Image courtesy of Boora Architects

OSU Teaching and Learning Facility

Boora Architects

Design Ambitions
Increased Student Retention
Increased Graduation Rates
More Active Learning Environment
Spectrum of Learning Objectives
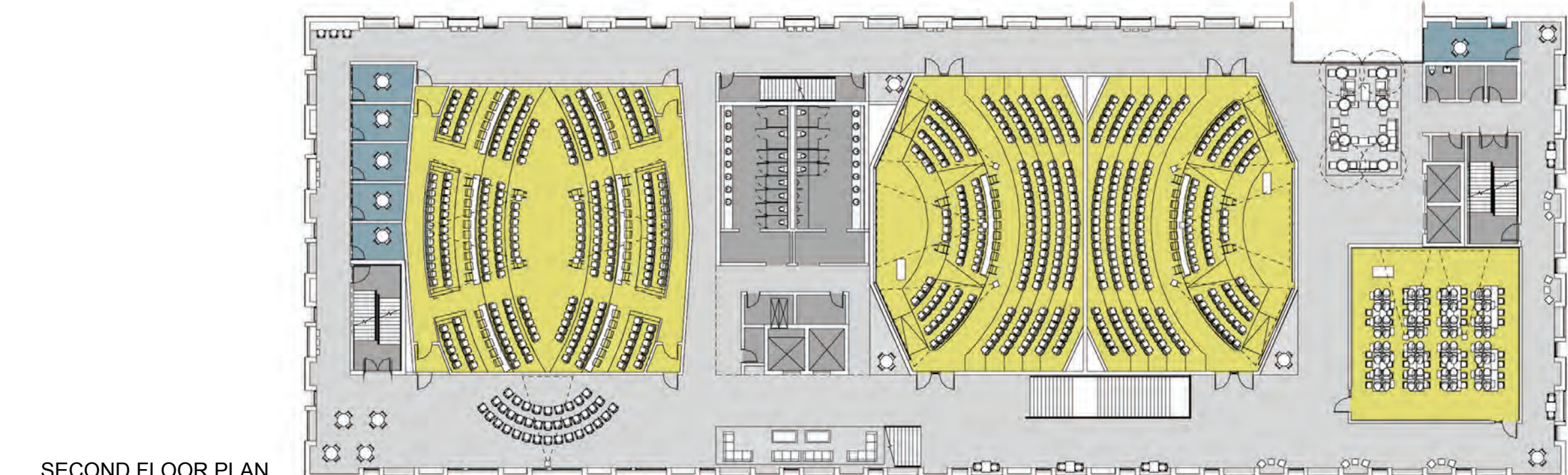Meet Campus Historical Requirements

Building Program
72K Sq. Feet
Lecture Halls and Classrooms for 2500 seats
Honors College
Offices

