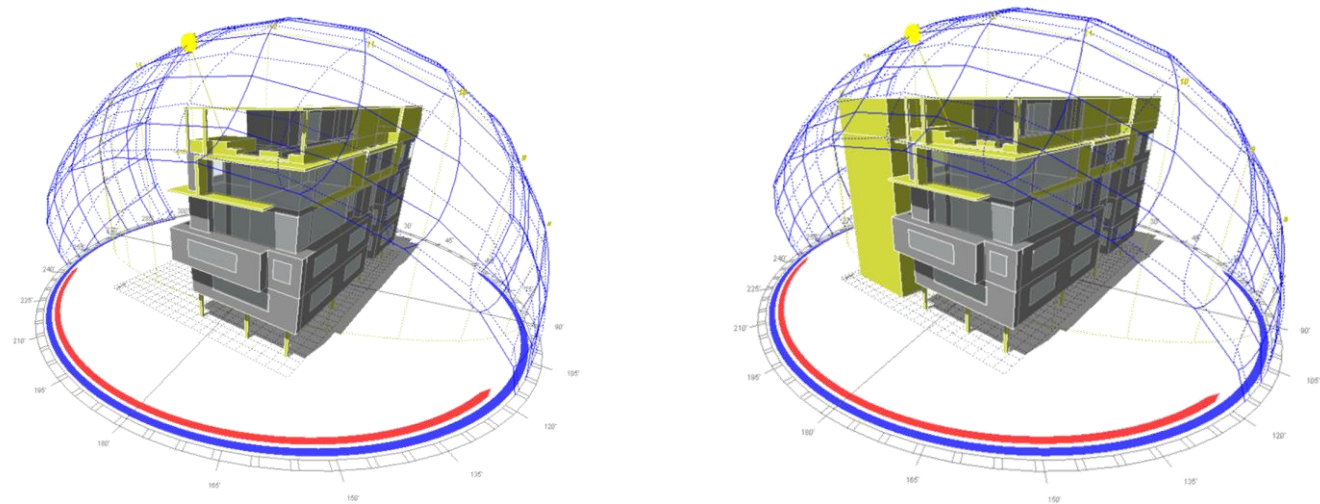
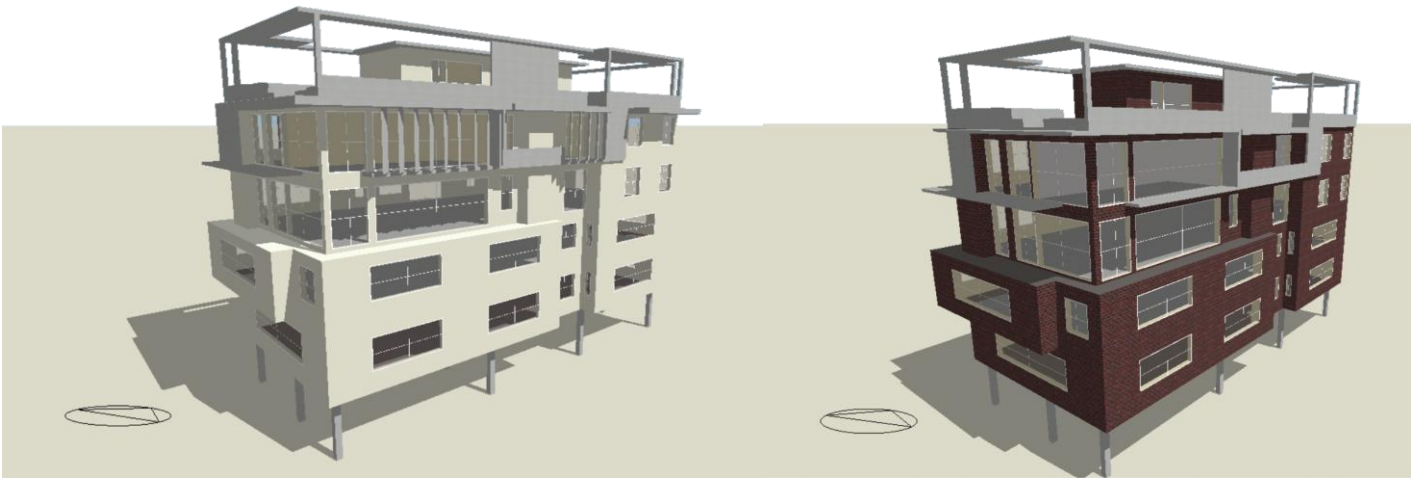


NextGen: Low-Energy Residential Prototype



Internship Project – Energy efficient, high performing residence
Location – New Delhi, India
Software Used – DesignBuilder (Energy Plus), Ecotect

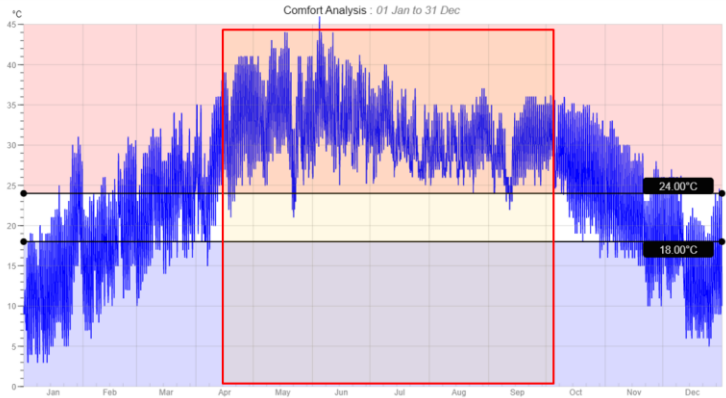
The project focuses on improving the daylighting, provision for natural ventilation, the envelope and system sizing and cooling load calculation with the prime aim to reduce the overall annual energy consumption of the building.



CLIMATE ANALYSIS

Ventilation Comfort Band Hours

Calculate Comfort Metrics



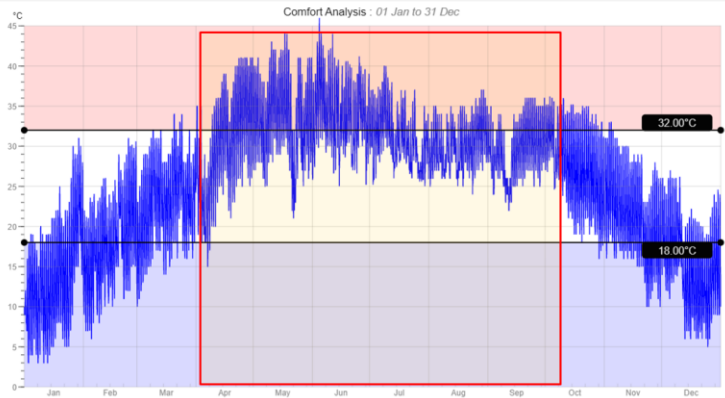
BELOW COMFORT			WITHIN COMFORT		ABOVE COMFORT		
Hrs	Deg.Hrs	Percent	Hrs	Percent	Hrs	Deg.Hrs	Percent
1688	9161.2	19.3%	1669	19.1%	5403	38117.9	61.7%

00:00 24:00 Dry Bulb Temperature Done

Only **19.1%** annual hours lie within the comfort range as per the TSI model of the National Building Code.

