2008

Pushing the Green Envelope: Education & Research Center for Sustainability

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pushing the (green) envelope

Education & Research Center for Sustainability

Independent Project submitted to
Roger Williams University, School of SAAHP
In fulfillment of the requirements of the B.Arch Degree in Architecture
In May 2008
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"To change the world,
Start with one step.
However small,
The first step is hardest of all"

~Dave Matthews Band &
Mark Batson

Table of Contents

Introduction

When trying to describe my feelings towards architecture and goals of accomplishment, I am drawn to the issues of the environment and how it could be improved through architecture. I find it hugely frustrating that people do not care that they are harming the planet on a daily basis, or if they do care, they do not care enough to change their ways. I find it frustrating that more people are not educated about sustainability and how easily it can be incorporated into their lives. Not only do they not know the simple things they can do to improve the world on a local scale, but some do not even know what sustainability is, how it came about, or why there is a need to take action. People need to take responsibility for their world, but before they can do that, they must know what they are doing wrong and why there is a need to change. To educate people globally, one must first educate at the local scale. Therefore, while I understand a single building will not educate or change the environment on a global scale, I do believe a single building can be a beacon of sustainable education to the public and teach principles to a community that can then be relayed to others.

Project Statement

I propose to design a Center for Sustainability that serves as a place to educate students and the public, as well as provide a place to research and experiment, in an effort to further the developing technologies of this ecological study. While living in a perpetually changing world, I believe a place is needed to teach about these changes as well as adapt to them. I propose to build a center that both educates people about the background of the subject as well as teaching them the present, practical aspects of sustainability. Classes and exhibits will give visitors the education needed to apply aspects of sustainable design to their daily lives. Meanwhile, research will be taking place in the building as well, looking for new and better ways to use the resources we have to improve the world. An incubator will provide spaces for start-up businesses to grow that are developing sustainable technologies in the research labs. The most important part of the building, however, is that it should be adaptable and changeable, like the world in which it is set. Yesterday's future is today's present, so that must be reflected in the design of this center. Today's research will be tomorrow's practical applications, and in a week, history. The technology associated with sustainability is not only ever changing, but fast paced. Therefore, the building and its architecture must reflect this dynamic nature and be able to adapt to it. It should convince the public by making sustainability appealing and accessible, purposeful and practical.

Conceptual Programmatic Goals

Create Interactive Spaces

In order to best reflect the principles of sustainability, spaces should be interactive and flexible. If the requirements for a space change, as they inherently will over time, the space should be adaptable to future needs. Spaces should also be interactive in relation to the way they engage the users.

Encourage Community Interaction

The Center should create dialogue between a variety of professions, ages, cultures and social classes. Everyone should interact with the common goal of learning about or furthering knowledge in the field of sustainability. Opportunities for interaction should occur in casual settings like the café or courtyard, as well as more formal settings like the research labs and incubator.

Provide Integrative Education

The building itself should educate, in the way it relates to the people using it, the site, and the ecosystem of which it is part. The building therefore should minimize its impact on the site and environment in an attempt to blur the transition between built environment and nature.

Display Evolutionary Design

The building should be changeable and adaptable to reflect the constantly changing technologies in the realm of sustainability. By creating flexible spaces, the building can reflect the newest happenings in sustainability at any given time, displaying to the community the future of the design world.

Program Outline

Lobby/Entry	500 sq. ft.
Entry needs to be 6' long minimum for LEED and capture dirt to keep it from entering the main part of the building	
Exhibit Space	1800sq. ft.
Space needs to be flexible to hold a various types and sizes of exhibits. Natural light should be controllable in this area to allow for digital exhibits as well.	
Auditorium(100p)	1500sq. ft.
Classes will be held here as well as a Sustainability lecture series. The space should be flexible to serve as a small concert hall if needed since the campus currently lacks one.	
Research Labs-5x1000sf	5000sq. ft.
Labs need to exhaust ducts and self closing doors for LEED if there is a possibility of hazardous materials being present. The labs should be easily accessible from the loading area.	
Learning Labs-4x600sf	2400sq. ft
Same requirements as Research Labs.	
Library/Resource Center	4000sq. ft.
Reading room - should have ample amounts of natural lighting and be separate from main library space.	
Computer Resource room - should have way of capturing the heat output from computers and using it within the room's ventilation system.	
Stacks - should be made from recycled or salvaged materials and be near the computer resource room.	
Materials Library - should be accessible from both the main library space and the lab areas.	
Periodicals	

Incubator -10x2000sf	20000sq. ft.
This area must be entirely flexible. The walls, furniture and lighting must all be changeable.	
Business Offices -10x100sf	1000sq. ft.
Business offices will be used by building workers and those organizing the companies that will be using the incubator spaces. They should be accessible from a different entrance than the main campus interface.	
Café	1200sq. ft.
Cafe should be easily accessible to all the building's users. It should be on an edge of the building to allow for outside seating nearby.	
Café Kitchen	300sq. ft.
Kitchen should be connected to the cafe and accessible to a service core or the loading dock area.	
Classrooms -5x600sf	3000sq. ft.
Classrooms should be intermingled between the learning labs and research labs, so students can transition easily between lecture learning and hands-on learning. Classrooms should have abundant natural light.	
Professor Offices -10x100sf	1000sq. ft
Offices should be near the classroom and lab areas and have easy access to the meeting room. Offices should be open and flexible to allow for user to choose their preferred furniture organization.	
Meeting Room	600sq. ft.
Support/Mechanical	1300sq. ft.
Restrooms/Circulation(15%)	6400sq. ft.
Total:	50000sq. ft.

Site Program

+ Outdoor Classrooms

  Clusters of trees should enclose areas that are set away from the main paths to serve as secondary locations for classroom learning.

+ Terrace/Roof Gardens

  A minimum of 50% of the roof needs to have vegetation.

+ Parking

  Handicap, Staff, Visitor, Fuel Efficient Vehicles

  A minimum of 50% of the parking needs to be underground, sunken, or covered.

+Bike Storage Area

  There should be enough storage area for 5% of the buildings occupants at peak hours

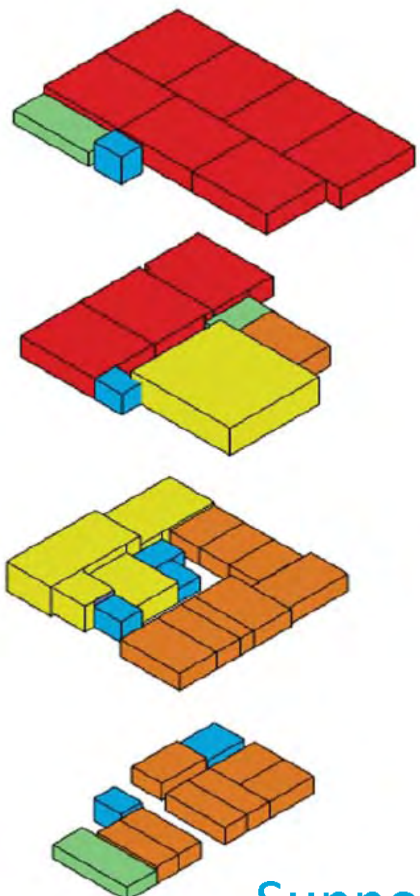
+Loading Dock

  If possible, existing loading dock should be salvaged and current location kept.

+Smoking Areas

  Following LEED standards, smoking areas must be 25' from any entry area or operable window

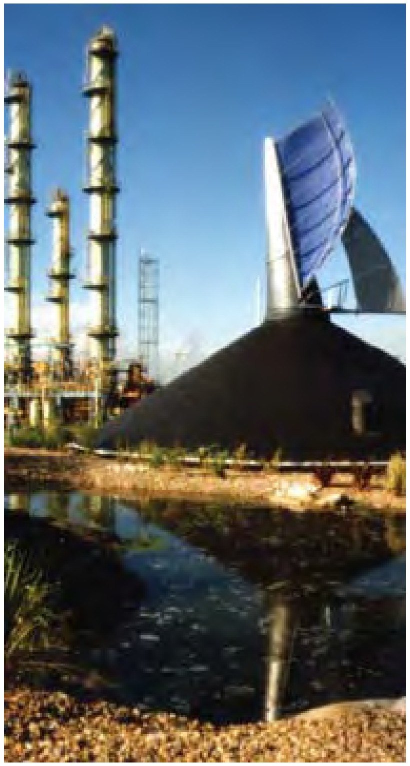
Program Adjacencies



In looking at adjacencies, it is important to use the conceptual programmatic goals as guidelines. At entry level, there is naturally a major amount of public space, but educational spaces are placed there as well. Above, there is a combination of public, educational, business, and administrative functions. By integrating the different types of spaces together, there is a greater chance for interaction, which will hopefully lead to conversation and the exchange of knowledge.

Support Business Educational Public Administration

Project Narrative



Walking across campus, the excited interaction between students and professors is heard as a constant background noise. Placed near the University Library, Gabelli Business School, and the Natural Sciences School, the Center for Sustainability links sustainable research and education with practical applications in business. Approaching the Center for Sustainability, the blue sky is reflected in the photo voltaic glass panes of the building leading to the entrance. The open area in front of the building serves as a gathering space where a variety of people are constantly exchanging ideas. People are lounging in the warm sun on the cistern benches reading for classes, and as well as others sipping coffee while discussing their current projects and research.

First thing in the morning, the bustle around the building is mostly researchers discussing their most current work and professors preparing for their morning classes. The exhibit curator is putting up new boards, displaying to the public the most current research happening in the labs. Businesses men and women are getting started up for their daily work in the incubator. A cool breeze comes in from the clerestory windows at the top of the tall entry area to cool the building.

Mid-morning a class of fourth graders comes in from one of the local elementary schools and all are immediately drawn to the blinking digital readings of the building's energy inputs and outputs in the lobby space. A tour guide greets them and explains what all the readings mean. Then he brings the group over to the "guts" of

the building, where all the inside materials are visible. It is unlike any of the other buildings on campus in the way it visually explains its structure and construction. The kids get to touch the various materials and see how they work. Next he brings the group to research labs, where the children get to observe the researchers testing different materials and technologies through the glass partitions. The researchers are busy working, but the kids get to watch and ask them questions if they have time. From there the guide brings them to the learning labs next door, where it is their turn to do some experiments. The atmosphere is bright and exciting to attract their attention. Kids, being ever ready to play, get to make their own toy cars that run on canola oil and then race them. They learn the principles of the concept and get to have fun at the same time, making them more likely to remember the lessons and explain it to their parents later. The exhibit spaces are their last stop, where they get to learn about the basics of sustainability, as well as the most recent technology that has been discovered. The interactive displays today show them how wind can be turned into enough energy to power their entire house. There are videos as well as miniature replicas of the turbines and cowls outside the building.

In addition to children learning all about sustainability in the building, college students are busy taking classes all morning as well. Some of the time is spent in the auditorium or classroom

but the rest is in the learning lab, where they do their own experiments, or in the case of the education majors, plan the next experiments to do with the visiting elementary schools.

Around lunchtime the areas in front of and behind the building get crowded again. Students eat with professors and researchers eat with businessmen. An elderly couple volunteering in the library for the day enjoys eating their lunch outside to observe the hustle and bustle of the campus
around this time of day. A soup made with local vegetables can be smelled when walking by the building and pulls people in.

The afternoon is busy in the incubator with businesses working hard to develop sustainable technologies and ways to market them to the unknowledgeable, everyday people. The space is dividable, allowing for small businesses as well as large with the easy slide of partitions. Offices nearby provide spaces for the workers that coordinate and oversee the use of the incubator. Phones are busy ringing as well as the hum of whatever photocopiers or printers are currently being used. Professors are in their offices as well, meeting with students and grading work.

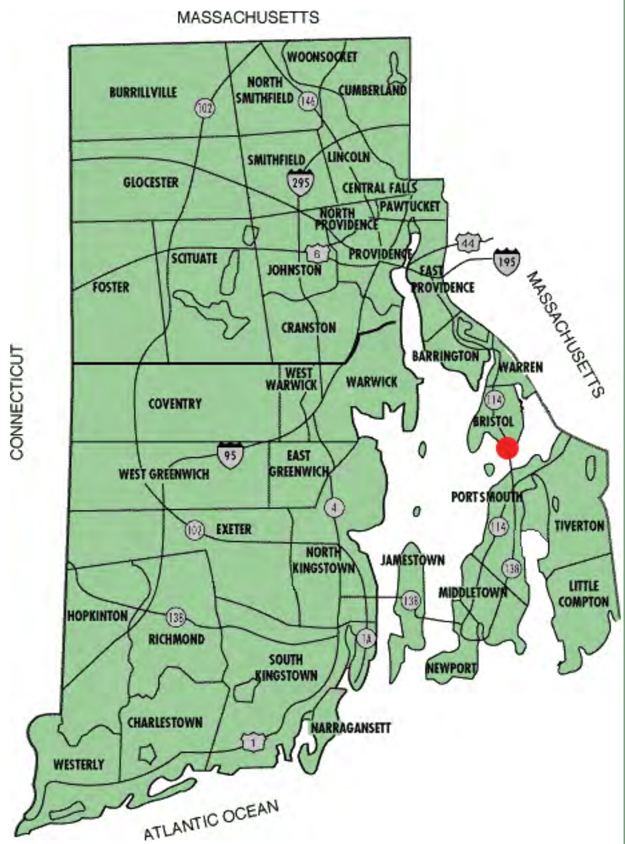
By late afternoon the building starts to quiet down, with students leaving for the day and the tours wrapping up as well. Around 5pm most people are getting ready to leave the building, but some students remain in the library and the café, reading and continuing their research. The library provides a comfortable

location with great light for reading and working.

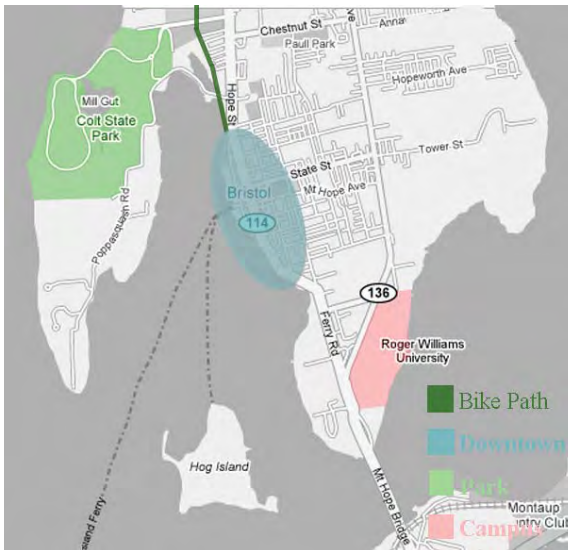
When the library closes, the building becomes quiet and empty, allowing it to cool down and recharge for the next day of excitement. The well lit courtyard out front is still lively with people meeting before dinner or sitting on the benches chatting on their cell phones. Evening lectures can be seen through the glow of the lobby.

Site

In choosing a location for the Center for Sustainability, the site of a campus seems like a logical one, linking the academic and business realms to strengthen the community interaction. It is also important to place it on a campus that is implementing sustainable initiatives and constantly attempting to make improvements. Roger Williams University has been doing so and I believe the site of the old Student Union would be a perfect location for such a building. The Bristol campus is easily accessible by public transit and close to both Providence and Boston, allowing for a wide range of daily commuters as well as occasional visitors.



Bristol, Rhode Island



Bristol is a small town with a large architectural history, located half an hour south of Providence and an hour from Boston. It is situated on beautiful Mount Hope Bay and is accessible from boat, vehicle, and public transportation directly from Newport and Providence.

Bristol was founded in 1680, after it was the site of the first battle in King Philip's War in 1675. It was attacked during the Revolutionary War as well, when the British marched down today's Hope Street and set fire to many of the buildings belonging to the troops.[1]

Bristol also is home to the oldest Fourth of July Celebration in America. This rich tradition draws huge crowds each year for the hours and hours of floats, bands, military personnel, and general spectacle that the town puts on. Hope Street even has a red, white, and blue strip running down the middle of the street rather than the typical yellow.

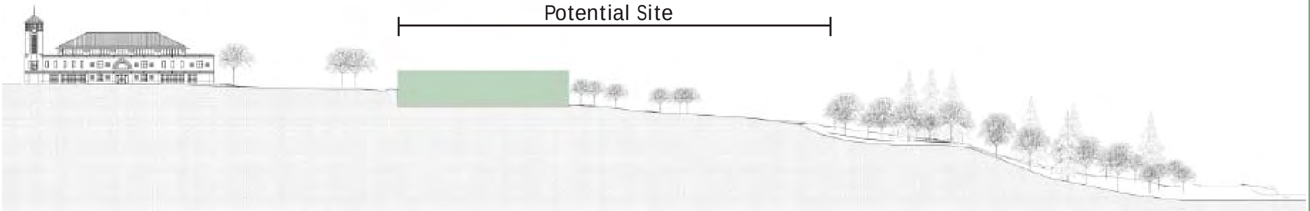
The downtown district is full of quaint shops and restaurants and has an active waterfront area. Independence Park, near the water, is one of the town's several green spaces. Others include the Town Common, where the Fourth of July Carnival is held, and Colt State Park, just outside the downtown area. Bristol is also home to a bike path that starts on the Northern edge of the downtown district and goes all the way to Providence. This allows for an additional link to an urban setting that does not require any fuel-dependent vehicle.

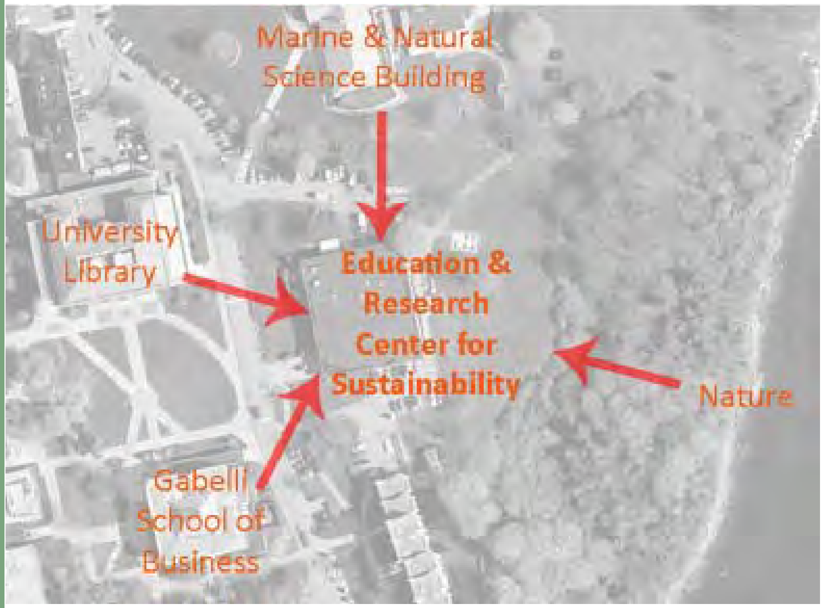
Roger Williams University Site

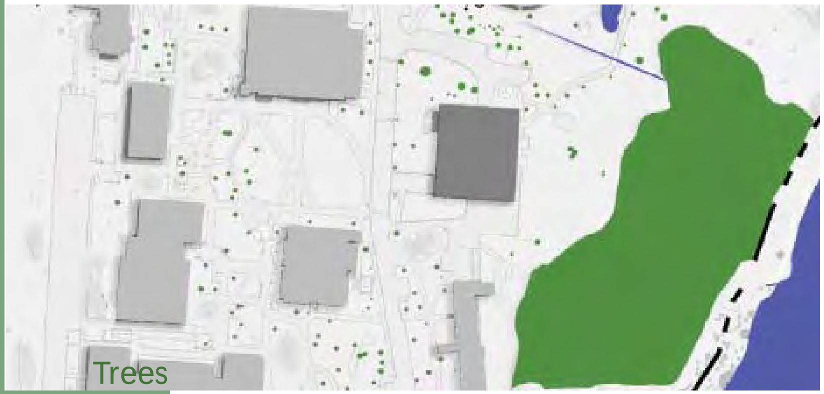
RWU New Academic Building (previously Student Union)

Roger Williams University is located less than 2 miles from Downtown Bristol, on the shores of Mount Hope Bay.

The location of the former Student Union is directly in the heart of the University campus, between the Business School and University Library. The newly completed Commons building has shifted the center of campus somewhat north, closer to the Architecture building and the Recreation Center so one of the goals of the Center for Sustainability is to reinvigorate that part of campus.





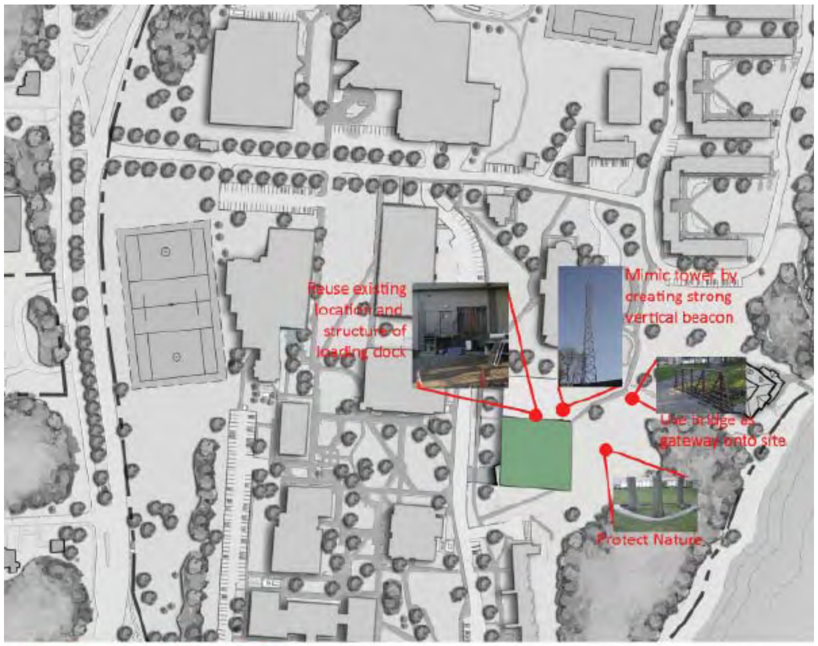


Conceptually, the location of the Education & Research Center for Sustainability on the site of the New Academic Building works well with the surrounding buildings. To the North is the Marine & Natural Science building, linking the environmental and ecological studies to the new Center. The University Library allows a connection to the research aspect of the center. The School of Business to the Southwest links the education of a Business major to the real world applications happening in the incubator spaces of the Center. Lastly, to the East is Mount Hope Bay. The connection to nature is most important to the study of sustainability and people's education about it, so having access to nature walks, tree groves, and water is a valuable asset that should be constantly considered during the design process.

The New Academic Building is only a 5 minute walk to the University Rhode Island Public Transportation (RIPTA) stop on the edge of campus along Route 114. This bus route goes between Newport and Providence, therefore allowing access to the campus from a wide range of locations, without the use of a personal vehicle.

In analyzing the current locations of entrances to the New Academic Building and its surroundings, it is important to consider where people will be coming from when the Center for Sustainability is built. The academic realm of users will be coming from within the campus most of the time. Therefore there needs to be an entrance on the west. The non-academic users will be arriving to campus on a daily basis and therefore will be arriving from either the parking area or the campus shuttle. The parking needs to be covered for environmental reasons as well as to gain LEED certification, so the lower part of the site would make the most sense. Therefore they will be arrive from the northeast corner, so an additional entrance should be placed there. This entrance may also be used by students coming from housing in that part of campus.

