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100t Pipe Tensioner

(DW. N. 810.00.000)

FOUNDATION LOADS & BOLTS STRESSES

0	04-Nov-08	GM		GM
Rev. N.	Date	Prepared by	Checked by	Approved by

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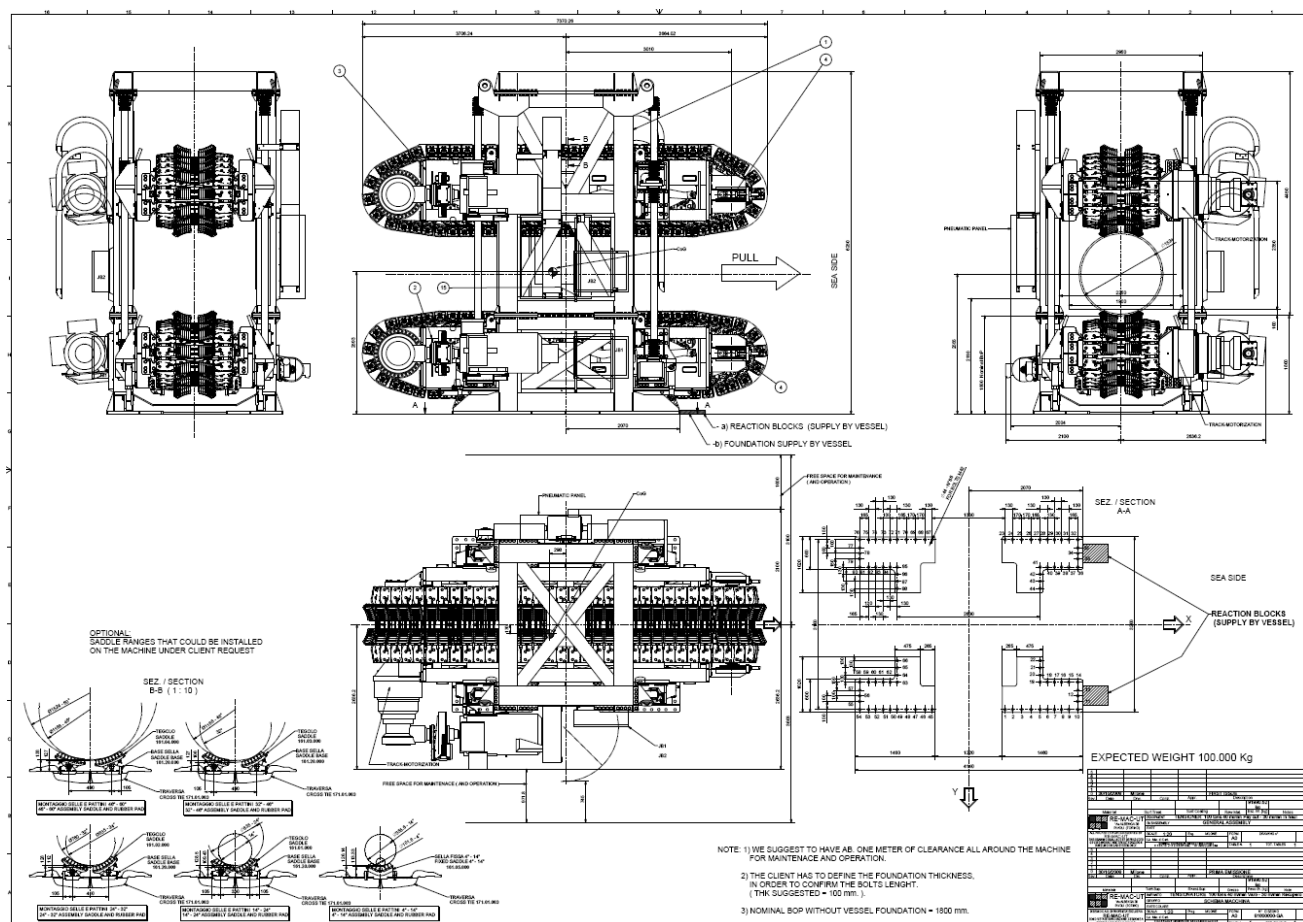


Figure 1 – 100 ton TENSIONER – Dwg. 810.00.000

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1. INTRODUCTION AND SCOPE

The scope of this document is to summarise the results of the calculations performed on the foundation bolts of the 100 ton tensioner (Fig. 1)

The calculations have been performed by traditional methods with in house programs.