Adaptive Comfort Band Hours

Calculate Comfort Metrics

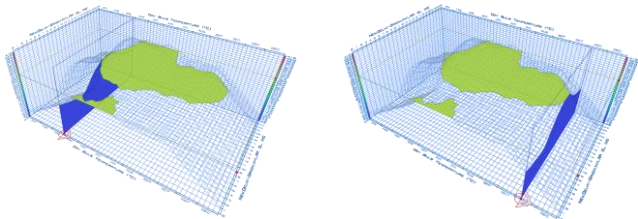
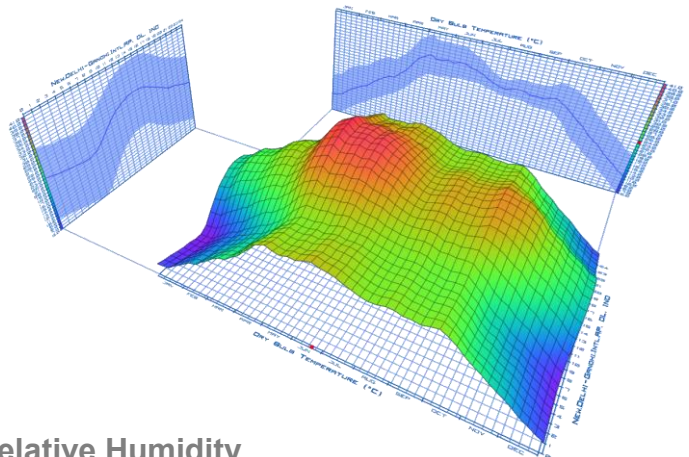


BELOW COMFORT			WITHIN COMFORT		ABOVE COMFORT		
Hrs	Deg.Hrs	Percent	Hrs	Percent	Hrs	Deg.Hrs	Percent
1688	9161.2	19.3%	5271	60.2%	1801	6987.4	20.6%

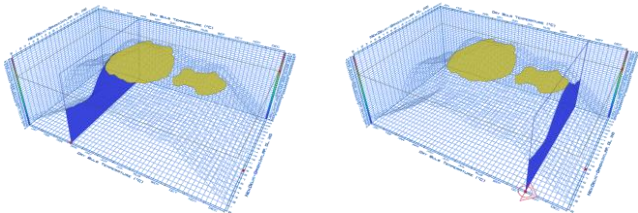
00:00 24:00 Dry Bulb Temperature Done

60.2% annual hours lie within the comfort range as per the TSI model of the National Building Code.

Dry Bulb Temperature

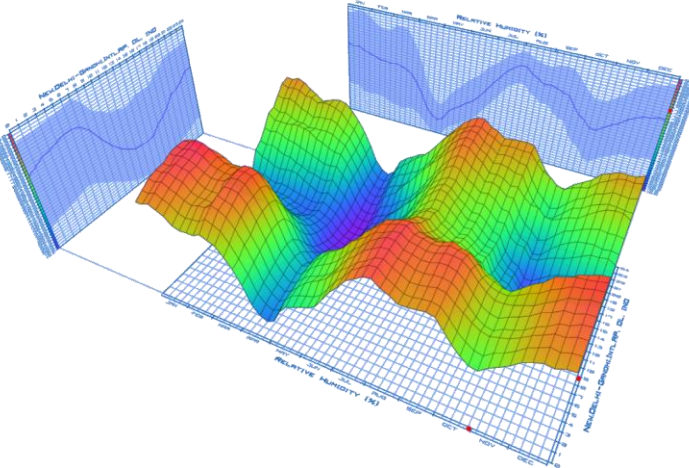


Warm period – 28th March & 8th November
(temp. > 30 deg C)



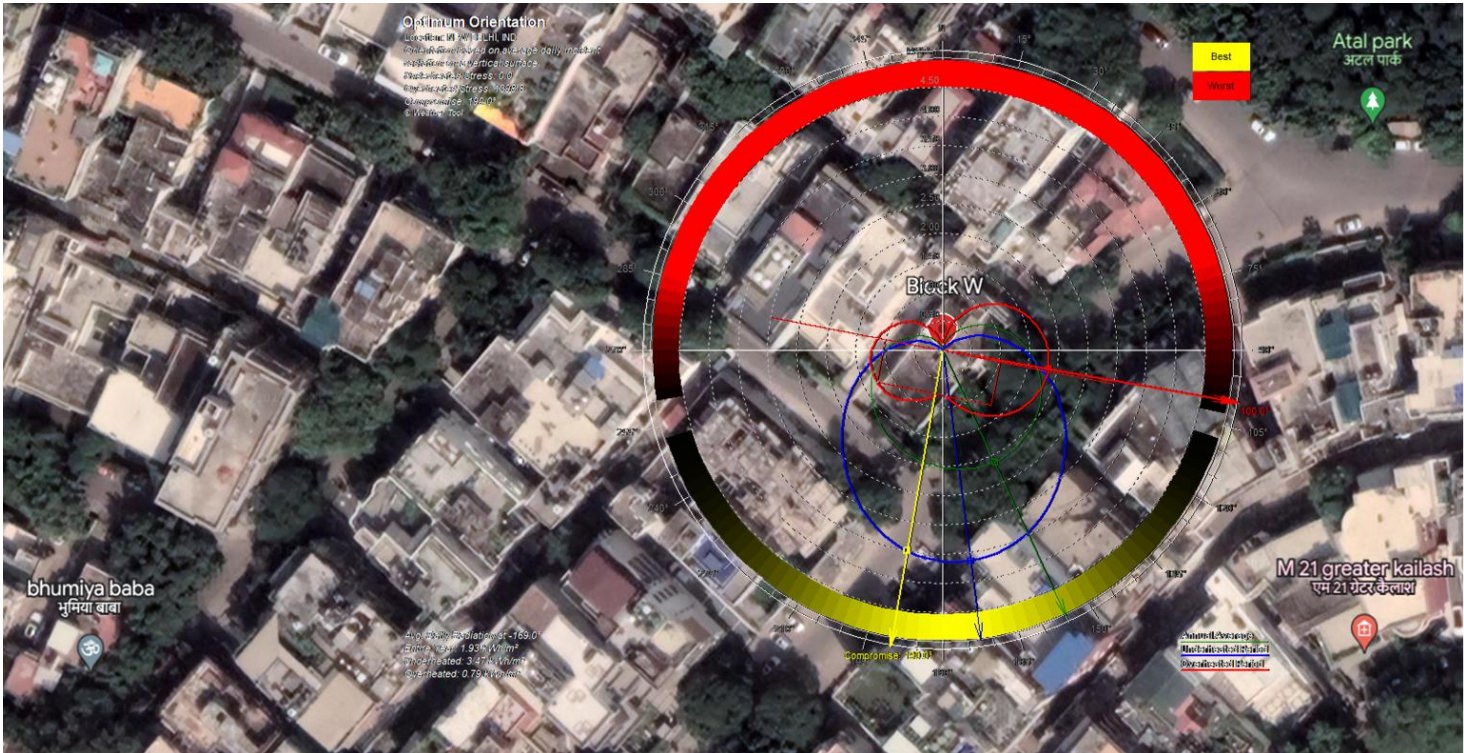
Hot' Period – 06th April & 30th October
(temp. > 32 deg C)

