STA BOTSTAB2

A Program for Rapid Analysis of the On-Bottom Stability of Submarine Pipelines in Accordance with DNV Recommended Practices

Technical Note

Revision 1

Produced by:
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STA PROJECT No. 515

Last Revision to this document: August 27th, 2008.

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1.0 INTRODUCTION

In 1988 the DNV company Veritec published "Recommended Practice RP-E305, ON-BOTTOM STABILITY DESIGN OF SUBMARINE PIPELINES". Stewart Technology Associates (STA) implemented the Simplified Stability Analysis in this document and embodied it into an easy to use Excel application called STA BOTSTAB.

Quoting E305:

The Simplified Stability Analysis is based on a quasi-static balance of forces acting on the pipe, but has been calibrated with results from the generalized stability analysis. The method generally gives pipe weights that form a conservative envelope of those obtained from the generalized stability analysis.

This method may be used for the vast majority of stability calculations, where the required submerged weight is the only parameter of interest.

End quote.

STA BOTSTAB has contains curve-fit equations and interpolation methods that remove the need for constantly looking up information in E306. The pipe weight required for an absolutely stable pipe is given by STA BOTSTAB.

In 2007 DNV introduced "Recommended Practice DNV-RP-F109, ON-BOTTOM STABILITY DESIGN OF SUBMARINE PIPELINES" which replaces E306. STA has implemented parts of the Generalized Lateral Stability Analysis method from F109 and incorporated them into STA BOTSTAB2. The full implementation will be completed shortly. The Absolute Lateral Static Stability Method may follow within STA BOTSTAB2.

The pipe weight required for a virtually stable pipe and the weight for a pipe that limits the lateral displacement to 10 pipe diameters are given by STA BOTSTAB2.

Note that this is Rev. 1 of this document and shows some data from STA BOTSTAB2, Rev. 1.

2.0 EXAMPLE SCREENSHOTS

Figure 1 shows the case of a 48" pipeline with 20.6 mm wall thickness and a concrete weight coating, increasing the OD to 58"

STA BOTSTAB2: On-Bottom Stability of Pipes	Date of run:	8/27/2008	file name: BOTSTAB2:XLS Revised 08/10/08
This software has been developed by: Stewart Technology Associates , Houston, Texas. Tel: (832) 472-2811; Fax: (713) 583-2058; info@stewart-usa.com			
Version 2, Rev 1.1 - RP-F109 Computations still under Development. Revision Date: 08/27/08			

Run Ref:	**Indian Oiltanking Design and Engineering (IOTDE) Ltd.**	Print Page 1	**Print Page 2** / **Print All**
Conditions &	**Second Trial**	Show Graphs	**Select Sea Bed Soil Type**
Pipe Info.:	**48" OD Oil Pipeline with Concrete Weight Coating**		

This program determines the on-bottom stability of a submarine pipe in accordance with the Veritec Recommended Practice "On-Bottom Stability of Submarine Pipelines", October 1988.
The program allows the user to input the design variables in the shaded cells. Using the data from the shaded cells the program calculates the velocities due to the current and waves.
From the calculated velocity the lift, drag and inertia forces on the pipe are determined. The required weight for the pipe is displayed above the actual submerged weight of the pipe
which is supplied by the user. If the required weight of the pipe is larger than the actual submerged weight a warning is given cautioning the user of potential stability problems.

metric units below	***User Defined Variables (in yellow shaded cells only)***					**normal flow regime**
1.2192 m	**48.00 in**	Pipe OD (Before Coating)	**0.0**	1.4732 m	**58.00 in**	Effective Pipe OD (includes reduction for penetration)
127.00 mm	**5.00 in**	Coating Thickness	**Penetration Switch**	31.00 m	**101.71 ft**	d, water depth
2242 kg/m^3	**140.0 lbf/ft^3**	Coating Density	**1 = ON, 0 = OFF**	0.127 m	**5.00 in**	diameter range for stability info. on other pipes
953.72 kgf/m	**640.69 lbf/ft**	Ws, submerged weight of pipe & con	Ref. current = 1.01 knot	0.52 m/sec	**1.70 ft/sec**	Ur, reference current velocity at elevation z_r
1025 kg/m^3	**64.00 lbf/ft^3**	pw, mass density of water		5.00 m	**16.40 ft**	z_r, elevation above sea bed for ref. current
10.00 m	**32.81 ft**	Hs, significant wave height		0.90	**0.90**	C_l, lift force coefficient (typical = 0.90)
3.00 hr	**3.00 hr**	Sea state duration in hours		1.20	**1.20**	C_d, drag coeff. (typ. 1.2 for sub-crit flow, 0.7 oscill.)
13.00 sec	**13.00 sec**	Tp, spectral peak period of surface waves		3.29	**3.29**	C_i, inertial coeff. (typical = 3.29)
no	**n**	Wave spreading (yes or no)		0.70	**0.70**	u_s, friction factor for soil (typical 0.7 for sand)
0°	**0°**	θ °, Wave Direction (0° to 90°, 0° gives max)		5.41E+05	5.41E+05	Re, Reynolds no. based on current and pipe diam.
3.3	**3.3**	gamma, peakedness parameter (1.0 for PM)		soil type	4	**Select Sea Bed Soil Type**
Show Graphs	***Tabulated Results - Using Veritec RP E305***		**Print All**			**medium sand**

Variables Used to Calculate Velocity Due to Wave Motion and Due to Current, Separately and Combined					
1.78 sec	1.78 sec	Tn, =sqrt(d/g), "natural period"	*Soil Properties in Accordance with Veritec RP E305 (medium sand)*		
0.137	0.137	Tn/Tp, ratio of natural/wave period	0.50 mm	0.020 in	d_{50}, mean grain size
3.69 m	12.10 ft	A_0, orbital semi-diameter of particle velocity	4.17E-05 m	4.17E-05 ft	z_0, bottom roughness parameter
0.00	0.00	K_b, Nikuradse's equiv. sand roughness param.	0.81	0.81	U_D/U_r velocity reduction factor for steady current
16.61	16.61	K, Keulegan Carpenter number = UsTu/D	119873	119873	z_r/z_0, ratio
2951	2951	A_0/K_b, ratio	106.08	106.08	z_{0a}/z_0, ratio of apparent to bottom roughness
0.96 m/sec^2	3.15 ft/sec^2	As, significant acceleration	3.63	3.63	U_S/U_r ratio of significant to reference velocity
0.335	0.335	(Us*Tn)/Hs, dependent on gamma and Tn/Tp	35329	35329	D/z_0, ratio of pipe diameter to bottom roughness
3998.98	3998.98	z_r/K_b, ratio	0.69	0.69	U_D/U_r velocity reduc. factor for waves & current
1.8827 m/s	6.18 ft/sec	Us*, significant water velocity	2.23E-01	2.23E-01	M, current to wave velocity ratio = UD/Us
3.61 m/s	11.85 ft/sec	U*, osc.vel.amp.single design oscillation	**0.42 m/s**	**1.38 ft/sec**	V (F109) = UD (E305)
0.95	0.95	Tu/Tp, dependent on gamma and Tn/Tp	4.42E-03 m	1.45E-02 ft	z0a, apparent roughness
0.14	0.14	Tn/Tu	877	877	τ, number of waves in the sea state
1.21	1.21	kt, Eq.3.16, depends on gamma	1.919	1.919	ku, ratio between design single oscillation amplitude a
1.88	1.88	T*, period associated with a single design oscillation	19.19 m	62.96 ft	H*, maximum wave height in the sea state
12.31 sec	12.31 sec	Tu, zero-up-crossing period	4.62	4.62	K*, Keulegan Car.no. single design oscillation=U*T*/D
1.00	1.00	R, wave direction & spreading reduc. fact.	**0.69**	**0.69**	UD/Ur velocity reduc. factor for waves & current
1.883 m/s	**6.18 ft/sec**	Us, sig. velocity due to wave motion	**0.36 m/s**	**1.17 ft/sec**	Ud, ave. veloc. over pipe from waves & current
28°	28°	phase angle in wave for max force	1.58	1.58	Fw, calibration factor, inc. safety factor of 1.1
195.30 kgf	430.63 lbf	horizontal force	1888.6 kgf/m	**1269 lbf/ft**	**Required submerged weight**
86.02 kgf	189.68 lbf	lift force	18527 N/m	**Warning Pipe Not Stable!**	

