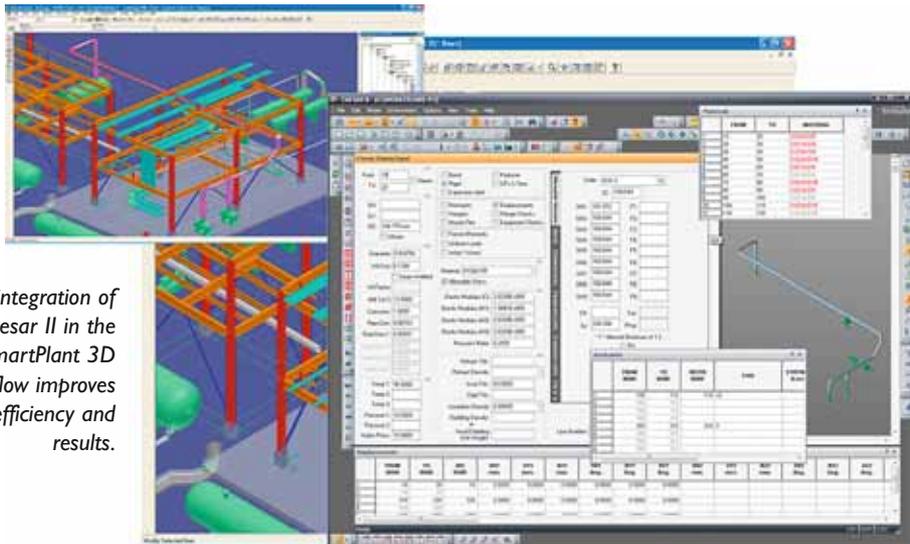


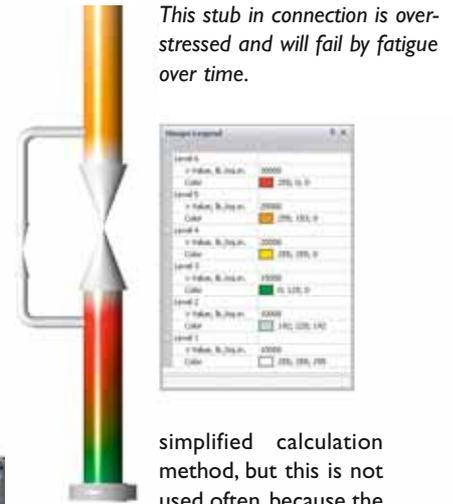
Pipe Stress Analysis – Do I really need it?

Although pipe stress is one of the most important aspects in the plant design process, many users don't really know why it is necessary. But the benefits are obvious.

by JÖRG THEIS



The integration of Caesar II in the SmartPlant 3D workflow improves efficiency and results.



This stub in connection is overstressed and will fail by fatigue over time.

simplified calculation method, but this is not used often, because the method is very conservative. As we may care a little more about the safety of plants in the future, the requirements for better design will increase. One of the reasons why erecting plants endures over spending is that there are not enough qualified pipe stress engineers to do the necessary analysis work. Nevertheless, support from a dedicated CAE tool can help. So, the question arises: Why not use the capability of a pipe stress program and save money? All these demands can be met with Caesar II

Pictures: Intergraph

The weight of pipes and the media passing through them cause deflection. Overstressing the system can be avoided by fitting pipe restraints. The easiest way to do this is to pick a maximum span from a table and position a support. But a temperature gradient causes thermal expansion and the pipe may elongate. Together with the internal pressure and external loads, the resulting stress can be very high. In addition, nozzle loads caused by pumps, for example, may need to be restricted. Moreover, some pipe installations have to be rated against wind, earthquake, waves, or other external loads. This can be achieved by introducing more flexibility into the pipe configuration, leading to a more sophisticated analysis. In addition, a lot of cost saving potential can be realized by looking for an optimized design rather than just following a mainstream approach. For example, the costs for vessel design can be reduced if the nozzle loads are minimized. Expansion loops are less expensive than using expansion joints. The question arises: How can we cross the chasm between restraints and flexibility, cost-saving initiatives and tight project schedules?

Business value of CAE

Some companies use their own calculation tools to meet these requirements. Rolf Limpert with BASF has compared the costs of simple verification against stress pipe analysis over a long period. A lot of money and resources may be saved by using a suitable CAE program to find an optimum design instead of relying on conservative dimensioning assumptions. A summary of this work can be found in Appendix Q of ISO 13 480. One of the reason why more money than necessary is spent on erecting plants, is that there are not enough qualified pipe stress engineers to do the necessary analysis work. But support from a dedicated CAE tool can help. So, the question arises: Why not use the capability of a pipe stress program and save money? All these demands can be met with Caesar II. Because the program is easy to learn and to use, it is perfect for both professional and occasional users needing an intuitive and template-driven user interface. It uses relatively large pipe lengths for flexibility and reduces loads on the nozzle. Also the ASME Code provides a similar

