

Lampiran 1: Output Hasil Analisis Caesar II

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CAESAR II STRESS REPORT FILE:CAESAR MODEL
CASE 2 (SUS) W+P1 DATE:DEC 19,2008
--Stress(lb./sq.in.)--
ELEMENT BENDING TORSION SIP'S CODE --(lb./sq.in.)--
NODES STRESS STRESS IN/OUT PLANE STRESS ALLOWABLE
STRESS STRESS %

**** CODE STRESS CHECK PASSED
PIPING CODE: B31.3 -1999, April 15, 1999

HIGHEST STRESSES: (lb./sq.in.)
CODE STRESS %: 94.23 @NODE 278
STRESS: 18846.0 ALLOWABLE: 20000.0
BENDING STRESS: 16165.9 @NODE 278
TORSIONAL STRESS: 1124.0 @NODE 80
AXIAL STRESS: 2680.0 @NODE 265
3D MAX INTENSITY: 18934.9 @NODE 278

10 20. 0. 1.000 / 1.000 770. 20000. 4.
20 221. 0. 1.000 / 1.000 1066. 20000. 5.

20 221. 0. 1.000 / 1.000 1066. 20000. 5.
28 376. 0. 1.000 / 1.000 1294. 20000. 6.

28 701. 0. 2.235 / 1.862 1618. 20000. 8.
29 589. -140. 2.235 / 1.862 1537. 20000. 8.

29 589. 140. 2.235 / 1.862 1537. 20000. 8.
30 537. -211. 2.235 / 1.862 1516. 20000. 8.

30 241. 211. 1.000 / 1.000 1221. 20000. 6.
40 218. -211. 1.000 / 1.000 1197. 20000. 6.

40 218. 211. 1.000 / 1.000 1197. 20000. 6.
48 1539. -211. 1.000 / 1.000 2519. 20000. 13.

48 3411. 211. 2.235 / 1.862 4391. 20000. 22.
49 4493. -282. 2.235 / 1.862 5378. 20000. 27.

49 4493. 282. 2.235 / 1.862 5378. 20000. 27.
50 5072. -201. 2.235 / 1.862 5901. 20000. 30.

50 2279. 201. 1.000 / 1.000 3108. 20000. 16.
60 2259. -201. 1.000 / 1.000 3015. 20000. 15.

60 2259. 201. 1.000 / 1.000 3015. 20000. 15.
70 2248. -201. 1.000 / 1.000 2910. 20000. 15.

70 2248. 201. 1.000 / 1.000 2910. 20000. 15.
78 2248. -201. 1.000 / 1.000 2885. 20000. 14.

78 4187. 201. 2.235 / 1.862 4823. 20000. 24.
79 2855. -937. 2.235 / 1.862 3586. 20000. 18.

79 2855. 937. 2.235 / 1.862 3586. 20000. 18.
80 4976. -1124. 2.235 / 1.862 5964. 20000. 30.

80 2238. 1124. 1.000 / 1.000 3218. 20000. 16.
85 570. -1124. 1.000 / 1.000 1549. 20000. 8.

92 5505. 1124. 1.000 / 1.000 6484. 20000. 32.
95 5884. -1124. 1.000 / 1.000 6864. 20000. 34.

95 5884. 1124. 1.000 / 1.000 6864. 20000. 34.

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(lanjutan)

CAESAR II STRESS REPORT		FILE:CAESAR MODEL				
CASE 2 (SUS) W+P1		DATE:DEC 19,2008				
--Stress(lb./sq.in.)--		--(lb./sq.in.)--				
ELEMENT	BENDING	TORSION	SIF'S	CODE	ALLOWABLE	
NODES	STRESS	STRESS	IN/OUT PLANE	STRESS	STRESS	%
100	6744.	-1124.	1.000 / 1.000	7724.	20000.	39.
100	6744.	1124.	1.000 / 1.000	7727.	20000.	39.
110	6657.	-1124.	1.000 / 1.000	7640.	20000.	38.
110	6657.	1124.	1.000 / 1.000	7640.	20000.	38.
120	4175.	-1124.	1.000 / 1.000	5158.	20000.	26.
120	4175.	1124.	1.000 / 1.000	5158.	20000.	26.
128	631.	-1124.	1.000 / 1.000	1613.	20000.	8.
128	1179.	1124.	2.235 / 1.862	2162.	20000.	11.
129	2063.	-764.	2.235 / 1.862	3048.	20000.	15.
129	2063.	764.	2.235 / 1.862	3048.	20000.	15.
130	1613.	-355.	2.235 / 1.862	2598.	20000.	13.
130	864.	355.	1.000 / 1.000	1848.	20000.	9.
140	4781.	-355.	1.000 / 1.000	5765.	20000.	29.
140	4781.	355.	1.000 / 1.000	5765.	20000.	29.
150	14215.	-355.	1.000 / 1.000	15199.	20000.	76.
150	14215.	355.	1.000 / 1.000	15199.	20000.	76.
160	6431.	-355.	1.000 / 1.000	7415.	20000.	37.
160	6431.	355.	1.000 / 1.000	7415.	20000.	37.
170	1044.	-355.	1.000 / 1.000	2028.	20000.	10.
170	1044.	355.	1.000 / 1.000	2028.	20000.	10.
180	3296.	-355.	1.518 / 1.691	4280.	20000.	21.
180	3295.	-221.	1.518 / 1.691	4281.	20000.	21.
190	443.	221.	1.000 / 1.000	1429.	20000.	7.
190	443.	-221.	1.000 / 1.000	1429.	20000.	7.
200	5226.	221.	1.000 / 1.000	6212.	20000.	31.
200	5226.	-221.	1.000 / 1.000	6212.	20000.	31.
210	12408.	221.	1.000 / 1.000	13394.	20000.	67.
210	12408.	-221.	1.000 / 1.000	13394.	20000.	67.
220	4085.	221.	1.000 / 1.000	5071.	20000.	25.
220	4085.	-221.	1.000 / 1.000	5071.	20000.	25.
228	698.	221.	1.000 / 1.000	1684.	20000.	8.
228	1300.	-221.	2.235 / 1.862	2287.	20000.	11.
229	1858.	575.	2.235 / 1.862	2842.	20000.	14.
229	1858.	-575.	2.235 / 1.862	2842.	20000.	14.
230	1192.	916.	2.235 / 1.862	2172.	20000.	11.
230	640.	-916.	1.000 / 1.000	1620.	20000.	8.
240	3337.	916.	1.000 / 1.000	4316.	20000.	22.
240	3337.	-916.	1.000 / 1.000	4316.	20000.	22.
250	4713.	916.	1.000 / 1.000	5693.	20000.	28.
250	4713.	-916.	1.000 / 1.000	5693.	20000.	28.
260	3707.	916.	1.000 / 1.000	4687.	20000.	23.

