efficient Gauss elimination solution scheme. The program can compute the mode shapes and vibration periods of the finite element site model and can also conduct linear or iterative, equivalent linear site response analysis using direct step-by-step time domain procedures. Time domain procedures can result in slightly more efficient numerical solutions than similar frequency domain based procedures with the added advantage of being able to perform nonlinear site response analysis using various solution strategies. The input to the program consists of site information (number of layers and layer material properties) and earthquake input information (the user can select from a library of twenty earthquake records). Histories of any layer response quantity (including stress, strain, displacement, velocity or acceleration) can be requested as output. Earthquake response spectra, computed from the analytical acceleration response of any layer, can also be obtained.

Operates on PC DOS computers.

USER GUIDE: Hart, J.D., and E.L. Wilson, "Simplified Earthquake Analysis of Buildings Including Site Effects," Report No. UCB/SEMM-89/23, Department of Civil Engineering, University of California, Berkeley, California, December 1989.

STRONG-MOTION DATA PROCESSING

EQPACK . . . A SOFTWARE AND DATABASE FOR EARTHQUAKE ENGINEERING APPLICATIONS

DEVELOPED BY:

F. Naeim and T. J. Dehghanyar
CASE Computer Aided Structural Engineering, Inc.
Los Angeles, California

SUMMARY: This software package provides the following facilities: (1) Estimation of the Peak Horizontal Ground Acceleration (PHGA) at a site for different soil conditions based on the earthquake magnitude and the epicentral distance, (2) Generation of Median Newmark and Hall response spectra for a given PHGA and damping level, (3) Generation of a Median Seed & Idriss response spectra for a given set of PHGA and soil conditions, (4) A database of acceleration time histories and response spectra for two horizontal and one vertical component of seven commonly used California earthquake records, and (5) Plotting, printing, filing, and scaling facilities for representation and manipulation of the data.

Operates on PC DOS computers with CGA or EGA only. Source code not available, executable file only.

USER GUIDE: CASE Computer Aided Structural Engineering, Inc., "EQPACK, A Software and Database for Earthquake Engineering Applications, User Manual," Los Angeles, California, March 1988.

PSEQGN . . . ARTIFICIAL GENERATION OF EARTHQUAKE ACCELEROGRAMS

DEVELOPED BY:

P. Ruiz and J. Penzien
Department of Civil Engineering
University of California, Berkeley

PC Version by:

T. F. Blake, Newbury Park, California 91320

SUMMARY: The program produces digitized records of acceleration, velocity, and displacement simulating those of earthquake ground motion. Random motion, having the required properties of white noise, is developed using a sequence of random numbers. A function to generate a random number sequence must be available. The random motion is modified by an intensity-time function to produce the bedrock motion. Surface motion is obtained by passing the bedrock motion through a second order linear filter. A parabolic baseline correction is applied to the accelerogram to limit drift.

Originally programmed for CDC computers, also operates on PC DOS and VAX computers.

USER GUIDE: Ruiz, P. and J. Penzien, "Probabilistic Study of the Behavior of Structures During Earthquakes," Earthquake Engineering Research Center, Report No. UCB/EERC-69/3, University of California, Berkeley, March 1969.

SIMQKE . . . SIMULATION OF EARTHQUAKE GROUND MOTIONS

DEVELOPED BY:

E. H. Vanmarcke, C. A. Cornell, D. A. Gasparini, and S. N. Hou
Department of Civil Engineering
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

PC Version by:

T. F. Blake, Newbury Park, California 91320

SUMMARY: SIMQKE generates statistically independent accelerograms, performs a baseline correlation on the generated motions to ensure zero final ground velocity, and calculates response spectra. One of the options in the program generates ground motions whose response spectra "match", or are compatible with, a set of specified smooth response spectra.

The basis for the spectrum compatible motion generation is the relationship between the response spectrum values for arbitrary damping and the "expected" Fourier amplitudes of the ground motion (Vanmarcke, 1976). The earthquakes are synthesized by superimposing sinusoidal components with pseudo-random phase angles, and by multiplying the resulting stationary trace by a user specified function representing the variation of ground motion intensity with time.