FIGURE 1 – Screenshot of Input (yellow Cells) and Results for Example Case.

In Figure 1 the predicted weight for a stable pipe is 1269 lbf/ft, or 1888 kgf/m. The input pipe weight is 641 lbf/ft. Hence the program warns that the pipe is not stable in this analysis. The significant wave height is 32.8 feet and the water depth is 108 feet. A JONSWAP spectrum is used with gamma = 3.3 and Tp = 13 seconds. No wave spreading has been specified and the wave direction is 0 degrees, which is perpendicular to the pipe. A current velocity of 1 knot has been specified, perpendicular to the pipe at an elevation of 16.4 feet above the sea bed. Lift, drag and inertia force coefficients have been specified in accordance with recommendations in E305. A friction coefficient is also given and the sea bed has been selected to be medium sand.

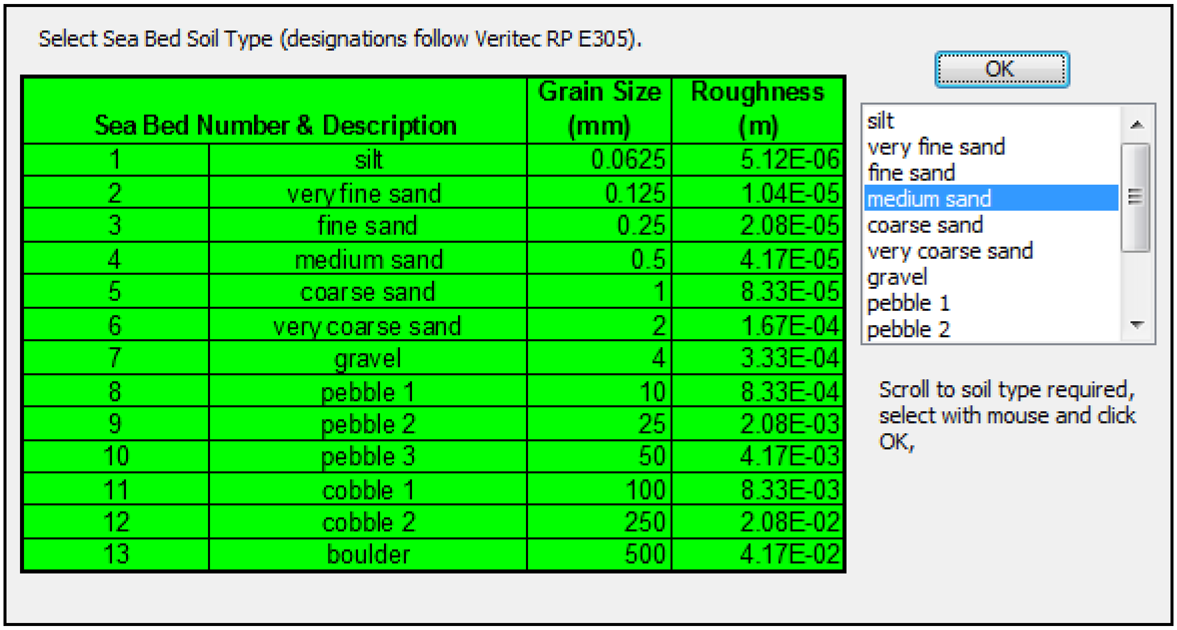
Clean Graphs		Tabulated Results - Using DNV-RP-F109 Generalized Lateral Stability Method This Area is For Stability On Sand (RP-F109)			Show Graphs
	3.496E+00	L, significant weight parameter = Ws/(0.5 ρw D Us^2)			K>10, use Lstable1
272.8 kgf/m	183.41 lbf/ft	Denom = 0.5.ρw.D.Us^2			
	7.060E+00	Lstable1/(2 + M)^2	1925.2 kgf/m	**1294 lbf/ft**	**Required Stable Submerged Weight1**
	6.474E+00	Lstable2	1765.2 kgf/m	**1186 lbf/ft**	**Required Stable Submerged Weight2**
	3.456E+00	L10_1000_waves	942.4 kgf/m	**633 lbf/ft**	**Minimum pipe weight required to limit the lateral displacement to 10 pipe diameters (1000 waves)**
	2.253E+00	L10_500_waves	614.4 kgf/m	**413 lbf/ft**	**Minimum pipe weight required to limit the lateral displacement to 10 pipe diameters (500 waves)**
	0.01559	N, spectral acceleration factor, Us/(g Tu)	1926.1 kgf/m	**1295 lbf/ft**	**=Lstable1/(2+M)^2*Denom**
	1.58	sg, pipe specific weight =1 + (2/pi).(N.K.L)			1.05<sg<3, method is OK
7000 N/m^3	45 lbf/cuft	γ's Submerged unit soil weight. For sand normally in the range 7 000 (very loose) to 13 500 N/m^3 (very dense).			
1.624	1.625	κs_initial, initial stiffness for penetration calculation			
0.0267	0.0267	zpi/D, initial penetration ratio	34.89	**Lstable**	
0.039 m	1.55 in	Initial Penetration (User may wish to reduce the pipe diameter to account for the penetration)			
		This Area is For Stability On Clay (RP-F109) and still needs testing			
2394 N/m^2	50 psf	su, undrained shear strength			
18000 N/m^3	115 lbf/cuft	γs Submerged unit soil weight. For clay can be taken as 18 000 N/m^3			
0.0903	0.0903	G, clay soil strength parameter			
0.3770	0.3772	κc_initial, initial stiffness for penetration calculation			
0.0409	0.0409	zpi/D, initial penetration ratio			
0.060 m	2.37 in	Initial Penetration (User may wish to reduce the pipe diameter to account for the penetration)			
0.2908	0.2908	F(M)	0.137	C1	
	1.42	L10/(2+M)^2	6.25	C2	
	11.87	Kb	0.56	C3	* On stiff clays this result may be conservative.
	7.776E+00	Lstable1	2120.4 kgf/m	**1425 lbf/ft** *	**Required Stable Submerged Weight1***
	1.424E+00	L10	388.2 kgf/m	**261 lbf/ft**	**Minimum pipe weight required to limit the lateral displacement to 10 pipe diameters**

FIGURE 2 – Equivalent Results Using F109

Figure 2 shows the results for the same input data, but using the generalized method from F109, and for the case of a sand sea bed. In this case the pipe weight required for a stable pipe is 1294 lbf/ft, almost exactly the same as in the E305 results. The weight required for an L10 pipe (that limits the lateral displacement to 10 pipe diameters) is predicted to be just 633 lbf/ft.

