

Children Museum



MARC 8600 - Environmental Evaluation of Building Projects

Instructor : Prof .Pairone

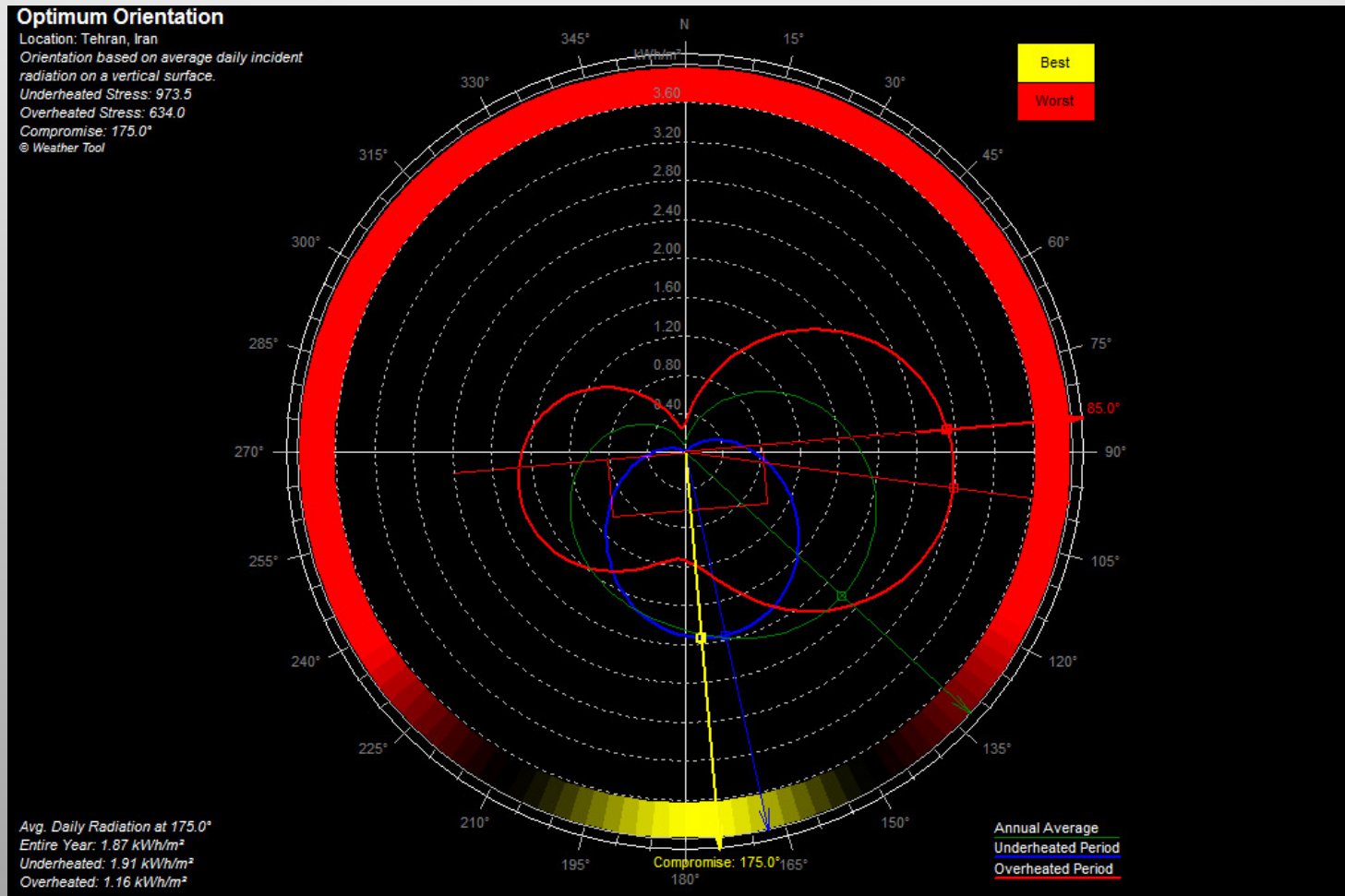
Student : Massih Nilforoushan

Fall 2010

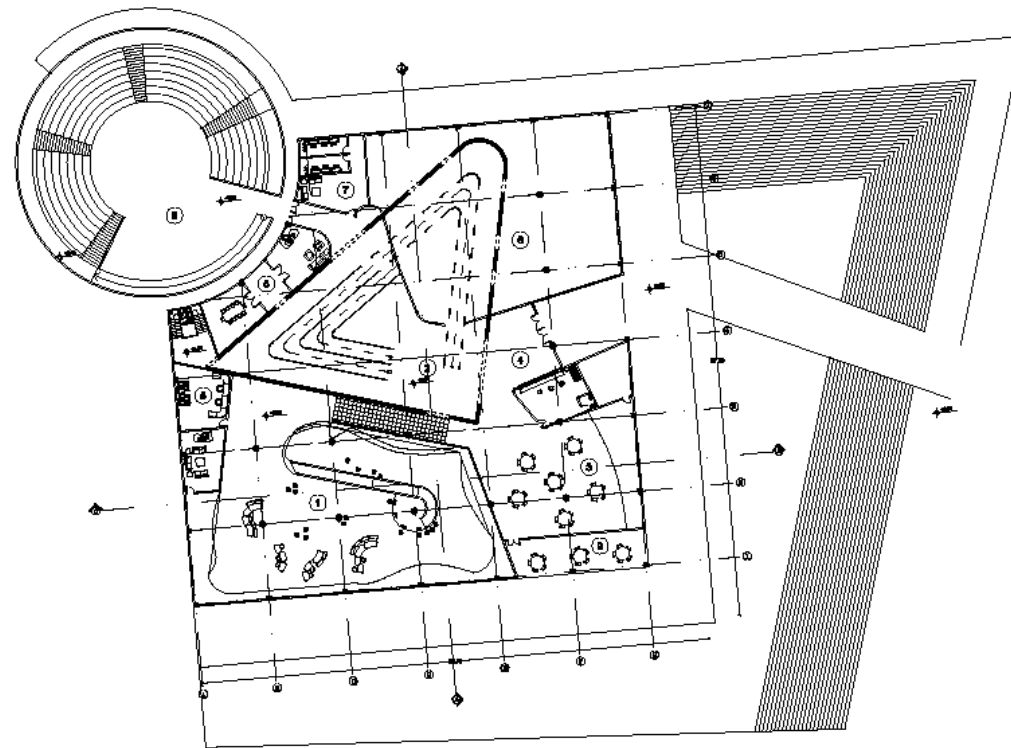
Site Plan



Optimum orientation in Tehran



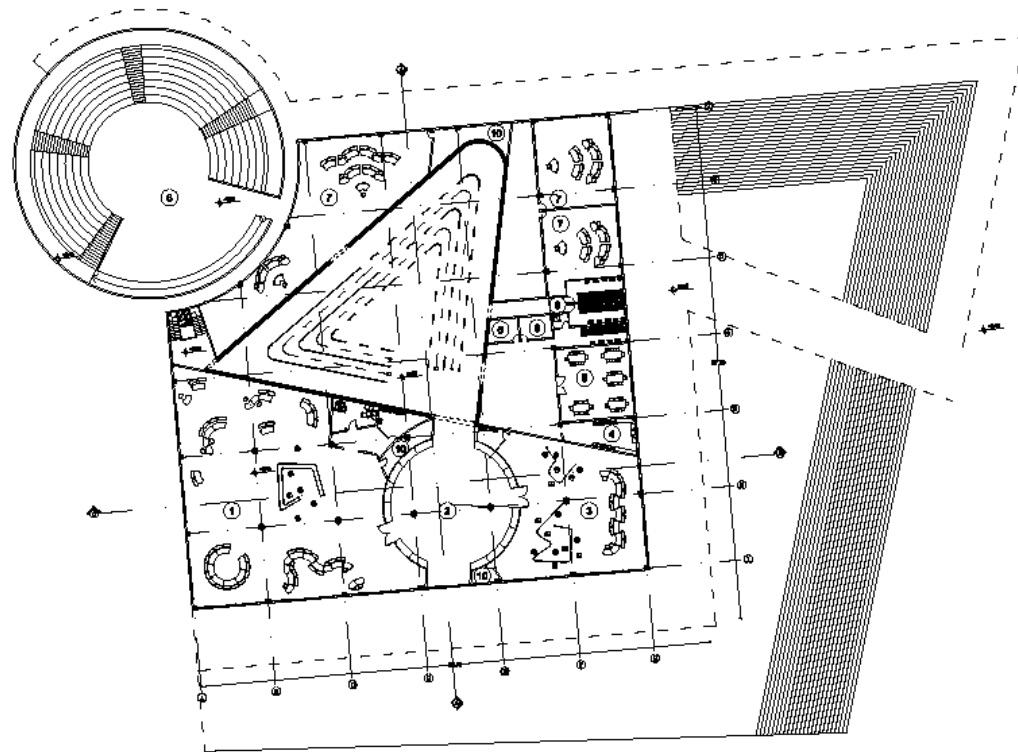
1st Floor Plan



- 1—LIBRARY
- 2—HALL
- 3—COFFEE SHOP
- 4—ENTRANCE
- 5—OFFICE
- 6—EXIBITION
- 7—MAKEUP ROOM
- 8—AMPHITHEATRE
- 9—BALCONY

1ST FLOORS PLAN

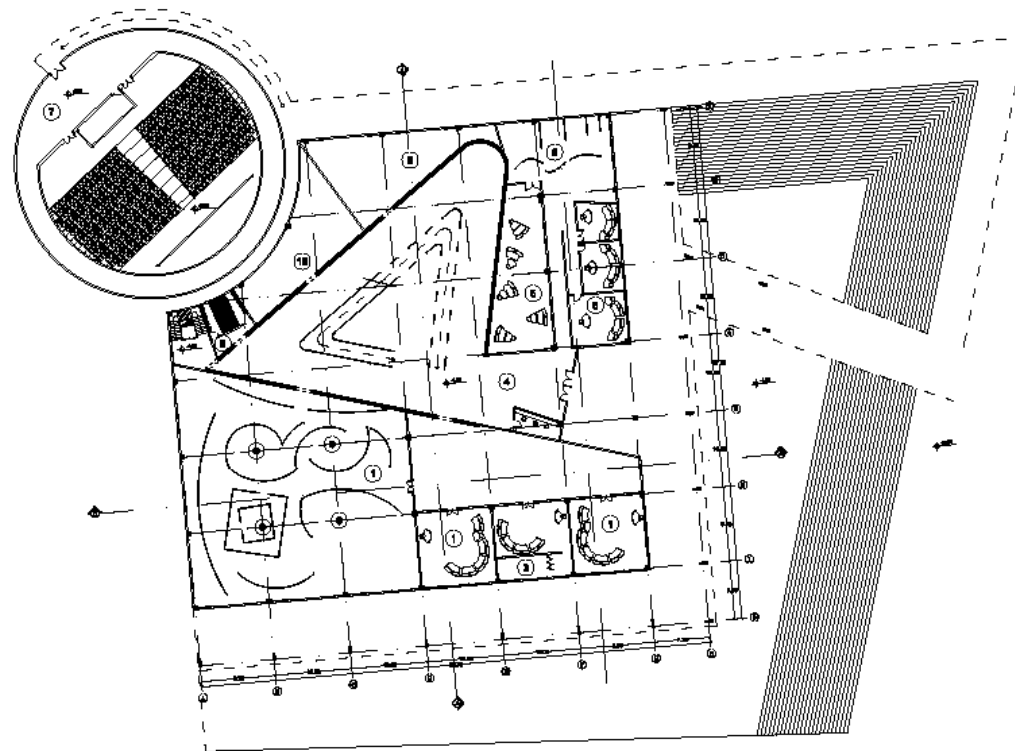
2nd Floor Plan



- 1-MATERIAL TESTING ROOM
- 2-HALL
- 3-PAINTING ROOM
- 4-KITCHEN
- 5-RESTAURANT
- 6-PRAY ROOM
- 7-CLASS
- 8-AMPHITHEATRE
- 9-W.C

