FINITE ELEMENT SOLUTION RESULTS

Results were generated with the finite element program FE/Pipe®.
Analysis Time Stamp: 11/22/2007 7:25:47 AM

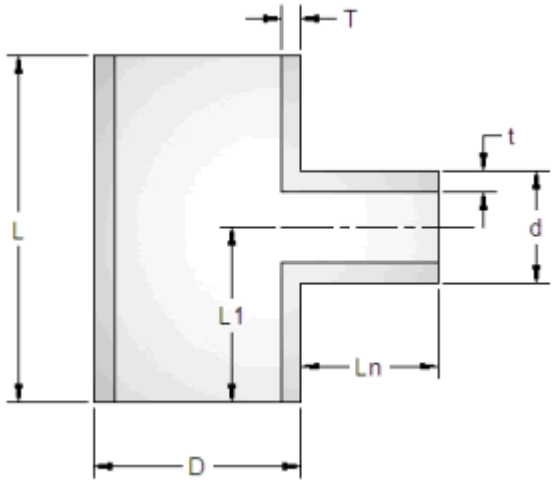
GEOMETRY INPUT

Dimensions for Cylindrical Shell

Outside Diameter	D =	14 [in.]
Wall Thickness	T =	.5 [in.]

Dimensions for Unreinforced Branch

Branch Diameter	d =	7 [in.]
Branch Wall Thickness	t =	.375 [in.]



OPTIONAL INPUT

Fillet Weld Size at Intersection	=	[in.]
Fillet Weld Size at Edge of Pad	=	[in.]
Mesh Density Setting	=	Standard Mesh Density

Load Option : SIFs are calculated for loadings thru the branch.
Boundary Condition Option : Top End of Header is not restrained

MATERIAL PROPERTIES

Material Properties for Parent and Branch:

Cold Allowable Stress	=	20000 [psi]
Hot Allowable Stress	=	20000 [psi]
Modulus of Elasticity	=	29e6 [psi]
Poisson's Ratio	=	0.30
Thermal Expansion Coefficient	=	6.5e-6 [in/in/°F]
Ambient Yield Stress	=	38000 [psi]
Hot Yield Stress	=	38000 [psi]
Ambient Tensile Stress	=	70000 [psi]
Fatigue Curve	=	Low Carbon Steel

STRESS INTENSIFICATION RESULTS

The following stress intensification factors are to be used in a beam-type analysis of the piping system. Inplane, Outplane and Torsional sif's should be used with the matching branch pipe whose diameter and thickness is given below. The axial sif should be

used to intensify the axial stress in the branch pipe calculated by F/A. The pressure sif should be used to intensify the nominal pressure stress in the PARENT or HEADER, calculated from PD/2T.

	In-Plane SIF	Out-of-Plane SIF	Torsion SIF	Axial SIF	Pressure SIF
FE-SIF	3.64	9.11	2.43	12.35	3.00
B31.3	3.06	3.83	1.00		
B31.1	4.23	4.23	4.23		
WRC 330	3.79	4.23	2.08		

BRANCH FLEXIBILITY RESULTS

The following stiffnesses should be used in a piping 'beam-type' analysis of the intersection. The stiffnesses should be inserted at the surface of the branch/header or nozzle/vessel junction. The general characteristics used for the branch pipe should be as given in the Geometry Input portion of this report.

Axial Stiffness [lb/in.]	2184382.00
In-Plane Bending Stiffness [in.lb./deg]	976528.50
Out-of-Plane Bending Stiffness [in.lb./deg]	307996.50
Torsional Stiffness [in.lb./deg]	5708951.00

ALLOWABLE LOAD RESULTS

	Maximum Individual Occuring	Conservative Simultaneous Occuring	Realistic Simultaneous Occuring
SECONDARY ALLOWABLES			
Axial Force [lb]	68450.54	22543.46	33815.20
In-Plane Moment [in-lb]	220109.60	51258.72	108736.20
Out-of-Plane Moment [in-lb]	148964.40	34690.55	73589.78
Torsional Moment [in-lb]	166168.10	54736.09	82104.13
Pressure [psi]	834.62	10.00	10.00
PRIMARY ALLOWABLES			
Axial Force [lb]	26181.87	8655.81	12983.71
In-Plane Moment [in-lb]	139696.40	32657.07	69276.10
Out-of-Plane Moment [in-lb]	55782.52	13040.37	27662.81
Torsional Moment [in-lb]	209427.30	69237.30	103856.00
Pressure [psi]	986.77	10.00	10.00

NOTES:

1) Maximum Individual Occuring Loads are the maximum allowed values of the respective loads if all other load components are zero, i.e. the listed axial force may be applied if the inplane,

outplane and torsional moments, and the pressure are zero.
2) The Conservative Allowable Simultaneous loads are the maximum loads that can be applied simultaneously. A conservative stress combination equation is used that typically produces stresses within 50-70% of the allowable stress.
3) The Realistic Allowable Simultaneous loads are the maximum loads that can be applied simultaneously. A more realistic stress combination equation is used based on experience at Paulin Research. Stresses are typically produced within 80-105% of the allowable.
4) Secondary allowable loads are limits for expansion and operating piping loads.
5) Primary allowable loads are limits for weight, primary and sustained type piping loads.

