An Assessment on the Physical Phenomena of Piping-Components-Supports Interaction

F.L. Cho, R.D. Raheja
Sargent & Lundy Engineers, 55 East Monroe Street, Chicago, Illinois 60603, U.S.A.

SUMMARY

This paper introduces a DESIGN-ANALYSIS approach for solving the often-encountered physical problem of system interaction for piping, components and supports when subjected to the worst loading combination for the designated plant service levels, as stipulated in the design environment.

The physical interaction between piping, components and supports shows that the system has the intricate characteristics of energy dissipation and/or energy absorption in the supported structures (piping and components) and supporting structure (restraints/supports).

Thus, the intent of this paper is to introduce the following features:

- an understanding of the physical mechanisms for system interaction in piping, components and supports resulting from a combination of system configuration, loads and constraint conditions.
- an evaluation of the response behavior of the integrated system (piping, components and supports) in the elastic-plastic state of the specified material.
- a formulation of computational algorithms for the boundary elements, which reflects a realistic representation of support and constraint conditions.

To illustrate the objectives of this paper, the following topical cases will be discussed:

Case 1: Data Management and System Modeling

Case 2: Representation of Boundary Elements

Case 3: Mechanisms of System Interaction

Using the most recent research information on the use of data base management systems, such as, free-field input, new eigenvalue techniques, high order finite elements, nonlinear analysis and substructure techniques, this paper will attempt to describe how the deformation characteristics of the integrated piping-components-supports interaction can be solved analytically.

Thus, this paper describes the significance of a recommended design-analysis method which can be efficient, practical and cost effective. Furthermore, it will serve as a means to assure the functional reliability of the integrated system by meeting the requirements of ASME Section III and Code Case N-47 criteria.