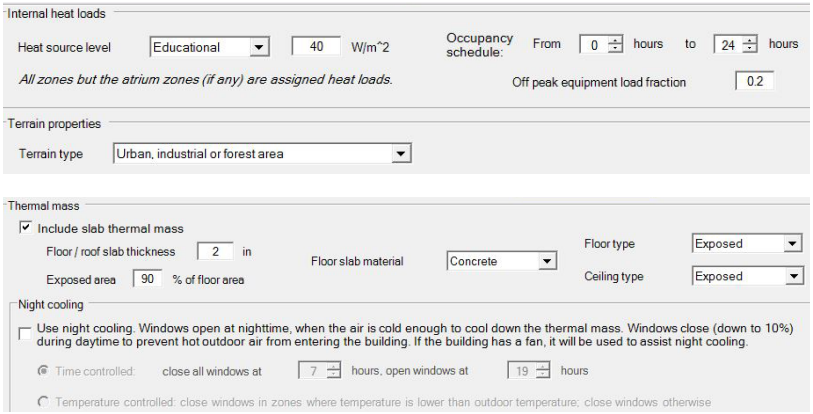
Ventilation Study | Meyerson Hall

Original Massing Details:

Location: Philadelphia, PA

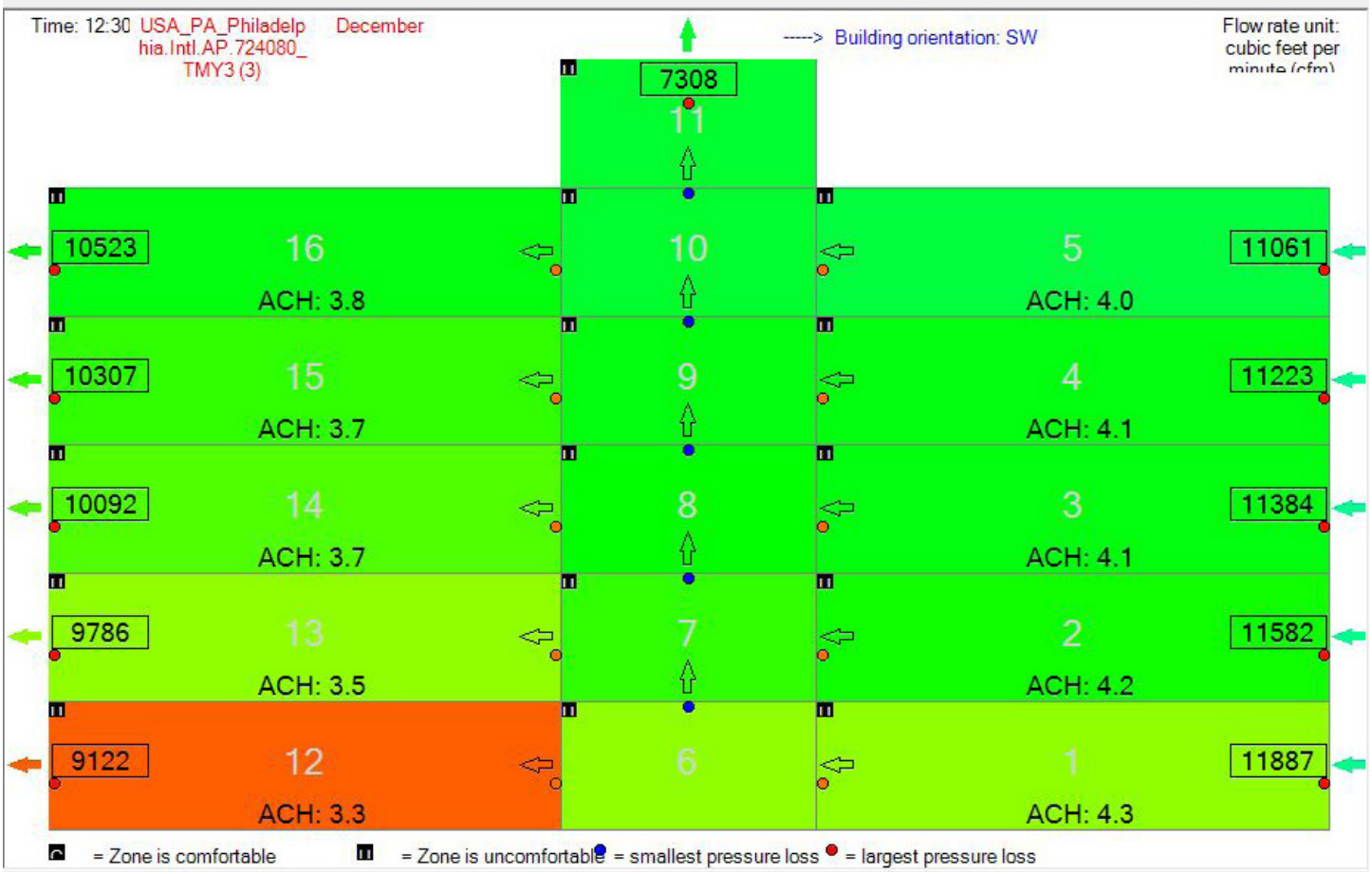


Number of floors:	5	
Floor length:	120	ft
Floor (bay) width:	120	ft
Floor-to-floor height:	11.5	ft
Floor-to-ceiling height:	10	ft
Shaft width:	30	ft
Shaft height:	16.4	ft

Building footprint:	32400.0
Occupied area per floor:	28800.0
Glazing-to-wall ratio per floor:	43.5
Opening-to-wall ratio per floor:	90.7
Ratio of roof opening to roof area:	0.3