The results in Figure 2 for clay are provided with the caution that the clay calculations have not yet been fully tested.

The following figures show screen captures of the dialog boxes that are displayed when the user clicks various buttons on the main screen.



Sea Bed Number & Description		Grain Size (mm)	Roughness (m)
1	silt	0.0625	5.12E-06
2	very fine sand	0.125	1.04E-05
3	fine sand	0.25	2.08E-05
4	medium sand	0.5	4.17E-05
5	coarse sand	1	8.33E-05
6	very coarse sand	2	1.67E-04
7	gravel	4	3.33E-04
8	pebble 1	10	8.33E-04
9	pebble 2	25	2.08E-03
10	pebble 3	50	4.17E-03
11	cobble 1	100	8.33E-03
12	cobble 2	250	2.08E-02
13	boulder	500	4.17E-02

Figure 3 – Dialog Box Enabling Selection of Sea Bed Soil Type.

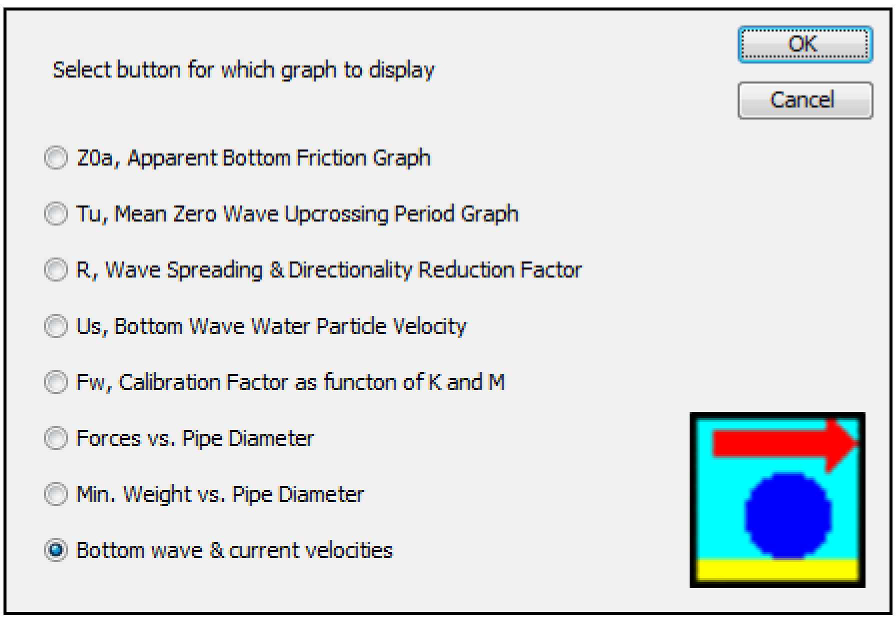


FIGURE 4 – Dialog Box to Select a Graph for Display and/or Printing.

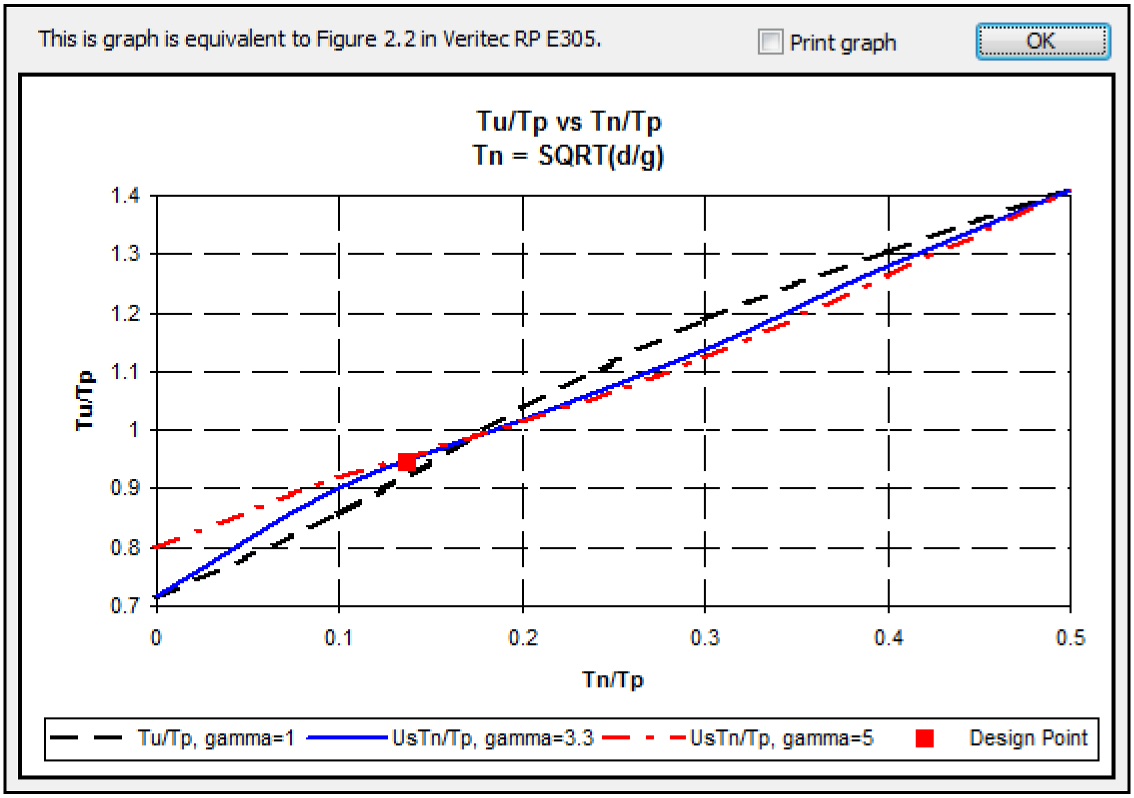

This is graph is equivalent to Figure 2.2 in Veritec RP E305.
Print graph
OK
Tu/Tp vs Tn/Tp
Tn = SQRT(d/g)
Tu/Tp
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0
0.1
0.2
0.3
0.4
0.5
Tn/Tp
Tu/Tp, gamma=1
UsTn/Tp, gamma=3.3
UsTn/Tp, gamma=5
Design Point

