

Quality Assurance Block

Caepipe

Version 5.11

Client : Users

Project : Tutorial

File Number :

Report Number :

Model Name : Sample

Title : Sample problem

Analyzed : Tue May 10 12:16:47 2005

Prepared by : _____ Date:
SST Systems, Inc.

Checked by : _____ Date:

Analysis Options	
Code	: Piping code = B31.3 (2002) Do not include axial force in stress calculations Do not use liberal allowable stresses
Temperature	: Reference temperature = 70 (F) Number of thermal cycles = 7000 Number of thermal loads = 1 Thermal = Operating - Sustained Use modulus at reference temperature
Pressure	: Pressure stress = PD / 4t Peak pressure factor = 1.00 Do not include Bourdon effect Use pressure correction for bends
Dynamics	: Cut off frequency = 33 Hz Number of modes = 20 Include missing mass correction Do not use friction in dynamic analysis
Misc.	: Include hanger stiffness Vertical direction = Y

Layout (11)

#	Node	Type	DX (ft'in")	DY (ft'in")	DZ (ft'in")	Matl	Sect	Load	Data
1	Title = Sample problem								
2	10	From							Anchor
3	20	Bend	9'0"			A53	8	1	
4	30				6'0"	A53	8	1	Hanger
5	40	Bend			6'0"	A53	8	1	
6	50			-6'0"		A53	8	1	Anchor
7	6" std pipe								
8	30	From							
9	60		6'0"			A53	6	1	
10	70	Valve	2'0"			A53	6	1	
11	80		6'0"			A53	6	1	Anchor

Anchors (3)

Node	KX (lb/inch)	KY (lb/inch)	KZ (lb/inch)	KXX (in-lb/deg)	KYY (in-lb/deg)	KZZ (in-lb/deg)	Releases					
							X	Y	Z	XX	YY	ZZ
10	Rigid	Rigid	Rigid	Rigid	Rigid	Rigid						
50	Rigid	Rigid	Rigid	Rigid	Rigid	Rigid						
80	Rigid	Rigid	Rigid	Rigid	Rigid	Rigid						

Bends (2)

Bend Node	Radius (inch)	Rad. Type	Thk (inch)	Bend Matl	Flex. Fact.	In Pln SIF	OutPl SIF	Int. Node	Angle (deg)	Int. Node	Angle (deg)
20	12	Long									
40	18	User									

Hangers (1)

Node	Type	No of	Load var%	Short range	Spring rate (lb/inch)	Load (lb)	Load Type	CNode
30	Grinnell	1	25					

Specified Displacements (1)										
Node	Type	Load	X (inch)	Y (inch)	Z (inch)	XX (deg)	YY (deg)	ZZ (deg)		
50	Anchor	T1		0.5						
Valves (1)										
From	To	Weight (lb)	Length (inch)	Thick X	Insul Wgt X	Add.Wgt (lb)	Offsets of Add.Wgt			
							DX (inch)	DY (inch)	DZ (inch)	
60	70	200		3.00	1.75	50	0	18	0	
Coordinates (12)										
Node	X (ft'in")	Y (ft'in")	Z (ft'in")							
10	0	0	0							
20A	8'0"	0	0							
20	9'0"	0	0							
20B	9'0"	0	1'0"							
30	9'0"	0	6'0"							
40A	9'0"	0	10'6"							
40	9'0"	0	12'0"							
40B	9'0"	-1'6"	12'0"							
50	9'0"	-6'0"	12'0"							
60	15'0"	0	6'0"							
70	17'0"	0	6'0"							
80	23'0"	0	6'0"							
Pipe material A53: A53 Grade B										
Density = 0.283 (lb/in3), Nu = 0.300, Joint factor = 1.00, Type = CS										
Temp (F)	E (psi)	Alpha (in/in/F)	Allowable (psi)							
-325	31.4E+6	5.00E-6	20000							
-200	30.8E+6	5.35E-6	20000							
-100	30.2E+6	5.65E-6	20000							
70	29.5E+6	6.07E-6	20000							
200	28.8E+6	6.38E-6	20000							
300	28.3E+6	6.60E-6	20000							
400	27.7E+6	6.82E-6	20000							
500	27.3E+6	7.02E-6	18900							
600	26.7E+6	7.23E-6	17300							
650	26.1E+6	7.33E-6	17000							
700	25.5E+6	7.44E-6	16500							
750	24.9E+6	7.54E-6	13000							
800	24.2E+6	7.65E-6	10800							
850	23.3E+6	7.75E-6	8700							
900	22.4E+6	7.84E-6	6500							
950	21.4E+6	7.91E-6	4500							
1000	20.4E+6	7.97E-6	2500							
1050	19.2E+6	8.05E-6	1600							
1100	18.0E+6	8.12E-6	1000							