2nd FLOORS PLAN

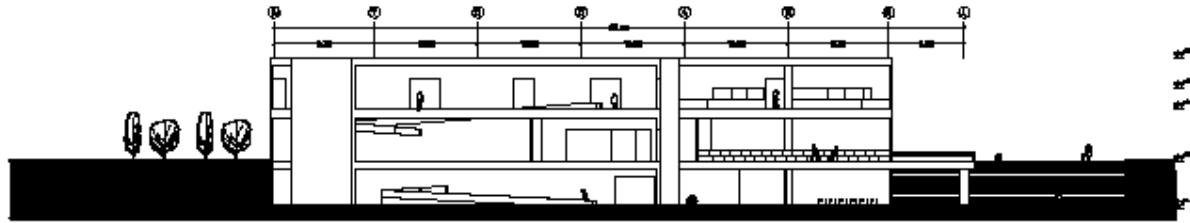
Basement Plan



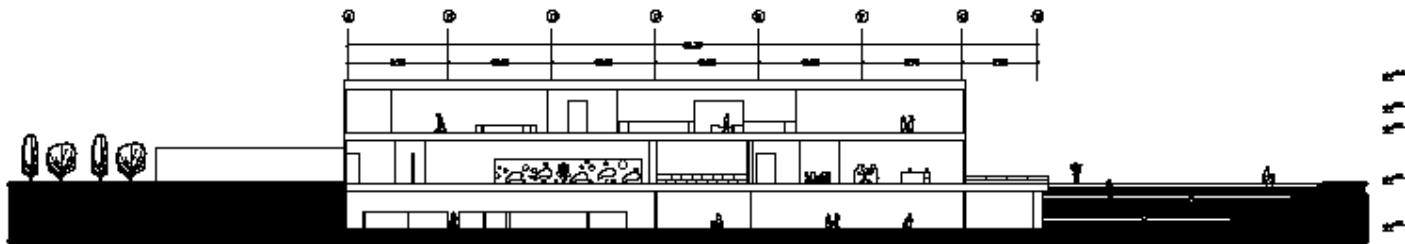
- 1-VISUAL AND SOUND CLASS
- 2-HALL
- 3-DARK ROOM
- 4-ENTRANCE
- 5-CLASS
- 6-MUSIC CLASS
- 7-AUDIOTURIOM
- 8-MECHANICAL ROOM
- 9-W.C

BASEMENT PLAN

Sections

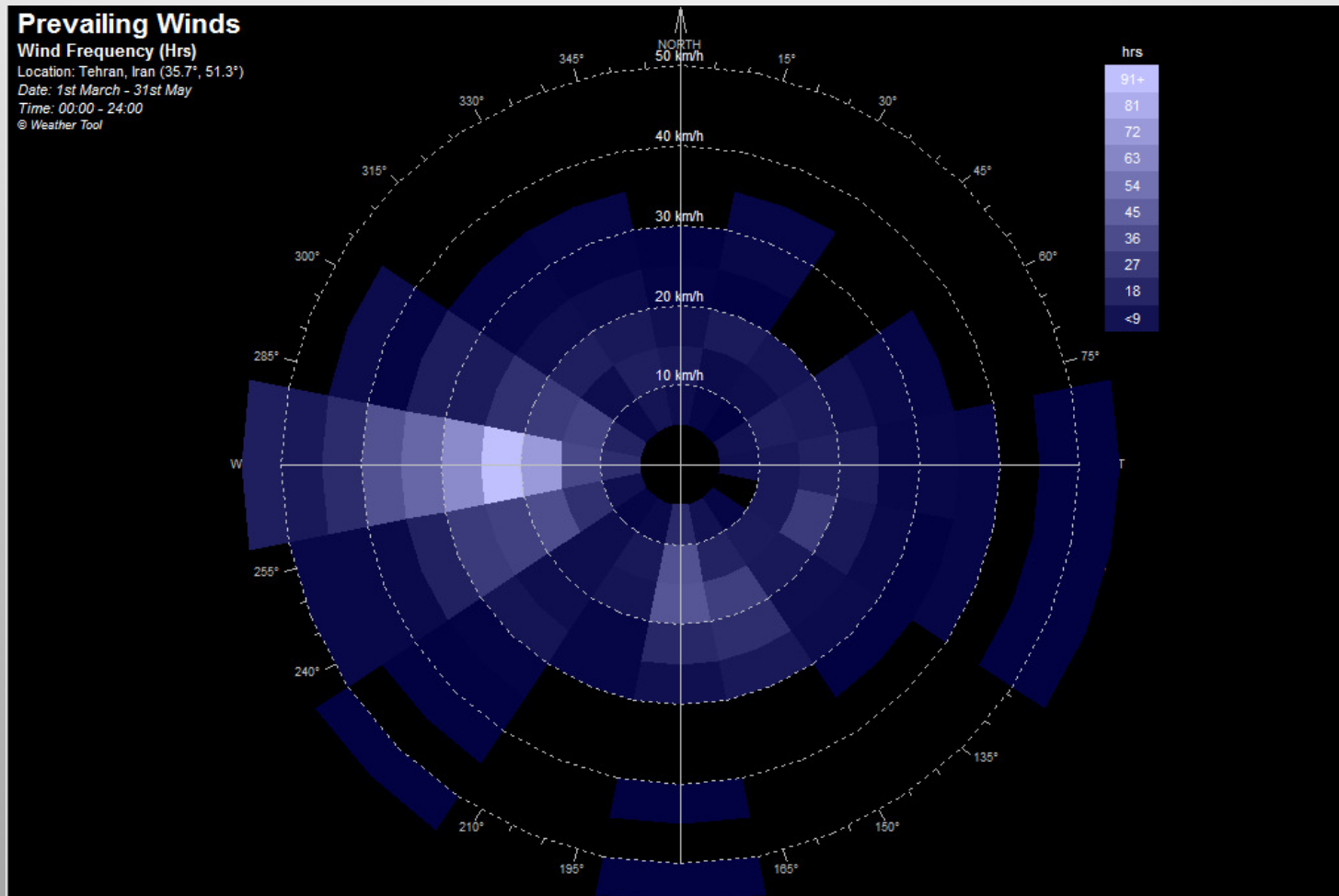


section A-A



section B-B

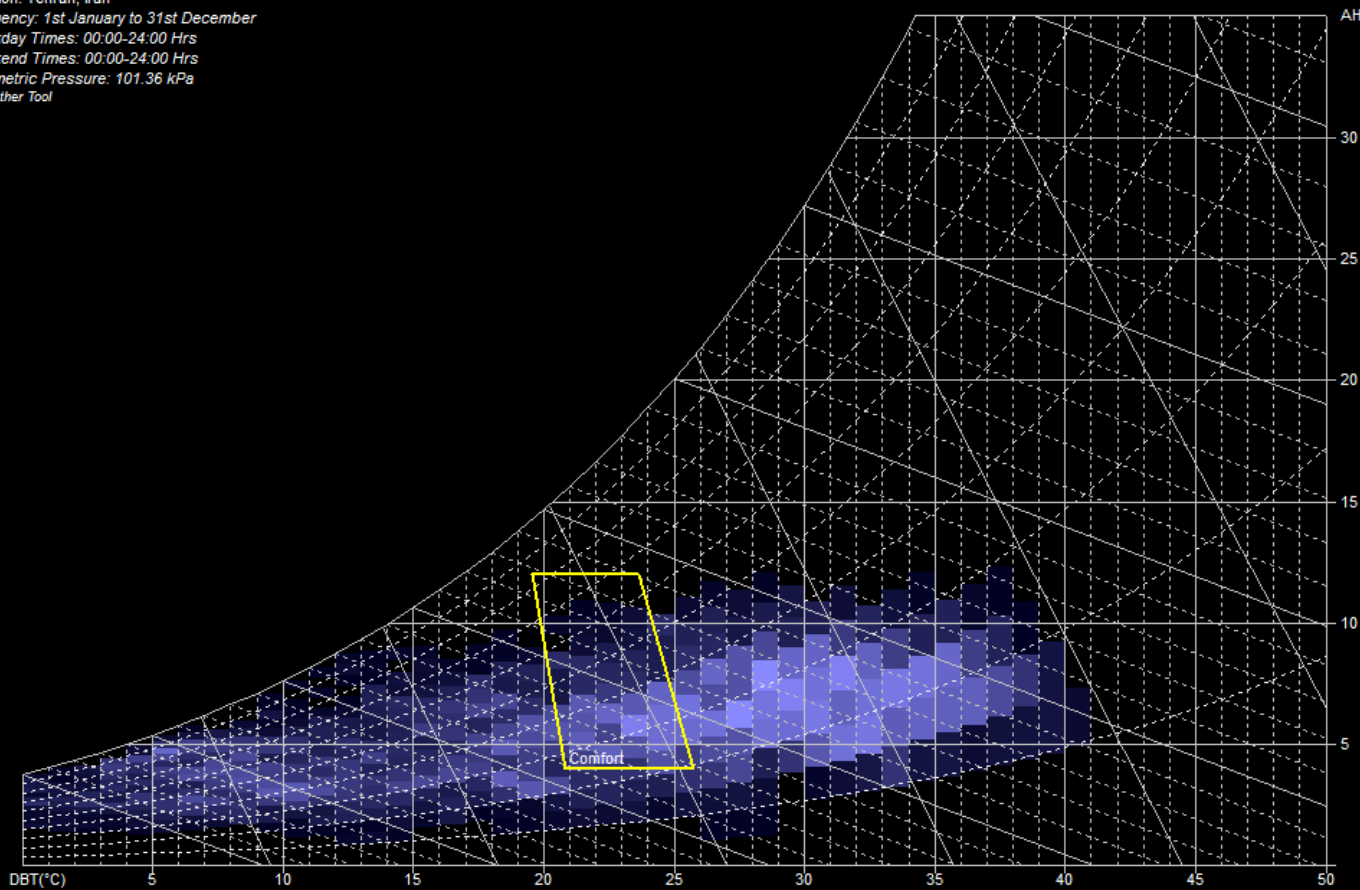
prevailing wind (all year)



Psychrometric

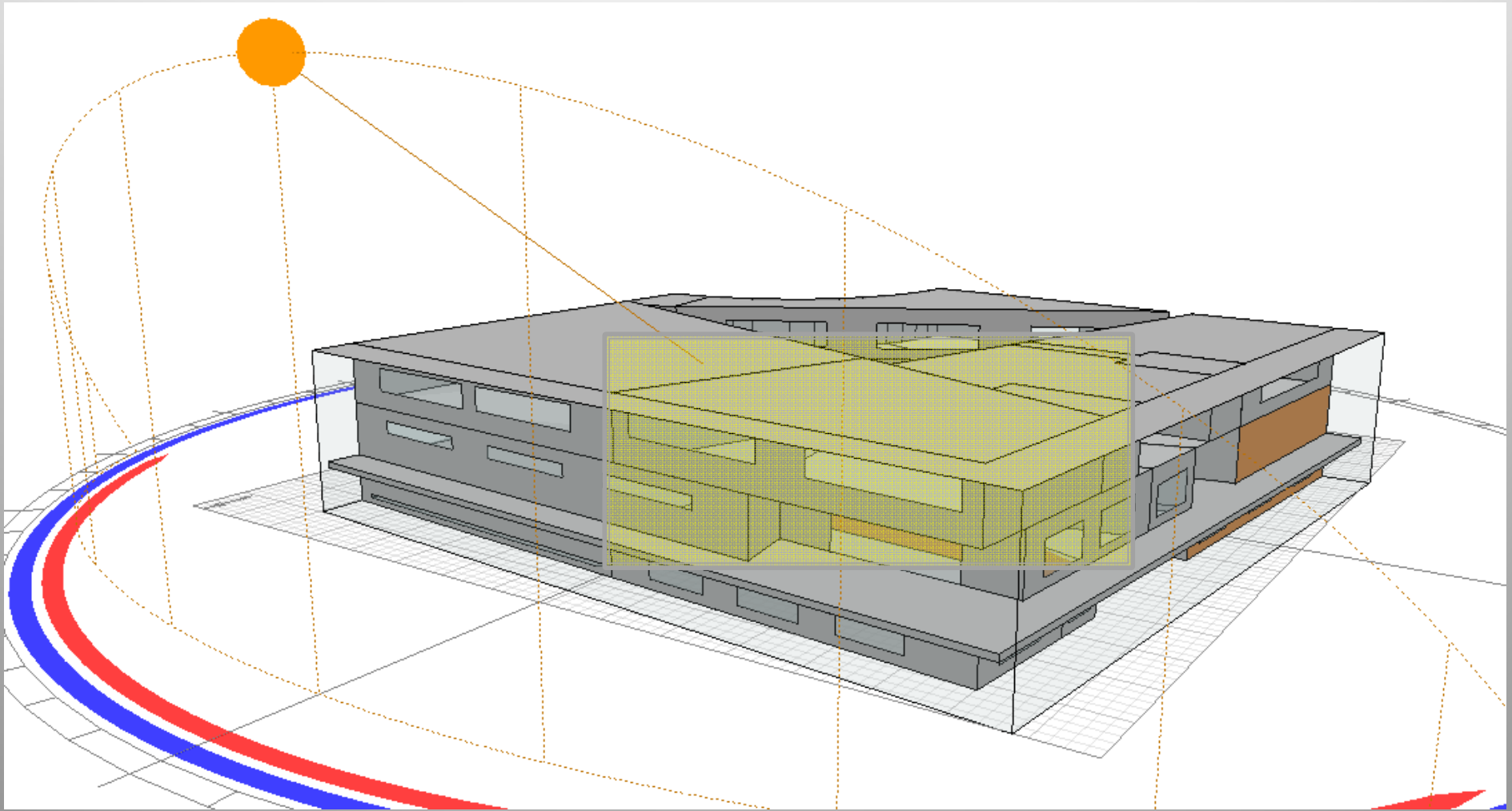
Psychrometric Chart

Location: Tehran, Iran
Frequency: 1st January to 31st December
Weekday Times: 00:00-24:00 Hrs
Weekend Times: 00:00-24:00 Hrs
Barometric Pressure: 101.36 kPa
© Weather Tool

