We are the Ridge team, which from now on, stands for awesome.

Spring Presentation
May 10th, 2013
Ridge Team 2013

Owners: Sinan M. (SLO), Anirudh R. (CA), & Maria S. (MN)

Chico, CA
Laura M. (CM)

Stanford, CA
Stephanie C. (SE)
Ramon I. (CM)

Denmark
Kleanthis C. (MEP)

Germany
Stefan E. (LCFM)
Toni G. (LCFM)

Slovenia
Stefan M. (SE)

Puerto Rico
Pablo C. (A)
Jorge S. (A)
Location: Reno, Nevada
Location: UN Reno

Stadium
Student Union
Library
Parking Garage

E 1st St, Reno, NV 89512, USA
Site Context
Site Context
Site Challenges

Min. temperature 23.3 °F
Max. temperature 92.2 °F
Avg. precipitation 7.3 in/yr

Mean sunshine 3650 hr/yr
Site Challenges

Average wind speed 5.7 knots  Seismically active zone

Average humidity 55 %
Design Challenges

Swinerton: Leapfrog Challenge

DPR: Whole Life Cycle Challenge

STV: Sustainable Target Value
Big Idea

5 smart building (security, SHM, etc.)
5 collaborate IN the building
Energy/Environment ideas/goals?
Big Idea

Industrial Evolution

Psychological Domain

Convergent

Production

Physical Domain

Divergent

Transformation

| A | SE | CM | MEP | LCFM |
Big Idea

Technology

Flexible Spaces

Rapid Prototyping Labs

Creativity

A | SE | CM | MEP | LCFM
Big Idea
Big Idea

Rapid Prototyping Lab

Creative Problem Solving + Production

Cafe & Lounge
Big Idea
L Concept

in steel & concrete

Transparent Engineering Building (TEB)
DD Concept

Central

X-Lattice
# Decision Matrix

## Economical

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Subcriteria</th>
<th>Description</th>
<th>Weighting [100 points]</th>
<th>DD-Cylinder</th>
<th>DD-X</th>
<th>L-Shape-Steel</th>
<th>L-Shape-Concrete</th>
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</thead>
<tbody>
<tr>
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<td>Points available</td>
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<td>31,7</td>
<td>115,0</td>
<td>102,7</td>
<td>109,3</td>
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<tr>
<td></td>
<td>Construction Costs</td>
<td>Calculation of the construction costs by RSMeans.</td>
<td>7,7</td>
<td>4,0</td>
<td>4,0</td>
<td>3,0</td>
<td>3,0</td>
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<tr>
<td></td>
<td>Operation &amp; Maintenance Costs</td>
<td>Includes expenses for cleaning, energy and administration as a whole.</td>
<td>7,3</td>
<td>3,0</td>
<td>3,0</td>
<td>4,0</td>
<td>4,0</td>
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<tr>
<td></td>
<td>NEA/GEA</td>
<td>The ratio of net external area to gross external area to determine</td>
<td>4,3</td>
<td>3,0</td>
<td>3,0</td>
<td>3,0</td>
<td>3,0</td>
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<tr>
<td></td>
<td>Construction Time</td>
<td>Required construction time according to the work schedules of</td>
<td>7,0</td>
<td>4,0</td>
<td>3,0</td>
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<td>2,0</td>
</tr>
<tr>
<td></td>
<td>Constructability</td>
<td>How the building will be built and what techniques will be used</td>
<td>5,3</td>
<td>4,0</td>
<td>3,0</td>
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<td>2,0</td>
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## Environmental (STV)