FIGURE 5

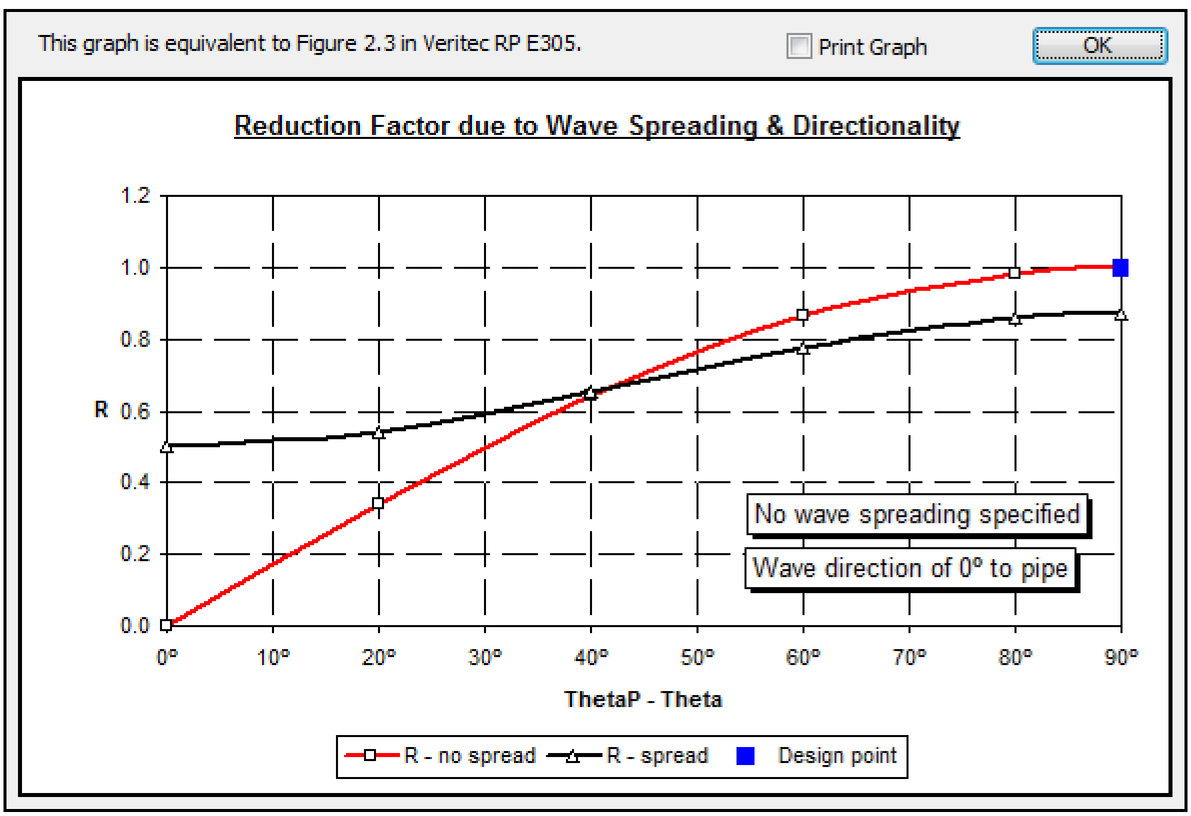

This graph is equivalent to Figure 2.3 in Veritec RP E305.
Print Graph
OK
Reduction Factor due to Wave Spreading & Directionality
R
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
ThetaP - Theta
No wave spreading specified
Wave direction of 0° to pipe
R - no spread
R - spread
Design point

