Early and Independent Compressive Strength Determination of Industrially Produced Concrete At Points of Delivery Using AI

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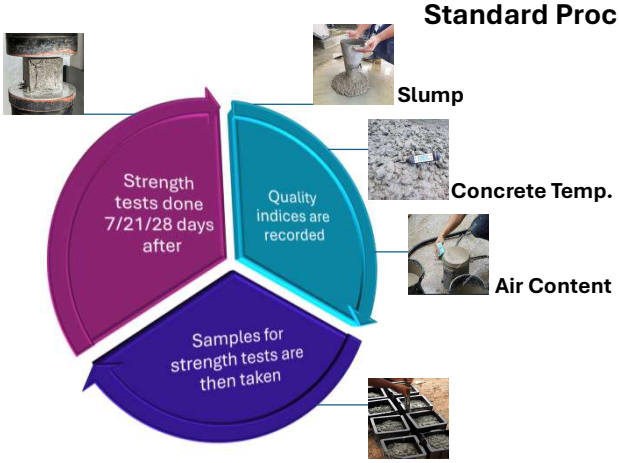
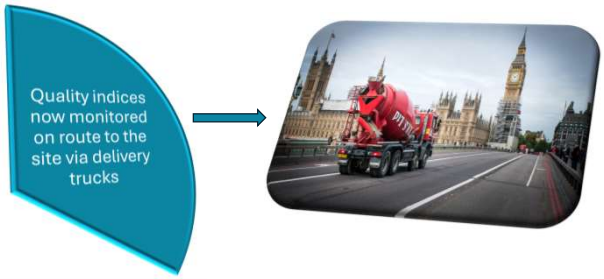
1ST Concrete Quality Assessment Process on Delivery to Site

Standard Process



Digital Testing of Fresh Concrete

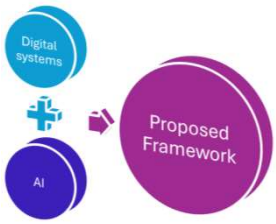
In November 2023, HS2 approved the use of VERIFI to reduce embodied carbon from concrete testing. VERIFI's sensors in delivery trucks monitor and print concrete properties like slump and temperature, eliminating manual measurements and saving carbon. Strength samples are still lab-tested, with results available after 28 days.



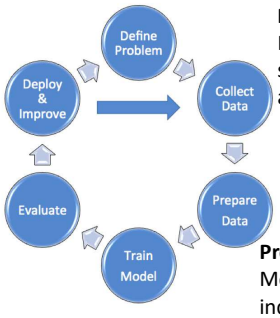
2ND Proposition & Methodology

Proposition: AI + Digital Testing

We propose enhancing the current technology by using concrete mix design data to predict the 28th-day concrete compressive strength at delivery with machine learning models. This approach eliminates the 3-week wait for strength results and reduces legal issues from non-conforming concrete.



Methodology: Machine Learning



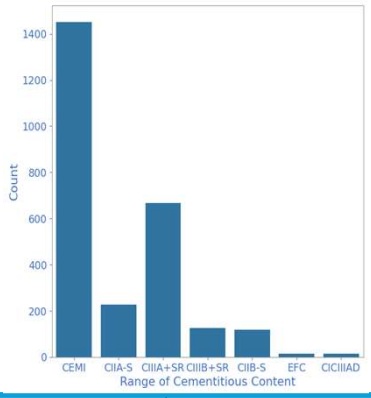
Problem Definition 1:
Model that predicts compressive strength given mix proportions and specification data.

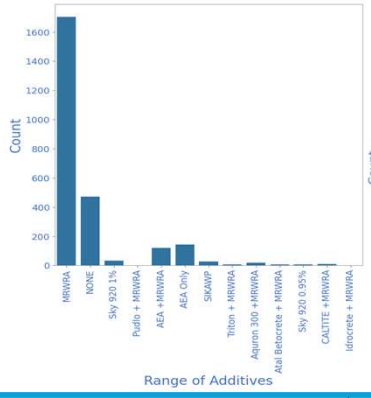
Problem Definition 2:
Model that predicts compressive strength independent of mix proportions for use at points of delivery.

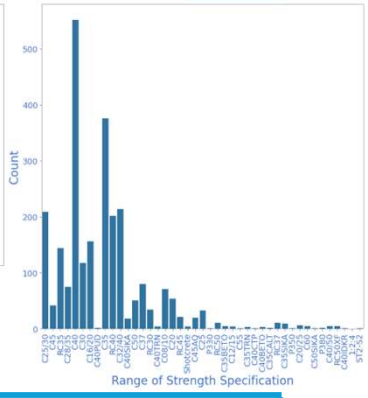
3RD The Research Data

The research data is data spanning a year of supply activities of a UK ready-mix concrete supplier.

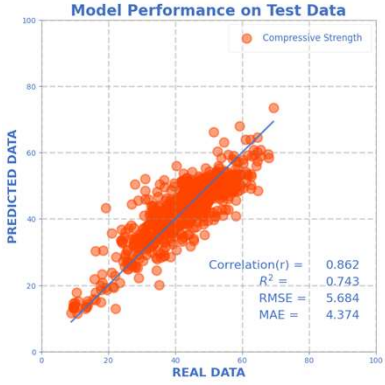
Most studies on concrete strength predictions use laboratory data reported in literature, not a lot of work is done on industrially produced concrete.







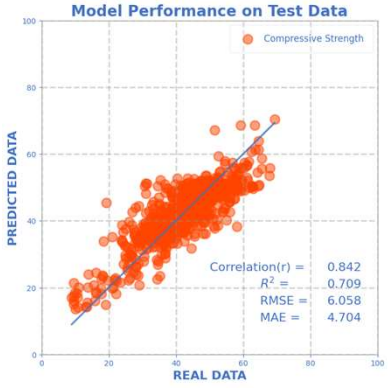
Standard Model Result



Model Inputs:
1. Cement Type
2. Admixture Type
3. Strength Class
4. CEM1 proportion
5. GGBS replacement
6. Total Cementitious material
7. Coarse aggregate proportion
8. Fine aggregate proportion
9. Water content
10. Water/cement ratio
11. Curing age
12. Slump at delivery
13. Ambient temp. at delivery

Independent Model Result

Model Inputs:
1. Cement Type
2. Admixture Type
3. Strength Class
4. Curing age
5. Slump at delivery
6. Ambient temp. at delivery



4TH Results & Research Impact

Future Work:
1. Improve the accuracy of the standard model by including admixture proportions.
2. Improve accuracy of independent model considering methods like transfer learning.

Research Impact:
1.Early strength determination.
2.Independent quality control for various concrete mixes.
3.Useful when mix proportion data is unavailable or incomplete.