Structure Inventory and Appraisal Sheet

Bridge Key: 021561 Agency ID: 021561 Sufficiency Rating: 50.3

IDENTIFICATION

State 1: 72 Puerto Rico Struc Num 8: 021561
Facility Carried 7: ITURREGUI AVENUE Location 9: ITURREGUI AVENUE
Rte.(On/Under)5A: Route On Structure Rte. Signing Prefix 5B: 5 City Street
Level of Service 5C: 0 None of the below Rte. Number 5D: 00000
Directional Suffix 5E: 0 N/A (NBI) % Responsibility : NA
SHD District 2: 01 County Code 3: 031
Place Code 4: 14290 Kilometer Post 11: 00.2 km
Feature Intersected 6: ITURREGUI CHANNEL
Latitude 16: 18d 25' 24" Longitude 17: 065d 59' 30"
Border Bridge Code 98: Unknown (P)
Border Bridge Number 99: Unknown

INSPECTION

Frequency 91: 24 months Inspection Date 90: 8/2/2005 Next Inspection: 08/02/2007
FC Frequency 92A: NA FC Inspection Date 93A: NA Next FC Inspection: NA
UW Frequency 92B: NA UW Inspection Date 93B: NA Next UW Inspection: NA
SI Frequency 92C: NA SI Date 93C: NA Next SI: NA
Element Frequency: 24 months Element Inspection Date: 08/02/2005 Next Elem. Insp. Due: 08/02/2007

CLASSIFICATION

Defense Highway 100: 0 Not a STRAHNET hwy Parallel Structure 101: No || bridge exists
Direction of Traffic 102: 2 2-way traffic Temporary Structure 103: Unknown (NBI)
Highway System 104: 0 Not on NHS NBIS Length 112: Long Enough
Toll Facility 20: 3 On free road Functional Class 26: 16 Urban Minor Arterial
Historical Significance 37: 5 Not eligible for NRHP
Owner 22: 01 State Highway Agency
Custodian 21: 01 State Highway Agency

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 5
Main Span Material/Design 43A/B:
2 Concrete Continuous 01
Deck Type 107: 1 Concrete-Cast-in-Place
Wearing Surface 108A: 6 Bituminous
Membrane 108B: 0 None
Deck Protection 108C: None

CONDITION

Deck 58: 5 Fair Super 59: 5 Fair Sub 60: 6 Satisfactory
Culvert 62: N N/A (NBI) Channel/Channel Protection 61: 6 Bank Slumping

LOAD RATING AND POSTING

Inventory Rating Method 65: 5 No rating Operating Rating Method 63:5 No rating
Inventory Rating 66: MS12.5 Operating Rating 64: MS13.5
Design Load 31: Unknown (NBI) Posting 70: 5 At/Above Legal Loads
Posting status 41: A Open, no restriction

AGE AND SERVICE

Year Built 27: 1958 Year Reconstructed 106: Unknown
Type of Service on 42A: 5 Highway-pedestrian
Type of Service under 42B: 5 Waterway
Lanes on 28A: 4 Lanes Under 28B: 0 Detour Length 19: 2.0 km
ADT 29: 34,400 Truck ADT 109: 4 % Year of ADT 30: 2002

APPRAISAL

Bridge Rail 36A: 0 Substandard Approach Rail 36C: N N/A or not required
Transition 36B: N N/A or not required Approach Rail Ends 36D: N N/A or not required
Str. Evaluation 67: 5 Above Min Tolerable Deck Geometry 68: 2 Intolerable - Replace
Underclearance, Vertical and Horizontal 69: N Not applicable (NBI)
Waterway Adequacy 71: 4 Tolerable Approach Alignment 72: 7 Above Min Criteria
Scour Critical 113: Unknown (P)

GEOMETRIC DATA

Length Max Span 48: 4.40 m Structure Length 49: 21.50 m
Curb/Sdwlk Wdth L 50A: 2.70 m Curb/Sidewalk Width R 50B: 2.70 m
Width Curb to Curb 51: 12.10 m Width Out to Out 52: 18.30 m
Approach Roadway Width 32: (w/ shoulders) 12.10 m Median 33: 0 No median
Deck Area: 393.00 m²
Skew 34: 0.00 ° Structure Flared 35: 0 No flare
Minimum Vertical Clearance Over Bridge 53: 99.99 m
Minimum Vertical Underclearance Reference 54A: N Feature not hwy or RR
Minimum Vertical Underclearance 54B: 00.00 m
Minimum Lateral Underclearance Reference R 55A: N Feature not hwy or RR
Minimum Lateral Undrclearance R 55: 00.00 m
Minimum Lateral Undrclearance L 56: 00.00 m

PROPOSED IMPROVEMENTS

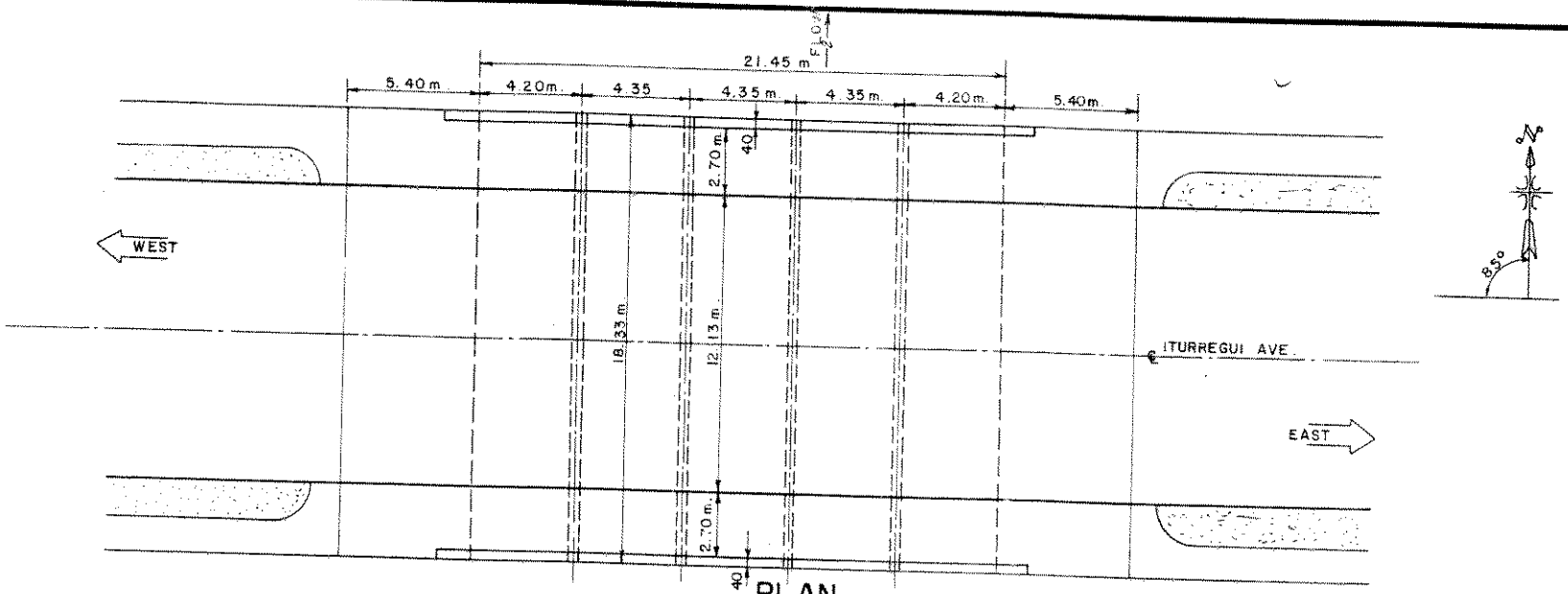
Bridge Cost 94: $ 547,000 Type of Work 75: 31 Repl-Load Capacity
Roadway Cost 95: $ 55,000 Length of Improvment 76: 29.70 m
Total Cost 96: $ 602,000 Future ADT 114: 42,036
Year of Cost Estimate 97: 2005 Year of Future ADT 115: 2020

NAVIGATION DATA

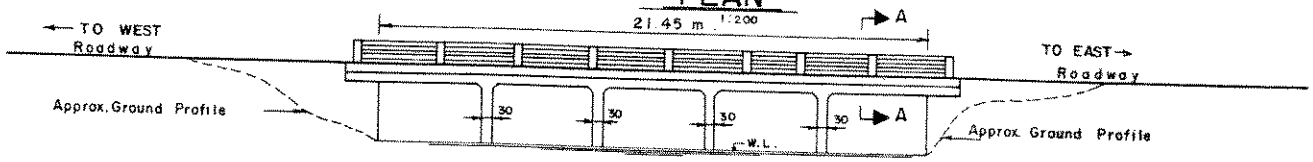
Navigation Control 38: 0 Permit Not Required
Vertical Clearance 39: 0.00 m Horizontal Clearance 40: 0.00 m
Pier Protection 111: 1 Not Required Lift Bridge Vertical Clearance 116:

ELEMENT CONDITION STATE DATA

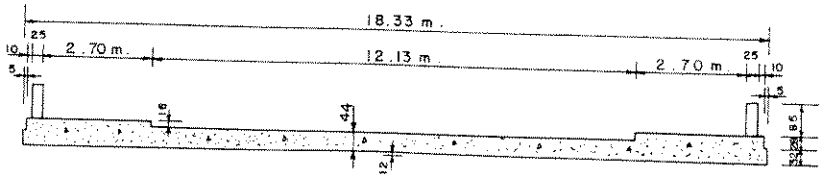
Str Unit	Elm/Env	Description	Units	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4	% in 5	Qty. St. 5
2	39/4	Unp Conc Slab/AC Ovl	sq.m.	393	100 %	393	0 %	0	0 %	0	0 %	0	0 %	0
2	210/4	R/Conc Pier Wall	m.	74	97 %	72	3 %	2	0 %	0	0 %	0	0 %	0
2	215/4	R/Conc Abutment	m.	38	89 %	34	11 %	4	0 %	0	0 %	0	0 %	0
2	331/4	Conc Bridge Railing	m.	43	65 %	28	7 %	3	28 %	12	0 %	0	0 %	0
2	359/4	Soffit Smart Flag	ea.	1	0 %	0	100 %	1	0 %	0	0 %	0	0 %	0



PLAN
1:200



ELEVATION
1:200



CROSS SECTION A-A
1:125

REVISED	HIGHWAY AND TRANSPORTATION AUTHORITY BRIDGE STUDIES AND EVALUATION OFFICE		
8/1993	BRIDGE OVER CREEK ITURREGUI AVE. CAROLINA		
2/1994			
	DRAWN BY: E. BENITEZ	4-17-75	BRIDGE NO. 2156 / DRWG. NO. 1
	CHECKED BY: G. VELASCO		
	APPROVED BY: S. LABOY		

3230 W. Commercial Boulevard
Suite 100
Fort Lauderdale, Florida 33309

FBPR Certificate of Authorization No. 24

ENGINEERING CALCULATIONS

DOCUMENT CONTROL	
Calc. No.:	**420010.00-0011-001**
File:	Tranvia (Carolina PR) Bridge Load Analysis.pdf
# Pages:	**146**

PROJECT INFORMATION	
Project:	Tranvia de Carolina (PR)
Subject:	Train Load Analysis on Existing Bridges
Element:	Bridge Load Rating

DESIGN	
Designed by:	Glenn F. Myers
Date:	7/14/06
Directed by:	Glenn F. Myers - FL PE #32644
QUALITY CONTROL	
Checked by:	
Date:	

REMARKS: ☐ Revised by Calculation No.:_____

Bridgers - Dairy:

Pages 1: Analysis Summary

Page 2-127: Bridge Load Analysis

Pages 128-137: Light Rail Vehicle Configurations

Pages 138-146: Existing Bridge Load Rating Reports

Tranvia de Carolina PR

Route Evaluation Study

Bridge Load Analysis

Bridge Number	Facility Description	Maximum Inventory Moment	Maximum Inventory Shear	Maximum ALRV Moment	Maximum ALRV Shear	Moment Rating Factor	Shear Rating Factor
		ft-kips	kips	ft-kips	kips		
009991	Ave. Campo Rico over PR26	1019	55.6	2464	174	0.414	0.320
012001	PR3 over Rio Grande de Loiza	2123	79.8	4810	236	0.441	0.338
020731	Ave. Dr. Sanchez Castaño over Arroyo Blasina	989	76.7	1325	139	0.746	0.552
020741	Ave. Fragoso over Arroyo Blasina	1221	77.8	1897	158	0.644	0.492
021561	Ave. Iturregui over Canal Iturregui	89.9	28.9	133	67.7	0.676	0.427
023311	PR 17 over PR 26	1463	78.4	2537	176	0.577	0.445
023321	PR17 over Laguna San Jose and PR 8	1803	78.8	3573	205	0.505	0.384
023721	PR187 over PR26	1661	78.7	3093	193	0.537	0.408
024581	PR26 over Ave. Los Angeles	1494	77.0	2702	182	0.553	0.423

Analysis Assumptions:

1.) Comparison assumes distribution of Light Rail Vehicle within one traffic lane (3.65m).

2.) Comparisons are based on service load comparison to Inventory Rating (usually governs for prestressed design).

3.) Only Can-Car (UTDC) ALRV used in the analysis. Seimens U2a vehicle appears similar in size and weight. Bombardier Light Rail Vehicle is slightly larger and significantly heavier than Can-Car ALRV and will result in rating factors.

4.) **Rating Factors less than 1.00 indicate a shortfall in structural capacity.**

Transit Load Check - Bridge 009991

General Design Parameters

Design References

(Acronym)....Design Reference

(LFD).....AASHTO Standard Specifications for Highway Bridges, 17th Edition

Defined Parameters

$kips \equiv 1000 \cdot lbf \qquad ksi \equiv 1000 \cdot psi \qquad CY \equiv 27ft^3 \qquad SY \equiv 9ft^2$

$klf \equiv \frac{kips}{ft} \qquad ksf \equiv \frac{kips}{ft^2} \qquad plf \equiv \frac{lbf}{ft} \qquad psf \equiv \frac{lbf}{ft^2} \qquad pcf \equiv \frac{lbf}{ft^3}$

Functions

Limit Check

$$check(actual, limit) := \begin{cases} \text{"O.K."} & \text{if } actual \le limit \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Equality Check

$$check_equal(value1, value2) := \begin{cases} \text{"O.K."} & \text{if } 0.999999 \le \left|\frac{value1}{value2}\right| \le 1.000001 \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Analysis per AASHTO LRFD Bridge Design Specifications

Bridge Design Span

Parameters

Bridge Length (Between Front Face of Backwalls) $L_{bridge} := 24.80 \cdot m$

Thickness of Expansion Joints $t_{exp} := 0 \cdot in$ Note : Uses Roofing Paper for Bond Breaker

Length of Slab $L_{slab} := L_{bridge} - 2 \cdot t_{exp}$ $L_{slab} = 81.365\ ft$

Use 2 layers of roofing paper at back of slab end diaphragm for expansion joint bond breaker

Bearing Distance from End of Bridge to Centerline of Bearing $dist_{cl.brg} := 12 \cdot in$

Span Between Centerline Bearings

Span $Span := L_{slab} - 2 \cdot dist_{cl.brg}$ $Span = 79.365\ ft$

Definition of Slab Design Sections (every 0.01L)

$$j_{brg} := \text{floor}\left(\frac{100 \cdot dist_{cl.brg}}{L_{slab}}\right) + 1 \qquad j_{brg} = 2.000$$

$$j := 0 .. j_{brg} - 1 \qquad Loc_j := \frac{j}{100} \cdot L_{slab}$$

$$Loc_{j_{brg}} := dist_{cl.brg}$$

$$j := j_{brg} + 1 .. 101 - j_{brg} \qquad Loc_j := \frac{j - 1}{100} \cdot L_{slab}$$

$$Loc_{102 - j_{brg}} := L_{slab} - dist_{cl.brg}$$

$$j := 102 - j_{brg} + 1 .. 102 \qquad Loc_j := \frac{j - 2}{100} \cdot L_{slab}$$

$$j := 0 .. 102$$

HS Live Load

Impact

$$Impact := \min\left(0.30, \frac{50}{125 + \frac{Span}{ft}}\right) \qquad Impact = 0.245$$

LFD Section 3.8.2.1, Eq. 3-1

Design Truck Load

HS Truck Designation: $HS := 14.2$

$num_{axles.truck} := 3$ $\qquad ai := 0 .. num_{axles.truck} - 1$ $\qquad lane_{width} := 12 \cdot ft$

Axle Loads and Spacing (Forward) **LFD Figure 3.7.7A**

$P_{axle.f.truck_{ai}} :=$

$8 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$

$Spacing_{axle.truck_{ai}} :=$

$0 \cdot ft$
$14 \cdot ft$
$14 \cdot ft$

$$Loc_{axle.f.truck_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.truck_n}$$

$$Loc_{axle.f.truck} = \begin{pmatrix} 0.000 \\ 14.000 \\ 28.000 \end{pmatrix} ft$$

Maximum Axle Load $\qquad P_{max.truck} := \max(P_{axle.f.truck}) \qquad P_{max.truck} = 22.720\,kips$

Axle Loads and Spacing (Reverse) $\qquad P_{axle.r.truck_{ai}} := P_{axle.f.truck_{num_{axles.truck}-1-ai}}$

$$Loc_{axle.r.truck_{ai}} := \begin{cases} 0 \cdot ft & \text{if } ai = 0 \\ \sum_{n=num_{axles.truck}-ai}^{num_{axles.truck}-1} Spacing_{axle.truck_n} & \text{otherwise} \end{cases}$$

HS Live Load (continued)

Truck Load Moment Calculation

$$M_{s.truck.f_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.truck.r_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.pos.truck_j} := \max\left(M_{s.truck.f_j}, M_{s.truck.r_j}\right)$$

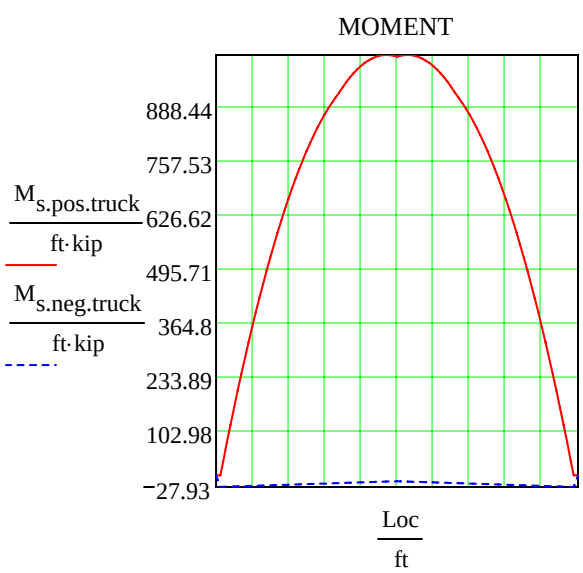
$$M_{s.neg.truck_j} := \begin{cases} -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ -(1 + Impact)\cdot P_{max.truck}\cdot\left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

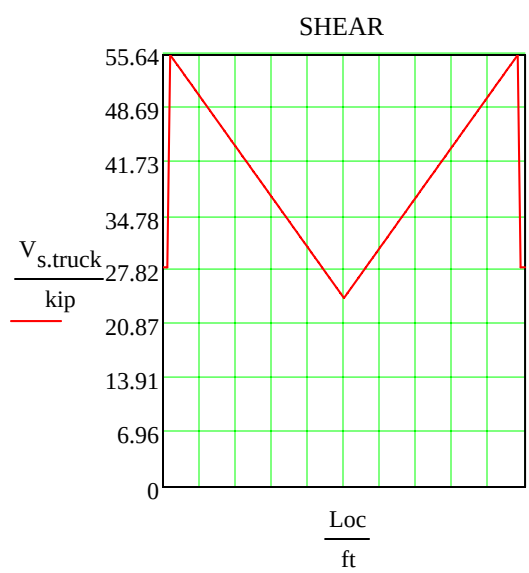
Live Load Truck Shear

$$V_{s.truck.f_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck.r_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck_j} := \max\left(V_{s.truck.f_j}, V_{s.truck.r_j}\right)$$





Lane Load Moment Calculation

Uniform Load: $w_{lane} := 0.64 \cdot klf \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Moment): $P_{conc.mom} := 18 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Shear): $P_{conc.shear} := 26 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

$$M_{s.pos.uni_j} := \begin{cases} SSM_{uni}\left(Span, w_{lane}, Loc_j - dist_{cl.brg}, 0 \cdot in\right) & \text{if } dist_{cl.brg} \le Loc_j \le L_{slab} - dist_{cl.brg} \\ 0 \cdot ft \cdot kips & \text{otherwise} \end{cases}$$

$$M_{s.neg.uni_j} := \begin{cases} \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot \left(Loc_j\right)^2}{2} & \text{if } Loc_j \le dist_{cl.brg} \\ \frac{-w_{lane} \cdot \left(L_{slab} - Loc_j\right)^2}{2} & \text{if } Loc_j \ge L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.conc_j} := \begin{cases} 0 \cdot ft \cdot kip & \text{if } dist_{cl.brg} \ge Loc_j \vee Loc_j \ge L_{slab} - dist_{cl.brg} \\ SSM_{conc}\left(Span, P_{conc.mom}, Loc_j - dist_{cl.brg}, Loc_j - dist_{cl.brg}\right) & \text{otherwise} \end{cases}$$

$$M_{s.neg.conc_j} := \begin{cases} -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Span - \left(Loc_j - dist_{cl.brg}\right)}{Span} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Loc_j - dist_{cl.brg}}{Span} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot Loc_j & \text{if } Loc_j \le dist_{cl.brg} \\ -P_{conc.mom} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.lane} := M_{s.pos.uni} + M_{s.pos.conc}$$

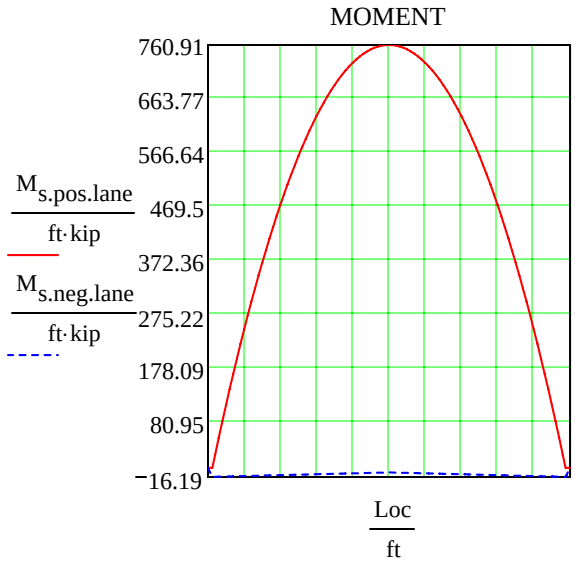
$$M_{s.neg.lane} := M_{s.neg.uni} + M_{s.neg.conc}$$

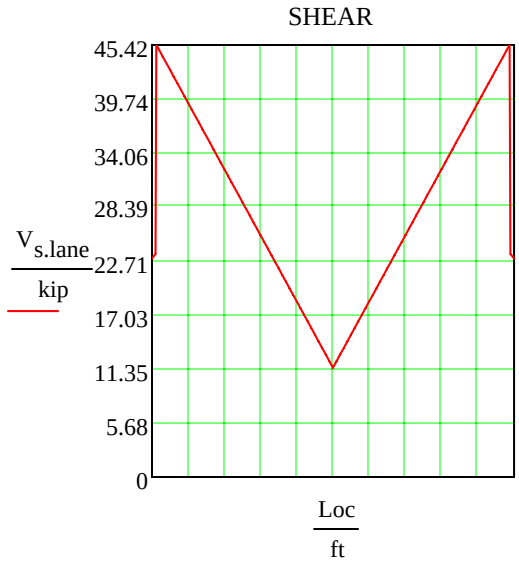
Lane Load Shear Calculation

$V_{s.uni_j} := SSV_{uni}(L_{slab}, w_{lane}, Loc_j, dist_{cl.brg})$

$V_{s.conc_j} := SSV_{conc}(L_{slab}, P_{conc.shear}, Loc_j, dist_{cl.brg})$

$V_{s.lane} := V_{s.uni} + V_{s.conc}$



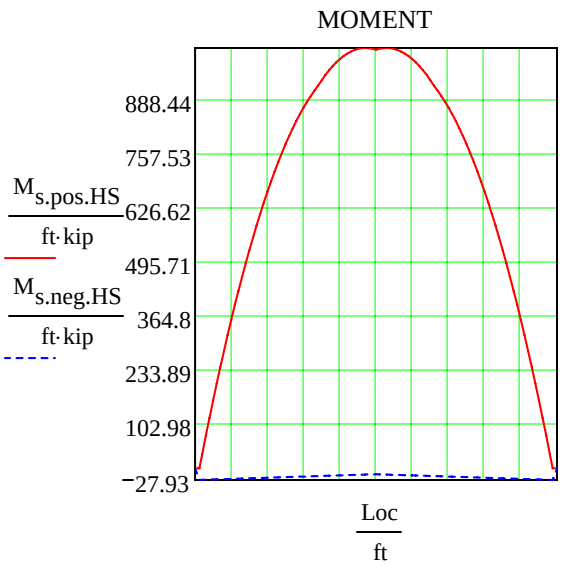


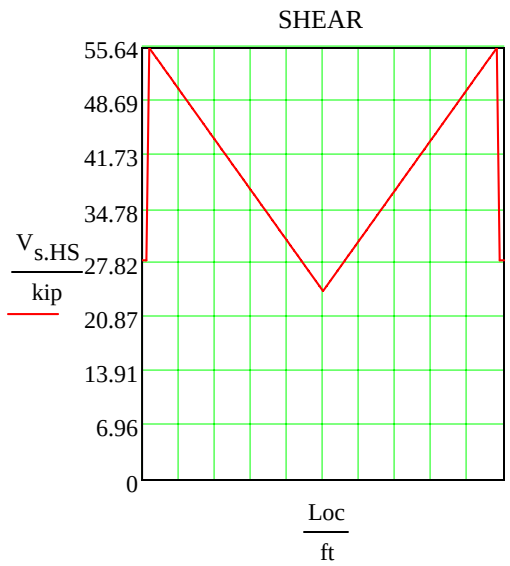
Critical HS Moments and Shears

$M_{s.pos.HS_j} := \max\left(M_{s.pos.truck_j}, M_{s.pos.uni_j}\right)$

$M_{s.neg.HS_j} := \min\left(M_{s.neg.truck_j}, M_{s.neg.uni_j}\right)$

$V_{s.HS_j} := \max\left(V_{s.truck_j}, V_{s.uni_j}\right)$





Maximum Loads:

$M_{s.max.HS} := \max\left(M_{s.pos.HS}\right)$ $\qquad M_{s.max.HS} = 1019.354\ ft \cdot kip$

$M_{s.min.HS} := \min\left(M_{s.neg.HS}\right)$ $\qquad M_{s.min.HS} = -27.931\ ft \cdot kip$

$V_{s.max.HS} := \max\left(V_{s.HS}\right)$ $\qquad V_{s.max.HS} = 55.642\ kip$

Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (no couples):

Number of Axles: $num_{axles.TC4200} := 6$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{36745 \cdot kgf + 47655 \cdot kgf}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$$Loc_{axle.TC4200} = \begin{pmatrix} 0.000 \\ 6.001 \\ 25.000 \\ 31.001 \\ 50.000 \\ 56.001 \end{pmatrix} ft$$

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 2464.158\ ft \cdot kips$

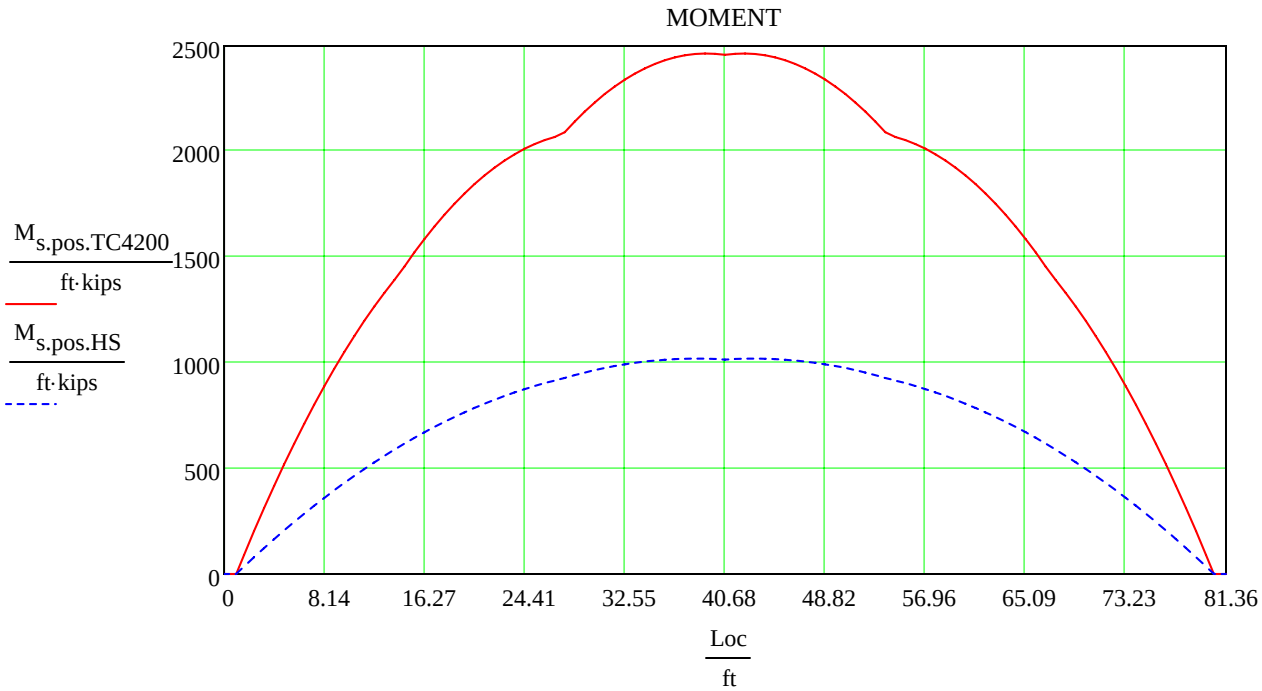
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