The program SIMQKE also has the capability to adjust, by iteration, the ordinates of the spectral density function to improve the agreement between computed and specified response spectra. Even without the last step, the average response spectrum (of a set of simulated motions) will match the smooth target spectrum very closely.

Operates on IBM mainframe, VAX and PC DOS computers.

USERS GUIDE: Gasparini, D.A., and E. H. Vanmarcke, "Simulated Earthquake Motions Compatible with Prescribed Response Spectra," M.I.T. Department of Civil Engineering Research Report R76-4, January 1976.

REFERENCE: Vanmarcke, E. H., "Structural Response to Earthquakes," Chapter 8 in *Seismic Risk and Engineering Decisions,* Edited by C. Lomnitz and E. Rosenblueth, published by Elsevier Publishing Co., Amsterdam, 1976.

SPECEQ/UQ . . . GENERATION OF RESPONSE SPECTRA DIGITIZED AT EQUAL/UNEQUAL TIME INTERVALS

DEVELOPED BY:

N. C. Nigam and P. C. Jennings
Earthquake Engineering Research Laboratory
California Institute of Technology
Pasadena, California 91125

PC Version by:

T. F. Blake, Newbury Park, California 91320

SUMMARY: These programs compute response spectra from earthquake accelerograms digitized at equal (SPECEQ) or unequal (SPECUQ) time intervals. The generated response spectra represent the maximum responses of a damped single - degree -of -freedom system to the specified earthquake ground acceleration. An exact analytical solution to the governing differential equation is used in the computation for successive linear segments of the excitation. Program outputs include: absolute acceleration, pseudo-acceleration, relative velocity, pseudovelocity, and displacement spectra.

Originally programmed for CDC computers, also operates on PC DOS computers.

USER GUIDE: Nigam, N. C., and P. C. Jennings, "Digital Calculation of Response Spectra from Strong-Motion Earthquake Records," Earthquake Engineering Research Laboratory, California Institute of Technology, Pasadena, June 1968.

SPECTR . . . SPECTRA RESPONSE ANALYSIS

DEVELOPED BY:

N. C. Donovan
Dames and Moore
San Francisco, California 94111

PC Version by:

T. F. Blake, Newbury Park, California 91320

SUMMARY: The program evaluates dynamic response spectra at various periods and presents the results as a log-log plot. On the basis of a given time-acceleration record, the program numerically integrates the normal convolution time integral for various natural periods and desired damping ratios. Relative displacements, relative and pseudo-relative velocities, absolute and pseudo-absolute accelerations are computed for natural periods from .01 seconds to 100 seconds. The program provides tables of displacement, velocity, and acceleration values with three measures of spectral intensity. A printer plot of desired damping ratios of the pseudo-relative velocity vs. natural period is presented on a 2 inch by 2 inch log-log grid.

Originally programmed for CDC computers, also operates on PC DOS computers.

USER GUIDE: Donovan, N. C., Dames and Moore, "Spectra Response Analysis, Program Documentation," San Francisco, California, 1972.

EARTHQUAKE HAZARD ANALYSIS

CALREL . . . A COMPUTER PROGRAM FOR STRUCTURAL RELIABILITY ANALYSIS

DEVELOPED BY:

P.-L. Liu, H.-Z. Lin, and A. Der Kiureghian
Department of Civil Engineering,
University of California, Berkeley

SUMMARY: CALREL is a general purpose structural reliability analysis program. It is designed to work on its own or to operate as a shell program in conjunction with other structural analysis programs. In CALREL, structural failure criteria are defined in terms of one or more limit-state functions. The specification is by the user in user-defined subroutines. CALREL is capable of computing the reliability of structural components as well as systems. Specific macro commands are available for the following types of analyses: (1) First-order component reliability analysis; (2) Second-order component analysis by both curvature-fitting and point-fitting methods; (3) First-order reliability bounds and PNET approximation for series systems; (4) First-order reliability sensitivity analysis with respect to distribution and limit-state function parameters; (5) Directional simulation for components and general systems, employing first or second-order fittings of the limit-state surfaces; and (6) Monte Carlo simulation for components and general systems.

CALREL has a large library of probability distributions for independent as well as dependent variables. Additional distributions may be included through a user-defined subroutine.

