Mechanical Engineering News

COADE ENGINEERING SOFTWARE

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New Avenues for Communication and Support

By: Richard Ay and David Little

In the continual effort to provide better customer relations, COADE has recently initiated two new options. The first is a form of "on-line" support, which allows COADE personnel to see (and optionally control) a User's desktop. The second is an "on-line" conferencing alternative.

"On-Line Support": COADE has always offered technical support, via phone, fax, and e-mail. There are instances, especially with phone support, when a great deal of time could be saved if the COADE engineer could see (and perhaps control) the user's desktop. This new technology from DesktopStreaming, Inc. allows just this.

When requested by a COADE engineer, a user will be directed to a web page on COADE's website. This page (shown in the figure below) allows the user to initiate an interactive "chat" session with COADE.

FOR THE POWER, PROCESS AND RELATED INDUSTRIES

The COADE Mechanical Engineering News Bulletin is published twice a year from the COADE offices in Houston, Texas. The Bulletin is intended to provide information about software applications and development for Mechanical Engineers serving the power, process and related industries. Additionally, the Bulletin serves as the official notification vehicle for software errors discovered in those Mechanical Engineering programs offered by COADE.

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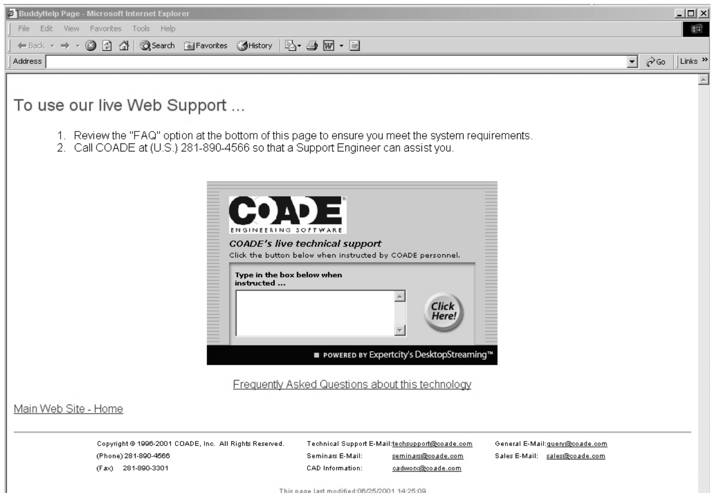
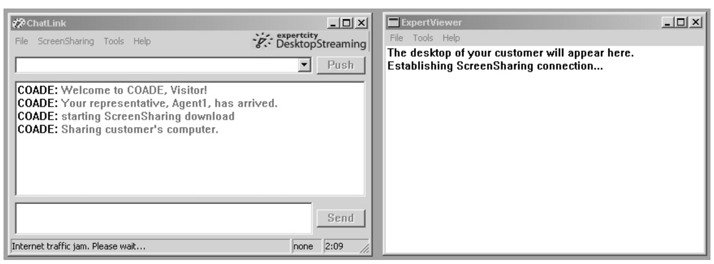
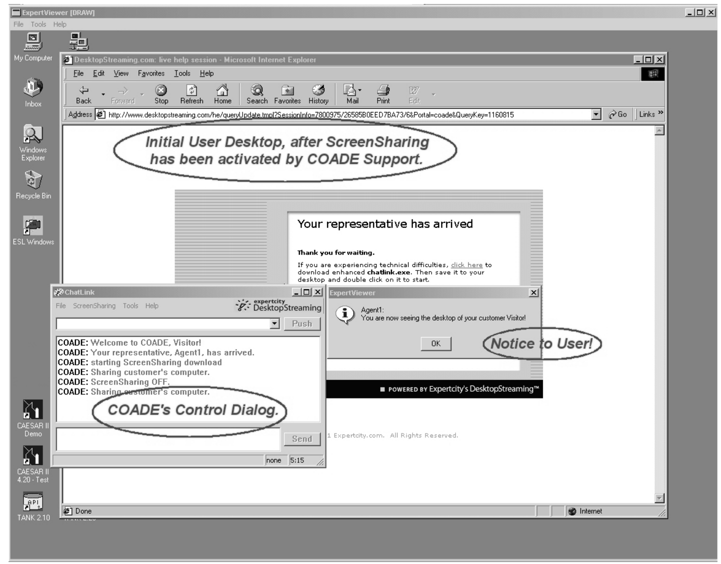


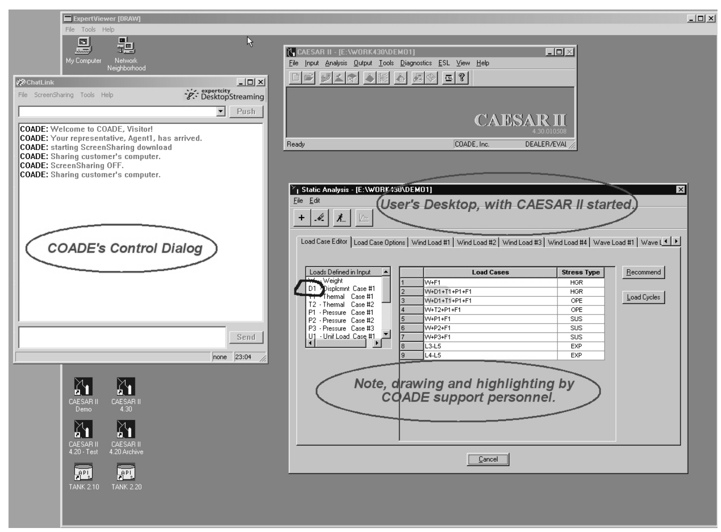
This is obviously not that much help, since the COADE engineer is already on the phone with the user. However, once connected, the COADE engineer, with the user's permission, can initiate desktop sharing. This is shown in the figure below:



Here we see the "Control Dialog" on the COADE workstation, as well as a notice that a ScreenSharing connection is being established. Once this connection is established (with a final [OK] from the user), the user's desktop appears on the COADE workstation, as shown below. In the figure below, notes have been added to define the various items.



Once ScreenSharing has been activated, the COADE engineer can minimize windows and run applications on the user's machine (obviously with the user's permission). At anytime, the user can break the connection. The figure below shows the result of the COADE engineer starting **CAESAR II** on the user's machine. Notice that the support engineer can use both drawing and highlighting tools to further assist with the user's understanding. In addition, the user can type and move his or her mouse while the COADE engineer observes the response.



We anticipate that this tool will be a valuable addition to our support mechanism, especially when users are unfamiliar with Operating System issues, or encounter problems that cannot be reproduced at COADE.

An immediate reaction to this may be: "I'm not letting anyone control my desktop!" The idea of ScreenSharing is safe because:

1. The user has to initiate contact from the website, COADE personnel can't do this.
2. A small browser plug-in is downloaded each time ScreenSharing is requested. The user can always reject this and abort the process.
3. As a final control, the user must click [OK] on the final connection prompt to finalize the connection.
4. And finally, the user can always break the connection by clicking on the "End Sharing" option.
5. When the session is over, the plug-in is deleted. COADE personnel cannot revisit the users machine.

"On-Line Conferencing" will be active by the end of July. Additional details on this option will appear in the next newsletter.

Planned Features for PVElite Version 4.20

By: Scott Mayeux

PVElite Version 4.20 is scheduled for release in August 2001.

This version of **PVElite** contains an array of new features that interactively help to shorten new vessel designs. The list of new items is extensive. A very abbreviated list of the new features include:

- External Pressure Calculations shown on the status bar
- Interactive Nozzle Reinforcement/Compensation Calculations
- Interactive Stiffening Ring Calculations
- Interactive Flange Calculations

In this article, we will review a simple horizontal vessel on two saddle supports and examine some of the bulleted items listed above.

In the Figure 1 below note that we have completed basic modeling of the vessel. In a review of the items on the status bar, please note the External MAWP for the Elliptical Head.

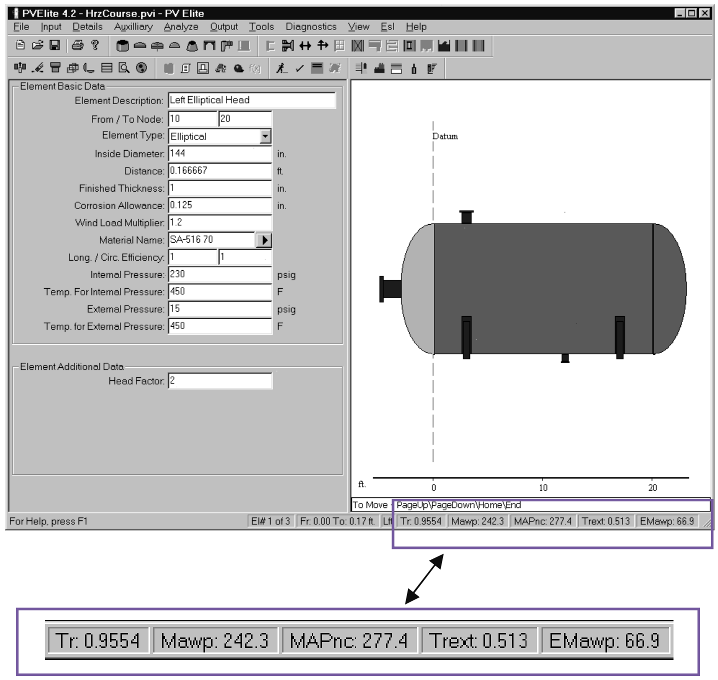


Figure 1 – Required Thickness and MAWP for 2:1 Elliptical Head

In Figure 2 below, the shell course is the currently selected element and the required thickness due to external pressure is shown on the status bar. Note the other terms, Trext, L, EMAWP and Slen, . The value Slen represents the length that the shell course can be to maintain an external pressure of 15.0 psig (full vacuum). The design length L is the actual stiffened length of the cylinder for external pressure calculations. This value L may vary for each cylindrical or Conical Section and it is usually the distance between lines of support, stiffeners or heads. For this model, L is the overall straight length plus 1/3 the depth of each head. That value turns out to be 22.33 feet or 268 inches. The allowable section length is 53.7 feet, so this section meets requirements for thickness considerations. Additionally note that **PVElite** also computes Trext, which is 0.741 in. This is the required thickness for external pressure. Since the given thickness is 1 inch, this confirms that the shell is adequate for the full vacuum condition.

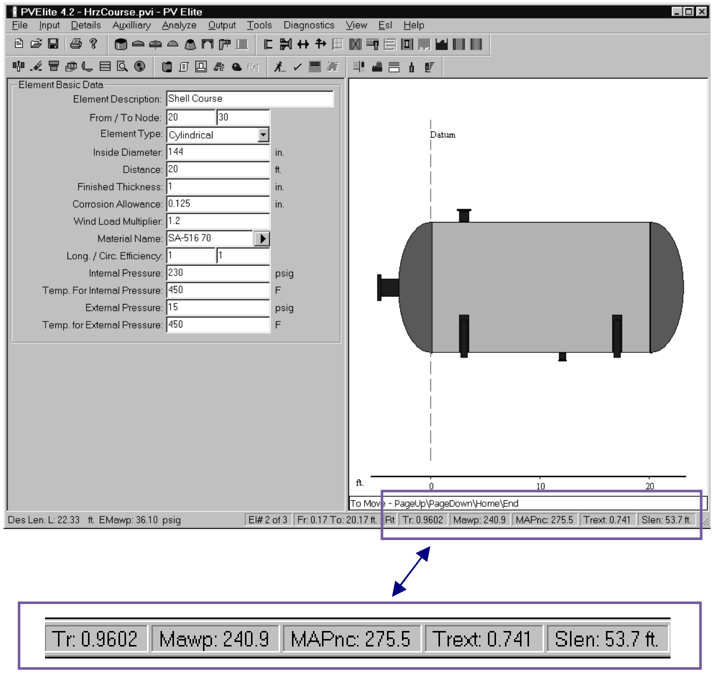


Figure 2 – Required Thickness, MAWP, Slen and Design Length for the Main Cylindrical Section

Also of interest is the fact that these calculations are interactive. Whenever a critical value is changed the status bar will be automatically updated displaying the new results. Another new interactive feature is the nozzle design. While in the nozzle dialog, you can select a nozzle that meets Code requirements. These requirements typically include area of replacement and minimum thickness. If the nozzle is not compliant with the Code, the result in the dialog would be colored red. Like the calculations for internal and external pressure above, the nozzle calculation results change as data is entered or changed.