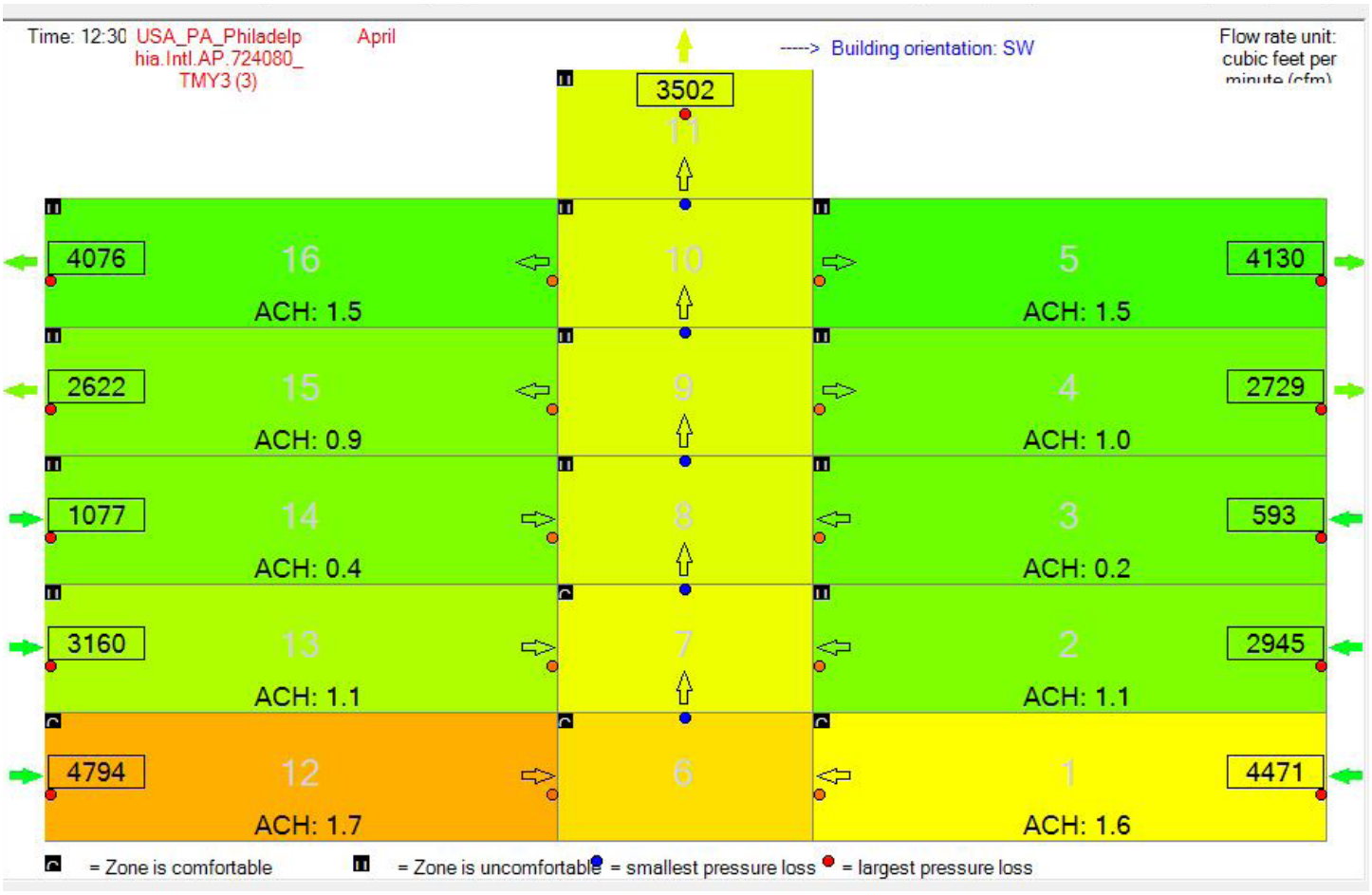
*central atrium

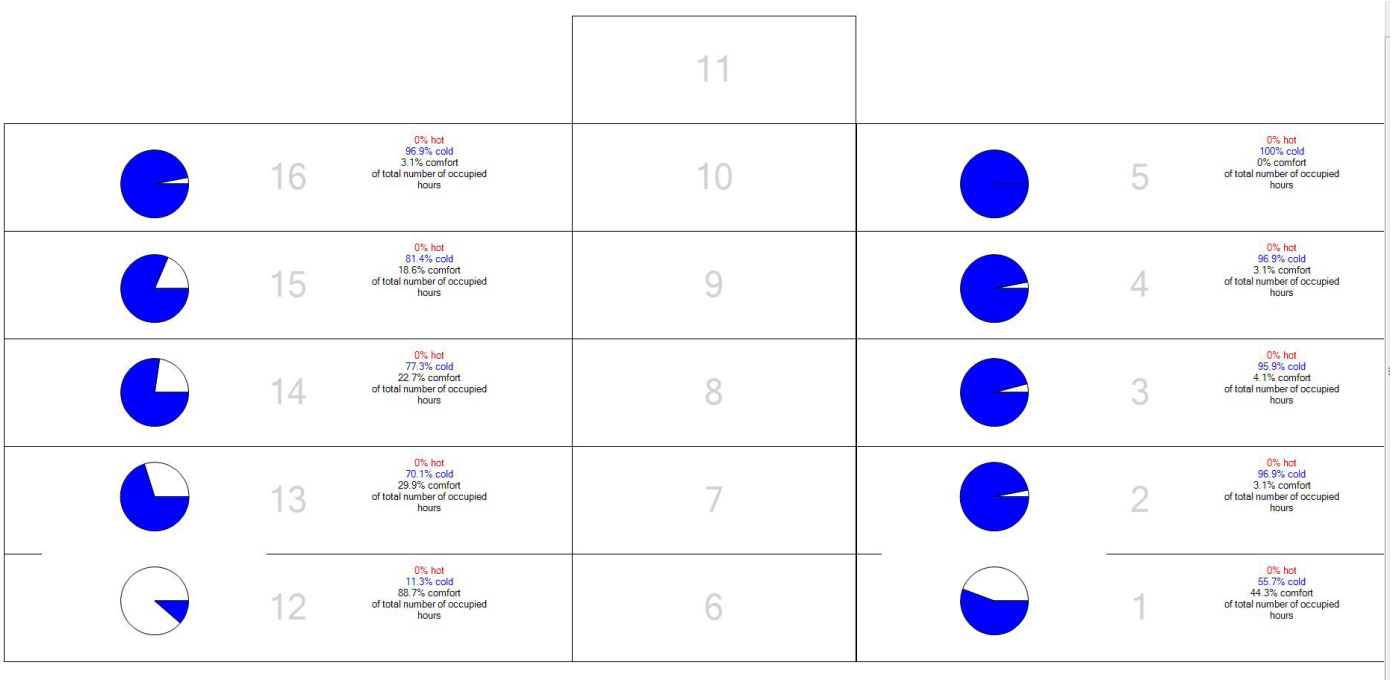
December, 13:30:



