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ANNUAL CONFERENCE ON FIRE RESEARCH
Book of Abstracts
November 2-5, 1998

Kellie Ann Beall, Editor

Building and Fire Research Laboratory
Gaithersburg, Maryland 20899

United States Department of Commerce
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U.S. Department of Commerce
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Wall and Ceiling Heat Flux Measurements in a Room-Corner Test

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Measurements were made to determine the incident total radiative and convective heat flux distribution imparted to the wall and ceiling above in the ISO 9705 room-corner test. Measurements were conducted for the 0.17 m square burner diffusion flame located 0.30 m above the floor. The room is 2.4 m high. Data were taken for burner levels ranging from 50 to 300 kW in 50 kW increments, as well as for the standard settings of 100 and 300 kW. These tests were carried out in the LSF facility in Montano Lucino. The method of measurement follows that of Ingason and de Ris [1] which utilizes a thermal steel plate. In this application of their method, a continuous energy balance on the plate, incorporating conduction loss from each thermocouple node to its four neighboring nodes, was used. Hence, as the burner levels were incremented, the data analysis of the thermocouple traces in time could directly used to derive the incident surface heat flux for each node. Complete details are presented in the M. S. Thesis by Dillon [2].

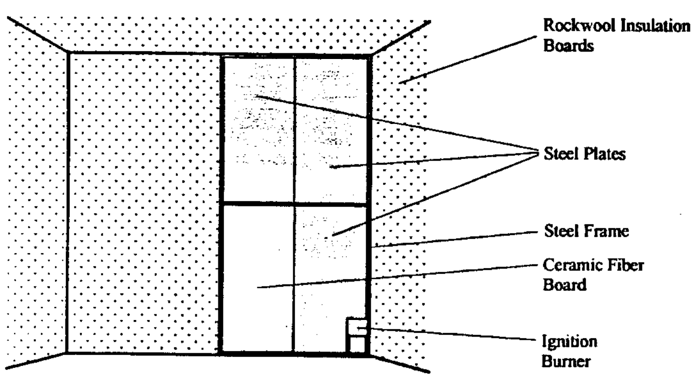

Figure 1. Wall configuration

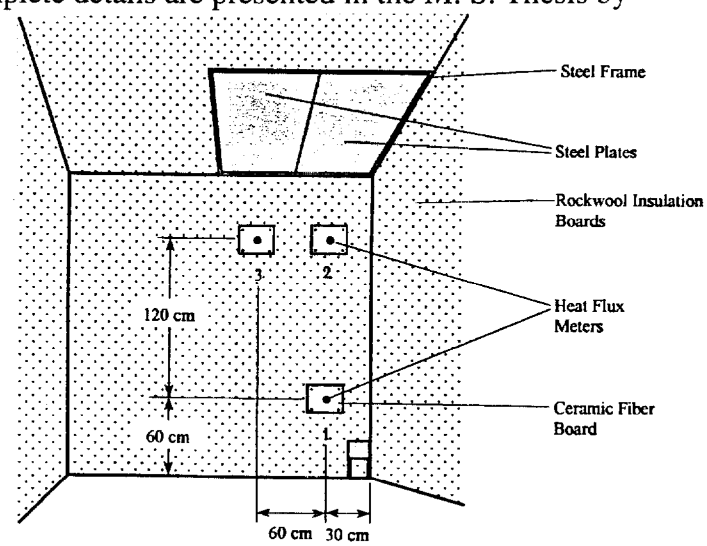

Figure 2. Ceiling configuration

The arrangements of the steel plates used in the room-corner tests are shown in Figures 1 and 2. The plates consisted of 1.2 by 0.6 m C-1018 carbon steel 5 mm thick, and had 32 thermocouples mechanically attached to the back face on 15 mm centers. The back side of the plate was insulated with two layers of 1/2 inch ceramic fiber insulation blanket followed with a rigid ceramic board 1 inch thick. The exposed face of the plate had been sand blasted and coated with high temperature (600 C) black paint.

In order to assess the accuracy of this thermal method, a study was done with a small plate irradiated by a controlled radiant source whose heat flux was simultaneously monitored throughout the heating of the steel plate. A schematic of the steel plate is shown in Figure 3. It was roughened with a glass bead blaster and coated with soot from a gasoline flame. Its back surface was insulated in a similar manner to the LSF tests, and results tend to support a nominal back face heat loss rate of about 5 per cent. Typical results are shown in Figure 4 in which step changes were applied at about 1000 s intervals, and the derived incident radiative heat flux from the energy balance is demonstrated to follow the actual flux. In these validation tests, the convective heat loss from the plate was computed as well.

