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Finite Difference Modelling of Temperature Distribution around Fire Generated Heat Source in an Enclosure

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Abstract : Industrial furnaces generally involve enclosures of fire typically initiated by the combustion of gases. The fire leads to temperature distribution inside the enclosure. A proper understanding of the temperature and velocity distribution within the enclosure is often required for optimal design and use of the furnace. This study was therefore directed at numerical modeling of temperature distribution inside an enclosure as typical in a furnace. A mathematical model was developed from the conservation of mass, momentum and energy. The stream function-vorticity formulation of the governing equations was solved by an alternating direction implicit (ADI) finite difference technique. The finite difference formulation obtained were then developed into a computer code. This was used to determine the temperature, velocities, stream function and vorticity. The effect of the wall heat conduction was also considered, by assuming a one-dimensional heat flow through the wall. The computer code (MATLAB program) developed was used for the determination of the aforementioned variables. The results obtained showed that the transient temperature distribution assumed a uniform profile which becomes more chaotic with increasing time. The vertical velocity showed increasing turbulent behavior with time, while the horizontal velocity assumed decreasing laminar behavior with time. All of these behaviours were equally reported in the literature. The developed model has provided understanding of heat transfer process in an industrial furnace.

Keywords : heat source, modelling, enclosure, furnace
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