Team 4

Integrated Research & Innovation Center

Design Team 4; Arch 553 -Comprehensive Design Studio; University of Idaho -Moscow/ Fall 2013

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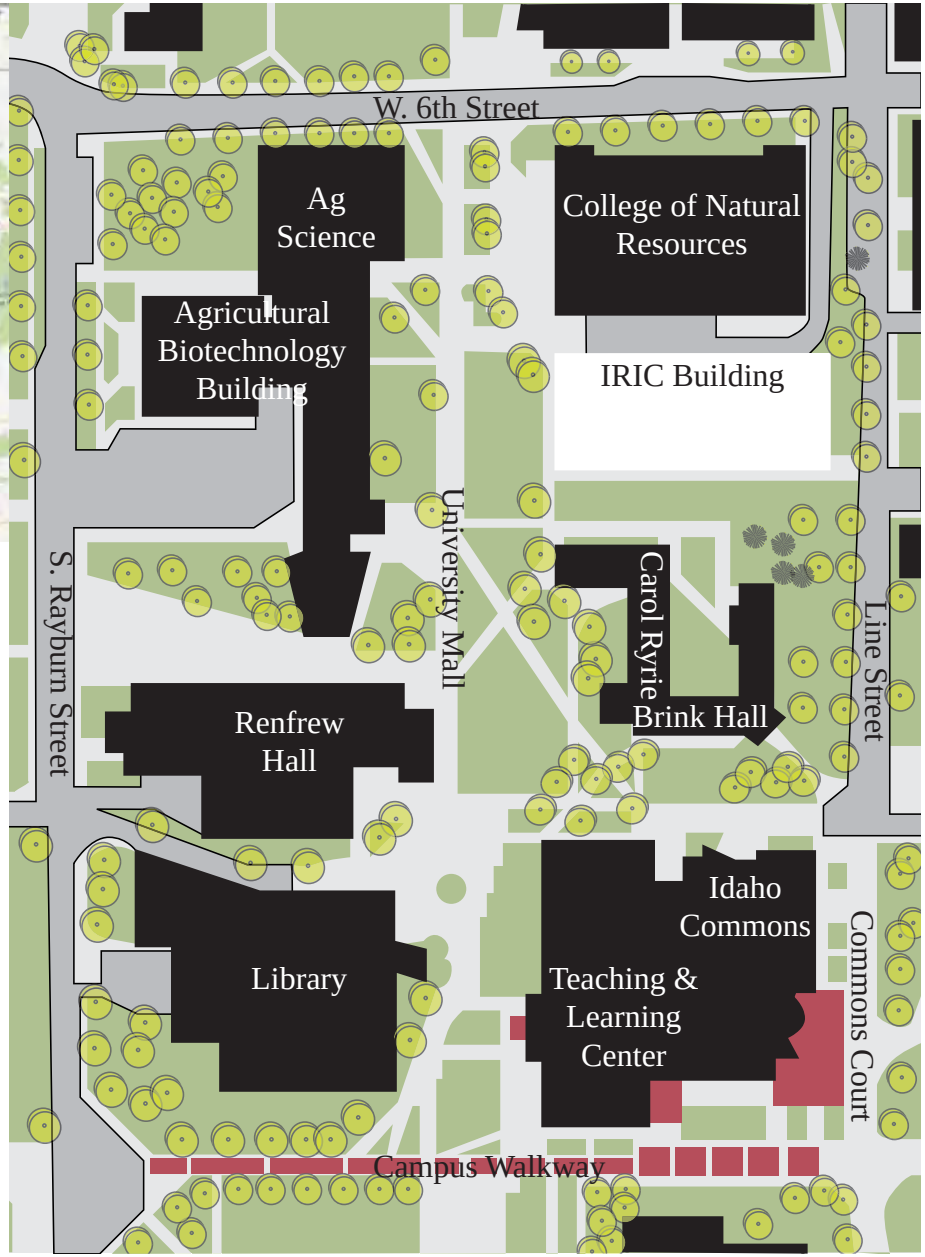

The design team set out to address the future role of the new IRIC building. Its design will be worked on collaboratively while emphasizing innovative approaches in cross disciplinary thinking. With that in mind, our team took on the challenge of creating a high performance building with low energy intensity, thereby reducing the overall carbon footprint.

The University's steam plant and chilling tower would provide the base level of comfort while the team employed other passive systems to create a comfortable and efficient building. Alternative renewable resources were substituted in place of finite resources contributing to a smaller carbon footprint leading to local economic stimulation by using local materials and labor.

Design Intentions

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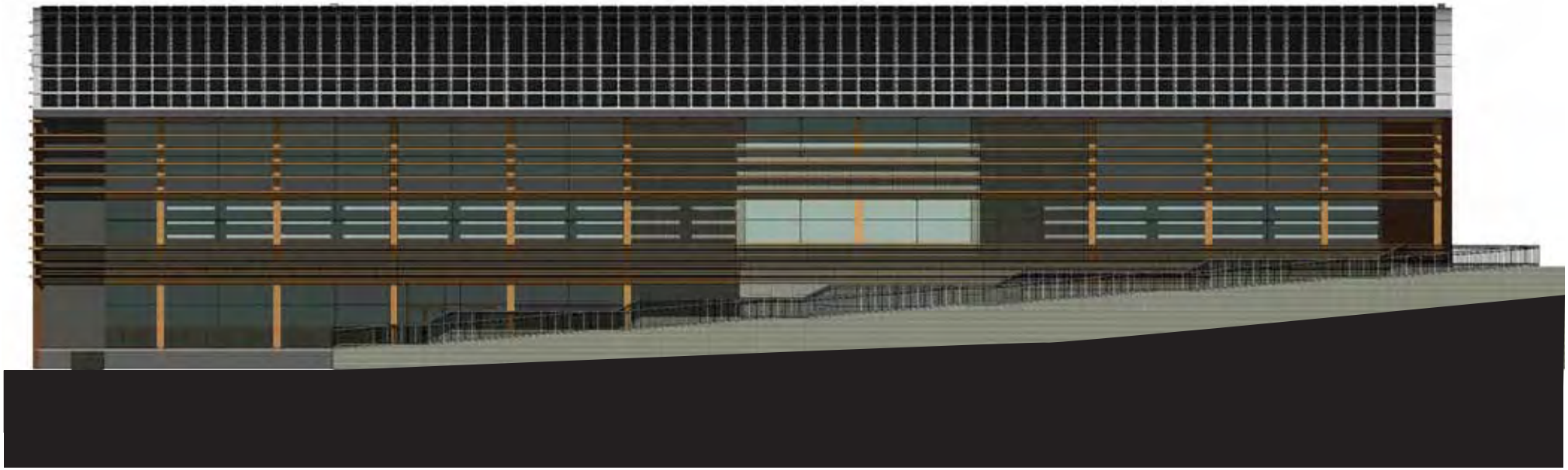

Elevations

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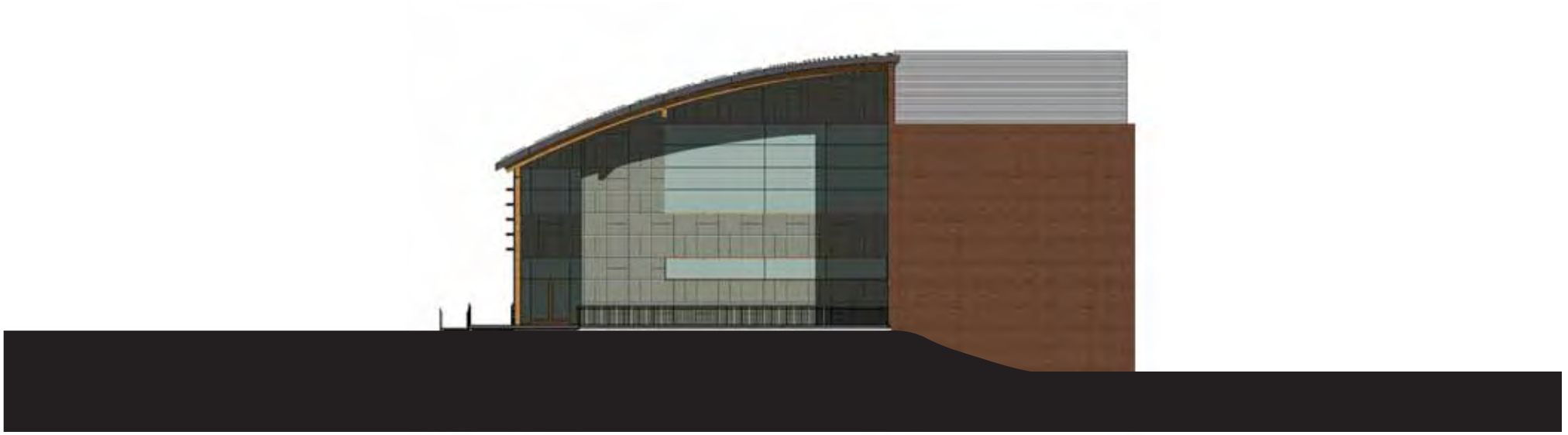

