" DISCOVERING PRECEDENT, SITE, AND PROGRAM "

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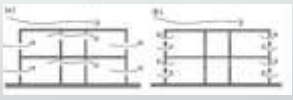
ST. LOUIS PUBLIC LIBRARY

Location: St. Louis, Missouri

Climate: Humid Subtropical Climate
-Apr/.-Sep. Is hot/humid
-Winter(Dec.-Feb.) is cold with occasional snow
-Cool winters and long hot summers

Site: NE City Park

Design Strategies for the Climate:
To reduce energy consumption, passive air cooling **strategy** is seen as a suitable option for all **subtropical** zones with both high **humid** summer and warm winter and **subtropical** zones with warm **humid** summer and mild winter.

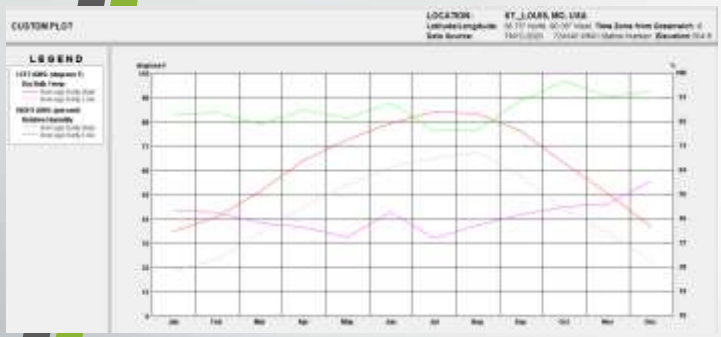


Cross ventilation and single sided ventilation.

High thermal mass with night ventilation strategies.

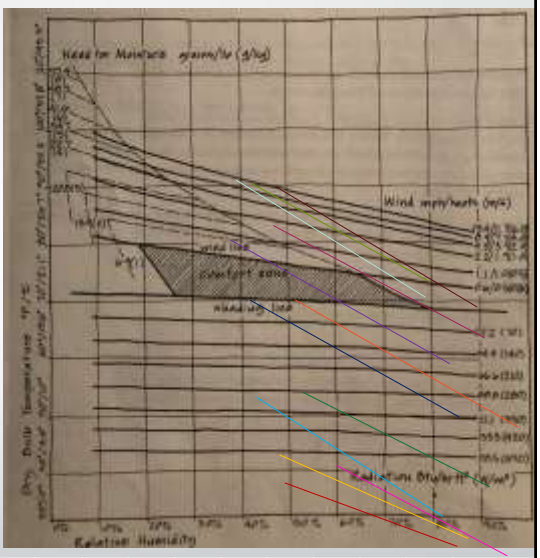
MH

B1.1 Climate Analysis: Bioclimatic Chart Plot



Record of Corresponding Average Monthly Temperature (F°) and Relative Humidity (%)

	Tem (HI)	RH (LO)	TEM (LO)	RH (HI)		TEM (HI)	RH (LO)	TEM (LO)	RH (HI)		TEM (HI)	RH (LO)	TEM (LO)	RH (HI)
Jan	38°	49%	21°	85%	May	80°	39%	59°	84%	Sep	83°	47%	64°	91%
Feb	44°	48%	26°	87%	Jun	88°	48%	68°	89%	Oct	70°	51%	47°	97%
Mar	55°	43%	33°	81%	Jul	91°	39%	71°	79%	Nov	55°	52%	38°	92%
Apr	70°	42%	50°	86%	Aug	90°	43%	74°	80%	Dec	41°	60%	25°	94%



For the comfort zone, the months that are most comfortable are April, May, September and October. Temperatures ranging from 70°-80°. The rest of the months are either too high or too cold in the other months. Humidity needs to be addressed as it's the highest for most of the months.