Pipe Sections (2)											
Name	Nom Dia	Sch	OD (inch)	Thk (inch)	Cor.Al (inch)	M.ToI (%)	Ins.Dens (lb/ft3)	Ins.Thk (inch)	Lin.Dens (lb/ft3)	Lin.Thk (inch)	Soil
8	8"	80	8.625	0.5			11	2			
6	6"	STD	6.625	0.28			11	2			
Pipe Loads (1)											
Name	T1 (F)	P1 (psi)	Specific gravity	Add.Wgt. (lb/ft)	Wind Load						
1	600	200	0.8								
B31.3 (2002) Code compliance (Sorted stresses)											
Sustained				Expansion							
Node	SL (psi)	SH (psi)	SL/SH	Node	SE (psi)	SA (psi)	SE/SA				
80	2504	17300	0.14	30	51519	29325	1.76				
60	2186	17300	0.13	50	49890	29325	1.70				
70	2117	17300	0.12	20A	44996	29325	1.53				
30	2020	17300	0.12	20B	32373	29325	1.10				
10	1416	17300	0.08	10	29813	29325	1.02				
40B	1079	17300	0.06	80	18818	29325	0.64				
20B	1000	17300	0.06	40A	17810	29325	0.61				
20A	938	17300	0.05	40B	9940	29325	0.34				
50	937	17300	0.05	60	9239	29325	0.32				
40A	886	17300	0.05	70	3960	29325	0.14				
B31.3 (2002) Code Compliance											
Node	Press. Allow. (psi)	Sustained			Expansion						
		SL (psi)	SH (psi)	SL/SH	SE (psi)	SA (psi)	SE/SA				
10	200	1416	17300	0.08	29813	29325	1.02				
20A	2103	913	17300	0.05	25828	29325	0.88				
20A	200	938	17300	0.05	44996	29325	1.53				
20B	2103	1000	17300	0.06	32373	29325	1.10				
20B	200	954	17300	0.06	18524	29325	0.63				
30	2103	1739	17300	0.10	51519	29325	1.76				
30	200	1727	17300	0.10	46307	29325	1.58				
40A	2103	883	17300	0.05	14909	29325	0.51				
40A	200	886	17300	0.05	17810	29325	0.61				
40B	2103	1079	17300	0.06	9940	29325	0.34				
40B	200	1041	17300	0.06	8949	29325	0.31				
50	2103	937	17300	0.05	49890	29325	1.70				
30	200	2020	17300	0.12	29014	29325	0.99				
60	1514	2186	17300	0.13	9239	29325	0.32				
70	200	2117	17300	0.12	3960	29325	0.14				
80	1514	2504	17300	0.14	18818	29325	0.64				
Hanger Report											
Node	No of	Type	Figure No.	Size	Spring rate (lb/inch)	Vert travel (inch)	Horz travel (inch)	Hot load (lb)	Cold load (lb)	Var (%)	
30	1	Grinnell	B-268	10	260	0.600	0.604	1249	1405	12	

Support load summary for anchor at node 10									
Load combination	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)			
Sustained	-13	-385	26	-365	-171	-1118			
Operating1	-28550	1474	-13762	-6909	57834	16248			
Maximum	-13	1474	26	-365	57834	16248			
Minimum	-28550	-385	-13762	-6909	-171	-1118			
Support load summary for anchor at node 50									
Load combination	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)			
Sustained	-40	-194	-27	124	103	-87			
Operating1	-17724	-4258	12531	48050	13222	88895			
Maximum	-40	-194	12531	48050	13222	88895			
Minimum	-17724	-4258	-27	124	103	-87			
Support load summary for anchor at node 80									
Load combination	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)			
Sustained	54	-365	1	-23	17	935			
Operating1	46275	1685	1231	-1594	5074	-11290			
Maximum	46275	1685	1231	-23	5074	935			
Minimum	54	-365	1	-1594	17	-11290			
Support load summary for hanger at node 30									
Load combination	Load (lb)								
Sustained	-1404								
Operating1	-1249								
Maximum	-1249								
Minimum	-1404								
Loads on Anchors: Sustained (W+P)									
Node	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)			
10	-13	-385	26	-365	-171	-1118			
50	-40	-194	-27	124	103	-87			
80	54	-365	1	-23	17	935			
Loads on Hangers: Sustained (W+P)									
Node	Type	Load (lb)	No.of	Total (lb)					
30	Grinnell	-1404	1	-1404					
Pipe forces in local coordinates: Sustained (W+P)									
Node	Axial (lb)	y Shear (lb)	z Shear (lb)	Torque (ft-lb)	Inplane(ft-lb)		Outplane(ft-lb)		SL (psi)
					Moment	SIF	Moment	SIF	
10	-13	-385	26	-365	-1118		-171		1416
20A	-13	129	26	-365	-97		35		913
20A	-13	26	-129	-365	-35	1.75	-97	1.46	938
20B	26	13	-230	-264	-74	1.75	171	1.46	1000
20B	26	230	13	-264	171		74		954
30	26	552	13	-264	-1784		140		1739
30	27	-536	-40	329	-1762		139		1727
40A	27	-247	-40	329	-1		-43		883
40A	27	247	40	329	1	1.33	43	1.11	886
40B	95	-27	40	103	-245	1.33	-269	1.11	1079
40B	95	-40	-27	103	-269		245		1041
50	-194	-40	-27	103	-87		124		937