(lanjutan)

CAESAR II STRESS REPORT		FILE:CAESAR MODEL				
CASE 2 (SUS) W+P1		DATE:DEC 19,2008				
---Stress(lb./sq.in.)---						
ELEMENT	BENDING	TORSION	SIF'S	CODE	ALLOWABLE	
NODES	STRESS	STRESS	IN/OUT PLANE	STRESS	STRESS	%
260	3707.	-916.	1.000 / 1.000	6387.	20000.	32.
265	2286.	916.	1.000 / 1.000	4966.	20000.	25.
265	2286.	-916.	1.000 / 1.000	4966.	20000.	25.
268	1737.	916.	1.000 / 1.000	4417.	20000.	22.
275	4251.	-916.	1.000 / 1.000	6931.	20000.	35.
278	7234.	916.	1.000 / 1.000	9915.	20000.	50.
278	16166.	-916.	2.235 / 1.862	18846.	20000.	94.
279	14031.	696.	2.235 / 1.862	16540.	20000.	83.
279	14031.	-696.	2.235 / 1.862	16540.	20000.	83.
280	3273.	90.	2.235 / 1.862	4732.	20000.	24.
280	1757.	-90.	1.000 / 1.000	2403.	20000.	12.
290	1757.	90.	1.000 / 1.000	2429.	20000.	12.
290	1757.	-90.	1.000 / 1.000	2429.	20000.	12.
300	1760.	90.	1.000 / 1.000	2526.	20000.	13.
300	1760.	-90.	1.000 / 1.000	2526.	20000.	13.
308	1765.	90.	1.000 / 1.000	2604.	20000.	13.
308	3940.	-90.	2.235 / 1.862	4778.	20000.	24.
309	3433.	126.	2.235 / 1.862	4325.	20000.	22.
309	3433.	-126.	2.235 / 1.862	4325.	20000.	22.
310	2393.	94.	2.235 / 1.862	3372.	20000.	17.
310	1074.	-94.	1.000 / 1.000	2054.	20000.	10.
320	340.	94.	1.000 / 1.000	1320.	20000.	7.
320	340.	-94.	1.000 / 1.000	1320.	20000.	7.
328	294.	94.	1.000 / 1.000	1274.	20000.	6.
328	656.	-94.	2.235 / 1.862	1636.	20000.	8.
329	339.	62.	2.235 / 1.862	1280.	20000.	6.
329	339.	-62.	2.235 / 1.862	1280.	20000.	6.
330	312.	0.	2.235 / 1.862	1220.	20000.	6.
330	168.	0.	1.000 / 1.000	1075.	20000.	5.
340	98.	0.	1.000 / 1.000	933.	20000.	5.
340	98.	0.	1.000 / 1.000	933.	20000.	5.
350	9.	0.	1.000 / 1.000	749.	20000.	4.
180	1962.	0.	1.518 / 1.691	2941.	20000.	15.
1000	643.	0.	1.000 / 1.000	1622.	20000.	8.
1000	643.	0.	1.000 / 1.000	1622.	20000.	8.
1010	58.	0.	1.000 / 1.000	1037.	20000.	5.
1010	58.	0.	1.000 / 1.000	1037.	20000.	5.
1020	2981.	0.	1.000 / 1.000	3961.	20000.	20.
1020	2981.	0.	1.000 / 1.000	3961.	20000.	20.
1030	1463.	0.	1.000 / 1.000	2442.	20000.	12.

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CAESAR II STRESS REPORT FILE:CAESAR MODEL
CASE 2 (SUS) W+P1 DATE:DEC 19,2008
--Stress(lb./sq.in.)--
ELEMENT BENDING TORSION SIF'S CODE ALLOWABLE
NODES STRESS STRESS IN/OUT PLANE STRESS STRESS %
1030 1463. 0. 1.000 / 1.000 2442. 20000. 12.
1040 3511. 0. 1.000 / 1.000 4490. 20000. 22.
1040 3511. 0. 1.000 / 1.000 4490. 20000. 22.
1050 3163. 0. 1.000 / 1.000 4142. 20000. 21.
1050 3163. 0. 1.000 / 1.000 4142. 20000. 21.
1060 419. 0. 1.000 / 1.000 1398. 20000. 7.
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CAESAR II STRESS REPORT FILE:CAESAR MODEL
CASE 3 (EXP) DS3=DS1-DS2 DATE:DEC 19,2008

--Stress (lb./sq.in.)--

ELEMENT	BENDING	TORSION	SIP'S	CODE	ALLOWABLE	
NODES	STRESS	STRESS	IN/OUT PLANE	STRESS	STRESS	%

**** CODE STRESS CHECK PASSED
PIPING CODE: B31.3 -1999, April 15, 1999

HIGHEST STRESSES: (lb./sq.in.)