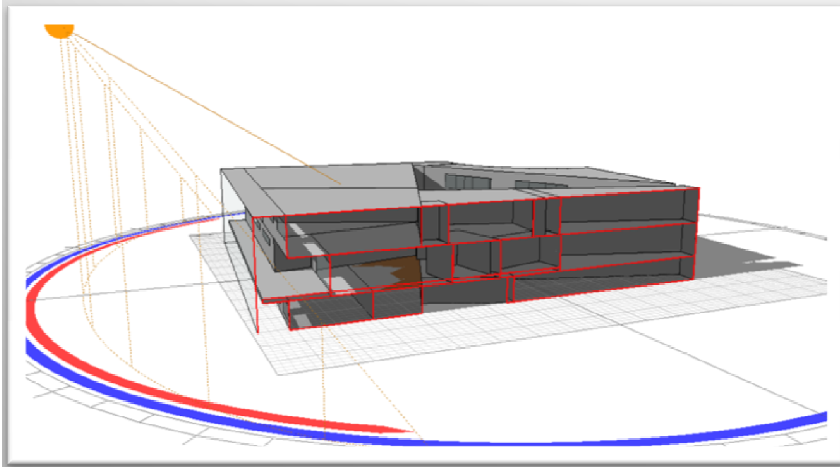


Psychrometric Chart(year)

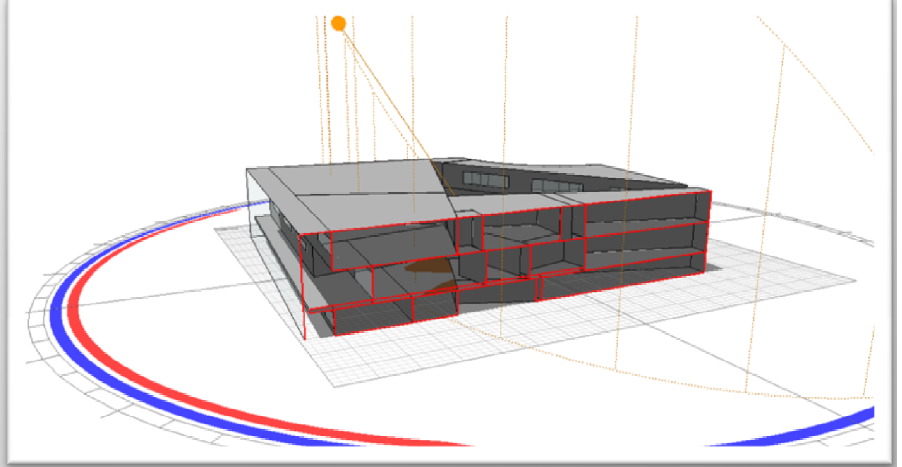
Atelier 2



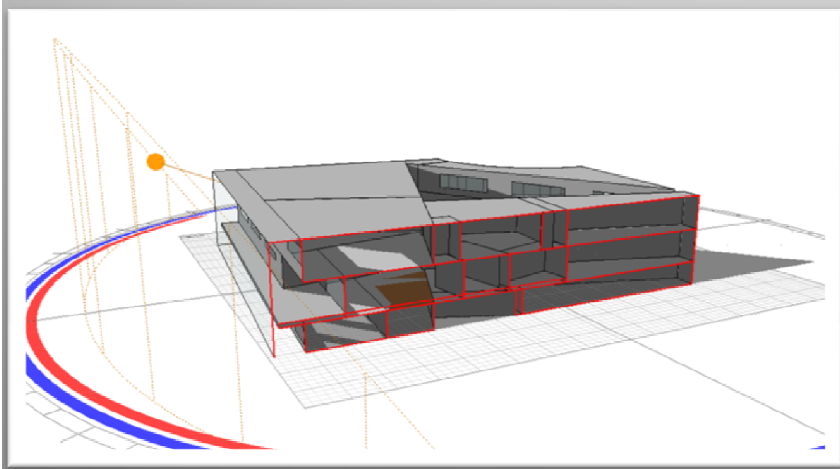
Atelier 2 (SHADOW)



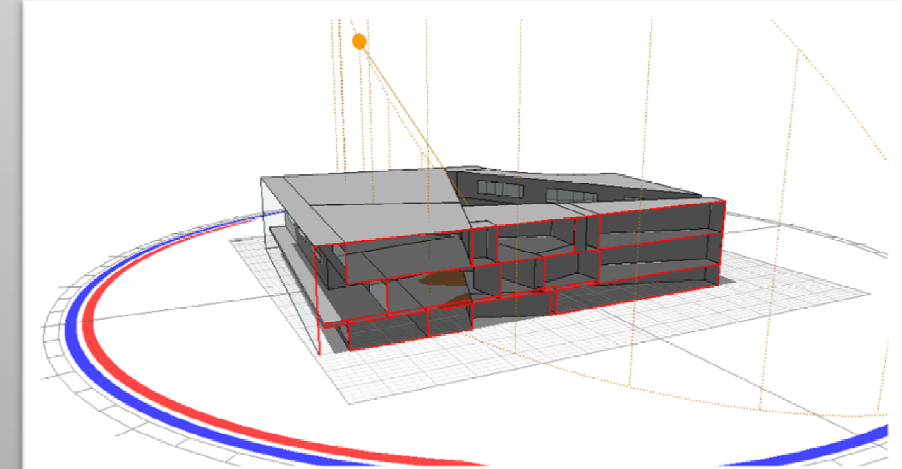
21th December 12pm



21th June 12pm



21th December 4pm



21th June 4pm

Atelier 2 (General Settings)

Internal Design Conditions:

Clothing(clo): Light Business Suite 1.00

Humidity:60 %

Air Speed: 0.50 m/s

Lighting Level :400 Lux

Occupancy and operation:

Occupancy: 60

Activity :65 W (Painting)

Schedule :

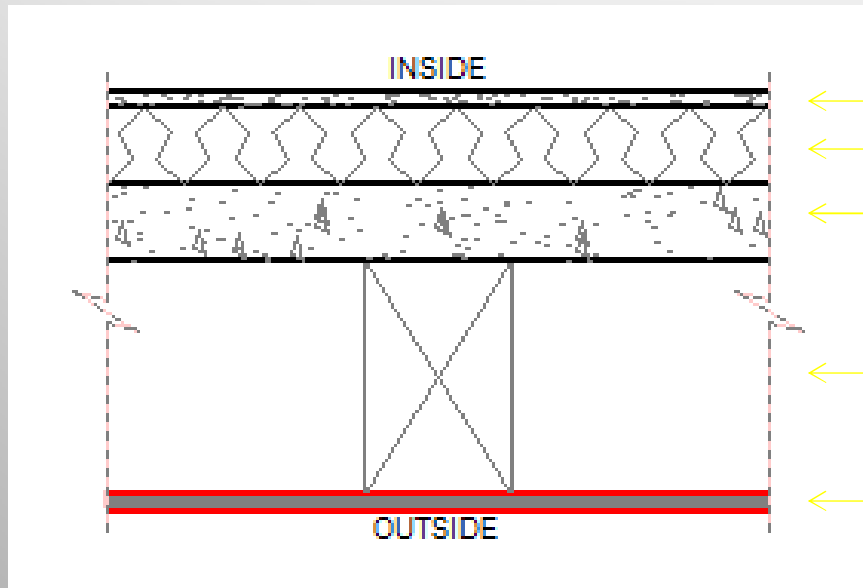
Standard Weekends : Fridays

Standard Weekdays: Saturday-Thursday (7am-6pm)

Comfort range of Temperature: 18.0 C 26.0C



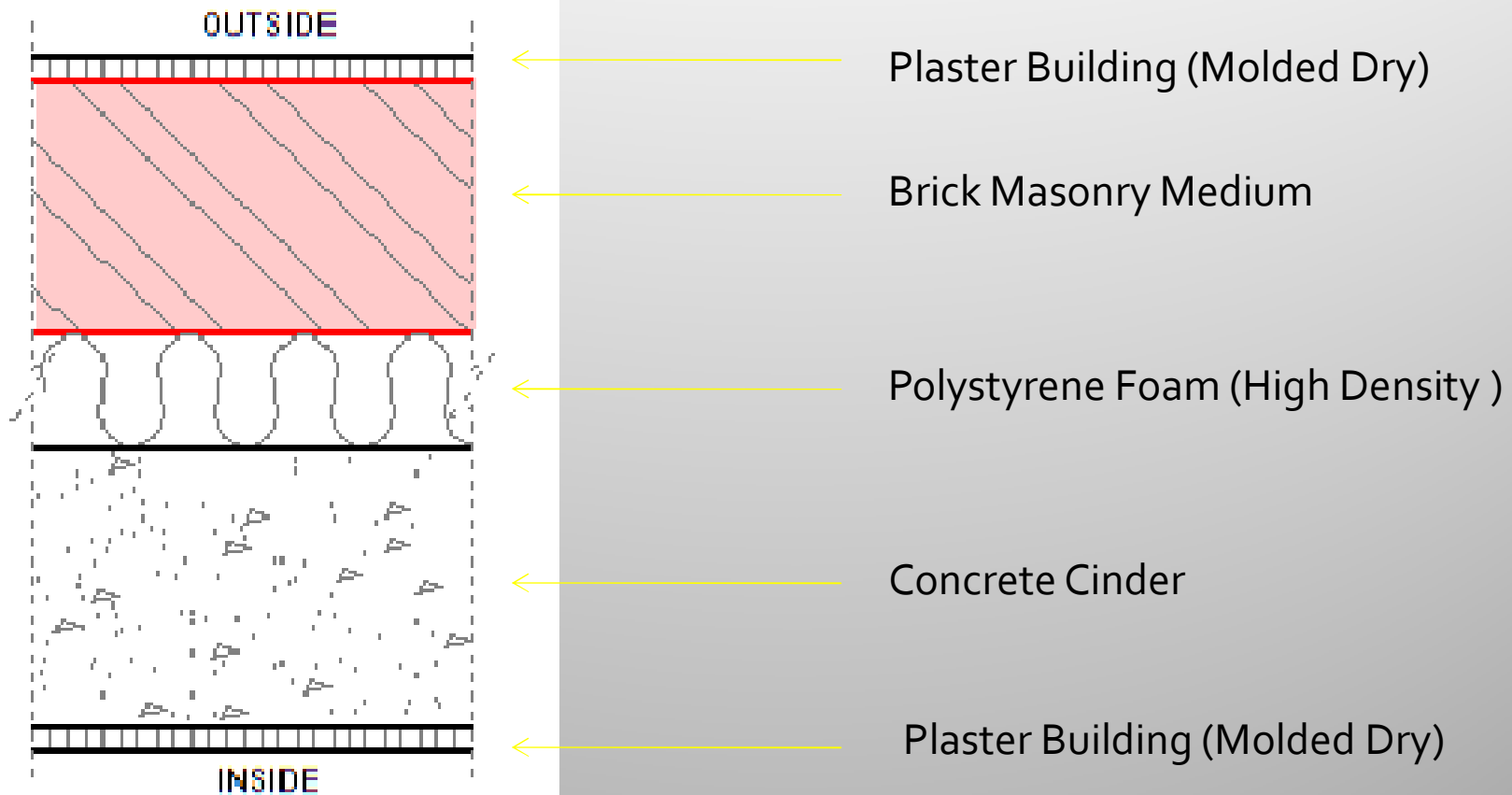
Atelier 2 (Materials)



- ← Plaster Board
- ← Polystyrene Foam (High Density)
- ← Roofing Slab, Aerated
- ← Air Gap
- ← Plaster Board

