FRP Mud Mats - Heavy Duty - Technical Data Sheet

Product Description

The conventional means of supporting an offshore jacket template during the pile driving operations is by the use of Mudmats. These mudmats provide a traditional soil bearing foundation.

Once the piles are driven, and the jacket to pile connection is made, the mudmats serve no further purpose. The traditional fabrication methodology is to use steel beams or pipe on even spacings and with the “skin” of the mudmat being steel plate-typically ¼” (6mm) thick to 3/8” (10mm) thick.

The pile driving operations typically only take 5-7 days. However, all-steel mudmats continue to draft from the cathodic protection system. The FRP Mud Mats, being non-metallic, do not draft from the CP system, and as a result, many anodes can be eliminated - thus reducing capital costs.

We have two sizes of mud mats: Standard Duty and Heavy Duty. Both possess a Modulus of Elasticity E of 3,600,000 psi, minimum - and Flexural Strength, F_b of 51,000 psi, minimum.

Because of the high Stiffness of the planks, the beam spacings in the Mud Mat framing can be further apart, thus eliminating joints, welding labour, steel and weight.

Although the modulus E of steel plate is much higher at 29,000,000 psi, the Moment of Inertia is much lower for steel plate.

- Our Standard Duty Planking is 23 times stiffer than 1/4" steel plate and about 7 times stiffer than 3/8" steel plate.
- Our Heavy Duty Planking is 94 times stiffer than 1/4" steel plate and about 28 times stiffer than 3/8" steel plate.

Specifications:

Mud Mats Skin Material - 1 foot wide strip	Stiffness lbs-in^2
Steel Plate 1/4" Thick	453,125
Steel Plate 3/8" Thick	1,529,300
Standard Duty Mud Mats	10,288,800
Heavy Duty Mud Mats	42,436,800

BENEFITS OF FRP MUD MATS

- Framing members are spaced much further apart resulting in fewer beams
- Reduced labour to fabricate fewer steel beam joints
- Reduction in overall jacket weight
- Many anodes are no longer required resulting in a significant capital saving
- Higher stiffness
- High flexural strengths
- Easy to install - no bolting / no epoxying.

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Reduced Anodes Calculation

Many anodes are reduced by eliminating the amount of steel exposed to seawater and to the mud.

By reducing the number of beams, the surface area of Wet Steel is greatly reduced. Because steel plate is metallic and touching the mud, the surface area of "Mudded Steel" is also greatly reduced.

For wetted steel, use the current draw of 0.006 amps/ft2. For mudded steel, a current draw of 0.002 amps/ft2. The typical anode consumption rate is 8.0 lbs/year/amp. The typical Platform Life, L, is typically 20 or 30 years, and the anodes are typically either 725 pounds anodes, LB or 1,100 pound anodes, LB.

The formula for calculating the number of anodes eliminated, N, by using FRP Mud Mats is:

N = [(WSA-steel – WSA-frp) ft^2 x (0.006 amps/ft^2)+(MSA-steel – MSA-frp) ft^2 x (0.002 amps/ft^2)] x (8.0 lbs/year/amp) x (PL-years)/LB-anode lbs.

- N = Number of anodes to be eliminated
- WSA-steel = Wetted Surface Area of the all-steel mudmat option
- WSA-frp = Wetted Surface Area of the mudmat using FRP planks
- MSA-steel = Mudded Surface Area of the all-steel mudmat option
- WSA-frp = Mudded Surface Area of the mudmat using FRP planks
- PL = Platform Life (20 years, 30 years, etc.)
- LBa-node = Poundage of anodes eliminated, such as 725 lbs or 1100 lb

Load vs Deflection and stress - Heavy Duty FRP Mud Mats	
Modulus of Elasticity, E	3,600,000 psi
Shear Modulus, G	500,000 psi
Flexural Strength, Tension Side	51,000 psi
Flexural Strength, Compression Side	40,000 psi
Shear Strength, Fv	7,000 psi
Moment of Inertia, I	11.7845 in^4
Section Modulus, Tension Side	6.0711 in^3
Section Modulus, Compression Side	9.0034 in^3
Web Shear Area, Aw	4.8125 in^2

FRP structural shapes, including FRP Mud Mats, have 2 components of deflection. A flexural component and a shear component due to the fact that FRP structural shapes possess a low Shear Modulus, G, of only 500,000 psi.

