Mechanical Engineering News

COADE, Inc.

For the Power, Petrochemical and Related Industries

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The **COADE** Mechanical Engineering News Bulletin is published periodically 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, petrochemical and related industries. Additionally the Bulletin will serve as the official notification vehicle for software errors discovered in those Mechanical Engineering Programs offered by **COADE**.

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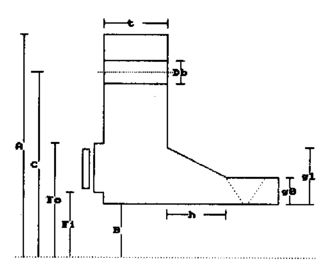
PC HARDWARE FOR THE ENGINEERING USER (Part 13)

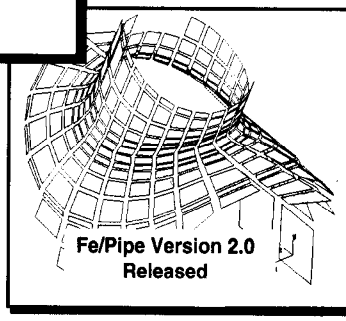
Recently an incompatibility was discovered between all COADE software and Toshiba T3100 computers. In an effort to save battery power, Toshiba modified the resistance of the parallel printer port. The ESL access (via the parallel port) is timed, based on a CPU calibration routine. Since the parallel port on the T3100 is much slower than anticipated, all COADE programs fail to find the ESL memory. This results in a program abort.

The ESL (External Software Lock) deserves an additional note. The ESL is the method COADE uses to insure that users have paid for the license to use the software, as opposed to illegally duplicating the software. It should therefore be obvious that the ESL is a valuable item. Over the last several months COADE has received numerous telephone calls requesting the purchase of just the ESL, not the software. COADE's view is that the ESL is the software, therefore another ESL can be purchased for the cost of an additional software license.



CAESAR II FLANGE SKETCH

Another telephone call explains how the ESL was lost and requests that we just send another. To illustrate our position on this matter, lets assume someone steals your computer. Are you going to call the computer store and ask for a replacement? Of course not, you turn it in to your insurance and buy another computer. Most business insurance policies will cover items such as our ESL. A stolen ESL represents an unauthorized copy of the software in use somewhere.



Fe/Pipe Version 2.0 Released

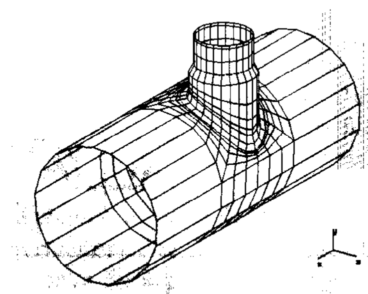
To conclude, the ESL is a very important part of COADE's software products. It is the user's responsibility to see that the ESL is insured against loss or theft.

***PC Performance*:**
With the ready availability of 386 and 486 PC's, 32 bit computing is finally becoming available to the PC engineering user. 32 bit computers can offer significant improvements in memory and speed. In the near future it will not be unusual for a single desktop PC to have over 24 Mbytes of memory! CPU speeds are increasing, disk speeds are increasing, disk capacities are increasing. What was once mainframe computing power will shortly be available on the desktop. This incredible increase in performance will alter the way that engineers use and manipulate data. What was once large and slow will now be small and quick. What was once a large finite element model will become a

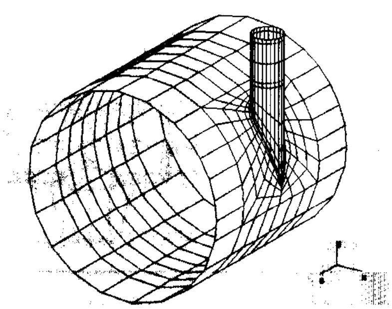
is overly conservative, accurate, or non-conservative.

- Calculation of the intersection load reduction factor. This tells the user what his load reduction will be if he inserts **Fe/Pipe** local stiffnesses back into his piping model. This is a very handy calculation tool. It tells the user if the local flexibility of the intersection will have an effect on his results before he even runs it on **CAESAR II**.