Pipe forces in local coordinates: Sustained (W+P)									
Node	Axial (lb)	y Shear (lb)	z Shear (lb)	Torque (ft-lb)	Inplane(ft-lb)		Outplane(ft-lb)		SL (psi)
					Moment	SIF	Moment	SIF	
30	-54	-316	-1	23	-593		1		2020
60	-54	-118	-1	23	710		-7		2186
70	-54	167	-1	23	661		-9		2117
80	-54	365	-1	23	-935		-17		2504
Other forces in local coordinates: Sustained (W+P)									
Node	Type	fx (lb)	fy (lb)	fz (lb)	mx (ft-lb)	my (ft-lb)	mz (ft-lb)		
60	Valve	-54	-93	-1	23	-7	735		
70		-54	142	-1	23	-9	686		
Element forces in global coordinates: Sustained (W+P)									
Node	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)			
10	13	385	-26	365	171	1118			
20A	-13	129	26	-365	35	-97			
20A	13	-129	-26	365	-35	97			
20B	-13	230	26	-171	74	-264			
20B	13	-230	-26	171	-74	264			
30	-13	552	26	1784	140	-264			
30	-40	536	-27	-1762	-139	-329			
40A	40	-247	27	1	-43	329			
40A	-40	247	-27	-1	43	-329			
40B	40	-95	27	-245	-103	269			
40B	-40	95	-27	245	103	-269			
50	40	194	27	-124	-103	87			
30	54	316	1	-23	-1	593			
60	-54	-118	-1	23	-7	710			
60	54	93	1	-23	7	-735			
70	-54	142	-1	23	-9	686			
70	54	-167	1	-23	9	-661			
80	-54	365	-1	23	-17	-935			
Displacements: Sustained (W+P)									
Node	X (inch)	Y (inch)	Z (inch)	XX (deg)	YY (deg)	ZZ (deg)			
10	0.000	0.000	0.000	0.0000	0.0000	0.0000			
20A	0.000	-0.008	0.002	-0.0100	-0.0014	-0.0056			
20B	-0.000	-0.007	0.002	-0.0125	-0.0004	-0.0064			
30	0.000	0.004	0.002	-0.0036	0.0010	-0.0110			
40A	0.001	0.002	0.002	0.0056	0.0016	-0.0059			
40B	0.001	0.000	0.001	0.0022	0.0016	-0.0021			
50	0.000	0.000	0.000	0.0000	0.0000	0.0000			
60	0.000	-0.012	0.001	-0.0019	0.0008	-0.0016			
70	0.000	-0.012	0.001	-0.0017	0.0008	0.0022			
80	0.000	0.000	0.000	0.0000	0.0000	0.0000			
Loads on Anchors: Expansion (T1)									
Node	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)			
10	-28537	1859	-13787	-6544	58005	17366			
50	-17684	-4064	12558	47926	13118	88983			