Building Performance Priorities
➔ **Low Energy Use**
➔ **Minimal Equipment**
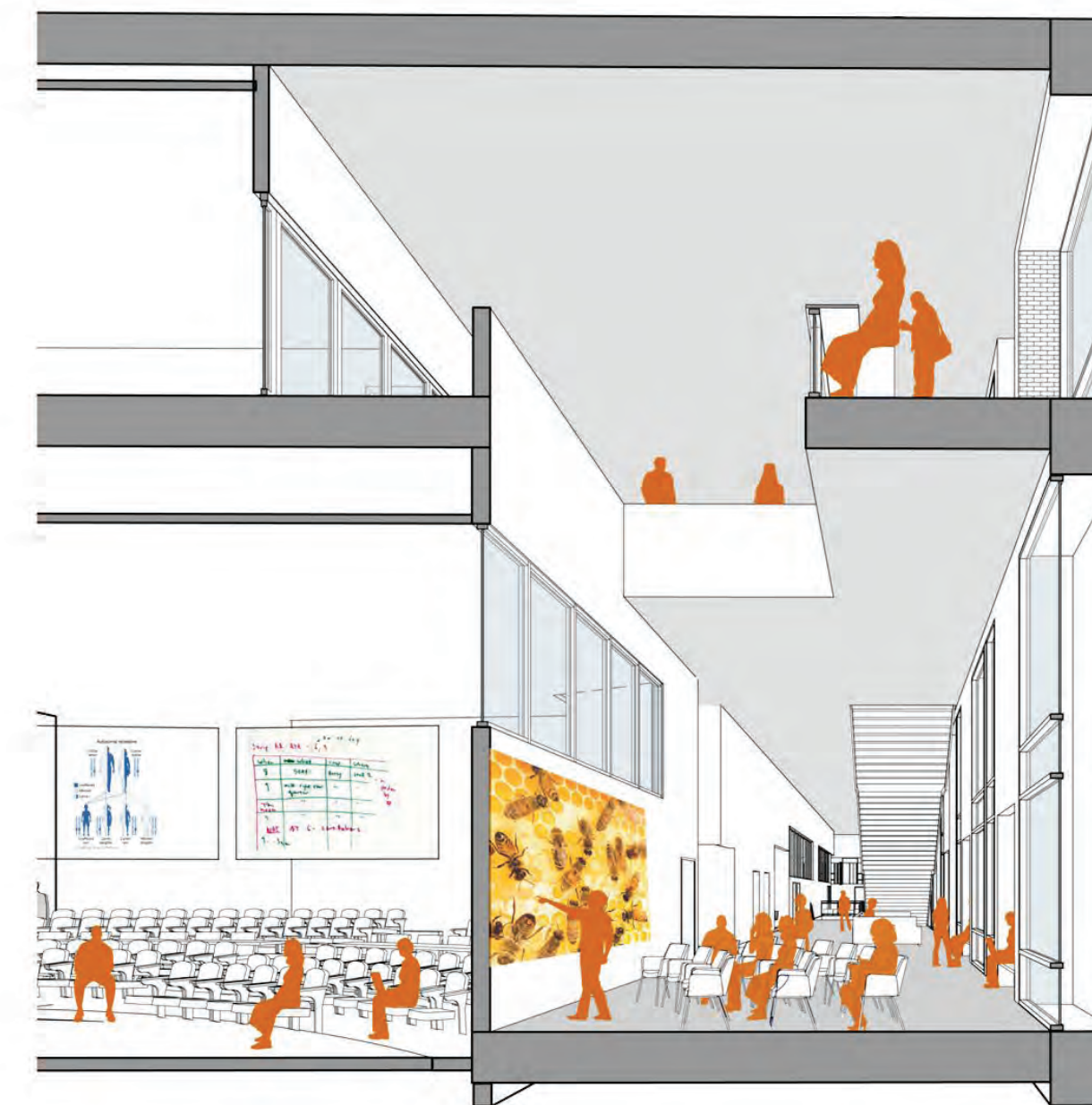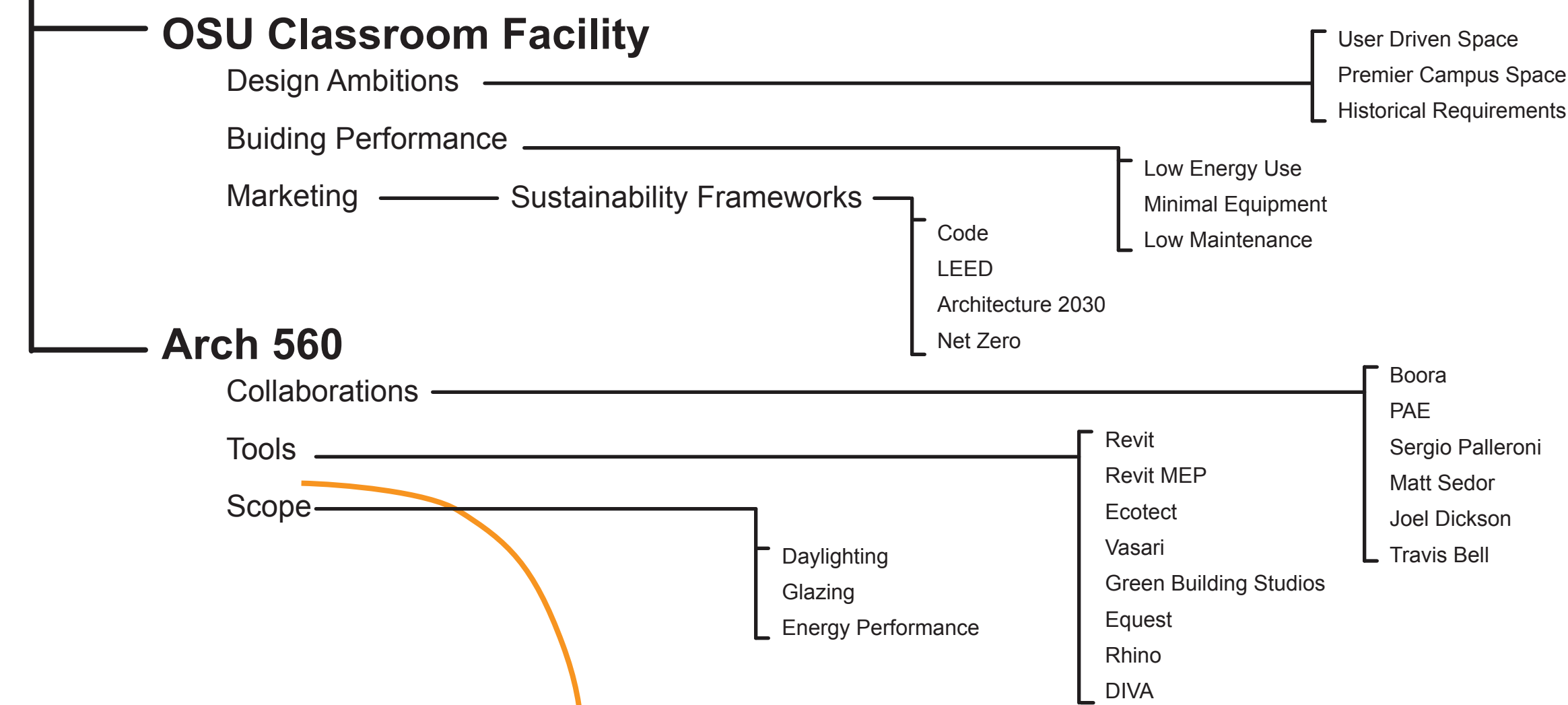➔ **Low Maintenance**
➔ **Budget Restraints**

Boora Proposal
➔ **Bringing Interior Circulation to the Perimeter**
➔ **Circulation Doubles as Informal Space**
➔ **Envelope as a "Permeable" Membrane**
Nouveau Lecture Hall Concepts

SECOND FLOOR PLAN
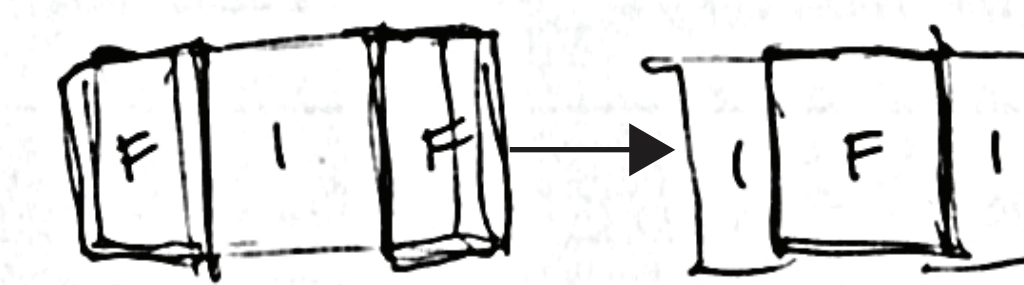*Image courtesy of Boora Architects*

OSU Classroom Facility
Design Ambitions
— User Driven Space
— Premier Campus Space
— Historical Requirements

Building Performance
Marketing — Sustainability Frameworks
— Low Energy Use
— Minimal Equipment
— Low Maintenance
— Code
— LEED
— Architecture 2030
— Net Zero