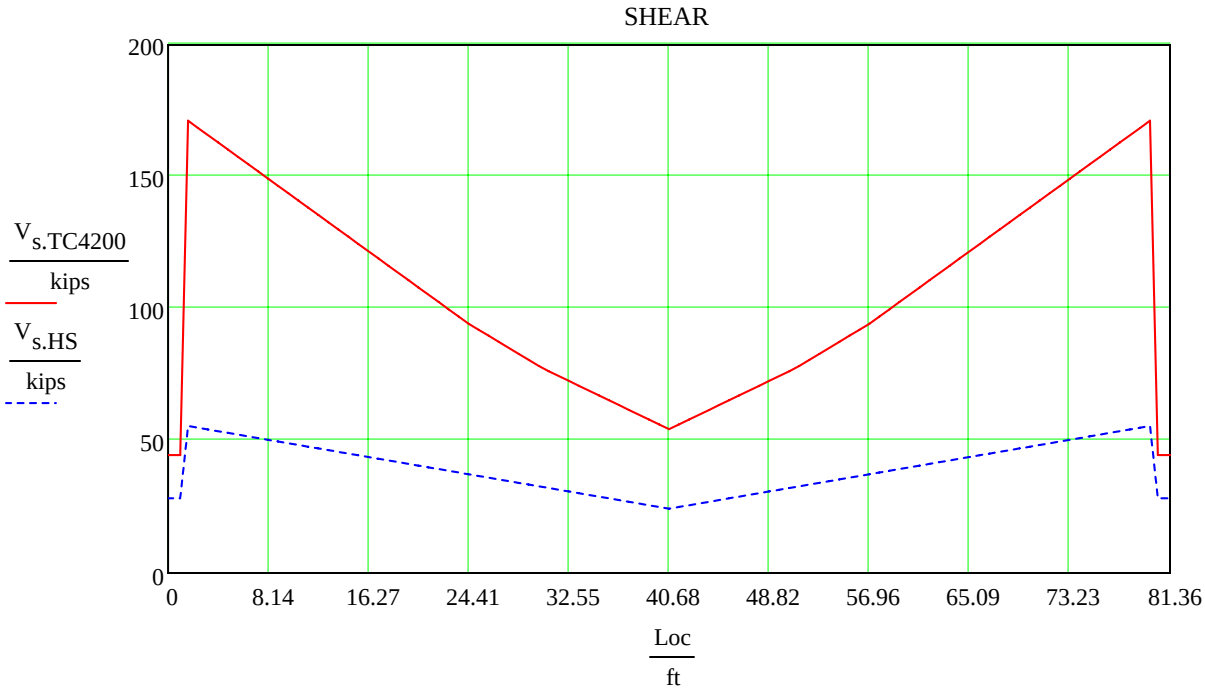
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 171.292\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (assume two coupled vehicles):

Number of Axles: $num_{axles.TC4200} := 12$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{2 \cdot (36745 \cdot kgf + 47655 \cdot kgf)}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$Loc_{axle.TC4200} =$

	0
0	0.000
1	6.001
2	25.000
3	31.001
4	50.000
5	56.001
6	75.000
7	81.001
8	100.000
9	106.001
10	125.000
11	131.001

ft

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 2464.158\ ft \cdot kips$

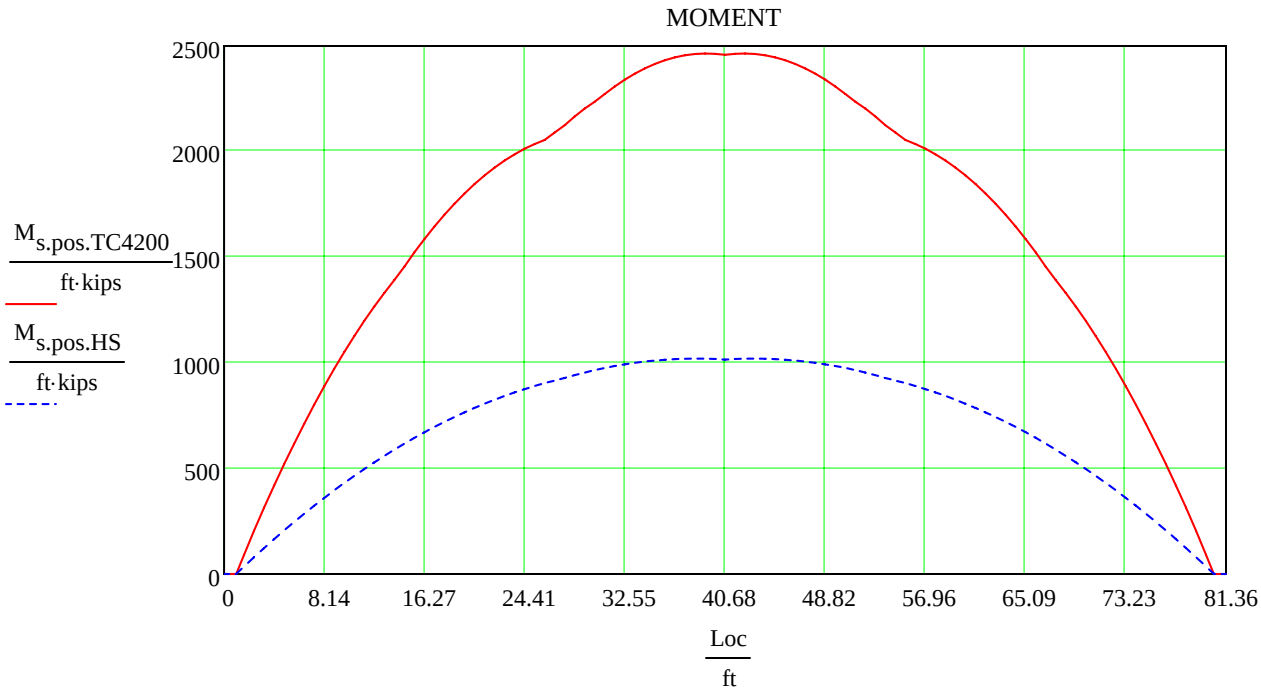
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

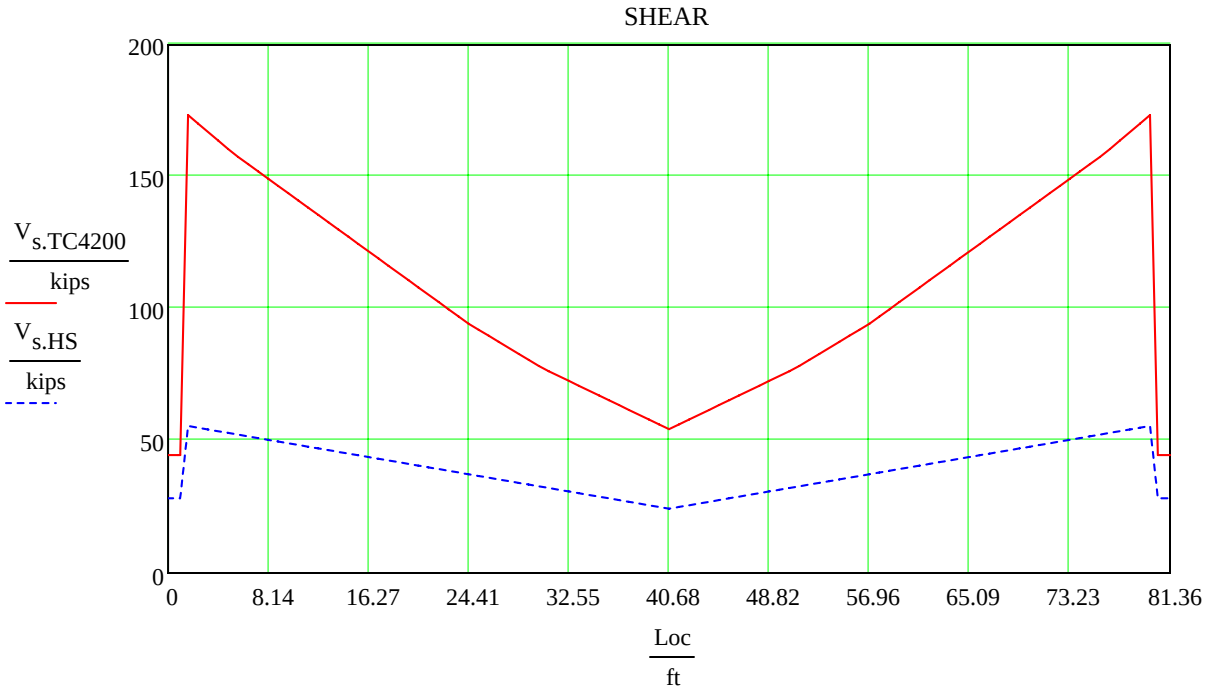
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 173.395\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Check - Bridge 012001

General Design Parameters

Design References

(Acronym)....Design Reference

(LFD).....AASHTO Standard Specifications for Highway Bridges, 17th Edition

Defined Parameters

$kips \equiv 1000 \cdot lbf \qquad ksi \equiv 1000 \cdot psi \qquad CY \equiv 27ft^3 \qquad SY \equiv 9ft^2$

$klf \equiv \frac{kips}{ft} \qquad ksf \equiv \frac{kips}{ft^2} \qquad plf \equiv \frac{lbf}{ft} \qquad psf \equiv \frac{lbf}{ft^2} \qquad pcf \equiv \frac{lbf}{ft^3}$

Functions

Limit Check

$$check(actual, limit) := \begin{cases} \text{"O.K."} & \text{if } actual \le limit \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Equality Check

$$check_equal(value1, value2) := \begin{cases} \text{"O.K."} & \text{if } 0.999999 \le \left|\frac{value1}{value2}\right| \le 1.000001 \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Analysis per AASHTO LRFD Bridge Design Specifications

Bridge Design Span

Parameters

Bridge Length (Between Front Face of Backwalls) $L_{bridge} := 35.00 \cdot m$

Thickness of Expansion Joints $t_{exp} := 0 \cdot in$ Note : Uses Roofing Paper for Bond Breaker

Length of Slab $L_{slab} := L_{bridge} - 2 \cdot t_{exp}$ $L_{slab} = 114.829\ ft$

Use 2 layers of roofing paper at back of slab end diaphragm for expansion joint bond breaker

Bearing Distance from End of Bridge to Centerline of Bearing $dist_{cl.brg} := 12 \cdot in$

Span Between Centerline Bearings

Span $Span := L_{slab} - 2 \cdot dist_{cl.brg}$ $Span = 112.829\ ft$

Definition of Slab Design Sections (every 0.01L)

$$j_{brg} := \text{floor}\left(\frac{100 \cdot dist_{cl.brg}}{L_{slab}}\right) + 1 \qquad j_{brg} = 1.000$$

$$j := 0 .. j_{brg} - 1 \qquad Loc_j := \frac{j}{100} \cdot L_{slab}$$

$$Loc_{j_{brg}} := dist_{cl.brg}$$

$$j := j_{brg} + 1 .. 101 - j_{brg} \qquad Loc_j := \frac{j - 1}{100} \cdot L_{slab}$$

$$Loc_{102 - j_{brg}} := L_{slab} - dist_{cl.brg}$$

$$j := 102 - j_{brg} + 1 .. 102 \qquad Loc_j := \frac{j - 2}{100} \cdot L_{slab}$$

$$j := 0 .. 102$$

HS Live Load

Impact

$$Impact := \min\left(0.30, \frac{50}{125 + \frac{Span}{ft}}\right) \qquad Impact = 0.210$$

LFD Section 3.8.2.1, Eq. 3-1

Design Truck Load

HS Truck Designation: $HS := 20.0$

$num_{axles.truck} := 3$ $\qquad ai := 0 .. num_{axles.truck} - 1$ $\qquad lane_{width} := 12 \cdot ft$

Axle Loads and Spacing (Forward) **LFD Figure 3.7.7A**

$P_{axle.f.truck_{ai}} :=$

$8 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$

$Spacing_{axle.truck_{ai}} :=$

$0 \cdot ft$
$14 \cdot ft$
$14 \cdot ft$

$$Loc_{axle.f.truck_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.truck_n}$$

$$Loc_{axle.f.truck} = \begin{pmatrix} 0.000 \\ 14.000 \\ 28.000 \end{pmatrix} ft$$

Maximum Axle Load $\qquad P_{max.truck} := \max(P_{axle.f.truck}) \qquad P_{max.truck} = 32.000\,kips$

Axle Loads and Spacing (Reverse) $\qquad P_{axle.r.truck_{ai}} := P_{axle.f.truck_{num_{axles.truck}-1-ai}}$

$$Loc_{axle.r.truck_{ai}} := \begin{cases} 0 \cdot ft & \text{if } ai = 0 \\ \sum_{n=num_{axles.truck}-ai}^{num_{axles.truck}-1} Spacing_{axle.truck_n} & \text{otherwise} \end{cases}$$

HS Live Load (continued)

Truck Load Moment Calculation

$$M_{s.truck.f_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.truck.r_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.pos.truck_j} := \max\left(M_{s.truck.f_j}, M_{s.truck.r_j}\right)$$

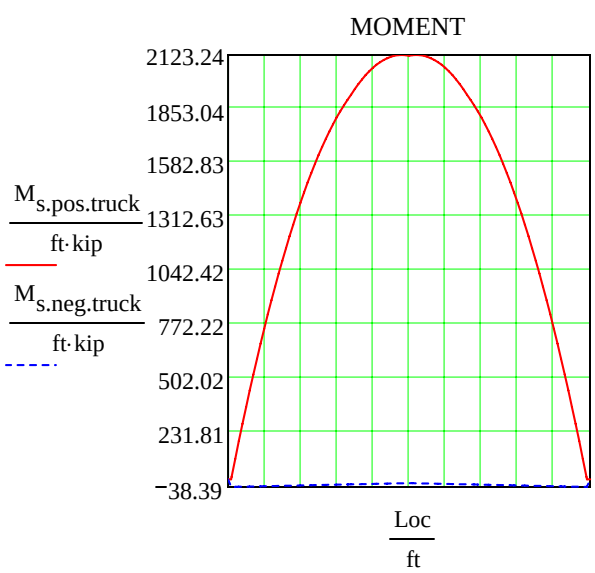
$$M_{s.neg.truck_j} := \begin{cases} -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ -(1 + Impact)\cdot P_{max.truck}\cdot\left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

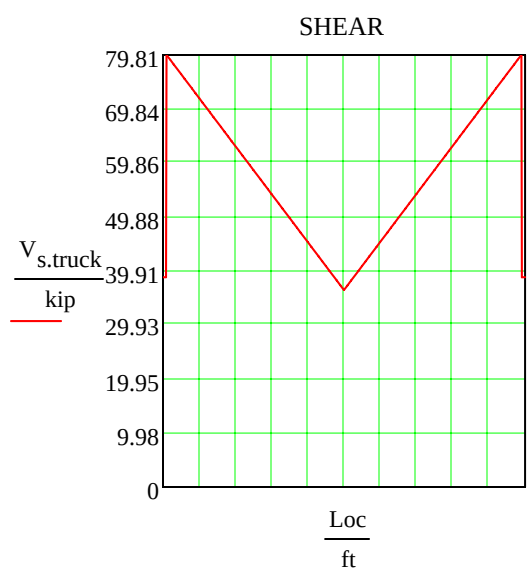
Live Load Truck Shear

$$V_{s.truck.f_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck.r_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck_j} := \max\left(V_{s.truck.f_j}, V_{s.truck.r_j}\right)$$





Lane Load Moment Calculation

Uniform Load: $w_{lane} := 0.64 \cdot klf \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Moment): $P_{conc.mom} := 18 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Shear): $P_{conc.shear} := 26 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

$$M_{s.pos.uni_j} := \begin{cases} SSM_{uni}\left(Span, w_{lane}, Loc_j - dist_{cl.brg}, 0 \cdot in\right) & \text{if } dist_{cl.brg} \le Loc_j \le L_{slab} - dist_{cl.brg} \\ 0 \cdot ft \cdot kips & \text{otherwise} \end{cases}$$

$$M_{s.neg.uni_j} := \begin{cases} \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot \left(Loc_j\right)^2}{2} & \text{if } Loc_j \le dist_{cl.brg} \\ \frac{-w_{lane} \cdot \left(L_{slab} - Loc_j\right)^2}{2} & \text{if } Loc_j \ge L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.conc_j} := \begin{cases} 0 \cdot ft \cdot kip & \text{if } dist_{cl.brg} \ge Loc_j \vee Loc_j \ge L_{slab} - dist_{cl.brg} \\ SSM_{conc}\left(Span, P_{conc.mom}, Loc_j - dist_{cl.brg}, Loc_j - dist_{cl.brg}\right) & \text{otherwise} \end{cases}$$

$$M_{s.neg.conc_j} := \begin{cases} -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Span - \left(Loc_j - dist_{cl.brg}\right)}{Span} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Loc_j - dist_{cl.brg}}{Span} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot Loc_j & \text{if } Loc_j \le dist_{cl.brg} \\ -P_{conc.mom} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.lane} := M_{s.pos.uni} + M_{s.pos.conc}$$

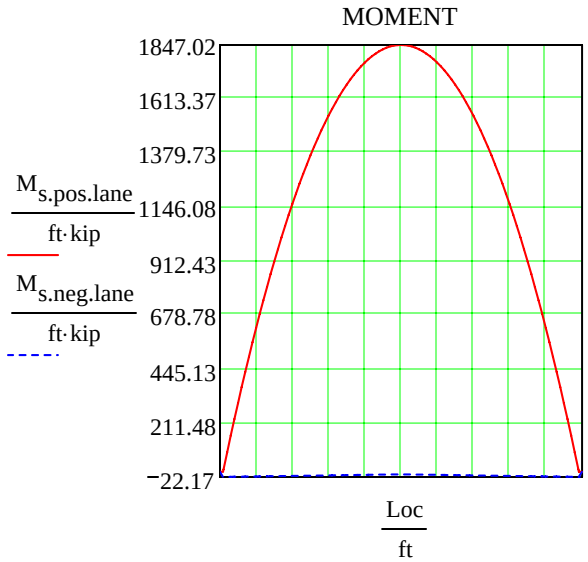
$$M_{s.neg.lane} := M_{s.neg.uni} + M_{s.neg.conc}$$

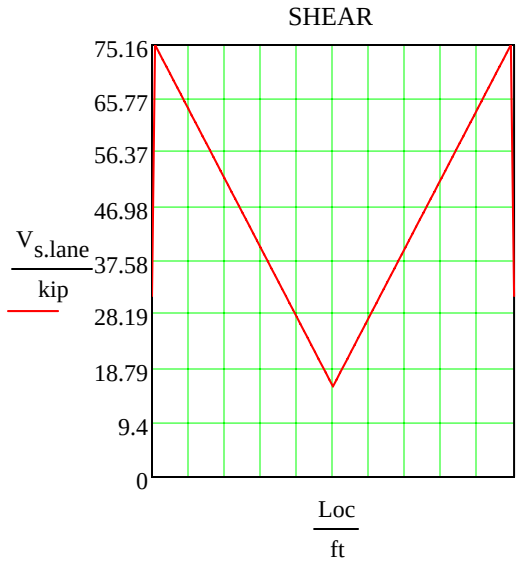
Lane Load Shear Calculation

$V_{s.uni_j} := SSV_{uni}(L_{slab}, w_{lane}, Loc_j, dist_{cl.brg})$

$V_{s.conc_j} := SSV_{conc}(L_{slab}, P_{conc.shear}, Loc_j, dist_{cl.brg})$

$V_{s.lane} := V_{s.uni} + V_{s.conc}$



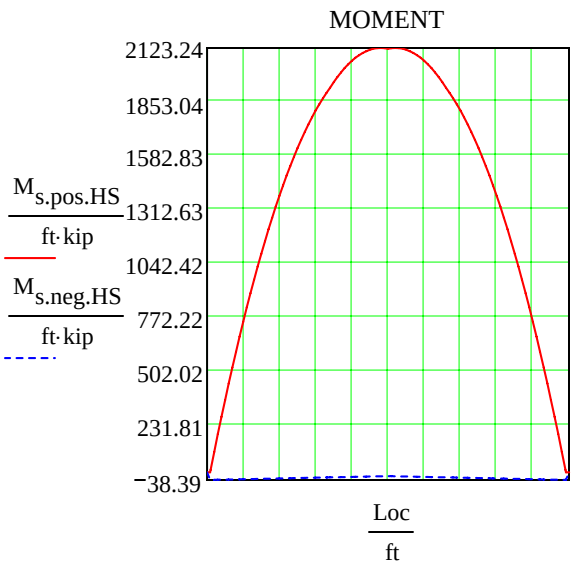


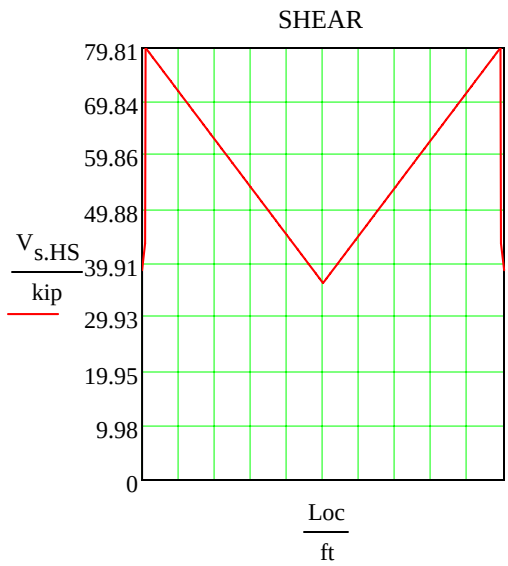
Critical HS Moments and Shears

$M_{s.pos.HS_j} := \max\left(M_{s.pos.truck_j}, M_{s.pos.uni_j}\right)$

$M_{s.neg.HS_j} := \min\left(M_{s.neg.truck_j}, M_{s.neg.uni_j}\right)$

$V_{s.HS_j} := \max\left(V_{s.truck_j}, V_{s.uni_j}\right)$





Maximum Loads:

$M_{s.max.HS} := \max\left(M_{s.pos.HS}\right)$ $\qquad M_{s.max.HS} = 2123.239\ ft \cdot kip$

$M_{s.min.HS} := \min\left(M_{s.neg.HS}\right)$ $\qquad M_{s.min.HS} = -38.390\ ft \cdot kip$

$V_{s.max.HS} := \max\left(V_{s.HS}\right)$ $\qquad V_{s.max.HS} = 79.814\ kip$

Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (no couples):

Number of Axles: $num_{axles.TC4200} := 6$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{36745 \cdot kgf + 47655 \cdot kgf}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$$Loc_{axle.TC4200} = \begin{pmatrix} 0.000 \\ 6.001 \\ 25.000 \\ 31.001 \\ 50.000 \\ 56.001 \end{pmatrix} ft$$

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 4330.108\ ft \cdot kips$

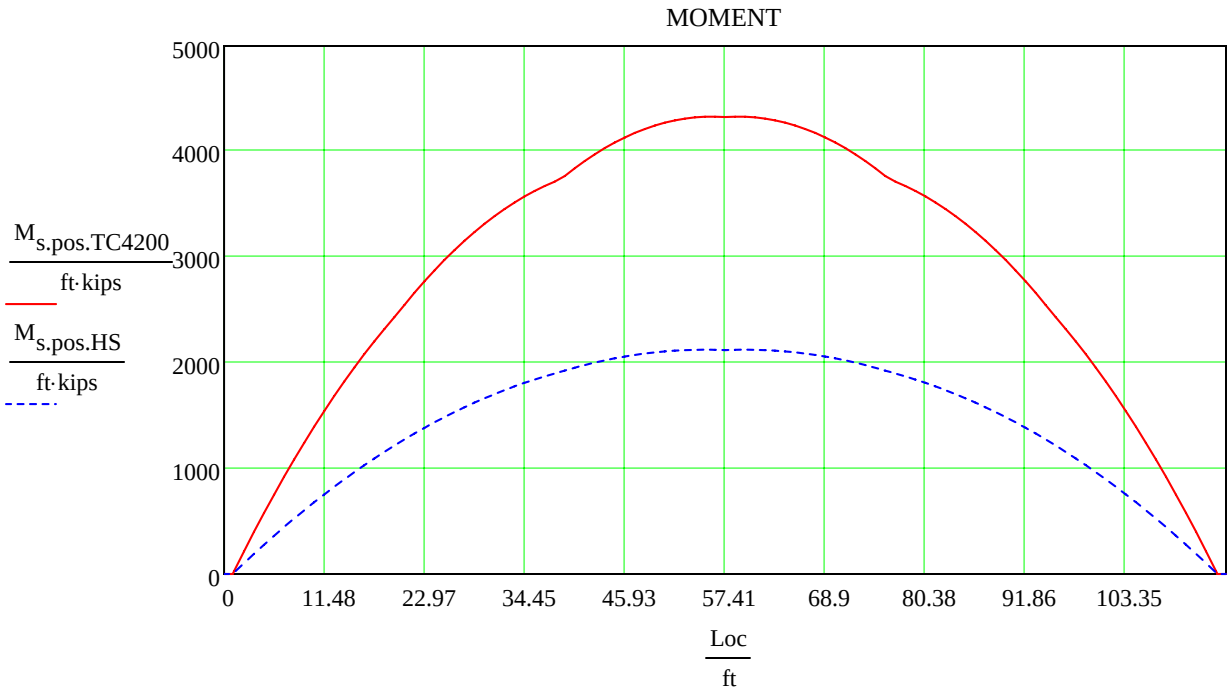
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

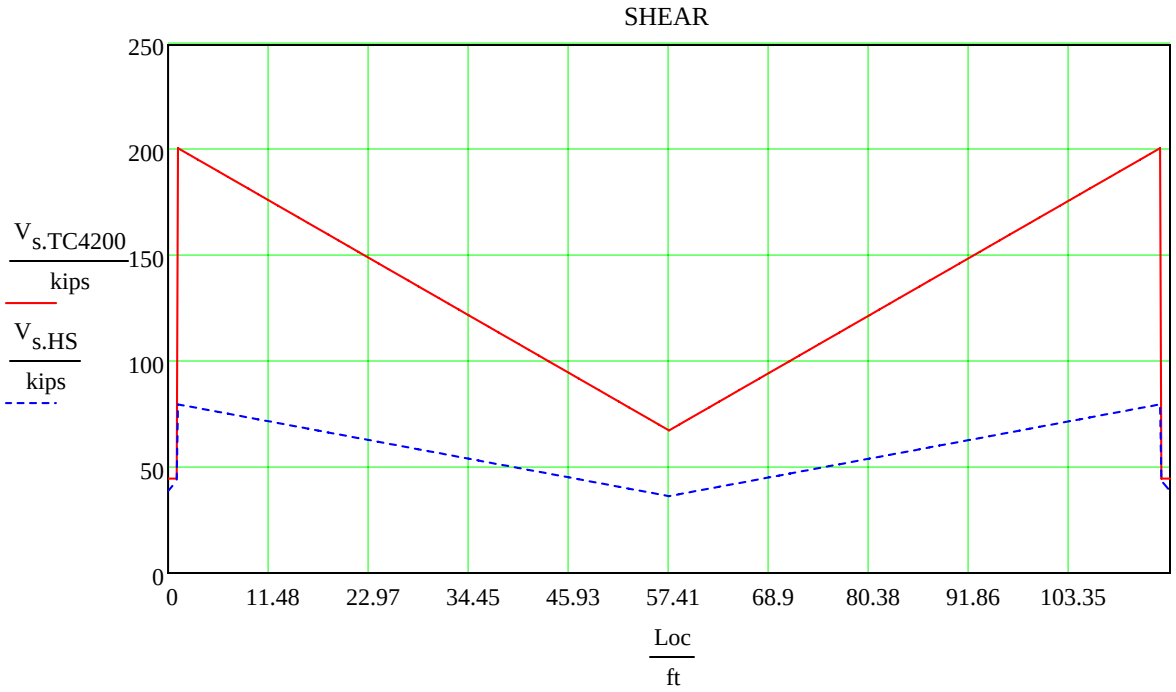
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 201.095\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (assume two coupled vehicles):

Number of Axles: $num_{axles.TC4200} := 12$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{2 \cdot (36745 \cdot kgf + 47655 \cdot kgf)}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
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$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$Loc_{axle.TC4200} =$

	0
0	0.000
1	6.001
2	25.000
3	31.001
4	50.000
5	56.001
6	75.000
7	81.001
8	100.000
9	106.001
10	125.000
11	131.001

ft

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 4810.347\ ft \cdot kips$

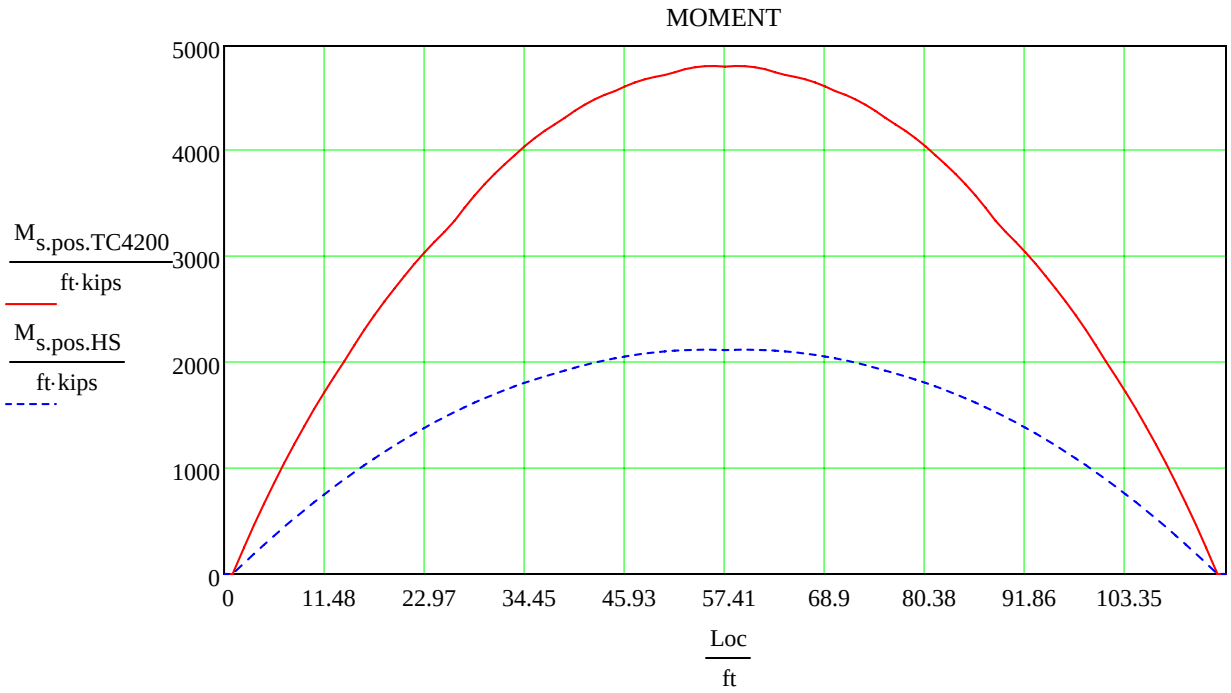
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

