strong>143656</strong></td>
<td><strong>51.9</strong></td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td><strong>592329</strong></td>
<td><strong>213.9</strong></td>
</tr>
</tbody>
</table>
RESULTS | Monthly Delivered Energy

<table>
<thead>
<tr>
<th>Month</th>
<th>Lighting, facility (kWh)</th>
<th>Cooling (kWh)</th>
<th>HVAC (kWh)</th>
<th>Heating (kWh)</th>
<th>Equipment, tenant (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>229301.0</td>
<td>3641.0</td>
<td>100276.0</td>
<td>115455.1</td>
<td>143656.0</td>
</tr>
<tr>
<td>Pine Cone – Building Comfort Reference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of hours when operative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>temperature is above 27° C in average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>zone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of total occupant hours with</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>thermal dissatisfaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Max. temperatures for thermal comfort in 3 different categories:

<table>
<thead>
<tr>
<th>Category</th>
<th>Winter [°F] (max)</th>
<th>Summer [°F] (max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (best)</td>
<td>73.4</td>
<td>77.9</td>
</tr>
<tr>
<td>II (good)</td>
<td>75.2</td>
<td>78.8</td>
</tr>
<tr>
<td>III (Acceptable)</td>
<td>77</td>
<td>80.6</td>
</tr>
</tbody>
</table>

Results:

<table>
<thead>
<tr>
<th>Comfort Category</th>
<th>No. of occupancy hours on a year</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (best)</td>
<td>3727</td>
</tr>
<tr>
<td>II (good)</td>
<td>4483</td>
</tr>
<tr>
<td>III (Acceptable)</td>
<td>5566</td>
</tr>
<tr>
<td>IV (Unacceptable)</td>
<td>698</td>
</tr>
</tbody>
</table>

The room temperature isn’t acceptable about 29 days, where it’s above 80.6 F in summer and 77 F in winter.
Max. temperatures for thermal comfort in 3 different categories:

<table>
<thead>
<tr>
<th>Category</th>
<th>Winter [F] (max)</th>
<th>Summer [F] (max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (best)</td>
<td>73.4</td>
<td>77.9</td>
</tr>
<tr>
<td>II (good)</td>
<td>75.2</td>
<td>78.8</td>
</tr>
<tr>
<td>III (Acceptable)</td>
<td>77</td>
<td>80.6</td>
</tr>
</tbody>
</table>

Results:

<table>
<thead>
<tr>
<th>Comfort Category</th>
<th>No. of occupancy hours on a year</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (best)</td>
<td>1327</td>
</tr>
<tr>
<td>II (good)</td>
<td>1592</td>
</tr>
<tr>
<td>III (Acceptable)</td>
<td>1970</td>
</tr>
<tr>
<td>IV (Unacceptable)</td>
<td>901</td>
</tr>
</tbody>
</table>

The room temperature isn’t acceptable about 38 days, where it’s above 80.6 F in summer and 77 F in winter.
CONSTRUCTION SITE ACCESS

- 1 mile from highway
- Easy access with one way traffic direction flow
- Bus stop next to the site (US 395)
- 1.2 miles (5 mins) to the hospital
Easy construction site access.
One way traffic direction – more space for construction process.
Parking for workers: neighboring parking building

Bus access: bus stops next to the site
CONSTRUCTION SITE VISUALIZATION

- Relax Area
- Storage Area
- Assembly Fabrication
- Delivery Area
- Fueling Area
- Mobile Crane
- Concrete Pump and Delivery
- Generator
- Trailers
- Eco Restrooms
- Recycling Area
LOCAL PROVIDERS

CONCRETE

TVD: LOCAL

Weigl Concrete & Construction
approx. 1.1 miles / 3 mins

STEEL

TVD: LOCAL

Martin Iron Works, Inc.
approx. 1.4 miles / 4 mins

MEP

TVD: LOCAL

Heating & Air Conditioning Contractors
approx 5,6 mil / 9 minutes
CONSTRUCTION SITE EQUIPMENT