FIGURE 6

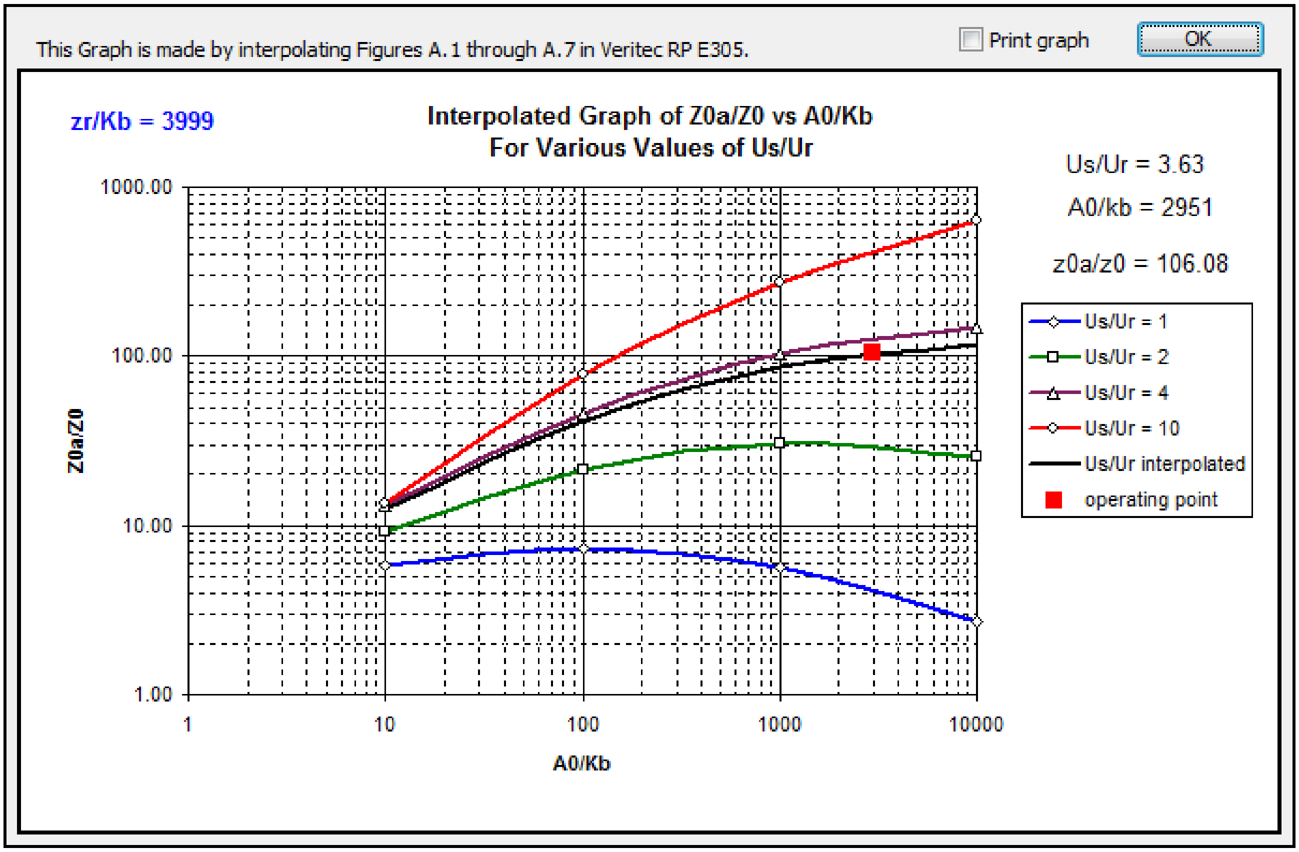


FIGURE 7

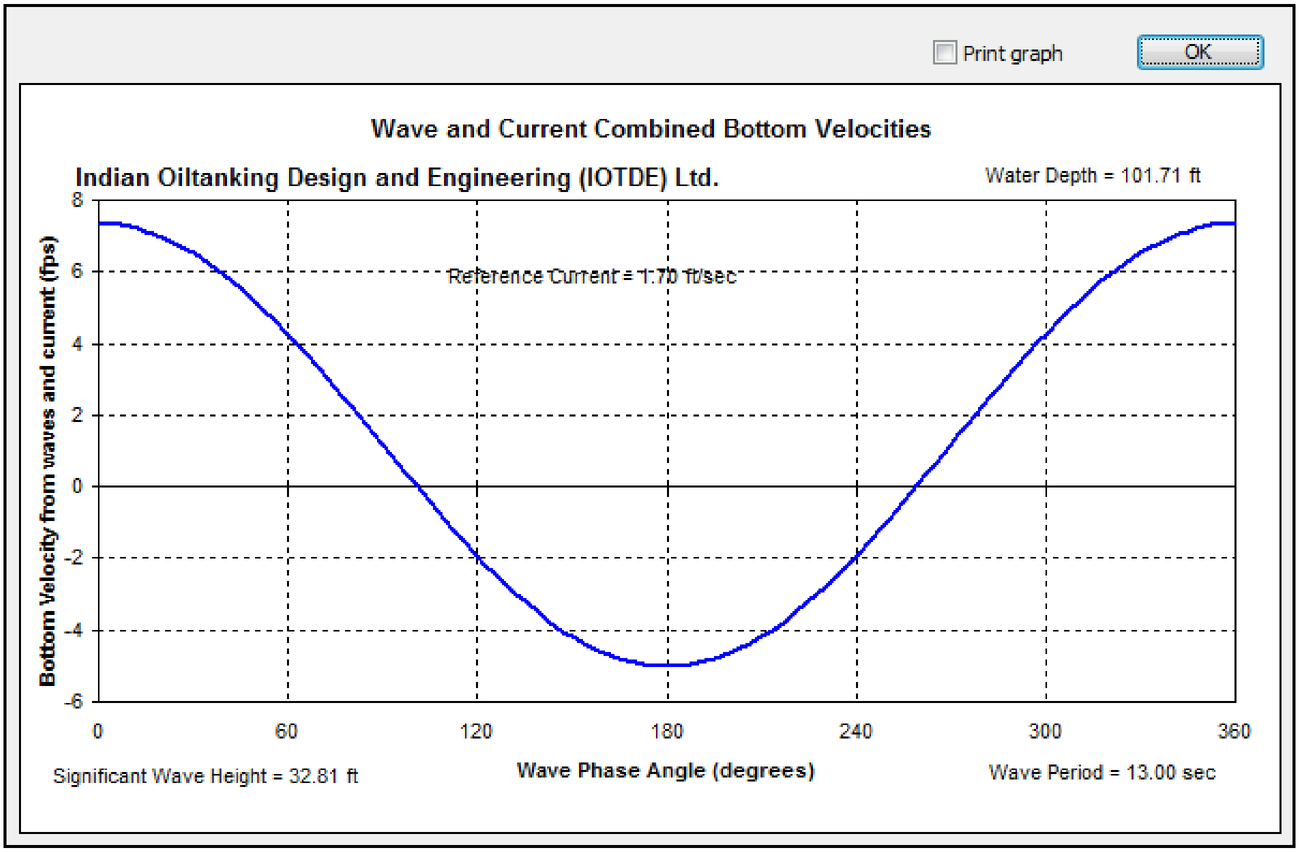

Print graph
OK
Wave and Current Combined Bottom Velocities
Indian Oiltanking Design and Engineering (IOTDE) Ltd.
Water Depth = 101.71 ft
Reference Current = 1.70 ft/sec
Bottom Velocity from waves and current (fps)
8
6
4
2
0
-2
-4
-6
0
60
120
180
240
300
360
Significant Wave Height = 32.81 ft
Wave Phase Angle (degrees)
Wave Period = 13.00 sec

FIGURE 8

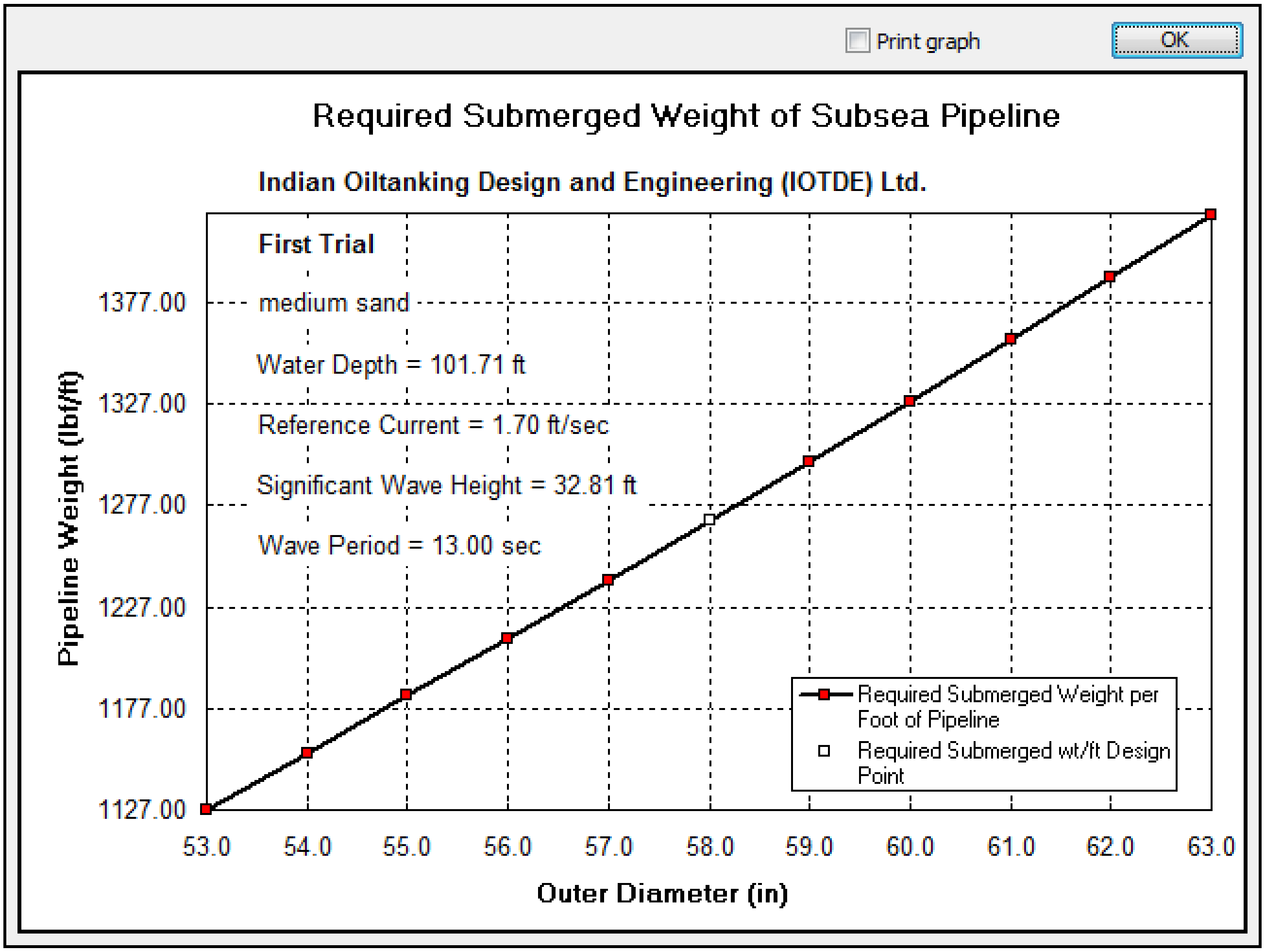


FIGURE 9 –Range of Stable Pipe Weights and Diameters (Diameter Range selected by user).