Campus Site
Existing Conditions



RWU Campus 1/200"=1'

The current site has a variety of facets than can be reused or designed into the new construction of the Center for Sustainability.

The existing tower on the site serves as a vertical beacon rising above the trees. This type of element will be necessary at the Center for Sustainability to gain visibility both within campus and from Route 114 and the campus entrance.

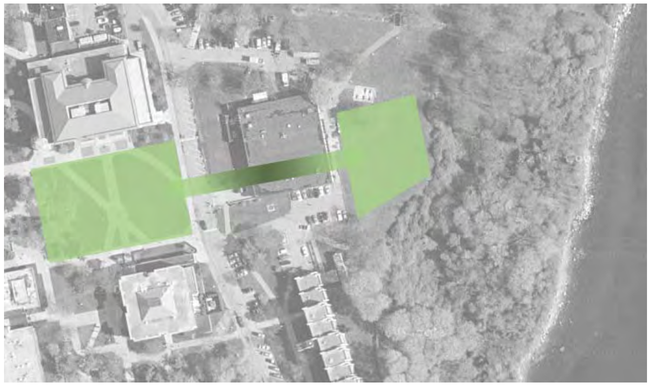
The existing loading dock can be reused for the new building and, depending on the parking location, perhaps in the same location.

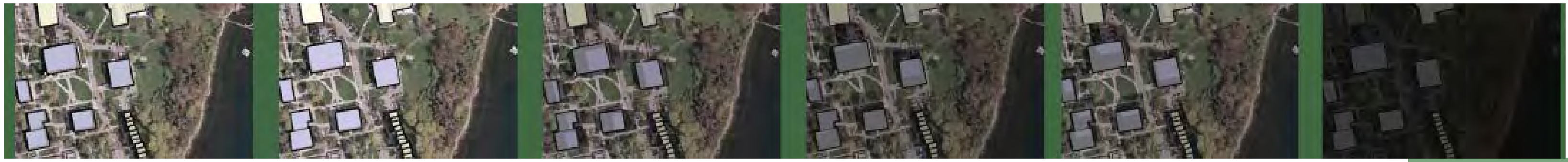
The pedestrian bridge on the eastern part of the site serves as a gateway into the site currently and should remain.



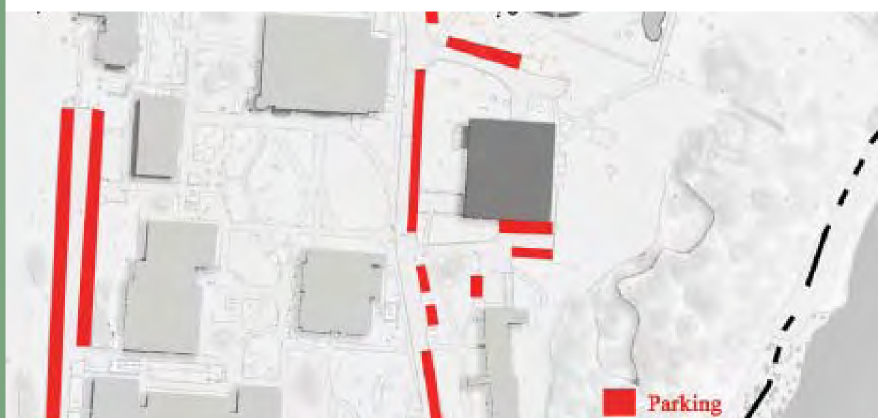

Campus Site
Green Space

Within the site, it will be important to incorporate as much green space as possible. This can be done by somehow linking the green space of the existing campus quad to the green space on the east part of the site. Exterior seating areas near the entry could serve as a secondary lobby in the warm months, and if the entry was on the south western part of the site, the seating areas would get plenty of southern light throughout the day. Green space on the southern part of the site would extend the quad and allow greater views of the bay.





Site Problems



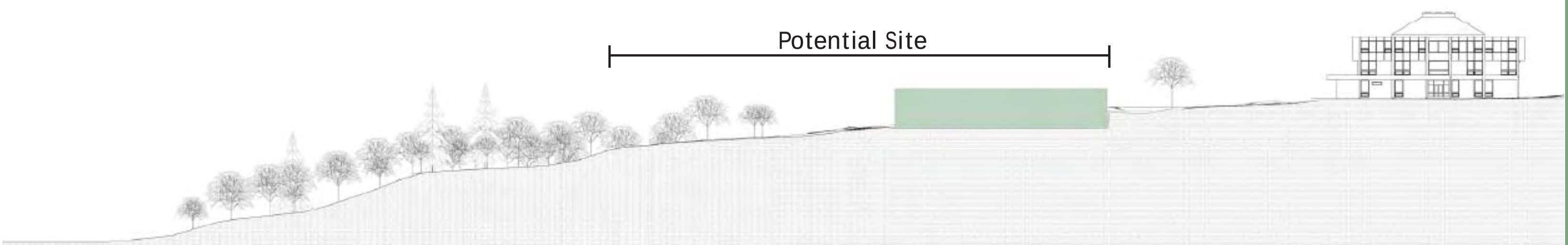
While the site’s location on campus works very well for some aspects of the project, it creates problems for others.

1. Vehicular Circulation - The only vehicular access to the site currently is a one way street on the western edge of the site. This is not a feasible solution for a building with such a major business interface component. Therefore an additional access road will have to be added, perhaps on the north-eastern corner, depending on the location of the parking. A drop off zone will also be needed, requiring easy entry and departure from the site.

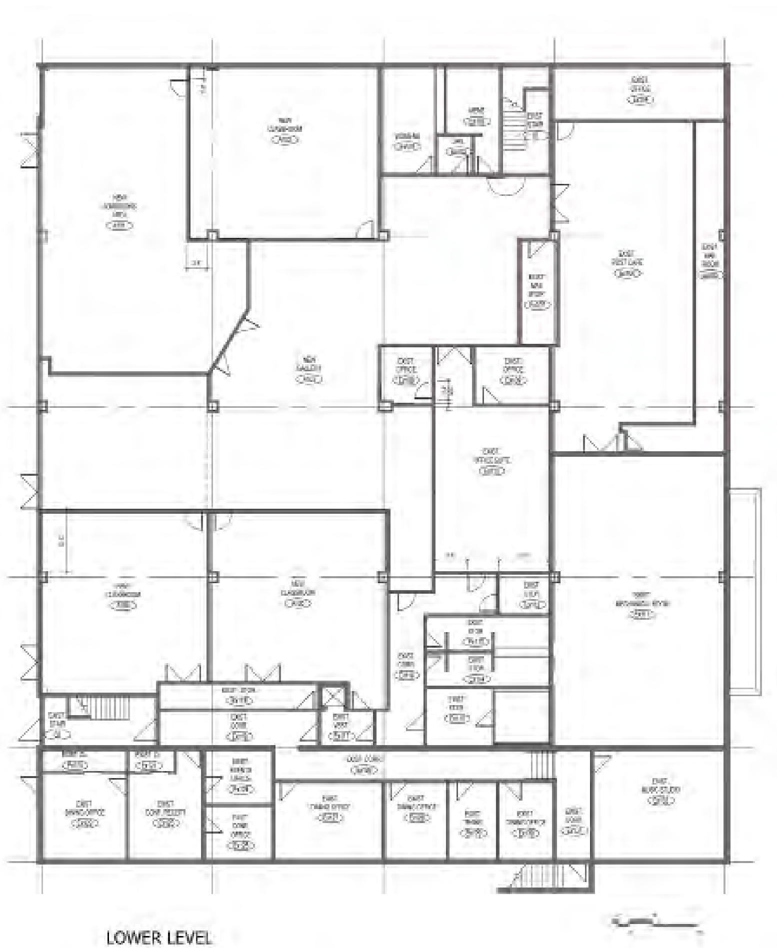
2. Location of parking - The existing parking is not sufficient for the number of people that will be coming and going on a daily basis to the Center, so the location of additional parking will be an issue. Whatever is added needs to be underground, sunken, or covered. Therefore, it can either go on the eastern, lower part of the site, or off the site entirely forcing the users to take the campus shuttle onto the site. If on the

eastern part of the site, it will be important to keep the amount of green space present, and not block the current pedestrian access path coming from the Bayside apartments.

3. Steep slope on eastern side of site -
The steep slope causes problems in terms of accessibility but also has a lot of opportunity associated with it. The sloped site would allow for the building to be strongly rooted to the earth and could easily orient itself to the sun, providing ample solar gain. It also allows the possibility of easily collecting rainwater into a retention system for reuse within the building.



New Academic Building Existing Conditions



Currently the New Academic Building holds classrooms, a cafe, a student hangout area, and offices. The majority of these functions are wrapped into the program for the Education and Research Center for Sustainability.

The existing building location should remain, with the new Center extending east if necessary. The current building is approximately 160’ in the North-South direction and 135’ in the East-West direction.

The materials of the old Student Union will be salvaged and reused whenever possible. All of the furniture will be stored while the new Center is being constructed and reused elsewhere.

Regulatory Environment
International Building Code

Use Group Classification:	**Assembly A-3:** The exhibition space, lecture hall, and library classify the build ing as Assembly (A-3). **Business:** Having educational occupancies for students above the 12th grade and both learning and research labs classifies the building as Business Group B.
Height Area Limitations:	**Type II Construction-** Under Assembly A-3, code allows for 3 stories 15,500 sf. However, under Section 507.6, the area of the building defined as A-3 will not be limited if the all the following conditions exist: The building shall not have a stage other than a platform. The building shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 The assembly floor shall be located at or within 21 inches of street or grade level and all exits are provided with ramps complying with Sec tion 1010.1 to the street or grade level. The building shall be surrounded and adjoined by public ways or yards not less than 60 feet in width. Under Business Group B, code allows for 5 stories 37,500sf
Fire Resistance:	Exterior bearing walls 1 hour rated Interior bearing walls 1 hour rated Floor construction 1 hour rated Fire walls need resistance rating of 3 hours

Floor Areas per Occupant:	Accessory Storage/Mechanical Equiptment	300gross
	Assembly Standing space	5 net
	Assembly with Fixed seats	depends on # of occupants
	Business Areas	100 gross
	Educational - Classroom area	20 net
	Library - Reading Room	50 net
	Stacks	100 gross
Egress Width Per Occupant: (With Sprinkler System)	Stairways	0.2 in/occupant
	Other Egress	0.15in/occupant

Code Analysis

Rhode Island State Building Code

Climate Zone:	5A
Ground Snow Load	30psf
Minimum Flat Roof Snow Load	30psf
Basic Wind Speed	110mph
Frost Depth	3’-4”

Roger Williams University is located in Bristol’s Educational Institutional (EI) Zoning District. This zone requires buildings to be designed in “a planned manner while protecting surrounding cultural, historic, and environmental resources.”[2] Since protecting environmental resources is an integral part of the Education & Research Center for Sustainability, abiding by this zoning ordinace will be guaranteed.

Code Analysis

Bristol Zoning Ordinance

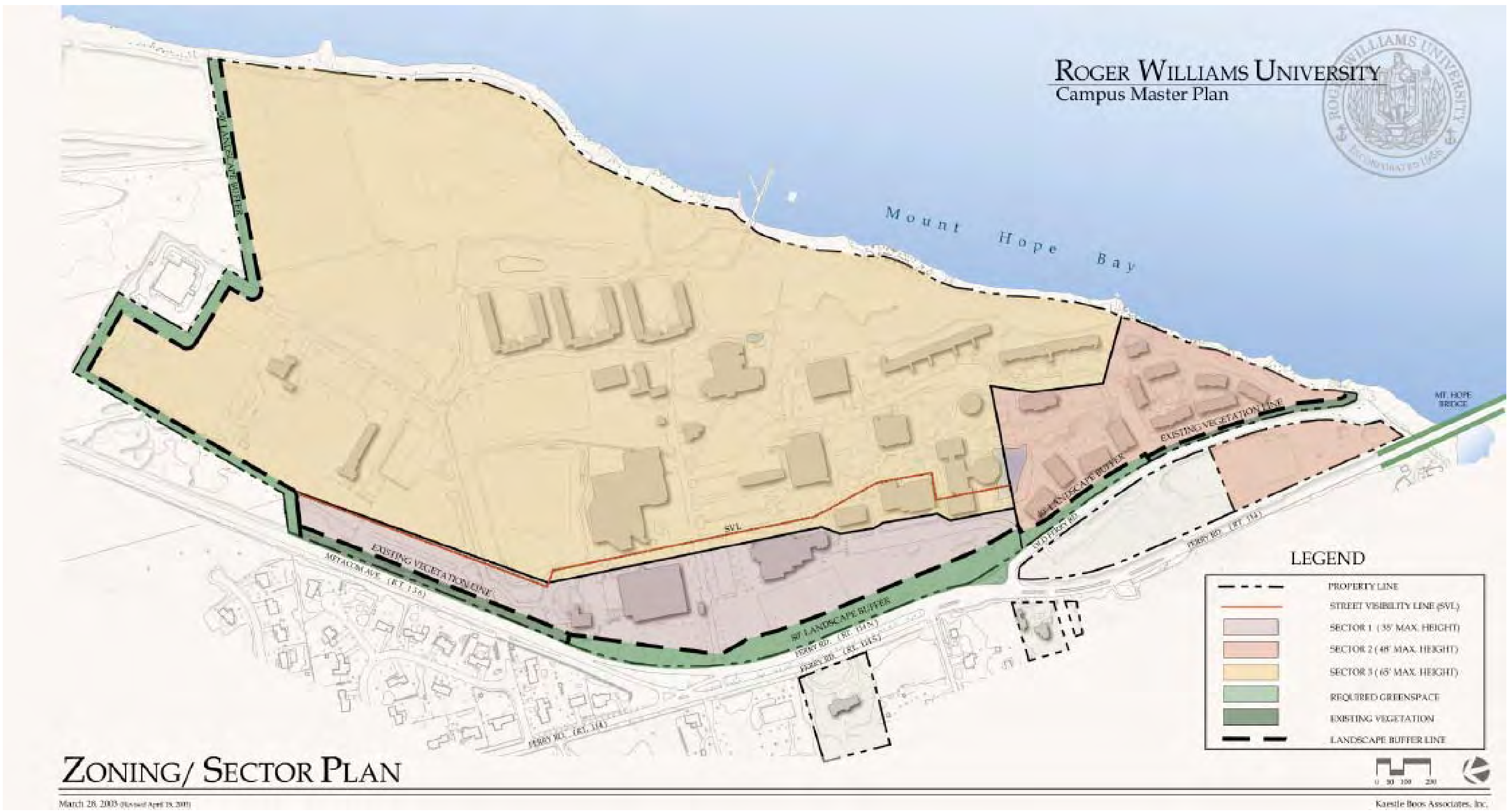
EI Zone:	Intended for College/University facilities
3 Sub-districts :	1. EI-35: 35 ft maximum height
(see pg45)	2. EI-48: 48 ft maximum height
	3. EI-65: 65 ft maximum height
Permitted Uses:	Gardening and Raising of Crops
	Nursery or Greenhouse/Agricultural (without sales on premises)
	Day Care Facility with more than 6 persons
	Library
	Museum, non-profit
	Book store/cafe
	Pump station
	Theater
	Playground/Park
	Open space
	Non-profit community or education center
Uses Allowed by Special Use Permit:	Specialty School
	Sewage treatment plant
	Camp for boys or girls, including music or art camp

Parking:	Parking must be located in same lot as structure Loading area should be on rear or side of building and in same lot Minimum Width - 10ft Minimum Length - 18ft
Setbacks	Minimum 10 ft from front lot line Parking spaces minimum 5 ft from building
Landscaping	Any parking area with more than 20 spaces must have adaquate landscaping on the interior area.

Natural Resources

Roger Williams University has a variety of natural resources at its fingertips that it has a responsibility to protect. These include both wetland areas and buffer zones between the coast and the rest of campus. These are important to keep in mind when designing the location of the new University Law School in the Campus master plan. It will not be able to go in any of these zones, or the 10-20% slope zones. These zones also keep the coastline building free and therefore something the entire campus can enjoy, especially with the addition of the seashell path along shore around the wetland area south to the campus dock.

Campus Zoning



Education & Research Center for Sustainability
Roger Williams University
Bristol, Rhode Island Emma Fischer 2008

Open Spaces


Roger Williams University
Campus Master Plan
Mount Hope Bay
Mt. Hope Bridge
LEGEND
WOODED AREA
CAMPUS OPEN SPACE
ATHLETIC FIELDS/RECREATION
LAWN AREAS
Existing Open Space and Outdoor Athletic Facilities Plan
Kamelle Bean Associates, Inc.

Coastal Flood Zoning
Bristol, Rhode Island

Being located on a peninsula, Bristol has flooding around its coast on a regular basis. The Coastal Flood Zones area designed both to keep buildings out of areas prone to regular flooding, and keep floodways open for directing the water back to Mt. Hope Bay. The majority of Roger Williams University is completely out of the flood zone, except for the eastern-most part of campus. Closest to the bay is the floodway zone used if there is chance flood, while a bit inland is the area of 0.2% annual chance flood.

The site of the Education and Research Center for Sustainability is well out of these most common flood zones in Bristol and is part of Zone X.

- Floodway for 1% annual chance flood

- Area of 0.2% annual chance flood

Zone X - outside of 0.2% annual chance floodplain

LEED Rating System
New Construction[3]*

Leadership in Energy and Environmental Design (LEED) is an important standard that the new construction of the Education and Research Center for Sustainability should adhere by in an effort to display to the campus and greater community their
environmental goals and standards. Since this is a forwards-thinking center, researching the newest sustainable technologies, it should also display them, which is why it should adhere to the highest LEED standard, Platinum. This means that out of the 69 possible points, which will be discussed in detail later, the building will have to adhere by at least 52 of them. If done, it will give the campus greater marketability, showing the rest of the collegiate world how important sustainability is to the Roger Williams University campus.

The points that are possible are broken down into a series of categories. They are:

Sustainable Sites	14 points
Water Efficiency	5 points
Energy & Atmosphere	17 points
Materials & Resources	13 points
Indoor Environmental Quality	15 points
Innovation & Design Process	5 points
Total:	69 points

* All LEED information comes from U.S.G.B.C's Green Building Rating System For New Construction & Major Renovations

LEED Rating System
Sustainable Sites Points

Prerequisite 1 Construction Activity Pollution Prevention **Required**

Requirements: Create and implement an Erosion and Sedimentation Control (ESC) Plan for all construction activities associated with the project. The ESC Plan shall conform to the erosion and sedimentation requirements of the 2003 EPA Construction General Permit OR local erosion and sedimentation control standards and codes, whichever is more stringent. The Plan shall describe the measures implemented to accomplish the following objectives:

- Prevent loss of soil during construction by stormwater runoff and/or wind erosion, including protecting topsoil by stockpiling for reuse.
- Prevent sedimentation of storm sewer or receiving streams.
- Prevent polluting the air with dust and particulate matter.

The Construction General Permit (CGP) outlines the provisions necessary to comply with Phase I and Phase II of the National Pollutant Discharge Elimination System (NPDES) program. While the CGP only applies to construction sites greater than 1 acre, the requirements are applied to all projects for the purposes of this prerequisite.

Credit 1 Site Selection **1**

Requirements: Do not develop buildings, hardscape, roads or parking areas on portions of sites that meet any one of the following criteria:

- Prime farmland as defined by the United States Department of Agriculture in the United States Code of Federal Regulations, Title 7, Volume 6, Parts 400 to 699, Section 657.5 (citation 7CFR657.5)
- Previously undeveloped land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by FEMA (Federal Emergency Management Agency)
- Land that is specifically identified as habitat for any species on Federal or State threatened or endangered lists

• Within 100 feet of any wetlands as defined by United States Code of Federal Regulations 40 CFR, Parts 230-233 and Part 22, and isolated wetlands or areas of special concern identified by state or local rule, OR within setback distances from wetlands prescribed in state or local regulations, as defined by local or state rule or law, whichever is more stringent
• Previously undeveloped land that is within 50 feet of a water body, defined as seas, lakes, rivers, streams and tributaries which support or could support fish, recreation or industrial use, consistent with the terminology of the Clean Water Act
• Land which prior to acquisition for the project was public parkland, unless land of equal or greater value as parkland is accepted in trade by the public landowner (Park Authority projects are exempt)

Credit 2 Development Density & Community Connectivity **~~1~~**
Not Possible

Credit 3 Brownfield Redevelopment **~~1~~**
Not Possible

Credit 4.1 Alternative Transportation, Public Transportation Access **1**
Requirements: Locate project within 1/2 mile of an existing, or planned and funded, commuter rail, light rail or subway station.
OR
Locate project within 1/4 mile of one or more stops for two or more public or campus bus lines usable by building occupants.

Credit 4.2 Alternative Transportation, Bicycle Storage & Changing Rooms **1**
Requirements: For commercial or institutional buildings, provide secure bicycle racks and/or storage (within 200 yards of a building entrance) for 5% or more of all

building users (measured at peak periods), AND, provide shower and changing facilities in the building, or within 200 yards of a building entrance, for 0.5% of Full-Time Equivalent (FTE) occupants.

Credit 4.3 Alternative Transportation, Low Emitting & Fuel Efficient Vehicles **1**

Requirements: Provide preferred parking for low-emitting and fuel-efficient vehicles for 5% of the total vehicle parking capacity of the site.

"Preferred parking" refers to the parking spots that are closest to the main entrance of the project (exclusive of spaces designated for handicapped) or parking passes provided at a discounted price.

Credit 4.4 Alternative Transportation, Parking Capacity **1**

Requirements: OPTION 1 — NON-RESIDENTIAL

• Size parking capacity to meet, but not exceed, minimum local zoning requirements, AND, provide preferred parking for carpools or vanpools for 5% of the total provided parking spaces.

OR OPTION 2 — NON-RESIDENTIAL

For projects that provide parking for less than 5% of FTE building occupants:

• Provide preferred parking for carpools or vanpools, marked as such, for 5% of total provided parking spaces.

Credit 5.1 Site Development, Protect or Restore Habitat **1**

Requirements: On previously developed or graded sites, restore or protect a minimum of 50% of the site area (excluding the building footprint) with native or adapted vegetation. Native/adapted plants are plants indigenous to a locality or cultivars of native plants that are adapted to the local climate and are not considered invasive species or noxious weeds. Projects earning SS Credit 2 and using vegetated roof surfaces may apply the vegetated roof surface to this calculation if the plants meet the definition of native/adapted.

Credit 5.2 Site Development, Maximize Open Space **1**

Requirements: For areas with no local zoning requirements (e.g., some university campuses,

military bases), provide vegetated open space area adjacent to the building that is equal to the building footprint.

Credit 6.1 Stormwater Design, Quantity Control **1**

Requirements: Implement a stormwater management plan that protects receiving stream channels from excessive erosion by implementing a stream channel protection strategy and quantity control strategies.

Credit 6.2 Stormwater Design, Quality Control **1**

Requirements: Implement a stormwater management plan that reduces impervious cover, promotes infiltration, and captures and treats the stormwater runoff from 90% of the average annual rainfall1 using acceptable best management practices (BMPs).

BMPs used to treat runoff must be capable of removing 80% of the average annual post development total suspended solids (TSS) load based on existing monitoring reports. BMPs are considered to meet these criteria if (1) they are designed in accordance with standards and specifications from a state or local program that has adopted these performance standards, or (2) there exists in-field performance monitoring data demonstrating compliance with the criteria. Data must conform to accepted protocol (e.g., Technology Acceptance Reciprocity Partnership [TARP], Washington State Department of Ecology) for BMP monitoring.

