Scientific Report

STSM Topic: "Fire testing, setup and safety."

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Host: Luke Bisby, Deputy Head of Institute for Infrastructure and Environment, School of Engineering, University of Edinburgh, Edinburgh, UK

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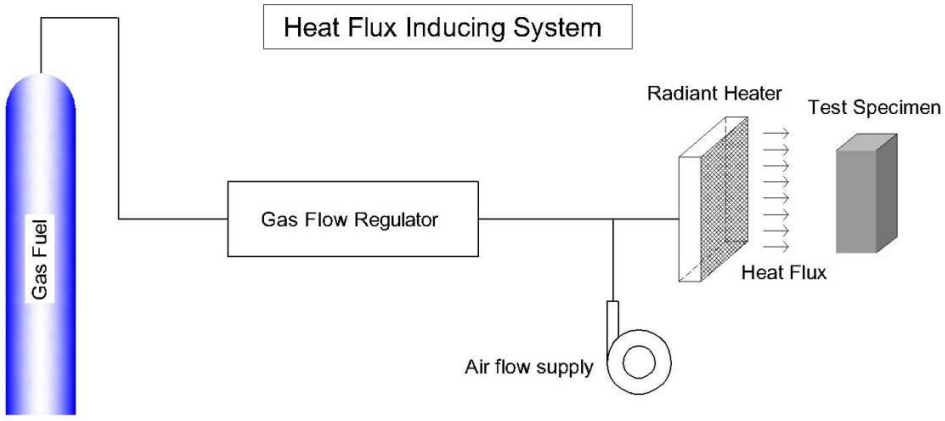
Short Term Scientific Mission Report

The main aim of the STSM was the participation and observation of fire experiments in the host's laboratory in order to acquire knowledge regarding the fire test's proper setup and safety. In the host's lab, a new method for non-standard fire testing is used which does not require the use of a furnace and implements smaller scale equipment, thus having a fraction of the construction and operational cost.

Since the beginning of the 20th century, fire tests in furnaces have been the prime method for fire resistance ratings and fire research in general. Larger or smaller furnaces and furnace facilities have been used for the testing of structural elements and materials in fire conditions. This type of testing, despite being almost the only method used by researchers, has two major disadvantages. Due to the fact that different materials with different thermal properties absorb a different heat flux, which flux highly depends on the gas temperature, and gas phase temperature time histories vary between different furnaces, comparison between materials with considerably different thermal properties is difficult. The second is that furnaces are quite expensive to install and to operate, especially the ones that can support large scale fire tests.

The fire lab at the Institute for Infrastructure and Environment at the University of Edinburgh has proposed and operates the *Heat-Transfer Rate Inducing System (H-TRIS)*, which is an array of propane-fired high performance radiant heaters, along with a mechanical linear

motion system, that defines the distance between the equipment and the specimen being tested. The system operates on the concept of Heat flux absorption by the material, which can be measured directly and in real time by heat flux sensors placed on the surface of the specimen. The distance between the thermal heaters and the test specimen defines different heat flux rates. This rate can be adjusted to create the desired heat flux rate that is absorbed by the material and represents the desired fire scenario. Also, by using data from the heat flux absorption of specimens in standard furnace tests, even “standard furnace conditions” can be reproduced. With the use of a high precision loop feedback system, this process can be done in real time, while the testing takes place. This method has a negligible cost compared to a furnace test, thus it can be repeated more times leading also to better statistical results. Furthermore, the test sample is not encased in an enclosure and the observation of the experiment is unobstructed. A schematic of the major components of a system using radiant heaters is presented in the following figure.



The safety measures required for the operation of the above-mentioned system are minimal. A gas shut-down safety control valve is inserted between the fuel supply and the rest of the circuit. A ventilation duct is required for the extraction of any smoke or toxic gas that might be created during the test. It is advised that heat detectors are installed in the facility as a means of active fire protection, in addition to the presence of fire extinguishers and other conventional fire extinguish systems. In general the heat that is released is localized and controlled, and there is not any significant heat exposure in the surrounding environment.

During the short term visit, the arrangement of the equipment of the proposed testing method was observed and studied. A key part of the process was the study of the correct application of the method, and also the handling and the solution of the potential problems that can arise during the test, so that they are avoided if a similar application of the testing method is applied in the beneficiary’s laboratory.