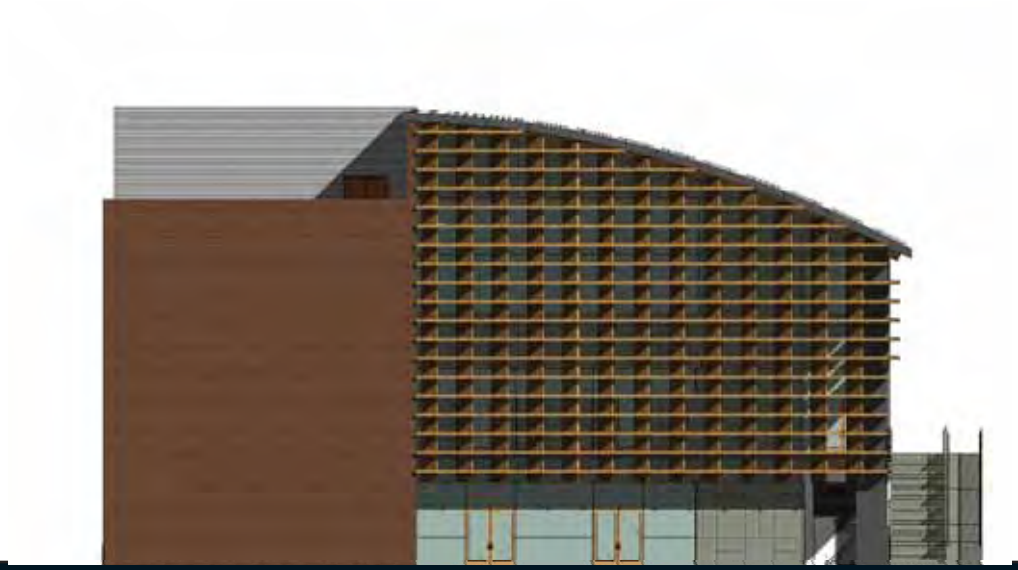

Elevations

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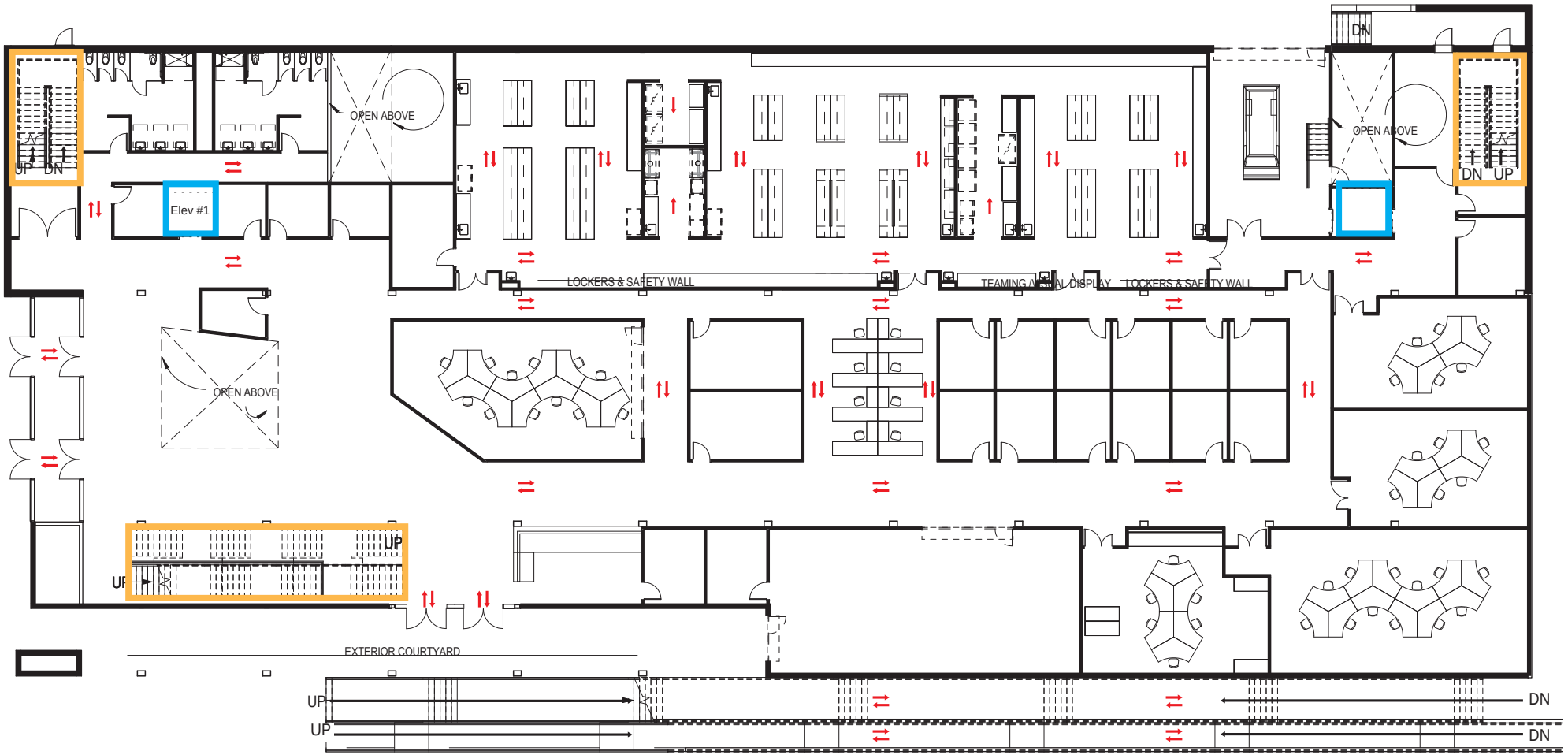

Ground Floor

N

Direction of Travel

Vertical Circulation

ADA Accessible Vertical Circulation

University Mall Entry

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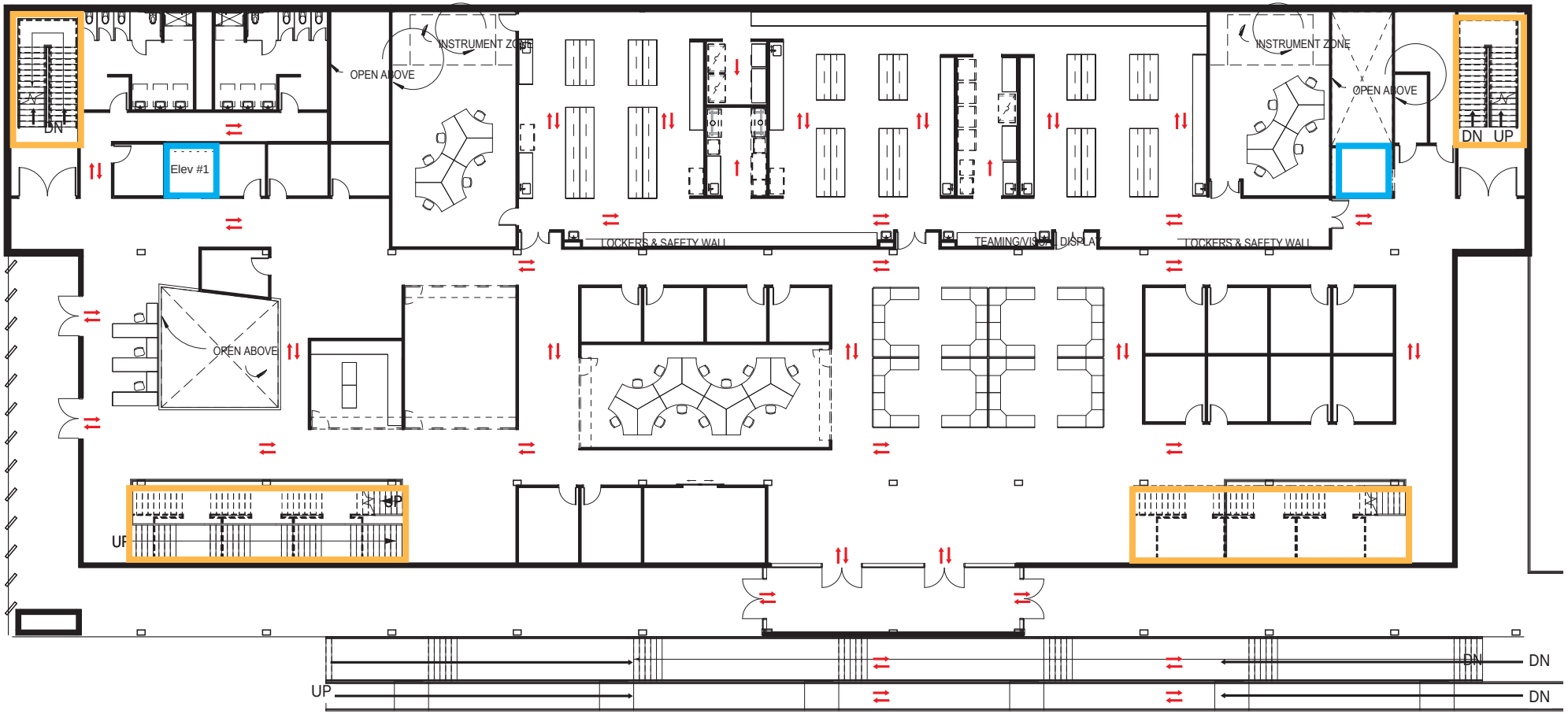