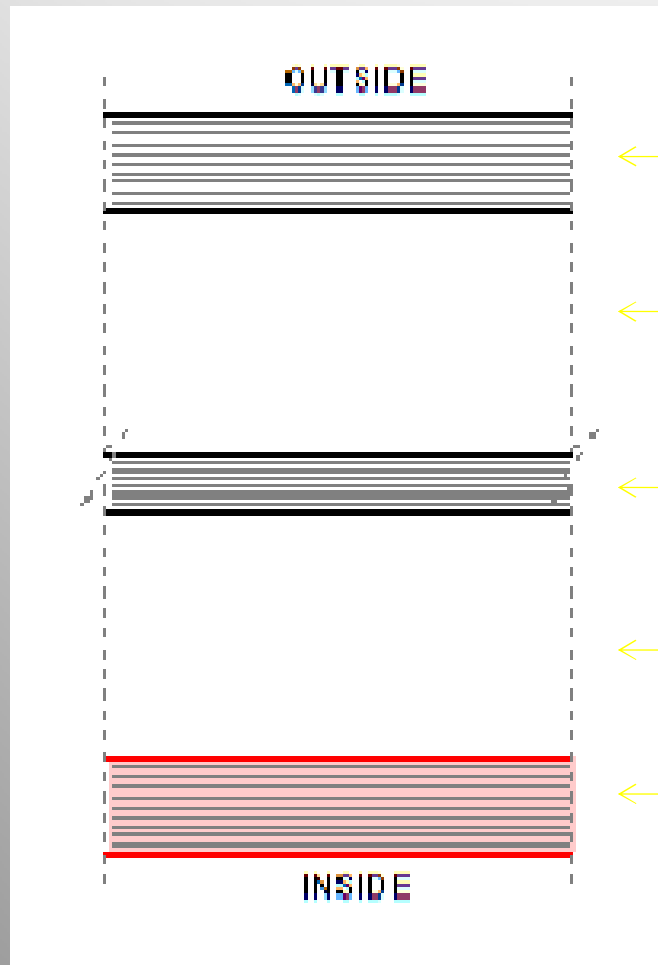
ConcFlr_Timber_Suspended
U-Value :0.150 W/m2.k

Atelier 2 (Materials)



BrickConcBlockPlaster_Wall
U-Value :0.150 W/m2.k

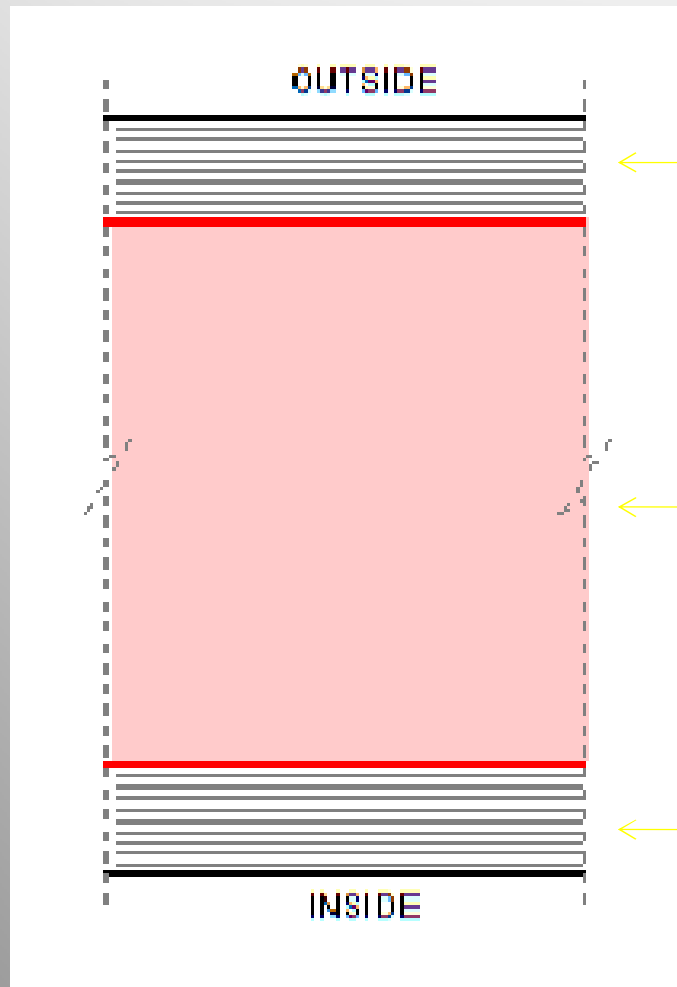
Atelier 2 (Materials)



- ← Glass Standard
- ← Argon Gas
- ← Glass Standard
- ← Argon Gas
- ← Glass Standard

Triple_glazed_Low_E
U-Value :1.080 W/m2.k

Atelier 2 (Materials)



← ETFE

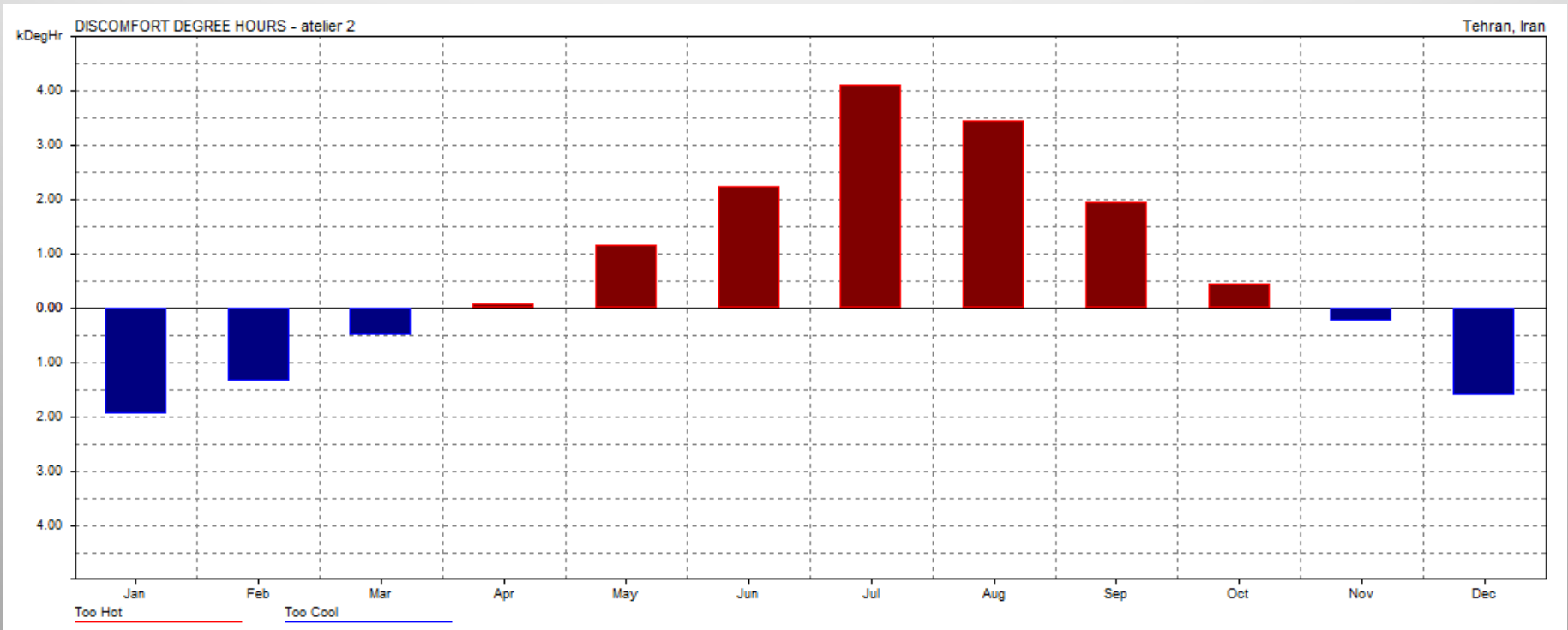
← Air Gap

← ETFE

ETFE Balloon

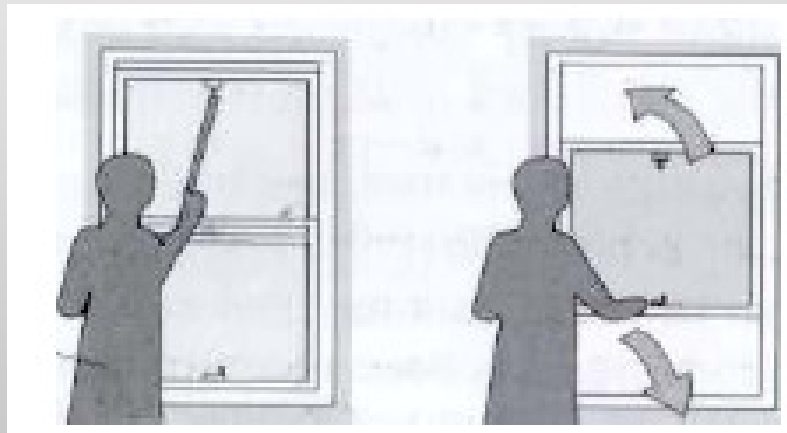
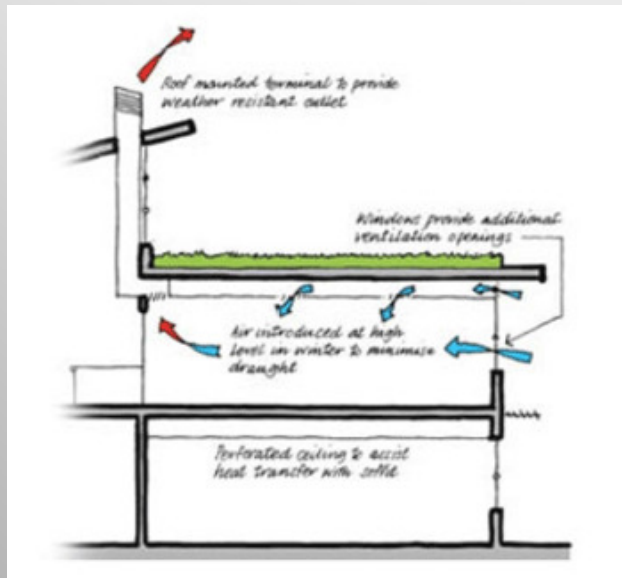
U-Value :1.800 W/m².k

Atelier 2 (Discomfort Degree Hours in a year)



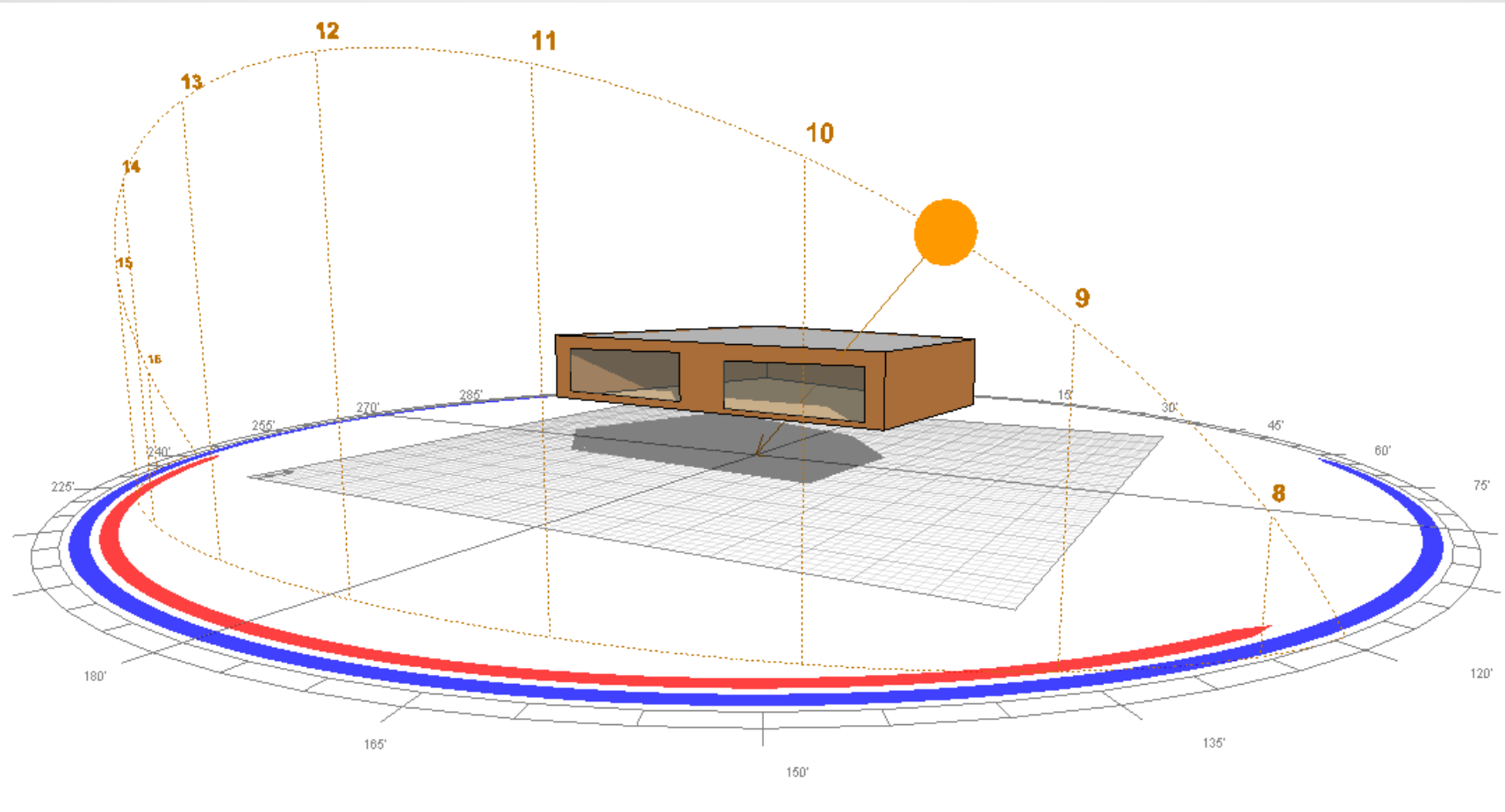
About 10 months of the year in discomfort situation without using any air-condition system.