Credit 7.1 Heat Island Effect, Non-Roof **1**

Requirements: OPTION 1

Provide any combination of the following strategies for 50% of the site hardscape (including roads, sidewalks, courtyards and parking lots):

- Shade (within 5 years of occupancy)
- Paving materials with a Solar Reflectance Index (SRI)2 of at least 29
- Open grid pavement system

OR OPTION 2

Place a minimum of 50% of parking spaces under cover (defined as under ground, under deck, under roof, or under a building). Any roof used to shade or cover parking must have an SRI of at least 29.

Credit 7.2 Heat Island Effect, Roof **1**

Requirements: Install a vegetated roof for at least 50% of the roof area.

Credit 8 Light Pollution Reduction **1**

Requirements: FOR INTERIOR LIGHTING

All non-emergency interior lighting shall be automatically controlled to turn off during non-business hours. Provide manual override capability for after hours use.

AND FOR EXTERIOR LIGHTING

Only light areas as required for safety and comfort. Do not exceed 80% of the lighting power densities for exterior areas and 50% for building facades and landscape features as defined

Points Achievable: 12 of 14

LEED Rating System
Water Efficiency

Credit 1.1 Water Efficient Landscaping, Reduce by 50% **1**

Requirements: Reduce potable water consumption for irrigation by 50% from a calculated mid-summer baseline case.

Reductions shall be attributed to any combination of the following items:

- Plant species factor
- Irrigation efficiency
- Use of captured rainwater
- Use of recycled wastewater
- Use of water treated and conveyed by a public agency specifically for non-potable uses

Credit 1.2 Water Efficient Landscaping, No Potable Use or No Irrigation **1**

Requirements: In addition to WE Credit 1.1, use only captured rainwater, recycled wastewater, recycled greywater, or water treated and conveyed by a public agency specifically for non-potable uses for irrigation.

Credit 2 Innovative Wastewater Technologies **1**

Requirements: Reduce potable water use for building sewage conveyance by 50% through the use of water-conserving fixtures (water closets, urinals) or non-potable water (captured rainwater, recycled greywater, and on-site or municipally treated wastewater).

Credit 3.1 Water Use Reduction, 20% Reduction **1**

Requirements: Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements. Calculations are based on estimated occupant usage and shall include only the following fixtures (as applicable to the building): water closets, urinals, lavatory faucets, showers and kitchen sinks.

Credit 3.2 Water Use Reduction, 30% Reduction **1**

Requirements: Employ strategies that in aggregate use 30% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 fixture performance requirements. Calculations are based on estimated occupant usage and shall include only the following fixtures (as applicable to the building): water closets, urinals, lavatory faucets, showers and kitchen sinks.

Points Achievable: 5 of 5

Prereq 1 Fundamental Commissioning of the Building Energy Systems **Required**

Requirements: The following commissioning process activities shall be completed by the commissioning team, in accordance with the LEED for New Construction 2.2 Reference Guide.

1) Designate an individual as the Commissioning Authority (CxA) to lead, review and oversee the completion of the commissioning process activities.

a) The CxA shall have documented commissioning authority experience in at least two building projects.

b) The individual serving as the CxA shall be independent of the project's design and construction management, though they may be employees of the firms providing those services. The CxA may be a qualified employee or consultant of the Owner.

c) The CxA shall report results, findings and recommendations directly to the Owner.

d) For projects smaller than 50,000 gross square feet, the CxA may include qualified persons on the design or construction teams who have the required experience.

2) The Owner shall document the Owner's Project Requirements (OPR). The design team shall develop the Basis of Design (BOD). The CxA shall review these documents for clarity and completeness. The Owner and design team shall be responsible for updates to their respective documents.

3) Develop and incorporate commissioning requirements into the construction documents.

4) Develop and implement a commissioning plan.

5) Verify the installation and performance of the systems to be commissioned.

6) Complete a summary commissioning report.

Commissioned Systems

Commissioning process activities shall be completed for the following energy-related systems, at a minimum:

- Heating, ventilating, air conditioning, and refrigeration (HVAC&R) systems (mechanical and passive) and associated controls
- Lighting and daylighting controls
- Domestic hot water systems
- Renewable energy systems (wind, solar etc.)

Prereq 2 Minimum Energy Performance **Required**

Requirements: Design the building project to comply with both—

- the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) of ASHRAE/IESNA Standard 90.1-2004 (without amendments); and
- the prescriptive requirements (Sections 5.5, 6.5, 7.5 and 9.5) or performance requirements (Section 11) of ASHRAE/IESNA Standard 90.1-2004 (without amendments).

Prereq 3 Fundamental Refrigerant Management **Required**

Requirements: Zero use of CFC-based refrigerants in new base building HVAC&R systems.

When reusing existing base building HVAC equipment, complete a comprehensive CFC phase-out conversion prior to project completion. Phase-out plans extending beyond the project completion date will be considered on their merits.

Credit 1 Optimize Energy Performance **2–10**

(2 points mandatory for LEED for New Construction projects registered after June 26, 2007)

Requirements: WHOLE BUILDING ENERGY SIMULATION (1–10 Points)

Demonstrate a percentage improvement in the proposed building performance rating compared to the baseline building performance rating per ASHRAE/IESNA Standard 90.1-2004 (without amendments) by a whole building project simulation using the

Building Performance Rating Method in Appendix G of the Standard. The minimum energy cost savings percentage for each point threshold is as follows:

New Buildings	Renovations Points
10.5%*	1
14%	2
17.5%	3
21%	4
24.5%	5
28%	6
31.5%	7
35%	8
38.5%	9
42%	10

Credit 2 On-Site Renewable Energy **1–3**

Requirements: Use on-site renewable energy systems to offset building energy cost. Calculate project performance by expressing the energy produced by the renewable systems as a percentage of the building annual energy cost and using the table below to determine the number of points achieved.

Use the building annual energy cost calculated in EA Credit 1 or use the Department of Energy (DOE) Commercial Buildings Energy Consumption Survey (CBECS) database to determine the estimated electricity use. (Table of use for different building types is provided in the Reference Guide.)

%	Renewable Energy Points
2.5%	1
7.5%	2
12.5%	3

Credit 3 Enhanced Commissioning **~~1~~**

Not Applicable

Credit 4 Enhanced Refrigerant Management **1**

Requirements: Do not use refrigerants.

Credit 5 Measurement & Verification **1**

Requirements: Develop and implement a Measurement & Verification (M&V) Plan consistent with Option D: Calibrated Simulation (Savings Estimation Method 2), or Option B: Energy Conservation Measure Isolation, as specified in the International Performance Measurement & Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction, April, 2003.

Credit 6 Green Power **1**

Requirements: Provide at least 35% of the building's electricity from renewable sources by engaging in at least a two-year renewable energy contract. Renewable sources are as defined by the Center for Resource Solutions (CRS) Green-e products certification requirements.

DETERMINE THE BASELINE ELECTRICITY USE

Use the annual electricity consumption from the results of EA Credit 1.

OR Use the Department of Energy (DOE) Commercial Buildings Energy Consumption Survey (CBECS) database to determine the estimated electricity use.

Points Achievable: 6-16 of 17

LEED Rating System
Materials & Resources

Prereq 1 Storage & Collection of Recyclables	**Required**
Requirements: Provide an easily accessible area that serves the entire building and is dedicated to the collection and storage of non-hazardous materials for recycling, including (at a minimum) paper, corrugated cardboard, glass, plastics and metals.	
Credit 1.1 Building Reuse, Maintain 75% of Existing Walls, Floors & Roof	**1**
Requirements: Maintain at least 75% (based on surface area) of existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and non-structural roofing material). Hazardous materials that are remediated as a part of the project scope shall be excluded from the calculation of the percentage maintained.	
Credit 1.2 Building Reuse, Maintain 95% of Existing Walls, Floors & Roof	**1**
Requirements: Maintain an additional 20% (95% total, based on surface area) of existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and non-structural roofing material). Hazardous materials that are re-mediated as a part of the project scope shall be excluded from the calculation of the percentage maintained.	
Credit 1.3 Building Reuse, Maintain 50% of Interior Non-Structural Elements	**1**
Requirements: Use existing interior non-structural elements (interior walls, doors, floor coverings and ceiling systems) in at least 50% (by area) of the completed building (including additions).	
Credit 2.1 Construction Waste Management, Divert 50% from Disposal	**1**
Requirements: Recycle and/or salvage at least 50% of non-hazardous construction and demolition debris. Develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and	

whether the materials will be sorted on-site or co-mingled. Excavated soil and land-clearing debris do not contribute to this credit. Calculations can be done by weight or volume, but must be consistent throughout.

Credit 2.2 Construction Waste Management, Divert 75% from Disposal **1**

Requirements: Recycle and/or salvage an additional 25% beyond MR Credit 2.1 (75% total) of non-hazardous construction and demolition debris. Excavated soil and land-clearing debris do not contribute to this credit. Calculations can be done by weight or volume, but must be consistent throughout.

Credit 3.1 Materials Reuse, 5% **1**

Requirements: Use salvaged, refurbished or reused materials such that the sum of these materials constitutes at least 5%, based on cost, of the total value of materials on the project. Mechanical, electrical and plumbing components and specialty items such as elevators and equipment shall not be included in this calculation. Only include materials permanently installed in the project. Furniture may be included, providing it is included consistently in MR Credits 3–7.

Credit 3.2 Materials Reuse, 10% **1**

Requirements: Use salvaged, refurbished or reused materials for an additional 5% beyond MR Credit 3.1 (10% total, based on cost). Mechanical, electrical and plumbing components and specialty items such as elevators and equipment shall not be included in this calculation. Only include materials permanently installed in the project. Furniture may be included, providing it is included consistently in MR Credits 3–7.

Credit 4.1 Recycled Content, 10% (post-consumer + 1/2 pre-consumer) **1**

Requirements: Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of the total value of the materials in the project.

The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to

determine the recycled content value.
Mechanical, electrical and plumbing components and specialty items such as elevators shall not be included in this calculation. Only include materials permanently installed in the project. Furniture may be included, providing it is included consistently in MR Credits 3–7.

Recycled content shall be defined in accordance with the International Organization of Standards document, ISO 14021—Environmental labels and declarations—Self-declared environmental claims (Type II environmental labeling).

Credit 4.2 Recycled Content, 20% (post-consumer + 1/2 pre-consumer) **1**

Requirements: Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes an additional 10% beyond MR Credit 4.1 (total of 20%, based on cost) of the total value of the materials in the project. The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value. Mechanical, electrical and plumbing components and specialty items such as elevators shall not be included in this calculation. Only include materials permanently installed in the project. Furniture may be included, providing it is included consistently in MR Credits 3–7.

Recycled content shall be defined in accordance with the International Organization of Standards document, ISO 14021—Environmental labels and declarations—Self-declared environmental claims (Type II environmental labeling).

Credit 5.1 Regional Materials, 10% Extracted, Processed & Manufactured Regionally **1**

Requirements: Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for a minimum of 10% (based on cost) of the total materials value. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

Credit 5.2 Regional Materials, 20% Extracted, Processed & Manufactured Regionally **1**

Requirements: Same as Credit 5.1 but with an additional 10%, therefore totalling 20%.

Credit 6 Rapidly Renewable Materials **1**

Requirements: Use rapidly renewable building materials and products (made from plants that are typically harvested within a ten-year cycle or shorter) for 2.5% of the total value of all building materials and products used in the project, based on cost.

Credit 7 Certified Wood **1**

Requirements: Use a minimum of 50% of wood-based materials and products, which are certified in accordance with the Forest Stewardship Council's (FSC) Principles and Criteria, for wood building components. These components include, but are not limited to, structural framing and general dimensional framing, flooring, sub-flooring, wood doors and finishes.

Only include materials permanently installed in the project. Furniture may be included, providing it is included consistently in MR Credits 3–7.

Points Achievable: 12 of 12

LEED Rating System
Indoor Environmental Quality

Prereq 1 Minimum IAQ Performance **Required**

Requirements: Meet the minimum requirements of Sections 4 through 7 of ASHRAE 62.1-2004, Ventilation for Acceptable Indoor Air Quality. Mechanical ventilation systems shall be designed using the Ventilation Rate Procedure or the applicable local code, whichever is more stringent. Naturally ventilated buildings shall comply with ASHRAE 62.1-2004, paragraph 5.1.

Prereq 2 Environmental Tobacco Smoke (ETS) Control **Required**

Requirements: • Prohibit smoking in the building.
• Locate any exterior designated smoking areas at least 25 feet away from entries, outdoor air intakes and operable windows.

Credit 1 Outdoor Air Delivery Monitoring **1**

Requirements: FOR NATURALLY VENTILATED SPACES
Monitor CO2 concentrations within all naturally ventilated spaces. CO2 monitoring shall be located within the room between 3 feet and 6 feet above the floor. One CO2 sensor may be used to represent multiple spaces if the natural ventilation design uses passive stack(s) or other means to induce airflow through those spaces equally and simultaneously without intervention by building occupants.

Credit 2 Increased Ventilation **1**

Requirements: Design natural ventilation systems for occupied spaces to meet the recommendations set forth in the Carbon Trust “Good Practice Guide 237” [1998]. Determine that natural ventilation is an effective strategy for the project by following the flow diagram process shown in Figure 1.18 of the Chartered

Institution of Building Services Engineers (CIBSE) Applications Manual 10: 2005, Natural ventilation in non-domestic buildings.

AND

• Use diagrams and calculations to show that the design of the natural ventilation systems meets the recommendations set forth in the CIBSE Applications Manual 10: 2005, Natural ventilation in non-domestic buildings.

Credit 3.1 Construction IAQ Management Plan, During Construction **1**

Requirements: Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of the building as follows:

• During construction meet or exceed the recommended Control Measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 1995, Chapter 3.

• Protect stored on-site or installed absorptive materials from moisture damage.

• If permanently installed air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 shall be used at each return air grille, as determined by ASHRAE 52.2-1999. Replace all filtration media immediately prior to occupancy.

Credit 3.2 Construction IAQ Management Plan, Before Occupancy **1**

Requirements: Develop and implement an Indoor Air Quality (IAQ) Management Plan for the pre-occupancy phase as follows:

OPTION 1 — Flush-Out

• After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of outdoor air per sq.ft. of floor area while maintaining an internal temperature of at least 60 degrees F and relative humidity no higher than 60%.

OR

• If occupancy is desired prior to completion of the flush-out, the space may be occupied following delivery of a minimum of 3,500 cu.ft. of outdoor air

per sq.ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm/sq.ft. of outside air or the design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14,000 cu.ft./sq.ft. of outside air has been delivered to the space.

Credit 4.1 Low-Emitting Materials, Adhesives & Sealants **1**

Requirements: All adhesives and sealants used on the interior of the building (defined as inside of the weatherproofing system and applied on-site) shall comply with the requirements of the following reference standards:

- Adhesives, Sealants and Sealant Primers: South Coast Air Quality Management District (SCAQMD) Rule #1168. VOC limits are listed in the table below and correspond to an effective date of July 1, 2005 and rule amendment date of January 7, 2005.

Architectural Applications	VOC Limit [g/L less water]	Specialty Applications	VOC Limit [g/L lesswater]
Indoor Carpet Adhesives	50	PVC Welding	510
Carpet Pad Adhesives	50	CPVC Welding	490
Wood Flooring Adhesives	100	ABS Welding	325
Rubber Floor Adhesives	60	Plastic Cement Welding	250
Subfloor Adhesives	50	Adhesive Primer for Plastic	550
Ceramic Tile Adhesives	65	Contact Adhesive	80
VCT & Asphalt Adhesives	50	Special Purpose Contact Adhesive	250
Drywall & Panel Adhesives	50	Structural Wood Member Adhesive	140
Cove Base Adhesives	50	Sheet Applied Rubber Lining Operations	850
Multipurpose Constr. Adhesives	70	Top & Trim Adhesive	250
Structural Glazing Adhesives	100		

Substrate Specific Applications	VOC Limit [g/L less water]	Sealants	VOC Limit [g/L lesswater]
Metal to Metal	30	Architectural	250
Plastic Foams	50	Nonmembrane Roof	300
Porous Material (except wood)	50	Roadway	250
Wood	30	Single-Ply Roof Membrane	450
Fiberglass	80	Other	420

Sealant Primers	VOC Limit [g/L less water]
Architectural Non Porous	250
Architectural Porous	775
Other	750

Credit 4.2 Low-Emitting Materials, Paints & Coatings **1**

Requirements: Paints and coatings used on the interior of the building (defined as inside of the weatherproofing system and applied on-site) shall comply with the following criteria:

- Architectural paints, coatings and primers applied to interior walls and ceilings: Do not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, First Edition, May 20, 1993.
  - o Flats: 50 g/L
  - o Non-Flats: 150 g/L
- Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates: Do not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.
- Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements: Do not exceed the VOC content limits established in South Coast Air

Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004.

o Clear wood finishes: varnish 350 g/L; lacquer 550 g/L
o Floor coatings: 100 g/L
o Sealers: waterproofing sealers 250 g/L; sanding sealers 275 g/L; all other sealers 200 g/L
o Shellacs: Clear 730 g/L; pigmented 550 g/L
o Stains: 250 g/L

Credit 4.3 Low-Emitting Materials, Carpet Systems **1**

Requirements: All carpet installed in the building interior shall meet the testing and product requirements of the Carpet and Rug Institute's Green Label Plus program.

All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute Green Label program.

All carpet adhesive shall meet the requirements of EQ Credit 4.1: VOC limit of 50 g/L.

Credit 4.4 Low-Emitting Materials, Composite Wood & Agrifiber Products **1**

Requirements: Composite wood and agrifiber products used on the interior of the building (defined as inside of the weatherproofing system) shall contain no added urea-formaldehyde resins. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins.

Composite wood and agrifiber products are defined as: particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates and door cores. Materials considered fit-out, furniture, and equipment (FF&E) are not considered base building elements and are not included.

Credit 5 Indoor Chemical & Pollutant Source Control **1**

Requirements: Design to minimize and control pollutant entry into buildings and later cross-contamination of regularly occupied areas:

• Employ permanent entryway systems at least six feet long in the primary direction of travel to capture dirt and particulates from entering the building at all entryways that are directly connected to the outdoors. Acceptable entryway systems include permanently installed grates, grilles, or slotted systems that allow for cleaning underneath. Roll-out mats are only acceptable when maintained on a weekly basis by a contracted service organization. Qualifying entryways are those that serve as regular entry points for building users.

• Where hazardous gases or chemicals may be present or used (including garages, housekeeping/laundry areas and copying/printing rooms), exhaust each space sufficiently to create negative pressure with respect to adjacent spaces with the doors to the room closed. For each of these spaces, provide self-closing doors and deck to deck partitions or a hard lid ceiling. The exhaust rate shall be at least 0.50 cfm/sq.ft., with no air re-circulation. The pressure differential with the surrounding spaces shall be at least 5 Pa (0.02 inches of water gauge) on average and 1 Pa (0.004 inches of water) at a minimum when the doors to the rooms are closed.

Credit 6.1 Controllability of Systems, Lighting **1**

Requirements: Provide individual lighting controls for 90% (minimum) of the building occupants to enable adjustments to suit individual task needs and preferences.

AND Provide lighting system controllability for all shared multi-occupant spaces to enable lighting adjustment that meets group needs and preferences.

Credit 6.2 Controllability of Systems, Thermal Comfort **1**

Requirements: Provide individual comfort controls for 50% (minimum) of the building occupants to enable adjustments to suit individual task needs and preferences. Operable windows can be used in lieu of comfort controls for occupants of areas that are 20 feet inside of and 10 feet to either side of the operable part of the window. The areas of operable window must meet the requirements of ASHRAE 62.1-2004 paragraph 5.1 Natural Ventilation.

AND Provide comfort system controls for all shared multi-occupant spaces to enable adjustments to suit group needs and preferences. Conditions for thermal comfort are described in ASHRAE Standard 55-2004 to include the primary factors of air temperature, radiant temperature, air speed and humidity. Comfort system control for the purposes of this credit is defined as the provision of control over at least one of these primary factors in the occupant's local environment.

Credit 7.1 Thermal Comfort, Design **1**

Requirements: Design HVAC systems and the building envelope to meet the requirements of ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy. Demonstrate design compliance in accordance with the Section 6.1.1 Documentation.

Credit 7.2 Thermal Comfort, Verification **1**

Requirements: months after occupancy. This survey should collect anonymous responses about thermal comfort in the building including an assessment of overall satisfaction with thermal performance and identification of thermal comfort-related problems. Agree to develop a plan for corrective action if the survey results indicate that more than 20% of occupants are dissatisfied with thermal comfort in the building. This plan should include measurement of relevant environmental variables in problem areas in accordance with ASHRAE Standard 55-2004.

Credit 8.1 Daylight & Views, Daylight 75% of Spaces **1**

Requirements: OPTION 1 — CALCULATION

Achieve a minimum glazing factor of 2% in a minimum of 75% of all regularly occupied areas. The glazing factor is calculated as follows:

$$\textbf{Glazing Factor} = \frac{\textbf{Window Area [SF]}}{\textbf{Floor Area [SF]}} \times \frac{\textbf{Window}}{\textbf{Geometry Factor}} \times \frac{\textbf{Actual Tvis}}{\textbf{Minimum Tvis}} \times \frac{\textbf{Window}}{\textbf{Height Factor}}$$

In all cases, only the square footage associated with the portions of rooms or spaces meeting

the minimum illumination requirements can be applied towards the 75% of total area calculation required to qualify for this credit.

Credit 8.2 Daylight & Views, Views for 90% of Spaces **1**

Requirements: Achieve direct line of sight to the outdoor environment via vision glazing between 2’6” and 7’6” above finish floor for building occupants in 90% of all regularly occupied areas. Determine the area with direct line of sight by totaling the regularly occupied square footage that meets the following criteria:

- In plan view, the area is within sight lines drawn from perimeter vision glazing.
- In section view, a direct sight line can be drawn from the area to perimeter vision glazing.

Line of sight may be drawn through interior glazing. For private offices, the entire square footage of the office can be counted if 75% or more of the area has direct line of sight to perimeter vision glazing. For multi-occupant spaces, the actual square footage with direct line of sight to perimeter vision glazing is counted.

Points Achievable: 15 of 15

LEED Rating System
Innovation & Design Process

Credit 1.1 Innovation in Design **1**

Requirements: In writing, identify the intent of the proposed innovation credit, the proposed requirement for compliance, the proposed submittals to demonstrate compliance, and the design approach (strategies) that might be used to meet the requirements.

Credit 1.2 Innovation in Design **1**

Requirements: Same as Credit 1.1.

Credit 1.3 Innovation in Design **1**

Requirements: Same as Credit 1.1.

Credit 1.4 Innovation in Design **1**

Requirements: Same as Credit 1.1.

Credit 2 LEED Accredited Professional **1**

Requirement: At least one principal participant of the project team shall be a LEED Accredited Professional (AP).

Points Achievable: 5 of 5

LEED Summary

Out of the 69 points that are possible, 56-66 are achievable in the Education & Research Center for Sustainability project, putting it in the LEED Platinum category as long as a minimum of 52 points are achieved.