The flexural component for a beam under a uniform load, such as a Mud Mats, is calculated as:

$\Delta f = 5*w*L^4/(384*E*I)$, where:

w = uniform loading, lbs/inch
L = clear span, inches
E = Modulus of Elasticity, 3,600,000 lbs/in^2
I = 11.7845 in^4

The shear component of deflection for a beam under a uniform load, such as Mud Mats, is calculated as:

$\Delta v = w*L^2/(8*Aw*G)$, where:

w = uniform loading, lbs/inch
L = clear span, inches
G = Shear Modulus, 500,000 lbs/in^2
Aw = 4.8125 in^2

The total deflection of Mud Mats under a uniform load is: $\Delta total = 5*w*L^4/(384*E*I) + w*L^2/(8*Aw*G)$

Also, the shorter the span, the larger the shear deformation component can be. For short spans, say 3 feet, it can be as much as 20-25%, but as the spans increase, like to 7 feet, it becomes negligible.

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Load vs Deflection & Stress - Heavy Duty Mud Mats

Simple Beam Deflections and Flexural Stresses of Heavy Duty FRP Mud Mats

Clear Span, ft.		Loading, lbs/square foot (Note: because the planks are 1'-0" wide, lbs/square feet = lbs/linear feet									
		250	400	550	700	850	1000	1150	1300	1450	1600
3	Δ	0.012	0.019	0.027	0.034	0.041	0.049	0.056	0.063	0.070	0.078
	f_{b-ts}	556	889	1223	1557	1890	2224	2557	2891	3224	3558
4	Δ	0.036	0.058	0.080	0.102	0.124	0.146	0.168	0.189	0.211	0.233
	f_{b-ts}	988	1581	2174	2767	3360	3953	4546	5139	5732	6325
5	Δ	0.087	0.139	0.191	0.243	0.295	0.347	0.399	0.451	0.503	0.555
	f_{b-ts}	1544	2471	3397	4324	5250	6177	7103	8030	8956	9883
6	Δ	0.177	0.284	0.390	0.497	0.603	0.710	0.816	0.923	1.029	1.136
	f_{b-ts}	2224	3558	4892	6226	7560	8895	10229	11563	12897	14231
7	Δ	0.326	0.522	0.717	0.913	1.108	1.304	1.500	1.695	-	-
	f_{b-ts}	3027	4843	6659	8475	10291	12107	13923	15739	-	-
8	Δ	0.553	0.885	1.217	1.549	1.880	2.212	-	-	-	-
	f_{b-ts}	3953	6325	8697	11069	13441	15813	-	-	-	-
9	Δ	0.883	1.412	1.942	2.471	3.001	-	-	-	-	-
	f_{b-ts}	5003	8005	11007	14009	17011	-	-	-	-	-
10	Δ	1.341	2.146	2.951	3.756	-	-	-	-	-	-
	f_{b-ts}	6177	9883	13589	17295	-	-	-	-	-	-
11	Δ	1.960	3.136	4.312	-	-	-	-	-	-	-
	f_{b-ts}	7474	11958	16443	-	-	-	-	-	-	-
12	Δ	2.772	4.435	-	-	-	-	-	-	-	-
	f_{b-ts}	8895	14231	-	-	-	-	-	-	-	-
13	Δ	3.813	6.101	-	-	-	-	-	-	-	-
	f_{b-ts}	10439	16702	-	-	-	-	-	-	-	-
14	Δ	5.124	-	-	-	-	-	-	-	-	-
	f_{b-ts}	12107	-	-	-	-	-	-	-	-	-
15	Δ	6.747	-	-	-	-	-	-	-	-	-
	f_{b-ts}	13897.9	-	-	-	-	-	-	-	-	-

