

SENSOR DATA ANALYSIS

(FOR FACILITIES MANAGEMENT)

FOSTER + PARTNERS



Data Extraction & Wrangling

The data included:

- Indoor air quality data (iaq.json)
- Outdoor air quality data (oaq.json)
- Sensor location data (floors.json)

Column	TimeStamp	Temperature	Humidity	CO2	Sensor ID
Description	Data & Time with 5 minutes interval	Temperature reading from the ceiling sensors in degrees celsius	Humidity reading from the ceiling sensors in percentage	CO2 reading from the ceiling sensors in ppm	Unique identification of each sensor
Data Type	datetime	float	integer	integer	string

Data Extraction & Wrangling

Data Preprocessing

Missing Value Check

Column Name	No. of Missing Values
documentTime	0
temp	0
humidity	0
co2	0
sensor_id	0

TimeStamp Typecasting

Available timestamp
type: string

Converted timestamp
type: datetime

Time Series Data

	temp
documentTime	
2023-01-23 00:03:37+00:00	23.5
2023-01-23 00:00:48+00:00	23.6
2023-01-23 00:04:53+00:00	22.0
2023-01-23 00:01:33+00:00	23.2
2023-01-23 00:04:29+00:00	22.8

Data Extraction & Wrangling

Data Preprocessing

Working Hours Reading

Available timestamp:
Whole day

Converted timestamp:
Working hours
(9am - 5pm)

Temperature Values

Sensor Reading	Temperature at desk height
23.5	22.0
23.6	22.1
22.0	20.5
23.2	21.7
22.8	21.3

Data Split

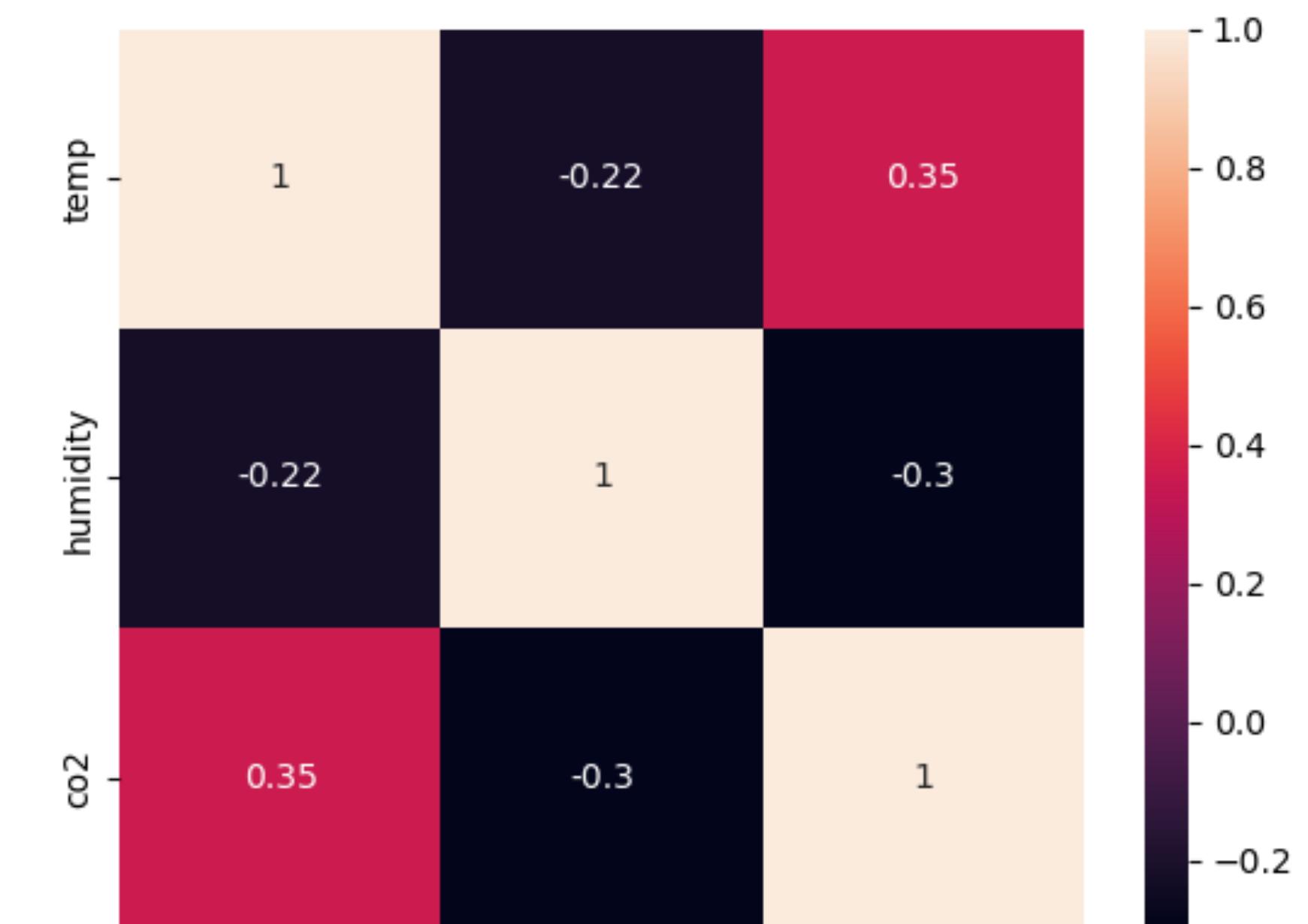
Data split, based on
sensor ID on each floor

