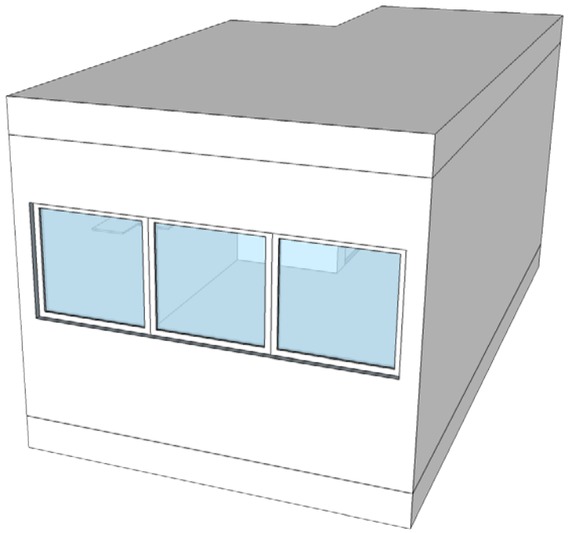
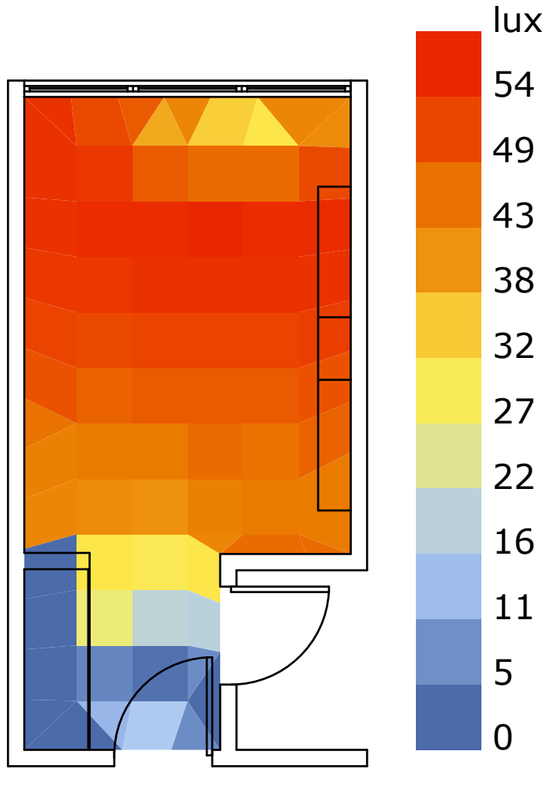


Base Case

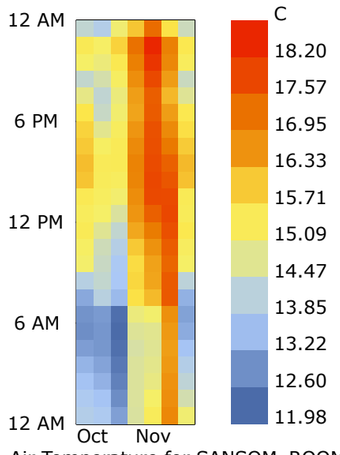
This base case model has been modified to have infiltration, lighting load, and a custom occupancy and lighting schedule inputted. Based on the inputted schedules, the room is calculated to be comfortable for 15.9% of the time, with 39.2% of the time being too hot, and 44.8% of the time being too cold. For this analysis the comfortable temperature is assumed to be at 22°C. The temperatures for a typical week show that it is typically 3 to 8 degrees cooler than comfortable. For a typical hot week, it is about 10 to 13 degrees hotter than comfortable. For a typical cold week, it is about 13 to 16 degrees colder than comfortable.

The daylight simulation of the base case shows that most of the room receives useful daylight for about 40-50% of the occupied time. There is a little bit of a glare issue under the window, resulting in useful daylight during only 27-32% of the time.