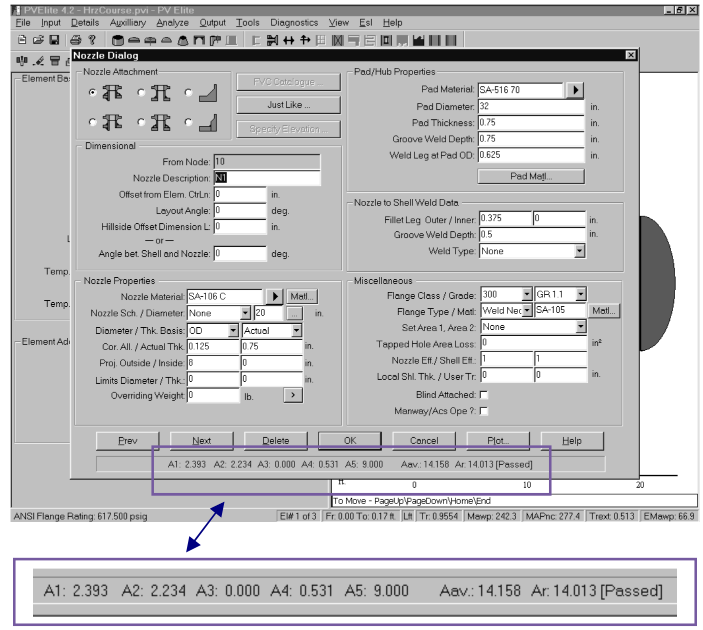


Figure 3 – Interactive Nozzle Calculations

Stiffening rings are also included in this new area of interactivity. In versions prior to 4.0, ring design has been an iterative process. Versions 4.0 and later can place and design stiffeners to meet Code requirements. In 4.2 rings can be selected and sized while on the input screen as shown in the Figure 4 below. Here we used the “Check Standard Bar” button to scroll through various ring sizes until a satisfactory ring is found. Additionally, the program will size the ring on entry into the dialog. Also note that **PVElite** 4.2 can add a group of stiffeners by specifying the number of rings to add and the spacing.

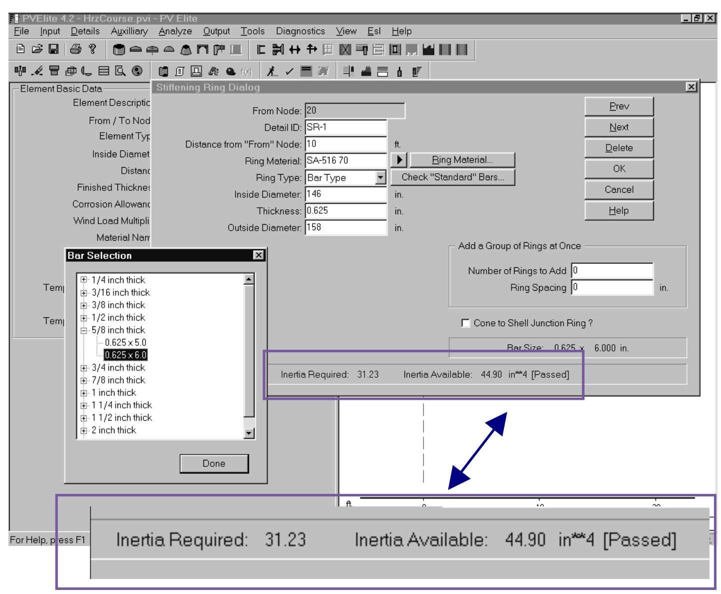


Figure 4 – Interactive Stiffening Ring Calculations

In the Component Analysis Module we have made similar progress. In some modules, such as shell/head, flange and nozzle the calculations are performed silently while the input is entered. Once the data is consistent and complete, the program will compute and format the important results. They will then be placed on the status bar as seen in the figures below.

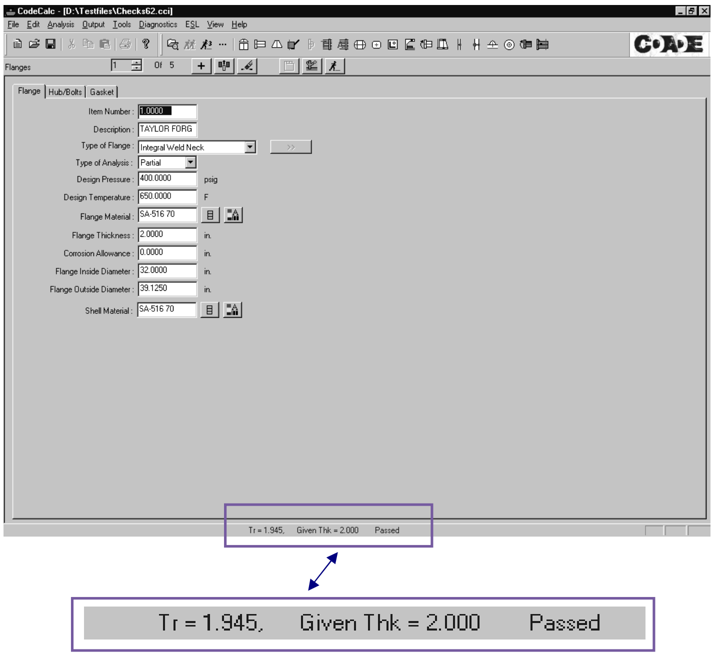


Figure 5 – Interactive Flange Calculations in the Component Analysis Processor

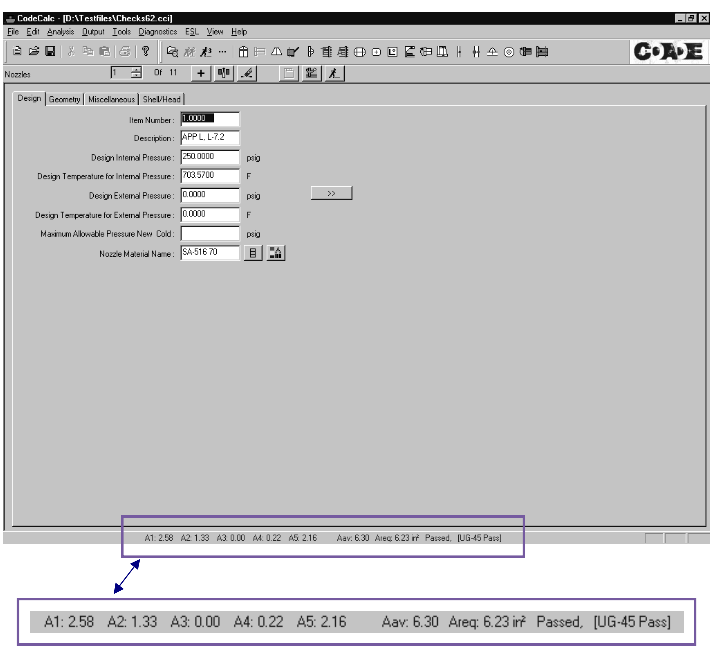


Figure 6 – Interactive Nozzle Calculations in the Component Analysis Processor

Other new features of the Component Analysis Module are:

- Trunnion Design
- Baseplate Design for Legs
- WRC 368
- Additional Material Database Search Capabilities

For a complete list of new features, visit our website at http://www.coade.com.

CAESAR II Development Status

By: Richard Ay

CAESAR II Version 4.30 was released to users (current on their update and maintenance plan) in March. This release has been well received by the user base. This release included a number of important changes which were detailed in the last issue (January 2001) of this newsletter. Subsequent to the release of Version 4.30, a "tips" document has been posted on the COADE website (http://www.coade.com) to illustrate some of the new features of this version.

Work on Version 4.40 has commenced, with a target release date of "1st Quarter 2002". Some of the major items to be included in this release include:

- The addition of the B31.11 piping code.
- Alternate alphabetic node descriptions.
- Incorporate necessary changes to implement a hydrotest load case.

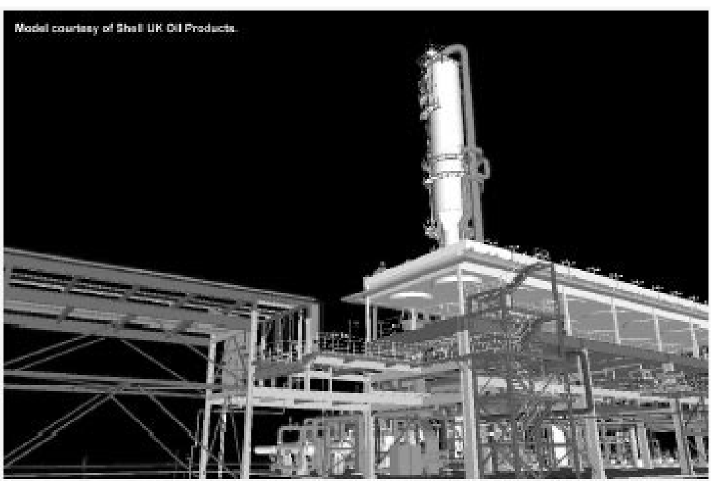
There are a host of other minor changes scheduled for this release, including: additional graphics updates, expansion of the configuration module, and the expansion of the "minimum wall thickness calculation" for all piping codes. In addition, a number of "user requests" will be addressed in this version.

CADWorx: Collaboration and Software Design

By: Vornel Walker

Many of you may have followed the progress of COADE's CAD product line, CADWorx, beginning in 1996 with the release of CADWorx/PIPE, continuing with the 1998 introduction of CADWorx/P&ID, and finally the recent release of CADWorx/LOOPS. Prior to developing CADWorx/PIPE, COADE made a commitment to make this product far superior to any other AutoCAD-based offerings available in the market.

We are pleased to say that we have achieved that goal and the CADWorx product line has proven itself to be head and shoulders above the competition when comparisons are made in the areas of features, benefits, cost, and customer support. But we have found that it is not always sufficient to be the best product available – it is often necessary to answer all potential needs as well – in other words, to offer a full suite of modules.



When the best cannot produce the best

The drive and focus of the CADWorx team has been the development of the best plant design system for the AutoCAD market. Tempered with that desire to produce the best was also the desire to deliver in a timely manner. For existing and potential users to be told that we will have the best 'XYZ module out in 2010' *AND* that it will be 'worth the wait' is not going to cut it.

So what is to be done if we want to offer the best to our end users but our resources are fully employed in providing increased functionality for our existing product range? Well there are three alternatives.

- Purchase a product for subsequent development.
- Re-badge another developer's existing product.
- Set up strategic alliances.

How do these options stack up?

Product Purchase
This seems like a good option for developers but all in all this sort of move is made towards packages that for some reason need further investment or resources to reach their full potential. At best, this could take a while before product is shipped; at worst, COADE, and the users, could be saddled with somebody else's problems.

Re-badging
This option (putting the CADWorx label on somebody else's product) has been used a lot by many companies and it may save on development resources. Even so the effort expended in making sure that the product and documentation have the look and feel of the rest of the product line can in it self be a major undertaking. Again, although quicker than purchasing a product for subsequent development, there is ultimately more work to be done as a one off, and the result cannot be built upon.

Strategic alliances
This idea is to find the best in the market and offer that solution with slight interface modifications 'as-is' to our end users. Our end users get what they come to expect (the best), they get it right away and they know that it will work with their current packages. Cool!

COADE Sets Up Strategic Alliance with LightWork Design

So where is all of this leading to? Well, COADE has decided to set up a strategic alliance with LightWork Design Ltd. LightWork Design is based in Sheffield in the United Kingdom and is a worldwide leader in the development and supply of 3D visualization software and author of NavisWorks a 3D real-time visualization and model review tool.