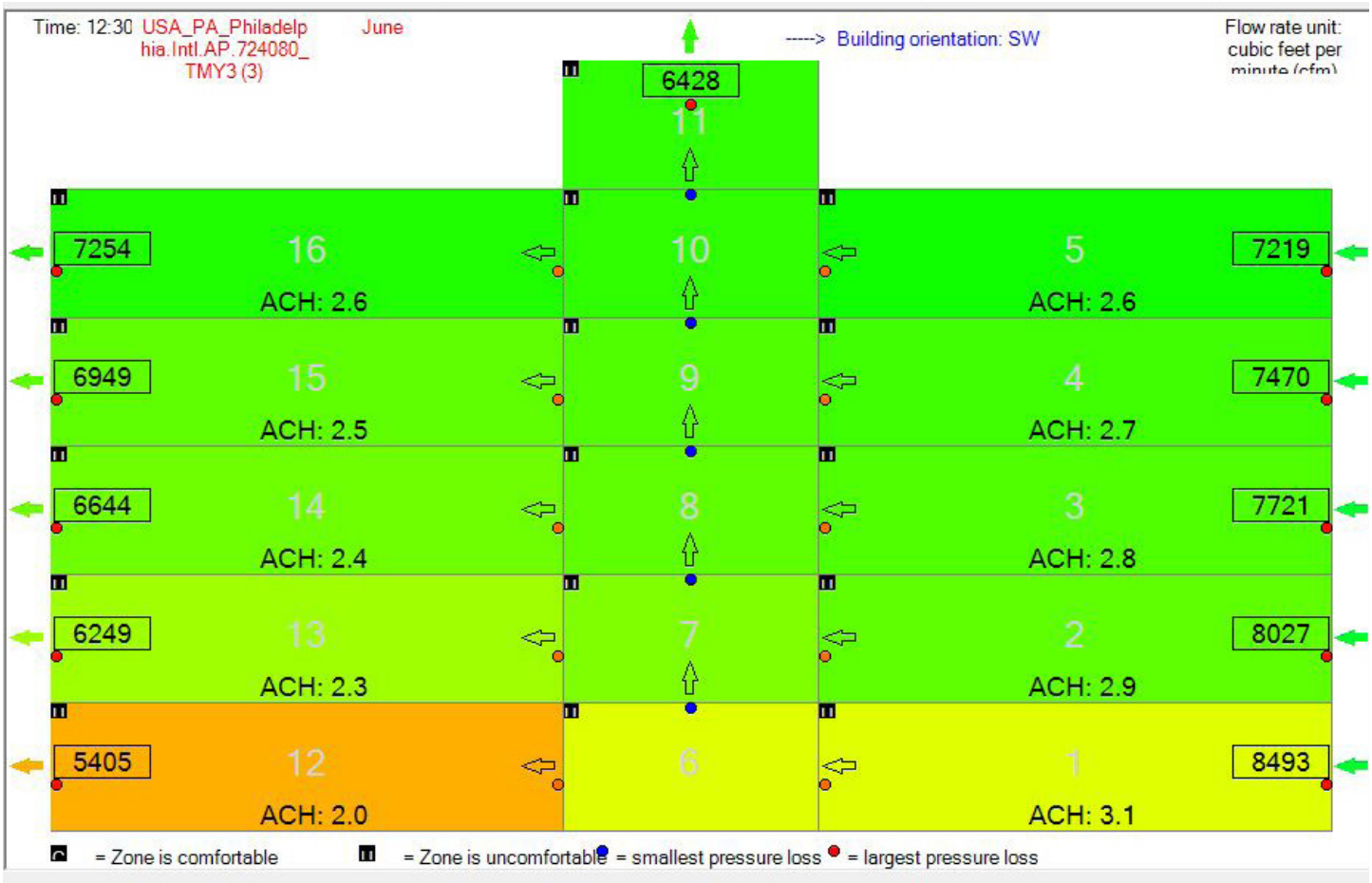

11
16
0% hot
100% cold
0% comfort
of total number of occupied hours
10
5
0% hot
100% cold
0% comfort
of total number of occupied hours
15
0% hot
100% cold
0% comfort
of total number of occupied hours
9
4
0% hot
100% cold
0% comfort
of total number of occupied hours
14
0% hot
100% cold
0% comfort
of total number of occupied hours
8
3
0% hot
100% cold
0% comfort
of total number of occupied hours
13
0% hot
100% cold
0% comfort
of total number of occupied hours
7
2
0% hot
100% cold
0% comfort
of total number of occupied hours
12
0% hot
100% cold
0% comfort
of total number of occupied hours
6
1
0% hot
100% cold
0% comfort
of total number of occupied hours

