Collaborating across the Atlantic

Lupe
SE
USA

Ou
SE
USA

Jennifer
CM
USA

Noah
CM
USA

Fanny
CM
Sweden

Elena
MEP
Denmark

Nace
A
Slovenia
Owners across the Atlantic

Elias SE
Mexico

Paola A
USA

Adam MEP
USA

Carlo CM
Sweden
TEAM PROCESS
Atlantic’s journey and **turning point**

**KICK OFF**
- Established project goals
- Formed strong team bond

**FIRST CONCEPT**
- Developed the modular ice cube concept

**PEER REVIEW**
- Absorbed valuable feedback and applied it to concepts

**WINTER PRESENTATION**
- Made a tough decision

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18JAN

25JAN

01FEB

08FEB

15FEB

22FEB

15MAR

**THE FIRST CYBER CLASS**
- Learned new tools
- Understood our discipline perspectives

**TEAM PROCESS**
- Changed the way we worked

**THE FIRST CRIT**
- Focused our product
A week in life of an **Atlantic Team Member**

- **Sunday**: Meet in VR
- **Monday**: Discipline office hours, sub meetings, individual work
- **Tuesday**: Discipline office hours, sub meetings, individual work
- **Wednesday**: Meet in 2D
- **Thursday**: Discipline office hours, sub meetings, individual work
- **Friday**: Peer Reviews, Critiques, Learn New Tools
- **Saturday**: Weekly team meeting preparation

- Team Focus
- Discipline Focus
The tools of an **effective global team**

**COLLABORATION**

- IRIS VR
- B360
- Nureva Span
- BrainMerge

**COMMUNICATION**

- Slack
- Zoom

**COORDINATION**

- Autodesk Insight 360
- Asterisk* alpha

Other tools mentioned include Google Calendar, Doodle, and Asana.
Owner interactions enhanced by VR

**DEVELOP**
Prepare materials for owner by Saturday morning

**FEEDBACK**
Process feedback from offline Slack interaction

**FEEDBACK**
Process feedback from online Sunday meeting

**ITERATE**
Re-work ideas and further develop

**Owner:** What’s happening here? *marks structural brace*

**Nace:** Hmmm, these steel elements are cutting through the public open space.

**Owner:** It would be nice to have a transparent wall here.

**Nace:** Yes, this may actually help. It creates a public semi-private interaction space.
Team values achieving **owner expectations**

**Sustainable Development**

- **Ecological**
- **Social**
- **Economical**
- **High Performance Building**
SITE ANALYSIS
Site Analysis **Sun Path**

*Summer*

*Winter*
Wind Speed (mph)

Period of Record: 01 Jan 1970 - 06 Jul 2017

Avg Speed: 8.6 mph

Thermal Comfort

8.7% 1 Comfort (761 hrs)
2 Sun Shading of Windows (0 hrs)
3 High Thermal Mass (0 hrs)
4 High Thermal Mass Night Flushed (0 hrs)
5 Direct Evaporative Cooling (0 hrs)
6 Two-Stage Evaporative Cooling (0 hrs)
7 Natural Ventilation Cooling (0 hrs)
8 Fan-Forced Ventilation Cooling (0 hrs)
21.7% 9 Internal Heat Gain (1902 hrs)
10 Passive Solar Direct Gain Low Mass (0 hrs)
11 Passive Solar Direct Gain High Mass (0 hrs)
12 Wind Protection of Outdoor Spaces (0 hrs)
13 Humidification Only (0 hrs)
5.7% 14 Dehumidification Only (499 hrs)
4.5% 15 Cooling, add Dehumidification if needed
59.4% 16 Heating, add Humidification if needed
100.0% Comfortable Hours using ASHRAE 8760
(8760 out of 8760 hrs)
ARCHITECTURE
Site Challenges & Opportunities
adapt to the site

grow to offer space

create habitats

protect the life inside

offer rooftop
Non-privatized public space is important.

In-between time isn’t wasted time.