LightWork Design has recently completed the modification of NavisWorks to recognize CADWorx components in a CADWorx 3D model. The high level of functionality, the ease of integration and intuitive user interface has convinced COADE that this is a tool of substantial benefit to its users.

NavisWorks for CADWorx

With NavisWorks™ from LightWork Design, the whole design team – from the client's CEO in the boardroom in Boston to the architect in the drawing office in London to the project manager on site in Sydney – can review the current design in 3D on a standard PC. Using NavisWorks, team members can navigate smoothly through the design, talk about it, show each other changes they want to make, and keep everybody actively involved – no matter where they are.

NavisWorks means decisions are made more quickly and nobody misses important design changes. The project can move along faster, operate smoother, and finish on time. Viewing the 3D model in NavisWorks is easy. Using the same PC you use every day, you can navigate through the latest model of your design. Best of all, NavisWorks can easily handle the very large models generated by your design groups.

By bringing all of the design models together in NavisWorks, you can find design faults or flaws early in the project. **NavisWorks can automatically check and show you any areas where the models interfere, or "clash," with each other.** Catching these faults early – during the design process, rather than on site – saves both time and money.

3D CAD is becoming an integral part of the design process for many companies; the need to visualize different 3D CAD files together in one model has become vital. But past options for achieving this have been expensive. Design review hardware and software have cost too much, and required too much training to use them. NavisWorks is the first affordable solution for visualization and real-time navigation of large 3D models in multiple file formats with clash detection.

NavisWorks improves communication throughout the life of your project. As a result, you keep unwanted hidden costs to a minimum and meet your completion date. Communicating in 3D has never been simpler!

The NavisWorks Suite

The NavisWorks suite comes in three tightly coordinated modules: Roamer, Publisher and Clash Detective.

Roamer

For quick and easy to use 3D model reviews such as walkthroughs, flybys, model animation, sectioning, component identification and 'red-lining' markups.

Rendering applies the object colors and any scene lights which form part of the model. The model can be viewed as a shaded render, wire-frame or hidden line view. The user also has full control over lighting a scene giving the ability to set scene, head and ambient lights with varying intensity.

A variety of viewpoints can be set up to view the model from known positions and alignments. These can then be saved as favorites. On recalling favorite viewpoints the navigation mode that was active when the viewpoint was created will be re-activated. The beauty of being able to set viewpoints is that Roamer can use those points to automatically create straight-line animations from viewpoint to viewpoint. Additional view points can be inserted into the animation from which Roamer can automatically create the intermediate scenes in the animation. Additionally, the viewpoint retains the section plane active at the time of viewpoint creation, which can be useful in animating sliding sections.

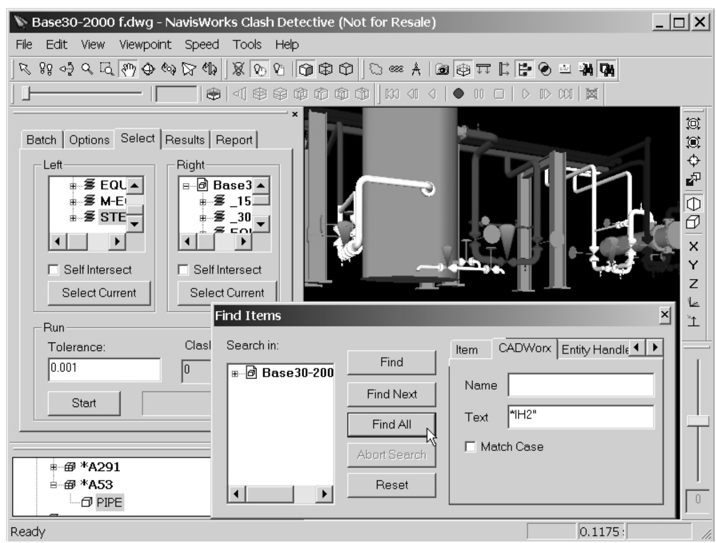
Publisher

Publisher includes Roamer capabilities and creates massive review models for use by NavisWorks Roamer and Clash Detective from multiple CAD packages and platforms. Publisher will also create PC based videos (AVI's) of animations run in using Roamer.

Clash Detective

Clash Detective includes Publisher and Roamer capabilities and performs collision checking on 3D models. Hard/Hard, Hard/Soft, Soft/Soft clashes are all catered for. Collision audit trails and full reporting of individual clashes is also provided.

Clash Detective checks your model(s) and shows you any areas where components interfere or 'clash ' with each other and allows you to manage your test criteria and results. From the Clash Detective control bar you can set up your clash tests, view the results, sort the results and produce detailed reports.



Managing a series of clash tests can get complicated, especially if you have a whole set of different layers you want to clash separately. The Clash Detective is designed to help you control these clash tests and leave an audit trail of clashes throughout the life of the project. One simple but time saving way it does this is by remembering the names of clashes throughout the project's life so you don't have to go through each clash every time you do a test to figure out whether it's a new clash, or one you have already seen and approved.

Clash Detective also allows you to assign a status to a clash and can update this status automatically, informing you of the current state of the clashes in the model. You can set up a batch of clash tests that you could run overnight, every night and for each test, choose the objects to clash against, along with the options for the test.

A clash test is a configuration of options and selections used in checking for clashes in a model. These are useful if you have set tests for your model and need to run them as a batch. You can create a number of different clash tests for a model and save them with the NavisWorks file set for later checking. If a project is large and requires multiple test criteria then multiple file sets can created. If tests from separate file sets are required at the same time, appending file sets together will merge the tests into a single list. Providing true project wide coordination of collision interference checking.

User Success Story

Shell UK's Stanlow Manufacturing Complex, in the United Kingdom houses the third-largest of the 53 Shell refineries worldwide. Stanlow processes 12 million tons of crude a year, and also manufactures petrochemicals. The 3.5 billion litres of petroleum Stanlow produces each year would drive a car around the world a million times. The two billion litres of kerosene Stanlow makes annually would fly 17,000 jumbo jets from Manchester, England to Los Angeles.

Stanlow Project and Plant staff have used NavisWorks to simulate new plant designs. This assists in determining best-practice processes for operation, health and safety at the new plant, and to train plant personnel.

"During the design of a new plant, NavisWorks provided the functionality to easily simulate the plant in 3D. We use it to train our personnel in the operation and safety procedures of the future plant. The software products we had previously used could only be run by CAD-trained people. We couldn't get the whole team involved.

Now that we have NavisWorks installed on a regular PC in a major plant control room, everyone in the plant control project can use it. This includes the people who are managing the design and the people who will operate the plant.

NavisWorks is the first viewer we've found flexible enough to really assist in our efforts to get the best out of our models."

Peter Fraser-Smith
Projects CAD Management
Shell UK Oil Products, Stanlow Manufacturing Complex

FAQ

What are the minimum computer requirements?

Whatever you run AutoCAD and CADWorx on will run NavisWorks, although NavisWorks (as will AutoCAD) will make full use of higher end graphics cards. Typically the NavisWorks models are so small that CAD models of many megabytes are reduced to just 100's of kilobytes.

Can I run Roamer by itself?

Yes and no. You will need Clash Detective or Publisher to produce the smaller NavisWorks files that can be manipulated by Roamer. This provides a cost effective solution, as only one copy of Clash Detective or Publisher is required for multiple installs of Roamer.

How are the programs packaged?

Each module is in fact a package.
Roamer can be purchased separately.
Each seat of Publisher includes Roamer functionality.
Each seat of Clash Detective includes Publisher and Roamer functionally.

How are the packages locked?

Using software locking that can be for individual seats or for floating network licenses.

Can NavisWorks recognize CADWorx objects?

Yes, NavisWorks has been optimized to recognize CADWorx objects during model navigation by their description, size and specification amongst other unique attributes.

Is NavisWorks Network enabled?

Yes.

How can I purchase NavisWorks for use with CADWorx?

Contact COADE (or your local NavisWorks dealer) for information.

Modeling of Internal Pressure and Thrust load on Nozzles using WRC 368

(by: Mandeep Singh and Dave Diehl)

The vessel-nozzle junction presents an unusual situation for stress analysis. Local areas of high stress occur near the junction because of the presence of the hole in shell wall and welds that attach the nozzle to the shell. The loads on the vessel-nozzle junction can be external (such as from the piping system) or can be due to internal pressure.

The Welding Research Council (WRC) Bulletins 107, 297 and 368, provide empirical methods, for calculating stresses at the vessel-nozzle junction. Many have asked how to model the thrust loads on the nozzle. WRC 368 addresses the internal pressure and the thrust loadings on the nozzle. In PVElite Version 4.2 we will implement WRC 368, as it can be a useful design aid. In this article, we examine various aspects of WRC 368 and how it affects the local stress calculations.

WRC 107 and WRC 297 provide the formulae for stresses resulting from external loading. WRC 107 has been discussed in two previous articles in June 1997, June 2000 newsletters. In this article, we will focus on stresses due to internal pressure.

Concepts

WRC 368 includes 2 loading components, the surface stress due to internal pressure and the pressure thrust load. Let's review the pressure thrust load.

Pressure Thrust

Pressure thrust is the force exerted on the vessel-nozzle junction due to the internal pressure. Figure 1 shows the arrangement of a typical vessel-nozzle junction.

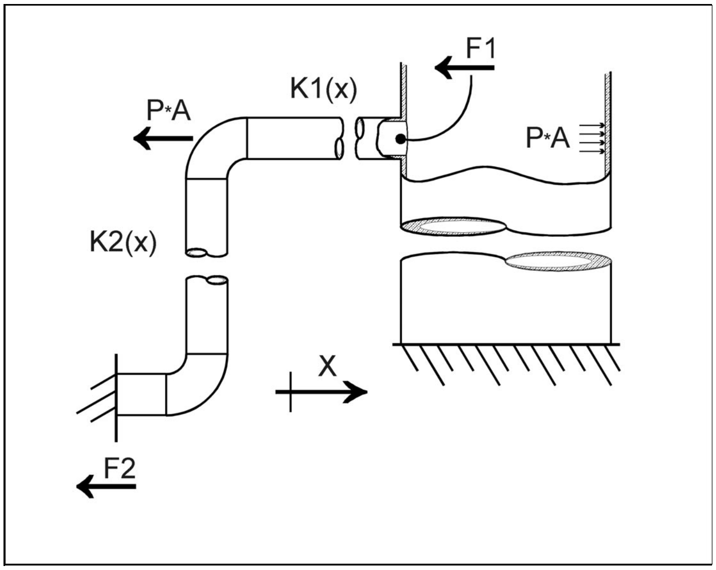
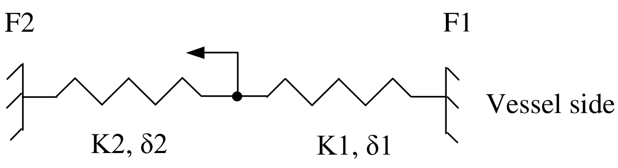


Figure 1

To illustrate further, let's assume the case of a nozzle attached to a vessel on one side and to the piping system on the other side. Let P be the internal pressure of the vessel and piping, and A be the inside area of the nozzle. Then the load of interest is P*A located on the elbow "upstream" from the nozzle, pointing away from the nozzle. The balancing force (P*A) acts on the vessel wall opposite to the nozzle and is shown in Figure 1. This balancing force is countered by the vessel support, which isolates it from the nozzle; hence it is not considered in this load evaluation.

The load on the vessel-nozzle junction will be a function of the stiffness between the vessel anchor and load (including any nozzle flexibilities) (Spring 1), and the stiffness of the system beyond the load (Spring 2). It can be visualized as two springs in series with the applied load between them.



