BUILDING ENERGY EFFICIENCY

Prepared by Cecilia Pinkrah

TODAY'S PRESENTATION

OUTLINE OF TOPICS

INTRODUCTION

ACCORDING TO WORLD INSTITUTE, BUILDINGS USE 40% OF THE WORLD'S ENERGY, MAKING THEM CRUCIAL FOR ENERGY EFFICIENCY IMPROVEMENTS. ADDRESSING HEATING AND COOLING NEEDS THROUGHOUT A BUILDING'S LIFECYCLE, INCLUDING OPERATION AND DESIGN STAGES, CAN LEAD TO ENERGY SAVINGS, LOWER OPERATIONAL COSTS, AND REDUCED ENVIRONMENTAL IMPACT.

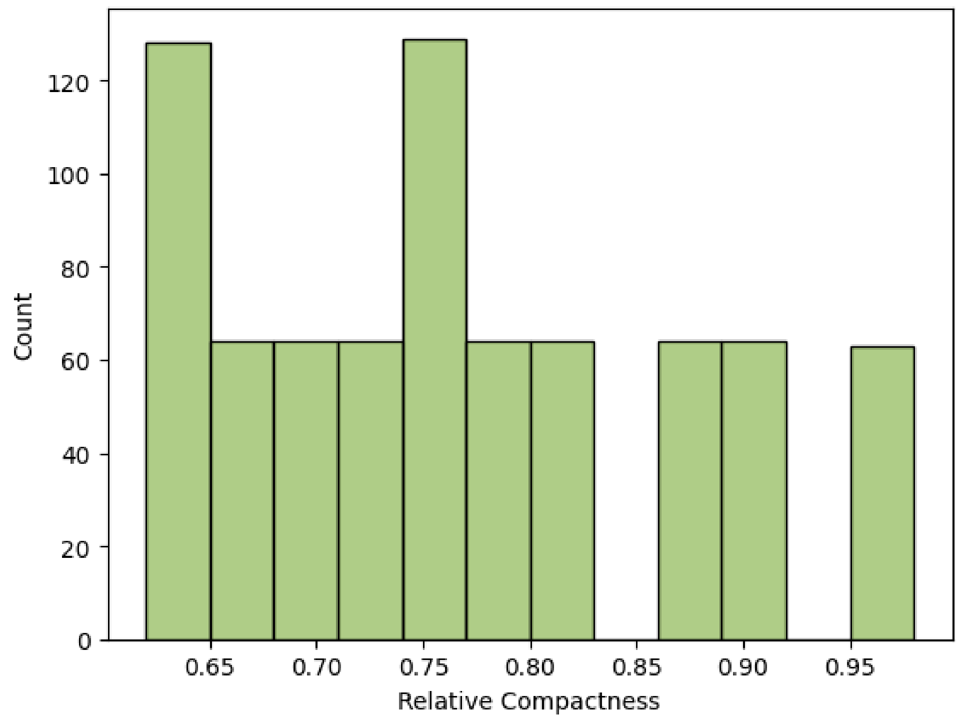
Project Objectives

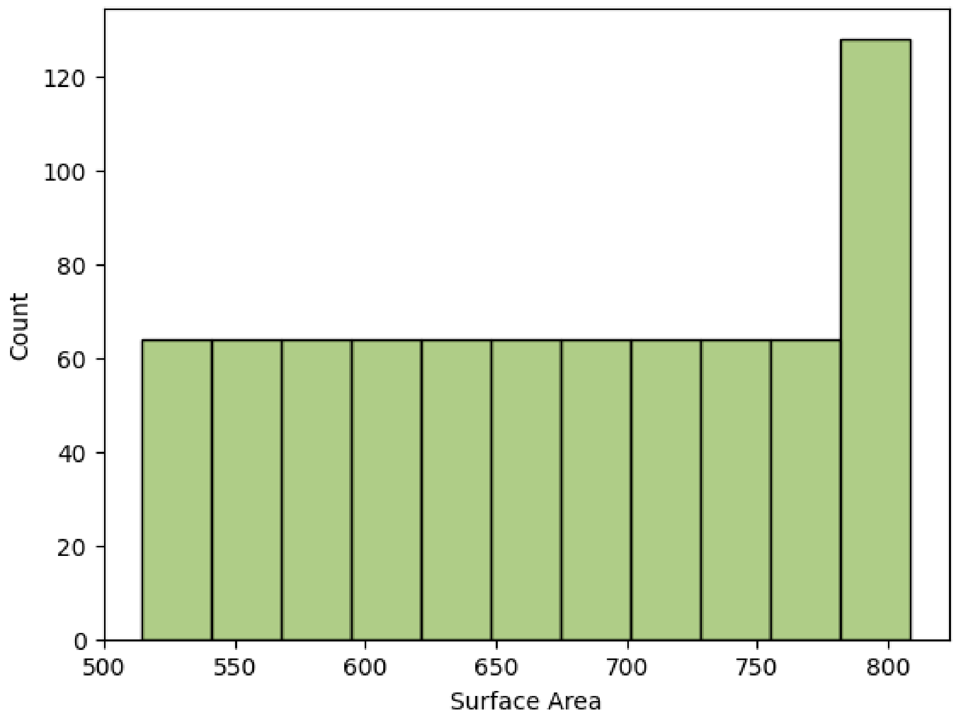
- The goal of this project is to develop a predictive model that can accurately forecast the heating and cooling load requirements for energy efficiency.

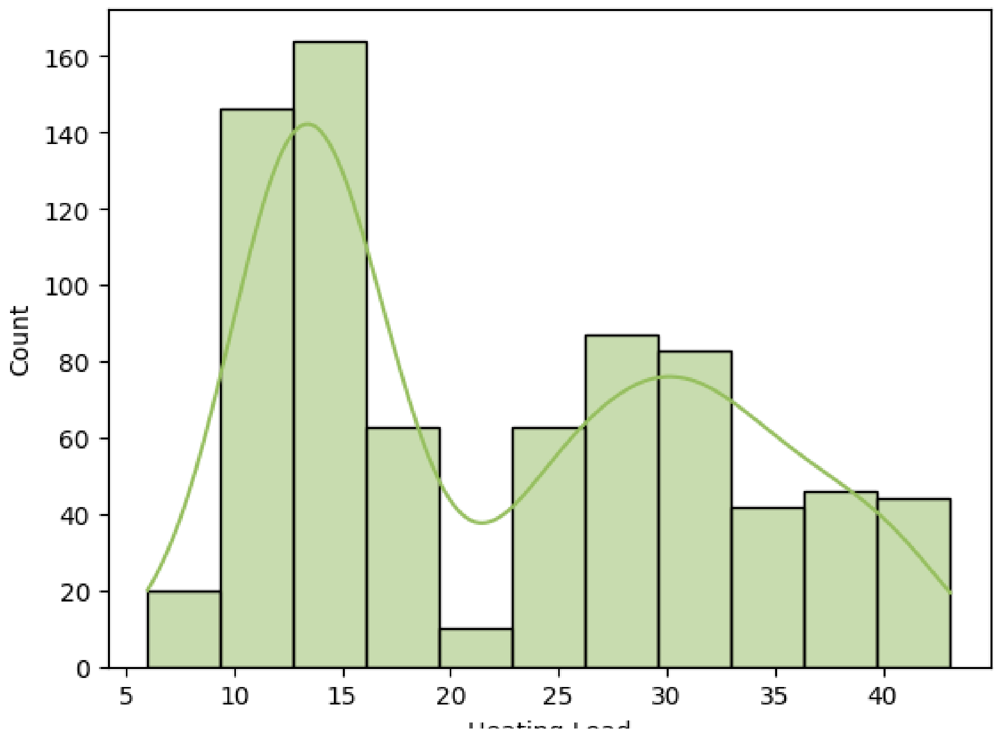
- This is important in the context of sustainable and energy-efficient building designs, as it helps optimize energy usage, reduce expenses, and minimize environmental impact.

