AEC-NASA TECH BRIEF

Computer Program Calculates Steady-State Temperature Distribution Within Plane or Axisymmetric Solids

The problem:

To provide a numerical procedure and a computer program for the steady-state temperature determination within plane or axisymmetric solids composed of many different materials of practically any geometry. The output of such a program could be used to plot isotherms or provide data to enable the performance of stress analyses or heat transfer calculations upon the bodies.

The solution:

A digital computer program using the finite element analysis technique to determine the steady-state temperature distribution within plane or axisymmetric solids.

How it's done:

The continuous body is replaced by a system of triangular or quadrilateral elements. Each element is numbered. Each nodal point of each element is identified by its X and Y coordinate. Input into the program consists of nodal point identification, temperature or heat flow at boundary nodal points, material identification of each element, conductivity of each material, and convective heat transfer coefficient and temperature at each boundary nodal point. Each quadrilateral element is divided into four triangular elements. The conductivity matrix for each triangle is formed and then combined to form a 5×5 conductive matrix with respect to the five points. The 5×5 matrix is then reduced to the 4×4 quadrilateral conductivity matrix by standard techniques. The quadrilateral conductivity matrix is then added to the conductivity matrix for the complete body. The nodal point temperatures are then found from the solution of the resulting matrix equations. Within the program this is accomplished by a large capacity, band matrix solver. All temperatures are then printed.

Notes:

1. This program is written in Fortran IV for an IBM 7094 computer.
2. A feature of this program is that it provides output which is compatible for input to available finite element stress analysis programs.
3. This program can be applied to heat transfer problems related to many heat exchanger applications.
4. Inquiries concerning this program may be directed to:

   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B67-10224

Patent status:

No patent action is contemplated by AEC or NASA.

Source: Edward L. Wilson
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