The force F is in equilibrium with the two spring forces F1 and F2:

$$F = F1 + F2 \qquad (1)$$

The spring stiffness K and the displacement δ can be related as:

$$K1 = F1 / \delta 1$$
$$K2 = F2 / \delta 2$$

So:

$$F = \delta 1 * K1 + \delta 2 * K2$$

Since, δ1 = δ2, let's denote it by δ:

So:

$$F = \delta * (K1 + K2)$$
$$\delta = F / (K1 + K2)$$

Pressure thrust load on the vessel-nozzle junction:

$$F1 = F * K1 / (K1 + K2) \quad (2)$$

If the piping system on the other side of the applied load (Spring 2) is stiff, for example due to an anchor, then pressure thrust will be absorbed by the anchor. Thus, the nozzle will experience very little direct axial stress. This can be seen from equation 2. Note that a greater K2 results in a lower thrust force F1. Therefore, in this case including all of the pressure thrust into analysis will be conservative.

If on the other hand the run of pipe denoted by spring 2 is flexible (maybe due to an expansion loop) then the nozzle will see more of the force due to pressure thrust. Therefore, we should add the appropriate portion of the pressure thrust.

There can be another extreme case; if the nozzle has a blind flange then it will experience the entire force due to the pressure thrust. We must include the whole pressure thrust load for this case.

Hence, the amount of pressure thrust acting on a nozzle depends on the structural response of the system to a pressure load. If appropriate pressure thrust loads are applied to the piping and are analyzed, the structural load at the nozzle due to pressure can be calculated. More research is warranted in this direction, to determine the amount of pressure thrust the vessel-nozzle junction experiences. Note: Except for the pressure effect on expansion joints, the CAESAR II program does not automatically include piping loads due to pressure. Instead, the longitudinal pressure stress is simply added to the piping stresses where applicable as a scalar.

If we cannot accurately determine the amount of pressure thrust, there is a method that analyzes the thrust load more accurately. Here we will review WRC 368 and compare it with other current methods. WRC 368 applies the full load due to pressure thrust (P*A).

Let's look at the various categories of stress caused by internal pressure and pressure thrust load.

Primary Stress

Primary stress is necessary to satisfy the equilibrium conditions with the external imposed loading such as P*A, M/Z. It may also be called load-controlled stress (ASME Code Case N-47-28). Primary stresses are not self-limiting in nature and can cause ductile rupture or a complete loss of load carrying capacity due to the plastic collapse of the structure upon single application of load (ASME). Primary stress can be further sub-categorized as:

- General Primary Membrane Stress (Pm)
  This is the average primary stress across a solid section. It excludes the effect of discontinuities and concentrations. An example is stress in a cylinder due to internal pressure given by Pd/2t.

- Local Primary Membrane Stress (Pl)
  This is the average stress across a solid section. It is caused by external edge resultants developed because of the global discontinuities. Examples include stresses developed at the nozzle hole or at the small end of a conical reducer.

Secondary Stress (Q)

Secondary stress is developed as result of imposed strain. Secondary stress is a global self-limiting stress. Bending stresses and the stresses due to thermal expansion come under this category.

Peak Stresses (F)

Peak stress is a localized self-limiting stress. It causes no objectionable distortion except that it may be a possible source of fatigue failure. Fatigue analysis for the vessel-attachment junction is explained in the June 2000 newsletter.

Nomenclature

Following nomenclature is used in this article:

R	:	Mean Vessel Radius
D	:	Mean Vessel Diameter
T	:	Vessel Thickness
d	:	Nozzle Diameter
t	:	Nozzle Thickness

WRC 368, an Introduction:

WRC-368, entitled "Stresses in Intersecting Cylinders Subjected to Pressure" was released in 1991. WRC 368 provides an approximate method of calculating the maximum stress intensities due to internal pressure at cylinder-nozzle intersections. It is based on the finite element analysis program developed by Prof. C.R. Steele, FAST2. The same program was used in the development of WRC 297.

The method for design of nozzles, subjected to pressure, is given in many pressure vessel codes. A typical method is the area-replacement method. This method assures that the general primary membrane stress near the opening remains below the level of stress before the hole was made. This method does not consider the local primary membrane stresses and bending stresses. The WRC 368 method provides the maximum value of membrane stress intensity (general and local, Pm+PL) and the membrane + bending stress intensity (Pm+PL+Q). Moreover, these stresses are calculated in both the shell and the nozzle. Therefore, WRC368 considers two additional criteria of failure, in addition to the case checked by the area-replacement method.

The FAST2 program, used for creating this Bulletin, applies the full pressure thrust force on the nozzle along with the internal pressure. Therefore, it can be deduced that WRC 368, which is based on FAST2 program, also includes the pressure thrust force on the nozzle. This was further confirmed by one of the authors of WRC 368. It is important because WRC 368 provides much better modeling of the pressure thrust load than the other current methods. Let's compare the analysis methods WRC 107, FEA and WRC 368.

Comparative Study:

Here we will compare the results from analysis performed using the following methods:

1. Pd/2t: This approach uses the general primary membrane stress equation (Pd/2t) for calculation of internal pressure stress. This method is used in the WRC 107/297 module in COADE's programs (CAESAR II, CodeCalc and PVElite), as WRC 107/297 only address external loads. For this approach we did not include the pressure thrust load, see Figure 2.

2. Pd/2t + full Pressure Thrust, Pd/2t + PT(107): This method uses the methodology of WRC 107. In addition to pressure, the whole thrust load (P*A) is applied as a load along the axis of the nozzle. Here we would check the box to include the pressure thrust load.

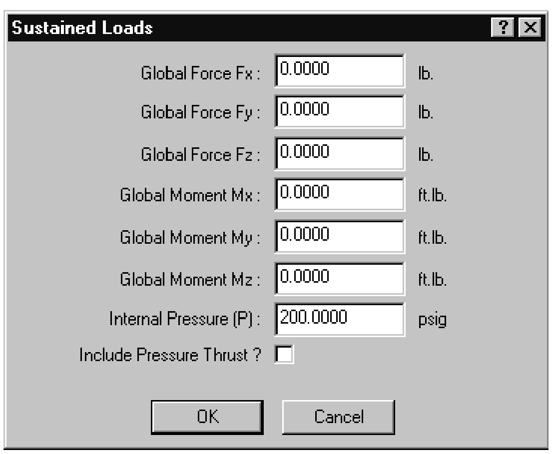


Figure 2

3. WRC 368: Here we used the WRC 368 feature implemented in CodeCalc/PVElite, to activate it click on the appropriate check box as shown in Figure 3. The Loadings include internal pressure and the full pressure thrust load on vessel-nozzle junction.

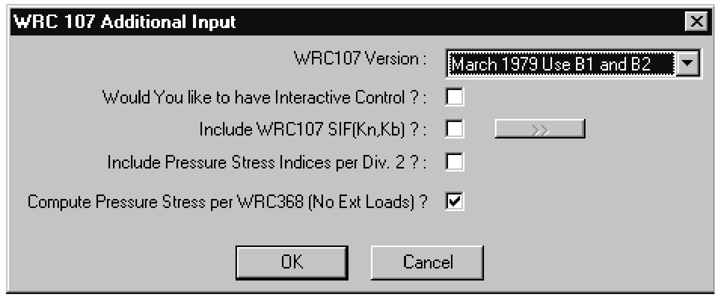


Figure 3

4. FEA: The NozPro finite element program, developed by Paulin Research Group, is used to analyze the models. This program also applies the whole pressure thrust load. Links to this program are conveniently provided in the WRC 107 module in CodeCalc/PVElite.

Internal Pressure only and No Pad:

First, we will do a comparison with internal pressure, no external loads and no reinforcement pad. However, the pressure thrust is an external load, it is considered here because it occurs when the system is pressurized.

Vessel:
Mean diameter: 70 inch
Thickness: 1 inch
Length: 220 inch

Nozzle:
Mean diameter: different runs at 14, 21, 28, 35 and 40 inch
Thickness: .875 inch
Length: 20 inch
Pressure: 200 psi

Let's check if these models are within the geometric limitation of WRC 107/368. The models with nozzle mean diameters of 21 inch to 40 inch exceed the curves used for calculating the bending stress due to radial load on the nozzle (in this case, the pressure thrust). This becomes more pronounced as the nozzle diameter increases. We will see later that this may have an effect on the accuracy of the bending stresses due to the thrust load.

The d/D ratio for the model with the mean nozzle diameter of 40 inches is 0.571, which exceeds the limitation of 0.5 in WRC 107/297/368.

Figure 4 displays the finite element mesh and the contour of the secondary stress, for the model with nozzle mean diameter of 14 inches.

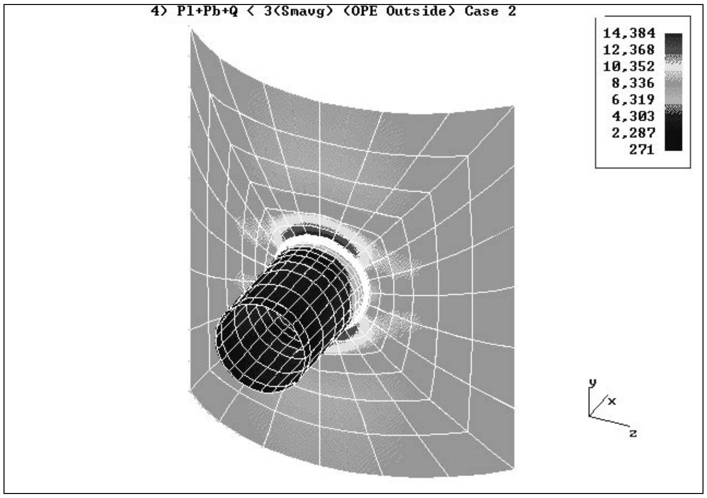


Figure 4

An important parameter in this evaluation is the d/D ratio (nozzle mean diameter/Vessel mean diameter). Therefore, to see its effect we varied the nozzle diameter from 14 to 40 inches, while keeping the rest of the geometry constant. The variation of the primary membrane stresses is shown in the Figure 5. The stresses from WRC 368 and from Pd/2t + PT(107) are close, the stresses from FEA taper off with the increasing d/D ratio.

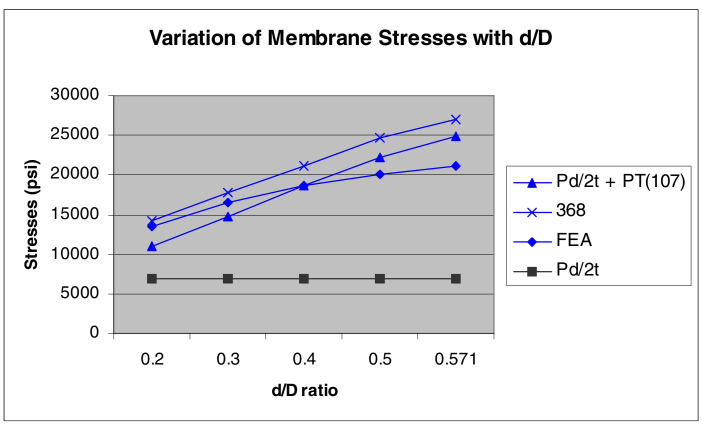


Figure 5

Figure 6 shows the variation of the membrane + bending stresses compared to the d/D ratio. Notice the increase in the stress values from the Pd/2t + PT(107) method with the increasing d/D ratio. If the allowable stress for this case is 60, 000 psi (3*S_{mavg}, for SA-516 70), the design fails miserably per Pd/2t + PT(107) method. However, it still passes when analyzed with FEA and WRC 368 methods!

The reason is simple, as the nozzle diameter increases; the thrust load (P*A) increases by the square of that amount and becomes a significant number. The tests used for preparing WRC 107 did not include internal pressure. Hence, the method Pd/2t + PT(107), does not properly address the pressure issues, especially for the bending stress. Another point to note is that for this method, the curve used for calculating the bending stress due to the thrust load was exceeded. In other words, there was no data available in WRC 107 for this case. Then program used the last value available on the curve, which introduces an inaccuracy. Hence, the increase in stress values from Pd/2t + PT(107) will also be affected by this.

The results from WRC 368 and FEA are relatively close. Indicating that, WRC 368 can be used as a design tool, if performing a finite element analysis is not an option.

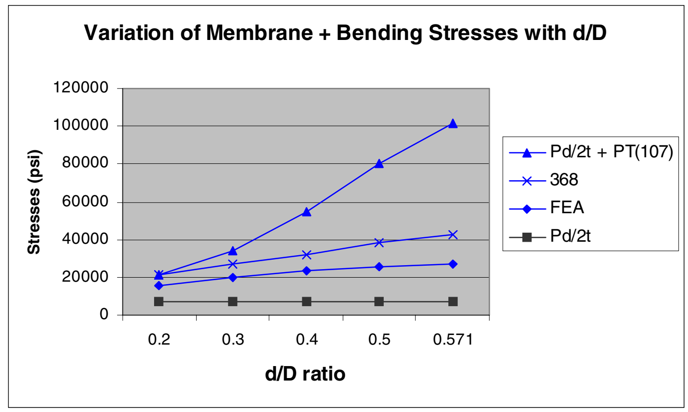


Figure 6

Stresses from the pd/2t method are much smaller than the other methods that additionally include the pressure thrust effect. Pressure thrust load can make a significant effect on stress level around the vessel-nozzle junction. Hence, it useful to check the system and estimate if any pressure thrust load exists.

Due to a more accurate analysis performed by FEA, this design still passes with the full pressure thrust load. We can also see that the accuracy of the WRC methods decrease with an increasing d/D ratio. The points with maximum membrane + bending stress per the FEA, are located in the longitudinal plane (shown in Figure 4), corresponding to the points A and B in the WRC 107 convention. However, WRC 107 reports areas of high stress near points C, D along the circumferential plane. That again suggests that WRC 107 is not appropriate for modeling the pressure loadings.

Reinforcement pad

WRC 107, 297 and 368 do not consider a reinforcement pad. WRC 368 recommends a rule of thumb that has been used successfully and provides somewhat accurate and generally conservative results.

If

$$\text{Pad width} > 1.65 * \sqrt{RT} \quad \text{and} \quad > \frac{d}{2}$$

then the shell thickness can be increased by the amount of pad thickness. This ensures that the pad be at least as wide as the region of discontinuity stress around the hole. If the pad does not satisfy these limitations then it should be ignored in the analysis. When the pad is not considered because of this limitation, the results from WRC 368 can be significantly conservative.

Internal pressure and External loads

To get a complete analysis of the vessel-nozzle junction, the stresses from external loads and ones from internal pressure should be combined. We considered using WRC 368 pressure stresses with the 107/297 stresses due to external loads in the section VIII Div 2 stress summation. However, there are some obstacles to this approach. The main reason is that WRC 368 provides the maximum stress intensity, but lacks information about the location and the orientation. On the other hand, the equations given in WRC 107/ 297 calculate the stresses at different locations around the vessel-nozzle junction and assign proper signs and directions to the stress values.

It is not possible to accurately calculate the stress intensity value due to the combined loads, using WRC 368 along with WRC 107/ 297. However, WRC 368 recommends that an upper bound on the combined stress can be obtained by adding the absolute value of the maximum stress from external loads to the results from WRC 368. This resulting combined stress can be quite conservative depending upon the stress distribution, as the maximum stress due to external loads and pressure can occur at different locations. Moreover, the stresses from these 2 loading conditions can also act in opposite directions to reduce the combined effect.

Limitations of WRC 368

WRC 368 has geometric limitations similar to those traditionally applied to WRC 107 and 297:

- $10 < D/T < 1000$
- $4 < d/t < 1000$
- $0.1 < t/T < 3$
- $0.3 < Dt/dT < 6$
- $0.3 < d/\sqrt{Dt} < 6.5$
- Nozzle must be isolated (it may not be close to a discontinuity) – not within $2.5\sqrt{RT}$ on vessel and not within $2.5\sqrt{rt}$ on nozzle.
- Results are based on nozzles extending normal to the vessel, on the outside only.

WRC 368 only addresses cylinder-to-cylinder intersections loaded under internal pressure. When these limits are exceeded then the results will not be as accurate.

Conclusions

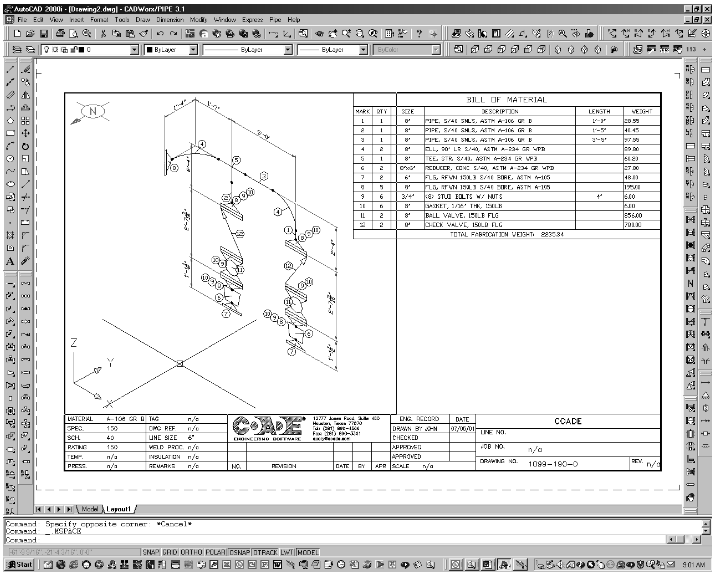
We have shown that for cylinder-nozzle junctions, under internal pressure only, WRC 368 is a better tool than the pd/2t + PT(107) method, assuming that FEA is most accurate. It provides a much more accurate modeling of the pressure thrust effect when the full thrust load acts on the vessel-nozzle junction, such as in case of a nozzle with a blind flange. Unfortunately, there is no option to control the amount of thrust load. Hence, WRC 368 will be conservative, in cases where only a portion of the thrust load acts on the nozzle. However, because of better accuracy than pd/2t + PT(107), the results may be more reasonable (as seen in the case above).

Utilizing WRC 368 along with WRC 107/297 is not very accurate for calculating the combined stress from pressure and external loads. This is because WRC 368 does not provide information about the location and the orientation of the stresses. However, if the stress analyst has an estimate of the pressure thrust, then a feasible option is to use the pd/2t + PT(107) method and instead of the full thrust load enter the estimated value in the radial load input (with proper signs). The analyst should also note that the results of WRC bulletins will be less accurate if the model exceeds the geometrical limitations or if the curves used for calculating the stresses are exceeded. If the analyst does not have an estimate of the thrust load, he or she can put the whole thrust load and watch-out for very high values of Membrane + Bending stresses. In those cases, WRC 368 can be used to check the pressure stress levels, or advanced analysis tools such as finite element method can be used to obtain accurate combined stress.

Overall, knowing the benefits and limitations of WRC 368, it can be a useful design aid.

Converting a CADWorx Paper Space Isometric to a Flat 2D Model Space Isometric

By: John Brinlee



This exercise is designed for CADWorx users who would like to have the option of creating a "traditional" Flat 2D Isometric drawing in AutoCAD Model Space from the default Paper Space/Model Space Isometric which is created using CADWorx' Automatic Isometric tool. This exercise could also be used to create a Flat 2D Stress Isometric from the stress isometric created using the CAESAR II/System In/Stress Iso utility in CADWorx/Pipe.

Requirements: ***IMPORTANT***
You must have the AutoCAD Express Tools loaded on your system

in order to achieve this conversion. Standard CADWorx or AutoCAD commands are shown in black bold italics, Express Tools commands are shown in red bold italics.

Step 1: Go into model space and explode all entities located in model space. Change your view to PLAN.

Command: EXPLODE
Select objects: ALL
Select objects: <CR>

Command: TILEMODE
Enter new value for TILEMODE <0>: 1

Command: PLAN
Enter an option [Current ucs/Ucs/World] <Current>:<CR>

Step 2: Return to paper space and with the Mview active select Layout Tools/Change Space ms/ps from the Express pull down menu. Type in ALL at the command line and hit enter to accept. At this time all entities that existed in model space in the drawing will be moved into paper space.

Enter new value for TILEMODE <1>: 0
Restoring cached viewports - Regenerating layout.
Command: MSPACE
Command: CHSPACE
Initializing...

Select objects: Specify opposite corner: 115 found, 19 groups

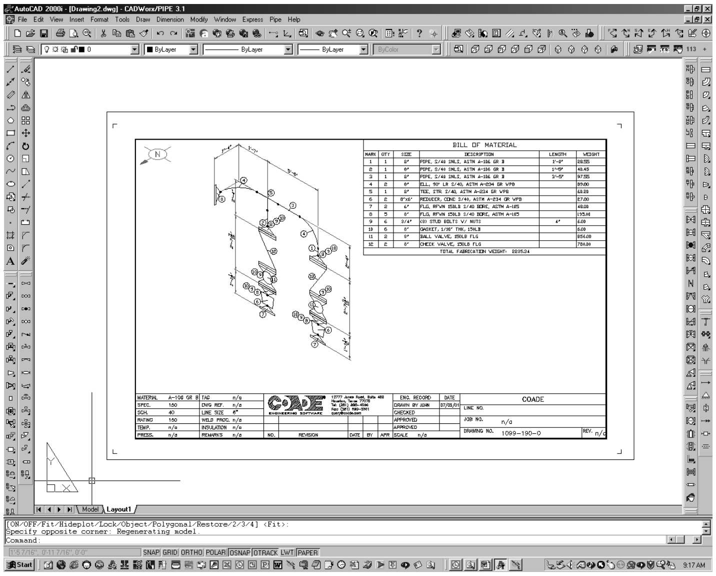
Select objects:
115 object(s) changed from MODEL space to PAPER space.
Objects were scaled by a factor of 1/16" to maintain visual appearance.

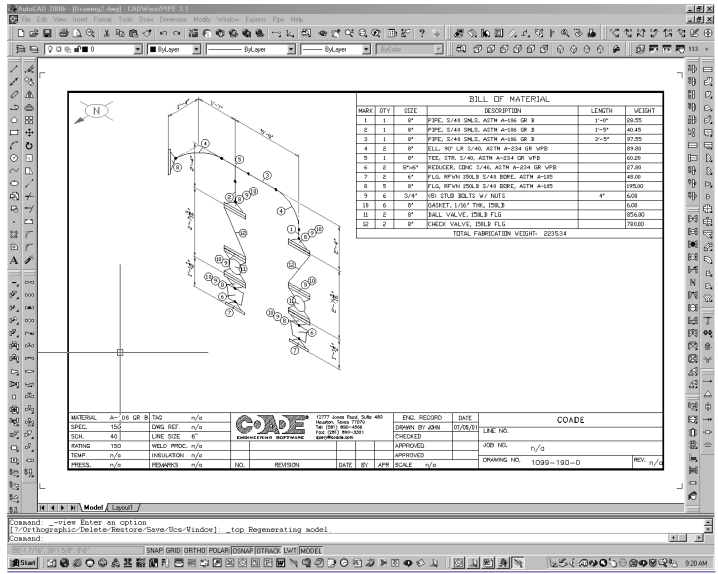
Step 3: From the Express pull down select Modify/Flatten Objects and select all the entities previously moved from model space to paper space by crossing or window. Answer NO to "Remove Hidden Lines?"

Command: Flatten
Select objects to convert to 2d...
Select objects: Specify opposite corner: 671 found, 31 groups
Select objects:
Remove hidden lines? <No><CR>

Step 4: Turn ViewL layer on and erase the original Mview created by AutoIso. Next execute the MVIEW command to create a new Mview in paper space to encompass all the items in the drawing including the border.

Command: MVIEW
Specify corner of viewport or <PICK A POINT OUTSIDE THE BORDER>
[ON/OFF/Fit/Hideplot/Lock/Object/Polygonal/Restore/2/3/4] <Fit>:
Specify opposite corner: <PICK ANOTHER POINT OPPOSITE FIRST POINT>Regenerating model.