First Floor

N

Direction of Travel

Vertical Circulation

ADA Accessible Vertical Circulation

University Mall Entry

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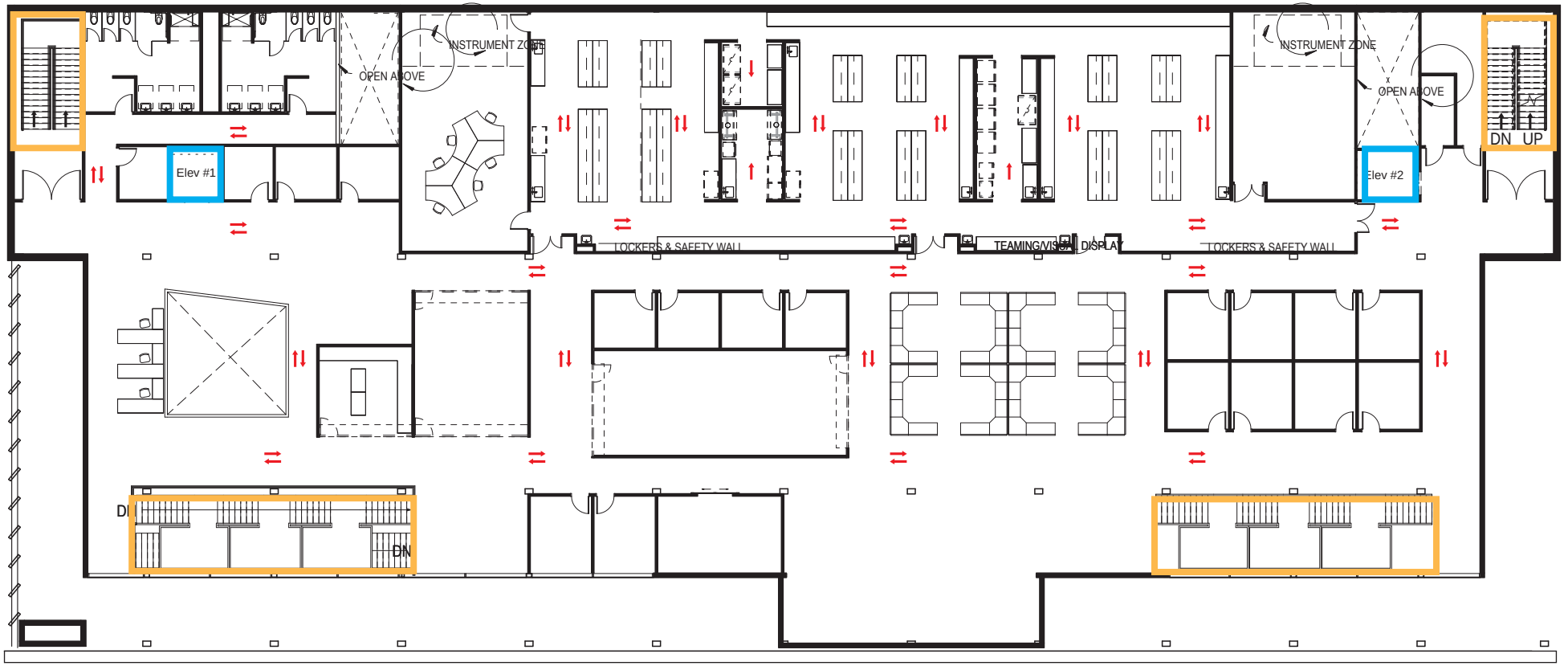

Second Floor

N

Direction of Travel

Vertical Circulation

ADA Accessible Vertical Circulation

University Mall Entry

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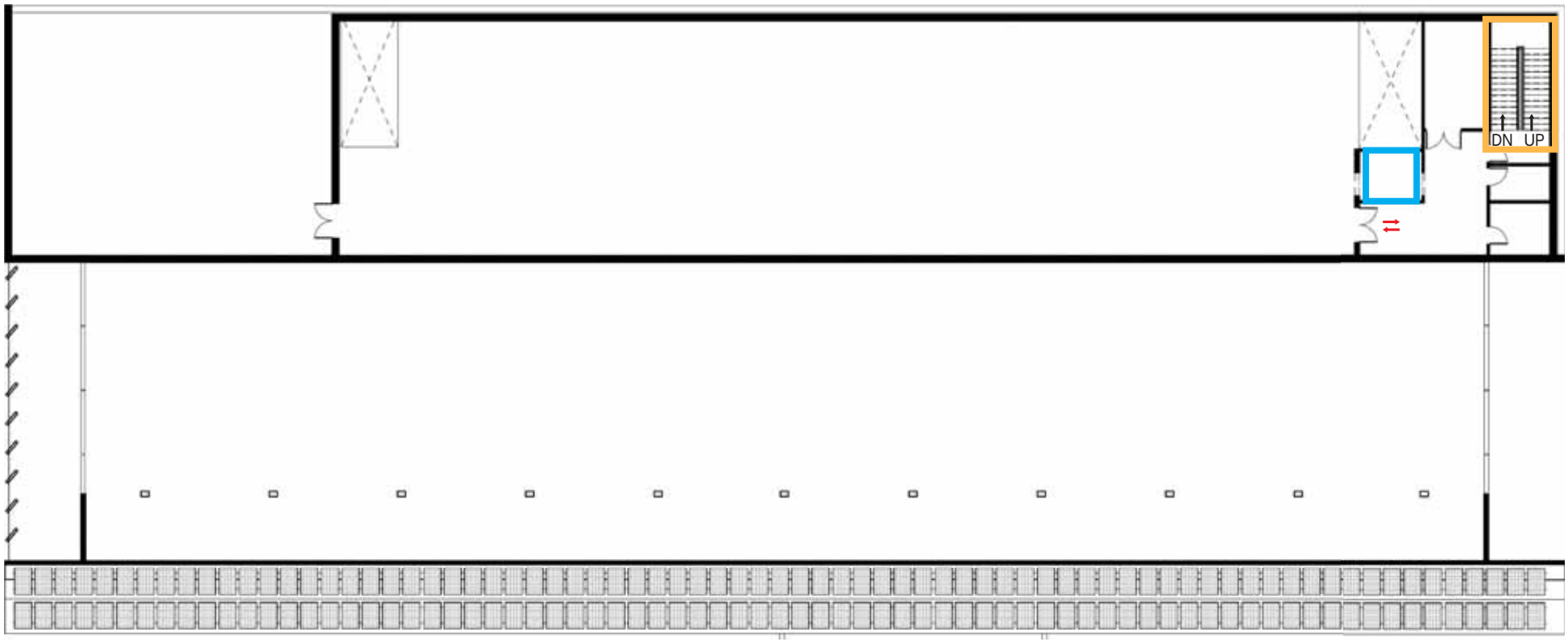

Penthouse Floor

Direction of Travel

Vertical Circulation

ADA Accessible Vertical Circulation

N

Mechanical House

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Glulam Timer Framing

- Rapid Erection Time
- Locally Skilled Labor Force
- Aesthetically Pleasing
- Renewable Resource
- Excellent Strength to Weight Ratio
- Long Spanning Ability
- Fire and Corrosion Resistant

Light Wood Framing

- Renewable Resource
- Locally Skilled Labor Force
- Economical
- Locally Available

D-Dalle Timber Slab

- Rapid On Site Assembly
- Locally Skilled Labor Force
- Aesthetically Pleasing
- Renewable Resource
- Excellent Strength to Weight Ratio
- Long Spanning Ability
- Fire and Corrosion Resistant

