TEAM ATLANTIC 15
Winter Cyber Presentation
Team Process
Imagine...

- Sexy Building
- User friendly
- Holistic Concept
- Muir Woods
- Heatpump
- Site Beauty
- Rainwater Collection
- WOW Factor

Pretty, pretty, pretty

7 Strangers getting to know each other
AEC 2015 – Atlantic

Floating in Space—Where are you??

Meetings once a week

We are getting better at this!?

Meetings once a week/Subgroups

Kick Off
Januar
Week 1

Peer Crits
February
Week 5

Mentor Crits
February
Week 6

Spring Quarter
April/May
Week 12-17

Winter Cyber Presentation
Week 9

Coordination
Collaboration
Communication

Meetings twice a week/Subgroups/Standups

Like/Wish?! Transparency?

Meetings twice a week/Subgroups
Never ever forget to reducing latency!
University of Wisconsin – Madison
Local Hazards and Challenges

• Constrained by lake, hill and forest
• High water table
• Extreme climate
• Proximity of College Library
• Howard Temin Lakeshore path
Site
Warm & Cold Weather

Average max. temperature: 28 °C
Average min. temperature: -12 °C
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Rain & Wind

Wind mostly from S-SW W-NW

Average yearly rainfall: 34.5 in
Average yearly snowfall: 38.2 in
Rain & Wind

Average yearly rainfall: 34.5 in
Average yearly snowfall: 38.2 in

Wind mostly from S-SW

Wind from northwest

Wind from south
Rain & Wind

Wind mostly from S-SW W-NW

Average yearly rainfall: 34.5 in
Average yearly snowfall: 38.2 in
Sun & Daylight

Location: Madison Dane Co. Rgnl Airport
Lat: 43.14° N
Lon: 89.35° W (Local Time Meridian: 90.00° W)

Sun Paths Shown:
- June 21
- March 21
- September 21
- January 1
- December 31
- December 21

North
West
South
East
ATOMI
STUDENT’S OFFICE
BIG CLASS ROOM
AEC 2015 – Atlantic

4th level

- Admin assistants
- Offices
- Bathroom
- Circulation
- Departments
- Chair Office
- Elevator shaft
- Faculty lounge
- Faculty office
- MEP Shaft
- Senior admin office

Scale: 10m = 33 ft
5th level

- Circulation
- Dressing room
- MEP room
- Sauna
- Shower
- Terrace

10m
33 ft
SOUTH

NORTH

ELEVATIONS
Structural Options
## Typical Loads

<table>
<thead>
<tr>
<th>Room Type</th>
<th>Live Load (psf)</th>
<th>Snow (psf)</th>
<th>Snow Drift (psf)</th>
<th>Wind (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Classroom</td>
<td>40</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Auditorium</td>
<td>100</td>
<td></td>
<td></td>
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<tr>
<td>Corridor (first floor)</td>
<td>100</td>
<td></td>
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<tr>
<td>Corridor</td>
<td>80</td>
<td></td>
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<tr>
<td>Lab</td>
<td>60</td>
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<tr>
<td>Partition</td>
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<tr>
<td>Mechanical Room</td>
<td>100</td>
<td></td>
<td></td>
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<tr>
<td>Roof</td>
<td>20</td>
<td></td>
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</tr>
</tbody>
</table>

Snow (psf) 30
Snow Drift (psf) 132
Wind (psf) 22.5
Typical Loads - Dead Load (Self-Weight)

**Steel**
- 2 in Metal Deck + 4.5 in LW Concrete Slab = 44 psf
- OR Bubble Deck = 30 psf
- Beam/Girder = 45 plf

**Concrete**
- Bubble Deck = 30 psf
- Beam/Girder = 35 plf

**Timber (CLT)**
- Floor = 3 psf
- Beam/Girder = 26 plf
Soil Profile

- High Water Table (6.5 ft below ground)
- Bearing Capacity = 4ksf
ATOMIC

Steel Structure
- Gravity System
  Bubble deck, steel column and beam/girder
- Lateral System
  Bubble deck and beam system

Concrete Structure
- Gravity System
  Bubble deck, reinforced concrete column and beam/girder
- Lateral System
  Bubble deck and beam system
Small Circular Grid Dia = 23 ft
Middle Circular Grid Dia = 60 ft
Large Circular Grid Dia = 98 ft
Largest Span = ~46 ft
ATOMI – Steel Structure