Notes:
1. After years of testing, 99% of Destructive Testing resulted in failure on the tension-side of the plank. The only compression-side failures were the result of a local bearing failure where the load being applied simple crushed the compression-side fibers"-"there wasn't enough bearing area under the applied load.
2. Typically, the FRP Mud Mat Planks are designed employing an Flexural Safety Factor of 4.0, thus limiting the Allowable Flexural Stress, FB-ALLOW to 12,750 psi +/-. In some instances, a Flexural Safety Factor of 3.0 have been allowed, thus the Allowable Flexural Stress, FB-ALLOW, was allowed to reach 17,000 psi.
3. Deflections and stresses represented with an - are not shown and are not recommended because the Flexural Safety Factor is less than 3.0. We recommend that the FRP Mud Mat Systems are designed using a Flexural Safety Factor of 4.0.
4. Deflections in excess of 3 inches are typically not recommended. If a deflection greater than 3 inches is used, a Strain Analysis should be performed to ensure that, due to the deflection, the mudmat planks do not "pop-out" from under the WTs.

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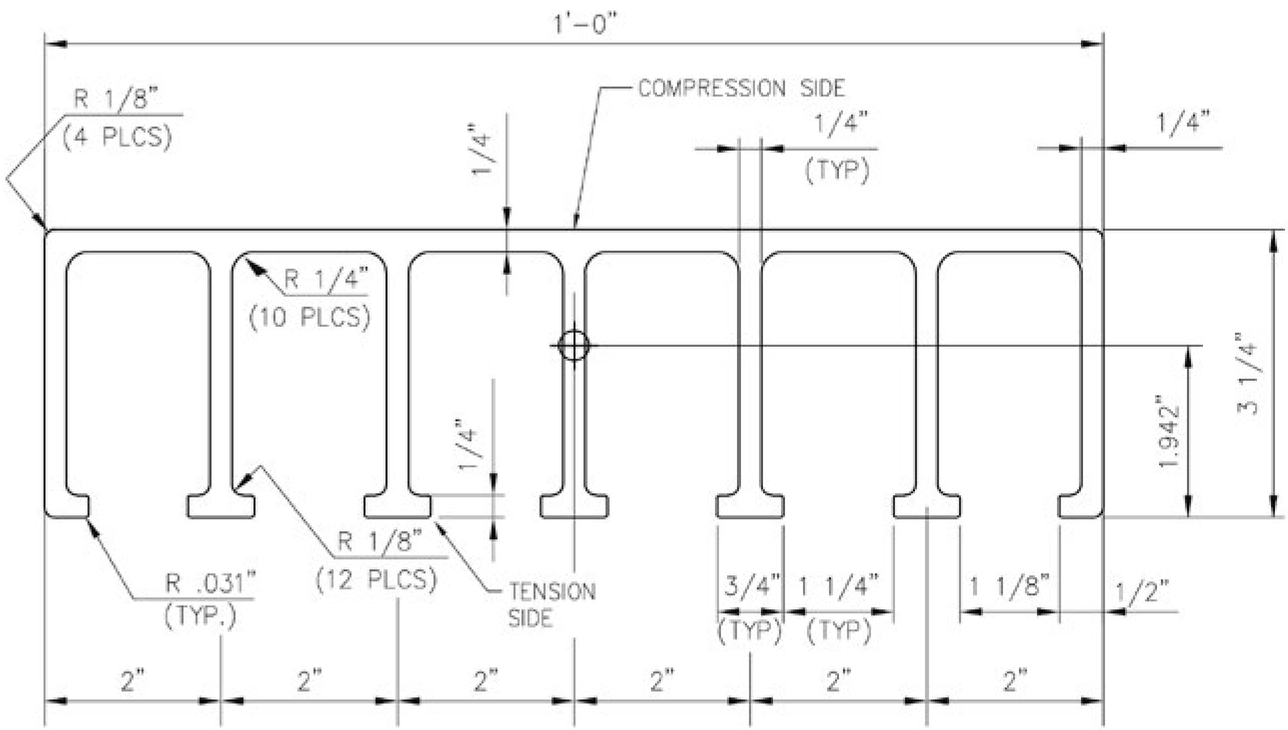
Longitudinal Shear & Average Shear Stress Table - Heavy Duty Mud Mats