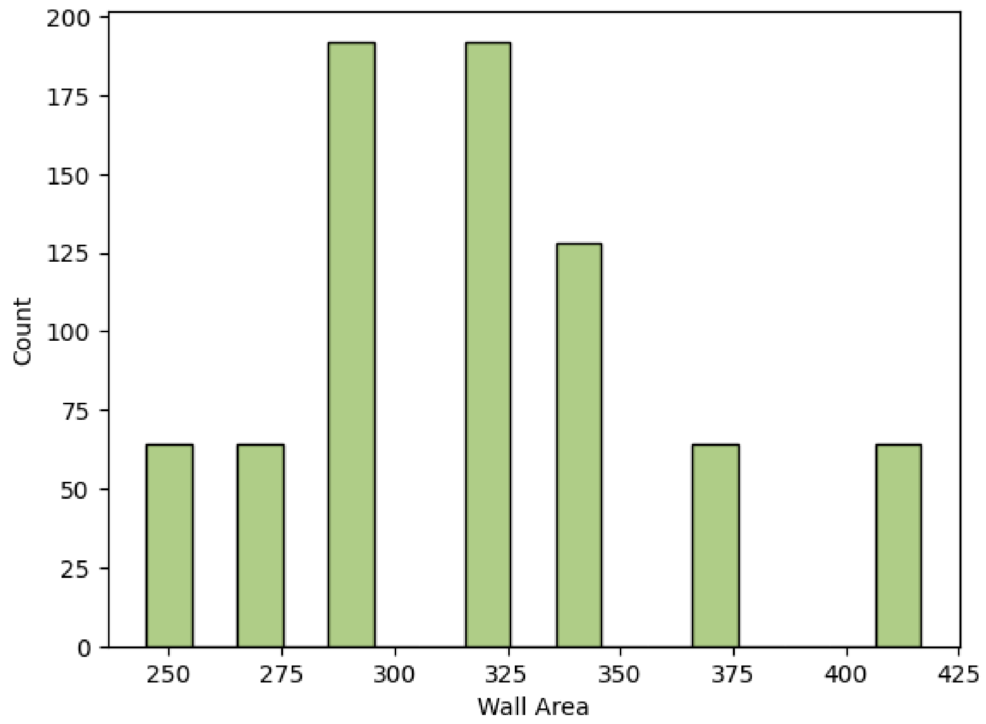
- The purpose of this study is to use several models and building energy performance data to anticipate how much heating and cooling will be required for building efficiency.

