TLC Building Study

Is the TLC Building living up to its promises?

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Background

The **Teaching and Learning Complex (TLC)** is the newest building in the UC Davis Campus. It is designed to be a low energy intensity building. Its design includes radiant ceiling panels, ceiling fans, and a dedicated outdoor air system with heat recovery. **But, is the building really living up to its energy efficiency promise?** This project is a first step to answer the question.

Canopy of solar panels that shade an outdoor seating area of TLC

Objectives

- To determine if the TLC is living up to its energy efficient design by comparing simulation energy data with actual data
- To recommend strategies for improving its energy performance and reducing operating cost

Scope of Work

Review literature that compares model and actual building performance

- Post fine tuning of simulation models is useful for optimizing and predicting energy performance (Aste et al., 2022)
- ASHRAE Guideline defines thresholds and tolerances for performance gap (Jain et al., 2020)

Identify discrepancies/patterns between the modeled data and actual data

- Compare energy use intensity (EUI), electricity, cold water and hot water demand, and Investigate effects of outside air temperature (OAT) on demand

Assess sparks and rules on SkySpark analytic tool to determine operational anomalies

- Track some Key Performance Indicators (KPIs) of the AHUand identify shortcomings such as setpoints not changing with schedule

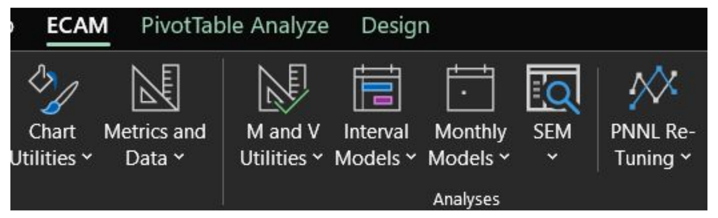
Recommend strategies for improving the building's energy performance

- Propose Energy Efficiency Measures (EEMs) for TLC building.

Methodology

Data Collection and Analysis

UC Davis Energy Conservation Office (ECO) team provided the model and actual data, including associated outside air temperature (OAT).



Energy Charting and Metrics Tool (ECAM) was adopted for analyzing load profiles

SkySpark by SkyFoundry

Skyspark analytics software for energy management and equipment fault detection was adopted for identifying operational shortcomings

Equity and Energy Justice

Everyone can give the thermal comfort feedback of the TLC building. UC Davis will adjust the temperature of the building to meet the feedback. The adjustment will be based on the majority of feedback. Therefore, it helps improve energy equity.