VC

Climate Analysis: Sun Chart

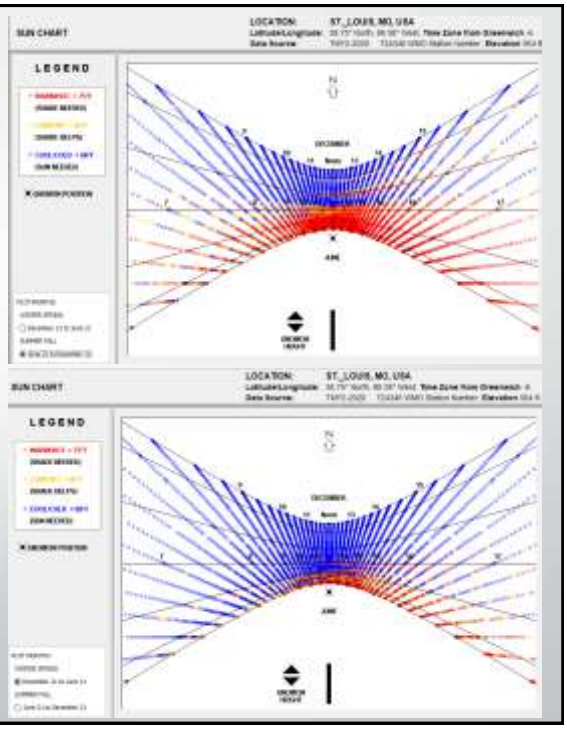
SUMMER FALL
June 21 – December 21:

Shade is needed as the temperature is >75Degree hotter in the summer to fall.

WINTER SPRING
December 21 – June 21:

During the winter to spring it's cooler, less warm but doesn't seem as intense. Almost the same as fall.

Overall, needs more shading for comfort.



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Climate Analysis: Sun Shading

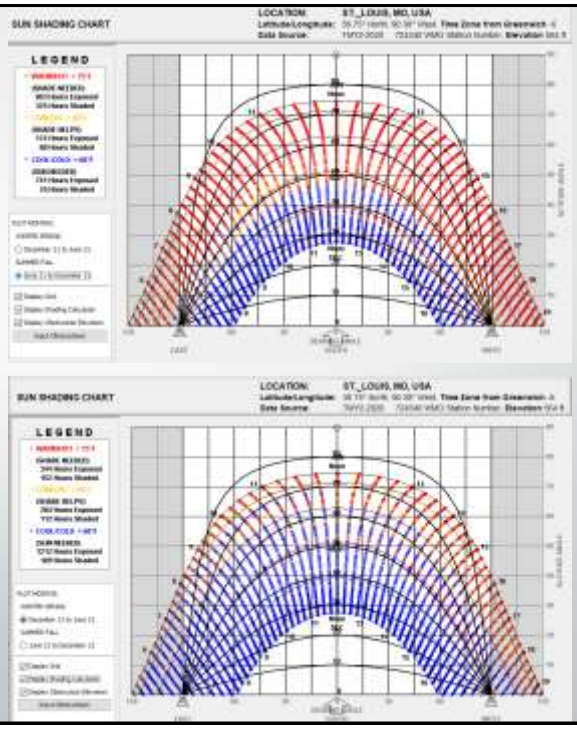
SUMMER FALL
June 21 – December 21:

Seems like there is almost an even balance of warm and cold from summer to fall and mostly shade in September.

WINTER SPRING
December 21 – June 21:

Most of the shade is after March but would need more shade in January for comfort.

Overall, it looks like it's colder towards winter in the fall than it is from winter to spring even though the winter is longer.



