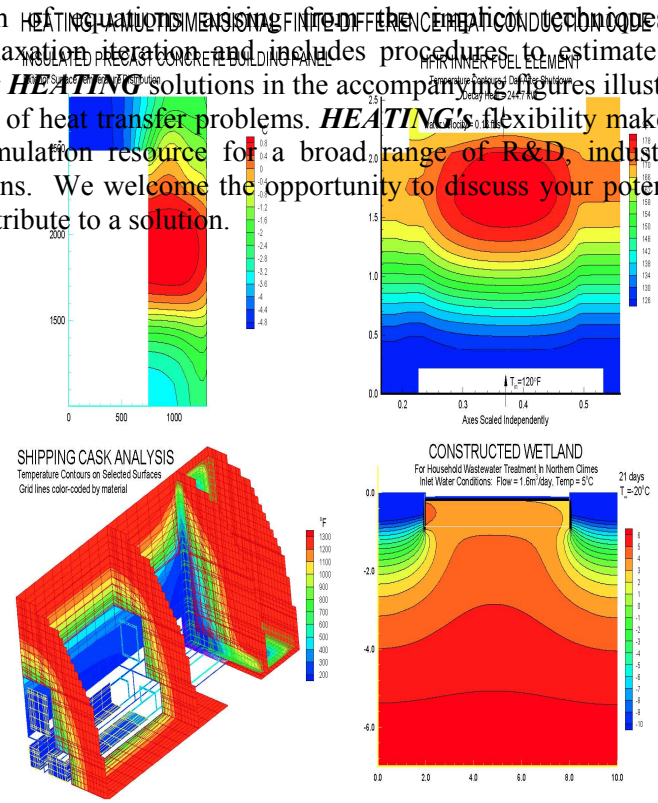
Scientific Computing within the ORNL Modeling and Simulation Group: NHC Code Development - HEATING

The ORNL Modeling and Simulation Group (MSG) develops sophisticated numerical solutions for a wide range of scientific, engineering, and operational applications. MSG's core competency is computational physics and engineering, and within our numerical heat conduction (NHC) focus area we have developed the ***HEATING*** heat-conduction software. ***HEATING*** is a general-purpose multidimensional finite-difference heat conduction code. ***HEATING*** is written in Fortran 77 and can solve steady-state and/or transient heat conduction problems in one-, two-, or three-dimensional Cartesian, cylindrical, or spherical coordinates. A model may include multiple materials, and the thermal conductivity, density, and specific heat of each material may be both time- and temperature-dependent. The thermal conductivity may also be anisotropic. Materials may undergo change of phase. Thermal properties of materials may be input or may be extracted from a material properties library. Heat-generation rates may be dependent on time, temperature, and position, and boundary temperatures may be time- and position-dependent. The boundary conditions, which may be surface-to-environment or surface-to-surface, may be specified temperatures or any combination of prescribed heat flux, forced convection, natural convection, and radiation. The boundary condition parameters may be time- and/or temperature-dependent. General graybody radiation problems may be modeled with user-defined factors for radiant exchange. The mesh spacing may be variable along each axis. Three steady-state solution techniques are available: point-successive-overrelaxation iterative method with extrapolation, direct-solution (for one-dimensional or two-dimensional problems), and conjugate gradient. Transient problems may be solved using any one of several finite-difference schemes: Crank-Nicolson implicit, Classical Implicit Procedure (CIP), Classical Explicit Procedure (CEP), or Levy explicit method (which for some circumstances allows a time step greater than the CEP stability criterion). The solution of the system of equations arising from the implicit techniques is accomplished by point-successive-overrelaxation iteration and includes procedures to estimate the optimum acceleration parameter. The four ***HEATING*** solutions in the accompanying figures illustrate ***HEATING's*** applicability to a wide range of heat transfer problems. ***HEATING's*** flexibility makes it an extremely versatile modeling and simulation resource for a broad range of R&D, industrial, homeland defense, and military applications. We welcome the opportunity to discuss your potential applications and ways ***HEATING*** can contribute to a solution.



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