Step 5: From PSPACE select Layout Tools/Change Space ms/ps from the Express pull down menu. Type in ALL at the command line and hit enter to accept. At this time all entities that existed in paper space in the drawing will be moved into model space. If you like you can erase the Mview at this time to clear the layout.

Command: chspace
Select objects: ALL
897 found
Select objects:
58 objects were not in the current space.
Ignoring 1 selected viewport(s).
838 object(s) changed from PAPER space to MODEL space.
Objects were scaled by a factor of 4 5/8" to maintain visual appearance.

Toggle to model space and your drawing should now look like this:

Command:
TILEMODE
Enter new value for TILEMODE <0>: 1
Restoring cached viewports.

CAESAR II Utility Programs

By: Richard Ay

This article discusses several small utility programs that have been developed to aid users of **CAESAR II**. These utility programs can be acquired by downloading them from the **CAESAR II** download area of the COADE web site (http://www.coade.com). The utilities discussed in this article are:

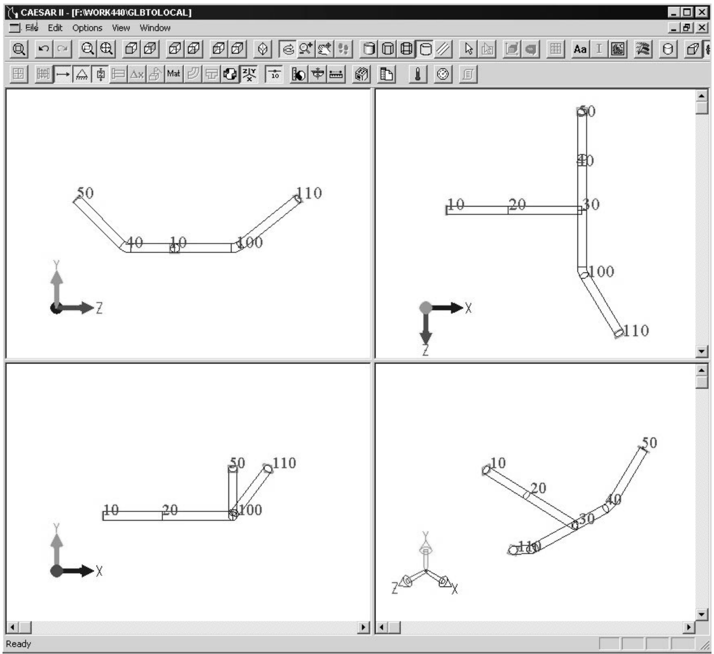
- Global to Local Coordinate System Transformation
- (User) Material Database Merge Facility

Global to Local Coordinate System Transformation:

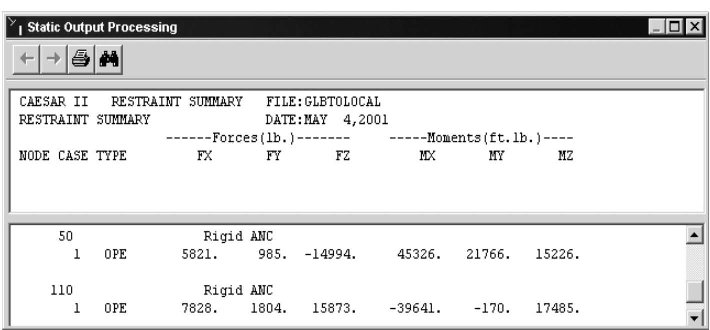
COADE has received more than one request for restraint loads in “local coordinates”, or displacements in “local coordinates”. This really doesn’t make any sense, since “points” don’t have a “local coordinate” system, only elements have a “local coordinate” system. (If you need a refresher on local coordinate systems, please review the associated articles in previous issues of *Mechanical Engineering News* – December 1992 and November 1994.)

What does make sense is to want displacements or restraint loads aligned with the local coordinate system of an associated element. If there was not the possibility of multiple elements being associated with a node, this would be a trivial report for **CAESAR II** to generate. However, for a restraint on the curvature of a bend, what is the local coordinate system? Additionally, you typically need the local coordinate system for only one or two elements in a model.

To answer this request, a small conversion utility has been developed. This program, GlbToLocal, transforms a set of data from the default **CAESAR II** global coordinate system (Y axis up) to the local coordinate system defined by a specified element. As an example, consider the small model below.



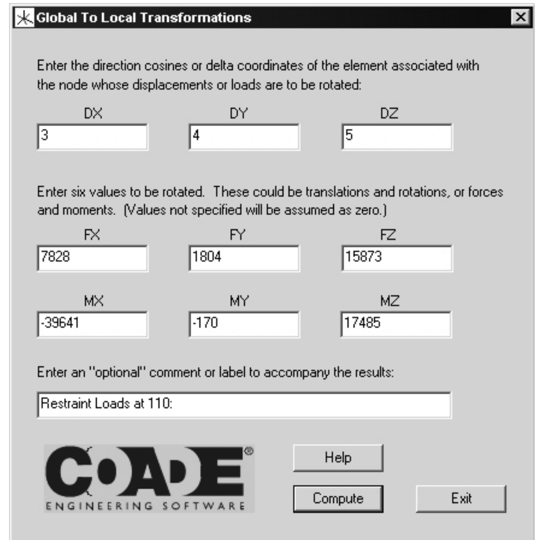
The leg from 40-50 is skewed in the YZ direction, while the leg from 100-110 is skewed in all three (XYZ) directions. Suppose one wanted to know what the restraint loads were, at 50 and 110, aligned with the connecting pipes. (Yes you could look at the local element force report and flip the signs, but suppose these nodes were not anchored and you wanted displacements aligned with the pipe element.) The global restraint summary is shown in the figure below.


Static Output Processing

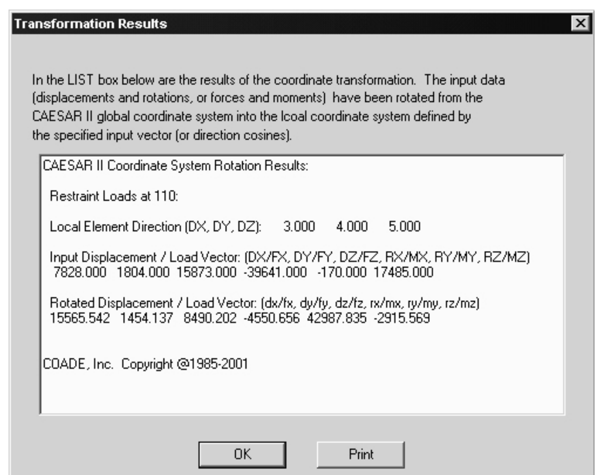
CAESAR II RESTRAINT SUMMARY FILE:GLBTOLOCAL
RESTRAINT SUMMARY DATE:MAY 4,2001

NODE	CASE	TYPE	FX (lb.)	FY (lb.)	FZ (lb.)	MX (ft.lb.)	MY (ft.lb.)	MZ (ft.lb.)
50		Rigid ANC						
	1	OPE	5821.	985.	-14994.	45326.	21766.	15226.
110		Rigid ANC						
	1	OPE	7828.	1804.	15873.	-39641.	-170.	17485.

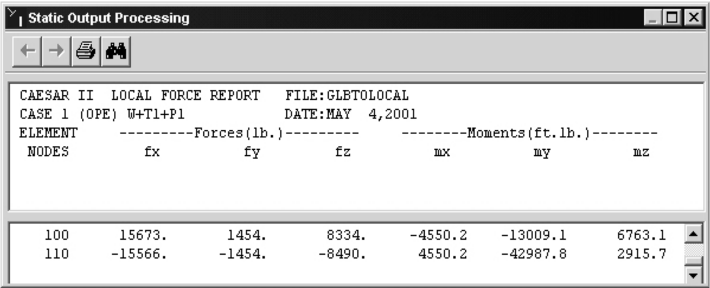
What would be the restraint loads at node 110, aligned with the element 100-110? In order to determine the "local" restraint loads, we must be able to specify the direction of the "local x" axis. This is accomplished by using the "delta coordinates" of the associated element, 100-110 in this case. These delta dimensions are: DX=3ft, DY=4ft, and DZ=5ft. All the necessary data is now available. Invoke the GLBTOLOCAL utility program. This produces the dialog shown in the figure below.



The element's delta coordinates have been specified, as well as the "global" restraint loads. An optional label has also been defined for labeling purposes. Clicking on the [Compute] button produces the output screen, shown below. (Note here that we follow the standard **CAESAR II** global coordinate system when specifying this input. The output represents that same data, rotated into the local coordinate system defined by the direction cosines specified in the input.)



This output dialog shows the specified element direction, the specified global data, and the resulting "local" data. In this instance, the rotated (local) load vector should match the loads at node 110 shown in the "Local Element Force" report, with a change in sign. This report is shown in the figure below.



Comparing these two dialogs, we see that the loads due indeed match, with a change in sign.

Additional usage tips can be obtained by clicking on the [Help] button on the main dialog.

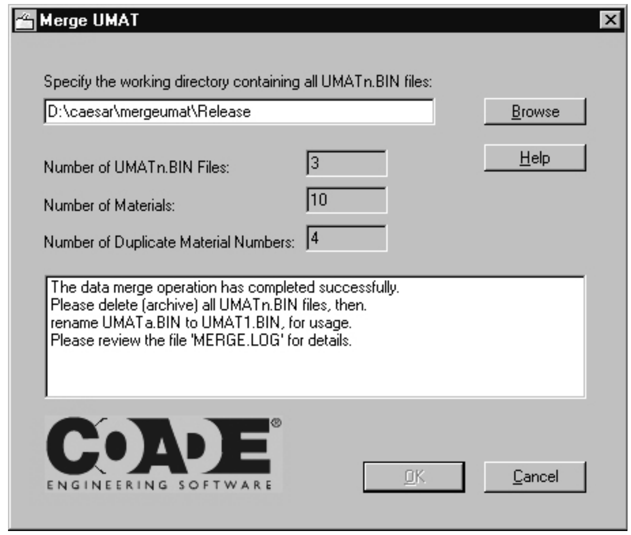
(User) Material Database Merge Facility:

Piping material information is distributed with **CAESAR II** in the file named CMAT.BIN, located in \Caesar\system, where \Caesar is the installation directory specified by the user. The contents of this file cannot be modified by the user.

Sometimes it is necessary to add materials to the database, or adjust materials already in the database. Since CMAT.BIN cannot be modified by users, an alternate material file is used. This alternate material file is named UMAT1.BIN, and is also located in \Caesar\system. All user additions or modifications are stored in UMAT1.BIN. (Prior to Version 4.20, the user material file was named UMAT.BIN. Version 4.20 changed and expanded the format of the material database, hence the name change.)

The use of UMAT1.BIN allows users to add materials to the **CAESAR II** material database, and to correct, or adjust, COADE supplied materials found in CMAT.BIN. **CAESAR II** reads CMAT.BIN first, then updates the memory image with the contents of UMAT1.BIN. Therefore, if the same material is found in both files, the data from UMAT1.BIN takes precedence.

The purpose of this utility, MERGEUMAT, is to give a manager or lead engineer the ability combine multiple UMAT1.BIN files. This will be necessary if multiple users have created their own UMAT1.BIN files (although if different users have reused the same material number, manual intervention is necessary). This utility will combine various UMAT1.BIN files into a "*master*" UMATa.BIN, to be renamed by the user to UMAT1.BIN.



MERGEUMAT assumes that all user material files have been transferred into the same data directory, and that all the files have been renamed to umat1.bin, umat2.bin, umat3.bin, etc. The merging operation will combine all (unique) data into UMATa.BIN. After the merging operation, the old UMAT files should be archived, and UMATa.BIN renamed to UMAT1.BIN. This new UMAT1.BIN should then be copied into \caesar\system for subsequent use by the program.

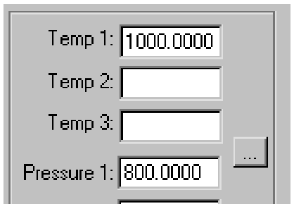
Additional usage details can be obtained by clicking on the [Help] button on the MERGEUMAT dialog. The download file also contains a detailed document describing the usage of this utility and shows example output.