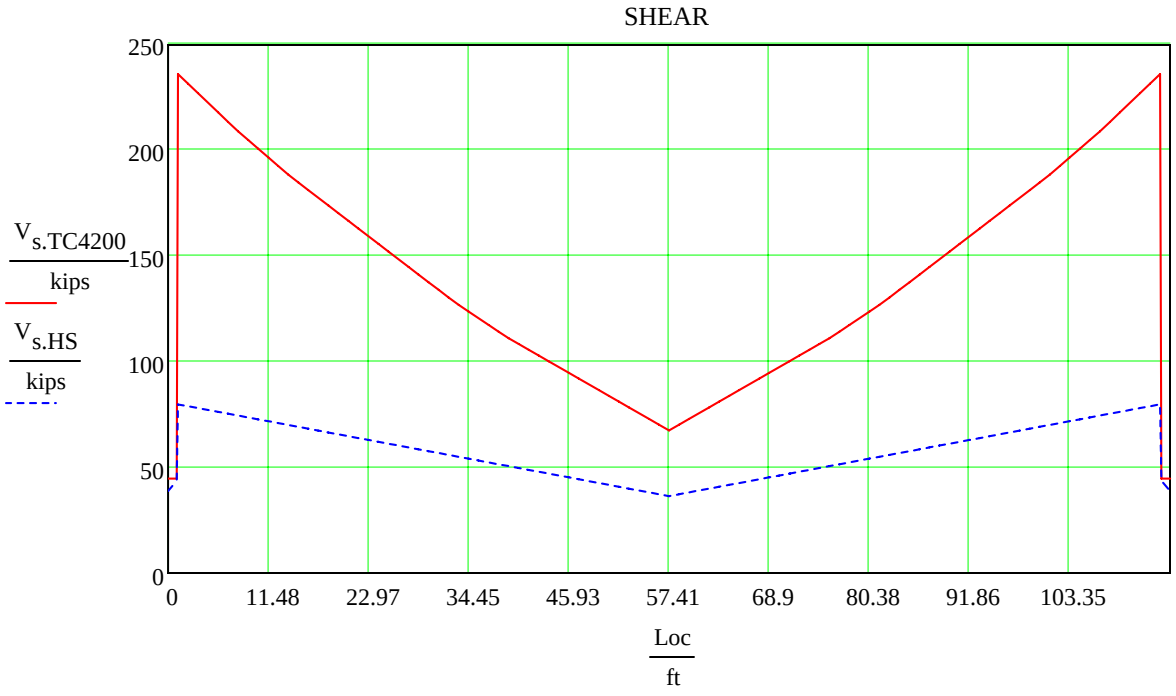
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 236.211\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Check - Bridge 020731

General Design Parameters

Design References

(Acronym)....Design Reference

(LFD).....AASHTO Standard Specifications for Highway Bridges, 17th Edition

Defined Parameters

$kips \equiv 1000 \cdot lbf \qquad ksi \equiv 1000 \cdot psi \qquad CY \equiv 27ft^3 \qquad SY \equiv 9ft^2$

$klf \equiv \frac{kips}{ft} \qquad ksf \equiv \frac{kips}{ft^2} \qquad plf \equiv \frac{lbf}{ft} \qquad psf \equiv \frac{lbf}{ft^2} \qquad pcf \equiv \frac{lbf}{ft^3}$

Functions

Limit Check

$$check(actual, limit) := \begin{cases} \text{"O.K."} & \text{if } actual \le limit \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Equality Check

$$check_equal(value1, value2) := \begin{cases} \text{"O.K."} & \text{if } 0.999999 \le \left|\frac{value1}{value2}\right| \le 1.000001 \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Analysis per AASHTO LRFD Bridge Design Specifications

Bridge Design Span

Parameters

Bridge Length (Between Front Face of Backwalls) $L_{bridge} := 18.40 \cdot m$

Thickness of Expansion Joints $t_{exp} := 0 \cdot in$ Note : Uses Roofing Paper for Bond Breaker

Length of Slab $L_{slab} := L_{bridge} - 2 \cdot t_{exp}$ $L_{slab} = 60.367\ ft$

Use 2 layers of roofing paper at back of slab end diaphragm for expansion joint bond breaker

Bearing Distance from End of Bridge to Centerline of Bearing $dist_{cl.brg} := 12 \cdot in$

Span Between Centerline Bearings

Span $Span := L_{slab} - 2 \cdot dist_{cl.brg}$ $Span = 58.367\ ft$

Definition of Slab Design Sections (every 0.01L)

$$j_{brg} := \text{floor}\left(\frac{100 \cdot dist_{cl.brg}}{L_{slab}}\right) + 1 \qquad j_{brg} = 2.000$$

$$j := 0 .. j_{brg} - 1 \qquad Loc_j := \frac{j}{100} \cdot L_{slab}$$

$$Loc_{j_{brg}} := dist_{cl.brg}$$

$$j := j_{brg} + 1 .. 101 - j_{brg} \qquad Loc_j := \frac{j - 1}{100} \cdot L_{slab}$$

$$Loc_{102 - j_{brg}} := L_{slab} - dist_{cl.brg}$$

$$j := 102 - j_{brg} + 1 .. 102 \qquad Loc_j := \frac{j - 2}{100} \cdot L_{slab}$$

$$j := 0 .. 102$$

HS Live Load

Impact

$$Impact := \min\left(0.30, \frac{50}{125 + \frac{Span}{ft}}\right) \qquad Impact = 0.273$$

LFD Section 3.8.2.1, Eq. 3-1

Design Truck Load

HS Truck Designation: $HS := 20.0$

$num_{axles.truck} := 3$ $\qquad ai := 0 .. num_{axles.truck} - 1$ $\qquad lane_{width} := 12 \cdot ft$

Axle Loads and Spacing (Forward) **LFD Figure 3.7.7A**

$P_{axle.f.truck_{ai}} :=$

$8 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$

$Spacing_{axle.truck_{ai}} :=$

$0 \cdot ft$
$14 \cdot ft$
$14 \cdot ft$

$$Loc_{axle.f.truck_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.truck_n}$$

$$Loc_{axle.f.truck} = \begin{pmatrix} 0.000 \\ 14.000 \\ 28.000 \end{pmatrix} ft$$

Maximum Axle Load $\qquad P_{max.truck} := \max(P_{axle.f.truck}) \qquad P_{max.truck} = 32.000\,kips$

Axle Loads and Spacing (Reverse) $\qquad P_{axle.r.truck_{ai}} := P_{axle.f.truck_{num_{axles.truck}-1-ai}}$

$$Loc_{axle.r.truck_{ai}} := \begin{cases} 0 \cdot ft & \text{if } ai = 0 \\ \sum_{n=num_{axles.truck}-ai}^{num_{axles.truck}-1} Spacing_{axle.truck_n} & \text{otherwise} \end{cases}$$

HS Live Load (continued)

Truck Load Moment Calculation

$$M_{s.truck.f_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.truck.r_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.pos.truck_j} := \max\left(M_{s.truck.f_j}, M_{s.truck.r_j}\right)$$

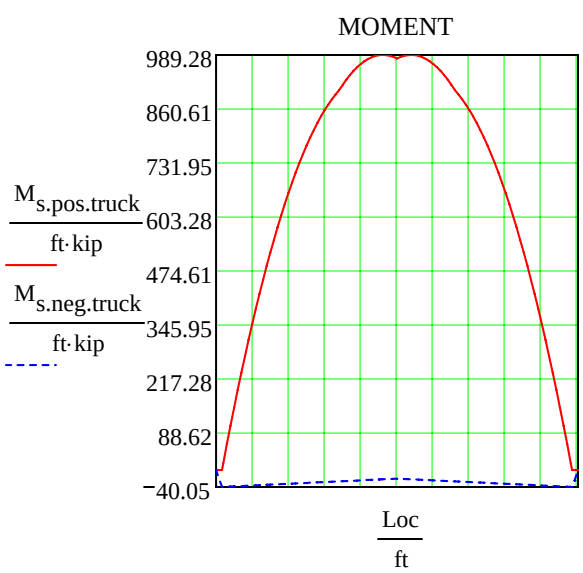
$$M_{s.neg.truck_j} := \begin{cases} -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ -(1 + Impact)\cdot P_{max.truck}\cdot\left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

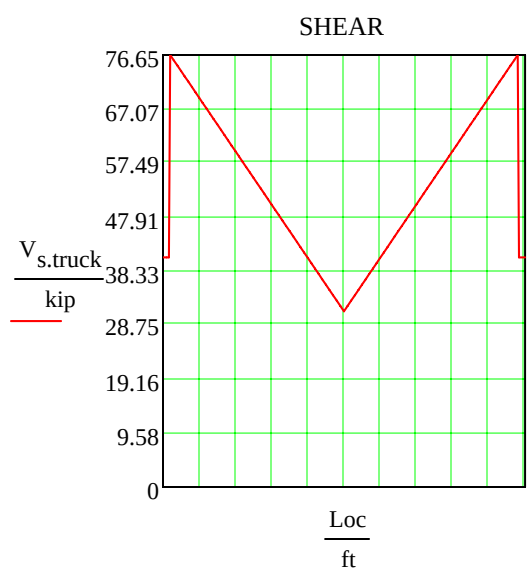
Live Load Truck Shear

$$V_{s.truck.f_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck.r_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck_j} := \max\left(V_{s.truck.f_j}, V_{s.truck.r_j}\right)$$





Lane Load Moment Calculation

Uniform Load: $w_{lane} := 0.64 \cdot klf \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Moment): $P_{conc.mom} := 18 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Shear): $P_{conc.shear} := 26 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

$$M_{s.pos.uni_j} := \begin{cases} SSM_{uni}\left(Span, w_{lane}, Loc_j - dist_{cl.brg}, 0 \cdot in\right) & \text{if } dist_{cl.brg} \le Loc_j \le L_{slab} - dist_{cl.brg} \\ 0 \cdot ft \cdot kips & \text{otherwise} \end{cases}$$

$$M_{s.neg.uni_j} := \begin{cases} \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot \left(Loc_j\right)^2}{2} & \text{if } Loc_j \le dist_{cl.brg} \\ \frac{-w_{lane} \cdot \left(L_{slab} - Loc_j\right)^2}{2} & \text{if } Loc_j \ge L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.conc_j} := \begin{cases} 0 \cdot ft \cdot kip & \text{if } dist_{cl.brg} \ge Loc_j \vee Loc_j \ge L_{slab} - dist_{cl.brg} \\ SSM_{conc}\left(Span, P_{conc.mom}, Loc_j - dist_{cl.brg}, Loc_j - dist_{cl.brg}\right) & \text{otherwise} \end{cases}$$

$$M_{s.neg.conc_j} := \begin{cases} -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Span - \left(Loc_j - dist_{cl.brg}\right)}{Span} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Loc_j - dist_{cl.brg}}{Span} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot Loc_j & \text{if } Loc_j \le dist_{cl.brg} \\ -P_{conc.mom} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.lane} := M_{s.pos.uni} + M_{s.pos.conc}$$

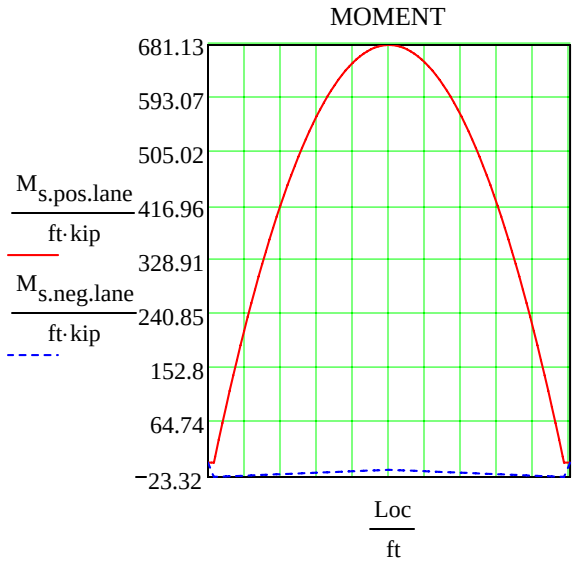
$$M_{s.neg.lane} := M_{s.neg.uni} + M_{s.neg.conc}$$

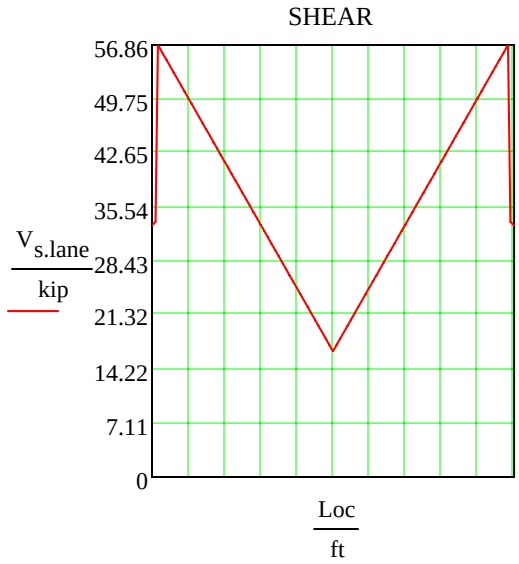
Lane Load Shear Calculation

$V_{s.uni_j} := SSV_{uni}(L_{slab}, w_{lane}, Loc_j, dist_{cl.brg})$

$V_{s.conc_j} := SSV_{conc}(L_{slab}, P_{conc.shear}, Loc_j, dist_{cl.brg})$

$V_{s.lane} := V_{s.uni} + V_{s.conc}$



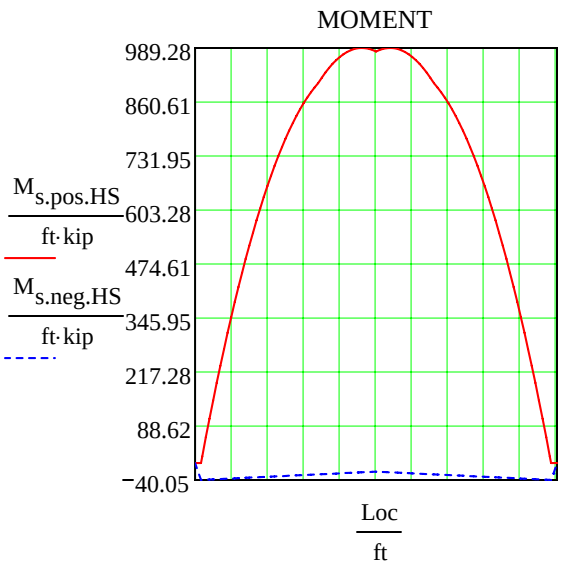


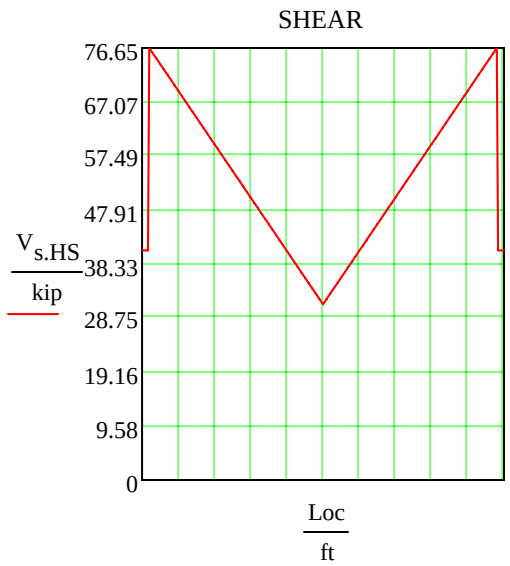
Critical HS Moments and Shears

$M_{s.pos.HS_j} := \max\left(M_{s.pos.truck_j}, M_{s.pos.uni_j}\right)$

$M_{s.neg.HS_j} := \min\left(M_{s.neg.truck_j}, M_{s.neg.uni_j}\right)$

$V_{s.HS_j} := \max\left(V_{s.truck_j}, V_{s.uni_j}\right)$





Maximum Loads:

$M_{s.max.HS} := \max\left(M_{s.pos.HS}\right)$ $\qquad M_{s.max.HS} = 989.280\ ft \cdot kip$

$M_{s.min.HS} := \min\left(M_{s.neg.HS}\right)$ $\qquad M_{s.min.HS} = -40.051\ ft \cdot kip$

$V_{s.max.HS} := \max\left(V_{s.HS}\right)$ $\qquad V_{s.max.HS} = 76.655\ kip$

Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (no couples):

Number of Axles: $num_{axles.TC4200} := 6$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{36745 \cdot kgf + 47655 \cdot kgf}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$$Loc_{axle.TC4200} = \begin{pmatrix} 0.000 \\ 6.001 \\ 25.000 \\ 31.001 \\ 50.000 \\ 56.001 \end{pmatrix} ft$$

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 1324.943\ ft \cdot kips$

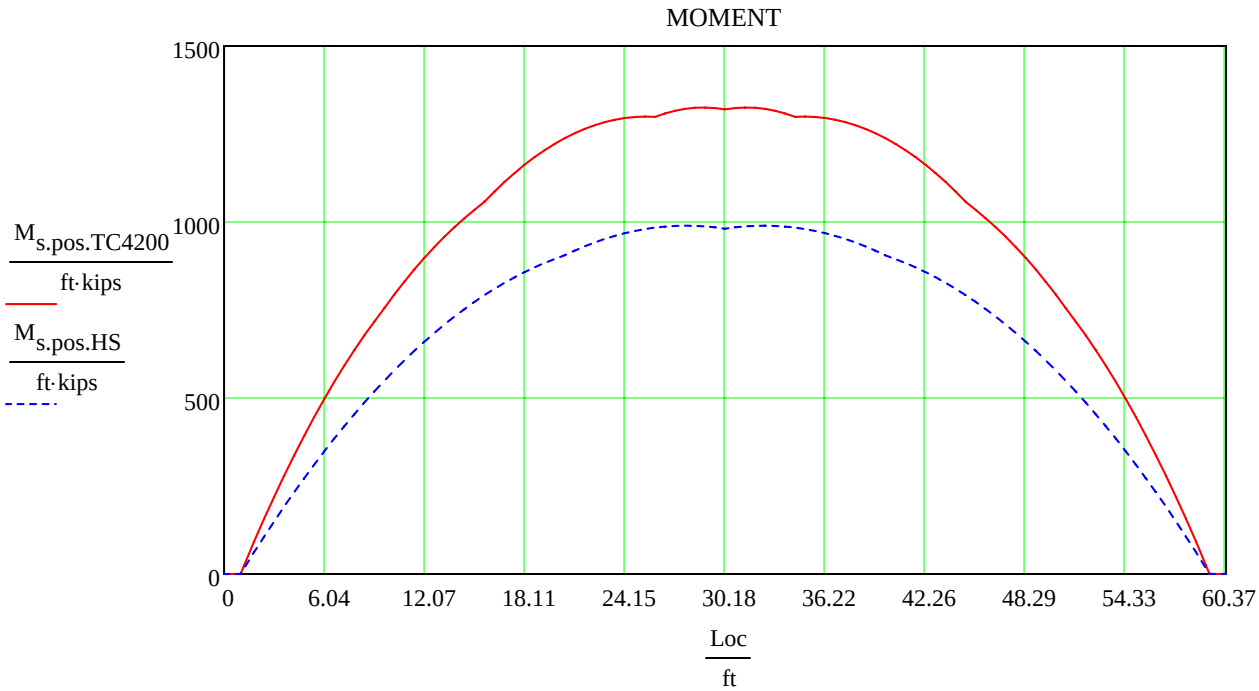
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

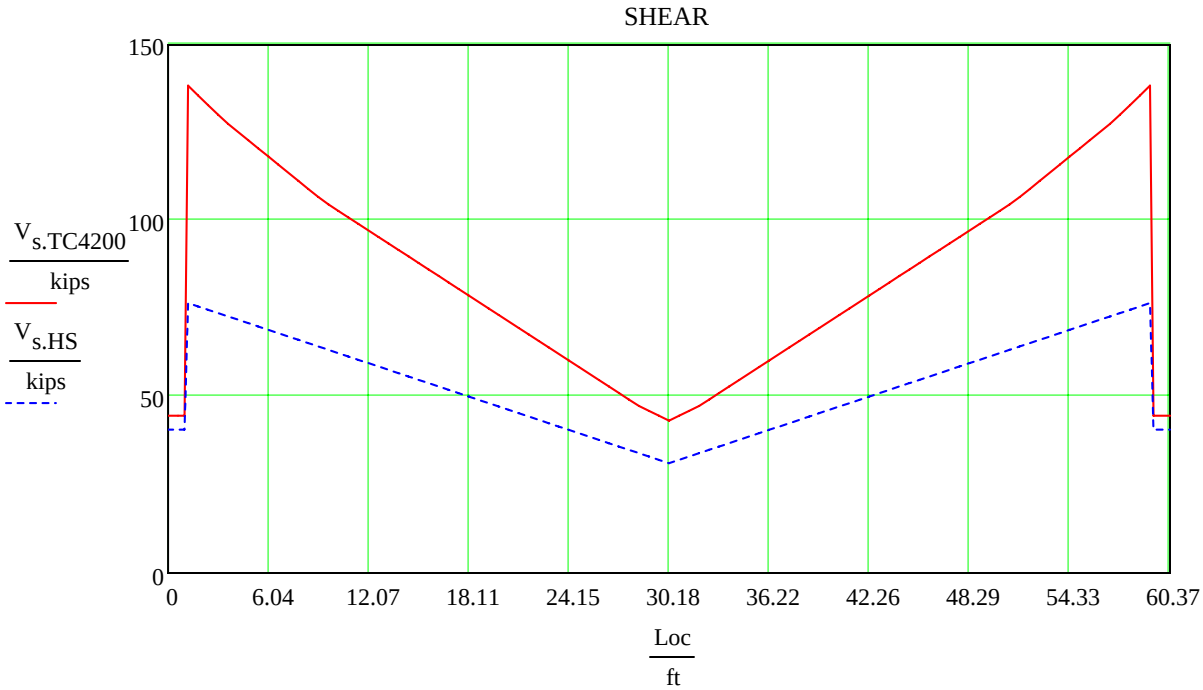
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 138.451\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (assume two coupled vehicles):

Number of Axles: $num_{axles.TC4200} := 12$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{2 \cdot (36745 \cdot kgf + 47655 \cdot kgf)}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
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$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$Loc_{axle.TC4200} =$

	0
0	0.000
1	6.001
2	25.000
3	31.001
4	50.000
5	56.001
6	75.000
7	81.001
8	100.000
9	106.001
10	125.000
11	131.001

ft

Maximum Axle Load (with Impact):

$P_{max.TC4200} := \max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 1324.943\ ft \cdot kips$

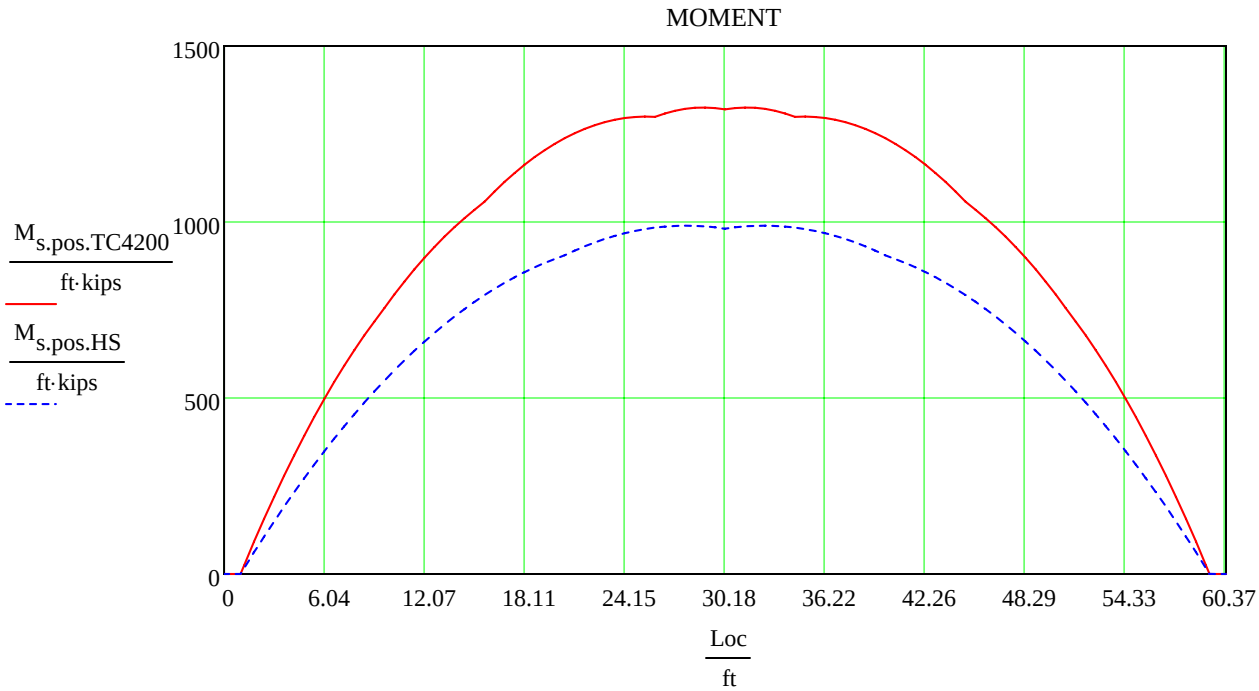
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

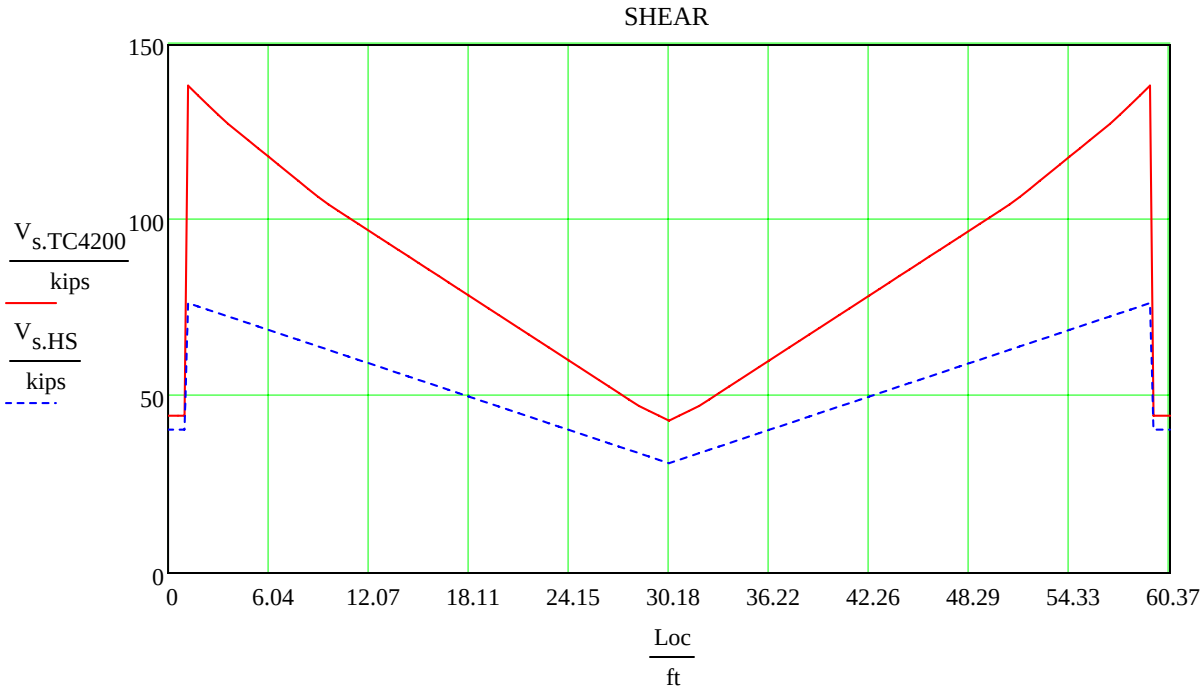
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 138.451\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Check - Bridge 020741

General Design Parameters

Design References

(Acronym)....Design Reference

(LFD).....AASHTO Standard Specifications for Highway Bridges, 17th Edition

Defined Parameters

$kips \equiv 1000 \cdot lbf \qquad ksi \equiv 1000 \cdot psi \qquad CY \equiv 27ft^3 \qquad SY \equiv 9ft^2$

$klf \equiv \frac{kips}{ft} \qquad ksf \equiv \frac{kips}{ft^2} \qquad plf \equiv \frac{lbf}{ft} \qquad psf \equiv \frac{lbf}{ft^2} \qquad pcf \equiv \frac{lbf}{ft^3}$

Functions

Limit Check

$$check(actual, limit) := \begin{cases} \text{"O.K."} & \text{if } actual \le limit \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Equality Check

$$check_equal(value1, value2) := \begin{cases} \text{"O.K."} & \text{if } 0.999999 \le \left|\frac{value1}{value2}\right| \le 1.000001 \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Analysis per AASHTO LRFD Bridge Design Specifications

Bridge Design Span

Parameters

Bridge Length (Between Front Face of Backwalls) $L_{bridge} := 21.70 \cdot m$

Thickness of Expansion Joints $t_{exp} := 0 \cdot in$ Note : Uses Roofing Paper for Bond Breaker

Length of Slab $L_{slab} := L_{bridge} - 2 \cdot t_{exp}$ $L_{slab} = 71.194\ ft$

Use 2 layers of roofing paper at back of slab end diaphragm for expansion joint bond breaker

Bearing Distance from End of Bridge to Centerline of Bearing $dist_{cl.brg} := 12 \cdot in$

Span Between Centerline Bearings

Span $Span := L_{slab} - 2 \cdot dist_{cl.brg}$ $Span = 69.194\ ft$

Definition of Slab Design Sections (every 0.01L)

$$j_{brg} := \text{floor}\left(\frac{100 \cdot dist_{cl.brg}}{L_{slab}}\right) + 1 \qquad j_{brg} = 2.000$$

$$j := 0 .. j_{brg} - 1 \qquad Loc_j := \frac{j}{100} \cdot L_{slab}$$

$$Loc_{j_{brg}} := dist_{cl.brg}$$

$$j := j_{brg} + 1 .. 101 - j_{brg} \qquad Loc_j := \frac{j - 1}{100} \cdot L_{slab}$$

$$Loc_{102 - j_{brg}} := L_{slab} - dist_{cl.brg}$$

$$j := 102 - j_{brg} + 1 .. 102 \qquad Loc_j := \frac{j - 2}{100} \cdot L_{slab}$$

$$j := 0 .. 102$$

HS Live Load

Impact

$$Impact := \min\left(0.30, \frac{50}{125 + \frac{Span}{ft}}\right) \qquad Impact = 0.257$$

LFD Section 3.8.2.1, Eq. 3-1

Design Truck Load

HS Truck Designation: $HS := 20.0$

$num_{axles.truck} := 3$ $\qquad ai := 0 .. num_{axles.truck} - 1$ $\qquad lane_{width} := 12 \cdot ft$

Axle Loads and Spacing (Forward) **LFD Figure 3.7.7A**

$P_{axle.f.truck_{ai}} :=$

$8 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$

$Spacing_{axle.truck_{ai}} :=$

$0 \cdot ft$
$14 \cdot ft$
$14 \cdot ft$

$$Loc_{axle.f.truck_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.truck_n}$$

$$Loc_{axle.f.truck} = \begin{pmatrix} 0.000 \\ 14.000 \\ 28.000 \end{pmatrix} ft$$

Maximum Axle Load $\qquad P_{max.truck} := \max(P_{axle.f.truck}) \qquad P_{max.truck} = 32.000\,kips$

Axle Loads and Spacing (Reverse) $\qquad P_{axle.r.truck_{ai}} := P_{axle.f.truck_{num_{axles.truck}-1-ai}}$

$$Loc_{axle.r.truck_{ai}} := \begin{cases} 0 \cdot ft & \text{if } ai = 0 \\ \sum_{n=num_{axles.truck}-ai}^{num_{axles.truck}-1} Spacing_{axle.truck_n} & \text{otherwise} \end{cases}$$

HS Live Load (continued)

Truck Load Moment Calculation

$$M_{s.truck.f_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.truck.r_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.pos.truck_j} := \max\left(M_{s.truck.f_j}, M_{s.truck.r_j}\right)$$

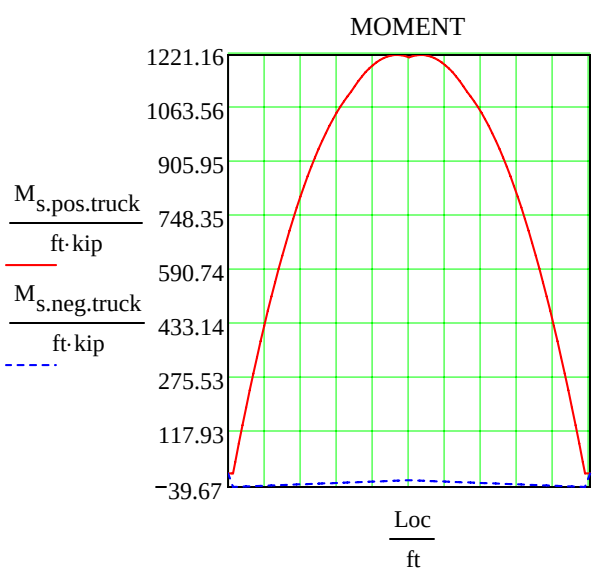
$$M_{s.neg.truck_j} := \begin{cases} -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ -(1 + Impact)\cdot P_{max.truck}\cdot\left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

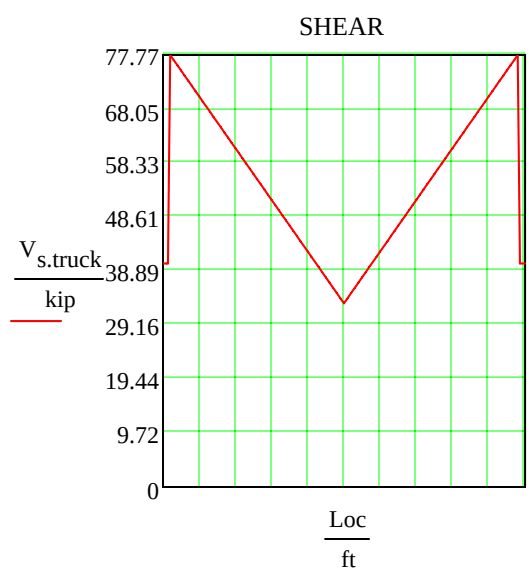
Live Load Truck Shear

$$V_{s.truck.f_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck.r_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck_j} := \max\left(V_{s.truck.f_j}, V_{s.truck.r_j}\right)$$





Lane Load Moment Calculation

Uniform Load: $w_{lane} := 0.64 \cdot klf \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Moment): $P_{conc.mom} := 18 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Shear): $P_{conc.shear} := 26 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

$$M_{s.pos.uni_j} := \begin{cases} SSM_{uni}\left(Span, w_{lane}, Loc_j - dist_{cl.brg}, 0 \cdot in\right) & \text{if } dist_{cl.brg} \le Loc_j \le L_{slab} - dist_{cl.brg} \\ 0 \cdot ft \cdot kips & \text{otherwise} \end{cases}$$

$$M_{s.neg.uni_j} := \begin{cases} \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot \left(Loc_j\right)^2}{2} & \text{if } Loc_j \le dist_{cl.brg} \\ \frac{-w_{lane} \cdot \left(L_{slab} - Loc_j\right)^2}{2} & \text{if } Loc_j \ge L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.conc_j} := \begin{cases} 0 \cdot ft \cdot kip & \text{if } dist_{cl.brg} \ge Loc_j \vee Loc_j \ge L_{slab} - dist_{cl.brg} \\ SSM_{conc}\left(Span, P_{conc.mom}, Loc_j - dist_{cl.brg}, Loc_j - dist_{cl.brg}\right) & \text{otherwise} \end{cases}$$

$$M_{s.neg.conc_j} := \begin{cases} -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Span - \left(Loc_j - dist_{cl.brg}\right)}{Span} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Loc_j - dist_{cl.brg}}{Span} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot Loc_j & \text{if } Loc_j \le dist_{cl.brg} \\ -P_{conc.mom} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.lane} := M_{s.pos.uni} + M_{s.pos.conc}$$

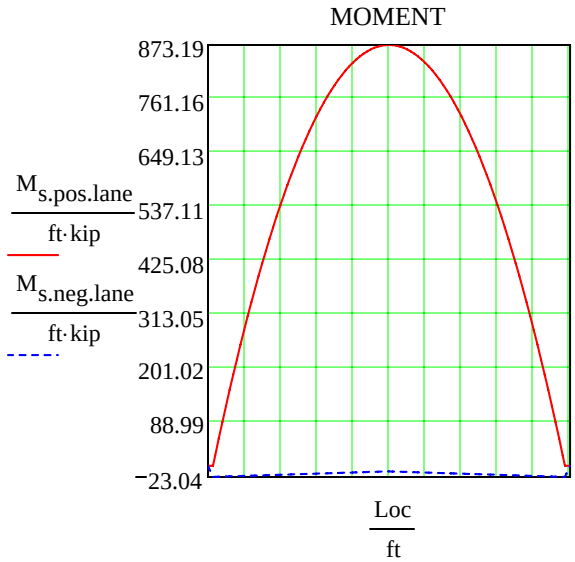
$$M_{s.neg.lane} := M_{s.neg.uni} + M_{s.neg.conc}$$

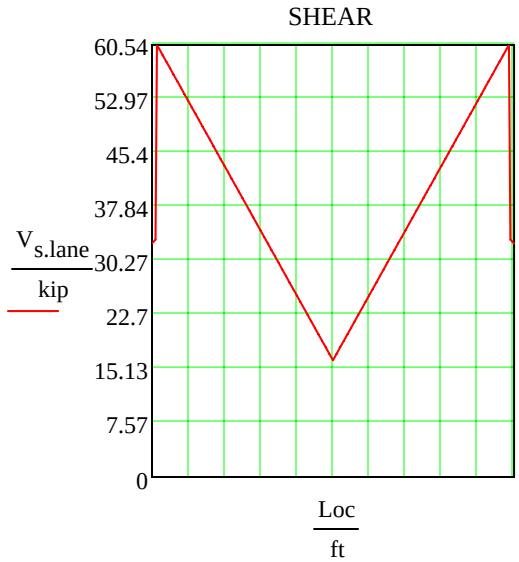
Lane Load Shear Calculation

$V_{s.uni_j} := SSV_{uni}(L_{slab}, w_{lane}, Loc_j, dist_{cl.brg})$

$V_{s.conc_j} := SSV_{conc}(L_{slab}, P_{conc.shear}, Loc_j, dist_{cl.brg})$

$V_{s.lane} := V_{s.uni} + V_{s.conc}$



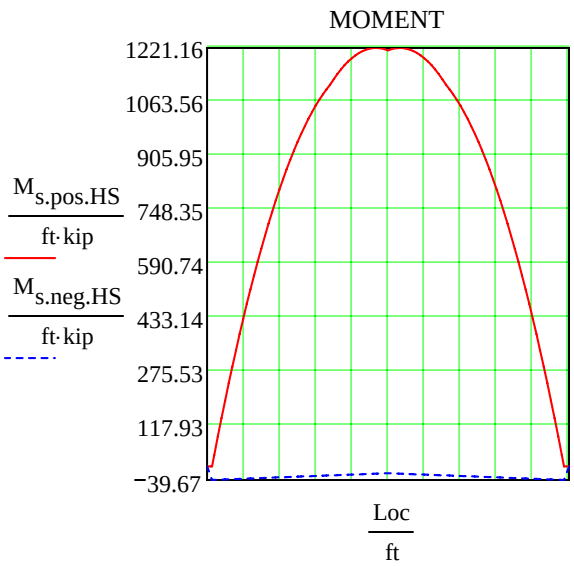


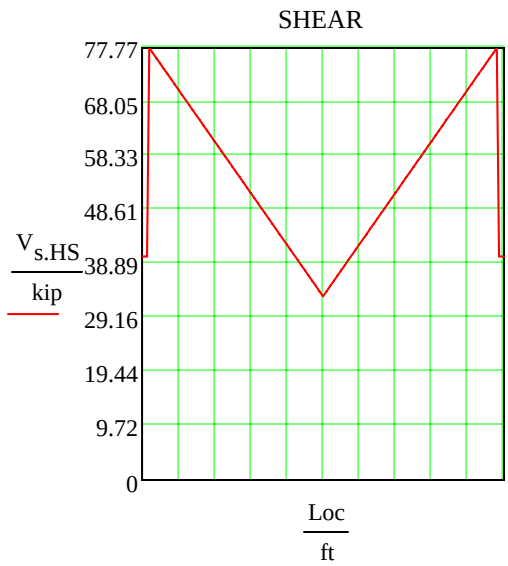
Critical HS Moments and Shears

$M_{s.pos.HS_j} := \max\left(M_{s.pos.truck_j}, M_{s.pos.uni_j}\right)$

$M_{s.neg.HS_j} := \min\left(M_{s.neg.truck_j}, M_{s.neg.uni_j}\right)$

$V_{s.HS_j} := \max\left(V_{s.truck_j}, V_{s.uni_j}\right)$





Maximum Loads:

$M_{s.max.HS} := \max\left(M_{s.pos.HS}\right)$ $\qquad M_{s.max.HS} = 1221.159\ ft \cdot kip$

$M_{s.min.HS} := \min\left(M_{s.neg.HS}\right)$ $\qquad M_{s.min.HS} = -39.674\ ft \cdot kip$

$V_{s.max.HS} := \max\left(V_{s.HS}\right)$ $\qquad V_{s.max.HS} = 77.771\ kip$

Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (no couples):

Number of Axles: $num_{axles.TC4200} := 6$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{36745 \cdot kgf + 47655 \cdot kgf}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$$Loc_{axle.TC4200} = \begin{pmatrix} 0.000 \\ 6.001 \\ 25.000 \\ 31.001 \\ 50.000 \\ 56.001 \end{pmatrix} ft$$

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 1897.382\ ft \cdot kips$

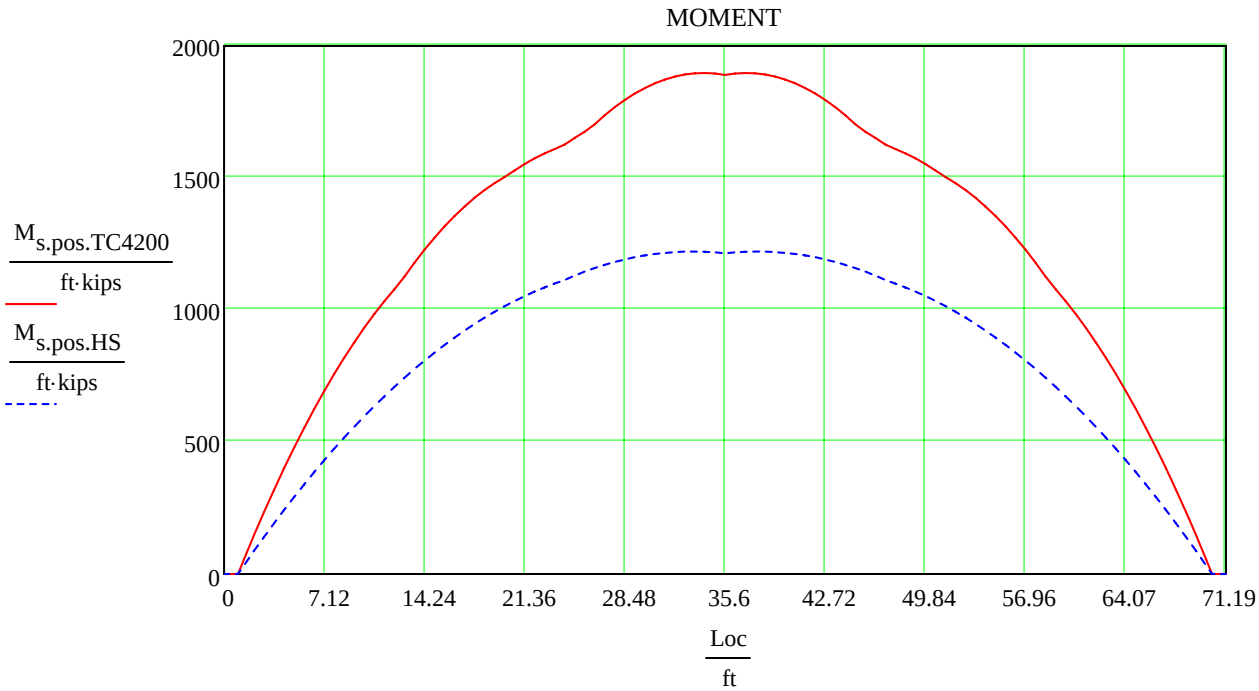
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

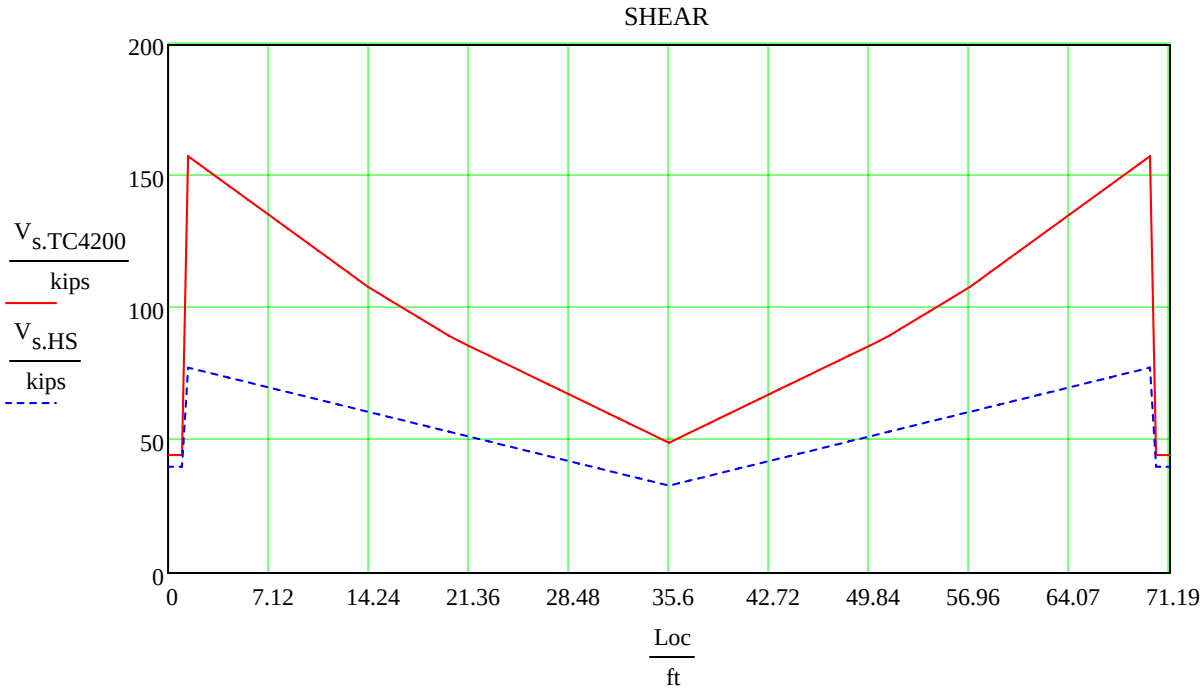
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 157.874\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (assume two coupled vehicles):

Number of Axles: $num_{axles.TC4200} := 12$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{2 \cdot (36745 \cdot kgf + 47655 \cdot kgf)}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$Loc_{axle.TC4200} =$

	0
0	0.000
1	6.001
2	25.000
3	31.001
4	50.000
5	56.001
6	75.000
7	81.001
8	100.000
9	106.001
10	125.000
11	131.001

ft

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 1897.382\ ft \cdot kips$

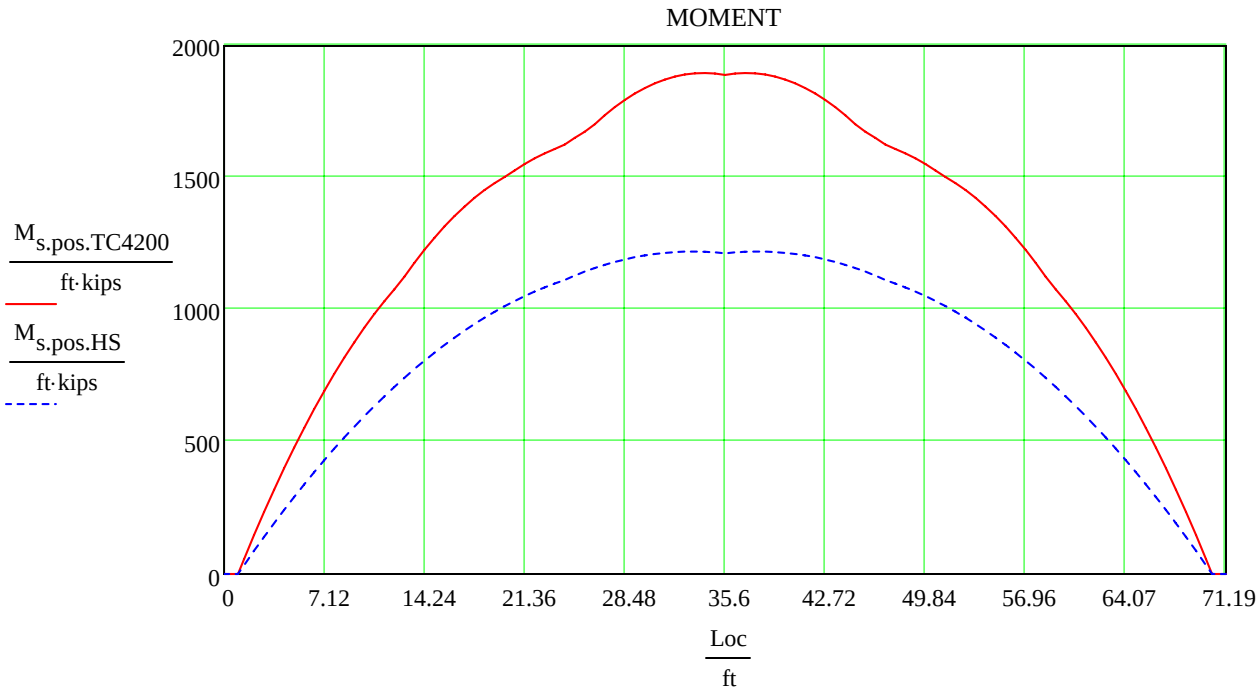
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

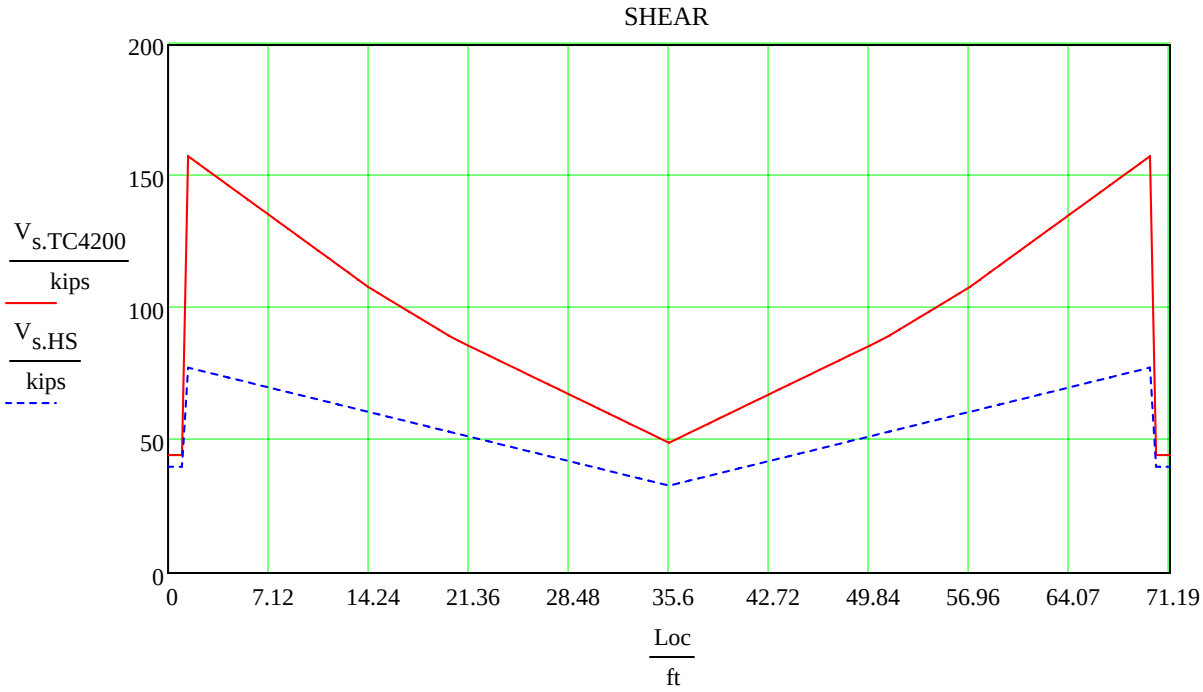
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 157.874\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Check - Bridge 021561

General Design Parameters

Design References

(Acronym)....Design Reference

(LFD).....AASHTO Standard Specifications for Highway Bridges, 17th Edition

Defined Parameters

$kips \equiv 1000 \cdot lbf \qquad ksi \equiv 1000 \cdot psi \qquad CY \equiv 27ft^3 \qquad SY \equiv 9ft^2$

$klf \equiv \frac{kips}{ft} \qquad ksf \equiv \frac{kips}{ft^2} \qquad plf \equiv \frac{lbf}{ft} \qquad psf \equiv \frac{lbf}{ft^2} \qquad pcf \equiv \frac{lbf}{ft^3}$

Functions

Limit Check

$$check(actual, limit) := \begin{cases} \text{"O.K."} & \text{if } actual \le limit \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Equality Check

$$check_equal(value1, value2) := \begin{cases} \text{"O.K."} & \text{if } 0.999999 \le \left|\frac{value1}{value2}\right| \le 1.000001 \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Analysis per AASHTO LRFD Bridge Design Specifications

Bridge Design Span

Parameters

Bridge Length (Between Front Face of Backwalls) $L_{bridge} := 4.40 \cdot m$

Thickness of Expansion Joints $t_{exp} := 0 \cdot in$ Note : Uses Roofing Paper for Bond Breaker

Length of Slab $L_{slab} := L_{bridge} - 2 \cdot t_{exp}$ $L_{slab} = 14.436\ ft$

Use 2 layers of roofing paper at back of slab end diaphragm for expansion joint bond breaker

Bearing Distance from End of Bridge to Centerline of Bearing $dist_{cl.brg} := 12 \cdot in$

Span Between Centerline Bearings

Span $Span := L_{slab} - 2 \cdot dist_{cl.brg}$ $Span = 12.436\ ft$

Definition of Slab Design Sections (every 0.01L)

$$j_{brg} := \text{floor}\left(\frac{100 \cdot dist_{cl.brg}}{L_{slab}}\right) + 1 \qquad j_{brg} = 7.000$$

$$j := 0 .. j_{brg} - 1 \qquad Loc_j := \frac{j}{100} \cdot L_{slab}$$

$$Loc_{j_{brg}} := dist_{cl.brg}$$

$$j := j_{brg} + 1 .. 101 - j_{brg} \qquad Loc_j := \frac{j - 1}{100} \cdot L_{slab}$$

$$Loc_{102 - j_{brg}} := L_{slab} - dist_{cl.brg}$$

$$j := 102 - j_{brg} + 1 .. 102 \qquad Loc_j := \frac{j - 2}{100} \cdot L_{slab}$$

$$j := 0 .. 102$$

HS Live Load

Impact

$$Impact := \min\left(0.30, \frac{50}{125 + \frac{Span}{ft}}\right) \qquad Impact = 0.300$$

LFD Section 3.8.2.1, Eq. 3-1

Design Truck Load

HS Truck Designation: $HS := 13.9$

$num_{axles.truck} := 3$ $\qquad ai := 0 .. num_{axles.truck} - 1$ $\qquad lane_{width} := 12 \cdot ft$

Axle Loads and Spacing (Forward) **LFD Figure 3.7.7A**

$P_{axle.f.truck_{ai}} :=$

$8 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$

$Spacing_{axle.truck_{ai}} :=$

$0 \cdot ft$
$14 \cdot ft$
$14 \cdot ft$

$$Loc_{axle.f.truck_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.truck_n}$$

$$Loc_{axle.f.truck} = \begin{pmatrix} 0.000 \\ 14.000 \\ 28.000 \end{pmatrix} ft$$

Maximum Axle Load $\qquad P_{max.truck} := \max(P_{axle.f.truck}) \qquad P_{max.truck} = 22.240\,kips$

Axle Loads and Spacing (Reverse) $\qquad P_{axle.r.truck_{ai}} := P_{axle.f.truck_{num_{axles.truck}-1-ai}}$

$$Loc_{axle.r.truck_{ai}} := \begin{cases} 0 \cdot ft & \text{if } ai = 0 \\ \sum_{n=num_{axles.truck}-ai}^{num_{axles.truck}-1} Spacing_{axle.truck_n} & \text{otherwise} \end{cases}$$

HS Live Load (continued)

Truck Load Moment Calculation

$$M_{s.truck.f_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.truck.r_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.pos.truck_j} := \max\left(M_{s.truck.f_j}, M_{s.truck.r_j}\right)$$

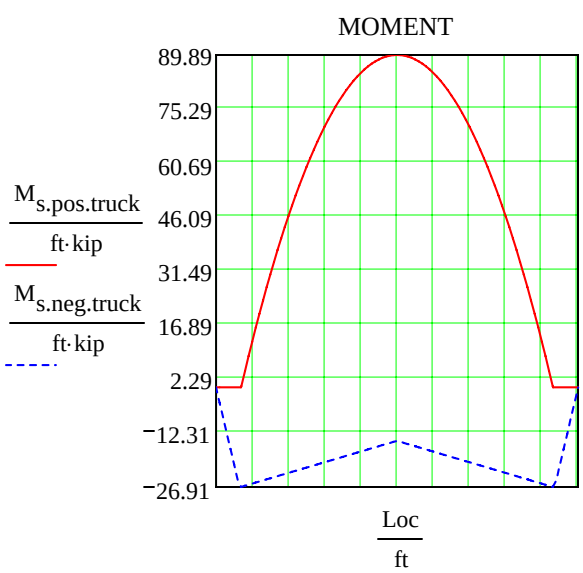
$$M_{s.neg.truck_j} := \begin{cases} -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ -(1 + Impact)\cdot P_{max.truck}\cdot\left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

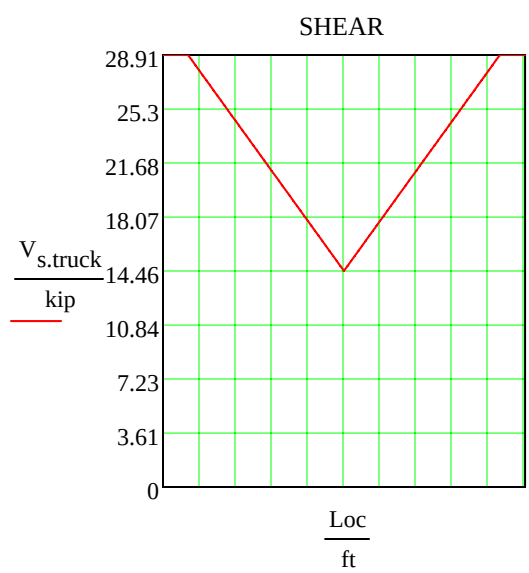
Live Load Truck Shear

$$V_{s.truck.f_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck.r_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck_j} := \max\left(V_{s.truck.f_j}, V_{s.truck.r_j}\right)$$





Lane Load Moment Calculation

Uniform Load: $w_{lane} := 0.64 \cdot klf \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Moment): $P_{conc.mom} := 18 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Shear): $P_{conc.shear} := 26 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

$$M_{s.pos.uni_j} := \begin{cases} SSM_{uni}\left(Span, w_{lane}, Loc_j - dist_{cl.brg}, 0 \cdot in\right) & \text{if } dist_{cl.brg} \le Loc_j \le L_{slab} - dist_{cl.brg} \\ 0 \cdot ft \cdot kips & \text{otherwise} \end{cases}$$

$$M_{s.neg.uni_j} := \begin{cases} \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot \left(Loc_j\right)^2}{2} & \text{if } Loc_j \le dist_{cl.brg} \\ \frac{-w_{lane} \cdot \left(L_{slab} - Loc_j\right)^2}{2} & \text{if } Loc_j \ge L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.conc_j} := \begin{cases} 0 \cdot ft \cdot kip & \text{if } dist_{cl.brg} \ge Loc_j \vee Loc_j \ge L_{slab} - dist_{cl.brg} \\ SSM_{conc}\left(Span, P_{conc.mom}, Loc_j - dist_{cl.brg}, Loc_j - dist_{cl.brg}\right) & \text{otherwise} \end{cases}$$

$$M_{s.neg.conc_j} := \begin{cases} -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Span - \left(Loc_j - dist_{cl.brg}\right)}{Span} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Loc_j - dist_{cl.brg}}{Span} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot Loc_j & \text{if } Loc_j \le dist_{cl.brg} \\ -P_{conc.mom} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.lane} := M_{s.pos.uni} + M_{s.pos.conc}$$