Data Extraction & Wrangling

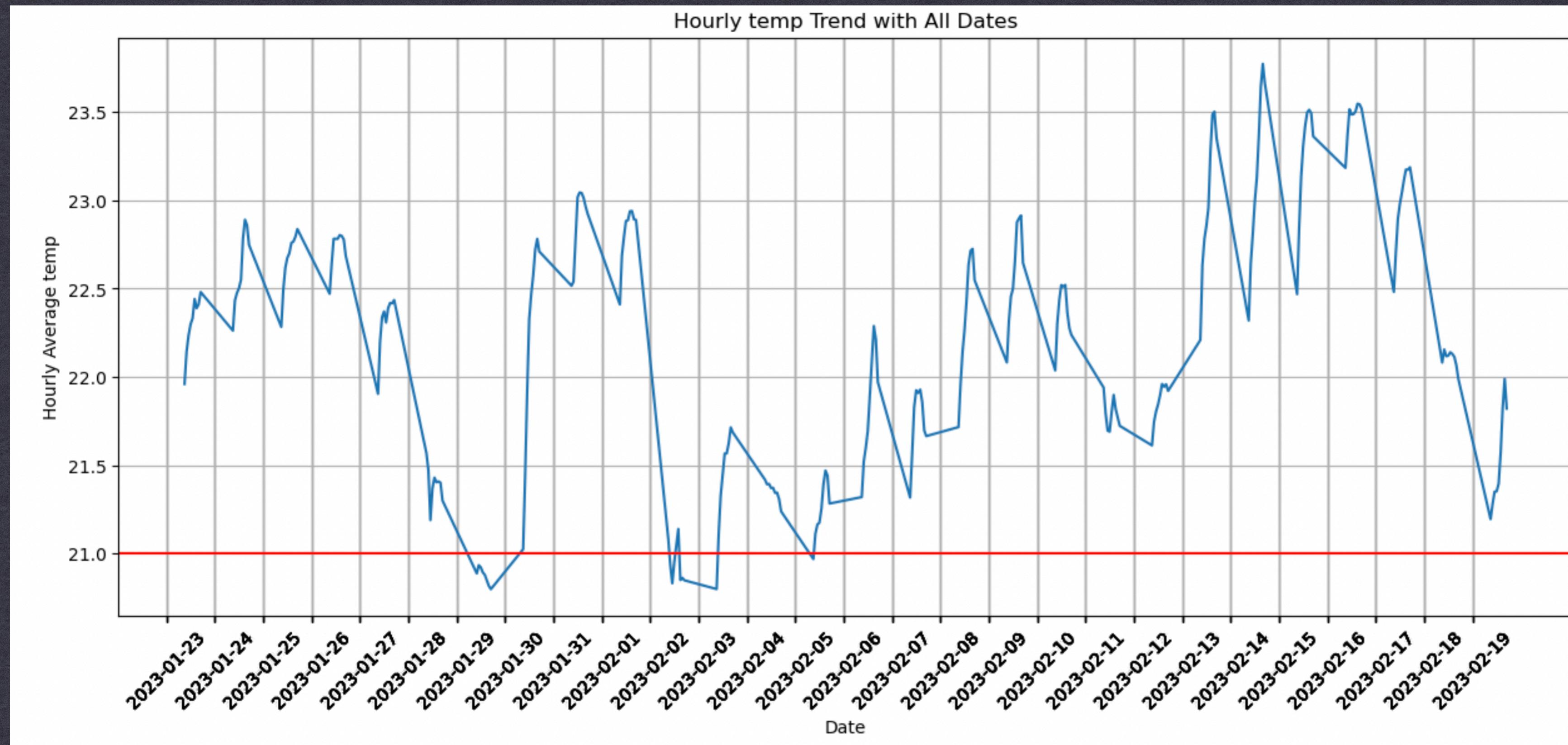
Data Preprocessing

The heat-map displays the Pearson correlation between the given variables, which include temperature, humidity, and CO2.

The weak correlation between these variables suggests no impact on each other.