Mixed mode System

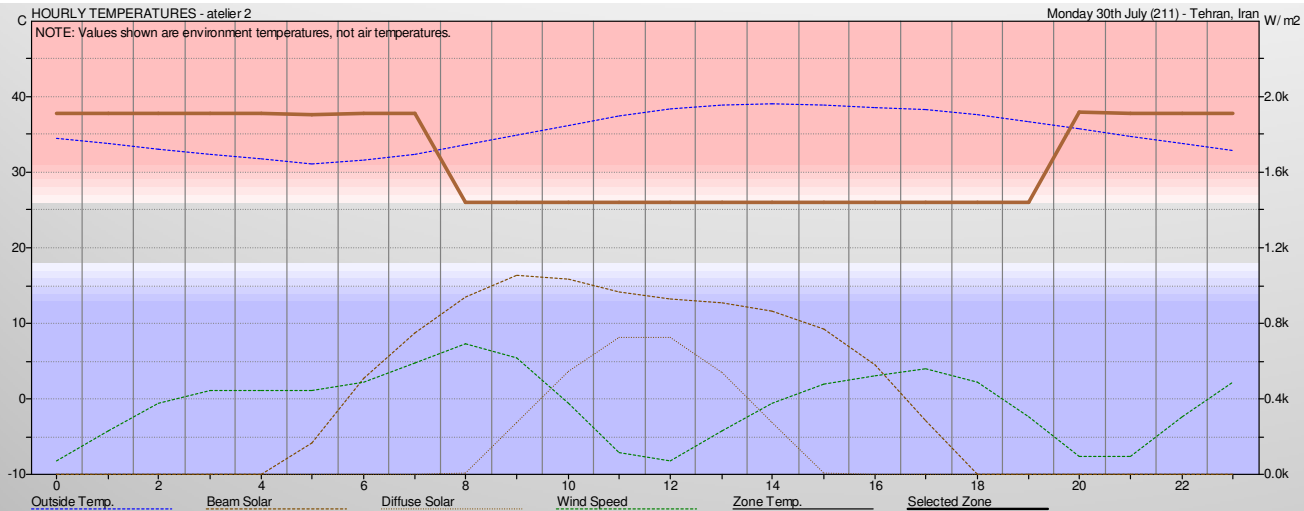


- A mixed mode ventilation system combines the best aspect of both natural ventilation and mechanical ventilation/air conditioning . The basic philosophy is to open the windows and switch off the air conditioning to avoid the energy penalty and consequential environmental effects of year round air conditioning.

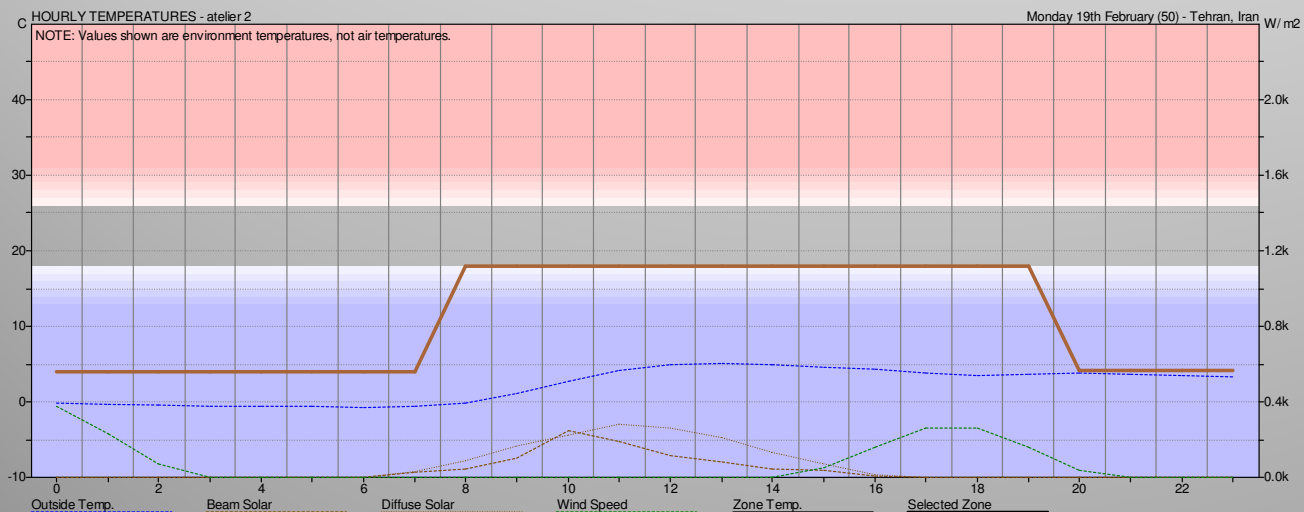
Atelier 2 (Using mixed-mode air condition system)



Atelier 2 (Using mixed-mode air condition system)

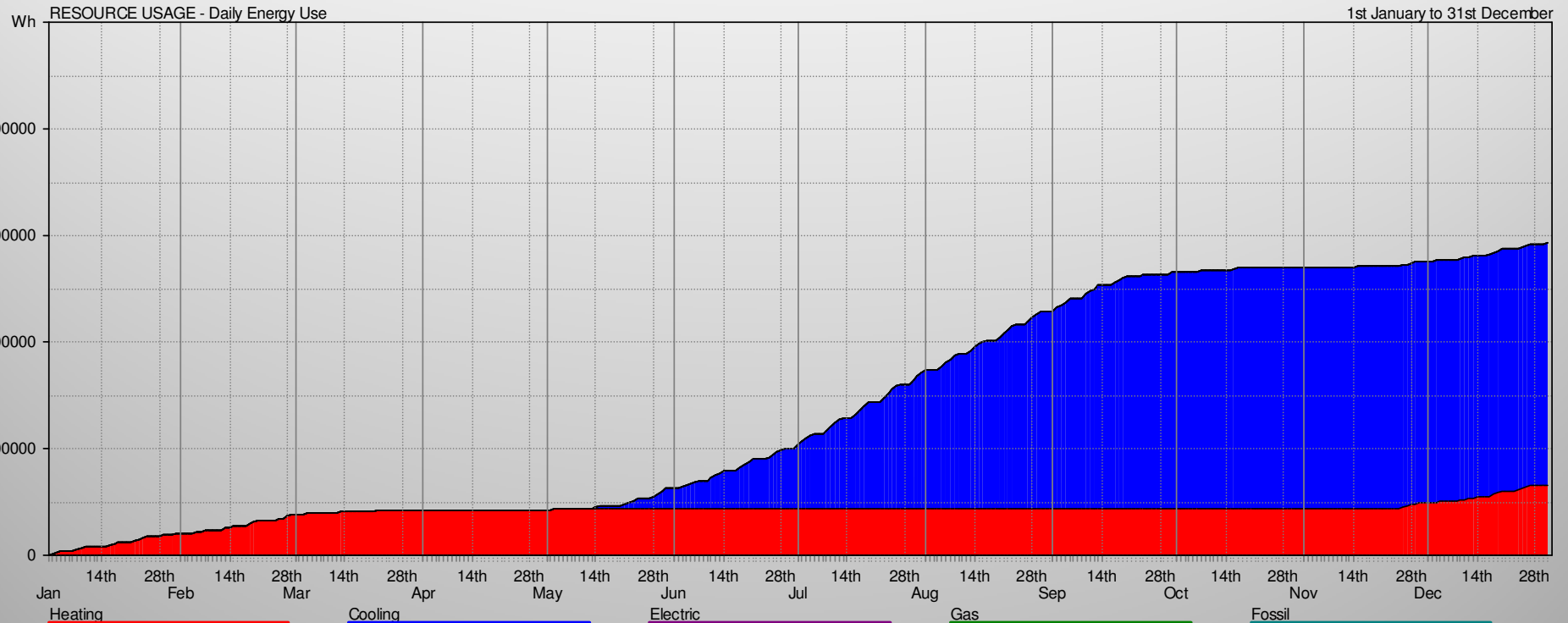


Hottest Day in Average:
30th July



Coldest Day in Average:
19th February

Atelier 2 (Using mixed-mode air condition system)



Energy Consumption for a year:

Heating Cooling

$$5.95 + 18.92 = 24.87$$

(KWh/m²y)

(KWh/m²y)

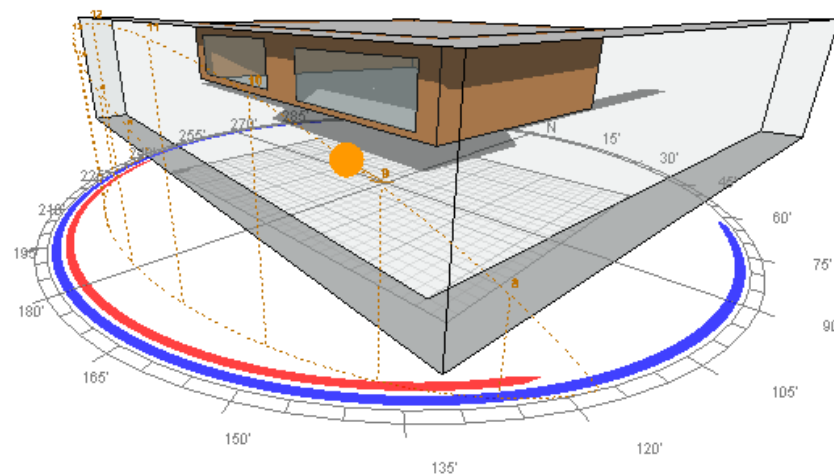
(KWh/m²y)

Atelier 2 (Using mixed-mode air condition system)