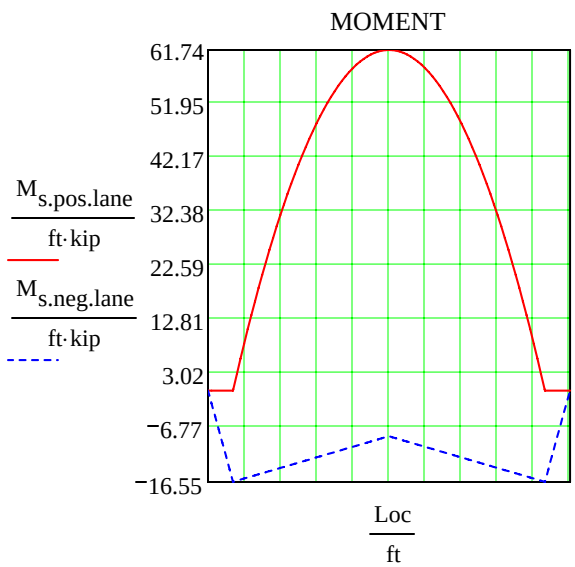
$$M_{s.neg.lane} := M_{s.neg.uni} + M_{s.neg.conc}$$

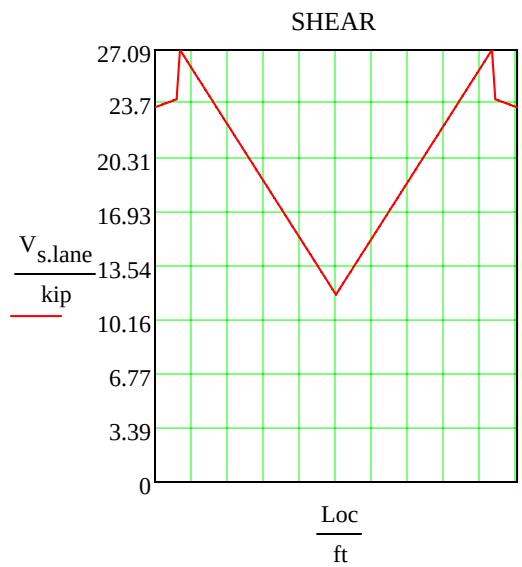
Lane Load Shear Calculation

$V_{s.uni_j} := SSV_{uni}(L_{slab}, w_{lane}, Loc_j, dist_{cl.brg})$

$V_{s.conc_j} := SSV_{conc}(L_{slab}, P_{conc.shear}, Loc_j, dist_{cl.brg})$

$V_{s.lane} := V_{s.uni} + V_{s.conc}$



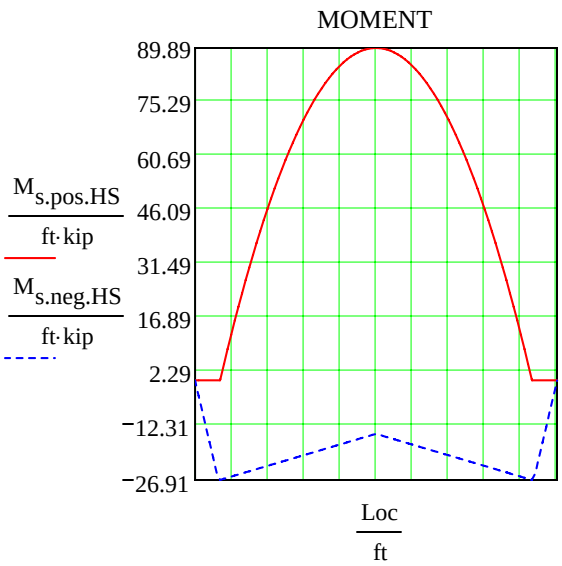


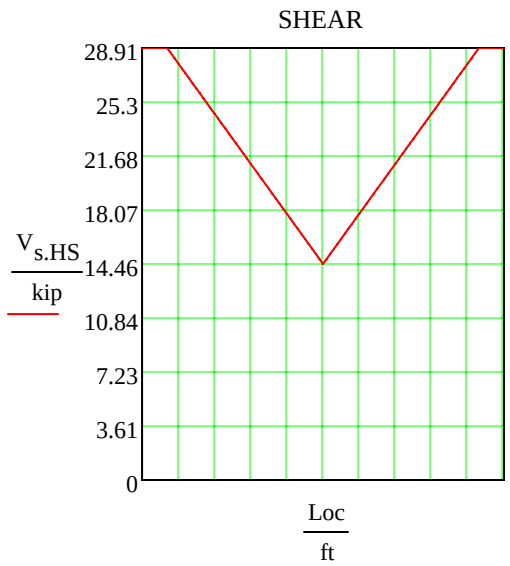
Critical HS Moments and Shears

$M_{s.pos.HS_j} := \max\left(M_{s.pos.truck_j}, M_{s.pos.uni_j}\right)$

$M_{s.neg.HS_j} := \min\left(M_{s.neg.truck_j}, M_{s.neg.uni_j}\right)$

$V_{s.HS_j} := \max\left(V_{s.truck_j}, V_{s.uni_j}\right)$





Maximum Loads:

$M_{s.max.HS} := \max\left(M_{s.pos.HS}\right)$ $\qquad M_{s.max.HS} = 89.885\ ft \cdot kip$

$M_{s.min.HS} := \min\left(M_{s.neg.HS}\right)$ $\qquad M_{s.min.HS} = -26.909\ ft \cdot kip$

$V_{s.max.HS} := \max\left(V_{s.HS}\right)$ $\qquad V_{s.max.HS} = 28.912\ kip$

Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (no couples):

Number of Axles: $num_{axles.TC4200} := 6$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{36745 \cdot kgf + 47655 \cdot kgf}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$$Loc_{axle.TC4200} = \begin{pmatrix} 0.000 \\ 6.001 \\ 25.000 \\ 31.001 \\ 50.000 \\ 56.001 \end{pmatrix} ft$$

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 133.187\ ft \cdot kips$

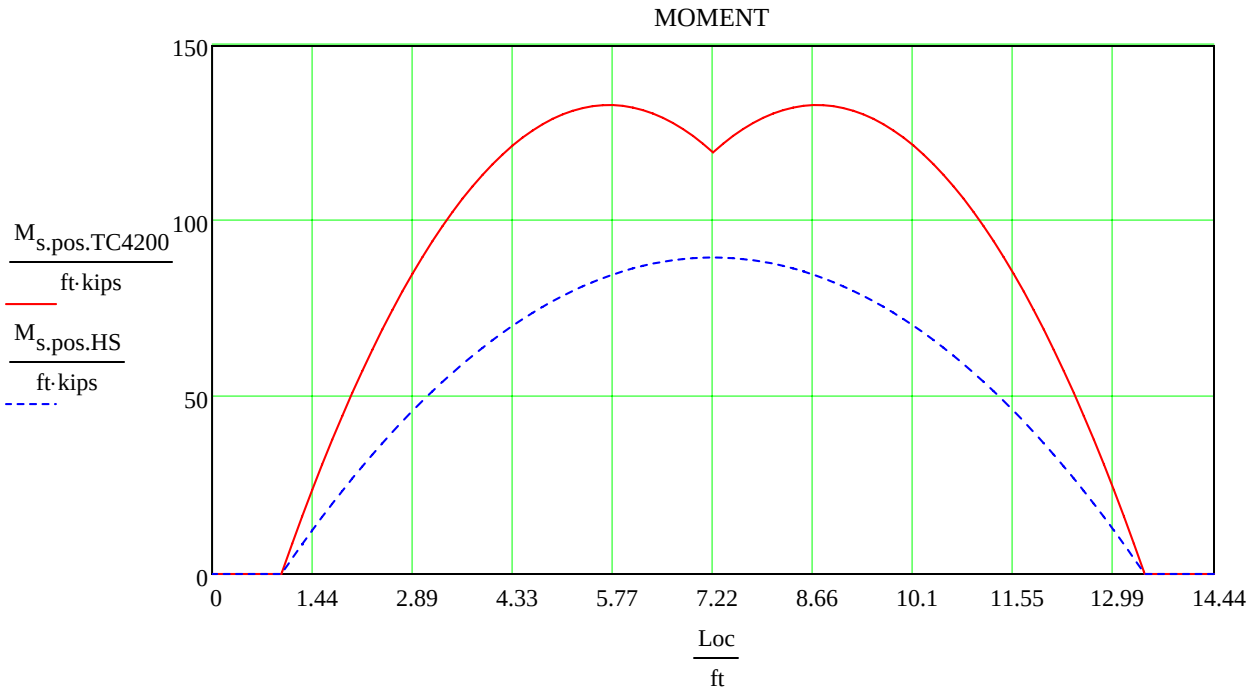
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

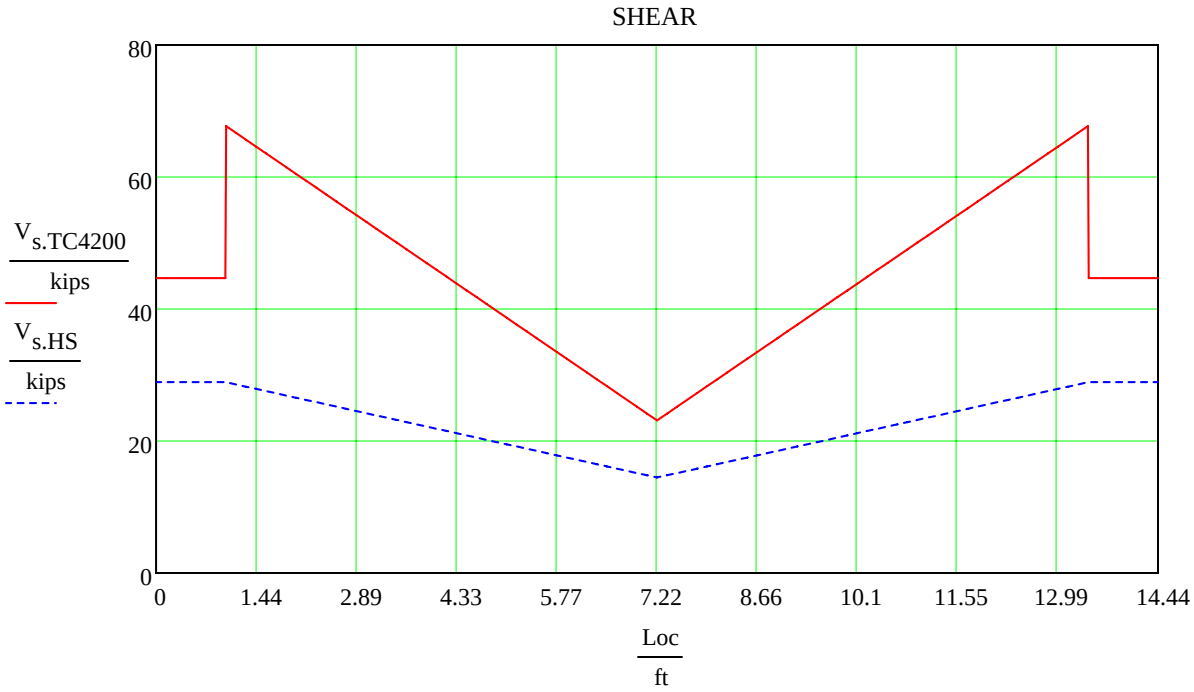
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 67.690\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (assume two coupled vehicles):

Number of Axles: $num_{axles.TC4200} := 12$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{2 \cdot (36745 \cdot kgf + 47655 \cdot kgf)}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$Loc_{axle.TC4200} =$

	0
0	0.000
1	6.001
2	25.000
3	31.001
4	50.000
5	56.001
6	75.000
7	81.001
8	100.000
9	106.001
10	125.000
11	131.001

ft

Maximum Axle Load (with Impact):

$P_{max.TC4200} := \max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 133.187\ ft \cdot kips$

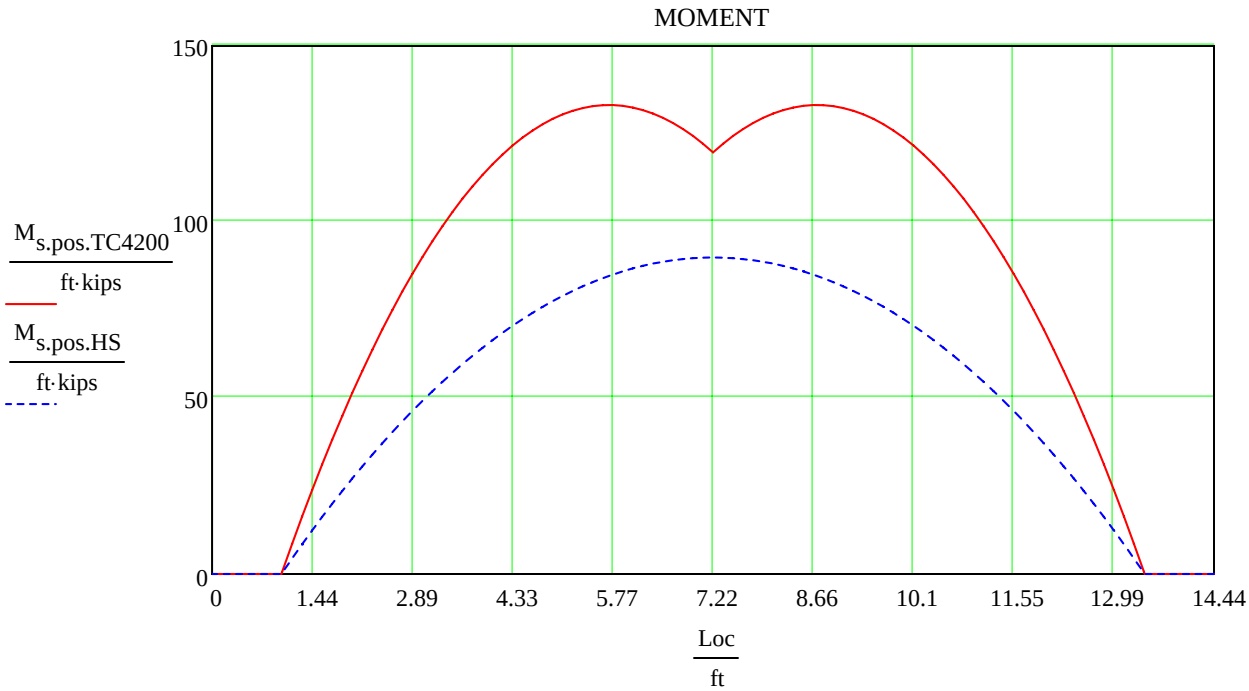
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

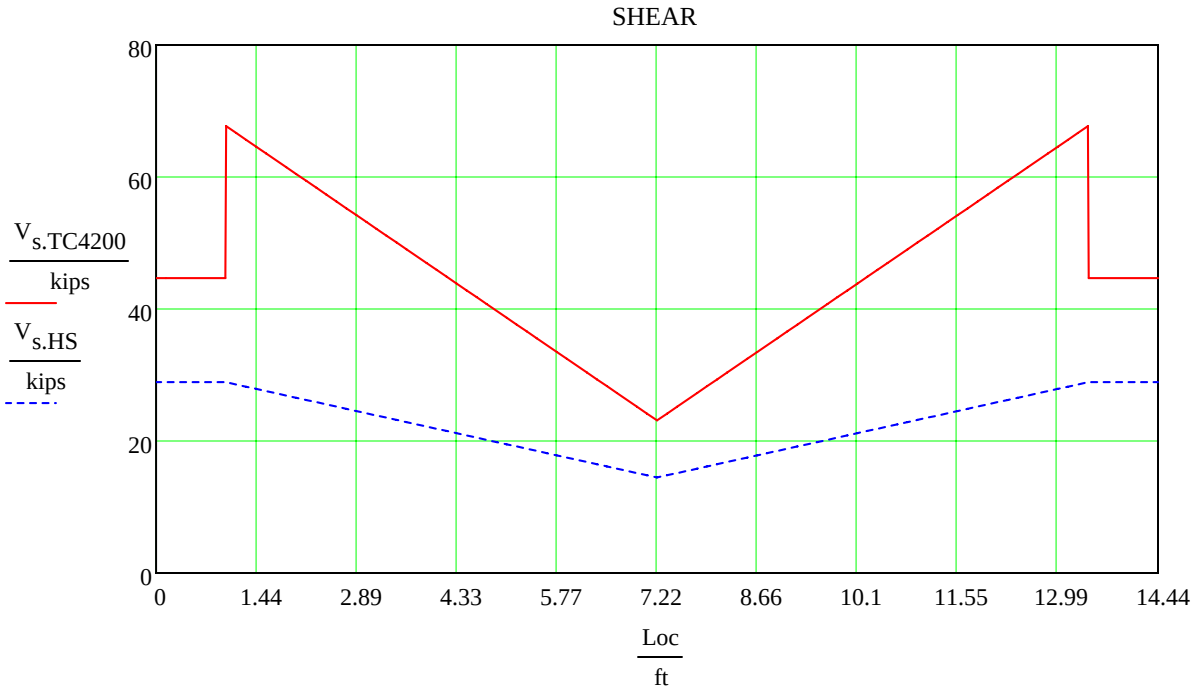
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 67.690\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Check - Bridge 023311

General Design Parameters

Design References

(Acronym)....Design Reference

(LFD).....AASHTO Standard Specifications for Highway Bridges, 17th Edition

Defined Parameters

$kips \equiv 1000 \cdot lbf \qquad ksi \equiv 1000 \cdot psi \qquad CY \equiv 27ft^3 \qquad SY \equiv 9ft^2$

$klf \equiv \frac{kips}{ft} \qquad ksf \equiv \frac{kips}{ft^2} \qquad plf \equiv \frac{lbf}{ft} \qquad psf \equiv \frac{lbf}{ft^2} \qquad pcf \equiv \frac{lbf}{ft^3}$

Functions

Limit Check

$$check(actual, limit) := \begin{cases} \text{"O.K."} & \text{if } actual \le limit \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Equality Check

$$check_equal(value1, value2) := \begin{cases} \text{"O.K."} & \text{if } 0.999999 \le \left|\frac{value1}{value2}\right| \le 1.000001 \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Analysis per AASHTO LRFD Bridge Design Specifications

Bridge Design Span

Parameters

Bridge Length (Between Front Face of Backwalls) $L_{bridge} := 25.20 \cdot m$

Thickness of Expansion Joints $t_{exp} := 0 \cdot in$ Note : Uses Roofing Paper for Bond Breaker

Length of Slab $L_{slab} := L_{bridge} - 2 \cdot t_{exp}$ $L_{slab} = 82.677\ ft$

Use 2 layers of roofing paper at back of slab end diaphragm for expansion joint bond breaker

Bearing Distance from End of Bridge to Centerline of Bearing $dist_{cl.brg} := 12 \cdot in$

Span Between Centerline Bearings

Span $Span := L_{slab} - 2 \cdot dist_{cl.brg}$ $Span = 80.677\ ft$

Definition of Slab Design Sections (every 0.01L)

$$j_{brg} := \text{floor}\left(\frac{100 \cdot dist_{cl.brg}}{L_{slab}}\right) + 1 \qquad j_{brg} = 2.000$$

$$j := 0 .. j_{brg} - 1 \qquad Loc_j := \frac{j}{100} \cdot L_{slab}$$

$$Loc_{j_{brg}} := dist_{cl.brg}$$

$$j := j_{brg} + 1 .. 101 - j_{brg} \qquad Loc_j := \frac{j - 1}{100} \cdot L_{slab}$$

$$Loc_{102 - j_{brg}} := L_{slab} - dist_{cl.brg}$$

$$j := 102 - j_{brg} + 1 .. 102 \qquad Loc_j := \frac{j - 2}{100} \cdot L_{slab}$$

$$j := 0 .. 102$$

HS Live Load

Impact

$$Impact := \min\left(0.30, \frac{50}{125 + \frac{Span}{ft}}\right) \qquad Impact = 0.243$$

LFD Section 3.8.2.1, Eq. 3-1

Design Truck Load

HS Truck Designation: $HS := 20$

$num_{axles.truck} := 3$ $\qquad ai := 0 .. num_{axles.truck} - 1$ $\qquad lane_{width} := 12 \cdot ft$

Axle Loads and Spacing (Forward) **LFD Figure 3.7.7A**

$P_{axle.f.truck_{ai}} :=$

$8 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$

$Spacing_{axle.truck_{ai}} :=$

$0 \cdot ft$
$14 \cdot ft$
$14 \cdot ft$

$$Loc_{axle.f.truck_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.truck_n}$$

$$Loc_{axle.f.truck} = \begin{pmatrix} 0.000 \\ 14.000 \\ 28.000 \end{pmatrix} ft$$

Maximum Axle Load $\qquad P_{max.truck} := \max(P_{axle.f.truck}) \qquad P_{max.truck} = 32.000\,kips$

Axle Loads and Spacing (Reverse) $\qquad P_{axle.r.truck_{ai}} := P_{axle.f.truck_{num_{axles.truck}-1-ai}}$

$$Loc_{axle.r.truck_{ai}} := \begin{cases} 0 \cdot ft & \text{if } ai = 0 \\ \sum_{n=num_{axles.truck}-ai}^{num_{axles.truck}-1} Spacing_{axle.truck_n} & \text{otherwise} \end{cases}$$

HS Live Load (continued)

Truck Load Moment Calculation

$$M_{s.truck.f_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.truck.r_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.pos.truck_j} := \max\left(M_{s.truck.f_j}, M_{s.truck.r_j}\right)$$

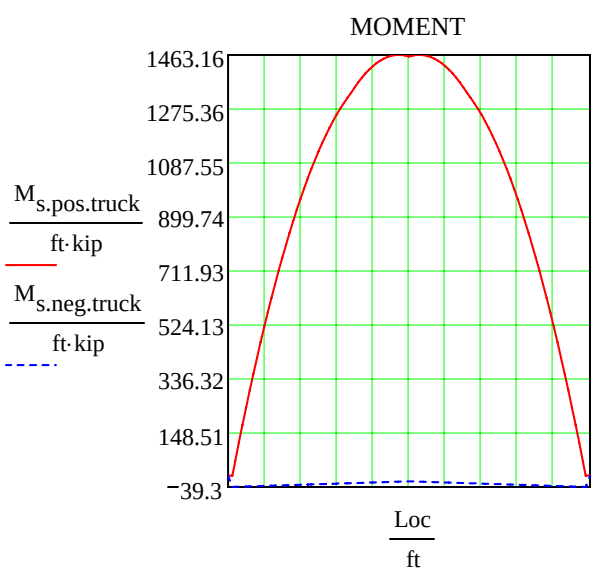
$$M_{s.neg.truck_j} := \begin{cases} -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ -(1 + Impact)\cdot P_{max.truck}\cdot\left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

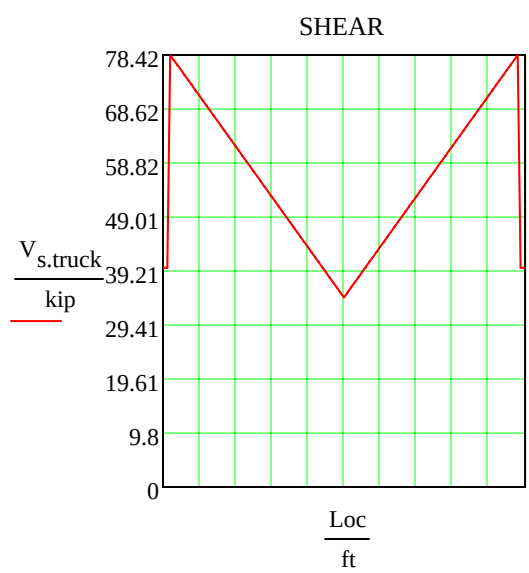
Live Load Truck Shear

$$V_{s.truck.f_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck.r_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck_j} := \max\left(V_{s.truck.f_j}, V_{s.truck.r_j}\right)$$





Lane Load Moment Calculation

Uniform Load: $w_{lane} := 0.64 \cdot klf \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Moment): $P_{conc.mom} := 18 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Shear): $P_{conc.shear} := 26 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

$$M_{s.pos.uni_j} := \begin{cases} SSM_{uni}\left(Span, w_{lane}, Loc_j - dist_{cl.brg}, 0 \cdot in\right) & \text{if } dist_{cl.brg} \le Loc_j \le L_{slab} - dist_{cl.brg} \\ 0 \cdot ft \cdot kips & \text{otherwise} \end{cases}$$

$$M_{s.neg.uni_j} := \begin{cases} \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot \left(Loc_j\right)^2}{2} & \text{if } Loc_j \le dist_{cl.brg} \\ \frac{-w_{lane} \cdot \left(L_{slab} - Loc_j\right)^2}{2} & \text{if } Loc_j \ge L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.conc_j} := \begin{cases} 0 \cdot ft \cdot kip & \text{if } dist_{cl.brg} \ge Loc_j \vee Loc_j \ge L_{slab} - dist_{cl.brg} \\ SSM_{conc}\left(Span, P_{conc.mom}, Loc_j - dist_{cl.brg}, Loc_j - dist_{cl.brg}\right) & \text{otherwise} \end{cases}$$

$$M_{s.neg.conc_j} := \begin{cases} -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Span - \left(Loc_j - dist_{cl.brg}\right)}{Span} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Loc_j - dist_{cl.brg}}{Span} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot Loc_j & \text{if } Loc_j \le dist_{cl.brg} \\ -P_{conc.mom} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.lane} := M_{s.pos.uni} + M_{s.pos.conc}$$

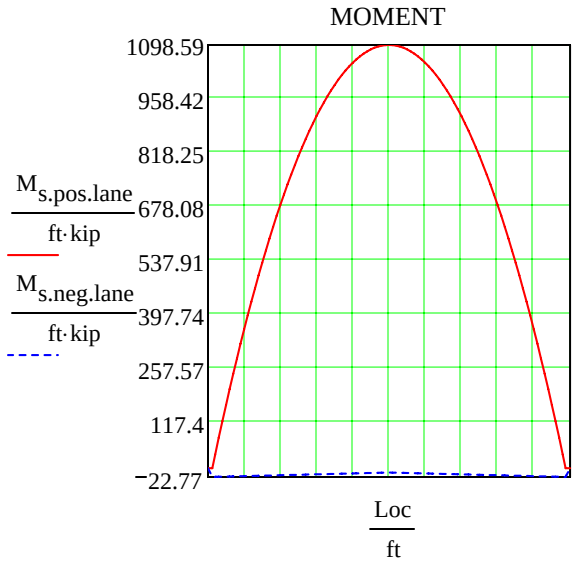
$$M_{s.neg.lane} := M_{s.neg.uni} + M_{s.neg.conc}$$

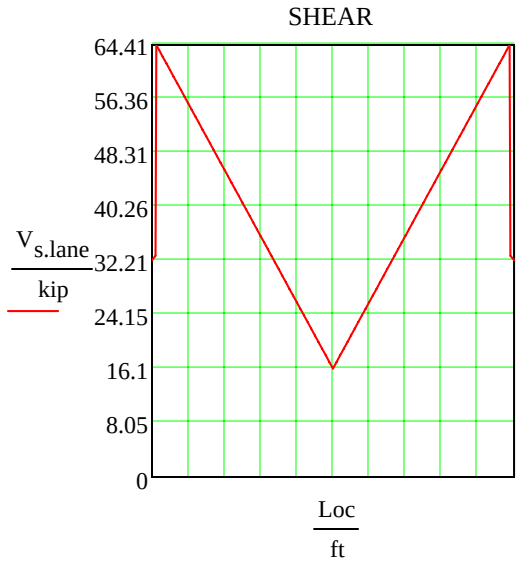
Lane Load Shear Calculation

$V_{s.uni_j} := SSV_{uni}(L_{slab}, w_{lane}, Loc_j, dist_{cl.brg})$

$V_{s.conc_j} := SSV_{conc}(L_{slab}, P_{conc.shear}, Loc_j, dist_{cl.brg})$

$V_{s.lane} := V_{s.uni} + V_{s.conc}$



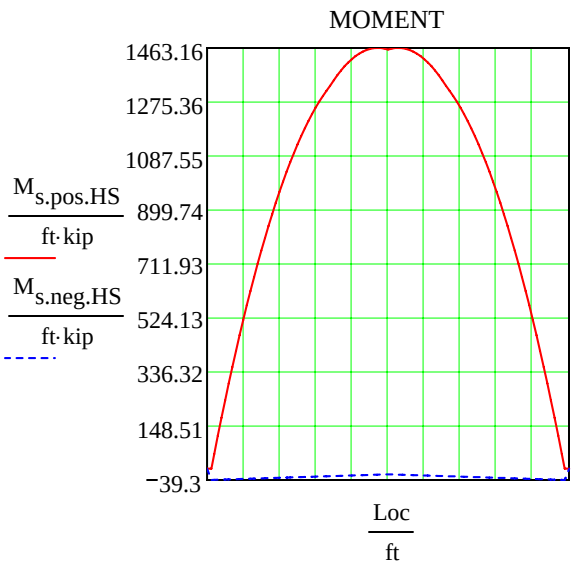


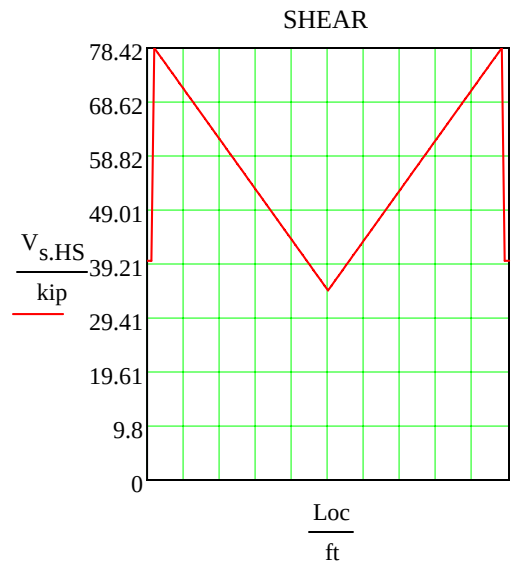
Critical HS Moments and Shears

$M_{s.pos.HS_j} := \max\left(M_{s.pos.truck_j}, M_{s.pos.uni_j}\right)$

$M_{s.neg.HS_j} := \min\left(M_{s.neg.truck_j}, M_{s.neg.uni_j}\right)$

$V_{s.HS_j} := \max\left(V_{s.truck_j}, V_{s.uni_j}\right)$





Maximum Loads:

$M_{s.max.HS} := \max\left(M_{s.pos.HS}\right)$ $\qquad M_{s.max.HS} = 1463.164\ ft \cdot kip$

$M_{s.min.HS} := \min\left(M_{s.neg.HS}\right)$ $\qquad M_{s.min.HS} = -39.298\ ft \cdot kip$

$V_{s.max.HS} := \max\left(V_{s.HS}\right)$ $\qquad V_{s.max.HS} = 78.424\ kip$

Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (no couples):

Number of Axles: $num_{axles.TC4200} := 6$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{36745 \cdot kgf + 47655 \cdot kgf}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$$Loc_{axle.TC4200} = \begin{pmatrix} 0.000 \\ 6.001 \\ 25.000 \\ 31.001 \\ 50.000 \\ 56.001 \end{pmatrix} ft$$

