

Pipeline Analysis Underwater with Structure using Casers II

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Abstract—Casers is the software generally used for various forces acting on the pipes in various conditions. It has been found that at certain conditions the pipeline may effects uncertainty forces and damage itself. So proper analysis has been done to ensure the stress acting on the pipeline and its safety. Taking the water as one of its medium of analysis. Also a supporting structure has been made with the reference of pipeline.

Keywords— Analysis, Piping, Casers II, Underwater, Structure, Cad Works

1 Introduction

The analysis contains of a pipeline which can withstand the various type of forces in all directions when it's implied into the water. The pipeline also contains structure made which is to be implied at the time of installing the pipeline into the water. The stress analysis has been done on pipe with the help of CASERS also the structure for the pipeline is made with the help of Cad Works. So to ensure that the structure and pipeline can withstand the stress acting on it.

2 Materials and Methods

The pipeline are made as the ASTM Standard Grades (i.e. SA 106 Grade B). About the structure is made up of the I-Section of length 6 in. Also there is made the small pyramid structure at the top so that it could cut the water forces and also withstand the pipes. The pyramid consists of a two square shape top and down bases. The top one has dimension of 4 in and down bases has dimension of 6 in.

3 Result

The result contains the details of the various force acting on the pipes at a certain point which can be generated with the help of casers. There is the use of Piping code B31.3 for doing load analysis at different point

4 List of Equations

Axial Stress : - $\sigma = \frac{Pd}{4t}$ unit is Kpa

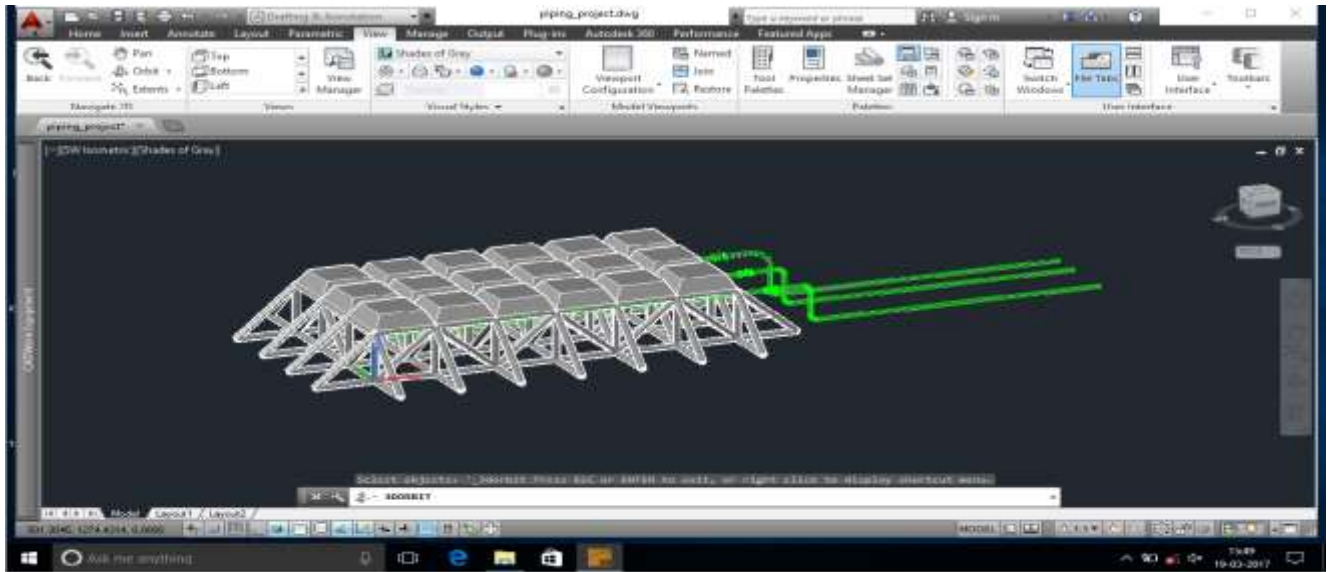
Bending Stress : - $\sigma = \frac{My}{I}$ unit is Kpa