Operates on Sun Workstations, PC DOS and VAX/VMS computers. Source code not available, executable file only. License agreement required.

USER GUIDE: Liu, L., Lin, H.-Z., andA. Der Kiureghian, "CALREL User Manual," Report No. UCB/SEMM-89/18, Department of Civil Engineering, University of California, Berkeley, California, August 1989.

DAMAGE . . . ASSESSMENT OF DAMAGEABILITY FOR EXISTING BUILDINGS IN A NATURAL HAZARDS ENVIRONMENT

DEVELOPED BY:

T. K. Hasselman, S-J. H. Chen,
R. T. Eguchi and J. H. Wiggins
J. H. Wiggins Company
Redondo Beach, California 90277

SUMMARY: DAMAGE is a tool for local building and safety officials to independently assess the damageability, or the potential safety, of individual buildings exposed to earthquake, severe wind, and tornado forces. The program offers a number of features which have been designed with the needs of the building official in mind.

Three structural modeling options are provided: Detailed Frame model, Story Stiffness model; and an Empirical model. These options allow the user to select the level of detail necessary for his problem.

Source code written in Fortran 4. Originally programmed for CDC computers.

USER GUIDE: Hasselman, T. K., S-J. H. Chen, R. T. Eguchi, and J. H. Wiggins, "Assessment of Damageability For Existing Buildings in a Natural Hazards Environment, Volume I: Methodology, Volume II: DAMAGE Computer Program Users Manual," Technical Report Numbers 80-1332-1 and 80-1332-2, J. H. Wiggins Company, September 1980.

EQRISK . . . EVALUATION OF SITES FOR EARTHQUAKE RISK

DEVELOPED BY:

R. K. McGuire
U. S. Geological Survey
Box 25046, Mail Stop 978
Denver Federal Center
Denver, Colorado 80225

PC Version by:

Risk Engineering, Inc.
Golden, Colorado 80403

SUMMARY: EQRISK is a computer program for the evaluation of earthquake risk at chosen sites. Seismic events are considered as point sources; their occurrence in space is defined by the user. A variety of parameters may be used to quantify ground shaking, such as peak ground acceleration, velocity, displacement, modified Mercalli intensity, spectral velocity, etc. An attenuation function must be specified by the user, and may be in analytical form or (with slight reprogramming) in tabular form. Output gives annual risks (probabilities of equaling or exceeding) for chosen values of the parameter values for preselected risk levels. Output is easily obtained for sites on a grid; thus the program is suitable for seismic mapping. Cartesian or longitude and latitude coordinates may be used.

The total computed risks for the parameter values specified are output, for each site of interest. The risks from each seismic source may be output, if desired, by the user. Also, if particular risk levels have been input, the parameter values associated with these risk levels are calculated and printed.

Originally programmed for CDC computers, also operates on PC DOS computers.

USER GUIDE: McGuire, R. K., "EQRISK—Evaluation of Earthquake Risk to Site," United States Department of the Interior, USGS, Open-File Report No. 76-67, 1976.

DOT . . . DETERMINATION OF TEMPERATURES

DETECT . . . DETERMINATION OF TEMPERATURES IN CONSTRUCTION

DEVELOPED BY:

R. M. Polivka and E. L. Wilson
Department of Civil Engineering
University of California, Berkeley

SUMMARY: DOT is a finite element heat transfer analysis program for both linear and nonlinear two-dimensional planar and axisymmetric heat conduction problems. Material nonlinearities such as temperature-dependent conductivity and specific heat are considered as well as nonlinear radiation boundary conditions for the case of structures exposed to a fire environment.

ELEMENT TYPES: (a) Two-dimensional 4-to-8 node isoparametric elements for planar or axisymmetric solids, (b) Convection and radiation surface elements, and (c) Cooling pipe elements. The structures to be analyzed may be composed of a combination of these element types.

BOUNDARY CONDITIONS: (a) Time-dependent nodal temperatures and/or heat flux specifications, (b) Convective surface heat transfer specifications where the convection coefficient may be temperature dependent and the environmental temperature can vary with time, and (c) Time-dependent internal heat generation. Additionally, the DOT program can analyze nonlinear radiation boundary conditions where the environmental temperature may be time dependent.

Originally programmed for CDC computers, also operates on IBM mainframe computers.