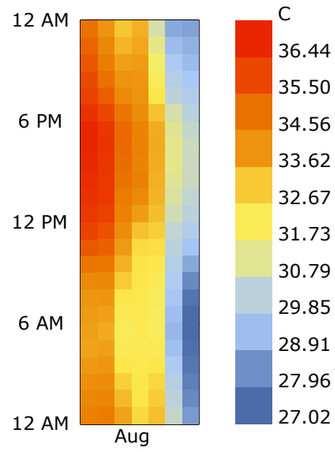


UDI 100<2000

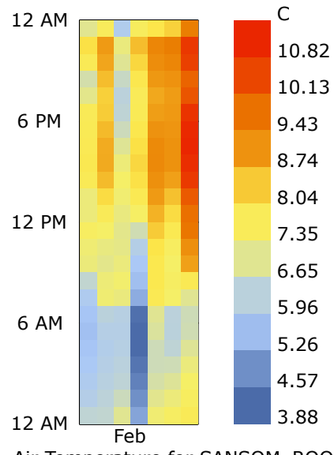
Air Temperature Range



Air Temperature for SANSOM_ROOM (C)
Typical Week
29 OCT 1:00 - 4 NOV 24:00

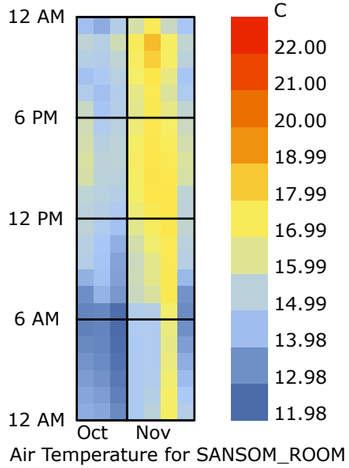


Air Temperature for SANSOM_ROOM (C)
Typical Hot Week
19 AUG 1:00 - 25 AUG 24:00

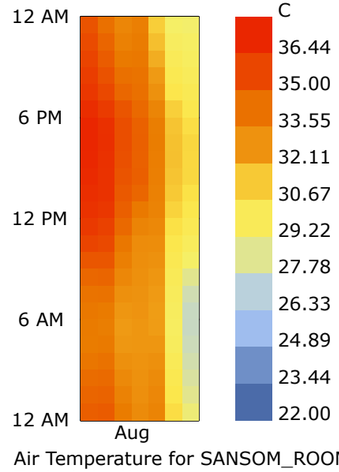


Air Temperature for SANSOM_ROOM (C)
Typical Cold Week
12 FEB 1:00 - 18 FEB 24:00

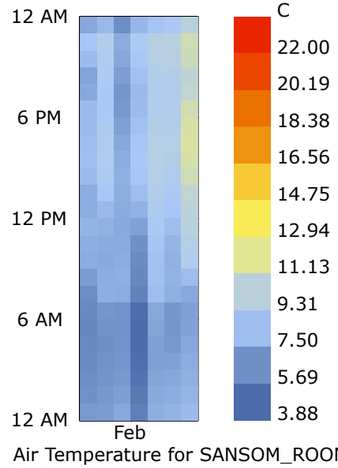
Air Temperature - Normalized against comfort (22°C)



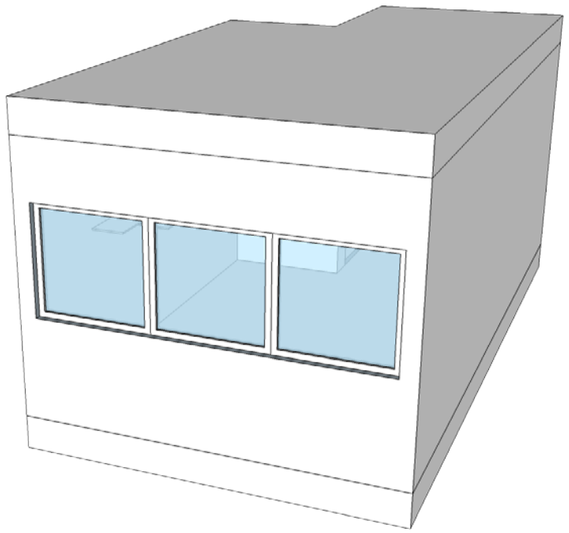
Air Temperature for SANSOM_ROOM (C)
Typical Week
29 OCT 1:00 - 4 NOV 24:00