Relative Humidity



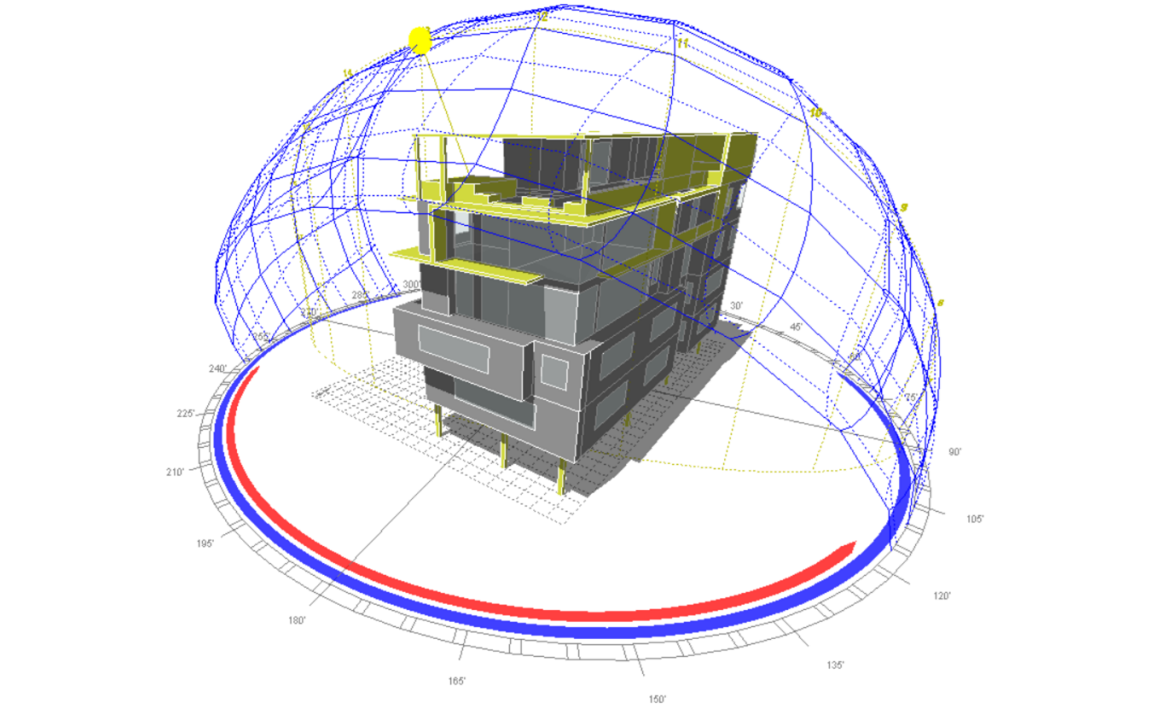
Low Humidity Months – Mid March – Mid June
& Mid Sept – Mid Nov
High Humidity Months – Jan – March end, Mid June – Mid Sept & Mid Nov to Dec end

SITE ANALYSIS



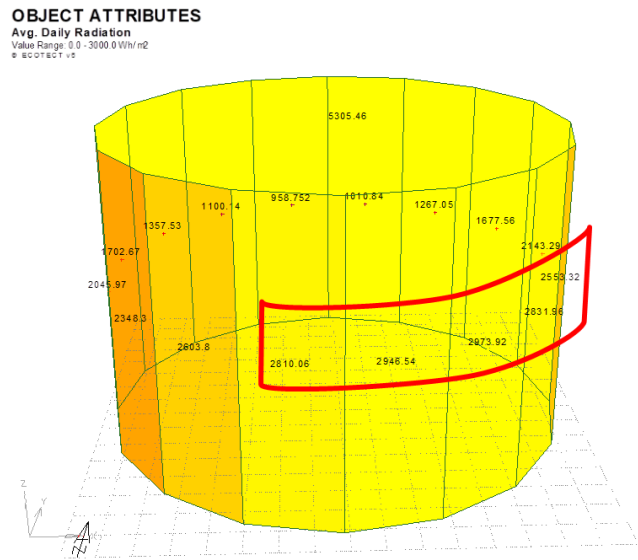
Optimum orientation for buildings in Delhi are with their longer axes along the East-West Line.

