*** Poster Abstract ***

The Thermal Response of Gypsum-panel/Steel-stud Wall Systems Exposed to Fire Environments—A Simulation for Use in Zone-type Fire Models

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ABSTRACT

The purpose of this work is to develop a method for simulating the thermal response of fire-environment-exposured wall systems constructed of gypsum panels mounted on steel studs. The objective is an experimentally-validated, modular, thermal-wall-model algorithm that can be easily integrated into zone-type compartment fire models or used for "stand-alone" analyses.

The generic wall system under consideration involves two arbitrary-thickness panels of one or more layers of gypsum board mounted one on each side of an array of vertical steel studs. The studs, separated at regular intervals, form an unfilled air gap between the panels. As is the case in practical implementations of these kinds of wall systems, the spacing of the studs is several times the thickness of the air gap. Also, the studs are typically fabricated from relatively thin-gage steel and they are not effective as paths for conductive heat transfer between the panels.

Results of experiments [1, 2] on the thermal response of the above type of wall systems to ASTM E119 standard-fire furnace exposures are shown to support a wall algorithm analysis where the time-dependent thermal response of the gypsum panels is simulated by an idealized system involving two gypsum board panels, infinite in extent and separated by an air gap, where the system is always heated at the two bounding outer surfaces by spatially-uniform heat fluxes, and where heat transfer across the air gap, between the two bounding inner surfaces, is only by radiation.

Within a specified time interval the algorithm solves an initial-value/boundary-value problem for the temperature distribution through the thicknessess of the two panels. The analysis is based on user-supplied temperature-dependent thermal properties for the gypsum board. (The present work uses property representations based on data in [2].)

The initial temperature distribution and the type of boundary conditions at the outer surfaces are user-specified. A variety of choices are possible for the boundary conditions. These include those that are expected to satisfy the requirements of any zone-type fire model and those that can be used to determine ASTM E119 or ISO 834 performance.

The algorithm output includes the final temperature distribution and, when outer surface temperatures are specified, the final rate of heat transfer to these surfaces.

KEYWORDS: ASTM E119, compartment fire model, fire barrier, fire modeling, gypsum panel, wall system, zone fire model.

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2. Sultan, M.A., A Model for Perdicting Heat Transfer Through Noninsulated Unloaded Steel-Stud Gypsum Wall Board Assemlies Exposed to Fire, Fire Technology, 3rd Quarter, pp. 339-359, 1996.

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