Air Temperature for SANSOM_ROOM (C)
Typical Hot Week
19 AUG 1:00 - 25 AUG 24:00



Air Temperature for SANSOM_ROOM (C)
Typical Cold Week
12 FEB 1:00 - 18 FEB 24:00

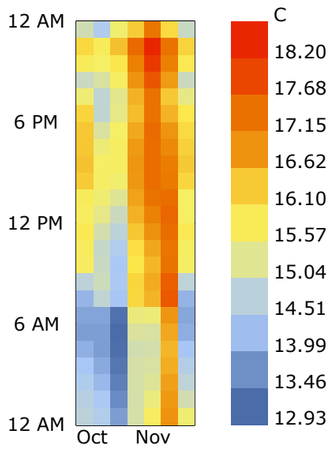


Maximum ventilation with doubled R-values

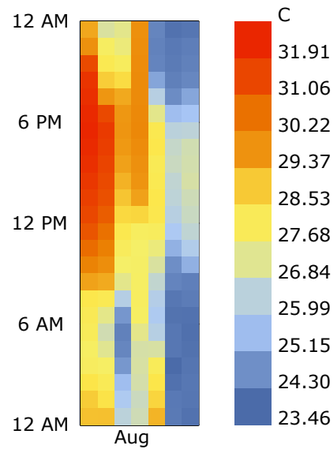
The first step in changing the design of the room is to change its thermal comfort. To do this, natural ventilation and changed EP construction for doubled R-values were incorporated into the design model. This had an profound effect on the thermal comfort of the room; the room is now comfortable for 42.7% of the time, with 12.9% of the time being too hot, and 44.4% of the time being too cold.

Analyzing these changes based on a week-by-week basis, it is revealed that increasing the R-value raises the lowest temperature of a typical week and a typical cold week to 1 degree higher. Using natural ventilation lowers the high temperatures of the typical hot week so that they are about 5 to 10 degrees hotter than comfortable.

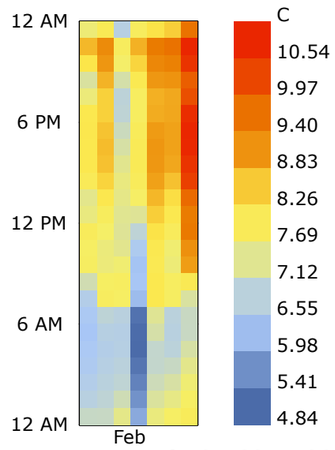
Air Temperature Range



Air Temperature for SANSOM_ROOM (C)
Typical Week
29 OCT 1:00 - 4 NOV 24:00

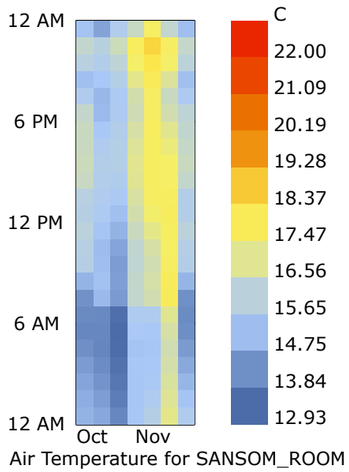


Air Temperature for SANSOM_ROOM (C) - Hourly
Typical Hot Week
19 AUG 1:00 - 25 AUG 24:00