Precedent Study
Program

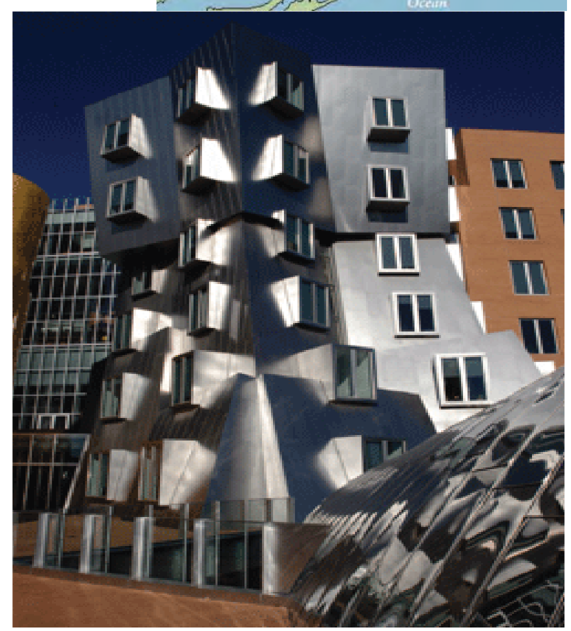
Stata Center, MIT Campus, Cambridge, MA[4]

Completed: 2004

Architect: Gehry Partners, LLP

Size: 720,000sf including underground garage

The Stata Center was chosen as a precedent for the Education & Research Center for Sustainability for its programmatic goals and ideas as well as the types of spaces that were designed. The Center for Sustainability would like to have the same type of interactive spaces that promote communication between user types as well as creativity. The building is located on a college campus and features sustainable elements as well, making it an even further source of knowledge.



Joyce, 55.

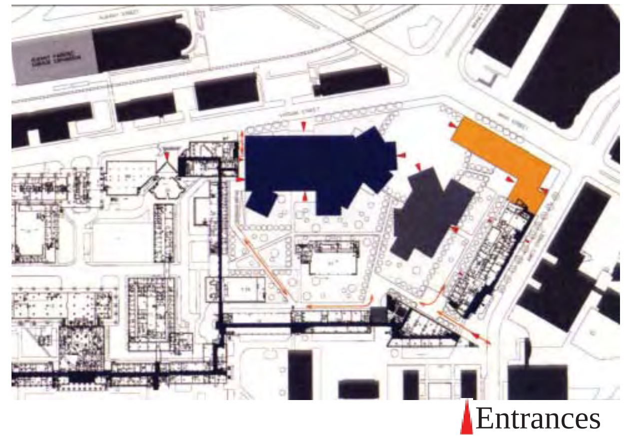
Stata Center's Programmatic Goals:

"1. Create collaborative and flexible research environments that foster frequent and intellectual interactions."

The interaction between students, teachers, researchers, and visitors is very important to the relaying of knowledge and therefore there needs to be many opportunities for these meetings to occur. They should also occur in a variety of spaces, both formally in the classroom, and informally in the halls, cafe, or library. The more opportunities the users have to interact, the better their exchange of knowledge will be.

"2. Integrate the building's occupants into campus circulation.
-open research environments
-connections to other research groups"

The Stata Center is a successful example of integrating the different programmatic elements together in a way that fosters both interaction and creativity. Since the program is similar in type to the Education & Research Center, looking at the way the Stata Center creates open research areas that are well connected to other labs and gathering spaces is important. While making efficient spaces is part of sustainable design, it will need to be balanced with enough circulation space to allow adequate connection spaces between research spaces.



"2. Integrate the building's occupants into campus circulation.
-access to teaching spaces
-extension of the corridor as social space

This programmatic goal needs to be considered at a variety of scales, from the macro level of the campus circulation, to the micro level of office organization to encourage social interaction. In the Stata Center, office organizations were studied to see which worked best for individual interaction, group interaction and the relationship between the user's personal space and the social space. The Stata Center was also successful in extending its corridor as a social area of the building. The "student street" has seating areas for people to gather between classes as well as chalk boarded walls to promote impromptu discussions or creative sessions.

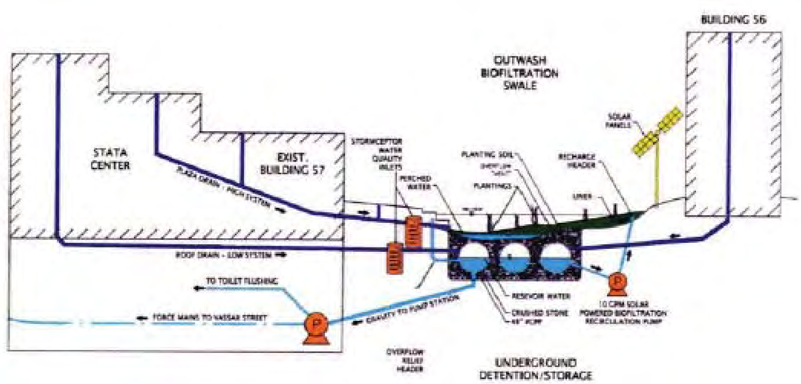
Joyce, 33.

3. Define the essence of the research and MIT through architectural expression

While Gehry's architecture is extreme in its awkward forms and angles, it does accurately reflect the creativity that takes place within. The forms themselves evoke creative thought, which is the goal that should be set for the Center for Sustainability as well. While it is clear that the students of MIT do not love Gehry's architecture, the fact that they have the creative freedom to display their opinions about it is the atmosphere that should be designed in Bristol.

4. Incorporate new technologies to improve building performance using environmentally responsible systems.

The Stata Center is located on a forward-thinking campus that wants to display developing technologies in the realm of sustainability. This is done by using systems that not only perform environmental tasks, but do so in a visible way, so users of the building are educated at the same time. The water that is recycled for toilet use is tinted, so in each bathroom there are signs explaining why the water is not clear. This type of visual education of environmentally responsible systems is what should be incorporated into the Center for Sustainability.



Joyce, 45.

Photonic Center, Boston University, MA[5]

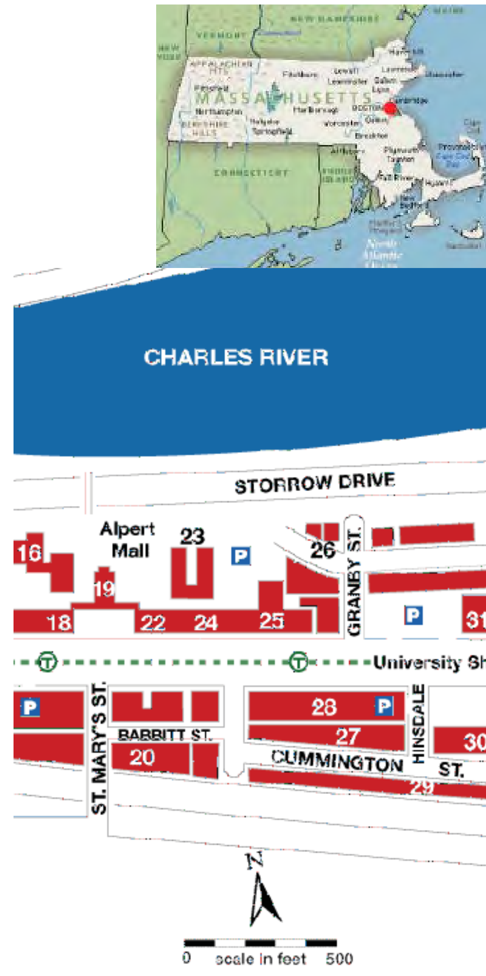
Completed: June 1997

Architect: Cannon Design

Size: 9 stories
160,000 sf

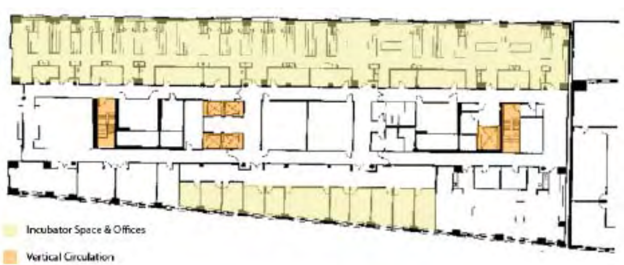
Holds:
- Data Center
- Classrooms
- Engineering
- Teaching Labs
- Dry Labs
- Offices
- Incubator space

Links Education world with Business world

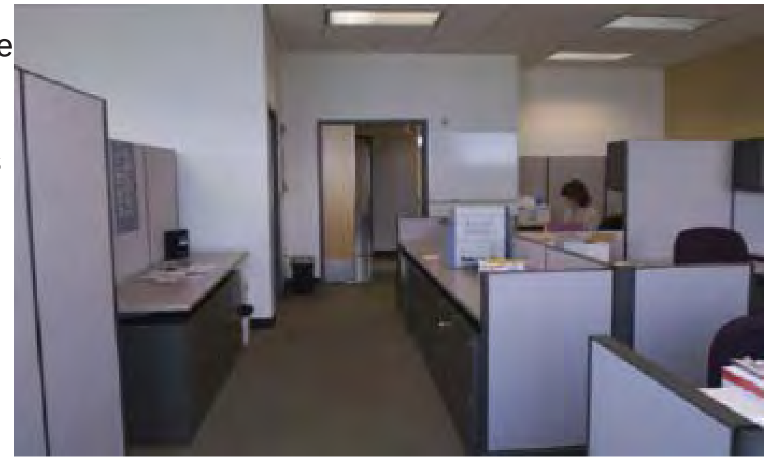


"In the business world, an incubator is an enterprise that is set up to provide offices space, equipment, and sometimes mentoring assistance and capital tonew businesses that are just getting started. (The term is familiar in poultry farming, where an incubator is a specially equipped home for baby chickens.) Business incubators are set up by universities, non-profit groups, and increasing by venture..."[6]

The Incubator space at Boston university's Photonic Center is flexible and reconfigurable so various size companies can work there. The space can hold up to 14 start-up companies, depending on their size, for 2-24 months. The total area that is used for incubator space in the building is 20,000 sq ft., which is approximately what will be in the Center for Sustainability as well. Therefore the sizes of equipment rooms, conference rooms, and the offices can be approximately the same.



The common sense behind incubator spaces is to provide shared access to laboratories and equipment, amenities like IT and reception services, so not each company will have to spend all the start up costs for these things. Therefore, by sharing the amenities, the companies have to spend less money, making them more likely to succeed in the business world, and the spaces are made more energy efficient than typical offices, because there is less equipment running, and therefore smaller energy bills.



Photonic Center Mission[7]:

"To support the students, faculty, and staff of Boston University in their pursuits to ***commercialize their discoveries and innovations*** *through the establishment of new business ventures while serving the greater societal need of* ***developing new solutions to today's "problems"*** *in the areas of technology, health care, engineering, basic sciences, education, and management…"*

Precedent Study
Environmental Center

Environmental Education Building:
Adam Joseph Lewis Center (AJLC) for Environmental Studies, Oberlin College, OH

Completed: January 2000

Architect: William McDonough

Size: 13,600 sf

"We intended to create not just a place for classes but rather a building that would help to redefine the relationship between humankind and the environment – one that would expand our sense of ecological possibilities"[8]

- David W. Orr, Professor & Director of O.C. Environmental Studies Program

The Lewis Center is located in the Southern part of the Oberlin campus. It is surrounded by residence halls and Co-Op facilities. The southern part of the building allows for entrance and drop off locations right off one of the primary circulation routes in the area. Therefore the area on the south is quite open, allowing for a great deal of southern sun exposure.

Siting a sustainable building is very important to its success. While its location for sun is ideal, the placement of it in a residential part of campus seems somewhat haphazard. The location of the Center for Sustainability, in the heart of the academic campus, seems a more suitable choice. It will still have the southern exposure, but will be better accessible to students and faculty throughout the school day.

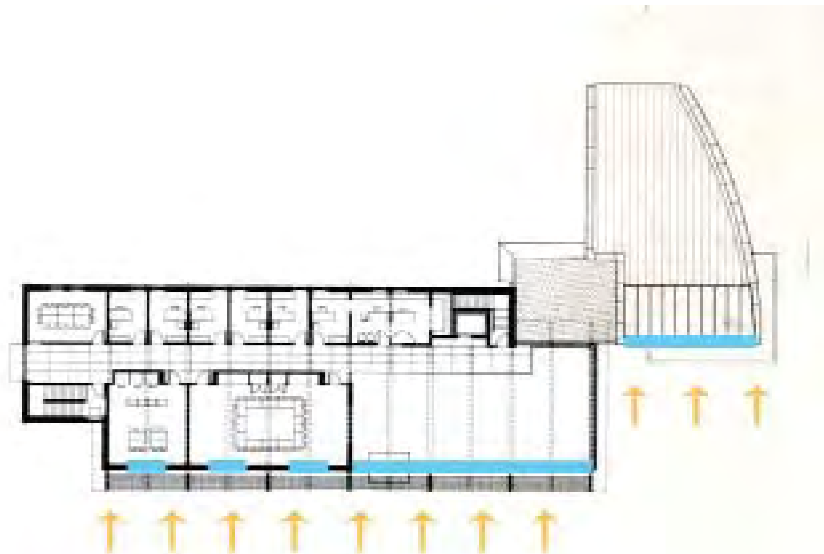
Users - The users for the Adam Joseph Lewis Center are quite similar to those expected in the Center for Sustainability.

Students – Students will be in the Lewis Center to attend classes, perform research, and use the Resource Center. The student uses will be the same in the Center for Sustainability, with the addition of cafe use and the business incubator space.

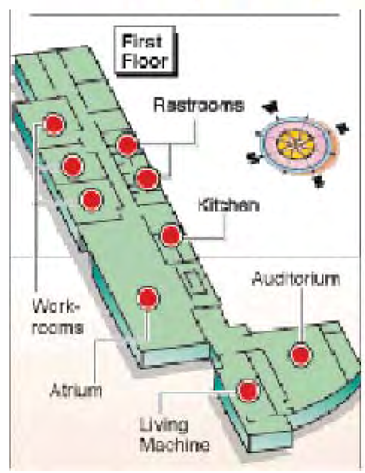
Professors – Professors will be in the building to teach classes, perform research and oversee student research, and work in their office spaces. These functions for professors will be in the same in the Center for Sustainability.

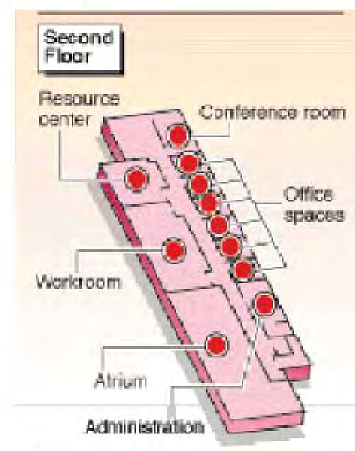
Visitors – Since tours are given to area schools and community groups, and exhibits are shown in atrium space, visitors come to the building on a regular basis, to see how sustainability can be integrated into a building. Visitors will also be thought of in the Center for Sustainability, with community and student outreach programs in addition to the tours and exhibits that will happen on a regular basis.

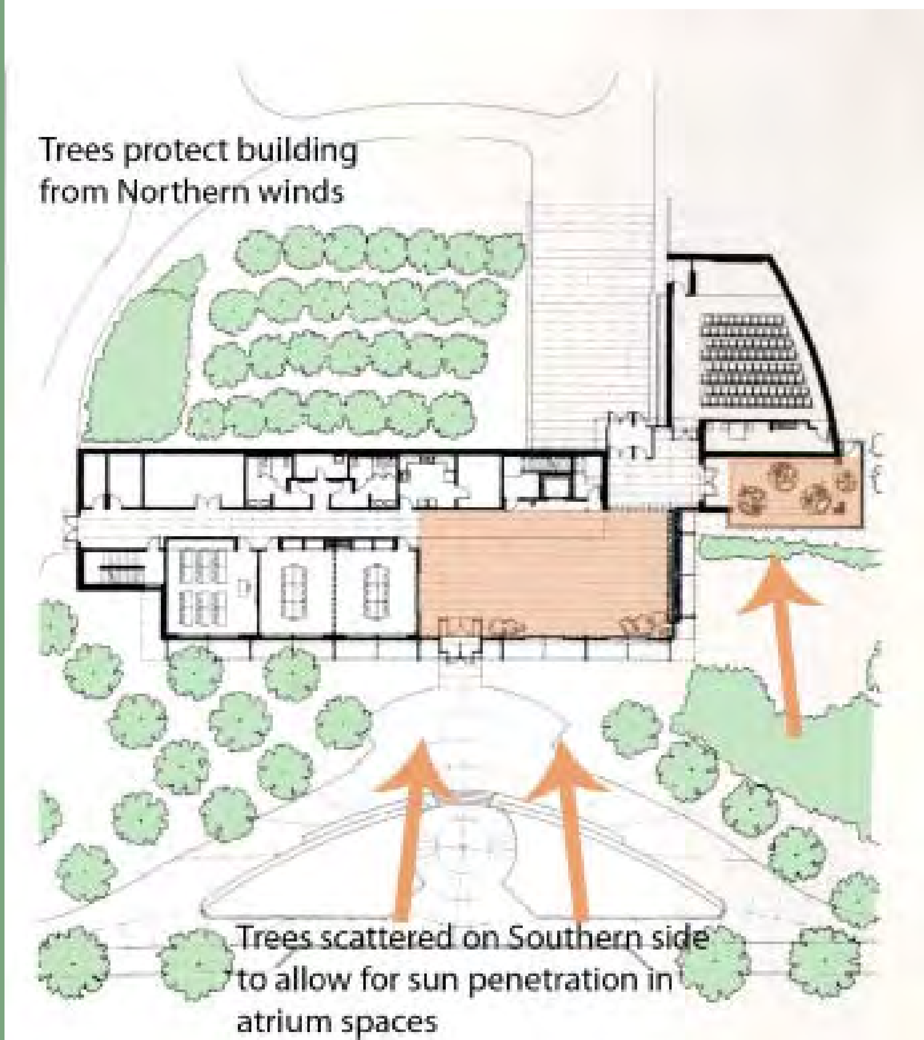
The placement of program within the building was very thought out in terms of sun exposure. The main public functions are all along the southern side of the building, allowing for maximum solar gain. These functions include the main atrium, the living machine, and workrooms. While solar gain is important, shading is also necessary in the warm months, which is why there is a large overhang along the southern wall, except by the living machine. The northern functions are primarily private use or support spaces. These include office spaces, a kitchen, a conference room, administration, rest rooms, and an auditorium. While the auditorium is a very public programmatic element, it does not require sunlight, which allows its placement on the northern side of the site.



The Center for Sustainability has a similar program and therefore will look towards the AJLC for site placement techniques. While the Center is nearly four times the size of the AJLC, the same principles can be applied at a larger scale.



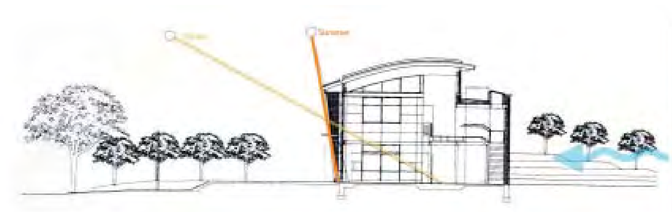




The use of the roof overhang, designed to shelter atrium space from harsh summer sun but allow the shallow sun to penetrate in the winter, is visible in the sectional sun penetration diagram below.

Vegetation is also important on the AJLC site. A tree grove on northern side of building, in addition to berming, protects the structure from the Northern winds. Scattering trees on the southern side allows for shading in the summer months and then sun exposure in the winter, when the leaves have fallen.

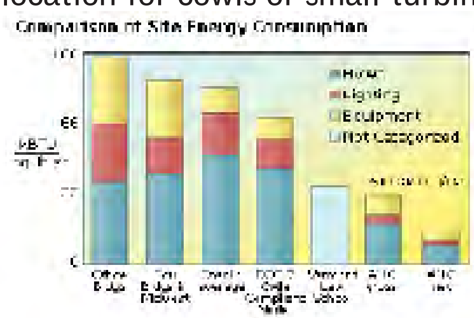
The same techniques will have to be applied at the Center for Sustainability, where harsh winds are a daily experience. Trees and berming to block some of the wind will be necessary, especially along the coast where the site is located.

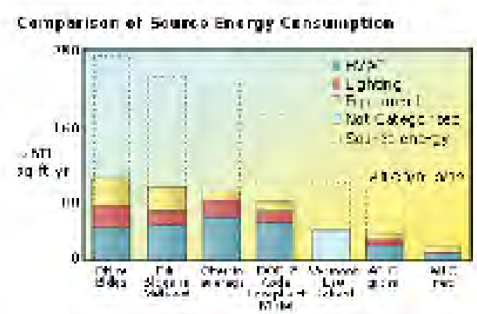


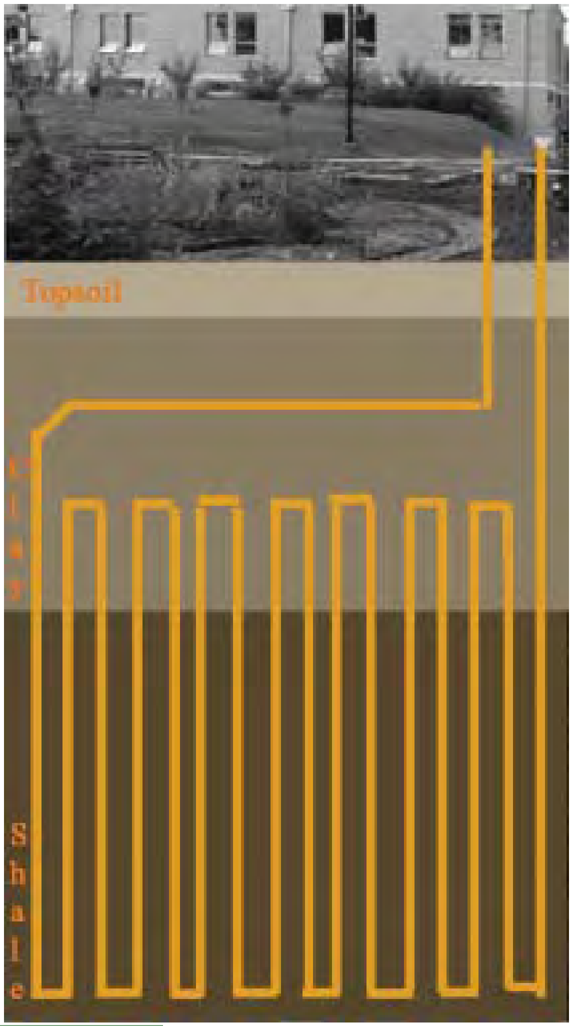
Energy Production:

Producing its own energy is a major component of AJLC's sustainable initiatives. The roof of the center has 3700sq. ft. of photo voltaic modules. This produces a great deal of energy, but after analyzing production and comsumption levels, it was found that the panels did not produce enough energy to equate the two. Therefore a solar array parking structure was added to make up the difference in energy production. The net consumption for the AJLC is 14,000BTU per sq. ft., which is just 17% of consumption of average Oberlin College buildings.

Energy production will be addressed at the Center for Sustainability as well, and will need to be monitored to make sure production levels are high enough to offset consumption levels. In addition to solar power, however, the prevalence of wind on the site makes it a possible location for cowls or small turbines on the roof.







Heating:

AJLC uses geothermal wells to provide heating for the building. There are 24 wells that are buried 240 ft. deep on the northern side of the building, underneath the vegetable garden. Water travels through the tubes and gets cooled by the earth's mass in the summer, and warmed in the winter. The pumps that push the water through the tubes is electrically powered, but the production far outweighs the electricity used to power the pump by 300-400%.

In addition to the geothermal wells, the AJLC also uses passive solar gain as a heating mechanism for the building. Southern facing Atrium glass lets sun in that warms the slate floor, which serves as a thermal mass. Then the heat in the floor is released at night when the building is cool, saving the university from additional heating costs.