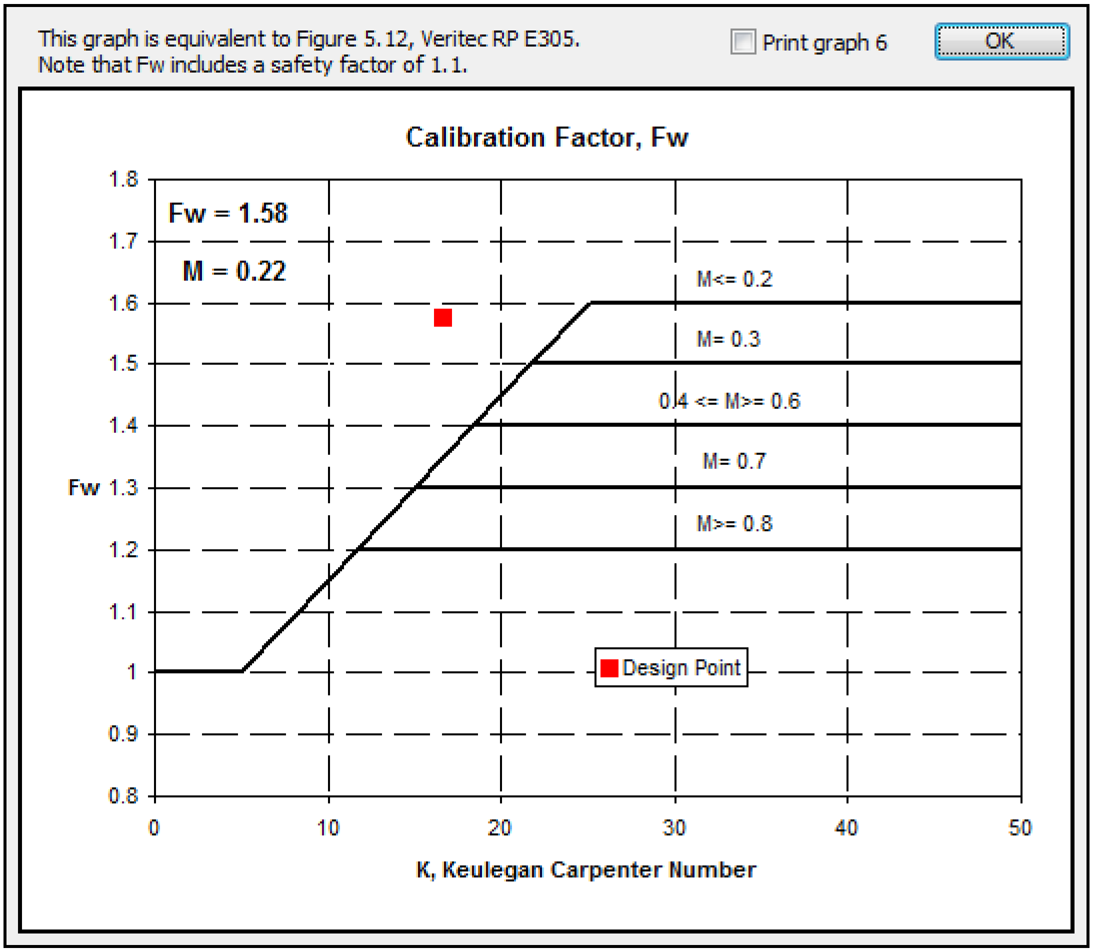


FIGURE 10 – Note at the Design Point Fw = 1.58.

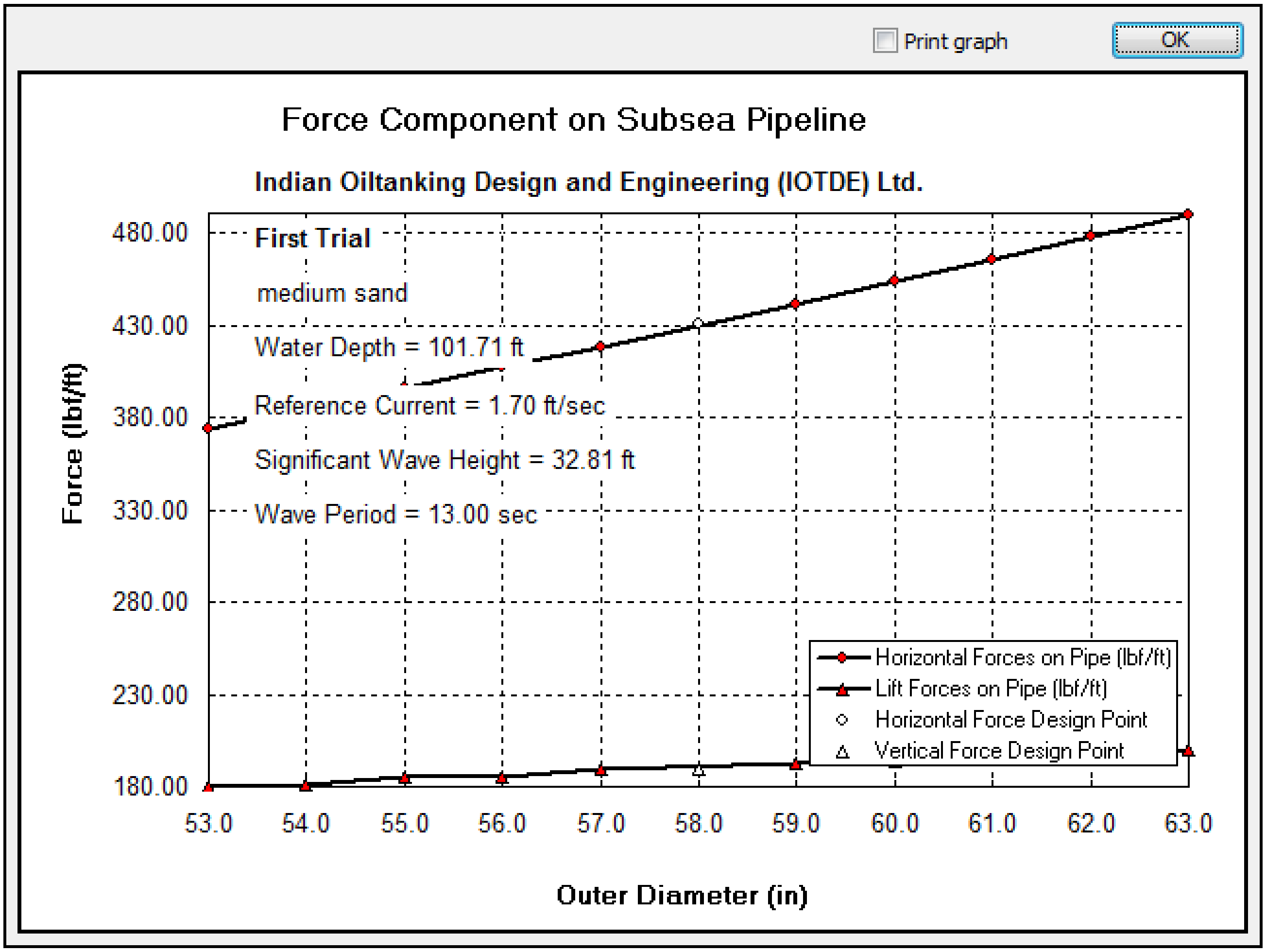


FIGURE 11 – Horizontal and Vertical Forces on User-Selected Range of Pipe Diameters

