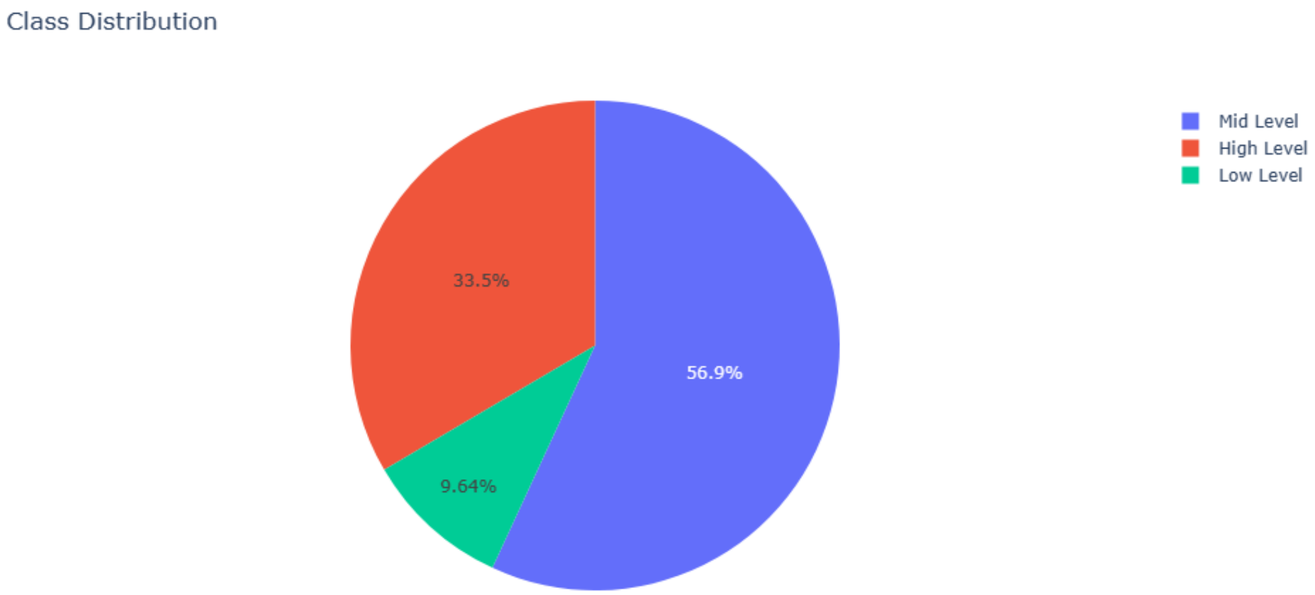
Construction AI-ML Case Study

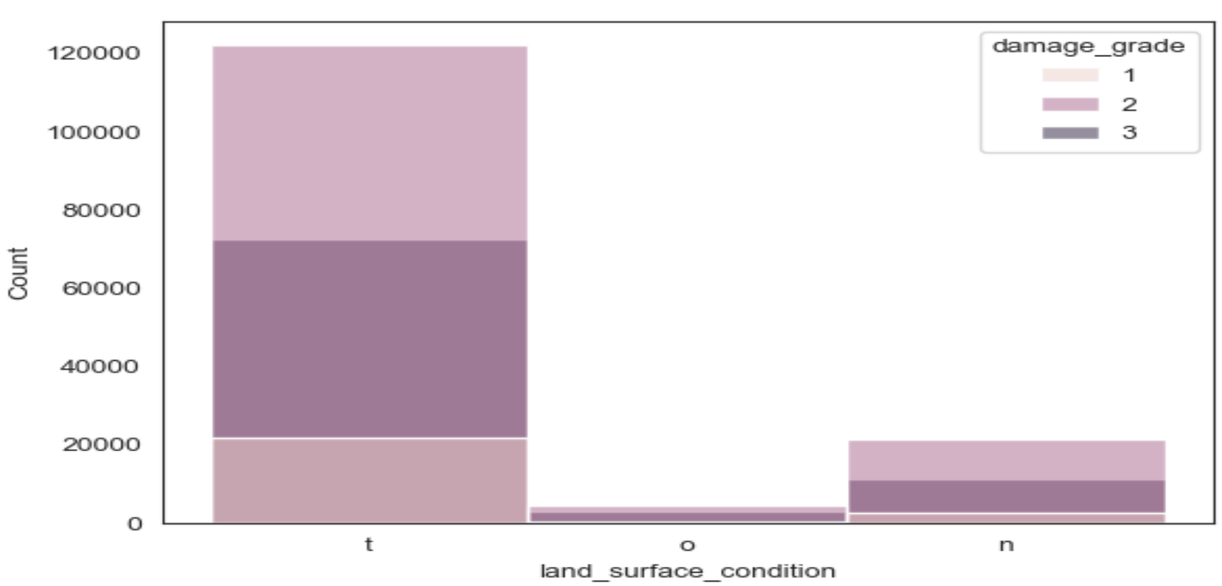
The construction industry plays a vital role in ensuring the safety and functionality of buildings, infrastructure, and other structures. One of the most critical aspects of the construction industry is assessing the damage grade of a building after natural disasters, such as earthquakes or hurricanes. Accurately classifying the damage grade of a building is crucial for determining the appropriate response and necessary repairs. Traditionally, experts use visual inspection and other methods to assess the damage grade of a building, but this process can be time-consuming, costly, and subjective.