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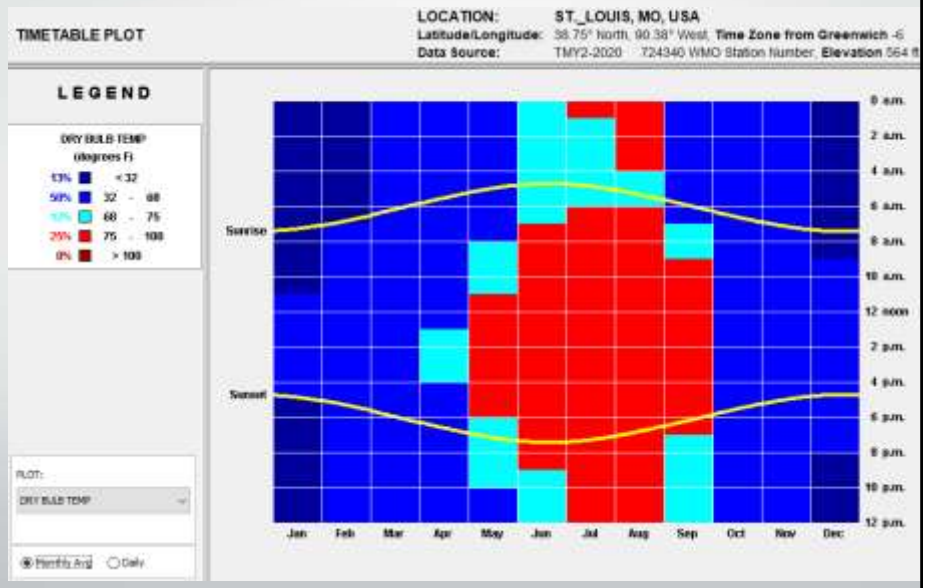
Climate Analysis: Timetable Plot

Cooling Months:
May - September

Heating Months:
Jan – April
October - December



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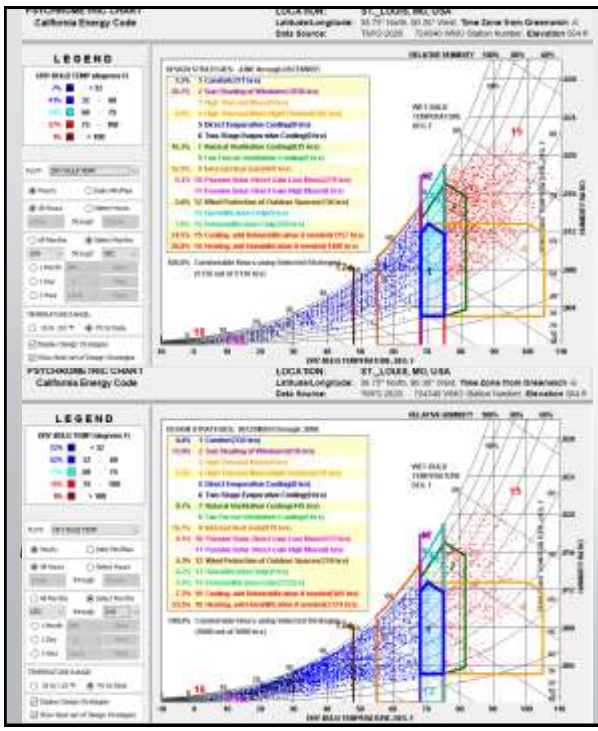

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Climate Analysis: Psychrometric Chart and Design Guideline

Passive Cooling Strategies

1. 20.2% Sun Shading of Windows (1038 hrs.)
2. 16.9% Internal Heat Gain (869hrs.)
3. 16.3% Natural Ventilation Cooling (835 hrs.)
4. 7.0% Dehumidification (359hrs.)
5. 6.9% High Thermal Mass Night Flushed (356 hrs.)
6. 5.4% Passive Solar Direct Gain Low Mass (279hrs.)

Passive Heating Strategies

1. 16.1% Internal Heat Gain (819 hrs.)
2. 12% Sun Shading of Windows (610hrs.)
3. 8.7% Natural Ventilation Cooling (445 hrs.)
4. 8.1% Passive Solar Direct Gain Low Mass (412 hrs.)
5. 5.5% High Thermal Mass Night Flushed (279 hrs.)
6. Wind Protection of Outdoor Spaces (218 hrs.)