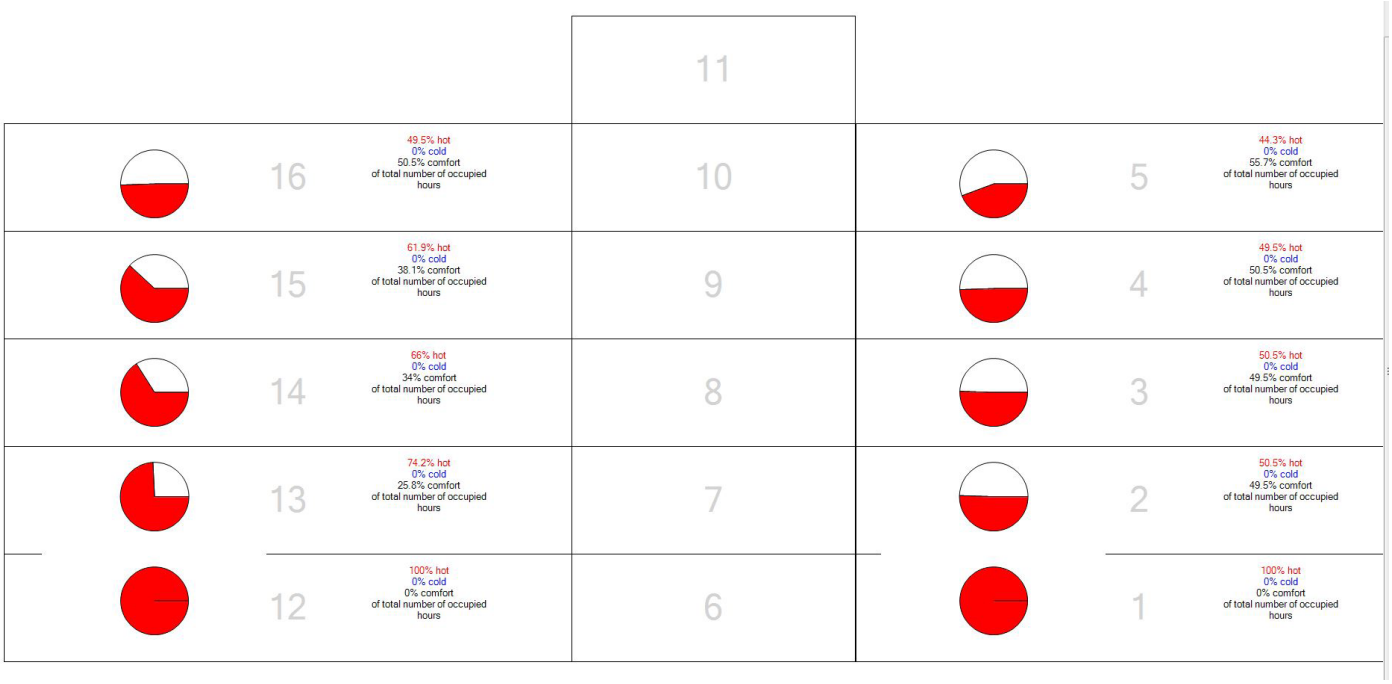
April, 13:30:


Time: 12:30 USA_PA_Philadelphia.Intl.AP.724080_TMY3 (3)
April
-----> Building orientation: SW
Flow rate unit: cubic feet per minute (cfm)
3502
11
4076
16
ACH: 1.5
10
5
4130
ACH: 1.5
2622
15
ACH: 0.9
9
4
2729
ACH: 1.0
1077
14
ACH: 0.4
8
3
593
ACH: 0.2
3160
13
ACH: 1.1
7
2
2945
ACH: 1.1
4794
12
ACH: 1.7
6
1
4471
ACH: 1.6
= Zone is comfortable
= Zone is uncomfortable
= smallest pressure loss
= largest pressure loss


11
16
0% hot
96.9% cold
3.1% comfort
of total number of occupied hours
10
5
0% hot
100% cold
0% comfort
of total number of occupied hours
15
0% hot
81.4% cold
18.6% comfort
of total number of occupied hours
9
4
0% hot
96.9% cold
3.1% comfort
of total number of occupied hours
14
0% hot
77.3% cold
22.7% comfort
of total number of occupied hours
8
3
0% hot
95.9% cold
4.1% comfort
of total number of occupied hours
13
0% hot
70.1% cold
29.9% comfort
of total number of occupied hours
7
2
0% hot
96.9% cold
3.1% comfort
of total number of occupied hours
12
0% hot
11.3% cold
88.7% comfort
of total number of occupied hours
6
1
0% hot
55.7% cold
44.3% comfort
of total number of occupied hours

June, 13:30:


Time: 12:30 USA_PA_Philadelphia.Intl.AP.724080_TMY3 (3)
June
-----> Building orientation: SW
Flow rate unit: cubic feet per minute (cfm)
6428
11
7254
16
ACH: 2.6
10
5
ACH: 2.6
7219
6949
15
ACH: 2.5
9
4
ACH: 2.7
7470
6644
14
ACH: 2.4
8
3
ACH: 2.8
7721
6249
13
ACH: 2.3
7
2
ACH: 2.9
8027
5405
12
ACH: 2.0
6
1
ACH: 3.1
8493
= Zone is comfortable
= Zone is uncomfortable
= smallest pressure loss
= largest pressure loss



