**Fibercrete Impact Resistance Prediction**

This project uses machine learning to predict the **impact resistance** of fiber-reinforced concrete containing **crumb rubber particles**. The predictions focus on impact energy at the **first crack (FCU)** and **ultimate failure (URU)** based on laboratory testing data.

**Dataset Description**

The dataset includes:

* Experimental results from concrete mixes with and without polypropylene fibers and crumb rubber.
* Tests conducted at two curing temperatures: -10°C and 25°C.
* Each sample measured:
* FC: Blows to first crack
* UR: Blows to ultimate failure
* PINPB: Percent increase in number of post-crack blows
* FCU: Energy absorbed until first crack (kN.mm)
* URU: Energy absorbed until failure (kN.mm)

**Sample Features**

| **Feature** | **Description** |
| --- | --- |
| FC | Number of blows to first crack |
| UR | Number of blows to ultimate failure |
| PINPB (%) | % increase in blows after first crack |
| CuringTemp | Curing temperature in Celsius |
| **FCU** | Impact energy to first crack (target) |
| **URU** | Impact energy to failure (target) |

**Machine Learning Model**

A **MultiOutputRegressor with XGBoost** was trained to predict:

* FCU (First Crack Energy)
* URU (Ultimate Failure Energy)

**Evaluation Metrics:**

* R² Score
* MAE (Mean Absolute Error)
* RMSE (Root Mean Squared Error)

**Feature Importance was also computed for each target variable.**

**Project Files**

fibercrete-impact-prediction/

├── impact\_resistance.csv # Cleaned dataset

├── modeling.ipynb # Jupyter Notebook (Colab-compatible)

├── impact\_model.pkl # Trained ML model

└── README.md # Project description

**Notes**

* This project is based on a Master's thesis in Civil Engineering – Construction Management.
* All experimental data were obtained through real lab testing.
* The goal is to help better design rubberized concrete with improved impact performance.

**License**

This project is open for academic and research use.