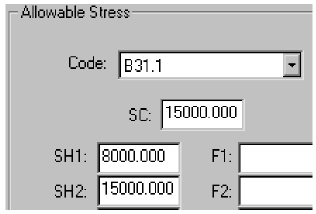
CAESAR II S_l / S_h and B31.3 / B31.1

By: John C. Luf - Washington Industrial / Process Group
Cleveland, Ohio

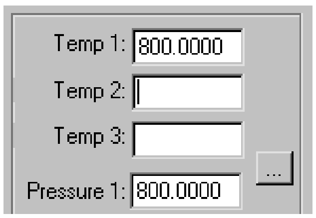
CAESAR II Problem?

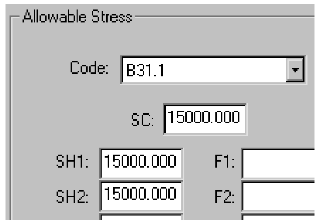
"**CAESAR II** is acting up…. It seems to ignore what we want it to do." This was the latest problem to occur on a recent project. As it turns out, what **CAESAR II** was being asked to do, it wasn't intended to do. On the particular job the designer decided to use the S_h value for the "Design Temperature" of the piping system being analyzed. In some or most cases the Design Temperature was well above the system's maximum operating temperature. So when a model was created the specific ASTM designated material was selected from the material drop down box along with a piping code (in this case B31.1). Then the design Temperature was input so that the program would automatically fill the S value boxes.





Then the actual maximum operating temperature would be typed in for T1, T2 etc.



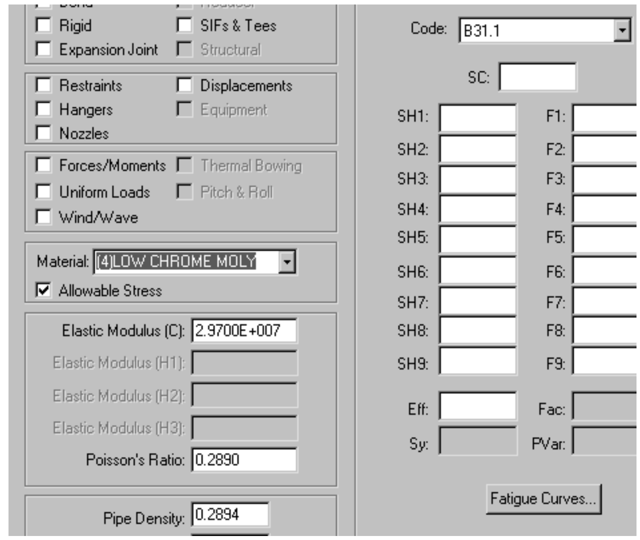


Note: SH1's *S* value changes to a different value. The analyst would then manually type in the previous *S* value and then move on. Well all appeared well but in some files when reviewing the Sustained loading code stress report often times **CAESAR II** would ignore the lower S_h value and the report would compare loading against the higher value, hence **CAESAR II** was "wrong".

Well the database feature has been a part of the program since the days of the DOS, **CAESAR II** V3.24. So I had doubts as to the fact that suddenly **CAESAR II** was broken! After discussing the situation with Richard Ay (COADE) I soon realized what was occurring was that the procedure being used was confusing the program… (Remember what happened when Human Beings gave Hal 9000 mixed Instructions!)

When you see the *S* values in the input windows' boxes you assume that those are the numbers that will automatically be used in the code stress summations. However they may or may not be used. When the input file is error checked the program looks at a complex set of instructions and based upon its interpretation of the logic instructions, and the user's input, it then looks up the S_h value to be used in the Code summations from the materials data base. Unfortunately **CAESAR II** can select the wrong value (if users have manually specified some S_h for database materials, changed materials back and forth, left some S_h values unspecified, or mixed database and non-database materials - all these things can cause problems), and may think you want it to use the number for the lower temperature. So how can you eliminate the confusion?

The best way to eliminate the confusion (and possible error) is to use one of the "generic" materials in the drop down list…



Note the S_h Values are zeroed out. This is because although the program knows what expansion coefficients, material properties etc. to use for Chrome Moly pipe it has no specific data to look up the code *S* value against.

Why?

After the fix was determined I asked the question… "Why do you want to use the design temperature of the piping specification to set the value for S_h instead of the maximum operating temperature?" The response was "The B31.1 code requires it!" for the review of S_l stresses. To say that I was surprised was an understatement!

So what does B31.1 and B31.3 have in mind for the basis of S_h, Design Pressure, Design Temperature, Thermal Displacement Calculations / code compliance, and Sustained loading Calculations / code compliance?

As always I find it helpful to look for answers within the specific code (in this case B31.1) and external sources (including other B31 Codebooks). The readers should note that at one time there was only one piping code B31 (1942 American Standard for Pressure Piping) with B31.3 making its first publication in 1959 (Ref.1)

These two codes share many things in common starting with the simple fact that they are intended for above ground piping systems that require engineering review/ evaluation in some cases.

My previous article used B31.1 to fill in a missing formula in B31.3 now it is B31.3's turn to reciprocate and supply a pair of definitions missing in B31.1.

Per B31.3a-2000 under the definitions states that…

Design Temperature *para 301.3* – The design temperature of each component in a piping system is the temperature at which, under coincident pressure, **the greatest thickness or highest component rating is required** in accordance with *para 301.2* (To satisfy the requirements of *para 301.2,* different components in the same piping system may have different design temperatures.) In establishing design temperatures consider at least the fluid temperatures, ambient temperatures, and the applicable portions of *paras. 301.3.2, 301.3.3,* and *301.3.4.*

Design Pressure *para 301.2.1* The design pressure of each component in a piping system shall be not less than the pressure at the most severe condition of coincident internal or external pressure and temperature (minimum or maximum) expected during service except as provided in *para 302.2.4*

So why does the B31.3 set of definitions offer more insight than the set of definitions that B31.1 has? *It should be noted that B31.1 also has excellent advice on these two subjects (this is again another time when both codes complement each other and offer the thorough reader the best advice).* Well B31.3 specifically talks about pressure wall or pressure thickness requirements as it refers to both of these terms. B31.1 makes no direct reference to this, as does B31.3!

Pressure calculations are a separate consideration of piping analysis. In actuality piping specifications are written to cover stated design conditions (stated within the specification). Generally the specification design range is set by the lowest rated component contained within the specification. Usually this is the ANSI flanges contained in the specification. This means that the Design Temperature can and often does exceed the actual maximum operating temperature of a piping system!

In other words the specification writer's definitions for Design Temperature and Design Pressure have in some cases no bearing on the actual system being analyzed. Indeed if we look at Sustained Load stresses S_l discussed in B31.3 and B31.1 we see that they shall both be < or = to S_h. The value for S_h as stated in B31.3 is… "basic allowable stress at maximum metal temperature expected during the displacement cycle under analysis" In B31.1 we see S_h as simply the allowable stress at the maximum temperature.

So what essential *variables of pressure and temperature related stress values* should be used for the evaluation of sustained stresses? Simply put, these should be the maximum temperature and pressure that a system will operate at. If a piping specification's Design conditions are higher, that's fine; don't mix a piping specification's design ratings with a piping system's analysis.

B31.1 speaks for itself!:

One of my editors, who is a person more literate than myself in the B31.1 code, has asked me to add these paragraphs.

B31.1 provides some direction and clarification on the issue of pressure design, "Design Temperature" and piping flexibility analysis.

In the section titled "Pressure Design of Components" *para 104.1.2 (A)* The value of SE being used to calculate the pressure wall in formula (3) uses the "Design Temperature" for its value.

Turning then to the section titled "Limits of Calculated Stresses due to Sustained Loads and Thermal Stresses" S_h the value being used in the calculation of S_L defines S_h as "maximum (hot) temperature."

Clearly the B31.1 sub committee separates the issue. Or as my editor states "I don't believe this distinction is a mistake on the part of the sub-committee, but is intentional. This should not be lost on the reader."

Summation Points:

- ✓ Read more than one code, B31.1 and B31.3 are excellent resources and complementary to each other.
- ✓ In Ref. 1 Design Temperature and Design Pressure are expounded upon in Chapter 2 "Pressure Design of Piping & Piping Components". This adds reinforcement to the idea that Design Temperature and Design Pressure pertain specifically to pressure design, rather than flexibility analysis.
- ✓ If the design limits exceed the maximum temperature and pressure of the system being analyzed IT IS NOT A B31 (.1 OR .3) REQUIREMENT TO ANALYZE TO THESE NON ACHIEVABLE LIMITS! This means that S_l, S_E, S_A, as well as the S_h stress allowable should be based solely upon the maximum operating temperature and pressure.
- ✓ If you wish to use a non-code allowable design stress value use the generic materials in **CAESAR II**'s drop down material window, NOT A SPECIFIC ASTM MATERIAL.
- ✓ Broaden your knowledge on the subject matter, read texts on the subject matter such as Ref. 1
- ✓ Read the lines and in-between the lines of text in your code-books carefully. In case of doubt seek the advice of another person recognized in the field. In our current state of technology this is easier than ever to accomplish.

A great deal of thanks to my Editors:

Richard Ay	COADE
Phil Ellenberger	WFI
Robert Heisler	Air Products and Chemicals
Glynn Woods	Technip

Reference:

1)Woods, Baguely "Practical Guide to ASME B31.3", ISBN 0-9696428-4-9

CADWorx Success Story – Malcolm Pirnie Goes 3D

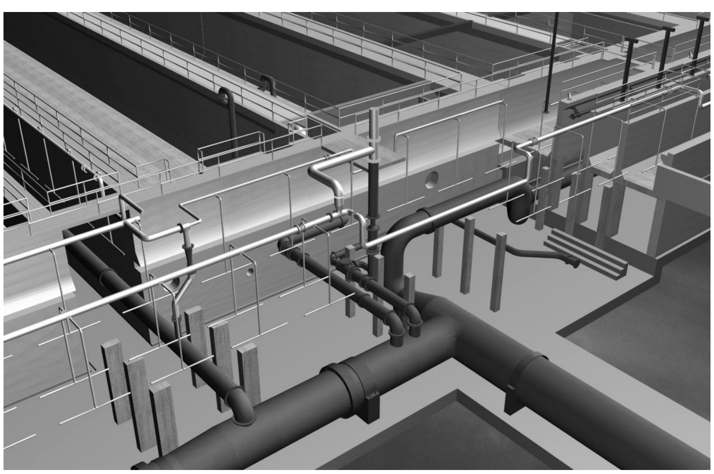
By: Vornel Walker

Nationwide environmental engineering consulting firm discovers advantages of ***CADWorx*** *software*

Orchard Park, New York – Imagine that you've been asked to upgrade a municipal wastewater treatment plant that was built nearly fifty years ago. Original drawings are available, but they haven't been updated in years. Would you take the job? Malcolm Pirnie, one of the nation's leading environmental engineering consulting firms, did. It not only accepted the job, but also decided to redraw the plant in 3D. To do the job, the firm used an AutoCAD-based software package called **CADWorx/PIPE** from COADE, Inc. (www.coade.com) — the only off-the-shelf software package that has the piping components for designing water treatment systems.

Choice of software just "fell into place"

"It's very interesting how everything just fell into place on this project," begins Tim Shafer, CADD Manager for Malcolm Pirnie's Buffalo, New York office. "We had considered buying a copy of **CADWorx/PIPE** for some time. Then this project came along and afforded us the perfect opportunity. The more we looked at this job, the more that 3D just seemed to be the obvious choice. Coincidentally, our client had also been evaluating **CADWorx**, and they were happy to have the project done in 3D. So we purchased our first seat of **CADWorx** and went right to work."



Lays out pipe within hours of CADWorx training

Learning to use the software was the easy part, reports Shafer. "We had one day of training from our AutoCAD reseller, CADD Ed Software Solutions of Batavia, New York, and then we hit the ground running. **CADWorx** was easy to learn and easy to use. After a couple of hours of training, we were laying out pipe."