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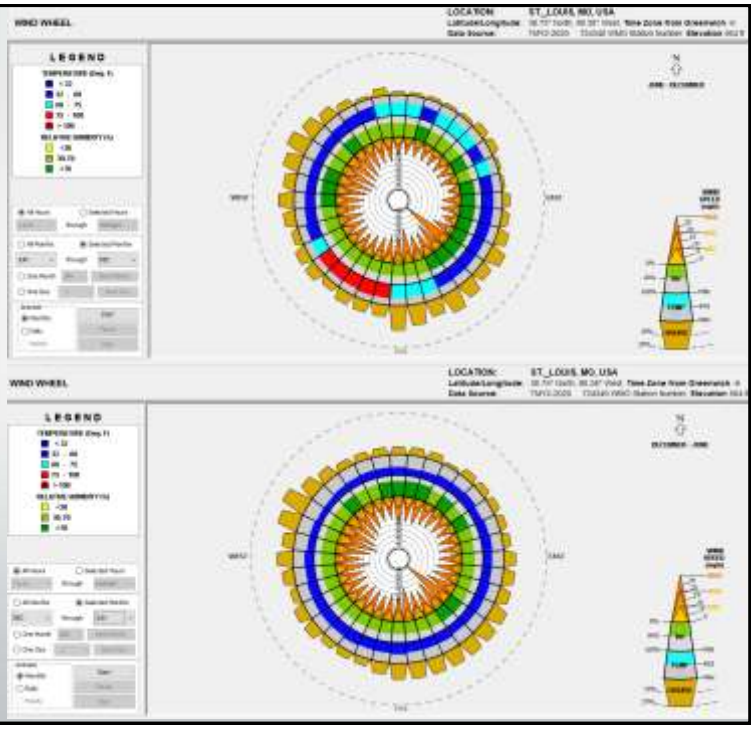
Climate Analysis: Wind Wheel

- June – December
  - Wind is strongest coming from the Southeast , majority of uncomfortable wind are coming from the Southwest. Summers do have some comfortable zones and is hotter in June. More humidity during this time as well.
- December – June
  - Wind direction hasn't changed but the average temperature stays the same being between 32-68 Degrees and the average humidity being between 30-70 degrees.

Overall, wind direction doesn't change very much nor does the velocity. Stays consistent.



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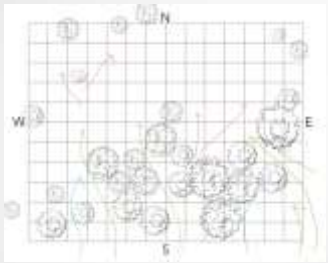
Climate Analysis - Site Wind Flows B1.2

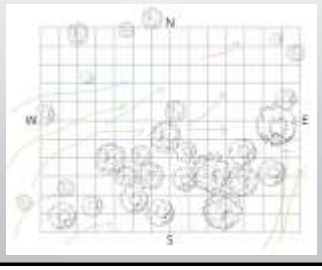
Major gusts coming from the Southwest/West direction during winter and spring months.

Fall - Prevailing wind from South
AWS: 7.7mph. % of calm: 35%

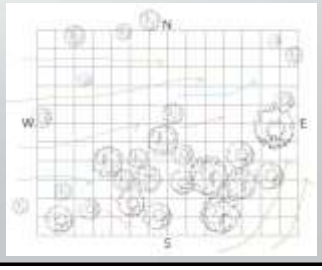


Winter - Prevailing wind from Southwest
AWS: 6.5mph. % of calm: 20%

Spring - Prevailing wind from Southwest
AWS: 9.5 mph. % of calm: 55%



Summer - Prevailing wind from West
AWS: 5.8 mph % of calm:45%



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B1.3 Sun Peg Shadow Plot – UTC –05:00

Spring

09:00 am 12:00pm 3:00pm

The shadows from in the spring from West to East. The large area in the North East has shade throughout spring.