- Bubble Deck  BD450 (1.5 ft)
- Column W14X74
- Girder
  - W18X46
  - W27X84 (Auditorium and Cantilever)
- Beam
  - W21X50 (Cantilever)
- Steel Rod  Dia. 6 in
ATOMI - Steel Structure

Max Cantilever = 18.5 ft

Column  W14X74
- Continuous
- One-Story

Girder
- W18X46
- W27X84
  (Auditorium+Cantilever)

Beam
- W21X50

First Floor

(Unit: ft)
ATOMI - Steel Structure

Column  W14X74
- Continuous
- One-Story

Girder
- W18X46
- W27X84
(Auditorium+Cantilever)

Beam  W21X50

Second Floor

Third Floor

Large Classrooms
ATOMI - Steel Structure

Prefabrication
ATOMI – Concrete Structure

- Bubble Deck  BD450 (1.5 ft)
- Column  18” Round
- Girder
  18” X 26”
  24” X 30” (Auditorium+ Cantilever)
- Beam
  18” X 30” (Cantilever)
- Steel Rod  Dia. 6 in
**ATOMI – Concrete Structure**

- **Max Cantilever** = 18.5 ft
- **Column 18” Round**
  - Continuous
  - One-Story
- **Girder**
  - 18” X 26”
  - 24” X 30”
  - (Auditorium+Cantilever)
- **Beam**
  - 18” X 30”

(Unit: ft) **First Floor**
ATOMI – Concrete Structure

Second Floor

- Column 18” Round
  - Continuous
  - One-Story

- Girder
  - 18” X 26”
  - 24” X 30” (Auditorium+Cantilever)

Third Floor

- Beam 18” X 30”
ATOMI - Load Path
## ATOMI - Comparison

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Steel</th>
<th>Concrete</th>
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<tbody>
<tr>
<td>Constructability</td>
<td>Beam Size Variation</td>
<td>Ring Connection</td>
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<tr>
<td></td>
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<td>Curved Member</td>
</tr>
<tr>
<td>Latency</td>
<td>Possible Prefabrication</td>
<td>Cold Weather</td>
</tr>
<tr>
<td>Construction Challenge</td>
<td>Large Members</td>
<td>Heavy Structure</td>
</tr>
<tr>
<td></td>
<td>Crane limits</td>
<td>Large Foundation</td>
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</tbody>
</table>

**Steel**
- Beam Size Variation
- Possible Prefabrication
- Large Members
- Crane limits

**Concrete**
- Ring Connection
- Curved Member
- Cold Weather
- Heavy Structure
- Large Foundation
MEP Option
Heat pump winter season

Snow must transform into water

Hill

Rainwater collection

4.5 \cdot 10^6 \text{ gallons}

Heating effect

Heatpump

130 kW

Natural Filter

3°C

The Lake

-30°C

Snow

Heat pump winter season

Rainwater collection

4.5 \cdot 10^6 \text{ gallons}

Heating effect

Heatpump

130 kW

Natural Filter

3°C

The Lake

-30°C

Snow
Heat pump summer season

- Hill
- Rainwater collection: 4.1 \times 10^5 \text{ gallons}
- Cooling effect
- Heat pump: 130 kW
- The Lake
  - 10°C
- Natural Filter
  - 30°C
Using water for thermal comfort

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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<tbody>
<tr>
<td>Better acoustics compared with chilled ceiling</td>
<td>Low heat capacity</td>
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<tr>
<td>Better response time</td>
<td>Less building height</td>
</tr>
<tr>
<td>Draught</td>
<td></td>
</tr>
<tr>
<td>Nonuniformly distributed</td>
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</tr>
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<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>High heat capacity</td>
<td>Low heat capacity</td>
</tr>
<tr>
<td>More building height</td>
<td>Less room height</td>
</tr>
<tr>
<td>Uniformly distributed</td>
<td>Draught</td>
</tr>
<tr>
<td>Better comfort</td>
<td>Nonuniformly distributed</td>
</tr>
</tbody>
</table>
### Mixing Ventilation