Torsion Stress : - $J = \frac{\pi}{32} (D^4 + d^4)$ unit is Kpa

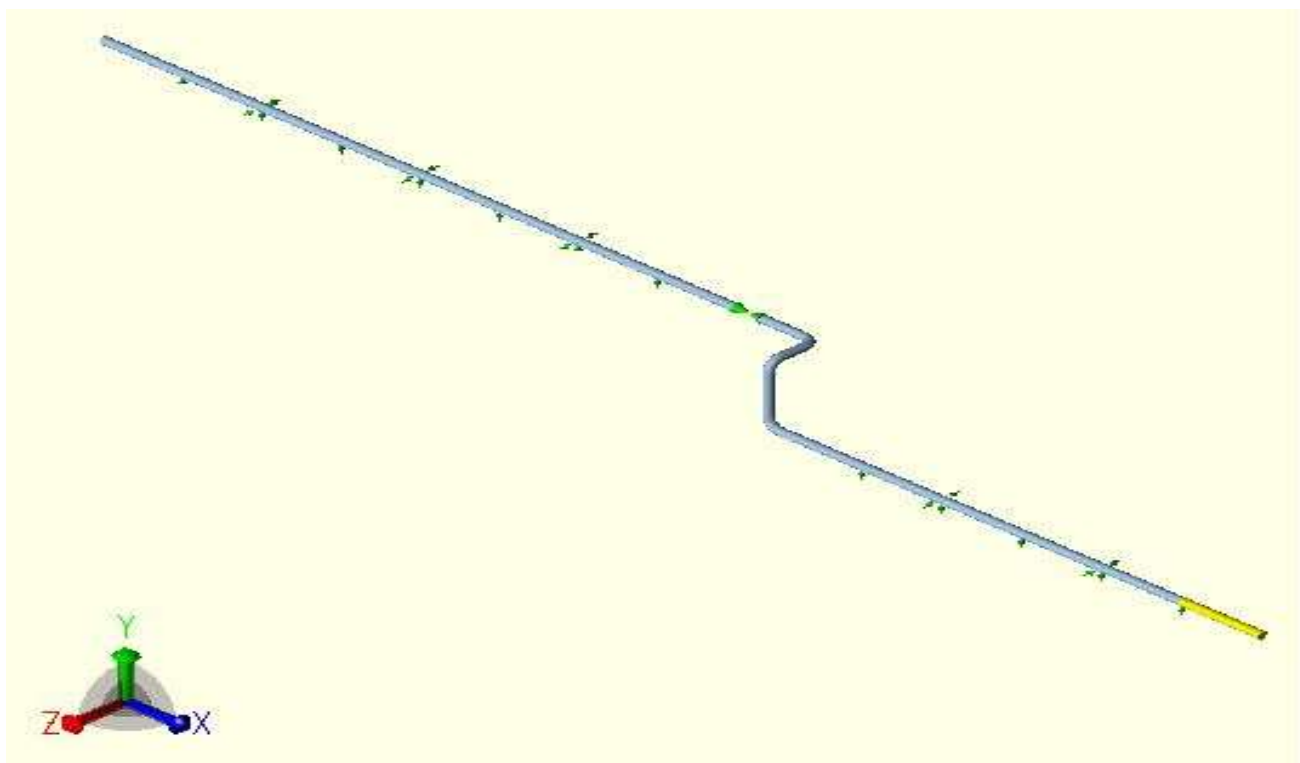
Hoop Stress : - $\sigma_{\theta} = \frac{F}{t}$ unit is Kpa

5 Figure

A) Structure figure



B) Pipeline Figure



6 Cases

1-CODE STRESS CHECK FAILED : LOADCASE 1

Highest Stresses: (KPa)

Ratio (%): 1147.9 @Node 15
 Code Stress: 1582870.3 Allowable Stress: 137895.1
 Axial Stress: 20976.6 @Node 11
 Bending Stress: 1566914.9 @Node 15
 Torsion Stress: 134859.8 @Node 60
 Hoop Stress: 42963.0 @Node 11
 Max Stress Intensity: 1592912.6 @Node 15

Node	Axial Stress KPa	Bending Stress KPa	Torsion Stress KPa	Hoop Stress KPa	Max Stress Intensity KPa	SIF/Ind ex In Plane	SIF/Ind ex Out Plane	Code Stress KPa	Allowable Stress KPa	Ratio %	Piping Code	
10	20976.6	0.0	0.0	42963.0	46090.0	1.000	1.000	20976.6	137895.1	15.2	B31.3	
11	20976.6	451373.3	0.0	42963.0	472349.8	1.000	1.000	472349.8	137895.1	342.5	B31.3	*
11	19719.0	451373.3	-0.0	42963.0	471092.2	1.000	1.000	471092.2	137895.1	341.6	B31.3	*
12	19719.0	46662.6	0.0	42963.0	68896.8	1.000	1.000	66381.6	137895.1	48.1	B31.3	
12	18376.9	46662.6	0.0	42963.0	70164.0	1.000	1.000	65039.5	137895.1	47.2	B31.3	
13	18376.9	178940.8	0.0	42963.0	202517.1	1.000	1.000	197317.7	137895.1	143.1	B31.3	*
13	15955.4	178940.8	0.0	42963.0	198787.7	1.000	1.000	194896.2	137895.1	141.3	B31.3	*
14	15955.4	240313.0	-0.0	42963.0	266310.8	1.000	1.000	256268.4	137895.1	185.8	B31.3	*
14	15955.4	240313.0	0.0	42963.0	257340.9	1.000	1.000	256268.4	137895.1	185.8	B31.3	*
15	15955.4	1566914.9	0.0	42963.0	1592912.6	1.000	1.000	1582870.3	137895.1	1147.9	B31.3	*

