

# Mechanical Engineering News



For the Power, Petrochemical and Related Industries

Volume 25  
June, 1998

The COADE Mechanical Engineering News Bulletin is intended to provide information about software applications and development for Mechanical Engineers serving the power, petrochemical, and related industries. The Bulletin also serves as the official notification vehicle for software errors discovered in those programs offered by COADE.

## Table of Contents

### What's New at COADE

<b>CODECALC</b> for Windows Released! .....	1
COADE adds a New Product: <b>CADWorx/P&amp;ID</b> ...	2
<b>PV Elite</b> 3.30 Enhancements .....	7
Customer Support: Independent Survey Shows COADE Leads the Pack .....	9
<b>CADWorx/Pipe</b> Contest: Who's the Winner? .....	9

### Technology You Can Use

Mechanical Engineering News Article Index .....	10
Pipe Stress Analysis of Fiberglass Reinforced Plastic (FRP) Piping (Part 2) .....	11
Modeling Victaulic Couplings in <b>CAESAR II</b> .....	16
Genesis of PDMS to <b>CAESAR II</b> Transfer Tool ...	19
CATIA and Intergraph Interfaces to <b>CAESAR II</b> ..	22
PC Hardware for the Engineering User (Part 25) ...	25
<b>CAESAR II</b> Notices .....	26
<b>PV Elite</b> Notices .....	27
<b>CODECALC</b> Notices .....	27
<b>TANK</b> Notices .....	27

## CODECALC for Windows Released!

By: Scott Mayeux

June 1998 marks the end of an era as **CODECALC** Version 6.00 for Windows replaces its predecessor, Version 5.60 for DOS. This new version of the software is designed to run under Windows 95 and Windows NT 4.0 or later.

## COADE Releases Three New Programs!!

- **CADWorx/P&ID**
- **CODECALC Version 6.00 for Windows**
- **CAESAR II / CATIA Interface**

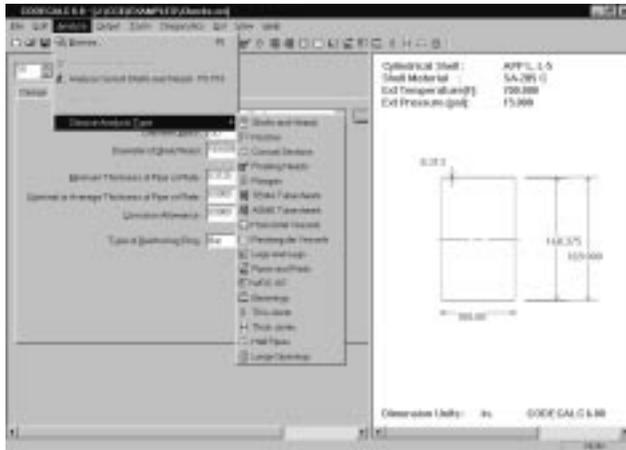
**CODECALC** 6.00 has several new features. First of all the graphics are integrated into the data entry process. As the data is entered, the graphic is updated automatically in the right hand pane. This simple feature helps users avoid data entry errors. Another feature is the use of tabbed dialogs. Displaying the input data in this format allows users to view all of the required entries in easy to access logical groupings. Also, the pop-up fields are accessible by changing a data item or by clicking the button located next to the data field.

This version of the program has been updated to meet the winter 1997 addenda. These addenda to the Code are mandatory on July 1, 1998. The Section VIII Division 1 material table was also updated to meet the extensive number of changes made to that section of the Code.

Below is a screen shot of a typical shell and head input screen in the new version:



This screen shows the analysis capabilities of Version 6.00.



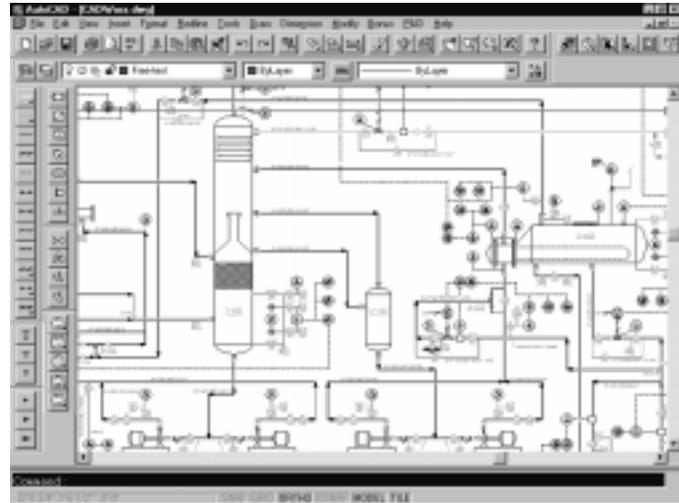
Another exciting change to the program is the use of HTML help. This help system is very easy to navigate. HTML help allows one to search for and print various help topics. For the Internet enabled, it also contains a web browser. A direct link to our web site is part of the help system and CODECALC itself. This graphic depicts the new HTML based help system.



### COADE Adds a New Product: CADWorx/P&ID

By: Vornel Walker

COADE has increased its number of products to six, with this month's introduction of **CADWorx/P&ID**, the only AutoCAD based 'Implementation Ready' CAD package for Process and Instrument Diagrams.



### Setting out to provide the best

When COADE set out to design their first piping package, **CADWorx/PIPE**, they asked one question. Was it necessary for users to purchase and learn individual packages to produce 2D, 3D, automatic isometrics and provide bi-directional links to **CAESAR II**?

The answer was no. **CADWorx/PIPE** became the first integrated package that enabled designers do all of the above at a price of up to one third that of our competitors.

After the success of **CADWorx/PIPE**, COADE wanted to offer the same quality and ease of use in a full featured and highly affordable P&ID package.

### CADWorx/P&ID breaks the mold

It was during the development of **CADWorx/P&ID** that COADE realized that we did not have to do things the old way. There was nothing stopping us from doing it right.

By not having to cater to an existing user base and having no legacy software to maintain, COADE was able take advantage of recent programming innovations and standards. **CADWorx/P&ID** is a product that truly looks forward.

**CADWorx/P&ID** uses the latest technological innovations from both Autodesk and Microsoft. ObjectARX™ to monitor commands and the Open Database Connectivity (ODBC) standard.

These innovations allow **CADWorx/P&ID** to provide fully automated drafting and editing techniques that ensure consistency and accuracy within its drawings and underlying data.

Because of this 'new start' COADE was able to produce the first truly 'Implementation Ready' CAD package for P&ID's and Process Diagrams.

### Providing what users need

Over the years design managers and plant managers have required different things from their process and instrument diagrams.

For drafting, the requirements were for software that would draw with ease and would give line lists plus basic valve and instrument takeoffs.

In the process and plant design departments, users wanted documents that gave them the accurate process information they required for layout and instrumentation hookups.

Plant and site managers wanted documents that aided in their task of Plant Management and OSHA compliance. They required documents that would be useful for the life of the plant.

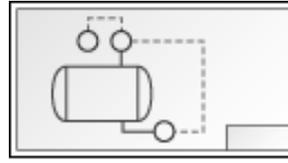
### What does 'Implementation Ready' Mean?

Implementation Ready is a term that we feel most accurately describes one of the main principals of **CADWorx/P&ID**.

By changing implementation levels, end users are not just enabling and disabling menus and commands. They are enabling **CADWorx/P&ID** to provide higher levels of data management and usability.

**CADWorx/P&ID** is unlike packages that just 'gray out' or disable menus and commands dependent on end users skill levels. **CADWorx/P&ID** does not cut down on what users need to get the job done.

### Implementation Level One



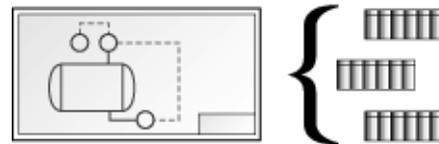
This level allows end users to generate P&ID's without an associated database. This is useful for the basic drafting of P&ID's and where no linked database is required.

Implementation level one provides a dynamic selection of attributed AutoCAD blocks that can be edited and modified.

Components can be easily added to match any user requirement, in fact users can even add blocks from their existing first generation P&ID packages and these blocks can be recognized by **CADWorx/P&ID**.

Implementation level 1 is a powerful yet simple solution for P&ID drafting that provides ease of use and great looking drawings.

### Implementation Level Two

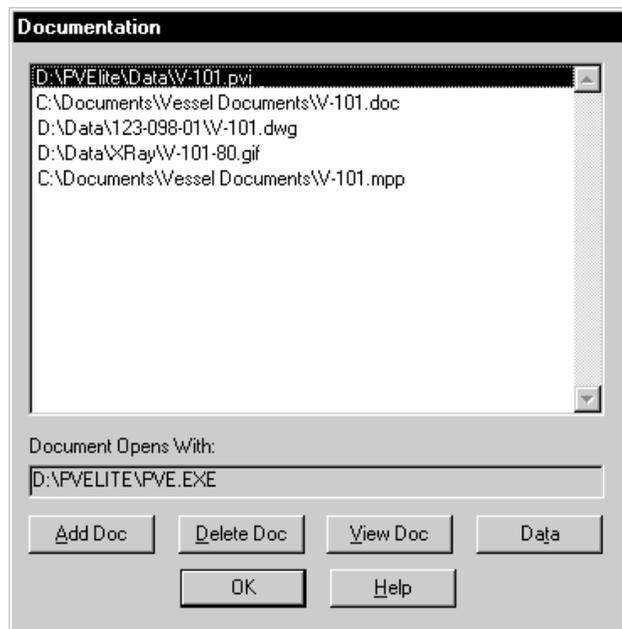


This level extends user capability of **CADWorx/P&ID** even further. Implementation level two allows users to attach multiple documents or files to items on their P&ID's.

While in a drawing users can click on an item to bring up the associated document dialog box.

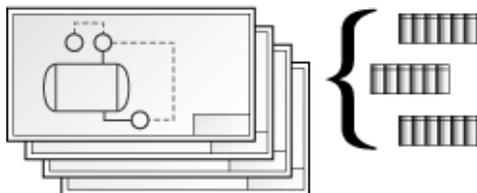
Once the associated document dialog box is open the highlighted document or file can be viewed or launched directly from within **CADWorx/P&ID** by its associated application. Therefore **CADWorx/P&ID** makes it simple to automatically maintain a complete process documentation database.

Databases are structured to user requirements and then stored within the drawing. Whenever a drawing is retrieved, the database recreates itself 'on the fly' to provide users with all the information linked to items within the P&ID.



Documents are easily accessible from CADWorx/P&ID

### Implementation Level Three



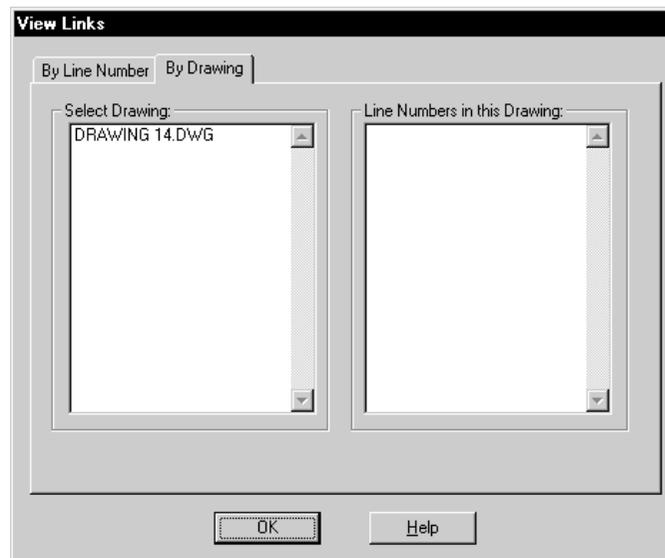
This level gives the highest degree of usability and power. If user requirements are for P&ID's linked to fully functional external databases then Implementation Level 3 provides the solution.

**CADWorx/P&ID** allows any number of users to read and write to the project database through multiple drawings. This enables database information to be entered or updated on any **CADWorx/P&ID** station or any database management terminal.

**CADWorx/P&ID** creates a user configurable central relational database, providing the designer or process engineer with a central location from which they can maintain process information.

Information is read and written bi-directionally. Changes made in the database automatically update the drawings. Changes made on the drawings are automatically updated in the database.

**CADWorx/P&ID** comes complete with powerful tools to ensure that data integrity is maintained. **CADWorx/P&ID** has been designed to match any data management requirement.



Process links between drawings can easily be viewed

### Upgrading between Implementation levels

**CADWorx/P&ID** allows end-users to grow into their commitment to data management and data integrity.

Those who use **CADWorx/P&ID** at lower implementation levels can 'upgrade' at any time to higher levels of data management.