**Advantages**
- The entire room is supplied with clean air
- Uniform comfort in the room

**Disadvantages**
- High energy consumption compared with DV
- High operating costs compared with DV
- Poorer air in the breathing zone compared with DV

### Displacement Ventilation

**Advantages**
- Cleaner air in breathing zone
- The entire room is supplied with air

**Disadvantages**
- High risk of draft
- Possibility of vertical temperature difference
Solutions for classrooms

Classrooms & Auditorium
- Atmospheric comfort
  - Contaminant removal effectiveness
  - Clean air in breathing zone
  - High CO2 level
- Thermal comfort
  - High person/thermal density
- Displacement ventilation system

Rest of the building
- Atmospheric comfort
  - Clean air in breathing zone
  - Low CO2 level
- Thermal comfort
  - Low thermal density
- Mixing ventilation system
Building systems

Auditorium
Classrooms

Underfloor displacement ventilation & chilled/heated ceiling

Rest of the building

Mixing ventilation & chilled/heated ceiling
SHELL
Telescopic seating
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Lecture - Concert - Sponsor event

Auditorium

A / E / C / MEP / LCFM
2nd level
- Auditorium
- Bathroom
- Circulation
- Elevator shaft
- LABS
- MEP room
- MEP Shaft
- Small classroom

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A / E / C / MEP / LCFM
View: 3rd level
Section West - East

10m
33 ft
Elevation East

10m
33 ft
Elevation North

10m
33 ft
Elevation West

10m
33 ft
Elevation South

10m
33 ft
Structural Options
SHELL

Timber (CLT) Structure
- Gravity System
  CLT floor
  CLT column and beams
- Lateral System
  Chevron braces

Steel Structure
- Gravity System
  Composite slab
  Steel column and beams
- Lateral System
  Moment Resisting Frame
SHELL - Timber (CLT) Structure

- 6 in CLT Floor
- Column 10 X 24 ¾
- Girder
  - 10 ½ X 31 ⁵⁄₈
  - 12 X 33 (Auditorium and Large Classrooms)
- Beam
  - 10 ½ X 24 ¾
  - 12 X 26 ¹⁄₈ (Auditorium and Large Classrooms)
- Chevron braces 3X11

(Unit: in)
SHELL - Timber (CLT) Structure

Max Beam Span = 46 ft
SHELL - Timber (CLT) Structure

Cantilever Span = 14 ft

Column 10” X 24 ¾”
Girder
10 ½ X 31 ½
12 X 33
(Auditorium and Large Classrooms)
Beam
10 ½ X 24 ¾
(Unit: in)

(Unit: ft)

First Floor
SHELL - Timber (CLT) Structure

Second Floor

Column 10” X 24 ¾”
- Continuous
- One story

Girder 10 ½ X 31 5/8

Beam 10 ½ X 24 ¾
(Unit: in)

Third Floor

Large Classrooms
(Unit: ft)
SHELL - Timber (CLT) Structure

Lateral System
SHELL

Load Path
SHELL - Steel Structure

- 6.5 in Composite Slab
- Column W14X74
- Girder
  - W18X46
  - W24X55 (Auditorium and Large Classrooms)
- Beam
  - W16X36
  - W21X50 (Auditorium and Large Classrooms)
- Braces 2” X 2”
SHELL - Steel Structure

Max Beam Span = 46 ft

(Unit: ft)
Shell - Timber (CLT) Structure

First Floor

Cantilever=14 ft

Column W14X74
Shell - Steel Structure

Second Floor

Column W14X74
### SHELL - Comparison

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Steel</th>
<th>Timber (CLT)</th>
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</thead>
<tbody>
<tr>
<td>Sustainability</td>
<td>Regular</td>
<td>Green Material</td>
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<tr>
<td>Framing System</td>
<td>Larger Span</td>
<td>Beam System Replaced by Deck</td>
</tr>
<tr>
<td>Material Accessibility</td>
<td>Available</td>
<td>Manufacturer Nearby</td>
</tr>
<tr>
<td>Crane Capacity</td>
<td>Heavy Elements</td>
<td>Light and Small Elements</td>
</tr>
</tbody>
</table>
Retaining Wall