Solar path analysis

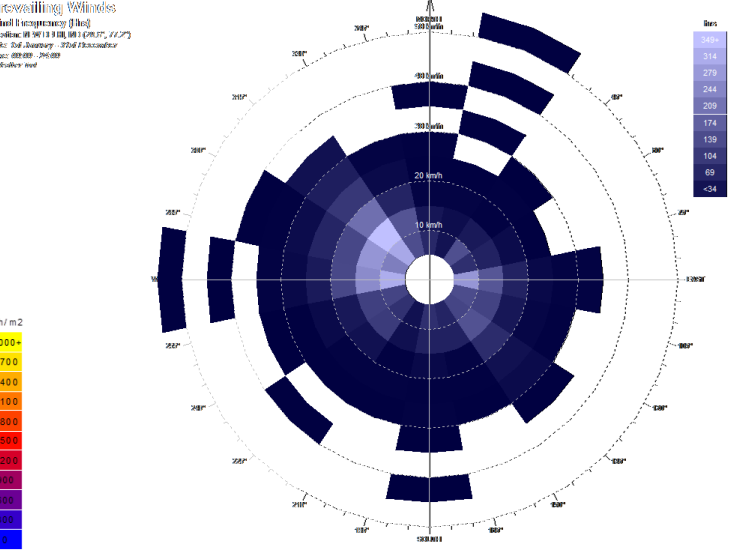


Present Scenario

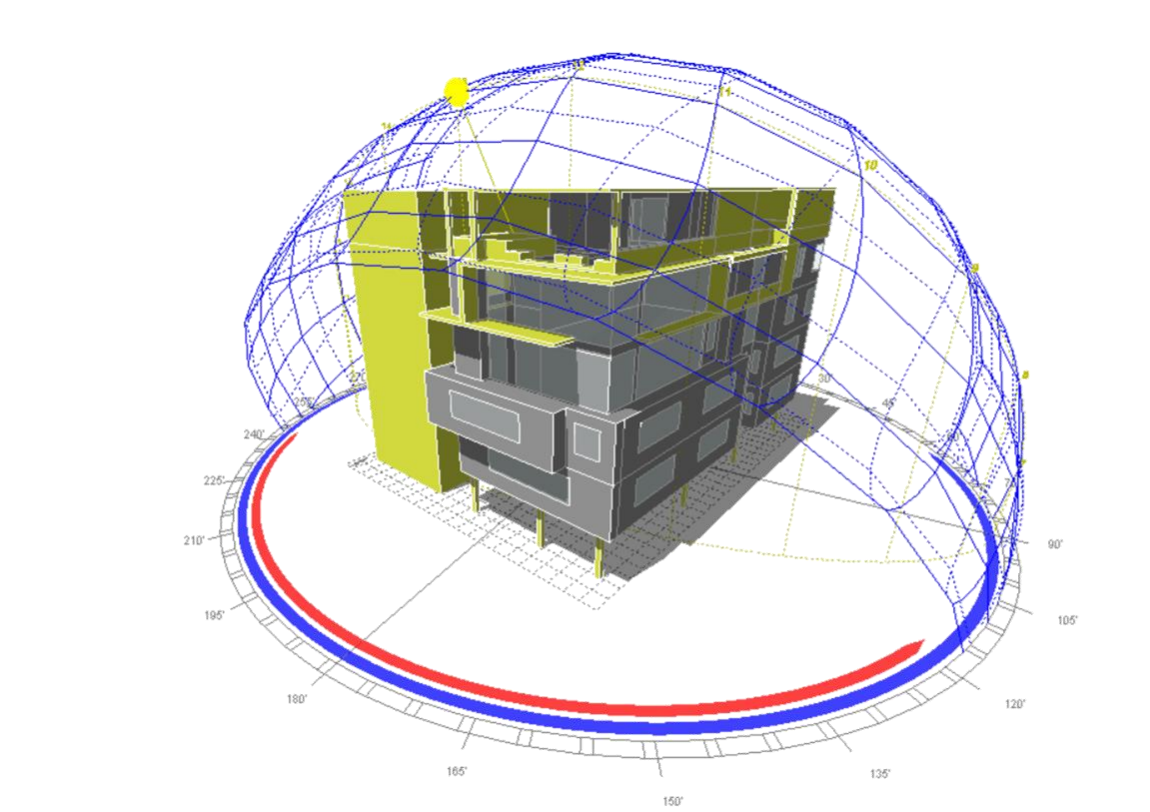
Incident Solar Radiation



Prevailing Wind Direction

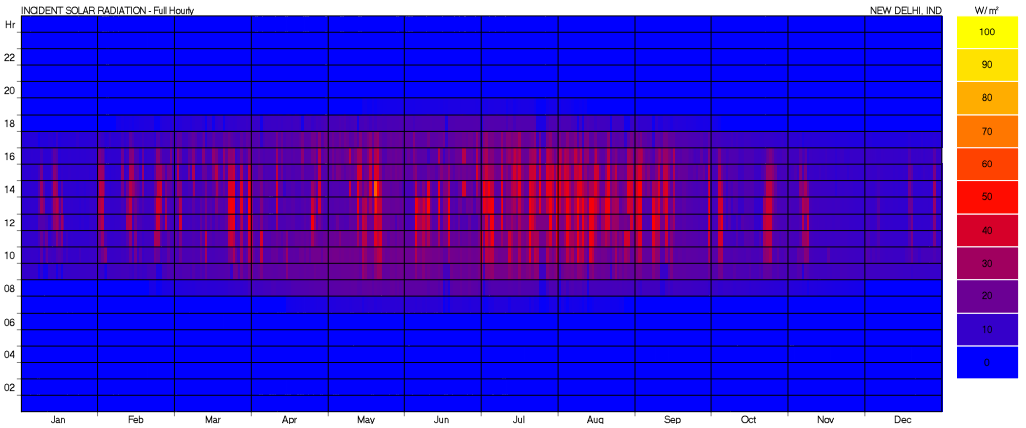
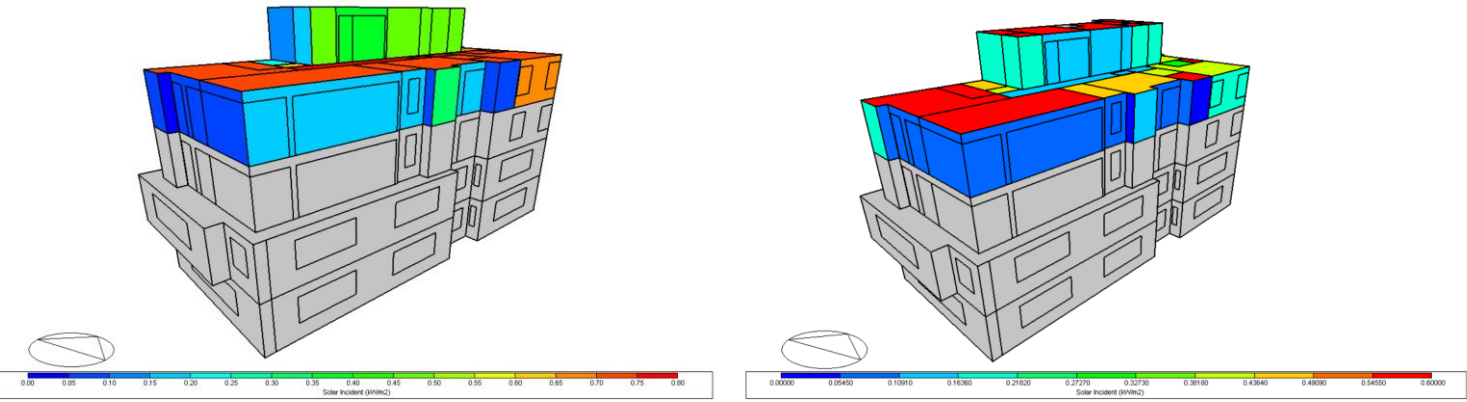


For this specific geographical location, The south and southeast side has the highest solar radiation on the vertical faces followed by the east and then west. Strategies to tackle this incident radiation on these facades.