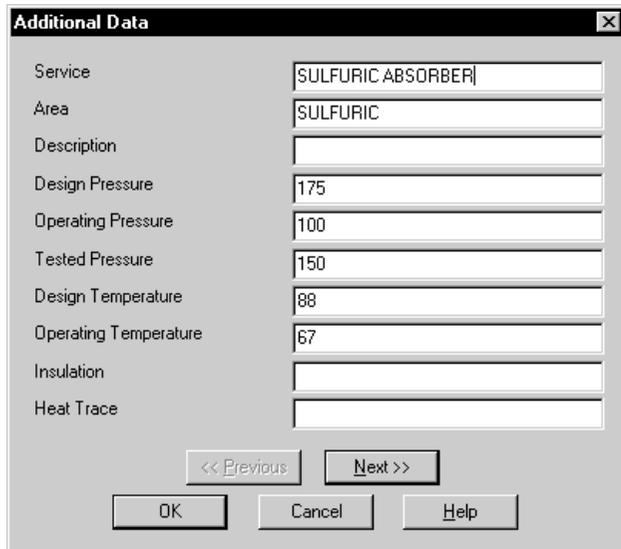
Whichever way users choose to work with **CADWorx/P&ID**, they know that the information they have placed in their drawings will remain vital for the life of the plant.

### Powerful Database Setup with Ease

Many other packages require that end users learn SQL (structured query language) commands and scripts to create relational databases.

**CADWorx/P&ID** makes it easy to set up a project database. User friendly dialog boxes enable users to create powerfully structured relational databases.

**CADWorx/P&ID** conforms to the Open Database Connectivity (ODBC) standard within the Windows 95/NT environment. This enables **CADWorx/P&ID** to create SQL databases in Microsoft Access or \*.DBF formats that are easy to access and maintain.



Additional fields can be added to databases

**Project Databases are Easily Configured**

While other programs provide a fixed set of fields within their databases, **CADWorx/P&ID** provides a dynamic solution.

At the beginning of a project users can simply bring up a dialog box that enables them to modify database tables and their columns. Then, just add, delete or edit any of the fields required within your project's relational database.

**CADWorx/P&ID** then creates or modifies the database fields or tables automatically to your new specifications. No SQL scripting or command knowledge is required.



Projects are easy to set up

**CADWorx/P&ID Features**

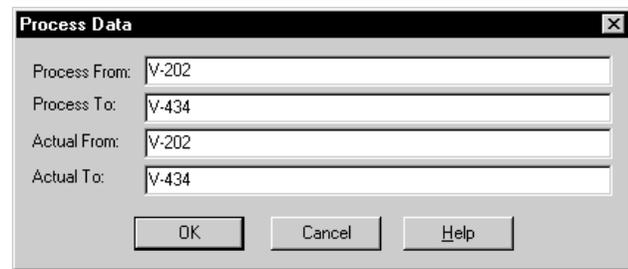
**CADWorx/P&ID** is quick and easy to install and set up. The installation procedure automatically associates itself with AutoCAD. Users can start a new drawing or set up a project within minutes of installation.

**Time Saving Automation**

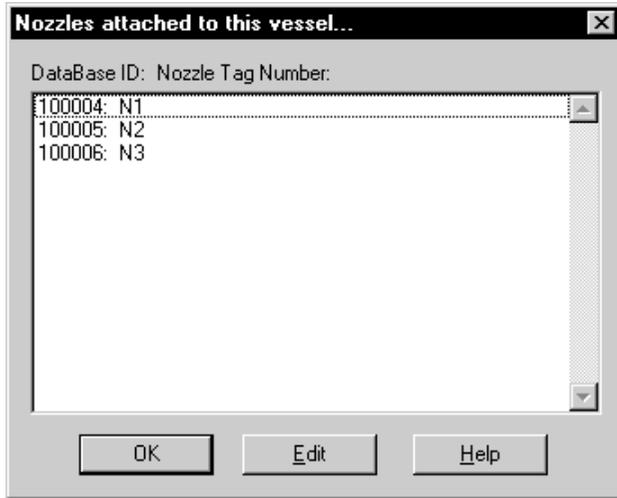
**CADWorx/P&ID** menus offer a comprehensive list of utilities to make drawing and database management fast, simple and accurate.

These allow users to:

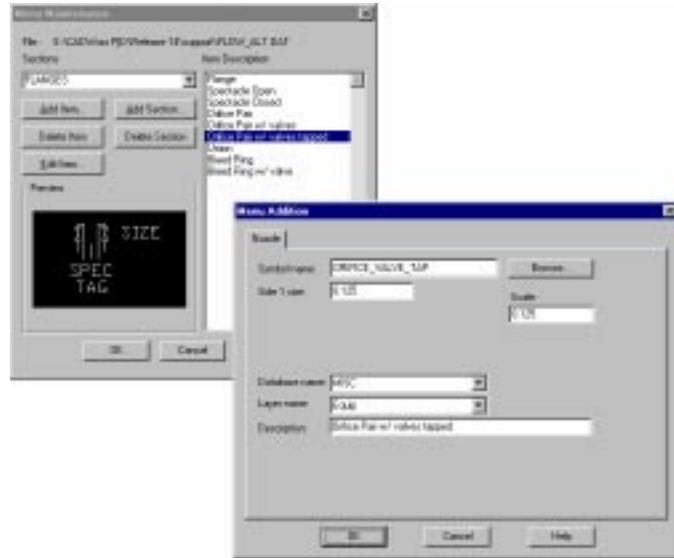
- Configure layers and project settings
- Edit symbols to match any user requirement
- Define line types for main and secondary processes
- Insert items into lines
- Annotate components, equipment and line numbers
- Update drawing annotation automatically from databases
- Automatically place arrows to indicate process flow direction
- Associate nozzles with pieces of equipment
- Produce line lists, from source equipment and connecting line numbers



**CADWorx/P&ID** line origin and destination



Nozzles are automatically associated with equipment

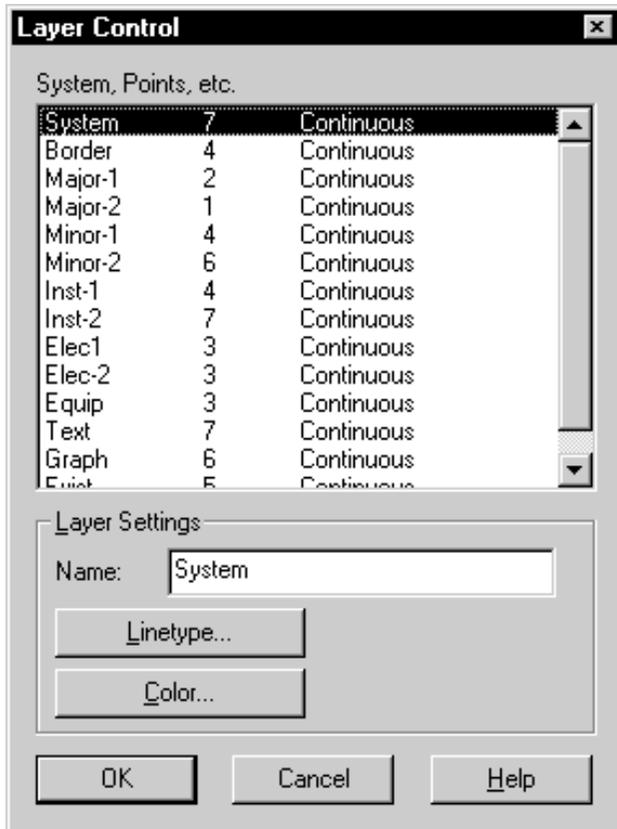


**Easy and Flexible Menu Modifications**

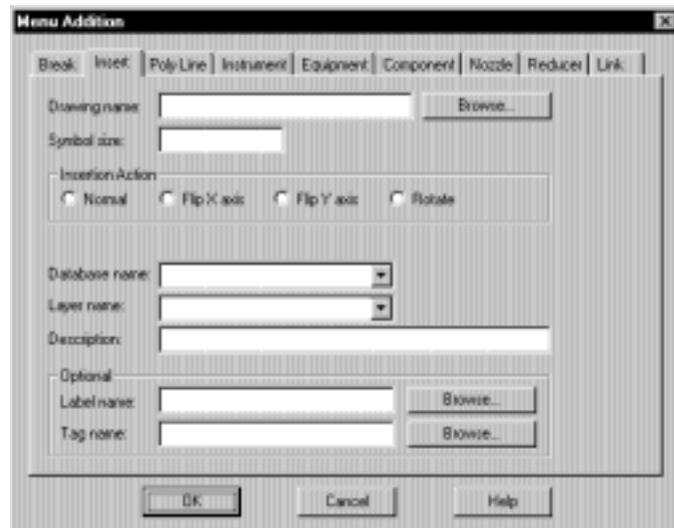
CADWorx/P&ID allows end-users to modify or create custom menus and add symbols, as required. There is no need to know how to create slide libraries or program in lisp.

The menu and symbols manager allows users to:

- Add or delete symbols at will
- Include symbols from your old P&ID package
- Add any number of user-defined symbols
- Include assemblies made up of multiple symbols
- See each and every symbol prior to insertion



Project layers can be easily modified



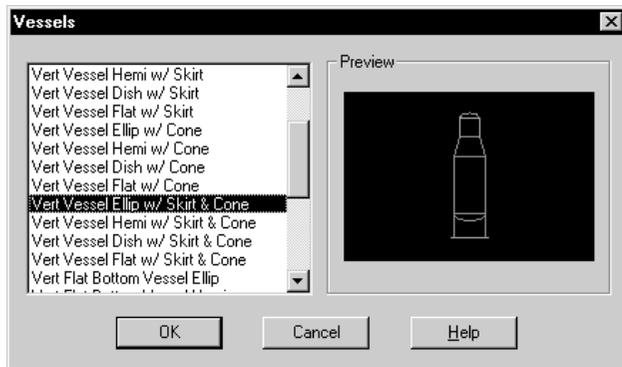
CADWorx/P&ID makes it simple to modify menus

**Comprehensive Symbol Libraries**

**CADWorx/P&ID** includes symbols for every need making it easy to create drawings right out of the box.

These include:

- Vessels, tanks and hoppers
- Compressors
- Pumps
- Valves
- ISA standard line types
- ISA standard instrumentation bubbles and symbols
- Main and secondary process line types



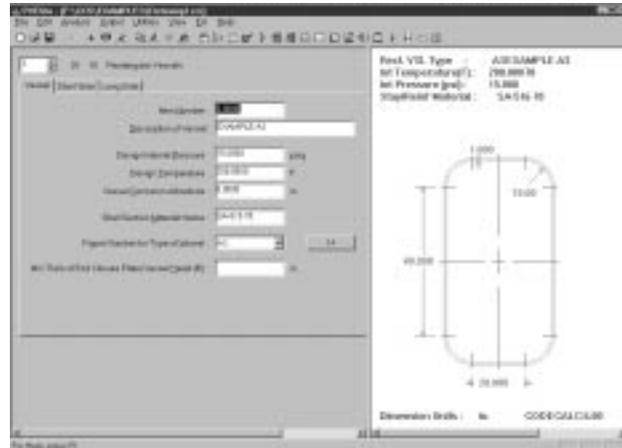
Symbols are easily selected from editable slide menus

**PV Elite 3.30 Enhancements**

By: Scott Mayeux

**PV Elite** version 3.30 is scheduled for release in June of 1998. This version of the program is compliant with the 1997 addenda to the ASME Codes Section VIII Division 1 and Division 2. Several enhancements have been made to the program by user request. A few of those changes are as follows:

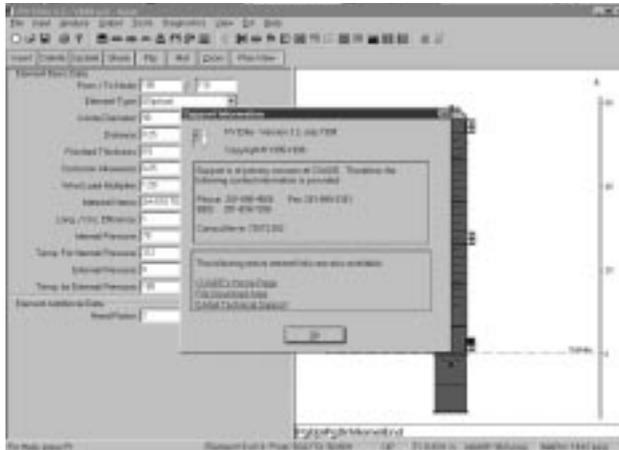
- A new addition to **PV Elite** 3.30 is **CODECALC** Version 6.00 for Windows. This program serves as **PV Elite**'s Component Analysis Module. This program completely replaces the component analysis program available in version 3.20. All of the capability of the **CODECALC** 6.00 program is included for users of the unlimited run or lease versions of the software. A typical window is shown below.



- The following graphic shows the new HTML help system the program uses. This help system can even serve as a web browser.