The use of geothermal wells is interesting, but the need for them to be so deep may make it unpractical in the Rhode Island coastal location. The use of passive solar gain is much more likely, with southern exposure prevalent.

Educational spaces:

Classrooms - The classrooms, being located on the southern side of the building, have good natural light. Natural ventilation was also planned through clerestory windows leading to the hallway. Wood beams and carpeting were made from recycled materials.

Auditorium: The auditorium has a capacity of 100 people, which is the same at the Center for Sustainability. The use panels from recycled materials for acoustics.

Outdoor Areas: Areas around the site are used for interactive lessons, student gardens, and research. This concept will be strongly addressed in Bristol in an attempt to link the interior and exterior, the built environment with nature.

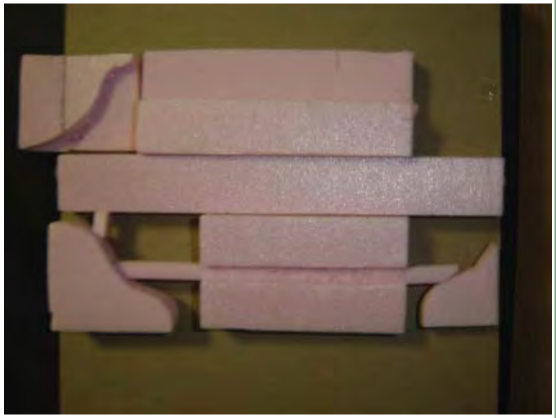
Design Process

Translating the programmatic volumes into a physical design was a difficult task. Many concept models were created, all of which were very different. Eventually two main concept options presented themselves.

The first, the “Rotated Axis Scheme” consisted of two main rectangular volumes running parallel to the site and linked by an atrium, circulation core. On either end of the main volumes were “special” program spaces, which were rotated off the main rectilinear axis of the campus and oriented our towards the bay. One of the rotated volumes was the library/resource center and the other was a meeting space for the Incubators.

This scheme stepped into the site but did not fully integrate itself with it. The rotated volumes did not orient to the rest of the campus and therefore felt somewhat haphazard. While the scheme did allow for a connection to the University Library, it did not create a successful interface with the campus quad.

Rotated Axis Scheme

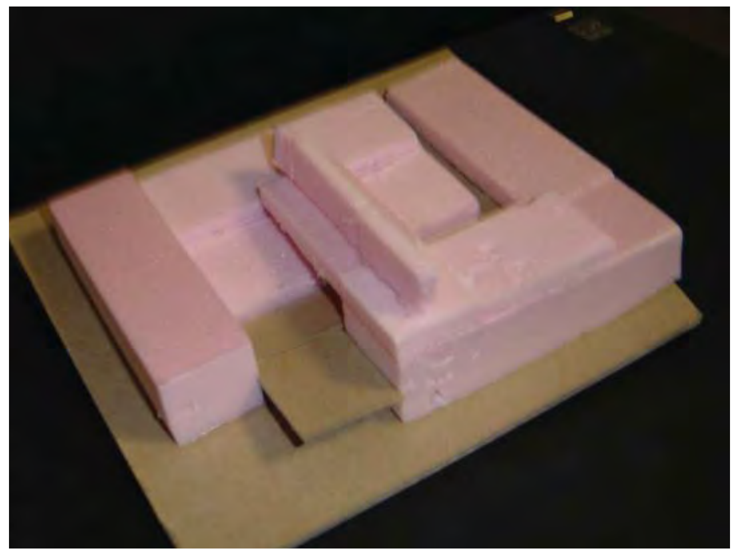


Concept Model

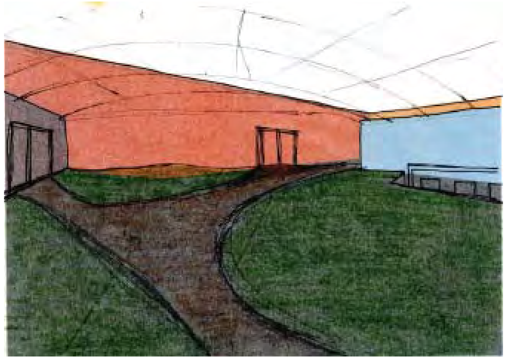

Continual Green Scheme

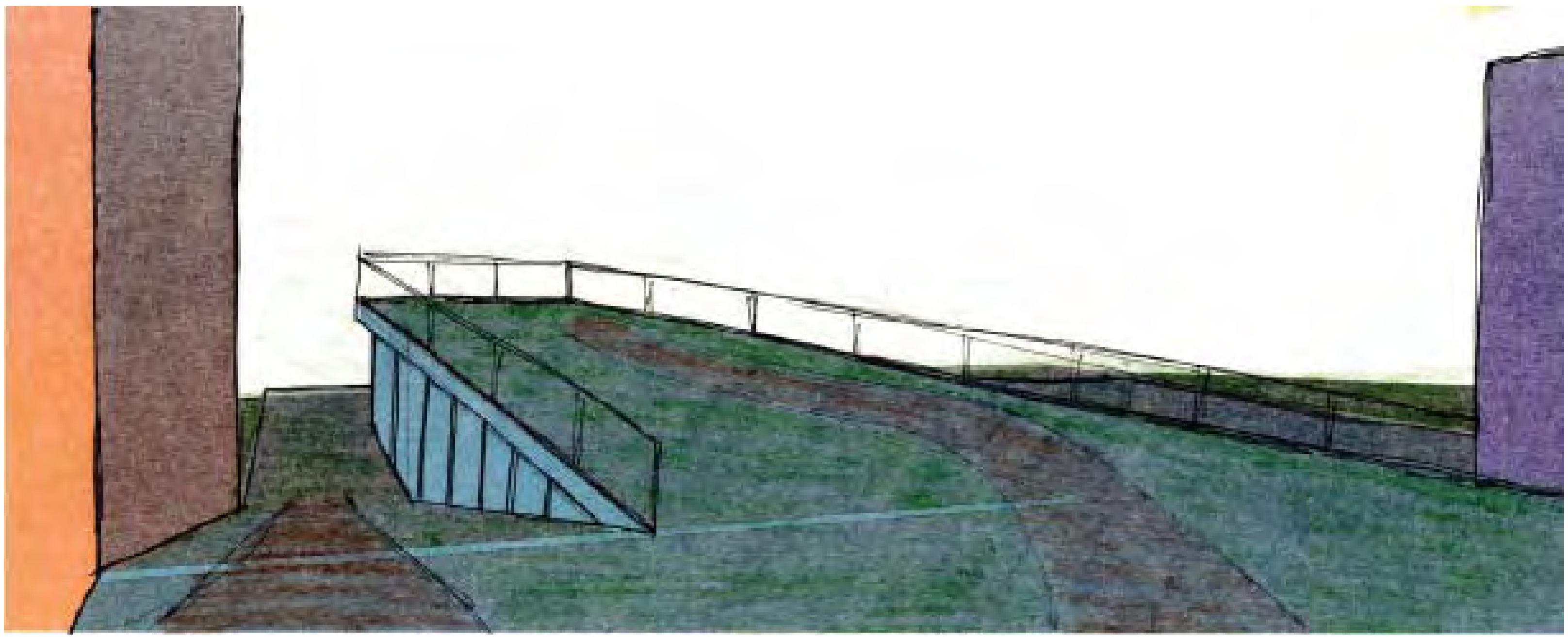
The second concept was the "Continual Green Scheme", which consisted of a series of volumes that interconnected, leaving a void path from the campus side to the bay side of the site. This path, the "Continual Green" allowed for uninterrupted access through the site without entering the building. Of course, the building also provided many opportunities to create relationships between the exterior and interior spaces as well. The volumes allowed for complex interaction between the programmatic elements. This concept was chosen, since it provided more opportunity to fully utilize the site and integrate it with the building.

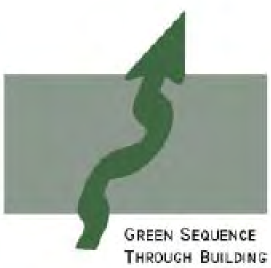

Concept Model


Concept Model Aerial

Translating the program into actual volumes was important, as well as creating the links between exterior and interior. The path through the building is as important as the building itself. Sketching these spaces helped to create a better sense how the interior and exterior spaces would interact.



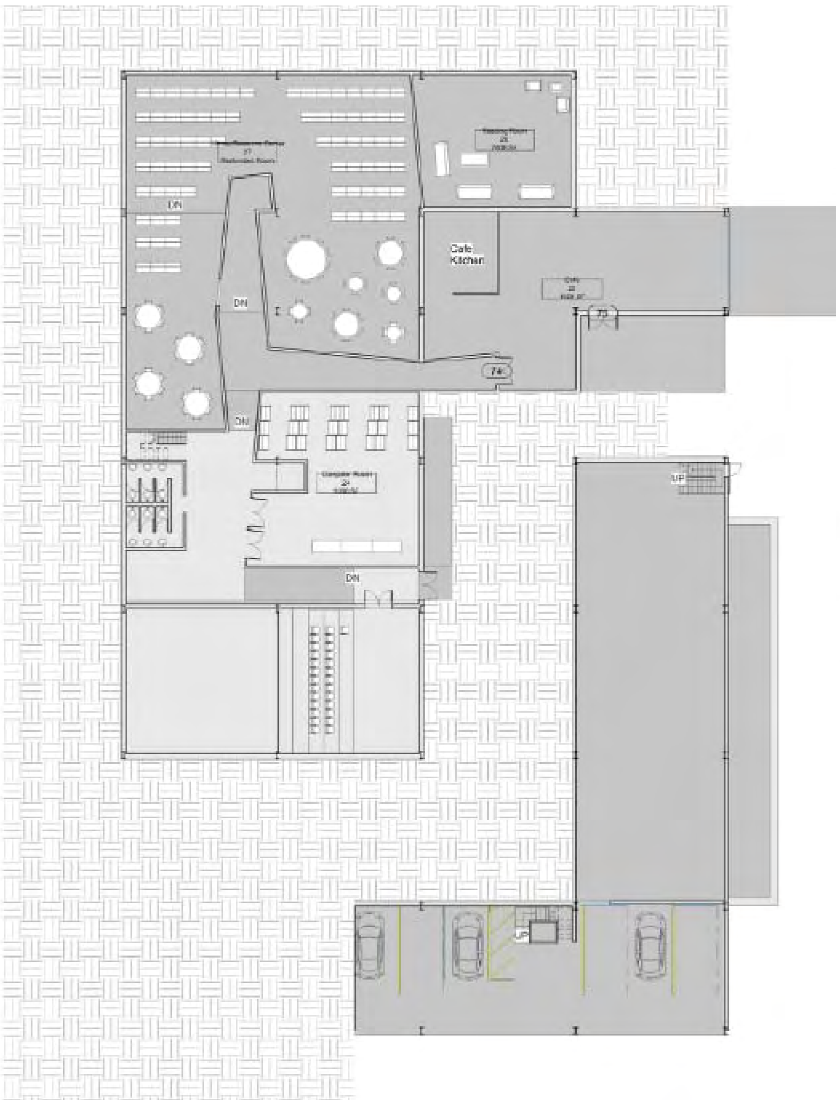


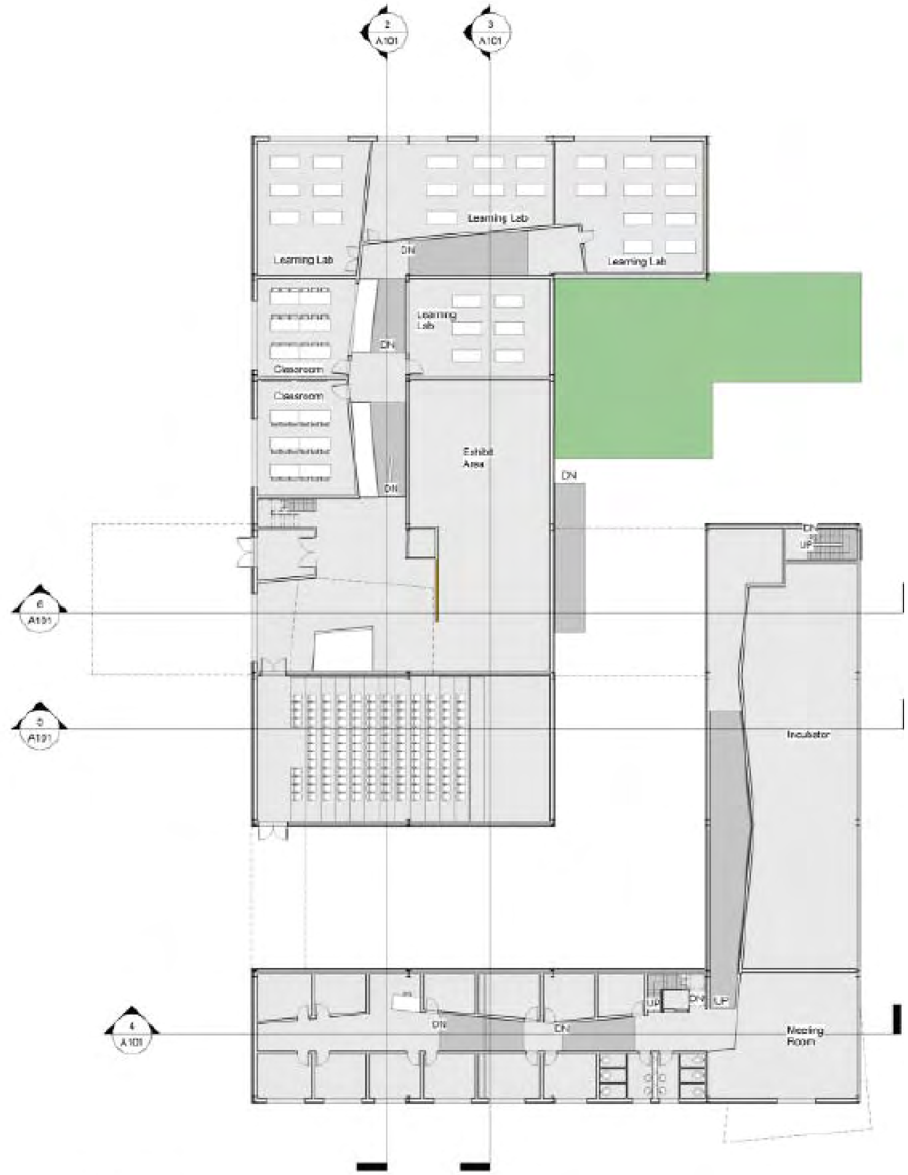

GREEN SEQUENCE
THROUGH BUILDING

Initially, one of the goals of the project in terms of sustainability was to reuse as much of the existing building as possible. This included materials, building footprint, and structure. While materials are relatively simple to reuse, sticking to the same building footprint proved impossible and not worth the effort. The structural grid was maintained in the design for a bit longer, but when floor-to-floor heights began shifting and exceptions to the grid began being made, it made more sense to let go of that as well. The structural material, however, would still be reused for the structure of the new building, since both are steel.

Use Existing Structural Grid

Building Plans





1 03 Entry Level
1/16" = 1'-0"

1 08 2nd Plus
1/16" = 1'-0"

08 3rd Plus
1/16" = 1'-0"

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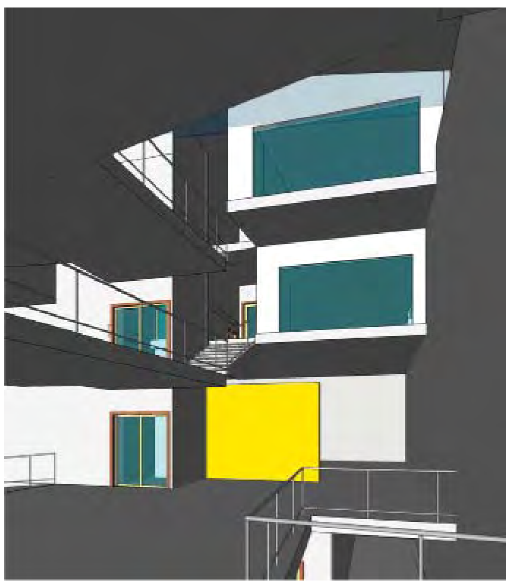
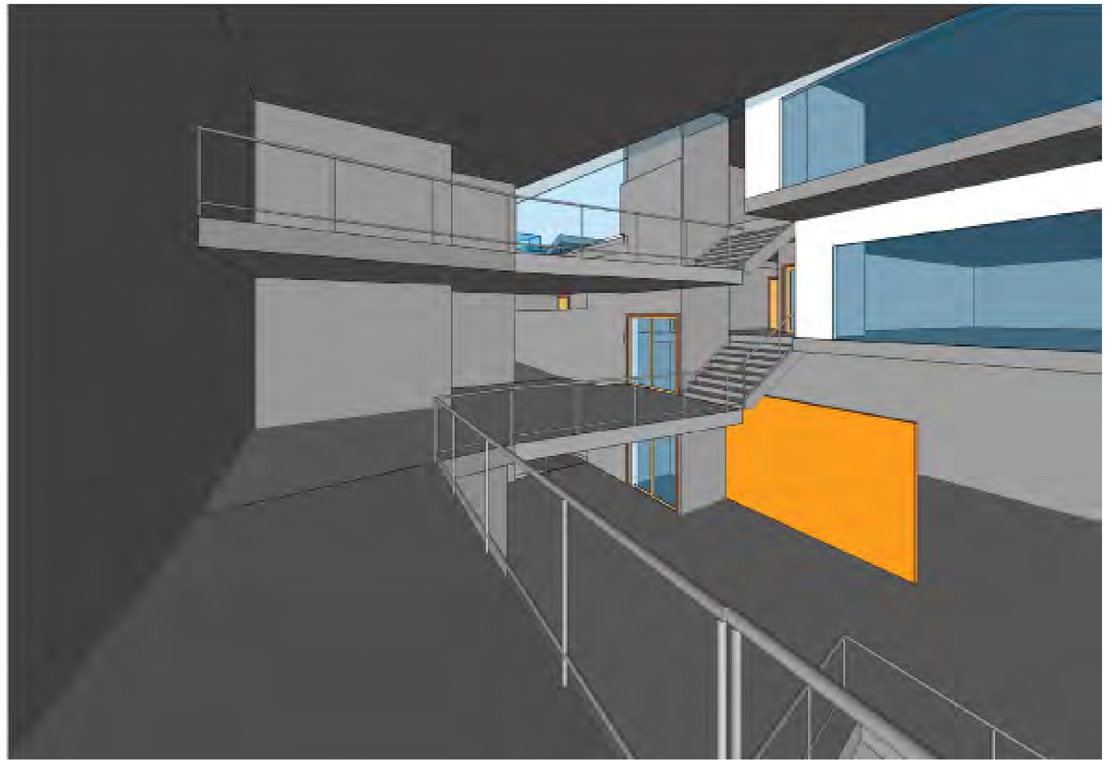
Classroom Atrium


Entry


Overlooking Entry/Incubator Wall

Gate Review Design

Green Connections

Program Interaction

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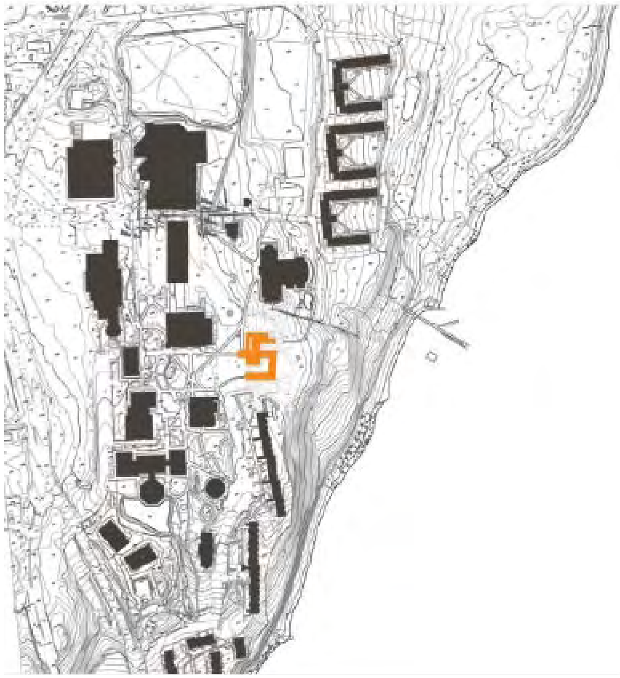
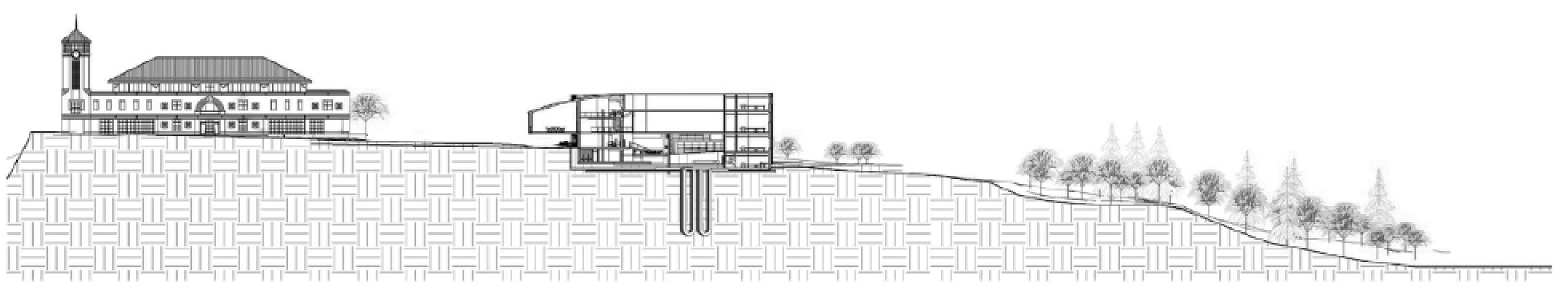


Campus Figure Ground

One of the main issues brought up at this review was the curved roof over the main entry to the building. Since it was the only curve in the building, its presence was questioned and it was suggested that it either be removed or become a stronger element. The cladding was also an issue, as the scale seemed too small and the pattern was too stagnant.

