

API RP 1102 Analysis Report

Steel Pipelines Crossing Railroads and Highways

PROJECT NAME

Demo - Case #1

CLIENT

ABC Pipeline

CALCULATED BY

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DATE

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API RP 1102 PIPELINE CROSSING ANALYSIS

Highway Crossing

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1. EXECUTIVE SUMMARY

OVERALL COMPLIANCE STATUS

PASS

All four design checks satisfied per API RP 1102

1.1 Design Check Summary

Design Check	Actual	Allowable	Unit	Status
1. Barlow Hoop Stress	25500.00	30240.00	psi	PASS
2. Von Mises Effective Stress	27046.60	30240.00	psi	PASS
3. Girth Weld Fatigue	1024.59	8640.00	psi	PASS
4. Longitudinal Weld Fatigue	1461.53	15120.00	psi	PASS

1.2 Pipeline Overview

Pipe Specification

OD x WT:	12.750 x 0.250 in
Grade:	X42
SMYS:	42,000 psi
Design Pressure:	1,000 psi

Installation

Crossing Type:	Highway Crossing
Pipeline Depth:	6.00 ft
Class Location:	Class 1
Design Factor:	0.72

2. INPUT PARAMETERS

2.1 Pipe Properties

Parameter	Symbol	Value	Unit
External Diameter	D	12.750	in
Wall Thickness	t_w	0.250	in
Pipe Grade	-	X42	-
Specified Min. Yield Strength	$SMYS$	42,000	psi
Design Pressure	P	1,000	psig
Class Location	-	Class 1	-
Design Factor	F	0.72	-
Longitudinal Joint Factor	E	1.00	-
Poisson's Ratio	ν	0.30	-

2.2 Earth Load Parameters

Parameter	Symbol	Value	Unit
Pipeline Depth	H	6.00	ft
Bored Diameter	B_d	14.75	in
Soil Type (Fig 4)	-	A - Loose/Soft	-
Unit Weight of Soil	γ	120.0	lbm/ft ³
Modulus of Soil Reaction	E'	0.50	ksi
Soil Resilient Modulus	E_r	10.0	ksi
Stiffness Factor (Fig 3)	K_{he}	3,069	-
Burial Factor (Fig 4)	B_c	1.09	-
Excavation Factor (Fig 5)	E_e	1.10	-

2.3 Highway Live Load Parameters

Parameter	Symbol	Value	Unit
Design Tandem Wheel Load	P_t	10,000	lbf
Contact Area	A_p	144	in ²
Impact Factor (Fig 7)	F_i	1.47	-

2.4 Highway Cyclic Stress Factors

Parameter	Symbol	Value	Unit
Stiffness Factor - Circ. (Fig 14)	K_{Hh}	14.3	-
Geometry Factor - Circ. (Fig 15)	G_{Hh}	1.00	-
Stiffness Factor - Long. (Fig 16)	K_{Lh}	9.8	-
Geometry Factor - Long. (Fig 17)	G_{Lh}	1.02	-
Axle Configuration Factor	L	1.00	-
Pavement Type Factor	R	1.00	-

2.5 Fatigue Endurance Limits

Parameter	Symbol	Value	Unit
Girth Weld Endurance Limit	S_{FG}	12,000	psi
Longitudinal Weld Endurance Limit	S_{FL}	21,000	psi

3. CALCULATION RESULTS

3.1 Intermediate Calculated Values

Parameter	Formula	Value	Unit
Barlow Hoop Stress	$S_{hi} = P \cdot D / (2 \cdot t_w)$	25,500	psi
Allowable Hoop Stress	$S_a = F \cdot E \cdot SMYS$	30,240	psi
Earth Load Circ. Stress	$S_{he} = K_{he} \cdot B_c \cdot E_e \cdot \gamma \cdot D$	3261.20	psi
Surface Pressure	$w = P_t / A_p$	69.44	psi
Thin-Wall Hoop Stress	$S_{hi} = P \cdot (D - t_w) / (2 \cdot t_w)$	25,000	psi
Cyclic Circ. Stress	ΔS_{Hh}	1461.53	psi
Cyclic Long. Stress	ΔS_{Lh}	1024.59	psi