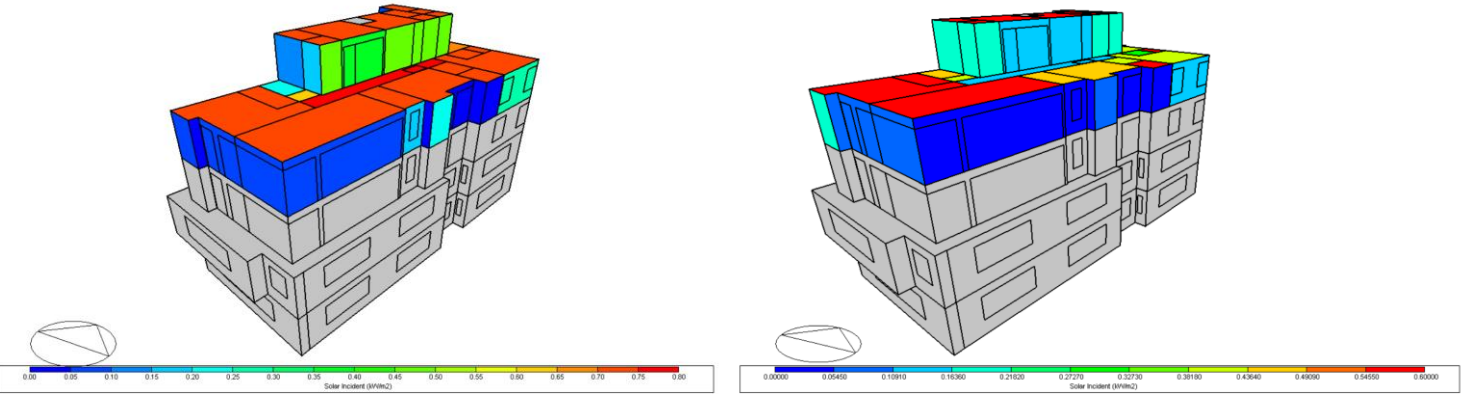


Future Scenario – When a neighboring building comes up next to the residence

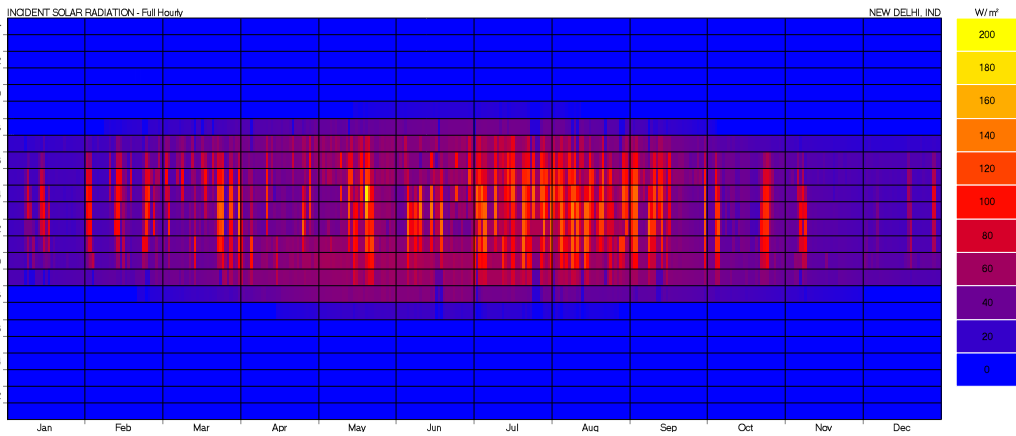
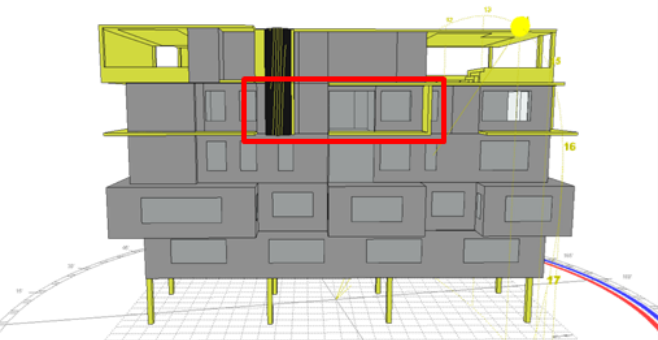
Incident Solar Radiation - Base case



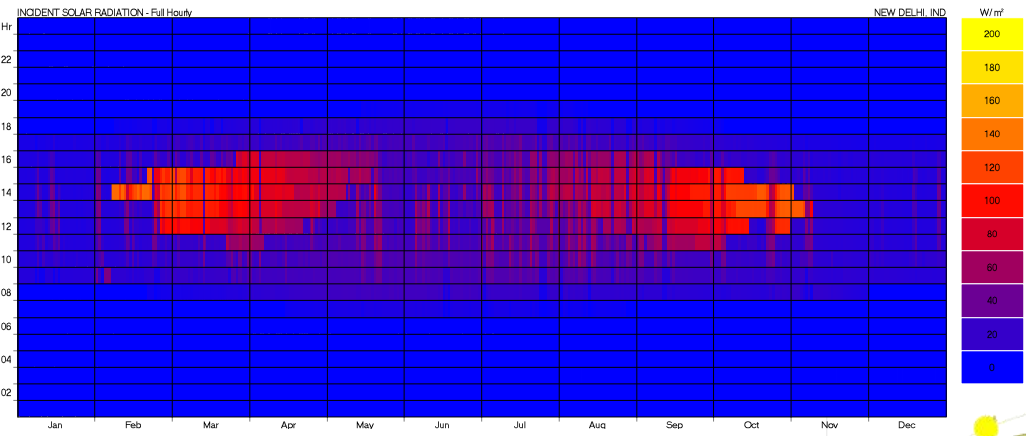
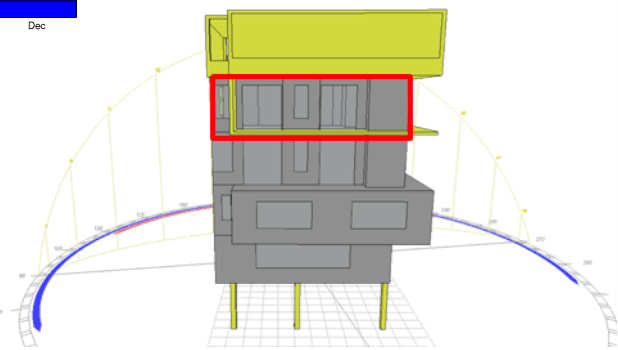
Incident Solar Radiation – Proposed case



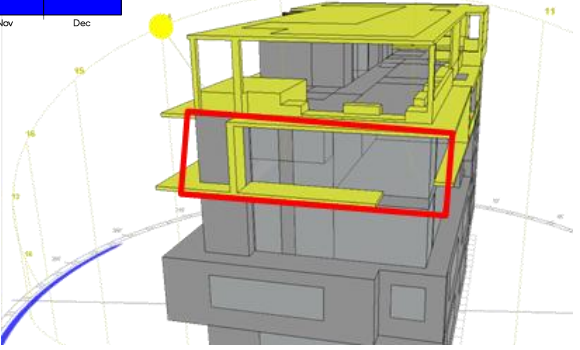
Orientation: West (Future scenario)
The windows on the West will experience less solar radiation from 10:00 am till 4:00 pm all year around



Orientation: North
The windows on the North will experience solar radiation from 9:00 am to 5:00 pm from mid-March till mid-September.