Summer

09:00 am 12:00pm 3:00pm

The shadows in the summer are the shortest , mostly in the NE don't have as much shade coverage as compared to the Spring.

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B1.3 Sun Peg Shadow Plot – UTC –05:00

Fall

09:00 am 12:00pm 3:00pm

The shadows in the fall is almost identical to the Spring, completely shade the area in the NE, causing the temperatures to be cooler than what they are.

Winter

09:00 am 12:00pm 3:00pm

- Winter shadows are the longest and provide a big shading area with less sun and lower temperature make the area the coldest.

- Overall, the trees on our assigned site add shadings to the area which is beneficial for St Louis Climate.

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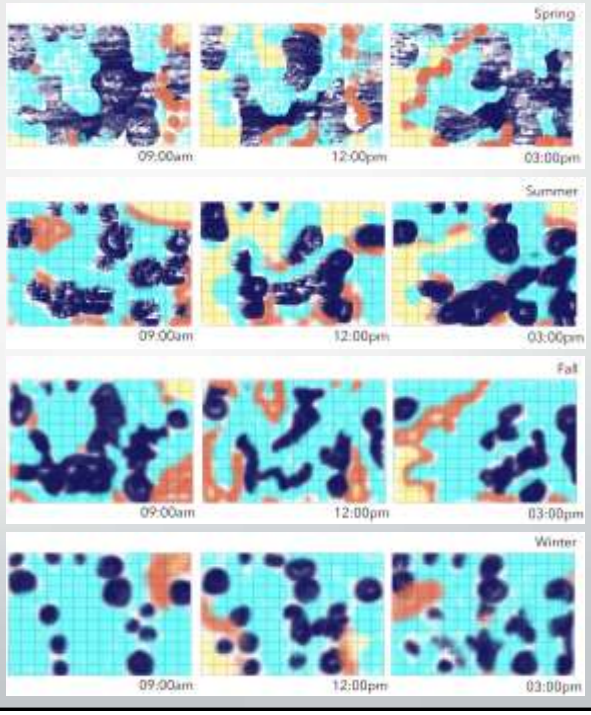
B1.4
Climate Response Matrix

09:00am:
Spring- will need heat source
Summer- will need cooling
Fall- barely will need heat
Winter- will need heat

12:00pm:
Spring- will need slight heat
Summer- will need cooling
Fall- at comfortable level
Winter- will need heat

03:00pm:
Spring- barely will need heat
Summer- will need light cooling
Fall- barely will need cooling
Winter- will need source of heat



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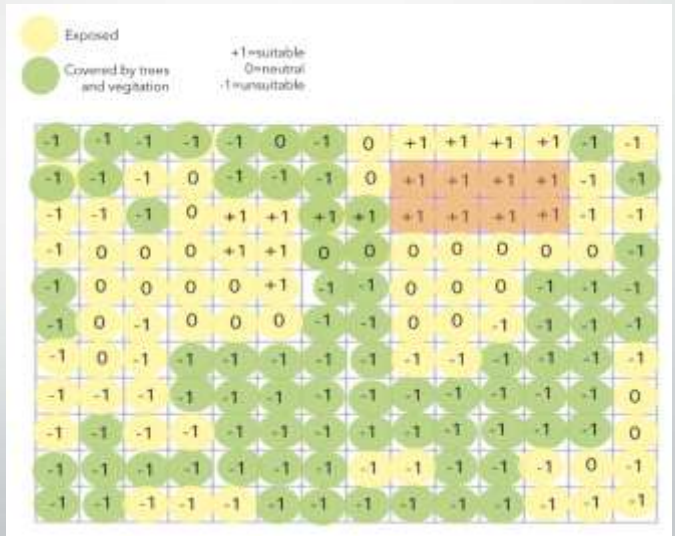
B 1.5
Climate Response Matrix Analysis

The most promising site location is highlighted. This site is lightly shaded year-round while still in a position to receive valuable sunlight as well throughout the year. The vegetation to the Southwest of the site provides protection from strong winds, but still allows a slight breeze through to cool the building.