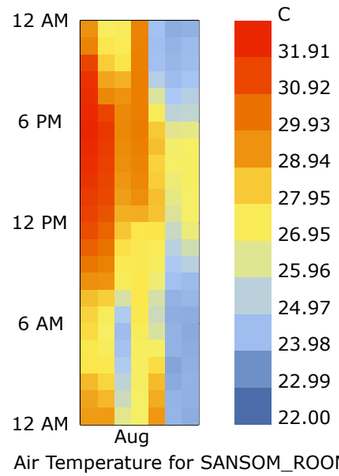


Air Temperature for SANSOM_ROOM (C)
Typical Cold Week
12 FEB 1:00 - 18 FEB 24:00

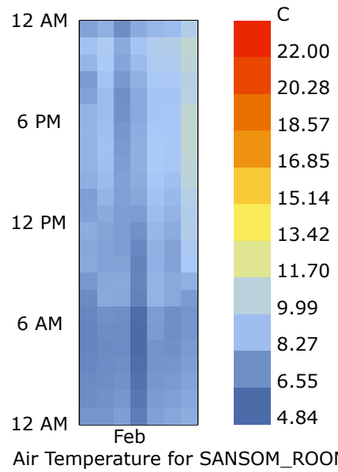
Air Temperature - Normalized against comfort (22°C)



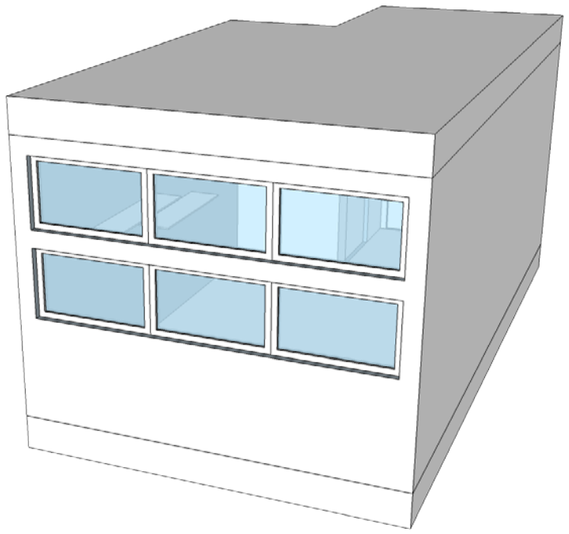
Air Temperature for SANSOM_ROOM (C)
Typical Week
29 OCT 1:00 - 4 NOV 24:00