Loads on Anchors: Expansion (T1)									
Node	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)			
80	46221	2051	1230	-1572	5057	-12225			
Loads on Hangers: Expansion (T1)									
Node	Type	Load (lb)	No.of	Total (lb)					
30	Grinnell	155	1	155					
Pipe forces in local coordinates: Expansion (T1)									
Node	Axial (lb)	y Shear (lb)	z Shear (lb)	Torque (ft-lb)	Inplane(ft-lb)		Outplane(ft-lb)		SE (psi)
					Moment	SIF	Moment	SIF	
10	-28537	1859	-13787	-6544	17366		58005		29813
20A	-28537	1859	-13787	-6544	2496		-52294		25828
20A	-28537	-13787	-1859	-6544	52294	1.75	2496	1.46	44996
20B	-13787	28537	-1859	637	37545	1.75	4686	1.46	32373
20B	-13787	1859	28537	637	4686		-37545		18524
30	-13787	1859	28537	637	-4608		105142		51519
30	-12558	4064	-17684	17121	-3036		92985		46307
40A	-12558	4064	-17684	17121	-21325		13407		14909
40A	-12558	-4064	17684	17121	21325	1.33	-13407	1.11	17810
40B	-4064	12558	17684	13118	8584	1.33	9405	1.11	9940
40B	-4064	-17684	12558	13118	9405		-8584		8949
50	-4064	-17684	12558	13118	88983		47926		49890
30	-46221	-2051	-1230	1572	-16483		12157		29014
60	-46221	-2051	-1230	1572	-4180		4779		9239
70	-46221	-2051	-1230	1572	-79		2320		3960
80	-46221	-2051	-1230	1572	12225		-5057		18818
Other forces in local coordinates: Expansion (T1)									
Node	Type	fx (lb)	fy (lb)	fz (lb)	mx (ft-lb)	my (ft-lb)	mz (ft-lb)		
60	Valve	-46221	-2051	-1230	1572	4779	-4180		
70		-46221	-2051	-1230	1572	2320	-79		
Element forces in global coordinates: Expansion (T1)									
Node	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)			
10	28537	-1859	13787	6544	-58005	-17366			
20A	-28537	1859	-13787	-6544	-52294	2496			
20A	28537	-1859	13787	6544	52294	-2496			
20B	-28537	1859	-13787	-4686	-37545	637			
20B	28537	-1859	13787	4686	37545	-637			
30	-28537	1859	-13787	4608	105142	637			
30	-17684	-4064	12558	-3036	-92985	-17121			
40A	17684	4064	-12558	21325	13407	17121			
40A	-17684	-4064	12558	-21325	-13407	-17121			
40B	17684	4064	-12558	8584	-13118	-9405			
40B	-17684	-4064	12558	-8584	13118	9405			
50	17684	4064	-12558	-47926	-13118	-88983			
30	46221	2051	1230	-1572	-12157	16483			
60	-46221	-2051	-1230	1572	4779	-4180			
60	46221	2051	1230	-1572	-4779	4180			
70	-46221	-2051	-1230	1572	2320	-79			

Element forces in global coordinates: Expansion (T1)								
Node	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)		
70	46221	2051	1230	-1572	-2320	79		
80	-46221	-2051	-1230	1572	-5057	12225		
Displacements: Expansion (T1)								
Node	X (inch)	Y (inch)	Z (inch)	XX (deg)	YY (deg)	ZZ (deg)		
10	0.000	0.000	0.000	0.0000	0.0000	0.0000		
20A	0.361	0.223	-0.395	-0.1801	0.0605	0.2102		
20B	0.283	0.318	-0.285	-0.2535	-0.8884	0.2538		
30	-0.601	0.596	-0.057	-0.2540	-0.4414	0.2647		
40A	-0.631	0.787	0.148	-0.1090	0.1919	0.5297		
40B	-0.364	0.706	0.173	0.2342	0.2030	0.5857		
50	0.000	0.500	0.000	0.0000	0.0000	0.0001		
60	-0.346	0.460	0.131	-0.1322	0.0636	-0.3513		
70	-0.256	0.309	0.100	-0.1218	0.0816	-0.3621		
80	0.000	0.000	0.000	0.0000	0.0000	0.0000		
Loads on Anchors: Operating (W+P1+T1)								
Node	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)		
10	-28550	1474	-13762	-6909	57834	16248		
50	-17724	-4258	12531	48050	13222	88895		
80	46275	1685	1231	-1594	5074	-11290		
Loads on Hangers: Operating (W+P1+T1)								
Node	Type	Load (lb)	No.of	Total (lb)				
30	Grinnell	-1249	1	-1249				
Pipe forces in local coordinates: Operating (W+P1+T1)								
Node	Axial (lb)	y Shear (lb)	z Shear (lb)	Torque (ft-lb)	Inplane(ft-lb)		Outplane(ft-lb)	
					Moment	SIF	Moment	SIF
10	-28550	1474	-13762	-6909	16248		57834	
20A	-28550	1988	-13762	-6909	2399		-52260	
20A	-28550	-13762	-1988	-6909	52260	1.75	2399	1.46
20B	-13762	28550	-2089	374	37471	1.75	4857	1.46
20B	-13762	2089	28550	374	4857		-37471	
30	-13762	2410	28550	374	-6392		105281	
30	-12531	3528	-17724	17450	-4798		93123	
40A	-12531	3818	-17724	17450	-21326		13365	
40A	-12531	-3818	17724	17450	21326	1.33	-13365	1.11
40B	-3969	12531	17724	13222	8339	1.33	9136	1.11
40B	-3969	-17724	12531	13222	9136		-8339	
50	-4258	-17724	12531	13222	88895		48050	
30	-46275	-2367	-1231	1594	-17076		12158	
60	-46275	-2168	-1231	1594	-3470		4773	
70	-46275	-1884	-1231	1594	582		2311	
80	-46275	-1685	-1231	1594	11290		-5074	