FINITE ELEMENT PLOTS

Figure 1. Finite Element Model

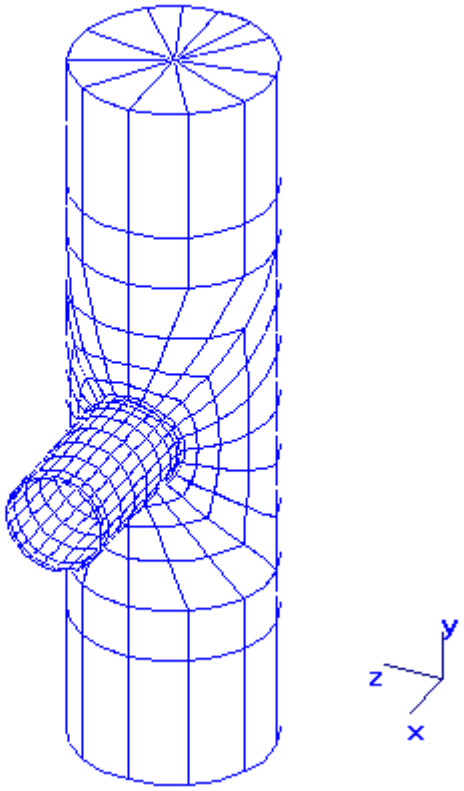


Figure 2. Axial SIF Load Case

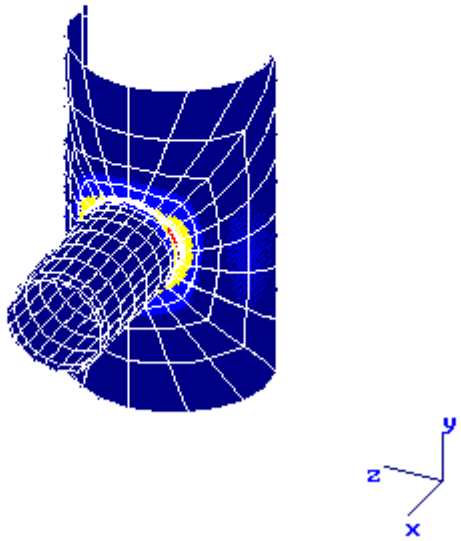


Figure 3. In-Plane Bending Load Case

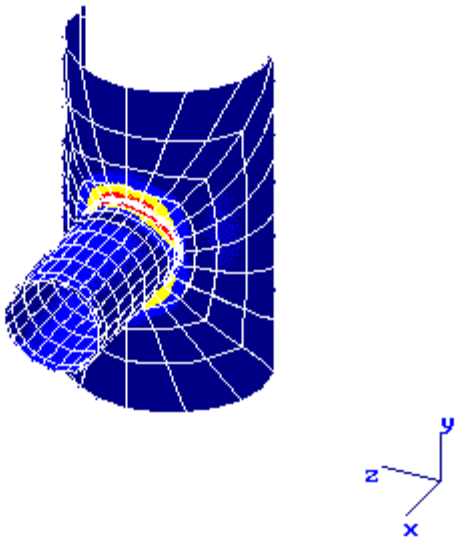


Figure 4. Out-of-Plane Bending Load Case

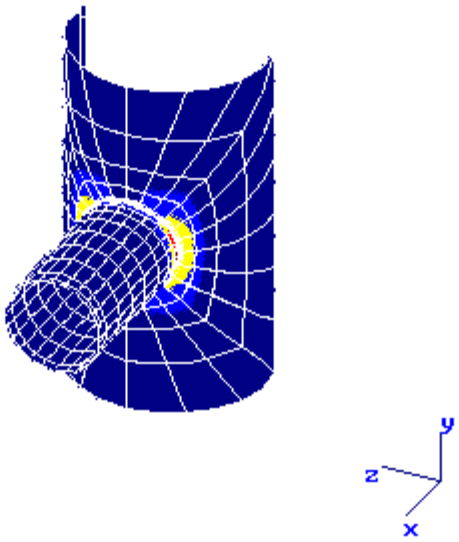


Figure 5. Torsional SIF Load Case

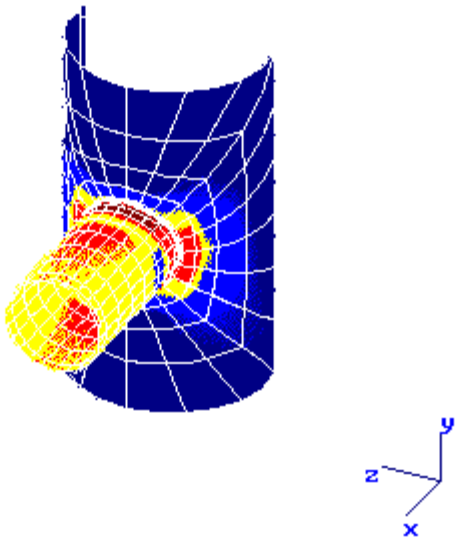
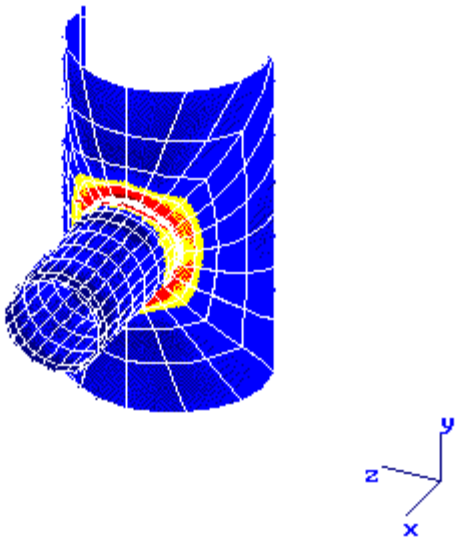


Figure 6. Pressure SIF Load Case


Y
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