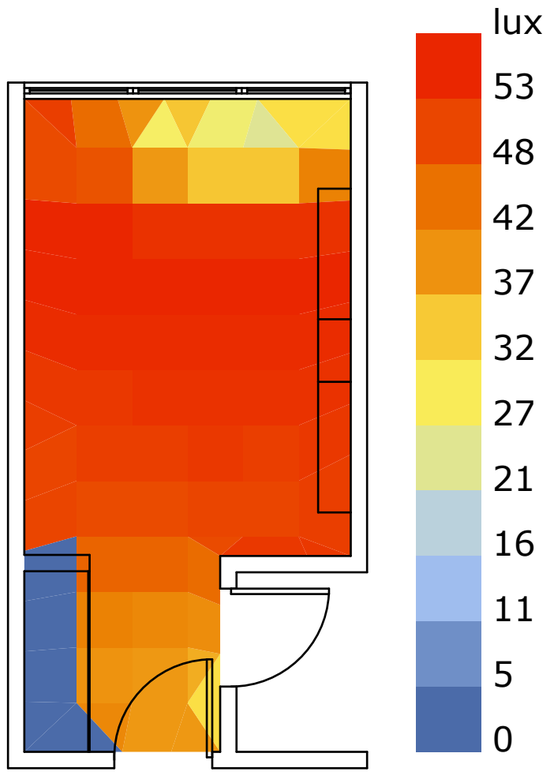


Air Temperature for SANSOM_ROOM (C)
Typical Hot Week
19 AUG 1:00 - 25 AUG 24:00



Air Temperature for SANSOM_ROOM (C)
Typical Cold Week
12 FEB 1:00 - 18 FEB 24:00



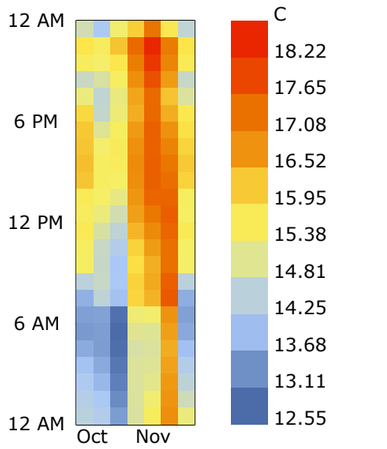


UDI 100<2000

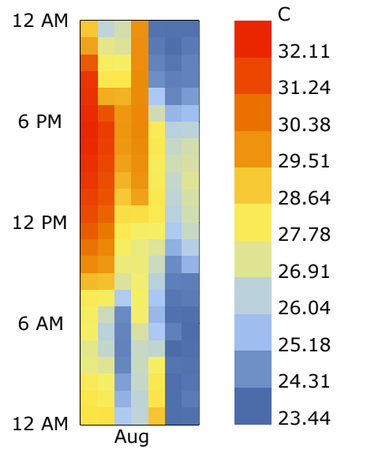
Increase daylight without sacrificing thermal comfort

The next step in improving the design of the room is to increase daylighting. However, to do that would involve increasing the area of the glazing, which would almost always decrease the thermal comfort of the room. To address this issue, the glazing design was separated into two smaller rows of glazing each, so that the overall glazing area increased but the area exposed to the lower R-value of the glazing would be small. The reflectance and transmittance of the room's materials and glazing were also increased from 70% to 80%. The result of this design change was increased daylight levels without sacrificing too much thermal comfort. This design is calculated to be comfortable for 42.1%, with 12.9% of the time being too hot and 45% of the time being too cold, which is very similar to the above case. However, the daylight level in the room increased so that all useful area of the room now receives useful daylight for 53% of the time, while the very far end of the room receives useful daylight for 37% of the time, up from the 5-16% of the base case.

