K Y O K A I ---- AN INTERACTIVE FEM.BEM PROGRAM

U S E R ' S G U I D E

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C O N T E N T S

P R E F A C E

The complete package of computer programs described in this document is available from

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KYOKAI is the general name of users group. The member of the group is not fixed and the membership is not guaranteed. Anyone who is interested in the KYOKAI is wellcomed to join the group and can get the KYOKAI system. The usage should be confined to non-commercial purpose.

1. S U M M A R Y

Today finite element technique proves as an efficient tool for engineers concerned with numerical mechanics. Mathematical modelling of the problem is the main interest for engineers and physicists.

Teaching the finite element concept to students is an important subject in university curriculum. Providing the students with a simplified access to general purpose finite element programs is essential to help them solve problems of their own after a short introduction of the principle of the finite element method. They must start building a model, solve the equations, check the validity of the model, and modify it quickly in open-ended manner in each undergraduate course.

Boundary element method is becoming a powerful technique in engineering, especially for problems of three dimensions, with singularities and with domain extending to infinity. Whilst many finite element computer codes are commercially available at present, general purpose boundary element programs are not so much released. Unfortunately commercially available programs are often too large to implement on a small computer.

Boundary element method and finite element method are not

competitive methods. Rather they are the alternative methods. They are expected to compensate each other. It is important to realize advantages and disadvantages of both methods and to select the method suitable to the particular problem at hand. Of course, there are many problems that can be tackled by both methods. The ideal system is the integrated solver of these two alternative methods.

In this resume, our endeavour is described on the development of a small turn-key finite element-boundary element program for non-profit educational users. The program structure and the interactive pre-post procedures are briefly discussed. The usefulness of the program will be illustrated by the finite element-boundary element analyses in engineering. The boundary element method is somewhat stressed in the presentation, because the method is not fully understood among practitioners at this moment.

Our program aimes at providing an easy-to-use environment of combined numerical techniques for researchers and students to solve applied mechanical problems on a mini-mainframe computer within a few hour. The system is designed to some extent to be machine independent and modular to facilitate the maintenance and to include new developments quickly and easily.

1.1 System Architecture.

The majer design constraint on the KYOKAI arises from a requirement for interactive computer graphics environment. If this could not be maintained, there would be some difficulties in model definition, result examination, and post-processing. Without graphic capability, the data check would be error prone.

The KYOKAI was developed on a PRIME 250 under the PRIMOS operating system with 512 kilobytes central memory, 32 megabytes peripheral disk storage, and a TEKTRONIX 4010 graphic display terminal. The minimum architecture required can be much smaller. The KYOKAI will run successfully on smaller mini-mainframe computers. The installation of the KYOKAI system on other computer system has been tested.

The KYOKAI command system controls the flow of tasks by keeping track of the user's selection of activities. Multi-user simulation is possible.

1.2 Outline of the Software.

The KYOKAI is a collection of standard finite element and boundary element subprograms performing a large number of well defined functions. Each subprogram is coded in FORTRAN IV. Large portion of the finite element programs is the translation of Zienkiewicz[1971]. The boundary element programs are translated from Brebbia[1978]. Preprocessor is the translation of Hinton and Owen [1979] and the postprocessor is the translation of Mori[1974]. Those translated programs were modified to meet the interactive requirement of the

KYOKAI system. The program is fully documented by COMMENT statements in the source listing.

The KYOKAI has a modular structure. Modules are classified according to the functions into four categories: pre-processing, interface, analysis, and post-processing. The hierarchal structure of the entire KYOKAI system is maintained.

The preprocessor generates finite element-boundary element mesh in an interactive (conversational) mode. Frequently used 2/D element libraries are included for the definition of arbitrary geometry.

The interface adjusts data structures between the mesh data generated by the pre-processor and the particular finite element-boundary element program. The interface creats an input data file to individual analysis program. The input file once generated can be easily modified and updated if the model is found to be unsatisfactory.

The analizers are finite element-boundary element programs. Each subprogram is designed to be mono-functional. This enables us to use mini-mainframe computers to treat the wide variety of engineering problems.

The postprocessor displays results almost automatically on a graphic terminal. It can plot the results virtually on any plotting device. The output numerical data file can be used subsequently as an possible input for drawing and manufacturing.

Any user libraries can be easily incorpolated in the KYOKAI system under the interactive environment.

R E F E R E N C E S

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