Integrated Research & Innovation Center

TEAM 5

Arch 553 - Graduate Studio
University of Idaho

TABLE OF CONTENTS:

Design Intensions:

"The University of Idaho Integrated Research and Innovation Center (IRIC) is charged with hosting discovery and sparking innovation based on interdisciplinary efforts gathered from across the broad spectrum of science, engineering, architecture and other related fields on campus. IRIC is a flagship project for the University in demonstrating how the resources of the academic community can be brought to bear on some of the most significant challenges facing the citizens of the State and the world today."

- IRIC Document 30 July 2013

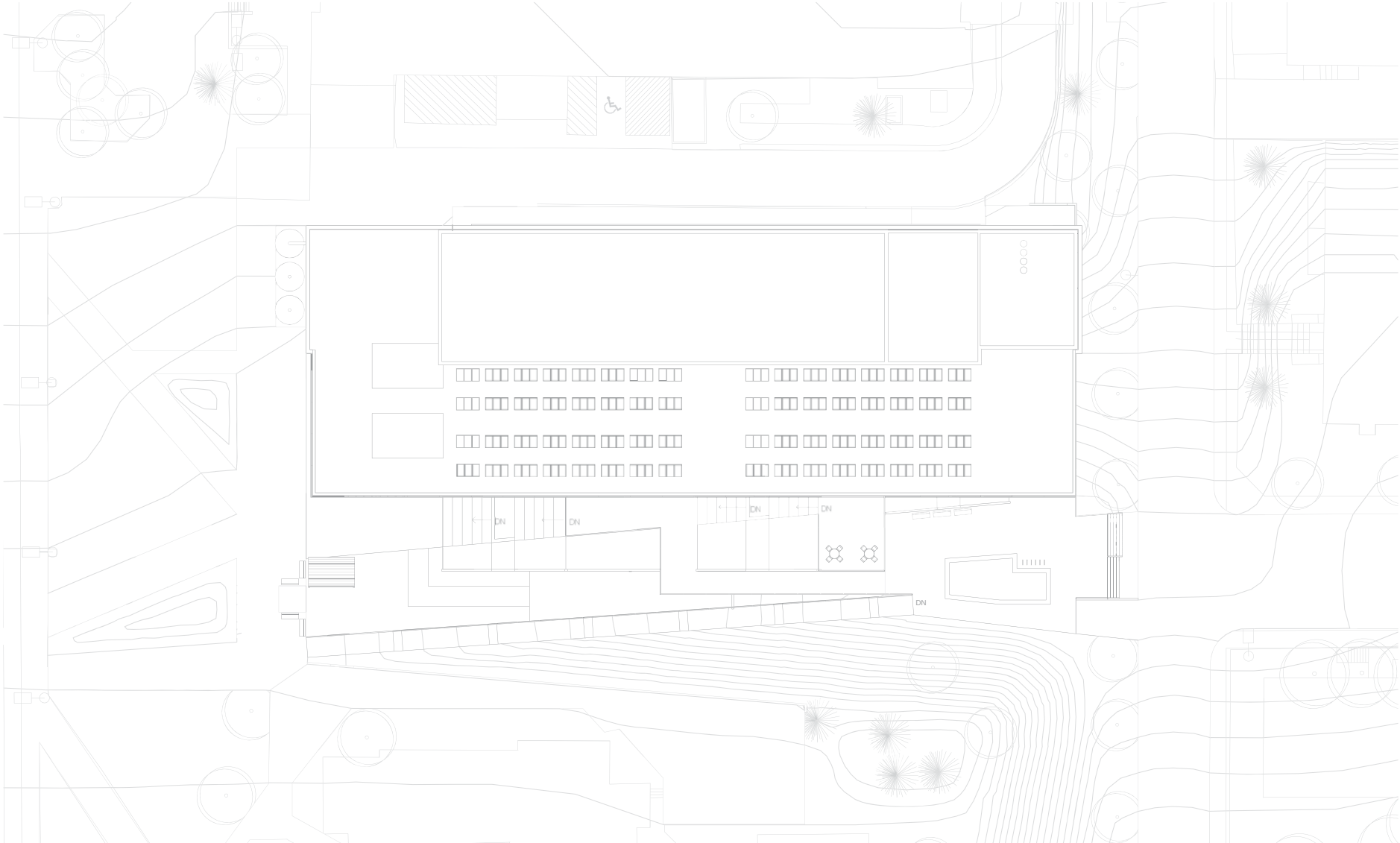
As graduate students at the University of Idaho, Moscow campus, we wanted to accept Ed Mazria's challenge to the architecture profession to produce carbon neutral buildings by 2030. This building provides the opportunity to make one step forward towards meeting this goal which both the AIA and the Association of US Mayors have endorsed.

In order to do so, as part of the competition put on by the Idaho Forest Products Commission, we have outlined **benefits of using large amounts of timber in the construction:**

- economical choice
- renewable resourse
- environmentally friendly
- grown locally
- relatively quick construction
- innovative material
- versatile material
- energy efficient (good insulator)
- reduces carbon footprint
- aesthetically pleasing
- educational opportunities

BUILDING SPECIFICS

- Site Plan
- Floor Plans
- North Facing Section
- South Elevation

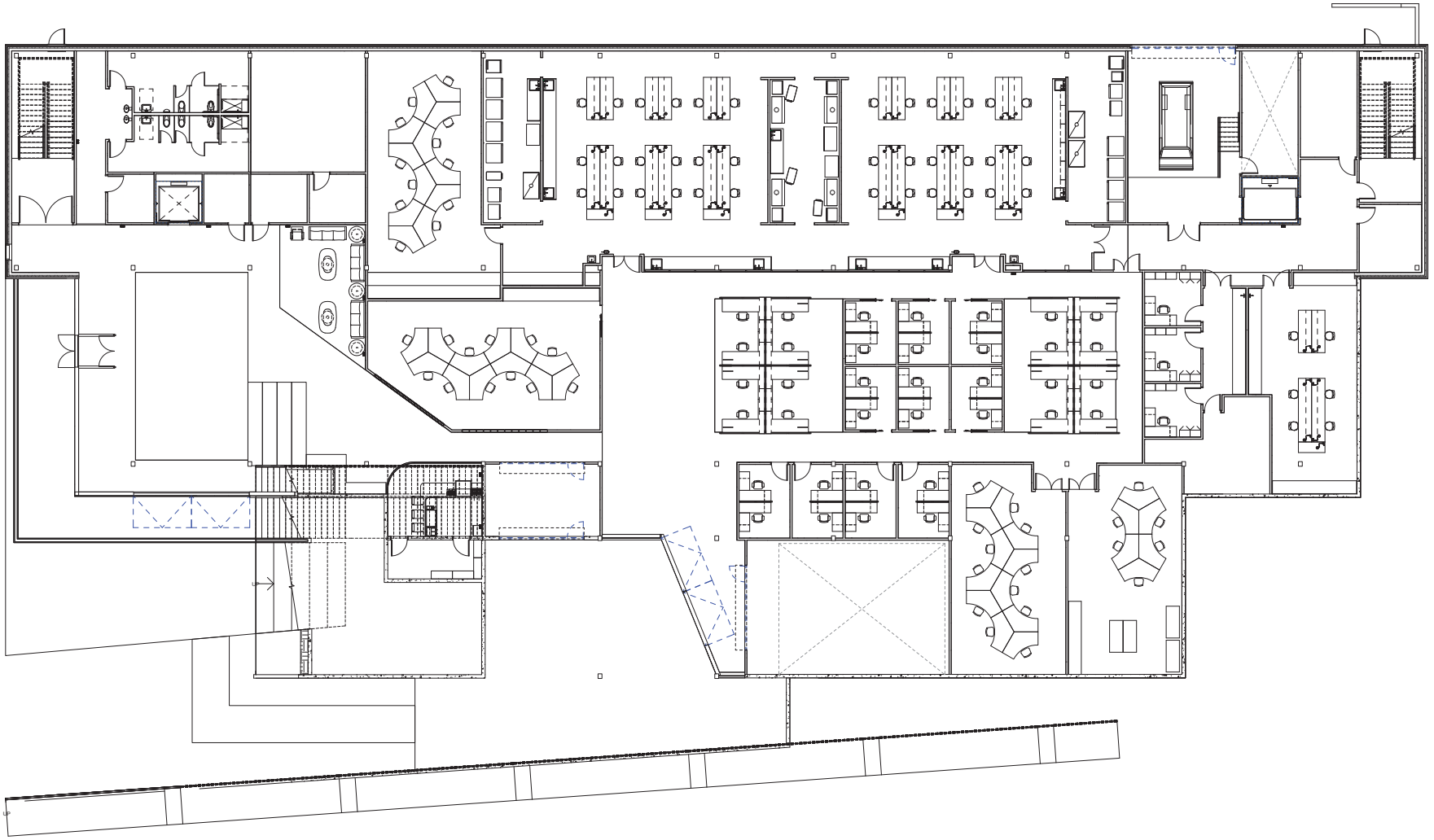


Site Plan:

Site and Context Map

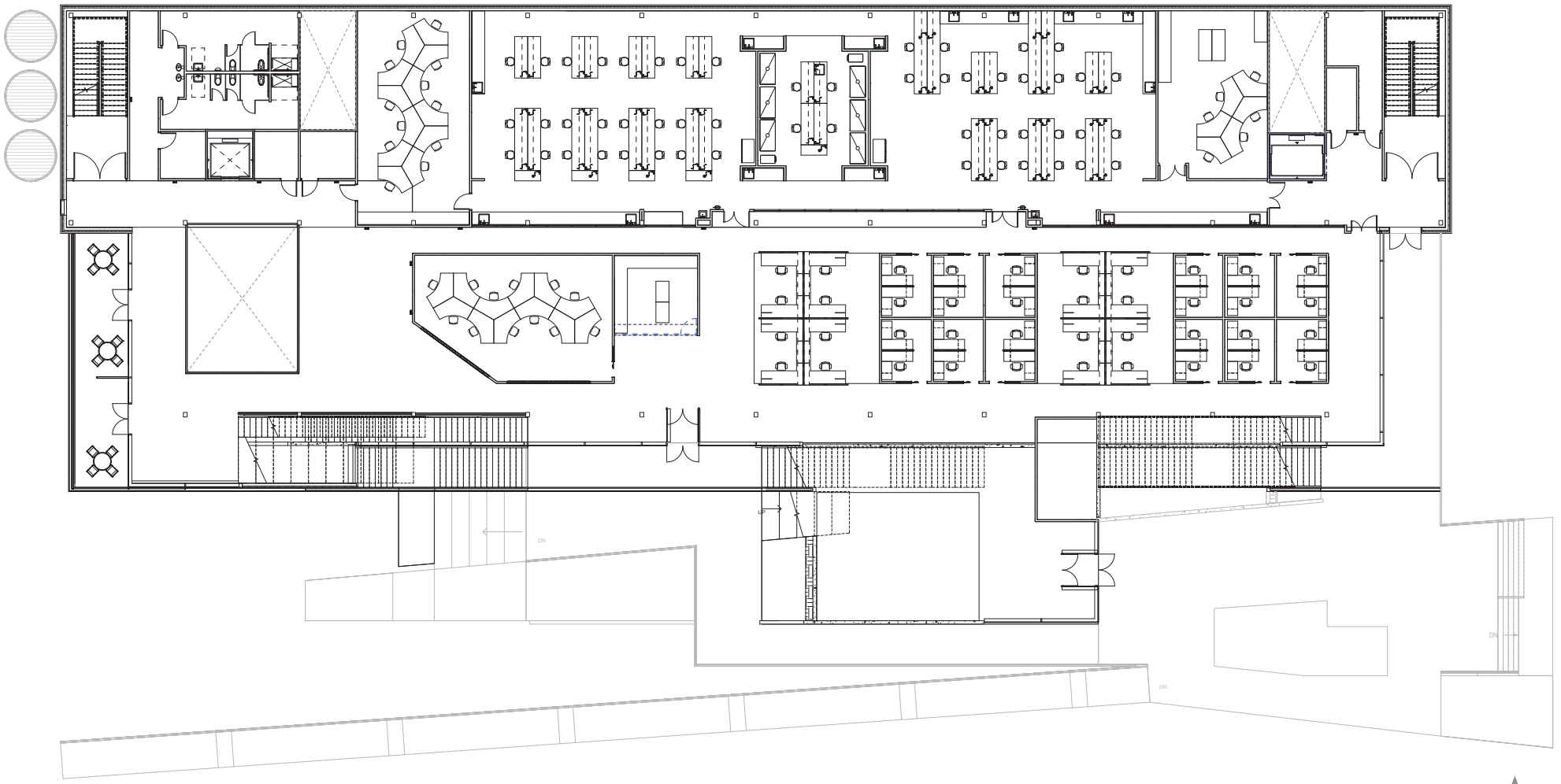
N

Floor Plans:



First Floor

N



Second Floor

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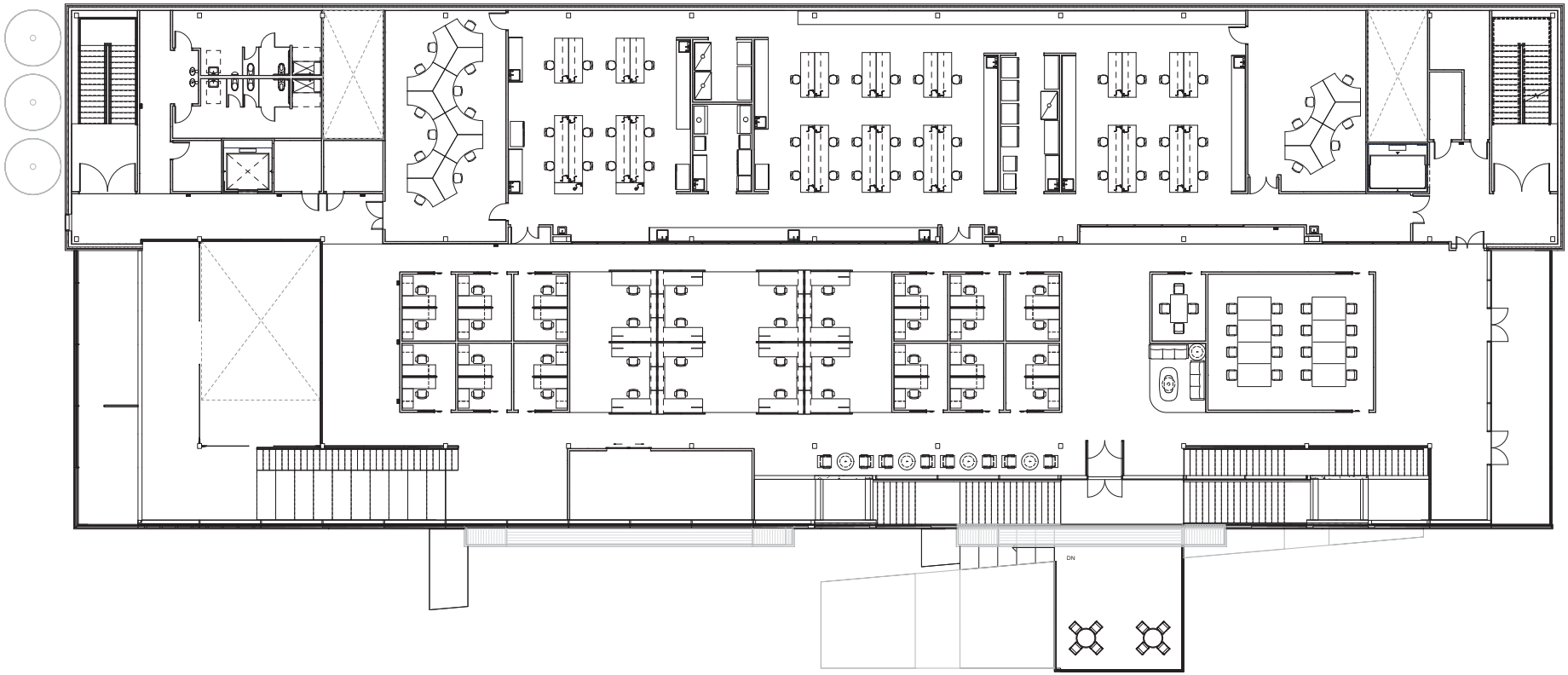
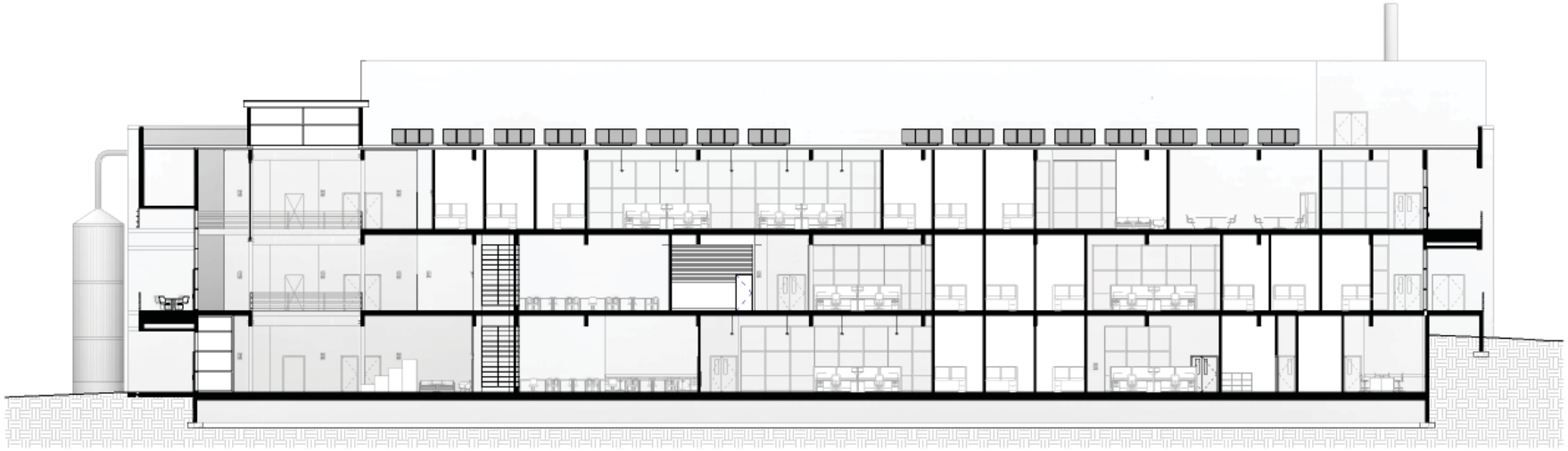


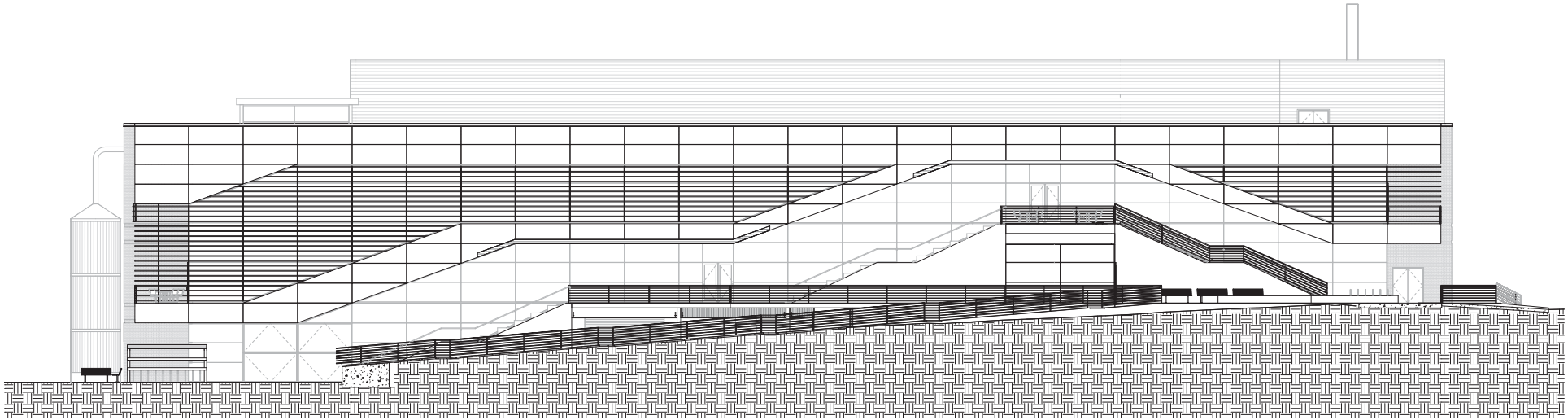
Third Floor

N

North Facing Section:



South Elevation:



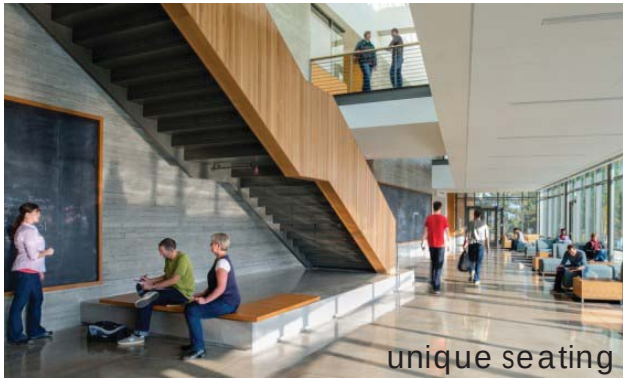
TIMBER MATERIALS

+ Interior Considerations
    - Structure
    - Ceiling
    - Flooring
    - Furniture

+ Exterior Considerations
    - Paneling
    - Shading
    - Water Catchment System
    - Furniture

Inspirational Images:

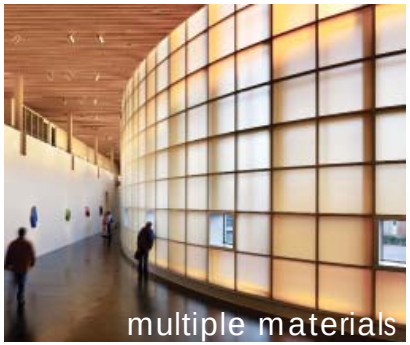

privacy screen


unique seating

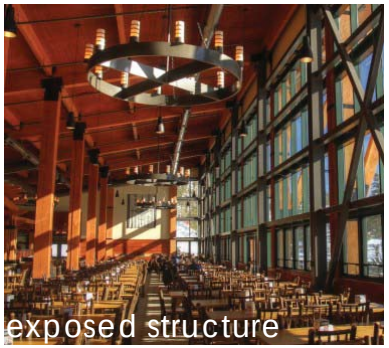

stair seating


stair material


lab space & hung lighting


multiple materials


paneling


exposed structure


shading

Interior Considerations:

Douglas-fir

Uses: Douglas-fir is the wood species our glue laminated beams, columns and cross laminated timber panels (CLT) will be manufactured out of due to its high strength characteristics. The CLT panels, our ceiling, act structurally to help transfer loads. Our beams and columns will be manufactured by Boise Cascade at their engineered wood plant in White City, Oregon.

Glulam Douglas-fir Beams:

Western White Pine

Uses: Western White Pine is the wood species that will be used on a lot of our interior elements. These elements include furniture like desks, chairs, and cabinets. It will also be used on our door frames to the offices. According to the Idaho Forest Products Commission it is a great species to use for such tasks. It is the also the most valuable softwood lumber in North America.

Western White Pine, clear:

Western Hemlock

Uses: Western Hemlock is the wood species that will be used for wood flooring throughout the interior of the building. It is a very versatile wood type with many uses. These uses range from the manufacturing of boxes, pallets, crates, flooring, and furniture. We are using it for flooring in our building due to its fine grain, even texture and durability.

Western Hemlock Flooring:

Exterior Considerations:

Ponderosa Pine

Uses: Ponderosa Pine is the wood species from Idaho forests we would have ultimately liked to have specified for our exterior paneling system. According to The Idaho Forrest Products Commission Ponderosa Pine is a good product to use for paneling and can be treated for outdoor use. However we could not find a manufacturer that produced large panels for exterior use, therefore we have specified an overseas product.

Western Red Cedar

Uses: Western Red Cedar is the wood species that will be used to create the shading device on the east, south, and west side of our building. It will also be used in the manufacturing of the three water cisterns on site, the exterior furniture, and entrance coverings. Although the wood for the cisterns will not be from Idaho (specified in chapter 8, Building Material Specifics), the wood for the shading device will be provided by Idaho Forest Group. This species is used because of its attractiveness, durability, and lightness. These qualities are great for the uses mentioned above.

Parklex paneling facade in use:

Western Red Cedar:

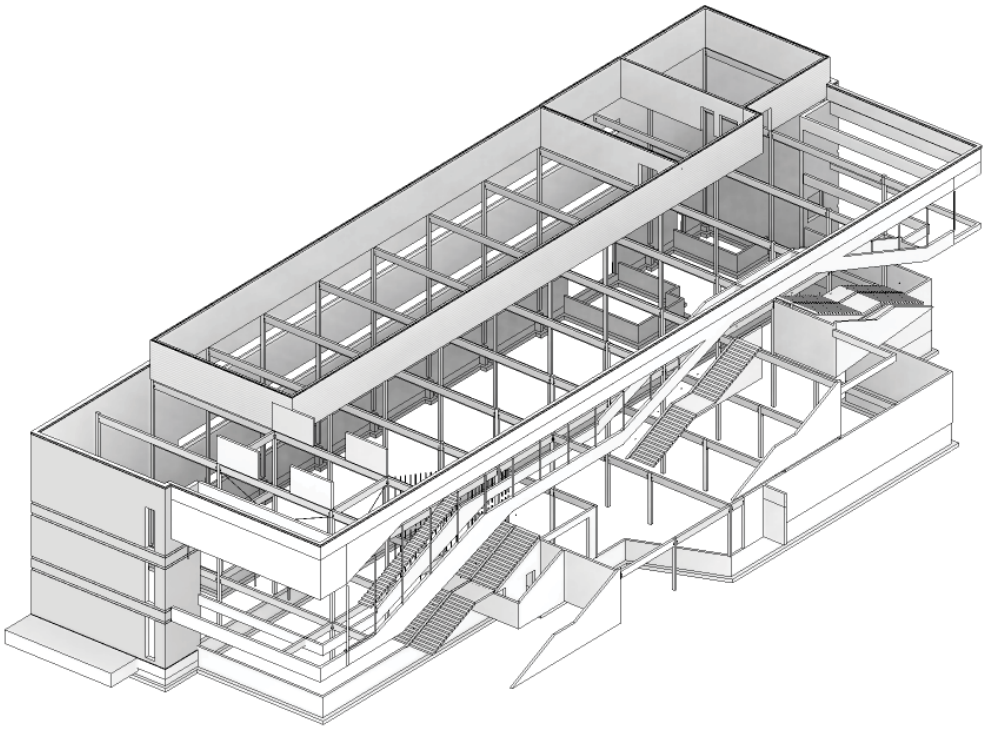
STRUCTURAL SYSTEMS

STRATEGIES:

The following structural systems have been implemented into the provided schematic design by NBBJ for the proposed Integrated Research and Innovation Center on the University of Idaho, Moscow campus:

+ Construction Types
    - Light Wood Frame
    - Timber Frame (Glulam)

+ Building Structure
    - Concrete Wall
    - Column
    - Beam
    - Cross Bracing
    - Cross Laminated Timber
    - Hollow Core Slab
    - Hybrid Wall Systems



Construction Types:

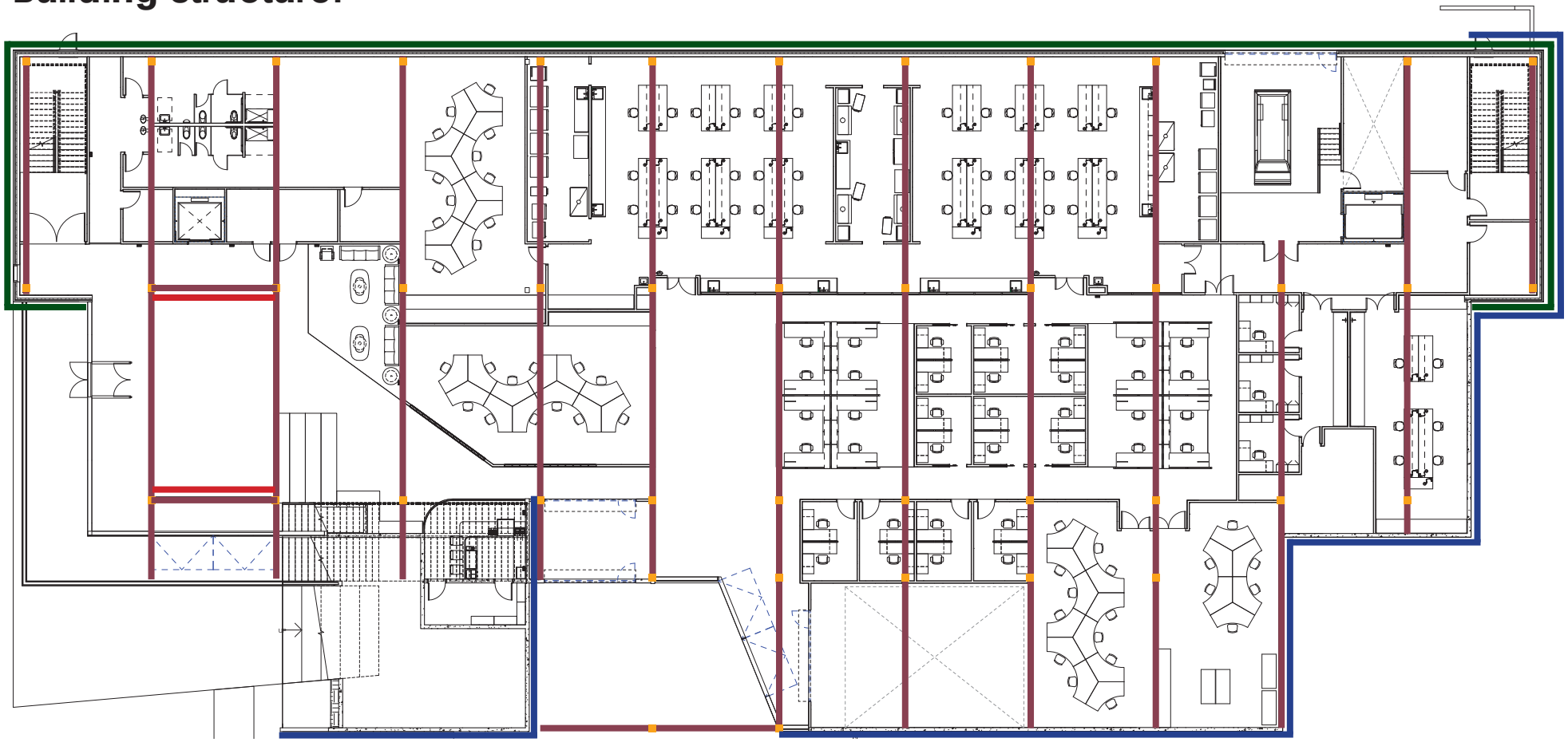
Light Wood Frame -

Benefits: - Flexible
- Economical
- Easily Assembled
- Quick Construction
- Renewable Resource
- Readily Available

Timber Frame (Glulam) -

Benefits: - Flexible
- Versatile
- Economical (when compared to steel & concrete)
- Good Strength to Weight Ratio
- Superior Fire Resistance
- Aesthetically Pleasing
- Renewable Resource
- Long Span Capabilities
- Corrosion Resistant

Building Structure:

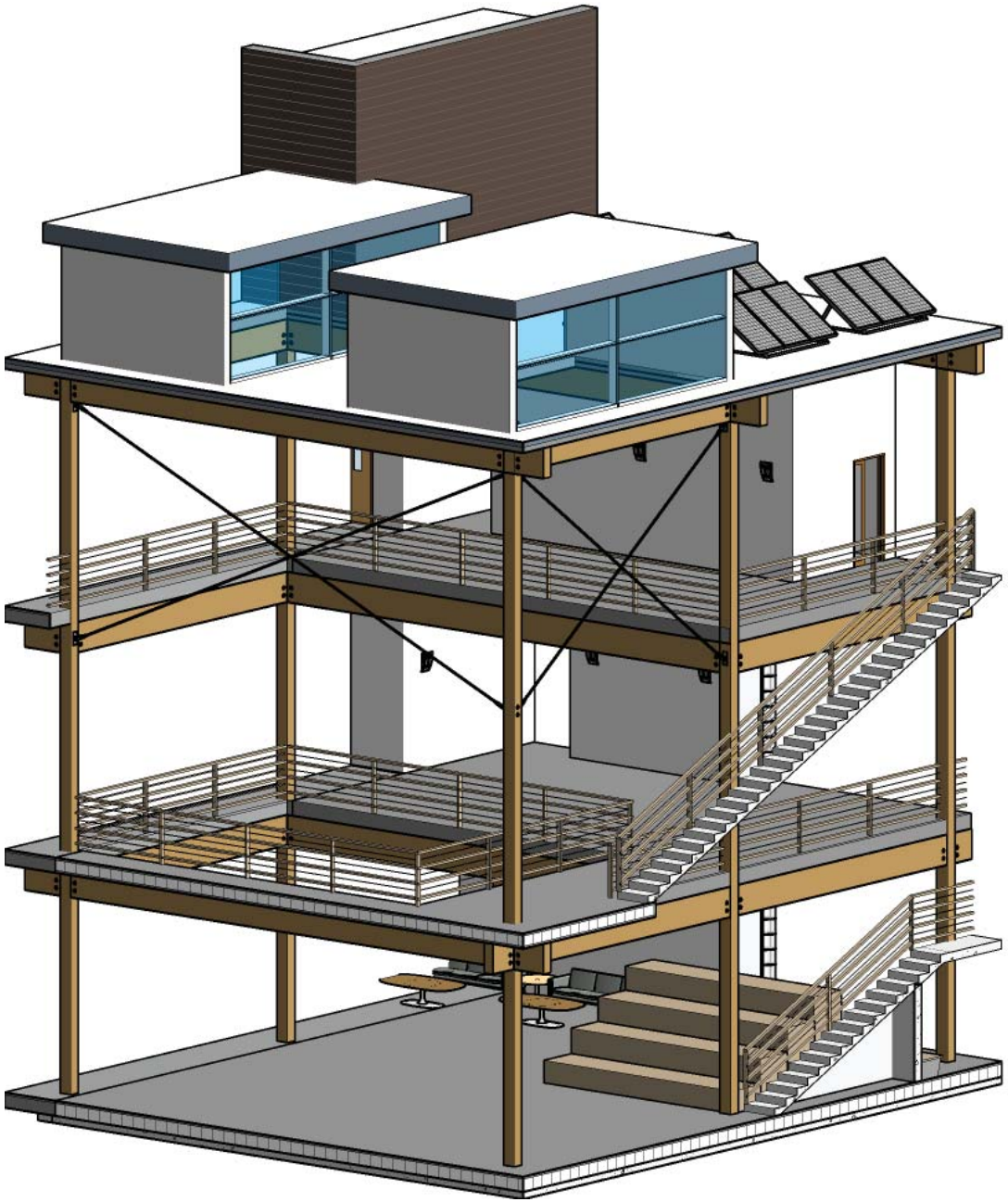


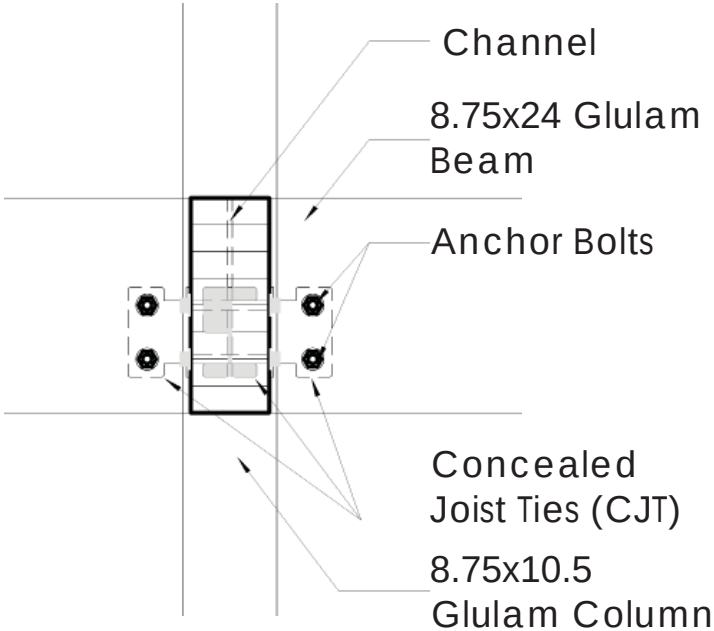
Concrete Wall
Hybrid Wall Systems
Cross Bracing
Column Placement
Beam Placement

First Floor Plan

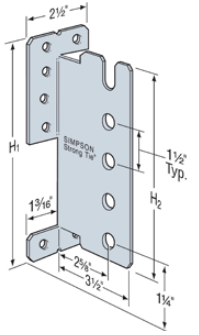
N

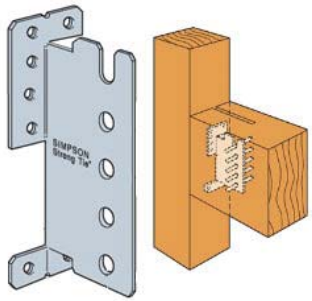
Beam and Column Connection -





Concealed Joist Tie Detail

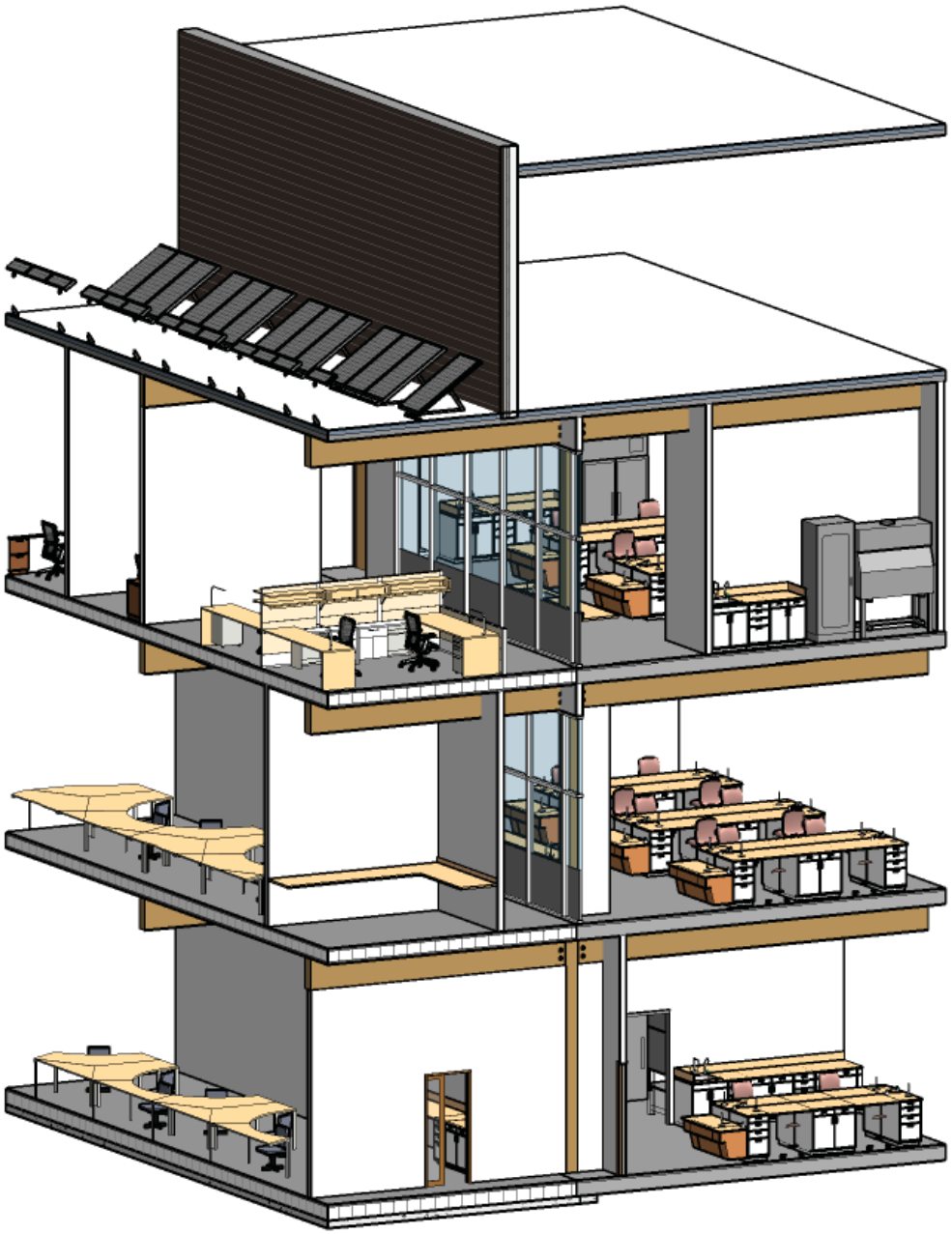


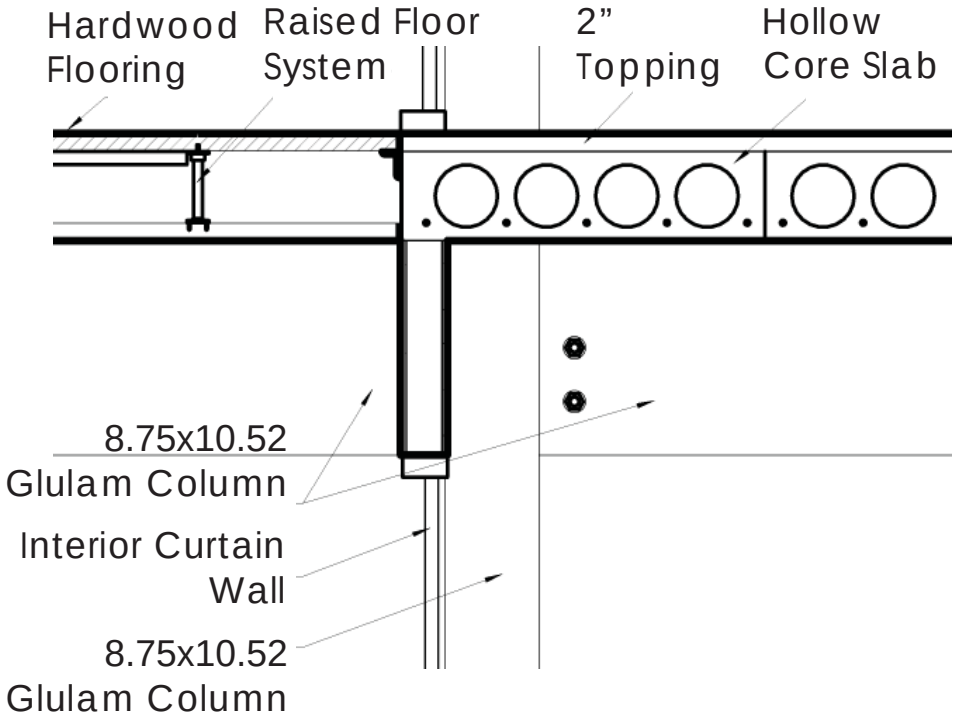


Beam to Column Connection Method

Simposon CJT: http://www.strongtie.com/products/connectors/cjt_apg.asp#

Floor Structure -

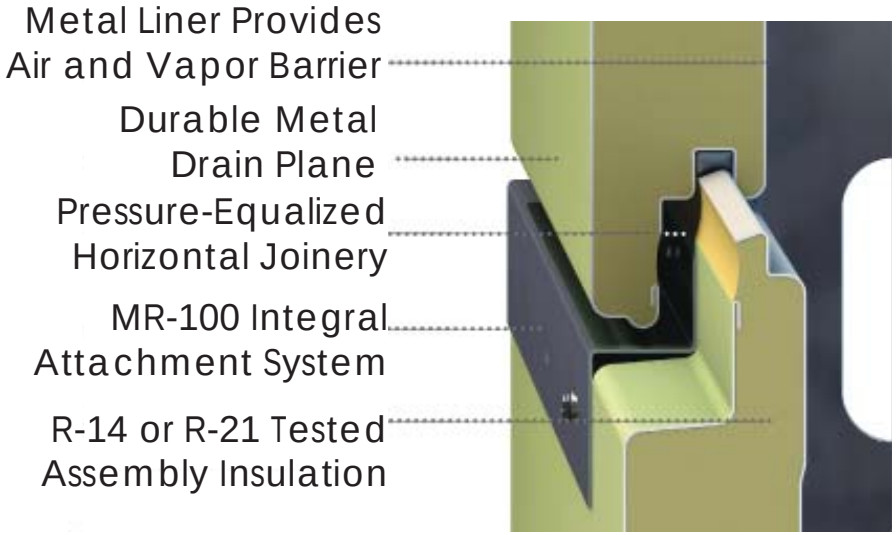


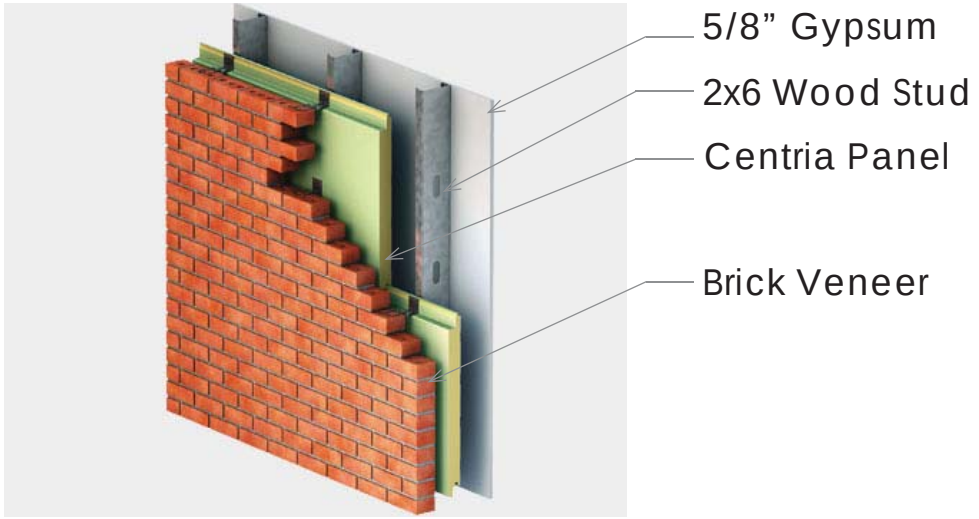


Raised Floor & Hollow Core Floor System Detail

Hybrid Wall Systems -

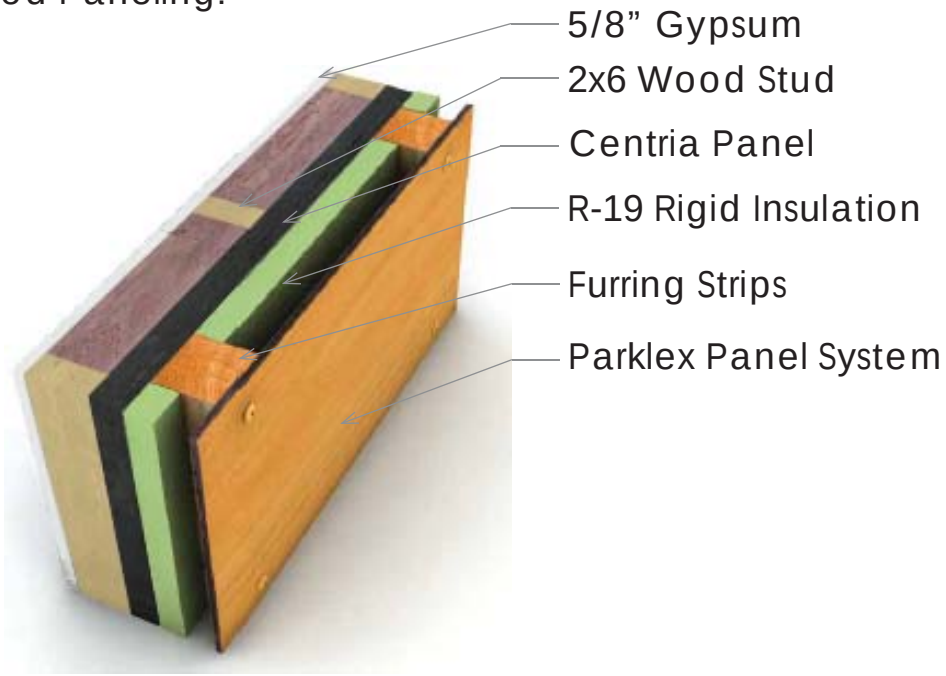
Light Wood Frame with Centria Panel and Brick Veneer:





Light Wood Frame with Centria Panel Exterior Parklex Wood Paneling:

HPL Core

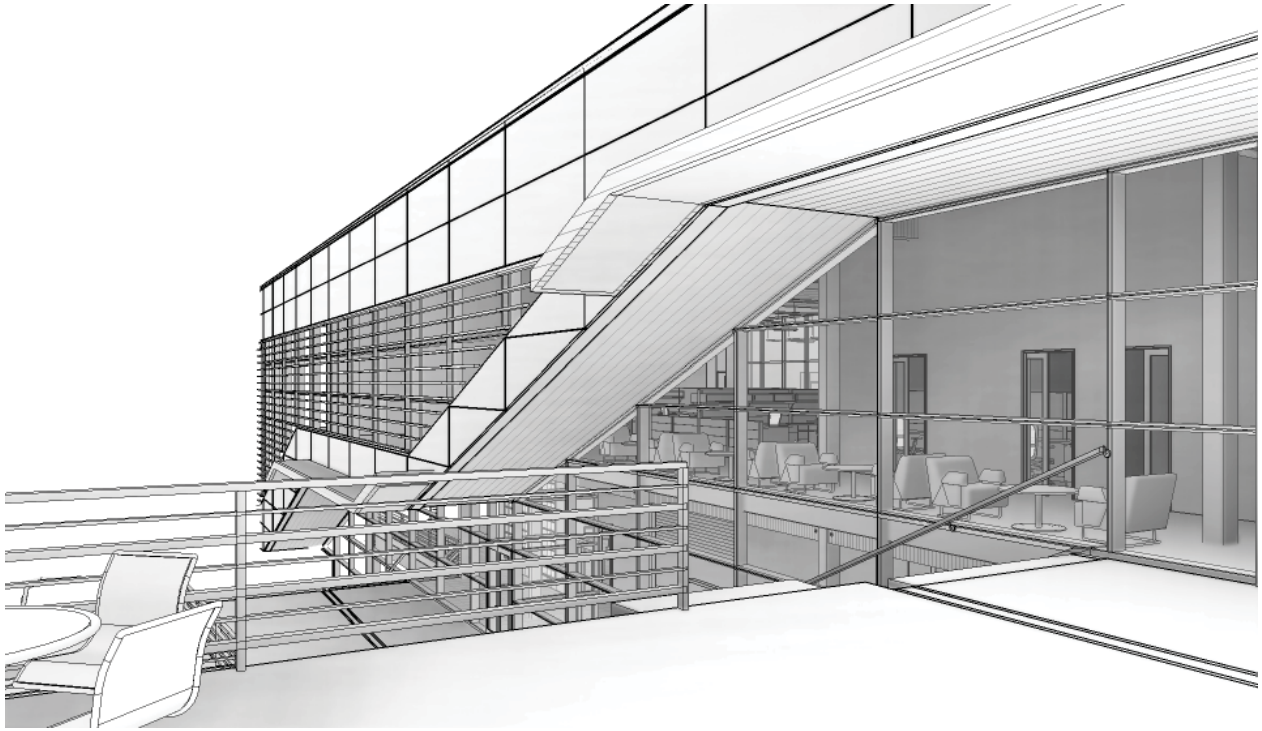


BUILDING ENVELOPE

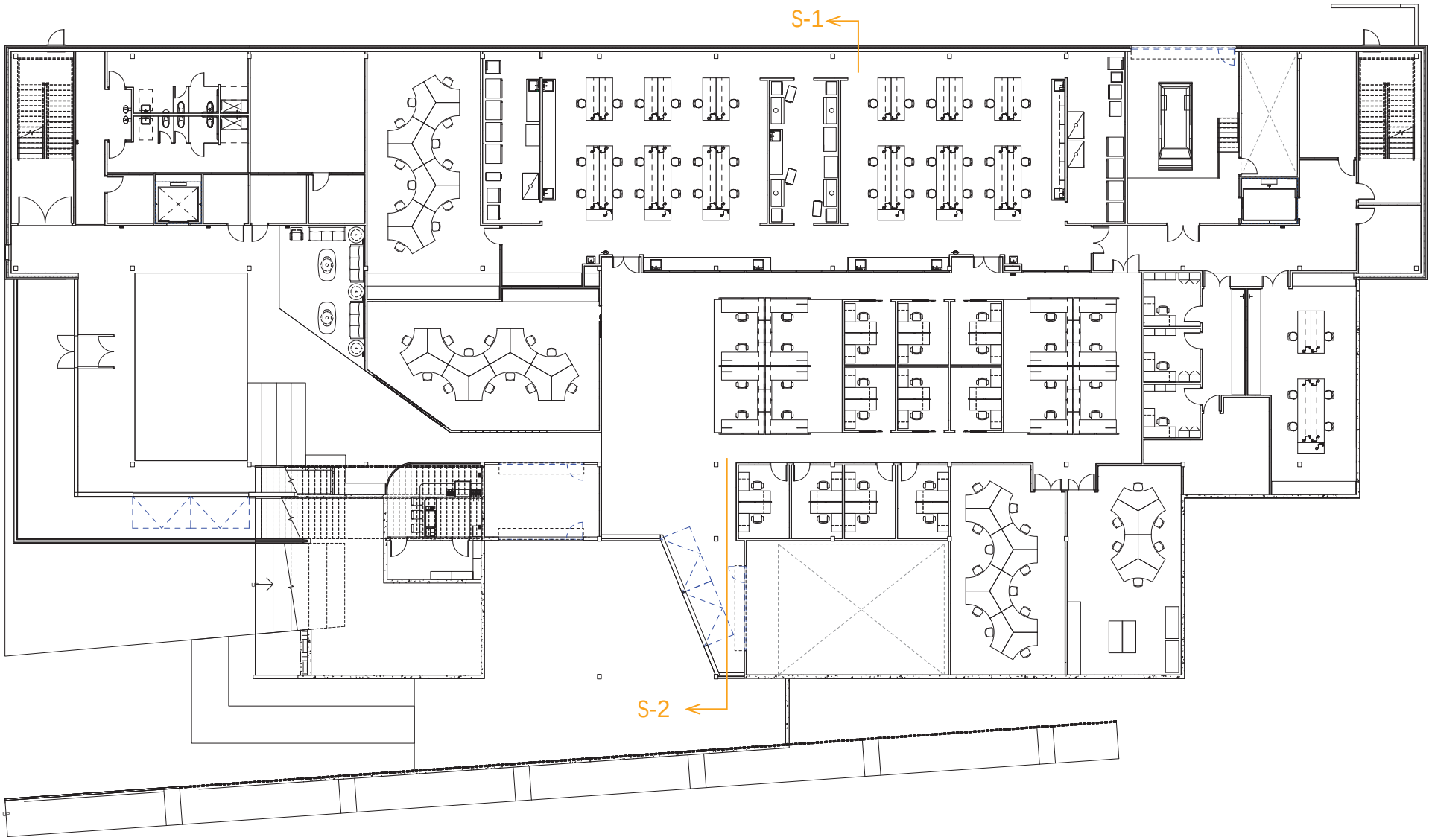
STRATEGIES:

The building envelope is comprised of several different elements. The following have been implemented:
- Curtain Wall
- Light Wood Framed with Brick Veneer
- Light Wood Framed with Parklex Paneling
- Reinforced
- Exterior Shading

Third Floor Entrance Perspective:



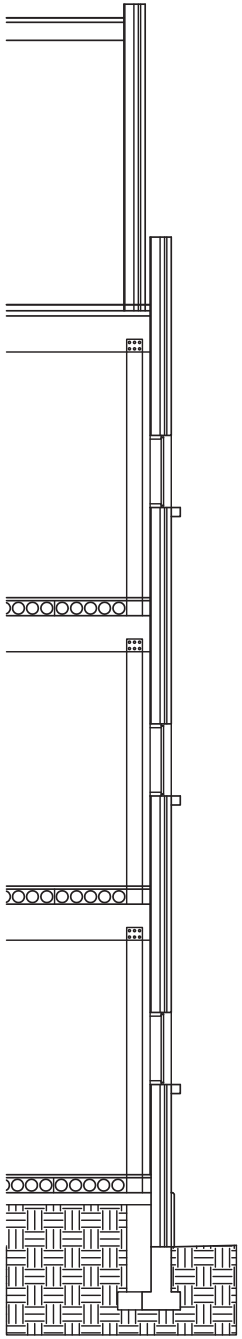
Building Envelope Section Locations:

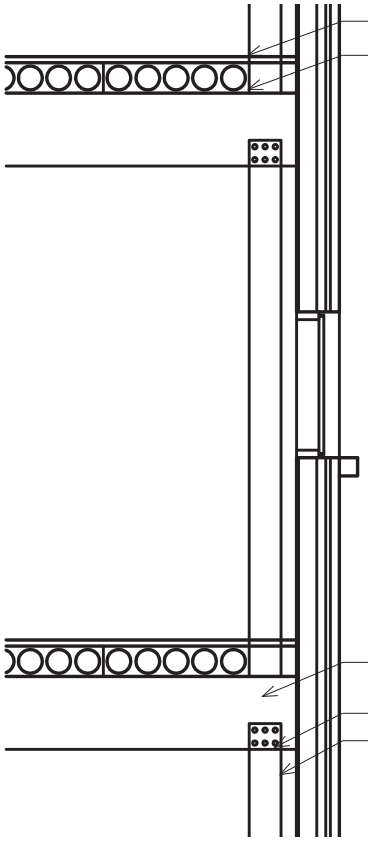


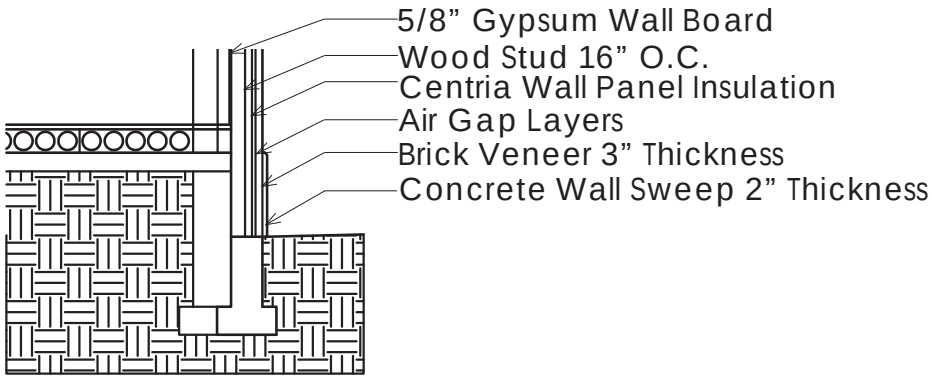
First Floor Plan

N

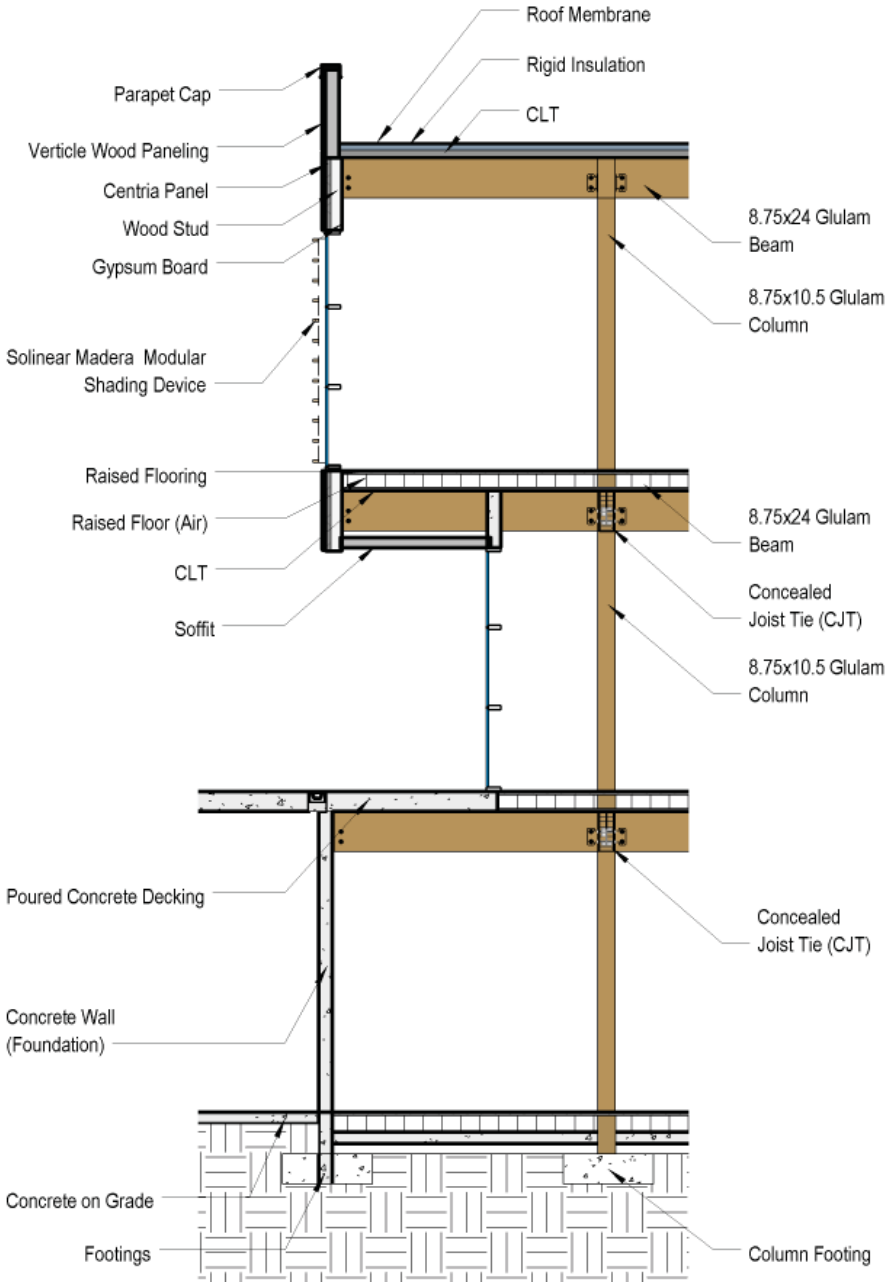
North Wall, West Facing: S-1

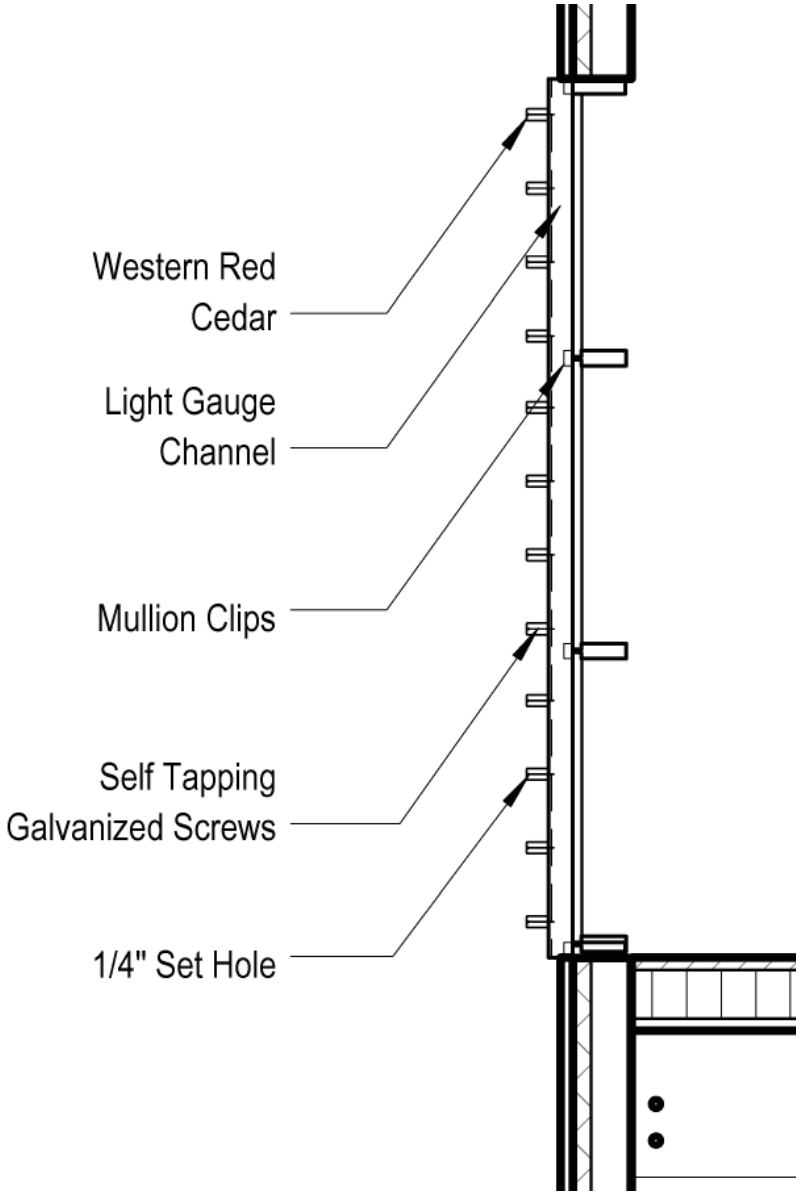






South Section, West Facing: S-2





Shading Device connection to Curtain Wall

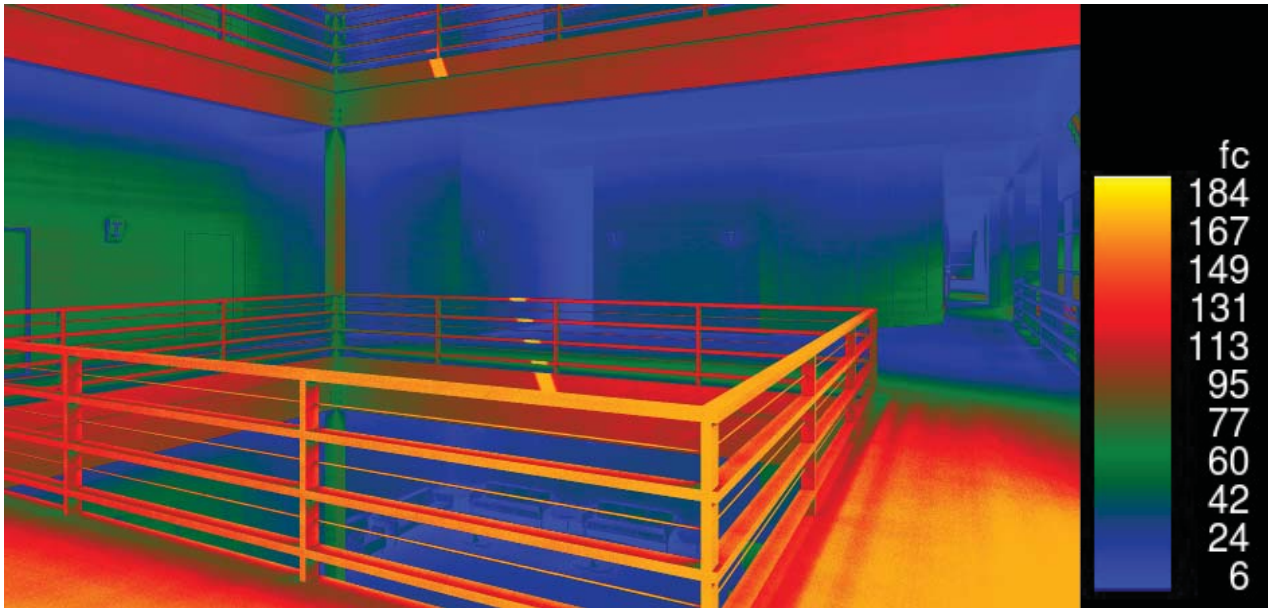
ENERGY EFFICIENCY

STRATEGIES:

The following strategies have been implemented into our energy analysis to improve the performance of this building:

- Double pane low-e glass
- Extensive shading
- High value insulation
- Thermal mass
- Energy efficient electrical lights

Daylighting Simulation: Atrium



Windows:

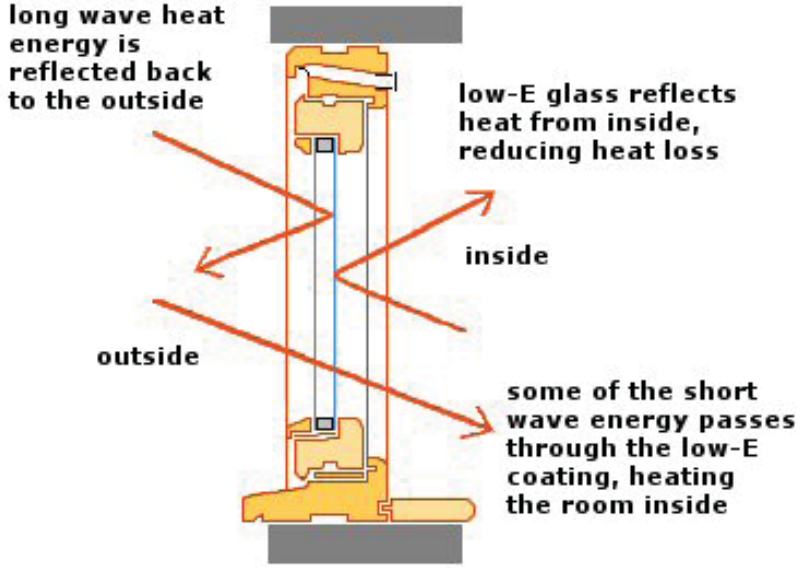
- Window Frames - Metal framing with a piece of non-conductive material sandwiched between metal parts to cut down on the flow of heat (instead of switching to wood, fiber glass, vinyl, or vinyl-clad wood frames)

- Double Pane - with a 3/4” space between sheets. Could be filled with argon to increase efficiency

- Glass Type - will have a low-e (low emissivity) coating. This coating will help reflect warmth back into the building during winter and will prevent unwanted heat gain in the building during the summer. The glass will have an approximate U-factor of <0.30 (U-factor measures the rate of heat transfer through a material)

- Exterior Shading - Curtain wall on south side is covered by cantilevering second and third floor over the first floor
  - Shading slats cover the curtain wall on south of floors two and three
  - Balconies on east and west side are set in

- Double Pane
- Low-E
- Exterior Shading

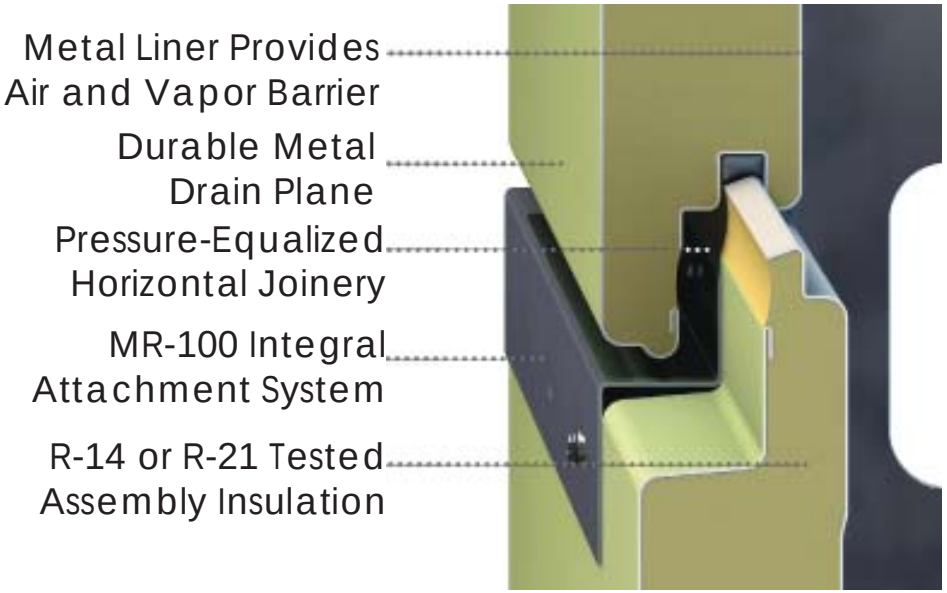


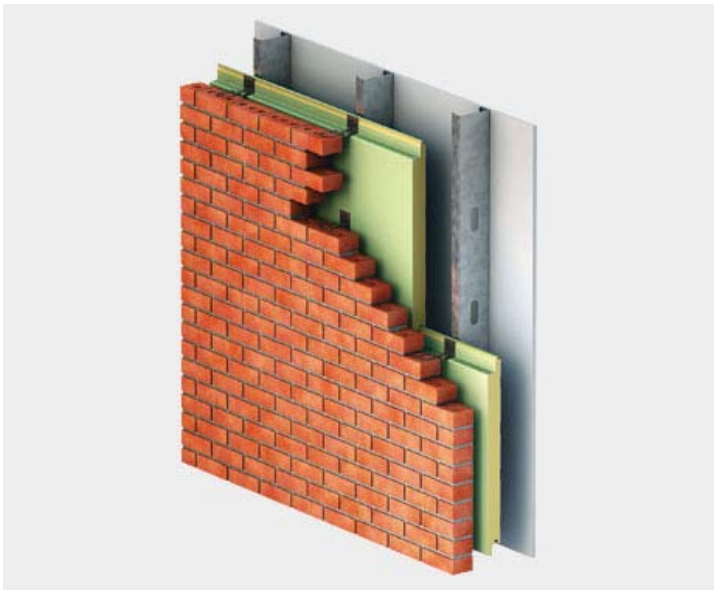
LOW-E GLASS REFLECTS HEAT, SAVING HEATING ENERGY

http://www.consumerenergycenter.org/home/windows/todays_windows.html
http://www.lowenergyhouse.com/site images/diagrams/low-E-310308.jpg

Exterior Walls:

- Insulation - CENTRIA's insulated composite back-up panel, Metal Wrap Series. The panel effectively controls moisture without sacrificing thermal efficiency.
  - Panel consists of two steel skins, permanently bonded to a poured-in-place foam insulating core.
  - Panel provides thermal, air, water, and vapor barriers.





- 3" panel thickness provides a **R-Value 21**

http://www.centriaperformance.com/technical_data/specifications.aspx
http://www.centriaperformance.com/products/wall/insulated_metal_back-up_panels/metalwrap/hor/200.aspx

Thermal Mass:

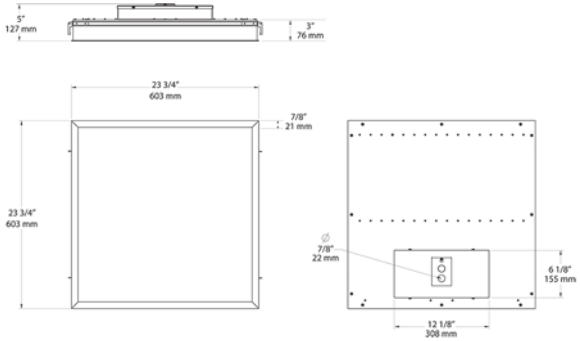
- Hollow Core Slab - in the lab spaces there is a 10” thick slab with a 2” topping layer of concrete.
  - Benefits of the hollow core slab include: heavy weight capacity, exceptional fire resistance, consume less raw materials to manufacture, offer the possibility for reuse and recycling, efficient span/depth ratio, can be easily altered to enable heating and cooling of a building, can be easily changed to include electrical wiring, plumbing, and sprinkler systems etc.

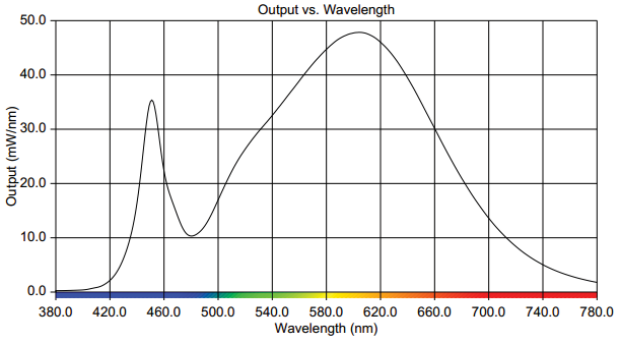
- Thermal Mass
- Easily altered to enable heating and cooling to building

http://www.ultraspan.ca/index.php?option=com_content&view=article&id=121:advantages-of-precast-prestressed-hollow-core-slabs&catid=83&Itemid=566

Electricity:

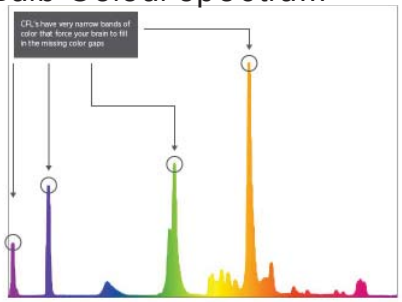
- Panel Lighting - RAB Lighting manufactures LED panel lights. The 2X2-34Y panel provide: 34W, with a colour temperature of 3000K, a colour accuracy of 85, and a 100,000 hour lifetime.



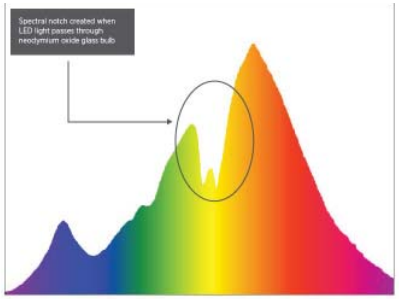


- Bulb lighting - Cree Lighting creates a LED bulb, that can replace the need for a 60 Watt bulb.
  - Warm/Soft White TW Series LED Bulb

Typical Compact Fluorescent Bulb Colour Spectrum



Cree TW Series LED Bulb Colour Spectrum



- These electrical lights will be paired with dynamic daylighting controls to help reduce electrical loads

http://www.rabweb.com/product.php?product=PANEL2X2-34Y#!prettyPhoto
http://www.creebulb.com/bulbs/warmsoft-white-tw-series-led-bulb-60-watt-replacement?lang=us-en

Energy Analysis Results:

Site Energy Consumption:

- This includes HVAC fans, lab equipment, daylight controlled energy efficient LED lighting, and other various plug loads. 486,512 kWh

Site Electricity Production:

- 6,688 square foot section of roof with high efficiency 60 cell Suniva Optimus Series Solar Panels with an energy rating of 18%. -143,948 kWh

HVAC

- Draw for mechanical system operation. 6,397 kWh

District Heating:

- Heating is provided by the University of Idaho steam plant which uses regional biofuels (wood chips). 757,764 kWh

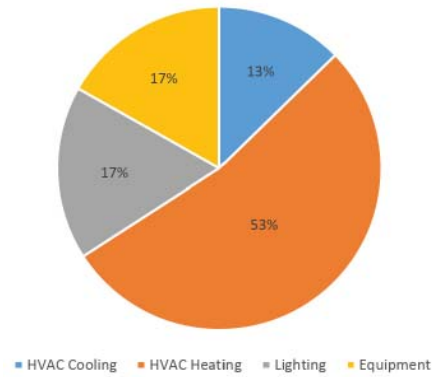
District Cooling:

- Cooling is accomplished by utilizing the University of Idaho's chilled water tower system. 180,600 kWh

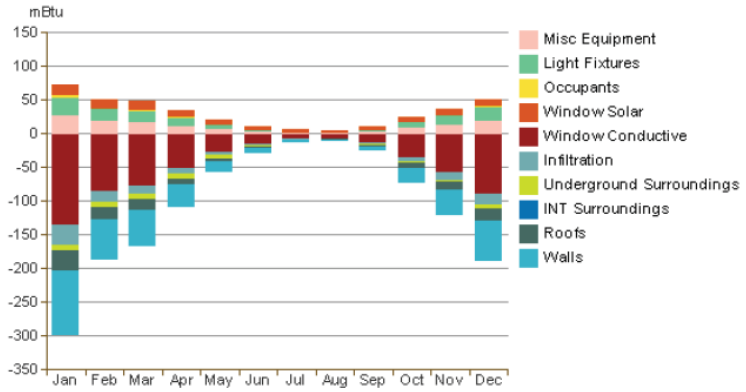
Annual Energy Consumption: 348,961 kWh

Resulting EUI: **17.25**

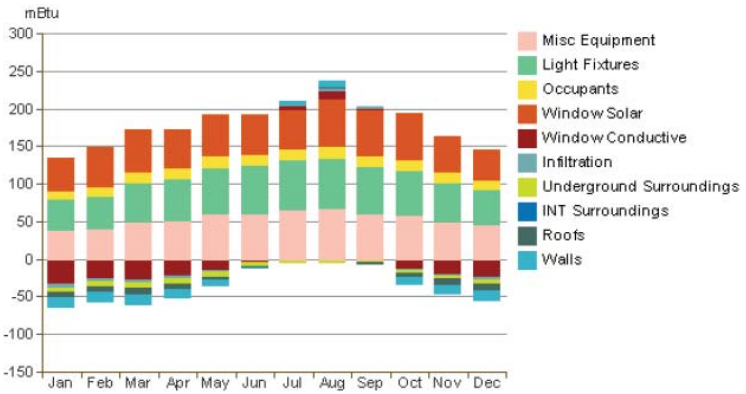
Energy Load Distribution (kWh)



Monthly Heating Load:



Monthly Cooling Load:



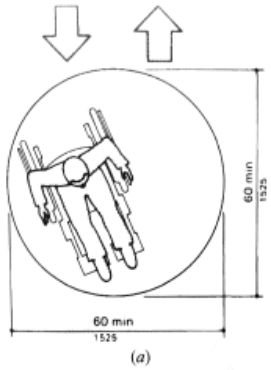
ACCESSIBLE CONSIDERATIONS

STRATEGIES:

The following considerations have been taken in our exterior site design and interior environments to make the building usable by all to the fullest and most beneficial extent.

- Multiple Site Entry Points
- Multiple Building Entry Points
- Pedestrian Pathways
- Circulation Routes
- Wheel Chair Accessible Features Throughout

Turning Radius:



Lab Space Counters:

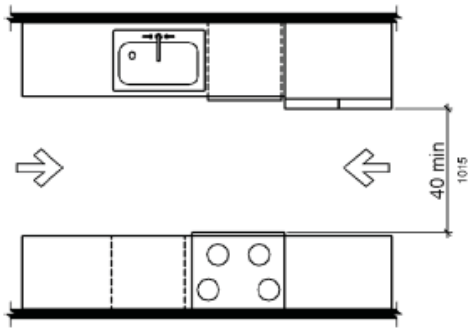


Figure 804.2.1
Pass Through Kitchens

Vertical Clearance:

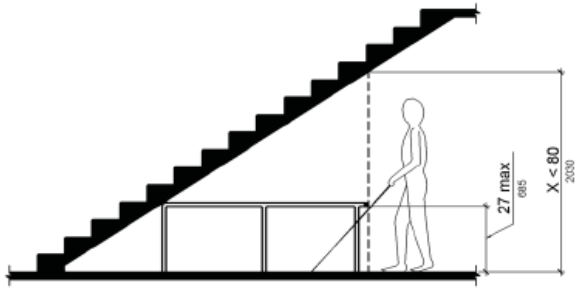


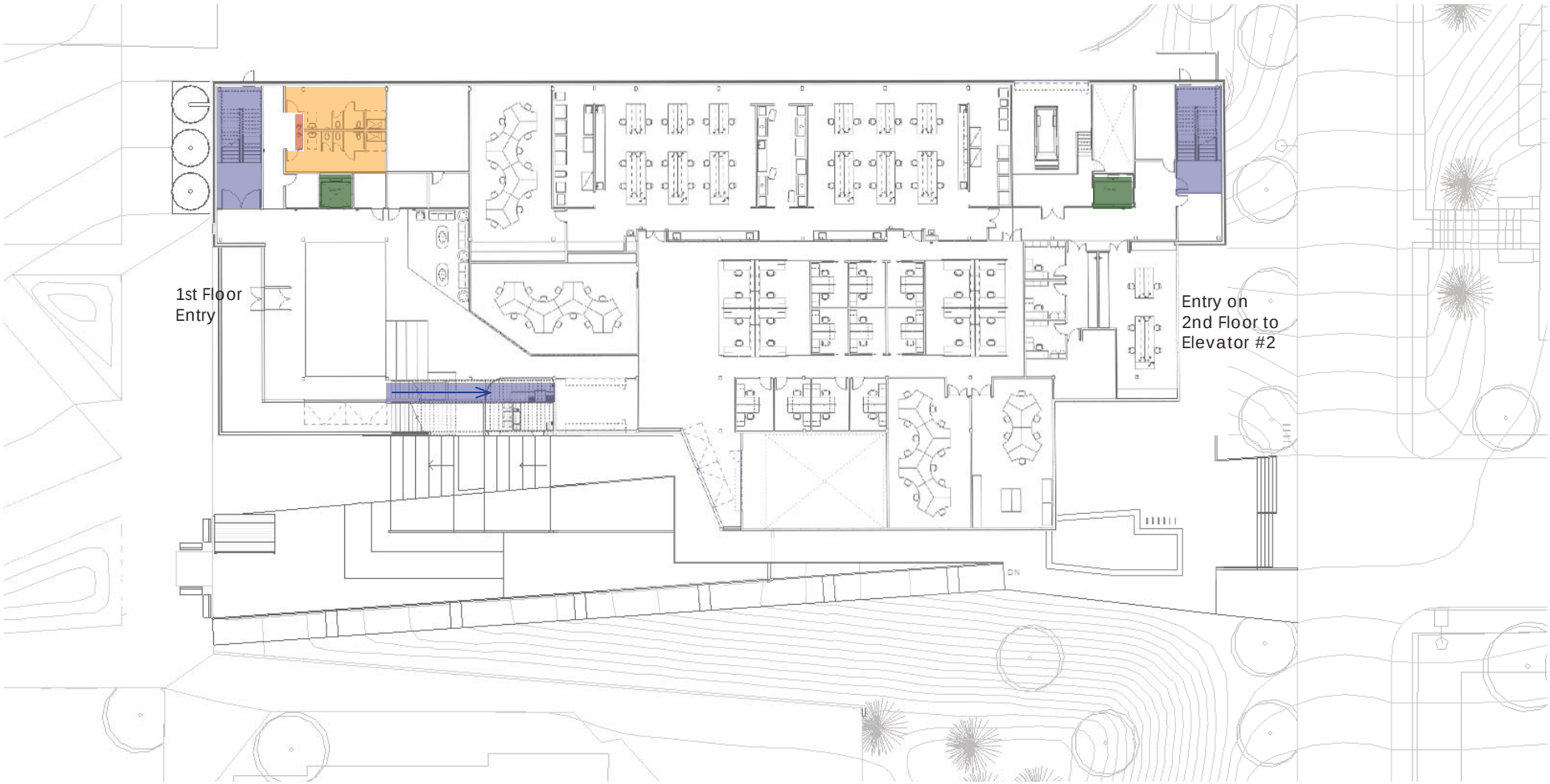
Figure 307.4
Vertical Clearance

Interior Circulation: First Floor

It is important for the building to accommodate all users especially with relation to entrances and location of building services like lavatories, elevators, and stairs.

- Stair Circulation
- Elevators
- Drinking Fountains
- Lavatories

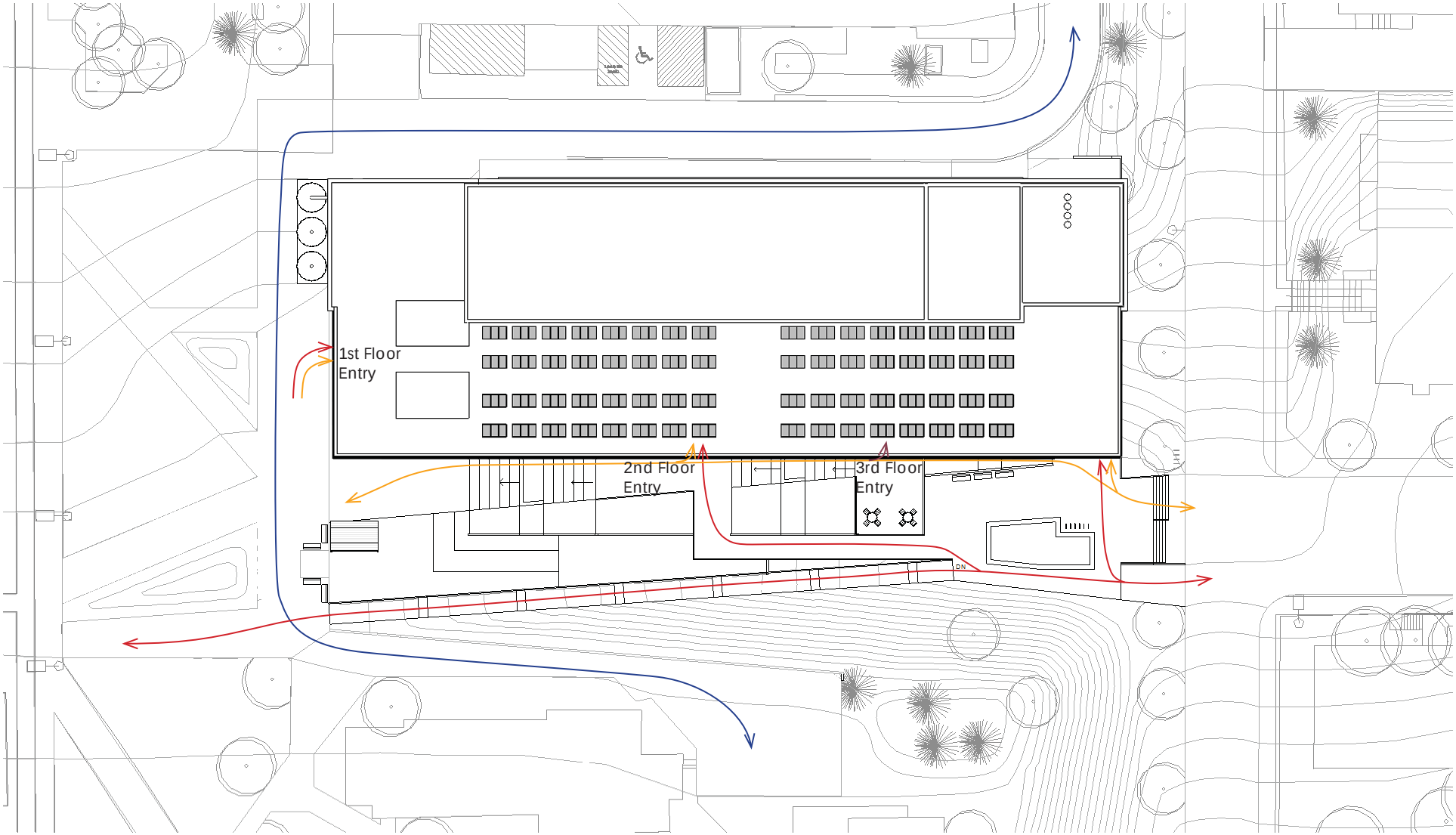
* All doors are a minimum width of 36”
* Hallways are 6’-0”
* Distance between counters in lab space is 7’-10”



Exterior Circulation:

It is important for circulation of people to work smoothly and in conjunction with site design elements, like the new building, existing buildings, and potential vehicle movements.

- Wheelchair Routes
- Walking Routes
- Maintenance Vehicle Route



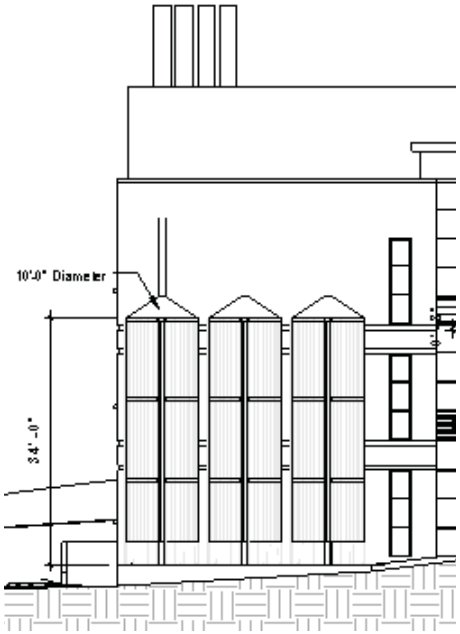
SITE CONSTRUCTION

STRATEGIES:

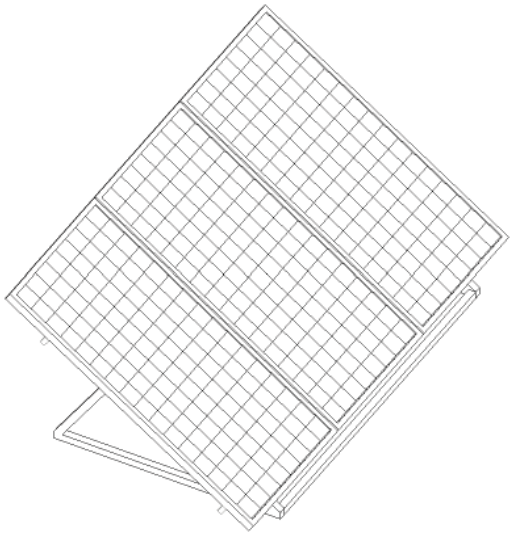
The following strategies have been implemented into our site design to express the aesthetic elements, educate users, and improve the performance of this building as a whole:

- Water Catchment Systems
- Energy Generation
- Pervious Surfaces
- Bioswales

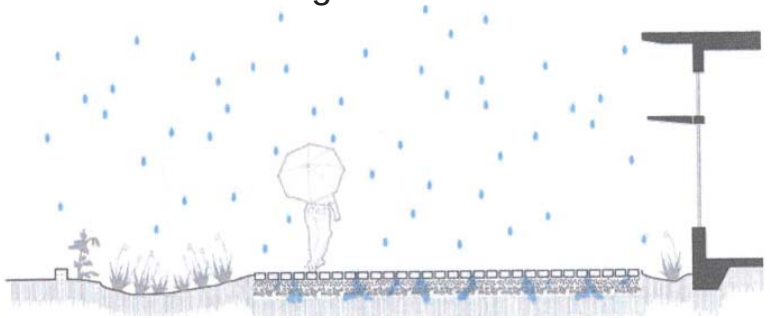
Water Catchment:



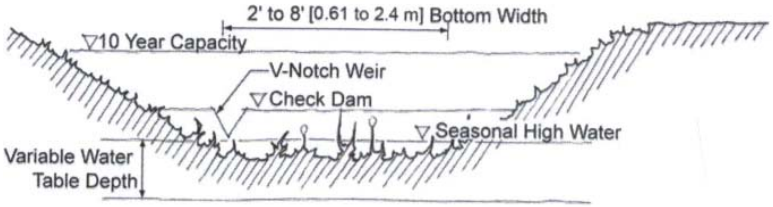
Energy Generation:



Permeable Paving:



Bioswale:



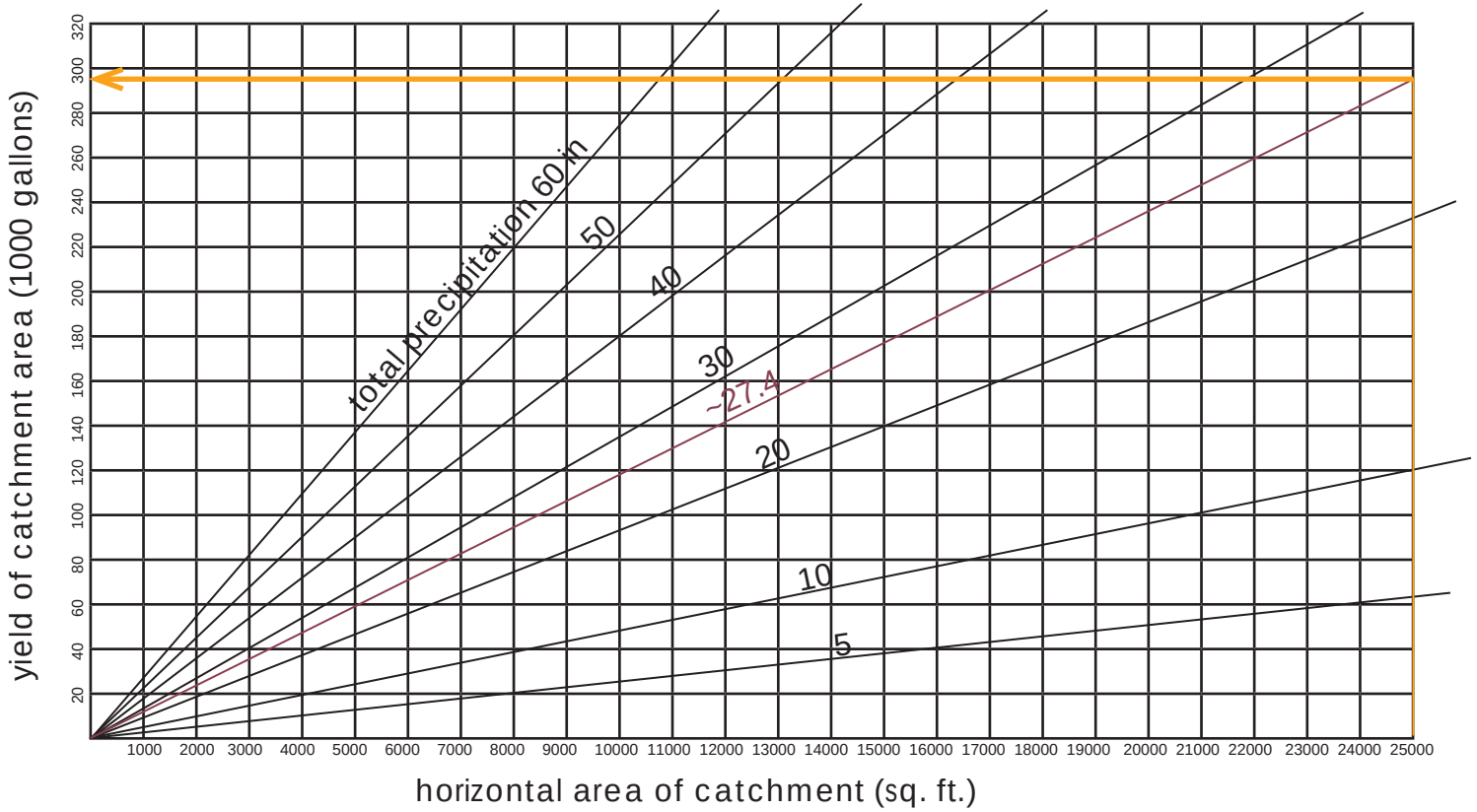
Cistern:

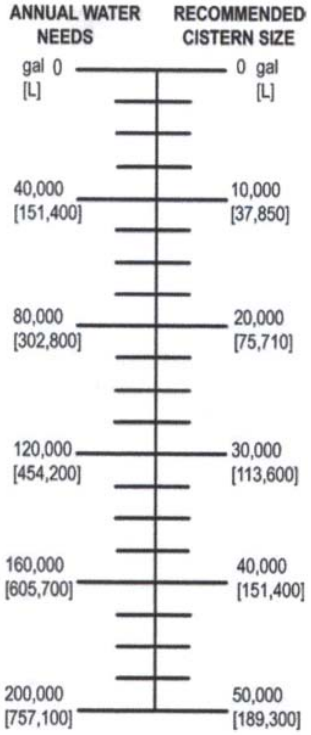
Based off of the area of the roof and average rainfall in Moscow, ID, the building run off water created by rainfall would be more than enough to supply Grey Water usage in the building. Water collected will be used for the flushing of toilets only.

Roof area: 24,924 sq. ft.
Average Precipitation: ~27.4 in

According to this chart found in The Green Studio Handbook the runoff from the roof is: ~290,500 gallons of rain water / yr
Due to losses from evaporation, snow, ice, and roof-debris-washing cycles, only 75% of average annual rainfall will be available for cistern storage.

290,500 x 0.75 = **217,875 gallons** will be available for cistern storage / yr





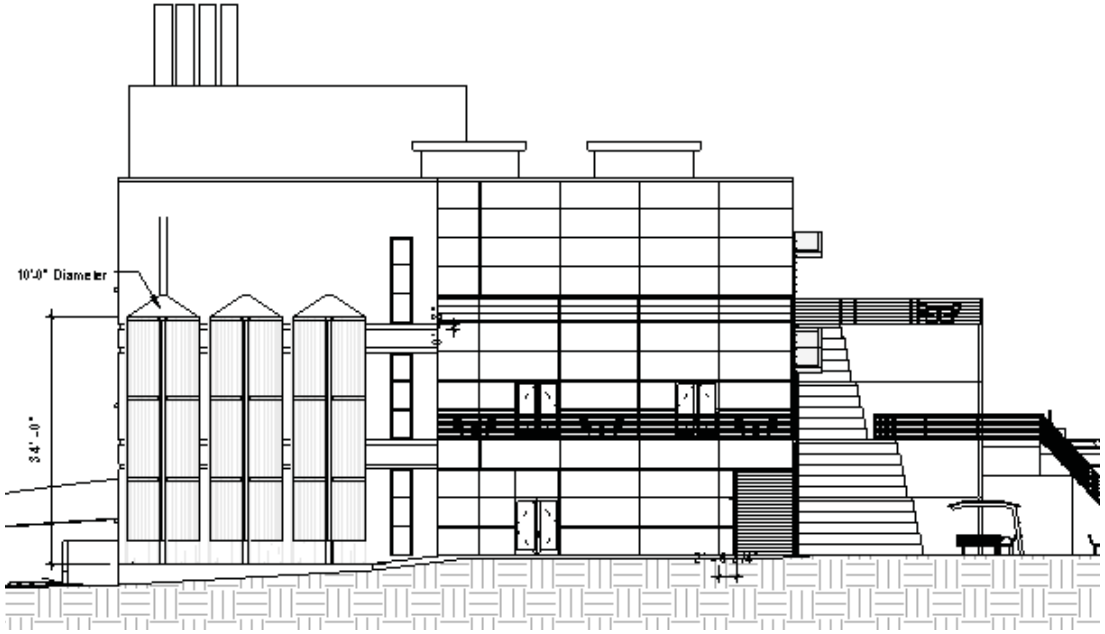
Do we need to collect all rain water, roof run off? - Yes
What will this water be used for? - Toilet / urinal flushes
How much water will be used for flushing toilets/urinals in one year? - Average water usage for dual cycle toilets x 1 fixture x average flushes per day per unit x realistic day occupancy x one yr.
1.3 gallons x 1 fixture x 3 flushes x 150 people x 365 days = **213,525 gallons per year**

*Rain water runoff can produce 217,875 gallons of water per year, therefore we need to collect all available water in order to meet the requirement for the flushing of toilets and urinals.

Sizing the Cistern:
According the image on previous page by capturing about 220,000 gallons of water we need a 55,000 gallon tank to store all rain water, roof, building, run off.

We have specified 3 tanks each with a 10'-0" diameter and 34'-0" in height.
All tanks combined can hold a total of 60,000 gallons of water.

