UQ Fire Project #2019.10

STUDY ON THE THERMAL PROPERTIES OF CONCRETE DURING FIRE

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Concrete, fire testing, Transient Plane Source (TPS)

Background and motivation

The design of fire safe concrete structure requires an understanding of the thermal response of the material during fire. For the above, the thermal properties (thermal conductivity, specific heat, density) become key for a sound heat transfer analysis.

Although widely used, concrete is not an 'easy' material when it comes to thermal characterisation in fire conditions; i.e. temperatures above 500°C. Concrete is a porous, heterogenous material that suffers various physical and chemical changes when heated. Today, modern concretes include various additives (e.g. fly ash, silica fume, etc) and synthetic fibres (e.g. polypropylene fibres), and mixes are design to achieve compressive strengths way above 100 MPa.

Presently, there are numerous sources (e.g. standards, design guidelines, research articles) containing a definition for the thermal properties of concrete. This has generated relative high divergence between many of these thermal properties used by practitioners.

Research objectives

This research will investigate the thermal properties of concrete during fire with the aim of generating a parametric library of properties based on the multiple variables usually used for concrete mixes; e.g. type aggregate, inclusion of additives, moisture content, inclusion of fibres, etc.

The **Transient Plate Source (TPS)** available in the Fire Laboratory at The University of Queensland will be used within the scope of this study.

Methodology

This project will be conducted in the following stages:

1. Produce a thorough literature review detailing available sources with thermal properties of concrete during fire
2. Define the concrete variables to be assessed within the scope of this study (type aggregate, inclusion of additives, moisture content, inclusion of fibres, age, moisture content, etc.)
3. Cast small-scale concrete samples to be tested using the TPS and Mass Loss Calorimeter
4. Produce a model and validate using a simple 1D heat transfer model

Recommended literature

[1] Log T and Gustafsson SE. (1995). Transient plane source (TPS) technique for measuring thermal transport properties of building materials. *Fire and Materials*. **[link]**

[2] Jansson R. (2004). Measurement of Concrete Thermal Properties at High Temperature. Proceedings from the *fib Task Group 4.3 workshop "Fire Design of Concrete Structures: What now? What next?"* [**link**]