Nod e	Axial Stress KPa	Bending Stress KPa	Torsio n Stress KPa	Hoop Stress KPa	Max Stress Intensity KPa	SIF/Ind ex In Plane	SIF/Ind ex Out Plane	Code Stress KPa	Allowab le Stress KPa	Ratio %	Pipin g Code	
15	10747.8	1566914.9	-0.0	42963.0	1577662.6	1.000	1.000	1577662.6	137895.1	1144.1	B31.3	*
20	10747.8	418928.6	-0.0	42963.0	450133.9	1.000	1.000	429676.4	137895.1	311.6	B31.3	*
20	10747.8	1037973.6	0.0	42963.0	1048721.4	1.859	1.549	789228.0	137895.1	572.3	B31.3	*
29	-12521.2	1391987.8	-10995.5	42963.0	1446629.3	1.859	1.549	1056740.9	137895.1	766.3	B31.3	*
29	-12521.2	1391987.8	10995.5	42963.0	1404681.0	1.859	1.549	1056740.9	137895.1	766.3	B31.3	*
30	-13293.3	1440449.6	-25952.1	42963.0	1496596.4	1.859	1.549	1094861.5	137895.1	794.0	B31.3	*
30	-13293.3	581564.4	25952.1	42963.0	613247.3	1.000	1.000	597117.9	137895.1	433.0	B31.3	*
40	-13256.7	580989.6	-25952.1	42963.0	638313.3	1.000	1.000	596508.8	137895.1	432.6	B31.3	*
40	-13256.7	580989.6	25952.1	42963.0	612663.4	1.000	1.000	596508.8	137895.1	432.6	B31.3	*
50	2072.3	377702.6	-25952.1	42963.0	420796.8	1.000	1.000	383305.4	137895.1	278.0	B31.3	*
50	2072.3	820026.9	25952.1	42963.0	825096.8	1.859	1.549	619271.5	137895.1	449.1	B31.3	*
59	5344.0	648864.6	89388.9	42963.0	708403.6	1.859	1.549	523467.3	137895.1	379.6	B31.3	*
59	5344.0	648864.6	-89388.9	42963.0	678196.3	1.859	1.549	523467.3	137895.1	379.6	B31.3	*
60	14898.9	325244.7	134859.8	42963.0	443692.7	1.859	1.549	373822.1	137895.1	271.1	B31.3	*

Nod e	Axial Stress KPa	Bending Stress KPa	Torsio n Stress KPa	Hoop Stress KPa	Max Stress Intensity KPa	SIF/Ind ex In Plane	SIF/Ind ex Out Plane	Code Stress KPa	Allowab le Stress KPa	Ratio %	Pipin g Code	
60	14898.9	131310.9	-134859.8	42963.0	306799.6	1.000	1.000	306799.6	137895.1	222.5	B31.3	*
70	14898.9	130582.0	134859.8	42963.0	312406.6	1.000	1.000	306452.9	137895.1	222.2	B31.3	*
70	14898.9	130582.0	-134859.8	42963.0	306452.9	1.000	1.000	306452.9	137895.1	222.2	B31.3	*
80	14898.9	122213.2	134859.8	42963.0	308268.5	1.000	1.000	302569.7	137895.1	219.4	B31.3	*
80	14898.9	300985.9	-134859.8	42963.0	415369.6	1.859	1.549	361463.0	137895.1	262.1	B31.3	*
89	9446.2	547811.9	99519.3	42963.0	613503.4	1.859	1.549	465051.5	137895.1	337.3	B31.3	*
89	9446.2	547811.9	-99519.3	42963.0	591737.4	1.859	1.549	465051.5	137895.1	337.3	B31.3	*
90	10747.8	688635.9	-0.0	42963.0	719841.2	1.859	1.549	527224.7	137895.1	382.3	B31.3	*
90	10747.8	319478.8	0.0	42963.0	338077.9	1.000	1.000	330226.6	137895.1	239.5	B31.3	*
100	10747.8	319347.3	-0.0	42963.0	350552.6	1.000	1.000	330095.1	137895.1	239.4	B31.3	*
100	10747.8	319347.3	0.0	42963.0	337952.4	1.000	1.000	330095.1	137895.1	239.4	B31.3	*
110	10747.8	178456.4	-0.0	42963.0	209661.7	1.000	1.000	189204.2	137895.1	137.2	B31.3	*
110	0.0	0.0	0.0	0.0	0.0	0.000	0.000	0.0	0.0	0.0	B31.3	
120	0.0	0.0	0.0	0.0	0.0	0.000	0.000	0.0	0.0	0.0	B31.3	