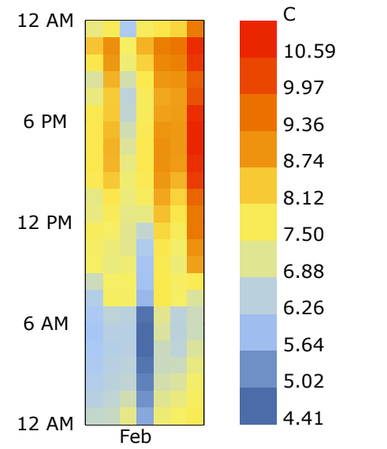
Air Temperature Range



Air Temperature for SANSOM_ROOM (C)
Typical Week
29 OCT 1:00 - 4 NOV 24:00

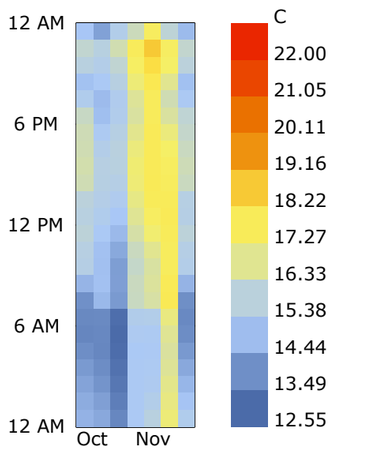


Air Temperature for SANSOM_ROOM (C)
Typical Hot Week
19 AUG 1:00 - 25 AUG 24:00

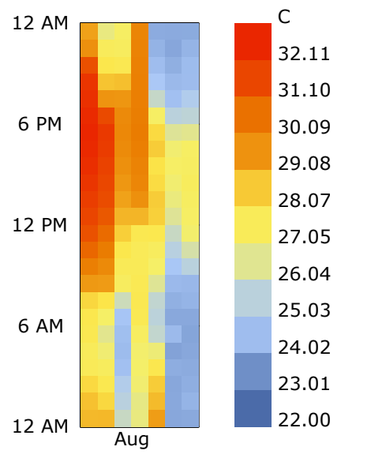


Air Temperature for SANSOM_ROOM (C)
Typical Cold Week
12 FEB 1:00 - 18 FEB 24:00

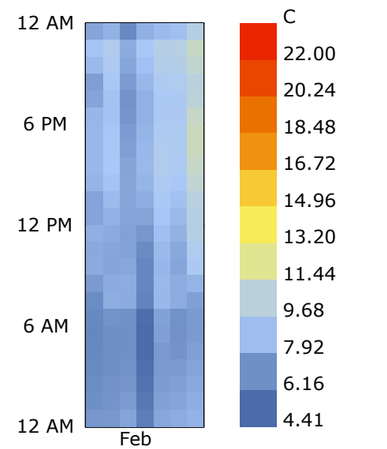
Air Temperature - Normalized against comfort (22°C)



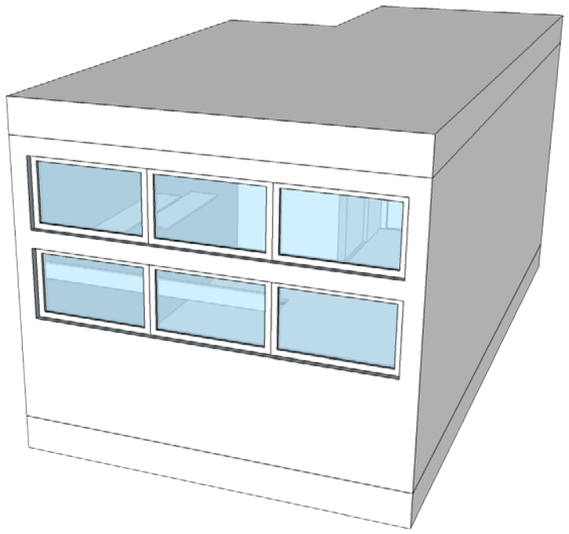
Air Temperature for SANSOM_ROOM (C)
Typical Week
29 OCT 1:00 - 4 NOV 24:00



Air Temperature for SANSOM_ROOM (C)
Typical Hot Week
19 AUG 1:00 - 25 AUG 24:00



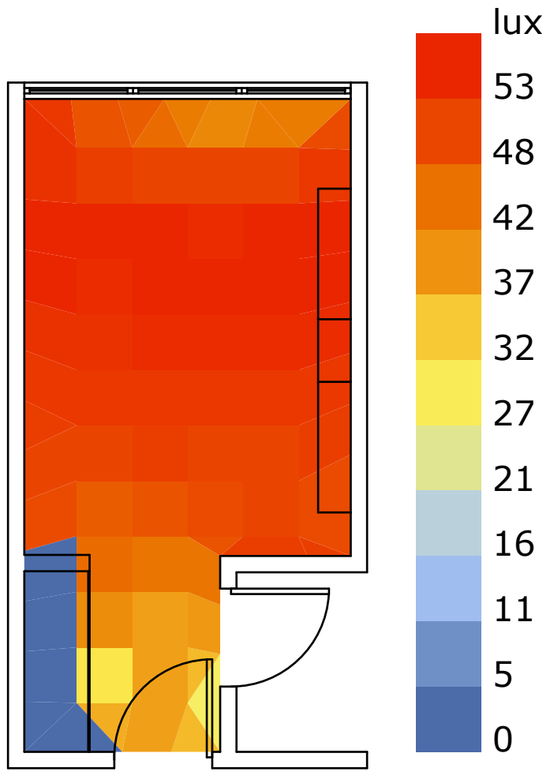
Air Temperature for SANSOM_ROOM (C)
Typical Cold Week
12 FEB 1:00 - 18 FEB 24:00



Reduce problematic glare

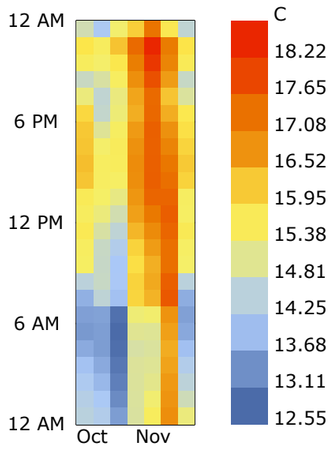
Finally, it is revealed in the improved design that glare under the window became a problem after increasing glazing area and material reflectance in the room. To ameliorate this problem, a light shelf was added to the northeast side of the lower window where the light coming in is the most problematic.