Single-use spaces are becoming obsolete.
A day in life of a student

name: Mike
age: 20
year: 2nd
role: engineering student

early morning
class

morning
individual work

noon
lunch break

afternoon
group work with professor

late afternoon
teamwork
A day in life of a student

Level 0
- learn
- relax

Level 1
- collaborate
- enjoy
- work

Level 2
- brainstorm
- feedback

Room Schedule:
- Staff area
- Classrooms
- Student offices
- Lounges
- Terrace
- Light Shaft
- Open Space
- Service space

50'
A day in life of a faculty

name: dr. Kim Bell
experience: 20 years
field: computer science

early morning
morning coffee

morning
lecture and individual work

noon
lunch break

afternoon
group work with students

late afternoon
individual work
A day in life of a faculty

Level 0
present

Level 1
collaborate

Level 2
work
improve

Room Schedule
- Staff area
- Classrooms
- Student offices
- Lounges
- Terrace
- Light Shaft
- Open Space
- Service space

50’
Level 0

Room Schedule
- Auditorium
- Large Classroom
- Vestibule
- Reception
- Lounge
- Outside Space
- Open Space
- Restroom
- Elevator
- MEP Shaft
Rooftop

Room Schedule
- Non walkable area
- Walkable area
- Light Shaft
- Elevator
- MEP Shaft
Section A-A

Room Schedule
- Non walkable area
- Walkable area
- Light Shaft
- Elevator
- MEP Shaft
Parametric Facade

archdaily.com
Parametric Facade

- regulate flow of light
- protect from heat losses
- part of structure
- prefabricated
- enhance spatial sensation
- create habitats
STRUCTURE
High Level Design Process

Identify site challenges and loadings

(Re)iterate concepts with design team

Peer + Mentor Feedback

Model and analyze

Asterisk* alpha

CORE studio Thornton Tomasetti

over 30 iterations

Team ATLANTIC
# Typical Building Loads

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<thead>
<tr>
<th>Use</th>
<th>Uniform Load (psf)</th>
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<tr>
<td><strong>Dead Loads</strong></td>
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<td>Typical Floors</td>
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<tr>
<td>Roof</td>
<td>82</td>
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<tr>
<td><strong>Live Loads</strong></td>
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<tr>
<td>Corridors (Lobbies and 1st Floor)</td>
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<td>Corridors (Above 1st Floor)</td>
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<td>Offices</td>
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<td>Classrooms</td>
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<tr>
<td>Stairs and Exit Ways</td>
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<tr>
<td>Roof (Inactive)</td>
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<tr>
<td>Roof (Active)</td>
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<tr>
<td><strong>Rain</strong></td>
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<tr>
<td><strong>Snow</strong></td>
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</table>

**Lateral Wind**

- 60 kips
- 55 kips
- 50 kips
- 165 kips
Site Soil Profile

- Bearing Capacity of 4 ksf
- Sensitivity to Frost Line (5’)
- High Water Table

0’

2’ Excavation

5’ Frost

6.5’ Fill

10’ Silty Clay

0’

6.5’

10’

30’

\( \phi = 35^\circ \quad \gamma = 125 \text{ PCF} \)

\( \phi = 41^\circ \quad \gamma = 130 \text{ PCF} \)
Maple Structural Solutions

Wood

Steel
Maple Wood

Gravity System
Glulam Columns and Girders

Lateral System
Cross Laminated Timber Shear Walls

Floor System
Cross Laminated Timber Panels

Earth Retaining System
Reinforced Concrete Retaining Wall

Foundation System
Isolated Footings
Maple Wood Structural Plans

- **Level 0**
  - 126' x 126'
  - Isolated Footing
  - 18” x 18” Column
  - 10.75” x 18” GWS
  - 12” CLT Shear Wall
  - 12” Retaining Wall
  - 14’ Grid

- **Level 1**
  - 126’ x 140’
  - 18” x 18” Column
  - 10.75” x 18” GWS
  - 12” CLT Shear Wall
  - 12” Retaining Wall
  - 14’ Grid
Maple **Wood Structural Plans**

- **Level 2**
- **Rooftop**

**Dimensions:**
- **18” x 18” Column**
- **10.75” x 18” GWS**
- **12” CLT Shear Wall**
- **14’ Grid**
Maple Wood **Load Path**