Structural Materials

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Column Placement

Concrete Wall

Beam Placement

Hybrid Wall
Light Wood Frame &
Timber Frame

Structural System

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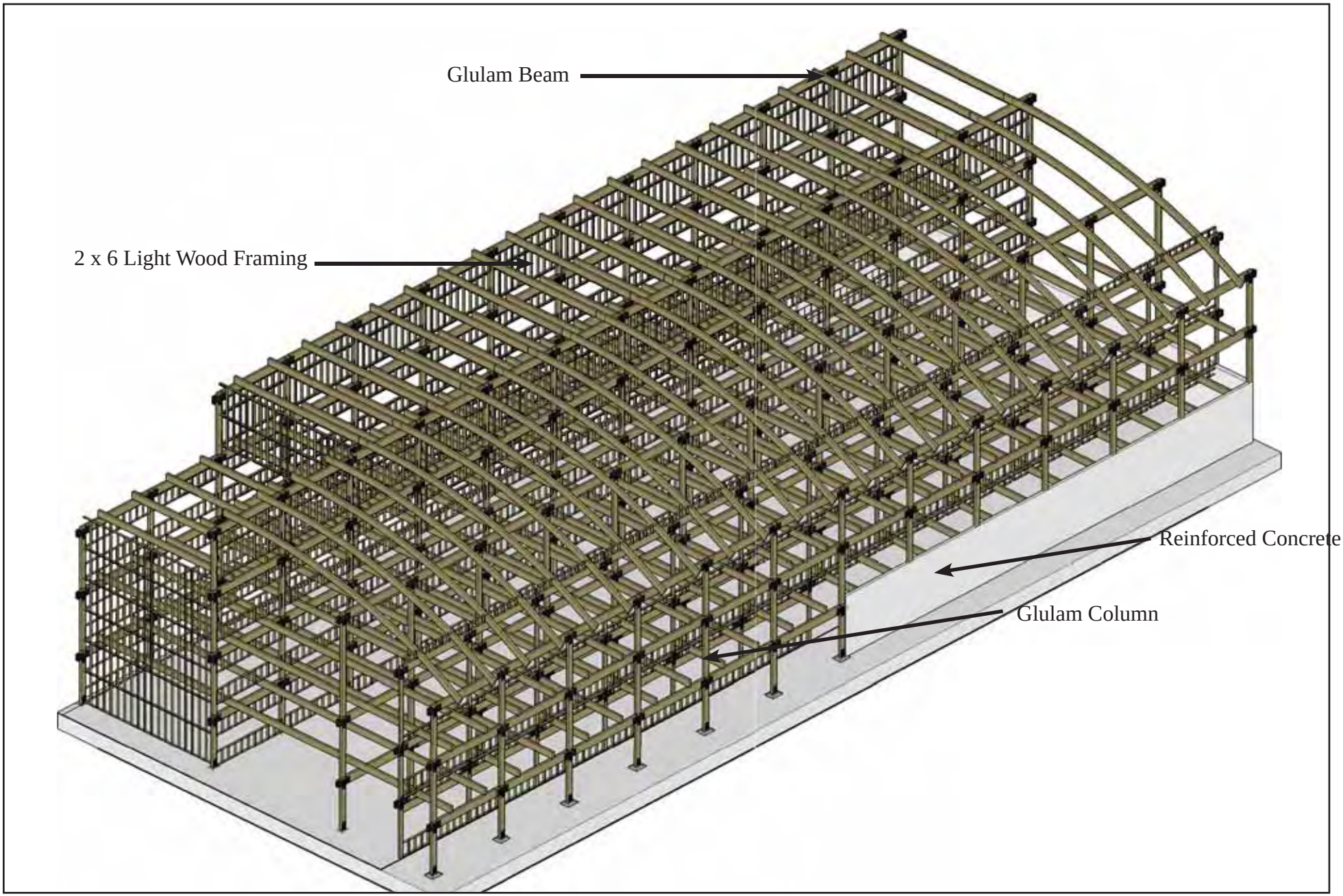

Structural Framing

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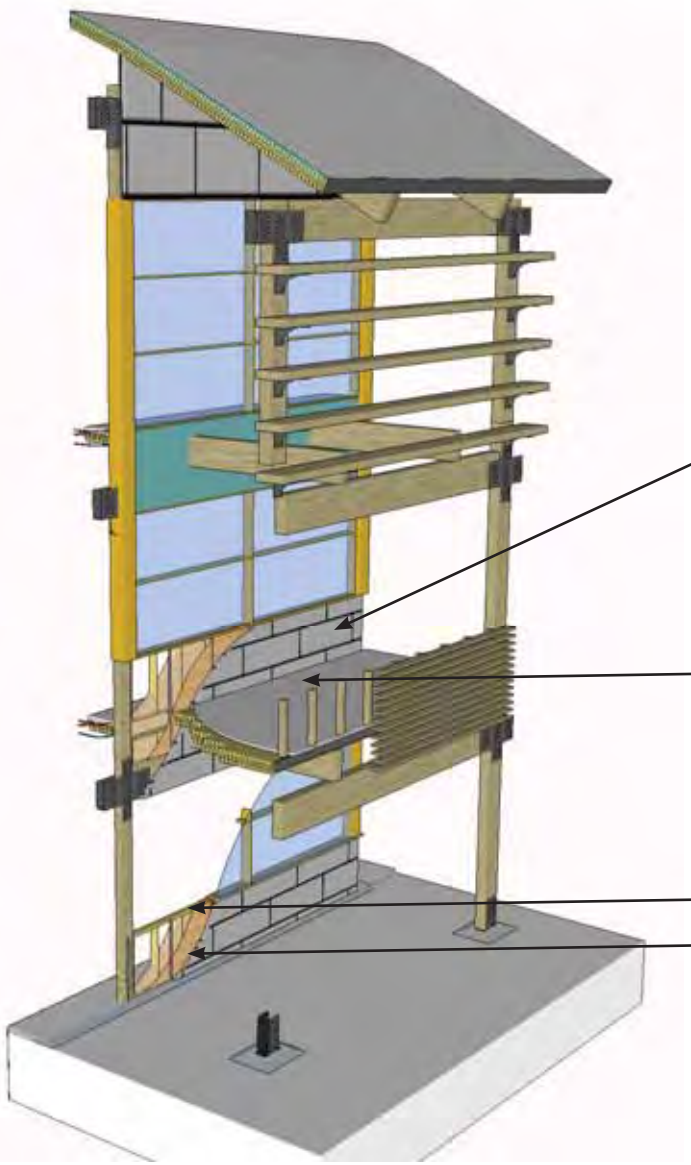


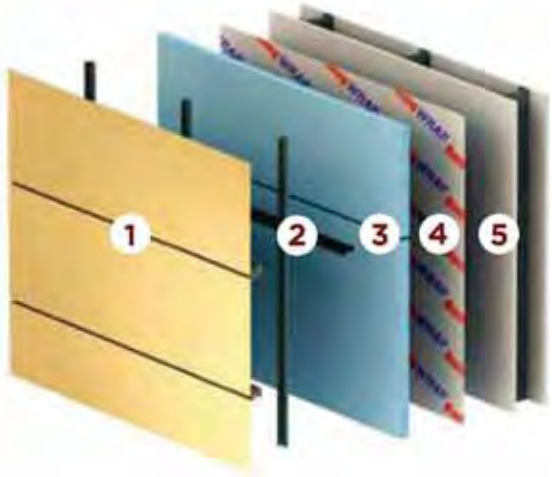
O'portune

Fully composed of dimensional lumber. Ideal for spans up to 12m

D-Dalle

Enhanced version of the O'portune slab, this timber/concrete composite slab is ideal for spans up to 18m without internal support

1. **Exterior rain screen**
2. **Zee support & vertical**
3. **Insulation**
4. **Air & vapor barrier**
5. **Exterior sheeting**



Building Envelope

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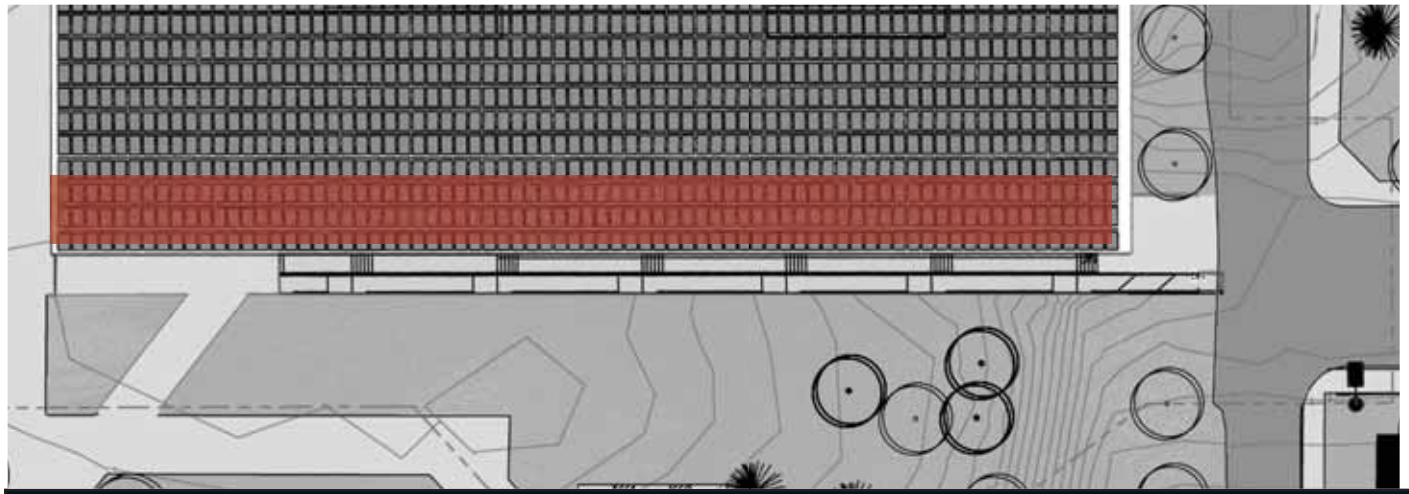
The roof's overhang acts as a shading device while providing additional SF for PV. The following daylighting study illustrates how well the overhang and shading devices work together, allowing adequate daylight into the space; reducing the need for the use of electric lighting.