This design change does not change anything about the thermal comfort of the room, but it does help reduce the glare under the window so that area now receives useful daylight for 37-48% of the time, up from the 21-27% of the previous design without light shelf, while retaining the useful daylight that penetrates deeper into the room at 53%.

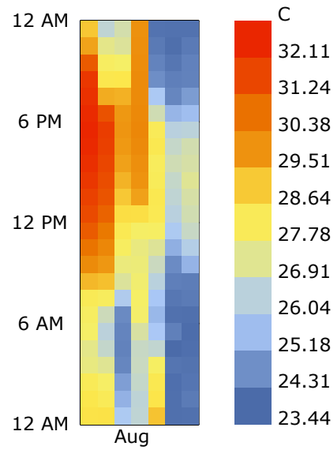


UDI 100<2000

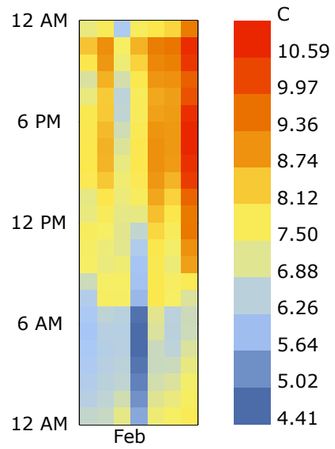
Air Temperature Range



Air Temperature for SANSOM_ROOM (C)
Typical Week
29 OCT 1:00 - 4 NOV 24:00

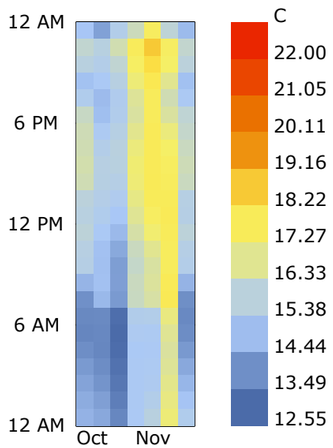


Air Temperature for SANSOM_ROOM (C)
Typical Hot Week
19 AUG 1:00 - 25 AUG 24:00

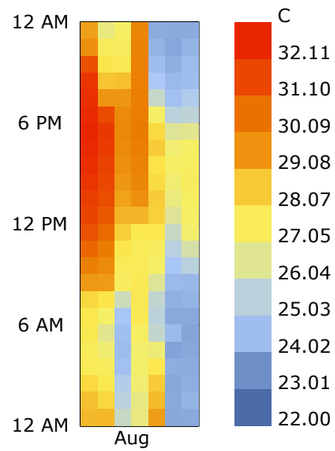


Air Temperature for SANSOM_ROOM (C)
Typical Cold Week
12 FEB 1:00 - 18 FEB 24:00

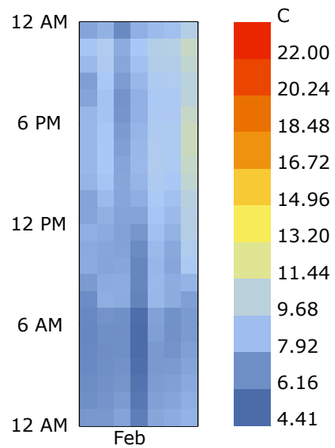
Air Temperature - Normalized against comfort (22°C)



Air Temperature for SANSOM_ROOM (C)
Typical Week
29 OCT 1:00 - 4 NOV 24:00



Air Temperature for SANSOM_ROOM (C)
Typical Hot Week
19 AUG 1:00 - 25 AUG 24:00



Air Temperature for SANSOM_ROOM (C)
Typical Cold Week
12 FEB 1:00 - 18 FEB 24:00