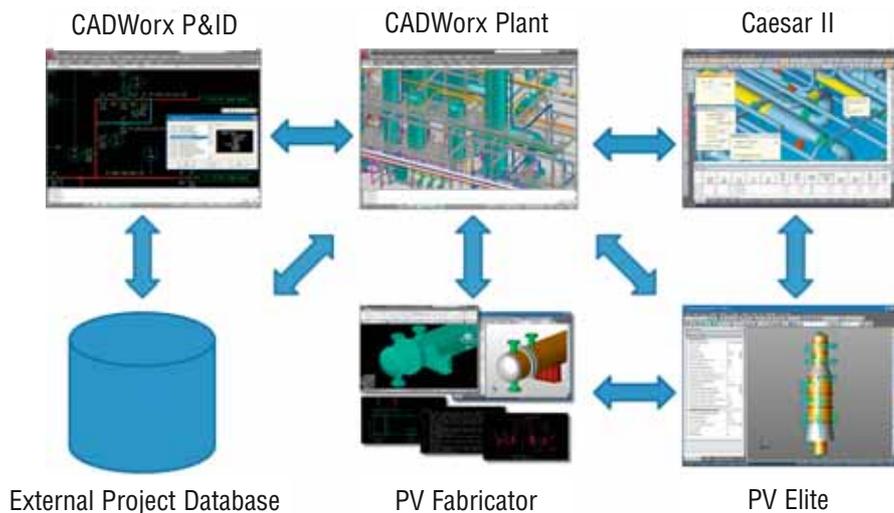
which is perfect for both professional and occasional users needing an intuitive and template-driven user interface. On the back of 25 years of development and feedback from customers, this product now offers a wide range of features, providing the user with an easy way to meet all requirements while saving mo-

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The workflow of ICAS ("Intergraph CADWorx Analysis Solution") shows the bidirectional exchange of data between the different solutions.

ney. Intergraph's plant design and analysis programs are easy to use, extremely flexible, totally scalable and trusted by over 80 percent of the leading plant engineering companies and owner/operators worldwide to deliver accurate, reliable results. Caesar II is the pipe stress analysis standard – a benchmark for all other tools available on the market.

In January 2010, Intergraph Corp. based in Huntsville, US state of Alabama, acquired Coade (Houston, US state of Texas) and rebranded it to "Intergraph CADWorx and Analysis Solutions". This acquisition offered the opportunity to integrate a data exchange solution between a high-end 3D plant design product and a top pipe stress analysis product.

Intergraph's CADWorx and analysis solutions work together to give you the power to tackle the most challenging and complex projects with greater ease and superior results. The biggest value can be gained by integrating Caesar II in Intergraph Software to support design workflows. CADWorx Plant is able to export a native Caesar II file format and import the results directly into the 3D model without rework. Data consistency is maintained through the whole process. This saves time and guarantees better results.

Smart Plant 3D is able to export most of the data relevant for pipe stress analysis. The results as support, hanger data or changes on the pipe run can be directly read into the Smart Plant 3D database. During this reading process, all the detail data are stored without any loss for further detailing. Since a lot of data about pipe stress are available in the early stages of the project lifecycle, engineering changes can be done at much lower expense.

Stress evaluation can be performed in compliance with over 30 international piping codes to meet local requirements. Caesar II evaluates FRP (fibre-reinforced plastic) and buried piping. Interfaces to other programs speed up data transfer and reduce errors. Comprehensive material databases from all other codes available on the market are ready for use. A lot of other valuable calculations are included. Maximum flange or nozzle loads can be read in and compared with specifications. Caesar II calculates API 610, WRC 107/297, flanges and a lot more. Pipes and nozzles are checked if they fail due to fatigue problems over time. Plant models in DWG format can be imported to improve the overview of the complete project. Elements can be placed with the help of visual support. The Expansion Loop wizard uses a cube built up directly on steel supports.

Calculation results are stored in a database and can be exported in a broad variety of data formats. The results can be depicted in standard reports or in a customized layout fulfilling professional documentation requirements. 3D plots or animations can also be added to the results. Nozzle loads can be exported directly to the pressure vessel software PV Elite. Since most pressure vessel designers use this software, everyone benefits from this integration. Caesar II is able to calculate steel structures. The data can be easily imported from CADWorx, Frame Works, or other software. This integrated feature can be used as easily as pipe stress calculation. Another remarkable feature that can save a lot of resources is the ability to perform dynamic calculations. The dynamic load factor is mostly used very con-

servatively, resulting in a lot of money being wasted.

Since the calculation model is already built-up, this feature is worth using. It includes seismic load evaluation, forced vibration, hammer loads, natural frequency, response spectrum, time history analysis, slug flow and more.

Isogen is a performant solution for the consequent automation of piping isometric drawing production and the de facto standard CAD system for drawing piping isometrics included in Caesar II. All the relevant data can easily be picked and placed on an isometric output. Company profiles can be used to deliver high quality outputs. With the Isogen wizard I-Configure, all parameters can be simply chosen from a list of options. A preview is used to shift all the data into place. Experienced users can also use the Project Manager. After this setup, isometric drawings can be generated for different projects in the same professional quality. A lot of the features of Caesar II improve results and help users find the best engineering. For instance, the Expansion Loop wizard generates the best possible loop for a given value. All the different options are calculated and the best is chosen for each specific case. The seismic wizard transforms the data provided into simple G loads. A lot of hanger producers made their data available for Caesar II and the user just has to select one item of this information to get the best results in this mode. There is no need to import further data from other sources.

The same easy option can be chosen for expansion joints — just choose a company and the wizard inserts all the relevant components into the model. Line numbers from pipes improve orientation as different views can be easily selected. 3D plots help the user identify possible issues in the model. Colour-coded stress models and animated displacements for any load case are available – these visualization techniques help the user get an overall picture of the problem, to identify critical sections, and to find the best solution. Such tools take the guess-work out of producing accurate analysis, recommend practical design changes and help bridge the gap between knowledge and experience. So Caesar II changes over the time of usage from a validation to a solution tool.

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For further information visit www.coade.com/products/caesarii