Computer Models
For
Fire and Smoke

Model Name: CCFM.VENTS (Consolidated Compartment Fire Model application code named VENTS)

Very Short Description: A user-friendly, multi-room fire model computer code which simulates the two-layer environment (layer-interface elevation, temperatures, and concentrations of products of combustion) in each room of a modeled facility due to a fire of time-dependent, user-specified, energy and product release rate. Can simulate forced and natural ventilation between rooms, wind and stack effects, and room environments of arbitrarily high pressure.

Modelers, Organizations: L.Y. Cooper, and G.P. Forney, Center for Fire Research, National Institute of Standards and Technology

References:

1. A Plan for the Development of the Generic Framework and Associated Computer Software for a Consolidated Compartment Fire Model Computer Code, Forney, G.P. and Cooper, L.Y., NBSIR 86-3500, National Institute of Standards and Technology (formerly National Bureau of Standards), Gaithersburg, MD, 1987.
2. Fire in a Room with a Hole: A Prototype Application of the Consolidated Compartment Fire Model (CCFM) Computer Code, Cooper, L.Y. and Forney, G.P., *Proceedings of the 1987 Fall Technical Meeting of the Eastern Section of the Combustion Institute*, Nov., 1987.
3. The consolidated Compartment Fire Model (CCFM) Computer Code Application CCFM.VENTS – Part 1: Physical Basis, Cooper, L.Y. and Forney G.P., to appear as NISTIR, National Institute of Standards and Technology, Gaithersburg, MD.
4. The Consolidated Compartment Fire Model (CCFM) Computer Code Application CCFM.VENTS – Part 2: Software Reference Guide, Forney G.P. and Cooper, L.Y., to appear as NISTIR, National Institute of Standards and Technology, Gaithersburg, MD.

5. The Consolidated Compartment Fire Model (CCFM) Computer Code Application CCFM.VENTS – Part 3: Catalog of Algorithms and Subroutines, Edited by Cooper, L.Y., and Forney, G.P., to appear as NISTIR, National Institute of Standards and Technology, Gaithersburg, MD.
6. The Consolidated Compartment Fire Model (CCFM) Computer Code Application CCFM.VENTS – Part 4: User's Reference Guide, Forney G.P., Cooper, L.Y. and Moss, W., to appear as NISTIR, National Institute of Standards and Technology, Gaithersburg, MD.

Availability: Two executable programs (one for IBM PC or compatible and one for Apple Mac II) and the source code are available on CFR Bulletin Board at no cost. Details on minimal software changes (less than 10 lines of code) required to port CCFM.VENTS to another computer are given in the main program.

Hardware: One of the two available executable codes will run on an IBM PC or compatible or an Apple Mac II with floating point hardware. The source code will compile and run on any computer that supports ANSI FORTRAN 77. Graphics adapter required to use graphing software, CCFMGRAF.

Language: An executable program is available for IBM PC or compatible computer or on an Apple Mac II. Source code in ANSI FORTRAN 77.

Size: 320K free memory for MS-DOS version.

Detailed Description:

CCFM.VENTS is a user-friendly, multi-room fire model computer code which simulates the two-layer environment (layer-interface elevation, temperatures, and concentrations of products of combustion) in each room of a modeled facility due to a fire of time-dependent, user-specified, energy and product release-rate. The model can simulate forced and natural ventilation between rooms, wind and stack effects, and room environments of arbitrarily high pressure.

The CCFM effort was initiated by a CFR/NIST priority project to develop a new-generation, multi-room compartment fire model computer code. The plan is to develop a CCFM computer code which consolidates past progress in zone-type compartment fire modeling, and which allows readily for integration of future advances with the greatest possible flexibility. It is envisioned that the CCFM will be developed in stages and that the development process will lead to a series of well-documented, user-friendly, and numerically-robust CCFM products. These would be versatile in the sense that they would provide a capability of

analyzing a particular compartment fire problem by using any one of a range of physical-phenomena-modeling sophistication, from the most basic to the most comprehensive. One final goal of the work is a Reference Fire Model (RFM) which, within the context of the zone-fire-model concept, would provide the best possible mathematical simulation of fire-generated environments.

To date the CCFM/RFM effort has lead to the well-documented (references 1-4), user-friendly, prototype, multi-room compartment fire model computer code, CCFM.VENTS. This first-stage CCFM code involves a basic model formulation and code structure that allows for the required futures growth flexibility. It also involves a relatively sophisticated and very general room-to-room forced and unforced vent flow capability. Finally, the code uses the simplest possible, point-source-plume, smoke-filling fire physics in the rooms-of-fire-origin and a very simple heat transfer calculation there and in other spaces.

Input variables required to implement CCFM.VENTS include: the floor area and the relative elevation of the floor and ceiling of each room of the modeled facility; the area and the relative elevations of the top and bottom of adjacent-room rectangular vents (i.e., doors, windows, and cracks). As mentioned, CCFM.VENTS uses a specified fire. Input data for this includes pairs of values for time and energy release rate which describe the fire's growth throughout the course of the simulation. Depending on the type of simulation required, other input data are also required, e.g., to simulate the action of forced ventilation systems, wind and stack effects, and concentrations throughout the facility of products of combustion.