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THE FIRE TESTS RELATING TO BUILDINGS AND BUILDING MATERIALS WHICH ARE AT PRESENT IN USE IN THE UNITED KINGDOM

by

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INTRODUCTION

The aim in designing any test is to be able to examine a particular property of a material under conditions representative of those in practice. It is also desirable that the tests should be simple to carry out. Sometimes our understanding of the problem is such that the testing can be reduced to simple laboratory procedure, as for example, in the test for combustibility of materials. On the other hand, tests on structures are costly, involving large-scale elements to obtain information on their performance under fire conditions, as at present it is not possible to interpret the fire behaviour of structures in terms of the physical properties of the materials used in their construction. It is hoped that present work on the examination of the properties of materials at high temperatures will ultimately enable structures to be designed for fire conditions, thus reducing the need for such costly tests, but there is no immediate prospect of this being achieved.

FIRE TESTS IN USE AT PRESENT OR IN THE COURSE OF DEVELOPMENT

All the fire tests at present in use in the United Kingdom are described in detail in British Standard 476 : 1953, "Fire Tests on Building Materials and Structures". They may be divided into classes, tests on structures and tests on materials:-

STRUCTURES

The performance of a structure is expressed in terms of its fire-resistance, that is the time for which it will continue to perform its normal function under fire conditions; thus a structure may be said to have a fire-resistance of $\frac{1}{2}$, 1, 2, 4 or 6 hours.

The parts of a building are grouped as follows for fire test purposes:-

Vertical separating elements such as walls, partitions, doors and windows; horizontal separating elements such as floors; and those elements whose only function is to support loads, such as columns and beams. The separating elements are required to act as barriers to the spread of fire and are exposed in the test to heat on one face only. Columns and beams are subjected to heat on those faces which would be exposed to fire.

The restraint and loads imposed on an element of structure in the test are intended to reproduce the stresses encountered in service. Heating is carried out under controlled conditions representing an average fire and continuous observations are made of the element of structure during the test. Its fire-resistance is the time elapsing from the start of the test to the occurrence of either collapse or flame penetration or the heat transmission exceeding a safe limit, the last two criteria applying only to separating elements.

It is hoped that during the next year a further structural test will be added. This deals with roofs and is designed to measure two properties, first, the time for which a roof will resist the penetration of fire when exposed to brands and radiation from a neighbouring building, and second, the conditions under which a fire would spread over the surface of the roof. The structure under test is 3 ft (91·5 cm) square and is inclined at an angle of 45°. In the penetration test, radiation

is applied to the surface and is equal to the radiation which would be experienced from a burning building of facade 50 ft (15·2 m) square with 50 per cent window openings which is 45 ft (13·7 m) distant. The temperature of the fire is assumed to be 1,000°C.

In order to simulate the effects of wind on the roof, the pressure on the under-surface of the section is reduced by an amount equivalent to 1·5 mm head of water corresponding to a wind speed of about 15 mile/h (6·7 m/sec). After the surface has been exposed to radiation for 5 minutes a flame is applied to the surface for a duration of 1 minute. Observations are made of the time at which smouldering or flaming starts on the under-side of the roof section. A separate test is used for assessing the flame spread over the roof. In this test the radiation intensity is arranged to vary uniformly across the roof so that it is possible from an observation of the distance of flame spread to ascertain the amount of radiation necessary to support flaming. If necessary this can be interpreted in terms of the distance from various types of building facades on fire.

The assessment of the flame spreading properties of the under-surface of the roof will be dealt with separately.

MATERIALS

Two fire tests for materials are described in British Standard 476 : 1953, the "Combustibility Test" and the "Surface Spread of Flame Test".

The "Combustibility Test" is designed to select those materials which will not contribute significantly to the evolution of heat in a fire, or what amounts to the same thing, those suitable for use in places where they may be subjected to prolonged heating, e.g. flue installations. The test consists of plunging the specimen into a furnace stabilized at 750°C and observing whether the specimen flames, produces vapours which are ignited by a pilot flame, or causes the temperature of the furnace to be raised 50°C or more above 750°C.

The second test for materials, the "Surface Spread of Flame Test," measures the rate and distance of spread of flame across wallboards when they are irradiated by a radiation panel, the plane of which is at right angles to that of the board under test. In this way the radiation varies continuously across the specimen and the performance of the board is measured by the distance and rate of flame spread across it.

A number of wallboards have been examined by this test and model rooms of various sizes have been constructed using these wallboards as internal linings. The results of this work have been reported by Hird and Fischl [1] who found that though the performance of the boards as assessed by the British Standard "Surface Spread of Flame Test" and the time of development of the fire in the model experiments gave results in the same order, it did seem that the highest class in the "Surface Spread of Flame Test" (lowest flame spread) was not sufficiently discriminating between wallboards that were almost non-combustible, and combustible boards that had merely received a flame-retardant treatment.

This has led to the development of a new test, which is not yet a British Standard, in which the specimen is built into one side of a non-combustible box and is subjected to radiant heat and flame. A grading is then made according to the ease of ignition and also as to what is in effect the rate and the total quantity of heat emitted. This test will be described in some detail in a following paper. It has the advantage that the performance of boards correlates uniformly with their performance in building fires, and it is able to give a rough quantitative assessment of the rate of heat released from the specimens under fire conditions. Unfortunately the test is not sensitive enought to indicate the rate of evolution of heat from materials which contain only small quantities of combustible material, and cannot therefore replace the "Combustibility Test" as well as the "Surface Spread of Flame Test".

REFERENCE

1. HIRD, D. and FISCHL, C. F. Fire hazard of internal linings. Department of Scientific and Industrial Research and Fire Offices' Committee (Joint Fire Research Organization) National Building Studies Special Report No. 22. 1954.

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