BENEFITS:

- Improve accuracy of designs and analyses.
- Improve analyses of components in cyclic service.
- Reduce stress on equipment.
- Increase plant and equipment life.
- Produce more cost-effective designs.
- Reduce design changes and iterations.
- Calculate more realistic loading conditions.
- Calculate more realistic allowable loads on nozzles.
- Analyze components outside of code limits.

FEATURES:

- Incorporate FEA results into CAESAR II model in an automated process.
- Improve WRC 107/297 calculations for loads on nozzles and attachments.
- Use more accurate SIFs and k factors.
- Enable FEA analysis of contoured tees.
- Support FEA analysis of bends and tees with or without dummy-leg supports.
- Compare SIFs and k factors between piping codes and FEA calculations.
- Calculate SIFs and k factors for standard geometries.
- Create tabular and graphical result reports.

PAULIN RESEARCH GROUP FEATOOLS™ FOR CAESAR II®

FEATools™ improves the quality of CAESAR II® users' analysis for critical service lines by incorporating finite element analysis (FEA) and other empirical sources into the evaluation process. By using Intergraph® CAESAR II in combination with FEATools, analyzed systems are neither over- nor under-designed, but designed with consistent safety factors, which also saves time and money.

FEATools from Paulin Research Group is available exclusively through Intergraph.

HIGHER ACCURACY, LOWER COSTS

Piping analysts know that that properly qualified FEA presents the greatest opportunity to produce the most accurate analysis results. However, FEA can be extremely time-intensive and require more technical expertise than is needed for the majority of pipe stress problems. An ideal solution would allow FEA results to be easily and seamlessly incorporated within traditional code-based pipe stress analysis, so that your jobs benefit from the accuracy of FEA and the practicality of code-based analysis. CAESAR II with FEATools provides this solution.

ADDRESSING CODE LIMITATIONS

There are well-known limitations in piping code accuracy when it comes to piping branch connections. Performing a complete FEA of a piping system can be prohibitively expensive. Instead, using FEA data for branch intersections is one of the most effective and pragmatic uses of FEA technology for code-based pipe stress analysis.

FEA RESULTS AND PIPING CODES

Piping codes such as ASME B31.3 Appendix D state that, in the absence of more directly applicable data, the engineer should use the stress intensification factor (SIF) and flexibility factor (k factor) data from Appendix D of the code. FEATools uses the results of the latest analysis, research, and testing to supply this "applicable data" to CAESAR II, and it does so seamlessly and intuitively.

NOZZLES

FEATools also provides a quick way of calculating nozzle stiffness, allowable loads, and stresses due to user-defined load sets. This more accurate nozzle flexibility reduces stress in the piping system during thermal load cases. This improves on the accuracy of older methods used in the industry for qualifying nozzle loads such as WRC 107 and WRC 297. It addresses nozzles on heads and shells as well as radial, hillside, and lateral nozzles.

WHEN TO USE

Accurate SIFs and k factors enable pipe stress analysts to use the built-in flexibility of a piping system to reduce unnecessary redesigns of the system, which often have design constraints or piping code limits. This reduces interdepartmental iterations in the design process and saves valuable time and money. FEA-derived SIFs and k factors are typically recommended in the following piping configurations:

- Systems with large diameter thin-walled pipe (D/T>50).
- Systems that connect to sensitive or rotating equipment.
- Systems with operating cycles anticipated to be more than 5000.
- Systems with short or stiff piping (where k factors have a large impact).
- Existing systems modeling or piping connections.
- Systems that require more accurate spring hanger design.
- Systems that use thin-walled welding tees.
- Systems where run i-factors control the solution and d/D ratios < 0.5.

CAESAR II INTEGRATION

FEATools supports code-based pipe, pressure vessel, and tank design. It was developed to interact only with CAESAR II. This means that, once calculated, branch SIFs and k factors are not only seamlessly and automatically transferred to the CAESAR II model, but the software retains the data for future analysis.

CAESAR II WORKFLOW

Because FEATools closely matches the way CAESAR II operates, the current workflows remain virtually unchanged. Users can continue to produce the deliverables that they have come to trust. For time efficiency, the software saves each branch FEA calculation in a database so users can reuse those values on subsequent jobs. If a user wants to return to the original model, the software creates the SIF and k factor-adjusted model as a copy, keeping the original intact.

REAL-WORLD TESTING

The original piping code SIF values for intersections were derived from work performed in the 1940s by A. R. C. Markl. Most of these experiments were performed on a single size piping run, from which all other SIF values were extrapolated. The SIF values in FEATools are based on the testing done by Markl plus many real-world and finite element calculations performed since those original tests. The current tests were derived from hundreds of pipe- and branch-size test models of various material thicknesses. This means FEATools provides the most comprehensive evaluation of SIFs for piping intersections to date.

RESULTS AND REPORTS

FEATools generates a log file of all of the modifications performed on the CAESAR II model. Users can produce the same reports they have always generated with CAESAR II without having to learn a new reporting tool.

COMPONENTS

- **CAESAR II FEA Translator** – Applies more relevant SIFs and flexibility (k) factors for branch connections automatically in the CAESAR II input file so FEA or improved correlation methods can be used. Includes the option for light, medium, or heavy walled tees, laterals, and the effect of weld thickness on SIFs and k factors.
- **FESIF** – Calculates SIFs for cylinder-to-cylinder or cylinder-to-head connections for fabricated assemblies.
- **FE107** – Calculates the stresses in shells or heads at nozzle intersections, which addresses integral, pad-reinforced, radial, hillside, and lateral nozzle configurations.
- **FETee** – Calculates SIFs for contoured welding tees for extruded or B16.9 geometries.
- **FEBend** – Calculates SIFs or evaluates external loads applied to bends with structural steel or pipe stanchions.
- **PRGik** – Instantly evaluates SIF (i) and k factors for Appendix D branch connection components. Helps the user determine if the system is sensitive to more applicable SIFs or k factors. Also provides Markl, Hinnant, and ASME allowable and mean failure curves for given piping stresses.

ABOUT INTERGRAPH

Intergraph is the leading global provider of engineering and geospatial software that enables customers to visualize complex data. Businesses and governments in more than 60 countries rely on Intergraph's industry-specific software to organize vast amounts of data to make processes and infrastructure better, safer and smarter. The company's software and services empower customers to build and operate more efficient plants and ships, create intelligent maps, and protect critical infrastructure and millions of people around the world.

Intergraph operates through two divisions: Process, Power & Marine (PP&M) and Security, Government & Infrastructure (SG&I). Intergraph PP&M provides enterprise engineering software for the design, construction, operation and data management of plants, ships and offshore facilities. Intergraph SG&I provides geospatially powered solutions, including ERDAS technologies, to the public safety and security, defense and intelligence, government, transportation, photogrammetry, and utilities and communications industries. Intergraph Government Solutions (IGS) is a wholly owned subsidiary of Intergraph Corporation responsible for the SG&I U.S. federal business.

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