CODE STRESS %:	72.18	@NODE	278			
STRESS:	22487.6	ALLOWABLE:	31153.9			
BENDING STRESS:	23597.6	@NODE	180			
TORSIONAL STRESS:	625.6	@NODE	309			
AXIAL STRESS:	62023.3	@NODE	85			
3D MAX INTENSITY:	82794.5	@NODE	100			

10	28.	0.	1.000 / 1.000	28.	49230.	0.
20	314.	0.	1.000 / 1.000	314.	48934.	1.
20	314.	0.	1.000 / 1.000	314.	48934.	1.
28	534.	0.	1.000 / 1.000	534.	48706.	1.
28	995.	0.	2.235 / 1.862	995.	48382.	2.
29	790.	-199.	2.235 / 1.862	884.	48463.	2.
29	790.	199.	2.235 / 1.862	884.	48463.	2.
30	129.	-300.	2.235 / 1.862	613.	48484.	1.
30	68.	300.	1.000 / 1.000	604.	48779.	1.
40	297.	-300.	1.000 / 1.000	669.	48803.	1.
40	297.	300.	1.000 / 1.000	669.	48803.	1.
48	526.	-300.	1.000 / 1.000	798.	47481.	2.
48	996.	300.	2.235 / 1.862	1163.	45609.	3.
49	351.	-401.	2.235 / 1.862	875.	44622.	2.
49	351.	401.	2.235 / 1.862	875.	44622.	2.
50	1059.	-286.	2.235 / 1.862	1203.	44099.	3.
50	558.	286.	1.000 / 1.000	799.	46892.	2.
60	353.	-286.	1.000 / 1.000	672.	46985.	1.
60	353.	286.	1.000 / 1.000	672.	46985.	1.
70	164.	-286.	1.000 / 1.000	595.	47090.	1.
70	164.	286.	1.000 / 1.000	595.	47090.	1.
78	169.	-286.	1.000 / 1.000	596.	47115.	1.
78	321.	286.	2.235 / 1.862	656.	45177.	1.
79	585.	-259.	2.235 / 1.862	782.	46414.	2.
79	585.	259.	2.235 / 1.862	782.	46414.	2.
80	1106.	-81.	2.235 / 1.862	1118.	44036.	3.
80	587.	81.	1.000 / 1.000	609.	46782.	1.
85	1102.	-81.	1.000 / 1.000	1114.	48451.	2.
92	2732.	81.	1.000 / 1.000	2736.	43516.	6.
95	3024.	-81.	1.000 / 1.000	3029.	43136.	7.
95	3024.	81.	1.000 / 1.000	3029.	43136.	7.

(lanjutan)

CAESAR II STRESS REPORT FILE:CAESAR MODEL
CASE 3 (EXP) DS3=DS1-DS2 DATE:DEC 19,2008

--Stress (lb./sq.in.)--

ELEMENT NODES	--(lb./sq.in.)--		SIF'S IN/OUT PLANE	CODE STRESS	--(lb./sq.in.)--	
	BENDING STRESS	TORSION STRESS			ALLOWABLE STRESS	%
100	3987.	-81.	1.000 / 1.000	3991.	42276.	9.
100	3987.	81.	1.000 / 1.000	3991.	42273.	9.
110	1866.	-81.	1.000 / 1.000	1873.	42360.	4.
110	1866.	81.	1.000 / 1.000	1873.	42360.	4.
120	269.	-81.	1.000 / 1.000	314.	44842.	1.
120	269.	81.	1.000 / 1.000	314.	44842.	1.
128	1896.	-81.	1.000 / 1.000	1903.	48387.	4.
128	4236.	81.	2.235 / 1.862	4240.	47838.	9.
129	5437.	-79.	2.235 / 1.862	5439.	46952.	12.
129	5437.	79.	2.235 / 1.862	5439.	46952.	12.
130	6807.	-30.	2.235 / 1.862	6807.	47402.	14.
130	3047.	30.	1.000 / 1.000	3048.	48152.	6.
140	5282.	-30.	1.000 / 1.000	5282.	44235.	12.
140	5282.	30.	1.000 / 1.000	5282.	44235.	12.
150	8180.	-30.	1.000 / 1.000	8180.	34801.	24.
150	8180.	30.	1.000 / 1.000	8180.	34801.	24.
160	414.	-30.	1.000 / 1.000	419.	42585.	1.
160	414.	30.	1.000 / 1.000	419.	42585.	1.
170	7634.	-30.	1.000 / 1.000	7634.	47972.	16.
170	7634.	30.	1.000 / 1.000	7634.	47972.	16.
180	23598.	-30.	1.518 / 1.691	23598.	45720.	52.
180	23340.	-360.	1.518 / 1.691	23351.	45719.	51.
190	7798.	360.	1.000 / 1.000	7831.	48571.	16.
190	7798.	-360.	1.000 / 1.000	7831.	48571.	16.
200	2983.	360.	1.000 / 1.000	3068.	43788.	7.
200	2983.	-360.	1.000 / 1.000	3068.	43788.	7.
210	8957.	360.	1.000 / 1.000	8986.	36606.	25.
210	8957.	-360.	1.000 / 1.000	8986.	36606.	25.
220	5523.	360.	1.000 / 1.000	5570.	44929.	12.
220	5523.	-360.	1.000 / 1.000	5570.	44929.	12.
228	3134.	360.	1.000 / 1.000	3216.	48316.	7.
228	7001.	-360.	2.235 / 1.862	7037.	47713.	15.
229	5671.	388.	2.235 / 1.862	5724.	47158.	12.
229	5671.	-388.	2.235 / 1.862	5724.	47158.	12.
230	4521.	339.	2.235 / 1.862	4572.	47828.	10.
230	2026.	-339.	1.000 / 1.000	2137.	48380.	4.
240	1586.	339.	1.000 / 1.000	1725.	45684.	4.
240	1586.	-339.	1.000 / 1.000	1725.	45684.	4.
250	4118.	339.	1.000 / 1.000	4174.	44307.	9.
250	4118.	-339.	1.000 / 1.000	4174.	44307.	9.
260	7074.	339.	1.000 / 1.000	7107.	45313.	16.

(lanjutan)