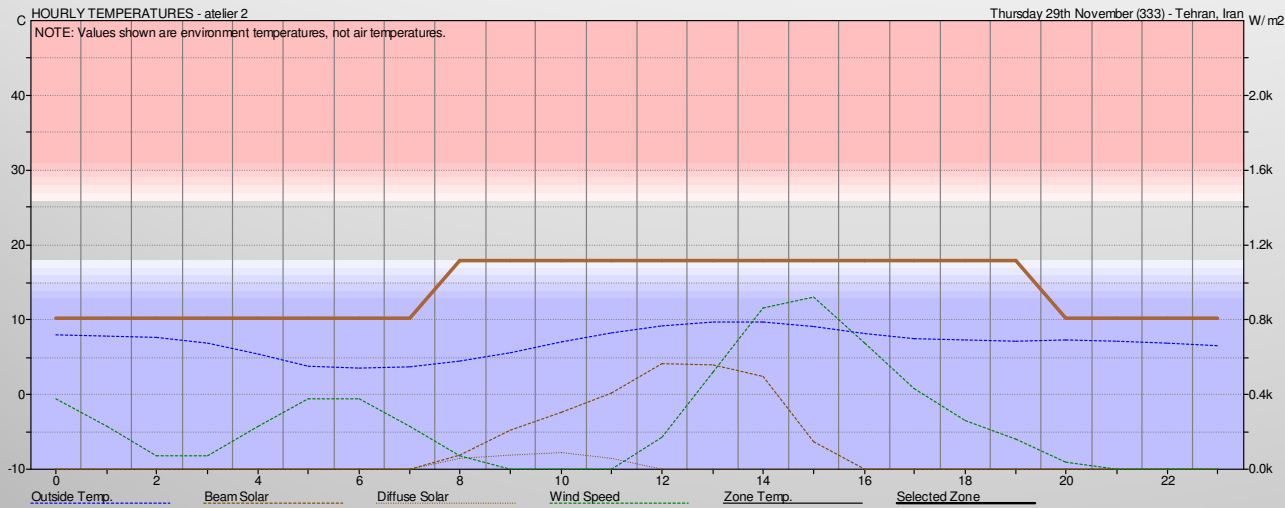
RESOURCE USAGE - Monthly Energy Use
With Mixed Mode System:

| MONTH | HEATING (Wh) | COOLING (Wh) | ELECTRIC (Wh) | GAS (Wh) | FOSSIL FUEL (Wh) |
|-------|-------------------|-------------------|------------------|-------------|---------------------|
| Jan | 895214 | 0 | 0 | 0 | 0 |
| Feb | 1588072 | 0 | 0 | 0 | 0 |
| Mar | 1821974 | 0 | 0 | 0 | 0 |
| Apr | 1827105 | 0 | 0 | 0 | 0 |
| May | 1828455 | 783165 | 0 | 0 | 0 |
| Jun | 1828455 | 2266231 | 0 | 0 | 0 |
| Jul | 1828455 | 4986380 | 0 | 0 | 0 |
| Aug | 1828455 | 7442442 | 0 | 0 | 0 |
| Sep | 1828455 | 8805461 | 0 | 0 | 0 |
| Oct | 1828494 | 9366022 | 0 | 0 | 0 |
| Nov | 2151434 | 9366022 | 0 | 0 | 0 |
| Dec | 2944319 | 9366022 | 0 | 0 | 0 |
| TOTAL | 2944.319 (KWH) | 9366.022 (KWH) | 0 | 0 | 0 |

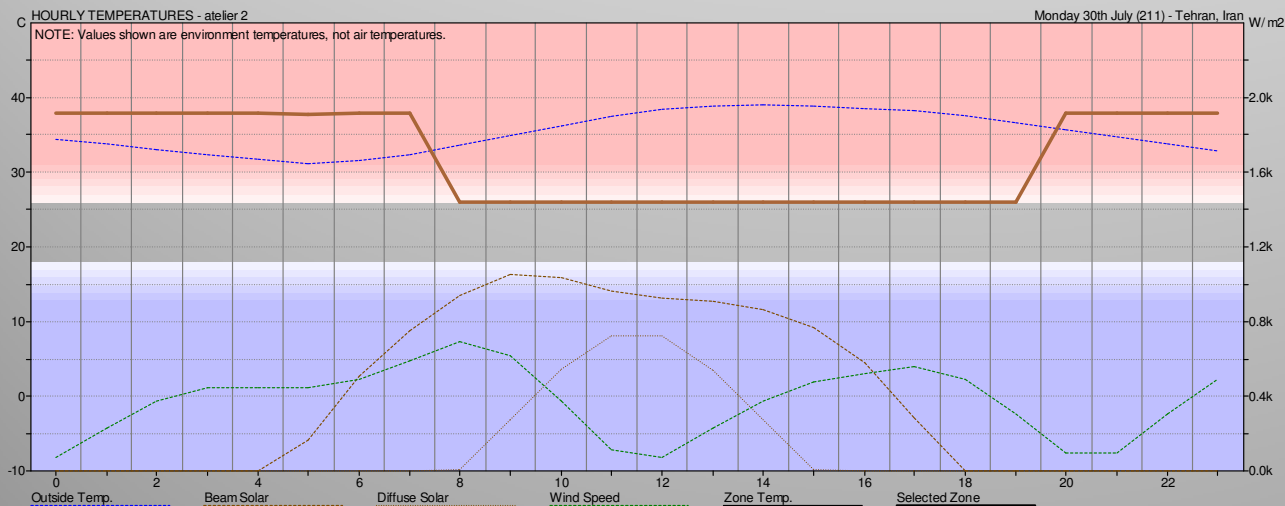
Atelier 2 (Increasing Triple glazed windows area on South Façade to increase the Solar Gain)



Atelier 2 (Increasing Triple glazed windows area on South Facade to increase the Solar Gain)

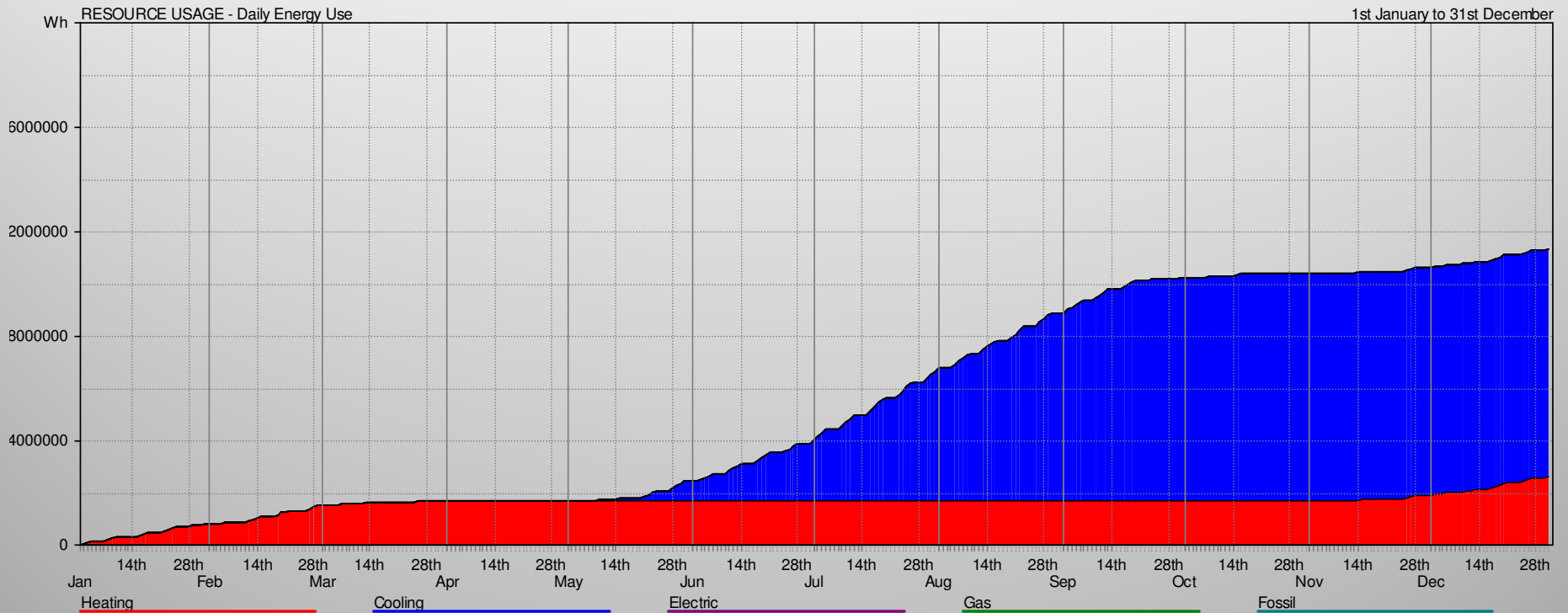


Hottest Day in Average:
 30th July



Coldest Day in Average:
 19th February

Atelier 2 (Increasing Triple glazed windows area on South Façade to increase the Solar Gain)



Energy Consumption for a year:

Heating Cooling

$$5.48 + 17.62 = 23.10$$

(KWh/m²y)

(KWh/m²y)

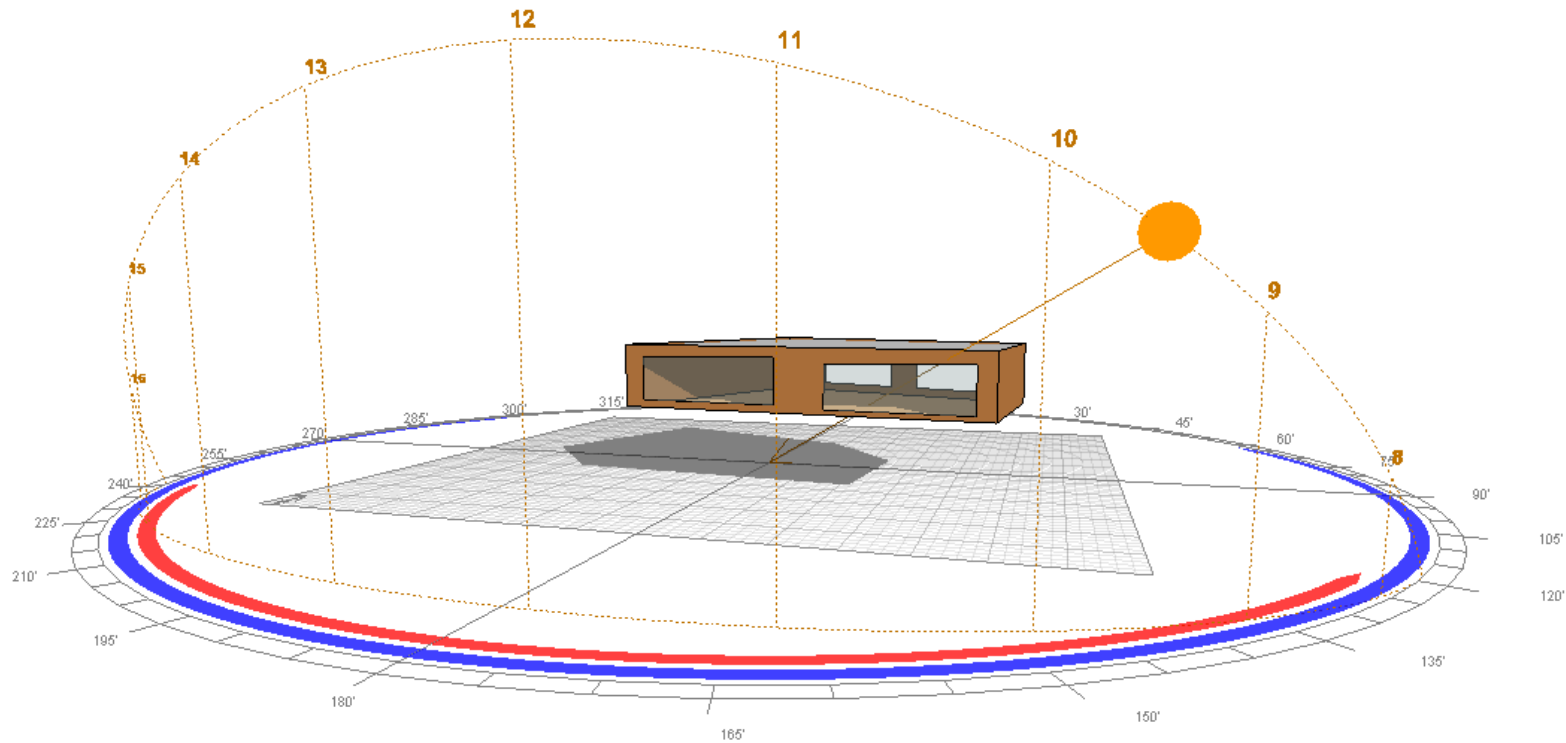
(KWh/m²y)

Atelier 2 (Increasing Triple glazed windows area on South Façade to increase the Solar Gain)