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Site Analysis

- WEATHER SENSATIONS

September 12th – 11:45 am
Moscow, Idaho

A: Warm

B: Cool with shading

C: Windy

D: Less to no wind

E: Most sunlight

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Site Visit Conclusion

In the beginning of the site analysis process we kept in mind the humid subtropical climate that the St. Louis Public Library was coming from.

When we met at East City Park, Moscow, Idaho to analyze the site we immediately noticed the change in wind as we moved throughout the site. Some areas being super windy and others completely still. As well as the change in temperature as we moved from spot to spot on the proposed site. Areas of open sun exposure were significantly warmer than shaded low areas.

(1) For the first spot, we took into consideration the amount of shade that was provided by the trees on the South-East area of the site. The shade would provide natural shading for the building making it more efficient. There was wind coming from the South-East/East side of the site. As well as the proposed site being on the highest part of the site and the coolest temperature wise.

(2) For the second spot, it was lower on the site with close to no wind exposure. This is an open area with optimal sun exposure to naturally light the building. Throughout the duration of the day, this area receives light shading from the trees to the South-East of this spot.

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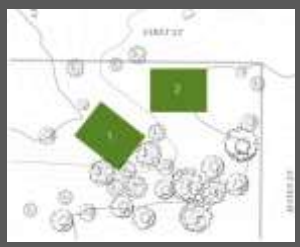
Building Placement



Based on our analysis of the site and climate we have decided to place our building program on site (2). The existing trees on the site block the winter winds and provide shade during the summer months. The large patch of trees in the South-East corner of the site block the winds entering the site during the summer just enough to provide cooling of the building, while the trees on the North-East section of the site are just thick enough to block the winter winds entering the site. Location (2) is also on a cooler area of the site, providing natural building cooling saving on energy in the summer months. The North facing side of the building program will be exposed to sunlight allowing for natural light to enter the building providing an energy saving opportunity.

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Thermal Zoning
c1.1 - Program Analysis- Use Schedules

- **How can the spaces in your building be grouped for similar thermal needs?**

Space	Area (ft^2)	Peak Hours	Off-Peak Hours	# of Occupants	Light Level	Equipment Use
PUBLIC LIBRARY		Monday -Saturday 10am-10pm	Saturday 10pm – Monday 10 am	540		
Archives	1000ft^2	Monday-Saturday 10am-5pm	Monday-Saturday (7pm-10pm) Saturday 10pm – Monday 10 am	45	moderate	high
2 Bathrooms	500ft^2	Mon- Sat (10am-11am)) (1pm-2pm) (5pm-7pm)	Mon-Sat (12pm-1pm)(2pm-5pm)(8pm-10pm) Saturday 10pm – Monday 10 am	20	high	moderate
Book Bindery and Workshop	3754ft^2	Monday-Saturday 10am-5pm	Monday-Saturday (7pm-10pm) Saturday 10pm – Monday 10 am	15	moderate	moderate
Circulation Desk	75ft^2	Monday -Saturday 10am-10pm	Saturday 10pm – Monday 10 am	3	high	high
Lecture Room for 50 People	1500ft^2	Monday-Friday10am-8pm Saturday 10am-2pm	Monday-Friday 8pm-10pm Saturday 2pm-10pm Saturday 10pm – Monday 10 am	50	low	low
Open Plan Office	1000ft^2	Monday -Friday 10am-5pm	Mon-Fri 5pm-10pm Saturday 10am -Monday 10am	45	moderate	moderate
3 Reading Areas for Adults, Children, and Periodicals	1800ft^2	Monday -Saturday 10am-10pm	Saturday 10pm – Monday 10 am	60	high	moderate
Stack Area	4,000ft^2	Monday -Saturday 10am-10pm	Saturday 10pm – Monday 10 am	160	moderate	moderate
Staff Lounge	250ft^2	Monday-Saturday (10am-11am)(3pm-2pm)(5pm-6pm)	Monday-Saturday (12pm-1pm)(2pm-5pm)(6pm-10pm) Saturday 10pm – Monday 10 am	10	low	low
Storage Room	4000ft^2	Monday – Saturday (10am-11am)(3pm-4pm)(9pm-10pm)	Monday-Saturday (12pm-3pm)(4pm-9pm) Saturday 10pm – Monday 10 am	160	low	low
Controlled Outdoor Reading Room	750ft^2	Monday -Saturday 10am-10pm	Saturday 10pm – Monday 10 am	30	low	moderate