Auto-ML techniques have shown promise in automating this process, which can save time and resources while improving accuracy and consistency. The objective is to develop a model that can classify the damage grade of a building based on various features such as building materials, structural design, location, and other relevant factors.

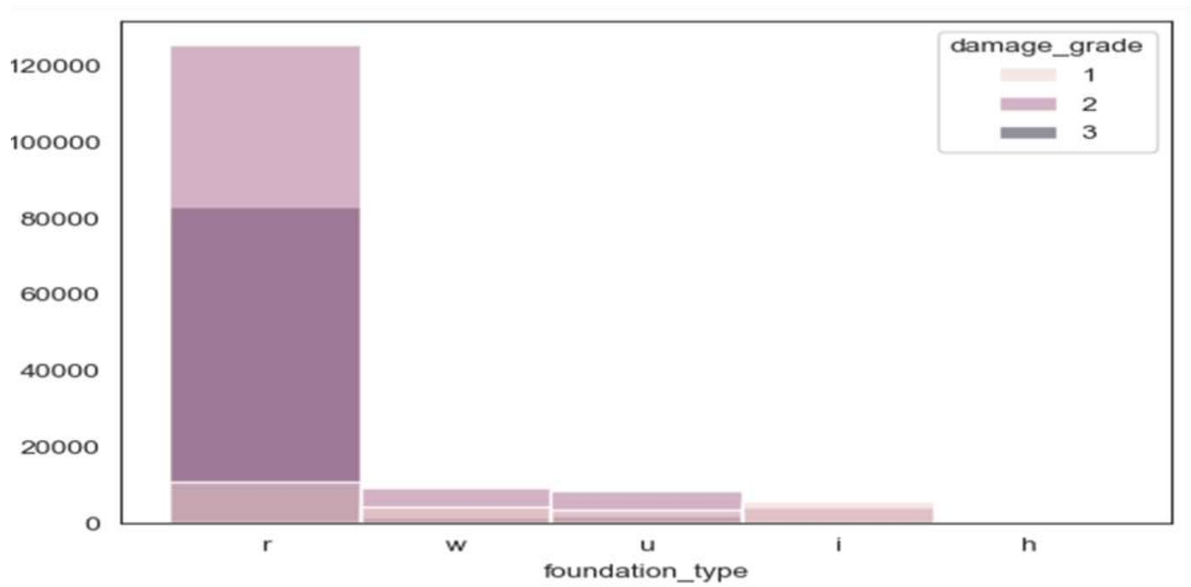


Damage Grade	Count
High Level	87218
Mid Level	148259
Low Level	25124

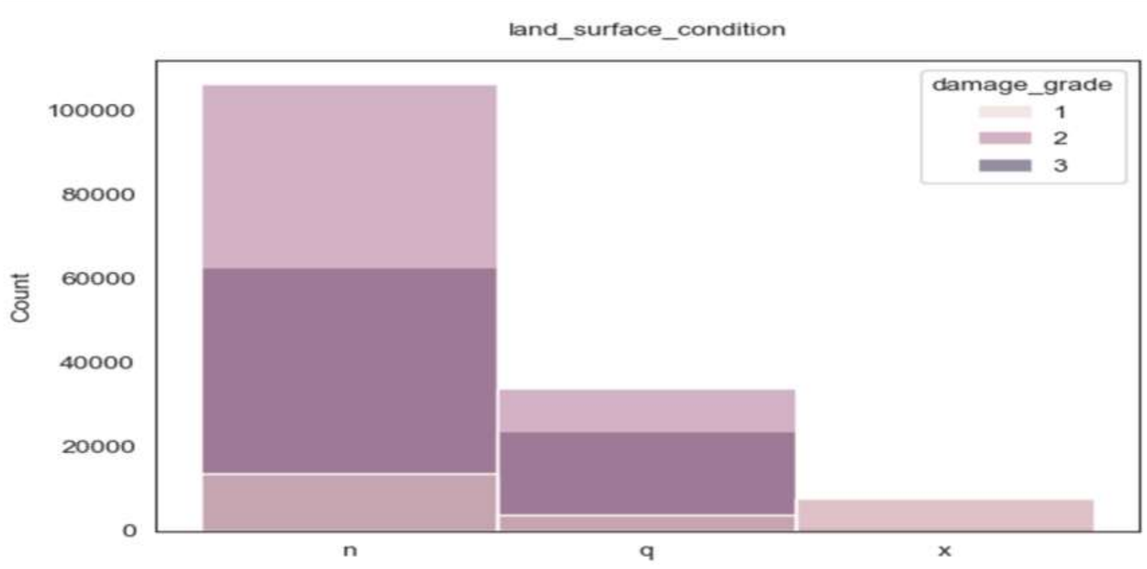
Features Responsible



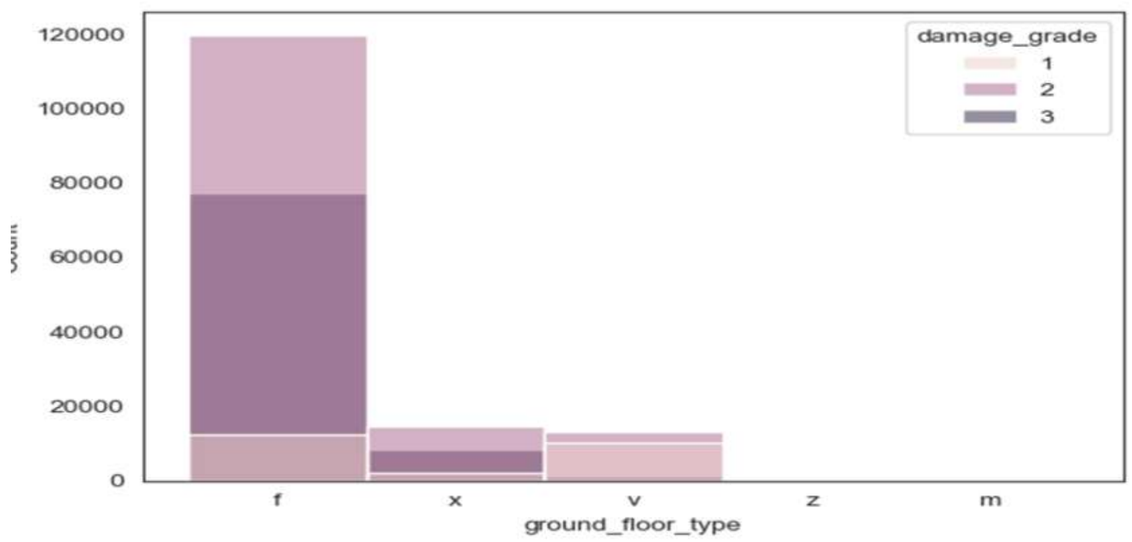
- t- type **land surface condition** has faced maximum number of damages where as o type land surface condition has faced minimum number of damages. So, to prevent damages company should build buildings on t type land surface condition.



- r-**type foundation** used in buildings has faced maximum number of damages where as h type foundation used in buildings has zero damages. So, to prevent damages company should use h type foundation.



- n-type **roof type** in buildings has faced maximum number of damages where as x-type roof type used in buildings has minimum damages. So, to prevent damages company should use x-type roof type on buildings



- f-type **ground-floor-type** used in buildings has faced maximum number of damages where as z, m type ground-floor-type used in buildings has zero damages. So, to prevent damages company should use z, m ground floor type.

Auto-ML Methodology Results

Case	Percentile	No. of Features	Random Forest	XGBoost	RNN	MLP	Decision Tree	Avg. Accuracy
Case 1	25	17	78.65	81.41	100	78.53	72.40	**82.19**
Case 2	50	34	83.46	86.57	100	78.53	71.92	**84.09**
Case 3	75	51	84.55	86.36	100	50.00	68.85	**77.95**
Case 4	90	62	84.41	86.39	100	50.03	68.68	**77.90**

- Based on our observation , RNN was the best performing algorithm with 100% accuracy across all percentile