(For the Conditions Just Analyzed)

STA BOTSTAB2: On-Bottom Stability of Pipes	Date of run:	8/27/2008	**file name: BOTSTAB2:XLS Revised 08/10/08**

This software has been developed by: Stewart Technology Associates, Houston, Texas. Tel: (832) 472-2811; Fax: (713) 583-2058; info@stewart-usa.com

Version 2, Rev 1.1 - RP-F109 Computations still under Development. Revision Date: 08/27/08

Run Ref:	**Indian Oiltanking Design and Engineering (IOTDE) Ltd.**	Print Page 1 / Print Page 2 / Print All
Conditions &	**Second Trial**	Show Graphs / Select Sea Bed Soil Type
Pipe Info.:	**48" OD Oil Pipeline with Concrete Weight Coating**	

This program determines the on-bottom stability of a submarine pipe in accordance with the Veritec Recommended Practice "On-Bottom Stability of Submarine Pipelines", October 1988.

The program allows the user to input the design variables in the shaded cells. Using the data from the shaded cells the program calculates the velocities due to the current and waves.

From the calculated velocity the lift, drag and inertia forces on the pipe are determined. The required weight for the pipe is displayed above the actual submerged weight of the pipe

which is supplied by the user. If the required weight of the pipe is larger than the actual submerged weight a warning is given cautioning the user of potential stability problems.

metric units below	*User Defined Variables (in yellow shaded cells only)*					**normal flow regime**
1.2192 m	**48.00 in**	Pipe OD (Before Coating)	**1.0**	1.5594 m	**61.39 in**	Effective Pipe OD (includes reduction for penetration)
203.20 mm	**8.00 in**	Coating Thickness	**Penetration Switch**	31.00 m	**101.71 ft**	d, water depth
3043 kg/m^3	**190.0 lbf/ft^3**	Coating Density	**1 = ON, 0 = OFF**	0.254 m	**10.00 in**	diameter range for stability info. on other pipes
2132.86 kgf/m	**1432.81 lbf/ft**	Ws, submerged weight of pipe & con	Ref. current = 1.01 knot	0.52 m/sec	**1.70 ft/sec**	Ur, reference current velocity at elevation z_r
1025 kg/m^3	**64.00 lbf/ft^3**	pw, mass density of water		5.00 m	**16.40 ft**	z_r, elevation above sea bed for ref. current
10.00 m	**32.81 ft**	Hs, significant wave height		0.90	**0.90**	C_l, lift force coefficient (typical = 0.90)
3.00 hr	**3.00 hr**	Sea state duration in hours		1.20	**1.20**	C_d, drag coeff. (typ. 1.2 for sub-crit flow, 0.7 oscill.)
13.00 sec	**13.00 sec**	Tp, spectral peak period of surface waves		3.29	**3.29**	C_i, inertial coeff. (typical = 3.29)
no	**n**	Wave spreading (yes or no)		0.70	**0.70**	u_s, friction factor for soil (typical 0.7 for sand)
0º	**0º**	θ º, Wave Direction (0º to 90º, 0º gives max)		5.76E+05	5.76E+05	Re, Reynolds no. based on current and pipe diam.
3.3	**3.3**	gamma, peakedness parameter (1.0 for PM)		soil type	4	**Select Sea Bed Soil Type**
Show Graphs	*Tabulated Results - Using Veritec RP E305*			**Print All**		**medium sand**

Variables Used to Calculate Velocity Due to Wave Motion and Due to Current, Separately and Combined					
1.78 sec	1.78 sec	Tn, =sqrt(d/g), "natural period"	*Soil Properties in Accordance with Veritec RP E305 (medium sand)*		
0.137	0.137	Tn/Tp, ratio of natural/wave period	0.50 mm	0.020 in	d_{50}, mean grain size
3.69 m	12.10 ft	A_0, orbital semi-diameter of particle velocity	4.17E-05 m	4.17E-05 ft	z_0, bottom roughness parameter
0.00	0.00	K_b, Nikuradse's equiv. sand roughness param.	0.81	0.81	U_D/U_r velocity reduction factor for steady current
15.70	15.70	K, Keulegan Carpenter number = UsTu/D	119873	119873	z_r/z_0, ratio
2951	2951	A_0/K_b, ratio	106.08	106.08	z_{0a}/z_0, ratio of apparent to bottom roughness
0.96 m/sec^2	3.15 ft/sec^2	As, significant acceleration	3.63	3.63	U_S/U_r ratio of significant to reference velocity
0.335	0.335	(Us*Tn)/Hs, dependent on gamma and Tn/Tp	37395	37395	D/z_0, ratio of pipe diameter to bottom roughness
3998.98	3998.98	z_r/K_b, ratio	0.69	0.69	U_D/U_r velocity reduc. factor for waves & current
1.8827 m/s	6.18 ft/sec	Us*, significant water velocity	2.24E-01	2.24E-01	M, current to wave velocity ratio = UD/Us
3.61 m/s	11.85 ft/sec	U*, osc.vel.amp.single design oscillation	**0.42 m/s**	**1.39 ft/sec**	V (F109) = UD (E305)
0.95	0.95	Tu/Tp, dependent on gamma and Tn/Tp	4.42E-03 m	1.45E-02 ft	z0a, apparent roughness
0.14	0.14	Tn/Tu	877	877	τ, number of waves in the sea state
1.21	1.21	kt, Eq.3.16, depends on gamma	1.919	1.919	ku, ratio between design single oscillation amplitude a
1.88	1.88	T*, period associated with a single design oscillation	19.19 m	62.96 ft	H*, maximum wave height in the sea state
12.31 sec	12.31 sec	Tu, zero-up-crossing period	4.36	4.36	K*, Keulegan Car.no. single design oscillation=U*T*/D
1.00	1.00	R, wave direction & spreading reduc. fact.	**0.69**	**0.69**	UD/Ur velocity reduc. factor for waves & current
1.883 m/s	**6.18 ft/sec**	Us, sig. velocity due to wave motion	**0.36 m/s**	**1.18 ft/sec**	Ud, ave. veloc. over pipe from waves & current
29º	29º	phase angle in wave for max force	1.58	1.58	Fw, calibration factor, inc. safety factor of 1.1
213.27 kgf	470.26 lbf	horizontal force	2040.4 kgf/m	**1371 lbf/ft**	**Required submerged weight**
90.01 kgf	198.48 lbf	lift force	20016 N/m	**Pipe is Stable**	

FIGURE 12 – System Re-Analyzed With Much Heavier Concrete Coating (probably at the limit of coating possibilities using current technology).