<table>
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<tr>
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<th>Subcriteria</th>
<th>Description</th>
<th>Weighting [100 points]</th>
<th>DD-Cylinder</th>
<th>DD-X</th>
<th>L-Shape-Steel</th>
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<tr>
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<td>21,3</td>
<td>58,7</td>
<td>58,7</td>
<td>64,3</td>
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<tr>
<td></td>
<td>CO2-Emission</td>
<td>CO2-Emission in tons per year.</td>
<td>5,3</td>
<td>2,0</td>
<td>2,0</td>
<td>3,0</td>
<td>4,0</td>
</tr>
<tr>
<td></td>
<td>Renewable Energy</td>
<td>Usage of renewable energy (e.g. PV, wind turbine, earth heat).</td>
<td>6,3</td>
<td>3,0</td>
<td>3,0</td>
<td>3,0</td>
<td>3,0</td>
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<tr>
<td></td>
<td>Life Cycle of Material</td>
<td>Life span of used materials.</td>
<td>5,0</td>
<td>3,0</td>
<td>3,0</td>
<td>4,0</td>
<td>4,0</td>
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<tr>
<td></td>
<td>Recycled Material</td>
<td>Usage of recycled materials.</td>
<td>4,7</td>
<td>3,0</td>
<td>3,0</td>
<td>2,0</td>
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</table>

## Social

<table>
<thead>
<tr>
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<th>Subcriteria</th>
<th>Description</th>
<th>Weighting [100 points]</th>
<th>DD-Cylinder</th>
<th>DD-X</th>
<th>L-Shape-Steel</th>
<th>L-Shape-Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>1,35</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td>31,7</td>
<td>97,7</td>
<td>107,7</td>
<td>101,3</td>
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<tr>
<td></td>
<td>Comfort</td>
<td>Comfort of the users and employees (mostly depending on the</td>
<td>7,7</td>
<td>4,0</td>
<td>4,0</td>
<td>3,0</td>
<td>3,0</td>
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<tr>
<td></td>
<td>Flexibility</td>
<td>Flexibility describes how spaces can be customized to different</td>
<td>5,3</td>
<td>3,0</td>
<td>3,0</td>
<td>3,0</td>
<td>3,0</td>
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<tr>
<td></td>
<td>Student/Faculty Collaboration</td>
<td>Interaction and collaboration between students and faculty members.</td>
<td>6,3</td>
<td>3,0</td>
<td>3,0</td>
<td>4,0</td>
<td>4,0</td>
</tr>
<tr>
<td></td>
<td>Design/Ionicity</td>
<td>Attractiveness and iconicity of the design building.</td>
<td>5,0</td>
<td>2,0</td>
<td>4,0</td>
<td>3,0</td>
<td>3,0</td>
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<tr>
<td></td>
<td>Innovation</td>
<td>In which extend innovations are included in the construction process.</td>
<td>7,3</td>
<td>3,0</td>
<td>3,0</td>
<td>3,0</td>
<td>3,0</td>
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</table>

## Discipline specials

<table>
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<th>Weighting [100 points]</th>
<th>DD-Cylinder</th>
<th>DD-X</th>
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<td></td>
<td></td>
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<tr>
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<td></td>
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<td>14,0</td>
<td>42,0</td>
<td>48,7</td>
<td>35,3</td>
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<tr>
<td></td>
<td>Architectural/Structural unity</td>
<td>Clarity of the structural and architectural concepts throughout</td>
<td>6,7</td>
<td>3,0</td>
<td>4,0</td>
<td>2,0</td>
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<tr>
<td></td>
<td>Context connection</td>
<td>How the design of the building connects with surroundings and</td>
<td>7,3</td>
<td>3,0</td>
<td>3,0</td>
<td>3,0</td>
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## Total Score

<table>
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<tr>
<th>Criteria</th>
<th>Subcriteria</th>
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<th>Weighting [100 points]</th>
<th>DD-Cylinder</th>
<th>DD-X</th>
<th>L-Shape-Steel</th>
<th>L-Shape-Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>313,3</td>
<td>317,7</td>
<td>310,3</td>
<td>296,3</td>
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</tbody>
</table>
Site Topography

A
SE
CM

7'
0'

MEP
LCFM
# Soil Properties

<table>
<thead>
<tr>
<th>Grade at 5,580 ft. Elevation</th>
<th>Soil Type</th>
<th>Thickness</th>
<th>Bearing Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 inches (0 ft.)</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>Water Table</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>48 inches (4.0 ft.)</td>
<td>Volcanic Rock</td>
<td>Unknown</td>
<td>8,000 psf</td>
</tr>
<tr>
<td>56 inches (4.67 ft.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>84 inches (7 ft.)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

- **pre-draining**: (-)
- **retaining walls**: (-)
- **higher building**: (+)

