Abstract

When designing a structure it is important to make sure that all external load, including fire, are accounted for. The probability of a fire happens in a building is highly uncertain, yet the effect is not negligible. In order to increase this structural fire safety awareness, structural and fire engineers need to be exposed to this serious problem, and an accurate and interactive tool is required.

Since the effect of fire to structure is very non-linear, finite element method is used in structural fire software and often it takes too much time to run. So, machine learning methods are developed in this research to "bypass" the long computational time by the software by predicting the wanted outputs by several inputs. By using machine learning method, it is expected that the structural behaviour under thermal load can be accurately predicted within a short period of time.

The machine learning methods used are polynomial regression and gradient boosting on decision trees, the results of which are compared and explained in this research. With the help of Latin Hypercube Sampling (LHS), the amount of simulations needed for this research can be minimized, and hence improving efficiency in the process.

During the analysis, uncommon behaviour of concrete structure is observed where a concrete beam may deflect upwards when heated from underneath. An unexpected turn is made in this research to further investigate and validate this behaviour using M-χ diagram and virtual work method to calculate the beam deflection.