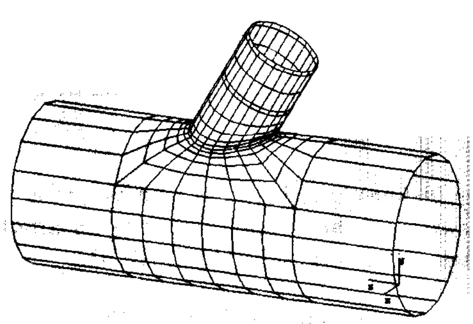
- New templates, new error checking, and more flexibility. Hillside and lateral nozzle templates were included in Version 2.0. Several examples are shown in the figures below:



Nozzle Reinforced Hillside Model



Completely Flush Hillside Model



Lateral Unreinforced Nozzle

PROVESSEL In December of 1991, Version 2.51 of **PROVESSEL** shipped to all users current on their updates. This version included flat and conical heads in the Tower and Horizontal modules, as well as the ability to perform external pressure computations of Towers with more than a single diameter or thickness.

Version 2.52 of **PROVESSEL** shipped to all recipients of Version 2.51 in February of 1992. This version included flat and conical heads in the Nozzle modules, and corrections to all reported user problems. The next version of **PROVESSEL**, Version 2.6, will incorporate the A91 code addendum.

CodeCalc In January of 1992, Version 5.02 of **CodeCalc** shipped to all recipients of Version 5.01. This version included streamlined access to the output module, additional printer control, and corrections to all reported user problems. The next version of **CodeCalc** will include the A91 code addendum.

INTERSECTION TYPES IN CAESAR II

Many users have questioned the differences between the various intersection types available in **CAESAR II**. This article will attempt to explain the intersection types available, their relationship to the B31 codes, and typical uses of each type, and the major differences between types.

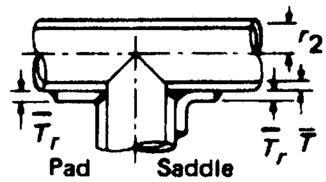
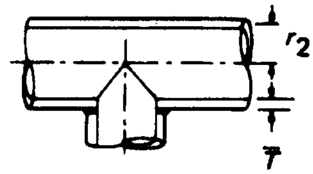
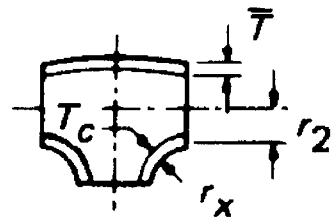
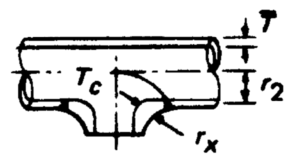
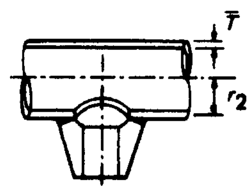
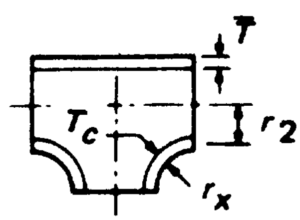
Recall that the spreadsheet label denoted "SIFs & TEEs" activates an auxiliary field in which the user may specify an intersection, and/or fitting stress intensification values. This auxiliary field is shown in the figure below. The valid intersection (or fitting) types are listed on the following page as an aid to the user.

```
NODE     10.000   PAD T
TYPE      3.000   FTG ro
SIF(i)            CROTCH
SIF(o)            WELD ID
WELD d            B1
FILLET            B2

NODE              PAD T
TYPE              FTG ro
SIF(i)            CROTCH
SIF(o)            WELD ID
WELD d'           B1
FILLET            B2

1 Reinforced      9 Socket/unfin
2 Unreinforced   10 Tapered
3 Welded         11 Threaded
4 Sweepolet      12 Dbl Welded
5 Weldolet       13 Lap Joint
6 Extruded       14 BF Sweepolet
7 Butt Weld      15 BF Latrolet
8 Socket         16 BF Ins Wld
```

The first important item to address is that only the first six types represent valid intersections as defined by the B31 codes. The remaining types are fittings only and are included for SIF purposes only. The table shown on the following page relates the six **CAESAR II** intersections to their B31.3 equivalent and includes the appropriate Code sketch.