Approach from Gabelli School of Business



Site Section through Campus

Lower Level Plan

Entry Level Plan

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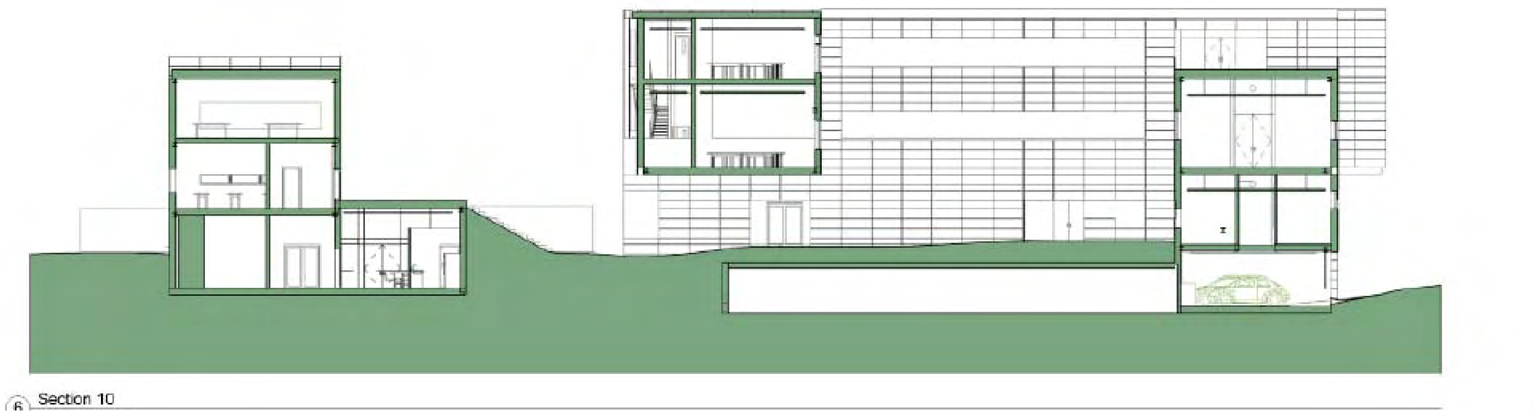
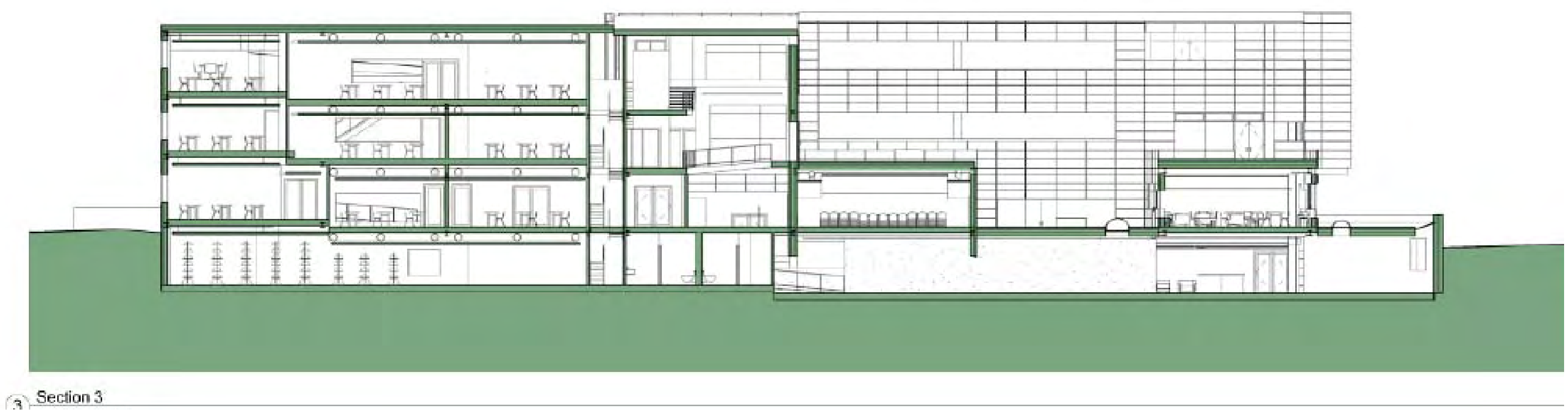
Second Level Plan

Entry Level Plan





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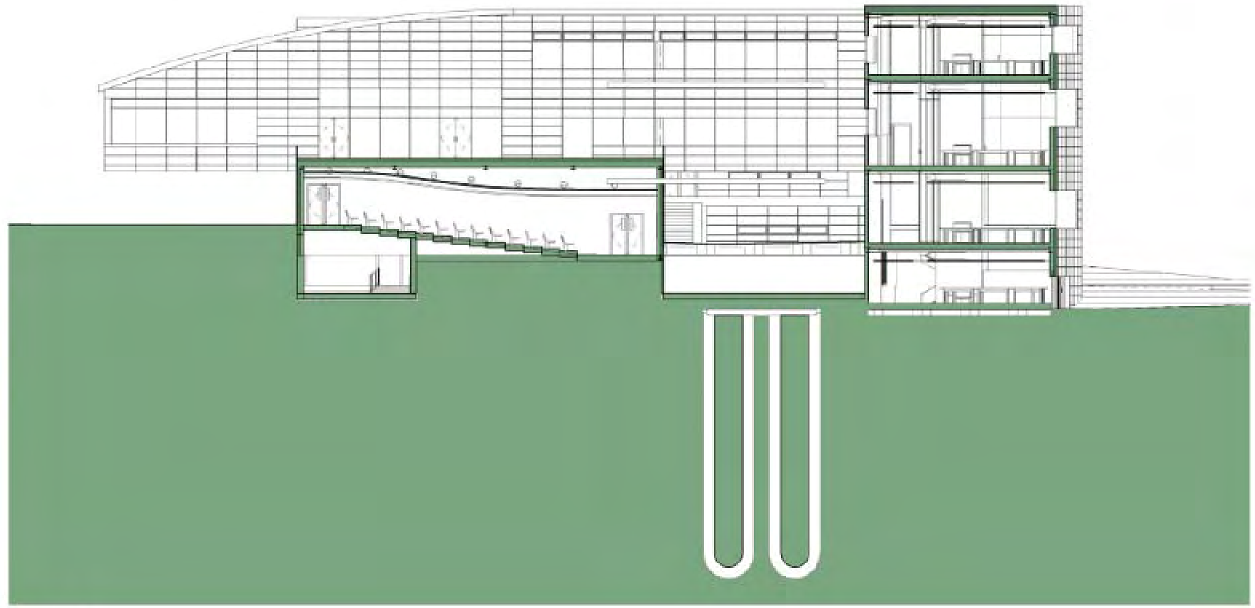
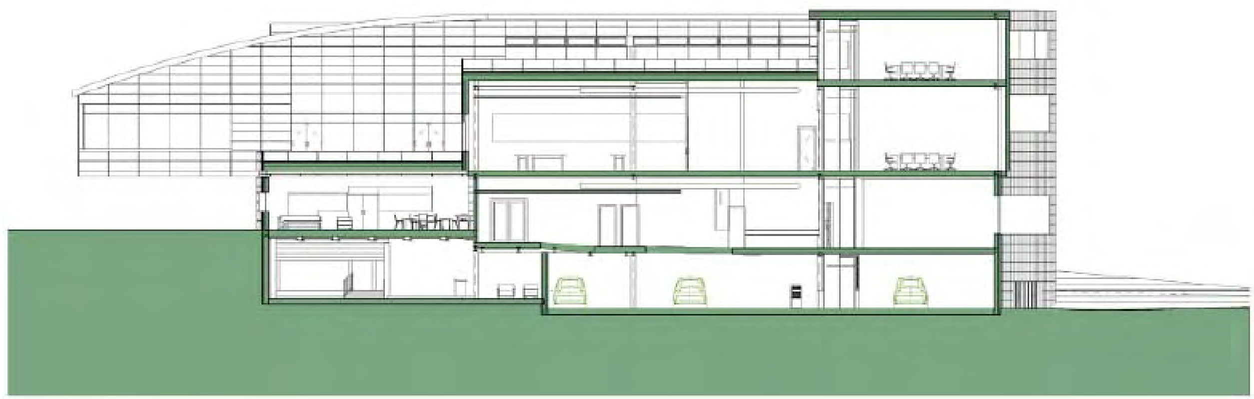
Perspective Down Green

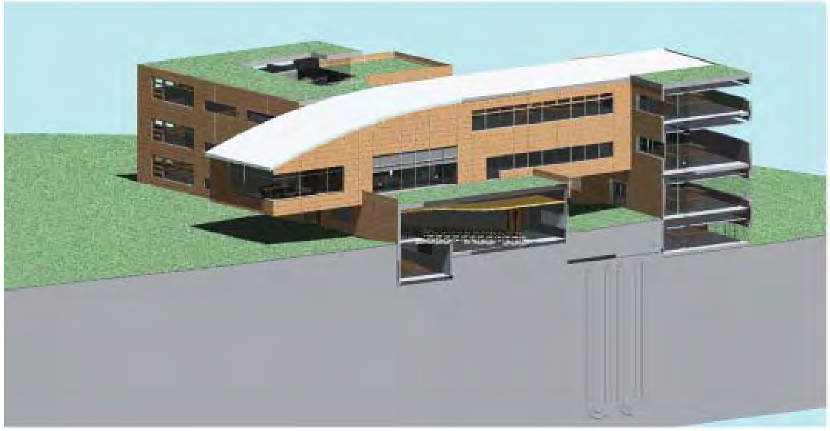


4 Section 8



5 Section 2

Cafe Entry Up Green



Section Perspective

Incubator Space

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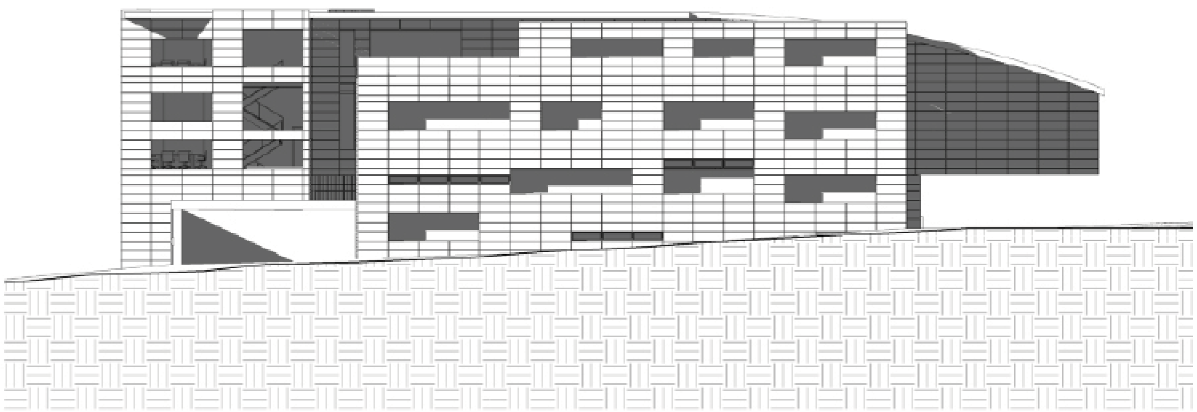
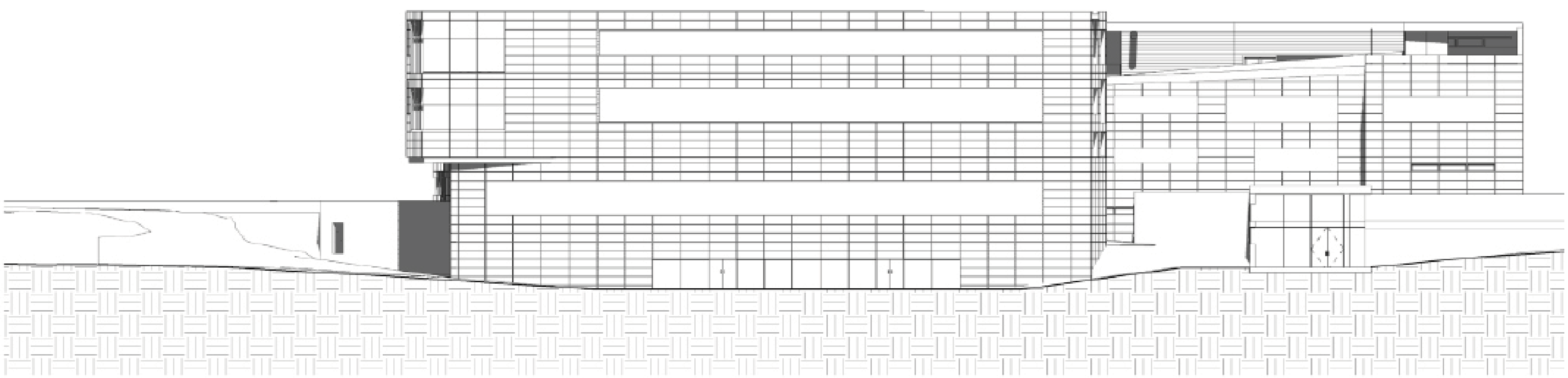
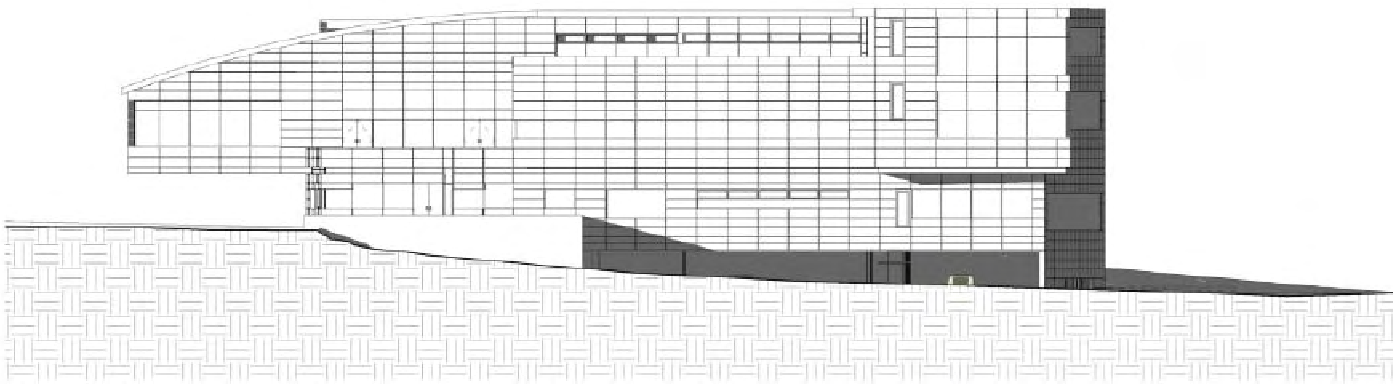


North Elevation

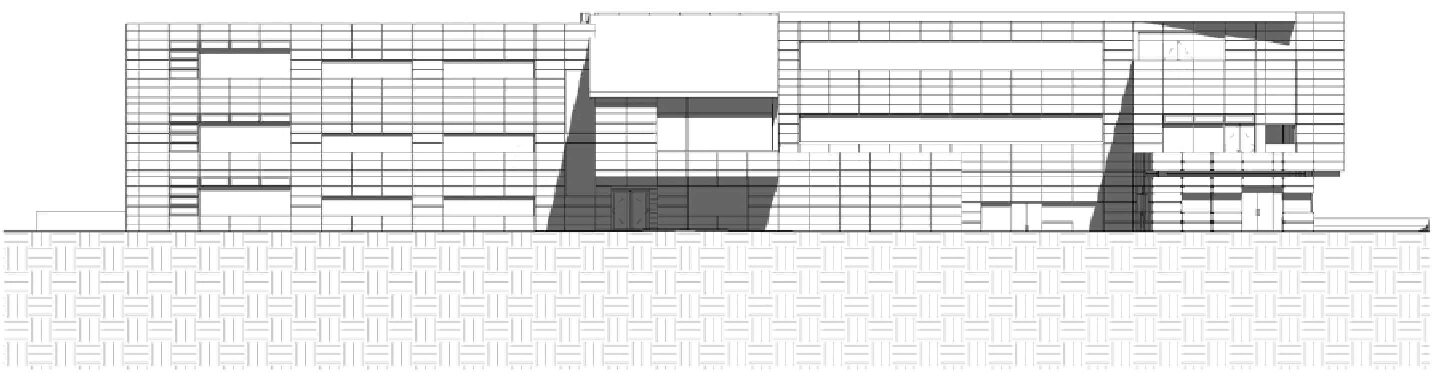
Atrium towards Lobby



East Elevation



South Elevation



West Elevation

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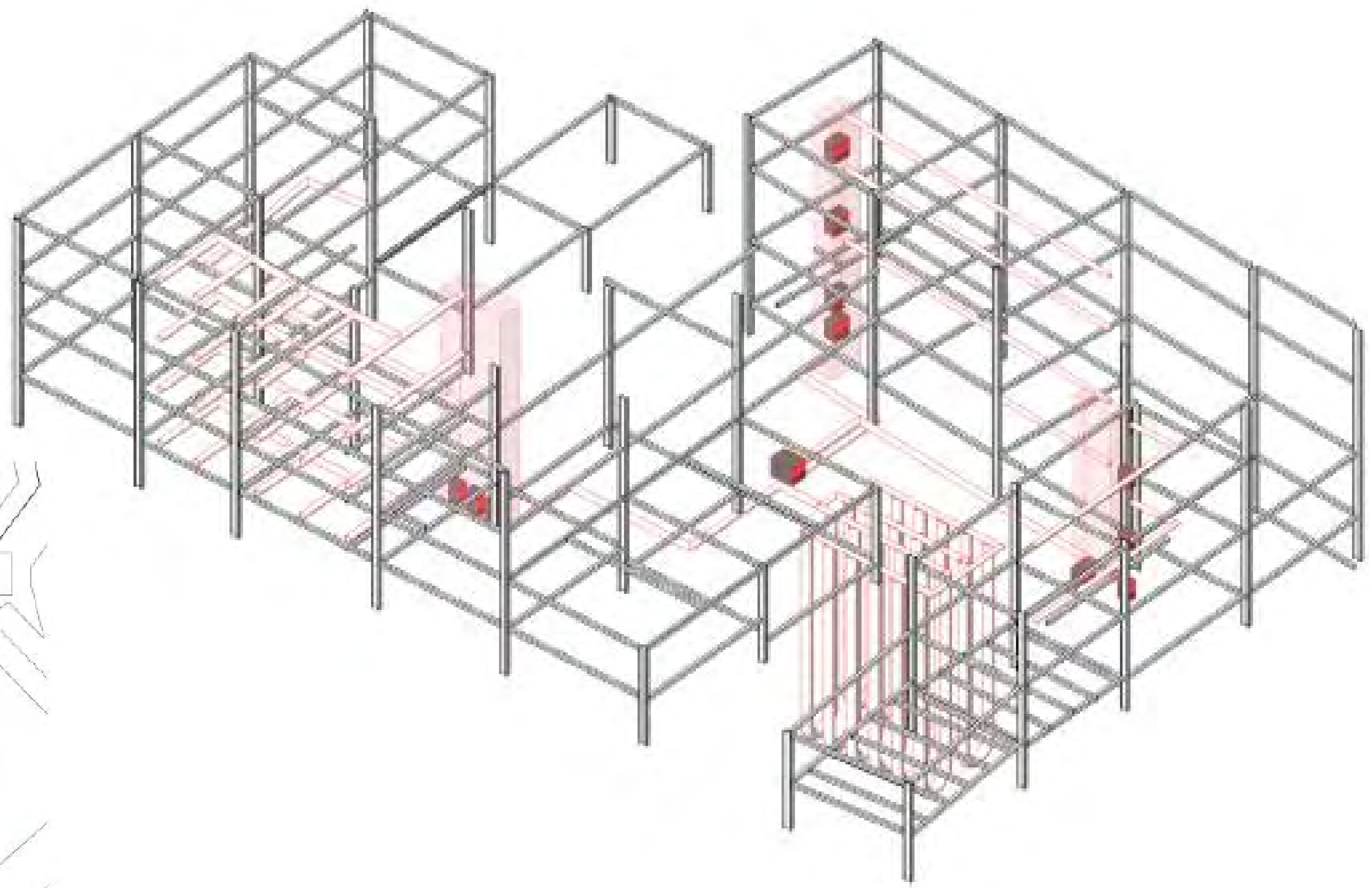
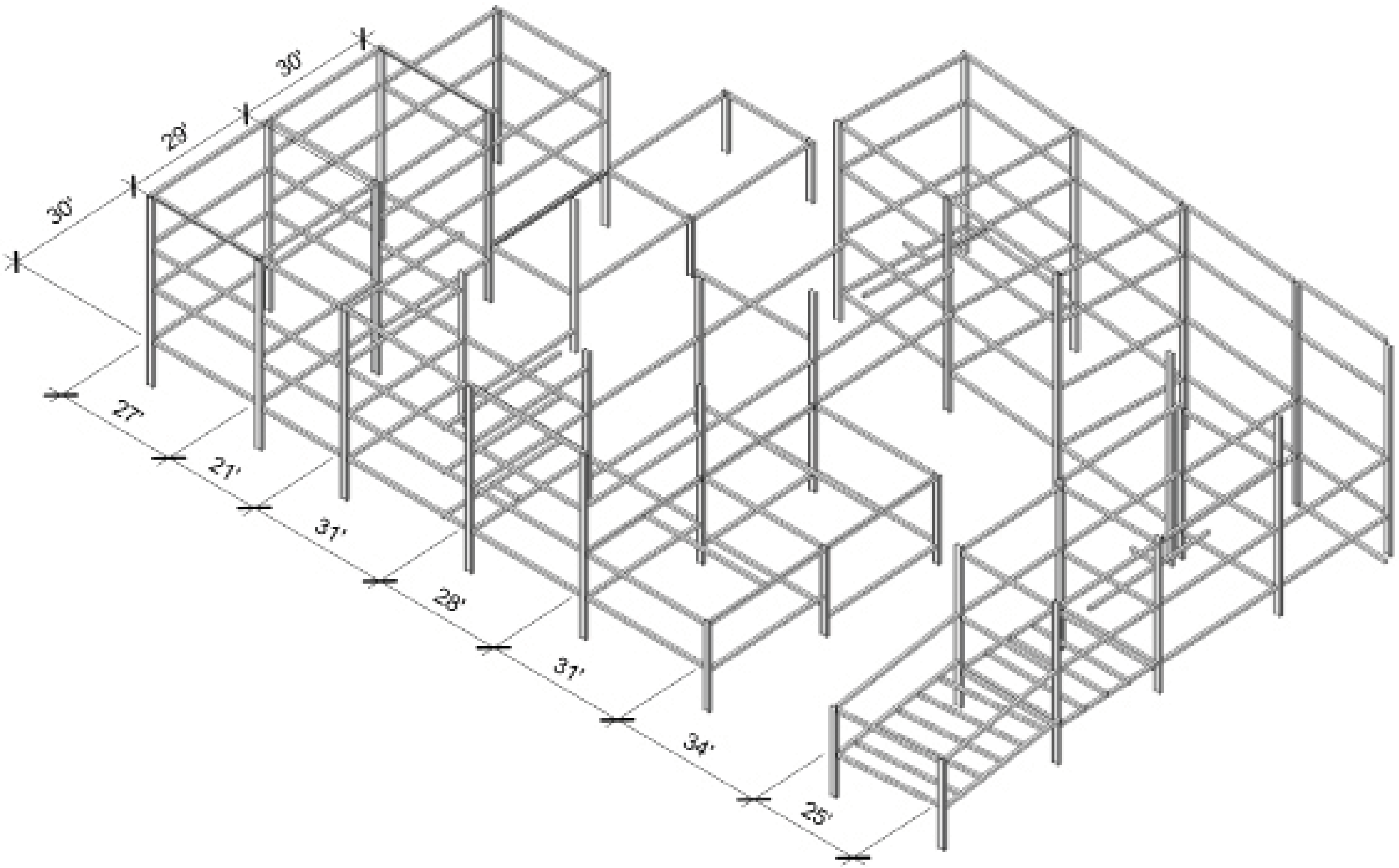
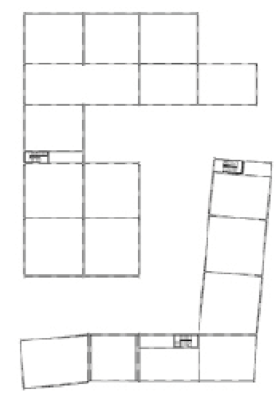