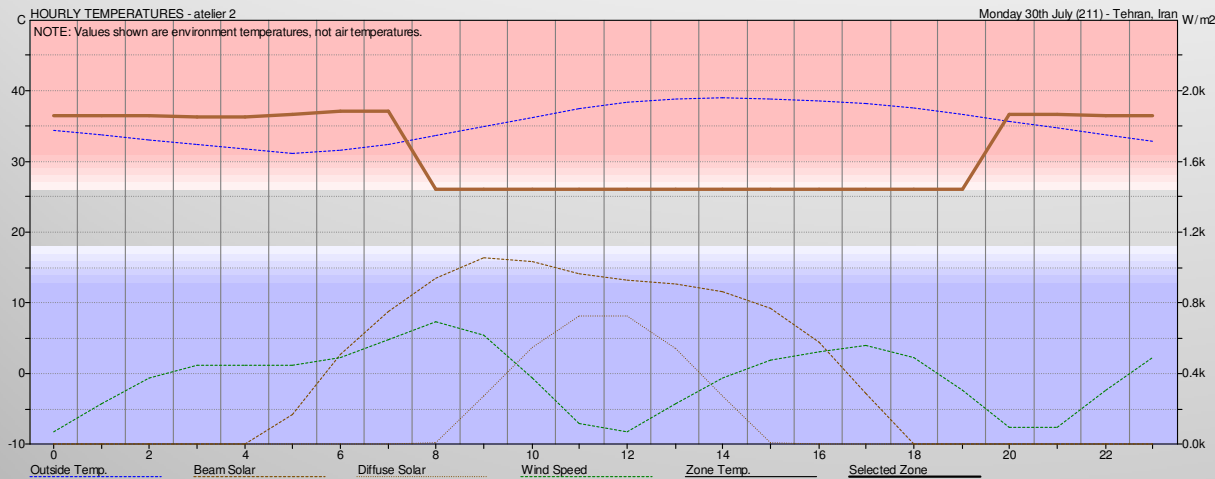
RESOURCE USAGE - Daily Energy Use
With Mixed Mode System:

| MONTH | HEATING (Wh) | COOLING (Wh) | ELECTRIC (Wh) | GAS (Wh) | FOSSIL FUEL (Wh) |
|-------|-----------------|-----------------|------------------|-------------|---------------------|
| Jan | 884156 | 0 | 0 | 0 | 0 |
| Feb | 1574063 | 0 | 0 | 0 | 0 |
| Mar | 1810137 | 0 | 0 | 0 | 0 |
| Apr | 1815179 | 0 | 0 | 0 | 0 |
| May | 1816284 | 755814 | 0 | 0 | 0 |
| Jun | 1816284 | 2190683 | 0 | 0 | 0 |
| Jul | 1816284 | 4828604 | 0 | 0 | 0 |
| Aug | 1816284 | 7185131 | 0 | 0 | 0 |
| Sep | 1816284 | 8478048 | 0 | 0 | 0 |
| Oct | 1816312 | 8718202 | 0 | 0 | 0 |
| Nov | 2031324 | 8718202 | 0 | 0 | 0 |
| Dec | 2713747 | 8718202 | 0 | 0 | 0 |
| TOTAL | 2713.747 | 8718.202 | 0 | 0 | 0 |
| | (KWH) | (KWH) | | | |

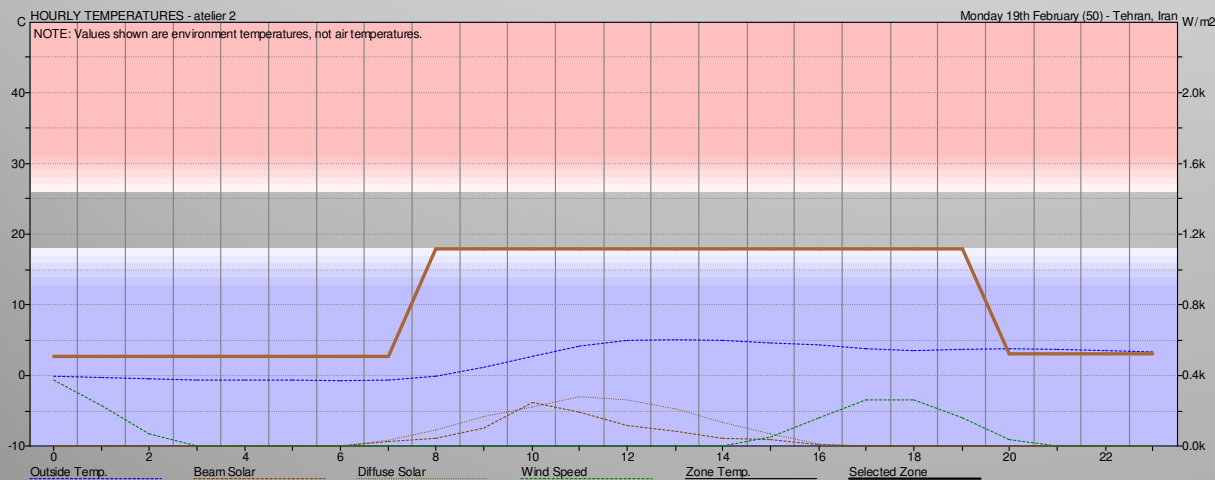
Atelier 2 (Triple glazed windows on North Façade to decrease the Cooling Energy consumption)



Atelier 2 (Triple glazed windows in North Façade to decrease the Cooling Energy consumption)

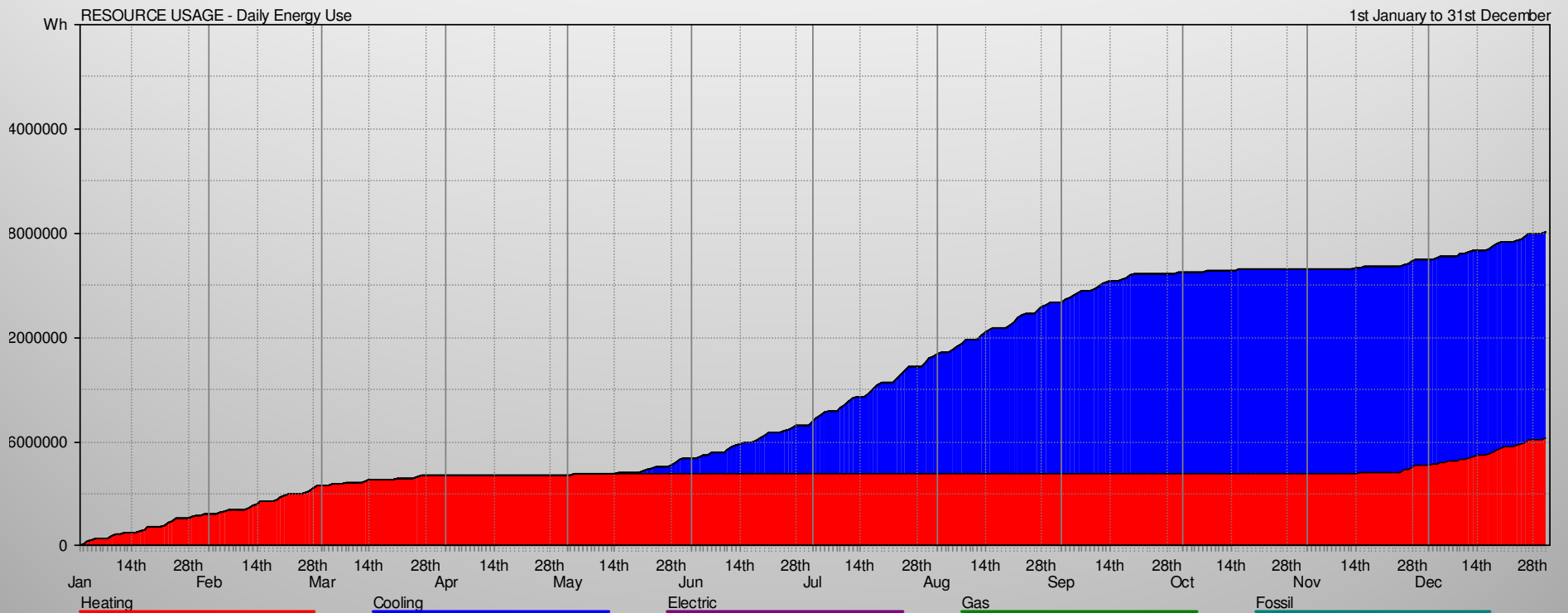


Hottest Day in Average:
30th July



Coldest Day in Average:
19th February

Atelier 2 (Adding Triple glazed windows on North Façade to decrease the Cooling Energy)



Energy Consumption for a year:

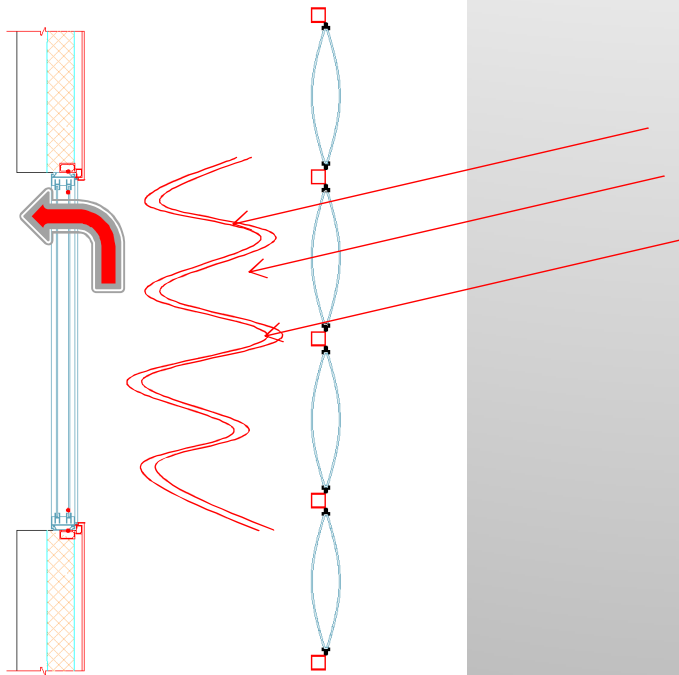
| | | | |
|------------------------|------------------------|---|------------------------|
| Heating | Cooling | | |
| 12.86 | + 23.87 | = | 36.73 |
| (KWh/m ² y) | (KWh/m ² y) | | (KWh/m ² y) |

Atelier 2 (Adding Triple glazed windows on North Façade to decrease the Cooling Energy consumption)

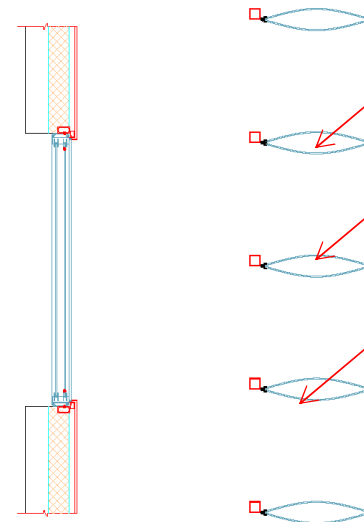
RESOURCE USAGE - Daily Energy Use
With Mixed Mode System:

| MONTH | HEATING (Wh) | COOLING (Wh) | ELECTRIC (Wh) | GAS (Wh) | FOSSIL FUEL (Wh) |
|-------|-----------------|-----------------|------------------|-------------|---------------------|
| Jan | 1930831 | 0 | 0 | 0 | 0 |
| Feb | 3523117 | 0 | 0 | 0 | 0 |
| Mar | 4240568 | 0 | 0 | 0 | 0 |
| Apr | 4263600 | 0 | 0 | 0 | 0 |
| May | 4266650 | 943364 | 0 | 0 | 0 |
| Jun | 4266650 | 2874974 | 0 | 0 | 0 |
| Jul | 4266650 | 6671932 | 0 | 0 | 0 |
| Aug | 4266650 | 9907803 | 0 | 0 | 0 |
| Sep | 4266650 | 11555983 | 0 | 0 | 0 |
| Oct | 4267106 | 11818084 | 0 | 0 | 0 |
| Nov | 4796565 | 11818084 | 0 | 0 | 0 |
| Dec | 6363554 | 11818084 | 0 | 0 | 0 |
| TOTAL | 6363.554 | 11818.084 | 0 | 0 | 0 |
| | (KWH) | (KWH) | | | |