**Cantilever Solution**
Parametric Structural Facade in Tension

14'
Maple Earth Retaining System

Soldier Pile System

P = 4312 plf

15'

6'
Maple Extending Timber to Pedestrian Bridge
Maple Steel

Gravity System
Steel Columns and Girders

Lateral System
Reinforced Concrete Shear Walls

Floor System
Composite Deck

Earth Retaining System
Reinforced Concrete Retaining Wall

Foundation System
Isolated Footings
Maple Steel Structural Plans

Level 0

126' x 126'

Level 1

14' Grid

- W12 Typical Column
- W12 Typical Beam
- 12” RC Shear Wall
- 12” Retaining Wall
Maple Steel Structural Plans

Level 2

Rooftop

- **W12** Typical Column
- **W12** Typical Beam
- **12”** RC Shear Wall
- **12”** Retaining Wall
- **14’** Grid
Maple Structural Solution Advantages

- Reduced Carbon Footprint
- Strong Big Idea Alignment
- Lightweight Structure, cost
- Thermal transfer

- Large Spans
- Ease of Construction, prefabrication
- Material Availability
- 100% recyclable, long-term saving
- Less deforestation
Heating Loads

Special requirements:
- Improved insulation
- Additional heater under windows
Cooling Loads

0 W/m^2 132 W/m^2

Special requirements:
- Shading system
- Bigger windows
Primary systems and flows

Source: MGE
Floor Sandwich - Maple - Wood and VAV

Floor slab 5.5"

VAV ducts 29"

Girder 16"

Floor to Ceiling height 12'2"

![Diagram showing VAV system and indoor air quality, initial cost, O&M cost, and ceiling level.]

- Indoor air quality
- Initial cost
- O&M cost
- Ceiling Level
Floor Sandwich - Maple - Steel and Active Chilled Beams

Floor slab 5.5"  |  Girder 12"
Air chilled beams 20"

Active chilled beams

Indoor air quality
Initial cost
O&M cost
Thermal comfort
Ceiling Level
SE and MEP
First Floor

- MEP shaft: 55 SF
- MEP shaft: 110 SF
Second Floor

MEP shaft: 55 SF

MEP shaft: 110 SF
Third Floor

MEP shaft: 55 SF

MEP shaft: 110 SF
Roof

MEP room: 350 SF
ICE CUBE
A day in life of a student

name: Lisa
age: 21
year: 3rd
role: engineering student

early morning
class

morning
individual work

noon
lunch break

afternoon
group work with professor

late afternoon
teamwork
A day in life of a student

Level 0
- Learn
- Refill

Level 1
- Collaborate
- Work
- Feedback

Level 2
- Enjoy
- Brainstorm

Room Schedule:
- Staff area
- Classrooms
- Student offices
- Lounges
- Terrace
- Light Shaft
- Open Space
- Service space

50’
A day in life of a faculty

name: dr. Graham Newton
experience: 17 years
field: environmental science

early morning
morning coffee

morning
lecture and individual work

noon
lunch break

afternoon
group work with students

late afternoon
individual work
A day in life of a faculty
Level 2

Room Schedule
- Department Chair Office
- Tech Support
- Senior Admin. Office
- Administrative assistants
- Faculty Office
- Terrace
- Instructional Lab
- VR Room
- Open Space
- Restroom
- Elevator
- MEP Shaft
PV Facade

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Challenges

- Local material and knowledge.
- Wood as main material.
- Energy efficient skin.
- Steel -> reusable.
- "Circular economy".
- Generate energy.
- Modular design.
- Prefab elements.
- Parametric design tools.
- VR technology.
- Clash detection.
- "Circular economy".
- Generate energy.
- Steel -> reusable.
- "Circular economy".
- Generate energy.
STRUCTURE
Ice Cube Structural Solutions

Modular Steel

Open Steel
Ice Cube Modular Steel

Gravity System
Steel Columns and Girders (Modules)

Lateral System
Steel Plate Shear Walls

Floor System
Composite Deck

Earth Retaining System
Reinforced Concrete Retaining Wall

Foundation System
Isolated Footings
Ice Cube **Module Detail**

Advantages to Modularity

- Limited Sizes
- Off-site Prefabrication
- Ease of construction
Ice Cube Modular Steel Plans