CAESAR II STRESS REPORT		FILE:CAESAR MODEL				
CASE 3 (EXP) DS3=DS1-DS2		DATE:DEC 19,2008				
--Stress(lb./sq.in.)---						
ELEMENT	BENDING	TORSION	SIF'S	CODE	ALLOWABLE	
NODES	STRESS	STRESS	IN/OUT PLANE	STRESS	STRESS	%
260	7074.	-339.	1.000 / 1.000	7107.	43613.	16.
265	7755.	339.	1.000 / 1.000	7784.	45034.	17.
265	7755.	-339.	1.000 / 1.000	7784.	45034.	17.
268	7994.	339.	1.000 / 1.000	8022.	45583.	18.
275	9532.	-339.	1.000 / 1.000	9556.	43069.	22.
278	10081.	339.	1.000 / 1.000	10104.	40086.	25.
278	22477.	-339.	2.235 / 1.862	22488.	31154.	72.
279	16241.	622.	2.235 / 1.862	16288.	33460.	49.
279	16241.	-622.	2.235 / 1.862	16288.	33460.	49.
280	1871.	446.	2.235 / 1.862	2073.	45268.	5.
280	1003.	-446.	1.000 / 1.000	1343.	47597.	3.
290	1001.	446.	1.000 / 1.000	1341.	47571.	3.
290	1001.	-446.	1.000 / 1.000	1341.	47571.	3.
300	1114.	446.	1.000 / 1.000	1428.	47474.	3.
300	1114.	-446.	1.000 / 1.000	1428.	47474.	3.
308	1303.	446.	1.000 / 1.000	1579.	47396.	3.
308	2722.	-446.	2.235 / 1.862	2865.	45222.	6.
309	2161.	626.	2.235 / 1.862	2497.	45675.	5.
309	2161.	-626.	2.235 / 1.862	2497.	45675.	5.
310	2467.	468.	2.235 / 1.862	2639.	46628.	6.
310	1187.	-468.	1.000 / 1.000	1512.	47946.	3.
320	670.	468.	1.000 / 1.000	1152.	48680.	2.
320	670.	-468.	1.000 / 1.000	1152.	48680.	2.
328	153.	468.	1.000 / 1.000	949.	48726.	2.
328	318.	-468.	2.235 / 1.862	989.	48364.	2.
329	1235.	310.	2.235 / 1.862	1382.	48720.	3.
329	1235.	-310.	2.235 / 1.862	1382.	48720.	3.
330	1554.	0.	2.235 / 1.862	1554.	48780.	3.
330	834.	0.	1.000 / 1.000	834.	48925.	2.
340	490.	0.	1.000 / 1.000	490.	49067.	1.
340	490.	0.	1.000 / 1.000	490.	49067.	1.
350	44.	0.	1.000 / 1.000	44.	49251.	0.
180	1343.	0.	1.518 / 1.691	1343.	47059.	3.
1000	431.	0.	1.000 / 1.000	431.	48378.	1.
1000	431.	0.	1.000 / 1.000	431.	48378.	1.
1010	77.	0.	1.000 / 1.000	77.	48963.	0.
1010	77.	0.	1.000 / 1.000	77.	48963.	0.
1020	311.	0.	1.000 / 1.000	311.	46039.	1.
1020	311.	0.	1.000 / 1.000	311.	46039.	1.
1030	235.	0.	1.000 / 1.000	235.	47558.	0.

(lanjutan)

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CAESAR II STRESS REPORT FILE:CAESAR MODEL
CASE 3 (EXP) DS3=DS1-DS2 DATE:DEC 19,2008
--Stress(lb./sq.in.)--
ELEMENT BENDING TORSION SIF'S CODE ALLOWABLE
NODES STRESS STRESS IN/OUT PLANE STRESS STRESS %
1030 235. 0. 1.000 / 1.000 235. 47558. 0.
1040 159. 0. 1.000 / 1.000 159. 45510. 0.
1040 159. 0. 1.000 / 1.000 159. 45510. 0.
1050 83. 0. 1.000 / 1.000 83. 45858. 0.
1050 83. 0. 1.000 / 1.000 83. 45858. 0.
1060 7. 0. 1.000 / 1.000 7. 48602. 0.
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AUTOPIPE MODEL
12/21/2008 PROJECT: REBIS
07:26 PM AutoPIPE+6.20 RESULT PAGE 2

** AUTOPIPE SYSTEM INFORMATION **
**

SYSTEM NAME : AUTOPIPE MODEL

PROJECT ID : PROJECT:

DESCRIPTION :

PREPARED BY : _____

CHECKED BY : _____

PIPING CODE : B31.3
VERTICAL AXIS : Y
AMBIENT TEMPERATURE : 69.8 deg F
COMPONENT LIBRARY : autopipe
MATERIAL LIBRARY : autob313
MODEL REVISION NUMBER : 8

 AUTOPIPE MODEL
 12/21/2008 PROJECT:
 07:26 PM

REBIS
 AutoPIPE+6.20 RESULT PAGE 3

Point name	Load combination	ASME B31.3b (2001) CODE COMPLIANCE (Moments in ft-lb)			S.I.F		(Stress in psi)			
		In-Pl. Moment	Out-Pl. Moment	Torsion Moment	In	Out	Eq. Load no.	Code type	Code Stress	Code Allow.
*** Segment A begin ***										
5000	Max P						(3a)	HOOP	2526	21601
	GR + Max P	0	0		1.00	1.00	(18)	SUST	1087	21601
	Cold to T1	0	0	0	1.00	1.00	(17)	DISP	0	34525
1X	Max P						(3a)	HOOP	2526	21601
	GR + Max P	0	0		1.00	1.00	(18)	SUST	1088	21601
	Cold to T1	0	0	0	1.00	1.00	(17)	DISP	0	34525
10	Max P						(3a)	HOOP	2526	20000
	GR + Max P	0	10		1.00	1.00	(18)	SUST	1105	20000
	Cold to T1	0	20	0	1.00	1.00	(17)	DISP	28	30000
20	Max P						(3a)	HOOP	2526	20000
	GR + Max P	0	110		1.00	1.00	(18)	SUST	1280	20000
	Cold to T1	0	222	0	1.00	1.00	(17)	DISP	314	30000
30 N-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	0	188		1.00	1.00	(18)	SUST	1415	20000
	Cold to T1	0	378	0	1.00	1.00	(17)	DISP	534	30000
30 N+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	0	188		2.27	1.89	(18)	SUST	1705	20000
	Cold to T1	0	378	0	2.27	1.89	(17)	DISP	1008	30000
30 M	Max P						(3a)	HOOP	2526	20000
	GR + Max P	54	149		2.27	1.89	(18)	SUST	1622	20000
	Cold to T1	4	300	281	2.27	1.89	(17)	DISP	893	30000
30 F-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	149	23		2.27	1.89	(18)	SUST	1682	20000
	Cold to T1	13	46	424	2.27	1.89	(17)	DISP	613	30000
30 F+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	149	23		1.00	1.00	(18)	SUST	1351	20000
	Cold to T1	13	46	424	1.00	1.00	(17)	DISP	603	30000
40	Max P						(3a)	HOOP	2526	20000
	GR + Max P	106	100		1.00	1.00	(18)	SUST	1342	20000
	Cold to T1	57	202	424	1.00	1.00	(17)	DISP	669	30000
50 N-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	756	178		1.00	1.00	(18)	SUST	2442	20000
	Cold to T1	101	358	424	1.00	1.00	(17)	DISP	797	30000
50 N+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	756	178		2.27	1.89	(18)	SUST	4131	20000
	Cold to T1	101	358	424	2.27	1.89	(17)	DISP	1173	30000

