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Derrick Load Testing

DERRICK LOAD TESTING

BACKGROUND

[0001] Derricks are used to move particularly large loads in setting such as shipyards, drilling rigs, etc. For example, derrick hoisting systems are used to lower into or lift out of wellbores drilling pipes. Derricks have to be tested regularly for their load capabilities, especially in view of the large size of the loads the derricks handle. In some cases, instead of actual load testing, engineering analysis may be performed to simulate a derrick load testing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] **FIGS. 1A-1D** show example schematic diagram illustrating systems and apparatus for derrick load testing, according to some embodiments.

[0003] **FIGS. 2A-2V** show example technical drawings illustrating components of systems and apparatus for derrick load testing, according to some embodiments.

DETAILED DESCRIPTION

[0004] Derrick load testing, where the capabilities of a derrick to support weight of large loads are tested, can be a complex or even impossible challenge in complicated environments such as drilling rigs or drill ships due to issues related to safety, cost, access, convenience, etc. For example, currently there are no practical solutions designed to load test a derrick on a drillship with conventional draw works, wireline hoisting equipment and wireline tensioners installed. In some cases, drillship derricks can be load tested on the ground after assembly but prior to installation on the ship by using an arrangement that includes a large capacity mobile crane, suitable foundations and rigging equipment. With a semi-submersible driller, and in contrast with drillships, a barge can be floated under the drill floor to perform load tests. These methods of derrick load testing, however, can be costly, complicated, time consuming and highly inefficient. In yet some cases, engineering analysis of the loading capabilities of derricks can be performed, in addition to or instead of, actual load testing. Engineering analysis, however, may not always accurately predict the loading capabilities of derricks, as derricks have been known to fail at load levels much less than the maximum load values calculated based on the analysis. As such, there is a need for a safe, efficient and transportable systems and apparatus configured for actual derrick load testing.

[0005] In some embodiments, the disclosed systems and apparatus reduce the afore-mentioned cost, time and complexity associated with derrick load tests while increasing safety and efficiency. For example, the disclosed systems and apparatus are configured to significantly reduce rig-up and rig-down time (e.g., by up to 75%, from about three to four days to less than a day, etc.). Further, the systems and apparatus may not necessitate, during derrick load testing, the removal of standard rig hoisting equipment such as but not limited to conventional draw works, wireline hoisting equipment, wireline tensioners, tensioning ring, etc., from drill sites, thereby reducing or eliminating the cost, complexity and safety issues attendant in removing such equipment. In addition, the need for additional or external support that can be used in existing derrick load testing systems such as water weights, load cells, special rigging equipment, etc., may also be reduced or eliminated. In some implementations, the systems and apparatus can be calibrated on shore before use on a rig or drillship, and the calibration can include verifying the accuracy of the driller's weight indicator, which can be a challenge in some derrick load test situations.

[0006] In some implementations, the disclosed systems and apparatus for derrick load testing allow the application of the full derrick hoisting load to proof load all or nearly all of the load path components. **FIGS. 1A-1D** show example schematic diagram illustrating such derrick load testing system 100, according to some embodiments. In some implementations, a drilling rig may include, among other things, a rotary table 110 at a drill floor 170 supported by rotary beams 160; the rotary table 110 is configured to provide rotational force to drill strings used in drilling wellbores at the drill site. The rig may also include a diverter housing 120 housing a diverter that is used to protect against shallow gas kicks during drilling operations. In some embodiments, the derrick load test system 100 includes the derrick load test apparatus 190 that includes the load frame 150 and multiple inserts 140 configured to mate with funnels 130 that are attached (e.g., permanently) to the diverter housing 120. That is, in some implementations, one or more (e.g., four) funnels 130 may be permanently attached or bolted to the diverter housing 120 and be configured to respectively receive the one or more (e.g., four) inserts 140 that are in turn coupled to the load frame 150 when the derrick load test apparatus 190 is pulled up into place during derrick load testing, as described below. **FIGS. 2C** and **2D** show additional example front view (**FIG. 2C**) and side view (**FIG. 2D**) technical drawings illustrating the mating of inserts 270 coupled to a load frame 280 with funnels 290 permanently attached to a diverter housing 205 during a derrick load testing. **FIG. 2G** shows an exploded view of the derrick load testing system 100 including a rotary table 220 at a drill floor 230. Further, funnels 240 attached to the diverter housing 250 of a diverter that is present at a drilling site are configured to receive inserts (not shown in **FIG. 2G**) coupled to the load frame 260. Example technical drawings illustrating various features of the funnels 240 are shown in **FIGS. 2J-2N**.

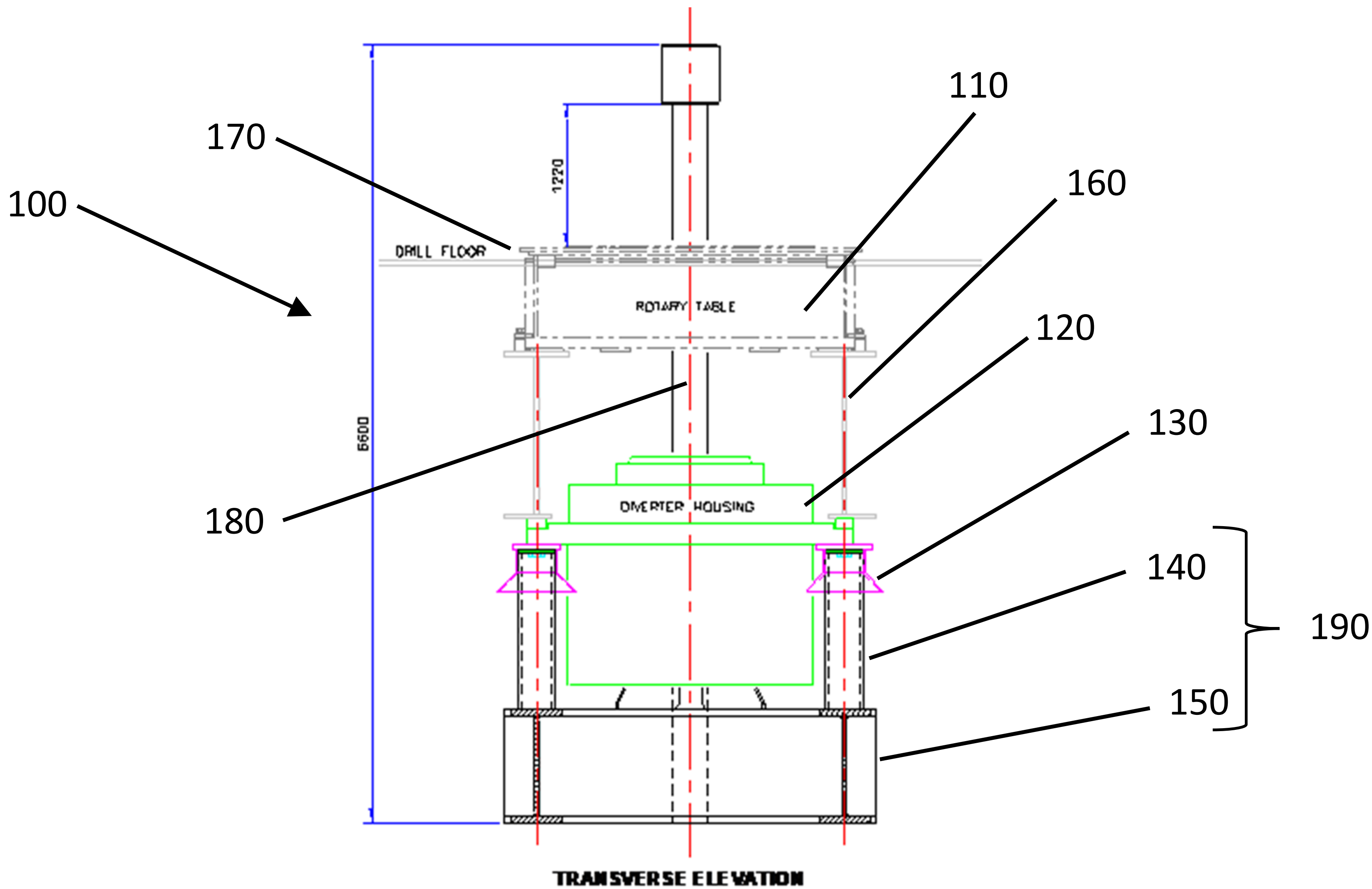
[0007] In some implementations, the derrick load test apparatus 190 may be configured to be transportable. That is, the derrick load test apparatus 190 may be configured such that it can be brought to the well center of a drilling site when needed to load test the derrick hoisting system of a drilling operation, and removed or transported away from the site when the load testing is complete.

[0008] In some implementations, a derrick load testing includes the process of a derrick (not shown) that includes a hoist 180 which in turn is coupled to the load frame 150 lifting up the load frame 150 and any load that is placed onto the load frame 150 towards the rotary table 110. During such derrick load testing, in some implementations, the tensioning ring (which is part of the tensioning system that is used to provide an upward force to a drilling riser during drilling operations) may be unlatched and lowered so that the tensioning ring may hang on the tensioner wires. That is, the tension ring and tensioner wire may not need to be removed during derrick load testing, saving time and cost by reducing complexity and inefficiency of the derrick load testing. Further, the derrick load test apparatus 190 which includes the load frame 150 may be positioned at the well center of the drill site such that a hoist 180 may be run through the rotary table 110 to be connected to and lift up the derrick load test apparatus 190 towards the rotary table 110. In some implementations, the derrick load test apparatus 190 may be designed or configured such that standard 9-5/8 inch casing slips used at drilling rigs can support the derrick load test apparatus 190. Once the derrick load test apparatus 190 is located at the well center, in some implementations, the hoist 180 may be latched onto the derrick load test apparatus 190 and the casing slips of the drill rig may open to allow the hoist 180 to lift the derrick load test apparatus 190 until the multiple inserts 140 of the derrick load test apparatus 190 mate fully with the respective funnels 130 that are permanently attached onto the diverter housing 120. In some implementations, the derrick load test apparatus 190 may include a lift cap or permanent lifting eye at the top to aid in the lifting up of the derrick load test apparatus 190 by the hoist 180. In some cases, a maximum pull level may be set on the draw works to prevent overloading. Once the multiple inserts 140 of the derrick load test apparatus 190 mate fully with the respective funnels 130, in some implementations, a desired load amount (e.g., up to 1500 ton) may be loaded onto the load frame 150 to perform the derrick load testing.

[0009] **FIGS. 1B** and **1C** show example schematic illustration of a side view (**FIG. 1B**) and top view (**FIG. 1C**) of the derrick load test apparatus 190 isolated or separate from the rest of the derrick load testing systems 100. As discussed above, the derrick load test apparatus 190 includes the load frame 105 and the multiple inserts 115. In some implementations, the load frame 105 and the multiple inserts 115 may be fabricated with standard 9-5/8 inch casing, which can be beneficial as that allows the use of standard bolts, inserts, etc., in coupling the hoist 180 to the derrick load test apparatus 190 to lift the derrick load test apparatus 190. In some implementations, the load frame 105 may be coupled to the hollow bar 125 (e.g., through which the hoist 180 traverses to connect to the load frame 105) via welding. In some implementations, instead of or in addition to welding, a clamp 210 (shown in **FIGS. 2E** and **2F**) may be used to couple the load frame 105 to the hollow bar 125. Example technical drawings illustrating various features of the clamp 210 are shown in **FIGS. 2O-2T**.

[0010] **FIG. 1C** shows an example schematic illustration of top view of the derrick load test apparatus 190 that includes four inserts 115 that are configured to respectively mate with four funnels 130 bolted to the diverter housing 140. It is to be noted that the number of inserts as shown in **FIG. 1C** is for illustration purposes and is non-limiting, i.e., the derrick load test apparatus 190 can have any practical number of inserts (e.g., two, three, five, six, seven, eight, nine, ten, etc.). The funnels 130 are bolted to the diverter housing 140 upside down where the funnel plates 135 are in contact with the surface of the diverter housing 120. For example, holes may be bored in the funnel plates 135 such that these holes may line up with holes that exist on the diverter housing 120 when the funnels 130 (and hence the funnel plates 135) are bolted or attached to the diverter housing 120. **FIGS. 2A-2V** show additional example technical drawings illustrating components of systems and apparatus for derrick load testing, according to some embodiments.

[0011] In some implementations, the use of the funnels 130 and the inserts 115 to couple the load frame 105 to the diverter housing 140 is advantageous in that this configuration removes the risk of damage to the bottom of the diverter housing 120 if one were to pull the load frame 105 up against the bottom of the diverter housing 120. Further, the configuration facilitates the application of the load in the load frame 105 directly to the main rotary beams 160 to which the diverter housing 120 is coupled, and the rotary beams 160 can be designed or configured to support a desired weight or load (e.g., up to 1500 ton). In addition, the funnels 130 may be left in place once attached to the diverter housing 120 (i.e., even when there is no derrick load testing such as during a drilling operation), which reduces the time and effort that goes into preparing a derrick hoisting system for a subsequent derrick load test.



110
170
100
160
120
130
140
150
190
180
1220
5600
DRILL FLOOR
ROTARY TABLE
DIVERTER HOUSING
TRANSVERSE ELEVATION

FIG. 1A

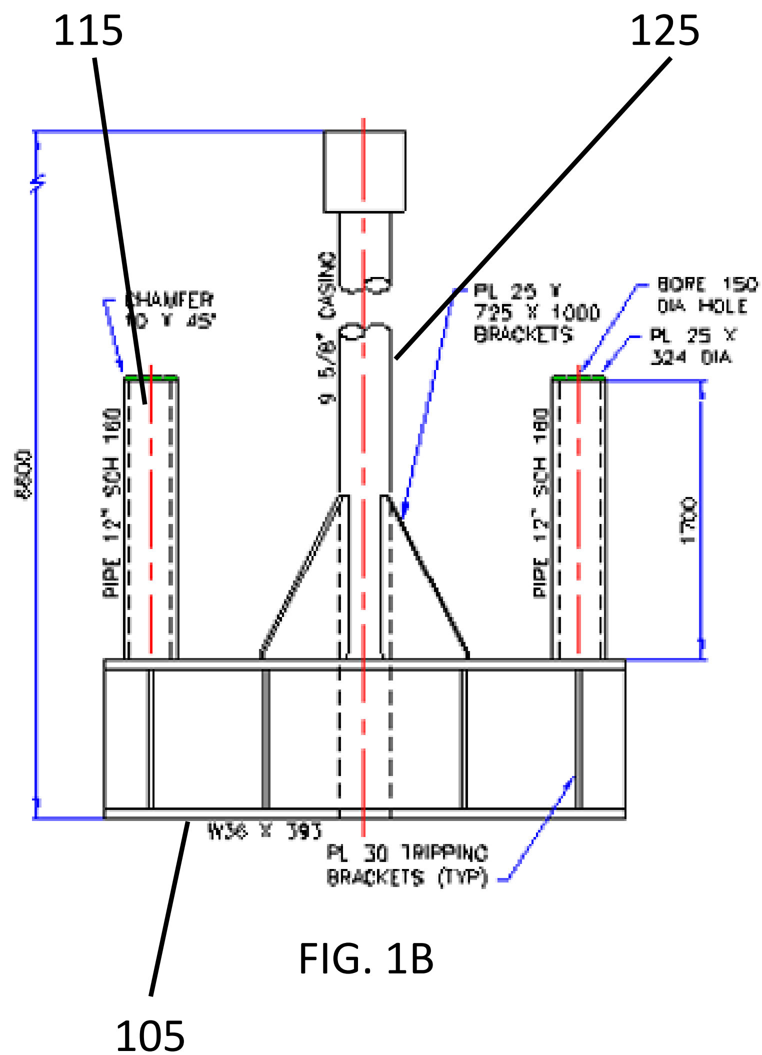


FIG. 1B

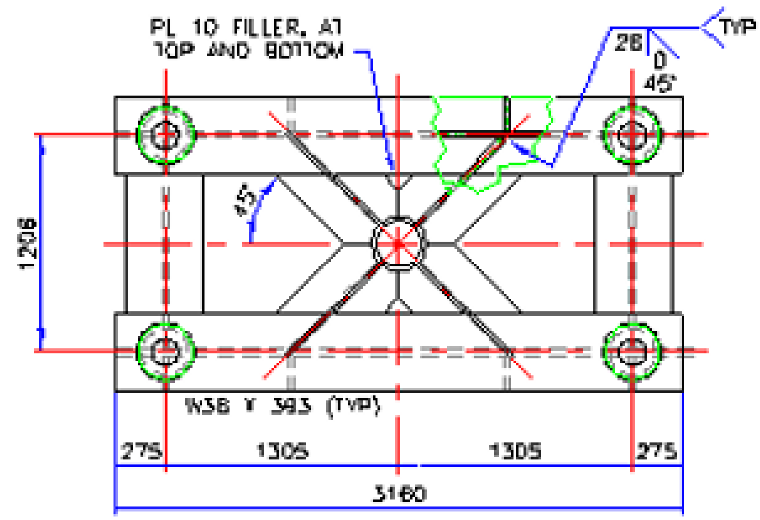


FIG. 1C

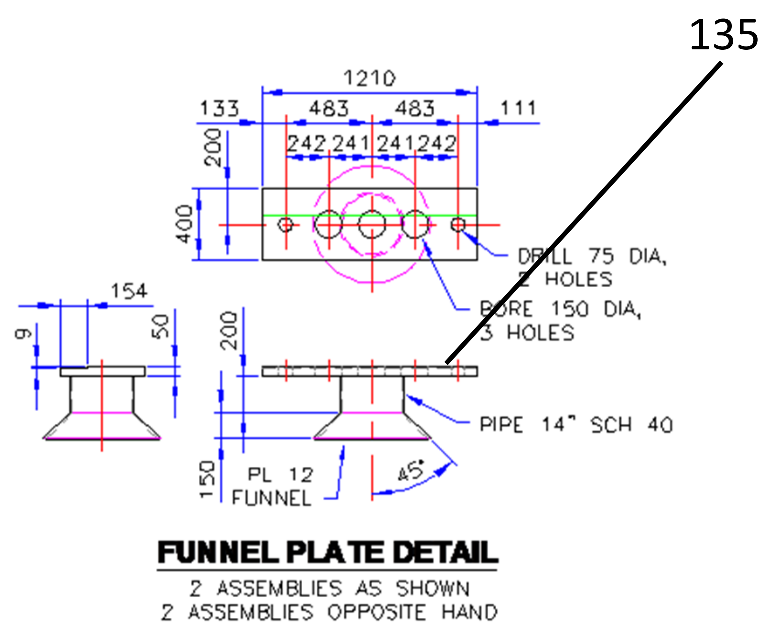
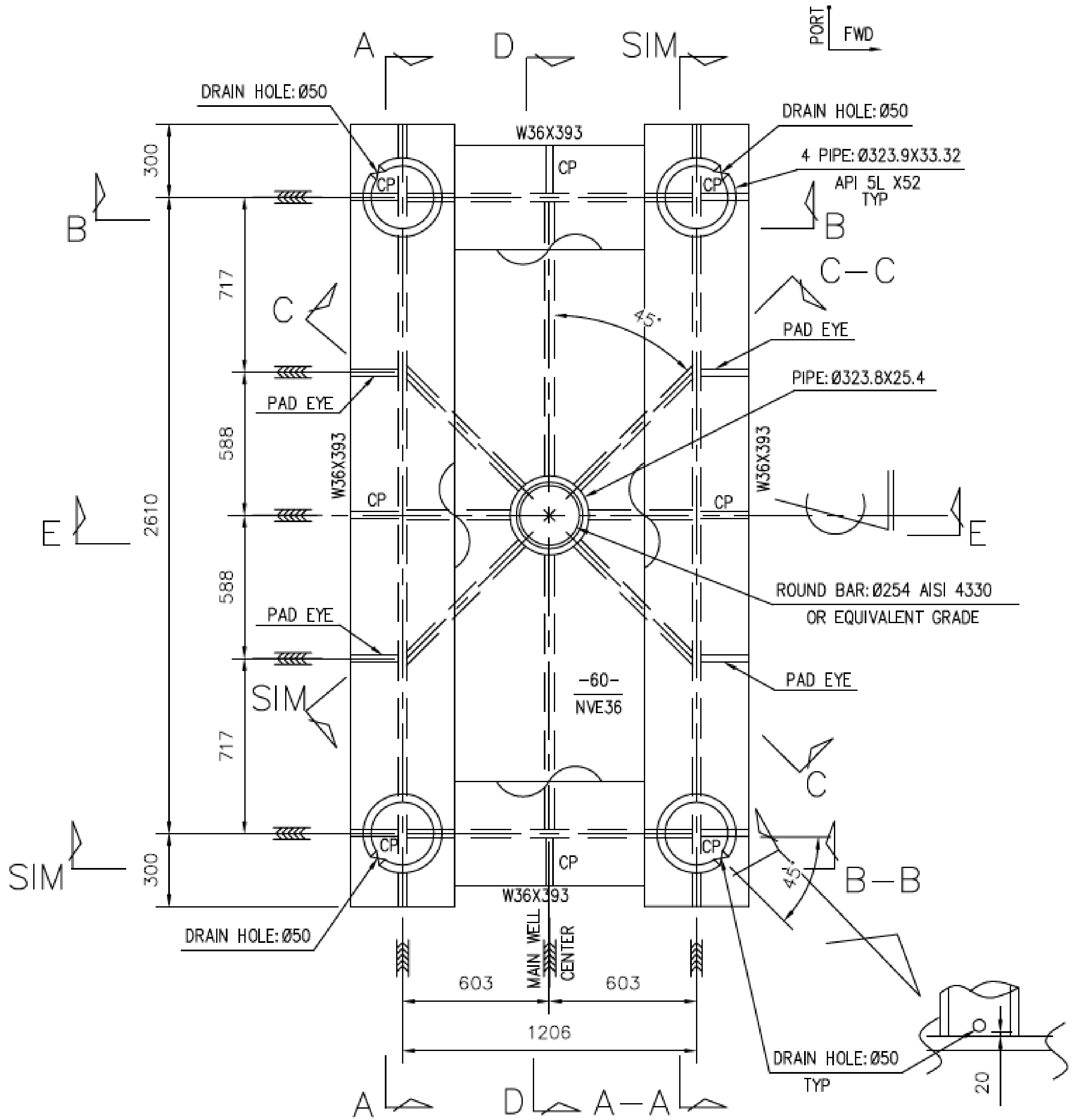
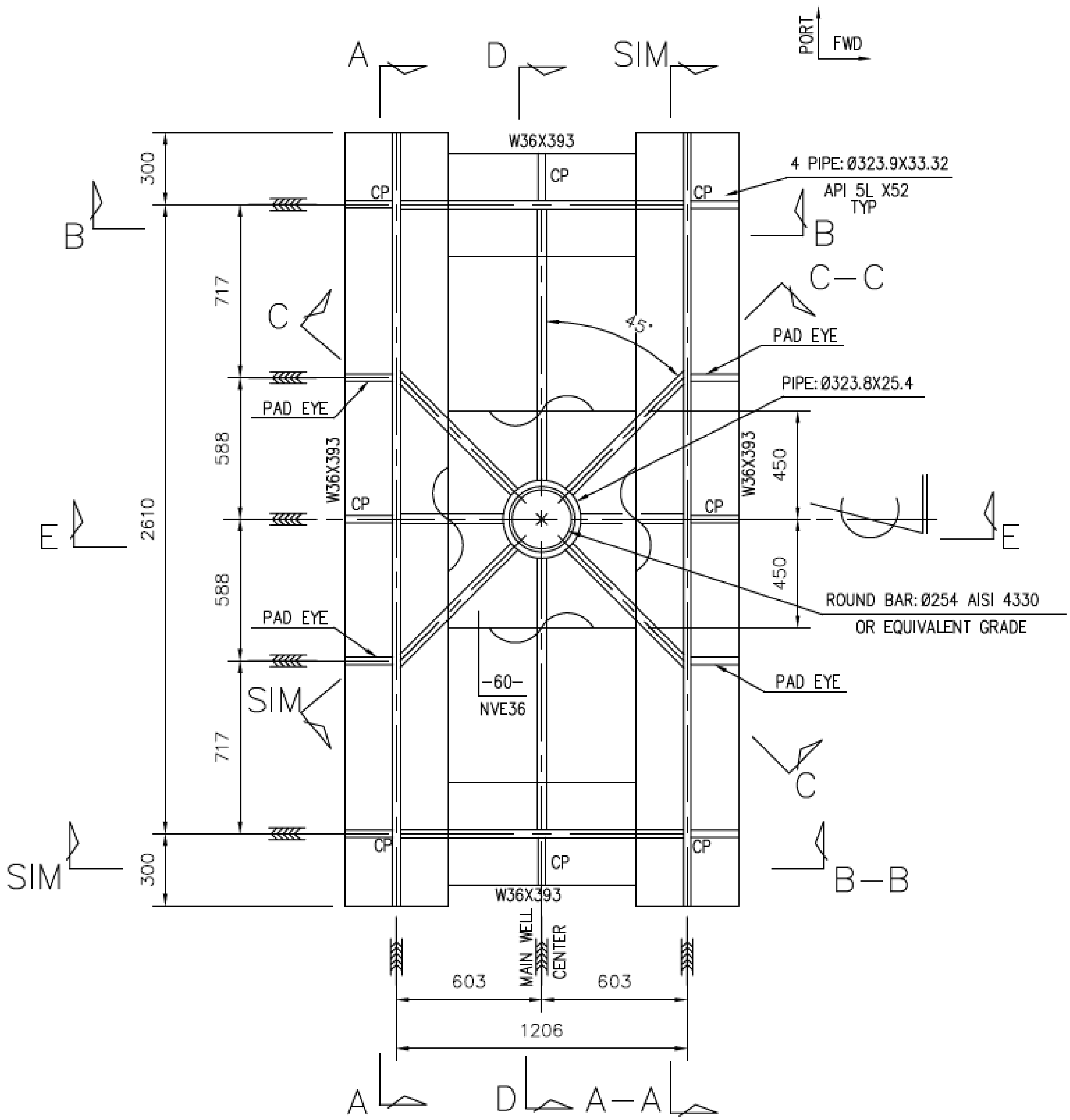


FIG. 1D



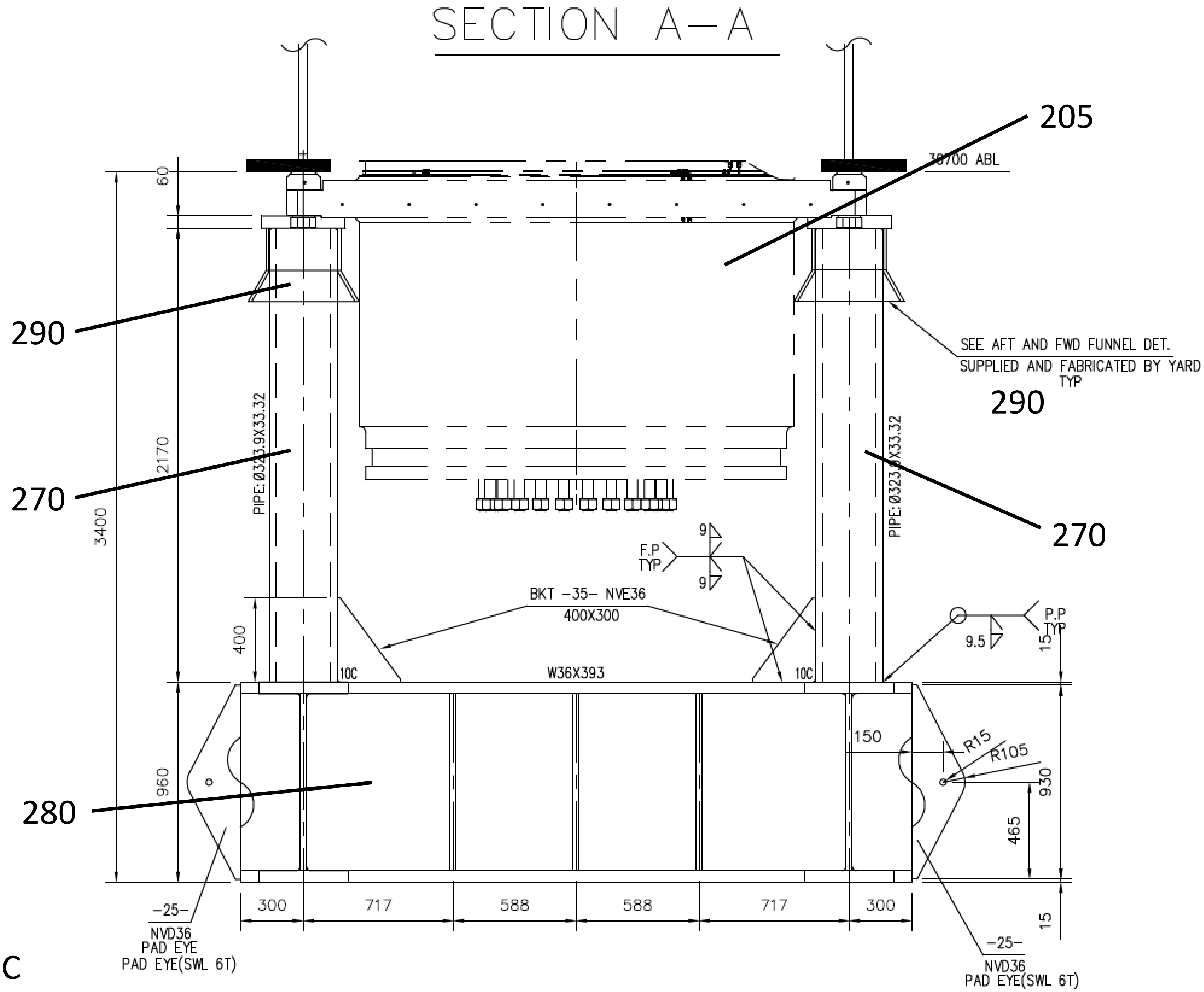
PORT
FWD
A
D
SIM
DRAIN HOLE:Ø50
W36X393
DRAIN HOLE:Ø50
4 PIPE:Ø323.9X33.32
API 5L X52
TYP
CP
B
C–C
C
717
300
PAD EYE
PIPE:Ø323.8X25.4
588
2610
E
W36X393
ROUND BAR:Ø254 AISI 4330
OR EQUIVALENT GRADE
-60-
NVE36
SIM
45°
B–B
MAIN WELL
CENTER
603
1206
DRAIN HOLE:Ø50
TYP
20
A–A

FIG. 2A



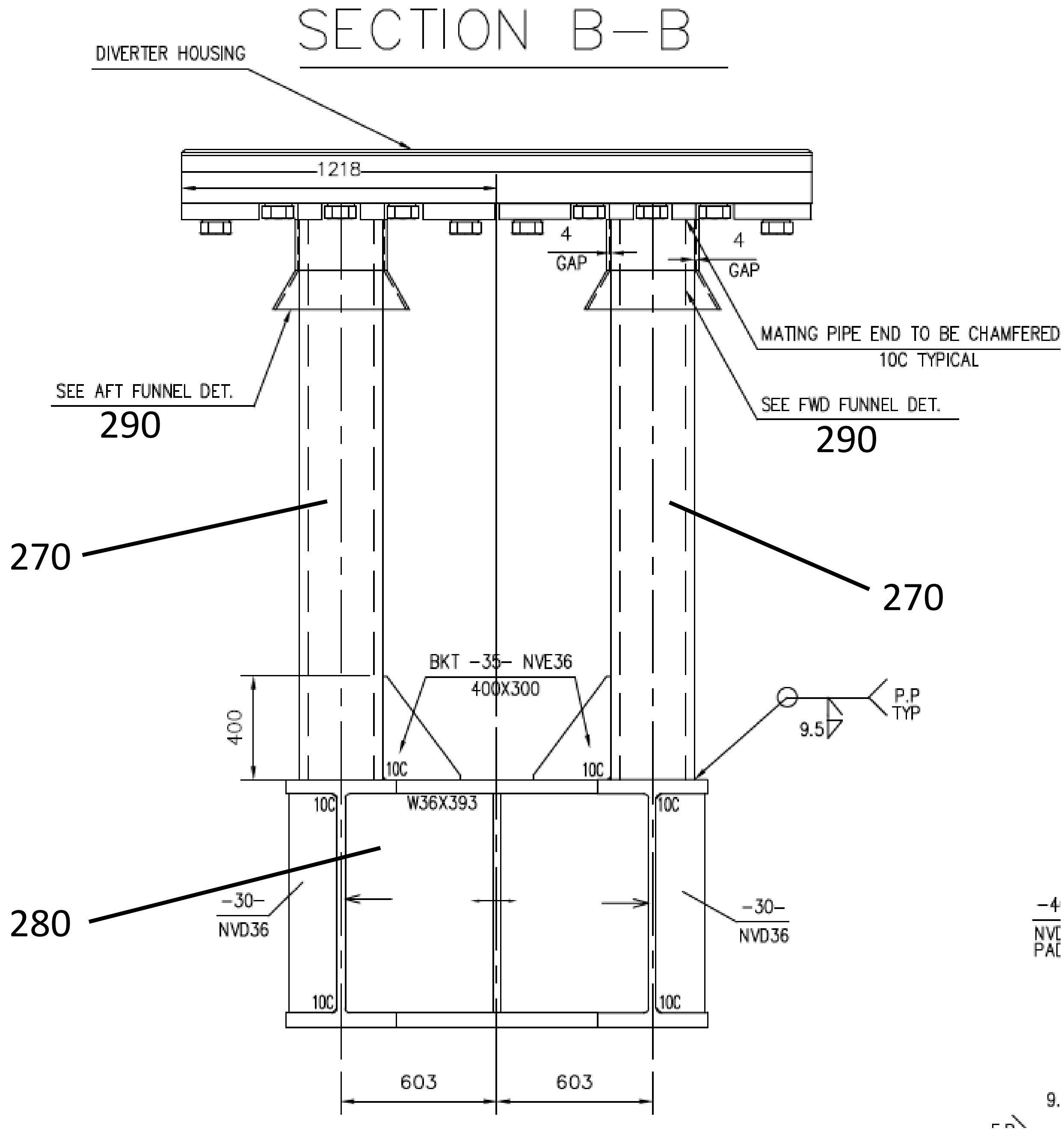
PORT
FWD
A
D
SIM
W36X393
CP
4 PIPE: Ø323.9X33.32
API 5L X52
TYP
B
C—C
C
PAD EYE
PIPE: Ø323.8X25.4
45°
300
717
588
2610
W36X393
450
E
ROUND BAR: Ø254 AISI 4330
OR EQUIVALENT GRADE
—60—
NVE36
SIM
B—B
MAIN WELL
CENTER
603
1206
A—A

FIG. 2B



SECTION A–A
205
30700 ABL
290
SEE AFT AND FWD FUNNEL DET.
SUPPLIED AND FABRICATED BY YARD
TYP
290
60
2170
3400
PIPE:Ø323.9X33.32
270
PIPE:Ø323.9X33.32
270
F.P
TYP
9
9
BKT –35– NVE36
400X300
P.P
TYP
9.5
400
10C
W36X393
10C
15
150
R15
R105
930
960
280
465
300
717
588
588
717
300
15
–25–
NVD36
PAD EYE
PAD EYE(SWL 6T)
–25–
NVD36
PAD EYE(SWL 6T)

FIG. 2C



SECTION B-B
DIVERTER HOUSING
1218
4
GAP
4
GAP
MATING PIPE END TO BE CHAMFERED
10C TYPICAL
SEE AFT FUNNEL DET.
290
SEE FWD FUNNEL DET.
290
270
270
BKT -35- NVE36
400X300
400
10C
10C
P.P
TYP
9.5
W36X393
10C
10C
280
-30-
NVD36
-30-
NVD36
10C
10C
603
603

FIG. 2D

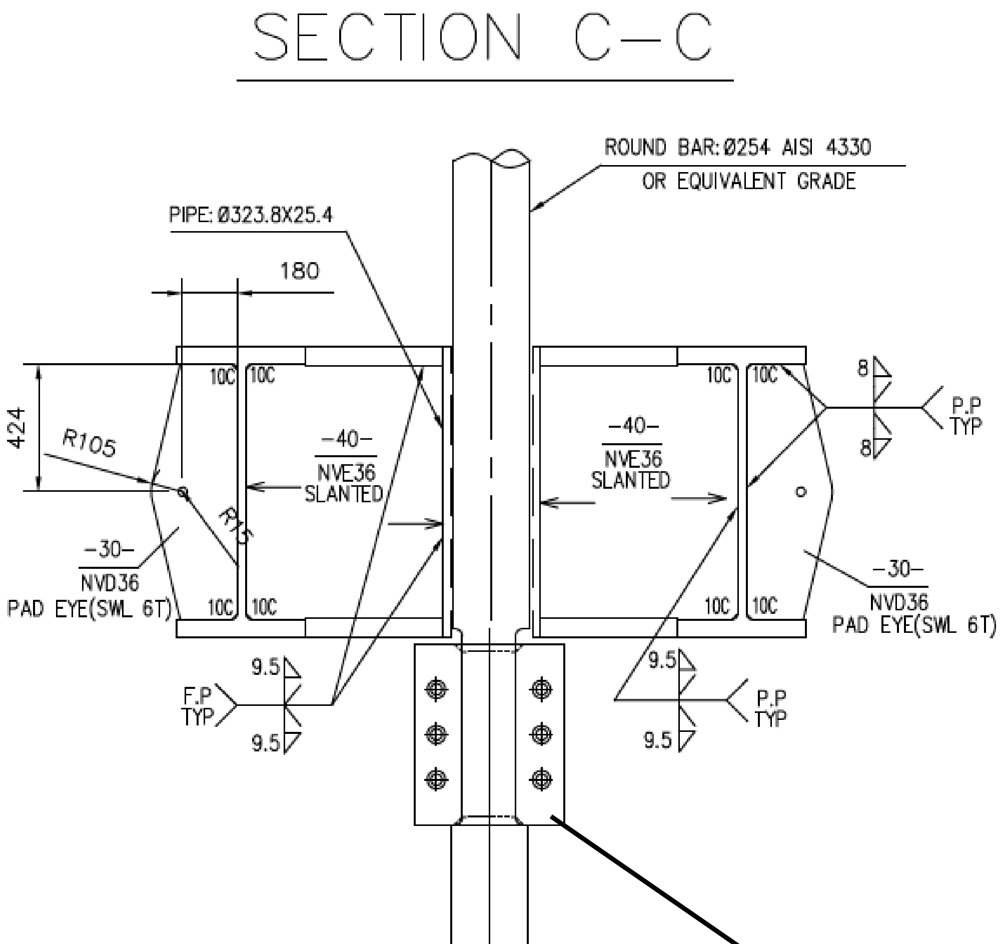
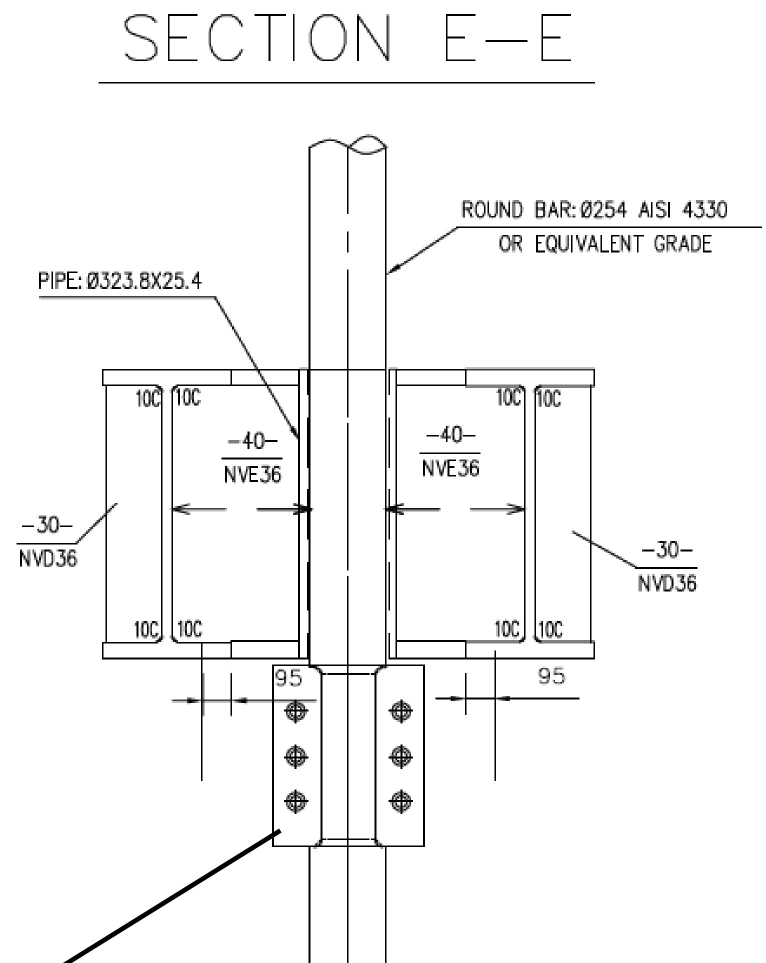


FIG. 2E



210

FIG. 2F

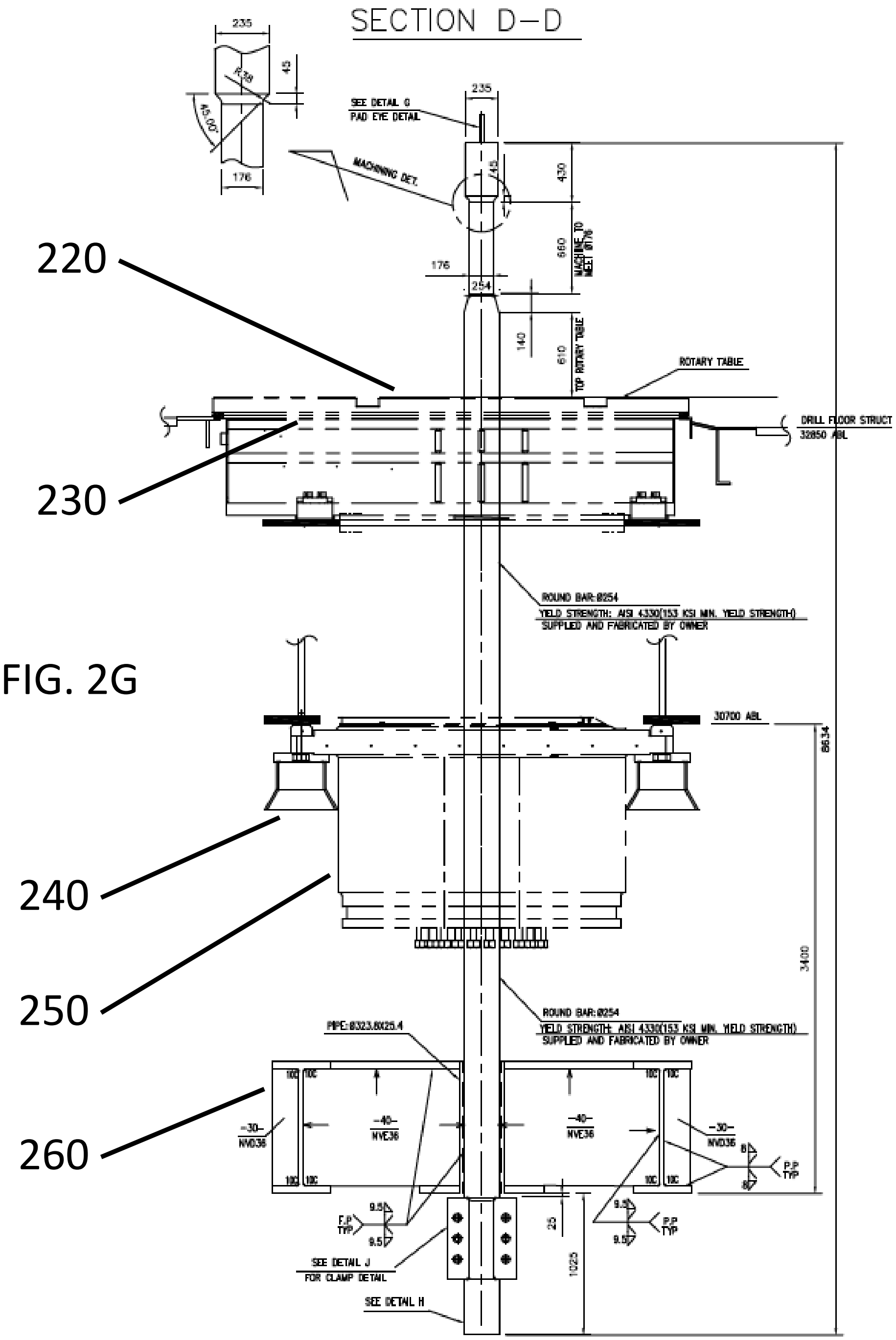


FIG. 2G

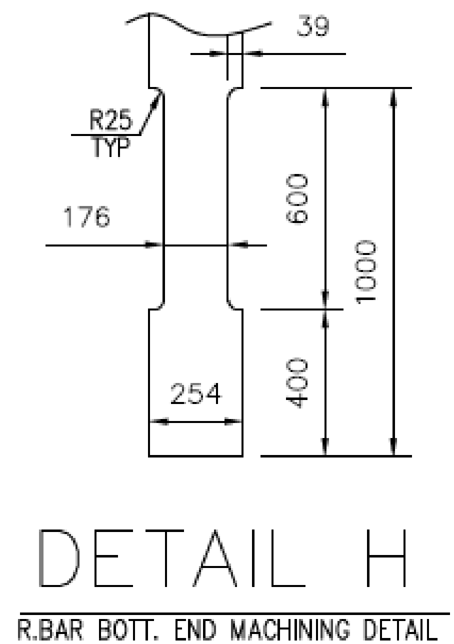


FIG. 2H

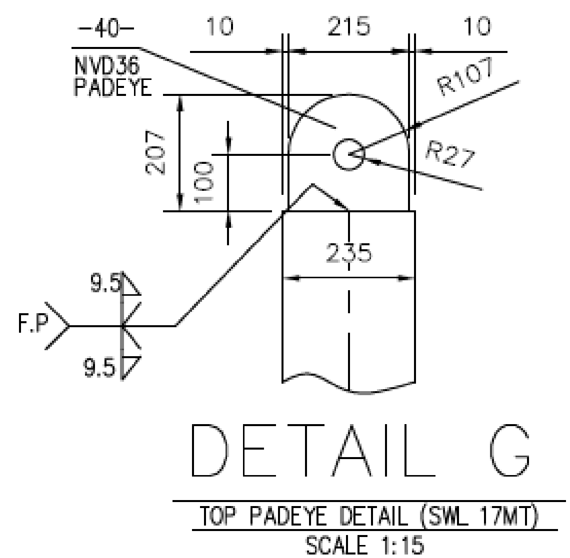


FIG. 2I

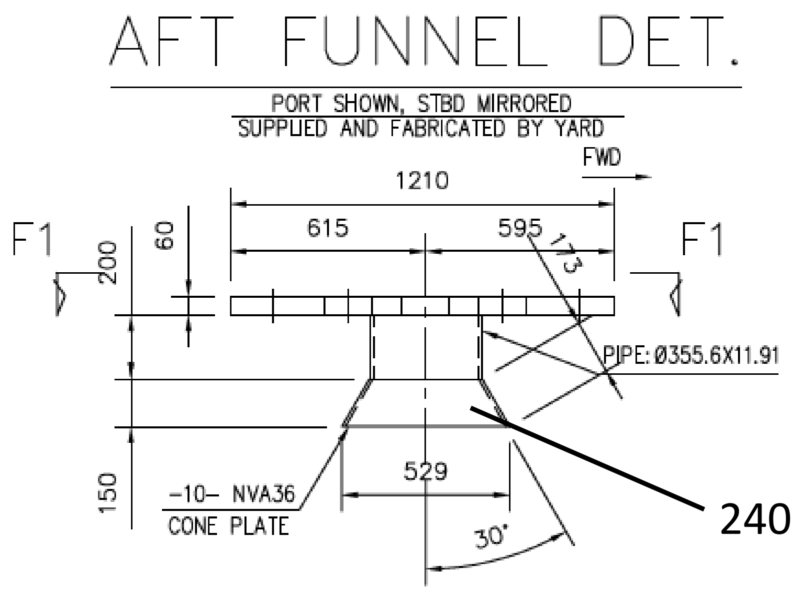


FIG. 2J

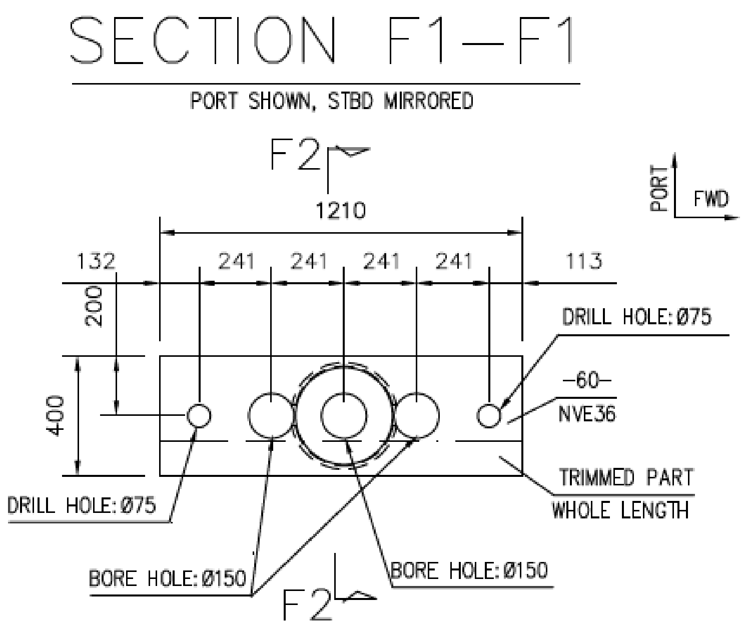


FIG. 2K

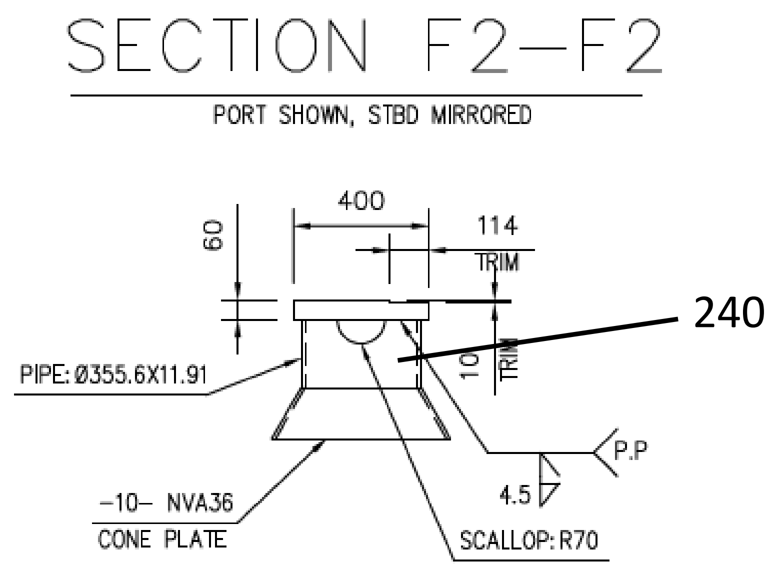


FIG. 2L

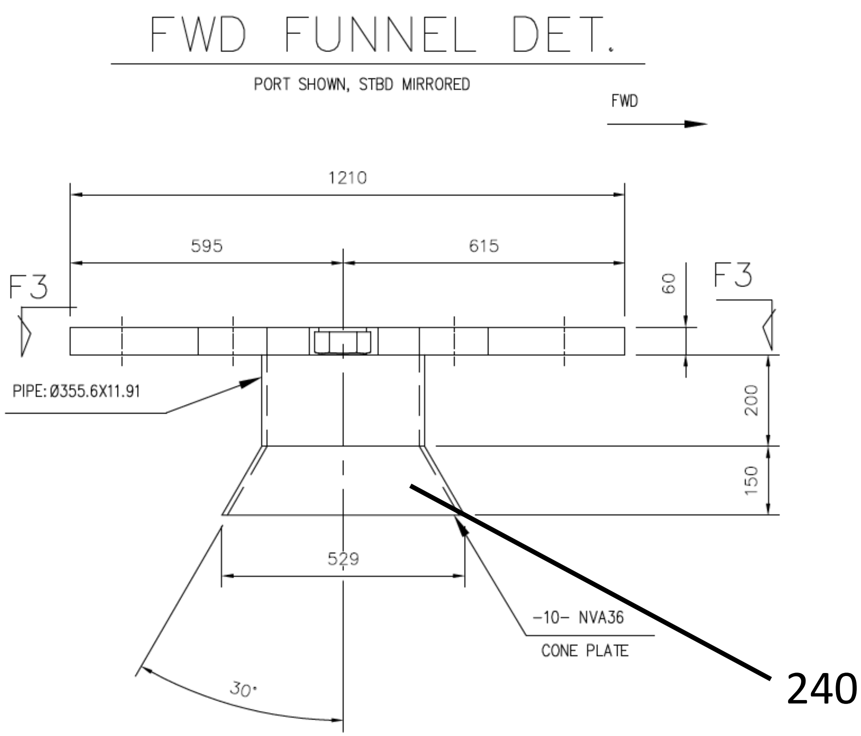

FWD FUNNEL DET.
PORT SHOWN, STBD MIRRORED
FWD
1210
595
615
F3
F3
60
PIPE: Ø355.6X11.91
200
150
529
-10- NVA36
CONE PLATE
30°
240

FIG. 2M

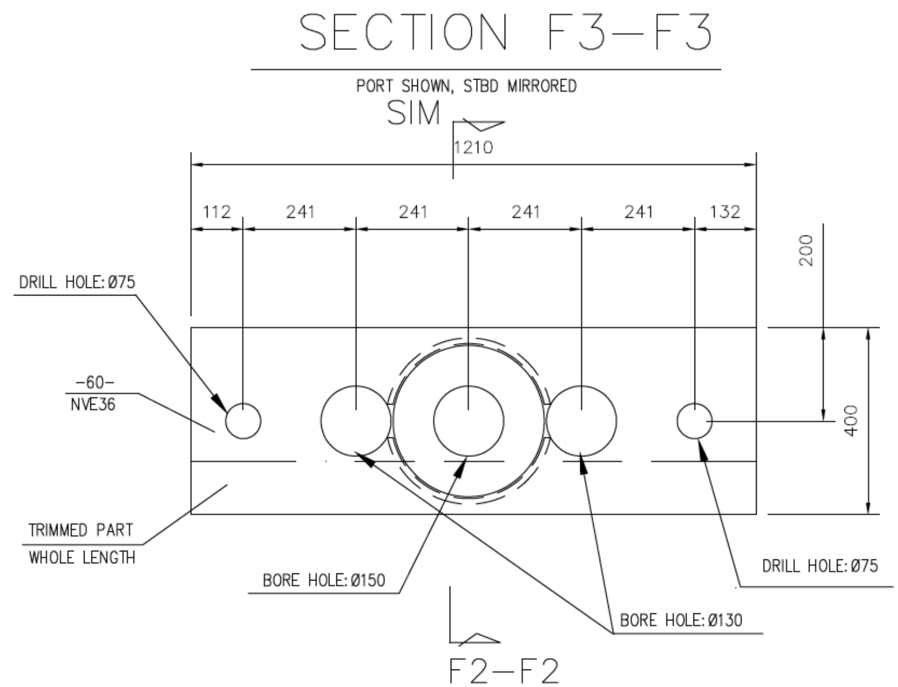
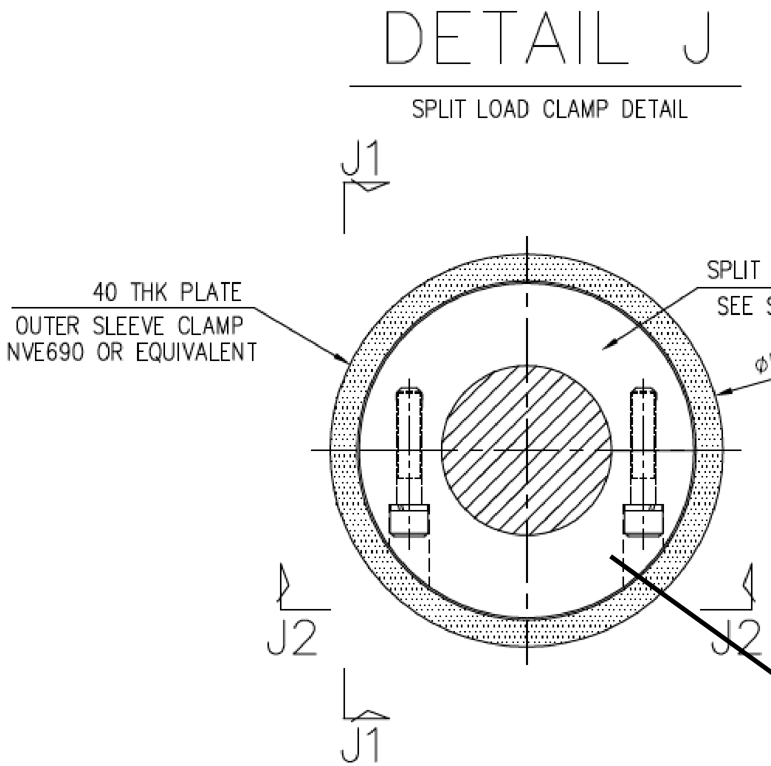
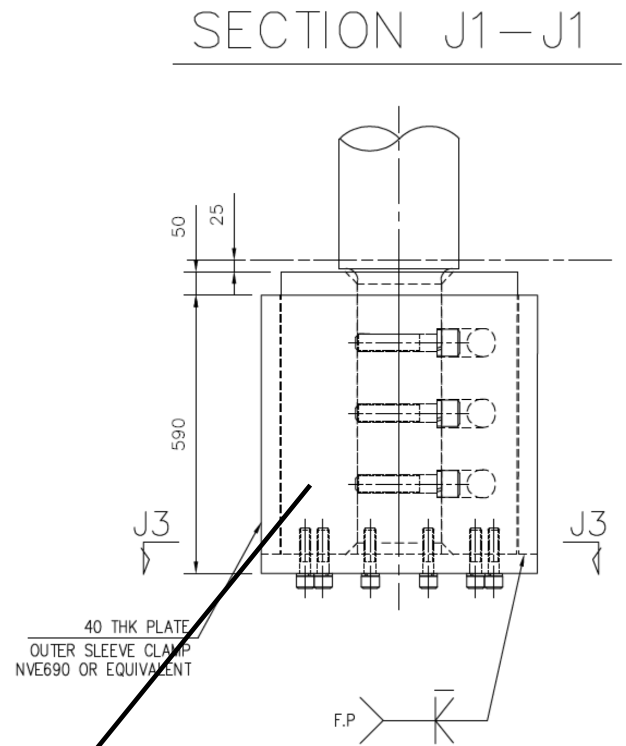

SECTION F3-F3
PORT SHOWN, STBD MIRRORED
SIM
1210
112
241
241
241
241
132
200
DRILL HOLE: Ø75
-60-
NVE36
400
TRIMMED PART
WHOLE LENGTH
BORE HOLE: Ø150
DRILL HOLE: Ø75
BORE HOLE: Ø130
F2-F2