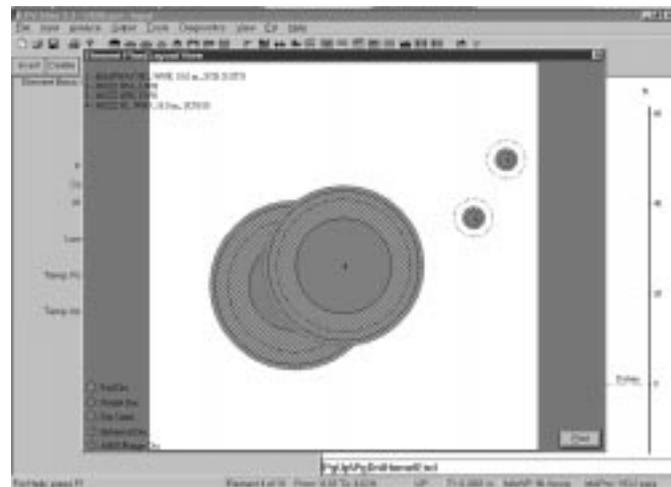
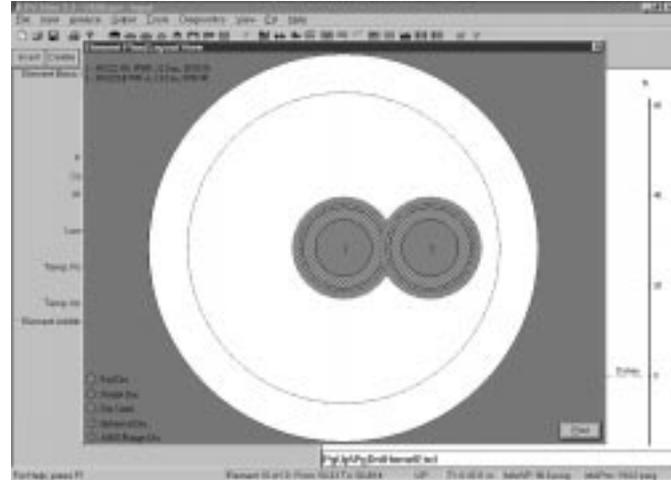
- This version of **PV Elite** includes some improvements for users operating at lower screen resolutions (800 x 600). The icon sizes were reduced so that the toolbars will fit nicely on the screen without having to be repositioned. This is welcome news to notebook users, since most notebook machines can only go up to 800x600.
- The help option provides a direct link to our web site. If your computer has an active Internet connection, you can readily access COADE's web site and obtain information and program revisions. Simply click on one of the links of interest and **PV Elite** launches your web browser and goes directly to the area that was clicked on. That screen is shown below:



- Another plus for the new version is the ability to specify the datum line. Since vessel drawings are dimensioned this way, it eases the entry of various details such as nozzles, platforms, trays etc. An Excel style grid viewer is used to enter these data items. This powerful feature allows cut and paste of details. The grid viewer is shown below:



- Another feature added was a plan view for heads and a layout view for shell courses. This element view shows the spatial relationship between the nozzles. The nozzle diameter, pad diameter, flange diameter and limits of reinforcement are displayed. This feature is handy because it allows the vessel designer to check for interference of nozzles. Also, during the program's execution an interference check is performed and the user is made aware of any clashes in the diameter limits.



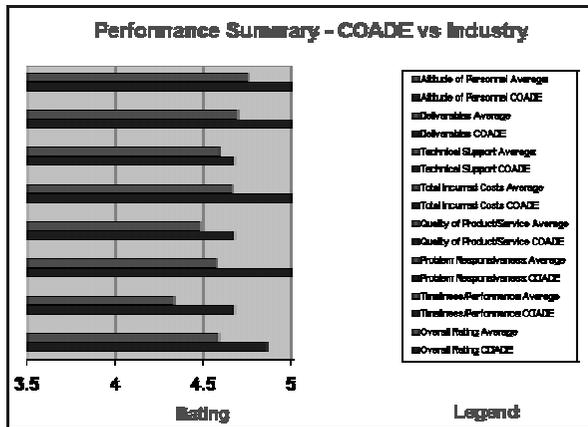
A few other changes are listed below:

- The UBC 1997 seismic design code was added.
- Some ASME materials from the interpretations were added to the BS-5500 material database.
- The stress report was revised and reworked.
- The program now runs faster due to a change in compiler technology.

### *Customer Support: Independent Survey Shows COADE Leads the Pack*

The chart below reports the finds of an independent study, commissioned by a potential COADE client, and conducted by **Dun & Bradstreet**. The findings of this study were released in November of 1997. This study rated COADE, Inc., its products, its support, and overall quality against similar companies.

The results of this study show that in all eight categories investigated, COADE surpassed the norm. Results were reported on a scale of 1 to 5, with 5 being the best, and 1 being the worst. The chart below shows these results in graphical format.



What do the various “legend” items mean? Each pair of bars corresponds to two legend entries. The *average* entry is average rating of other corporations. The *COADE* entry is the rating for COADE. **Attitude of Personnel** is the attitude of supplier personnel about the supplier and toward customers. **Deliverables** is the actual quantity and content delivered versus the quantity and content ordered. **Technical Support** is the level of ongoing service to support or enhance the purchased product. **Total Incurred Cost** is the promised total cost of the product or service versus any additional incurred. **Quality of Product or Service** is the level of quality of the purchased product or service. **Problem Responsiveness** is the responsiveness of the supplier to any product or service problem. **Timeliness/Performance** is the delivery of product or performance of service in the promised time frame. **Overall Rating** is the overall satisfaction with the suppliers performance.

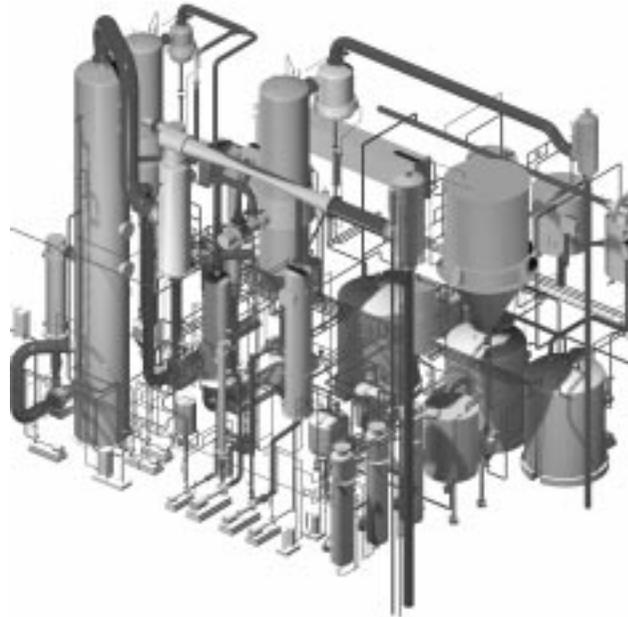
COADE has always maintained the philosophy that “Customer support comes first”. This study reveals that this policy is actually implemented at COADE.

### *CADWorx/Pipe Contest: Who’s the Winner?*

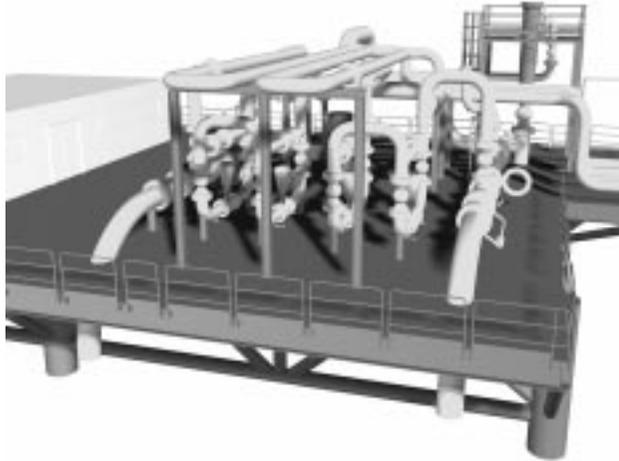
In June, 1997, COADE sponsored a best drawing contest, for those customers using CADWorx/Pipe. The first place winner was Jeff Kraker, who works with Crown Iron Works Company in Roseville, Minnesota. The CADWorx Development staff unanimously voted the model Jeff sent us as the first place winner. The second place winner was Farhad Salehi with ImageGrafix in Dubai, United Arab Emirates.

Both Jeff and Farhad utilized the solid capabilities within **CADWorx/PIPE** for the development of the models. This allows for automatically generated plans, sections, and isometrics when working in this fashion.

Below is the model Jeff sent us. This is a 2.5 million dollar Glycerine Refining and Methyl Ester Distillation plant for Cressida in Honduras. As you can see, it is quite a complicated model. This is about 1/3 of the total plant designed with **CADWorx/PIPE**.



Farhad sent us a model of an offshore platform, one view of which is shown below.



The first place winner will receive one-year of free updates and maintenance. Both winners will receive a framed plotted picture of their model presented with a plaque indicating first and second place. We wish to thank both Jeff and Farhad, as well as all of the other contestants, for their participation in this contest and taking the time to provide us with these models.

### *Mechanical Engineering News* *Article Index*

At the request of many COADE clients, we have compiled the following index of articles from all past issues of Mechanical Engineering News. This index is intended to aid clients in finding reference articles quickly. (Articles on Software Development, Seminars, and General News have been omitted for brevity.) This index listing updates the ones published in December 1993 and February 1996.

#### **Subject: Code Requirements**

<b>Title</b>	<b>Issue</b>	<b>Page</b>
AISC Unity Checks on Pressure Vessel Legs	8/92	8
ASCE 95 Wind Code Revision	10/96	16
Expansion Case for Temperatures Below Ambient	5/93	32
A Review of ASME's Ext. Pressure Calculations	2/96	20
Sustained & Expansion Stress Cases	5/88	4
Sustained & Expansion Follow Up	11/88	10

#### **Subject: Dynamics**

<b>Title</b>	<b>Issue</b>	<b>Page</b>
An Introduction to Time History Analysis	12/93	9
Dynamics Basics	11/87	3
Dynamics, Damped Harmonic Motion	4/89	7
Dynamics, The Range Check	11/88	4

#### **Subject: Dynamics (Continued)**

<b>Title</b>	<b>Issue</b>	<b>Page</b>
Dynamic Questions & Answers	7/90	8
Missing Mass Correction in Spectral Analysis	5/93	8
Pulse Table Generator	11/94	9
Seismic Analysis of Tall Vertical Process Towers	4/95	15
Time History Input (Establishing...)	6/94	8

#### **Subject: Hardware**

<b>Title</b>	<b>Issue</b>	<b>Page</b>
ESL's and Multiple Computers	8/92	2
Machine Times	5/88	2
Memory Requirements	5/88	2
Network Questions & Answers	4/95	5
Network Versions	6/94	1
Printer Configuration	6/94	13
Virus Infections	7/90	1
Virus Infections (Revisited)	6/94	13
Virus Update	10/90	2

#### **Subject: General Information**

<b>Title</b>	<b>Issue</b>	<b>Page</b>
API-650 Addendum	4/95	7
API-650 Addendum 2	10/96	17
API-650 Nozzle Flexibilities	12/93	6
API-653 2nd Edition	10/96	18
ASME B31G Criteria	5/93	27
ASME External Pressure Chart Name Changes	12/92	6
ASME Div 2 Nozzle Reinforcing Calculations	12/97	7
The Basics of Electronic File Transfer (E-Mail)	6/97	3
FE/Pipe-CAESAR II Transfer Line Study	3/92	6
FE/Pipe-CAESAR II SIFs & Flexibilities	12/92	8
Finite Elements in Practice	3/92	16
Flange Allowable Stresses	10/91	6
Flange Design (Influence of Corrosion On ...)	6/94	6
Flange Leakage	10/91	3
Flange Rigidity Calculations	6/94	5
Flange Stresses	12/92	7
Incorrect Results From Piping Analysis	11/88	8
Numerical Sensitivity Checks	11/87	9
Rectangular Vessel Computations	6/94	7
Static & Dynamic Analysis of High Pressure Sys.	3/90	6
What Makes Piping/Finite Element Jobs Big?	5/87	2
WEB Site Debuts	10/96	1
WEB Site Enhancements	6/97	8
WEB Site Usage Increases	12/97	6

#### **Subject: Life Extension & Failures**

<b>Title</b>	<b>Issue</b>	<b>Page</b>
API-653 Tank Bottom Inspection and Evaluation	10/96	9
Applying API-653	4/95	7
Evaluation of Creep Stresses	5/93	18
Evaluation of Fatigue Stresses	12/92	12
Fine Tuning & Sensitivity Studies	11/94	6
Piping Failure Caused by Elastic Follow-Up	8/92	10