Nod e	Axial Stress KPa	Bending Stress KPa	Torsion Stress KPa	Hoop Stress KPa	Max Stress Intensity KPa	SIF/Ind ex In Plane	SIF/Ind ex Out Plane	Code Stress KPa	Allowable Stress KPa	Ratio %	Pipin g Code	
120	10747.8	53315.5	0.0	42963.0	84140.3	1.000	1.000	64063.3	137895.1	46.5	B31.3	
121	10747.8	1244019.9	-0.0	42963.0	1275225.3	1.000	1.000	1254767.8	137895.1	909.9	B31.3	*
121	15790.1	1244019.9	0.0	42963.0	1259810.0	1.000	1.000	1259810.0	137895.1	913.6	B31.3	*
122	15790.1	139371.6	0.0	42963.0	165534.6	1.000	1.000	155161.6	137895.1	112.5	B31.3	*
122	15790.1	139371.6	-0.0	42963.0	161201.3	1.000	1.000	155161.6	137895.1	112.5	B31.3	*
123	15790.1	88052.4	-0.0	42963.0	114215.5	1.000	1.000	103842.5	137895.1	75.3	B31.3	
123	17996.2	88052.4	0.0	42963.0	110033.3	1.000	1.000	106048.7	137895.1	76.9	B31.3	
124	17996.2	107515.8	0.0	42963.0	131472.7	1.000	1.000	125512.0	137895.1	91.0	B31.3	
124	19387.5	107515.8	-0.0	42963.0	127211.4	1.000	1.000	126903.3	137895.1	92.0	B31.3	
125	19387.5	85611.1	0.0	42963.0	108176.8	1.000	1.000	104998.6	137895.1	76.1	B31.3	
125	20344.3	85611.1	0.0	42963.0	105955.4	1.000	1.000	105955.4	137895.1	76.8	B31.3	
126	20344.3	15121.5	0.0	42963.0	46090.0	1.000	1.000	35465.8	137895.1	25.7	B31.3	
126	20502.4	15121.5	0.0	42963.0	46090.0	1.000	1.000	35623.9	137895.1	25.8	B31.3	
127	20502.4	438388.1	0.0	42963.0	459838.8	1.000	1.000	458890.4	137895.1	332.8	B31.3	*
127	20976.6	438388.1	0.0	42963.0	459364.6	1.000	1.000	459364.6	137895.1	333.1	B31.3	*
130	20976.6	0.0	0.0	42963.0	46090.0	1.000	1.000	20976.6	137895.1	15.2	B31.3	

2-CODE STRESS CHECK FAILED : LOADCASE 2

Highest Stresses: (KPa)

Ratio (%): 1143.0 @Node 15
 Code Stress: 1576193.9 Allowable Stress: 137895.1
 Axial Stress: 20976.6 @Node 11
 Bending Stress: 1560098.9 @Node 15
 Torsion Stress: 135404.8 @Node 60
 Hoop Stress: 42963.0 @Node 11
 Max Stress Intensity: 1585957.0 @Node 15

Nod e	Axial Stress KPa	Bending Stress KPa	Torsio n Stress KPa	Hoop Stress KPa	Max Stress Intensity KPa	SIF/Ind ex In Plane	SIF/Ind ex Out Plane	Code Stress KPa	Allowab le Stress KPa	Ratio %	Pipin g Code	
10	20976.6	0.0	0.0	42963.0	46090.0	1.000	1.000	20976.6	137895.1	15.2	B31.3	
11	20976.6	451373.3	0.0	42963.0	472349.8	1.000	1.000	472349.8	137895.1	342.5	B31.3	*
11	19603.7	451373.3	0.0	42963.0	470976.9	1.000	1.000	470976.9	137895.1	341.5	B31.3	*
12	19603.7	46256.0	-0.0	42963.0	68605.5	1.000	1.000	65859.6	137895.1	47.8	B31.3	
12	17849.9	46256.0	0.0	42963.0	70303.0	1.000	1.000	64105.8	137895.1	46.5	B31.3	
13	17849.9	177389.5	-0.0	42963.0	201492.8	1.000	1.000	195239.4	137895.1	141.6	B31.3	*
13	16094.9	177389.5	0.0	42963.0	197168.1	1.000	1.000	193484.5	137895.1	140.3	B31.3	*
14	16094.9	233338.0	-0.0	42963.0	259196.2	1.000	1.000	249433.0	137895.1	180.9	B31.3	*
14	16094.9	233338.0	0.0	42963.0	250546.8	1.000	1.000	249433.0	137895.1	180.9	B31.3	*
15	16094.9	1560098.9	0.0	42963.0	1585957.0	1.000	1.000	1576193.9	137895.1	1143.0	B31.3	*