Shafer reports, "The challenging part was not the software, but rather the record drawings we had to work with. Some of them dated back to 1953, and none of them were 100% accurate. The client's plant had been extensively modified over the years, and for most areas accurate record drawings simply did not exist. We had to fill in the 'gaps' before we could start laying out the new work."

Documenting the undocumented

Shafer and his team used a very creative approach of taking photographs and shooting videotape throughout the plant as the project got underway. The combination of the visual records they took plus the 3D capabilities of **CADWorx** paid some huge dividends.

"It seemed like we encountered challenges at every turn. Basically, we had to perform 'as built' measurements of nearly two-thirds of the client's plant before we could start any new work. The development of these drawings was, if anything, more difficult than laying out the new pipe. We were demolishing a lot of existing piping and, in the congested pipe galleries, every inch of pipe and clearance was important. So, we weren't able to work on the new piping until we had the old stuff accurately mapped. Being able to view the system 'virtually' back in our office using **CADWorx** was a big help."

Still pictures and video integrated into plant database

Shafer continues, "Our original goal was to build the model in 3D, but we went beyond that. We actually linked the **CADWorx** model to a GIS database using AutoCAD Map. If you click on a section of pipe, information such as the year the pipe was installed, the length of the pipe, its material and size, and other information can be displayed. Plus it displays still pictures and video footage. It's very powerful to have all this information available within the AutoCAD environment. We and our client now have an excellent plant model that can be used for years to come."

CADWorx aids in problem solving

CADWorx not only helped Malcolm Pirnie to model the wastewater treatment plant quickly and accurately – but also increased its understanding of certain engineering challenges. "At first glance, the record drawings of some sections of the plant didn't seem to make sense – such as areas where old piping was embedded in concrete or concealed in pipe chases. Once we mapped the existing piping into **CADWorx**, we were able to look at it from different angles and gain a better understanding of the existing piping and how it affected our design work."

Visualization key not only during the project, but also before

CADWorx provided Malcolm Pirnie with the benefits that it expected– namely speed and accuracy in laying out hundreds of pipes. But it also provided some extra benefits that the firm didn't count on. "A lot of the time," reports Shafer, "you have to present projects to town boards and public forums and explain the work that you're planning– and the 3D visualization capabilities of **CADWorx** are very helpful in that respect. You can show people exactly what you're talking about, and show a project from both the inside and outside. People can understand a 3D model a lot better than a series of 2D drawings."

Future plans for CADWorx

Shafer and his staff admit that they are early adopters of new technology and enjoy trying new software products as they come down the pike. Based on their experience with **CADWorx**, they're sticking with that approach. In fact, Shafer plans to tell the rest of the company his experiences with **CADWorx** at an upcoming Malcolm Pirnie meeting. "Our company holds a firm-wide technical symposium every two years, and about 500 people attend from various offices across the country. At this year's symposium, we will be doing a workshop on **CADWorx**."

"**CADWorx** is giving Malcolm Pirnie a competitive edge," concludes Shafer. "If companies don't embrace this kind of technology now, they are going to find themselves being left behind."

PC Hardware/Software for the Engineering User (Part 31)

A number of COADE software programs allow users to send output directly to MS Word. Recently a problem has been noted with Office XP, which results in the error message "Failed to Create Object" being displayed.

Research on this issue reveals a new security feature added by Microsoft, which prevents macros from running, unless specifically enabled by the user. The "cause" and "resolution" as detailed by Microsoft is as follows:

CAUSE

Office XP adds a security option to deliberately lock out programmatic access to the VBA object model from any Automation client unless a user chooses to permit such access. This is a per user and per application setting, and denies access by default. This security option makes it more difficult for unauthorized programs to build "self-replicating" code that can harm end-user systems.

RESOLUTION

For any Automation client to be able to access the VBA object model programmatically, the user running the code must explicitly grant access. To turn on access, the user must follow these steps:

1. Open the Office application in question. On the **Tools** menu, click **Macro**, and then click **Security** to open the **Macro Security** dialog box.
2. On the **Trusted Sources** tab, click to select the **Trust access to Visual Basic Project** check box to turn on access.
3. Click **OK** to apply the setting. You may need to restart the application for the code to run properly if you automate from a Component Object Model (COM) add-in or template.

COADE software programs ship with several "macro" files, to enable the proper setup of the resulting WORD document. This setup includes page headers and footers, report titles, and so forth. These setup macros are read from the file WORD.BAS, found in the "\system" subdirectory, beneath the program's installation directory. Two additional .BAS files are provided: WORDPS.BAS and WORDNPS.BAT. When installed directly from the COADE CD, WORD.BAS and WORDPS.BAS are identical. WORDPS.BAS includes "page setup" information, such as margin settings and paper size settings. WORDNPS.BAS does not contain this "page setup" information. To implement WORDNPS.BAS (which only saves time when WORD creates a new document), simply copy WORDNPS.BAS to WORD.BAS. To switch back to the "page setup" version, copy WORDPS.BAS to WORD.BAS.

This switching back and forth between "page setup" and "no page setup" can be accomplished easily by invoking either of two batch files, also provided in the "\system" subdirectory. WordNoPageSetup.bat copies WORDNPS.BAS to WORD.BAS. WordPageSetup.bat copies WORDPS.BAS to WORD.BAS.

The .BAS files are simple text files, that can be edited if necessary. (***Note, make a backup copy before you modify these files. Fouling up these files will render the Word interface inoperable***.) One reason you may want to modify these files is to change the default paper size, say to A4. This can be accomplished by the following steps:

1. Open WORD.BAS with a text editor. (NotePad will suffice if you have nothing better.)
2. Find the "SetupThePage" macro. (This begins on Line 100 if your editor displays line numbers.)

3. In this macro, find the line for ".PageWidth" (line 117 if your editor displays line numbers). Change the value of "8.5" to "8.27".
4. On the following line for ".PageHeight", change the "11" to "11.69".
5. Save the file
6. Exit your editor.
7. Test your changes.
8. Optionally, you may want to copy WORD.BAS back to WORDPS.BAS, so both files remain identical.

CAESAR II Notices

Listed below are those errors & omissions in the **CAESAR II** program that have been identified since the last newsletter. These corrections are available for download from our WEB site. Unless otherwise stated, all of these changes and corrections are contained in the 010703 build of Version 4.30.

1) **AISC Module:**
   - Corrected the determination of the shear center for angle cross sections.

2) **Structural Input Module:**
   - Corrected the drawing routines to apply units conversion constants.
   - Corrected graphics toolbar buttons for "zoom" and "reset".
   - Added double line plotting to the graphics.
   - Corrected plotting of channel and tee sections when rotated with a beta angle.

3) **Buried Pipe Modeler:**
   - Corrected the generation of "explicitly defined" bend elements to avoid the generation of "zero length" elements.
   - Corrected the insulation density specification on above ground elements with no specified insulation thickness.
   - Corrected a memory allocation error for buried jobs with wind loading.

4) **Stress Computation Modules:**
   - Corrected the SRSS stress summation for pressure when using B31.4, B31.4 Ch9, B31.8, B31.8 Ch8, Z662, and BS7159.

5) **Animation Module:**
   - Added a check for "zero length" elements in the plot view.
   - Corrected bend plotting to avoid "break-away" animation when bend angles approached zero.

6) **Element Generator:**
   - Corrected the initialization of the flag that invokes the modified form of "Airy" and "Stokes" waves.
   - Corrected a "sign error" in the computation of the "Z" fixed end moment for uniform loads when pressure stiffening of straight pipes is activated.

7) **Error Checker Module:**
   - Corrected the implementation of WRC329 for B31.1 reduced intersection SIF computations.

8) **Input Echo / Neutral File Module:**
   - Relinked to avoid the need for the Microsoft "debug" DLL.

9) **Intergraph Interface:**
   - Expanded allowed model size.

10) **Static Load Case Setup Module:**
   - Corrected a problem causing F9 to be listed as an available load twice.
   - Corrected a problem in the "load case options" where highlighting an entire column caused a crash.

11) **Output Modules:**
   - Corrected the SRSS stress summation for pressure when using B31.4, B31.4 Ch9, B31.8, B31.8 Ch8, Z662, and BS7159.
   - Corrected a problem causing BS7159 allowables to print as zero.
   - Corrected a problem sending "Miscellaneous" reports to WORD, causing titles to be reprinted with every data line.

12) **PCF Interface:**
   - Corrected bend coordinate associations when breaking attached piping for restraints.
   - Corrected reading operations to handle input lines with trailing blanks.

13) **Piping Input Module:**
- Corrected the display of uniform "duplicated forward" values.
- Corrected to include P3 through P9 when determining the maximum pressure to use in the "bend SIF" scratchpad, for pressure stiffening.
- Corrected the "LIST – Rotate" option when the "Z" axis is vertical.
- Corrected a problem (causing a crash) when attempting to display the SIF/TEE auxiliary from the "LIST" processor.

14) **Dynamic Setup Module:**
- Corrected a data storage problem (for dynamic analysis) when mixing designed and predefined spring hangers, with multiple hanger design operating cases.

15) **WRC107 Module:**
- Corrected the problems caused by "zero byte" data files.
- Corrected the computation of pressure stresses when the user elects to consider the reinforcing pad.

16) **MS Word Templates:**
- Corrected to include headers for job name, date, and page number.

17) **Naval DLL:**
- Revised stokes 5th iteration routine.
- Modified stokes 5th solution per published correction.
- Modified particle table depth reporting.

TANK Notices

Listed below are those errors & omissions in the **TANK** program that have been identified since the last newsletter. These corrections are available for download from our WEB site.

1) **Input Module:**
- Corrected to handle "mixed case" file names. Corrected for the 010403 build.
- Corrected a problem in the "title page" where user entered text was duplicated. Corrected for the 010403 build.

2) **Solution Module:**
- Corrected the usage of the "thickness of bottom course as constructed" for API-653 base plate computations. Corrected in 010403 build.
- Corrected the usage of bolt corrosion for wind / seismic calculations. Corrected in 010403 build.
- Corrected the usage of user specified roof load values for cone/dome/umbrella roofs in the roof thickness computations. Corrected in 001205 build.

3) **Material Database Editor:**
- Corrected to allow the deletion of "user added" materials. Corrected in 010403 build.

CODECALC Notices

Listed below are those errors & omissions in the **CODECALC** program that have been identified since the last newsletter. These corrections were made in the build of 010209, and are available for download from our WEB site.

1) WRC 107: The nozzle merge feature was not converting material properties into user units. This conversion problem only affected files with non-English units.

2) Material Database: The TEMA/ASME numbers for some materials, used for looking up Young's Modulus and Coefficient of thermal expansion, were updated.

3) Flange, ASME Tubesheet and Floating Head: For the full-face gasket flanges, the program was not computing the correct partition gasket width.

4) Material UNS Number: The program now displays the material UNS number in the input echo, along with the material name. The modules updated in the build are - Flange, ASME Tubesheet, TEMA Tubesheet, Floating Head, Thick Expansion Joint and WRC-107.

PVElite Notices

Listed below are those errors & omissions in the **PVElite** program that have been identified since the last newsletter. These corrections are available for download from our WEB site.

1) Nozzle Dialog - Depending on the path taken through the nozzle dialog a program abort could occur, specifically if one of the lookup buttons was pressed before tabbing past the nozzle diameter.

2) Detail Properties - Under PD:5500, the allowable stresses for detail components were not being updated if the design temperature was changed.

3) Nozzle Analysis - The strength reduction factor for set on (abutting) nozzles when constructed of different materials was not handled in the Division 2 area of replacement calculations.

4) The corroded hydrotest option was not handled by the program for the Zick analysis in the test condition.

5) The distance for stiffening ring inclusion in conical calculations was not computed correctly due to a units problem.

6) For vessels with intermediate skirts that had large differences in element diameter diameters, the natural frequency calculation was in error. This usually resulted in very low natural frequency.