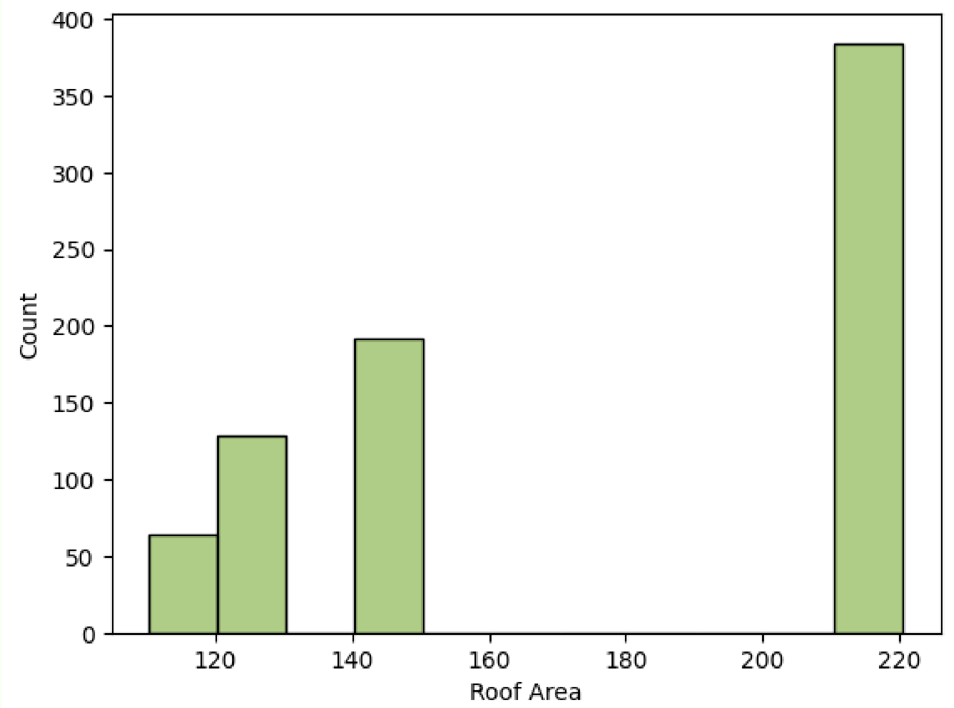
Data Overview

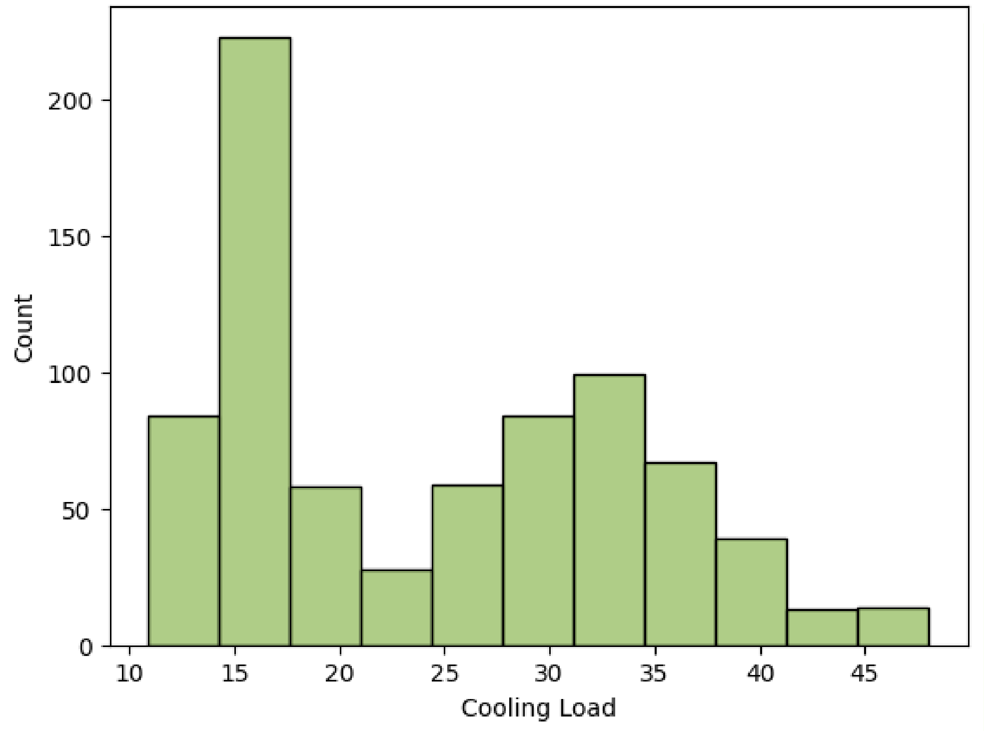


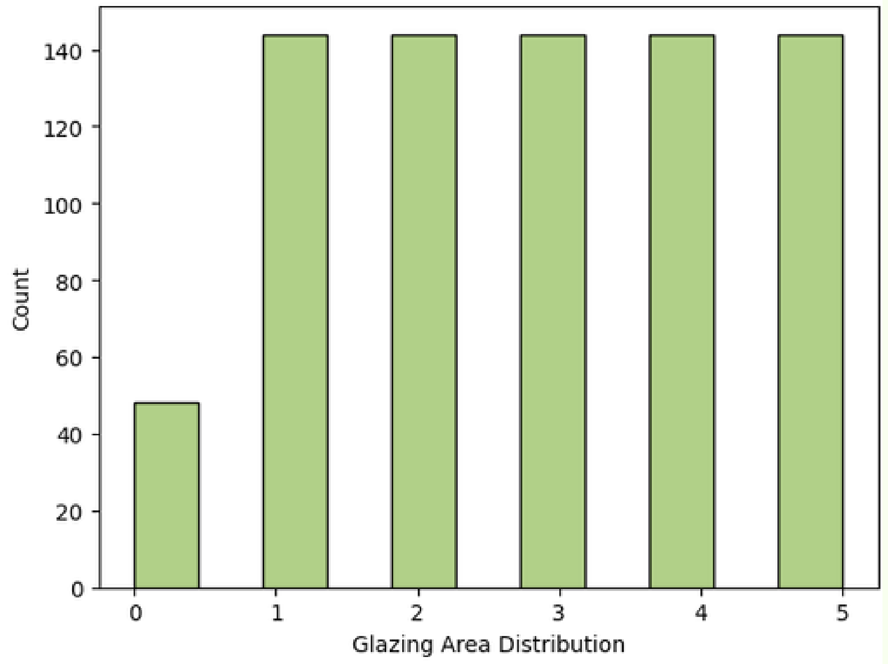




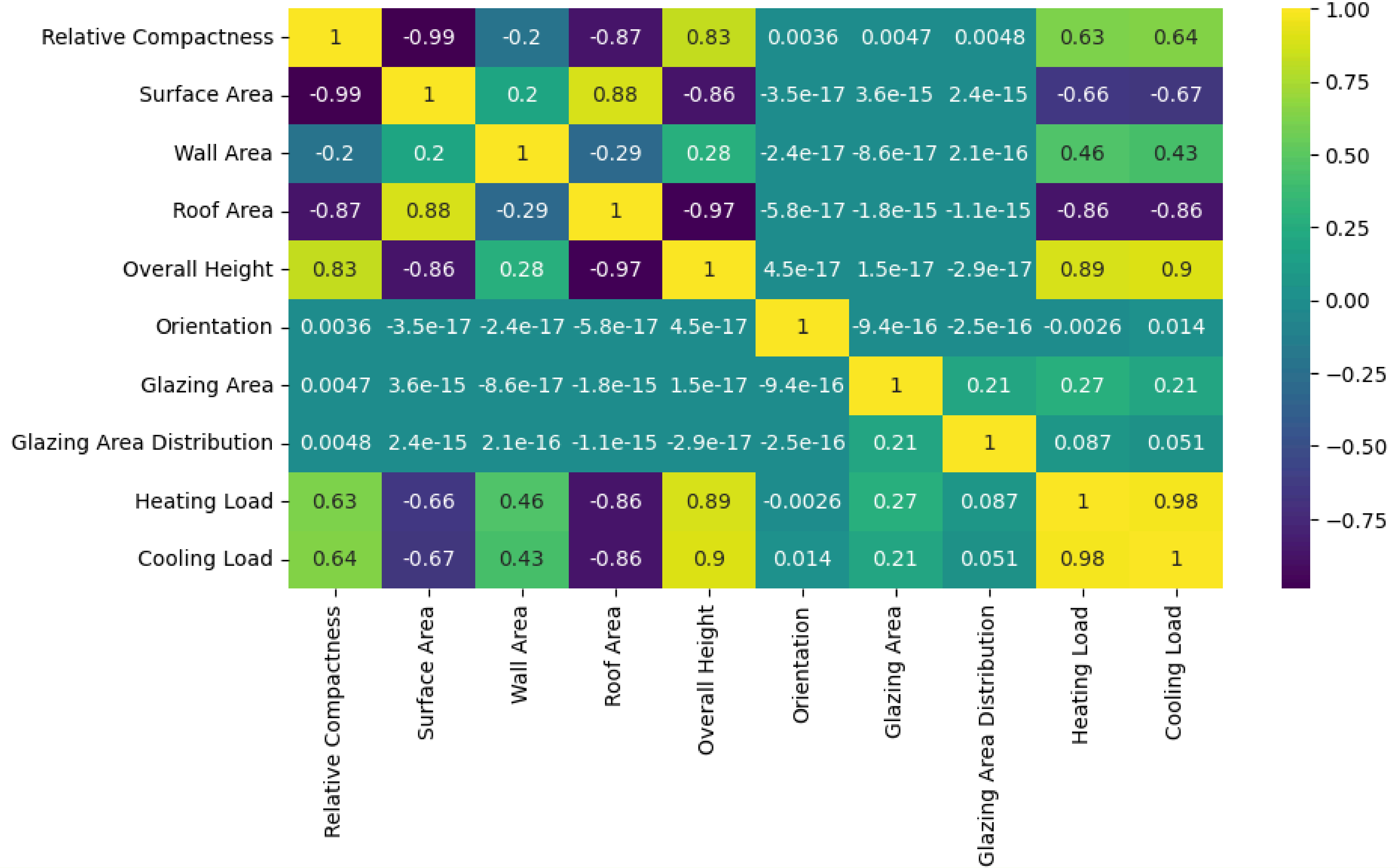








HEAT MAP


Relative Compactness
Surface Area
Wall Area
Roof Area
Overall Height
Orientation
Glazing Area
Glazing Area Distribution
Heating Load
Cooling Load
1 -0.99 -0.2 -0.87 0.83 0.0036 0.0047 0.0048 0.63 0.64
-0.99 1 0.2 0.88 -0.86 -3.5e-17 3.6e-15 2.4e-15 -0.66 -0.67
-0.2 0.2 1 -0.29 0.28 -2.4e-17 -8.6e-17 2.1e-16 0.46 0.43
-0.87 0.88 -0.29 1 -0.97 -5.8e-17 -1.8e-15 -1.1e-15 -0.86 -0.86
0.83 -0.86 0.28 -0.97 1 4.5e-17 1.5e-17 -2.9e-17 0.89 0.9
0.0036 -3.5e-17 -2.4e-17 -5.8e-17 4.5e-17 1 -9.4e-16 -2.5e-16 -0.0026 0.014
0.0047 3.6e-15 -8.6e-17 -1.8e-15 1.5e-17 -9.4e-16 1 0.21 0.27 0.21
0.0048 2.4e-15 2.1e-16 -1.1e-15 -2.9e-17 -2.5e-16 0.21 1 0.087 0.051
0.63 -0.66 0.46 -0.86 0.89 -0.0026 0.27 0.087 1 0.98
0.64 -0.67 0.43 -0.86 0.9 0.014 0.21 0.051 0.98 1
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75

DATA PRE-PROCESSING

SPLITING THE DATA INTO FEATURE AND TARGET VARIABLES