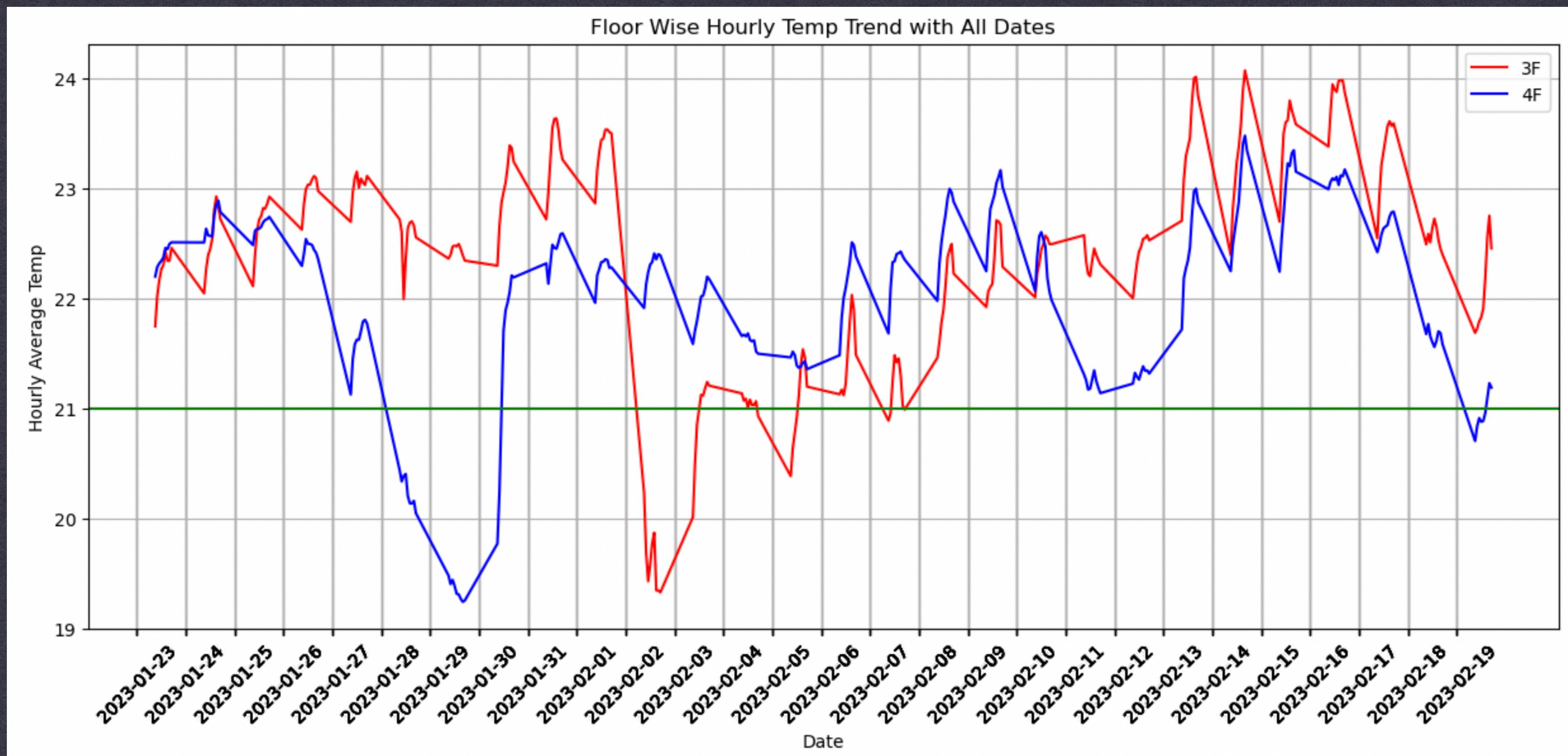


TEMPERATURE TREND ABOVE 21⁰



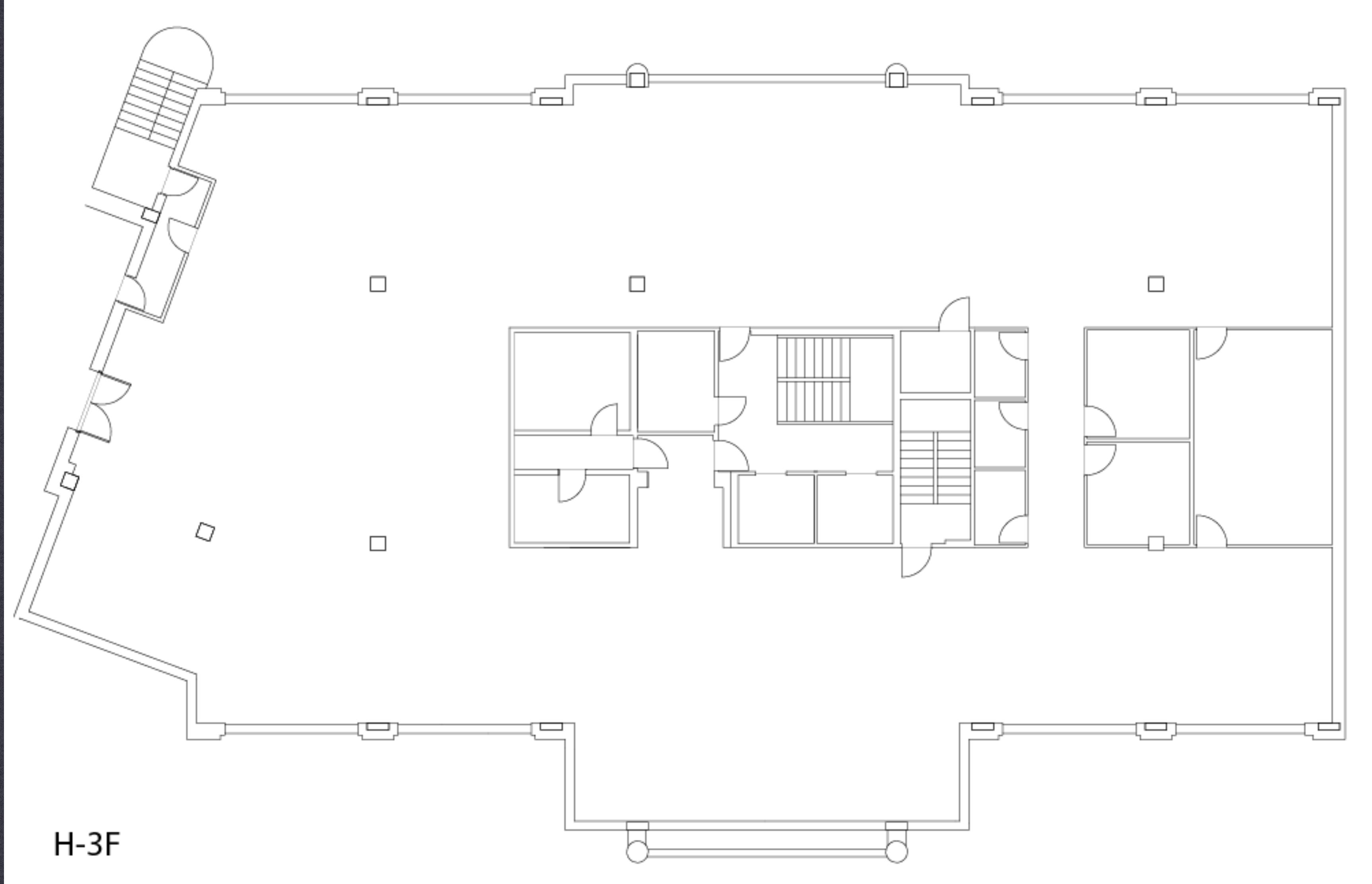
- The temperature trend displays hourly averages, with 12 values per hour.
- The facilities manager has set the temperature threshold, which is marked as the red line.
- One inference is that the drop occurs primarily on weekends, though some occur on weekdays.
- Around 3 days have the temperature drop below threshold, out of which only 1 is the weekend.

FLOOR WISE TEMPERATURE TREND



- The temperature on the 4th floor drops on weekends, with a particularly large drop on 29/01/2023.
- The temperature on the third floor drops on weekends, but on 02/02/2023 (a weekday), it significantly dropped followed by a lower temperature compared to the fourth floor for the entire week.

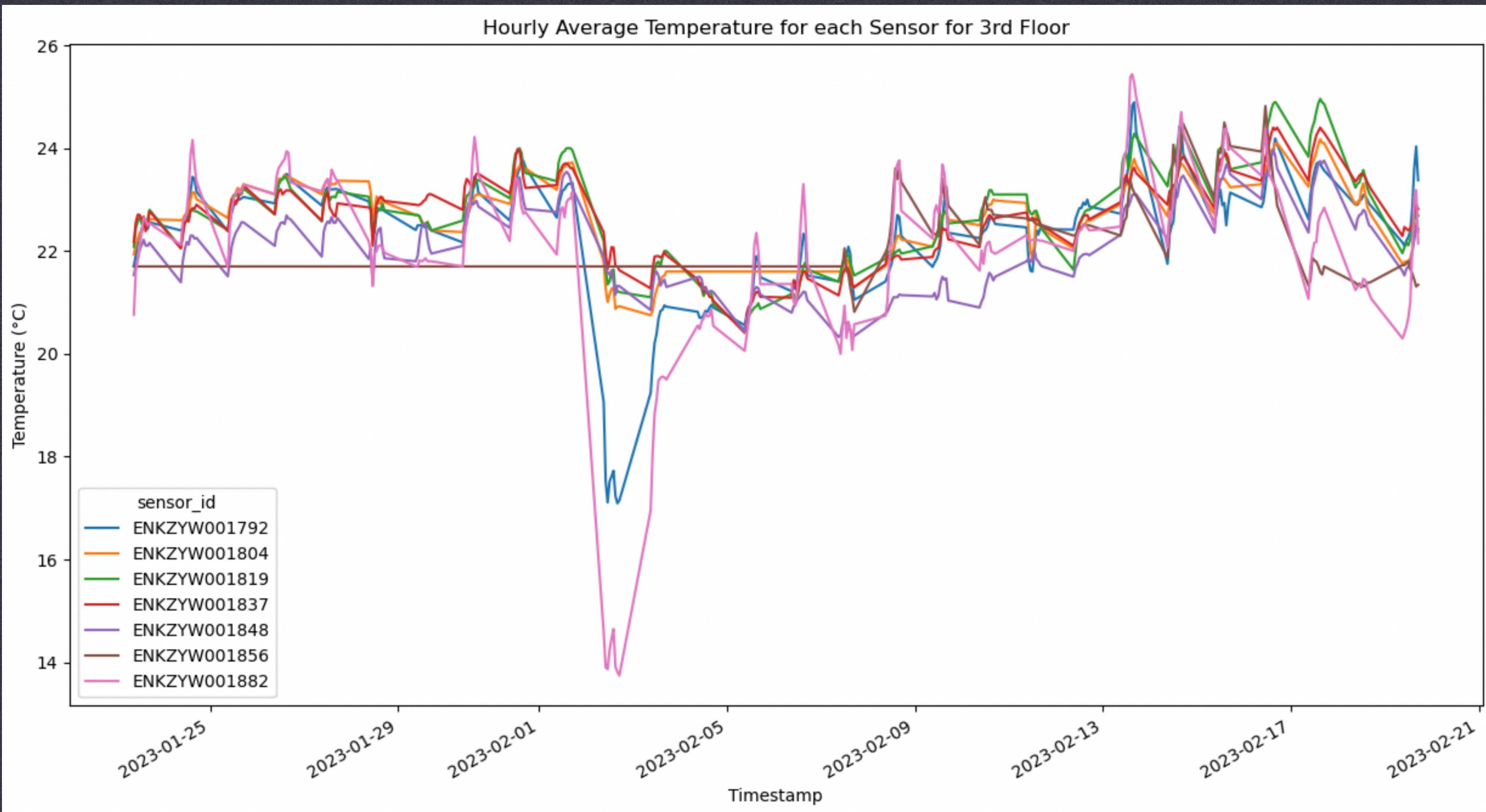
3RD FLOOR PLAN



The floor plan shows that this floor is probably insulated.

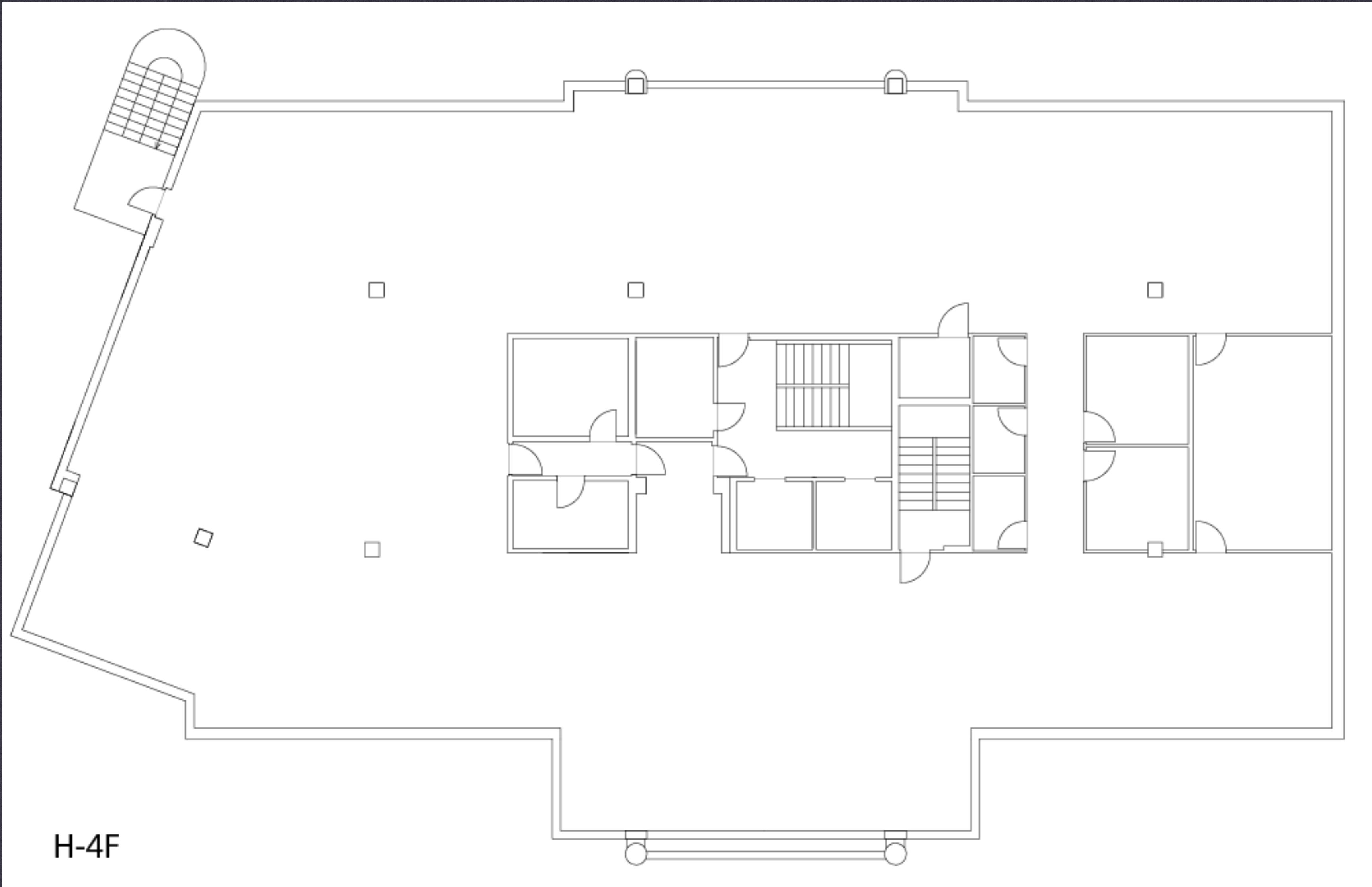
- The floor seems to have insulated glass units (IGUs), providing insulation from outside weather.
- Insulation seems to be maintaining the indoor temperature.

3RD FLOOR TEMPERATURE BY EACH SENSOR



- Most sensors show similar values, indicating well-maintained temperatures due to insulation.
- On a weekday, there has been a significant drop shown by ENKZYW001792 and 1882. This could be due to a fault in the sensor, HVAC system, or insulation.

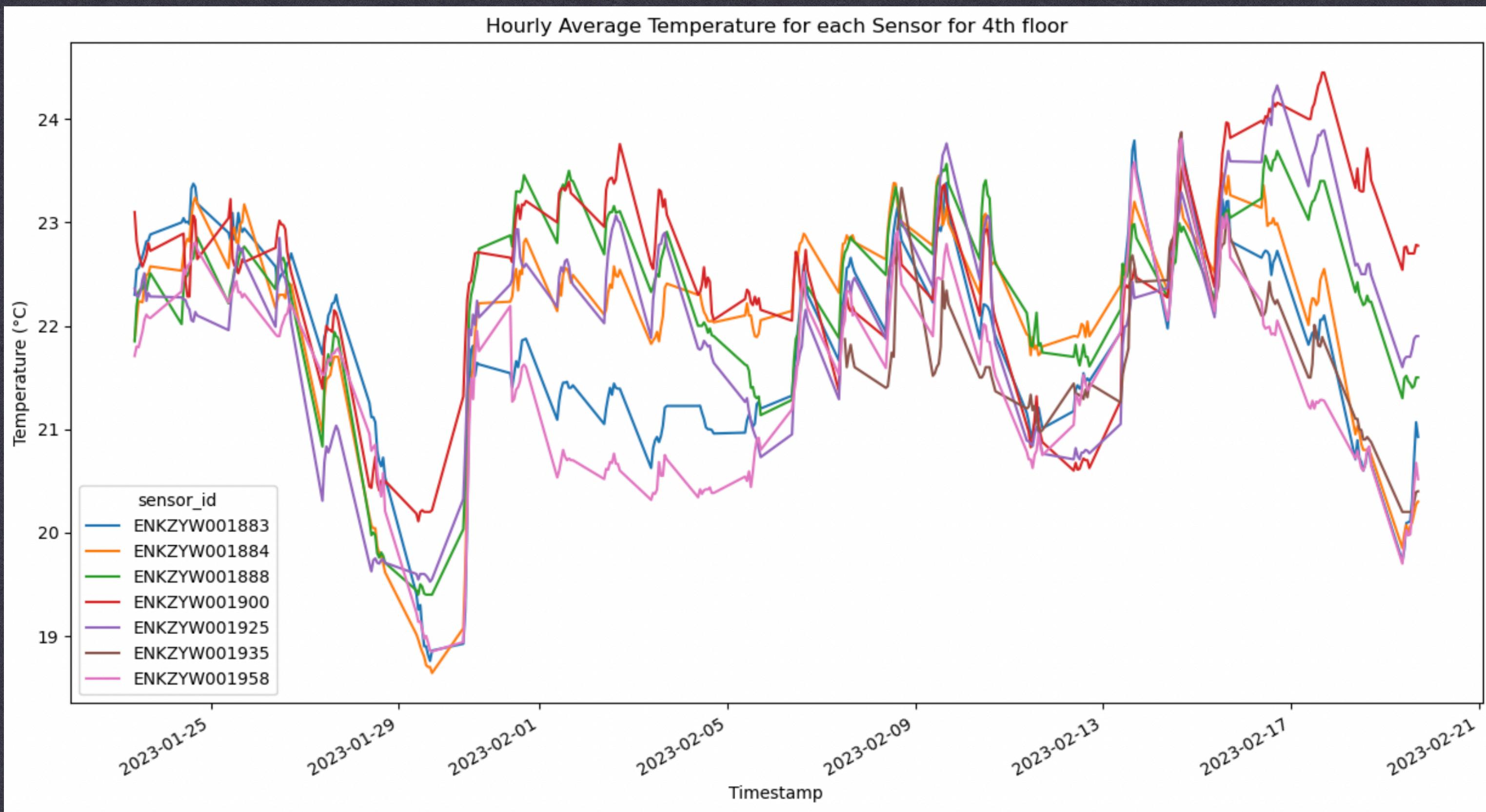
4TH FLOOR PLAN



The floor plan shows that this floor is probably not insulated, as a result of which:

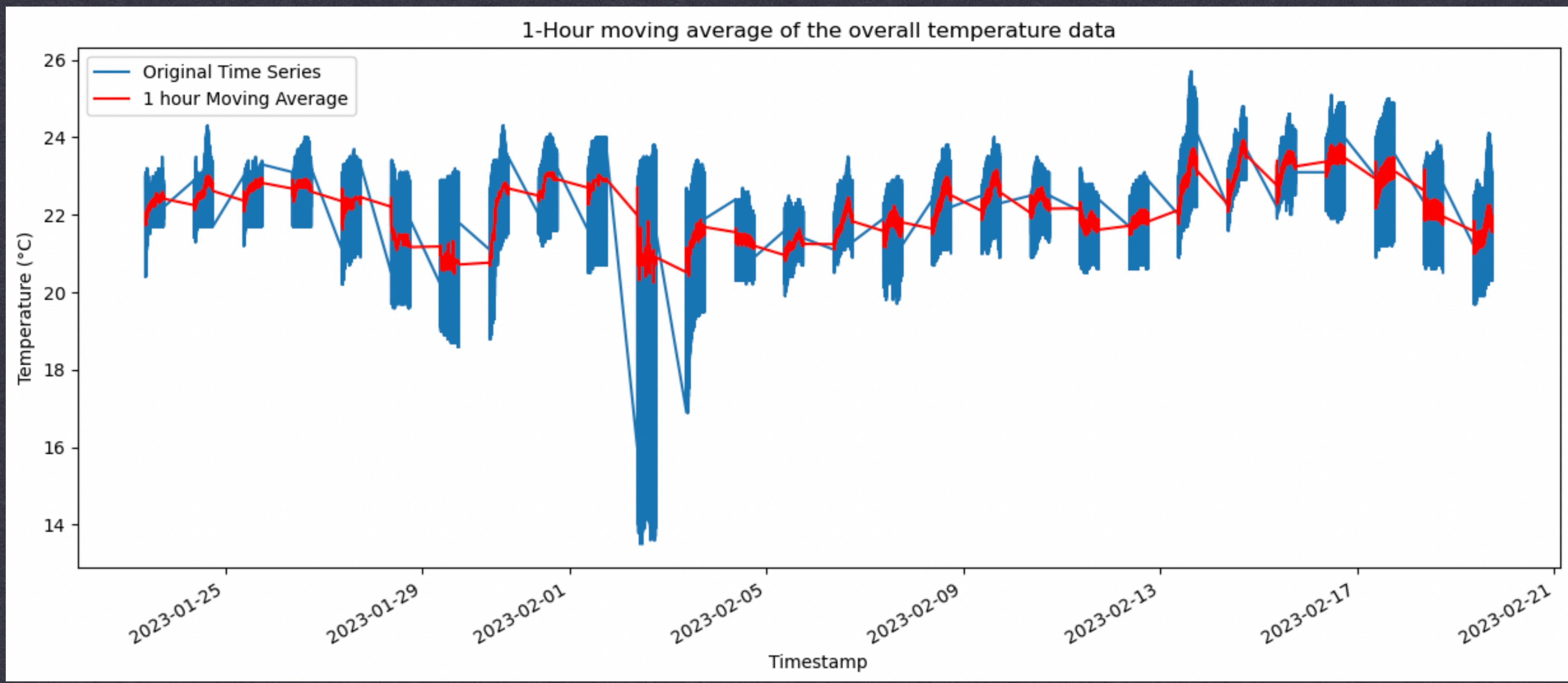
- The outdoor weather conditions could have an impact on the indoor temperature.
- There could be a notable impact when HVAC systems are turned off.

4RD FLOOR TEMPERATURE BY EACH SENSOR



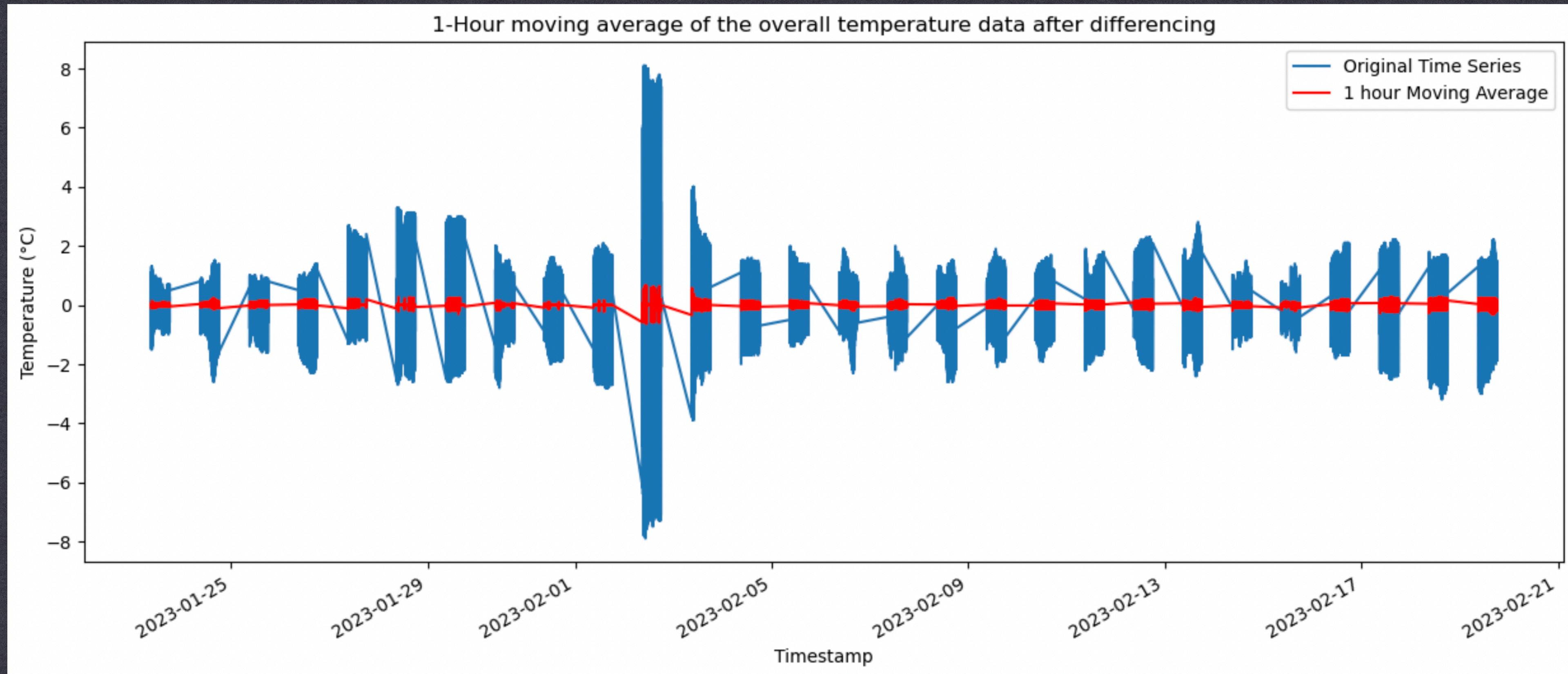
- Sensors indicate temperature variations across the floor, suggesting the absence of insulation.
- Based on the sensor readings, it appears that the temperature drops as expected during weekends.

STATIONARITY OF TEMPERATURE DATA



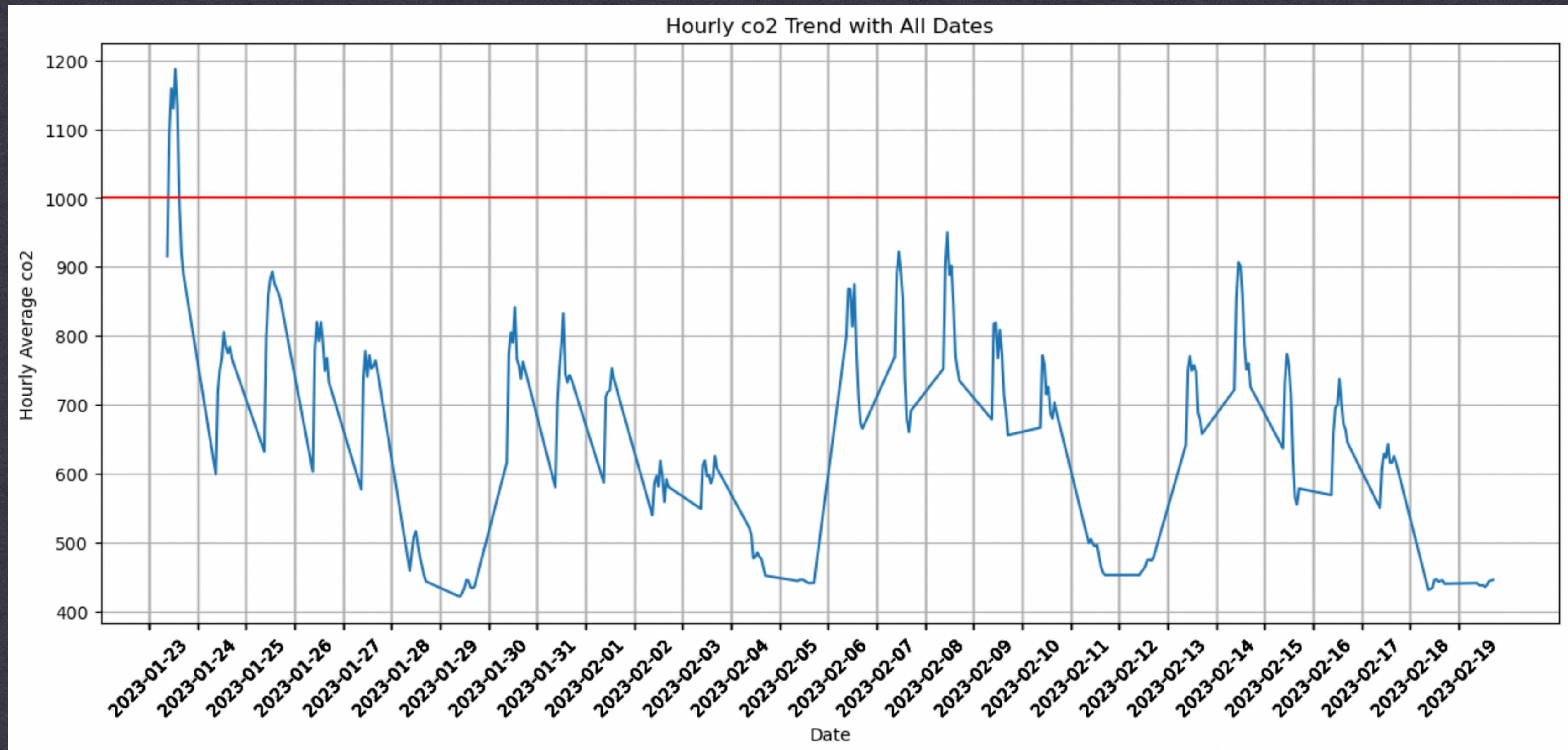
- The 1-hour (12 values) moving average graph above indicates data being non-stationary.
- The non-stationarity is confirmed by the Augmented Dickey-Fuller (ADF) test with a p-value of 0.08549.

STATIONARITY OF TEMPERATURE DATA



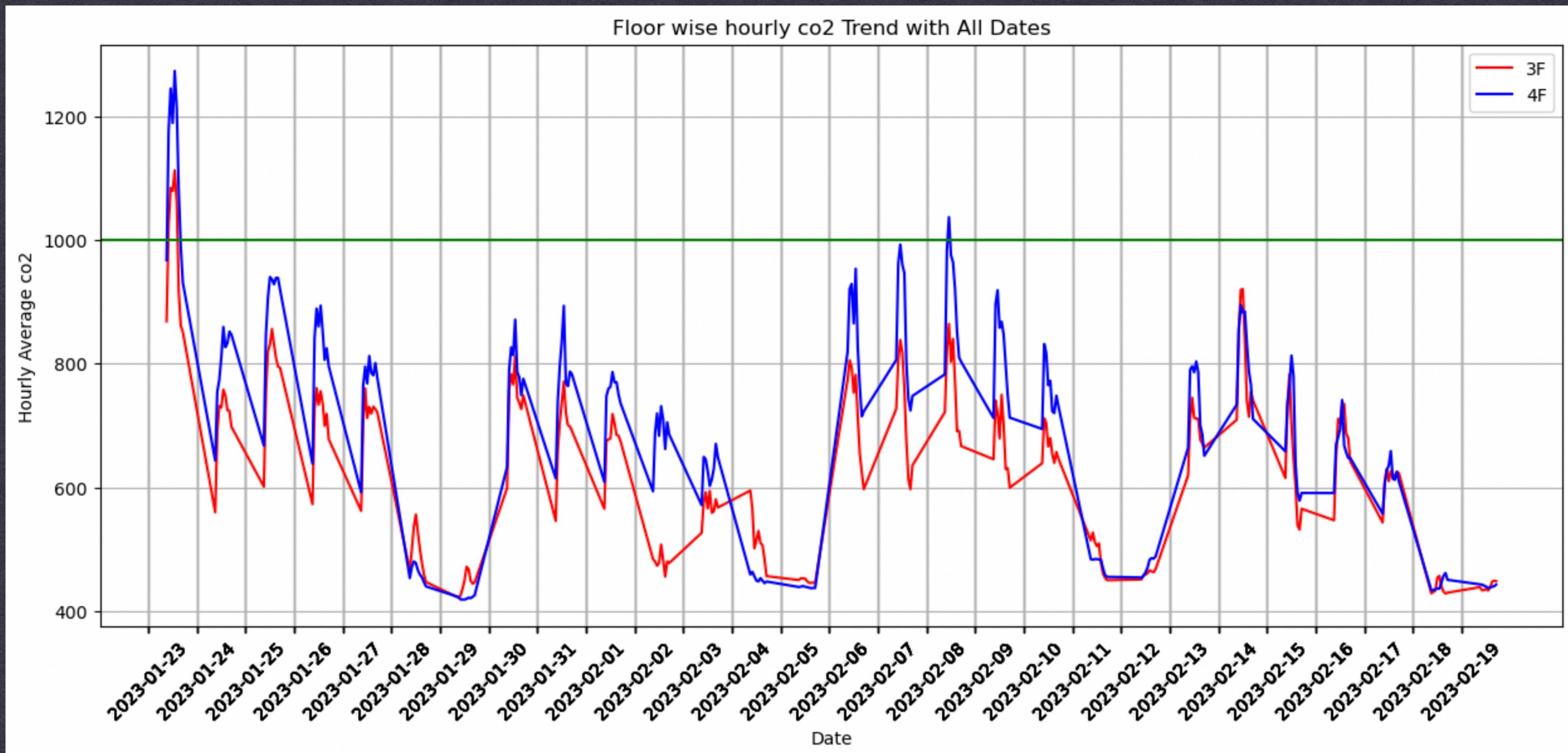
- The updated 1-hour (12 values) moving average graph above indicates data being stationary.
- To achieve stationarity, the temperature data was subjected to single order differencing.

CO2 TREND



- The graph shows the hourly average of CO2 level with a 1000 ppm threshold (red line).
- The CO2 level is maintained under the threshold, probably using HVAC systems.
- An unusual spike appears at the beginning, possibly due to system failure or a surge in headcount from an event.

FLOOR WISE CO2 TREND



- According to the graph, the CO₂ level on the 4th floor is a bit higher than that on the 3rd floor.
- The levels indicate the potential for either high occupancy or an HVAC problem.

CO2 DATA ANALYSIS

TimeStamp	co2 Level
09:03:22	449
09:08:23	449
09:13:24	449
09:18:25	449
09:23:26	449
...	...
17:35:04	449
17:40:05	449
17:45:06	449
17:50:07	449
17:55:08	449

Based on the CO2 level sensor data, the following insights can be derived:

- The data follows a trend which repeats itself after regular intervals.
- The CO2 levels drop on weekends due to low occupancy during office hours.
- The data is stationary and no further differencing is needed, as indicated by a p-value of 0.0016 from the ADF test.
- The snippet on the left indicates a default/reset value every 5 minutes.

CONCLUDING POINTS

- Although the outdoor sensor data is provided, it doesn't exhibit a significant impact or correlation with the indoor sensor data.
- The values where the temperature drops abruptly cannot be removed to prevent data loss.
- In some cases, the temperature readings are far from the set threshold (although in the expected direction), resulting in unnecessary strain on the HVAC system and increased costs.
- The CO₂ level value 449 comprises just 1.5% of the entire data, so it is removed for accurate forecasting.

THANK-YOU