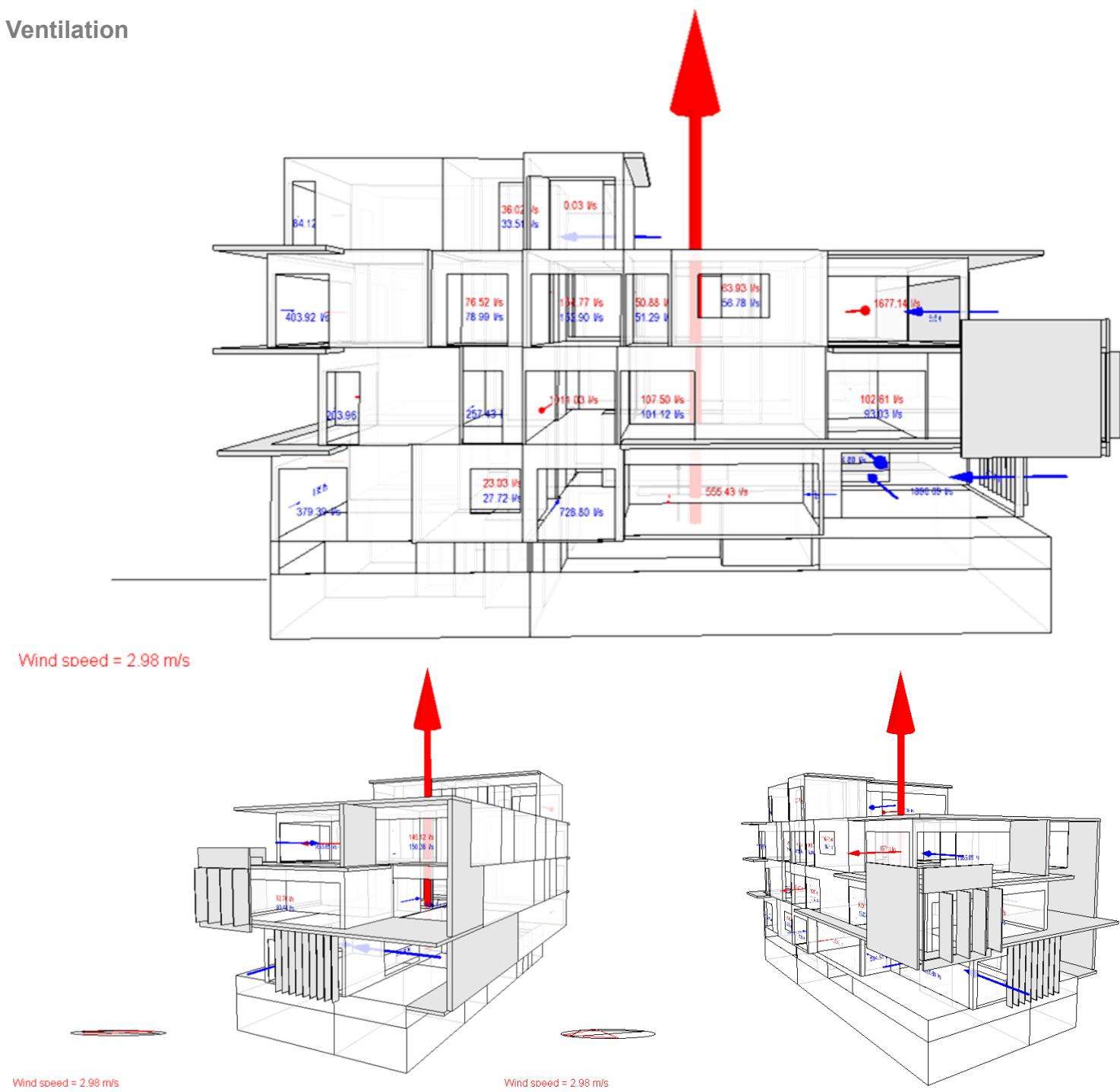


Orientation: South
The windows on the south will experience solar radiation from 11:00 am till 4:00 pm in the month of February to mid-May and from mid-August to mid-November.