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 2537.291\ ft \cdot kips$

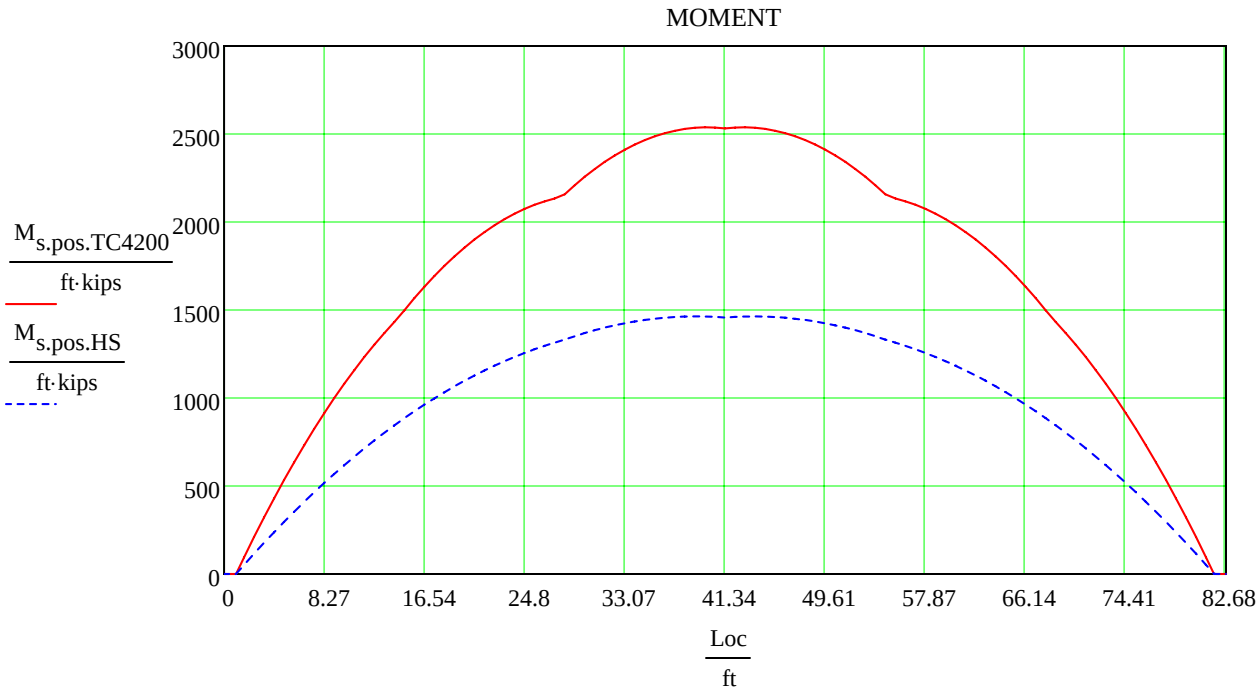
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

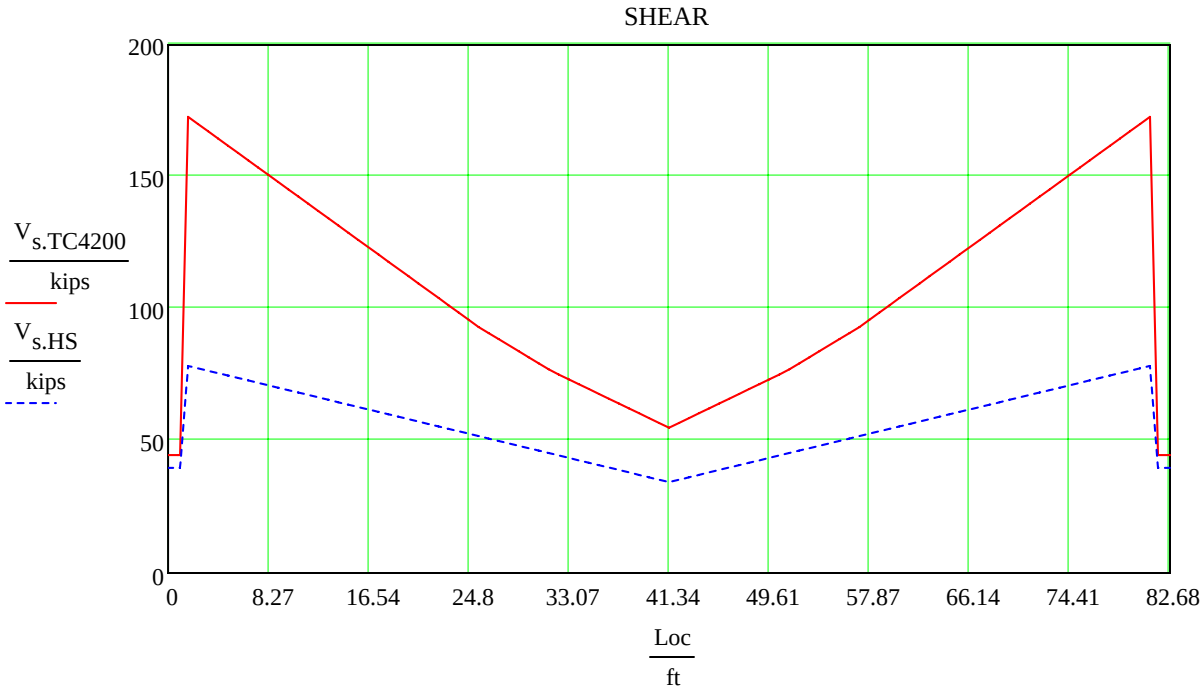
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 172.777\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (assume two coupled vehicles):

Number of Axles: $num_{axles.TC4200} := 12$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{2 \cdot (36745 \cdot kgf + 47655 \cdot kgf)}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$Loc_{axle.TC4200} =$

	0
0	0.000
1	6.001
2	25.000
3	31.001
4	50.000
5	56.001
6	75.000
7	81.001
8	100.000
9	106.001
10	125.000
11	131.001

ft

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 2537.291\ ft \cdot kips$

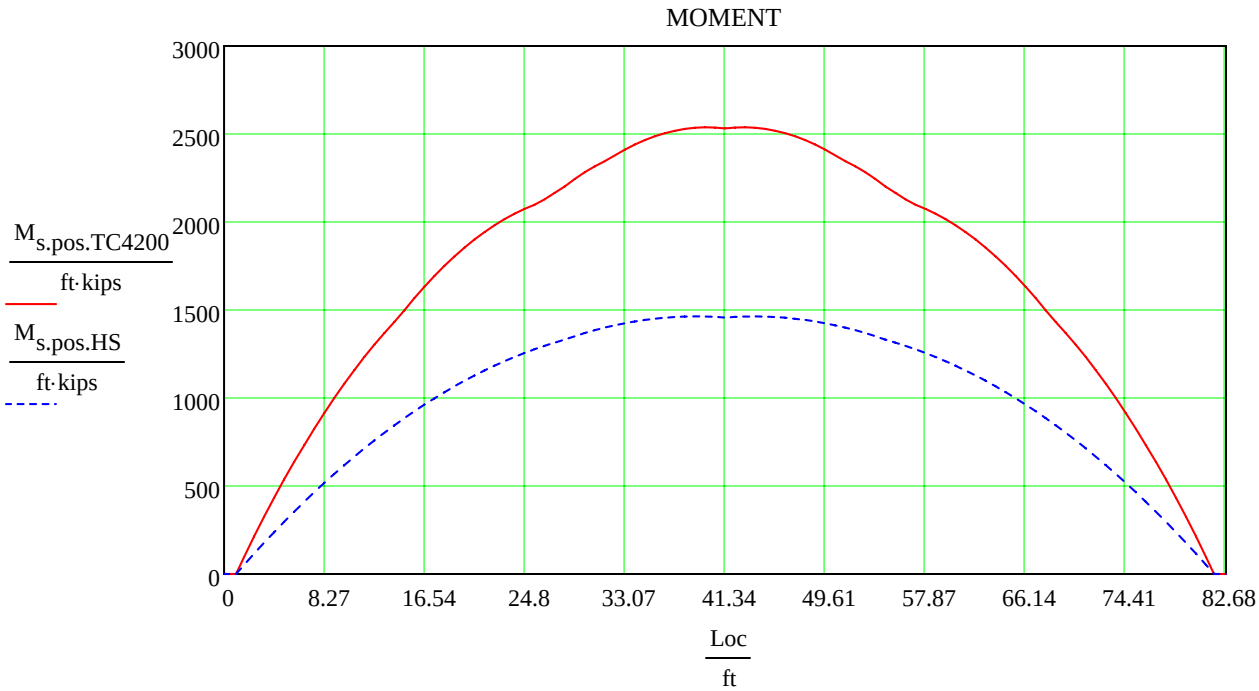
$\boxed{check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}}$

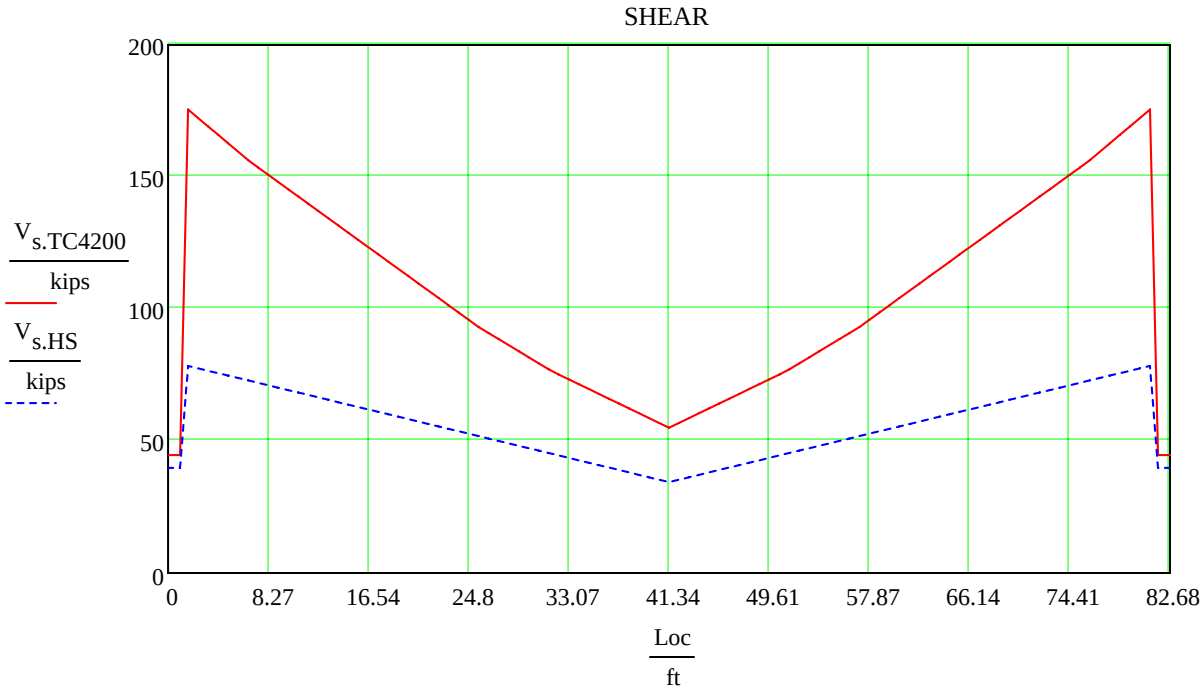
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 175.558\ kips$ $\boxed{check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}}$

TC 4200 ALRV Loading





Transit Load Check - Bridge 023321

General Design Parameters

Design References

(Acronym)....Design Reference

(LFD).....AASHTO Standard Specifications for Highway Bridges, 17th Edition

Defined Parameters

$kips \equiv 1000 \cdot lbf \qquad ksi \equiv 1000 \cdot psi \qquad CY \equiv 27ft^3 \qquad SY \equiv 9ft^2$

$klf \equiv \frac{kips}{ft} \qquad ksf \equiv \frac{kips}{ft^2} \qquad plf \equiv \frac{lbf}{ft} \qquad psf \equiv \frac{lbf}{ft^2} \qquad pcf \equiv \frac{lbf}{ft^3}$

Functions

Limit Check

$$check(actual, limit) := \begin{cases} \text{"O.K."} & \text{if } actual \le limit \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Equality Check

$$check_equal(value1, value2) := \begin{cases} \text{"O.K."} & \text{if } 0.999999 \le \left|\frac{value1}{value2}\right| \le 1.000001 \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Analysis per AASHTO LRFD Bridge Design Specifications

Bridge Design Span

Parameters

Bridge Length (Between Front Face of Backwalls) $L_{bridge} := 30.20 \cdot m$

Thickness of Expansion Joints $t_{exp} := 0 \cdot in$ Note : Uses Roofing Paper for Bond Breaker

Length of Slab $L_{slab} := L_{bridge} - 2 \cdot t_{exp}$ $L_{slab} = 99.081\ ft$

Use 2 layers of roofing paper at back of slab end diaphragm for expansion joint bond breaker

Bearing Distance from End of Bridge to Centerline of Bearing $dist_{cl.brg} := 12 \cdot in$

Span Between Centerline Bearings

Span $Span := L_{slab} - 2 \cdot dist_{cl.brg}$ $Span = 97.081\ ft$

Definition of Slab Design Sections (every 0.01L)

$$j_{brg} := \text{floor}\left(\frac{100 \cdot dist_{cl.brg}}{L_{slab}}\right) + 1 \qquad j_{brg} = 2.000$$

$$j := 0 .. j_{brg} - 1 \qquad Loc_j := \frac{j}{100} \cdot L_{slab}$$

$$Loc_{j_{brg}} := dist_{cl.brg}$$

$$j := j_{brg} + 1 .. 101 - j_{brg} \qquad Loc_j := \frac{j - 1}{100} \cdot L_{slab}$$

$$Loc_{102 - j_{brg}} := L_{slab} - dist_{cl.brg}$$

$$j := 102 - j_{brg} + 1 .. 102 \qquad Loc_j := \frac{j - 2}{100} \cdot L_{slab}$$

$$j := 0 .. 102$$

HS Live Load

Impact

$$Impact := \min\left(0.30, \frac{50}{125 + \frac{Span}{ft}}\right) \qquad Impact = 0.225$$

LFD Section 3.8.2.1, Eq. 3-1

Design Truck Load

HS Truck Designation: $HS := 20$

$num_{axles.truck} := 3$ $\qquad ai := 0 .. num_{axles.truck} - 1$ $\qquad lane_{width} := 12 \cdot ft$

Axle Loads and Spacing (Forward) **LFD Figure 3.7.7A**

$P_{axle.f.truck_{ai}} :=$

$8 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$

$Spacing_{axle.truck_{ai}} :=$

$0 \cdot ft$
$14 \cdot ft$
$14 \cdot ft$

$$Loc_{axle.f.truck_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.truck_n}$$

$$Loc_{axle.f.truck} = \begin{pmatrix} 0.000 \\ 14.000 \\ 28.000 \end{pmatrix} ft$$

Maximum Axle Load $\qquad P_{max.truck} := \max(P_{axle.f.truck}) \qquad P_{max.truck} = 32.000\,kips$

Axle Loads and Spacing (Reverse) $\qquad P_{axle.r.truck_{ai}} := P_{axle.f.truck_{num_{axles.truck}-1-ai}}$

$$Loc_{axle.r.truck_{ai}} := \begin{cases} 0 \cdot ft & \text{if } ai = 0 \\ \sum_{n=num_{axles.truck}-ai}^{num_{axles.truck}-1} Spacing_{axle.truck_n} & \text{otherwise} \end{cases}$$

HS Live Load (continued)

Truck Load Moment Calculation

$$M_{s.truck.f_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.truck.r_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.pos.truck_j} := \max\left(M_{s.truck.f_j}, M_{s.truck.r_j}\right)$$

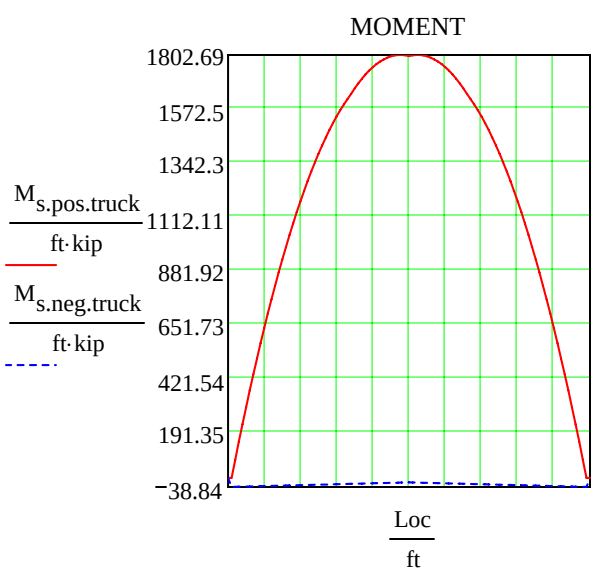
$$M_{s.neg.truck_j} := \begin{cases} -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ -(1 + Impact)\cdot P_{max.truck}\cdot\left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

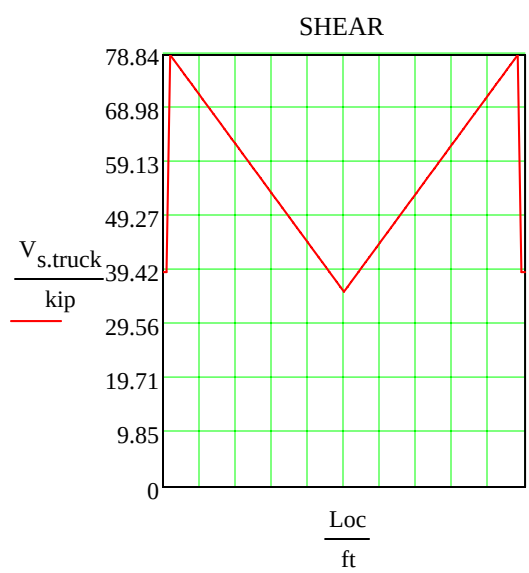
Live Load Truck Shear

$$V_{s.truck.f_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck.r_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck_j} := \max\left(V_{s.truck.f_j}, V_{s.truck.r_j}\right)$$





Lane Load Moment Calculation

Uniform Load: $w_{lane} := 0.64 \cdot klf \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Moment): $P_{conc.mom} := 18 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Shear): $P_{conc.shear} := 26 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

$$M_{s.pos.uni_j} := \begin{cases} SSM_{uni}\left(Span, w_{lane}, Loc_j - dist_{cl.brg}, 0 \cdot in\right) & \text{if } dist_{cl.brg} \le Loc_j \le L_{slab} - dist_{cl.brg} \\ 0 \cdot ft \cdot kips & \text{otherwise} \end{cases}$$

$$M_{s.neg.uni_j} := \begin{cases} \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot \left(Loc_j\right)^2}{2} & \text{if } Loc_j \le dist_{cl.brg} \\ \frac{-w_{lane} \cdot \left(L_{slab} - Loc_j\right)^2}{2} & \text{if } Loc_j \ge L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.conc_j} := \begin{cases} 0 \cdot ft \cdot kip & \text{if } dist_{cl.brg} \ge Loc_j \vee Loc_j \ge L_{slab} - dist_{cl.brg} \\ SSM_{conc}\left(Span, P_{conc.mom}, Loc_j - dist_{cl.brg}, Loc_j - dist_{cl.brg}\right) & \text{otherwise} \end{cases}$$

$$M_{s.neg.conc_j} := \begin{cases} -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Span - \left(Loc_j - dist_{cl.brg}\right)}{Span} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Loc_j - dist_{cl.brg}}{Span} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot Loc_j & \text{if } Loc_j \le dist_{cl.brg} \\ -P_{conc.mom} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.lane} := M_{s.pos.uni} + M_{s.pos.conc}$$

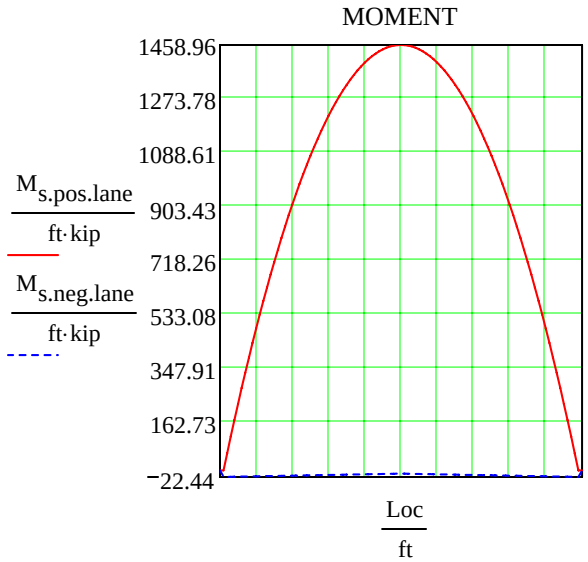
$$M_{s.neg.lane} := M_{s.neg.uni} + M_{s.neg.conc}$$

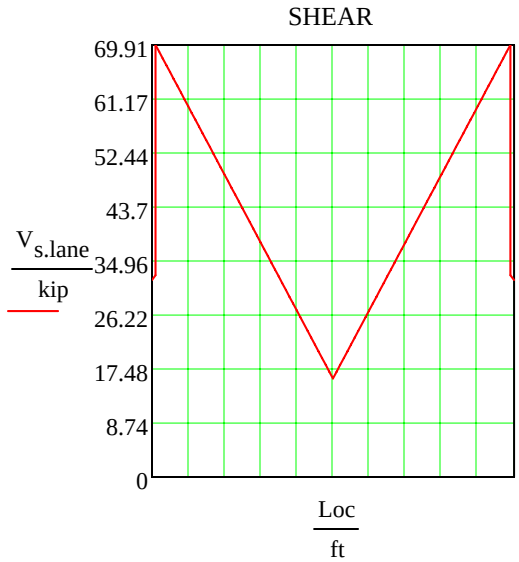
Lane Load Shear Calculation

$V_{s.uni_j} := SSV_{uni}(L_{slab}, w_{lane}, Loc_j, dist_{cl.brg})$

$V_{s.conc_j} := SSV_{conc}(L_{slab}, P_{conc.shear}, Loc_j, dist_{cl.brg})$

$V_{s.lane} := V_{s.uni} + V_{s.conc}$



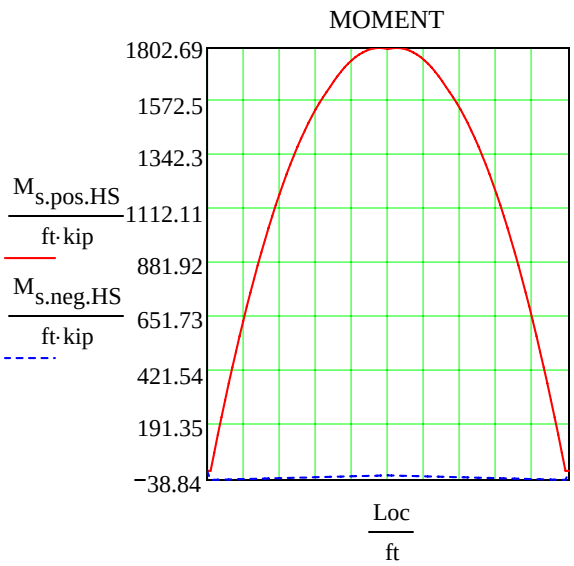


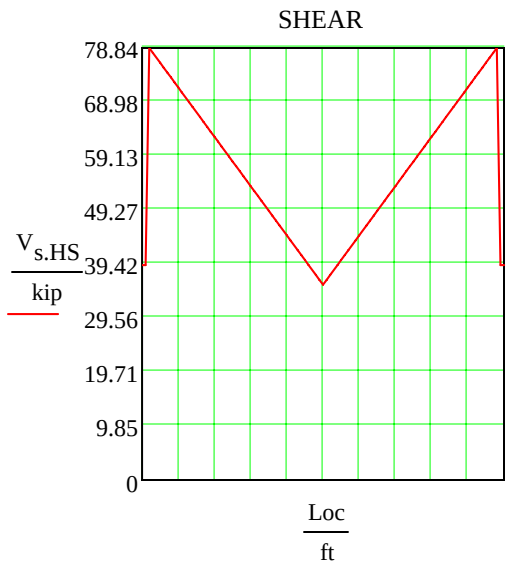
Critical HS Moments and Shears

$M_{s.pos.HS_j} := \max\left(M_{s.pos.truck_j}, M_{s.pos.uni_j}\right)$

$M_{s.neg.HS_j} := \min\left(M_{s.neg.truck_j}, M_{s.neg.uni_j}\right)$

$V_{s.HS_j} := \max\left(V_{s.truck_j}, V_{s.uni_j}\right)$





Maximum Loads:

$M_{s.max.HS} := \max\left(M_{s.pos.HS}\right)$ $\qquad M_{s.max.HS} = 1802.688\ ft \cdot kip$

$M_{s.min.HS} := \min\left(M_{s.neg.HS}\right)$ $\qquad M_{s.min.HS} = -38.844\ ft \cdot kip$

$V_{s.max.HS} := \max\left(V_{s.HS}\right)$ $\qquad V_{s.max.HS} = 78.838\ kip$

Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (no couples):

Number of Axles: $num_{axles.TC4200} := 6$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{36745 \cdot kgf + 47655 \cdot kgf}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$$Loc_{axle.TC4200} = \begin{pmatrix} 0.000 \\ 6.001 \\ 25.000 \\ 31.001 \\ 50.000 \\ 56.001 \end{pmatrix} ft$$

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 3451.470\ ft \cdot kips$

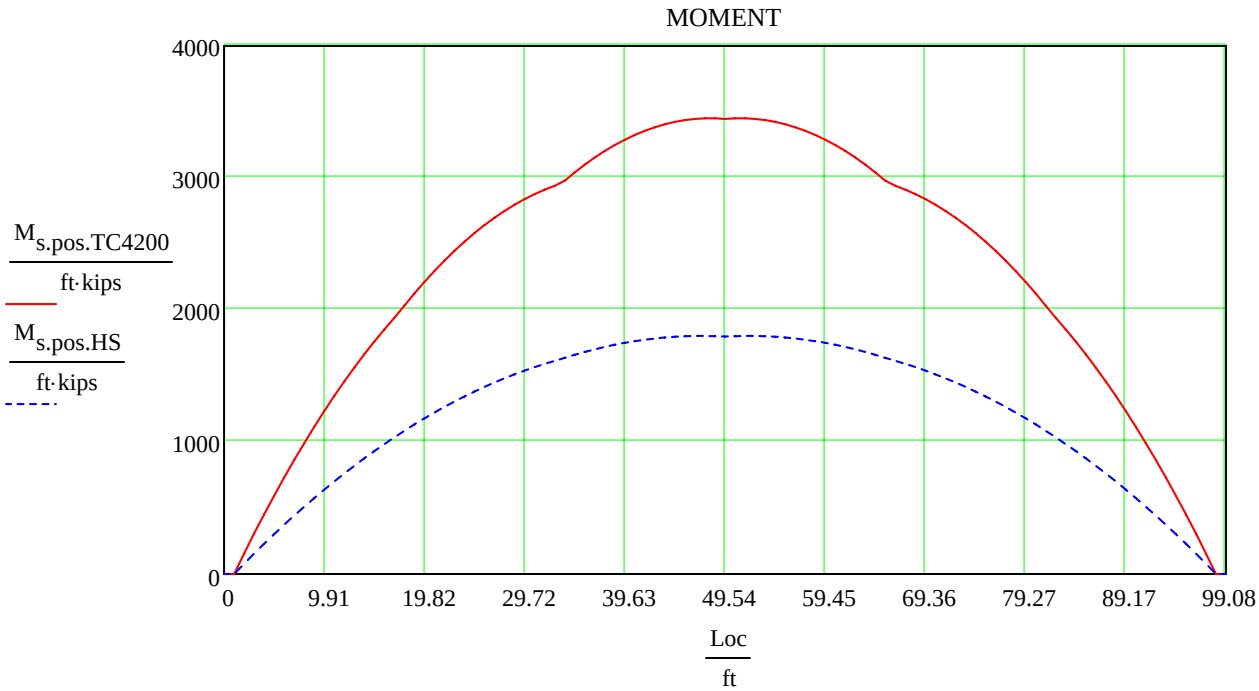
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

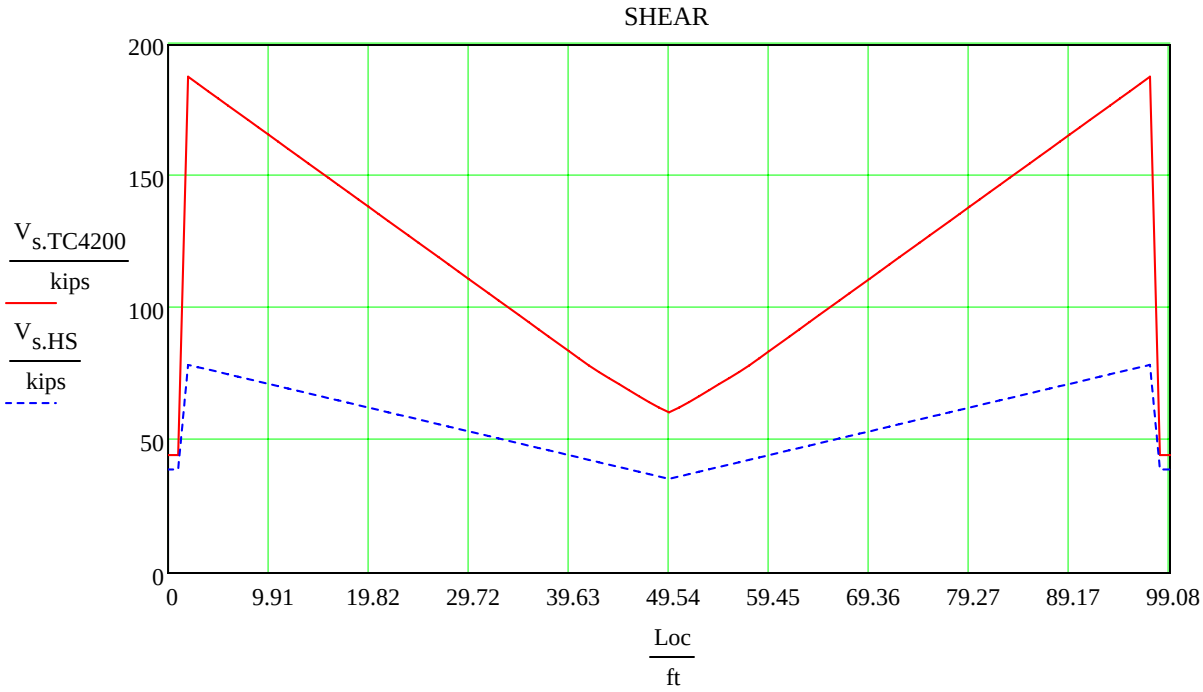
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 187.952\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (assume two coupled vehicles):