Arch 560
Collaborations
Tools
Scope

— Boora
— PAE
— Sergio Palleroni
— Matt Sedor
— Joel Dickson
— Travis Bell

— Revit
— Revit MEP
— Ecotect
— Vasari
— Green Building Studios
— Equest
— Rhino
— DIVA

— Daylighting
— Glazing
— Energy Performance
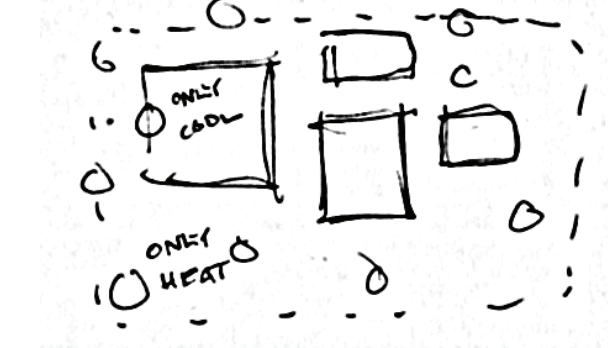
Interior circulation doubles as informal learning space and is wrapped around the perimeter of the building.
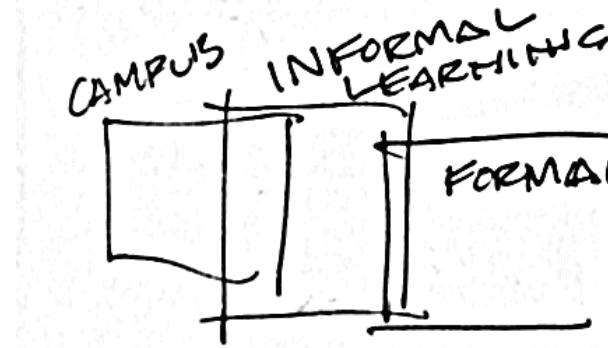
That Informal learning space also acts as the buffer zone between the formal learning spaces and the rest of the campus.

There are possible energy implications based on the organization of the floor plan.

(1) VIEW OF FORUM LOOKING EAST
Image courtesy of Boora Architects
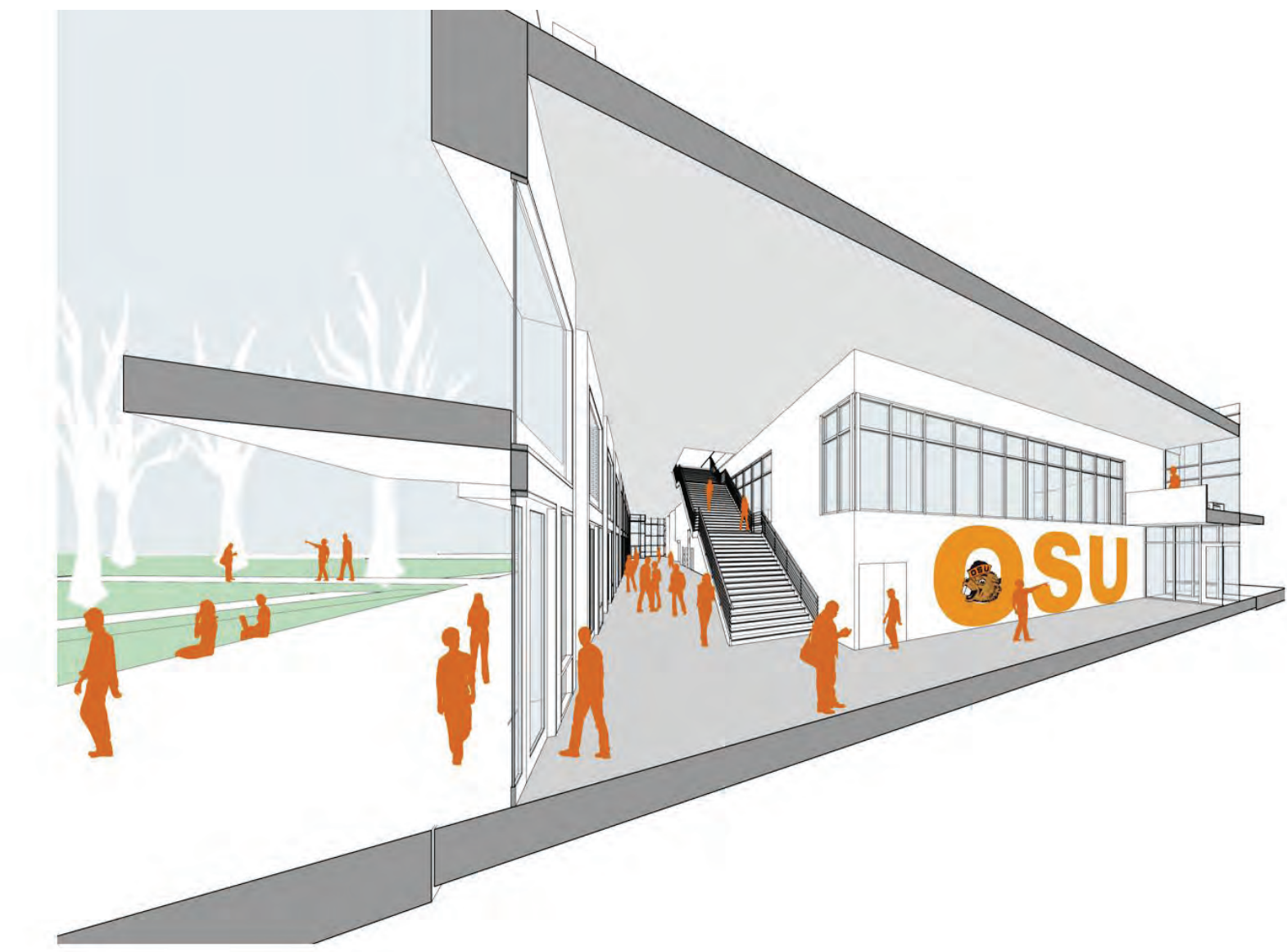
(2) VIEW OF LOBBY LOOKING WEST
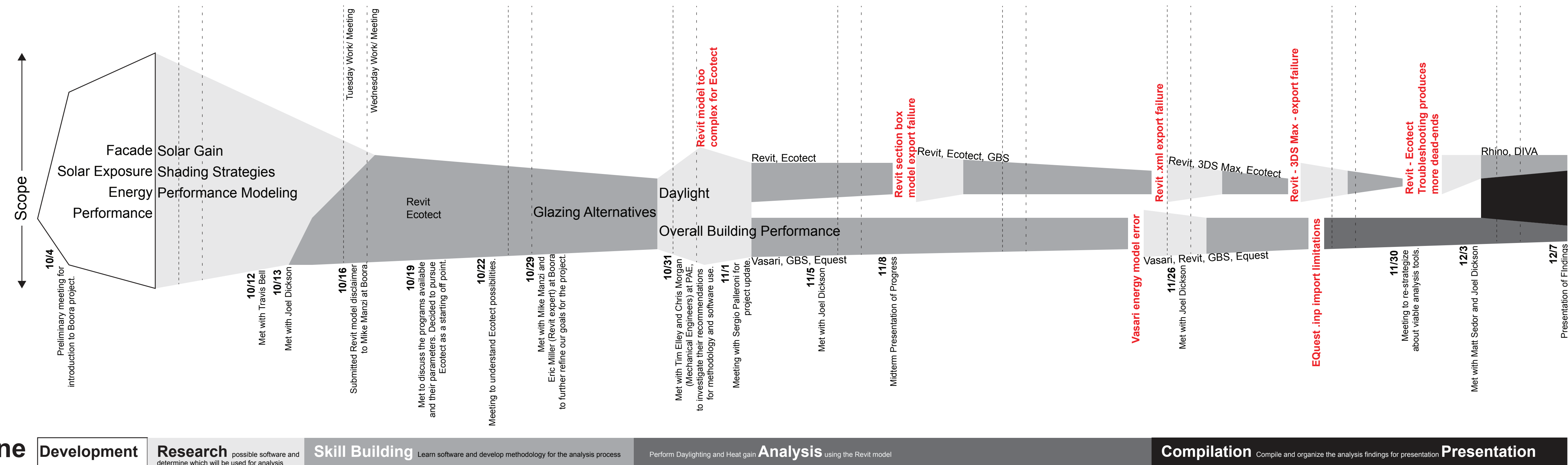*Image courtesy of Boora Architects*