8 Mechanical Plan
1" = 50'-0"

7 03Geothermal Heating/Cooling



5 01Structure



12 Structural Plan
1" = 50'-0"

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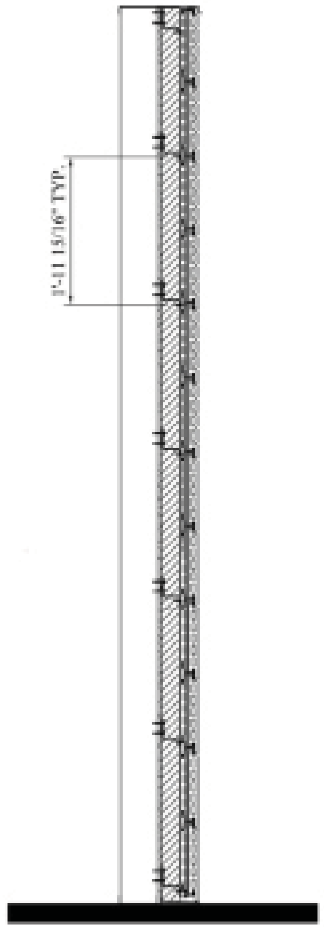
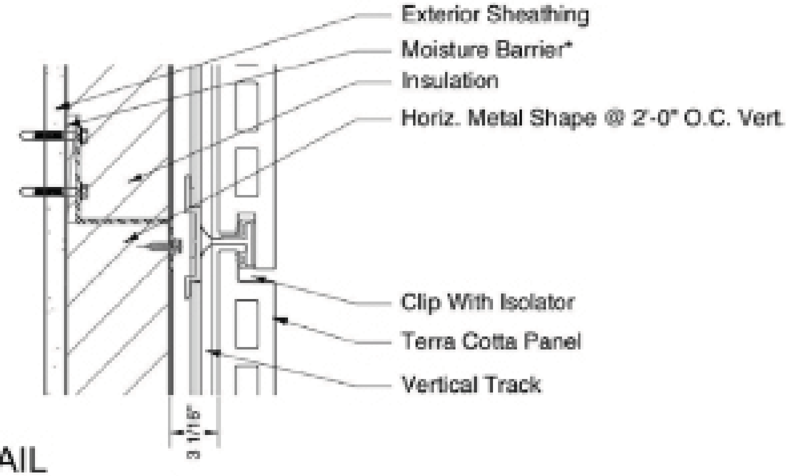
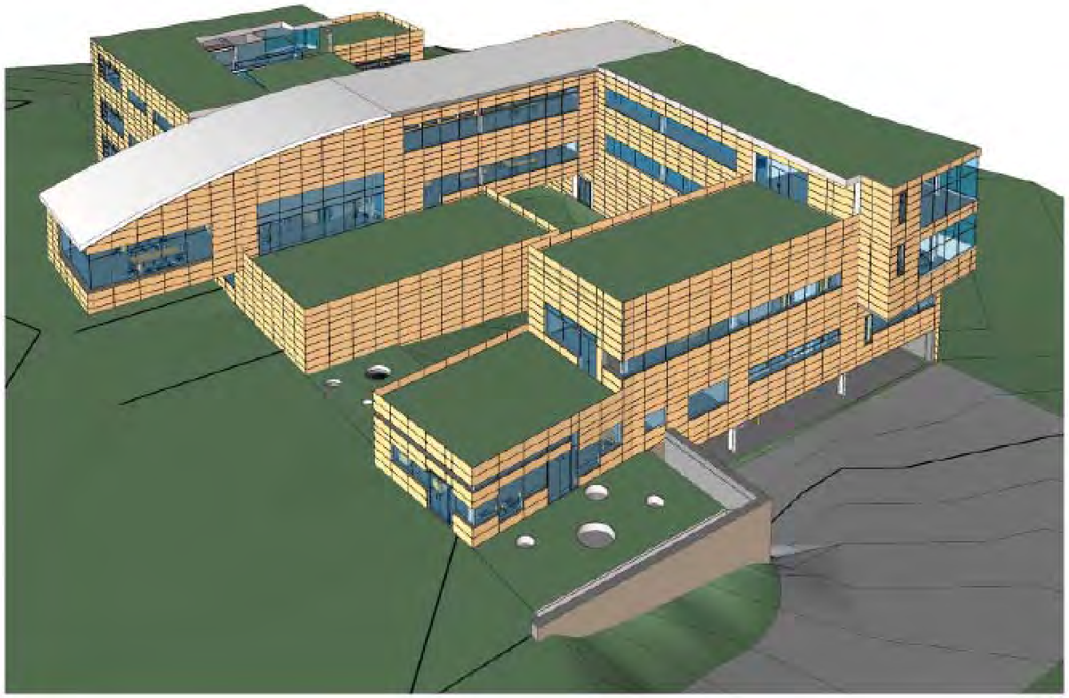




DETAIL

Auditorium Interior


Entry


Aerial View of Green Roofs

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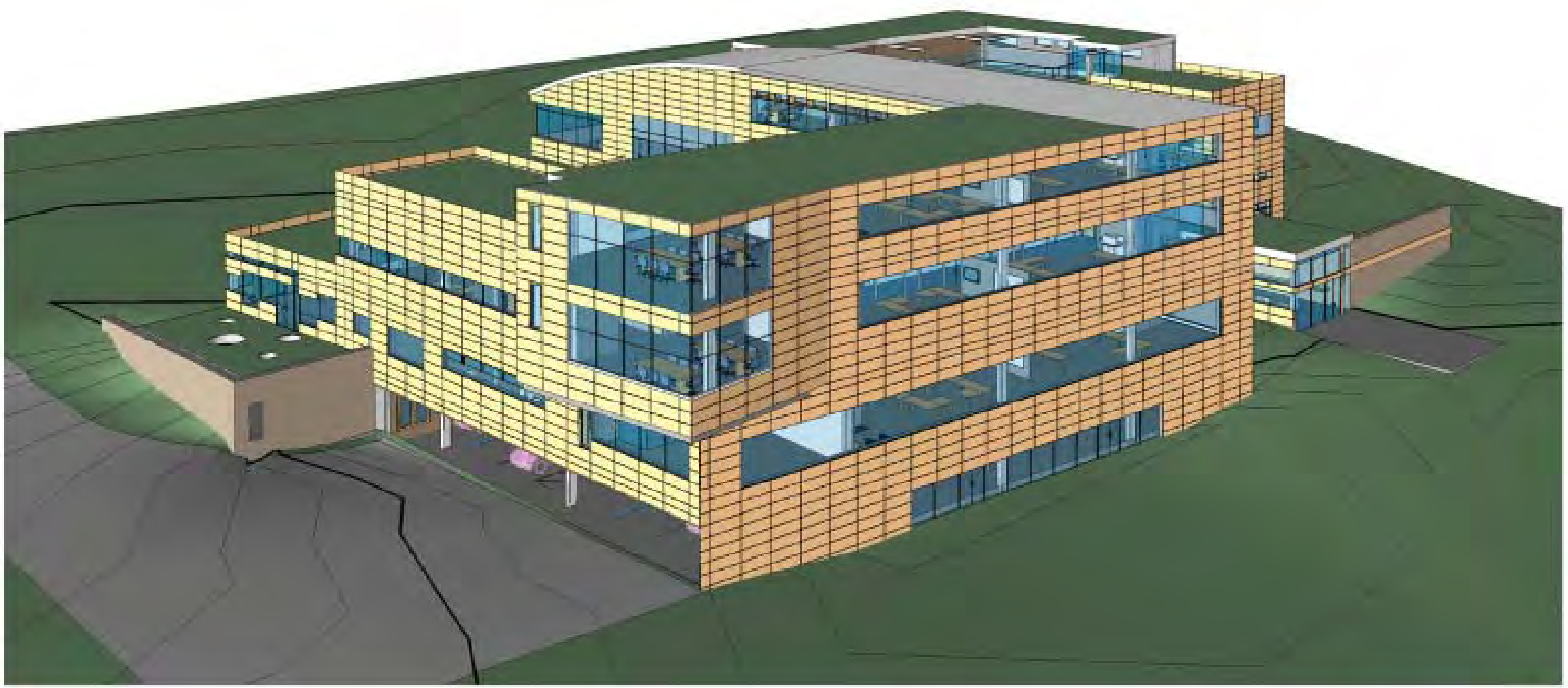


View of Incubator Volumes and Covered Parking

Final Design

Creating a Continuous Green is an important Parti on many levels for the Education and Research Center for Sustainability. Located in the heart of the Roger Williams University campus, the building creates a physical link between the quadrangle and the bay. Users can enter on the quad side or at the bottom of the hill, or a variety of places in between. They can walk through the site and continue down the hill without entering the building. At the same time, the building is very permeable, with many opportunities for the user to be physically connected to the site. Therefore the user can easily flow between two, whether it is to go onto one of the green roofs for some fresh air, have a quick bite outside the café, or take the short cut down the hill.

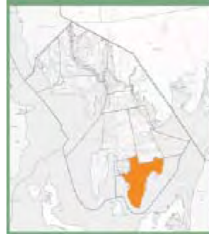
It is important for the user to be physically as well as visually connected to the green. When the physical opportunity is not available, windows and skylights give the user strategic views of the site. The underground gallery has skylights that wash the display walls with soft light, so even though the user is deeply rooted in the site they do not feel constrained.

In addition to continuity, interaction is also very important to the link between exterior and interior, as well as the success of the program in the building. In choosing a location for the Center for Sustainability, the site of a campus seems like a logical one, linking the academic and business realms to strengthen the community interaction. Since there are a variety of users, visual and physical connections within the building have been made so the users can have constant contact. By integrating the different types of spaces together, there is a greater chance for interaction, which will hopefully lead to conversation and the exchange of knowledge. The goal is to have the variety of users each share their expertise with others in an exciting learning environment.

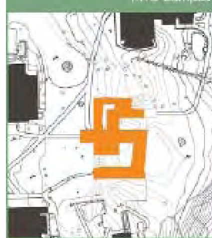
The building uses a steel frame structure with the bay size approximately the same as the previous building on the site but modified as needed. The steel is recycled from existing materials, as well as the foundation walls. The cladding is sustainable TerraClad terracotta rainscreen panel system in 1.5'x5' or 1'x5' panels, which get hung off metal strips connected back to the structure.

The building is heated and cooled using geothermal wells that naturally cool or heat water that is then pumped through air handlers located in the three main parts of the building. In addition, operable windows are used all over the building to optimize the potential for natural ventilation on such a windy site.

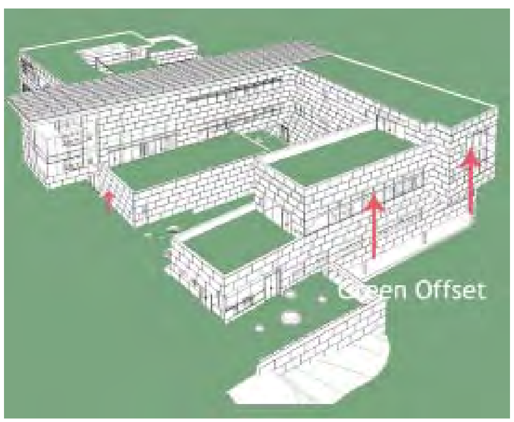

Rhode Island


Bristol County

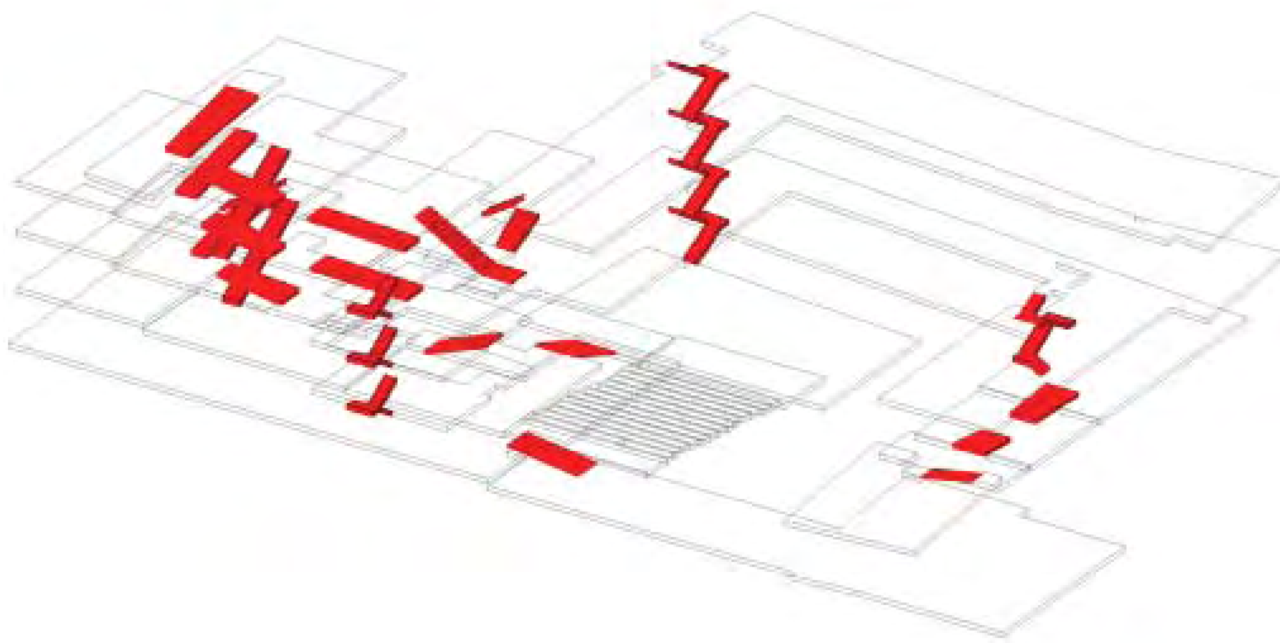

RWU Campus


RWU Inner Campus

Concept



Site Plan 1/32"=1'0"



Egress

Program

Administration	
Business Offices	10 x 100sf=1000sf
Meeting Room	5 x 600sf=3000sf
Public	
Lobby	900sf
Resource Center	4000sf
Auditorium(164people)	1800sf
Exhibition Gallery	1500sf
Cafe	1200sf
Student Lounge	900sf
Education	
Classrooms	5 x 600sf=3000sf
Learning Labs	4 x 600sf=2400sf
Research Labs	5 x1000sf-5000sf
Business	
Incubator Spaces	10x2000sf=20000sf
Support	
Circulation	10000sf
Cafe Kitchen	300sf
Restrooms	1400sf
Mech/Elec	1300sf
	TOTAL:58000sf

Site Section 1/32"=1'0"

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Roger Williams University
Bristol, Rhode Island

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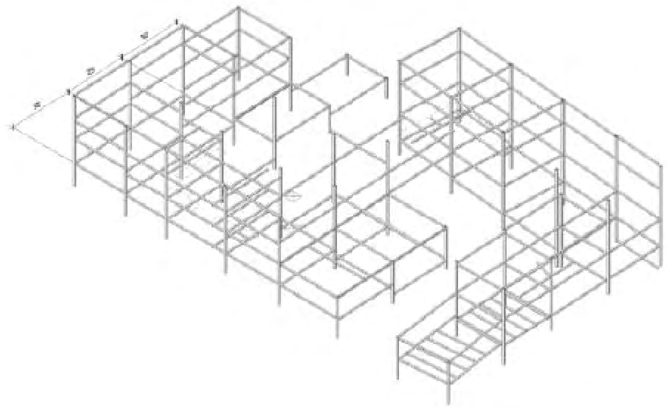
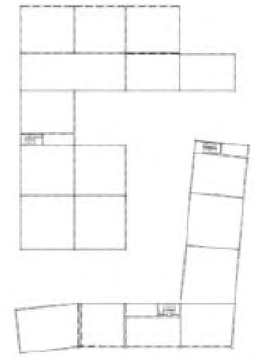
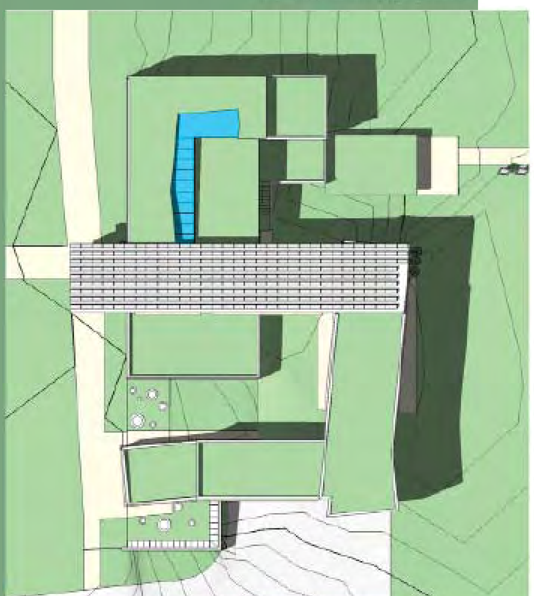
Green Connections



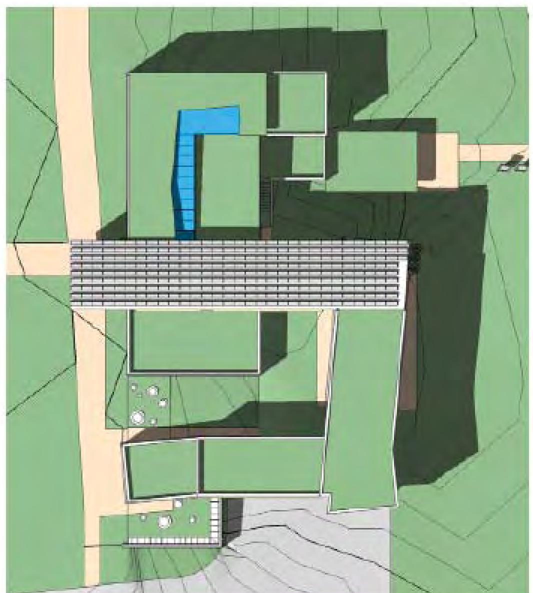
Structure



Structural Plan

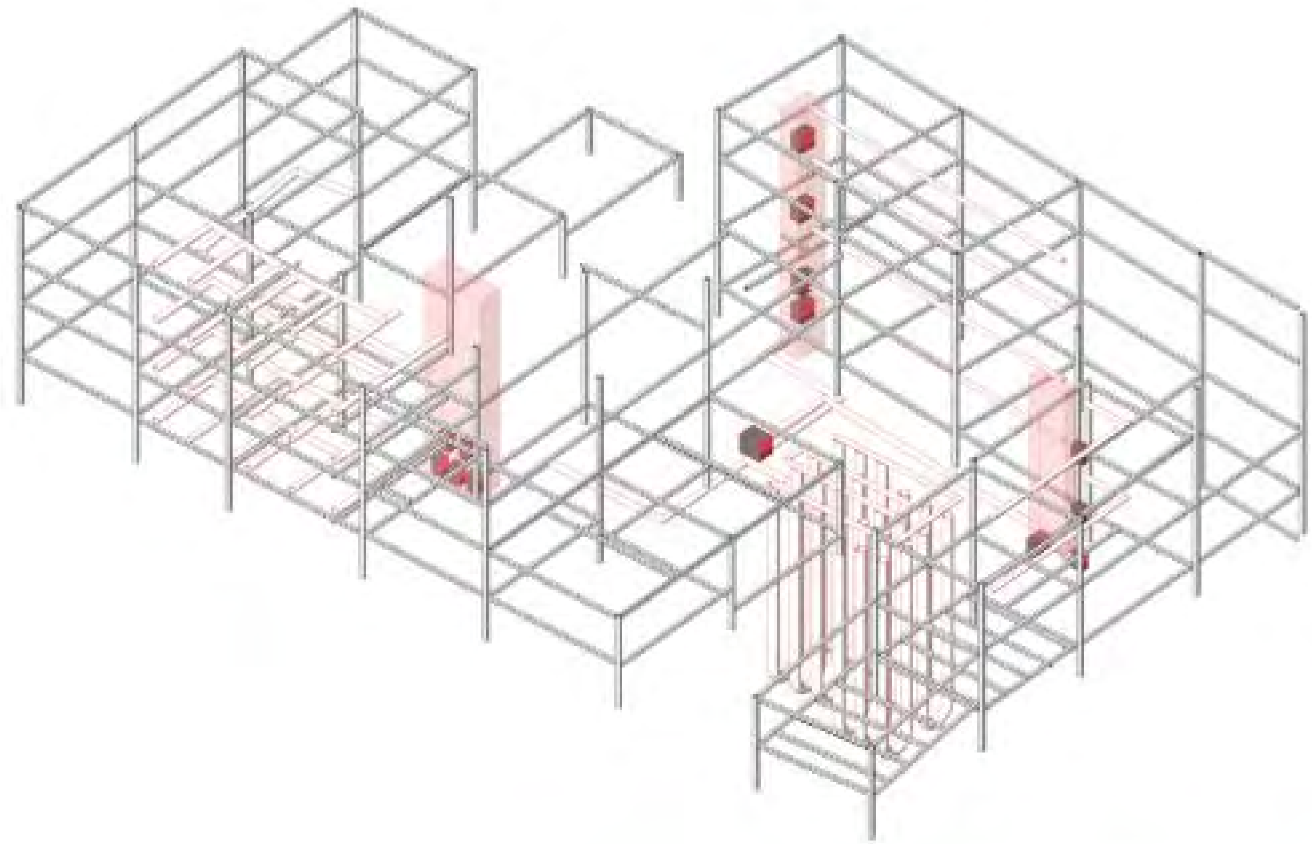


Spring/Fall Equinox Shadows - 2pm



Summer Solstice Shadows - 2pm

Winter Solstice Shadows - 2pm



Geothermal Heating/Cooling System

Program Interaction

Mechanical Plan

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Entry

Entry to Continual Green

Down Green

Building Section 1/8"=1'-0"
AA

Lower Level Plan 1/16"=1'-0"

Entry Level Plan 1/16"=1'-0"