Level 0

Level 1

- **W12** Typical Column
- **W14** Typical Girder
- **0.5”** SPSW
- **12”** Retaining Wall
- **13’ 6”** Grid
Ice Cube Modular Steel Plans

Level 2

Rooftop

- W12 Typical Column
- W14 Typical Girder
- 0.5” SPSW
- 12” Retaining Wall
- 13’ 6” Grid
Ice Cube **Modular Steel Load Path**
Ice Cube Open Steel

Gravity System
Steel Columns and Girders

Lateral System
Moment Frame

Floor System
Composite Deck

Earth Retaining System
Reinforced Concrete Retaining Wall

Foundation System
Isolated Footings
Ice Cube Open Steel Plans

Level 0

Level 1

W12 Typical Column
W12 Typical Girder
W14 Typical Girder
12" Retaining Wall
13' 6" Grid
Ice Cube Open Steel Plans

Level 2

Rooftop

- **W12** Typical Column
- **W12** Typical Girder
- **W14** Typical Girder
- **12”** Retaining Wall
- **13’ 6”** Grid
Ice Cube Foundation System

Advantages to Isolated Footings

- Limit footprint excavation
- Low concrete
- Above water table
Ice Cube Earth Retaining System

Cantilever RC Retaining Wall

P = 4312 plf
Ice Cube Structural Solution Advantages

Modular Steel
- Consistent Element Sizes
- Strong Big Idea Alignment
- Prefabricated Modules

Open Steel
- Open Floor Plans
- Less Material
- Hidden Lateral System
Heating Loads

- Faculty offices
- Small classrooms
- Faculty offices
- Seminar rooms
- Instructional labs

Special requirements:
- Improved insulation
- Additional heater under windows
Cooling Loads

Special requirements:
- Shading system
- Smaller windows
SE and MEP
Floor Sandwich - Moment steel frame and VAV

Floor slab 5"
Girder 12"
VAV duct 29"
Free height 12' 2"
Floor Sandwich - Steel plate shear wall and radiant panel

Floor slab 5.5"

Girder 14"

Girder 14"

Girder 14"

Radiant plate 20"

Floor to Ceiling height 12" 11"
First Floor

MEP shaft: 50 SF

MEP room: 350 SF

MEP shaft: 110 SF
Second Floor

- MEP shaft: 50 SF
- MEP shaft: 110 SF
Third Floor

 MEP shaft: 50 SF

 MEP shaft: 110 SF
CONSTRUCTION
P-D-C-A Construction site work process

Plan
- Objectives
- Site safety plan
- Pre task planning with const. workers

Do
- Processes
- Complete task

Check
- Monitoring
- Self inspections

Act
- Continual improvement
- Evaluation and adjustment
- Continue with upcoming task
Site Protection

- Lake and Tree
- Noise Control
- Waste Management
Site Protection

- Lake and Tree
- Noise Control
- Waste Management
Site Protection

- Lake and Tree
- Noise Control
- Waste Management
Equipment (Excavation/Backfilling)

320 CAT Hydraulic Excavator

Standard Dump Truck (Local Availability)

Front Loader

Small Bobcat Loader
Equipment (Construction)

- Liebherr 1160 - 160t Crane
- Boom Lift
- Telescoping Forklift
- Concrete Pump Truck
Pedestrian Walkway to Lakeshore Path. Separated driveway for traffic to parking lot

Driven Pile Construction Fencing (8')

Erosion Control (Silt Fencing)

Gates

Vehicular Site Access

Pedestrian Site Access

Parking for Building to
Toilets/Handwash Station

160t Crawler Crane

Misc Laydown Area

Pedestrian Walkway to Lakeshore Path. Separated driveway for traffic to parking lot

Driven Pile Construction Fencing (8')

Erosion Control (Silt Fencing)