USER GUIDE: Polivka, R. M., and E. L. Wilson, "Finite Element Analysis of Non-linear Heat Transfer Problems", Department of Civil Engineering, Report No. UC SESM 76-2, University of California, Berkeley, June 1976.

Wilson, E. L., "DOT-DICE The Determination of Temperatures within Mass Concrete Structures", Department of Civil Engineering, Report No. UCB/SESM-68/17, University of California, Berkeley, December 1968.

ERST . . . EARTHQUAKE RESPONSE OF SEA-BASED STORAGE TANKS

DEVELOPED BY:

S.-C. Lee
Dynamics Technology, Inc.
Torrance, California 90505

SUMMARY: ERST evaluates the elasto-hydrodynamic response of submerged oil storage tanks to earthquake ground motion. A hybrid finite element method is used, in which the tank structure, the interior fluids, and the near field of the exterior water region are discretized into a ring-shaped mesh network. The tank structure is rigidly attached to the ocean floor. The tank is axisymmetric, has a flexible wall and/or roof, and is filled with two different layers of fluid. Both the dynamic and the static responses are evaluated.

Source code written in Fortran 4. Originally programmed for CDC computers.

USER GUIDE: Lee, S-C., "Earthquake Response of Sea-based Storage Tanks by a Hybrid Element Method - Theory and Computer Analysis," Dynamics Technology, Inc., Report No. DT-7814-2, March 1981.

FIRES-RC2 . . . FIRE RESPONSE OF STRUCTURES - REINFORCED CONCRETE FRAMES

FIRES-T3 . . . FIRE RESPONSE OF STRUCTURES - THERMAL,THREE-DIMENSIONAL VERSION

DEVELOPED BY:

R. Iding, B. Bresler, and Z. Nizamuddin
Department of Civil Engineering
University of California, Berkeley

SUMMARY: FIRES-T3 evaluates the temperature distribution history of structures in fire environments. There are options for fully three-dimensional solids, two-dimensional cross sections, and structures in which heat flow is one-dimensional. The program also permits the use of one-, two-, and three-dimensional elements in the same structure. Structures may consist of one material, or may be composites such as reinforced concrete.

The heat flow problem is modeled in FIRES-T3 by the heat conduction boundary value problem. These equations are nonlinear because of the temperature dependence of the thermal properties of structural materials and the heat transfer mechanisms associated with fire environments. The solution technique used in the program is a finite element method coupled with time step integration. The nonlinearity of the problem requires an iterative solution process within each step. The element library includes isoparametric 8-node hexahedra and 4-nodetetrahedra for three-dimensional solids, 4-node isoparametric quadrilaterals and triangles for two-dimensional modeling, and 2-node isoparametric bar elements for one-dimensional problems. Fire environments are represented by a linear model or a nonlinear model that includes both convective and radiative mechanisms.

FIRES-RC2 evaluates the structural response of plane or reinforced concrete frames in fire environments. Temperature distributions generated by a companion program, FIRES-T3, can be used directly as input for FIRES-RC2.

A nonlinear direct stiffness formulation coupled with time step integration is the analytical technique used in the program. Within a given time step, a tangent stiffness iterative approach is used to find a deformed shape which results in equilibrium between internal stresses and external forces.

The material behavior models for concrete and steel account for dimensional changes caused by temperature differentials, changes in mechanical properties of materials with changes in temperature, degradation of sections by cracking and/or crushing, and increased rates of shrinkage and creep with an increase in temperature. Nonlinear stress-strain laws, in which inelastic deformation associated with unloading is accounted for, are used to model concrete and steel behavior.

Source code written in Fortran 4. Originally programmed for CDC computers.

USER GUIDES: Iding, R., B. Bresler, and Z. Nizamuddin, "FIRES-T3, A Computer Program for the Fire Response of Structures - Thermal," Fire Research Group, Report No. UCB FRG 77-15, Structural Engineering and Structural Mechanics, Department of Civil Engineering, University of California, Berkeley, October 1977.

Iding, R., B. Bresler, and Z. Nizamuddin, "FIRES-RC II, A Computer Program for the Fire Response of Structures - Reinforced Concrete Frames," Fire Research Group, Report No. UCB FRG 77-8, Structural Engineering and Structural Mechanics, Department of Civil Engineering, University of California, Berkeley, July 1977.