Chesapeake Bay Foundation
Rainwater Catchment System

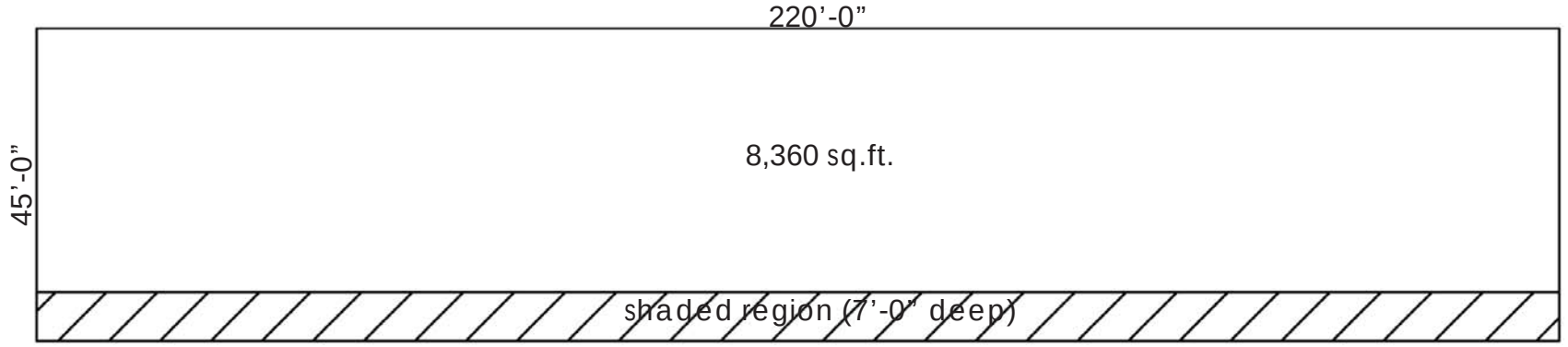


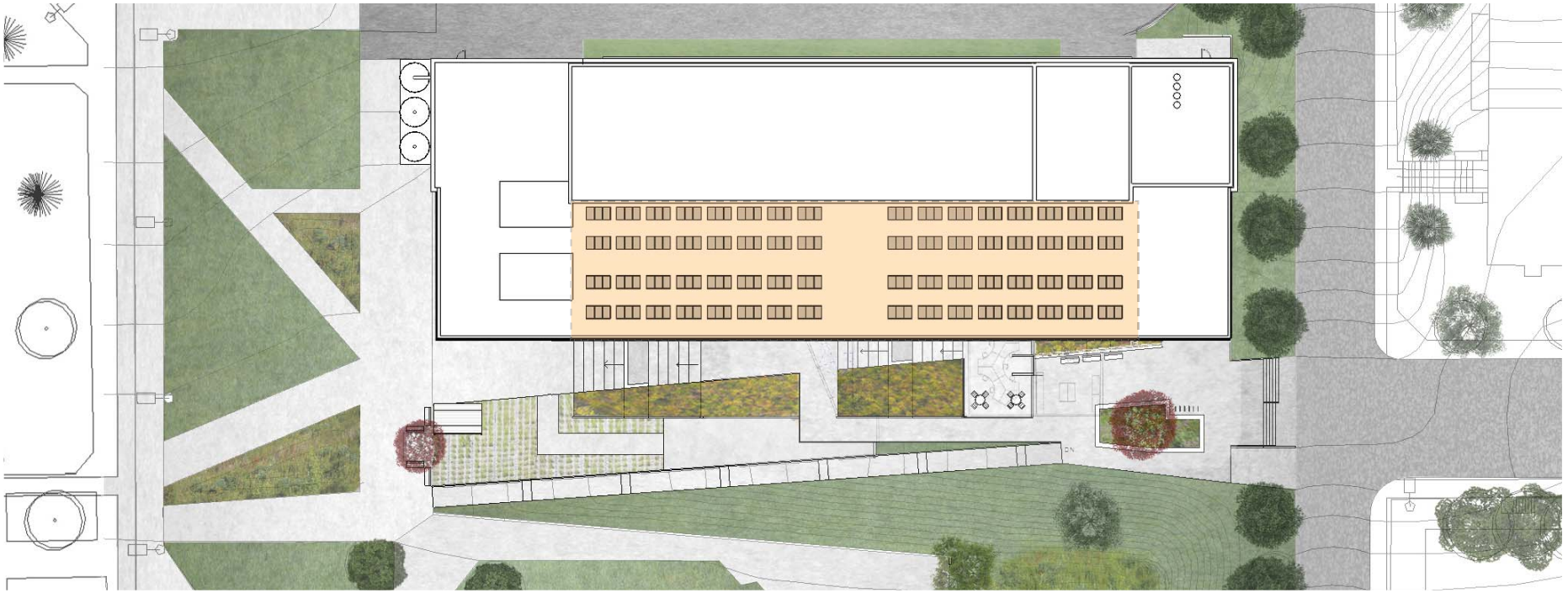
IRIC Rainwater Catchment System

Photovoltaics:

If we place photovoltaics on the roof in front of the penthouse facing south, a substantial amount of energy can be created on site.

Total selected roof area: 38’-0” x 220’-0” = 8,360 sq.ft
Selected roof area: 8,360 sq.ft. x .80% = 6,688 sq.ft. (minus area for walkways, 20% of selected area)





RESULTS

143,938 kWh per Year

Month	Solar Radiation (kWh / m^2 / day)
January	2.26
February	3.96
March	4.38
April	5.28
May	5.88
June	6.27
July	6.73
August	6.48
September	5.43
October	4.18
November	2.70
December	2.57
Annual	**4.68**

Array Type: Open Rack
Array Tilt: 46.7 °
Calculated Efficiency Rating: High - 18%
Suniva 60 Cell Panel Rating: Over 19%

Created Energy / Plug Load + Lighting
143,938 / 486,522 x 100 = ~ 30%

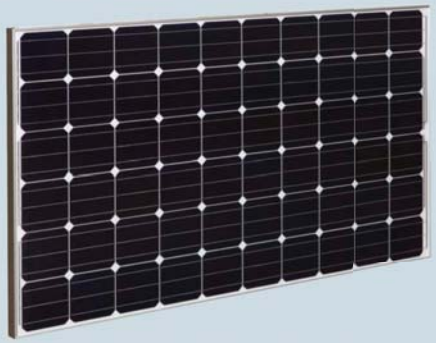
30% Annual Reduction in Off Site Energy

OPTIMUS SERIES: OPT 60 CELL MODULES

Suniva
The Brilliance of Solar Made Sensible®

High-quality and high-efficiency
PV yields sensible solar

SUNIVA OPTIMUS® SERIES MONOCRYSTALLINE SOLAR MODULES



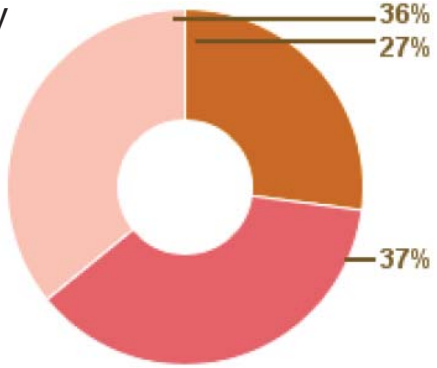
OPTXXX-60-4-100 (60 CELL MODULE)

The Optimus® modules consist of Suniva's latest technology: ARTisun® Select. These superior monocrystalline cells are designed and manufactured in the U.S.A. using our proprietary low-cost processing techniques. Engineered with our pioneering ion implantation technology, high power-density Optimus modules provide excellent value, performance and reliability.

Certifications:

UL 1703 IEC 61215 IEC 61730- 1/2 · QEO · FSEC · AS5033 Compliant · CEC AUSTRALIA · PVEL PID CERT

Energy Use: Electricity

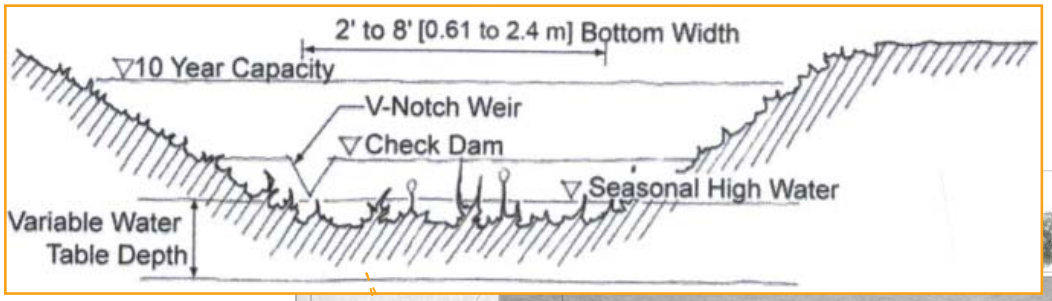


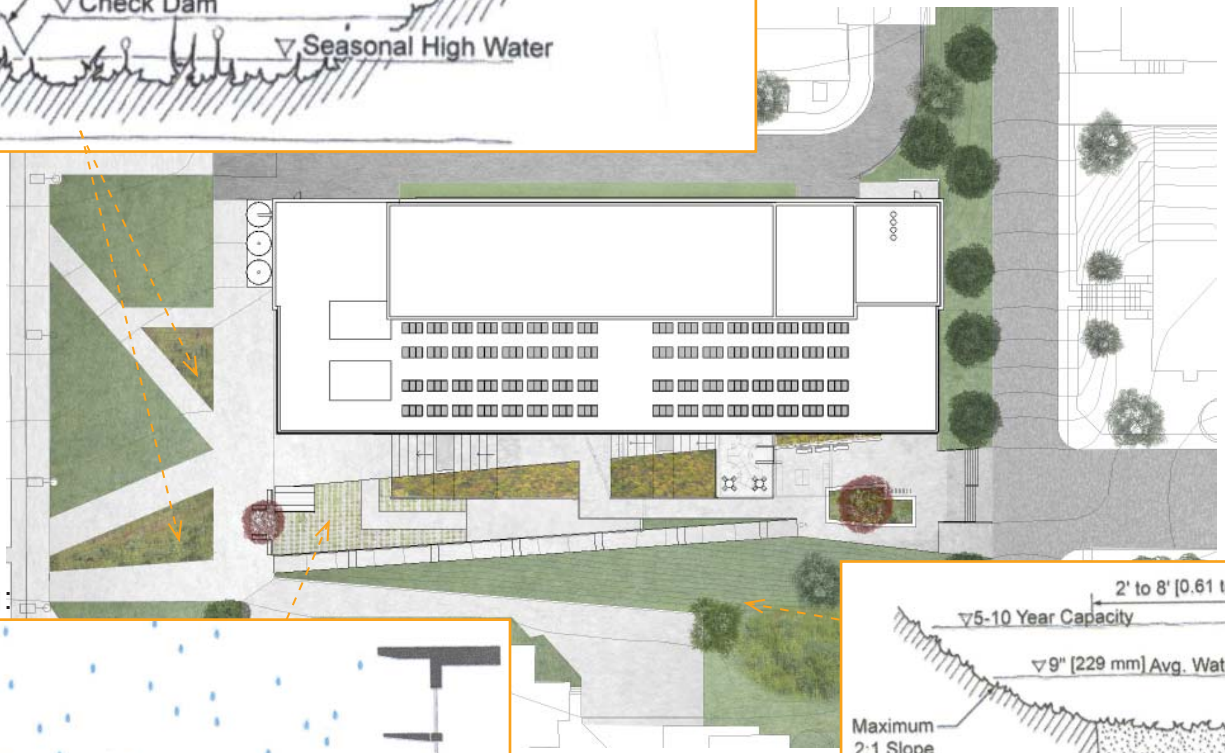
			(kWh)
HVAC	27%	$25,951	180,594
Lighting	37%	$35,516	247,158
Misc Equipment	36%	$34,396	239,364
		$95,863	667,116

Permeable Surfaces + Bioswales:

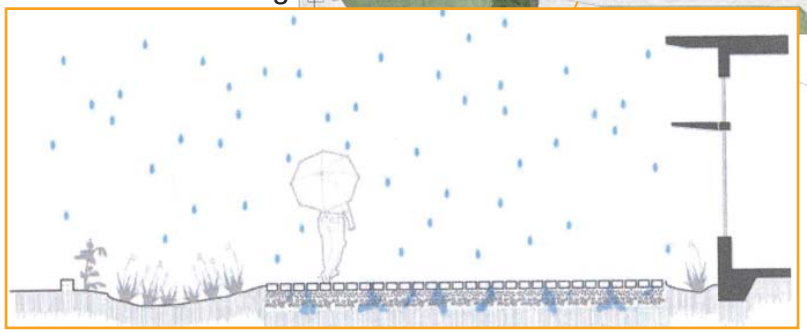
Implementing water catchment systems such as bioswales and increasing the amount of permeable surfaces on site not only creates an additional aesthetic depth and intrigue to the site, but also reduces the amount of hardscape. This allows as much water as possible to naturally filter back into the earths' surface.

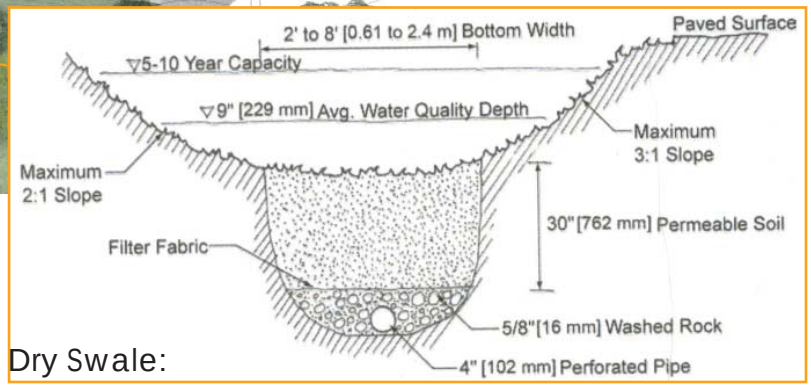
Types of Surfaces:





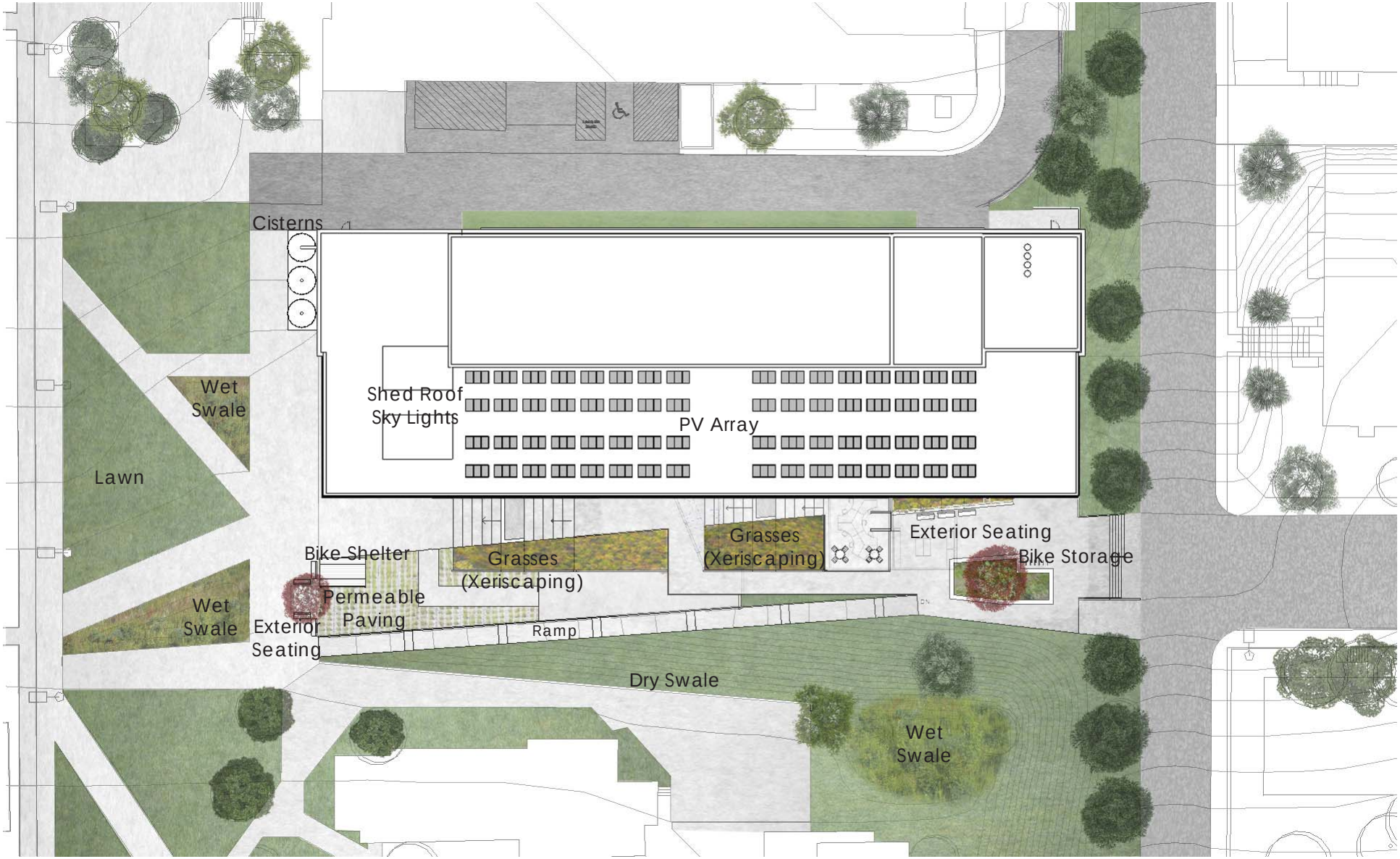
Permeable Paving:





Dry Swale:

Visual Representation of Permeable Surfaces and Site Elements:



BUILDING MATERIAL SPECIFICS

STRATEGIES:

In this section the carbon debt collection of major materials will be graded by: low, medium, high standards:

- Glulam Timber
- Sawn Lumber
- Brick Veneer
- Exterior Wood Paneling
- Cross Laminated Timber
- Hollow Core Slab
- Cistern Tanks
- Vegetation

Glulam Timber:

Boise Cascade -

Boise Cascade owns and operates two laminated veneer lumber manufacturing plants located in Alexandria, Louisiana, and White City, Oregon. From these manufacturing plants Boise Cascade has sixty distributing locations across the United States and Canada.