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Point name	Load combination	ASME B31.3b (2001) CODE COMPLIANCE (Moments in ft-lb)			S.I.F		Eq. Load no.	Load type	(Stress in psi)	
		In-Pl. Moment	Out-Pl. Moment	Torsion Moment	In	Out			Code Stress	Code Allow.
50 M	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1042	7		2.27	1.89	(18)	SUST	5200	20000
	Cold to T1	110	14	567	2.27	1.89	(17)	DISP	875	30000
50 F-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1174	188		2.27	1.89	(18)	SUST	5764	20000
	Cold to T1	114	378	404	2.27	1.89	(17)	DISP	1215	30000
50 F+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1174	188		1.00	1.00	(18)	SUST	3160	20000
	Cold to T1	114	378	404	1.00	1.00	(17)	DISP	798	30000
60	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1174	110		1.00	1.00	(18)	SUST	3143	20000
	Cold to T1	114	222	404	1.00	1.00	(17)	DISP	671	30000
70	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1174	10		1.00	1.00	(18)	SUST	3134	20000
	Cold to T1	114	20	404	1.00	1.00	(17)	DISP	594	30000
80 N-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1174	17		1.00	1.00	(18)	SUST	3134	20000
	Cold to T1	114	35	404	1.00	1.00	(17)	DISP	596	30000
80 N+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	17	1174		2.27	1.89	(18)	SUST	4951	20000
	Cold to T1	35	114	404	2.27	1.89	(17)	DISP	657	30000
80 M	Max P						(3a)	HOOP	2526	20000
	GR + Max P	376	688		2.27	1.89	(18)	SUST	3795	20000
	Cold to T1	72	205	366	2.27	1.89	(17)	DISP	788	30000
80 F-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1244	201		2.27	1.89	(18)	SUST	6044	20000
	Cold to T1	94	404	114	2.27	1.89	(17)	DISP	1131	30000
80 F+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1244	201		1.00	1.00	(18)	SUST	3284	20000
	Cold to T1	94	404	114	1.00	1.00	(17)	DISP	608	30000
85	Max P						(3a)	HOOP	2526	20000
	GR + Max P	92	152		1.00	1.00	(18)	SUST	1398	20000
	Cold to T1	91	775	114	1.00	1.00	(17)	DISP	1114	30000
92	Max P						(3a)	HOOP	2526	20000
	GR + Max P	2298	0		1.00	1.00	(18)	SUST	5092	20000
	Cold to T1	82	1932	114	1.00	1.00	(17)	DISP	2736	30000
95	Max P						(3a)	HOOP	2526	20000
	GR + Max P	2555	27		1.00	1.00	(18)	SUST	5540	20000
	Cold to T1	81	2140	114	1.00	1.00	(17)	DISP	3029	30000

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Point name	Load combination	ASME B31.3b (2001) CODE COMPLIANCE (Moments in ft-lb)			S.I.F		Eq. Load no.	Load type	(Stress in psi)	
		In-Pl. Moment	Out-Pl. Moment	Torsion Moment	In	Out			Code Stress	Code Allow.
100	Max P						(3a)	HOOP	2526	20000
	GR + Max P	3175	117		1.00	1.00	(18)	SUST	6625	20000
	Cold to T1	75	2822	114	1.00	1.00	(17)	DISP	3991	30000
110	Max P						(3a)	HOOP	2526	20000
	GR + Max P	3386	59		1.00	1.00	(18)	SUST	6988	20000
	Cold to T1	64	1325	114	1.00	1.00	(17)	DISP	1880	30000
120	Max P						(3a)	HOOP	2526	20000
	GR + Max P	2220	0		1.00	1.00	(18)	SUST	4956	20000
	Cold to T1	54	173	114	1.00	1.00	(17)	DISP	302	30000
130 N-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	381	45		1.00	1.00	(18)	SUST	1757	20000
	Cold to T1	45	1328	114	1.00	1.00	(17)	DISP	1884	30000
130 N+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	45	381		2.27	1.89	(18)	SUST	2355	20000
	Cold to T1	1328	45	114	2.27	1.89	(17)	DISP	4254	30000
130 M	Max P						(3a)	HOOP	2526	20000
	GR + Max P	51	608		2.27	1.89	(18)	SUST	3098	20000
	Cold to T1	1708	50	112	2.27	1.89	(17)	DISP	5468	30000
130 F-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	48	436		2.27	1.89	(18)	SUST	2535	20000
	Cold to T1	2140	116	43	2.27	1.89	(17)	DISP	6856	30000
130 F+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	436	48		1.00	1.00	(18)	SUST	1852	20000
	Cold to T1	116	2140	43	1.00	1.00	(17)	DISP	3028	30000
140	Max P						(3a)	HOOP	2526	20000
	GR + Max P	2602	15		1.00	1.00	(18)	SUST	5622	20000
	Cold to T1	125	3726	43	1.00	1.00	(17)	DISP	5266	30000
150	Max P						(3a)	HOOP	2526	20000
	GR + Max P	7759	27		1.00	1.00	(18)	SUST	14608	20000
	Cold to T1	135	5781	43	1.00	1.00	(17)	DISP	8168	30000
160	Max P						(3a)	HOOP	2526	20000
	GR + Max P	3367	3		1.00	1.00	(18)	SUST	6955	20000
	Cold to T1	209	207	43	1.00	1.00	(17)	DISP	420	30000
170	Max P						(3a)	HOOP	2526	20000
	GR + Max P	351	22		1.00	1.00	(18)	SUST	1701	20000
	Cold to T1	554	5368	43	1.00	1.00	(17)	DISP	7623	30000
180 -	Max P						(3a)	HOOP	2526	20000
	GR + Max P	46	1289		1.85	2.14	(18)	SUST	5888	20000
	Cold to T1	10942	899	43	1.85	2.14	(17)	DISP	28746	30000