Proposed Methodology

How do different glazing systems impact lighting loads?
-Measure the impact of different glazing systems against use of electric lights
-Create segment model in Revit Export into Ecotect
-Run lighting analysis for all of the possible glazing schemes
-Create visual comparison

How do different glazing systems impact overall energy requirements?
-Measure the impact of different glazing systems in terms of overall energy use
-Create simplified building model in Vasari
-Export through Green Building Studio into EQuest
-Run energy analysis for all of the possible glazing schemes
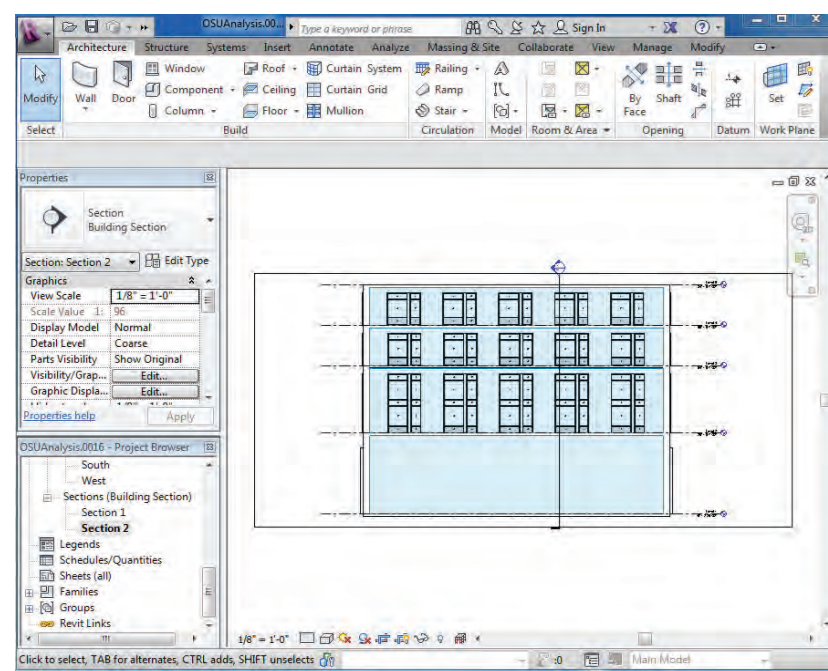-Create visual comparison

Actual Timeline

Scope

Facade — Solar Gain
Solar Exposure — Shading Strategies
Energy — Performance Modeling
Performance

Revit, Ecotect — Revit model too complex for Ecotect

Revit
Ecotect — Glazing Alternatives — Daylight — Revit, Ecotect, GBS — Revit section box model export failure — Revit .xml export failure — Revit, 3DS Max, Ecotect — Revit - 3DS Max - export failure — Revit - Ecotect Troubleshooting produces more dead-ends — Rhino, DIVA

Overall Building Performance — Vasari, GBS, Equest — Vasari energy model error — Vasari, Revit, GBS, Equest — EQuest .inp import limitations

Preliminary meeting for introduction to Boora project.
10/4

10/12 Met with Travis Bell
10/13 Met with Joel Dickson
Tuesday Work/ Meeting
Wednesday Work/ Meeting
10/16 Submitted Revit model disclaimer to Mike Manzi at Boora
10/19 Met to discuss the programs available and their parameters. Decided to pursue Ecotect as a starting off point.
10/22 Meeting to understand Ecotect possibilities.
10/29 Met with Mike Manzi and Eric Miller (Revit expert) at Boora to further refine our goals for the project.
10/31 Met with Tim Elley and Chris Morgan (Mechanical Engineers) at PAE, to investigate their recommendations for methodology and software use.
11/1 Meeting with Sergio Palleroni for project update.
11/5 Met with Joel Dickson
11/8 Midterm Presentation of Progress
11/26 Met with Joel Dickson
11/30 Meeting to re-strategize about viable analysis tools.
12/3 Met with Matt Sedor and Joel Dickson
12/7 Presentation of Findings