SEAWAVE . . . A MODEL OF TSUNAMI GENERATION AND PROPAGATION

DEVELOPED BY:

M. Brandsma
Tetra Tech, Inc.
Pasadena, California 91107

SUMMARY: SEAWAVE models the tsunami resulting from the instantaneous vertical displacement of the sea floor caused by an earthquake. The program performs finite difference solutions of the long-wave equations in spherical coordinates on a variable depth bathymetry and can be easily applied to any problem where the surface of a water body of variable depth is deformed as an initial condition. Matched impedance boundary conditions are applied to any open boundaries the user may specify. Outputs include synoptic printouts of the wave field, a tabulation of wave histories at selected points, and line printer plots of the wave histories.

Source code written in Fortran 4. Originally programmed for CDC computers. Only one subroutine (WHATDT) uses instructions specific to CDC machines. The use of this routine is convenient, but not necessary, for running the program.

USER GUIDE: Brandsma, M., D. Divoky and L-S. Hwang, "Users's Guide to SEAWAVE: A Model of Tsunami Generation and Propagation," Tetra Tech, Inc., Pasadena, California, July 1976.

SHORE-III . . . SHELL OF REVOLUTION FINITE ELEMENT PROGRAM

DEVELOPED BY:

P. K. Basu and P. L. Gould
Washington University
St. Louis, Missouri 63130

SUMMARY: SHORE-III is a finite element program for the linear static and dynamic analysis of arbitrarily loaded, thin to moderately thick elastic shells of revolution. The meridional curve of the shell may have any quadratic shape including the closed end case. The material of the shell may be isotropic, or single or multilayered orthotropic. The shell may have discrete supports in the form of a framework of linear members with various end conditions and arrangements. Such a framework may also be located at any other level excepting the top. Also, framed structures which follow the form of a surface of revolution, and axisymmetric plates can be analyzed. The shell is discretized by a series of high precision curved rotational elements and special cap elements. Discontinuous meridian curves are permissible. The thickness of an element may vary linearly along the meridian. Loading conditions include concentrated line loads, distributed loads, and thermal loads. All loads (both thermal and mechanical) which are asymmetric are required to be expanded in Fourier harmonics. Nonzero nodal displacements can also be prescribed. In the case of dynamic analysis, the effect of the base accelerations due to earthquakes can be considered.

Various printout options for displacements, stress-resultants, and stresses are available. The time history plot for displacements and stress resultants can be obtained on the printer. Alternately, for off-line plotting on a Calcomp plotter system, a plot tape can be created. If desired, intermediate results, e.g., stiffness and mass matrices, may be printed out.

Operates on IBM mainframe computers.

USER GUIDES: Basu, P. K., and P. L. Gould, "SHORE-III - Shell of Revolution Finite Element Program, Theoretical Manual", Research Report No. 48, Structures Division, Department of Civil Engineering, Washington University, St. Louis, September, 1977.

Basu, P. K., and P. L. Gould, "SHORE-III - Shell of Revolution Finite Element Program, Users Manual," Research Report No. 49, Structures Division, Department of Civil Engineering, Washington University, St. Louis, September, 1977.

SPASM . . . SEISMIC PILE ANALYSIS WITH SUPPORT MOTION

DEVELOPED BY:

H. Matlock and S. H. C. Foo
Ertec, Inc.
Long Beach, California 90807, and
Department of Civil Engineering
University of Texas at Austin
Austin, Texas

SUMMARY: A dynamic analysis for lateral soil-pile behavior has been developed and implemented in a beam-column computer program. The analytical method enables the study of the lateral response of soil-pile systems under earthquake ground motion. Wave loadings and mudslide effects may also be considered.

The single pile member is represented in the analysis by a discrete element mechanical model which is restricted to linearly elastic behavior. Simplified superstructure effects can be simulated by increased stiffness along the pile member within the structural system and by coupled rotational restraints at appropriate joints. All input data for the pile, soil and motion can be freely varied along the length. Stability and accuracy are maintained in the dynamic analysis by the use of an implicit (Crank-Nicolson) type of numerical solution.