Total Height 30ft

6 in

21 in
Foundations

**ATOMI** - Pile Foundation, 8 ft

- Heavy structural system (Concrete or Steel)
- Under water table

**SHELL** - Shallow Foundation, 6 ft

- More columns
- Lighter weight
- Without touching water table
MEP Option
Shadows from Atomi/Shell and surroundings

October 9 am
October 12 am
October 3 pm
## Sustainable Target Value for Atomi/Shell

<table>
<thead>
<tr>
<th>CARBON (KgCO2e)</th>
<th>ENERGY (MJ)</th>
<th>WATER (KgH2O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atom - Steel</td>
<td>30%</td>
<td>31%</td>
</tr>
<tr>
<td>Atom - Concrete</td>
<td>28%</td>
<td>30%</td>
</tr>
<tr>
<td>Shell - Steel</td>
<td>43%</td>
<td>45%</td>
</tr>
<tr>
<td>Shell - Wood</td>
<td>45%</td>
<td>49%</td>
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</tbody>
</table>

*CARBON (KgCO2e), ENERGY (MJ), WATER (KgH2O)*
CM Items
Construction activity pollution prevention

<table>
<thead>
<tr>
<th>Measure</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>„Super“ silt fence</td>
<td>$10/L.F.</td>
</tr>
<tr>
<td>Construction road stabilization</td>
<td>$5/S.Y.</td>
</tr>
<tr>
<td>Stablilized constr. entrance</td>
<td>$2,500</td>
</tr>
<tr>
<td>Storm drain inlet protection</td>
<td>$175/Ea.</td>
</tr>
<tr>
<td>Total Cost Estimate</td>
<td>$15,000</td>
</tr>
</tbody>
</table>

Lake Mendota

„Shaker Plates“

Silt fence system
Atomi – Steel Structure Site Logistics

- Continuation of Lakeshore Path
- Lull Path
- Separated Recycling
- Delivery Route
- SITE
- Staging
- Jobsite Office
- Crane
- Turn Around Area
- Student Path
- Job site boundaries/fence
Atomi - Concrete Structure Site Logistics

- Continuation of Lakeshore Path
- Lull Path
- Pump Truck
- Jobsite Office
- Crane
- Jobsite Office
- Separated Recycling and R/M Wash Out Area
- Delivery Route
- Rebar Cage Tying and Form Tying
- Turn Around Area
- Student Path
Shell Site Logistics - Both Structural Options

Continuation of Lakeshore Path
Separated Recycling
Lull Path
Delivery Route

Job site boundaries/fence
Site
Staging
Crane
Jobsite Office
Student Path
Turn Around Area
### Schedules and Key Milestones

#### Concrete Atomi
- **Dewater**: Build Structure/Enclosure
- **Build Interior**: Fin/Com

#### Steel Atomi
- **Dewater**: Build Structure/Enclosure
- **Build Interior**: Finish/Commish

#### CLT Shell
- **Dewater**: Build Structure/Enclosure
- **Build Interior**: Finish/Com

#### Steel Shell
- **Dewater**: Build Structure/Enclosure
- **Build Interior**: Finish/Com

---

<table>
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<tr>
<th>Milestone</th>
<th>2019</th>
<th>2020</th>
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<tr>
<td>Build Structure/Enclosure</td>
<td>Jan-Jun</td>
<td>Jan-Jul Aug</td>
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<tr>
<td><strong>Preliminary Shell Construction Schedule - CLT Structure</strong></td>
<td>Jan-Jun</td>
<td>Jan-Jun</td>
</tr>
<tr>
<td><strong>Preliminary Shell Construction Schedule - Steel Structure</strong></td>
<td>Jan-Jun</td>
<td>Jan-Jun</td>
</tr>
</tbody>
</table>

- Construction begins
- Enclosure Complete
- Lab space open
- All space open
TVD - Setting the Target

- Public-Private Partnership (PPP)
  - Contract period: 25 years
  - Maximum annual budget to rent: $1,000,000
    - Maximum budget to rent in the contract period: $25,000,000
    - Construction costs: maximum 40% ($10,000,000)
- Target: $8,750,000 – SHELL
- Target: $9,500,000 – ATOM
Target Value Design - SHELL