Number of Axles: $num_{axles.TC4200} := 12$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{2 \cdot (36745 \cdot kgf + 47655 \cdot kgf)}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$Loc_{axle.TC4200} =$

	0
0	0.000
1	6.001
2	25.000
3	31.001
4	50.000
5	56.001
6	75.000
7	81.001
8	100.000
9	106.001
10	125.000
11	131.001

ft

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 3573.233\ ft \cdot kips$

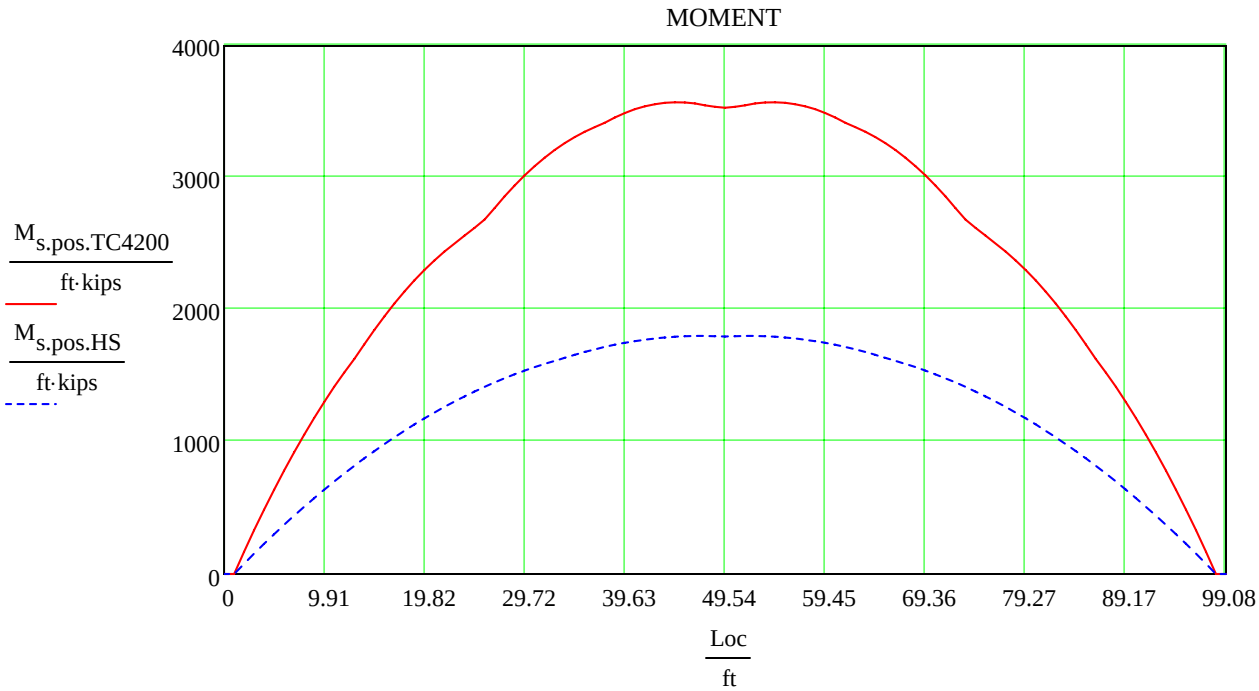
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

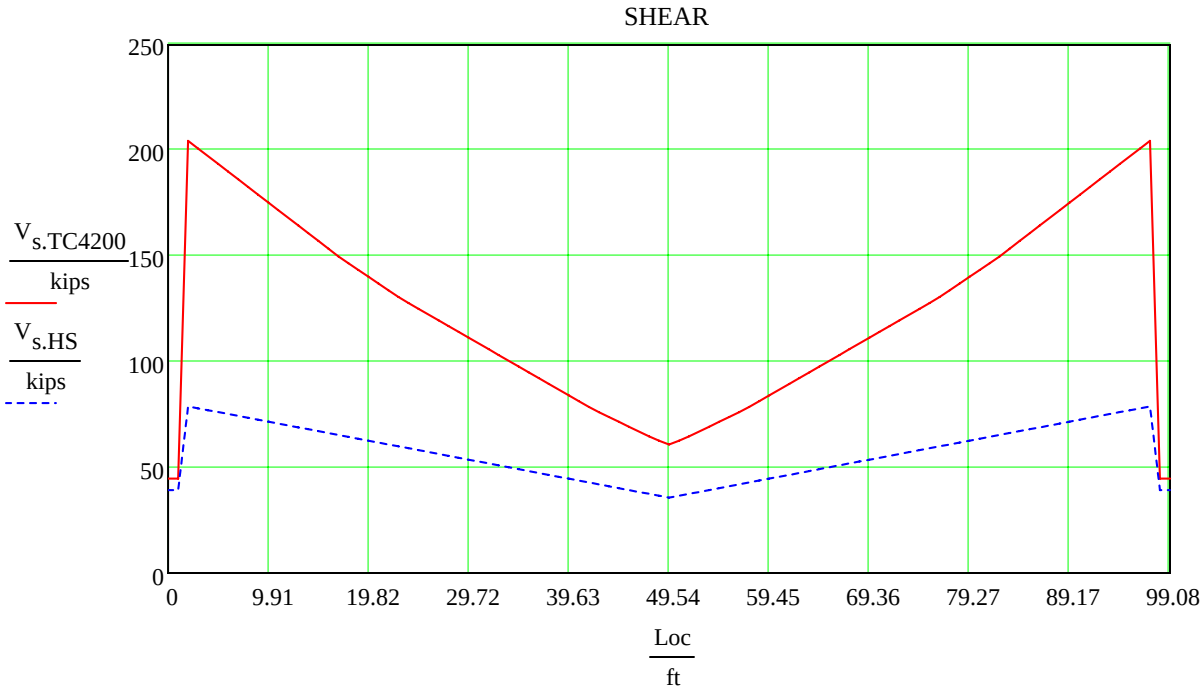
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 204.603\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Check - Bridge 023721

General Design Parameters

Design References

(Acronym)....Design Reference

(LFD).....AASHTO Standard Specifications for Highway Bridges, 17th Edition

Defined Parameters

$kips \equiv 1000 \cdot lbf \qquad ksi \equiv 1000 \cdot psi \qquad CY \equiv 27ft^3 \qquad SY \equiv 9ft^2$

$klf \equiv \frac{kips}{ft} \qquad ksf \equiv \frac{kips}{ft^2} \qquad plf \equiv \frac{lbf}{ft} \qquad psf \equiv \frac{lbf}{ft^2} \qquad pcf \equiv \frac{lbf}{ft^3}$

Functions

Limit Check

$$check(actual, limit) := \begin{cases} \text{"O.K."} & \text{if } actual \le limit \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Equality Check

$$check_equal(value1, value2) := \begin{cases} \text{"O.K."} & \text{if } 0.999999 \le \left|\frac{value1}{value2}\right| \le 1.000001 \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Analysis per AASHTO LRFD Bridge Design Specifications

Bridge Design Span

Parameters

Bridge Length (Between Front Face of Backwalls) $L_{bridge} := 28.10 \cdot m$

Thickness of Expansion Joints $t_{exp} := 0 \cdot in$ Note : Uses Roofing Paper for Bond Breaker

Length of Slab $L_{slab} := L_{bridge} - 2 \cdot t_{exp}$ $L_{slab} = 92.192\ ft$

Use 2 layers of roofing paper at back of slab end diaphragm for expansion joint bond breaker

Bearing Distance from End of Bridge to Centerline of Bearing $dist_{cl.brg} := 12 \cdot in$

Span Between Centerline Bearings

Span $Span := L_{slab} - 2 \cdot dist_{cl.brg}$ $Span = 90.192\ ft$

Definition of Slab Design Sections (every 0.01L)

$$j_{brg} := \text{floor}\left(\frac{100 \cdot dist_{cl.brg}}{L_{slab}}\right) + 1 \qquad j_{brg} = 2.000$$

$$j := 0 .. j_{brg} - 1 \qquad Loc_j := \frac{j}{100} \cdot L_{slab}$$

$$Loc_{j_{brg}} := dist_{cl.brg}$$

$$j := j_{brg} + 1 .. 101 - j_{brg} \qquad Loc_j := \frac{j - 1}{100} \cdot L_{slab}$$

$$Loc_{102 - j_{brg}} := L_{slab} - dist_{cl.brg}$$

$$j := 102 - j_{brg} + 1 .. 102 \qquad Loc_j := \frac{j - 2}{100} \cdot L_{slab}$$

$$j := 0 .. 102$$

HS Live Load

Impact

$$Impact := \min\left(0.30, \frac{50}{125 + \frac{Span}{ft}}\right) \qquad Impact = 0.232$$

LFD Section 3.8.2.1, Eq. 3-1

Design Truck Load

HS Truck Designation: $HS := 20$

$num_{axles.truck} := 3$ $\qquad ai := 0 .. num_{axles.truck} - 1$ $\qquad lane_{width} := 12 \cdot ft$

Axle Loads and Spacing (Forward) **LFD Figure 3.7.7A**

$P_{axle.f.truck_{ai}} :=$

$8 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$

$Spacing_{axle.truck_{ai}} :=$

$0 \cdot ft$
$14 \cdot ft$
$14 \cdot ft$

$$Loc_{axle.f.truck_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.truck_n}$$

$$Loc_{axle.f.truck} = \begin{pmatrix} 0.000 \\ 14.000 \\ 28.000 \end{pmatrix} ft$$

Maximum Axle Load $\qquad P_{max.truck} := \max(P_{axle.f.truck}) \qquad P_{max.truck} = 32.000\,kips$

Axle Loads and Spacing (Reverse) $\qquad P_{axle.r.truck_{ai}} := P_{axle.f.truck_{num_{axles.truck}-1-ai}}$

$$Loc_{axle.r.truck_{ai}} := \begin{cases} 0 \cdot ft & \text{if } ai = 0 \\ \sum_{n=num_{axles.truck}-ai}^{num_{axles.truck}-1} Spacing_{axle.truck_n} & \text{otherwise} \end{cases}$$

HS Live Load (continued)

Truck Load Moment Calculation

$$M_{s.truck.f_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.truck.r_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.pos.truck_j} := \max\left(M_{s.truck.f_j}, M_{s.truck.r_j}\right)$$

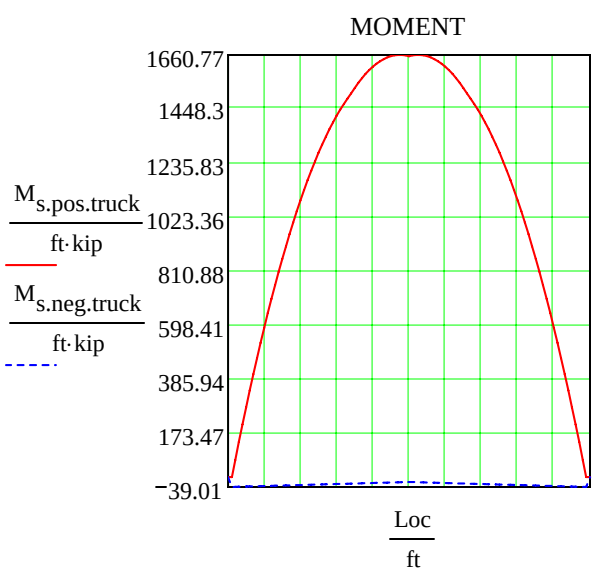
$$M_{s.neg.truck_j} := \begin{cases} -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ -(1 + Impact)\cdot P_{max.truck}\cdot\left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

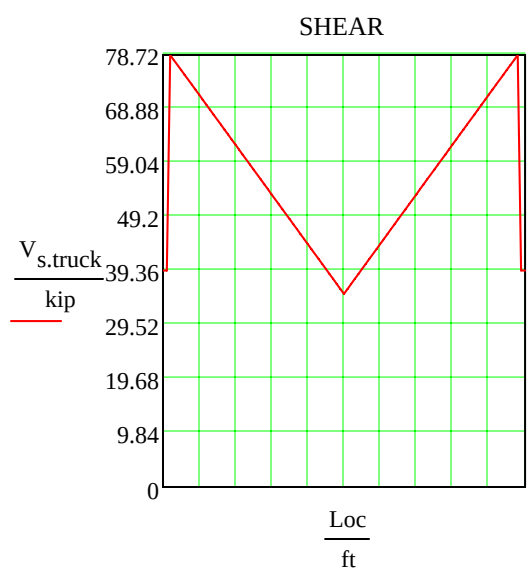
Live Load Truck Shear

$$V_{s.truck.f_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck.r_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck_j} := \max\left(V_{s.truck.f_j}, V_{s.truck.r_j}\right)$$





Lane Load Moment Calculation

Uniform Load: $w_{lane} := 0.64 \cdot klf \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Moment): $P_{conc.mom} := 18 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Shear): $P_{conc.shear} := 26 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

$$M_{s.pos.uni_j} := \begin{cases} SSM_{uni}\left(Span, w_{lane}, Loc_j - dist_{cl.brg}, 0 \cdot in\right) & \text{if } dist_{cl.brg} \le Loc_j \le L_{slab} - dist_{cl.brg} \\ 0 \cdot ft \cdot kips & \text{otherwise} \end{cases}$$

$$M_{s.neg.uni_j} := \begin{cases} \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot \left(Loc_j\right)^2}{2} & \text{if } Loc_j \le dist_{cl.brg} \\ \frac{-w_{lane} \cdot \left(L_{slab} - Loc_j\right)^2}{2} & \text{if } Loc_j \ge L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.conc_j} := \begin{cases} 0 \cdot ft \cdot kip & \text{if } dist_{cl.brg} \ge Loc_j \vee Loc_j \ge L_{slab} - dist_{cl.brg} \\ SSM_{conc}\left(Span, P_{conc.mom}, Loc_j - dist_{cl.brg}, Loc_j - dist_{cl.brg}\right) & \text{otherwise} \end{cases}$$

$$M_{s.neg.conc_j} := \begin{cases} -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Span - \left(Loc_j - dist_{cl.brg}\right)}{Span} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Loc_j - dist_{cl.brg}}{Span} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot Loc_j & \text{if } Loc_j \le dist_{cl.brg} \\ -P_{conc.mom} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.lane} := M_{s.pos.uni} + M_{s.pos.conc}$$

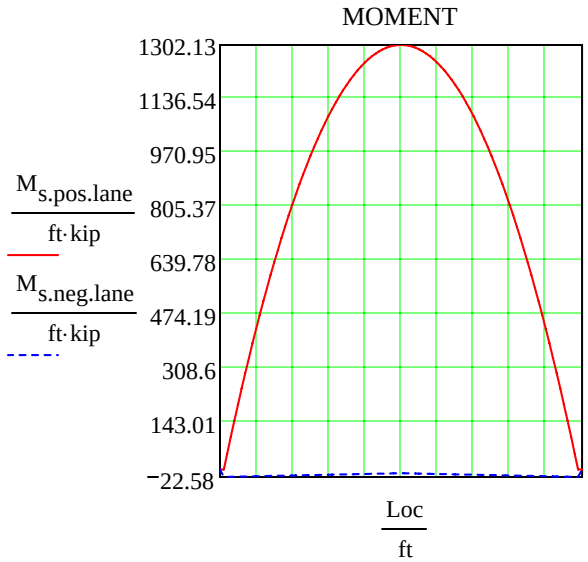
$$M_{s.neg.lane} := M_{s.neg.uni} + M_{s.neg.conc}$$

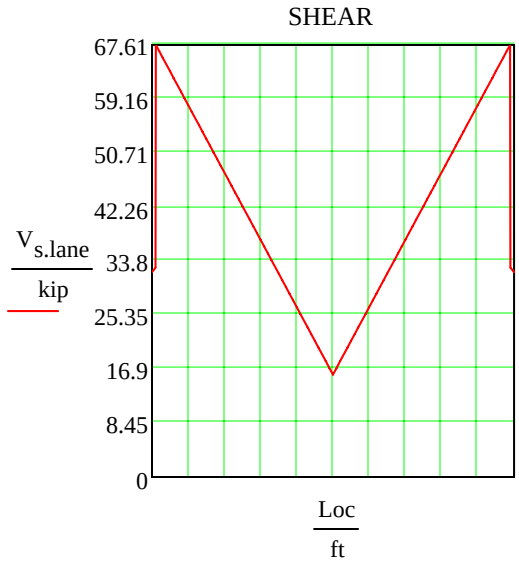
Lane Load Shear Calculation

$V_{s.uni_j} := SSV_{uni}(L_{slab}, w_{lane}, Loc_j, dist_{cl.brg})$

$V_{s.conc_j} := SSV_{conc}(L_{slab}, P_{conc.shear}, Loc_j, dist_{cl.brg})$

$V_{s.lane} := V_{s.uni} + V_{s.conc}$



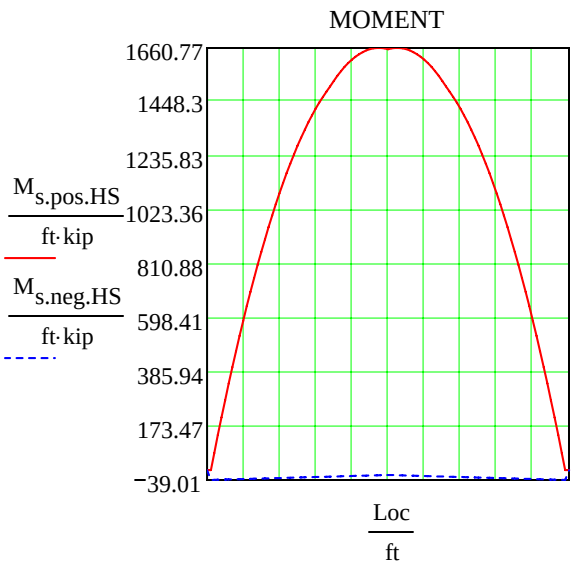


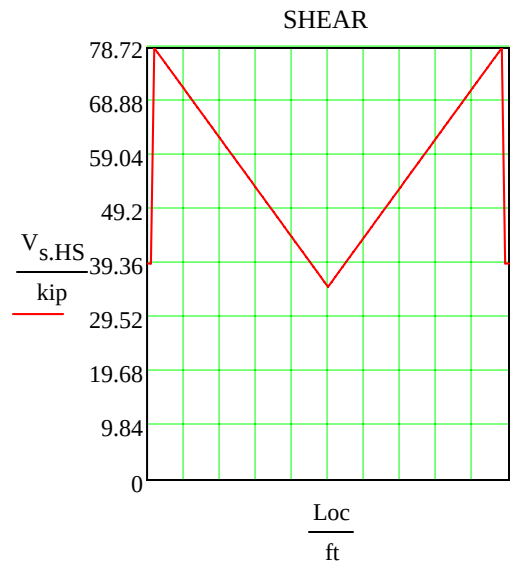
Critical HS Moments and Shears

$M_{s.pos.HS_j} := \max\left(M_{s.pos.truck_j}, M_{s.pos.uni_j}\right)$

$M_{s.neg.HS_j} := \min\left(M_{s.neg.truck_j}, M_{s.neg.uni_j}\right)$

$V_{s.HS_j} := \max\left(V_{s.truck_j}, V_{s.uni_j}\right)$





Maximum Loads:

$M_{s.max.HS} := \max\left(M_{s.pos.HS}\right)$ $\qquad M_{s.max.HS} = 1660.773\ ft \cdot kip$

$M_{s.min.HS} := \min\left(M_{s.neg.HS}\right)$ $\qquad M_{s.min.HS} = -39.007\ ft \cdot kip$

$V_{s.max.HS} := \max\left(V_{s.HS}\right)$ $\qquad V_{s.max.HS} = 78.717\ kip$

Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (no couples):

Number of Axles: $num_{axles.TC4200} := 6$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{36745 \cdot kgf + 47655 \cdot kgf}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$$Loc_{axle.TC4200} = \begin{pmatrix} 0.000 \\ 6.001 \\ 25.000 \\ 31.001 \\ 50.000 \\ 56.001 \end{pmatrix} ft$$

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 3067.513\ ft \cdot kips$

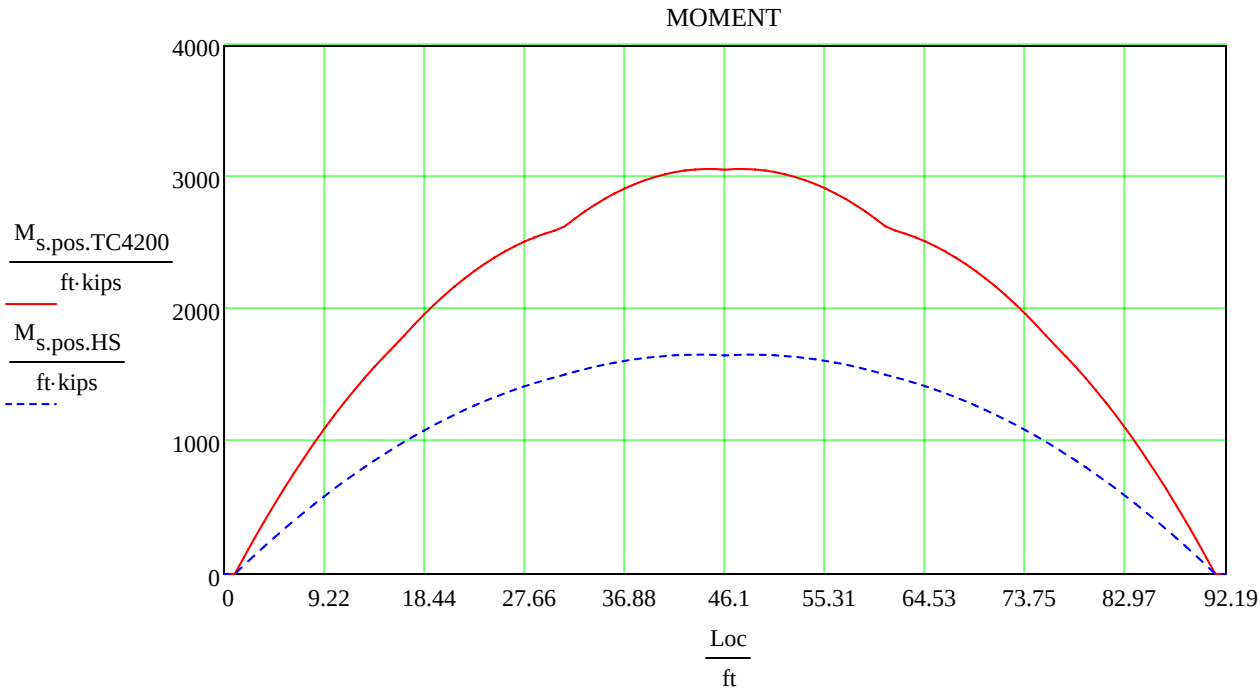
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

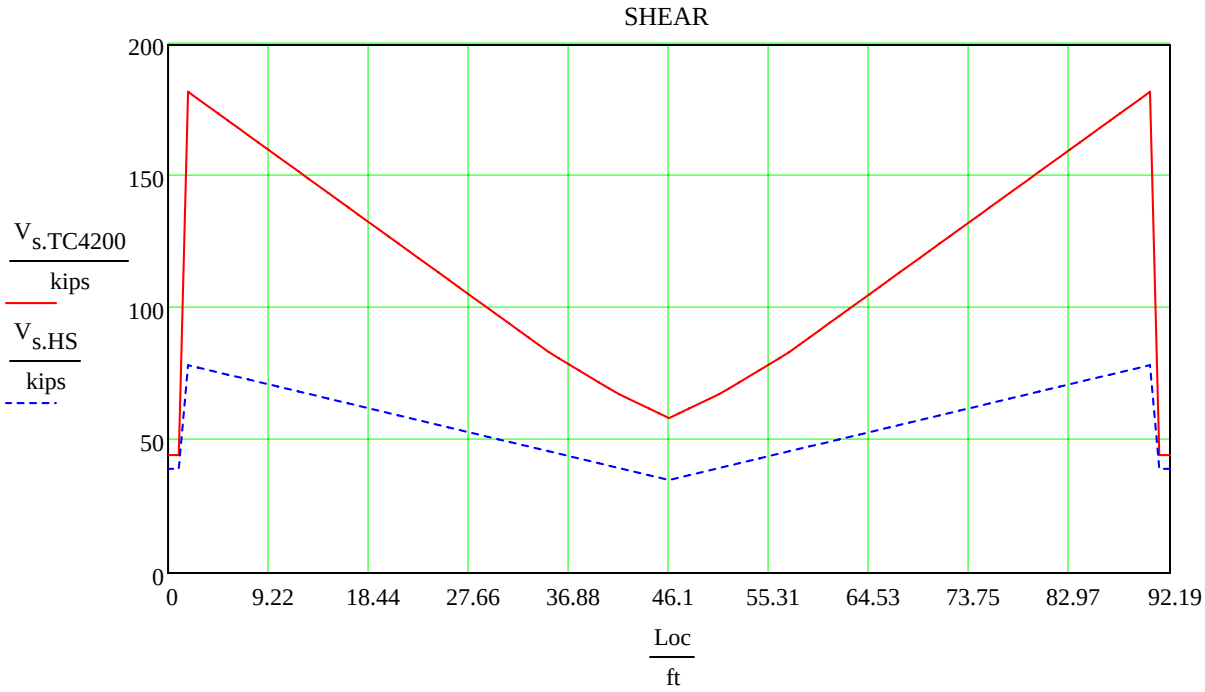
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 182.251\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (assume two coupled vehicles):

Number of Axles: $num_{axles.TC4200} := 12$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{2 \cdot (36745 \cdot kgf + 47655 \cdot kgf)}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
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$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$Loc_{axle.TC4200} =$

	0
0	0.000
1	6.001
2	25.000
3	31.001
4	50.000
5	56.001
6	75.000
7	81.001
8	100.000
9	106.001
10	125.000
11	131.001

ft

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 3092.594\ ft \cdot kips$

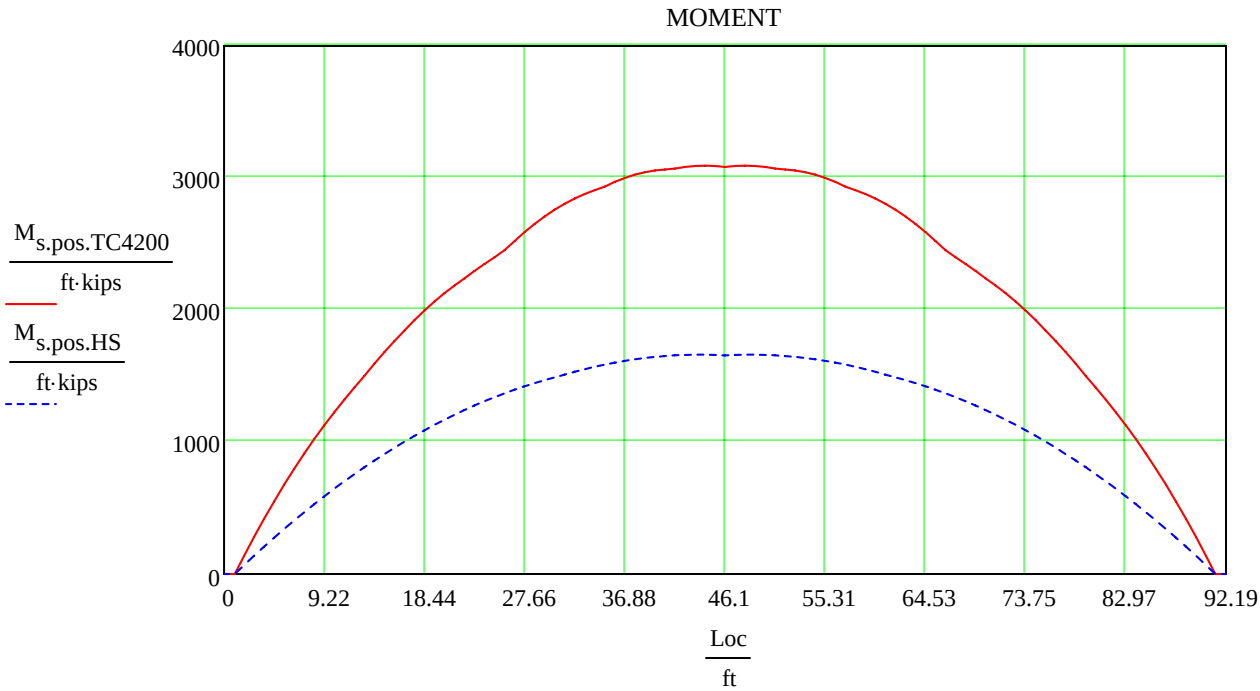
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

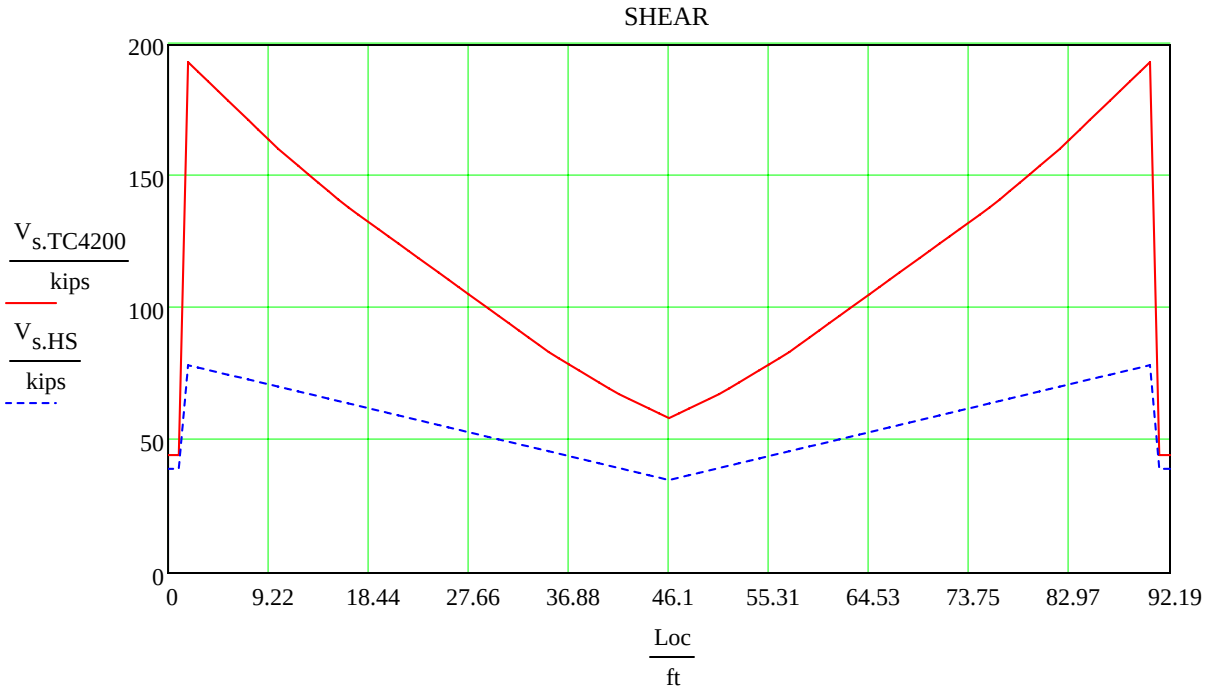
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 193.488\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Check - Bridge 024581