The soil-pile coupling at each node along the embedded length of the pile is represented by a multi-element assemblage of friction blocks, springs, and dashpots which facilitate the examination of hysteretic soil-pile interaction under earthquake loading. The present nonlinear inelastic soil support model allows either degradation or hardening of resistance as a function of deflection and of the number of reversals of deflection in the range beyond an initially elastic condition. Furthermore, the formation of gaps is allowed in order to properly represent the expected soil-pile interplay in the upper layers of the soil.

The computer program is formulated to allow interfacing with either a superstructure program or a free-field motion program.

Public distribution of the computer program, SPASM, was made possible by the Chevron Oil Field Research Company, La Habra, California.Originally programmed for CDC computers, also operates on Univac computers.

USER GUIDES: Matlock, H., and S. H. C. Foo, "Simulation of Lateral Pile Behavior Under Earthquake Motion,"A report to Chevron Oil Field Research Company, La Habra, California, The University of Texas at Austin, Department of Civil Engineering, July 1978.

Matlock, H., S. H. C. Foo, C-F. Tsai, and I. Lam, "SPASM8-A Dynamic Beam-Column Program for Seismic Pile Analysis With Support Motion," Fugro, Inc., Long Beach, CA, January 1979.

TEMPO . . . TRANSPORTATION EMERGENCY MANAGEMENT OF POST-DISASTER OPERATIONS

DEVELOPED BY:

S. A. Ardekani and M. I. Jabri
Transportation Research
Civil Engineering Department
University of Texas at Arlington
Arlington, Texas 76019-0308

SUMMARY: TEMPO is a microcomputer-based, decision-support tool developed to address the vital transportation needs following a major earthquake. This decision tool has four main modules, namely, grahpical network representation and editing, vehicle routing, traffic diversion and transit management functions.

TEMPO is a user-friendly, menu-driven software capable of real-time processing of data. Its speed of execution is attributed to its programming language (C++), efficient database management structure, and the heuristic traffic management algorithms employed. Moreover, a GIS-based data structure allows graphical user interaction and network editing.

The network module in TEMPO is designed to allow updating of street network conditions based on the incoming information. As such, the operations centers will have access to an updated transportation network database as well as a graphical representation of the latest network conditions. Information available for each link and node of the network can be requested and updated through use of a cursor on the graphical screen display of the transportation network. Repeated zooms are allowed to provide the needed resolution.

The vehicle routing module of TEMPO allows the determination of the shortest path connecting any pair of nodes in the network. The origin and destination nodes are specified by a cursor. Either time-based or distance-based shortest paths can be obtained.

The traffic diversion module provides the needed input for development of diversion strategies around link closures and network blockages. The traditional trip distribution and assignment procedures are heuristically modified so that diversion strategies may be devised in real-time in a PC environment.

The transit management module in TEMPO enables the user to graphically and interactively redesign the pre-disaster transit network. Specific links may be deleted or added to an existing route. Following modifications in transit routes, the network files can be automatically updated to relect the redesigned routes and revised attributes.

Operates on PC DOS computers. Source code not available, executable file only.

USER GUIDES: Ardekani, S.A., and M.I. Jabri, "Transportation Emergency Management of Post-disaster Operations (TEMPO) User Manual," Department

of Civil Engineering, The University of Texas at Arlington, Arlington, Texas 76018-0308, April 1992.

Ardekani, S.A., "A Decision Tool for Transportation Operations Following Urban Disasters," Final Project Report to Earthquake Hazard Mitigation Program, National Science Foundation (Grant No. BCS-9005042), Transportation Research, Civil Engineering Department, The University of Texas at Arlington, Arlington, Texas, April 1992.