Shading Device

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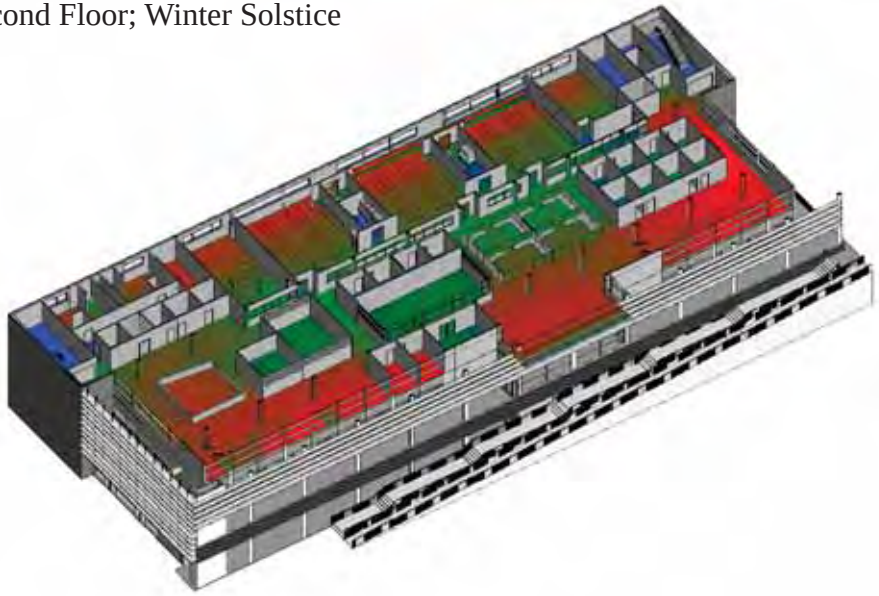
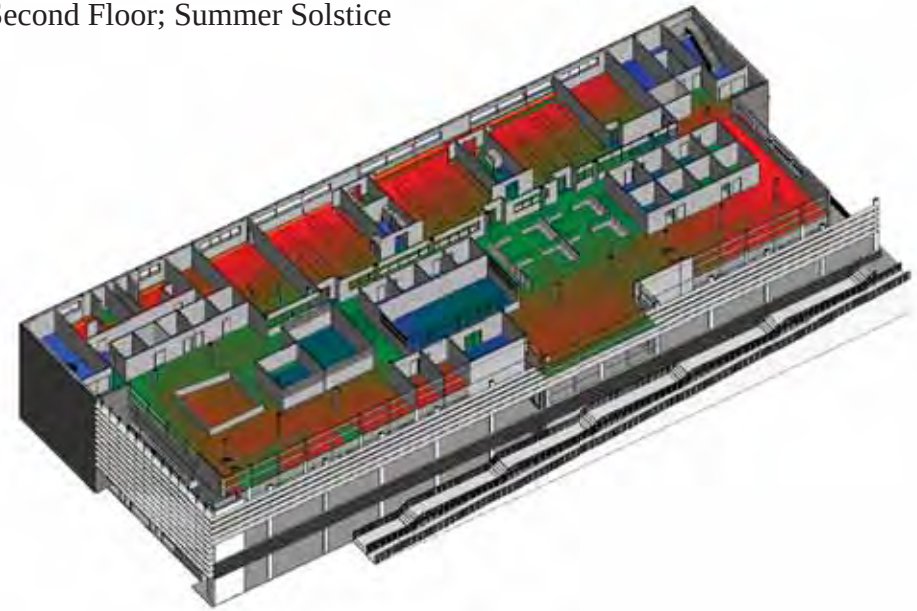
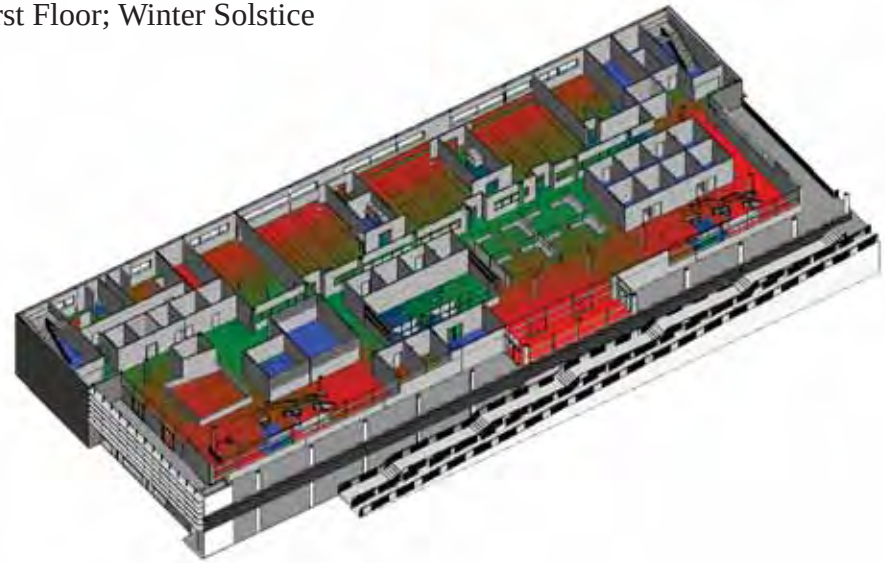
Second Floor; Winter Solstice