Other forces in local coordinates: Operating (W+P1+T1)							
Node	Type	fx (lb)	fy (lb)	fz (lb)	mx (ft-lb)	my (ft-lb)	mz (ft-lb)
60	Valve	-46275	-2143	-1231	1594	4773	-3445
70		-46275	-1909	-1231	1594	2311	607
Element forces in global coordinates: Operating (W+P1+T1)							
Node	FX (lb)	FY (lb)	FZ (lb)	MX (ft-lb)	MY (ft-lb)	MZ (ft-lb)	
10	28550	-1474	13762	6909	-57834	-16248	
20A	-28550	1988	-13762	-6909	-52260	2399	
20A	28550	-1988	13762	6909	52260	-2399	
20B	-28550	2089	-13762	-4857	-37471	374	
20B	28550	-2089	13762	4857	37471	-374	
30	-28550	2410	-13762	6392	105281	374	
30	-17724	-3528	12531	-4798	-93123	-17450	
40A	17724	3818	-12531	21326	13365	17450	
40A	-17724	-3818	12531	-21326	-13365	-17450	
40B	17724	3969	-12531	8339	-13222	-9136	
40B	-17724	-3969	12531	-8339	13222	9136	
50	17724	4258	-12531	-48050	-13222	-88895	
30	46275	2367	1231	-1594	-12158	17076	
60	-46275	-2168	-1231	1594	4773	-3470	
60	46275	2143	1231	-1594	-4773	3445	
70	-46275	-1909	-1231	1594	2311	607	
70	46275	1884	1231	-1594	-2311	-582	
80	-46275	-1685	-1231	1594	-5074	11290	
Displacements: Operating (W+P1+T1)							
Node	X (inch)	Y (inch)	Z (inch)	XX (deg)	YY (deg)	ZZ (deg)	
10	0.000	0.000	0.000	0.0000	0.0000	0.0000	
20A	0.361	0.215	-0.393	-0.1901	0.0590	0.2046	
20B	0.283	0.311	-0.283	-0.2661	-0.8888	0.2473	
30	-0.601	0.600	-0.055	-0.2577	-0.4404	0.2537	
40A	-0.630	0.788	0.150	-0.1035	0.1935	0.5238	
40B	-0.363	0.706	0.173	0.2364	0.2046	0.5836	
50	0.000	0.500	0.000	0.0000	0.0000	0.0001	
60	-0.346	0.448	0.132	-0.1341	0.0644	-0.3529	
70	-0.256	0.297	0.101	-0.1236	0.0824	-0.3599	
80	0.000	0.000	0.000	0.0000	0.0000	0.0000	
Center of gravity							
X = 9.9221, Y = -0.4651, Z = 5.4697 (ft'in") Total weight = 2347.9 (lb)							
Bill of materials: Materials							
#	Name	Description					
1	A53	A53 Grade B					
Bill of materials: Pipes							
#	Material	OD (inch)	Thk (inch)	Total length (ft'in")	Total weight (lb)		
1	A53	6.625	0.28	12'0"	227.45		

Bill of materials: Pipes							
#	Material	OD (inch)	Thk (inch)	Total length (ft'in")	Total weight (lb)		
2	A53	8.625	0.5	22'0"	953.53		
Bill of materials: Bends							
#	Material	OD (inch)	Thk (inch)	Radius (inch)	Angle (deg)	Count	Total weight (lb)
1	A53	8.625	0.5	12	90.00	1	68.082
2	A53	8.625	0.5	18	90.00	1	102.12
Bill of materials: Valves							
#	OD (inch)	Thk (inch)	Weight (lb)	Add.Weight (lb)	Count	Total weight (lb)	
1	6.625	0.28	200	50	1	250	

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