EARTHWORKS

TVD: LOCAL

A&K Earth Movers, Inc.
approx. 11.7 miles / 15 mins
(engineering office)
*also asphalt recycling

CONSTRUCTION EQUIPMENT

TVD: LOCAL

United Rentals
5 branches within a 97.4 mile radius

Bragg Reno
Approx. 8 miles / 15 mins
Wheel Loader

JCB 436ZX
Horsepower: 150 hp
Operating Weight: 31,458 lb.
Bucket Capacity Heaped: 3.5 cu. yd.
Powered By: Diesel

Excavator

John Deere 120
Power: 89 hp
Operating Weight: 28,840 lb.
Bucket Capacity: 0.79 cu. yd.
Powered By: Diesel

Dozer

John Deere 650J
Power: 90 hp
Blade Capacity: 2.6 cu. yd.
Powered By: Diesel

Mini-Excavator

Kubota KX161-3 5.5 Ton
Power: 42 hp
Operating Weight: 11,345 lb.
Powered By: Diesel

Roller

Wacker RD12A 35IN Double Drum Vibratory Roller
Operating Weight: 2,171 lb.
Vibration Frequency: 4,200 vpm
Centrifugal Force: 3,400 lb.
Powered By: Gasoline
CONSTRUCTION SITE EQUIPMENT

Equipment rental

Mobile Hydraulic Crane
Grove TM 9120 120 Ton

Concrete Pump
CONNECTING WITH THE COMMUNITY

Construction site – **OPEN/VISITING DAYS** – education

**Augmented reality**

Using QR codes around construction site for visualizing the building being built.
SCHEDULING – START

Goal: Enclose the building between May and October to avoid snow slowing the construction.

*Ridge Team 2011

May 1st 2015
MAIN CONSTRUCTION START SHIFT DUE TO BETTER CONDITIONS

Owners have agreed.
Timeline – Winter vs. Spring Quarter

DEWATERING START

DEWATERING END

approx. 4 months

BUILDING CONSTRUCTION START (May 2015)

BUILDING ENCLOSED (October 2015)

END April 2016
BUILDING ZONING

ZONE A

ZONE B

Approx. 5150 SF

Approx. 5800 SF

Approx. 4850 SF

Approx. 7650 SF
SCHEDULING - START & END

Dewatering
3 months prior to construction

TVD: LOCAL
SCHEDULING
Trade consideration and optimization on zoning
SCHEDULING - FACADE

Finish facade
Start curtain wall

Trade consideration and optimization on zoning
SCHEDULING - SERVICES & INTERIORS

MEP installation after level enclosement

Interior walls then floor finishes then ceiling finishes
CLASH DETECTIONS

• Early BIM integration – awareness of other disciplines – less clashes

REVIT

• Linked model – possible clash awareness

NAVISWORKS

• Explicit clash detection – two models at a time, by level, etc.
• Clash report – high number, but more logical clashes than critical

REAL–TIME VIRTUAL WALKTHROUGH (3D ICC & OTHER)

• Experience and live solving of problems
Ducts should be moved by 2 feet higher!

Needs wall openings
CLASH DETECTIONS – S vs. MEP

Duct though a floor slab.
BIG DEAL / EASY FIX

Exhaust hitting column.
SMALL PROBLEM / EASY FIX
CLASH DETECTIONS – A vs. S

Duct though a floor slab.  
BIG DEAL / EASY FIX

Exhaust hitting column.  
SMALL PROBLEM / EASY FIX
Move the column!
**LABS RENTING**

**Target Value:** Renting labs for the whole period of construction.

**Pros and cons:**

(+) easier transition for students who use labs

(+) easier scheduling – faster construction

(−) more expensive

$450 per day > 365 days (max. construction time) > $164,250

**Cost:** $165,000
BUDGET vs. INFLATION

Proposed inflation rates in US from 2012 to 2015 (Source: Trading Economisc)

Budget loss on inflation
BY-PASSING INFLATION

$8,500,000 donation

- $500,000 inflation *

- $165,000 lab rent

- $335,000 contingency

> Target Value: $7,500,000

*IDEA:
With investments into safe „risk free“ plans we can bypass inflation-based budget loss.