AIRFLOW ANALYSIS

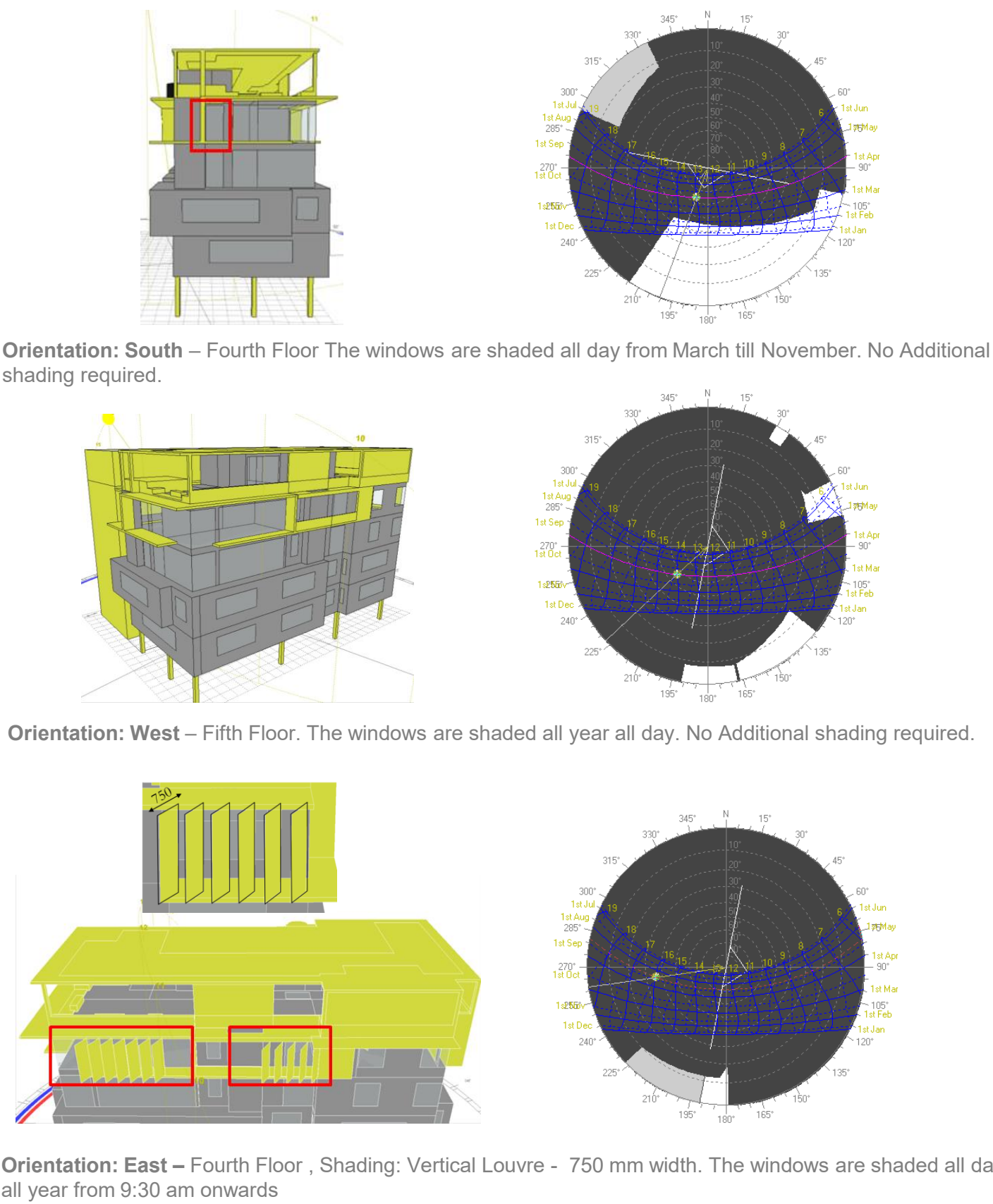
Ventilation



- This diagram represents the natural ventilation pattern (i.e. the software suggests that the movement of air will follow this path) through the residence.
- The blue arrows represent entrance pathways, and the red arrows represent exit pathways.
- The thicker and longer the arrow, the more the volume and velocity of air it represents.
- The large arrow, visible on the right, represents the ventilation exit-path.