Nod e	Axial Stress KPa	Bending Stress KPa	Torsion Stress KPa	Hoop Stress KPa	Max Stress Intensity KPa	SIF/Ind ex In Plane	SIF/Ind ex Out Plane	Code Stress KPa	Allowable Stress KPa	Ratio %	Pipin g Code	
15	10765.0	1560098.9	-0.0	42963.0	1570863.9	1.000	1.000	1570863.9	137895.1	1139.2	B31.3	*
20	10765.0	420206.9	-0.0	42963.0	451395.0	1.000	1.000	430972.0	137895.1	312.5	B31.3	*
20	10765.0	1041120.6	-0.0	42963.0	1051885.6	1.859	1.549	791605.5	137895.1	574.1	B31.3	*
29	-12414.1	1393801.8	-11178.2	42963.0	1448341.5	1.859	1.549	1058001.6	137895.1	767.3	B31.3	*
29	-12414.1	1393801.8	11178.2	42963.0	1406393.5	1.859	1.549	1058001.6	137895.1	767.3	B31.3	*
30	-13159.1	1441802.1	-26067.1	42963.0	1497822.0	1.859	1.549	1095751.8	137895.1	794.6	B31.3	*
30	-13159.1	582100.8	26067.1	42963.0	613633.7	1.000	1.000	597538.6	137895.1	433.3	B31.3	*
40	-13122.6	581526.4	-26067.1	42963.0	638733.3	1.000	1.000	596929.9	137895.1	432.9	B31.3	*
40	-13122.6	581526.4	26067.1	42963.0	613050.1	1.000	1.000	596929.9	137895.1	432.9	B31.3	*
50	2206.5	377331.1	-26067.1	42963.0	420323.4	1.000	1.000	383101.5	137895.1	277.8	B31.3	*
50	2206.5	818227.2	26067.1	42963.0	823254.5	1.859	1.549	618079.6	137895.1	448.2	B31.3	*
59	5498.1	645736.9	89672.1	42963.0	705372.4	1.859	1.549	521602.5	137895.1	378.3	B31.3	*
59	5498.1	645736.9	-89672.1	42963.0	675478.7	1.859	1.549	521602.5	137895.1	378.3	B31.3	*

Nod e	Axial Stress KPa	Bending Stress KPa	Torsion Stress KPa	Hoop Stress KPa	Max Stress Intensity KPa	SIF/Ind ex In Plane	SIF/Ind ex Out Plane	Code Stress KPa	Allowable Stress KPa	Ratio %	Pipin g Code	
60	14982.7	319639.4	135404.8	42963.0	439859.3	1.859	1.549	371774.4	137895.1	269.6	B31.3	*
60	14982.7	129044.4	-135404.8	42963.0	306727.3	1.000	1.000	306727.3	137895.1	222.4	B31.3	*
70	14982.7	128322.2	135404.8	42963.0	312175.7	1.000	1.000	306388.9	137895.1	222.2	B31.3	*
70	14982.7	128322.2	-135404.8	42963.0	306388.9	1.000	1.000	306388.9	137895.1	222.2	B31.3	*
80	14982.7	121548.7	135404.8	42963.0	308862.1	1.000	1.000	303279.9	137895.1	219.9	B31.3	*
80	14982.7	299448.1	-135404.8	42963.0	414975.4	1.859	1.549	361567.5	137895.1	262.2	B31.3	*
89	9517.7	548215.4	99742.3	42963.0	613962.1	1.859	1.549	465580.4	137895.1	337.6	B31.3	*
89	9517.7	548215.4	-99742.3	42963.0	592334.6	1.859	1.549	465580.4	137895.1	337.6	B31.3	*
90	10765.0	689010.1	-0.0	42963.0	720198.2	1.859	1.549	527522.6	137895.1	382.6	B31.3	*
90	10765.0	319693.6	0.0	42963.0	338265.6	1.000	1.000	330458.6	137895.1	239.6	B31.3	*
100	10765.0	319557.5	0.0	42963.0	350745.6	1.000	1.000	330322.5	137895.1	239.5	B31.3	*
100	10765.0	319557.5	0.0	42963.0	338135.8	1.000	1.000	330322.5	137895.1	239.5	B31.3	*
110	10765.0	176386.5	-0.0	42963.0	207574.7	1.000	1.000	187151.6	137895.1	135.7	B31.3	*
110	0.0	0.0	0.0	0.0	0.0	0.000	0.000	0.0	0.0	0.0	B31.3	
	0.0	0.0	0.0	0.0	0.0	0.000	0.000	0.0	0.0	0.0	B31.3	