SHELL: Timber

<table>
<thead>
<tr>
<th></th>
<th>ESTIMATED VALUE</th>
<th>TARGET VALUE</th>
<th>VALUE DELTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>$ 8,700,000</td>
<td>$ 8,750,000</td>
<td>$ 50,000</td>
</tr>
<tr>
<td>A Substructure</td>
<td>$ 790,000</td>
<td>$ 750,000</td>
<td>$ (40,000)</td>
</tr>
<tr>
<td>B Shell</td>
<td>$ 2,800,000</td>
<td>$ 2,700,000</td>
<td>$ (100,000)</td>
</tr>
<tr>
<td>C Interiors</td>
<td>$ 1,180,000</td>
<td>$ 1,300,000</td>
<td>$ 120,000</td>
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<tr>
<td>D Services</td>
<td>$ 2,600,000</td>
<td>$ 2,600,000</td>
<td>$ -</td>
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<tr>
<td>E Equipment and Furnish</td>
<td>$ 100,000</td>
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<td>$ -</td>
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<tr>
<td>F Specialty Construction</td>
<td>$ 150,000</td>
<td>$ 200,000</td>
<td>$ 50,000</td>
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<tr>
<td>G Building Sitework</td>
<td>$ 380,000</td>
<td>$ 400,000</td>
<td>$ 20,000</td>
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<tr>
<td>H General Conditions</td>
<td>$ 700,000</td>
<td>$ 700,000</td>
<td>$ -</td>
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</table>

SHELL: Steel

<table>
<thead>
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<tr>
<td>TOTAL</td>
<td>$ 9,000,000</td>
<td>$ 8,750,000</td>
<td>$ (250,000)</td>
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<tr>
<td>A Substructure</td>
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<td>$ 800,000</td>
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<tr>
<td>B Shell</td>
<td>$ 3,050,000</td>
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<td>$ (200,000)</td>
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<td>$ 700,000</td>
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Target Value Design - ATOM

ATOMI: Steel

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<td>$10,000,000</td>
<td>$9,500,000</td>
<td>$(500,000)</td>
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<tr>
<td>A Substructure</td>
<td>$880,000</td>
<td>$800,000</td>
<td>$(80,000)</td>
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<tr>
<td>B Shell</td>
<td>$3,330,000</td>
<td>$3,010,000</td>
<td>$(320,000)</td>
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<tr>
<td>C Interiors</td>
<td>$1,400,000</td>
<td>$1,400,000</td>
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<tr>
<td>D Services</td>
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<td>$2,700,000</td>
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<tr>
<td>E Equipment and Furnishing</td>
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<td>$100,000</td>
<td>$0</td>
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<tr>
<td>F Specialty Construction</td>
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<td>$300,000</td>
<td>$40,000</td>
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<td>G Building Sitework</td>
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<tr>
<td>H General Conditions</td>
<td>$700,000</td>
<td>$780,000</td>
<td>$60,000</td>
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ATOMI: Concrete

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<td>$(50,000)</td>
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<td>$0</td>
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<td>$0</td>
</tr>
<tr>
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<td>$370,000</td>
<td>$70,000</td>
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<tr>
<td>G Building Sitework</td>
<td>$430,000</td>
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<td>$0</td>
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<tr>
<td>H General Conditions</td>
<td>$730,000</td>
<td>$760,000</td>
<td>$30,000</td>
</tr>
</tbody>
</table>
Cost Estimation Summary

- **SHELL Timber**: $8.7 mil
- **SHELL Steel**: $9.0 mil
- **ATOMI Steel**: $10.0 mil
- **ATOMI Concrete**: $9.7 mil

Shell Target: 8.75
Atomi Target: 9.5
<table>
<thead>
<tr>
<th>SHELL</th>
<th>ATOMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timber</td>
<td>Concrete</td>
</tr>
<tr>
<td>Steel</td>
<td>Steel</td>
</tr>
<tr>
<td><strong>Excavation:</strong> 7,500 C.Y.</td>
<td><strong>Excavation:</strong> 10,500 C.Y.</td>
</tr>
<tr>
<td>$8,700,000</td>
<td>$9,000,000</td>
</tr>
<tr>
<td>48 weeks</td>
<td>46 weeks</td>
</tr>
<tr>
<td>$10,000,000</td>
<td>$9,700,000</td>
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<tr>
<td>52 weeks</td>
<td>56 weeks</td>
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</table>
LCFM Risk/ LCC
Risks with greater impact on project success