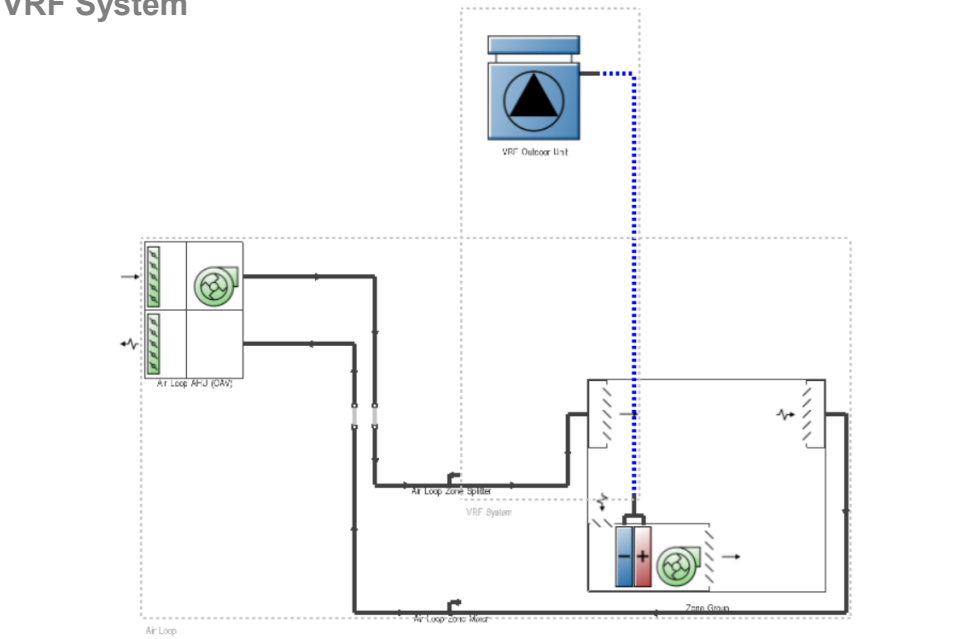
SHADING ANALYSIS

NOTE – Shading Analysis was Performed for every window



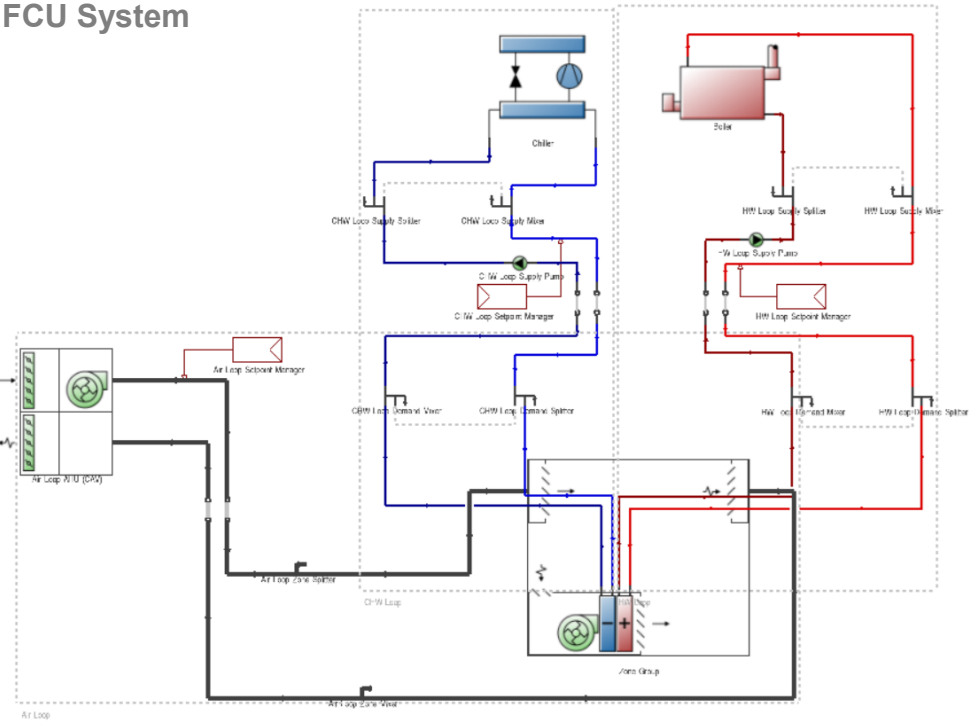
SYSTEM SIZING AND CALCULATIONS

VRF System



- EPI: 124.58 kWh/m2
- VRF Outdoor Unit: 49.26 kW

FCU System



- EPI: 105.2 kWh/m2
- Chiller: 30 kW

Cooling Load Assessment

Block	Zone	Design Capacity (kW)	Design Flow Rate (m3/s)	Total Cooling Load (kW)	Sensible (kW)	Latent (kW)	Air Temperature (°C)	Humidity (%)	Floor Area (m2)	Volume (m3)	Flow/Floor Area (l/s-m2)	Design Cooling Load Per Floor Area(W/m2)	Outside Dry-Bulb Temperature at Time of Peak Cooling Load(°C)
Ground floor	Zone 7	0.92	0.055	0.8	0.79	0	26	41.9	5.056	14.411	10.811	181.539	33.08
Ground floor	Zone 8	19.03	1.127	16.55	16.36	0.19	26	42	130.586	461.043	8.628	145.762	43.8
Ground floor	Zone 6	3.95	0.234	3.44	3.4	0.04	26	42	24.168	68.88	9.689	163.53	41.98
Ground floor	Zone 5	0.64	0.038	0.55	0.55	0.01	26	41.9	4.318	12.307	8.744	147.532	33.08
Ground floor	Zone 4	1.65	0.097	1.43	1.42	0.02	26	42	13.214	32.884	7.374	124.505	33.08
Ground floor	Zone 3	2.95	0.174	2.56	2.53	0.03	26	42	21.81	62.158	7.995	135.187	41.33
Ground floor	Zone 1	1.37	0.081	1.19	1.18	0.01	26	41.9	10.351	29.5	7.829	131.985	33.08
First floor	Zone 10	4.07	0.241	3.54	3.5	0.04	26	42	32.76	93.365	7.357	124.337	33.08
First floor	Zone 12	8.84	0.522	7.69	7.57	0.11	26	42.1	79.105	225.448	6.593	111.728	41.98
First floor	Zone 11	2.76	0.163	2.4	2.37	0.02	26	42	17.472	49.796	9.349	157.796	41.98
First floor	Zone 9	3.26	0.193	2.83	2.8	0.04	26	42	25.766	73.434	7.474	126.463	41.33
First floor	Zone 2	1.25	0.074	1.09	1.08	0.01	26	41.9	9.115	25.979	8.132	137.137	33.08
First floor	Zone 8	3.79	0.224	3.3	3.26	0.04	26	42	30.292	86.333	7.401	125.254	41.33
First floor	Zone 5	1.04	0.062	0.9	0.9	0.01	26	41.9	7.054	20.103	8.74	147.208	33.08
First floor	Zone 4	0.81	0.048	0.71	0.7	0	26	41.9	5.03	14.334	9.63	161.953	33.08
First floor	Zone 6	2.56	0.152	2.23	2.2	0.02	26	41.9	19.722	56.208	7.691	129.765	33.08
First floor	Zone 1	1.71	0.101	1.48	1.47	0.01	26	41.9	12.856	36.64	7.88	132.83	33.08
Second floor	Zone 8	2.89	0.171	2.51	2.48	0.03	26	42	20.751	59.141	8.244	139.337	41.98
Second floor	Zone 15	1.79	0.106	1.55	1.54	0.02	26	42	11.481	32.721	9.213	155.517	41.98
Second floor	Zone 14	0.93	0.055	0.81	0.8	0.01	26	41.9	6.026	17.174	9.169	154.476	33.08
Second floor	Zone 13	8.17	0.483	7.11	7.01	0.1	26	42.1	69.742	198.765	6.92	117.205	41.98
Second floor	Zone 4	1.32	0.078	1.15	1.14	0.01	26	41.9	9.222	26.281	8.504	143.305	33.08
Second floor	Zone 11	2.53	0.15	2.2	2.17	0.03	26	42	19.149	54.576	7.812	132.095	41.33
Second floor	Zone 2	1.13	0.067	0.98	0.97	0.01	26	41.9	7.499	21.371	8.925	150.261	33.08
Second floor	Zone 10	1.2	0.071	1.04	1.03	0.01	26	41.9	5.461	15.565	13.012	218.968	41.98
Second floor	Zone 3	1.12	0.067	0.98	0.97	0.01	26	41.9	7.948	22.652	8.398	141.534	33.08
Second floor	Zone 7	3.38	0.2	2.94	2.9	0.03	26	42	23.545	67.104	8.49	143.466	41.33
Second floor	Zone 6	1.21	0.072	1.05	1.04	0.01	26	41.9	8.905	25.379	8.035	135.485	33.08
Second floor	Zone 5	2.37	0.141	2.06	2.04	0.02	26	41.9	17.748	50.581	7.925	133.671	33.08
Second floor	Zone 1	2.72	0.161	2.37	2.34	0.03	26	42	19.929	56.799	8.081	136.577	43.02
Third floor	Zone 7	2.96	0.175	2.58	2.55	0.03	26	42	21.133	60.229	8.296	140.198	41.33
Third floor	Zone 6	1.57	0.093	1.36	1.35	0.01	26	41.9	10.93	31.15	8.505	143.31	33.08
Third floor	Zone 4	0.46	0.028	0.4	0.4	0	26	41.8	2.743	7.817	10.078	169.423	33.08
Third floor	Zone 5	5.19	0.307	4.51	4.45	0.06	26	42	40.061	114.173	7.655	129.477	43.8
Third floor	Zone 1	2.53	0.15	2.2	2.19	0.02	26	41.9	11.306	32.222	13.31	223.929	41.33
Third floor	Zone 2	1.29	0.076	1.12	1.11	0.01	26	42	7.882	22.463	9.675	163.226	41.33
Basement	Zone 6	8.17	0.479	7.11	6.96	0.15	26	42.3	105.882	317.647	4.524	77.19	41.98
Basement	Zone 3	1.89	0.11	1.64	1.6	0.04	26	42	21.513	64.54	5.114	87.813	33.08
Basement	Zone 1	1.18	0.069	1.03	1	0.02	26	41.9	12.342	37.027	5.604	95.632	33.08
Basement	Zone 12	2.72	0.13	2.36	1.9	0.47	26.06	46.7	26.724	80.171	4.865	101.613	27.68
Basement	Zone 13	0.39	0.014	0.34	0.2	0.14	26.08	54.9	1.979	5.938	6.838	198.412	28.72
Basement	Zone 5	0.71	0.042	0.61	0.6	0.01	26	41.9	6.007	18.022	6.928	117.57	33.08
Basement	Zone 14	0.33	0.012	0.28	0.17	0.11	26.08	53	1.624	4.871	7.329	201.622	30.88
Basement	Zone 2	3.08	0.182	2.68	2.65	0.03	26	42	20.87	62.61	8.727	147.404	41.98
Basement	Zone 11	1.24	0.055	1.08	0.8	0.29	26.06	48.7	10.756	32.268	5.082	115.735	27.68
Basement	Zone 8	1.08	0.049	0.94	0.72	0.22	26.06	47.8	9.61	28.83	5.137	112.822	27.68
Basement	Zone 9	0.28	0.01	0.24	0.15	0.1	26.08	53.2	1.262	3.787	7.927	221.268	28.72
Basement	Zone 7	0.33	0.012	0.29	0.17	0.12	26.08	54.2	1.608	4.825	7.277	207.601	28.72
Basement	Zone 10	0.31	0.011	0.27	0.17	0.1	26.09	52.5	1.471	4.414	7.717	209.905	30.88
-	Totals	127.06	7.41	110.49	107.65	2.84	26	42.4	991.787	2943.938	7.472	128.115	

Based on current assumptions –

- Double Glazing
- Insulated roof
- Shading as per design
- 26 degree Indoor Setpoint Temperature with 40% RH

Cooling Load

- Total = 112 kW
- OR
- 32 TR