#### **Subject: Designing/Drafting**

<b>Title</b>	<b>Issue</b>	<b>Page</b>
CADWorx Introduction	2/96	3
CADWorx Capabilities	2/96	9
Interfacing CAESAR II and CADWorx	2/96	16
Genesis of PDMS to CAESAR II Transfer Tool	6/98	19

**Subject: Modeling**

<b>Title</b>	<b>Issue</b>	<b>Page</b>
Bend Elastic Models	3/87	3
Buried Pipe Analysis	4/89	3
Buried Pipe, The Overburden Compaction Mult.	3/92	3
Calcium Silicate (Density)	11/94	4
Cold Spring Discussion	10/90	11
Combining Models in CAESAR II	2/96	8
Double Rod Modeling	7/90	11
Global vs Local Coordinate Systems	12/92	3
Global vs Local Coordinate Systems (Bends)	11/94	4
Expansion Joint Modeler (Part 1)	5/93	29
Estimation of Nozzle Loads	12/93	14
Hanger Design Discussions (Part 1)	3/90	4
Hanger Design Discussions (Part 2)	10/90	7
Hillside & Off Angle Nozzles	12/93	7
Hillside Nozzle Angle Calculations – revisited	2/96	12
Large Rotation Rods and Hangers	11/87	9
Modeling Victaulic Couplings	6/98	16
Pipe Stress analysis of FRP Piping - Part 1	12/97	10
Pipe Stress analysis of FRP Piping - Part 2	6/98	11
Plastic Pipe Modeling	4/91	5
Relative Rigid Stiffnesses	11/88	11
Selecting & Evaluating an Expansion Jnt Assembly	12/93	12
Some Nuances of Spring Hanger Design	5/87	7
Spring Hanger Design	10/90	4
Spring Cans with Friction	2/96	16
Slip Joint Modeling	4/91	9
A Technique for the Analysis of Non-Simultaneously		
Thermally displaced Piping Systems (Hot Tapping)	10/96	13
Tees & SIFs	3/92	4
Tee Types	3/92	14
Underground Pipe Modeling Philosophies	4/91	8
User Specified Wind Profiles	3/92	14

**Subject: Quality Assurance**

<b>Title</b>	<b>Issue</b>	<b>Page</b>
Benchmarking CAESAR II & ANSYS	10/91	3
CAESAR II Quality Assurance Manual	5/93	5
COADE Software Revision Procedures	10/96	7
COADE Software Revision Procedures	12/97	4
Software Quality Assurance	10/90	7

**Subject: Strength of Materials**

<b>Title</b>	<b>Issue</b>	<b>Page</b>
Maximum Shear Stress Intensity	8/92	4
Octahedral Shear Stress	3/87	4
Torispherical Head Equations	12/92	6
How to use WRC107 in COADE Software Programs	6/97	9

*Pipe Stress Analysis of Fiberglass Reinforced Plastic (FRP) Piping (Part 2) - FRP Analysis Using CAESAR II*

By: Tom Van Laan

**(This is the second of two parts of this article. In the first part, presented in the last issue of Mechanical Engineering News, the theory of stress analysis of fiberglass reinforced plastic pipe was presented on the micro-, mini-, and macro-analytical levels; with the discussion of macro-analytical level covering the implementation of the most prominent FRP piping codes. This, the second part of this article, details the specific use of the CAESAR II software in the analysis of FRP piping.)**

**Practical applications — use of CAESAR II:** CAESAR II was the first widely-accepted pipe stress software developed for the personal computer. Maintained, supported, and marketed by COADE, Inc. of Houston, Texas, this program currently has over 5000 licensees in 50 countries. Because of the world-wide success enjoyed by the program, its wide range of static and dynamic analytic capabilities, its seamless bi-directional interface with the piping design program **CADWorx/PIPE**, and its simplicity of use, **CAESAR II** was selected by many members of the European Fiberglass Piping Institute as the software which could best bring the convenience and confidence of stress analysis, long enjoyed by users of using steel pipe, to the FRP industry.

**CAESAR II**, introduced in 1984, has had the ability to model orthotropic materials such as FRP almost since its inception. Recently its capabilities have been expanded through the addition of the BS 7159 Code and the UKOOA Specification. Modeling under these two options will be described in this presentation.

**CAESAR II's** user-friendly, menu driven (Figure 9) approach, with context-sensitive help, and full-mouse operability, leads the user through the analysis from input to output, making the program very easy to use even for the "casual" stress analyst. Features such as its built in databases, expansion joint modeler, and automatic spring hanger selection have saved countless engineers innumerable hours. Esoteric modeling details are left behind the scenes, defaulting to the most probable or common values. However, **CAESAR II** is powerful enough to permit modification of many of these details through configuration parameters, which permit the analysis to be completely tailored to one's specific needs. For example, FRP material parameters corresponding to those of many vendors' lines are provided with **CAESAR II** and may be pre-selected by the user to be the default values whenever FRP piping is used. Other

options, as to whether the BS 7159 pressure stiffening requirements should be carried out using design strain or actual strain can be set in CAESAR II's configuration module as well.



Figure 9 - CAESAR II Main Menu

Input of a piping model in CAESAR II is intuitive, with each segment of pipe described on an individual spreadsheet (Figure 10). The spreadsheet is divided into areas where geometry, cross-sectional data, material parameters, loading/operating conditions, boundary conditions, and specialized piping information (such as bend information, intersection types, etc.) can be described. Most of these values automatically carry forward from one element to the next, so they need not be entered again until there is a change. Modeling of an entire system is as simple as using the [Alt-C] key to bring up new spreadsheets for the entry of subsequent piping elements.



Figure 10 - CAESAR II Element Spread Sheet

Selecting material 20 — Plastic (FRP) – activates CAESAR II's orthotropic material model and brings

in the appropriate material parameters from the pre-selected materials (Fig 11). The orthotropic material model is indicated by the changing of two fields from their previous isotropic values: “Elastic Modulus (C)” —> “Elastic Modulus/axial” and “Poisson's Ratio” —> “Ea/Eh\* Vh/a”. These changes are necessary due to the fact that orthotropic models require more material parameters than do isotropic. For example, there is no longer a single modulus of elasticity for the material, but now two — axial and hoop. There is no longer a single Poisson's ratio, but again two —  $V_{h/a}$  (Poisson's ratio relating strain in the axial direction due to strain in the hoop direction) and  $V_{a/h}$  (Poisson's ratio relating strain in the hoop direction due to strain in the axial direction). Also, unlike isotropic materials, the shear modulus does not follow the relationship  $G = 1 / E (1 - V)$ , so that value must be explicitly input as well.

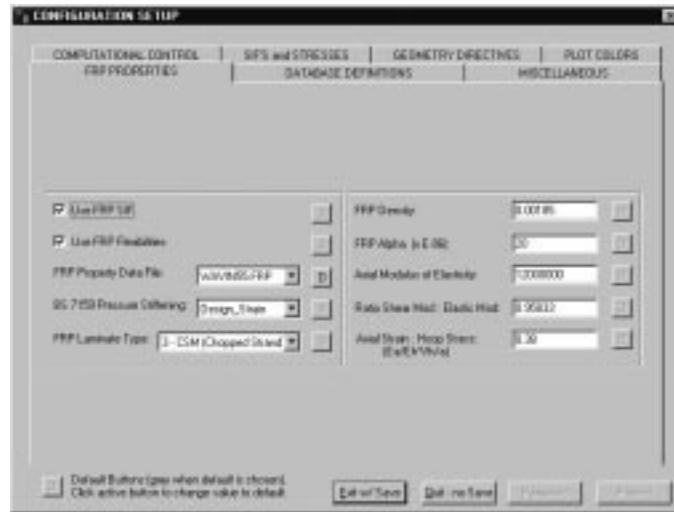


Figure 11 - CAESAR II Default FRP Material Parameters Spread Sheet

In order to minimize input, a few of these parameters can be combined, due to their use in the program. Generally, the only time that the modulus of elasticity in the hoop direction, or the Poisson's ratios are used during flexibility analysis is when calculating piping elongation due to pressure (note that the modulus of elasticity in the hoop direction is used when determining certain stress allowables for the BS 7159 code):

$$d_x = (\sigma_x / E_a - V_{a/h} * \sigma_{hoop} / E_h) L$$

Where:

- $d_x$  = extension of piping element due to pressure
- $\sigma_x$  = longitudinal pressure stress in the piping element
- $E_a$  = modulus of elasticity in the axial direction

- $V_{a/h}$  = Poisson's ratio relating strain in the axial direction due to stress in the hoop direction
- $\sigma_{hoop}$  = hoop pressure stress in the piping element
- $E_h$  = modulus of elasticity in the hoop direction
- $L$  = length of piping element

This equation can be rearranged, to require only a single new parameter, as:

$$d_x = (\sigma_x - \sigma_{hoop} * (E_a / E_h * V_{a/h})) * L / E_a$$

Note, that in theory, that single parameter,  $(E_a / E_h * V_{a/h})$  is identical to  $V_{h/a}$ .



Figure 12 - CAESAR II Special Execution Options Spread Sheet

The shear modulus of the material is required in order to develop the stiffness matrix; in CAESAR II, this value, expressed as a ratio of the axial modulus of elasticity, is brought in from the pre-selected material, or can be changed on a problem-wise basis using the special execution parameter screen accessed by the Kaux "menu" from the piping spreadsheet (Figure 12). This screen also shows the coefficient of thermal expansion (extracted from the vendor file or entered by the user) for the material, as well as the default laminate type, as defined by the BS 7159 Code:

**Type 1** – All chopped strand mat (CSM) construction with an internal and an external surface tissue reinforced layer.

**Type 2** – Chopped strand mat (CSM) and woven roving (WR) construction with an internal and an external surface tissue reinforced layer.

**Type 3** – Chopped strand mat (CSM) and multi-filament roving construction with an internal and an external surface tissue reinforced layer.

The latter is used during the calculation of flexibility and stress intensification factors for piping bends.

Bend and tee information may be entered easily through use of auxiliary spreadsheets. Bend radius and laminate type may be changed on a bend by bend basis, as shown in Figure 13. BS 7159 fabricated and moulded tee types are specified by defining CAESAR II tee types 2 and 3 respectively at intersection points. CAESAR II automatically calculates the appropriate flexibility and stress intensification factors for these fittings as per code requirements.



Figure 13 - CAESAR II Bend Auxiliary Data Screen

Required code data may be entered on the ALLOWABLES auxiliary spreadsheet (Figure 14); with the program providing fields for CODE (both number 27 – BS 7159 and 28 – UKOOA are available). After selection of BS 7159, CAESAR II provides fields for entry of the following code parameters:

$$SH_{1,2,3} = \text{longitudinal design stress} = \epsilon_d E_{LAMP}$$

$Kn_{1,2,3}$  = cyclic reduction factor (as per BS 7159 paragraph 4.3.4)

$Eh/Ea$  = ratio of hoop modulus of elasticity to axial modulus of elasticity

$K$  = temperature differential multiplier (as per BS 7159 paragraph 7.2.1)



**FIGURE 14 - CAESAR II Allowable Stress Auxiliary Data Screen (BS 7159)**

After selection of UKOOA, CAESAR II provides fields for entry of the following code parameters (Figure 15):

SH1,2,3 = hoop design stress =  $f_1 * LTHS$

R1,2,3 = ratio  $r (\sigma_{a(0:1)} / \sigma_{a(2:1)})$

$f_1$  = system factor of safety (defaults to 0.67 if omitted)

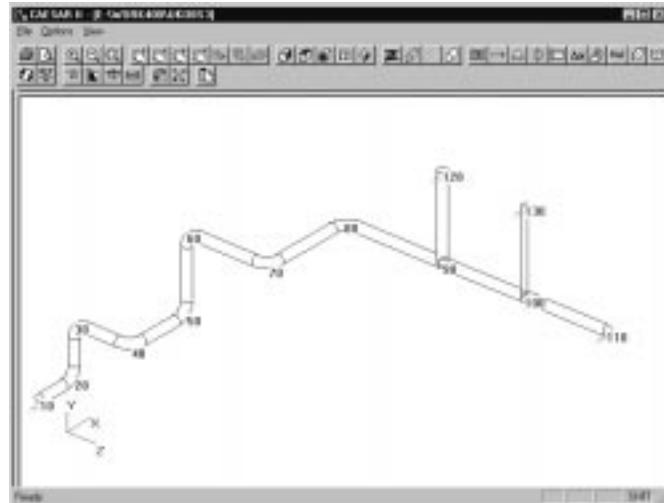
K = temperature differential multiplier (same as BS 7159)



**Figure 15 - CAESAR II Allowable Stress Auxiliary Data Screen (UKOOA)**

These parameters need only be entered a single time, unless they change at some point in the system.