Ask mentors Axel Seifert and Matthias Ehrlich

> Investment in government bonds

$8,500,000 donation

$500,000 inflation

-$165,000 lab rent

-$335,000 contingency

> Target Value: $8,000,000

POSSIBLE TARGET VALUE
TREATED AS ANOTHER CONTINGENCY FACTOR
Winter Quarter’s Modified cost estimate

RS Means
Square Foot Cost Estimate
CONCRETE STRUCTURE
Building cost:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architectural Fees</td>
<td>9%</td>
</tr>
<tr>
<td>User Fees</td>
<td>0%</td>
</tr>
<tr>
<td>Substructure</td>
<td>5%</td>
</tr>
<tr>
<td>Shell</td>
<td>18%</td>
</tr>
<tr>
<td>Interiors</td>
<td>17%</td>
</tr>
<tr>
<td>Services</td>
<td>33%</td>
</tr>
<tr>
<td>Contractor Fees</td>
<td>18%</td>
</tr>
<tr>
<td>Building Special Site Work</td>
<td>0%</td>
</tr>
<tr>
<td>Construction</td>
<td>0%</td>
</tr>
<tr>
<td>Equipment &amp; Furnishing</td>
<td>0%</td>
</tr>
</tbody>
</table>

PINE CONE

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dewatering</td>
<td>$183,750</td>
<td>2%</td>
</tr>
<tr>
<td>Substructure</td>
<td>$320,500</td>
<td>4%</td>
</tr>
<tr>
<td>Shell</td>
<td>$1,100,000</td>
<td>15%</td>
</tr>
<tr>
<td>Interiors</td>
<td>$1,085,000</td>
<td>14%</td>
</tr>
<tr>
<td>Services</td>
<td>$2,224,000</td>
<td>29%</td>
</tr>
<tr>
<td>Special Construction</td>
<td>$400,000</td>
<td>5%</td>
</tr>
<tr>
<td>Building Site Work</td>
<td>$100,000</td>
<td>1%</td>
</tr>
<tr>
<td>Contractor Fees</td>
<td>$1,231,500</td>
<td>16%</td>
</tr>
<tr>
<td>Architectural Fees</td>
<td>$616,000</td>
<td>8%</td>
</tr>
<tr>
<td>Contingency</td>
<td>$300,000</td>
<td>4%</td>
</tr>
</tbody>
</table>

| Building cost             | $7,560,750| 100%       |

Concrete Structure estimate: $928,315
Revt: $650,698

Building cost: $7,560,750

70% precast
30% cast in place
Estimation process

RS Means – Square Foot Estimator

(College, Classroom, 2–3 Story with Decorative Concrete Block.)

Past years Ridge teams estimates comparison

(Setting up average building cost estimated value.)

Estimations for dewatering process

Material take-offs from Revit

(Substructure and shell components)

RS Means Cost Books

(Renting equipment, sitework, special construction, etc.)