3.2 Principal Stresses & Von Mises

Parameter	Formula	Value	Unit
Principal Stress 1	$S_1 = S_{he} + \Delta S_H + S_{hi}$	29,723	psi
Principal Stress 2	$S_2 = \Delta S_L + \nu \cdot (S_{he} + S_{hi})$	9,503	psi
Principal Stress 3	$S_3 = -P$	-1,000	psi
Von Mises Effective Stress	$S_{eff} = \sqrt{(S_1^2 - S_1 \cdot S_3 + S_3^2)}$	27,047	psi
Allowable Effective Stress	$S_a = F \cdot SMYS$	30,240	psi

3.3 Fatigue Stress Summary

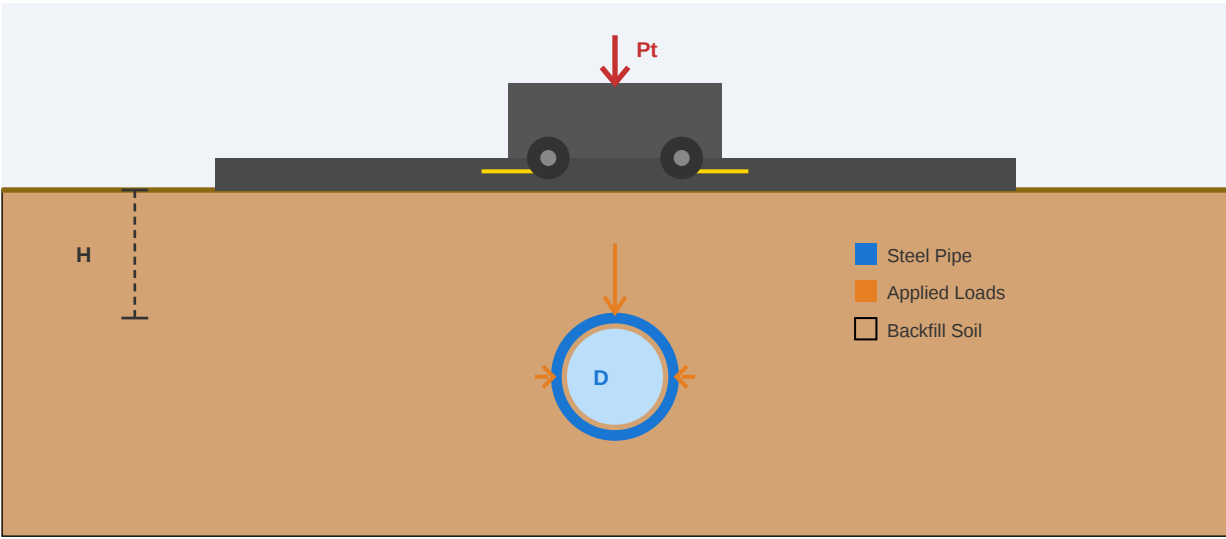
Parameter	Formula	Value	Unit
Girth Weld Cyclic Stress	ΔS_{Lh}	1024.59	psi
Girth Weld Allowable	$S_{FG} \cdot F$	8,640	psi
Long. Weld Cyclic Stress	ΔS_{Hh}	1461.53	psi
Long. Weld Allowable	$S_{FL} \cdot F$	15,120	psi

4. DESIGN CHECK VERIFICATION

4.1 Design Check Summary

Design Check	Acceptance Criterion	Actual (psi)	Allowable (psi)	Status
Barlow Hoop Stress	$S_{hi} = P \cdot D / (2 \cdot t_w) \leq F \cdot E \cdot SMYS$	25,500	30,240	PASS
Von Mises Effective Stress	$S_{eff} = \sqrt{(S_1^2 - S_1 \cdot S_3 + S_3^2)} \leq F \cdot SMYS$	27,047	30,240	PASS
Girth Weld Fatigue	$\Delta S_{Lh} \leq S_{FG} \cdot F$	1024.59	8,640	PASS
Longitudinal Weld Fatigue	$\Delta S_{Hh} \leq S_{FL} \cdot F$	1461.53	15,120	PASS
Overall Result				PASS

4.2 Cross-Section Diagram — Highway Crossing



5. CONCLUSIONS AND RECOMMENDATIONS

API RP 1102 Highway Crossing Analysis — COMPLIANT

All four design checks are satisfied. The pipeline design meets API RP 1102 requirements for highway crossing.

Construction Recommendations

1. Maintain minimum cover depth of 6.0 ft during construction
2. Use proper backfill material and compaction procedures per API RP 1102
3. All girth welds shall be inspected per applicable standards
4. Monitor pipeline for settlement after construction
5. Conduct post-construction integrity verification