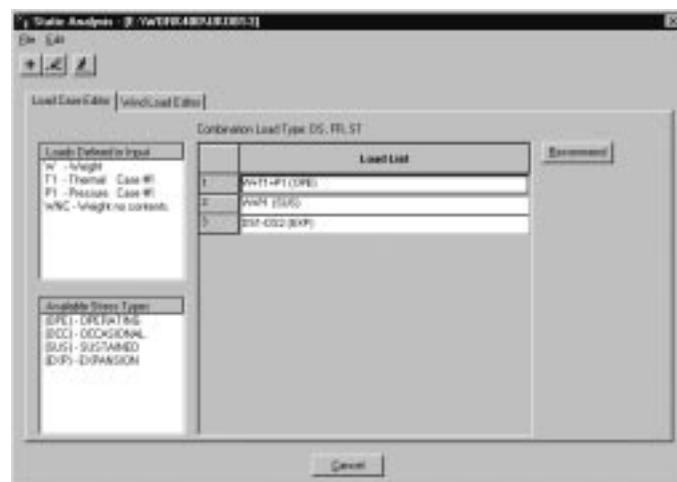
Data entry for FRP piping is that simple; a typical model is shown in Figure 16.



**Figure 16 - CAESAR II Model Verification Graphics**

Performing the analysis is even simpler than the system modeling. CAESAR II evaluates the operating parameters and automatically builds the appropriate load cases; in this case three are built (Figure 17):

1. **Operating** (includes pipe and fluid weight, temperature, equipment displacements, pressure, etc.). This case is used to determine maximum code stress/strain, operational equipment nozzle and restraint loads, hot displacements, etc.
2. **Cold** (same as above, except excluding temperature and equipment movements). This case is used to determine cold equipment nozzle and restraint loads.
3. **Expansion** (cyclic stress range between the cold and hot case). This case may be used to evaluate fatigue criteria as per paragraph 4.3.4 of the BS 7159 Code.



**Figure 17 - CAESAR II Load Case Editor**

After analyzing the response of the system under these loads, **CAESAR II** presents the user with a menu of possible output reports (Figure 18). Reports may be designated by selecting a combination of load case and results type (displacements, restraint loads, element forces and moments, and stresses). From the stress report, the user can determine at a glance whether the system passed or failed the stress criteria (Figure 19).



Figure 18 - CAESAR II Output Report Menu

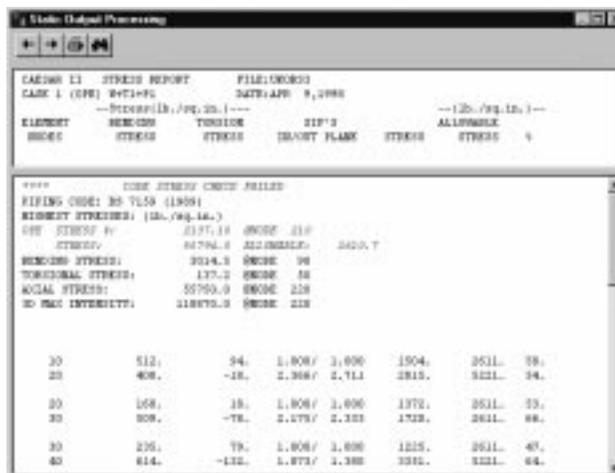


Figure 19 - CAESAR II Stress Report Header

All results may also be reviewed graphically; many of these, such as the displaced piping position are more readily digested in graphic form (Figure 20).

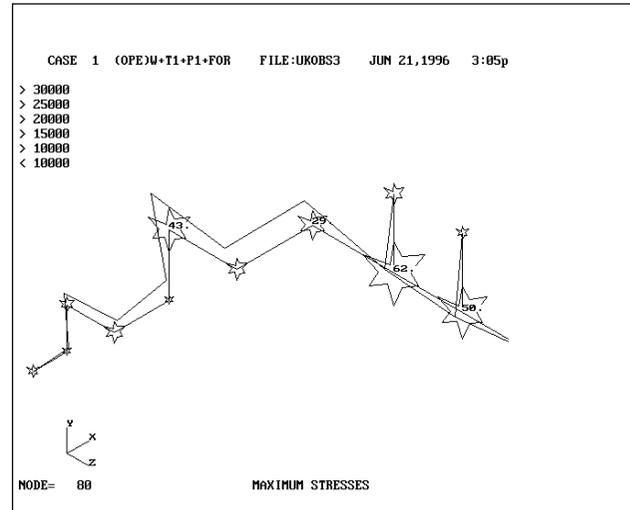


Figure 20 - CAESAR II Output Graphics

For UKOOA code, the piping is considered to be within allowables when the operating stress falls within the idealized stress envelope (indicated by the straight line in Figure 21).

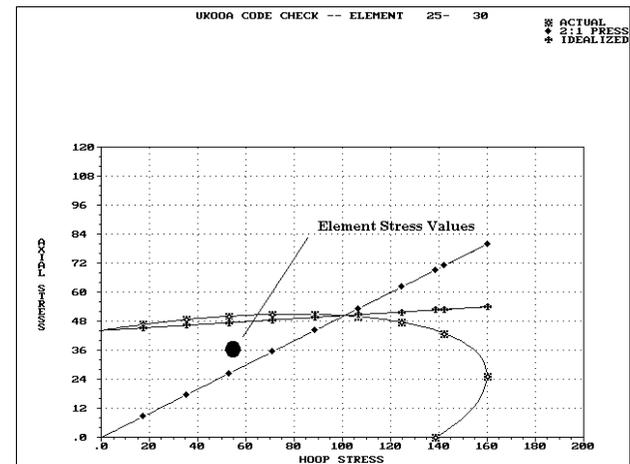


Figure 21 - CAESAR II UKOOA Envelope Graphics

**Conclusion:** A reliable, powerful, yet easy to use, pipe stress analysis program with world wide acceptance is now available for evaluation of FRP piping systems as per the requirements of the most sophisticated FRP piping codes. This means that access to the same analytical methods and tools long enjoyed by engineers using steel pipe is available to any potential user of FRP piping – ensuring that design and installation of FRP systems will maximize safety, economy, and reliability.

## Modeling Victaulic Couplings in CAESAR II

By: David Diehl

### Introduction

Over the years I fielded many modeling questions on the Victaulic Coupling. In most cases, since I had no direct knowledge of the joint, I asked the **CAESAR II** user what it was they were trying to do, what was important to them and what they knew about its characteristics. In most cases, once the basic modeling concept was conveyed, the user could move on to complete the input without further assistance. It wasn't until last year at a trade show – the Power Gen Show in Dallas – that I got the chance to see the joint, talk to the people in the Victaulic booth and generate my own opinions about modeling this joint in **CAESAR II**. After reviewing their catalog and speaking to their engineering group in Pennsylvania, I decided to write this article. Even if you do not use these joints, the concepts covered here might improve your **CAESAR II** models.

The Victaulic booth at the show featured the coupling itself. They were running a contest to see who could assemble the joint the fastest. That's the major feature of this pipe joining assembly – it's quick and easy. The pipe or pipe component has a circumferential groove near the connection end. A unique gasket sits over and across the gap between the two ends to be joined. The final piece of this assembly, the housing, holds the gasket in place and engages the two components with a ridge seated in each of the two grooves. See Figure 1. Bolts hold the housing together to complete the assembly. Certainly not as rugged as many other joining methods but a Victaulic coupling is a feasible alternative for its range of temperatures and pressures.

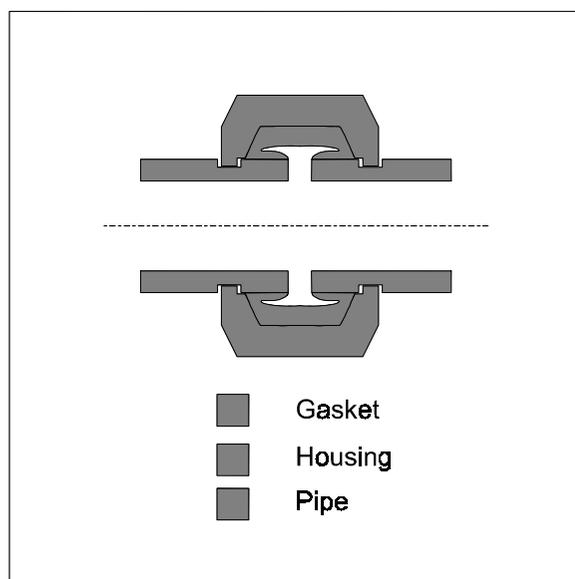


Figure 1

Again, this joint allows direct contact between the gasket and the pipe contents through the gap between the connected pieces. It's the pressure in the concave cross section in the gasket (the "C" shaped Victaulic gasket) that seals the joint. This gasket sets the limits on the applicable pressures and temperatures for the joint. Typically the working temperature range is -30 to 350 °F and the maximum pressure of 1000 psi for pipe up to 6 inches but this rating drops to 250 psi for 24 inch pipe. (There is a safety factor of 3 in these pressure limits.) Many low temperature systems using these joints probably would not require formal analysis. But engineers have cause to evaluate these systems if they are connected to sensitive equipment or equipment that's subject to vibration. The reason is that Victaulic couplings can absorb thermal growth and vibration.

Victaulic produces two types of these couplings – the rigid system and the flexible system. There is no play in the rigid system but, as the name implies, the flexible system has an inherent "looseness". The ridges at the ends of the housing do not fill the full gap in the pipe grooves. The gasket seals the joint but there is a sloppiness in the coupling. This play can be very useful in many piping designs. Thermal strain, settlement and vibration can be absorbed in these joints thereby eliminating the need for added piping flexibility. The Victaulic catalog even shows an expansion joint composed of several of these couplings in series over a 30-inch length. **CAESAR II** users wishing to take advantage of this flexibility want to model it accurately.

### The important characteristics of the coupling

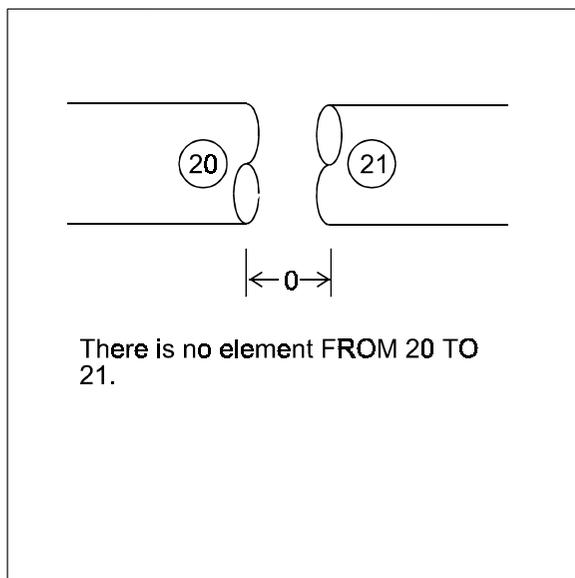
The connected pieces can separate up to ¼ inch by using the space in these grooves. The pipe size and groove manufacture control this coupling performance. Grooves can be rolled or cut. (Rolled grooves have half the "freedom" of the cut grooves.) When designing systems with these couplings, Victaulic recommends reducing these "gaps" by 25 to 50% depending on pipe size. These grooves also allow the pipe to deflect off its axis. The table (for rolled grooves) shows 3.4 degrees for ¾-inch pipe down to 0.3 degrees for 24-inch pipe. These numbers may sound small but experienced **CAESAR II** users recognize the value of this flexibility in reducing pipe bending loads and stresses. How do we model this in **CAESAR II**?

### The key in CAESAR II

Everyone wants to model the coupling as a special element in **CAESAR II** – perhaps an expansion joint or just a flimsy piece of pipe from one groove to the other. But that won't provide the play or gap in the joint. Gaps are a nonlinear effect. **CAESAR II** does not have nonlinear elements but it does have nonlinear restraints. This restraint definition can be used to model these couplings. Just as the pipe running between two nodes supplies the stiffness relationship between the nodes, so too, restraints can be defined in all six degrees of freedom (X, Y, Z, RX, RY &

RZ) to serve a similar purpose. The key is the restraint CNODE in **CAESAR II**. The NODE/CNODE restraint pair serves in place of the element FROM/TO pair. The stiffness fields for each of the six restraints are left blank to use the default (rigid) stiffness. The play in the coupling is modeled by specifying a GAP for the appropriate restraint(s). Since it's either axial deflection or off-axis angulation, pick the degree(s) of freedom that you believe will control the joint.

An example will help here – see Figure 2. A pipe runs from node 10 to node 20 and then another from node 20 to node 30. This piping runs in the X direction. Let's put a Victaulic coupling at node 20. Simply change the FROM node on the second pipe to 21 and define a set of six rigid restraints (X, Y, Z, RX, RY & RZ) at NODE 20 with a CNODE 21. As it stands now, this definition works just like the 10-20 and 20-30 model. What makes it a Victaulic Coupling is the additional GAP definition for the X restraint to model the axial play in the joint. (A GAP on the RY and RZ restraints would model the angulation instead.)



**Figure 2**

Several issues should be mentioned when using this simple approach. First of all, don't spend your valuable time entering data for each and every coupling. On the first pass code through the couplings and enter these NODE/CNODE restraints only at those locations where you think they may be "important". You can always go back and add more where you need them. Oftentimes we have (new) users call up about a job that will not converge\* on a solution only to discover that they completely modeled every nonlinear effect available – one way supports, gaps, rod models and friction.

Instead of moving to convergence, the iterative technique gets trapped in a loop, repeating a sequence of restraint changes until you abort the whole process. We tell them that a more complicated model does not necessarily produce a "better" model. You will finish your work faster by starting with a simpler model and improving it when and where the system results dictate.

Except for non-convergence, **CAESAR II** will always produce results. They may not be sensible but numbers will always be generated. You must check your modeling assumptions especially when nonlinear conditions (here, gaps) are present. Make sure the pipe moves in the right direction. Check the loads at those points where the gap was ignored, if they're high, re-run the job with the gap added. If you put in an axial gap that doesn't close and there's a large bending moment, you may want to replace the axial gap with a bending "gap" and vice versa. This means that when you first view results you are checking your modeling assumptions. If your assumptions prove to be correct, then you can check the system results. If your simplifying assumptions prove wrong, then take the time to adjust your model. This strategy will save time in the long run.

Remember, too, that the **CAESAR II** gap is both positive and negative – a 1/8 inch gap on an X restraint between nodes 20 and 21 means that node 20 can move up to 1/8 inch in X either towards or away from 21. If you wish to get fancier, break the X restraint into a +X restraint and a -X restraint and put the appropriate gap on one or both. Don't forget that the Victaulic gap table (on page 9 of the catalog) lists gaps for rolled grooves; cut grooves have double the movement. Also, Victaulic recommends reducing these movements (by 25 to 50%) when designing your systems. They, too, recognize that more accurate data for these little bits does not necessarily produce a better analysis overall.

One benefit to this NODE/CNODE model is that the loads across the coupling show up in the restraint report. In the Restraint Summary, all six restraints at the node show up on a single line. These NODE/CNODE combinations are quite useful in other applications as well. If you model through a pump and wish to itemize the nozzle loads, just specify a single anchor restraint between a NODE/CNODE pair at the flange. Be sure to list the node on the pump side as the CNODE so that the output report shows the proper signs – the piping loads on the pump and not the pump loads on the piping.

#### **A finer model**

The modeling technique described to this point will do a good job for a majority of piping systems but there is

always a better model. Other considerations were addressed in my discussion with the Victaulic representative. First of all, the gasket will add no stiffness to the connection so no load is required to compress or open the gasket. A simple free-or-fixed gap model is sufficient (**CAESAR II**'s bilinear restraint stiffness is not necessary). The joint may not have gasket stiffness but the joint will require some load to start it moving. On a good connection, a line pressure of 15 psi will pull the pipe out to the limits of the coupling. You could say that pressure thrust must overcome the joint friction to start moving through the gap<sup>†</sup>. This pressure thrust in the joint is not included in **CAESAR II** models. (Except for expansion joint models and the explicit inclusion of bourdon effects, pipe deflection due to pressure is not considered in **CAESAR II**.) If pressure "pops" the joint, then the thermal expansion will have the full gap available for expansion. To take advantage of this extra gap, you can include the pressure thrust by adding a force on either end of the joint pointing away from the joint. See Figure 3. The magnitude of the thrust force is simply the pressure times the inside area of the pipe. Friction, as such, is not included in this model but there may be reasons to account for it. If at least one gap is not closed along a straight run, there will be no axial load calculated along that run, not even the inherent friction load. If this run connects to a piece of sensitive equipment, the friction load necessary to close these joints should be included "by hand", that is, add a force directly to the nozzle. If the pipe is out of round, these friction loads may be higher.

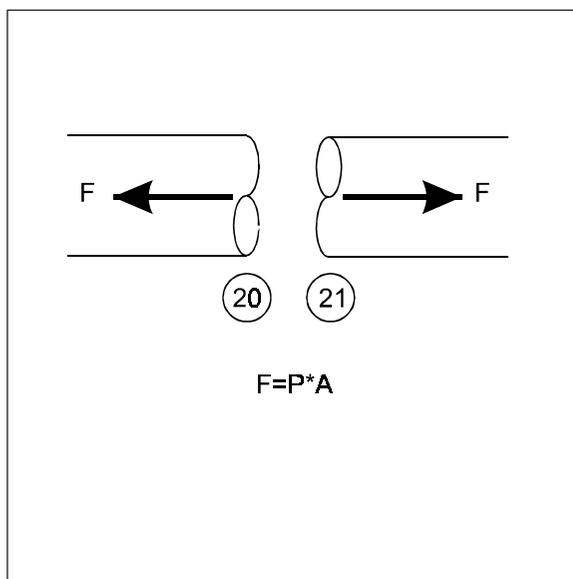


Figure 3

Let's review one additional model adjustment. The coupling model to this point isolates the axial gap from the bending gap. I suggest using one or the other. But in fact, these two terms, axial separation and off-axis angulation are not independent. At the limits, a joint that fully extends axially will be rigid in bending and a joint that takes all the bending cannot extend. "But what about the middle ground?" I asked the Victaulic rep. He said if I wanted to combine both terms I should be sure to keep the sum of the actual to allowable ratios less than 1 (axial displacement / axial gap + bending / bending gap < 1). So, if you run the simple model for axial movement but you have a relatively large bending moment, you can include a rotational gap set to the pro-rated limit. As you might imagine, several iterations may be required to settle the model down. Such iteration may improve the analytical model but I am unsure of its value in the overall analysis.

### Other considerations

Keep in mind that the groove in the pipe may have a reduced wall thickness. While the roll groove removes no metal from the pipe (the entire cross section follows the groove), the cut groove removes metal. This reduction in wall thickness should be considered as an allowance in the required wall thickness. It's not a deep groove though; in fact it's less than the depth required in threaded connections. Check this in thin wall and high-pressure piping.

One concerned user called to ask about flexibility and stress implications of the joint, particularly on bends. Appendix D of the B31.3 piping code shows adjustments for bends with flanges. The flanges addressed by the code serve as stiffening rings for the bend and prevent the bend from ovalizing under a bending load. Bend ovalization reduces the moment of inertia of the cross section and this, in turn, reduces the element stiffness while at the same time the stress increases. The flanges therefore decrease the bend flexibility and reduce the stress intensification factors. Do these Victaulic couplings stiffen the bend? I think not. Does the groove alone call for an increase in the stress intensification factor (SIF)? B31.3 shows an SIF of 2.3 for threaded pipe joints; but how similar is the groove to a threaded joint? It's probably better to focus on the overall connection to answer this question. A threaded connection is a rigid, load-bearing joint; the Victaulic coupling is not. I don't think the coupling should have an SIF of 2.3 but it probably wouldn't hurt to specify it as such. If the point is "overstressed" (on paper) it's probably overloaded. The high stress in the output would serve as a reminder to take a closer look. If additional consideration indicates that the joint is OK, rerun without the SIF so the final report doesn't cause others to ask the question you just answered.

### Get the big picture

The main point of this review is to properly model a Victaulic coupling. On the way, though, we also touched on several aspects of general modeling and CAESAR II specifics. Hopefully this information will be useful even if you do not use these fittings. Keep in mind that CAESAR II is a system analysis tool not a local analysis package. Yes, we can check shell stresses, attached equipment and flanges but the focus is on the system loads and deflections and the pipe stresses that result. You would be fooling yourself to push for the accuracy found in today's finite element analysis but, then again, it would be a waste of modeling time and computing resources to use finite element software for **system analysis**.

With this big picture in mind, you can see why I suggest a simple model for the initial pass and save the fancy modeling for situations that deserve it. That implies (and rightly so) that the results should be checked not for only high stress and high load but also for the soundness of the input. Clearly those stress and load results are invalid if the model is incorrect. So check those results to confirm the model first and refine the model where and when it's significant to your analysis. Fine tuning a model, where unnecessary, is a waste of time. You use these tools to save time.

\* **CAESAR II** uses an iterative method to determine whether or not a nonlinear restraint is active. If the restraint is active, its stiffness is included in the analysis; if it's not active, the stiffness is not included. After running the load case, the program will test each nonlinear restraint to see if the linear assumption was correct. All incorrect "guesses" are updated and the load case is re-analyzed. Iteration continues until convergence, until all these restraint assumptions are met.

† If you estimate the friction force as 15 psi times the inside area of the pipe, you can compare the axial load at nodes where the couplings were not modeled to this value. If the piping loads are much higher than this friction force and you need the flexibility, you would benefit by including this coupling in the model.

### *Genesis of PDMS to CAESAR II Transfer Tool*

By: Misa Jovic, SHEDDEN UHDE PTY LTD,  
A Company of the Krupp Engineering Group  
Melbourne, Australia

#### Synopsis

The stress analysis group of SHEDDEN UHDE Pty. Ltd. has achieved a simple method of electronically transferring piping configuration data from PDMS to **CAESAR II**. This process allows large gains in productivity, elimination of modeling errors and improved understanding between piping design and stress analysis engineers.

#### Introduction

In past years, piping design has been divided between the layout designers and stress analysis engineers. With the proliferation of new generation software, these two groups can be more closely interrelated, resulting in a dramatic improvement in overall design efficiency. A solid understanding of the preferences and limitations of other engineering disciplines, and to a large extent improved bi-directional communication, enhances this improvement.

One of the new generation of software packages that allows this possibility to happen is **CADWorx/PIPE**. It is the first CAD software to feature fully bi-directional interfacing capabilities with the analytical package **CAESAR II**. Although **CADWorx/PIPE** has wide applicability, it has been employed by SHEDDEN UHDE in the past 12 months with the primary aim of :

- Creating 3D isometric piping models for stress analysis purposes,
- Generating CAD drawings that include stress analysis results information from **CAESAR II** – Stress ISO and Multiple ISO features,
- Automatic production of piping fabrication isometric drawings – Auto Isometric feature.

After an extensive "on the job" testing period, **CADWorx/PIPE** has become an important modeling and report-generating tool. The significant benefits it brought have been appreciated not only by stress analysis engineers, but also by piping layout designers and engineers from other disciplines.

**Defining When a Piping System Should be Analysed**

The combination of pipe sizes and process design conditions has traditionally been used when deciding if a detailed stress analysis is required. While this may be appropriate at initial stages of the design, to solely rely on it, could lead to omissions or gross overservicing of the required stress analysis work. The lack of early information regarding the piping layout configuration is the main impediment for making a proper selection of the extent of stress analysis required. Although the answer to this question is not simple, it is apparent that the sooner the layout becomes available, the better are the chances for optimizing the process of selection of piping for analysis.

**PDMS to CAESAR II Interfacing**

This goal of enabling early access to piping layout configuration, has been the impetus for in-house development of a transfer tool between the PDMS design package and CAESAR II stress analysis software (see Figure 1). To overcome the inherent deficiencies of today's CAD/Analysis interfaces, which are usually CAD-driven, the transfer of data has been carried out in two steps. The first step is the transfer of data from PDMS to CADWorx/PIPE. The second step is driven by the analytical package CAESAR II and involves a virtually trouble free transfer of data from CADWorx/PIPE to CAESAR II. The generated models are comparable to those previously created manually by the analyst. The fact that both packages,

(i.e. CADWorx/PIPE and CAESAR II) are produced by the same vendor, effectively eliminates version compatibility maintenance problems and brings immediate benefits from all upgrades and enhancements.

**Implementing the Process**

Using the transfer from PDMS to CAESAR II via

CADWorx/PIPE, any pipe or branch from the PDMS model can be downloaded at any stage of the design process (see Figure 2). Firstly, the model is sent into CADWorx/PIPE. The transfer is quick, simple, and accurate and takes only a few minutes to accomplish. The CADWorx/PIPE environment is then used to group the piping into piping systems suitable for stress analysis. At this stage the model is also checked for possible inaccuracies, outfitted with pipe supports if necessary and cleansed of any undesired elements. Using the simple "System Out..." command the model is then exported into CAESAR II for detail stress and flexibility analysis.

The stress analysis engineer completes the model in CAESAR II, entering a minimum temperatures, pressures and the appropriate pipe material. The model is then analyzed, and, if required, modified within CAESAR II to meet the stress analysis criteria (see Figure 3). To communicate the results with the piping layout design group, the analyst returns to the CADWorx environment and creates one or more stress isometric drawings. The process repeats itself as further modifications are made to the piping layout.

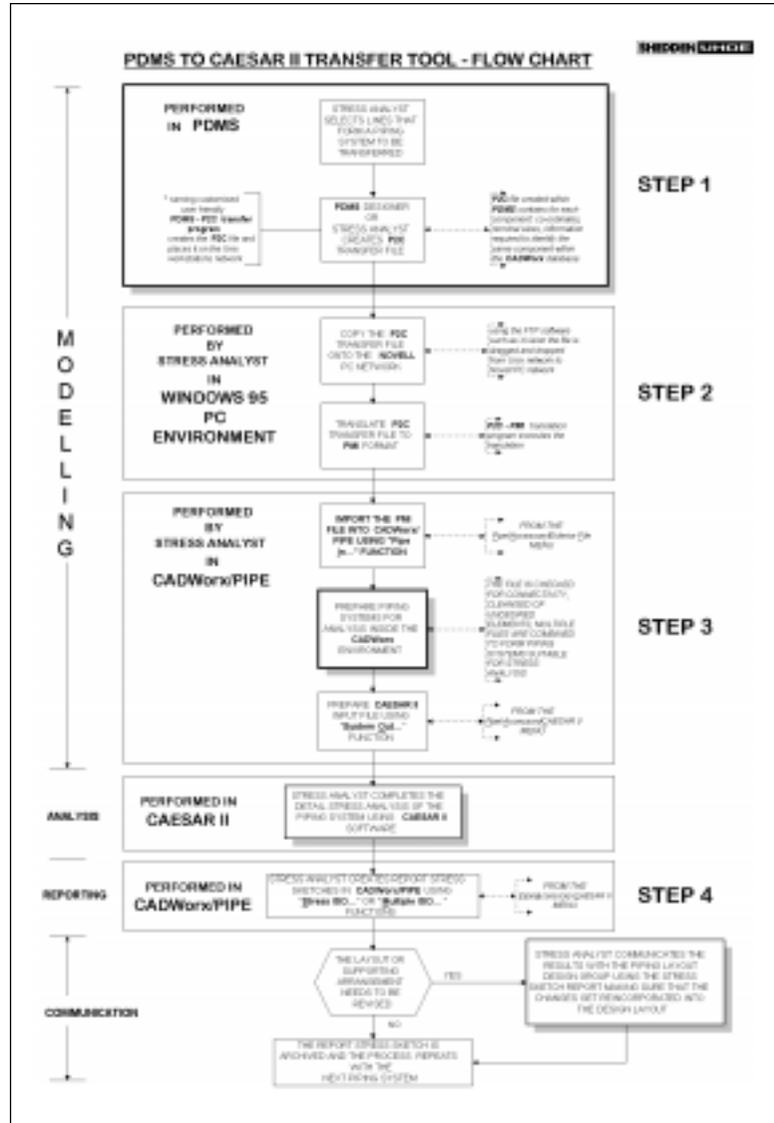


Figure 1



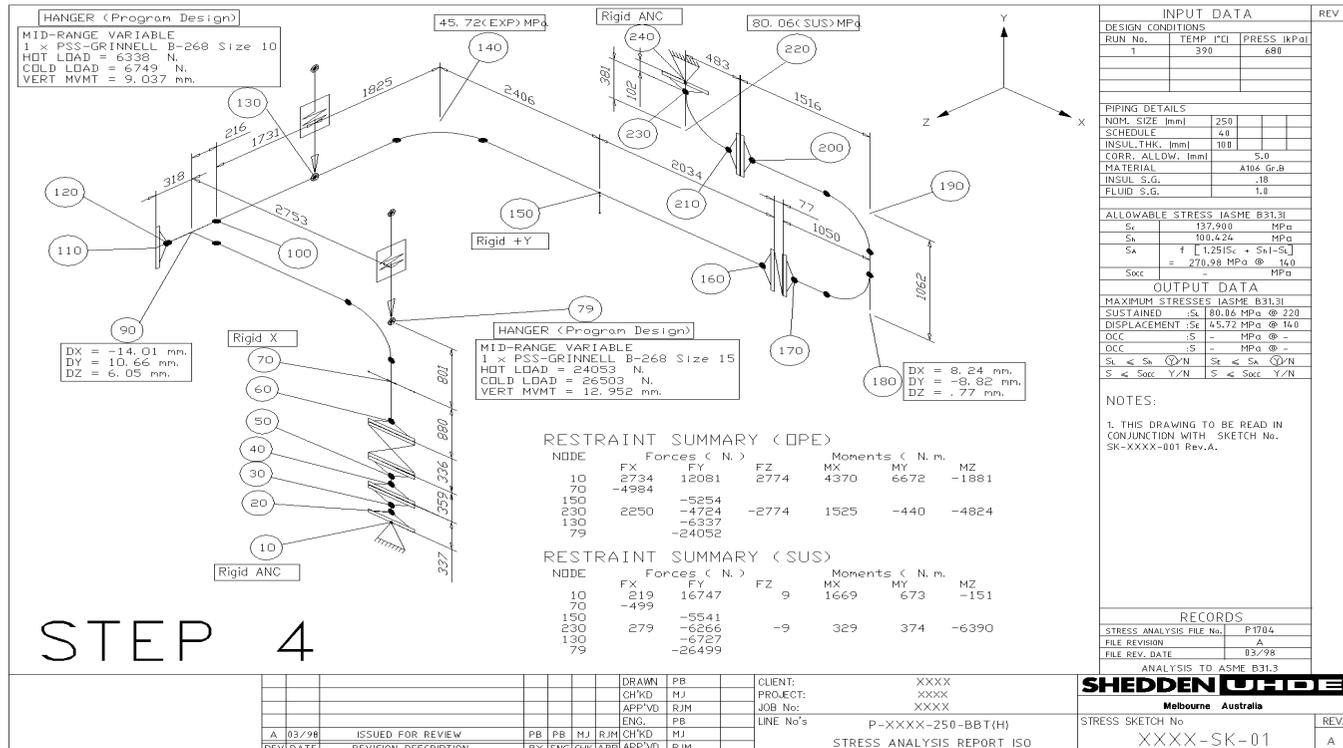


Figure 4

**Note to All Users:**

COADE does a great deal of support via fax and e-mail. Several times a month, we are unable to respond to support issues due to communication problems (either bad addresses, incorrect fax numbers, etc.), and the lack of alternative contact information.

To insure we can properly support you, please insure that your e-mail includes a fax and phone number, and that your fax includes a phone number and e-mail address.

### *The CATIA and Intergraph Interfaces to CAESAR II*

By: Griselda Mani and Richard Ay

For over a decade, **CAESAR II** has provided interfaces to various CAD programs. As a general rule, there are two stages necessary to transfer a model from a CAD system to a stress program. Stage one is run on the CAD side, and involves the generation of a "neutral file". Each CAD program has their own "neutral file", with some containing node numbers, some have elements sorted, some contain material information, and some contain restraint information. Often other non-stress related items are contained in the "neutral file" and must be filtered out (gaskets, valve handwheels).

During the generation of the "neutral file", the CAD system may display various messages reporting the status of the data extraction. Care should be exercised here, since this step often aborts with incomplete "neutral files" if an entity is encountered which is not in the active piping specification.

Once a completed "neutral file" is available, stage two can commence. Stage two is the translation of the "neutral file" by the stress program into its native data format. Each CAD program - "neutral file" combination requires its own translator on the stress side. The steps performed by these translators varies according the completeness of the "neutral file" and how closely it conforms to the way a stress engineer would code a model. For additional details on what is involved in the data translation, and how it should be done, please refer to the articles "CADWorx/PIPE Introduction" and "CADWorx/PIPE - A Model for CAD/Analysis Integration", which can be found in the February 1996 issue of *Mechanical Engineering News*.

The remainder of this article discusses the state of two interfaces available in **CAESAR II**. First, a new interface recently available for **CAESAR II** (the CATIA/CCPlant interface) is described. Next, the improvements made to the Intergraph interface are discussed.

#### **CATIA**

CATIA-CADAM Plant (CCPlant) Solution® is a powerful UNIX® based 3D CAD package. CCPlant uses the latest object-oriented technology to give intelligence to every plant component. The plant components not only contain information about their industrial characteristics and behavior, they also know about themselves and their relationship to the other plant components. Using a module available from COADE (as of July 1998), CCPlant now has the capability of creating a piping neutral file containing the geometry of the CCPlant model including restraint and

equipment location. This neutral file also contains properties such as temperatures, pressures, materials and insulation. Reading the CCPlant neutral file is one of the new features to be offered in **CAESAR II** 4.10.

CCPlant's object-oriented technology provides an excellent platform for conversion to a **CAESAR II** model. Connectivity information is obtained from each object and all CCPlant connectors are converted to **CAESAR II** nodes. Each element is then processed; the element is mapped to a **CAESAR II** element and its geometry and industrial characteristics are obtained. The characteristics of the element, which are transferred to **CAESAR II**, include component type, material, weight, size, insulation, temperature, and pressure. Once all the elements have been processed, the unnecessary node/connectors are eliminated, and the CCPlant components become **CAESAR II** components. Finally, the element's connection points are intelligently renumbered with a node numbering scheme corresponding to that which a stress engineer typically uses.

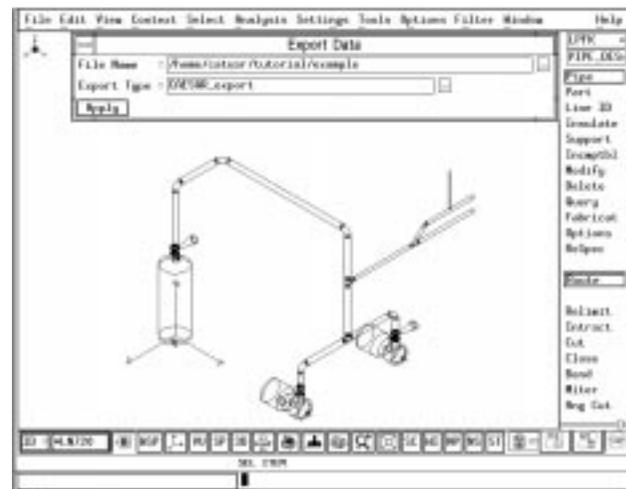
Converting a CCPlant model to a **CAESAR II** model is simple. The interface works in the general fashion that other CAD interfaces offers. The process is illustrated below.

#### **STEP 1 Creating the CCPlant Neutral File**

Once the model is ready for exporting, type the command:

```
/objexp
```

from the **CCPlant** command line. The Export Data window is now displayed.



Select the elements to be exported; the model can be exported in several parts or as a whole. Confirm the element selection. A series of messages are displayed indicating current status of the export process until completed.

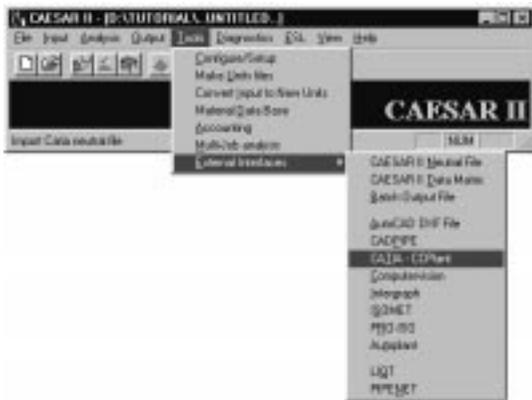
A log file is created having the same name and path as the neutral file with the extension **.log**. The log file contains any significant warning or error messages, and should be reviewed by the user following every model export. If no fatal error messages are obtained, the **CCPlant** neutral file is created.

The CCPlant neutral file must now be transferred to the PC (probably via diskette) for conversion to the **CAESAR II** input file.

**STEP 2 Converting the CCPlant Neutral File to a CAESAR II Input File**

Run the **CAESAR II** program. From the **CAESAR II** window menu select:

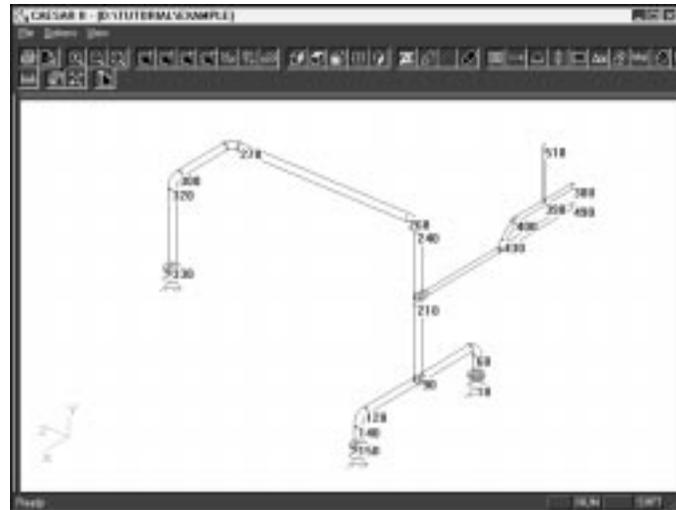
**Tools>External Interfaces>CATIA - CCPlant.**



Enter the name of the **CCPlant** neutral file and then click on **[Convert]**.



Below is the CCPlant model converted to a **CAESAR II** model:

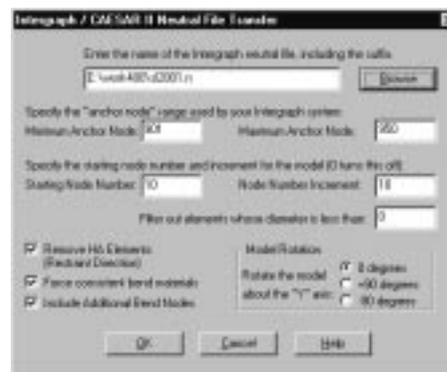


This interface will be available in CATIA-CADAM Plant Solution Version 4.1.8.1 and in **CAESAR II** 4.10.

**Intergraph**

The Intergraph PDS (Piping Design System) is in widespread use around the world. Most of these installations also utilize **CAESAR II** for their stress analysis work. The PDS system has the capability to generate a “neutral file” of designated lines from the CAD model. This “neutral file” contains the basic geometry of the piping system as well as temperatures, pressures, materials, and restraint locations. **CAESAR II** has had the ability to read the Intergraph “neutral file” since Version 3.00 in April of 1990. (To utilize this neutral file, it must be transferred to the PC running **CAESAR II**.)

Recently, the **CAESAR II** Intergraph Interface has been enhanced to provide more capabilities in importing the PDS “neutral file”. Many of these enhancements are a direct result of user requests. The new Interface (April 1998) dialog box is shown in the figure below.



This dialog box shows several new options, not available in previous versions. These items are discussed in the paragraphs below.

**FORCE CONSISTENT BEND MATERIALS** - This check box allows the interface to insure that all bend elements (incoming and outgoing) have the same material name and properties. Often, bends are given a different material name than that of the attached piping, while the properties are the same. This check box allows the program to change the material information as necessary on the bend elements to that of the attached piping.

**INCLUDE ADDITIONAL BEND NODES** - This check box allows the interface to add a mid-point node and a near-point node on bends. Unchecking this box causes bends to have only the far-point node.

**MODEL ROTATION** - This group of radio buttons is used to specify the rotation of the model about the Y axis. The default is zero which leaves the model alone. The +90 button rotates the model a positive 90 degrees, while the -90 button rotates the model a negative 90 degrees. (Note, the Y axis is vertical in **CAESAR II**.)

The following items have also been added or improved in this version of the Intergraph Interface:

- conversion from a Windows application to an MFC application - this presents a more usable initial dialog box with a file "browse" option for locating the neutral files
- a "progress" dialog box has been added to monitor progress during the conversion
- acquisition of rigid weights has been modified to look in field #6, then #8
- weight acquisition for valves has been improved
- implemented COADE material data base with mapping file
- corrected geometry for back-to-back tees
- segments are ordered in a more logical way
- a new node renumbering and data condensation routine (to enable data duplication)
- a "help" option to explain the fields on the initial dialog

Users implementing this interface for the first time are urged to verify the completeness of the "neutral file" before passing it to **CAESAR II**. An example of a complete neutral file can be found in the **CAESAR II** Technical Reference Manual.

### *PC Hardware for the Engineering User (Part 25) - Insuring Your System DLLs are Current*

By: Richard Ay

The Windows releases of **PV Elite**, **CADWorx/PIPE**, and **CAESAR II** have been well received by the COADE user base. However, a number of unexpected problems have been encountered, and summarily attributed to DLL problems at the system level.

DLLs are "Dynamic Link Libraries", which provide common routines for programs. These common routines are loaded from the DLL on request from the running program. DLLs offer two advantages; first the distributed programs are smaller because they do not contain the code which resides in the DLL, and second, sharing common code provides the same appearance and behavior to all programs.

However, DLLs do have a drawback, if the DLL is out of date (or is otherwise corrupted), every program relying on it will fail to execute properly. This is one reason why great care must be exercised when installing software, since many installation routines replace system level DLLs. When a shared DLL is updated (replaced), the system must be restarted for the new file to become operational.

With Windows 95 and Windows NT 4.00 both in common use, and each with their various Service Packs (bug fixes from Microsoft), it is easy to imagine the various versions of the same DLLs in distribution. Out of date DLLs can wreak havoc on application software that depends on a certain version level.

The table below lists the DLL files used by **CAESAR II** Version 4.00. The table includes the version information for Windows NT and 95 as obtained from COADE computers. Your DLL versions should be at least at this level, to insure proper functionality of the software.

DLL NAME	OPERATING SYSTEM	
	NT 4.00 Srv 3	95 Srv 1
ADVAPI32.dll	4	4.70.1215
COMCTL32.dll	4.7	4.7
comdlg32.dll	4	4.00.951
GDI32.dll	4	4.00.950
KERNEL32.dll	4	4.00.950
MFC42.DLL	4.2.6068	4.21.7160
MSFRT40.dll	4.00.523	4.00.524

DLL NAME	OPERATING SYSTEM	
	NT 4.00 Srv 3	95 Srv 1
MSVCRT.dll	4.20.6201	5.00.7128
ole32.dll	4	2.1
OLEAUT32.dll	2.20.4054	2.20.4118
oledlg.dll	1	1
OLEPRO32.DLL	5.0.4055	5.0.4118
SHELL32.dll	4	4.00.951
urlmon.dll	4.70.1215	4.70.1215
USER32.dll	4	4.00.950
VERSION.dll	4	4.00.950
WSOCK32.dll	4	4.00.950

To check the version level of your DLLs, run the program DLLVERSN. This program can be invoked from the "Diagnostic\DLLVersion" menu option. DLLVERSN is a Windows console (DOS box style) application which uses the file DLLVERSN.LST as input, and creates a file named DLLVERSN.CSV as output, in the program directory. This output file is a comma delimited file suitable for import into Excel. Once the data is in Excel, it can be formatted, printed, and compared to the table above.

### *CAESAR II Notices*

Listed below are those errors and omissions in the **CAESAR II** program that have been identified since the last newsletter.

Since the last newsletter, **CAESAR II** Version 4.00 has been released (January 1998). This is the Windows 95/NT version of the software. Being the first release under a new operating system, using a new compiler, Version 4.00 has had a number of updates (intermediate builds) to correct operational and interfacing problems. The build dates associated with **CAESAR II** Version 4.00 are: 980122, 980209, 980316, and 980505.

At the build of 980316, the **CAESAR II** CD was re-cut and reshipped to all Full Run and Lease customers. The major items addressed in each of these builds are listed below.

#### **Build 980122:**

1. Several corrections were made to the dynamic input module: help facility, scroll bars, comment line operation.
2. The input module was revised to: allow skewed restraint specification, removed upper node limit of 10,000, corrected description of generated expansion joint elements.
3. Output reports were corrected in: the flange analysis and the API-617 analysis.

#### **Build 980209:**

1. A browse function was added to several modules: structural unity check, WRC297 – SIFs – Flanges, WRC107.
2. The configuration module was modified to save certain data items correctly.
3. Graphics printing has been improved for "black and white" printers.

#### **Build 980316:**

1. Static load case setup/error checking improved.
2. The configuration module was modified to handle more than 10 units files in a directory.
3. Core library routines updated to provide 50% speed increase for disk operations.

4. The input processor was modified to correct: file sharing issues, small pipe size schedules and thicknesses, and graphics / spreadsheet conflicts.

**Build 980505:**

1. Modified all (necessary) modules to address file/path names containing blanks and periods.
2. Corrected a problem with the 'crotch radius specification" for WRC-329 calculations.
3. Corrected printer font problems.

*PV Elite Notices*

---

Listed below are those errors and omissions in the **PV Elite** program that have been identified since the last newsletter. These patches are available for download from our BBS and WEB sites.

1. The value of the standard air density used in the vortex shedding routines was incorrect.
2. In the stress due to combined loads report, if the combined tensile stress for a load case was not tensile, the program would compare that stress to the wrong allowable. This was a conservative error.
3. In the Zick analysis, the value of A, the distance from the saddle to the head tangent was computed incorrectly in some cases (namely when body flanges were used) causing conservative stress results.
4. When a vessel had section type stiffeners, the values for the distance and the area were being transposed each time that data was read in.
5. For nozzle reinforcement per Div. 2, the program in some cases would compute the area in the nozzle wall when the thickness limit was below the bevel for type HB nozzles.

*CODECALC Notices*

---

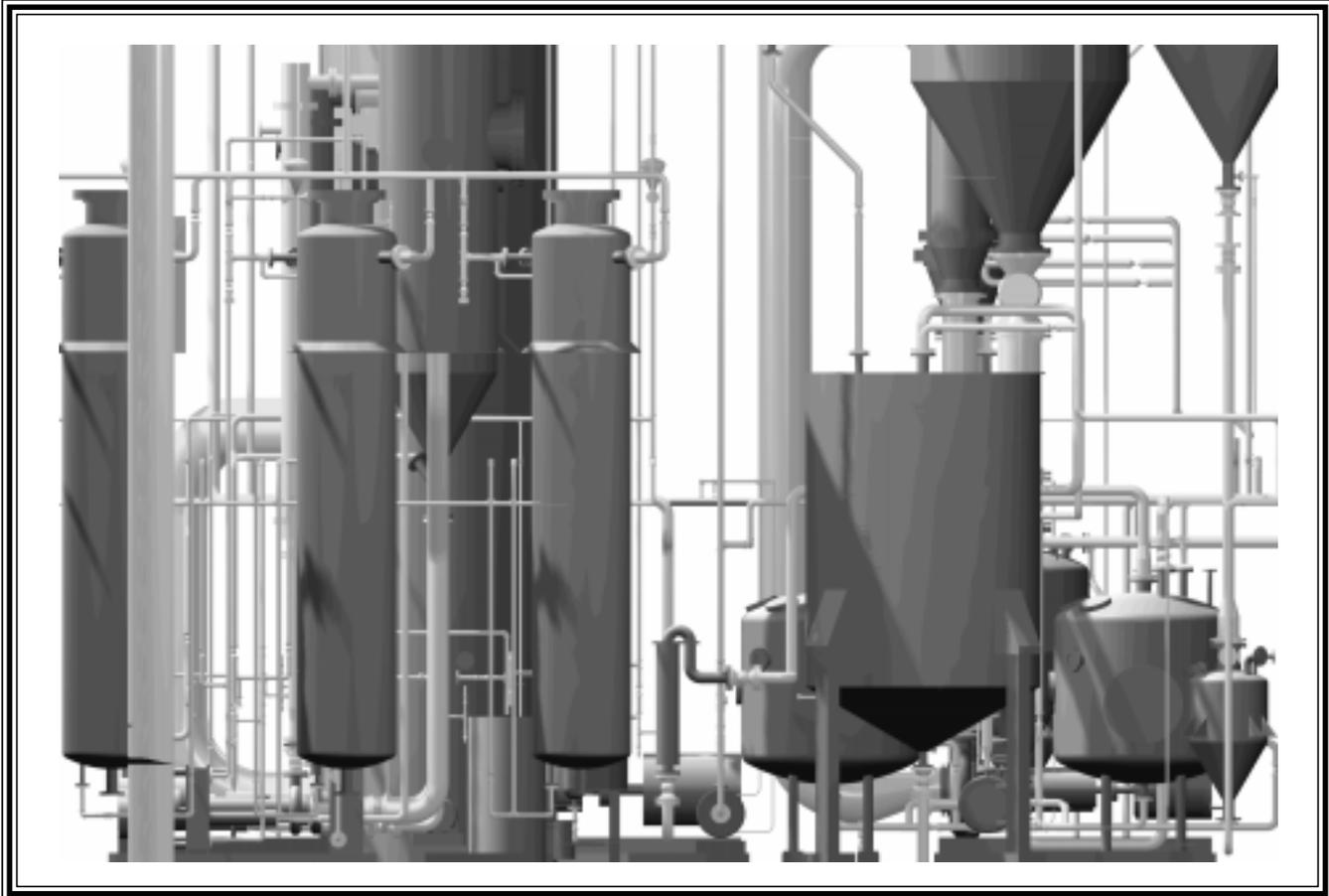
There have been no errors reported in CODECALC Version 5.60 since the December 1997 newsletter.

*TANK Notices*

---

Listed below are those errors and omissions in the **TANK** program that have been identified since the last newsletter.

1. **Output Report Module:** Several output values were not properly converted to the active units system; weight used for Section 3.11 stability, roof plate corrosion allowance, and the column cap diameter. Additionally, the roof plate corrosion allowance was not reported. These problems were corrected in Build 042898 and posted on the WEB site for download.



**What is this? See page 9.**

---

**COADE Engineering Software**

12777 Jones Rd. Suite 480  
Houston, Texas 77070

Tel: 281-890-4566  
WEB: [www.coade.com](http://www.coade.com)

Fax: 281-890-3301  
E-Mail: [query@coade.com](mailto:query@coade.com)

BBS: 281-890-7286  
CompuServe: 73073,362

---