In this process, the data is split into two parts. i.e. feature variable(X) and target variable(y). This data set has multiple target variables, y1(Heating Load) and y2(Cooling Load).

USING THE TRAIN_TEST SPLIT ALGORITHM

Over here, we import train_test split algorithm from sklearn.model_selection. This algorithm splits X and y into X_train, X_test, y_train and y_test . In this case, X_train, X_test, y1_train, y1_test, y2_train and y2_test . This 6 set of data will be used in the model building

MODEL BUILDING

Heating Load

	Model	Before Hyperparameter Tuning	After Hyperparameter Tuning
0	Support Vector Regressor	0.68	0.98
1	Lasso	0.77	0.88
2	Ridge	0.88	0.89
3	KneighborsRegressor	0.95	0.95
4	XGBoost	0.90	0.99
5	GradientBoost	0.96	0.95
6	RandomForestRegressor	0.97	0.96

Cooling Load

	Model	Before Hyperparameter Tuning	After Hyperparameter Tuning
0	Support Vector Regressor	0.69	0.99
1	Lasso	0.79	0.90
2	Ridge	0.91	0.91
3	KneighborsRegressor	0.95	0.95
4	XGBoost	0.98	1.00
5	GradientBoost	0.98	0.98
6	RandomForestRegressor	0.93	0.93

MODEL COMPARISION

	Model	MSE	RMSE
0	Support Vector Regressor	4.079423	2.019758
1	Lasso	4.079423	2.019758
2	Ridge	4.079423	2.019758
3	KneighborsRegressor	4.079423	2.019758
4	XGBoost	4.079423	2.019758
5	GradientBoost	4.079423	2.019758
6	RandomForestRegressor	4.079423	2.019758

	Model	Heating Test Score	Cooling Test Score
4	XGBoost	0.998571	0.987760
0	Support Vector Regressor	0.991937	0.981505
6	RandomForestRegressor	0.990220	0.963131
5	GradientBoost	0.980330	0.956289
3	KneighborsRegressor	0.949426	0.954008
2	Ridge	0.911552	0.890349
1	Lasso	0.903265	0.877447

MODEL SELECTION

eXtreme Gradient Boosting Regressor(XGBoostRegressor) is the best-performing model, followed by the Support Vector Regressor model, when taking into account the R2 scores of the various models.

CONCLUSION

- **Recommendation**: This model can be integrated into the Heating. Ventilation and Air Conditioning system (HVAC)

- **Conclusion** : The XGBoostRegressor, with an R2 score of 0.9877 and 0.9985 for Cooling Load and Heating Load respectively, was found to be the best-performing regression model after a variety of models, including Support Vector Regressor, Random Forest Regressor.

Thank you