

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
*754	101M&TS	BOONE	95	48
STA.		TO STA.		
FED. ROAD DIST. NO.		ILLINOIS	FED. AID PROJECT	

# SHAFT ANALYSIS

**BROM'S OVERTURNING & TORSION SHAFT ANALYSIS**  
 I.D.O.T. BBS CENTRAL GEOTECHNICAL UNIT Modified on 9/1/2005

38 foot mast arm

TOTAL MOMENT APPLIED AT TOP OF SHAFT ===== KIP-FT (POSITIVE BEING CLOCKWISE)  
 TOTAL SHEAR APPLIED AT TOP OF SHAFT ===== KIPS (POSITIVE TO THE RIGHT)  
 TOTAL TORQUE APPLIED AT TOP OF SHAFT ===== FT-KIPS  
 DIAMETER OF FOUNDATION SHAFT ===== FT. (WHICH IS A 30 IN. DIAMETER)  
 DEPTH BELOW SURFACE TO WATERTABLE ===== FT. (MUST BE PLACED BETWEEN SOIL LAYERS)  
 DEPTH OF FROST/DISTURBED SOIL BELOW SURFACE ===== FT. (MUST BE PLACED BETWEEN SOIL LAYERS) (FOR TORQUE ANALYSIS)  
 DEPTH OF NEGLECTED SOIL PRESSURE (1.5x DIA) ===== FT. (PLACE BETWEEN LAYERS) (FOR COHESIVE LAYERS/MOMENT ANALYSIS)  
 CRITICAL SURFACE CROSS SLOPE IN A 15' RADIUS ===== DEG. (WHICH IS A -3.01: 1' SLOPE)  
 FACTOR OF SAFETY FOR OVERTURNING ===== F.S. (REDUCES SOIL SHEAR STRENGTH BY 69.0%)  
 FACTOR OF SAFETY FOR TWISTING ===== F.S. (REDUCES SKIN FRICTION RESISTING TORQUE BY 11.3%)

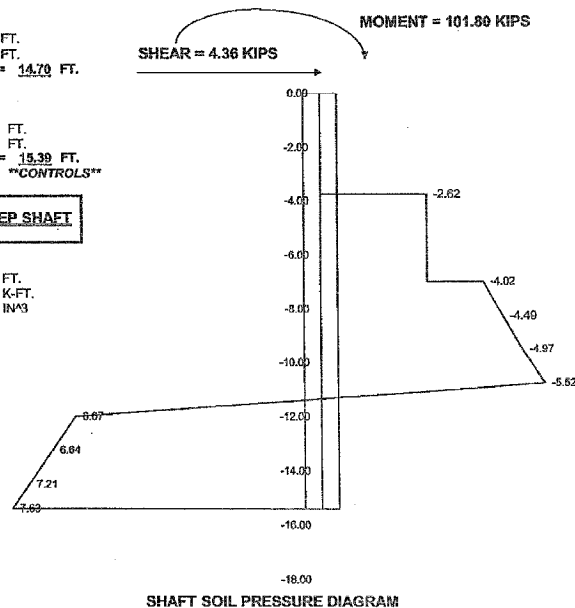
LAYER THICK (FT)	COHES. INTER. (KSF)	S.P.T. BLOWS (N)	FRICTION ANGLE (DEG)	UNIT WEIGHT (PCF)	BOUYANT SOIL PRESSURE (K/FT)	SUM SHEAR (KIPS)	SUM MOMENT (KIP-FT)	SUM TORQUE (FT-K)
AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER
1	3.00	0.0	115.7	115.7	0.000	4.360	101.800	66.000
2	0.75	0.0	121.5	59.1	0.000	4.360	114.880	86.000
3		0.0	115.7	53.3	-2.620	4.360	118.150	93.127
4		0.0	115.7	53.3	-2.620	2.986	120.893	91.332
5		0.0	115.7	53.3	-2.620	-0.890	121.630	88.340
6		28.1	115.7	53.3	-4.019	-4.154	118.484	85.347
7		28.1	115.7	53.3	-4.493	-9.475	110.028	80.127
8		31.6	124.2	61.8	-4.967	-15.381	94.571	71.320
9		31.6	124.2	61.8	-5.517	-21.933	71.320	40.895
10		32.9	126.9	64.5	6.066	-23.233	40.895	16.742
11		32.9	126.9	64.5	6.640	-15.292	16.742	2.964
12		33.5	128.0	65.6	7.214	-6.633	2.964	-0.027
13		33.5	128.0	65.6		0.000		
14		33.5	128.0	65.6				
15		33.8	128.5	66.1				
16		33.8	128.5	66.1				
17		33.2	127.5	65.1				
18		33.2	127.5	65.1				

LAYER OF ZERO TORQUE ===== 12  
 DISTANCE THRU LAYER ===== 0.20 FT.  
 SUM OF LAYERS ABOVE ===== 14.50 FT.  
 LENGTH TO RESIST "TORQUE" WITH F.S. ===== 14.70 FT.

