A PIPING ANALYSIS PROGRAM OF ASEA-ATOM

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SUMMARY

This piping program handles the static, dynamic and thermal gradient analyses of a piping system and verifies the stresses obtained according to the criteria of the ASME III Code in a fully automated manner.

The specific topology of the pipe system is extensively exploited for generation of the nodal and element information of the discrete model of the system. For each straight or curved segment, homogenous as to material, dimension and welds, one card of input is given, defining these quantities as well as the number of elements. Geometric information (coordinates of tangent intersection points and radius) are needed only for bent segment. A non-zero integer value of one input parameter defines a specific choice of support generated and applied by the program.

The automated numbering of the system degrees of freedom leads to a global stiffness matrix with small bandwidth, except at those degrees of freedom representing branch connections, where couplings with large bandwidth occur. The compacted (or "skyline") storage scheme ideally suits this situation, and effective, standard algorithms for equation solving and eigenvalue extraction can be employed. The triangularized stiffness matrices are saved on the data base and recovered for solution runs.

Changes of the pipe system lay out leads to small reruns, since the numbering of branchpoints, etc. is independent of the element subdivision and specific geometric values and the formulation of loads, which is recovered from the data base, refers to these numbers.

Dynamic loads treated are e.g. pressure pulses and earthquakes (time history, response spectra). Each loading is numbered by the program and the resulting moments automatically added to a specific file of the data base.

The load sets to be considered in the ASME III analysis are defined as to its type (dead weight, thermal, dynamic (inertial), dynamic) and the numbers corresponding to the participating loadings and values of the parameters describing the temperature distribution ($\Delta T_1, \Delta T_2$) are given. From this information, the program creates (or adds) information to the load set file, which is the sole input to the ASME III analysis, the fatigue part of which is extended to cover dependent occurencies of loadings.

The full use of the topology of a pipe system and the integrated data base system reduces user input and effort to a minimum and leads to considerable savings in computer costs.