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Point name	Load combination	ASME B31.3b (2001) CODE COMPLIANCE (Moments in ft-lb)			S.I.F		Eq. Load no.	Load type	(Stress in psi)	
		In-Pl. Moment	Out-Pl. Moment	Torsion Moment	In	Out			Code Stress	Code Allow.
180 +	Max P						(3a)	HOOP	2526	20000
	GR + Max P	38	1289		1.85	2.14	(18)	SUST	5887	20000
	Cold to T1	10821	899	505	1.85	2.14	(17)	DISP	28441	30000
190	Max P						(3a)	HOOP	2526	20000
	GR + Max P	57	22		1.00	1.00	(18)	SUST	1193	20000
	Cold to T1	1500	5305	505	1.00	1.00	(17)	DISP	7820	30000
200	Max P						(3a)	HOOP	2526	20000
	GR + Max P	2778	6		1.00	1.00	(18)	SUST	5929	20000
	Cold to T1	2102	212	505	1.00	1.00	(17)	DISP	3067	30000
210	Max P						(3a)	HOOP	2526	20000
	GR + Max P	6875	10		1.00	1.00	(18)	SUST	13068	20000
	Cold to T1	2703	5728	505	1.00	1.00	(17)	DISP	8974	30000
220	Max P						(3a)	HOOP	2526	20000
	GR + Max P	2261	8		1.00	1.00	(18)	SUST	5027	20000
	Cold to T1	1113	3737	505	1.00	1.00	(17)	DISP	5553	30000
230 N-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	359	6		1.00	1.00	(18)	SUST	1713	20000
	Cold to T1	114	2201	505	1.00	1.00	(17)	DISP	3194	30000
230 N+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	6	359		2.27	1.89	(18)	SUST	2269	20000
	Cold to T1	2201	114	505	2.27	1.89	(17)	DISP	7086	30000
230 M	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1	557		2.27	1.89	(18)	SUST	2921	20000
	Cold to T1	1782	19	544	2.27	1.89	(17)	DISP	5754	30000
230 F-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	15	387		2.27	1.89	(18)	SUST	2362	20000
	Cold to T1	1413	141	478	2.27	1.89	(17)	DISP	4587	30000
230 F+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	387	15		1.00	1.00	(18)	SUST	1762	20000
	Cold to T1	141	1413	478	1.00	1.00	(17)	DISP	2116	30000
240	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1807	81		1.00	1.00	(18)	SUST	4240	20000
	Cold to T1	1085	289	478	1.00	1.00	(17)	DISP	1724	30000
250	Max P						(3a)	HOOP	2526	20000
	GR + Max P	2430	168		1.00	1.00	(18)	SUST	5332	20000
	Cold to T1	2675	1168	478	1.00	1.00	(17)	DISP	4178	30000
260	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1678	254		1.00	1.00	(18)	SUST	4044	20000
	Cold to T1	4265	2626	478	1.00	1.00	(17)	DISP	7107	30000

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Point name	Load combination	ASME B31.3b (2001) CODE COMPLIANCE (Moments in ft-lb)			S.I.F		Eq. Load no.	Load type	(Stress in psi)	
		In-Pl. Moment	Out-Pl. Moment	Torsion Moment	In	Out			Code Stress	Code Allow.
265	Max P						(3a)	HOOP	2526	20000
	GR + Max P	786	167		1.00	1.00	(18)	SUST	2488	20000
	Cold to T1	5060	2127	478	1.00	1.00	(17)	DISP	7782	30000
268	Max P						(3a)	HOOP	2526	20000
	GR + Max P	447	140		1.00	1.00	(18)	SUST	1903	20000
	Cold to T1	5302	1975	478	1.00	1.00	(17)	DISP	8020	30000
275	Max P						(3a)	HOOP	2526	20000
	GR + Max P	2403	8		1.00	1.00	(18)	SUST	5275	20000
	Cold to T1	6650	1129	478	1.00	1.00	(17)	DISP	9551	30000
280 N-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	3703	55		1.00	1.00	(18)	SUST	7540	20000
	Cold to T1	7081	858	478	1.00	1.00	(17)	DISP	10098	30000
280 N+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	3703	55		2.27	1.89	(18)	SUST	15706	20000
	Cold to T1	7081	858	478	2.27	1.89	(17)	DISP	22786	30000
280 M	Max P						(3a)	HOOP	2526	20000
	GR + Max P	3098	621		2.27	1.89	(18)	SUST	13489	20000
	Cold to T1	5142	108	878	2.27	1.89	(17)	DISP	16504	30000
280 F-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	8	933		2.27	1.89	(18)	SUST	4158	20000
	Cold to T1	55	706	630	2.27	1.89	(17)	DISP	2089	30000
280 F+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	933	8		1.00	1.00	(18)	SUST	2714	20000
	Cold to T1	706	55	630	1.00	1.00	(17)	DISP	1339	30000
290	Max P						(3a)	HOOP	2526	20000
	GR + Max P	933	5		1.00	1.00	(18)	SUST	2714	20000
	Cold to T1	706	31	630	1.00	1.00	(17)	DISP	1337	30000
300	Max P						(3a)	HOOP	2526	20000
	GR + Max P	933	52		1.00	1.00	(18)	SUST	2716	20000
	Cold to T1	706	346	630	1.00	1.00	(17)	DISP	1423	30000
310 N-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	933	89		1.00	1.00	(18)	SUST	2721	20000
	Cold to T1	706	589	630	1.00	1.00	(17)	DISP	1574	30000
310 N+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	933	89		2.27	1.89	(18)	SUST	4783	20000
	Cold to T1	706	589	630	2.27	1.89	(17)	DISP	2891	30000
310 M	Max P						(3a)	HOOP	2526	20000
	GR + Max P	809	3		2.27	1.89	(18)	SUST	4280	20000
	Cold to T1	682	22	883	2.27	1.89	(17)	DISP	2515	30000

