#1 (OPE) W + P + T + D + F
#2 (OPE) W + P + F
#3 (SUS) W + P
#4 (EXP) D1 - D2

In reviewing these load cases, let's start with sustained stresses. Because the Codes ignore cold spring effects with respect to stresses, the sustained stresses are simply those resulting from a weight plus pressure case (case #3). Since the expansion stresses are described in the Codes as those resulting from the differential between extreme conditions of the piping system, in this case it is required that we have both cold and hot operating conditions (cases 1 and 2, respectively). The necessity of both the hot and cold operating conditions is to include the nonlinear effects introduced into the system by the cold spring in our calculation of the stress range. These effects are necessary in order to compute the correct expansion stresses.

Although no credit is permitted for stresses, the Codes do permit credit for load calculations. Paragraph 319.2.4 of B31.3 states, "However, in calculating the thrusts and moments where actual reactions as well as their range of variations are significant, credit is given for cold spring." Reading further to discover how much credit is allowed, paragraph 319.5.1 uses 2/3 of the cold spring factor in computing the maximum reaction force of the code equation 22. The explanation is as follows, "The factor two-thirds is based on experience which shows that specified cold spring cannot be fully assured, even with elaborate precautions." With that in mind, a second run of **CAESAR II** could be used to take the cold spring into effect for the equipment loads. The required load case of this set would be:

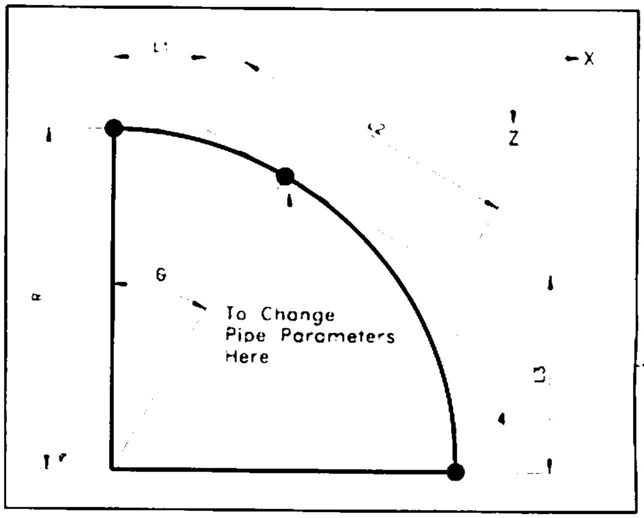
(OPE) W + P + T + D + F

Where the cold spring force F is generated by using a cold spring element with a length of only 2/3 of the specified cut short length.

For further information regarding this topic refer to the discussions in the **CAESAR II** manuals.

Q. How do I split bends into two separate elements?

A. There are occasions, while modelling a system, when it is advantageous to split a bend into more than one element. One example would be when modelling a reducing elbow. By splitting the bend into two elements, the pipe parameters can be changed at a specific location (angle) along the bend. The following figure shows a bend split at an angle θ. The three length dimensions (L1, L2, and L3) are defined below the schematic.



$$L_1 = R\left(\frac{1+SIN\theta - COS\theta}{1+SIN\theta + COS\theta}\right)$$

$$L_2 = R\left(\frac{2}{1+SIN\theta + COS\theta}\right)$$

$$L_3 = R\left(\frac{1-SIN\theta + COS\theta}{1+SIN\theta + COS\theta}\right)$$

Figure 9 - Bend split at angle θ

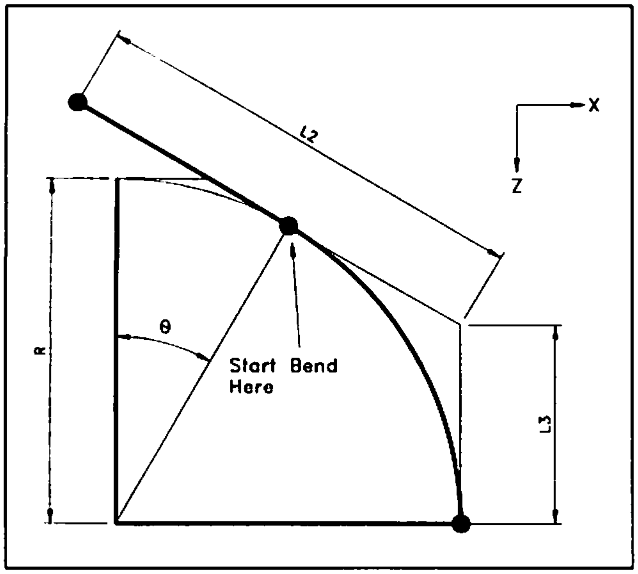
In order to split the shown bend at the angle θ, three spreadsheets of data are required to completely define the two bend elements.