Nod e	Axial Stress KPa	Bending Stress KPa	Torsion Stress KPa	Hoop Stress KPa	Max Stress Intensity KPa	SIF/Ind ex In Plane	SIF/Ind ex Out Plane	Code Stress KPa	Allowable Stress KPa	Ratio %	Pipin g Code	
120											3	
120	10765 .0	52603.1	0.0	42963 .0	83443.4	1.000	1.000	63368.1	137895. 1	46.0	B31. 3	
121	10765 .0	1251541 .5	0.0	42963 .0	1282729 .6	1.000	1.000	1262306 .6	137895. 1	915.4	B31. 3	*
121	15758 .0	1251541 .5	0.0	42963 .0	1267299 .5	1.000	1.000	1267299 .5	137895. 1	919.0	B31. 3	*
122	15758 .0	128542. 6	0.0	42963 .0	154737. 8	1.000	1.000	144300. 6	137895. 1	104.6	B31. 3	*
122	15758 .0	128542. 6	-0.0	42963 .0	150901. 9	1.000	1.000	144300. 6	137895. 1	104.6	B31. 3	*
123	15758 .0	91462.1	0.0	42963 .0	117657. 2	1.000	1.000	107220. 0	137895. 1	77.8	B31. 3	
123	17897 .2	91462.1	0.0	42963 .0	113385. 3	1.000	1.000	109359. 3	137895. 1	79.3	B31. 3	
124	17897 .2	108298. 6	0.0	42963 .0	132354. 5	1.000	1.000	126195. 9	137895. 1	91.5	B31. 3	
124	19194 .6	108298. 6	0.0	42963 .0	128151. 1	1.000	1.000	127493. 2	137895. 1	92.5	B31. 3	
125	19194 .6	85425.9	0.0	42963 .0	108184. 5	1.000	1.000	104620. 5	137895. 1	75.9	B31. 3	
125	20004 .7	85425.9	-0.0	42963 .0	105518. 9	1.000	1.000	105430. 6	137895. 1	76.5	B31. 3	
126	20004 .7	15078.3	-0.0	42963 .0	46090.0	1.000	1.000	35082.9	137895. 1	25.4	B31. 3	
126	20549 .1	15078.3	0.0	42963 .0	46090.0	1.000	1.000	35627.3	137895. 1	25.8	B31. 3	
127	20549 .1	438388. 1	0.0	42963 .0	459792. 2	1.000	1.000	458937. 2	137895. 1	332.8	B31. 3	*
127	20976 .6	438388. 1	0.0	42963 .0	459364. 6	1.000	1.000	459364. 6	137895. 1	333.1	B31. 3	*

Node	Axial Stress KPa	Bending Stress KPa	Torsion Stress KPa	Hoop Stress KPa	Max Stress Intensity KPa	SIF/Index In Plane	SIF/Index Out Plane	Code Stress KPa	Allowable Stress KPa	Ratio %	Piping Code
130	20976.6	0.0	0.0	42963.0	46090.0	1.000	1.000	20976.6	137895.1	15.2	B31.3

3-CODE STRESS CHECK PASSED : LOADCASE 3

Highest Stresses: (KPa)

Ratio (%): 6.5 @Node 124

Code Stress: 14137.5 Allowable Stress: 218542.0

Axial Stress: 14001.5 @Node 124

Bending Stress: 7791.6 @Node 90

Torsion Stress: 1634.9 @Node 60

Hoop Stress: 0.0 @Node 11

Max Stress Intensity: 21252.0 @Node 123

Node	Axial Stress KPa	Bending Stress KPa	Torsion Stress KPa	Hoop Stress KPa	Max Stress Intensity KPa	SIF/Index In Plane	SIF/Index Out Plane	Code Stress KPa	Allowable Stress KPa	Ratio %	Piping Code
10	-0.0	0.0	-0.0	0.0	0.0	1.000	1.000	0.0	323761.3	0.0	B31.3
11	-0.0	0.0	0.0	0.0	0.0	1.000	1.000	0.0	206842.7	0.0	B31.3
11	-7738.0	0.0	-0.0	0.0	11311.1	1.000	1.000	7738.0	206842.7	3.7	B31.3
12	-7738.0	60.0	0.0	0.0	11396.9	1.000	1.000	7798.0	278356.2	2.8	B31.3
12	-10171.9	60.0	-0.0	0.0	14954.7	1.000	1.000	10231.9	279698.3	3.7	B31.3
13	-10171.9	218.2	0.0	0.0	15180.9	1.000	1.000	10390.0	206842.7	5.0	B31.3
13	-9861.9	218.2	-0.0	0.0	14727.8	1.000	1.000	10080.1	206842.7	4.9	B31.3
14	-9861.9	183.8	0.0	0.0	14678.7	1.000	1.000	10045.7	206842.7	4.9	B31.3