- Flood
- Vandalism 6
- Lakeshorepath,...
- Muir Woods
- Heating/Cooling 4
- University of...
- Water Recycling/... 2
- High water table
- Green Roof 0
- Collecting Water
- Earth pressure...
- Climate Conditions
- Heatpump
Risks with greater impact on project success

- Vandalism
- Heating/Cooling
- Water Recycling/...
- Green Roof
- Collecting Water
- Climate Conditions
- Flood
- Heat pump
- Security System

AEC 2015 – Atlantic
Risks with greater impact on project success

- Flood
- Lakeshorepath, UnionTerrace
- Muir Woods
- University of Wisconsin
- High water table
- Earth pressure (excavation)
- Climate Conditions
- Heatpump
- Collecting Water

Collecting Water

Green Roof

Water Recycling/Collecting

Heating/Cooling

Vandalism

Risks with greater impact on project success
Risks with greater impact on project success

<table>
<thead>
<tr>
<th>Material</th>
<th>Jan-Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Atom</td>
<td>Dewater</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Build Structure/Enclosure</td>
<td>Build Interior</td>
<td>Fin/Com</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel Atom</td>
<td>Dewater</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Build Structure/Enclosure</td>
<td>Build Interior</td>
<td>Finish/Commish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLT Shell</td>
<td>Dewater</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Build Structure/Enclosure</td>
<td>Build Interior</td>
<td>Finish/Com</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel Shell</td>
<td>Dewater</td>
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<td></td>
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<td></td>
<td>Build Structure/Enclosure</td>
<td>Build Interior</td>
<td>Finish/Com</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Concrete Atom**: Dewater = construction begins, Build Structure/Enclosure = Enclosure Complete, Build Interior = lab space open, Fin/Com = all space open
- **Steel Atom**: Dewater = construction begins, Build Structure/Enclosure = Enclosure Complete, Build Interior = lab space open, Finish/Commish = all space open
- **CLT Shell**: Dewater = construction begins, Build Structure/Enclosure = Enclosure Complete, Build Interior = lab space open, Finish/Com = all space open
- **Steel Shell**: Dewater = construction begins, Build Structure/Enclosure = Enclosure Complete, Build Interior = lab space open, Finish/Com = all space open

- **Green Roof**
- **Collecting Water**
- **Climate Conditions**
- **Heatpump**
- **High water table**
- **Earth pressure...**
LCC Calculation

Maintenance Cost + Operation Cost
+ Water Costs + Energy Costs
+ Construction Cost + Replacement

= Life Cycle Cost Guesstimate (LCC)

Trade Off
**Heat pump**

<table>
<thead>
<tr>
<th>Heatpump</th>
<th>Typ: WWP W 120 IDH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost in Dollars</td>
<td></td>
</tr>
<tr>
<td>Initial Cost</td>
<td>75.281</td>
</tr>
<tr>
<td>Approval</td>
<td>2.226</td>
</tr>
<tr>
<td>Comonents</td>
<td>1.113</td>
</tr>
<tr>
<td>Boring/ Finish</td>
<td>4.451</td>
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<tr>
<td>Pumping/ Try outs</td>
<td>1.335</td>
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<tr>
<td>Connection</td>
<td>8.902</td>
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<tr>
<td>Maintenance Cost</td>
<td>1.669/ per year</td>
</tr>
<tr>
<td>Lifetime</td>
<td>20-25 years</td>
</tr>
</tbody>
</table>