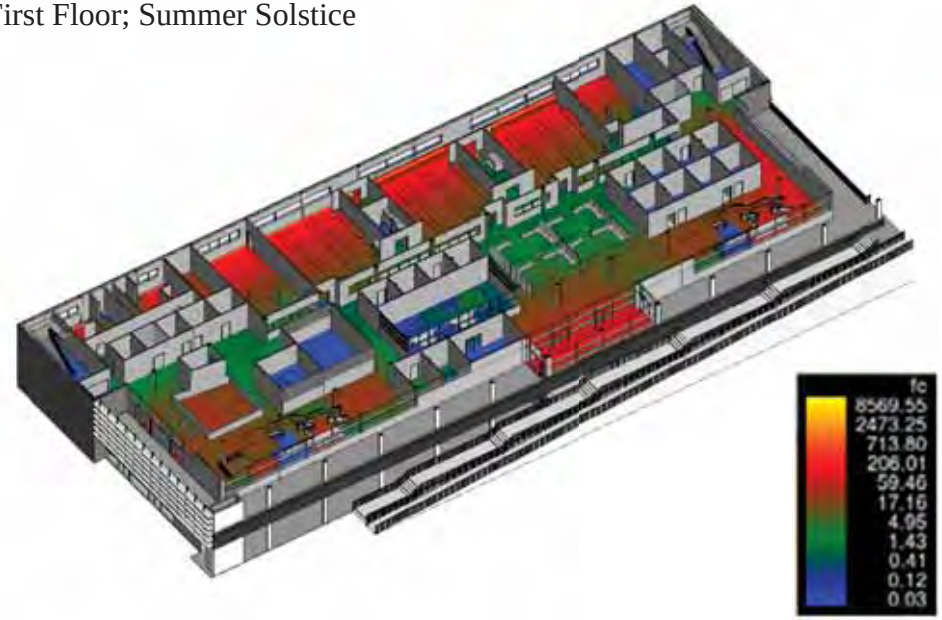
Second Floor; Summer Solstice



First Floor; Winter Solstice



First Floor; Summer Solstice



Daylight Strategy

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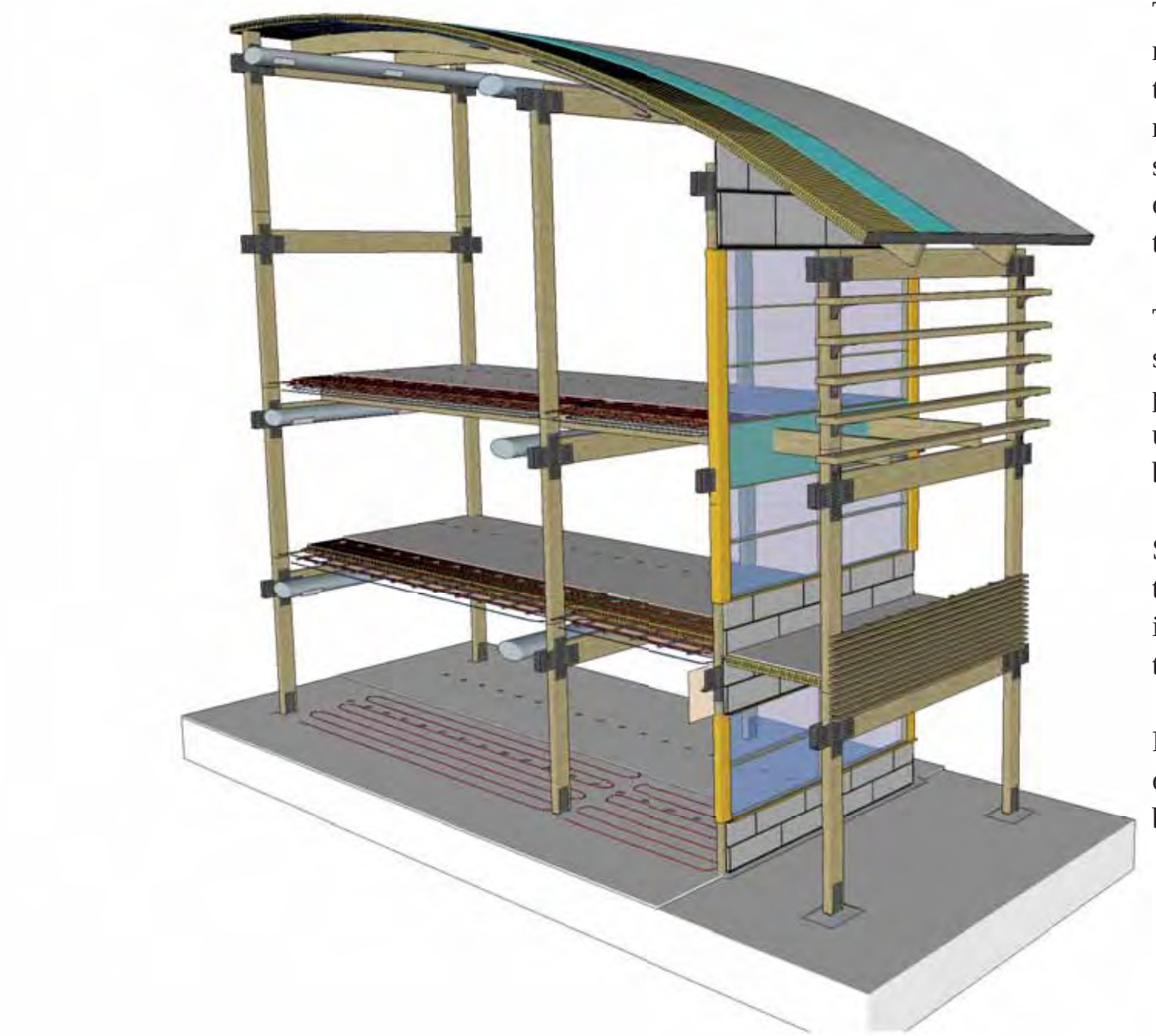

The building's structure and systems merge into one throughout much of the building. Electrical conduit and radiant heating are imbedded into the structural slab hidden from view without the unfortunate impact of hiding the structure from view.

The unique profile of the structural slab alows for traditional copper plumbing along the underside to be used in place of the clunky chilled beam providing an aesthetic in itself.

Shading devices are intertwined with the structural elements, leading to the illusion of an extremely lengthy structure.

PV panels and solor collectors sit up on the roof acting as shading devices by providing power and solar light.

Systems Integrations

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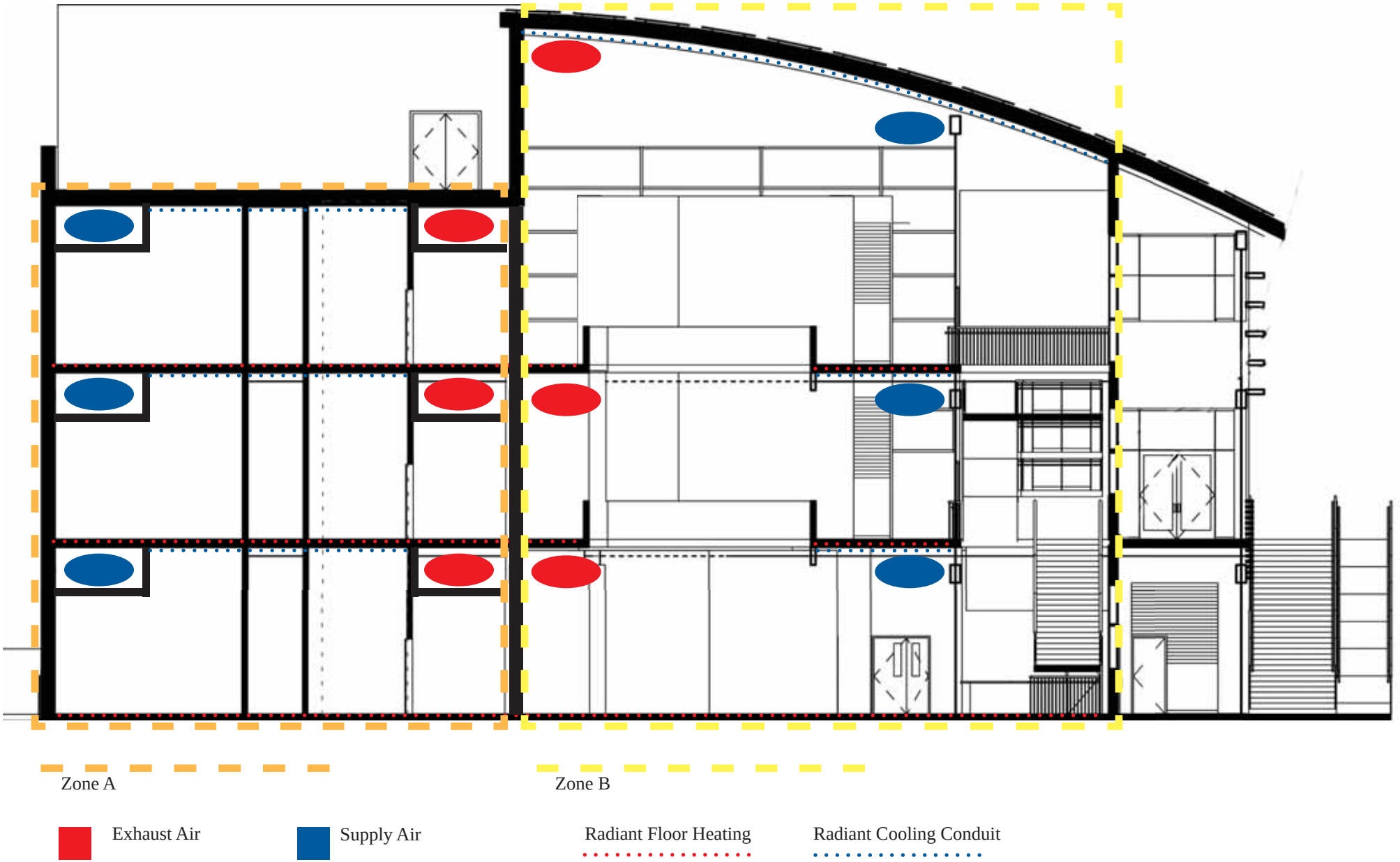

Services Distribution Section

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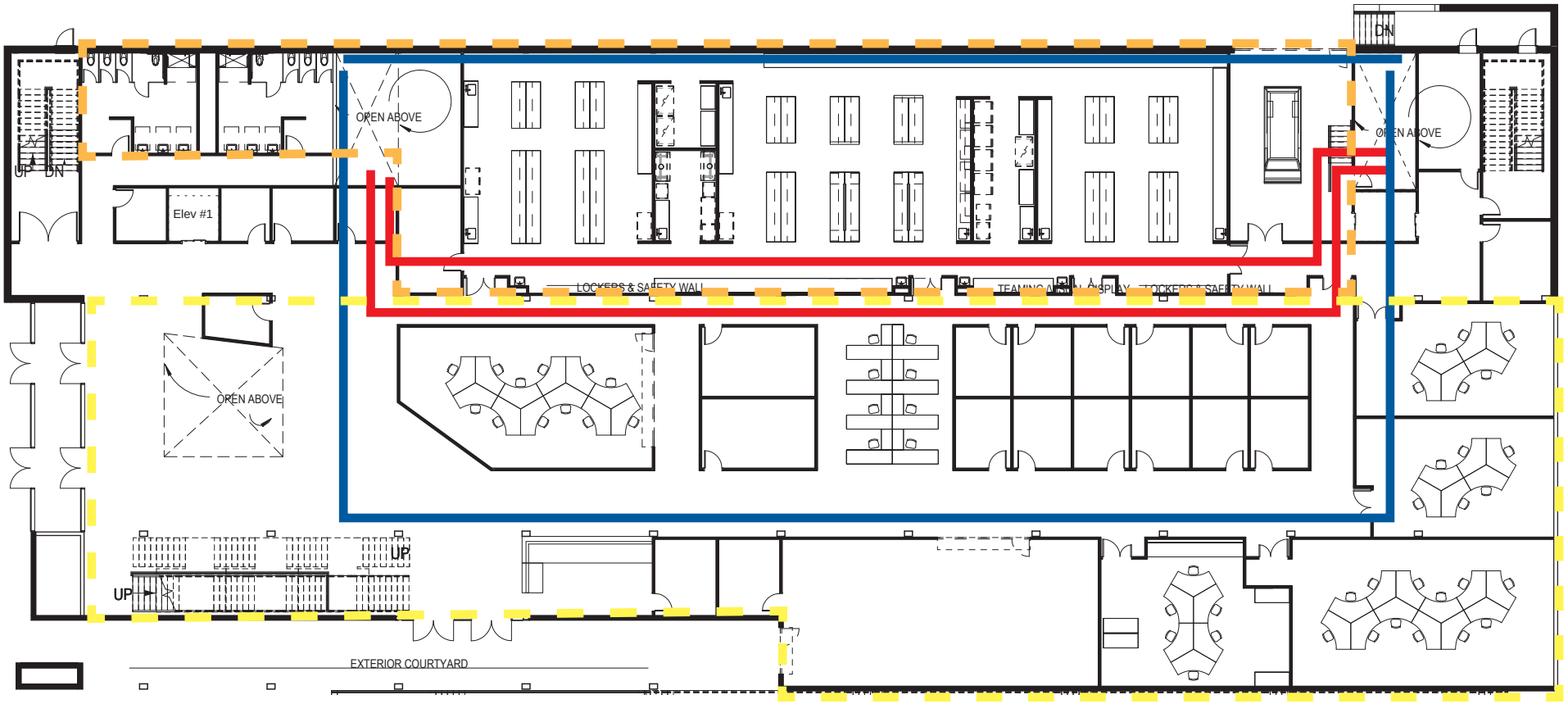