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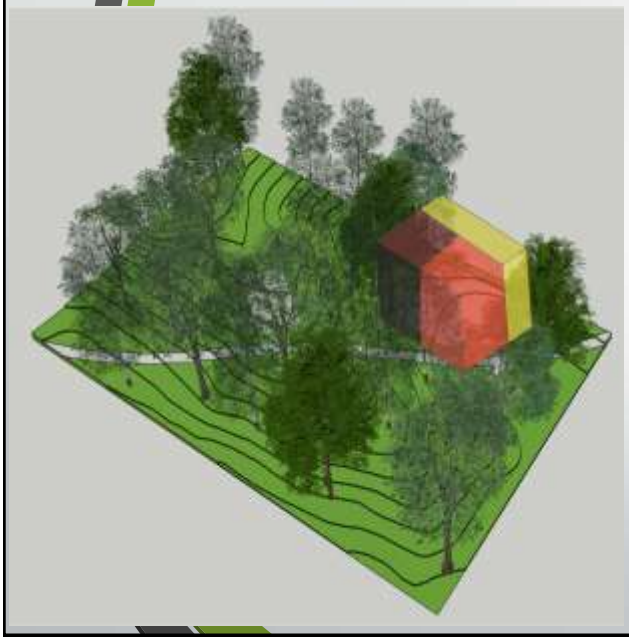
C1.2-Program Analysis - Thermal Zoning



Zoning 1 has the highest level in thermal load density. Zoning 2 has the most moderate thermal load. Zoning 3 has the lowest thermal load. The zones are in one building but with the zones facing the direction they need to be.

ZONES		
Zone 1	Zone 2	Zone 3
2 Bathroom	Archives	Lecture Room
3 Reading Rooms/Adult/Children	Stack Room	Staff Lounge
Circulation Desk	Open Plan Office	Storage Room
	Book Binding & Workshop	Controlled Outdoor Reading Room

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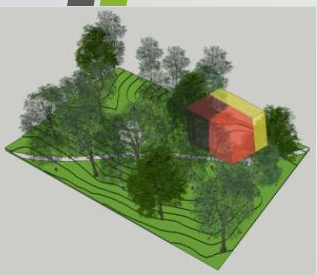
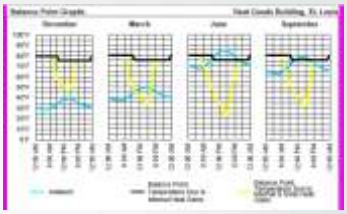
Balance Point Spread Sheet



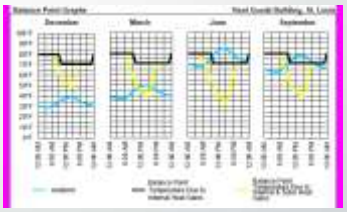
Schematically, zone 1 would be placed in the South East as the wind is blocked by the trees, allowing the high thermal load to cool down naturally.

Zoning 1: Programs:
2 Bathrooms
3 Reading Rooms/Adult/Children
Circulation Desk



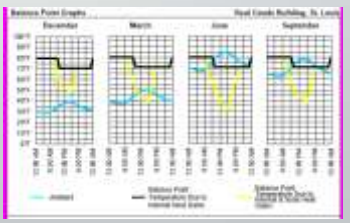
Zoning 2 would be placed in the north to allow natural daylighting.