2. ACCEPTANCE CRITERIA

The following assumptions will be considered as the acceptance criteria for the Bolts :

MATERIAL	LOAD VALUES
BOLTS	<ul style="list-style-type: none"> Allowable stress : 120 MPa Min friction coefficient to avoid slipping : $f = 0,12$

Table 1

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3. BOLTS LAYOUT

The bolts layout is presented in Fig. 2

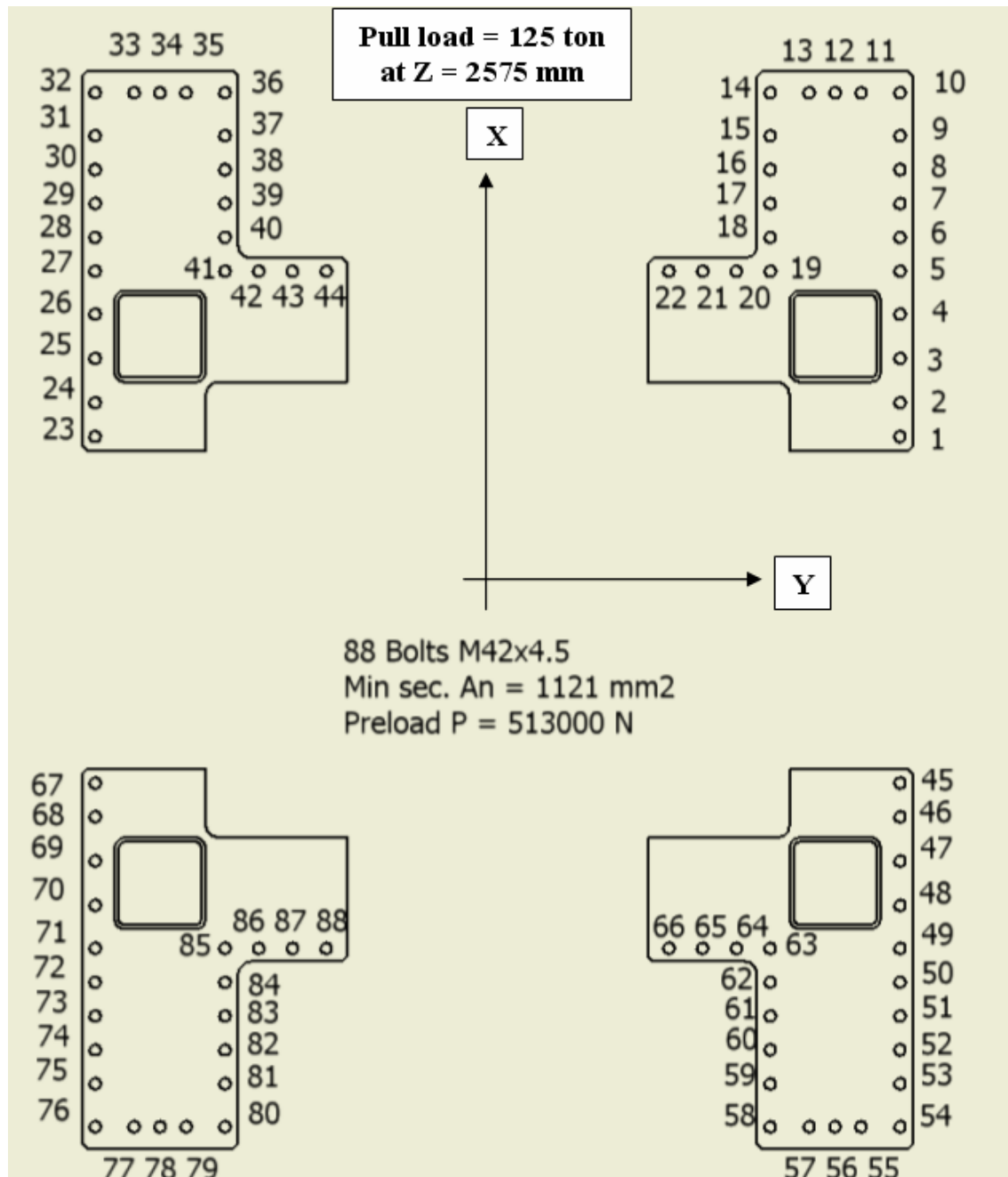


Figure 2 – 100 ton Tensioner - Dwg. 810.00.000
Bolts layout and load condition

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4. SUMMARY OF DATA

The weights and load used to do this calculation are the following:

- Tensioner dead weight 95 tons (expected weight); **100t for Calculation**
- Tensioner Pick Pull = 125 tons (it is the max. pick holding Pull; the Tensioner rated Pull is 100 tons)

It will be considered the following load conditions :

- Pipelaying working condition

We considered two load conditions :

- CASE A : The F_y forces have the direction of the +Y axis
- CASE B : The F_y forces have the direction of the -Y axis
- X axis = parallel to Firing Line axis
- Y axis = transversal to Firing Line axis

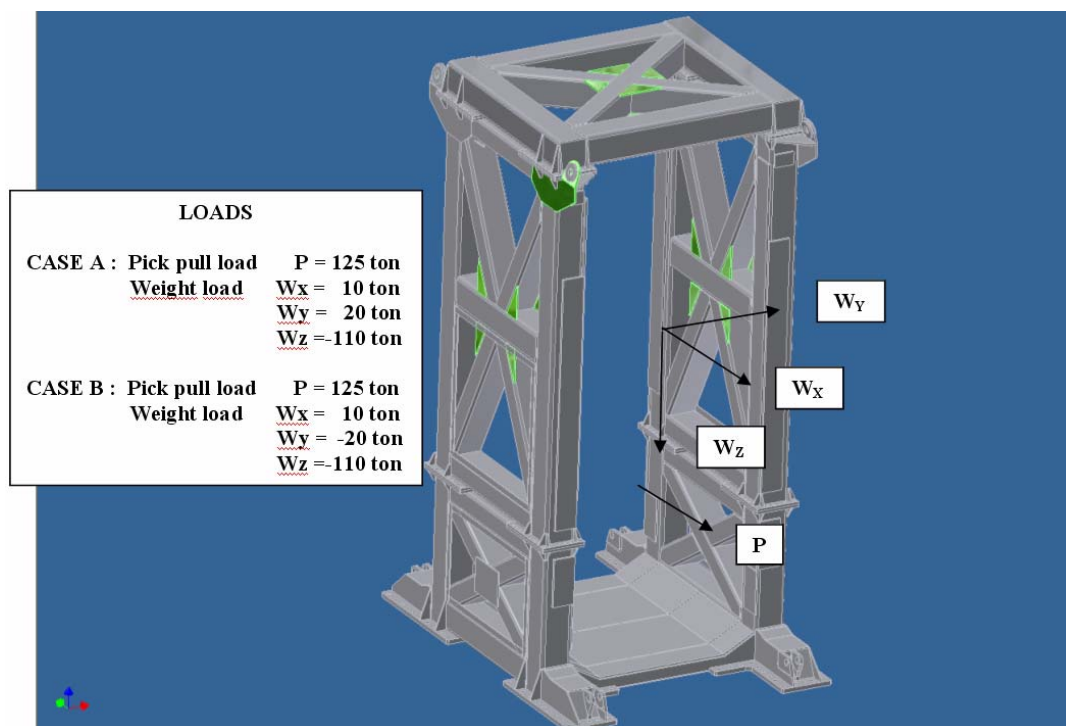
The Pull is always according +X.

Tensioner weight and loads		
	Value	Unit
Nominal pull load	100	tons
Pick pull load (assumed for calculation)	125	tons
Weight (expected)	95	tons
Weight (assumed for calculation)	100	tons
Max longitudinal acceleration (a_x)	1	m/s ²
Max transversal acceleration (a_y)	2	m/s ²
Max vertical acceleration (incl. gravity) (a_z)	11.5	m/s ²

TAB 1

The acceleration values include the static gravity or load component.

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ANN. 1 – 100 ton Tensioner – Dwg. 810.00.000
Load conditions

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ANN 2 - 100 ton Tensioner - Foundation Bolts

88 Bolts M42 x 4.5 -

CASE A: X load = 135 ton ; Y load = 20 ton ; Z load = -110 ton

BOLT N.	X SHEAR LOAD [N]	Y SHEAR LOAD [N]	SHEAR LOAD [N]	Z-AXIAL LOAD [N]	BOLT STRESS [MPa]
1	16267	1707	16357	-29083	-25,9
2	16267	1605	16346	-30984	-27,7
3	16267	1471	16334	-33472	-29,8
4	16267	1338	16322	-35959	-32,1
5	16267	1208	16312	-38373	-34,2
6	16267	1106	16305	-40275	-35,9
7	16267	1004	16298	-42177	-37,7
8	16267	902	16292	-44079	-39,3
9	16267	800	16287	-45981	-41,0
10	16267	670	16281	-48395	-43,2
11	16149	670	16163	-47709	-42,6
12	16071	670	16085	-47252	-42,2
13	15992	670	16006	-46794	-41,8
14	15874	670	15888	-46108	-41,1
15	15874	800	15894	-43694	-38,9
16	15874	902	15900	-41792	-37,3
17	15874	1004	15906	-39890	-35,6
18	15874	1106	15913	-37988	-33,8
19	15874	1208	15920	-36086	-32,2
20	15772	1208	15818	-35491	-31,7
21	15670	1208	15717	-34897	-31,1
22	15568	1208	15615	-34302	-30,6
23	13832	1707	13937	-14902	-13,3
24	13832	1605	13925	-16804	-15,0
25	13832	1471	13910	-19291	-17,2
26	13832	1338	13896	-21778	-19,4
27	13832	1208	13884	-24192	-21,6
28	13832	1106	13876	-26094	-23,2
29	13832	1004	13868	-27996	-25,0
30	13832	902	13861	-29898	-26,7
31	13832	800	13855	-31800	-28,4
32	13832	670	13848	-34214	-30,5
33	13950	670	13966	-34901	-31,1
34	14028	670	14044	-35358	-31,6
35	14107	670	14123	-35816	-32,0
36	14225	670	14240	-36502	-32,6
37	14225	800	14247	-34088	-30,4
38	14225	902	14253	-32186	-28,7
39	14225	1004	14260	-30284	-27,0
40	14225	1106	14267	-28382	-25,3
41	14225	1208	14276	-26480	-23,6
42	14327	1208	14378	-27074	-24,1
43	14429	1208	14479	-27669	-24,7
44	14531	1208	14581	-28264	-25,2

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45	16267	2752	16498	-9623	-8,6
46	16267	2854	16516	-7721	-6,9
47	16267	2988	16539	-5234	-4,7
48	16267	3121	16564	-2747	-2,5
49	16267	3251	16589	-333	-0,3
50	16267	3353	16609	1569	1,4
51	16267	3455	16630	3471	3,1
52	16267	3557	16651	5373	4,8
53	16267	3659	16674	7275	6,5
54	16267	3789	16703	9689	8,6
55	16149	3789	16588	10376	9,2
56	16071	3789	16511	10833	9,7
57	15992	3789	16435	11291	10,1
58	15874	3789	16320	11977	10,7
59	15874	3659	16291	9563	8,5
60	15874	3557	16268	7661	6,9
61	15874	3455	16246	5759	5,1
62	15874	3353	16225	3857	3,4
63	15874	3251	16204	1954	1,8
64	15772	3251	16104	2549	2,3
65	15670	3251	16004	3144	2,8
66	15568	3251	15904	3738	3,3
67	13832	2752	14103	4558	4,0
68	13832	2854	14123	6459	5,8
69	13832	2988	14151	8947	7,9
70	13832	3121	14179	11434	10,2
71	13832	3251	14209	13848	12,4
72	13832	3353	14232	15750	14,0
73	13832	3455	14257	17652	15,8
74	13832	3557	14282	19554	17,5
75	13832	3659	14308	21456	19,1
76	13832	3789	14341	23870	21,3
77	13950	3789	14455	23184	20,7
78	14028	3789	14531	22727	20,3
79	14107	3789	14607	22269	19,9
80	14225	3789	14720	21583	19,2
81	14225	3659	14688	19169	17,1
82	14225	3557	14663	17267	15,4
83	14225	3455	14638	15365	13,7
84	14225	3353	14614	13463	12,0
85	14225	3251	14591	11561	10,3
86	14327	3251	14691	10966	9,8
87	14429	3251	14790	10372	9,2
88	14531	3251	14890	9777	8,7

Minimum friction coefficient = 0.03

AXIAL LOAD : - COMPRESSION ; + TRACTION

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ANN 3- 100 ton Tensioner - Foundation Bolts
88 Bolts M42 x 4.5 -

CASE B: X load = 135 ton ; Y load = -20 ton ; Z load = -110 ton

BOLT N.	X SHEAR LOAD [N]	Y SHEAR LOAD [N]	SHEAR LOAD [N]	Z-AXIAL LOAD [N]	BOLT STRESS [MPa]
1	15762	-2535	15965	-18679	-16,7
2	15762	-2595	15975	-20581	-18,3
3	15762	-2673	15987	-23068	-20,6
4	15762	-2752	16001	-25556	-22,8
5	15762	-2827	16014	-27970	-24,9
6	15762	-2887	16025	-29872	-26,7
7	15762	-2947	16036	-31774	-28,4
8	15762	-3007	16047	-33676	-30,0
9	15762	-3067	16058	-35578	-31,8
10	15762	-3143	16073	-37992	-33,9
11	15693	-3143	16005	-38313	-34,1
12	15647	-3143	15960	-38526	-34,3
13	15601	-3143	15915	-38740	-34,5
14	15532	-3143	15847	-39061	-34,8
15	15532	-3067	15832	-36647	-32,7
16	15532	-3007	15821	-34745	-31,0
17	15532	-2947	15810	-32843	-29,3
18	15532	-2887	15799	-30941	-27,6
19	15532	-2827	15788	-29038	-25,9
20	15473	-2827	15729	-29316	-26,2
21	15413	-2827	15670	-29594	-26,4
22	15353	-2827	15611	-29872	-26,7
23	14336	-2535	14559	-25305	-22,6
24	14336	-2595	14570	-27207	-24,2
25	14336	-2673	14584	-29694	-26,5
26	14336	-2752	14598	-32182	-28,7
27	14336	-2827	14613	-34596	-30,9
28	14336	-2887	14624	-36498	-32,6
29	14336	-2947	14636	-38400	-34,2
30	14336	-3007	14648	-40302	-36,0
31	14336	-3067	14661	-42204	-37,7
32	14336	-3143	14677	-44618	-39,8
33	14405	-3143	14744	-44297	-39,5
34	14452	-3143	14789	-44083	-39,3
35	14497	-3143	14834	-43870	-39,1
36	14566	-3143	14902	-43549	-38,8
37	14566	-3067	14886	-41135	-36,7
38	14566	-3007	14874	-39233	-35,0
39	14566	-2947	14862	-37331	-33,3
40	14566	-2887	14850	-35429	-31,6
41	14566	-2827	14838	-33527	-29,9

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42	14626	-2827	14897	-33249	-29,6
43	14686	-2827	14956	-32971	-29,4
44	14746	-2827	15014	-32693	-29,1
45	15762	-1924	15879	780	0,7
46	15762	-1864	15872	2682	2,4
47	15762	-1786	15863	5169	4,6
48	15762	-1707	15855	7657	6,9
49	15762	-1632	15847	10071	9,0
50	15762	-1572	15841	11973	10,7
51	15762	-1512	15835	13875	12,4
52	15762	-1452	15829	15777	14,0
53	15762	-1392	15824	17679	15,8
54	15762	-1317	15817	20093	18,0
55	15693	-1317	15748	19772	17,7
56	15647	-1317	15703	19558	17,5
57	15601	-1317	15657	19345	17,3
58	15532	-1317	15588	19024	17,0
59	15532	-1392	15595	16610	14,8
60	15532	-1452	15600	14708	13,1
61	15532	-1512	15606	12806	11,4
62	15532	-1572	15612	10904	9,7
63	15532	-1632	15618	9002	8,0
64	15473	-1632	15558	8724	7,7
65	15413	-1632	15499	8446	7,6
66	15353	-1632	15439	8168	7,3
67	14336	-1924	14465	-5846	-5,2
68	14336	-1864	14457	-3944	-3,5
69	14336	-1786	14447	-1457	-1,3
70	14336	-1707	14438	1031	0,9
71	14336	-1632	14429	3445	3,0
72	14336	-1572	14422	5347	4,8
73	14336	-1512	14416	7249	6,5
74	14336	-1452	14410	9151	8,1
75	14336	-1392	14404	11053	9,9
76	14336	-1317	14397	13467	12,0
77	14405	-1317	14466	13788	12,3
78	14452	-1317	14511	14001	12,5
79	14497	-1317	14557	14215	12,7
80	14566	-1317	14626	14536	12,9
81	14566	-1392	14633	12122	10,8
82	14566	-1452	14639	10220	9,1
83	14566	-1512	14645	8318	7,5
84	14566	-1572	14651	6415	5,7
85	14566	-1632	14658	4513	4,0
86	14626	-1632	14717	4791	4,3
87	14686	-1632	14776	5069	4,5
88	14746	-1632	14836	5347	4,8

Minimum friction coefficient = 0.03

AXIAL LOAD : - COMPRESSION ; + TRACTION

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5. CONCLUSIONS

As usual, we suggest to take in consideration the "higher load value" only; and we suggest to increase with a coefficient = 1.20 (increase of 20%), in order to have a minimum safety factor for various contingency .