**Weishaupt subsidiary**

**Weishaupt America Inc.**

2587 Millennium Dr., Unit A
Elgin, IL 60124
Wisconsin/ United States
## Guesstimates for Life Cycle Costs

<table>
<thead>
<tr>
<th></th>
<th>SHELL-Steel</th>
<th>SHELL-Wood</th>
<th>ATOMI-Steel</th>
<th>ATOMI-Concrete</th>
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</thead>
<tbody>
<tr>
<td><strong>Construction Cost</strong></td>
<td>$8,900,000</td>
<td>$8,700,000</td>
<td>$10,100,000</td>
<td>$9,800,000</td>
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<tr>
<td><strong>Operation Cost</strong></td>
<td>$5,600,000</td>
<td>$5,600,000</td>
<td>$8,100,000</td>
<td>$8,100,000</td>
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<tr>
<td><strong>Maintenance Cost</strong></td>
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<td>$2,600,000</td>
<td>$2,800,000</td>
<td>$2,800,000</td>
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<tr>
<td><strong>Replacement</strong></td>
<td>$1,400,000</td>
<td>$1,400,000</td>
<td>$1,300,000</td>
<td>$1,300,000</td>
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<tr>
<td><strong>LCC</strong></td>
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<td>$18,300,000</td>
<td>$22,400,000</td>
<td>$22,100,000</td>
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</table>
LEED
<table>
<thead>
<tr>
<th>SHELL</th>
<th>LEED CRITERIA</th>
<th>ATOMI</th>
<th>In charge</th>
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<tbody>
<tr>
<td>1</td>
<td>Integrative Process</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Location and Transportation</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Sustainable Sites</td>
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<td>11</td>
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<td>6</td>
<td>Water Efficiency</td>
<td>4</td>
<td>7</td>
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<tr>
<td>10</td>
<td>Energy and Atmosphere</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Materials and Resources</td>
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<td>8</td>
<td>Indoor Environmental Quality</td>
<td>8</td>
<td>15</td>
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<tr>
<td>1</td>
<td>Innovation</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Regional Priority</td>
<td>4</td>
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<tr>
<td><strong>47</strong></td>
<td><strong>90</strong></td>
<td><strong>TOTAL</strong></td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>
LEED Dynamic Plaque
Decision Matrix
AEC 2015 – Atlantic

A / E / C / MEP / LCFM

Decison Matrix

Ecology
- Latency
- Water
- Material Reduction
- Innovative systems
- Green Materials
- Integration

Social
- Atmosphere
- Collaboration
- Coherent Concept
- Innovation
- Prestige

Economic
- Operation Cost
- Maintenance Cost
- Room Program
- Usability of the roof
- Rent

Construction
- Building Costs
- Prefab
- Schedule
- Reduction on emissions
- Constructability

Well-Being
- Indoor quality
- Air ventilation
- Acoustics
- Natural Light
- Materials
- Indoor design concept
- Lake views

Const-
truction

Economic

Social

Ecology

AEC

Decison Matrix
Result

<table>
<thead>
<tr>
<th>Scale</th>
<th>Model performs Criteria...</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>poor</td>
</tr>
<tr>
<td>3-5</td>
<td>reasonable</td>
</tr>
<tr>
<td>6-8</td>
<td>good</td>
</tr>
<tr>
<td>9/10</td>
<td>excellent</td>
</tr>
</tbody>
</table>

- SHELL-Steel: 7.12
- SHELL-Wood: 7.38
- ATOMI-Steel: 6.40
- ATOMI-Concrete: 6.43
AEC 2015 – Atlantic

Result

<table>
<thead>
<tr>
<th></th>
<th>SHELL Steel</th>
<th>SHELL Wood</th>
<th>ATOM Steel</th>
<th>ATOM Concrete</th>
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<tbody>
<tr>
<td>Ecology</td>
<td>5.7</td>
<td>6.6</td>
<td>5.0</td>
<td>5.1</td>
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<tr>
<td>Social</td>
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<td>7.8</td>
<td>7.7</td>
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<td>Economics</td>
<td>7.3</td>
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<td>6.4</td>
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<td>Construction</td>
<td>6.8</td>
<td>7.0</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Well-Being</td>
<td>8.2</td>
<td>8.2</td>
<td>8.2</td>
<td>8.2</td>
</tr>
</tbody>
</table>
Team Atlantic 2015 proudly presents:
Shell in Timber
THANK YOU:

Course Director: Renate Fruchter

Mentors: John Nelson
Greg Luth

Owners Björn Wündsch
Tim Tarek Fergin

Jana Unterschütz Sarah Russell-Smith
Jackie Yiyang Jiao Glenn Katz
Andrej Kurent Maria Frank
Dorian Curcanu Flavia Grey

And Everyone, who has helped us along the journey with great advice, opinions and feedback. Get ready for a lot more questions!