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Point name	Load combination	ASME B31.3b (2001) CODE COMPLIANCE (Moments in ft-lb)			S.I.F		Eq. Load no.	Load type	(Stress in psi)	
		In-Pl. Moment	Out-Pl. Moment	Torsion Moment	In	Out			Code Stress	Code Allow.
310 F-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	543	84		2.27	1.89	(18)	SUST	3249	20000
	Cold to T1	625	558	661	2.27	1.89	(17)	DISP	2662	30000
310 F+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	543	84		1.00	1.00	(18)	SUST	2045	20000
	Cold to T1	625	558	661	1.00	1.00	(17)	DISP	1508	30000
320	Max P						(3a)	HOOP	2526	20000
	GR + Max P	226	48		1.00	1.00	(18)	SUST	1490	20000
	Cold to T1	353	315	661	1.00	1.00	(17)	DISP	1148	30000
330 N-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	177	11		1.00	1.00	(18)	SUST	1396	20000
	Cold to T1	81	72	661	1.00	1.00	(17)	DISP	946	30000
330 N+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	177	11		2.27	1.89	(18)	SUST	1787	20000
	Cold to T1	81	72	661	2.27	1.89	(17)	DISP	988	30000
330 M	Max P						(3a)	HOOP	2526	20000
	GR + Max P	62	71		2.27	1.89	(18)	SUST	1425	20000
	Cold to T1	24	468	438	2.27	1.89	(17)	DISP	1394	30000
330 F-	Max P						(3a)	HOOP	2526	20000
	GR + Max P	0	89		2.27	1.89	(18)	SUST	1380	20000
	Cold to T1	0	589	0	2.27	1.89	(17)	DISP	1571	30000
330 F+	Max P						(3a)	HOOP	2526	20000
	GR + Max P	0	89		1.00	1.00	(18)	SUST	1242	20000
	Cold to T1	0	589	0	1.00	1.00	(17)	DISP	832	30000
340	Max P						(3a)	HOOP	2526	20000
	GR + Max P	0	52		1.00	1.00	(18)	SUST	1178	20000
	Cold to T1	0	346	0	1.00	1.00	(17)	DISP	489	30000
350	Max P						(3a)	HOOP	2526	20000
	GR + Max P	0	5		1.00	1.00	(18)	SUST	1096	20000
	Cold to T1	0	31	0	1.00	1.00	(17)	DISP	44	30000
*** Segment A end ***										
*** Segment B begin ***										
180	Max P						(3a)	HOOP	2526	20000
	GR + Max P	84	522		1.85	2.14	(18)	SUST	3049	20000
	Cold to T1	121	548	0	1.85	2.14	(17)	DISP	1682	30000
1000	Max P						(3a)	HOOP	2526	20000
	GR + Max P	402	56		1.00	1.00	(18)	SUST	1794	20000
	Cold to T1	291	81	0	1.00	1.00	(17)	DISP	427	30000

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Point name	Load combination	ASME B31.3b (2001) CODE COMPLIANCE (Moments in ft-lb)			S.I.F		Eq. Load no.	Load type	(Stress in psi)	
		In-Pl. Moment	Out-Pl. Moment	Torsion Moment	In	Out			Code Stress	Code Allow.
1010	Max P						(3a)	HOOP	2526	20000
	GR + Max P	50	28		1.00	1.00	(18)	SUST	1188	20000
	Cold to T1	35	40	0	1.00	1.00	(17)	DISP	76	30000
1020	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1878	0		1.00	1.00	(18)	SUST	4360	20000
	Cold to T1	221	0	0	1.00	1.00	(17)	DISP	312	30000
1030	Max P						(3a)	HOOP	2526	20000
	GR + Max P	712	0		1.00	1.00	(18)	SUST	2328	20000
	Cold to T1	167	0	0	1.00	1.00	(17)	DISP	236	30000
1040	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1926	0		1.00	1.00	(18)	SUST	4443	20000
	Cold to T1	113	0	0	1.00	1.00	(17)	DISP	160	30000
1050	Max P						(3a)	HOOP	2526	20000
	GR + Max P	1764	0		1.00	1.00	(18)	SUST	4162	20000
	Cold to T1	59	0	0	1.00	1.00	(17)	DISP	84	30000
1060	Max P						(3a)	HOOP	2526	20000
	GR + Max P	228	0		1.00	1.00	(18)	SUST	1484	20000
	Cold to T1	5	0	0	1.00	1.00	(17)	DISP	7	30000

*** Segment B end ***

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S Y S T E M S U M M A R Y

Maximum sustained stress

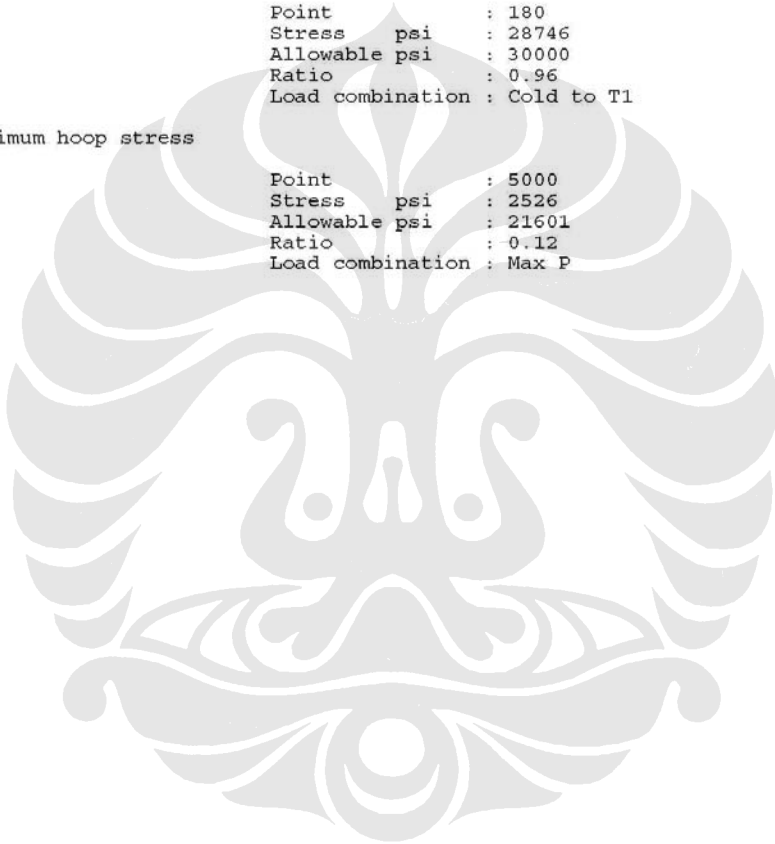
Point : 280 N
Stress psi : 15706
Allowable psi : 20000
Ratio : 0.79
Load combination : GR + Max P