- 50^{th} percentile is the best percentile with an average accuracy of 84.09%.

Conclusion

In conclusion, the classification of the damage grade of a building for the construction industry is a critical task that can benefit from Auto-ML techniques. By using a dataset of buildings with known damage grades, a model can be trained to classify the damage grade of a new building based on its features and attributes. This can help construction companies to assess the safety and structural integrity of buildings, as well as plan for maintenance and repair work. The dataset has 2,60,601 records with 9 Categorical Features and 31 Numerical Features.
56.9% of the dataset shows that damage grade of the building is Mid-level.

For classification, models were created with algorithms using Auto-ML techniques like Decision tree, Recurrent Neural Network, Multilayer Perceptron, Random forest and XGBoost . With these models, performance measurement values were obtained for feature sets of 17, 34, 51 and 62. The Auto-ML algorithms were able to predict whether a damage grade is High or Mid or Low with an average accuracy between 77% – 83% and helped to identify factors that determine damage grade of the building. The major factors include Land surface condition, Foundation type, Roof type and Ground floor type. When the results are examined, it is observed that with the addition of each new feature, the success of classification decreased. Based on the performance measurement values obtained, it is possible to say that the study achieved success in classifying whether the damage grade of a building is high or low or mid. By leveraging Auto-ML to classify building damage grade, the construction industry can improve safety and efficiency while reducing costs and resources.