Clean Graphs		***Tabulated Results - Using DNV-RP-F109 Generalized Lateral Stability Method***			Show Graphs
		This Area is For Stability On Sand (RP-F109)			
	7.386E+00	L, significant weight parameter = Ws/(0.5 ρw D Us^2)		**K>10, use Lstable1**	
288.8 kgf/m	194.14 lbf/ft	Denom = 0.5.ρw.D.Us^2			
	7.144E+00	Lstable1/(2 + M)^2	2061.8 kgf/m	**1386 lbf/ft**	**Required Stable Submerged Weight1**
	6.482E+00	Lstable2	1870.7 kgf/m	**1257 lbf/ft**	**Required Stable Submerged Weight2**
	3.321E+00	L10_1000_waves	958.5 kgf/m	**644 lbf/ft**	**Minimum pipe weight required to limit the lateral displacement to 10 pipe diameters (1000 waves)**
	2.180E+00	L10_500_waves	629.3 kgf/m	**423 lbf/ft**	**Minimum pipe weight required to limit the lateral displacement to 10 pipe diameters (500 waves)**
	0.01559	N, spectral acceleration factor, Us/(g Tu)	2062.8 kgf/m	**1387 lbf/ft**	**=Lstable1/(2+M)^2*Denom**
	2.15	sg, pipe specific weight =1 + (2/pi).(N.K.L)		**1.05<sg<3, method is OK**	
7000 N/m^3	45 lbf/cuft	γ's Submerged unit soil weight. For sand normally in the range 7 000 (very loose) to 13 500 N/m^3 (very dense).			
0.814	0.814	κs_initial, initial stiffness for penetration calculation			
0.0425	0.0425	zpi/D, initial penetration ratio	35.34	**Lstable**	
0.066 m	2.61 in	Initial Penetration (User may wish to reduce the pipe diameter to account for the penetration)			
		This Area is For Stability On Clay (RP-F109) and still needs testing			
2394 N/m^2	**50 psf**	su, undrained shear strength			
18000 N/m^3	115 lbf/cuft	γs Submerged unit soil weight. For clay can be taken as 18 000 N/m^3			
0.0853	0.0853	G, clay soil strength parameter			
0.1784	0.1785	κc_initial, initial stiffness for penetration calculation			
0.0931	0.0931	zpi/D, initial penetration ratio			
0.145 m	5.71 in	Initial Penetration (User may wish to reduce the pipe diameter to account for the penetration)			
0.2904	0.2904	**F(M)**	0.146	C1	
	1.47	L10/(2+M)^2	6.07	C2	
	12.32	Kb	0.55	C3	* On stiff clays this result may be conservative.
	7.766E+00	Lstable1	2241.4 kgf/m	**1506 lbf/ft** *	**Required Stable Submerged Weight1***
	1.469E+00	L10	423.9 kgf/m	**285 lbf/ft**	**Minimum pipe weight required to limit the lateral displacement to 10 pipe diameters**

FIGURE 13 – Results Using F109 (for case shown in Figure 12)

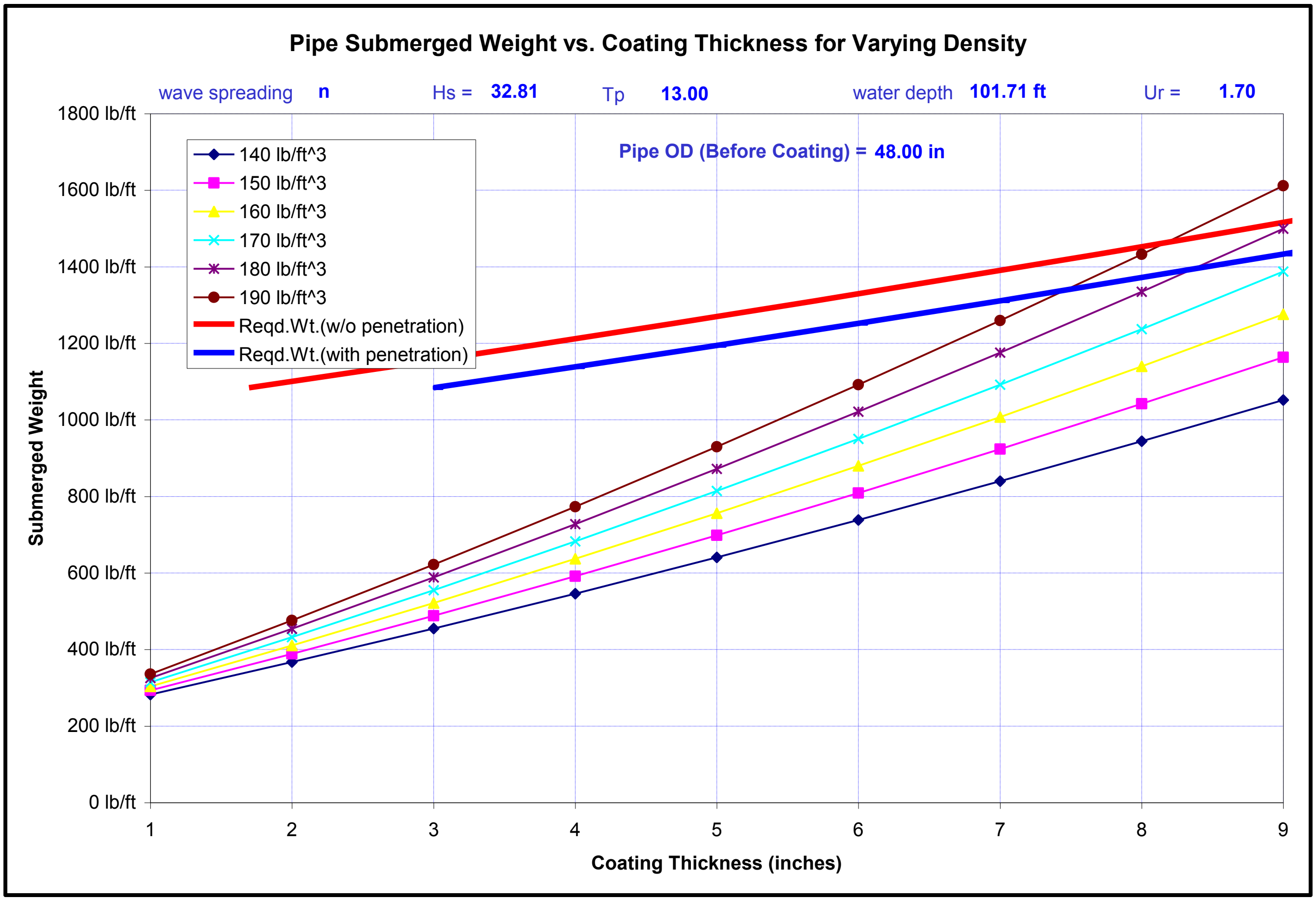


FIGURE 14 – Relationships Between Coating Thicknesses, Concrete Densities and Stable Pipe Required Wt/Ft.

3.0 VERIFICATION

STA BOTSTAB was initially compared to the examples given in E305 and it was verified that it was providing correct answers.

STA BOTSTAB2 shows similar answers for calculated stable pipe sizes using the E305 methodology and the new F109 methods that have been implemented.

4.0 USERS

STA has used STA BOTSTAB for the 15, or so, years since it was developed. During this time a few (less than 10) other companies have purchased a license for the program.