CAESAR II TYPE	B31.3 TYPE	NOTES	SKETCH
1 Reinforced	Reinforced	· Used to lower SIFs · Not a fitting · Modified Pipe	
2 Unreinforced	Unreinforced	· Routine Intersection · Not a fitting · Modified pipe · Usually the cheapest	
3 Welded Tee	Welding Tee	· Usually size-on-size · Governed by B16.9 · Usually the lowest SIF · Usually Expensive	
4 Sweepolet	Welded-in contour	· "Sit-in" fitting · Forged fitting on a pipe	
5 Weldolet	Branch Welded On	-"Sit-on" fitting · Forged fitting on a pipe	
6 Extruded	Extruded Welding Tee	· Seldom used · Used for thick wall manifolds · Extruded from straight pipe	

USER SPECIFIED WIND PROFILES

For users specifying their own wind pressure or velocity profiles, you may need to adjust the shape factor entered on the element spreadsheets. The reason for this adjustment is outlined below. Users should also note that the ANSI A58.1 guidelines have been replaced by ASCE #7 (1990). This rewrite of the specification has no affect on the computations performed by **CAESAR II**.

1) ANSI uses an equation of the form Pressure equivalent = 1/2 (mass of fluid)(velocity * velocity). This kinetic energy formulation is used when the analyst uses the ANSI 58.1 (ASCE #7) parameters off of the wind

loading spreadsheet.

2) When the user enters his/her own pressure versus elevation, care should be taken to divide the wind shape factor by 2.0 if the kinetic energy/ANSI approach is to be used.

3) By default when the user inputs the velocity/pressure information there is no allowance for the 1/2 factor as it is in ANSI, because this theory is based on the momentum equation. Recall the following equation from fluid mechanics :

   The summation of forces in the "x" direction = the sum of Vx(pV dot A) + d/dt of the integral over the control surface Vx p dv, where:

   p = the density of the fluid
   Vx = the velocity of the fluid in the "x" direction
   A = the area over/through which the fluid is flowing
   dv = the change in the mass flow rate of the fluid

   Since the change in mass flowrate is assumed to be zero for a constant flow process, this integrates to 0. Hence we have $Fx = p V^2 A$. This implies that the equivalent pressure = $p V^2$. The forces generated can be easily checked by a single element example.

4) Fluid load on a body completely immersed in a fluid is typically computed from :

   $$F = 1/2 \, p V^2 + Fv$$

   where Fv is a function of skin friction, etc. The actual load on a cylindrical body is probably somewhere between $1/2 \, p V^2$ and $p V^2$, being closer to $1/2 \, p V^2$.

ANSI A58.1 gives us the $1/2 \, p V^2$ equation and tells us to use it explicitly with some regard for surface effects etc. When the user enters his own velocity or pressure versus elevation **CAESAR II** uses pV^2 times the shape factor. It is up to the user to adjust the shape factor in these instances to get his desired value between $1/2 \, p V^2$ and $p V^2$.

In summary, when specifying velocity or pressure profiles, divide the normal shape factor by 2.

FINITE ELEMENTS IN PRACTICE

The Finite Element Method (FEM) using shells and volumes has long been regarded as a powerful tool for mechanical analysis. In the early 1970's the first versions of ANSYS (and others) were being used for all sorts of mechanical calculations in the offshore, aerospace and nuclear industries. For many reasons this analytical capability has never reached the day-to-day world of the piping and vessel engineer. This article discusses some of the reasons this has happened, what the piping/vessel engineer is missing as a result, and its effect on the economy and safety of plants.

There are three basic reasons that FEM is not used more often in the everyday piping/vessel design environment:

1) Cost

2) Perceived Usefulness

3) Required Expertise

Some of the costs typically associated with running a finite element analysis are listed below:

- The cost of using or buying the finite element software.
- The cost of the computer, or service bureau time required to run the software.
- The education expense required to train an engineer to use finite element software properly.
- The man-time charge required to generate a good FEM model. Most typical FEM models take days to input by the "non-expert" user.
- The man-time charge required to compare the results from most FEM programs and the applicable code allowables.

Because the above costs are high with respect to the running of a pipe stress program, or ASME Section VIII, Div. 1 pressure vessel program, FE techniques that can improve on beam, and Section VIII, Div. 1 methods are not used. As a result, the typical piping/vessel engineer has not had the opportunity to explore the possibilities that a more refined analysis can offer, and thus the percieved usefulness of finite element methods is low.

In summary: FEM methods are not used more frequently in day-to-day piping and vessel calculations because: