Parkson
Treating Water Right

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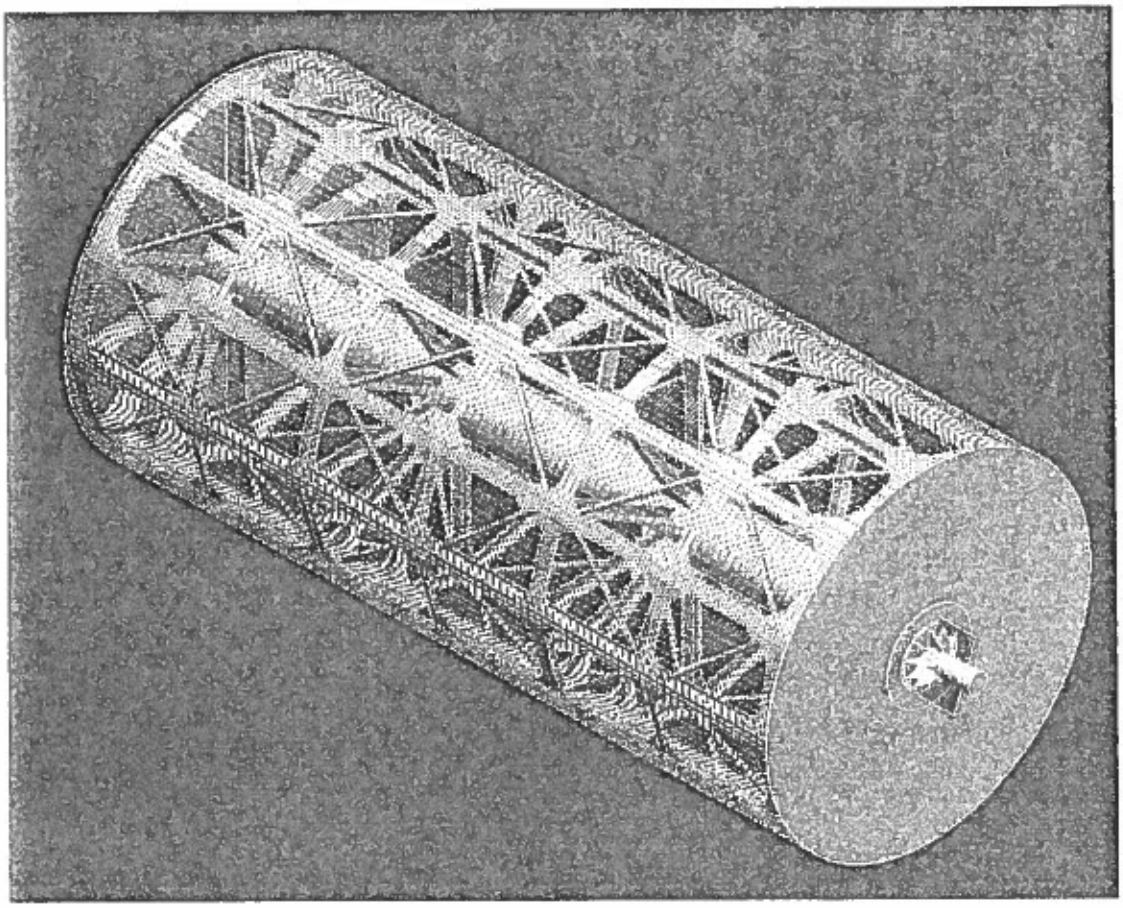
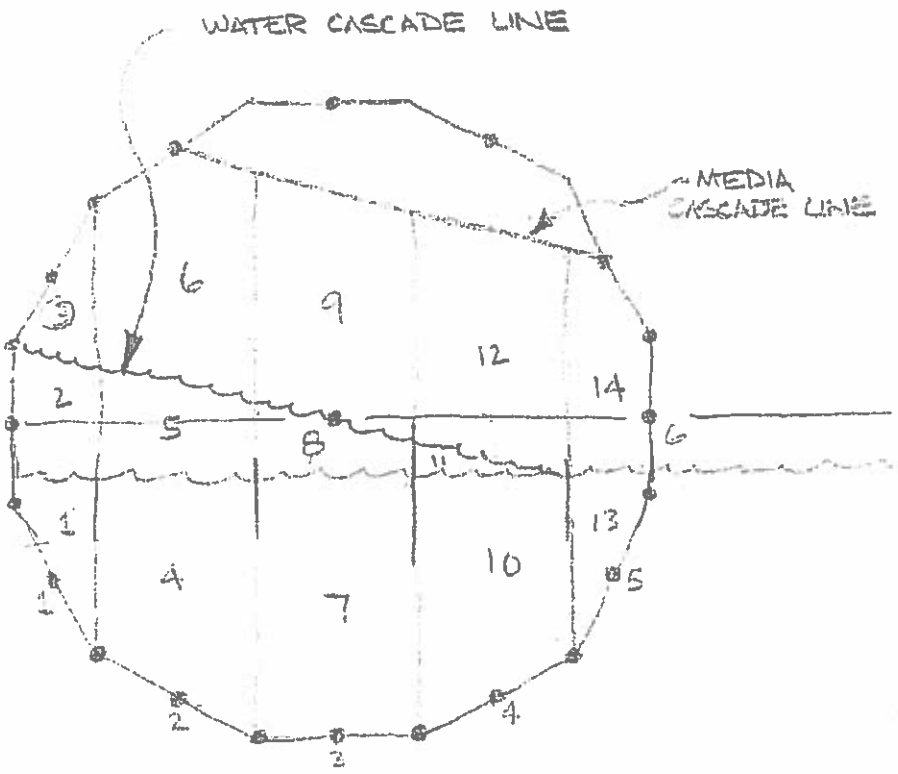
Geo Reactor Calculations

BOM:

DESCRIPTION	MATERIAL	QUANTITY	WEIGHT (LBS)
SHAFT PIPE	A53	1	5140
STUB DE	C1018	1	591
STUB NDE	C1018	1	477
RING	1020	4	590
GUSSET	A36	20	50
BEAM	A36	12	3084
PLATE END	A36	2	4114
STIFFENER END	A36	24	1104
STIFF TOP END	A36	24	744
STIFF TOP INTER	A36	24	792
FLAT BAR	A36	24	482
STIFF CENTER	A36	24	1200
FLAT BAR	A36	24	680
ANGLE	A36	36	522
TIANGULAR B.	A36	144	360
PIPE	A53	72	1530
WIRE MESH	304	1	1000
		TOTAL	21990



Density of Water: 0.0361 lbs/in^3
Density of media (empty): 0.0325 lbs/in^3



Area	1	1220.80	1263.53	in^2
Area	2	854.60	884.51	in^2
Area	3	327.10	338.55	in^2
Area	4	3558.80	3683.36	in^2
Area	5	2150.50	2225.77	in^2
Area	6	1444.30	1494.85	in^2
Area	7	4229.10	4377.12	in^2
Area	8	2275.80	2355.45	in^2
Area	9	1787.40	1849.96	in^2
Area	10	3095.90	3204.26	in^2
Area	11	1687.60	1746.67	in^2
Area	12	1548.00	1602.18	in^2
Area	13	1160.90	1201.53	in^2
Area	14	794.70	822.51	in^2
Area	15	1384.40	1432.85	in^2

Load of empty Media on stringers:
Assuming 90% filled with media.

Stringer Load (Media)	1	3289.85	lbs
Stringer Load (Media)	2	14526.21	lbs
Stringer Load (Media)	3	17976.98	lbs
Stringer Load (Media)	4	15569.18	lbs
Stringer Load (Media)	5	7992.78	lbs

Load of Water on stringers:
Assuming 1828056 in3 of water

Stringer Load (Water)	1	9547.32	lbs
Stringer Load (Water)	2	24024.71	lbs
Stringer Load (Water)	3	25424.52	lbs
Stringer Load (Water)	4	18853.34	lbs
Stringer Load (Water)	5	0.00	lbs

Total Load on stringers:

Stringer Total Load	1	12837.17	lbs
Stringer Total Load	2	38550.92	lbs
Stringer Total Load	3	43401.50	lbs
Stringer Total Load	4	34422.52	lbs
Stringer Total Load	5	7992.78	lbs

Arm Lengths:

Arm Length of Stringer 1 & 4	54.951	in
Arm Length of Stringer 2 & 5	34.563	in

Torque Needed:

Stringer Torque	1	705,415.24	in-lbs
Stringer Torque	2	1,332,435.50	in-lbs
Stringer Torque	3	-	in-lbs
Stringer Torque	4	(1,189,745.64)	in-lbs
Stringer Torque	5	(439,211.51)	in-lbs
Total Torque Needed		408,894	in-lbs
Bracket Force	Compression	11,518	in-lbs

Geo Welding Criteria

- All welds will be per latest American Welding Society standards
- All fillet welds will be 1/4"
- All fillet welds of plate to shaft tube will be fully welded
- All fillet welds of plate to bulkhead will be stitch welded 3 on 6
- All butt welds will be 1/4" beveled one side and fully welded for attachment of plate to beam on top side and fillet weld on bottom side
- All butt welds of plate to plate will be 1/4" beveled on each plate on both sides
- Stub shaft assemblies will be shrink fit and fully welded

Geo Wire Mesh attachment

- All materials will be 304
- Wire mesh will be attached to drum with straps fastened 3/8" fasteners
- Angle stiffener will be attached over wire mesh with 1/2" fasteners
- Wire mesh will be support by wire cables 1/4"dia 1x19 strands and tensioned with turnbuckles

Finite Element Analysis Results

In this section the material limits are compared against the FEA results. The yield stress of A-36 is 36 kpsi. Below are the stress levels for the stringers and shaft. The main purpose of this design was to move all the stresses away from the welds and perimeter of the structure and concentrate them on the strongest component of the structure. This component is the shaft. By doing this the reversing stresses are minimized and the structure exhibits a considerable amount of less warping.

The load applied to the shaft and stringers contain a 1.5 DLF. The weight of the complete structure was distributed along the shaft and the stubs constrained to have zero DOF. This adds an extra safety margin. The loads applied are as follows:

Shaft	133,973.01	lbs
Stringer	43401.50	lbs
Dynamic Load Factor	1.5	

The current plan is to place load cells being used in the Cape May unit to obtain empirical data. Once these values are obtained they will be used to refine the current FEA model and calculate stresses and strains on the structure.

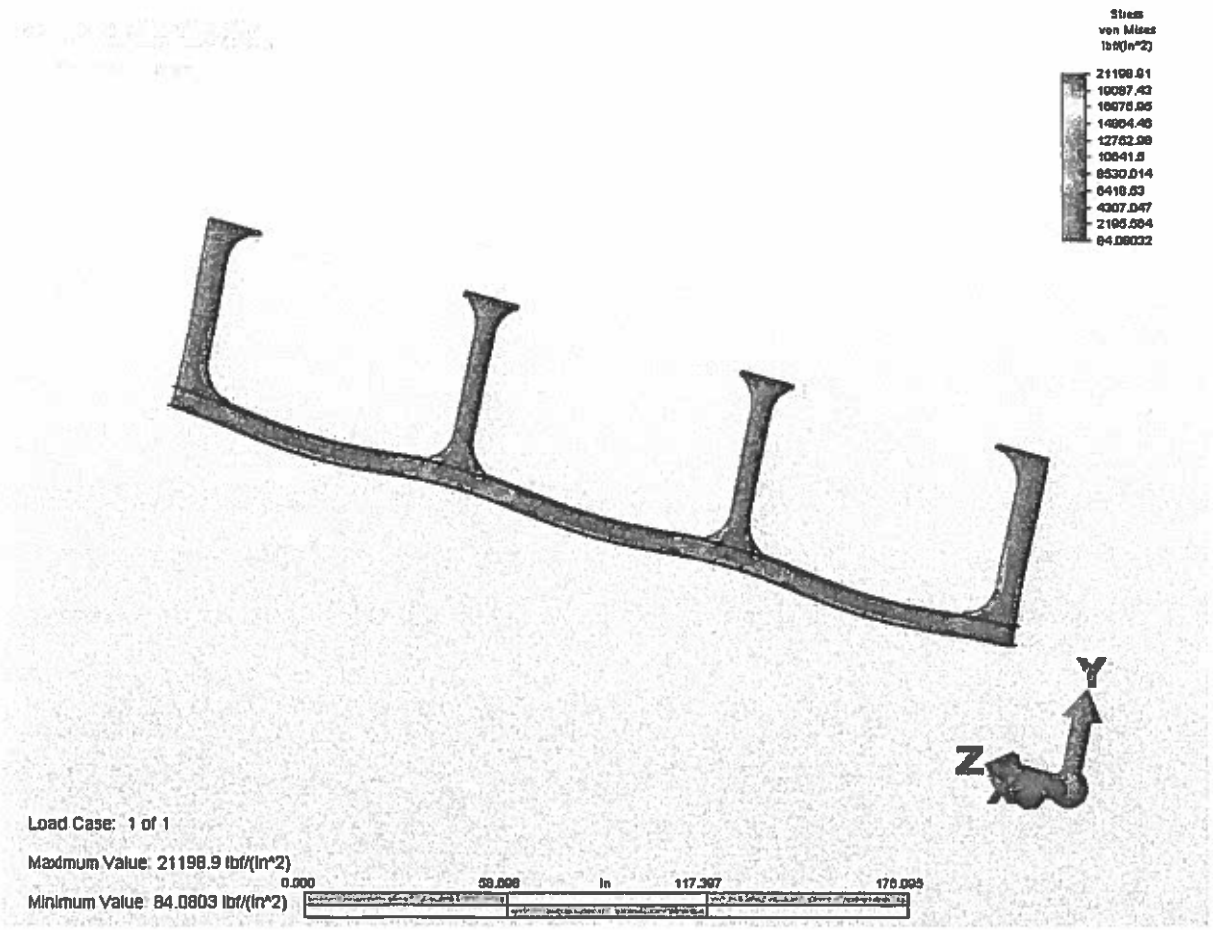
It is understood that adding more weight to the structure does not compensate for fatigue cracking. Currently we are unable to perform dynamic FEA, however, we have taken into account all the different factors that affect fatigue cracking when applying the loads and designing the unit. These factors are cyclic stress state, geometry, surface quality, material type, residual stresses, size and distribution of internal defects, direction of loading and environment. Also, critical welding locations must be inspected and prepared.

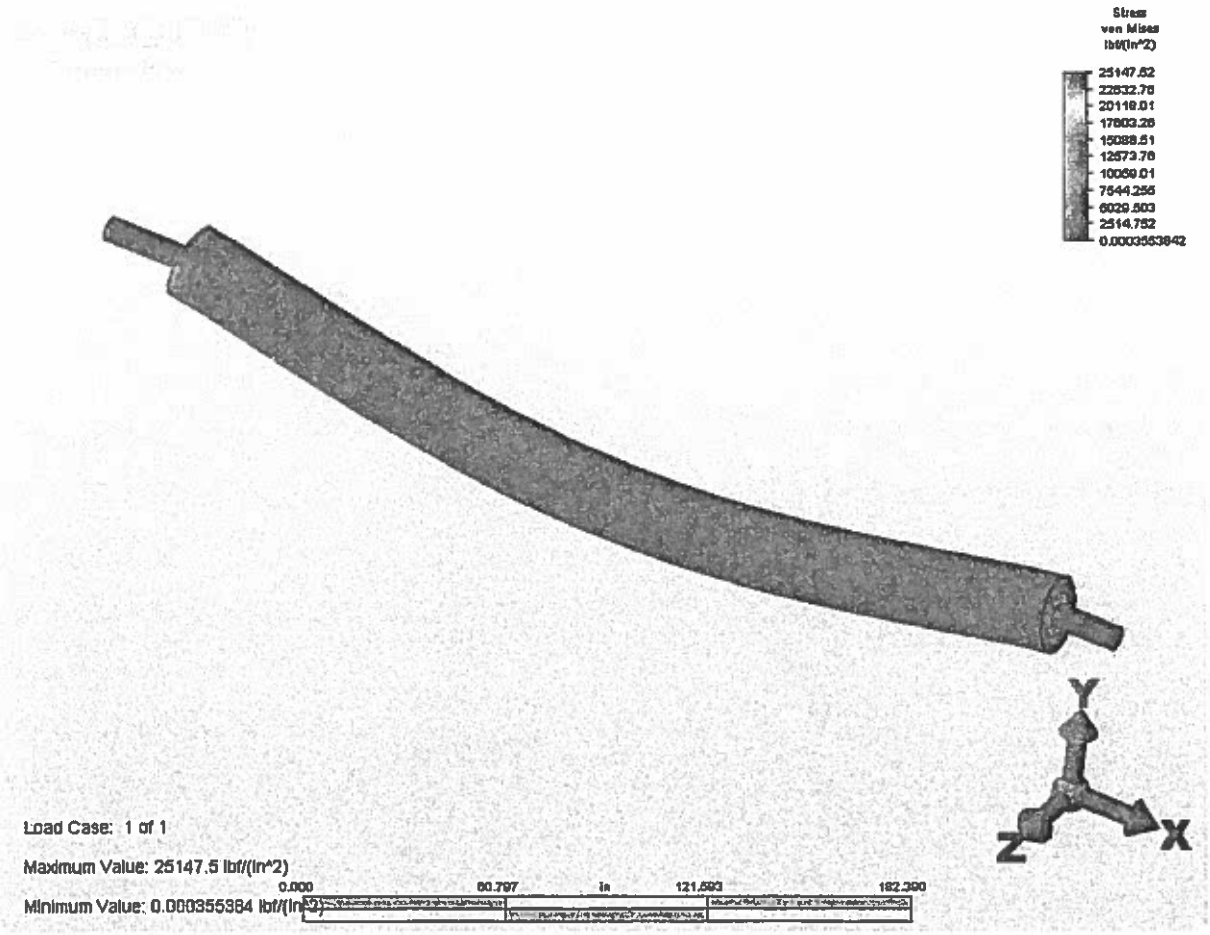
It is recommended that surfaces at critical welding locations be prepared for welding by grooving so that a multi-pass full penetration weld can be achieved. We are using ductile metals such as A-36, which have a large transition fatigue life. This correlates with crack initiation inversely, in other words, a large transition fatigue life results in low crack initiation. All of this will be investigated in more detail once empirical data is obtained from Cape May.

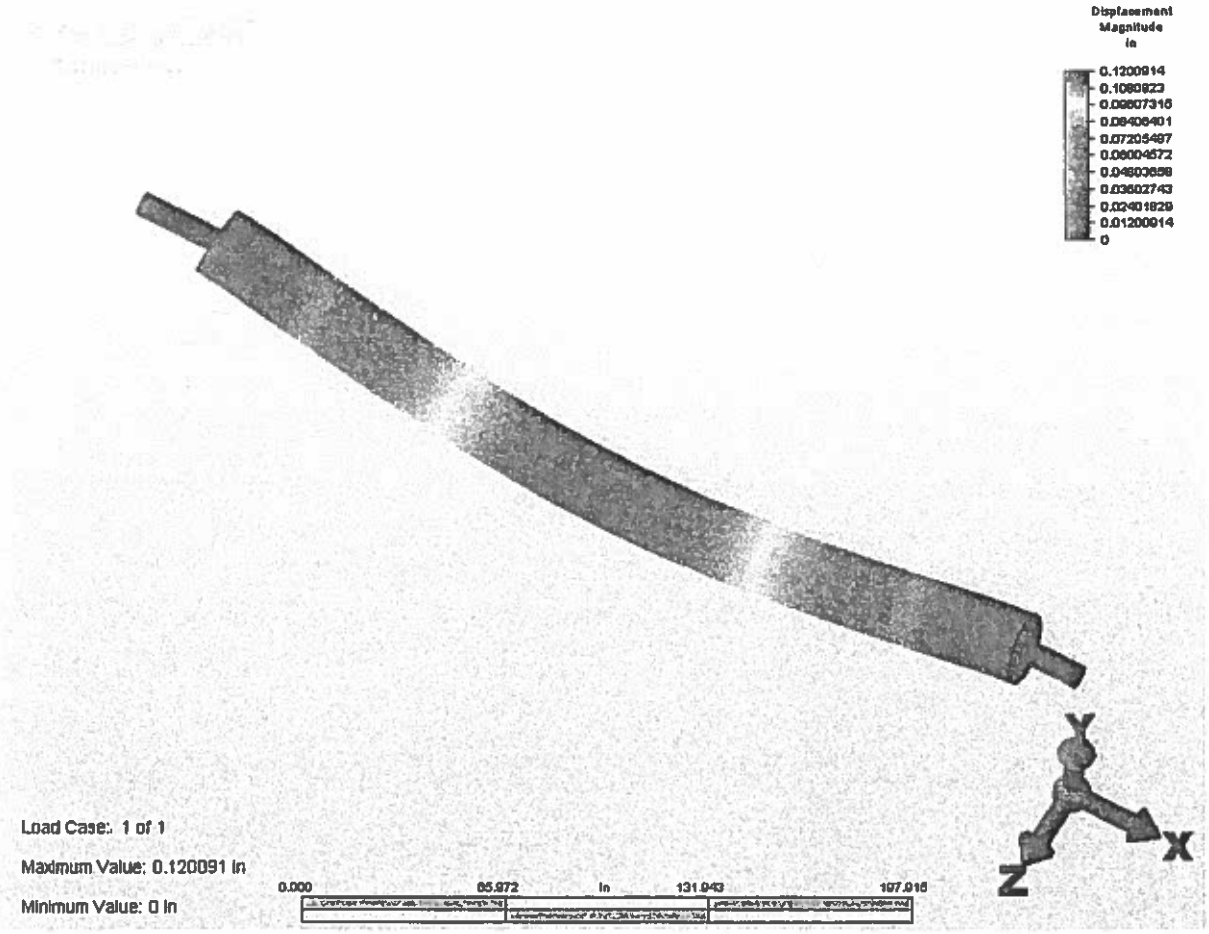
Results

Stringer	Maximum Displacement	Maximum Stress	A-36 Maximum Yield Stress	A-53 Maximum Yield Stress
Worst case	0.07 in	15000 lbs-in^2	36000 lbs-in^2	35000 lbs-in2
Best Case	0 in	84 lbs-in^2		

Shaft	Maximum Displacement	Maximum Stress	A-36 Maximum Yield Stress	A-53 Maximum Yield Stress
Worst case	.1 in	25000 lbs-in^2	36000 lbs-in^2	35000 lbs-in2
Best Case	0 in	2000 lbs-in^2		


Stress
von Mises
lbf/(in^2)
21198.91
19087.43
16975.95
14864.46
12752.98
10641.5
8530.014
6418.53
4307.047
2195.564
84.08032
Y
Z
Load Case: 1 of 1
Maximum Value: 21198.9 lbf/(in^2)
Minimum Value: 84.0803 lbf/(in^2)
0.000
58.698
in
117.397
176.095


Stress
von Mises
lbf/(in^2)
25147.52
22532.76
20118.01
17603.26
15088.51
12573.76
10059.01
7544.256
5029.503
2514.752
0.000355384
Y
Z
X
Load Case: 1 of 1
Maximum Value: 25147.5 lbf/(in^2)
Minimum Value: 0.000355384 lbf/(in^2)
0.000
60.797
in
121.593
182.390


Displacement
Magnitude
in
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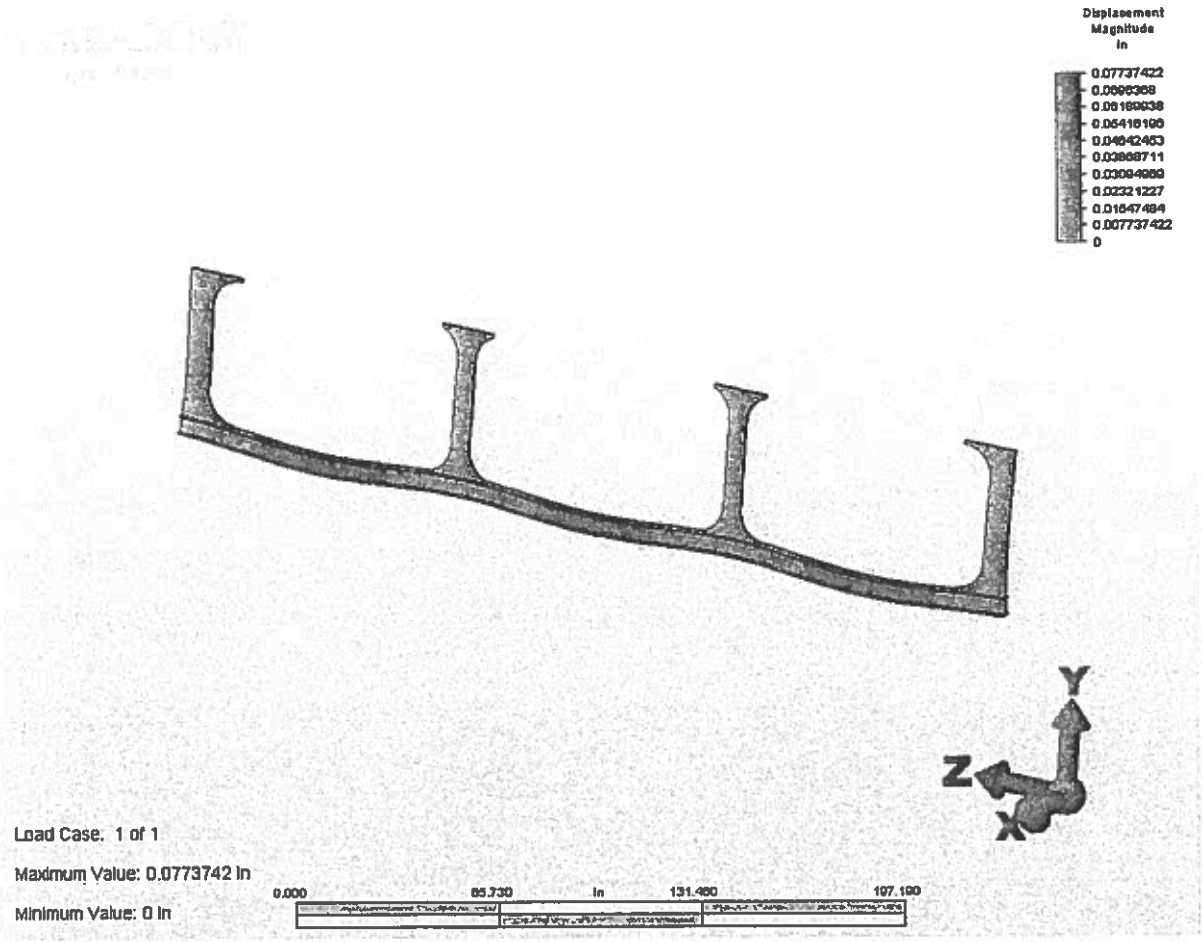
0.1080823
0.09607316
0.08406401
0.07205487
0.06004572
0.04803658
0.03602743
0.02401829
0.01200914
0
Load Case: 1 of 1
Maximum Value: 0.120091 in
Minimum Value: 0 in
0.000
65.972
in
131.943
197.916
Y
X
Z


Displacement
Magnitude
in
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0.0696368
0.06189936
0.05416190
0.04642453
0.03868711
0.03094966
0.02321227
0.01547484
0.007737422
0
Y
Z
X
Load Case: 1 of 1
Maximum Value: 0.0773742 in
Minimum Value: 0 in
0.000
65.730
in
131.460
197.190

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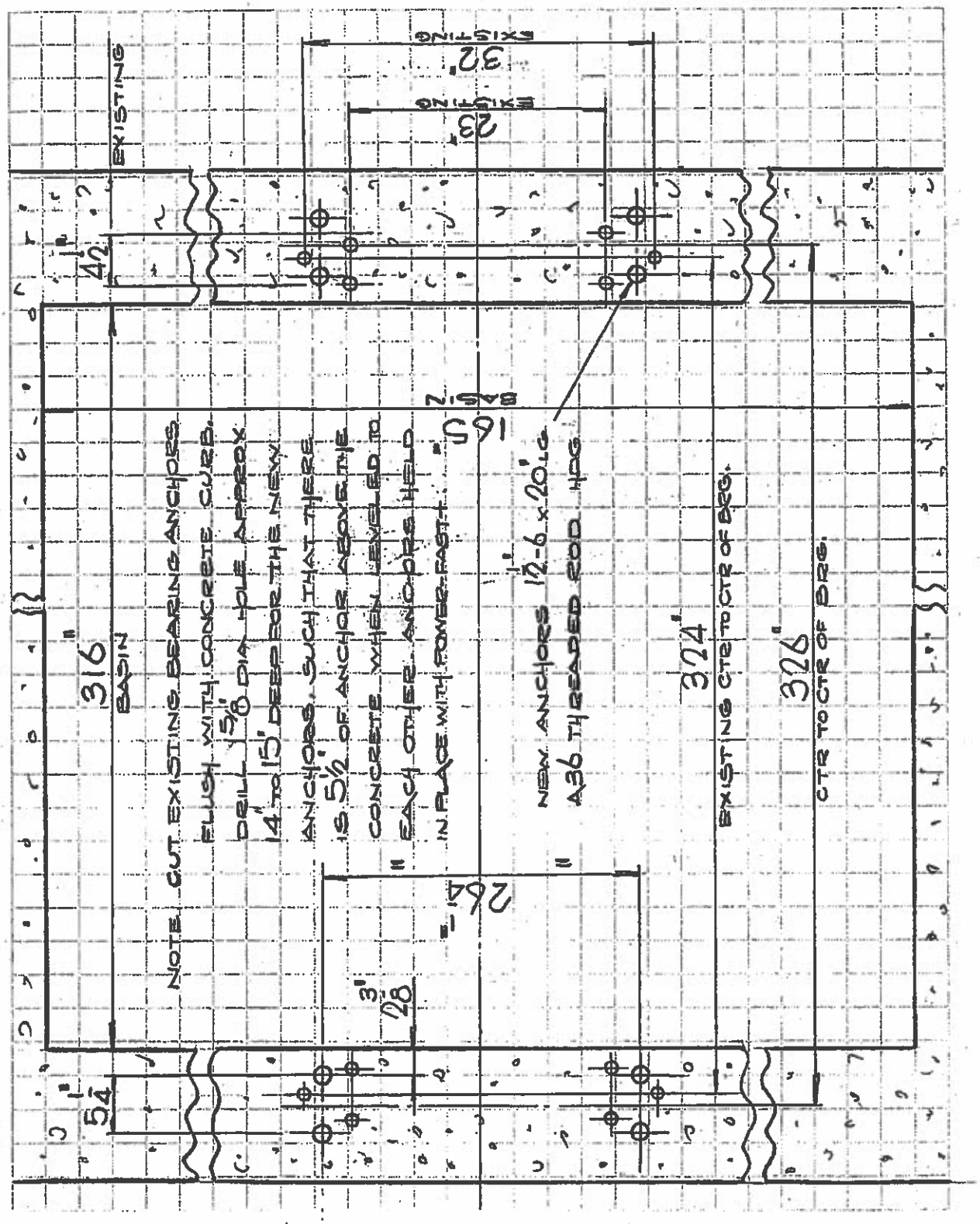
PROJECT: CAPE MAY GEO

DESCRIPTION: BEARING ANCHOR LOCAT'N

DATE: 2-19-09 REF: 1/2 - 1 BY: [signature] SHEET 1 OF 1



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PROJECT: CAPE MAY GEO

DESCRIPTION: DRUM SHAFT LAYOUT

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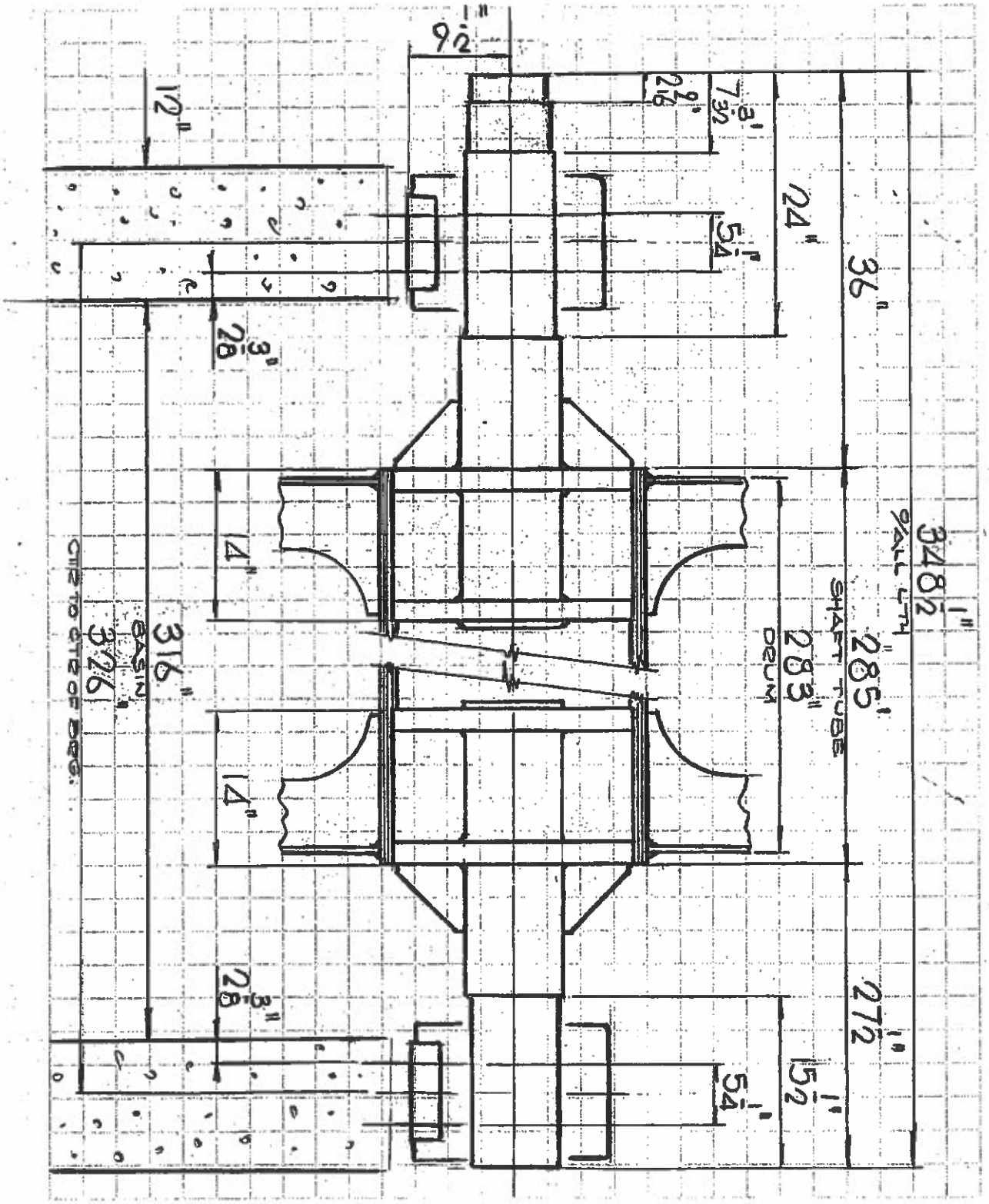

PARKSON CORPORATION

PROJECT: CAPE MAY

DESCRIPTION: GEO DRUM WELD CONN

DATE: 2·19·09 REF: 1:1 BY: [signature] SHEET 1 OF 1