Longitudinal Shear Stress Table Calculated through Global Centroid, τ_{LS} = (V*Q)/(I*t) Average Shear Stress, τ_{AVG} = V/Aw		
Q =	4.659	in^3 as calculated about the Global Centroid
I =	2.858	in^4
t =	1.75	in (7 legs x 0.25 inches thick) = 1.75 inches
d =	2.75	Inches, depth of webs (top & bottom flanges not included)
Aw =	4.8125	in^2



Heavy Duty FRP Mud Mats Planking - Scale N.T.S.	
Flexural Strength = 40,000 PSI (Compression side)	I_x = 11.785 in^4
Flexural Strength = 51,000 PSI (Tension side)	S_x Max. = 9.003 in^3
Modulus of elasticity = 3.6 x 10^6 PSI	S_x Min. = 6.071 in^3
	A = 9.129 in^2
Wt/Ft "In-Air" = -7.684 PSF	
Submerged Wt. = -3.627 PSF	

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Longitudinal Shear & Average Shear Stress Table - Heavy Duty Mud Mats

V = acting shear force, pounds Aw = web shear area, in^2

Longitudinal Shear Stress Through Global Centroid & Average Shear Stress Table - Heavy Duty FRP Mud Mats

Clear Span, ft.		Loading, lbs/square foot (Note: because the planks are 1'-0" wide, lbs/square feet = lbs/linear feet									
		250	**400**	**550**	**700**	**850**	**1000**	**1150**	**1300**	**1450**	**1600**
3	V	375	600	825	1050	1275	1500	1725	1950	2175	2400
	T_{LS}	85	136	186	237	288	339	390	441	491	542
	T_{AVG}	78	125	171	218	265	312	358	405	452	499
4	V	500	800	1100	1400	1700	2000	2300	2600	2900	3200
	T_{LS}	113	181	249	316	384	452	520	587	655	723
	T_{AVG}	104	166	229	291	353	416	478	540	603	665
5	V	625	1000	1375	1750	2125	2500	2875	3250	3625	4000
	T_{LS}	141	226	311	395	480	565	649	734	819	904
	T_{AVG}	130	208	286	364	442	519	597	675	753	831
6	V	750	1200	1650	2100	2550	3000	3450	3900	4350	4800
	T_{LS}	169	271	373	474	576	678	779	881	983	1084
	T_{AVG}	156	249	343	436	530	623	717	810	904	997
7	V	875	1400	1925	2450	2975	3500	4025	4550	-	-
	T_{LS}	198	316	435	553	672	791	909	1028	-	-
	T_{AVG}	182	291	400	509	618	727	836	945	-	-
8	V	1000	1600	2200	2800	3400	4000	-	-	-	-
	T_{LS}	226	361	497	633	768	904	-	-	-	-
	T_{AVG}	208	332	457	582	706	831	-	-	-	-
9	V	1125	1800	2475	3150	3825	-	-	-	-	-
	T_{LS}	254	407	559	712	864	-	-	-	-	-
	T_{AVG}	234	374	514	655	795	-	-	-	-	-
10	V	1250	2000	2750	3500	-	-	-	-	-	-
	T_{LS}	282	452	621	791	-	-	-	-	-	-
	T_{AVG}	260	416	571	727	-	-	-	-	-	-
11	V	1375	2200	3025	-	-	-	-	-	-	-
	T_{LS}	311	497	683	-	-	-	-	-	-	
	T_{LS}	286	457	629	-	-	-	-	-	-	-
12	V	1500	2400	-	-	-	-	-	-	-	-
	T_{LS}	339	542	-	-	-	-	-	-	-	-
	T_{LS}	312	499	-	-	-	-	-	-	-	-

Notes:

1. Longitudinal Shear and Average Shear Stresses represented with - are not shown and are not recommended because these loadings and spans are governed by the acting flexural stresses, which are exceeding the Minimum Recommended Flexural Safety Factor of 3.0. We recommend a Flexural Safety Factor of 4.0.