Zone A

Zone B

Exhaust Air

Supply Air

Radiant Floor Heating

Chilled Pipes

Services Distribution Section

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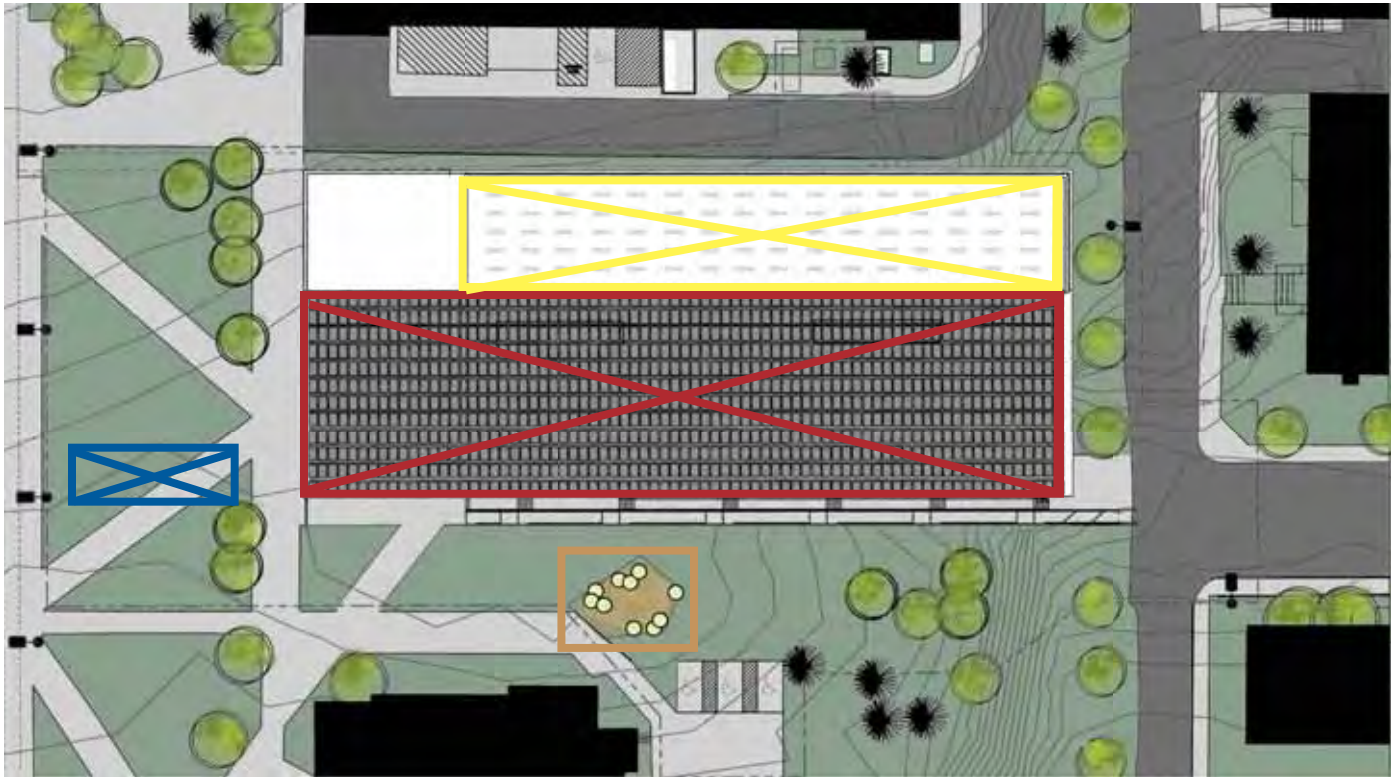


Underground gray water storage

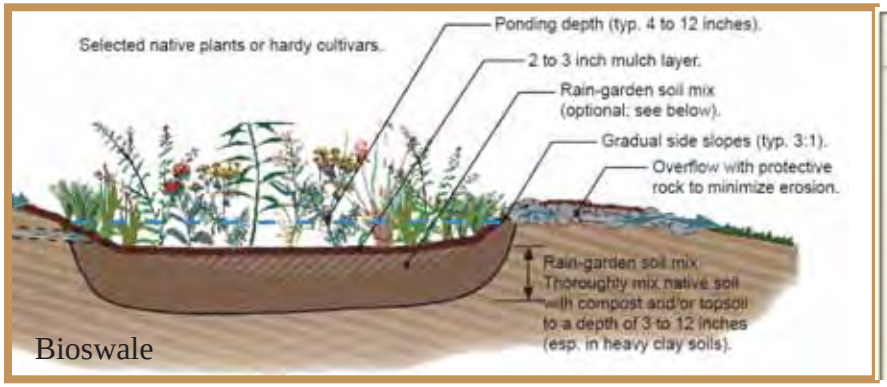
12,000 SF PV solar panel array

9,000 SF Paran solar light receivers

The natural topogrghy of the site was ideal for placing a bioswale to capture rainwater runoff with all its sediment and contaminents instead of the traditional drainage that reaches the Paradise Creek without filtration or treatment.

The roofs 33,500 SF also presents an ample space for generating electricity onsite with Photovoltaic panels.

In addition, the IRIC Building will project sunlight into those areas unable to take adavantage of the natural daylight; not only promoting healther inhabitants, but also saving energy that is normally used to power traditional lighting fixtures.



Bioswale

	Material	Cost (low → high)	Installation (hard → easy)	Longevity (short → long)	Durability* (low → high)	Maintenance Access (hard → easy)	Best Use Capacity (gallons)
Underground	Fiberglass	$$$$$	●●●○○	●●●●○	●●○○○	●●●●○	5,000 to 30,000
	Polyethylene	$	●●●●●	●●●○○	●●●○○	●●○○○	< 5,000
	Steel Reinforced Polyethylene (SRPE)	$$$	●●●●○	●●●●●	●●●●●	●●●●○	10,000 to 100,000+
	Plastic Crates	$$$	●●●○○	●●○○○	●○○○○	●○○○○	5,000 to 30,000 (with light loading)
	Concrete	$$$$$	●●○○○	●●●●○	●●○○○	●●●●○	30,000+ (with high loading)
	Fabricated Steel	$$$$	●●●○○	●●●○○	●●●●○	●●●●○	not recommended
	Waterproof Corrugated Metal	$$	●●●●○	●●●○○	●●●●●	●●●●○	5,000 to 30,000

Site Development

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	Fixtures	Flow Rate	Usage	Total
Males Occupants				160.0
Females Occupants				182.0
Toilet	21.0	1.2 gpf		
Male			1.0 uses	192.0
Female			4.0 uses	873.6
Uninal	3.0	0.0 gpf	3.0 uses	0.0
bathroom skin	18.0	0.5 gpm		
Male			0.3 min.	24.0
Female			0.5 min.	45.5
Wash stations Sink	51.0	0.5 gpm		
Male			1.0 min.	80.0
Female			1.0 min.	91.0
Shower	6.0	2.5 gpm		
Male			8.0 min.	N/A
Female			14.0 min.	N/A

1,306.1 Gallons per day

Gray water for Toilets and Unitals:

1,065.6 gpd x 260 days = 277,056.0 gpy

Cistern Capacity:

1,065.6 gpd x 90 days = 95,904.0 gal

95,904.0 gal/7.48 gal/ft^3 = 12,821.4 ft^3

Runoff from the roof is collected in an underground cistern located under the University Mall. This gray water can be recycled and reused in the flushing of the IRIC's toilets in place of potable water. This represents an estimated consumption of 277,056 gallons per year, a reduction of total potable water usage by 82%. This location allows for the construction of a much larger storage tank capable of absorbing flash runoffs from the surrounding buildings and discharging it slowly instead of washing sediment into the nearby Paradise Creek.

