PACKAGE ID - 000386P075000 MAGNUM2D

KWIC TITLE - Radionuclide Transport Porous Media

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LIMITATION CODE -UNL **AUDIENCE CODE -** UNL

COMPLETION DATE - 08/01/1988 **PUBLICATION DATE -** 08/01/1988

DESCRIPTION - MAGNUM2D was developed to analyze thermally driven fluid motion in the deep basalts below the Paco Basin at the Westinghouse Hanford Site. Has been used in the Basalt Waste Isolation Project to simulate nonisothermal groundwater flow in a heterogeneous anisotropic medium and heat transport in a water/rock system near a high level nuclear waste repository. Allows three representations of the hydrogeologic system: an equivalent porous continuum, a system of discrete, unfilled, and interconnecting fractures separated by impervious rock mass, and a low permeability porous continuum with several discrete, unfilled fractures traversing the medium. The calculation assumes local thermodynamic equilibrium between the rock and groundwater, nonisothermal Darcian flow in the continuum portions of the rock, and nonisothermal Poiseuille flow in discrete unfilled fractures. In addition, the code accounts for thermal loading within the elements, zero normal gradient and fixed boundary conditions for both temperature and hydraulic head, and simulation of the temperature and flow independently. The Q2DGEOM preprocessor was developed to generate, modify, plot and verify quadratic two dimensional finite element geometries. The BCGEN preprocessor generates the boundary conditions for head and temperature and ICGEN generates the initial conditions. The GRIDDER postprocessor interpolates nonregularly spaced nodal flow and temperature data onto a regular rectangular grid. CONTOUR plots and labels contour lines for a function of two variables and PARAM plots cross sections and time histories for a function of time and one or two spatial variables. NPRINT generates data tables that display the data along horizontal or vertical cross sections. VELPLT differentiates the hydraulic head and buoyancy data and plots the velocity vectors. The PATH postprocessor plots flow paths and computes the corresponding travel times.

PACKAGE CONTENTS - Media Directory; Software Abstract; RHO-BW-CR-143P; Media Includes Source, Sample Problems, Machine Readable Documentation, Auxiliary Programs, Command Files;

SOURCE CODE INCLUDED? - Yes

MEDIA QUANTITY - 1 CD Rom

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METHOD OF SOLUTION - MAGNUM2D is a two dimensional finite element numerical model for transient or steady state analysis of coupled processes of advective and conductive heat transfers in a porous continuum and bouyancy driven groundwater flow in a saturated, fractured, porous medium. The governing equations consist of a set of coupled, quasilinear partial differential equations that are based on the physical laws of fluid continuity and conservation of momentum and energy. The solutions are based on a Galerkin finite element scheme, using a block diagonal frontal solution technique. The computational network consist of both quadrilateral and triangular elements to model the continuum regions of the spatial domain, and line elements to represent the discrete fractures within the domain. A Newton-Raphson algorithm is embedded in the Galerkin functional to formulate the problem in terms of the incremental changes in the dependent variables. This method allows substantial flexibility in discretization of the spatial domain. The flow equations are solved simultaneously, and the flow and heat transfer equations are solved in alternating sequence. The simulation domain may be modeled in two cartesian dimensions or in a radial coordinate system that is symmetric around the vertical axis.

COMPUTER - PRIME 750

OPERATING SYSTEMS - PRIMOS 19.4

PROGRAMMING LANGUAGES - FORTRAN 77

SOFTWARE LIMITATIONS - MAGNUM2D requires the proprietary CA-DISSPLA graphics library to utlize the graphics post processor; this program is not included.

SOURCE CODE AVAILABLE (Y/N) - Y

UNIQUE FEATURES - Maxima of 3000 nodes, 960 elements, 225 heat source elements, 50 thermal load points, 25 material types, 25 time intervals, 5 binary input files. The number of nodes define the element: 8 nodes specify a quadrilateral, 6 nodes specify a triangular shape and 3 node specify a linear element. The element aspect ratio affects the accuracy of the results and should be kept at a value below 100. The reference temperature must be between 0.0 and 300.0 degrees C.

RELATED SOFTWARE - MAGNUM2D generates the fluid flow fields that are used by the radionuclide transport model CHAINT (ESTSC 387) to compute release rate and cumulative release.

HARDWARE REQS - MAGNUM2D requires approximately 100K words on a PRIME 750, depending on the system implementation and problem size. The graphics post processors require a plotting or graphics terminal. GRIDDER, CONTOUR, PATH2D each require

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HARDWARE REQS (CONT) Approximately 100K words on a PRIME, PARAM requires 80K words, and KPRINT and VELPLT each require 50K words.

TIME REQUIREMENTS - Time requirementsare problem dependant. Approximately 0.5 CPU seconds are required per element per time step on a PRIME 750M.

REFERENCES - R.L. England, N.W. Kline, K.J. Ekblad, and R.G. Baca, MAGUM2D Computer Code: User Guide, RHO-BW-CR-143P, January 1985.

ABSTRACT STATUS - Abstract first distributed 1989. Prime 750 version submitted August 1988.

SUBJECT CLASS CODE - HR

KEYWORDS -
COMPUTER PROGRAM DOCUMENTATION
M CODES
RADIONUCLIDE MIGRATION
POROUS MATERIALS
RADIOACTIVE WASTE MANAGEMENT
RADIOACTIVE WASTE FACILITIES
GROUND WATER
WASTE MANAGEMENT
FLUID FLOW
FLOW MODELS
RADIOACTIVE WASTE STORAGE
RADIOACTIVE WASTE DISPOSAL
HYDRAULICS
TEMPERATURE DISTRIBUTION
WASTE-ROCK INTERACTIONS
FINITE ELEMENT METHOD
HEAT TRANSFER
PARTIAL DIFFERENTIAL EQUATIONS
ROCK-FLUID INTERACTIONS

EDB SUBJECT CATEGORIES -
990200 540230 420400

SPONSOR - DOE/RW

PACKAGE TYPE - SCREENED