Budget consideration

Modified cost estimate
Cost estimate

FINAL COST ESTIMATE $ 7,694,472

Target value budget $ 7,500,000
<table>
<thead>
<tr>
<th>Sustainable Sites</th>
<th>14 Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Efficiency</td>
<td>5 Points</td>
</tr>
<tr>
<td>Energy &amp; Atmosphere</td>
<td>17 Points</td>
</tr>
<tr>
<td>Materials &amp; Resources</td>
<td>13 Points</td>
</tr>
<tr>
<td>Indoor Environmental Quality</td>
<td>15 Points</td>
</tr>
<tr>
<td>Innovation &amp; Design Process</td>
<td>5 Points</td>
</tr>
<tr>
<td><strong>Project Totals (pre-certification estimates)</strong></td>
<td><strong>69 Points</strong></td>
</tr>
</tbody>
</table>

Projected Value of LEED Gold Certification
OUR POP
OUR PRODUCT
OUR ORGANIZATION

- Box
- Dropbox
- Email
OUR POP

Early BIM integration

BIM Manager

BIM implementation
- Templates
- Protocols
OUR POP „TRIANGULATION“

ORGANIZATION

ORGANIZATION

PROCESS

PRODUCT
Everybody agrees on using Revit in the early stages

- Prepare Revit project templates

- Prepare user guidelines on how to use templates

- Prepare tutorials (linking, view depth)

- Establish sharing/linking of models
Revit Workflow for RidgeRS

One of the basics in effective and collaborative BIM workflow is to establish it.

This document is a combination of standardization, tutorials, and advice for each team member on how to utilize Revit in her/his process and design to establish an effective BIM workflow for the whole team.

1 BASIC REVIT TEMPLATE

Each Revit (Architecture, Structure or MEP) user starts his project with a project template. The template is not the same, but it is a program specific one, with some arrangements made so that the collaboration and the linking of different discipline’s files go together as fluent as possible.

These project templates will be updated probably many times. That doesn’t mean that the user will have to start the design and the modeling process all over again. It will just be used with the tool called “Transfer Project Standards” from the template file to the latest file of design. That is how all the important new properties of the template will be copied with the design preserved as it was before.

The template serves as the organizational structure of our Revit projects.

2 1ST STEPS OF DESIGN

Each discipline will start the design process basically from scratch. At first no linking will be established. Maybe just an underlay or a reference of other discipline (i.e. Architecture) will be used for guidance.

That reference can be a Revit model or preferably DWG underlay.

2.1 Standardizations

2.1.1 File naming

File naming of the models will be the same as established for the whole project.

2.1.2 Materials

When modifying existing materials or adding new ones please use the following naming:

- # - stands for our Ridge team and for sorting in the dialog box.
- : - please use space & dash & space
- m - name of material, short and understandable

2.1.3 Building orientation

Everyone should start the modeling in Project North orientation. It is not a true north. It’s the orientation that we agree on. For now we use the orientation of the grids that exist in the template.

3 1ST STAGE OF LINKING MODELS

After the basic architectural and structural models will be prepared, BIM Manager will take those models and establish the linking. Those models will be then shared back again to each discipline to enable further design process.
BIM IMPLEMENTATION

REVIT MODEL LINKING

Problem When You Open Project

If you get this notification, you should Open Manage Links...
BUILDING MODELS

SITE MODEL

STRUCTURAL MODEL

ARCHITECTURAL MODEL

Pushing coordinates to the model

DROPBOX AS A CLOUD MODEL SERVER
INTERACTIONS

- SOCIAL FACTOR OF BIM INTEGRATION
- MEETINGS
- MENTOR MEETINGS RECORDINGS
WEEKLY TEAM ENERGY SURVEY – ANALYSIS

TEAM ENERGY LEVEL

- Overall team rate
- Overall personal rate

DISCIPLINE’S RATINGS

- Kristian (A)
- Maryanne (S)
- Annemarie (S)
- Milos (CM)
- Bedriye (MEP)
GO RIDGERS!
GO PINE CONE!
THANK YOU RENATE!

& THANK YOU:

Gitte Sørensen, Lauren Scammell, Greg Luth, Axel Seifert and Matthias Ehrlich, Henry Tooryani, David Bendet, Glenn Katz, Frank Scheiber, Guido Morgenthal, Daniel Gonzales, Tomo Cerovsek, Martin Lah, Ziga Turk, Erik Kneer