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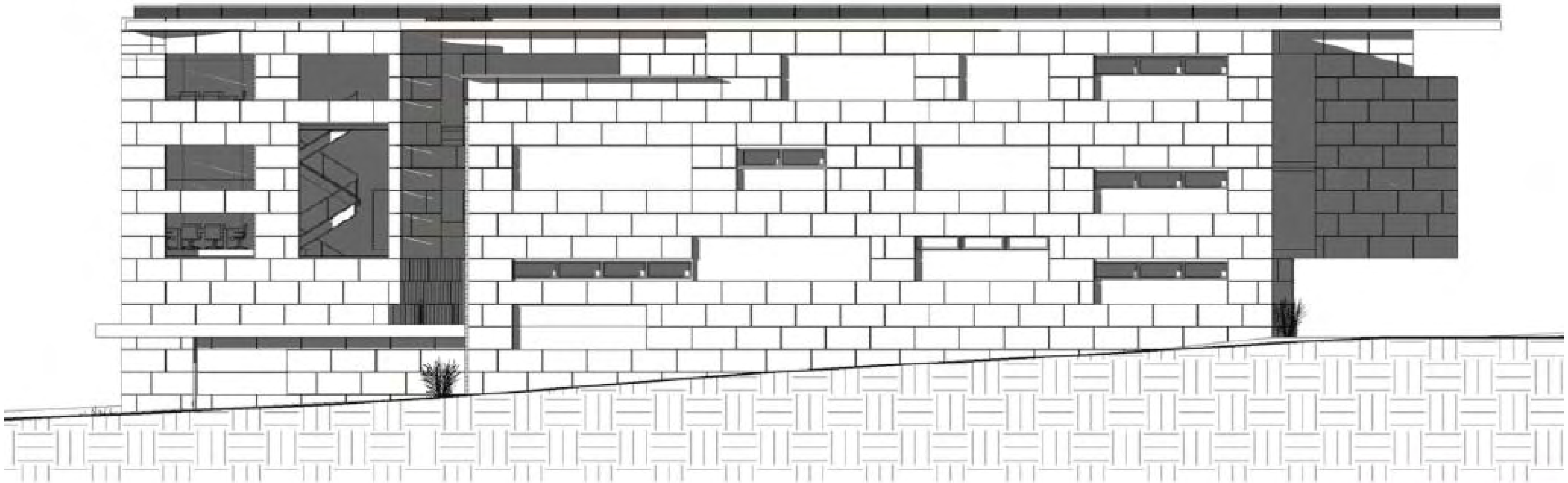
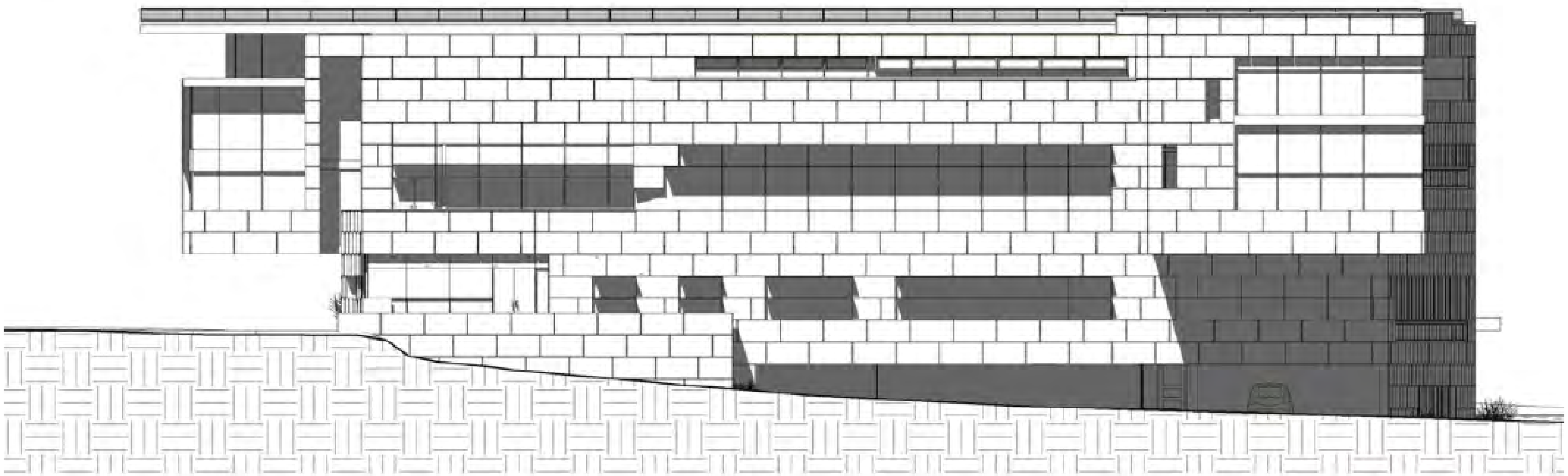
Second Level Plan 1/16"=1'-0"

Third Level Plan 1/16"=1'-0"



North Elevation 1/8"=1'-0"



South Elevation 1/8"=1'-0"

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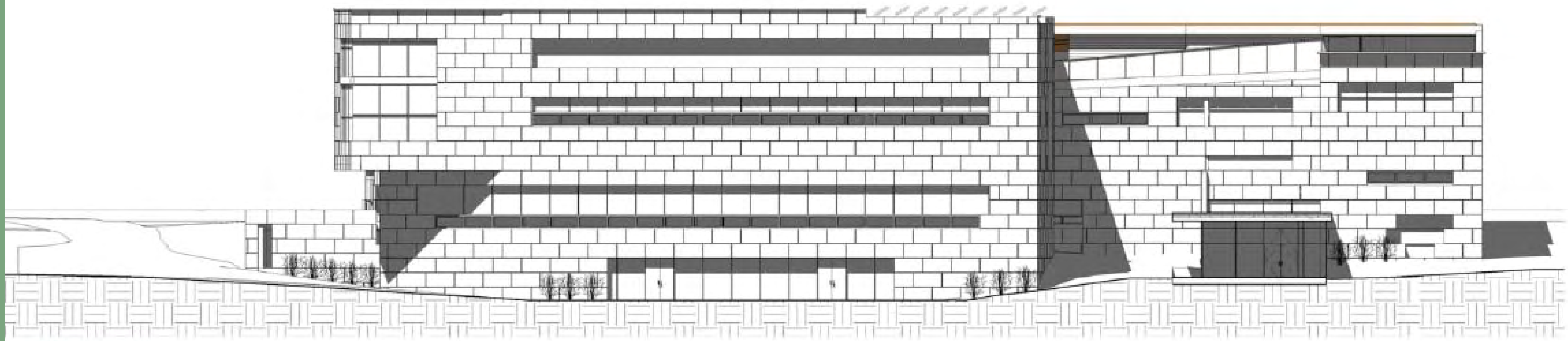
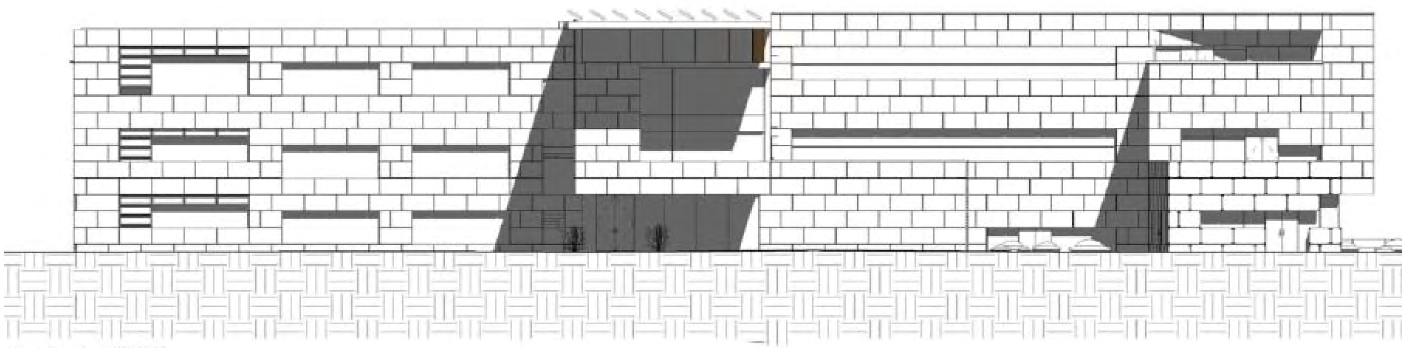
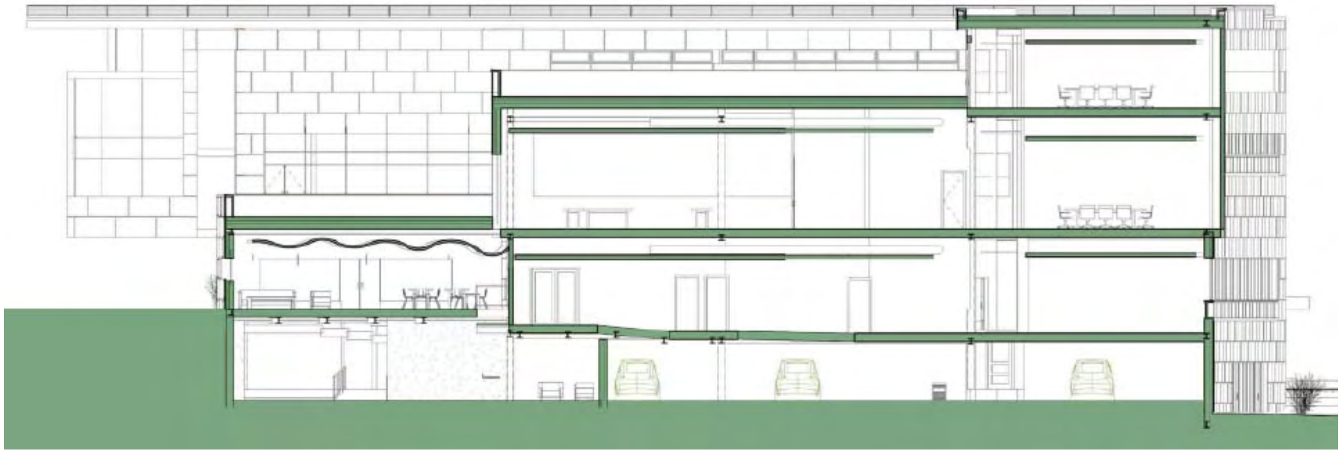
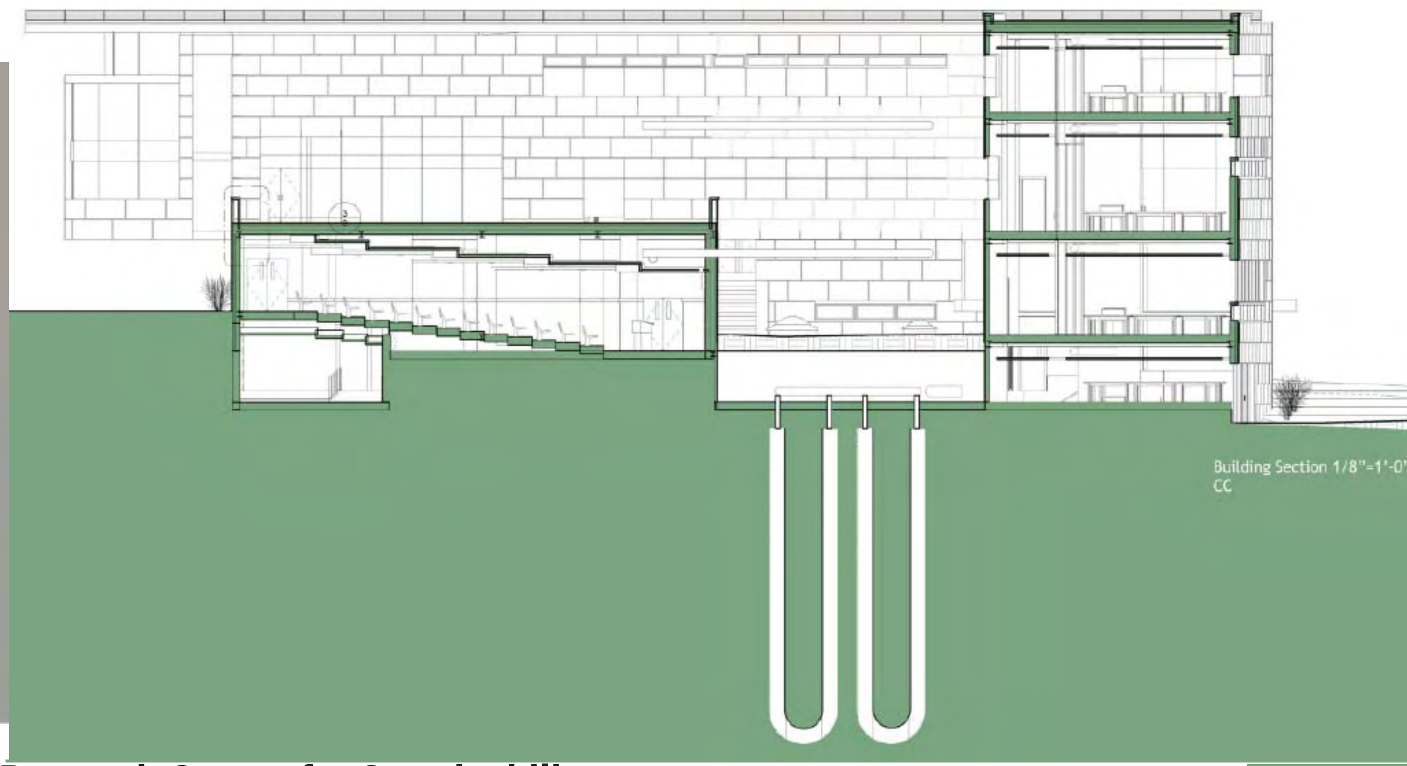


East Elevation 1/8"=1'-0"



West Elevation 1/8"=1'-0"





/ from Auditorium

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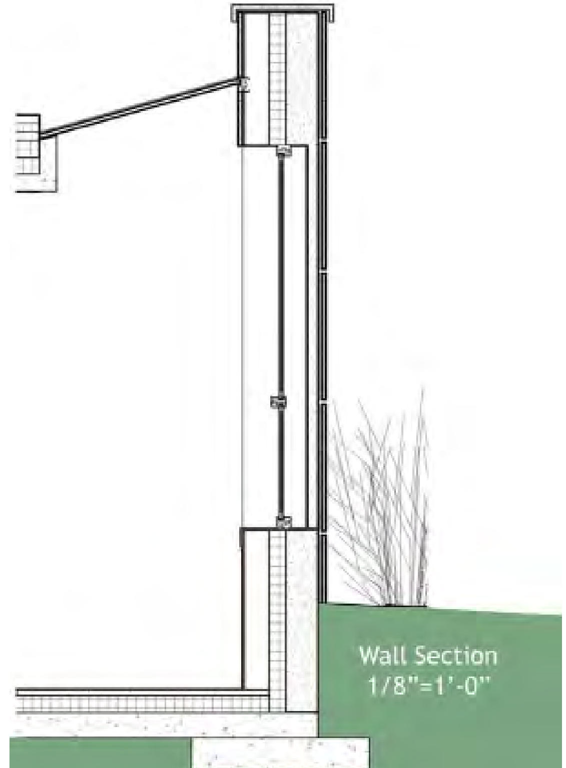
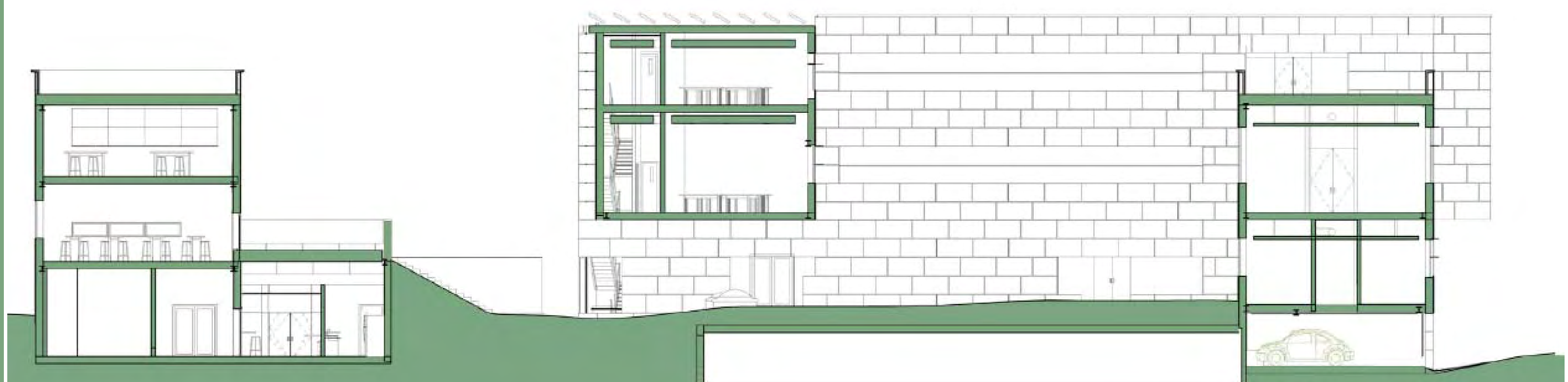
Under Incubator

Green near Cafe

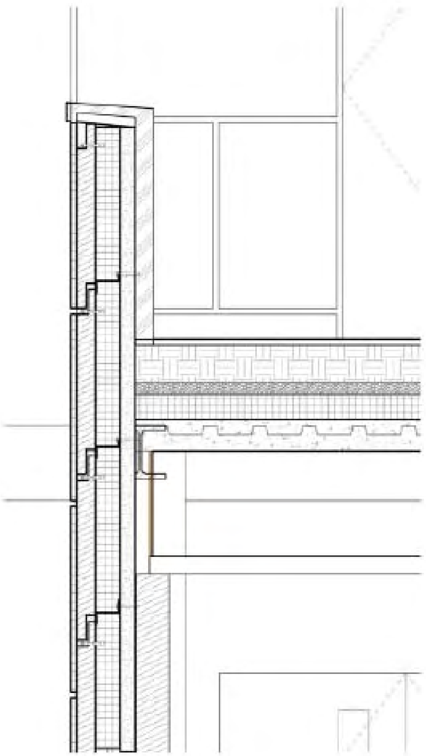


Wall Section
1/8"=1'-0"

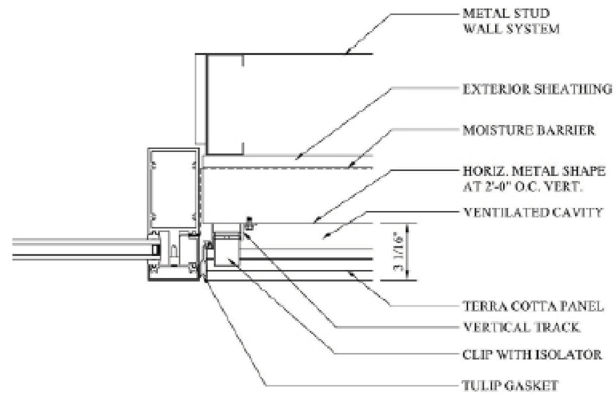


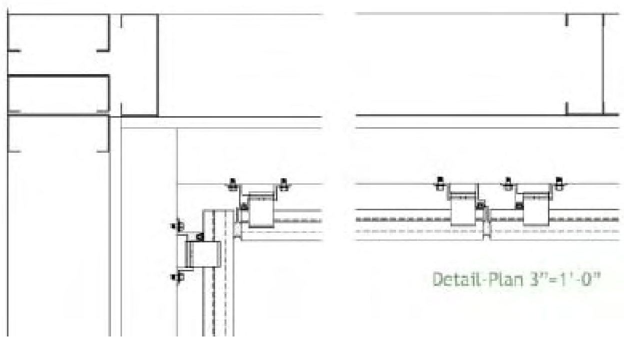
Building Section 1/8"=1'-0"
CC

The use of a TerraClad rainscreen paneling system was used for the cladding of the building for both its sustainable material as well as the rainscreen technology. The connection between the green roofs and the paneling system can be seen to the left. Plan connections are below and to the right.

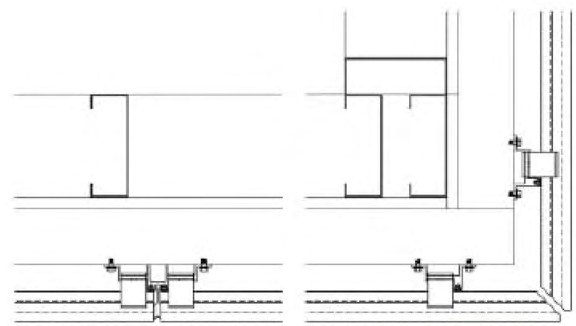


Green Roof Detail
1"=1'-0"





Detail-Plan 3"=1'-0"



Detail-Plan 3"=1'-0"

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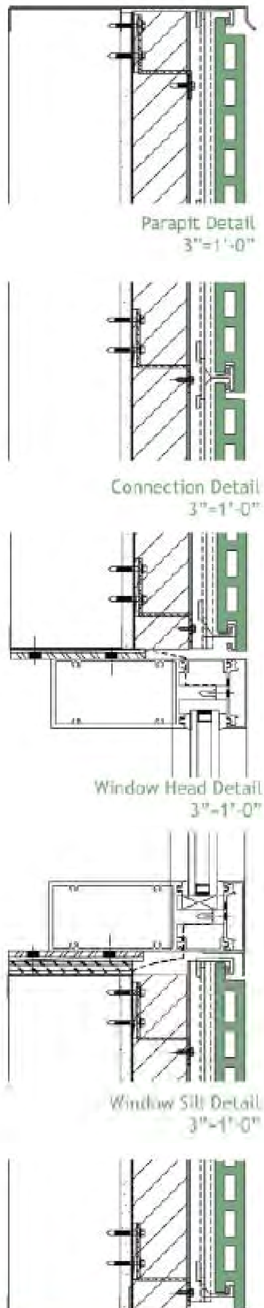


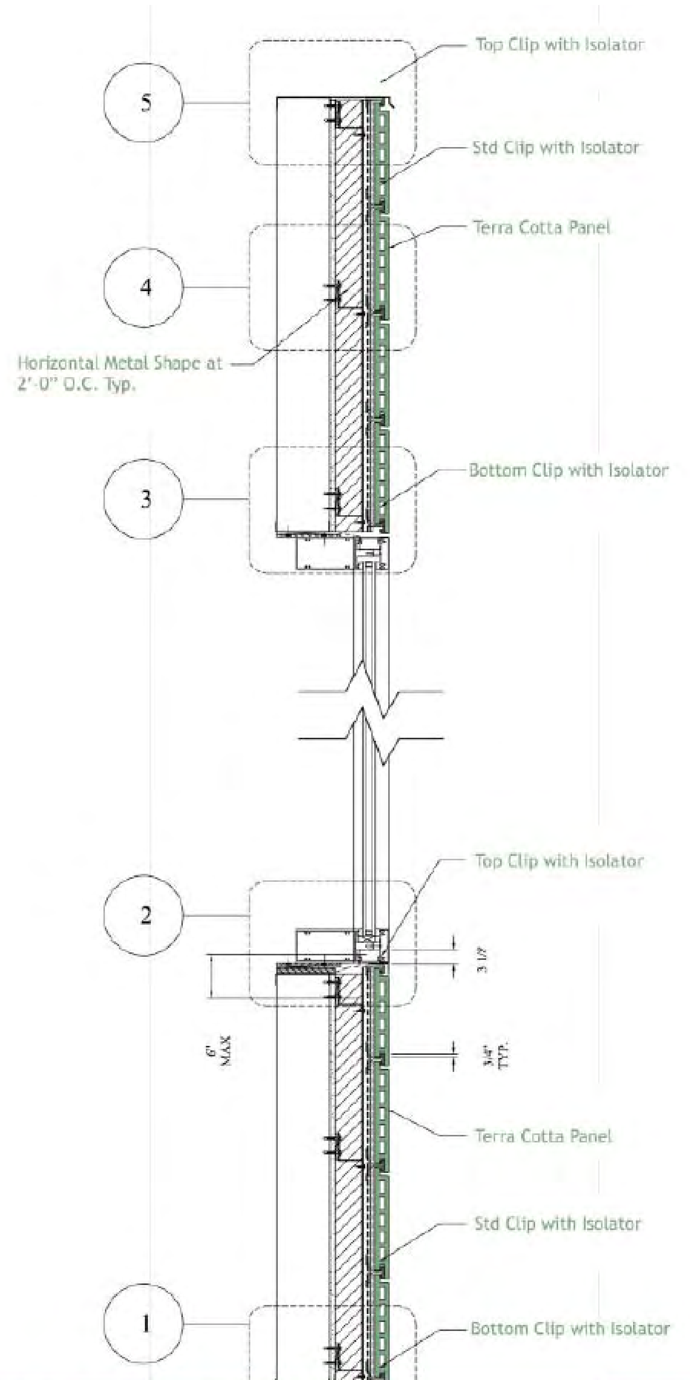
Parapit Detail
3"=1'-0"

Connection Detail
3"=1'-0"

Window Head Detail
3"=1'-0"

Window Sill Detail
3"=1'-0"

Ground Connection Detail
3"=1'-0"



TerraClad Wall Construction
1 1/2" = 1'-0"

Auditorium

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Incubator


Existing Conditions

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Lobby

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Approach from Gabelli School of Business

Student Lounge

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Student Lounge

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~ Mahatma Gandhi