Abstract

This dissertation presents a methodology involving experimental setup and design, for the investigation of ignition and flame spread characteristics of combustible ceilings. The flame spread is an important parameter to study for understanding the fire growth and develop the design fires.

The experimental setup consisted of rectangular (1500mm x 500mm x150mm) CLT samples placed at a distance above a radiant panel. The radiant panel created a heat flux distribution along the length of the samples and line burner was used to ignite the sample from one end. The experiment and sample was instrumented with solid phase thermocouples to measure the temperature through the thickness for the thermal penetration. Bidirectional probes along with differential pressure gauges was implemented to gather the velocity data. Video recording was done to extract the flame spread rate from the footages later on.

The experimental scheme consisted of 6 tests conducted, at different representative heat flux distributions to study the effect of heat flux on the ignition times and the flame spread rates. It was found that in this orientation the flame spread is highly sensitive to the geometric changes. The fluid dynamics play a major role in the fire behaviour as well, as no flaming was observed right above the radiant panel due to high turbulence and high gas velocities low residence times. Flame initially spreads on the edges and these two edge flames joined each other downstream from the radiant panel, the pyrolysis gases released from sample right above the radiant panel did not burn right away, rather travelled downstream and burn there. Flames extended far beyond the pyrolysis front and due to buoyancy, flames kept attached to the ceiling, hence no distinction between the flame spread and flame extension could be made.

Critical heat flux for ignition was found to be 14.47kW/m2 with the ignition/pyrolysis temperature of 3780C. the max flame spread rate was 125mm/s for test 2 with 45kW/m2