ADDITIONAL SOFTWARE AVAILABLE THROUGH NISEE

ACE—Analysis of Critical Elements for the Seismic Evaluation of Existing Multistory Residential Buildings. Pinkham, C.W., S.B. Barnes & Associates; Los Angeles, California; and Hart, G.C., J.H. Wiggins Company; Redondo Beach, California. CDC mainframe version

ASHSD2—Dynamic Stress Analysis of Axisymmetric Structures Under Arbitrary Loading. Ghosh, S., and Wilson, E.L.; University of California, Berkeley, California. Revised: Lin, C-J., United Engineers and Constructors; Philadelphia, Pennsylvania. CDC and IBM mainframe versions

BROKE—Dynamic Analysis of Electric Transmission Line Systems With Broken Wires. Fleming, J.F., and Siddiqui, F.; University of Pittsburgh, Pittsburgh, Pennsylvania. CDC mainframe version

CAL78—Computer Analysis Language for the Static and Dynamic Analysis of Structural Systems. Wilson, E.L.; University of California, Berkeley, California. This is the mainframe computer version of the CAL program. CDC mainframe version

COMBAT—COMPREHENSIVE BUILDING ANALYSIS TOOL. Computech Engineering Services, Inc.; Berkeley, California. PC-windows version

DAEM—Detailed Analytical Evaluation Method for Natural Hazards Evaluation of Existing Buildings. Culver, C.G., and Lew, H.S., Center for Building Technology, NBS, Washington DC, Hart, G.C., and Pinkham, C.W., S.B. Barnes & Associates; Los Angeles, California. CDC mainframe version

DRAIN-2D—Inelastic Dynamic Response of Plane Structures, Kanaan, A.E. and G.H. Powell, University of California, Berkeley, California; and Jain, A.K., and S.C. Goel; University of Michigan, Ann Arbor, Michigan. CDC, IBM and PC-DOS versions

DRTABS—(DRAIN-TABS) Inelastic Earthquake Response of Three-Dimensional Buildings. Guendelman, R., and Powell, G.H.; University of California, Berkeley, California. CDC and IBM mainframe versions

EATSW—Earthquake Response of Axisymmetric Tower Structures Surrounded by Water. Liaw, C.-Y., and Chopra, A.K.; University of California, Berkeley, California. CDC mainframe version

EFRAME—Equivalent Frame Analysis of Unbraced Reinforced Concrete Buildings for Static Lateral Loads. Vanderbilt, M.D.; Colorado State University, Fort Collins, Colorado. CDC mainframe version

EMOI—Extended Matrix Operation Interpreter. Mays, J.R.; University of Colorado at Denver, Denver, Colorado. CDC mainframe version

EXCEMTANK—Response of an Empty Cylindrical Ground Supported Liquid Storage Tank to Base Excitation. Shaaban, S.H., and Nash, W.A.; University of Massachusetts, Amherst, Massachusetts. CDC mainframe version

EXDOMTANK—Seismic Response of a Domed Cylindrical Liquid Storage Tank. Balendra, T., and Nash, W.A.; University of Massachusetts, Amherst, Massachusetts. CDC mainframe version

FTAP—Fault Tree Analysis Program. Willie, R.; University of California, Berkeley, California. CDC and IBM mainframe version

HYPAM—Hydrodynamic Pressure and Added Mass for Axisymmetric Bodies. Nilrat, F.; University of California, Berkeley, California. CDC mainframe version

LAYER—Deconvolution of Surface Accelerograms for Horizontally Stratified Soil Layers. Rukos, E.A.; University of California, Berkeley, California. CDC mainframe version

POLYCHAIN—Reliability Evaluation of Large-Scale Undirected Networks via Polygon-to-Chain Reductions. Resende, L.I.P; University of California, Berkeley, California. CDC mainframe version

PSDGEN and PSAP—Stochastic Seismic Analysis of Piping Systems Subjected to Multiple Support Excitations. Lee, M.-C., and Penzien, J.; University of California, Berkeley, California. CDC mainframe version

SAKE—Inelastic Response of R/C Frames to Earthquakes. Otani, S.; University of Illinois at Urbana-Champaign, Urbana, Illinois. CDC main frame version

SHOCHU—Nonlinear Response Spectra for Probabilistic Seismic Design and Damage Assessment of Reinforced Concrete Structures. Murakami, M., Chiba University, Japan; and Penzien, J., University of California, Berkeley, California. CDC mainframe version

SHRINC—Nonuniform Drying Shrinkage in Concrete Members. Iding, R.H., and Bresler, B.; University of California, Berkeley, California. CDC mainframe version

SOLIDSAP—Static Analysis Program for Three-Dimensional Pounding. Wilson, E.L.; University of California, Berkeley, California. CDC mainframe version