FIG. 2N

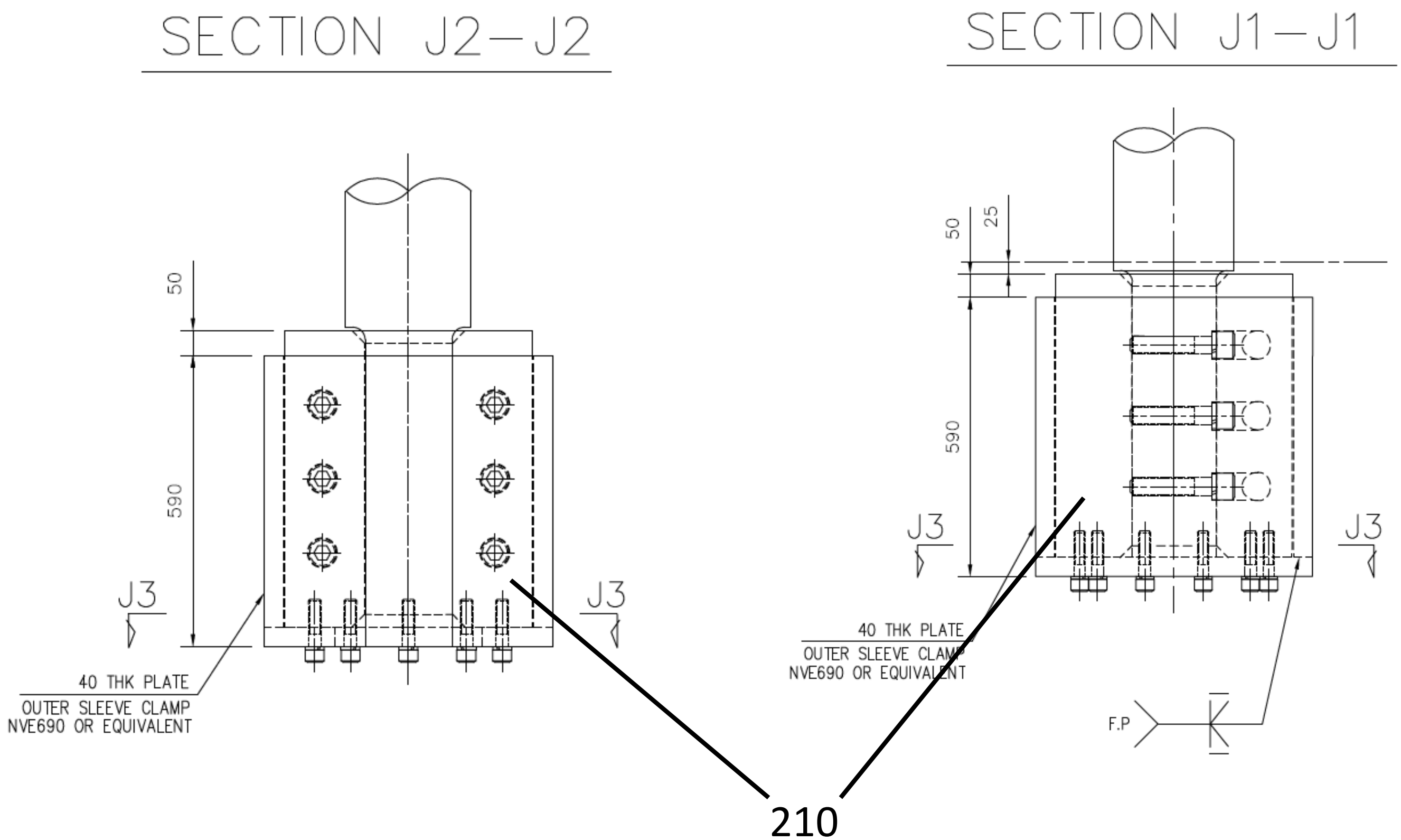




210

FIG. 2O

FIG. 2P



SECTION J2—J2
SECTION J1—J1
50
590
25
J3
40 THK PLATE
OUTER SLEEVE CLAMP
NVE690 OR EQUIVALENT
F.P
210

FIG. 2Q

FIG. 2R

SECTION J2—J2

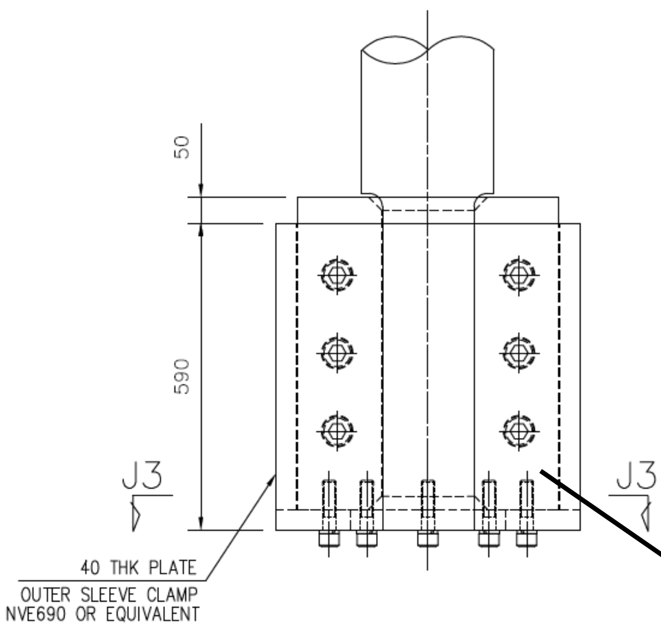


FIG. 2S

SECTION J3—J3

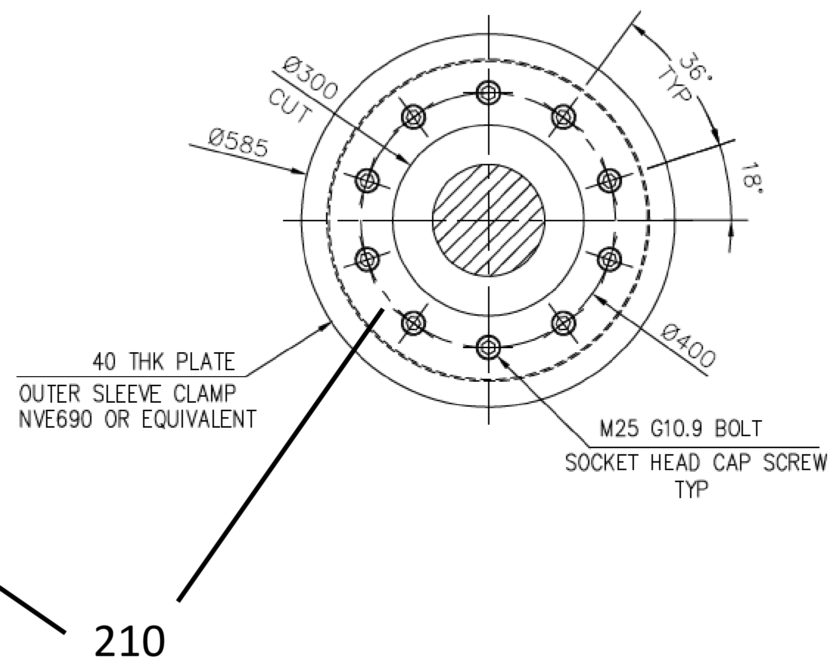


FIG. 2T

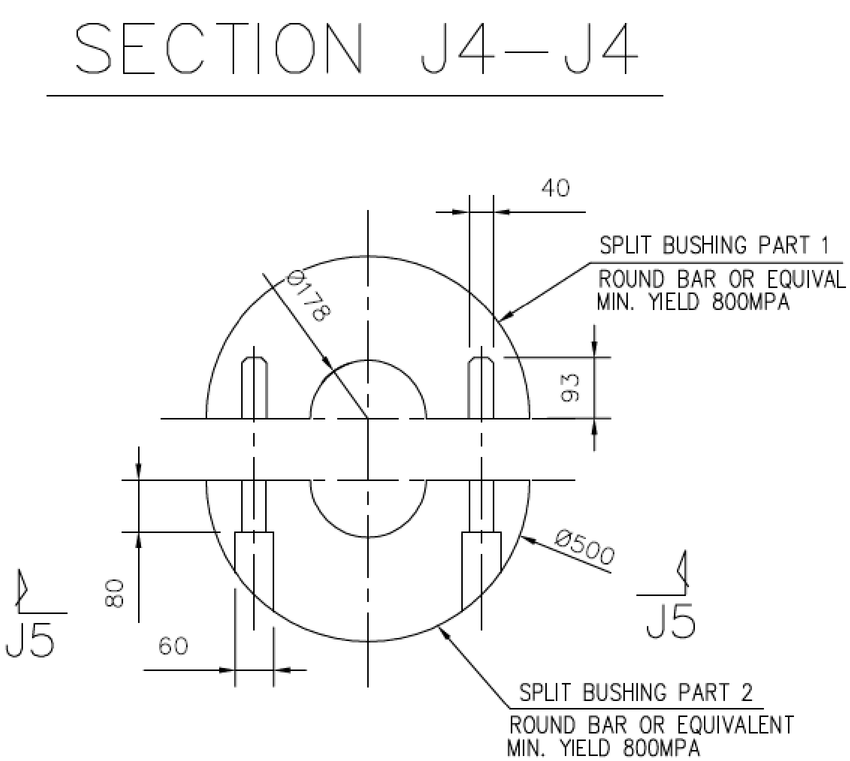

SECTION J4-J4
40
SPLIT BUSHING PART 1
ROUND BAR OR EQUIVAL
MIN. YIELD 800MPA
Ø178
93
Ø500
80
60
J5
J5
SPLIT BUSHING PART 2
ROUND BAR OR EQUIVALENT
MIN. YIELD 800MPA

FIG. 2U

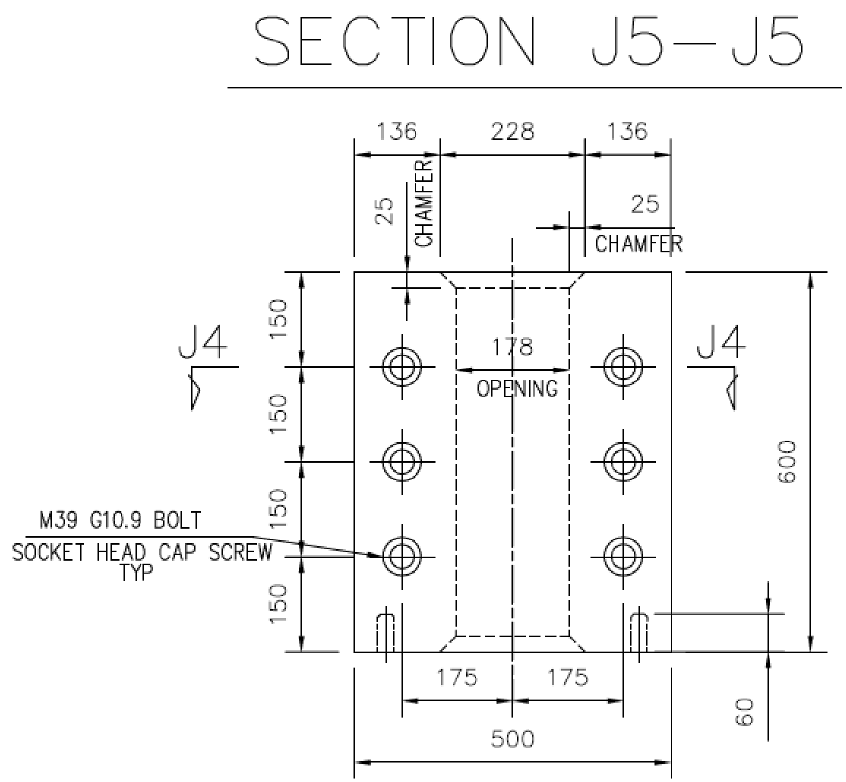

SECTION J5-J5
136
228
136
25
CHAMFER
25
CHAMFER
150
150
150
150
178
OPENING
J4
J4
600
M39 G10.9 BOLT
SOCKET HEAD CAP SCREW
TYP
175
175
500
60

FIG. 2V