Proposed Timeline

| Development | Research possible software and determine which will be used for analysis | Skill Building Learn software and develop methodology for the analysis process | Perform Daylighting and Heat gain Analysis using the Revit model | Compilation Compile and organize the analysis findings for presentation Presentation |

Tools:
## The search for the ultimate performance evaluation software

Revit
BIM is the predominant form of modeling; architects and engineers use different forms based on their particular concerns (e.g. volumes vs. wall systems). Several attempts were made to work starting with the Revit model provided by Boora.
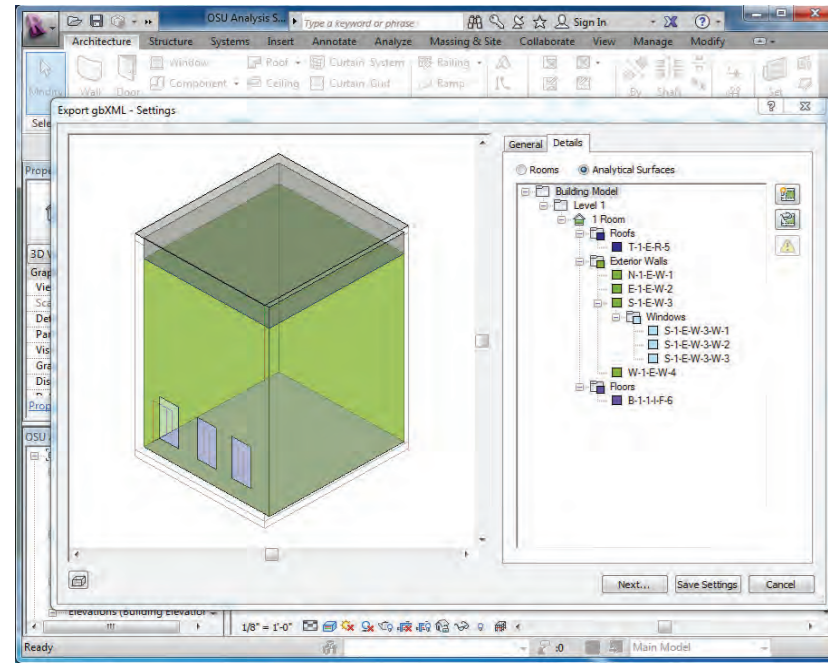
Revit's GBxml
export interface: the primary suggested route for bringing a model from Revit to Ecotect. This proved almost impossible, possibly because Ecotect is no longer a supported, updated program. GBxml is also the file type used by Green Building Studios.
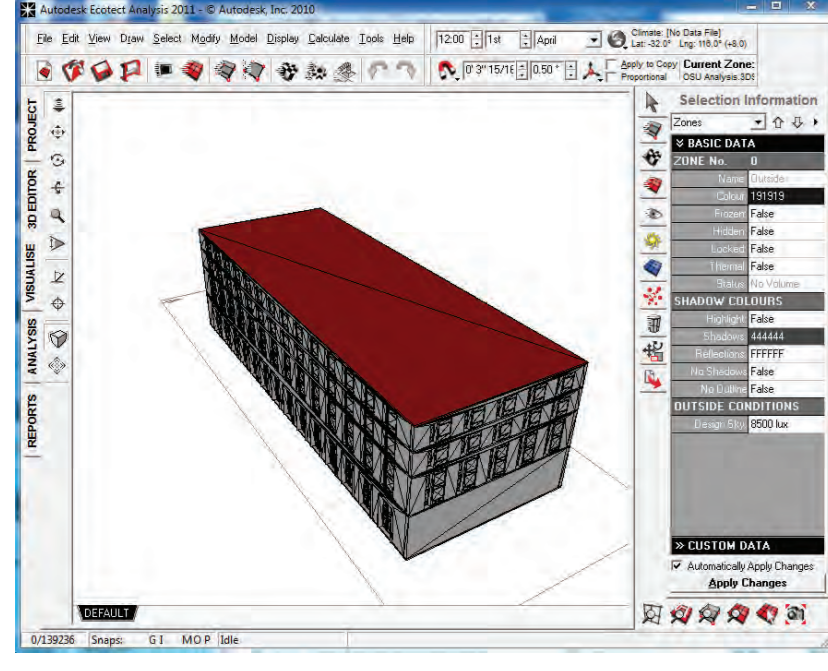
Ecotect
As of 2011 an unsupported platform for light and energy performance analysis. Uses gbXML format (exportable from Revit) This is a screen shot of the 3DS Max model in its complex mesh format.
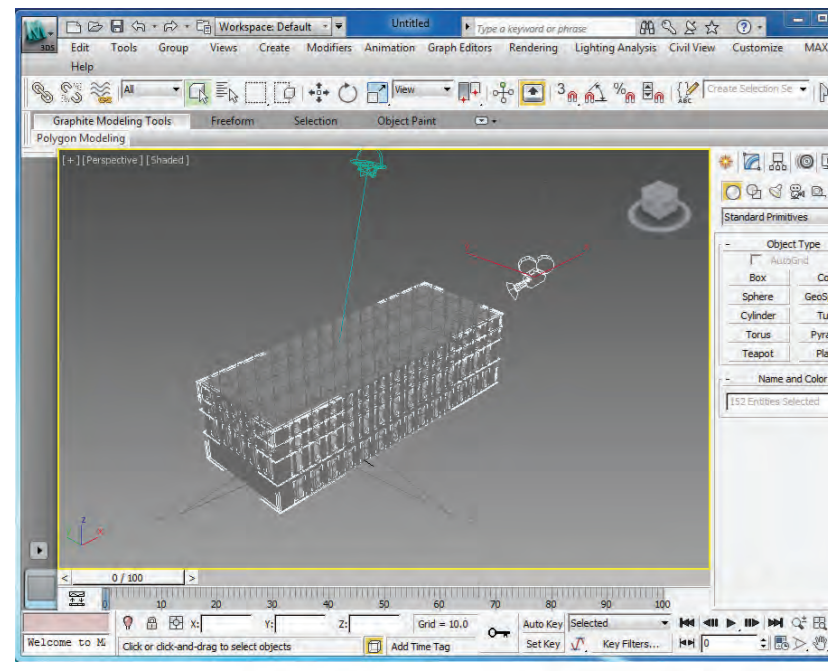
3DS Max
Autodesk's 3D Rendering tool. Used as a trial for importing the Revit Model into Ecotect.
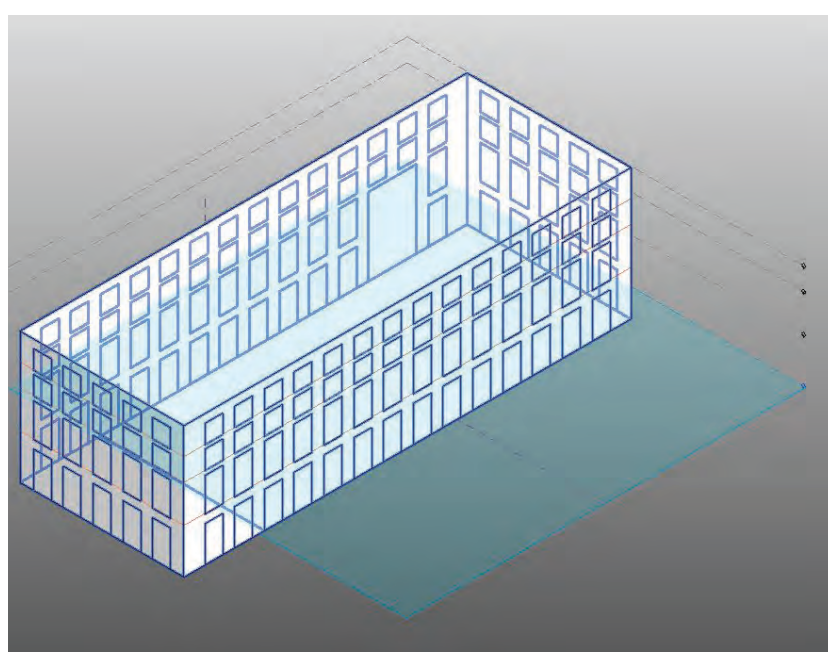
Vasari (beta)
The offspring of Ecotect; a simplified version with fewer daylight evaluation functions. Suggested by PAE after finding that using Revit with Ecotect would not produce the desired analyses.