Spreadsheet 1. Code first elbow:
Bend (Y/N) Y
Radius = R
ΔX = L1+Length coming into tangent
ΔZ = 0

Spreadsheet 2. Code second elbow:
Bend (Y/N) Y
Radius = R
ΔX = L2cosθ
ΔZ = L2sinθ

Spreadsheet 3. Code next pipe:
Bend(Y/N) N
ΔX = 0
ΔZ = L3 + Length beyond tangent

A second reason to split the bend is if the pipe is coming into the bend at an off angle. In this situation, the angle θ represents the angle from 90 degrees to the tangent point of the bend and straight run of pipe. The dimensions of L2 and L3 are defined below the figure.



$$L_2 = L_3 + \text{Tangent Length}$$

$$L_3 = R\left(\frac{1 - SIN\theta + COS\theta}{1 + SIN\theta + COS\theta}\right)$$

Figure 10 - Straight pipe intersecting bend at angle θ

In this case, two spreadsheets are required to define the bend.

Spreadsheet 1. Code straight run:
Bend (Y/N) Y
Radius = R
$\Delta X = L2\cos\theta$
$\Delta Z = L2\sin\theta$

Spreadsheet 2. Code next pipe:
Bend (Y/N) N
$\Delta X = 0$
ΔZ = L3 + Length beyond tangent

Q. Why are there no forces and stresses computed on rigid elements?

A. This question typically arises in the form of, "When I look at the force report, why do I not see any forces and moments on the rigid elements?"

By default **CAESAR II** does not show the forces and moments on rigid elements. There is, however, a flag that can be turned on in order to see these results. From within the input, choose [K]aux. From the auxiliary menu choose option**5-Special Execution Parameters**. One of the special execution parameters is a flag to print forces on rigid elements. Once this is turned on, these forces and moments will appear in the output reports.

As for the stresses, it is true that no stresses will be computed on rigid elements. Because rigid elements are typically used as constructs, valves, equipment, etc., **CAESAR II** has no way of calculating the cross-sectional area, therefore the stresses cannot be computed.

CAESAR II Specifications

Listed below are those errors & omissions in the **CAESAR II** program that have been identified since the last newsletter. These items are listed in two classes. Class 1 errors are problems or anomalies that might lead to the generation of erroneous results. Class 2 errors are general problems that may result in confusion or an abort condition, but do not cause erroneous results.

Class 1

1) Element Generator: An error has been discovered in the element generator when setting up horizontal "large rotation" rod restraints, when the user specified a negative direction cosine. The direction was always considered as positive. This error was corrected in Patch C.

2) Dynamic Stress Computation Module: An error was discovered in the stress computation modules such that the "stress type" indicator for "time history" runs was uninitialized. This caused most runs to "assume" the SUS/OCC stress type. This error was corrected in Patch C.

3) Piping Error Check Module: An error has been discovered in the presentation of the "minimum required wall thickness" value. The units conversion constant was applied improperly causing non-English values to be reported incorrectly. This error is corrected is Version 3.22.

4) Piping Error Check Module: An error has been discovered in the conversion of the API-650 user data to internal program units. The input assumes the "length" conversion factor for the nozzle and fluid heights, while the error checker assumes the "diameter" conversion factor. This mix-up may produce errors if the units file in use employs different conversion units for length and diameter, and the nozzle height to diameter ratio is less than 1.5. Note, all COADE supplied units files use consistent units, and therefore do not exhibit this problem. This error is corrected in Version 3.22.