Comparison of Model and Reality

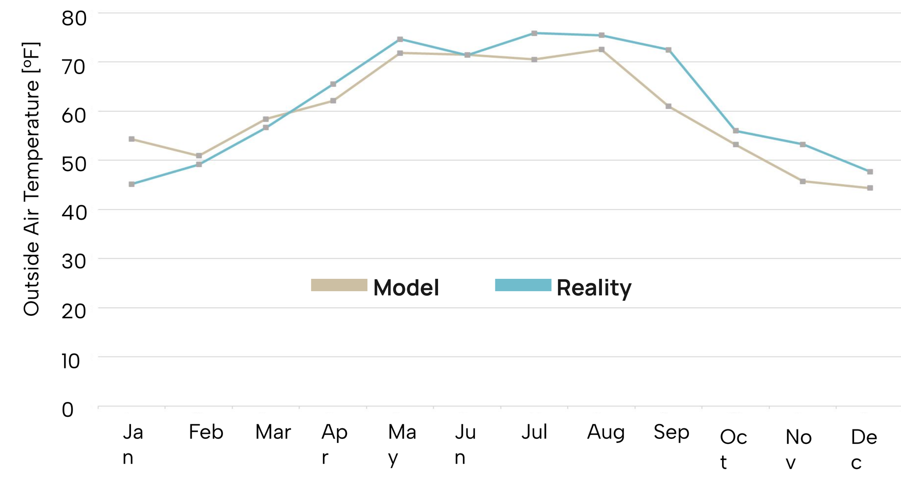
Total **EUI**

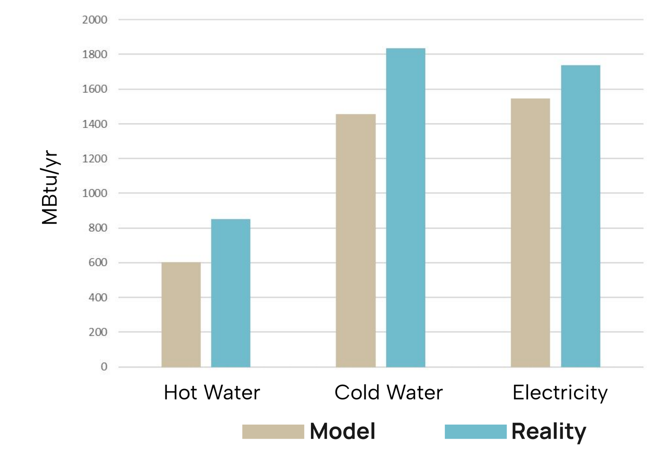
40 kBtu/sq.ft Reality

35 kBtu/sq.ft Model

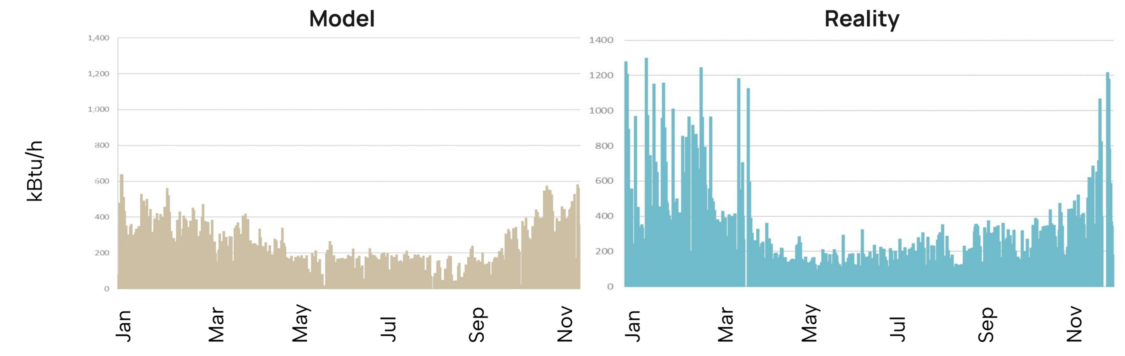
75 kBtu/sq.ft avrg. classroom building

Model Assumptions - OAT





Hot Water Consumption

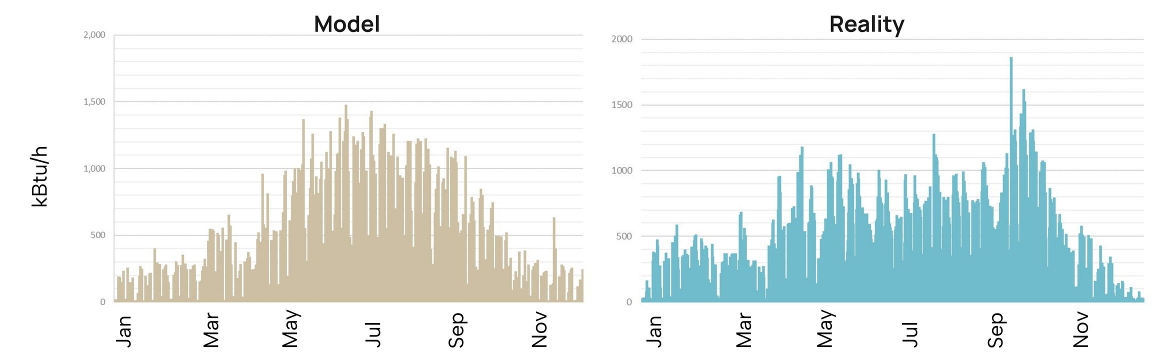


	Model	Reality
Total	603759 kBtu	850652 kBtu
Peak	650 kBtu/h	1300 kBtu/h
Baseload	0	0

Findings

- Summer and fall is similar
- **Peaks** are way **higher** in reality
- Winter 2022 colder than average