Recycling/Dumpster #2

Vehicular Site Access

Gates

Pedestrian Site Access

Gang Formwork Laydown Area

Steel/Prefab Laydown Area

Earthwork Area

Toilets/Handwash Station

Stackable Construction and Labor Offices

Parking for Campus Building to West

Site Footprint
Local Material Sourcing

- Concrete Suppliers
- Equipment Rental
- Timber Manufacturers
- Steel Suppliers
- Prefabrication Location
- Union Labor Location
- Construction Site
Prefabrication

- Steel Structure
- Walls and slabs
- MEPF System

Pros

- Scheduling
- Cost

Cons

- Narrow Site
# Scheduling -- Ice Cube

## Steel Plate Shear Wall

<table>
<thead>
<tr>
<th>Task</th>
<th>Plan Start</th>
<th>Plan Duration</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
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Concrete work finished: Semester Starts

Total 28 Weeks

## Moment Frame

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<th>Plan Duration</th>
<th>July</th>
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Total 27 Weeks
## Scheduling -- Maple

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**Concrete work finished**

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</tbody>
</table>

**Total 29 Weeks**

**Total 27 Weeks**

---

**Semester Starts**
Supply Chain Management

- Linking BIM Model with supply chain
- Just In Time Delivery with RFID
Construction cost MAPLE - Wood structure

Estimated cost: $9,000,000
Construction cost MAPLE - steel frame RC shear wall

Estimated cost: $8,800,000
Construction cost ICE CUBE-moment frame

Estimated cost: $10 800 000
Construction cost ICE CUBE - Steel plate shear walls

### TVD - SUMMARY

<table>
<thead>
<tr>
<th>COST ESTIMATE</th>
<th>TARGET VALUE</th>
<th>ESTIMATED VALUE</th>
<th>VALUE DELTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVD - TRACKING TARGET OVER TIME</td>
<td></td>
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</tbody>
</table>

- **TOTAL**
  - $10 700 000
  - $11 700 000
  - $1 000 000

- **Estimated cost**: $10 700 000
Construction Cost Comparison

MAPLE

$9 000 000

ICE CUBE

$8 800 000

$10 800 000

$10 700 000
STV comparison - Ice cube concept
STV comparison - Maple concept
Highest Value

TVD - TARGETS BY CLUSTER

- TARGET VALUE
- ESTIMATED VALUE
- VALUE DELTA

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

57%
21%
81%
DECISION
## Decision Criteria

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td><strong>Buildable</strong></td>
<td>Ease of construction</td>
</tr>
<tr>
<td><strong>Usable</strong></td>
<td>Functional spaces</td>
</tr>
<tr>
<td><strong>Operable</strong></td>
<td>Ease of lifecycle maintenance</td>
</tr>
<tr>
<td><strong>Sustainable</strong></td>
<td>Minimal environmental impact and extended lifecycle</td>
</tr>
<tr>
<td><strong>Aesthetics</strong></td>
<td>The overall look of the building</td>
</tr>
<tr>
<td><strong>Community Integration</strong></td>
<td>Building increases community interactions</td>
</tr>
<tr>
<td><strong>Site Integration</strong></td>
<td>Surroundings (nature, buildings) well integrated with building</td>
</tr>
<tr>
<td><strong>AEC Collaboration</strong></td>
<td>Will require higher collaboration among AEC teams</td>
</tr>
<tr>
<td><strong>Carbon Footprint</strong></td>
<td>Low carbon emissions during lifecycle</td>
</tr>
<tr>
<td><strong>Materials</strong></td>
<td>Use of local materials</td>
</tr>
<tr>
<td><strong>Lifecycle Cost</strong></td>
<td>Cost including construction and o&amp;m</td>
</tr>
<tr>
<td><strong>ROI</strong></td>
<td>Expected return on investment</td>
</tr>
</tbody>
</table>
Decision Concepts Evaluation

Ice Cube - Modular Steel
- ROI
- Usable
- Lifecycle Cost
- Operable
- Sustainable
- Carbon Footprint
- AEC Collaboration
- Community Integration

Maple - Wood
- ROI
- Usable
- Lifecycle Cost
- Operable
- Sustainable
- Carbon Footprint
- AEC Collaboration
- Community Integration

Project team
Owner team
THANK YOU