Maximum displacement stress

Point : 180
Stress psi : 28746
Allowable psi : 30000
Ratio : 0.96
Load combination : Cold to T1

Maximum hoop stress

Point : 5000
Stress psi : 2526
Allowable psi : 21601
Ratio : 0.12
Load combination : Max P



AUTOPIPE MODEL
12/21/2008 PROJECT:
07:26 PM

REBIS
AutoPIPE+6.20 RESULT PAGE 11

S Y S T E M S U M M A R Y

Maximum sustained stress ratio

Point : 280 N
Stress psi : 15706
Allowable psi : 20000
Ratio : 0.79
Load combination : GR + Max P

Maximum displacement stress ratio

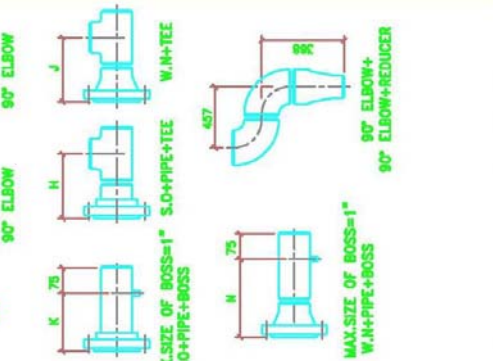
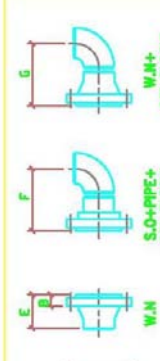
Point : 180
Stress psi : 28746
Allowable psi : 30000
Ratio : 0.96
Load combination : Cold to T1

Maximum hoop stress ratio

Point : 10
Stress psi : 2526
Allowable psi : 20000
Ratio : 0.13
Load combination : Max P

* * * The system satisfies ASME B31.3 code requirements * * *
* * * for the selected options * * *

TYPE	CL.125FF		CL.300		CL.600		CL.900		CL.1500		CL.2500		RATING & CONNECTION	ASME CL.125 FF		ASME CL.300 RJ		ASME CL.600 RJ		ASME CL.900 RJ		ASME CL.1500 RJ		ASME CL.2500 RJ			
	RF	RF	RF	RF	RF	RF	RF	RF	RF	RF	RF	RF		MARK	L	H	W	T	L	H	W	T	L	H	W	T	
A	278	317.5	355.6	381	356	381	394	483	287	287	287	287	GATE	501	505	505	505	505	505	505	505	505	505	505	505	505	505
B	25.5	36.0	54.1	82.0	56.0	84.0	92.6	120.7	356	485	305	82	GLOBE	445	305	113	460	766	457	177	559	689	610	290	240	240	240
C	39.6	52.3	73.4						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
D	87	99	120						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
E	142.8	142.8	142.8	142.8	142.8	142.8	142.8	142.8	142.8	142.8	142.8	142.8	GATE	445	305	113	460	766	457	177	559	689	610	290	240	240	240
F	316	328	349						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
G	316	327	352						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
H	230	242	253						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
J	232	241	267						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
K	115	130	150						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
L	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
M	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
N	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
O	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
P	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
Q	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
R	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
S	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
T	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
U	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
V	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
W	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
X	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
Y	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240
Z	185	175	200						356				CHECK	445	305	113	460	766	457	177	559	689	610	290	240	240	240



NO.	DESCRIPTION	DATE	BY	CHKD	APPROVED

P. T. REKAYASA INDUSTRI
ENGINEERING & CONSTRUCTION
JAKARTA, INDONESIA

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NO.	DESCRIPTION	DATE	BY	CHKD	APPROVED

TITLE: ALL - PROJECT
PIPING DESIGN DATA
PIPING PARTS DIMENSION & WEIGHT
NPS 6"

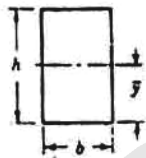
SCALE: NONE
PROJECT: 426-WI-032-04
DRAWING NO.:
SHEET 12 OF 40

NO.	DESCRIPTION	DATE	BY	CHKD	APPROVED

NO.	DESCRIPTION	DATE	BY	CHKD	APPROVED

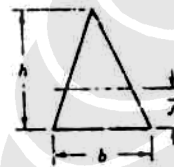
A = Luas
 I = Momen inersia
 J = Momen inersia polar
 Z = Modulus penampang
 k = Jari-jari girasi
 \bar{y} = Jarak titik berat

Empat persegi



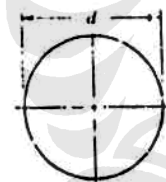
$$\begin{aligned}
 A &= bh & k &= 0.289h \\
 I &= \frac{bh^3}{12} & \bar{y} &= \frac{h}{2} \\
 Z &= \frac{bh^2}{6}
 \end{aligned}$$

Segi tiga



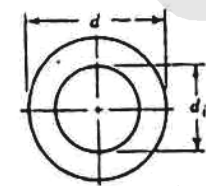
$$\begin{aligned}
 A &= \frac{bh}{2} & k &= 0.236h \\
 I &= \frac{bh^3}{36} & \bar{y} &= \frac{h}{3} \\
 Z &= \frac{bh^2}{24}
 \end{aligned}$$

Lingkaran



$$\begin{aligned}
 A &= \frac{\pi d^2}{4} & J &= \frac{\pi d^4}{32} \\
 I &= \frac{\pi d^4}{64} & k &= \frac{d}{4} \\
 Z &= \frac{\pi d^3}{32} & \bar{y} &= \frac{d}{2}
 \end{aligned}$$

Pipa



$$\begin{aligned}
 A &= \frac{\pi}{4} (d^2 - d_i^2) & J &= \frac{\pi}{32} (d^4 - d_i^4) \\
 I &= \frac{\pi}{64} (d^4 - d_i^4) & k &= \sqrt{\frac{d^2 + d_i^2}{16}} \\
 Z &= \frac{\pi}{32d} (d^4 - d_i^4) & \bar{y} &= \frac{d}{2}
 \end{aligned}$$

Loading	Equivalent Nodal Loading	