**Source**: Ridge 2012
## Orientation

<table>
<thead>
<tr>
<th></th>
<th>Total EUI (kBtu/sf/yr)</th>
<th>Life Cycle Energy Cost ($)</th>
<th>Net CO₂ (tn/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>70</td>
<td>630,000</td>
<td>155</td>
</tr>
<tr>
<td>SE</td>
<td>68</td>
<td>615,000</td>
<td>145</td>
</tr>
<tr>
<td>CM</td>
<td>71</td>
<td>650,000</td>
<td>165</td>
</tr>
<tr>
<td>MEP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCFM</td>
<td></td>
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</table>
Building Placement
Basement Level - Furnished
## Basement Level

<table>
<thead>
<tr>
<th>A</th>
<th>SE</th>
<th>CM</th>
<th>MEP</th>
<th>LCFM</th>
</tr>
</thead>
</table>
Basement Level
Basement Level - Structure

Legend:
- **W8x24**
- **W8x40**
- **W12x30**
- **W12x50**
- Retaining wall
Foundations and Retaining Wall

- pad footings
- foundation slab
- 14' retaining wall
Concrete

- Production of 1 tonne of cement absorbs up to 100 kg more CO$_2$ than it emits
- Strength and cost parity with traditional concrete
Basement Level - Duct Network

Overhead System VAV

Supply
Return
Auditorium 3D
Basement Level - Daylight
Additional Income
Additional Income

NPV: $9,820,000 with rental / $11,700,000 without rental
First Level - Furnished
First Level - Structure

Legend:
- Pink: W8x18
- Orange: W8x24
- Green: W12x50
- Blue: W27x129
First Level - Duct Network

Sensors
- CO\textsubscript{2}
- Temperature

Supply
Return
First Level - Daylight
Floor Sandwich
Floor Sandwich

Composite slab: 4 1/2"  
Steel beams: 8"  
Ducts & installations: 4"  
Girders: 12"  
Ceiling panels: 1"  
Total: 17 1/2"
Clash Detection
Second Level - Furnished
Second Level
Second Level - Structure

Legend:
- **W8x24**
- **W8x40**
- **W12x50**
- **W27x129**
Second Level - Duct Network

Carbon (kgCO2e)
Water (kgH2O)
Energy (MJ)

- Targets
- Project before
- Project after

Supply
Return
Second Level - Daylight
## Sustainability

**Double Skin Facade**
- **improved IAQ**
- **reduced energy consumption**

**Photovoltaics**
- **energy production**
- **reduced CO$_2$**

### Double Skin Facade (DSF)
- **+2.9**
- **+2.1**
- **+2.1**
- **+1.3**
- **+2.0**

### Photovoltaics
- **+4.7**
- **+3.9**
- **+2.4**
- **+1.9**
- **+1.7**
- **+1.7**

<table>
<thead>
<tr>
<th>A</th>
<th>SE</th>
<th>CM</th>
<th>MEP</th>
<th>LCFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 w/o pv</td>
<td>0.0 with pv</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DSF Details

- Exhaust vent with operable glass louvers
- Inner skin with 2-pane glass
- Outer skin - Fritting shading
- Outer skin - Transparent PV
- Intake trench with operable damper

Transparent PV
- 50.1 MWh
- 20.1%

*Cambridge Public Library, Cambridge MA
Double Skin Facade

• decision between single facade and double skin facade
• additional costs through DSF
• added annual savings & increased energy efficiency
Double Skin Facade

Alternative life cycle

Savings $1 150 000

<table>
<thead>
<tr>
<th>A</th>
<th>SE</th>
<th>CM</th>
<th>MEP</th>
<th>LCFM</th>
</tr>
</thead>
</table>
Third Level - Floor Plan

- Core
- Faculty Offices
- Lounge
- Mechanical Shafts
- Storage
Third Level - Furnished
Third Level
Third Level - Structure

Legend:
- **Blue** W8x18
- **Orange** W8x24
- **Pink** W8x40
- **Green** W12x50
Third Level - Duct Network

Velocity
- Main Ducts
  - 21.3 fps
- Branch Ducts
  - 11.5 fps

Supply
Return
Third Level - Daylight
Photovoltaics

- Tilt 30°
- Nominal Power 30 kW
- Area 250 m²
- System Output 141.6 kWh/day
Photovoltaics

Life cycle PV roof  Savings $1 350 000
Rainwater Harvesting

- Collectable rainwater/snow
- 72200 gal/year
- Underground tank
- 8000 gal (7' d x 30' l)
- first-flush diverter
Section BB

<table>
<thead>
<tr>
<th>30’ - 0”</th>
<th>19’ - 3”</th>
<th>9’ - 9”</th>
<th>9’</th>
<th>37’ - 0”</th>
<th>9’</th>
<th>9’ - 9”</th>
<th>19’ - 3”</th>
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</thead>
<tbody>
<tr>
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<td>19’ - 3”</td>
<td>9’ - 9”</td>
<td>9’</td>
<td>37’ - 0”</td>
<td>9’</td>
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<td>19’ - 3”</td>
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<td>19’ - 0”</td>
<td>9’ - 6”</td>
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<td>8’ - 0”</td>
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<td>2’ - 6”</td>
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<td>9’</td>
<td>9’ - 6”</td>
<td>9’</td>
<td>9’ - 6”</td>
<td>9’ - 6”</td>
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<tr>
<td>13’ - 6”</td>
<td>9’ - 6”</td>
<td>9’ - 6”</td>
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<td>9’</td>
<td>9’ - 6”</td>
<td>9’ - 6”</td>
</tr>
</tbody>
</table>
Section BB Diagram

Creativity / Collaboration

Production

Bathroom / Core
Southwest Elevation
Southeast Elevation
North Elevation
# SE Load Conditions

<table>
<thead>
<tr>
<th>Load Condition</th>
<th>IBC 2006</th>
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<tbody>
<tr>
<td>Roof Dead Load</td>
<td>90 psf</td>
</tr>
<tr>
<td>Roof Live Load</td>
<td>20 psf</td>
</tr>
<tr>
<td>Roof Snow Load</td>
<td>40 psf</td>
</tr>
<tr>
<td>Other Floor Dead Loads</td>
<td>75 psf</td>
</tr>
<tr>
<td>Other Floor Live Loads</td>
<td>60-100 psf</td>
</tr>
<tr>
<td>Wind Shear</td>
<td>100 mph =&gt; 1.5 kips / foot</td>
</tr>
<tr>
<td>Earthquake Shear</td>
<td>R=3.25 =&gt; 1900 kips</td>
</tr>
<tr>
<td>Retaining-soil Shear</td>
<td>4.7 kips / foot</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site Class</th>
<th>Occupancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>B - Rock</td>
<td>I</td>
</tr>
</tbody>
</table>
Lateral Support

• Earthquake shear: prevailing load
• Options considered
  • Shear walls
  • Rocking frames
  • Diagrid
## Diagrid Shape

<table>
<thead>
<tr>
<th></th>
<th>No. Diag</th>
<th>Length (ft.)</th>
<th>No. Joints</th>
<th>Max Comp. (k)</th>
<th>Max Tens. (k)</th>
<th>Avg. Force (k)</th>
<th>Avg. Area (sq. in.)</th>
<th>Est. Weight (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>39</td>
<td>14.1</td>
<td>27</td>
<td>-285.9</td>
<td>127.6</td>
<td>69.3</td>
<td>1.39</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>57</td>
<td>12.2</td>
<td>38</td>
<td>-185.5</td>
<td>70.2</td>
<td>46.3</td>
<td>0.93</td>
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<tr>
<td>3</td>
<td></td>
<td>77</td>
<td>14.1</td>
<td>91</td>
<td>-189.9</td>
<td>146.5</td>
<td>36.4</td>
<td>0.73</td>
</tr>
</tbody>
</table>
Maintain constant diameter to keep constant appearance among floors, but vary HSS thickness to optimize for weight
ETABS Analysis
Seismic - Story Drifts

Max = 0.26%
Max = 0.32%
Connection Detail

- Bolt the diagonals to gusset plate
- Weld the gusset plate to the flange of the girder
The Rise of the Diagrid

Preferred prefab element:
~2,800 lbs
Just within Truck Length/Width requirements
The Rise of the Diagrid

1. Bolt HSS to Girder
2. Bolt Girder to Girder
3. Remove Temporary Structure
4D Sequence
Construction Site Access
Construction Site Logistics
Construction Site Logistics
Construction Tracking

Query for Materials
Construction Tracking

Monitor activities and resources in real time
Construction Tracking

**People:** Helmet worn unit with GPS, WiFi and IMU

**Material:** Slim chip uses WiFi and GPS, integration with MEP and Structural sensors

**Equipment (crane):** Integration of built-in software with GPS
Milestones:

- Retaining wall
- Finishing the computer labs (April 15th 2016)
- Installation of the diagrid
Structural Health
Approx. 500 strain gauges at critical locations on steel framing (i.e. diagrid connections, center of girders)

At $50/sensor, total cost = $25,000
Occupancy Sensors

Low Level - Motion detectors used to control lighting

Medium Level - Count the number of occupants in a zone to refine estimates for HVAC and lighting needs. Potential to identify presence in case of emergency

High Level - Activity monitoring or ability to identify specific persons for best estimate of HVAC needs and security

Owners request sensors capable of a rough estimate of the number of people in a room (+/- 5)
HVAC & Light Sensors

Room controllers with batteryless sensors

Energy harvesting from surroundings
HVAC & Light Sensors

investment costs ~ $34 000
annual savings       $16 000
overall productivity increase up to ~ 30 %
Sustainability App

- Encourage occupants to act more sustainably
- Provide sensor data in an easy-to-understand format
Water Management

Water savings

• Dual mode toilets
  • 72% in partial mode
  • 59% in full mode
• Waterless urinals
  • 375 gal./per day
• Sensor bathroom faucets
  • 60% to conventional
Plug Load & Solar Pads

7020 kWh/year through mobile devices & laptops lead to about $3750 a year for electricity.

80 solar pads with the total cost of $9920 preserve those expenses.
# Delivered Energy Overview

<table>
<thead>
<tr>
<th></th>
<th>Delivered energy kWh</th>
<th>kWh/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting, facility</td>
<td>5749</td>
<td>1.7</td>
</tr>
<tr>
<td>HVAC aux</td>
<td>50576</td>
<td>15.1</td>
</tr>
<tr>
<td>Total, Facility electric</td>
<td>56325</td>
<td>16.8</td>
</tr>
<tr>
<td>District cooling</td>
<td>121537</td>
<td>36.3</td>
</tr>
<tr>
<td>District heating</td>
<td>41679</td>
<td>12.4</td>
</tr>
<tr>
<td>Total, Facility district</td>
<td>163216</td>
<td>48.7</td>
</tr>
<tr>
<td>Total</td>
<td>219541</td>
<td>65.5</td>
</tr>
<tr>
<td>Equipment, tenant</td>
<td>48366</td>
<td>14.4</td>
</tr>
<tr>
<td>Total, Tenant electric</td>
<td>48366</td>
<td>14.4</td>
</tr>
<tr>
<td>Grand total</td>
<td>267907</td>
<td>80.0</td>
</tr>
</tbody>
</table>

Total delivered energy:
- Natural Gas 163216 kWh
- Electricity 104691 kWh
- PV production 101801 kWh

Total delivered energy density: 49.6 kWh/m²
Building Indoor Comfort

% of hours when operative temperature is above 27 °C

7 %

% of total occupants hours with thermal dissatisfaction

10 %

Auditorium

Big Classroom
Sustainable Target Value

- Carbon (kgCO2e)
- Water (kgH2O)
- Energy (MJ)

Graph showing the comparison between project and carbon targets over a period of 50 units.

Legend:
- Project Carbon (kgCO2e)
- Carbon Target
**LEED Scorecard**

- LEED for New Construction
- LEED Gold

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable Sites</td>
<td>17 to 21</td>
</tr>
<tr>
<td>Water Efficiency</td>
<td>10</td>
</tr>
<tr>
<td>Energy &amp; Atmosphere</td>
<td>27</td>
</tr>
<tr>
<td>Materials &amp; Resources</td>
<td>5</td>
</tr>
<tr>
<td>Indoor Environmental Quality</td>
<td>13 to 15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>72 to 78</strong></td>
</tr>
</tbody>
</table>
Construction Cost Estimate

Final Cost: $8,391,000
Target Budget: $8,382,000

Glazing is ~24% of total cost!
Life Cycle Process Savings

Summed up for whole life cycle savings of 34%
Team Process & Interactions

- emails not needed
  - except for with owners/mentors
- team & subgroup meetings
- discussion and links
- file sharing
- modeling and analysis
- graphic communication

Damn, an email!
# Modes of Communication

<table>
<thead>
<tr>
<th>Modes of Communication</th>
<th>Primary</th>
<th>Secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text, images, videos, links to other websites, etc.</td>
<td>facebook</td>
<td>Gmail by Google</td>
</tr>
<tr>
<td>Instant messaging</td>
<td>facebook</td>
<td>talk, skype</td>
</tr>
<tr>
<td>Voice</td>
<td>GoToMeeting</td>
<td>skype, 3D I.C.C.</td>
</tr>
<tr>
<td>File Sharing</td>
<td>Google Drive</td>
<td>Dropbox, box</td>
</tr>
</tbody>
</table>
Team & Subgroup Meetings

for walkthroughs

Screen sharing & sketching in

A  SE  CM  MEP  LCFM
Discussion and Links

for 2 person meetings

Idea sharing and discussions in

Stefan Markic
For the "water pipe going from roof through the building" idea, here is a solution of staying nice (also applicable in other water sculptures):
www.youtube.com/watch?feature=player_embedded&v=IPM8OR6W6WE

The Official Ultra-Ever Dry Product Video - Superhydrophobic and oleophobic coating
www.youtube.com
Ultra-Ever Dry is a superhydrophobic (water) and

I Like · Comment · Follow Post · Share · February 9 at 5:15am

Jorge A. Silén, Kleanthis Mhnsenoaizei and Sinan Mihelč like this.

Kleanthis Mhnsenoaizei impressive!!
February 9 at 9:24am · Like

Write a comment...
File Sharing

Usage in Megabytes

- Google Drive: 1976
- Dropbox: 764

Usage by Number of Files

- Google Drive: 1731
- Dropbox: 226
Welcome to the Ridge Team Blog!

Have you ever wondered how a building is designed? Curious on how the future building construction might look like? Or just looking for some new material to procrastinate with? Then you are in the right place! We are an excited group of student engineers and architects who have just embarked in the tricky journey of designing a building from scratch, with an extra spin: we are all spread out across the world. Curious? Go on.

This is a product of the Problem Based Learning (PBL) class called Computer Integrated Architecture/Engineering/Construction Global Teamwork (let’s just call it PBL) hosted by Stanford University but actually a collaboration of several universities (more information at http://pbl.stanford.edu/). The idea is to have students of different
Modeling and Analysis

Architecture

SketchUp

Structure

ETABS

Construction

bluebeam

MEP

VICO SOFTWARE

IDAB ICE

 MEP

VELUX

Daylight Visualizer

 A

 SE

 CM

 MEP

 LCFM
Graphic Communication

MS Paint

A
SE
CM
MEP
LCFM
Duct Network - Basement
Laura M: Flexibility is key.

Stephanie C: Sometimes it is better NOT to be colocated (... that way one infection can't decimate an entire team).

Kleanthis C: When nine individualists set a common goal, that is the key for a successful team.
Lessons Learned

Stefan M: Time zones are logical. But imperial ...

Ramon I: In low context, high latency communication, clarity and specificity are essential.

Pablo C: Love your engineer as much as you love yourself.

Jorge A: See things from a new perspective.
Summary

- innovative technology
- user friendly facility
- "smart" building
- LEED Gold
- constructed on schedule
- final cost = $8 391 000
Thanks!

Special thanks to Renate, Maria, Sinan, Anirudh and the mentors we've worked with:
Humberto Cavallin, Greg Luth, Justin Bocian, Prof. Jon Wren, Prof. Eduardo Miranda, Prof. Hamid Aghajan and AIR Lab, John Nelson, Sarah Russell-Smith, Luis Rivera
Thanks!
Thanks!