Water Collection

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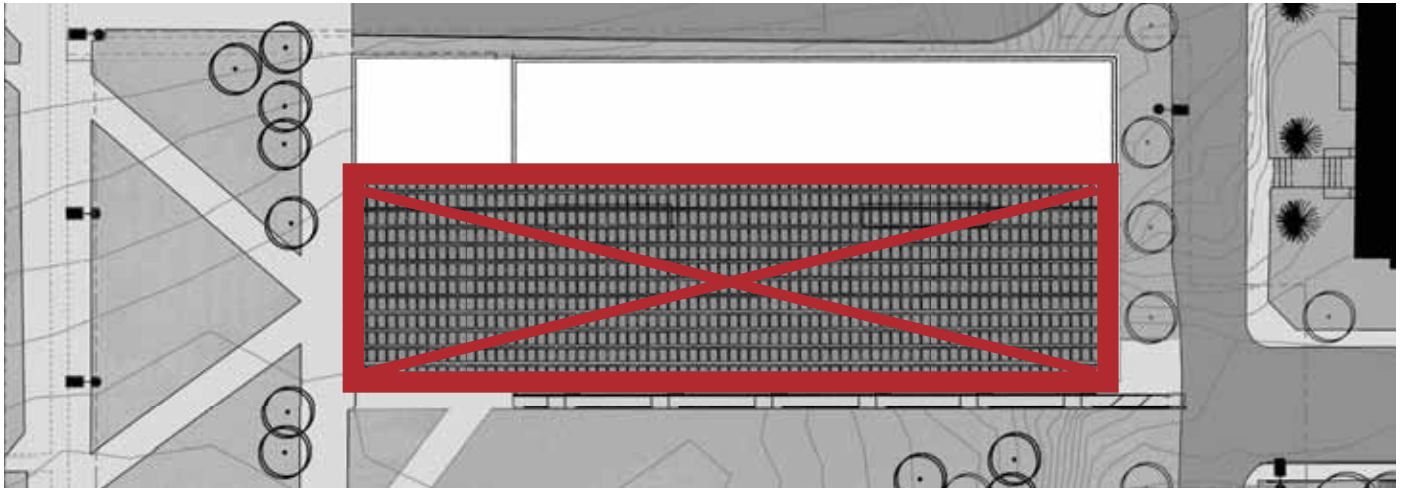
		Units	Power Load: KW/h	Total KW/h	hr/day	KWh/day	Days/year	KWh/year	KWh/Sf/yr	kbtu/sf/yr
									75,000.00	
Solar Panels	87.5 deg	75.00	3.10	232.50	12.20	2,836.50	365.00	1,035,322.50		
Solar Panels	85.25 deg	75.00	3.10	232.50	12.20	2,836.50	365.00	1,035,322.50		
Solar Panels	83.0 deg	75.00	4.00	300.00	12.20	3,660.00	365.00	1,335,900.00		
Solar Panels	80.5 deg	75.00	4.00	300.00	12.20	3,660.00	365.00	1,335,900.00		
Solar Panels	78.25 deg	75.00	4.00	300.00	12.20	3,660.00	365.00	1,335,900.00		
Solar Panels	76 deg	75.00	4.00	300.00	12.20	3,660.00	365.00	1,335,900.00		
Solar Panels	74.75 deg	75.00	4.00	300.00	12.20	3,660.00	365.00	1,335,900.00		
Solar Panels	71.5 deg	75.00	4.00	300.00	12.20	3,660.00	365.00	1,335,900.00		
Solar Panels	69.5 deg	75.00	4.00	300.00	12.20	3,660.00	365.00	1,335,900.00		
Solar Panels	67.5 deg	75.00	4.00	300.00	12.20	3,660.00	365.00	1,335,900.00		
Solar Panels	65.25 deg	75.00	3.10	232.50	12.20	2,836.50	365.00	1,035,322.50		
Solar Panels	63.5 deg	75.00	3.10	232.50	12.20	2,836.50	365.00	1,035,322.50		
		900.00	44.40	3,330.00	146.40	40,626.00		14,828,490.00	190.11	648.678309
Solar Offset EUI									81.11	276.75



Solar Power Analysis

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	Units	Power Load: KW/h	Total KW/h	hr/day	KWh/day	days/year	KWh/year	KWh/Sf/yr	kbtu/sf/yr
								78,000.00	
Lighting				7AM - 10PM					
Parans L2 Hybrid 2x2 Solar & LED	480.00			15.00	224.57	260.00	58,386.93	0.75	2.55415998
Led	480.00	0.02	7.20	30.84	222.05				
Sunlight output 15 ft.	112.00								
Sunlight output 30 ft.	128.00								
Sunlight output 50 ft.	126.00								
Sunlight output 65 ft.	114.00	0.00	0.23	11.04	2.52				
Ametrix Suspended LED	180.00	0.02	2.88	8.00	23.04	260.00	5,990.40	0.08	0.26205248
Subtotal	660.00	0.03	10.31	49.88	247.61		64,377.33	0.83	2.82
Equipment									
Air Handeling Exchange Units 6/hr	6.00	150.00	900.00	24.00	21,600.00	365.00	7,884,000.00	101.08	344.888777
Refrigerators	12.00	1.05	12.55	24.00	301.25	365.00	109,955.52	1.41	4.81004882
Freezers	12.00	2.30	27.60	24.00	662.40	365.00	241,776.00	3.10	10.5765892
Sub Zero Freezers	6.00	2.40	14.40	24.00	345.60	365.00	126,144.00	1.62	5.51822044
Incubators	6.00	1.45	8.70	24.00	208.80	365.00	76,212.00	0.98	3.33392485
Fume Hoods	9.00	1.04	9.32	4.00	37.26	260.00	9,687.60	0.12	0.42378799
Biological Hoods	6.00	0.14	0.83	4.00	3.31	260.00	861.12	0.01	0.03767004
Computers	60.00	0.10	6.00	8.00	48.00	260.00	12,480.00	0.16	0.54594266
Lazer Printers	12.00	0.03	0.30	24.00	7.20	365.00	2,628.00	0.03	0.11496293
Laptop Computers	30.00	0.09	2.70	8.00	21.60	260.00	5,616.00	0.07	0.2456742
Sutotal	159.00	158.58	982.40	168.00	23,235.42		8,469,360.24	108.58	370.50
Total EUI								109.41	373.31
Solar Panels	900.00	44.40	3,330.00	146.40	40,626.00		14,828,490.00	190.11	648.678309
Solar Offset EUI								80.70	275.37

Energy Analysis

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Building Materials	Amount of Building	Manufacturing embodied engergy	Transportation embodied energy	Carbon Footprint	renewable/Reusable resorce
Structural					
Douglas Fir Glulam timber frame*	High	Low	Low	1	Renewable
Douglas Fir 2 x 6 Studs*^	High	Low	Low	1	Renewable
Douglas Fir D-Dalle structural deck panels*	High	Moderate	Low	1	Renewable
Steal brakets	Low	High	Low	1	Reusable
Reinforced Concrete*	Moderate	High	Low	2	-
Point value		2	1		
Envelope					
Centria Panels	High	High	Low	2	Reusable
Doulglas Fir Glulam shading device*	Moderate	Low	Low	1	Renewable
Tripple pane glazing	Moderate	High	Moderate	2.5	Reusable
Straw-Clay insulation*^	High	Low	Low	1	Renewable
brick*^	Low	High	Low	1	Reusable
Point value		2.2	1.2		
Roofing					
Douglas Fir Glulam Timber Frame*	Low	Low	Low	1	Renewable
Douglas Fir D-Dalle structural deck*	Low	Moderate	Low	1	Renewable
Rigid Insulation	Low	Maderate	Low	1	-
Standing Seam Metal Roofing	Low	High	Low	1	-
Solar Panels	High	High	Low	3	-
Point value		2.2	1		
Scale		2.1	1.1	1.4	

1=Low; 2=Moderate; 3=High

*Contains local materials

^ Manufacured in Idaho

Carbon Footprint

Integrated Research & Innovation Center

The IRIC is more than a carbon neutral building, it's a carbon eater. Throughout the use of glulam timber framing and light wood framing infill, the building locks away significant amounts of carbon while spurring the Idaho economy with local small growth timber managment policies providing the structural frame of the building. Additional materials such as the Straw Muck used as insulation contributes to the local economy and the health of the environment by using biodegradable building materials. Additional carbon offsets are also valuable when taking into account the availablity of the products locally, and the practicality of material knowledge to skilled manpower.

Passive systems such as the large southern overhang and Paran solar lights reduce the use of fossil fuels needed while contributing to the occupants' comfort.

Conclusion

Integrated Research & Innovation Center