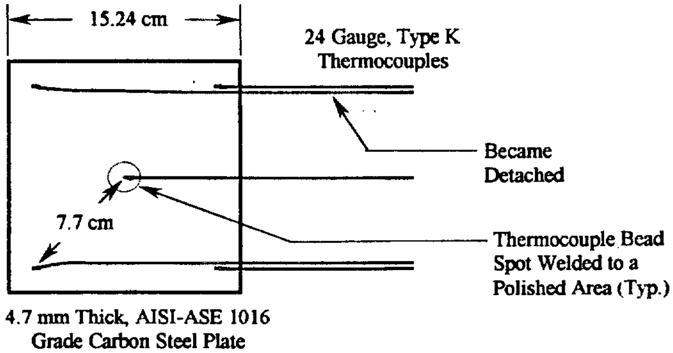

Figure 3. Validation sample

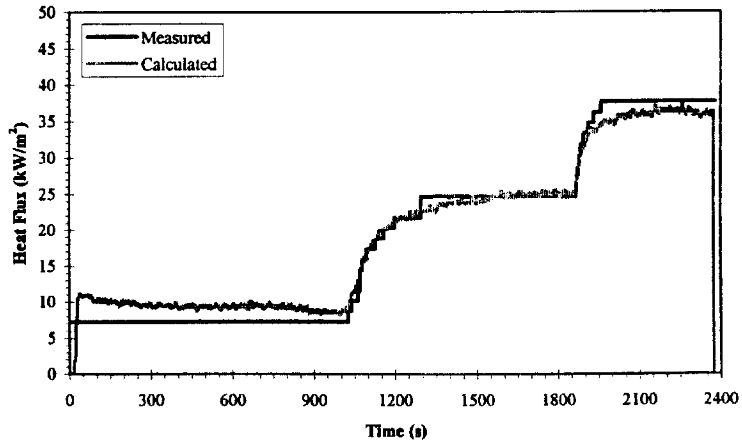

Figure 4. Validation results

Sample incident heat flux distributions for the room-corner test are shown in Figure 5. These room measurements were also compared to imbedded heat flux meters at selected positions. The thermal analysis method compared favorably with the meters measurements, and the previous measurements of Kokkala [3] for an open corner without a ceiling. Plans are underway to more fully analyze the results and explore correlations for their prediction.

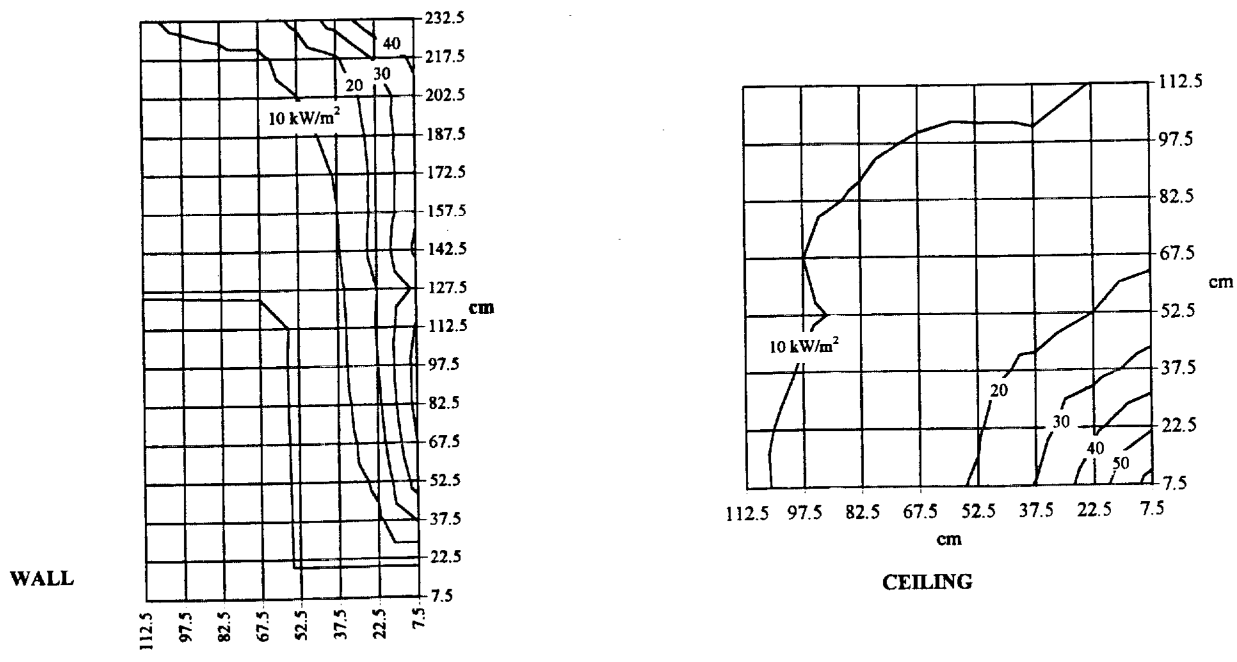

Figure 5. Wall and ceiling heat flux at 100 kW

1. Ingason, H. And de Ris, J., "Flame Heat Transfer in Storage Geometries" in H. Ingason, Dept. of Fire Safety Engineering, Rep. LUTVDG/(TVBB-1013), Lund Univ., Sweden, 1996.
2. Dillon, S. E., M. S. Thesis, Dept. of Fire Prot. Engrg., Univ. of Maryland, College Park, MD, Aug. 1998.
3. Kokkala, M. A., "Characteristics of a Flame in an Open Corner of Walls", Interflam '93, Inter.Sci. Comm. Ltd., London, 1993.