LAYER OF ZERO MOMENT ===== 13  
 DISTANCE THRU LAYER ===== 0.00 FT.  
 SUM OF LAYERS ABOVE ===== 15.39 FT.  
 LENGTH TO RESIST "MOMENT" WITH F.S. ===== 15.39 FT.  
 \*\*CONTROLS\*\*

USE 30.0 IN. DIAMETER, 15.39 FT. DEEP SHAFT

SHAFT ROTATION DEPTH ===== 11.500 FT.  
 MAXIMUM MOMENT ===== 121.78 K-FT.  
 MIN. REQ'D SECT. MODULUS ===== 73.80 IN<sup>3</sup>



BROMS SHAFT FOUNDATION ANALYSIS Broms Overturning Torsion Shaft.xls

4/19/2006

**BROM'S OVERTURNING & TORSION SHAFT ANALYSIS**  
 I.D.O.T. BBS CENTRAL GEOTECHNICAL UNIT Modified on 9/1/2005

38 foot mast arm

TOTAL MOMENT APPLIED AT TOP OF SHAFT ===== KIP-FT (POSITIVE BEING CLOCKWISE)  
 TOTAL SHEAR APPLIED AT TOP OF SHAFT ===== KIPS (POSITIVE TO THE RIGHT)  
 TOTAL TORQUE APPLIED AT TOP OF SHAFT ===== FT-KIPS  
 DIAMETER OF FOUNDATION SHAFT ===== FT. (WHICH IS A 36 IN. DIAMETER)  
 DEPTH BELOW SURFACE TO WATERTABLE ===== FT. (MUST BE PLACED BETWEEN SOIL LAYERS)  
 DEPTH OF FROST/DISTURBED SOIL BELOW SURFACE ===== FT. (MUST BE PLACED BETWEEN SOIL LAYERS) (FOR TORQUE ANALYSIS)  
 DEPTH OF NEGLECTED SOIL PRESSURE (1.5x DIA) ===== FT. (PLACE BETWEEN LAYERS) (FOR COHESIVE LAYERS/MOMENT ANALYSIS)  
 CRITICAL SURFACE CROSS SLOPE IN A 15' RADIUS ===== DEG. (WHICH IS A -3.01: 1' SLOPE)  
 FACTOR OF SAFETY FOR OVERTURNING ===== F.S. (REDUCES SOIL SHEAR STRENGTH BY 69.0%)  
 FACTOR OF SAFETY FOR TWISTING ===== F.S. (REDUCES SKIN FRICTION RESISTING TORQUE BY 11.3%)

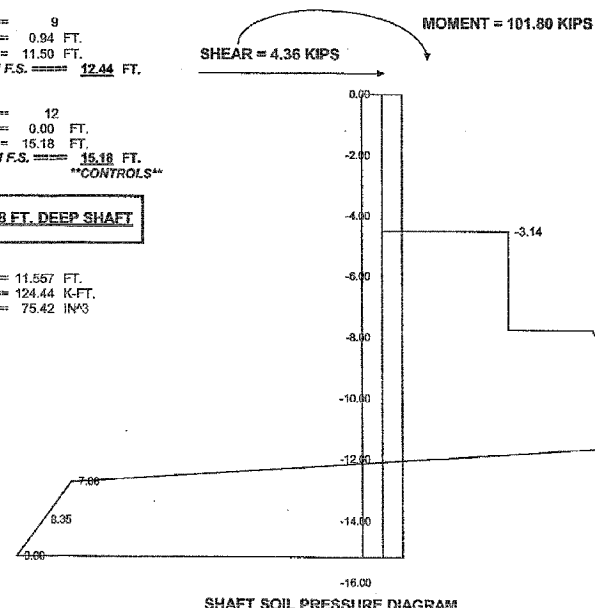
LAYER THICK (FT)	COHES. INTER. (KSF)	S.P.T. BLOWS (N)	FRICTION ANGLE (DEG)	UNIT WEIGHT (PCF)	BOUYANT SOIL PRESSURE (K/FT)	SUM SHEAR (KIPS)	SUM MOMENT (KIP-FT)	SUM TORQUE (FT-K)
AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER	AT TOP / AT BOT. OF EACH LAYER
1	3.00	0.0	115.7	115.7	0.000	4.360	101.800	66.000
2	1.50	0.0	121.5	59.1	0.000	4.360	114.880	121.420
3		0.0	115.7	53.3	-3.144	4.360	121.420	123.806
4		0.0	115.7	53.3	-3.144	2.002	123.806	123.806
5		0.0	115.7	53.3	-3.144	-1.927	123.853	118.957
6		28.1	115.7	53.3	-5.201	-5.770	118.957	107.454
7		28.1	115.7	53.3	-5.770	-12.714	107.454	86.931
8		31.6	124.2	61.8	-6.339	-19.275	86.931	56.464
9		31.6	124.2	61.8	-6.998	-26.610	56.464	25.322
10		32.9	126.9	64.5	7.658	-20.273	25.322	6.143
11		32.9	126.9	64.5	8.346	-10.270	6.143	-0.015
12		33.5	128.0	65.6				
13		33.5	128.0	65.6				
14		33.5	128.0	65.6				
15		33.8	128.5	66.1				
16		33.8	128.5	66.1				
17		33.2	127.5	65.1				
18		33.2	127.5	65.1				

LAYER OF ZERO TORQUE ===== 9  
 DISTANCE THRU LAYER ===== 0.94 FT.  
 SUM OF LAYERS ABOVE ===== 11.50 FT.  
 LENGTH TO RESIST "TORQUE" WITH F.S. ===== 12.44 FT.

LAYER OF ZERO MOMENT ===== 12  
 DISTANCE THRU LAYER ===== 0.00 FT.  
 SUM OF LAYERS ABOVE ===== 15.18 FT.  
 LENGTH TO RESIST "MOMENT" WITH F.S. ===== 15.18 FT.  
 \*\*CONTROLS\*\*

USE 36.0 IN. DIAMETER, 15.18 FT. DEEP SHAFT

SHAFT ROTATION DEPTH ===== 11.567 FT.  
 MAXIMUM MOMENT ===== 124.44 K-FT.  
 MIN. REQ'D SECT. MODULUS ===== 75.42 IN<sup>3</sup>



BROMS SHAFT FOUNDATION ANALYSIS Broms Overturning Torsion Shaft.xls

4/19/2006

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