Cold Water Consumption

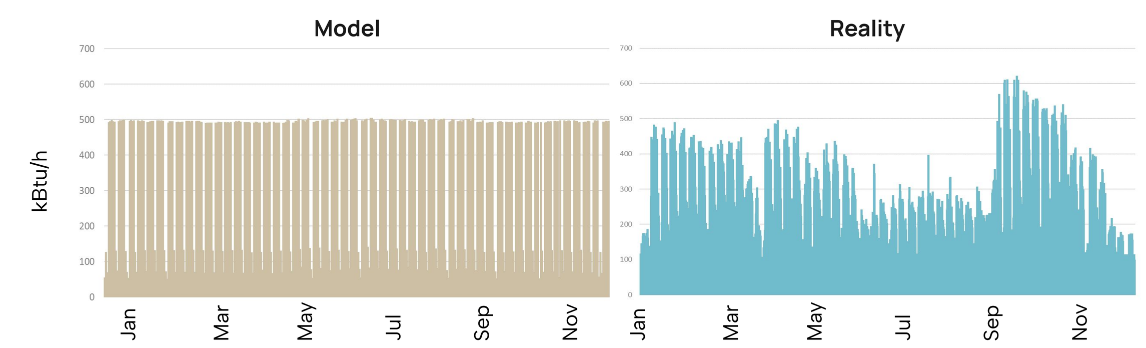


	Model	Reality
Total	1456484 kBtu	1837063 kBtu
Peak	~1500 kBut/h	~1850 kBtu/h
Baseload	5 kBtu/h	15 kBtu/h

Findings

- Reality highly depends on building **Schedule**
- Peak and total higher in reality (Sep. 2022 was hot)
- **Baseload higher** in reality but still low

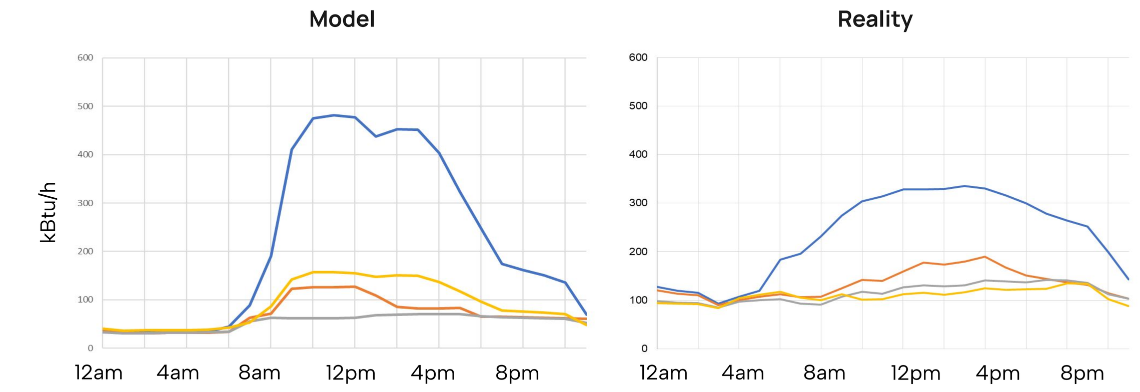
Electricity Consumption



	Model	Reality
Total	1545033 kBtu	1737464 kBtu
Peak	~500 kBtu/h	~600 kBtu/h
Baseload	~30 kBtu/h	~110 kBtu/h

Findings

- Model assumed **constant Electricity** consumption
- Reality highly depends on **Building Schedule**
- Baseload much higher in Reality!



Weekday — Saturday — Holiday — Sunday

Findings

- **Peak** higher in model
- **Schedule** different
- **Baseload** much higher in Reality!

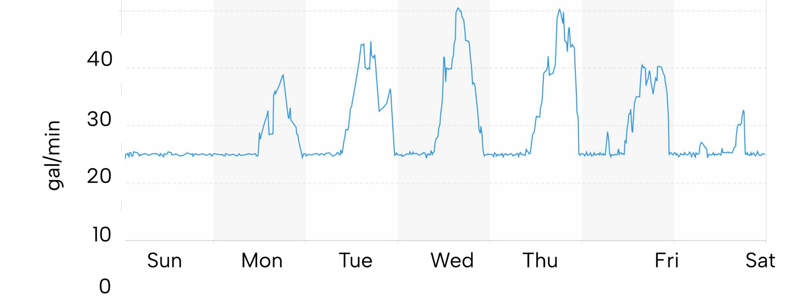
Suggestions for improvements

Problem 1: High Electricity Baseload

110 kBtu/h Reality

30 kBtu/h Model

Causes: Plug loads that are not turned off; Cold water pump is always running



Problem 2: High Cold Water Consumption

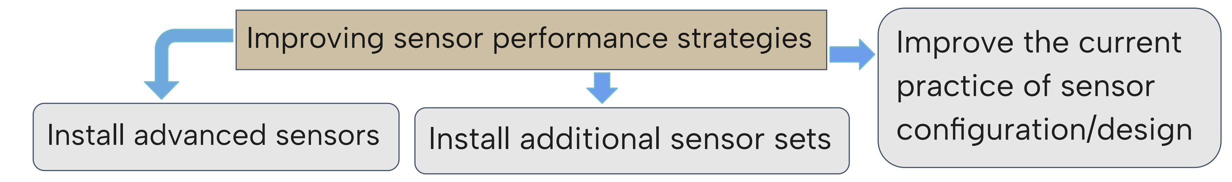
Issue: Occasionally OA is heated up in HX and needs to be cooled down again