Green Building Studios
Web-based software for analysing energy use and carbon footprint. Origin of the "GB" in gbXML. Exports INP format for use in EQuest.
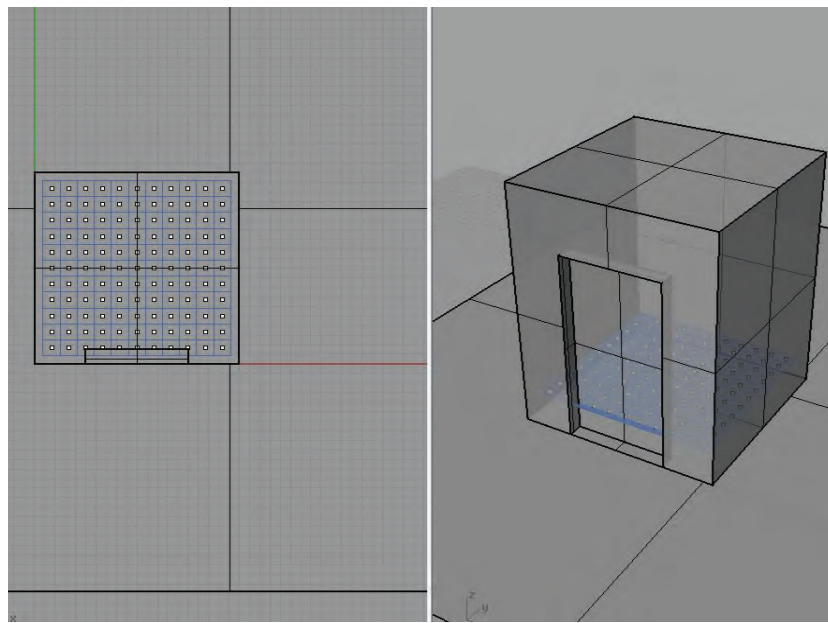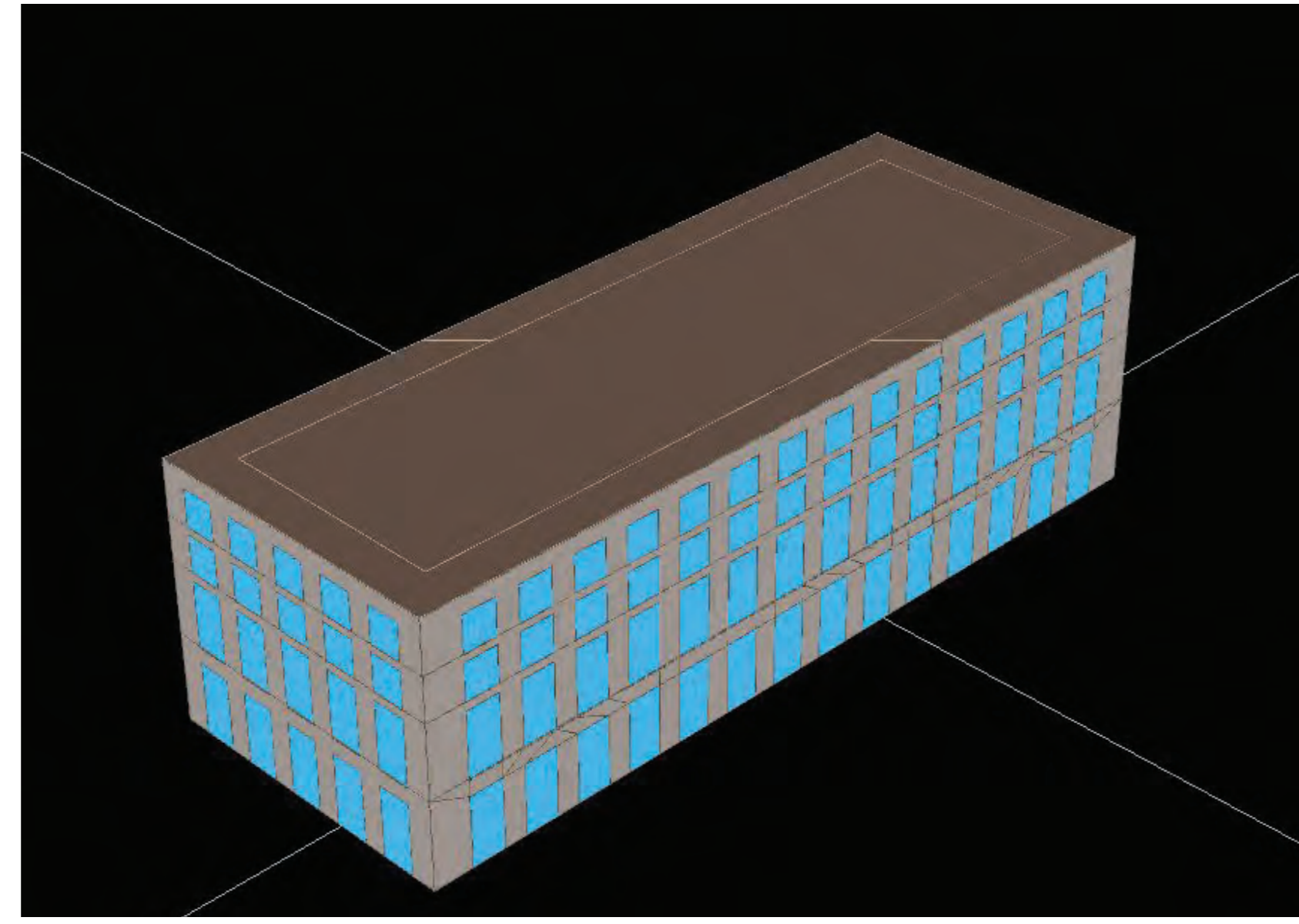
Rhino
An alternative 3D Modeling software known for its ease of use with unconventional shapes and materials.