Thermal Buffer Zone

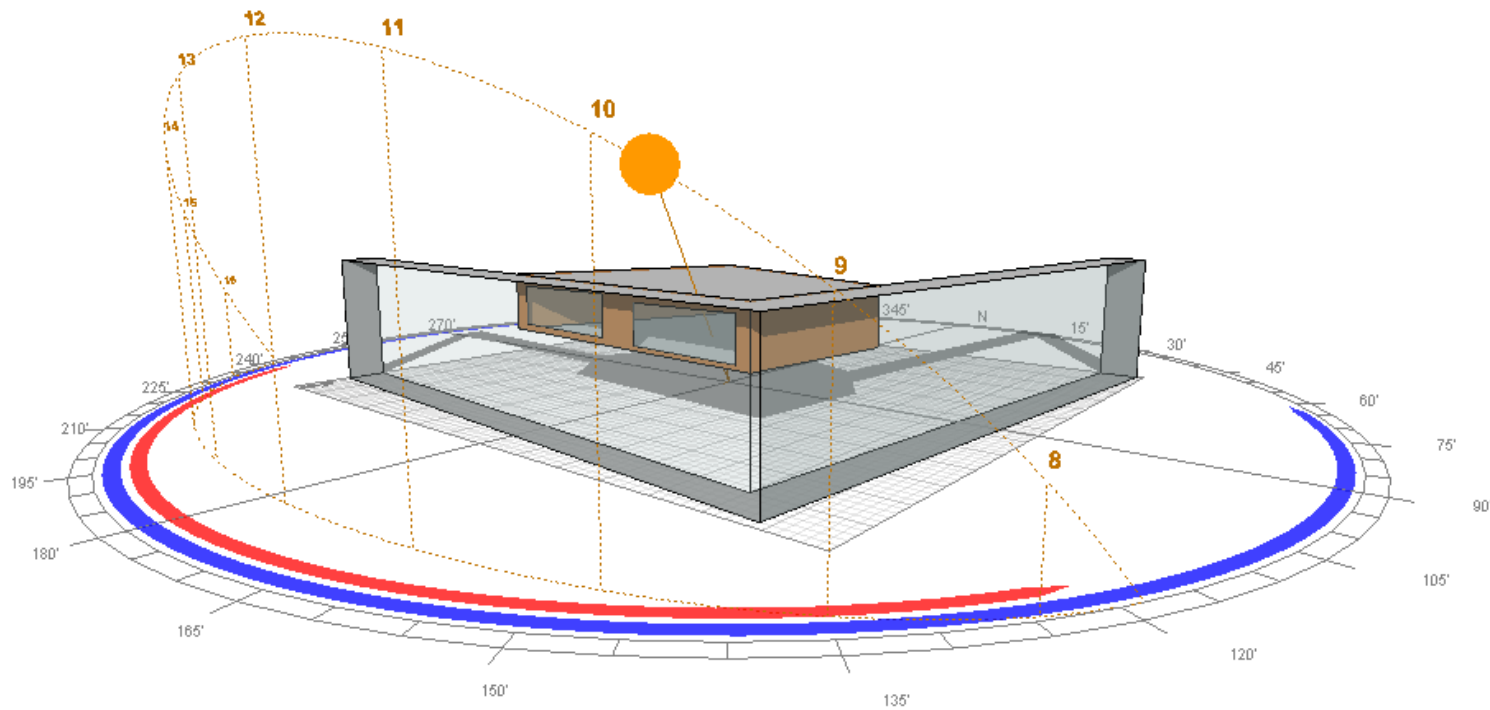


Using ETFE Balloons to create thermal buffer zone to decrease the Heating energy consumption

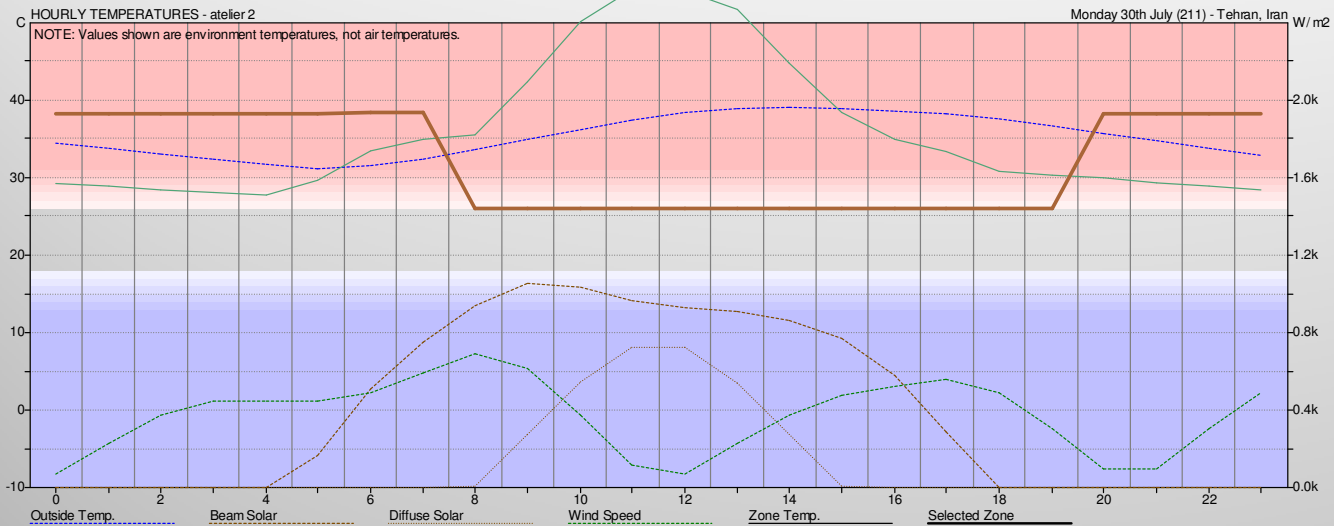


Operable buffer zone
To avoid over heating in summer
ETFE Balloon change direct sun
light to diffused light

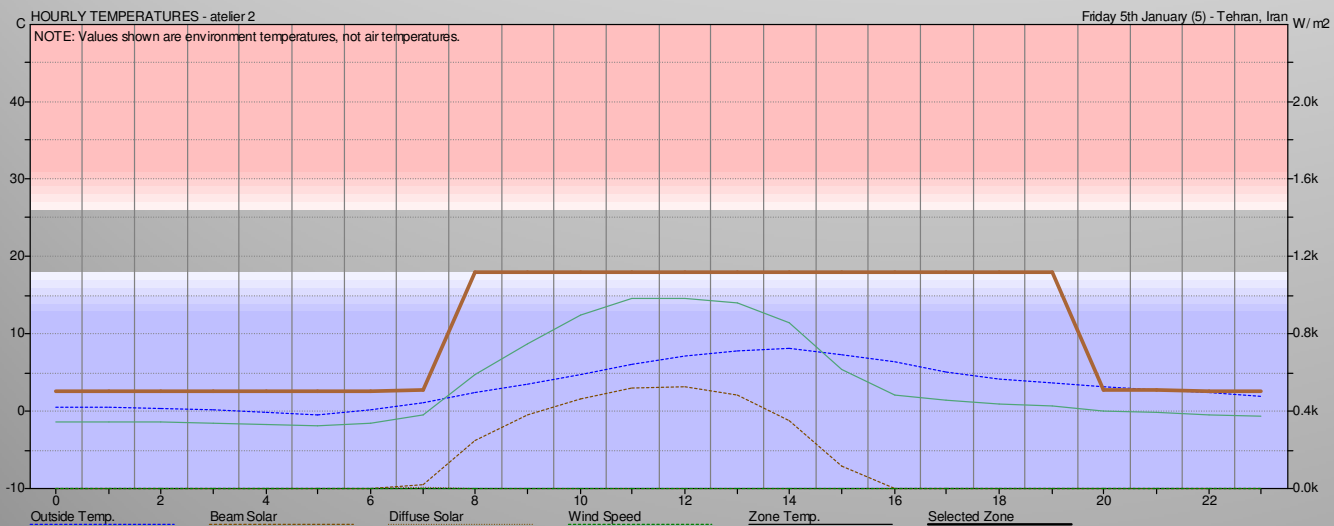
Atelier 2 (Modeling Thermal Buffer Zone)



Atelier 2 (Thermal Buffer Zone)

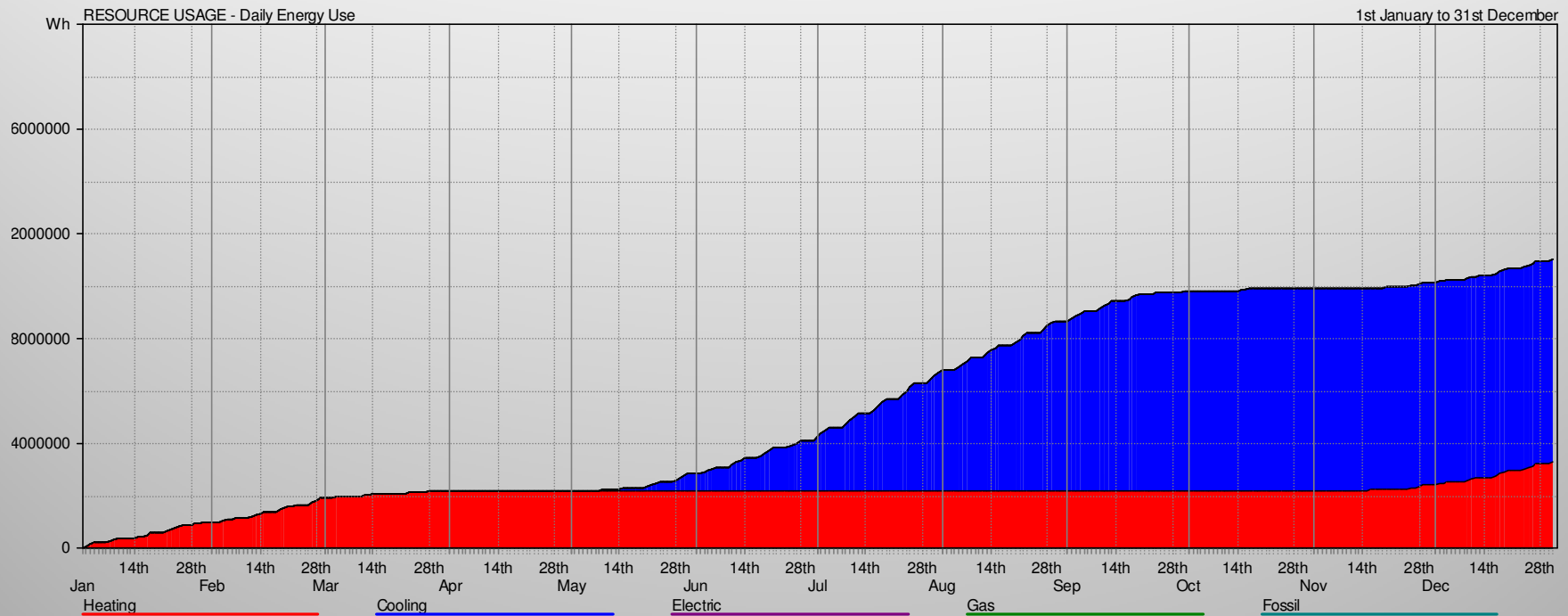


Hottest Day in Average:
30th July



Coldest Day in Average:
19th February

Atelier 2 (Thermal Buffer Zone)



Energy Consumption for a year:

Heating Cooling

$$4.20 + 21.86 = 26.06$$

(KWh/m²y) (KWh/m²y) (KWh/m²y)

Atelier 2 (Thermal Buffer Zone)

RESOURCE USAGE - Daily Energy Use

With Mixed Mode System:

| FUEL MONTH | HEATING COOLING | | | ELECTRIC | GAS | FOSSIL |
|---------------|-----------------|-----------|------|----------|------|--------|
| | (Wh) | (Wh) | (Wh) | (Wh) | (Wh) | (Wh) |
| Jan | 920532 | 0 | 0 | 0 | 0 | 0 |
| Feb | 1602931 | 0 | 0 | 0 | 0 | 0 |
| Mar | 1814207 | 0 | 0 | 0 | 0 | 0 |
| Apr | 1862076 | 0 | 0 | 0 | 0 | 0 |
| May | 1862076 | 3320381 | 0 | 0 | 0 | 0 |
| Jun | 1862076 | 7352062 | 0 | 0 | 0 | 0 |
| Jul | 1862076 | 9010402 | 0 | 0 | 0 | 0 |
| Aug | 1862076 | 9862774 | 0 | 0 | 0 | 0 |
| Sep | 1862076 | 10822185 | 0 | 0 | 0 | 0 |
| Oct | 1924028 | 10822185 | 0 | 0 | 0 | 0 |
| Nov | 1996278 | 10822185 | 0 | 0 | 0 | 0 |
| Dec | 2078970 | 10822185 | 0 | 0 | 0 | 0 |
| TOTAL | 2078.970 | 10822.185 | 0 | 0 | 0 | 0 |
| | (KWH) | (KWH) | | | | |

Energy Consumption Table

| Energy Consumption | Heating | Cooling |
|---|---------------------------------|---------------------------------|
| 1-Using mixed-mode air condition system | 5.95 (KWh/m ² y) | 18.92 (KWh/m ² y) |
| 2-Increasing Triple glazed windows area on South Façade | 5.48 (KWh/m ² y) | 17.62 (KWh/m ² y) |
| 3-Triple glazed windows on North Façade | 12.86 (KWh/m ² y) | 23.87 (KWh/m ² y) |
| 4-Using Thermal Buffer Zone | 4.20 (KWh/m ² y) | 21.86 (KWh/m ² y) |

Total Energy Consumption: 21.82
(KWh/m²y)

Conclusion

By using thermal Buffer zone in cold days and increasing the area of south windows and using good isolation for other sides of the building energy consumption is:

21.82
(KWh/m²y)

- Energy conservation 40 %
- If we consider Indianapolis Museum of Art as a champion in high energy performance project (with Energy Star Certification), the energy consumption is close to my project`s energy consumption(The consumption is 58494(KWH per day)).