We are specifying Boise Cascade Glue Laminated Timber from their White City, Oregon manufacturing facility, 559 miles away from the construction site.

Carbon Debt Estimation: **MEDIUM**

Sawn Lumber:

Idaho Forrest Group -

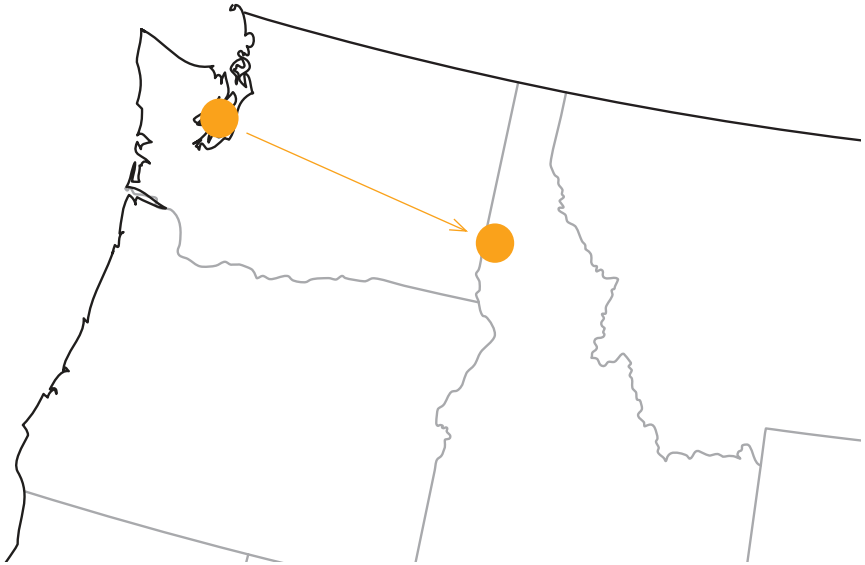
Idaho Forest Group is a well respected company that manufactures and distributes Idaho lumber. Idaho Forest Group will be utilized in supplying Douglas-fir for the overall light wood frame construction of the building and in supplying Western Red Cedar for the exterior shading system.

Within the state of Idaho they operate five mills. The mill closest to the building site is located in Lewiston ID, 32 miles south.

Carbon Debt Estimation: **LOW**

Brick:

Mutual Materials -



Mutual Materials, a leading manufacturer and distributor of masonry and hardscape products, is a company that has been supplying the Pacific Northwest since the 1900s. Mutual operates ten manufacturing facilities. Three of these are brick plants.

We are specifying Mutual Materials to supply for the brick hybrid wall system. The manufacturing facility is located in Bellevue, WA, 291 miles away.

Carbon Debt Estimation: **LOW**

Exterior Wood Paneling

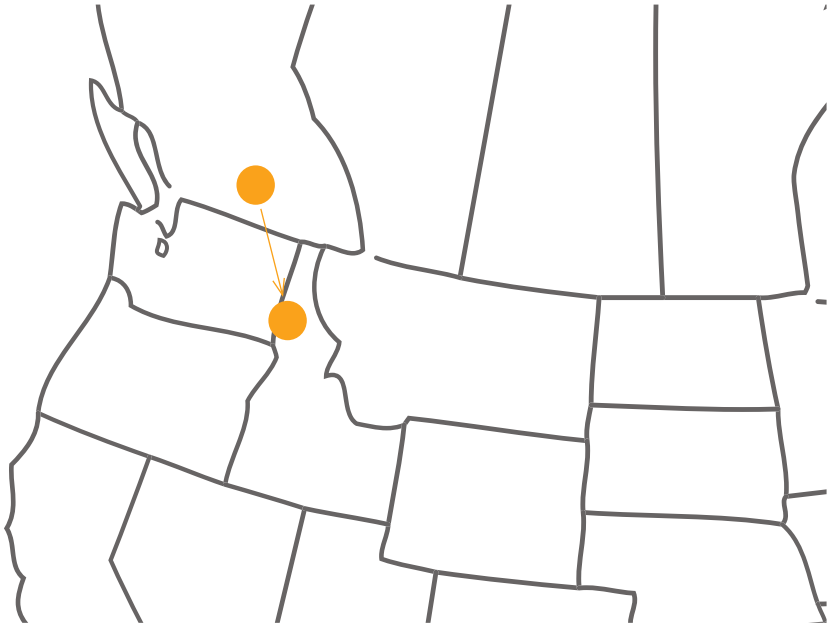
Parklex Facade -

For the exterior facade system we have specified a natural wood product that is manufactured in Navarra, Spain. Although, we would have preferred to have specified an American product and even more so an Idaho product we could not find an exterior paneling manufacturer that could have produced elements to the size we preferred. However, this provides an opportunity for American wood manufactures to explore such possibilities in the wood industry.

Carbon Debt Estimation: **HIGH**

Cross Laminated Timber:

Structurlam -



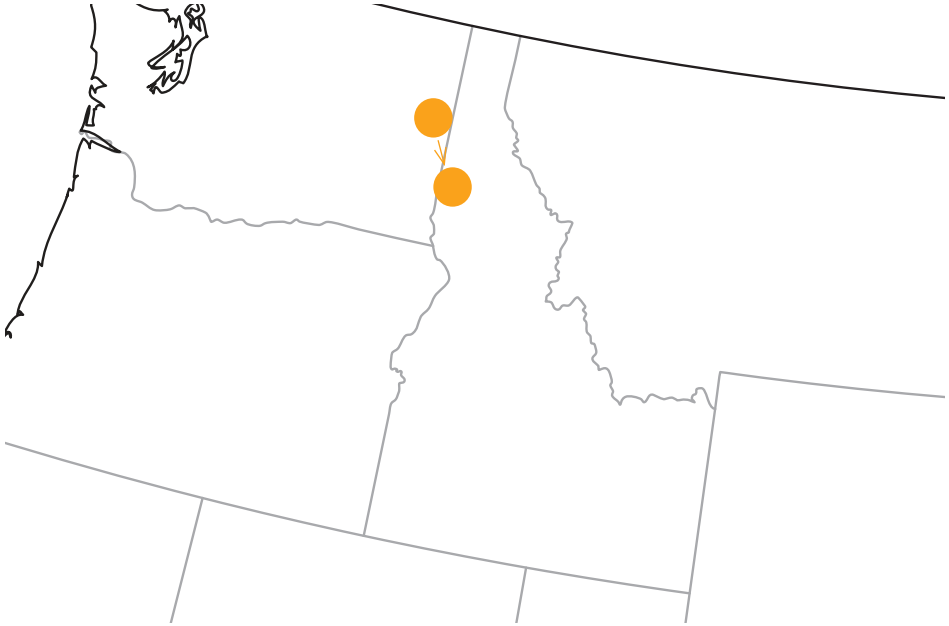
Structurlam, Innovative Wood Specialists is a company ran out of Penticton, British Columbia, Canada. They offer a variety of products that includes Cross Laminated Timber, a great product choice for this building due to its reduced carbon footprint and easy to assemble abilities.

Their manufacturing site in Penticton, BC Canada is 306 miles from the construction site on the University of Idaho, Moscow, campus.

Carbon Debt Estimation: **LOW**

Hollow Core Slab:

Central Pre-Mix Prestress Co. -



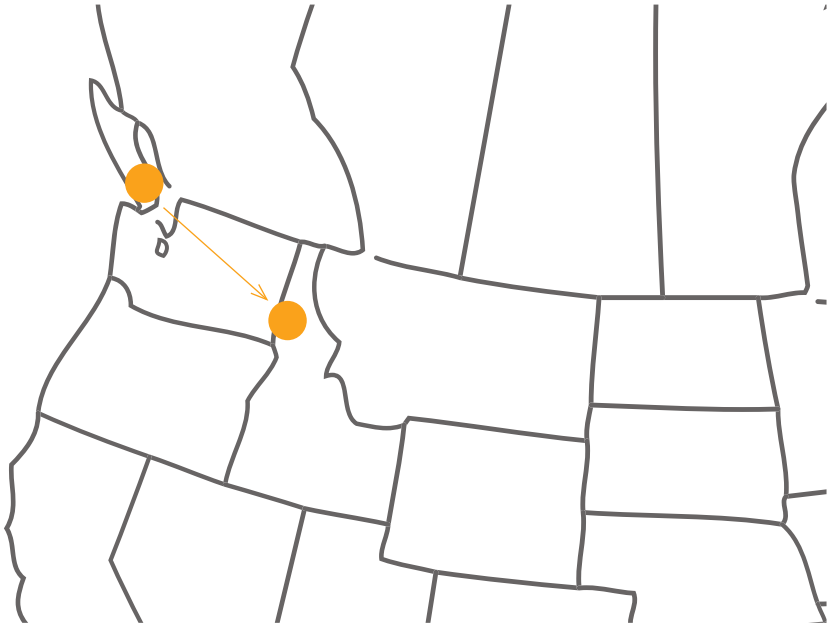
Central Pre-Mix Prestress Co. located in Spokane, Washington, has been in the business of designing and manufacturing prestressed concrete elements for over 50 years. According to Central Pre-Mix Prestress, “precast provides superior life-cycle costs due to its durability and energy efficiency.”

Their Spokane manufacturing facility, in Spokane, is 88 miles away. Even though this is not a wood product, it does not have a long way to travel.

Carbon Debt Estimation: **MEDIUM**

Cistern Tanks:

Forest Lumber & Cooperage Ltd. -



Forest Lumber and Cooperage is the company we have chosen to supply us with the water cisterns on site, to collect building rain water run off from the roof. They provide custom sizes and ship world wide. Their product is easily transported, and installation / building them is simple on site with the pieces numbered.

Forest Lumber and Cooperage is based in Sooke, British Columbia Canada, 465 miles from Moscow.

Carbon Debt Estimation: **MEDIUM**

Vegetation:

University of Idaho -

The University of Idaho has extensive plant resources and knowledge made available by the College of Agriculture and the help of Facilities to the opportunities of landscaping for this project.

Because we are planning on using the knowledge of the people and the plants researched and grown on campus there are many design options for the landscaping of the site.

Carbon Debt Estimation: **NONE**

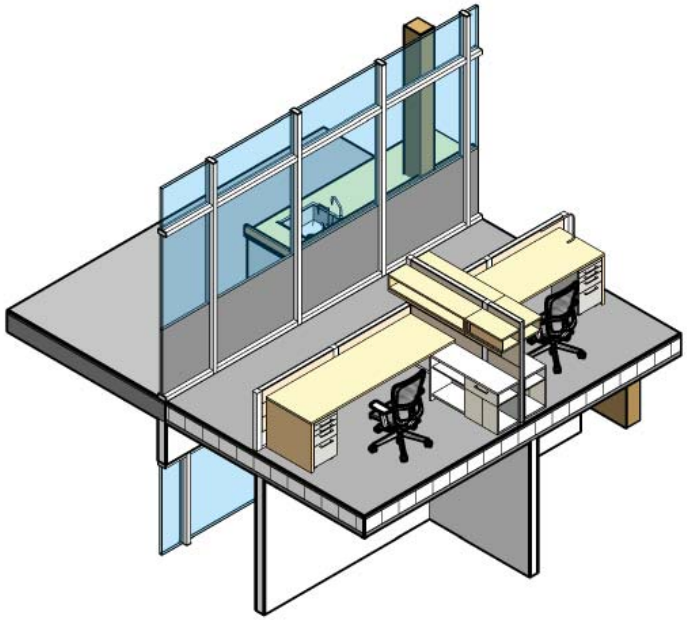
INTEGRATION of SYSTEMS

STRATEGIES:

The following considerations have been taken in our exterior site design and interior environments to make the building usable by all to the fullest and most beneficial extent.

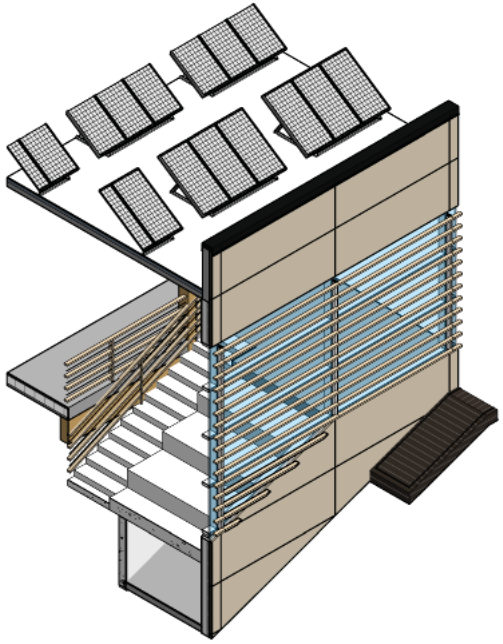
- Beam to Column Connection
- Raised Flooring
- Drainage from Entrance Roof Overhangs to Ground
- Cafe (seating, back wall element)
- Shading Device
- Material Combinations
- Lighting Features
- Paving Design

Structure and HVAC Integration:



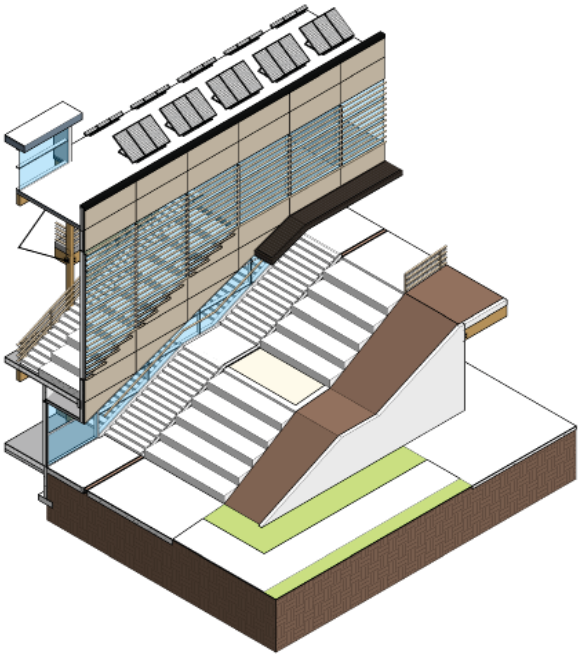
This section perspective shows how the structure, beams and colums, are connected to the floor and ceiling systems, providing a raised floor for the HVAC delivery.

Structure and Envelope Integration:



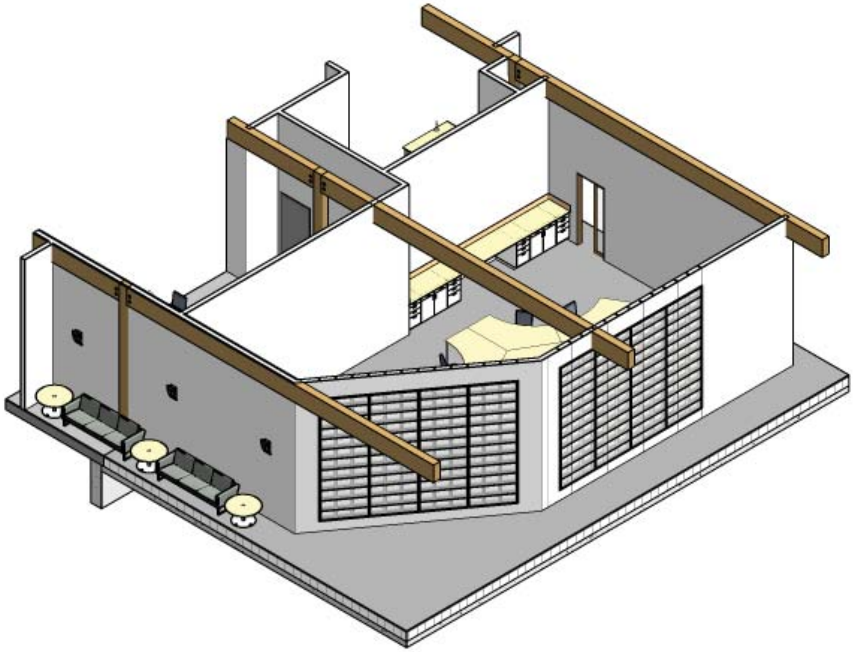
This section perspective shows how the envelope, curtain wall and integrated wall system is intertwined with the connection of the shading device.

Building Envelope and Site Design:



This section perspective shows how we can use the building envelope elements to direct building water run off from the entrance overhangs to the site for irrigation purposes. The option chosen provides a creative design solution that affects site design in drainage systems, by channeling water run off, and paving options.

Structure, Electrical and Interior Design:



This section perspective shows how we chose to integrate lights into the structure of the building. In open spaces lights will be hung from the structural CLT panel which also acts as finished ceiling. It also shows how our interior design elements create an aesthetically pleasing environment for its occupants.

THANK YOU!