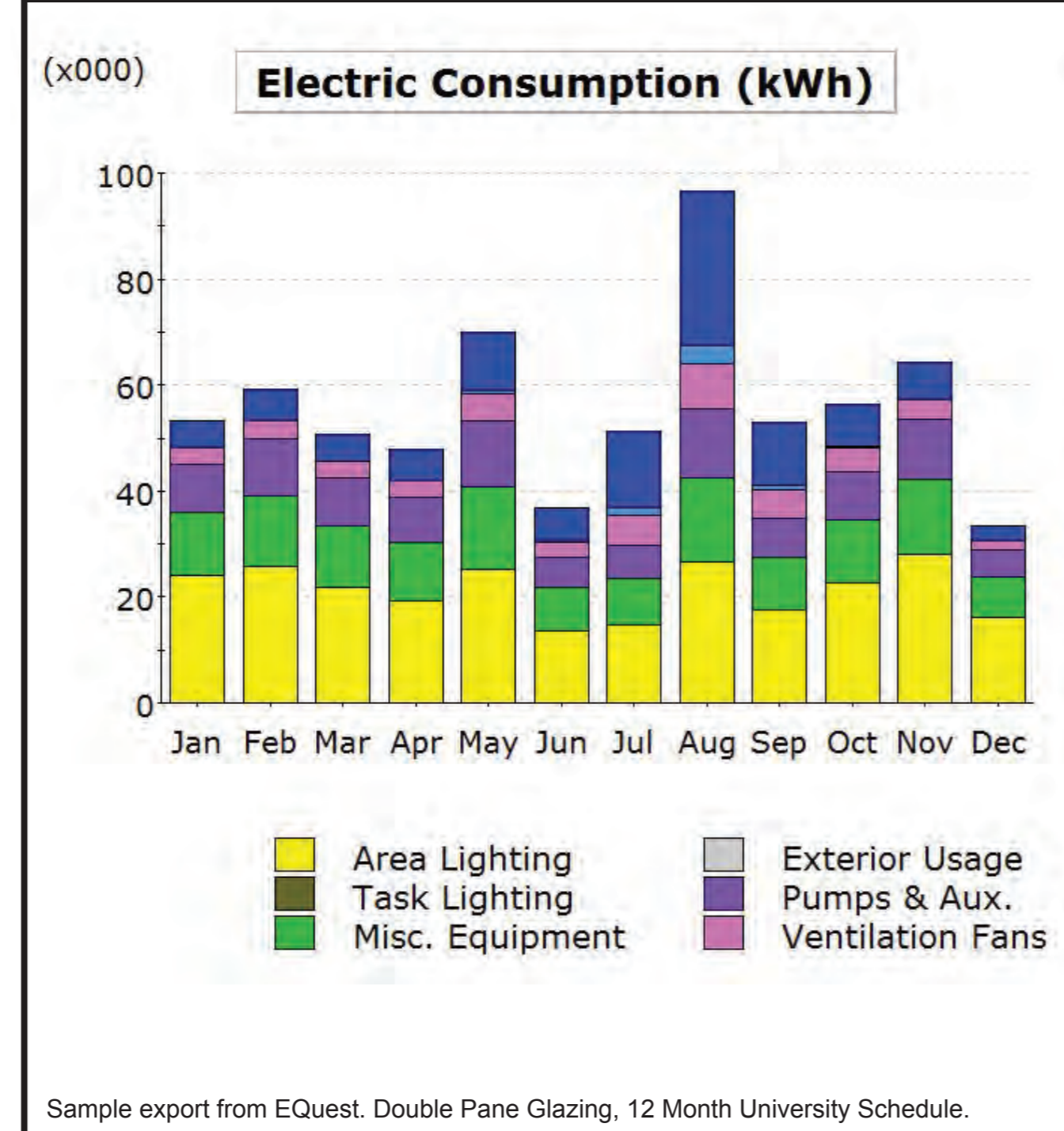
DIVA
Plug-in for Rhino that performs Daylighting and Energy Analysis.
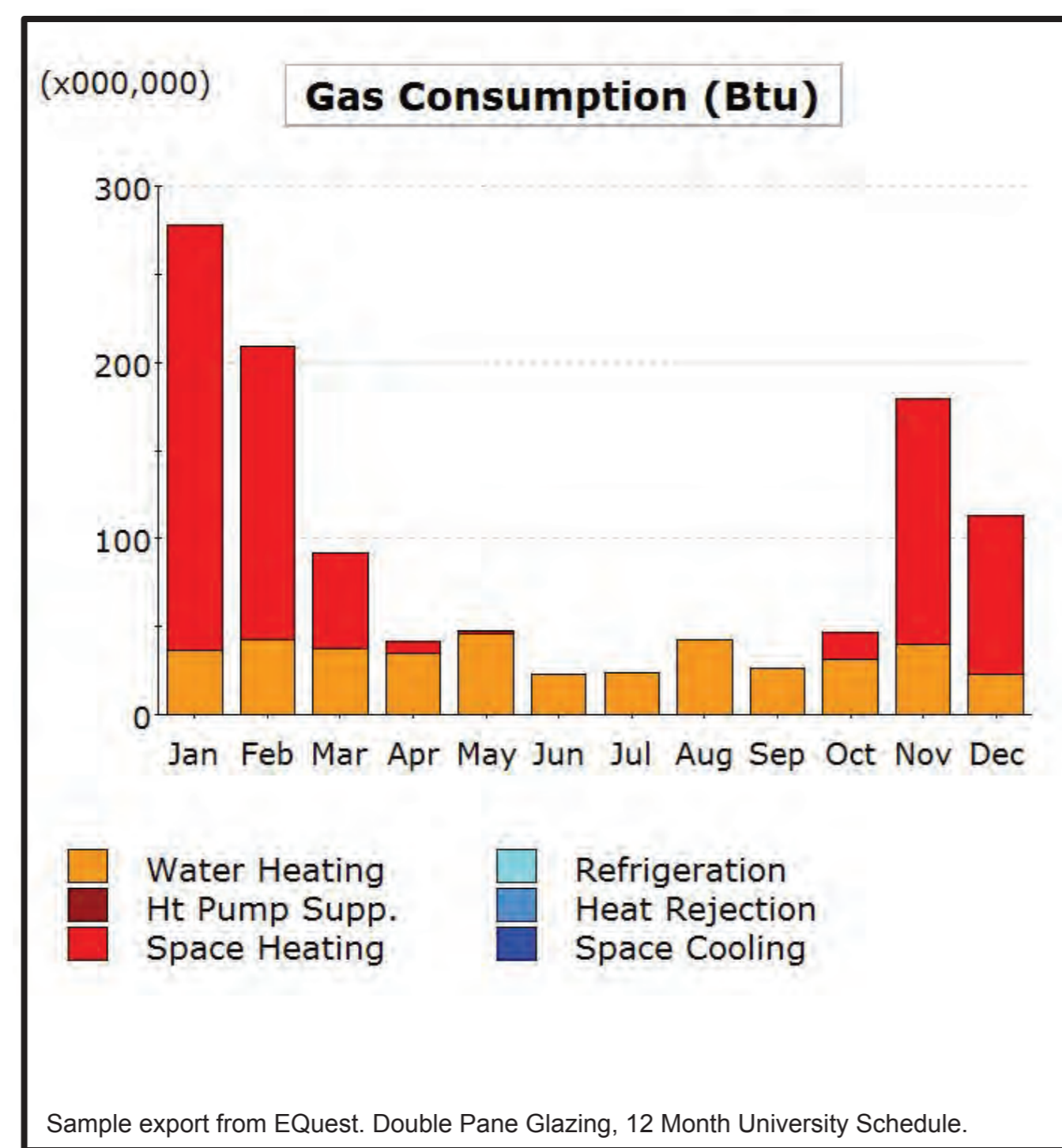
EQuest
Freeware overall building energy analysis tool. It ultimately proved to be the most successful attempt at finding useable energy usage data.