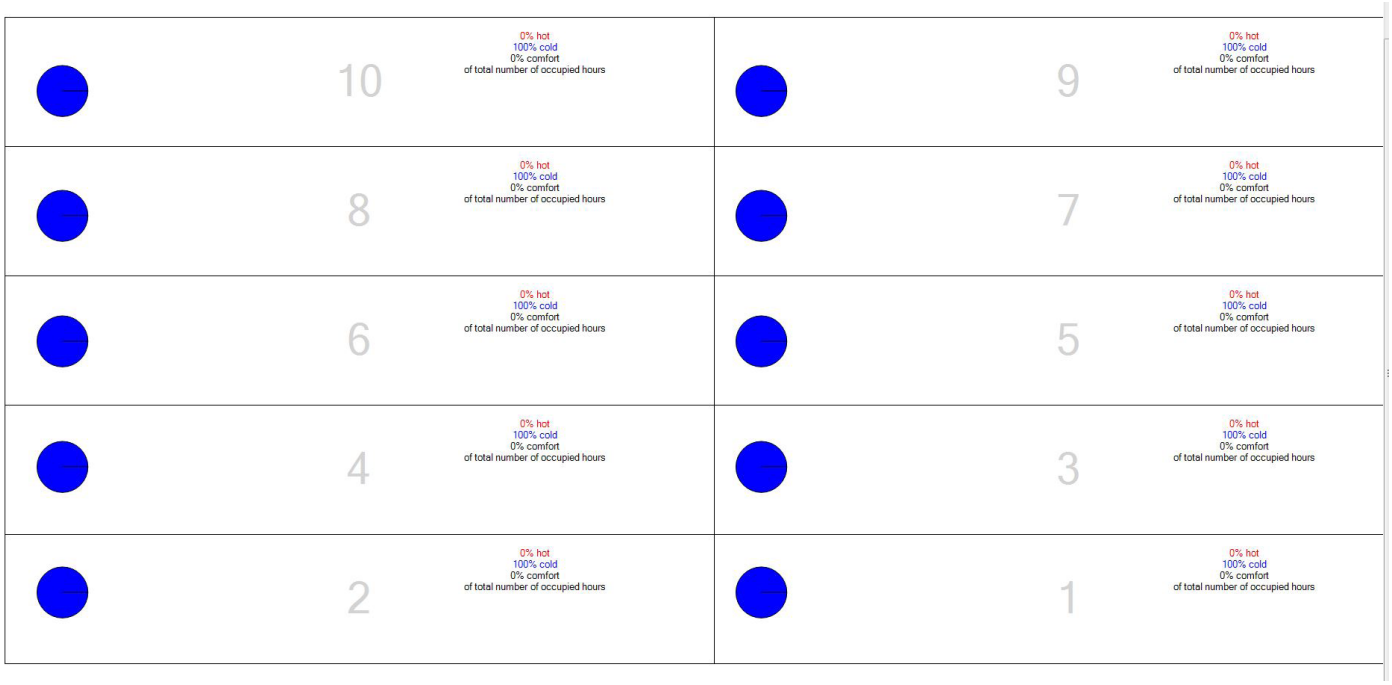
Design Strategy 1:

As there is a disparity between comfort levels of the top most and lowest levels, I changed the massing to have cross ventilation, hopefully for even ventilation. Experimentation with the glazing-to-wall ratio yielded 36.2% per floor. This ratio is especially productive for the spring but remains too high for the winters and too low for the summers.

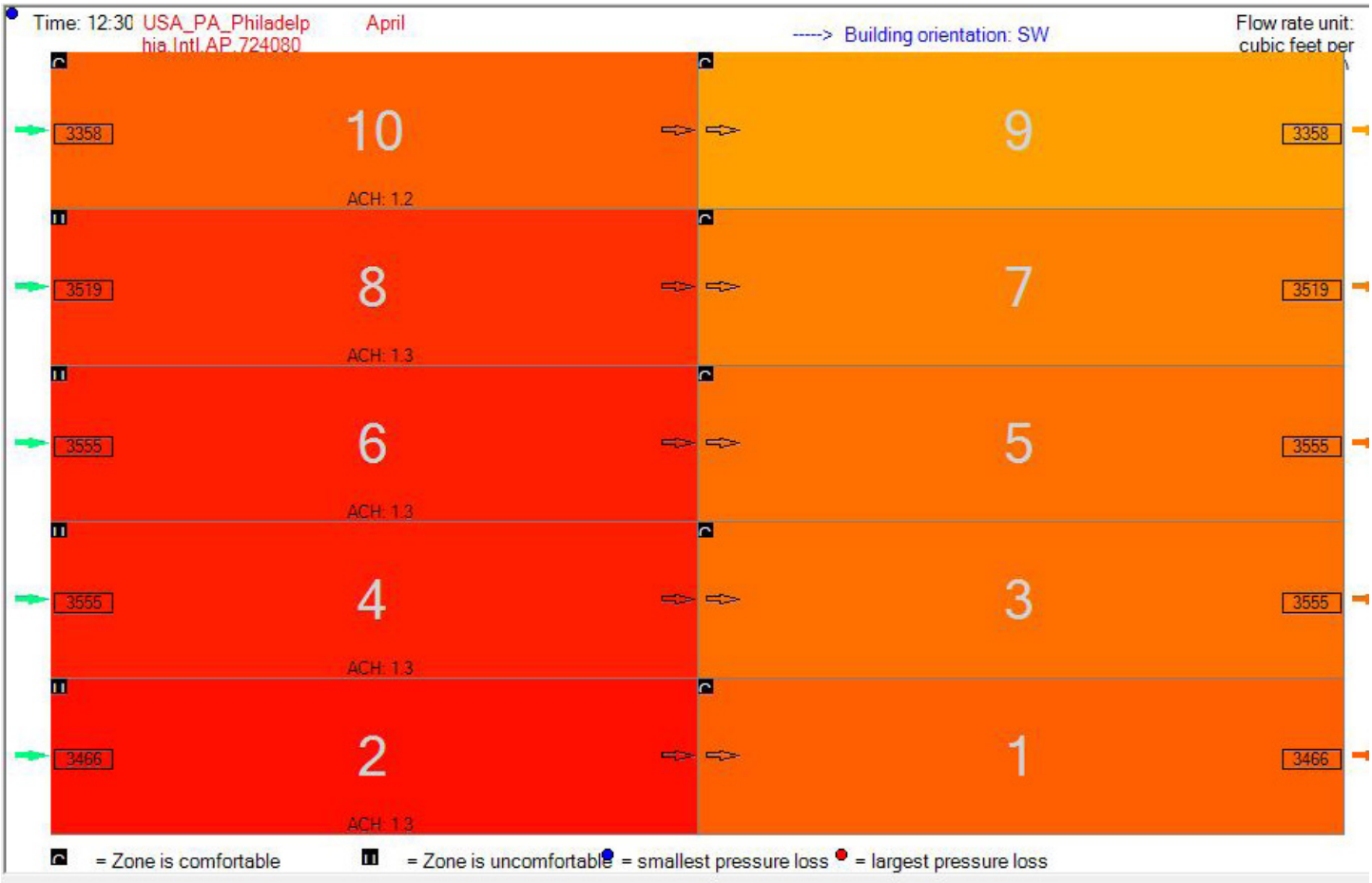
The windows were set as double openings.