Nod e	Axial Stress KPa	Bendin g Stress KPa	Torsio n Stress KPa	Hoop Stress KPa	Max Stress Intensit y KPa	SIF/Inde x In Plane	SIF/Inde x Out Plane	Code Stress KPa	Allowabl e Stress KPa	Rati o %	Pipin g Code
14	-9861.9	183.8	0.0	0.0	14678.7	1.000	1.000	10045.7	206842.7	4.9	B31.3
15	-9861.9	355.8	-0.0	0.0	14924.6	1.000	1.000	10217.7	206842.7	4.9	B31.3
15	-174.9	355.8	0.0	0.0	764.4	1.000	1.000	530.7	206842.7	0.3	B31.3
20	-174.9	3221.0	0.0	0.0	4861.8	1.000	1.000	3395.8	206842.7	1.6	B31.3
20	-174.9	7695.8	0.0	0.0	11261.0	2.478	2.065	7870.7	206842.7	3.8	B31.3
29	-168.6	7384.0	-581.8	0.0	10868.5	2.478	2.065	7641.7	206842.7	3.7	B31.3
29	-168.6	7384.0	581.8	0.0	10868.5	2.478	2.065	7641.7	206842.7	3.7	B31.3
30	-63.6	5376.7	-892.3	0.0	7983.9	2.478	2.065	5725.5	206842.7	2.8	B31.3
30	-63.6	2173.5	892.3	0.0	3665.0	1.000	1.000	2861.7	206842.7	1.4	B31.3
40	-63.6	2163.4	-892.3	0.0	3652.4	1.000	1.000	2853.8	206842.7	1.4	B31.3
40	-63.6	2163.4	892.3	0.0	3652.4	1.000	1.000	2853.8	206842.7	1.4	B31.3
50	-63.6	2544.5	-892.3	0.0	4136.5	1.000	1.000	3160.2	206842.7	1.5	B31.3
50	-63.6	5520.0	892.3	0.0	8183.8	2.478	2.065	5861.9	206842.7	2.8	B31.3
59	-73.1	3863.8	-1570.7	0.0	6449.0	2.478	2.065	5036.6	206842.7	2.4	B31.3
59	-73.1	3863.8	1570.7	0.0	6449.0	2.478	2.065	5036.6	206842.7	2.4	B31.3
60	-39.7	3106.0	-1634.9	0.0	5562.4	2.478	2.065	4537.3	206842.7	2.2	B31.3
60	-39.7	1318.4	1634.9	0.0	3803.8	1.000	1.000	3540.7	206842.7	1.7	B31.3
70	-39.7	1309.4	-1634.9	0.0	3797.2	1.000	1.000	3537.2	206842.7	1.7	B31.3
70	-39.7	1309.4	1634.9	0.0	3797.2	1.000	1.000	3537.2	206842.7	1.7	B31.3

Nod e	Axial Stress KPa	Bendin g Stress KPa	Torsio n Stress KPa	Hoop Stress KPa	Max Stress Intensit y KPa	SIF/Inde x In Plane	SIF/Inde x Out Plane	Code Stress KPa	Allowabl e Stress KPa	Rati o %	Pipin g Code
80	-39.7	1272.1	-1634.9	0.0	3770.4	1.000	1.000	3523.2	206842.7	1.7	B31.3
80	-39.7	3109.3	1634.9	0.0	5566.2	2.478	2.065	4539.6	206842.7	2.2	B31.3
89	-151.7	6676.8	-1077.4	0.0	10004.7	2.478	2.065	7160.4	206842.7	3.5	B31.3
89	-151.7	6676.8	1077.4	0.0	10004.7	2.478	2.065	7160.4	206842.7	3.5	B31.3
90	-174.9	7791.6	0.0	0.0	11398.0	2.478	2.065	7966.5	206842.7	3.9	B31.3
90	-174.9	3526.5	0.0	0.0	5298.7	1.000	1.000	3701.4	206842.7	1.8	B31.3
100	-174.9	3522.0	-0.0	0.0	5292.3	1.000	1.000	3696.9	206842.7	1.8	B31.3
100	-174.9	3522.0	0.0	0.0	5292.3	1.000	1.000	3696.9	206842.7	1.8	B31.3
110	-174.9	2032.1	-0.0	0.0	3161.6	1.000	1.000	2207.0	206842.7	1.1	B31.3
110	0.0	0.0	0.0	0.0	0.0	0.000	0.000	0.0	0.0	0.0	B31.3
120	0.0	0.0	0.0	0.0	0.0	0.000	0.000	0.0	0.0	0.0	B31.3
120	-174.9	1095.0	0.0	0.0	1821.5	1.000	1.000	1269.9	280674.5	0.5	B31.3
121	-174.9	1798.8	0.0	0.0	2828.0	1.000	1.000	1973.7	206842.7	1.0	B31.3
121	-11082.9	1798.8	0.0	0.0	18773.1	1.000	1.000	12881.8	206842.7	6.2	B31.3
122	-11082.9	560.8	0.0	0.0	17002.7	1.000	1.000	11643.7	206842.7	5.6	B31.3
122	-11082.9	560.8	0.0	0.0	17002.7	1.000	1.000	11643.7	206842.7	5.6	B31.3
123	-11082.9	549.0	0.0	0.0	16985.7	1.000	1.000	11631.9	237517.8	4.9	B31.3
123	-	549.0	0.0	0.0	21252.0	1.000	1.000	14550.	235378.5	6.2	B31.3