EQuest Model screen shot.

Electric Consumption (kWh) (x000)

Area Lighting, Task Lighting, Misc. Equipment, Exterior Usage, Pumps & Aux., Ventilation Fans

Sample export from EQuest. Double Pane Glazing, 12 Month University Schedule.

Annual Electricity Use (kWh x 100)

Double Pane	673
Double Pane 12% Spandrel	661
Double Pane 40% White Frit	621
Double Pane 80% White Frit	639
Triple Pane	579
Triple Pane 40% Gray Frit	600

Gas Consumption (Btu) (x000,000)

Water Heating, Ht Pump Supp., Space Heating, Refrigeration, Heat Rejection, Space Cooling

Sample export from EQuest. Double Pane Glazing, 12 Month University Schedule.

Annual Gas Use (Btu x 1,000,000)

Double Pane	1122
Double Pane 12% Spandrel	1066
Double Pane 40% White Frit	1200
Double Pane 80% White Frit	1193
Triple Pane	1076
Triple Pane 40% Gray Frit	1053

Glazing Coefficients — VLT, SHGC, U

Annual Cooling Energy (kWh x 1000)

Triple Pane	70
Triple Pane 40% Gray Frit	73
Double Pane 80% White Frit	88
Double Pane 40% White Frit	90
Double Pane 12% Spandrel	98
Double Pane	112

Glazing Coefficients — VLT, SHGC, U

Annual Lighting Load (kWh x 1000)

Double Pane	255
Triple Pane	262
Double Pane 40% White Frit	263
Double Pane 12% Spandrel	278
Triple Pane 40% Gray Frit	282
Double Pane 80% White Frit	284

Glazing Coefficients — VLT, SHGC, U

Annual Heating Energy (BTUs x 1,000,000)

Triple Pane 40% Gray Frit	645
Double Pane 12% Spandrel	660
Triple Pane	668
Double Pane	715
Double Pane 80% White Frit	786
Double Pane 40% White Frit	793