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FRP Mud Mats - Standard 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-in²
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/ft^2. 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 1,200 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 - Standard 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	2.858 in^4
Section Modulus, Tension Side	2.446 in^3
Section Modulus, Compression Side	4.046 in^3
Web Shear Area, Aw	2.4063 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 = 2.8577 in^4

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

$\Delta v = w*L2/(8*Aw*G)$, where:

w = uniform loading, lbs/inch
L = clear span, inches
G = Shear Modulus, 500,000 lbs/in^2
Aw = 2.40625 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 - Standard Duty Mud Mats

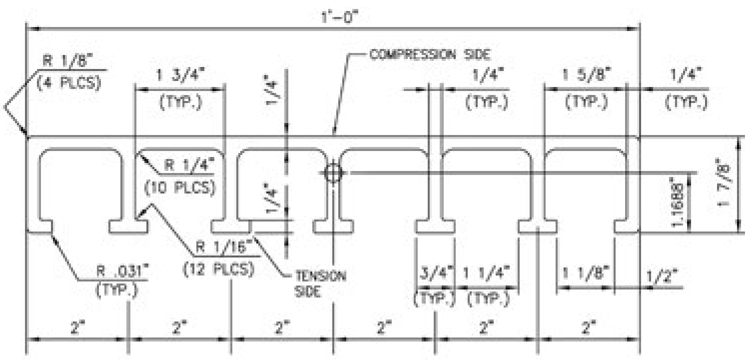
Simple Beam Deflections and Flexural Stresses of Standard Duty FRP Mud Mats											
Clear Span, ft.		**Loading, lbs/square foot (Note: because the planks are 1'-0" wide, lbs/square feet = lbs/linear feet**									
		250	**400**	**550**	**700**	**850**	**1000**	**1150**	**1300**	**1450**	**1600**
3	Δ	0.047	0.075	0.104	0.132	0.160	0.188	0.217	0.245	0.273	0.301
	f_{b-ts}	1380	2208	3036	3864	4692	5520	6348	7176	8004	8832
4	Δ	0.145	0.232	0.319	0.406	0.493	0.580	0.667	0.754	0.841	0.928
	f_{b-ts}	2453	3926	5398	6870	8342	9814	11286	12758	14230	15702
5	Δ	0.350	0.559	0.769	0.979	1.188	1.398	1.608	-	-	-
	f_{b-ts}	3834	6134	8434	10734	13034	15334	17634	-	-	-
6	Δ	0.720	1.152	1.584	2.016	2.447	-	-	-	-	-
	f_{b-ts}	5520	8832	12145	15457	18769	-	-	-	-	-
7	Δ	1.328	2.125	2.922	-	-	-	-	-	-	-
	f_{b-ts}	7514	12022	16530	-	-	-	-	-	-	-
8	Δ	2.260	3.615	-	-	-	-	-	-	-	-
	f_{b-ts}	9814	15702	-	-	-	-	-	-	-	-
9	Δ	3.613	-	-	-	-	-	-	-	-	-
	f_{b-ts}	12421	-	-	-	-	-	-	-	-	-
10	Δ	5.499	-	-	-	-	-	-	-	-	-
	f_{b-ts}	15334	-	-	-	-	-	-	-	-	-

Notes: Δ = Deflection, f_{b-ts} = acting flexural stress tension - side

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

Longitudinal Shear Stress Table Calculated through Global Centroid, $\tau_{LS} = (V*Q)/(I*t)$
Average Shear Stress, $\tau_{AVG} = V/Aw$

Q =	1.977	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 =	1.375	Inches, depth of webs (top & bottom flanges not included)
Aw =	2.40625	in^2
V = acting shear force, pounds Aw = web shear area, in^2		



Standard Duty FRP Mud Mats Planking	
Flexural Strength = 40,000 PSI (Compression side)	I_x = 2.858 in^4
Flexural Strength = 51,000 PSI (Tension side)	S_x Max. = 4.047 in^3
Modulus of elasticity = 3.6 x 10^6 PSI	S_x Min. = 2.445 in^3
	A = 6.722 in^2
Wt/Ft "In-Air" = -5.69 PSF	
Submerged Wt. = -2.70 PSF	

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

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

Longitudinal Shear Stress Through Global Centroid & Average Shear Stress Table - Standard 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}	148	237	326	415	504	593	682	771	860	949
	T_{AVG}	156	249	343	436	530	623	717	810	904	997
4	V	500	800	1100	1400	1700	2000	2300	2600	2900	3200
	T_{LS}	198	316	435	554	672	791	909	1028	1147	1265
	T_{AVG}	208	332	457	582	706	831	956	1081	1205	1330
5	V	625	1000	1375	1750	2125	2500	2875	-	-	-
	T_{LS}	247	395	544	692	840	989	1137	-	-	-
	T_{AVG}	260	416	571	727	883	1039	1195	-	-	-
6	V	750	1200	1650	2100	2550	-	-	-	-	-
	T_{LS}	297	474	652	830	1008	-	-	-	-	-
	T_{AVG}	312	499	686	873	1060	-	-	-	-	-
7	V	875	1400	1925	-	-	-	-	-	-	-
	T_{LS}	346	554	761	-	-	-	-	-	-	-
	T_{AVG}	364	582	800	-	-	-	-	-	-	-
8	V	1000	1600	-	-	-	-	-	-	-	-
	T_{LS}	395	633	-	-	-	-	-	-	-	-
	T_{AVG}	416	665	-	-	-	-	-	-	-	-
9	V	1125	-	-	-	-	-	-	-	-	-
	T_{LS}	445	-	-	-	-	-	-	-	-	-
	T_{AVG}	468	-	-	-	-	-	-	-	-	-
10	V	1250	-	-	-	-	-	-	-	-	-
	T_{LS}	494	-	-	-	-	-	-	-	-	-
	T_{AVG}	519	-	-	-	-	-	-	-	-	-

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.