SUBWALL—Practical Elastic Analysis and Design of R/C Structural Walls using Finite Elements. Le, D.Q., and Popov, E.P.; University of California, Berkeley, California; and Petersson, H.B., Chalmers University of Technology, Goteborg, Sweden. CDC mainframe version

TABS80—Three-Dimensional Analysis of Building Systems. Dovey, H.H., and Wilson, E.L.; University of California, Berkeley, California. CDC mainframe version

TANKFREQ—Natural Frequencies of Cylindrical Liquid Storage Containers. Mouzakis, T., Nash, W.A., Colonell, J.M., and Wu, C.I.; University of Massachusetts, Amherst, Massachusetts. CDC mainframe version

TIMES—Times Series Analysis and Forecasting. Pack, D., Ohio State University, Ohio; and Willie, R., University of California, Berkeley, California. CDC mainframe version

TOJO 80—Tower-Joint Computer Program. Bouwkamp, J.G., Hollings, J.P., Maison, B.F., and Row, D.G., J.G. Bouwkamp, Inc.; Berkeley, California. CDC mainframe version

Each program package in this series is $ 50 domestic and $ 100 foreign. Manuals available separately. Costs vary. Please write for quotes.

SOFTWARE FOR FINITE ELEMENT ANALYSIS OF CONCRETE BOX GIRDER BRIDGES AND REINFORCED AND PRESTRESSED CONCRETE STRUCTURES

CELL4—Analysis of Post-Tensioned Box Girder Bridges. Scordelis, A.C.; Chan, E.C.; Ketchum, M.A.; and Van Der Walt, P.P. IBM mainframe

CURDI4—Analysis of Circularly Curved or Straight Prismatic Folded Plate Bridge Structures Bridges. Scordelis, A.C.; Chan, E.C.; Ketchum, M.A.; and Van Der Walt, P.P. IBM mainframe

FINPLA2—Computer Program for Non-Prismatic Box Girder Bridge Structures. Meyer, C.; and Scordelis, A.C. CDC mainframe

LAPBOX and NAPBOX—Analysis of Curved Nonprismatic Reinforced and Prestressed Concrete Box Girder Bridges. Choudhury, D. CDC mainframe

MULSTR—Analysis of Orthotropic Folded Plates with Eccentric Stiffeners. Willam, K.J.; and Scordelis, A.C. CDC mainframe

MUPDI4—Analysis of Straight Prismatic Folded Plate Bridge Structures. Scordelis, A.C.; Chan, E.C.;Ketchum, M.A.; and Van Der Walt, P.P. IBM mainframe

NARCS—Nonlinear Analysis of Reinforced Concrete Slabs and Shells. Lin, C.S. CDC mainframe

NASHL—Nonlinear Geometric, Material and Time Dependent Analysis of Reinforced Concrete Shells with Edge Beams. Chan, E.C.; and Scordelis, A.C. CDC mainframe

NOBOX—Nonlinear Analysis and Ultimate Strength of Multi-Cell Reinforced Concrete Box Girder Bridges. Seible, F. CDC mainframe

NOPARC—Nonlinear Geometric Material and Time Dependent Analysis of Reinforced and Prestressed Concrete Slabs and Panels. Van Greunen, J. CDC mainframe

NOTACS—NonlinearAnalysis of Reinforced Concrete Panels, Slabs and Shells for Dependent Effects. Kabir, A.F. CDC mainframe

PCFRAME—Nonlinear Geometric Material and Time-Dependent Analysis of Reinforced and Prestressed Concrete Frames. Kang, Y.J. IBM mainframe

PCF3D—Nonlinear Geometric Material and Time Dependent Analysis of Three Dimensional Reinforced and Prestressed Concrete Frames. Mari, A.R. IBM mainframe

SEGAN—Analysis of Curved Segmentally Erected Prestressed Concrete Box Girder Bridges. Vanzyl, S.F. CDC mainframe

SFRAME—Redistribution of Stresses in Segmentally Erected Prestressed Concrete Bridges. Ketchum, M.A. PC-DOS version

SHLAG—Shear Lag Analysis of Simple and Continuous T, I and Box Beams. Song, Q.G. PC-DOS version

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