Zoning 2:Programs:
Archives
Stack Room
Open Plan Office



Zoning 3 would be place in the SW as it's protected from the wind by the trees but also because it's a warm spot, it can be an opportunity for energy saving.

Zoning 3: Programs
Lecture Room
Staff Lounge
Storage Room
Controlled Outdoor Reading Room



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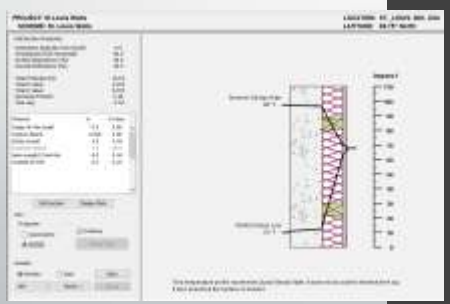
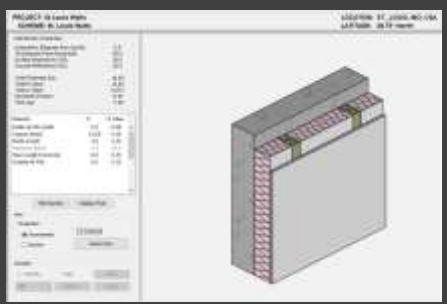
C1.6 - Energy conservation chart

Table C1.6.1 Energy Conservation Strategies

Characteristic Balance Point Temperature Chart	Strategies									
heating always		X	X		X			X		
heating and cooling required: heating		X	X		X			X		X
heating and cooling required: cooling-outside warmer than inside	X			X		X		X	X	
heating and cooling required: cooling-outside cooler than inside	X			X		X	X		X	
cooling always required: cooling-warmer than inside	X			X		X		X		
cooling always required: cooling-outside cooler than inside	X			X		X	X			X

For best energy conservation and human comfort, both heating and cooling strategies are needed depending on the seasons.





OPAQUE PROGRAM

The best material used for the building from inside to outside is gypsum board, Inside air film, studs (wood) , Insulation Board and a heavyweight concrete that will keep the temperature comfortable in St. Louis.

Total Thickness (in): 10.63
Total R Value: 13.63
Total U value: 0.073
Decrement Factor: 0.46

MP

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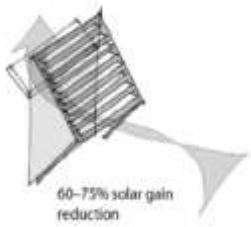
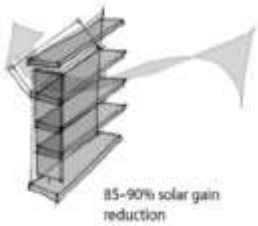
C1.6 - Design strategies

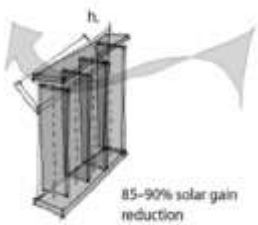
Operable shading devices for windows which could open and allow the windows to switch to solar heat gain into the building during colder months and open for natural ventilation and passive cooling during the hot months. The shading system can also turn into a canopy to connect the indoor space with the park during the comfortable time.

North Facing Facade
Horizontal Shading device

West Facing Facade
Vertical Shading device







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Conclusion

We were given the most optimal site for many reasons. We chose to place our building on the lower section of the site for a higher potential in ventilation and cooling and heating precedents. By placing the building towards the lowermost part of the site, we have a natural windbreak from the trees that surrounds the building. The wind will not be too harsh no matter what direction it comes from, because there is limited winds. It creates a space that is ideal for ventilation. For the summer season, operable shading devices are suggested due to higher sun exposure on the North and West façade, we can conclude that it would easier to keep warm in the winter and still manage to keep cool in the summer.

MH

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