Node	Axial Stress KPa	Bending Stress KPa	Torsion Stress KPa	Hoop Stress KPa	Max Stress Intensity KPa	SIF/Index In Plane	SIF/Index Out Plane	Code Stress KPa	Allowable Stress KPa	Ratio %	Piping Code
	14001.5							5			
124	-14001.5	136.0	0.0	0.0	20661.4	1.000	1.000	14137.5	218542.0	6.5	B31.3
124	-13723.3	136.0	0.0	0.0	20254.7	1.000	1.000	13859.2	217244.6	6.4	B31.3
125	-13723.3	38.5	0.0	0.0	20115.3	1.000	1.000	13761.8	239739.3	5.7	B31.3
125	-10172.2	38.5	0.0	0.0	14924.5	1.000	1.000	10210.8	238782.5	4.3	B31.3
126	-10172.2	29.0	0.0	0.0	14910.9	1.000	1.000	10201.2	309272.0	3.3	B31.3
126	-8897.6	29.0	0.0	0.0	13047.7	1.000	1.000	8926.6	309110.5	2.9	B31.3
127	-8897.6	0.0	0.0	0.0	13006.3	1.000	1.000	8897.6	206842.7	4.3	B31.3
127	0.0	0.0	0.0	0.0	0.0	1.000	1.000	0.0	206842.7	0.0	B31.3
130	0.0	0.0	0.0	0.0	0.0	1.000	1.000	0.0	323761.3	0.0	B31.3

4- Displacement Report in XYZ Direction

Node	DX mm.	DY mm.	DZ mm.	RX deg.	RY deg.	RZ deg.
10	0.722	-36.983	0.054	-1.9867	-0.0013	-0.9785
11	0.409	-0.000	-0.003	-1.9867	-0.0013	-0.4411
12	0.202	-0.000	0.025	-1.9867	0.0049	0.1786
13	0.039	-0.000	-0.028	-1.9867	-0.0214	-0.3227
14	-0.113	23.282	-2.000	-1.9867	-0.0607	-0.4899
15	-0.265	-0.000	0.351	-1.9867	0.3083	2.4175
20	-0.491	-169.464	24.261	-1.9867	0.6497	4.1516
29	-6.546	-185.559	23.250	-2.0240	0.5555	2.4593
30	-13.258	-189.070	14.528	-2.1348	0.4856	0.4869
40	-13.290	-189.070	14.386	-2.1350	0.4852	0.4837
50	-10.498	-189.011	-47.647	-2.3879	0.3225	-0.5650
59	-5.843	-194.461	-60.288	-3.0167	0.0062	-1.4808
60	-1.728	-210.068	-66.585	-3.5465	-0.2804	-1.7938
70	-1.708	-210.305	-66.586	-3.5472	-0.2804	-1.7957
80	1.605	-254.878	-66.661	-3.6197	-0.2149	-2.1475
89	1.636	-267.192	-66.528	-3.4173	0.2568	-2.4268

Node	DX mm.	DY mm.	DZ mm.	RX deg.	RY deg.	RZ deg.
90	0.766	-260.425	-64.029	-3.1713	0.7744	-3.2207
100	0.766	-260.210	-63.977	-3.1713	0.7752	-3.2223
110	0.650	-183.286	-44.487	-3.1713	0.9353	-3.6740
120	0.551	-131.741	-31.371	-3.1713	0.9349	-3.6779
121	0.329	-0.000	-0.414	-3.1713	0.3743	-1.7456
122	0.196	14.474	2.000	-3.1713	-0.0757	0.3665
123	0.064	-0.000	0.015	-3.1713	-0.0181	0.1752
124	-0.051	-0.000	-0.018	-3.1713	0.0042	-0.0489
125	-0.180	-0.000	0.003	-3.1713	-0.0007	0.0345
126	-0.358	-0.000	-0.002	-3.1713	0.0001	-0.0988
127	-0.556	-0.000	0.000	-3.1713	0.0000	0.3890
130	-0.864	-33.486	0.001	-3.1713	0.0000	0.9034

7 Conclusion

After doing the analysis it can be conclude that the design and structure both are appropriate to withstand the forces and stress when they are submerged into the water.

8 Acknowledgement

I am thankful to Mr Nirav Parikh, Head of Project Gaud, Parul Intitution of Technology, Limda

9 Reference

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