10250 kBtu/month wasted Energy

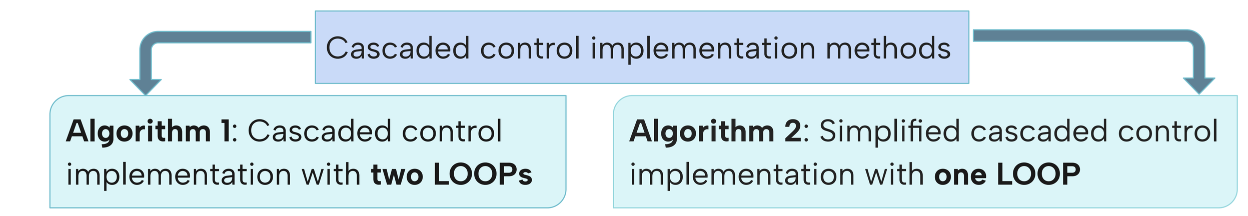
Solution: Bypass around HX

53 $/month possible savings

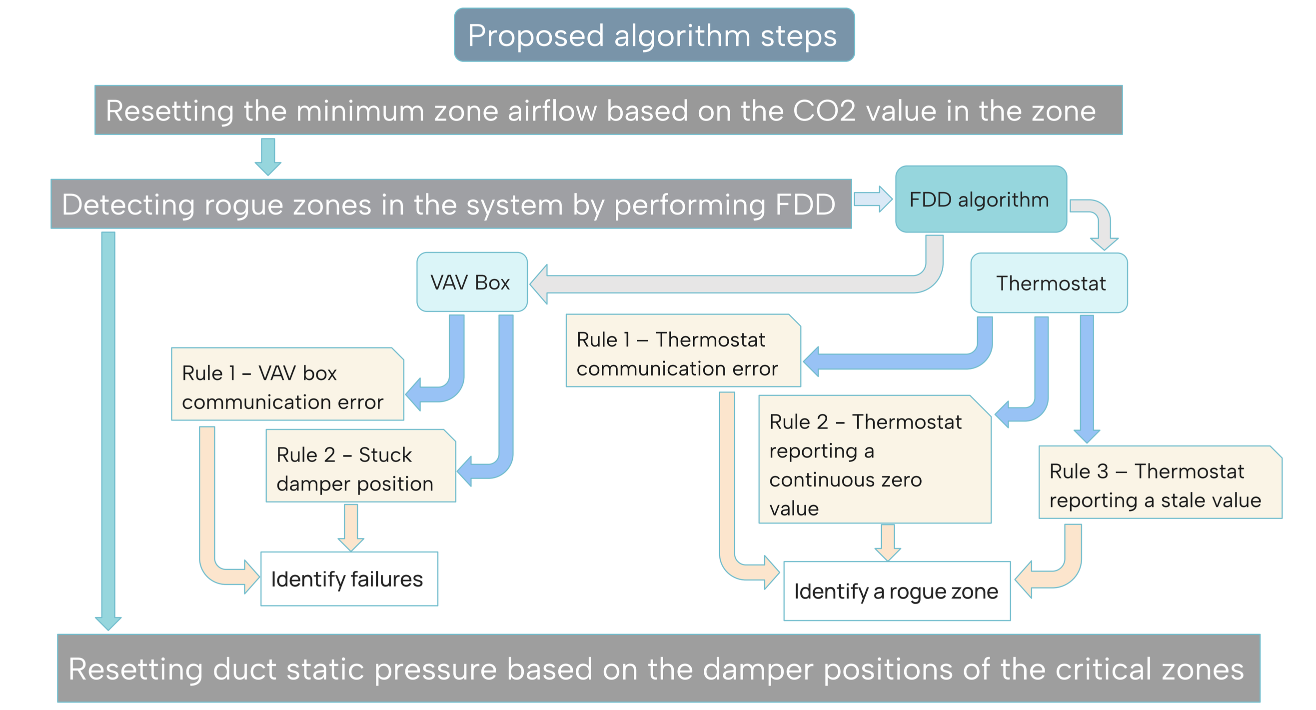
Problem 3: AHU Mixed Air Temp and Outside Air Temperature Sensors not matching at 100% Outside Air Damper



Problem 4: AHU Valve Hunting



Problem 5: AHU Supply Static Pressure Setpoint Not Met & AHU Supply End of Line Static Pressure Setpoint Not Met



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