

HDD Installation Stress Analysis

ASCE MOP 108 / PRCI PR-227-9424 Engineering Analysis Report

PROJECT NAME

Demo - Case #1

CLIENT

ABC Pipeline

CALCULATED BY

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DATE

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HORIZONTAL DIRECTIONAL DRILLING (HDD)

Engineering Analysis Report

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1. GEOMETRY ANALYSIS

1.1 Input Parameters

Entry Parameters

Entry Station:	0+00.00
Entry Elevation:	0.00 ft
Entry Angle:	12.00°
Entry Radius:	2,000 ft
Bottom Elevation:	-60.00 ft

Exit Parameters

Exit Station:	15+00.00
Exit Elevation:	0.00 ft
Exit Angle:	10.00°
Exit Radius:	2,000 ft

1.2 Profile Summary

Point on Profile	Station	Elevation (ft)
Entry Point	0+00.00	0.00
Entry PC	0+76.66	-16.30
Entry PT	4+92.49	-60.00
Exit PC	9+84.75	-60.00
Exit PT	13+32.04	-29.62
Exit Point	15+00.00	0.00
Total Length	1500.0 ft	
HDD Measured Distance	1509.1 ft	

2. PULL FORCE ANALYSIS

2.1 Pipe Specifications

Pipe Properties

Outside Diameter:	16.000 in
Wall Thickness:	0.375 in
Pipe Grade:	Grade B
SMYS:	35,000 psi
Elastic Modulus:	29,500,000 psi
Water Filled:	No

Mud Properties

Mud Density:	11.5 lb/gal
Drag Coefficient:	0.050 lb/in ²

2.2 Pull Force Calculations

Segment	Length (ft)	F _{friction} (lb)	F _{drag} (lb)	F _{weight} (lb)	ΔT (lb)	T _{cumulative} (lb)
Section 1 - Exit Tangent	170.5	2,896	5,144	1,702	9,742	9,742
Section 2 - Exit Curve	349.1	9,129	10,528	1,749	21,405	31,147
Section 3 - Bottom Tan- gent	492.3	8,488	14,846	0	23,334	54,481
Section 4 - Entry Curve	418.9	13,460	12,633	2,517	23,576	78,057
Section 5 - Entry Tangent	78.4	1,322	2,364	937	2,749	80,806

Total Estimated Pull Force

80,806 lb

(40.4 tons)

3. INSTALLATION STRESS ANALYSIS

3.1 Critical Point Analysis

Point	Station	Depth (ft)	Tension (lb)	f_t (psi)	f_b (psi)	f_h (psi)	Com- bined All	Status
Exit Point	15+00.00	0.00	0	0	0	0	0.000	PASS
Exit PT	13+32.04	29.62	9,742	529	9,833	377	0.142	PASS
Exit PC	9+84.75	60.00	31,147	1,692	0	765	0.011	PASS
Entry PT	4+92.49	60.00	54,481	2,960	0	765	0.019	PASS
Entry PC	0+76.66	16.30	78,057	4,240	9,833	208	0.256	PASS
Entry Point	0+00.00	0.00	80,806	4,390	0	0	0.025	PASS

4. DETAILED STRESS CALCULATIONS

Exit Point - Station 15+00.00

Depth: 0.00 ft

Tension: 0 lb

Straight Section

Stress Type	Calculated	Allowable	Unity Check	Status
Tensile (f_t)	0 psi	31,500 psi	0.000	PASS
Bending (f_b)	0 psi	26,250 psi	0.000	PASS
Hoop (f_h)	0 psi	9,507 psi	0.000	PASS
Combined All	$A^2 + B^2 + vAB$		0.000	PASS

Exit PT - Station 13+32.04

Depth: 29.62 ft

Tension: 9,742 lb

Radius: 2,000 ft

Stress Type	Calculated	Allowable	Unity Check	Status
Tensile (f_t)	529 psi	31,500 psi	0.017	PASS
Bending (f_b)	9,833 psi	26,250 psi	0.375	PASS
Hoop (f_h)	377 psi	9,507 psi	0.040	PASS
Combined All	$A^2 + B^2 + vAB$		0.142	PASS

Exit PC - Station 9+84.75

Depth: 60.00 ft

Tension: 31,147 lb

Straight Section

Stress Type	Calculated	Allowable	Unity Check	Status
Tensile (f_t)	1,692 psi	31,500 psi	0.054	PASS
Bending (f_b)	0 psi	26,250 psi	0.000	PASS
Hoop (f_h)	765 psi	9,507 psi	0.080	PASS
Combined All	$A^2 + B^2 + vAB$		0.011	PASS

4.1 Detailed Stress Calculations (Continued)

Entry PT - Station 4+92.49

Depth: 60.00 ft

Tension: 54,481 lb

Straight Section

Stress Type	Calculated	Allowable	Unity Check	Status
Tensile (f_t)	2,960 psi	31,500 psi	0.094	PASS
Bending (f_b)	0 psi	26,250 psi	0.000	PASS
Hoop (f_h)	765 psi	9,507 psi	0.080	PASS
Combined All	$A^2 + B^2 + 2vAB$		0.019	PASS

Entry PC - Station 0+76.66

Depth: 16.30 ft

Tension: 78,057 lb

Radius: 2,000 ft

Stress Type	Calculated	Allowable	Unity Check	Status
Tensile (f_t)	4,240 psi	31,500 psi	0.135	PASS
Bending (f_b)	9,833 psi	26,250 psi	0.375	PASS
Hoop (f_h)	208 psi	9,507 psi	0.022	PASS
Combined All	$A^2 + B^2 + 2vAB$		0.256	PASS

Entry Point - Station 0+00.00

Depth: 0.00 ft

Tension: 80,806 lb

Straight Section

Stress Type	Calculated	Allowable	Unity Check	Status
Tensile (f_t)	4,390 psi	31,500 psi	0.139	PASS
Bending (f_b)	0 psi	26,250 psi	0.000	PASS
Hoop (f_h)	0 psi	9,507 psi	0.000	PASS
Combined All	$A^2 + B^2 + 2vAB$		0.025	PASS

5. ANALYSIS SUMMARY

Overall Status

PASS

All stress checks within allowable limits

Critical Values

Max Unity Check:

0.256

Critical Point:

Entry PC

Unity Check Limit:

1.000

6. CONCLUSIONS AND RECOMMENDATIONS

Design Verification

The HDD design meets all structural requirements

- All unity checks are below 1.0
- Tensile stresses are within allowable limits
- Bending stresses are acceptable for the selected radii
- External hoop stresses are within buckling limits
- The selected pipe grade (Grade B) is adequate

Key Design Parameters Summary

Total HDD Length:	1500.0 ft
Maximum Depth:	60.00 ft
Estimated Pull Force:	80,806 lb
Pipe Specification:	Grade B, 16.000" OD × 0.375" WT