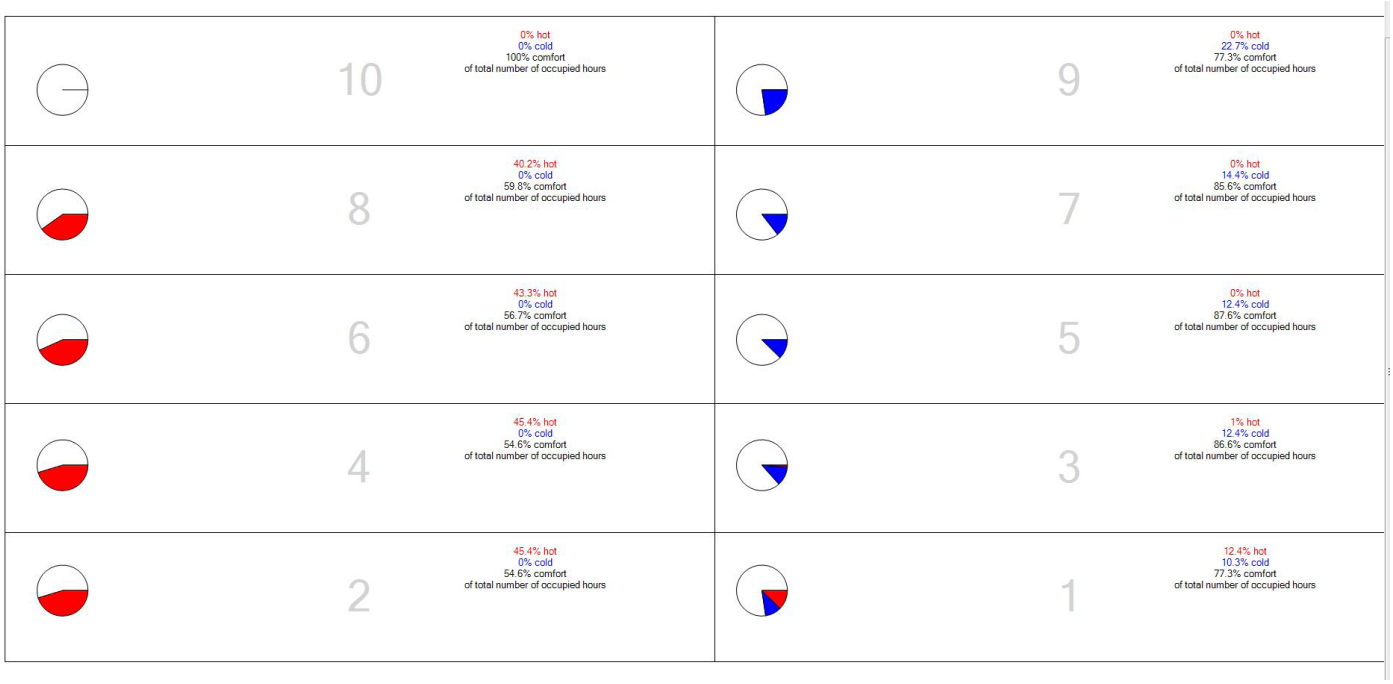
Finally, the floors were indicated as thermal masses with a thickness of 1'. The massing utilizes temperature controlled night cooling. This means that at night, the heat gained throughout the day is released through open windows in areas where the indoor temperature is higher than the outdoor temperature.

December, 13:30:

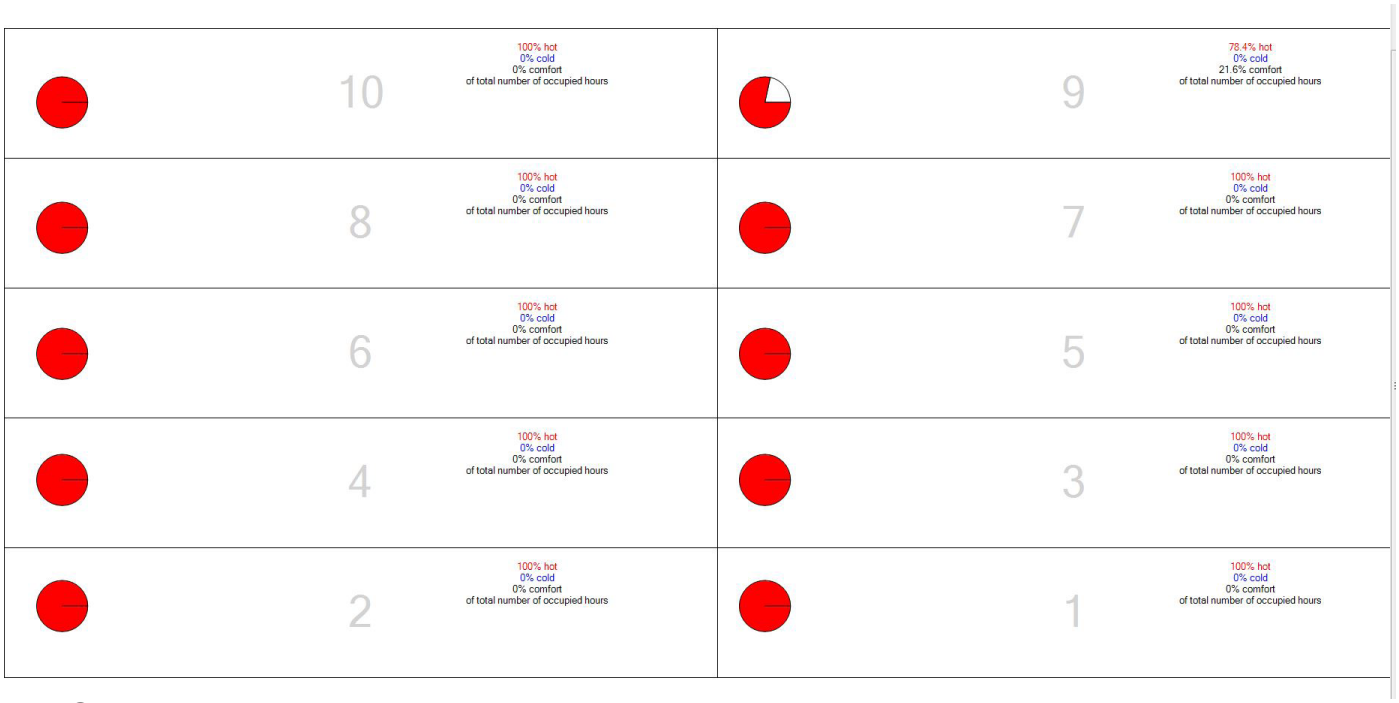


April, 13:30:


Time: 12:30 USA_PA_Philadelphia.Intl.AP.724080
April
-----> Building orientation: SW
Flow rate unit: cubic feet per
3358
10
ACH: 1.2
9
3358
3519
8
ACH: 1.3
7
3519
3555
6
ACH: 1.3
5
3555
3555
4
ACH: 1.3
3
3555
3466
2
ACH: 1.3
1
3466
= Zone is comfortable
= Zone is uncomfortable
= smallest pressure loss
= largest pressure loss


10
0% hot
0% cold
100% comfort
of total number of occupied hours
9
0% hot
22.7% cold
77.3% comfort
of total number of occupied hours
8
40.2% hot
0% cold
59.8% comfort
of total number of occupied hours
7
0% hot
14.4% cold
85.6% comfort
of total number of occupied hours
6
43.3% hot
0% cold
56.7% comfort
of total number of occupied hours
5
0% hot
12.4% cold
87.6% comfort
of total number of occupied hours
4
45.4% hot
0% cold
54.6% comfort
of total number of occupied hours
3
1% hot
12.4% cold
86.6% comfort
of total number of occupied hours
2
45.4% hot
0% cold
54.6% comfort
of total number of occupied hours
1
12.4% hot
10.3% cold
77.3% comfort
of total number of occupied hours

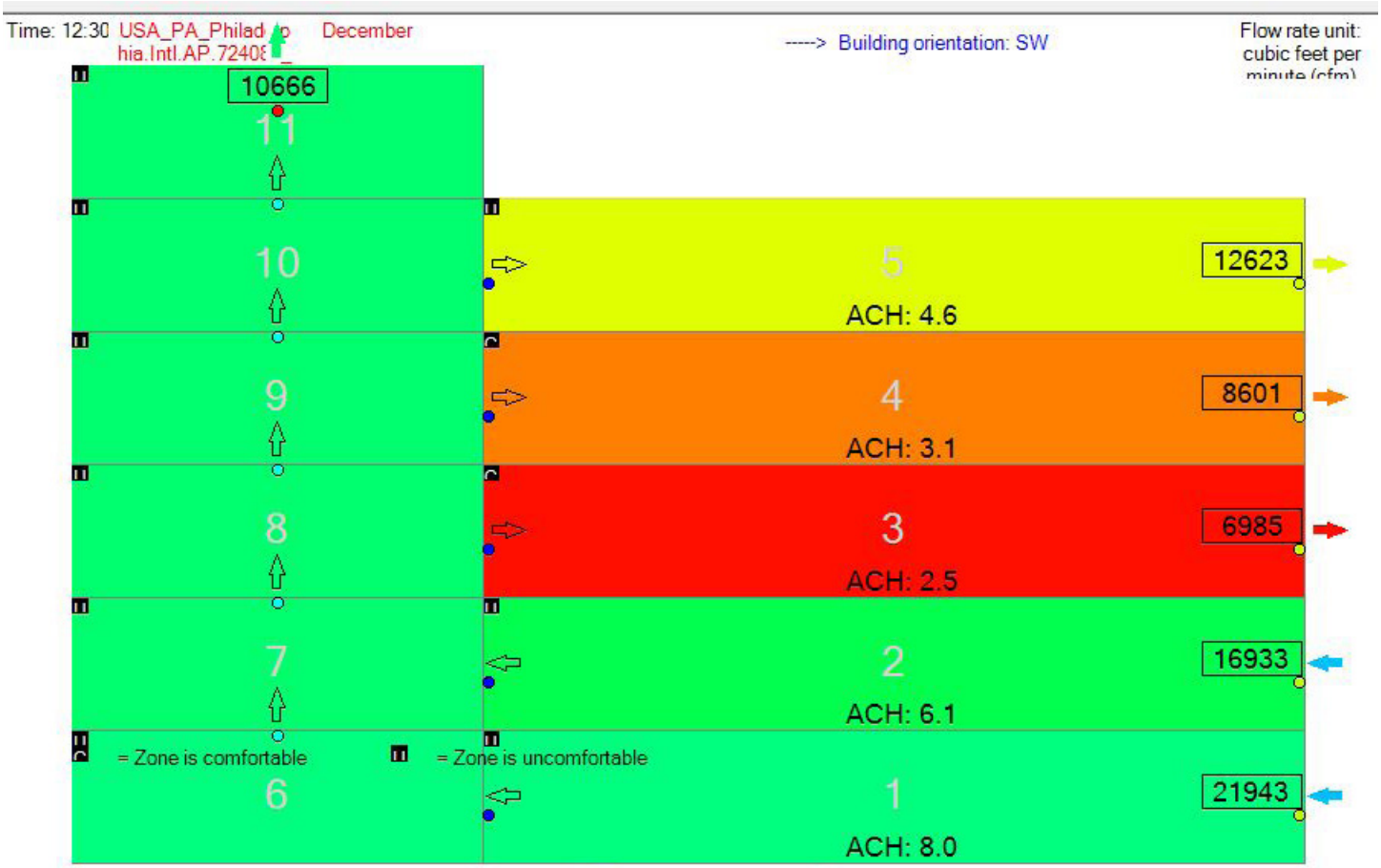
June, 13:30:



Design Strategy 2:

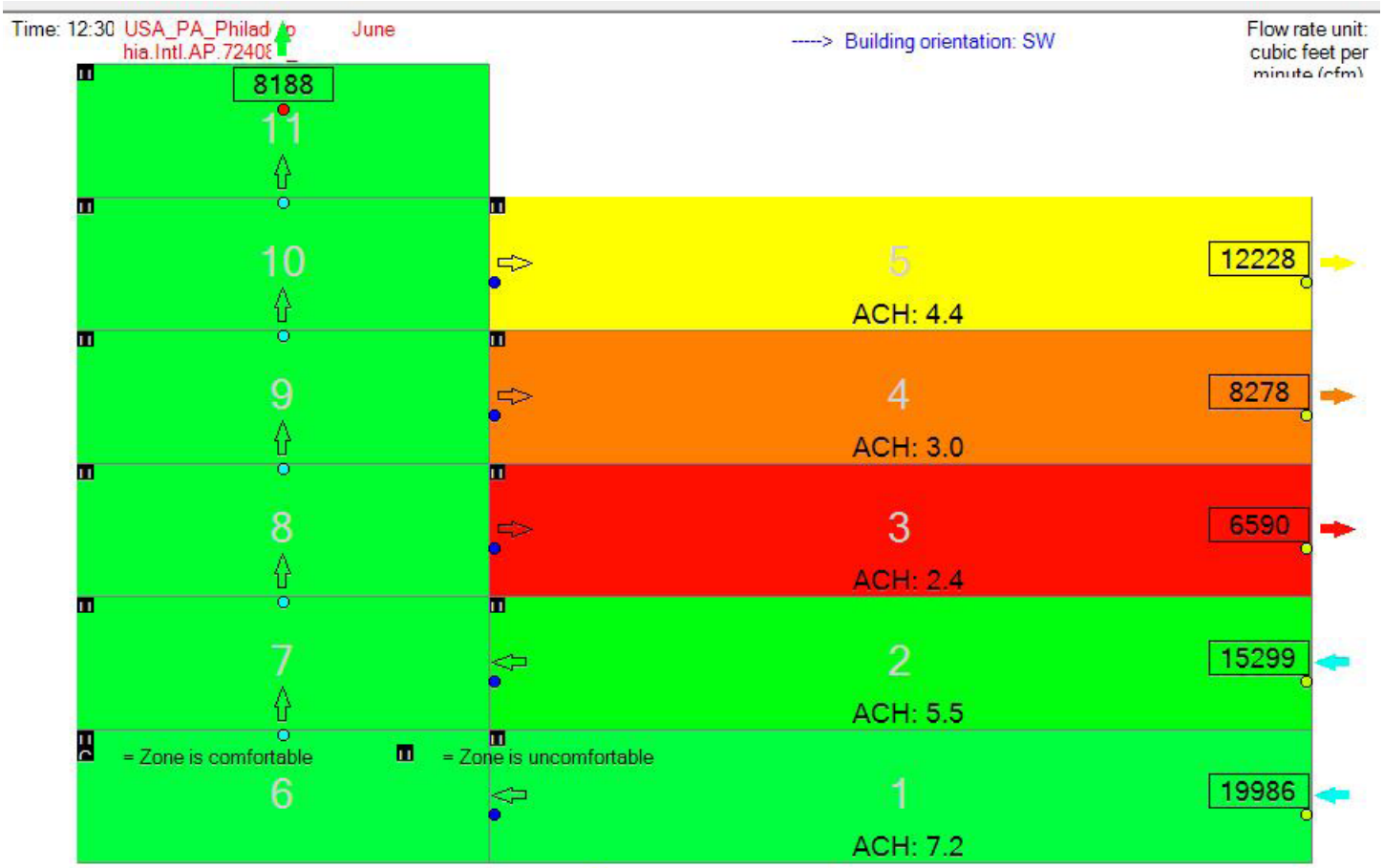
For the second design strategy, I changed the massing to a ventilation shaft and removed the thermal mass so as not to retain heat during the summers. The interesting observation is that the middle floors retain heat which works for the colder weather. The top floors are still to warm for the summer however, despite the window-to-wall ratio increase to 43.5%.

December, 13:30:



11			
10		5	0% hot 100% cold 0% comfort of total number of occupied hours
9		4	0% hot 70.1% cold 29.9% comfort of total number of occupied hours
8		3	0% hot 25.8% cold 74.2% comfort of total number of occupied hours
7		2	0% hot 100% cold 0% comfort of total number of occupied hours
6		1	0% hot 100% cold 0% comfort of total number of occupied hours

June, 13:30:



11			
10		5	100% hot 0% cold 0% comfort of total number of occupied hours
9		4	100% hot 0% cold 0% comfort of total number of occupied hours
8		3	100% hot 0% cold 0% comfort of total number of occupied hours
7		2	64.9% hot 0% cold 35.1% comfort of total number of occupied hours
6		1	50.5% hot 0% cold 49.5% comfort of total number of occupied hours