General Design Parameters

Design References

(Acronym)....Design Reference

(LFD).....AASHTO Standard Specifications for Highway Bridges, 17th Edition

Defined Parameters

$kips \equiv 1000 \cdot lbf \qquad ksi \equiv 1000 \cdot psi \qquad CY \equiv 27ft^3 \qquad SY \equiv 9ft^2$

$klf \equiv \frac{kips}{ft} \qquad ksf \equiv \frac{kips}{ft^2} \qquad plf \equiv \frac{lbf}{ft} \qquad psf \equiv \frac{lbf}{ft^2} \qquad pcf \equiv \frac{lbf}{ft^3}$

Functions

Limit Check

$$check(actual, limit) := \begin{cases} \text{"O.K."} & \text{if } actual \le limit \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Equality Check

$$check_equal(value1, value2) := \begin{cases} \text{"O.K."} & \text{if } 0.999999 \le \left|\frac{value1}{value2}\right| \le 1.000001 \\ \text{"No Good"} & \text{otherwise} \end{cases}$$

Analysis per AASHTO LRFD Bridge Design Specifications

Bridge Design Span

Parameters

Bridge Length (Between Front Face of Backwalls) $L_{bridge} := 26.10 \cdot m$

Thickness of Expansion Joints $t_{exp} := 0 \cdot in$ Note : Uses Roofing Paper for Bond Breaker

Length of Slab $L_{slab} := L_{bridge} - 2 \cdot t_{exp}$ $L_{slab} = 85.630\ ft$

Use 2 layers of roofing paper at back of slab end diaphragm for expansion joint bond breaker

Bearing Distance from End of Bridge to Centerline of Bearing $dist_{cl.brg} := 12 \cdot in$

Span Between Centerline Bearings

Span $Span := L_{slab} - 2 \cdot dist_{cl.brg}$ $Span = 83.630\ ft$

Definition of Slab Design Sections (every 0.01L)

$$j_{brg} := \text{floor}\left(\frac{100 \cdot dist_{cl.brg}}{L_{slab}}\right) + 1 \qquad j_{brg} = 2.000$$

$$j := 0 .. j_{brg} - 1 \qquad Loc_j := \frac{j}{100} \cdot L_{slab}$$

$$Loc_{j_{brg}} := dist_{cl.brg}$$

$$j := j_{brg} + 1 .. 101 - j_{brg} \qquad Loc_j := \frac{j - 1}{100} \cdot L_{slab}$$

$$Loc_{102 - j_{brg}} := L_{slab} - dist_{cl.brg}$$

$$j := 102 - j_{brg} + 1 .. 102 \qquad Loc_j := \frac{j - 2}{100} \cdot L_{slab}$$

$$j := 0 .. 102$$

HS Live Load

Impact

$$Impact := \min\left(0.30, \frac{50}{125 + \frac{Span}{ft}}\right) \qquad Impact = 0.240$$

LFD Section 3.8.2.1, Eq. 3-1

Design Truck Load

HS Truck Designation: $HS := 19.6$

$num_{axles.truck} := 3$ $\qquad ai := 0 .. num_{axles.truck} - 1$ $\qquad lane_{width} := 12 \cdot ft$

Axle Loads and Spacing (Forward) **LFD Figure 3.7.7A**

$P_{axle.f.truck_{ai}} :=$

$8 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$
$32 \cdot kips \cdot \frac{HS}{20}$

$Spacing_{axle.truck_{ai}} :=$

$0 \cdot ft$
$14 \cdot ft$
$14 \cdot ft$

$$Loc_{axle.f.truck_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.truck_n}$$

$$Loc_{axle.f.truck} = \begin{pmatrix} 0.000 \\ 14.000 \\ 28.000 \end{pmatrix} ft$$

Maximum Axle Load $\qquad P_{max.truck} := \max(P_{axle.f.truck}) \qquad P_{max.truck} = 31.360\,kips$

Axle Loads and Spacing (Reverse) $\qquad P_{axle.r.truck_{ai}} := P_{axle.f.truck_{num_{axles.truck}-1-ai}}$

$$Loc_{axle.r.truck_{ai}} := \begin{cases} 0 \cdot ft & \text{if } ai = 0 \\ \sum_{n=num_{axles.truck}-ai}^{num_{axles.truck}-1} Spacing_{axle.truck_n} & \text{otherwise} \end{cases}$$

HS Live Load (continued)

Truck Load Moment Calculation

$$M_{s.truck.f_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.truck.r_j} := (1 + Impact)\cdot SSM_{mcl}\left(L_{slab}, Span, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$M_{s.pos.truck_j} := \max\left(M_{s.truck.f_j}, M_{s.truck.r_j}\right)$$

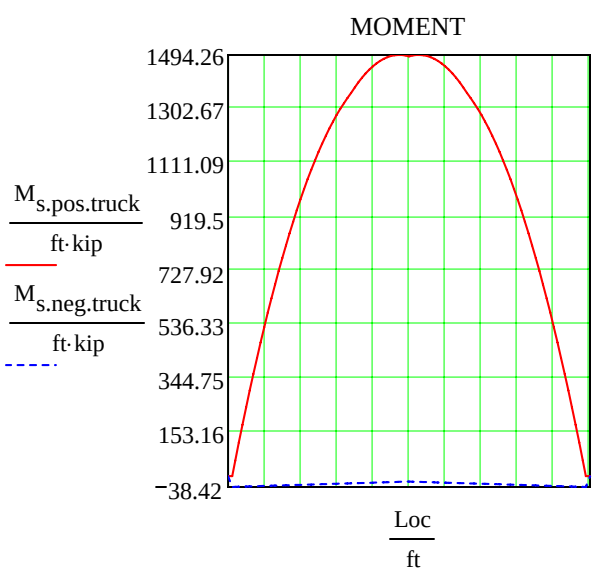
$$M_{s.neg.truck_j} := \begin{cases} -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot dist_{cl.brg}\cdot\dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \dfrac{L_{slab}}{2} \\ -(1 + Impact)\cdot P_{max.truck}\cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ -(1 + Impact)\cdot P_{max.truck}\cdot\left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

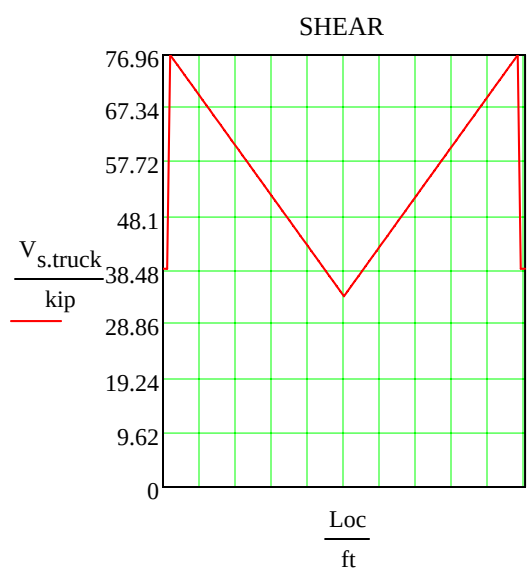
Live Load Truck Shear

$$V_{s.truck.f_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.f.truck}, Loc_{axle.f.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck.r_j} := (1 + Impact)\cdot SSV_{mcl}\left(L_{slab}, P_{axle.r.truck}, Loc_{axle.r.truck}, Loc_j, num_{axles.truck}, dist_{cl.brg}\right)$$

$$V_{s.truck_j} := \max\left(V_{s.truck.f_j}, V_{s.truck.r_j}\right)$$





Lane Load Moment Calculation

Uniform Load: $w_{lane} := 0.64 \cdot klf \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Moment): $P_{conc.mom} := 18 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

Conc. Load (Shear): $P_{conc.shear} := 26 \cdot kip \cdot \frac{HS}{20} \cdot (1 + Impact)$ **LFD Figure 3.7.6B**

$$M_{s.pos.uni_j} := \begin{cases} SSM_{uni}\left(Span, w_{lane}, Loc_j - dist_{cl.brg}, 0 \cdot in\right) & \text{if } dist_{cl.brg} \le Loc_j \le L_{slab} - dist_{cl.brg} \\ 0 \cdot ft \cdot kips & \text{otherwise} \end{cases}$$

$$M_{s.neg.uni_j} := \begin{cases} \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot dist_{cl.brg}^2}{2} \cdot \frac{Loc_j}{L_{slab}} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ \frac{-w_{lane} \cdot \left(Loc_j\right)^2}{2} & \text{if } Loc_j \le dist_{cl.brg} \\ \frac{-w_{lane} \cdot \left(L_{slab} - Loc_j\right)^2}{2} & \text{if } Loc_j \ge L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.conc_j} := \begin{cases} 0 \cdot ft \cdot kip & \text{if } dist_{cl.brg} \ge Loc_j \vee Loc_j \ge L_{slab} - dist_{cl.brg} \\ SSM_{conc}\left(Span, P_{conc.mom}, Loc_j - dist_{cl.brg}, Loc_j - dist_{cl.brg}\right) & \text{otherwise} \end{cases}$$

$$M_{s.neg.conc_j} := \begin{cases} -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Span - \left(Loc_j - dist_{cl.brg}\right)}{Span} & \text{if } Loc_j < \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot dist_{cl.brg} \cdot \frac{Loc_j - dist_{cl.brg}}{Span} & \text{if } Loc_j \ge \frac{L_{slab}}{2} \\ -P_{conc.mom} \cdot Loc_j & \text{if } Loc_j \le dist_{cl.brg} \\ -P_{conc.mom} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$$M_{s.pos.lane} := M_{s.pos.uni} + M_{s.pos.conc}$$

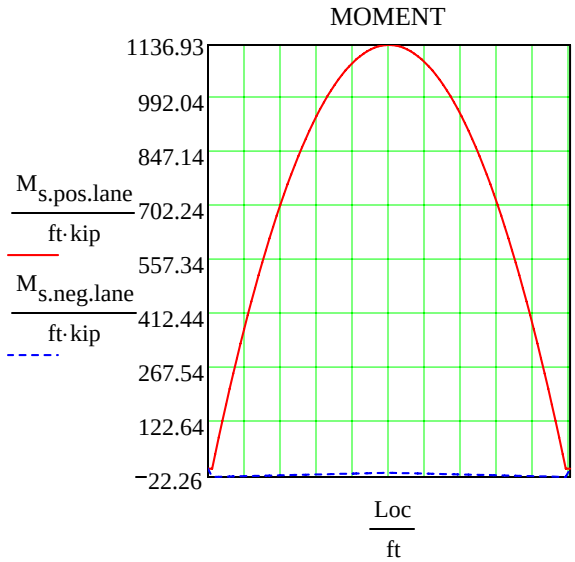
$$M_{s.neg.lane} := M_{s.neg.uni} + M_{s.neg.conc}$$

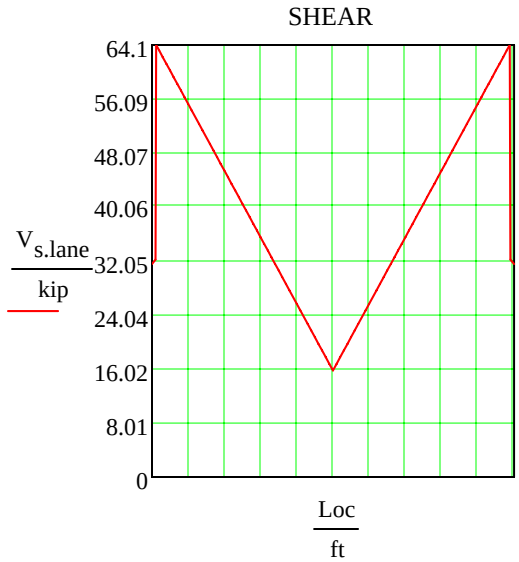
Lane Load Shear Calculation

$V_{s.uni_j} := SSV_{uni}(L_{slab}, w_{lane}, Loc_j, dist_{cl.brg})$

$V_{s.conc_j} := SSV_{conc}(L_{slab}, P_{conc.shear}, Loc_j, dist_{cl.brg})$

$V_{s.lane} := V_{s.uni} + V_{s.conc}$



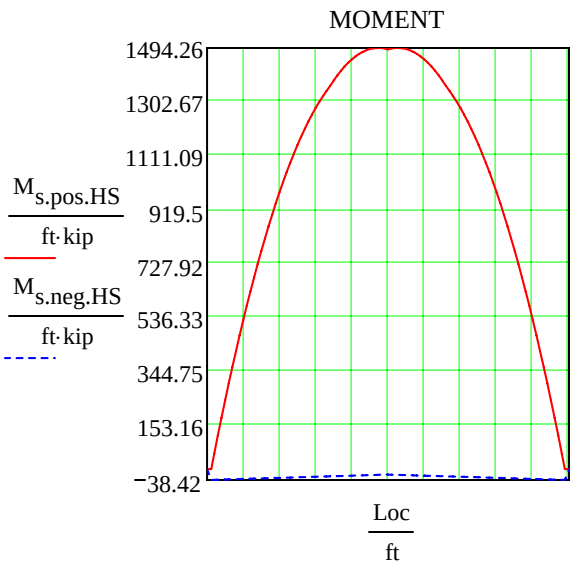


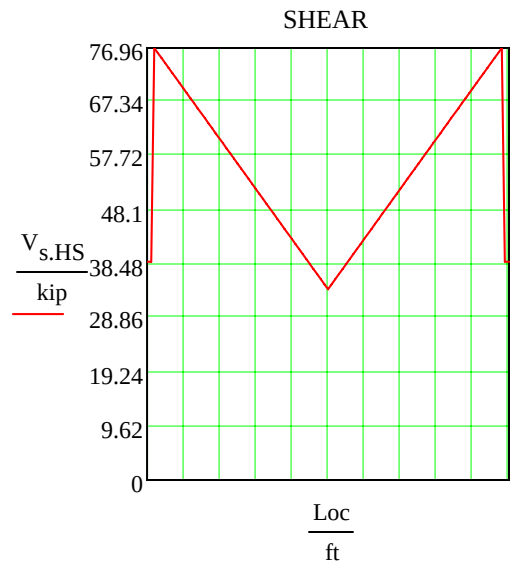
Critical HS Moments and Shears

$M_{s.pos.HS_j} := \max\left(M_{s.pos.truck_j}, M_{s.pos.uni_j}\right)$

$M_{s.neg.HS_j} := \min\left(M_{s.neg.truck_j}, M_{s.neg.uni_j}\right)$

$V_{s.HS_j} := \max\left(V_{s.truck_j}, V_{s.uni_j}\right)$





Maximum Loads:

$M_{s.max.HS} := \max\left(M_{s.pos.HS}\right)$ $\qquad M_{s.max.HS} = 1494.258\ ft \cdot kip$

$M_{s.min.HS} := \min\left(M_{s.neg.HS}\right)$ $\qquad M_{s.min.HS} = -38.422\ ft \cdot kip$

$V_{s.max.HS} := \max\left(V_{s.HS}\right)$ $\qquad V_{s.max.HS} = 76.963\ kip$

Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (no couples):

Number of Axles: $num_{axles.TC4200} := 6$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{36745 \cdot kgf + 47655 \cdot kgf}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$$Loc_{axle.TC4200} = \begin{pmatrix} 0.000 \\ 6.001 \\ 25.000 \\ 31.001 \\ 50.000 \\ 56.001 \end{pmatrix} ft$$

Maximum Axle Load (with Impact):

$P_{max.TC4200} := max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 2701.842\ ft \cdot kips$

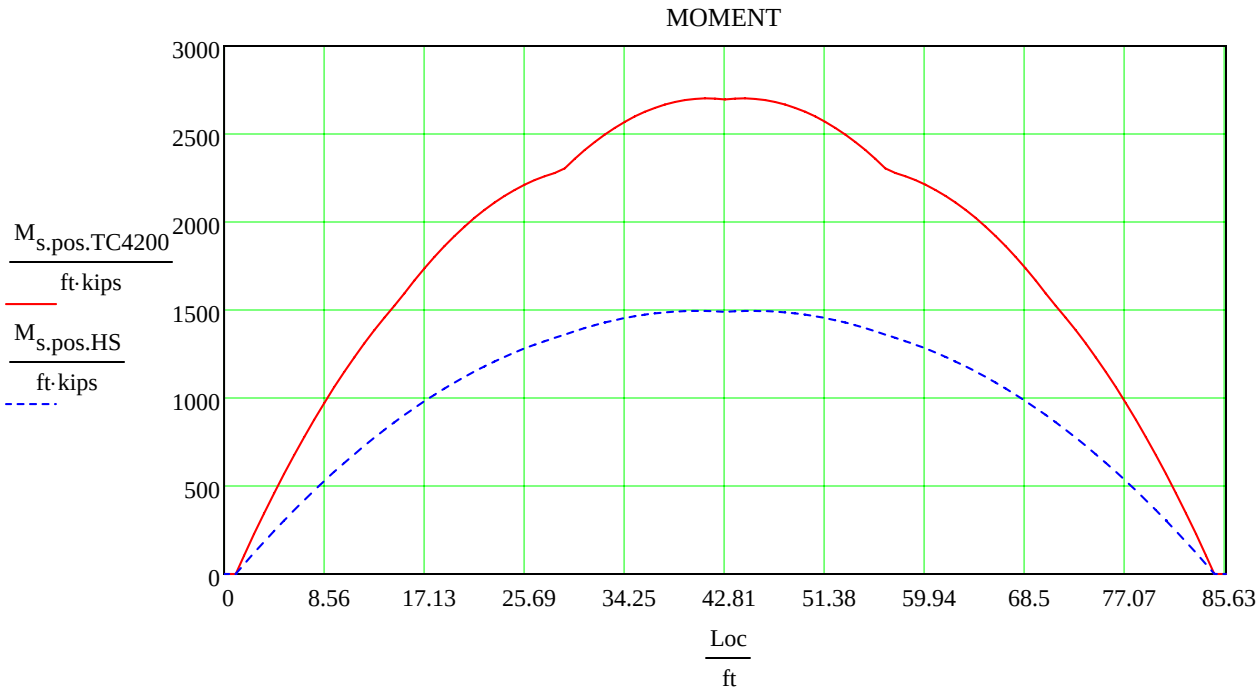
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

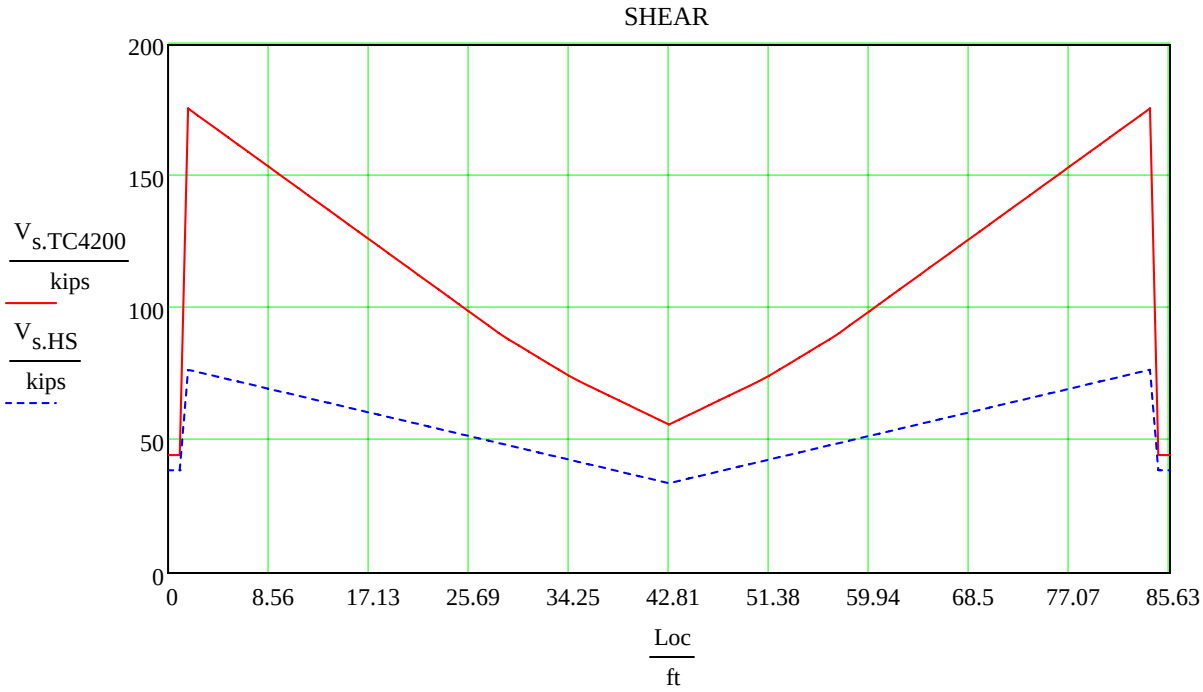
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 175.948\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





Transit Load Checks - Verification that HS Inventory Rated Loading is the Critical Loading

Transit Load Check - TC 4200 ALRV (assume two coupled vehicles):

Number of Axles: $num_{axles.TC4200} := 12$ Axle Index: $ai := 0 .. num_{axles.TC4200} - 1$

Assumptions for Axle Loads:
1.) All axle loads are balanced and equal
2.) Normal Passenger Load in Vehicle corresponds to service inventory load

Axle Loads: $P_{axle} := \frac{2 \cdot (36745 \cdot kgf + 47655 \cdot kgf)}{num_{axles.TC4200}}$ $P_{axle} = 31.012\,kip$

Vehicle Impact (assumed for steel rail vehicle): $Impact := 20\%$

Axle Load Array: $P_{axle.TC4200_{ai}} :=$

$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$
$P_{axle} \cdot (1 + Impact)$

Axle Spacing Array: $Spacing_{axle.TC4200_{ai}} :=$

$0 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 m$
$5.791 \cdot m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$
$5.791 m$
$1.829 \cdot m$

Axle Location Array (from first axle as reference):

$$Loc_{axle.TC4200_{ai}} := \sum_{n=0}^{ai} Spacing_{axle.TC4200_n}$$

$Loc_{axle.TC4200} =$

	0
0	0.000
1	6.001
2	25.000
3	31.001
4	50.000
5	56.001
6	75.000
7	81.001
8	100.000
9	106.001
10	125.000
11	131.001

ft

Maximum Axle Load (with Impact):

$P_{max.TC4200} := \max(P_{axle.TC4200})$

$P_{max.TC4200} = 37.214\,kips$

Moment Calculation

$$M_{s.pos.TC4200_j} := SSM_{mcl}\left(L_{slab}, Span, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$$M_{s.neg.TC4200_j} := \begin{cases} P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{L_{slab} - Loc_j}{L_{slab}} & \text{if } Loc_j < \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot dist_{cl.brg} \cdot \dfrac{Loc_j}{L_{slab}} & \text{if } Loc_j \geq \dfrac{L_{slab}}{2} \\ P_{max.TC4200} \cdot Loc_j & \text{if } Loc_j < dist_{cl.brg} \\ P_{max.TC4200} \cdot \left(L_{slab} - Loc_j\right) & \text{if } Loc_j > L_{slab} - dist_{cl.brg} \end{cases}$$

$M_{s.max.TC4200} := \max\left(M_{s.pos.TC4200}\right)$ $M_{s.max.TC4200} = 2701.842\ ft \cdot kips$

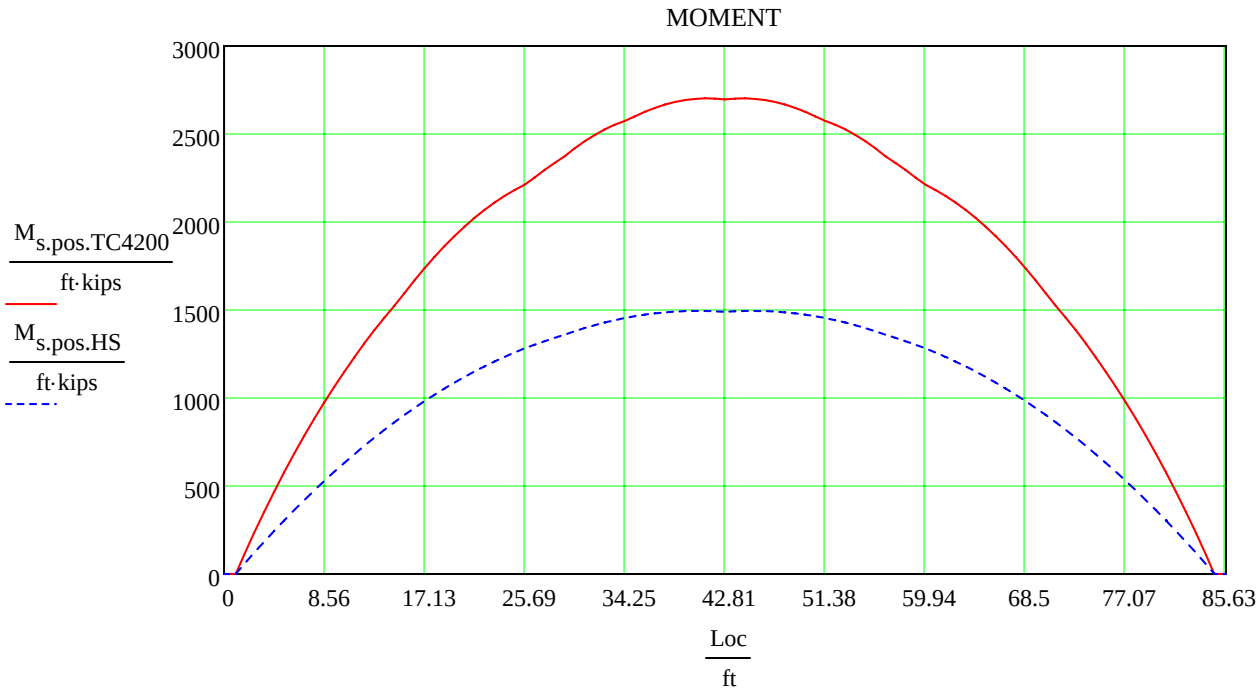
$check\left(M_{s.max.TC4200}, M_{s.max.HS}\right) = \text{"No Good"}$

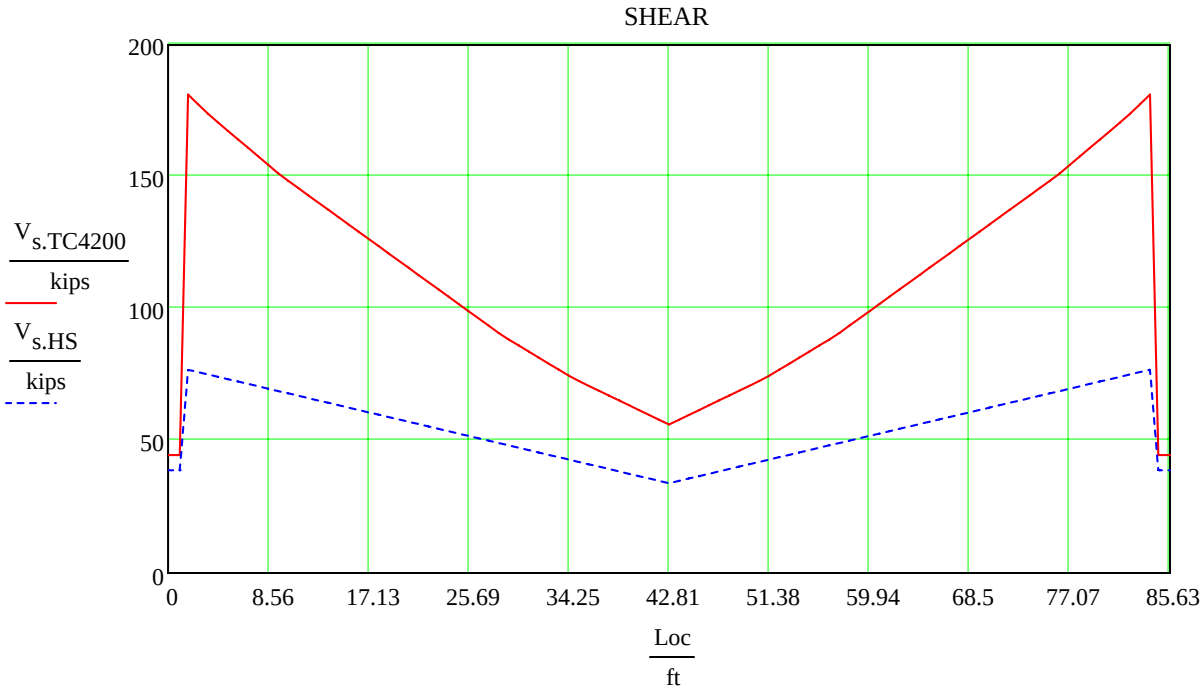
Shear Calculation

$$V_{s.TC4200_j} := (1 + Impact) \cdot SSV_{mcl}\left(L_{slab}, P_{axle.TC4200}, Loc_{axle.TC4200}, Loc_j, num_{axles.TC4200}, dist_{cl.brg}\right)$$

$V_{s.max.TC4200} := \max\left(V_{s.TC4200}\right)$ $V_{s.max.TC4200} = 181.199\ kips$ $check\left(V_{s.max.TC4200}, V_{s.max.HS}\right) = \text{"No Good"}$

TC 4200 ALRV Loading





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B

ALRV

Articulated Light Rail Vehicle

TC 4200 is the articulated variant of the CLRV, the ALRV (Articulated Light Rail Vehicle) built by CanCar Rail (UTDC). 4200 is the first of 52 cars built in 1987-88.

When the TTC made the decision to continue operating its streetcars into the next century, they searched for a streetcar to replace the venerable PCCs. They settled upon the CLRV. The Ontario Government owned Urban Transit Development Corporation designed and built these new models with help from a Swiss manufacturer, and soon the new models were trundling Toronto's streets. It was UTDC who decided to experiment with the design, a little, to see if the CLRV model could be modified to produce a longer, articulated version. Articulated vehicles were common in Europe, and it was felt that by utilizing this concept would make the model attractive to transit companies thinking of getting into the LRT business (as was starting at that time).

With this in mind, the original order for 200 CLRVs was cut to 196, so that UTDC would have components enough to produce 2 prototypes for the ALRV. Actually, only one prototype was constructed, and who knows what happened to the other two streetcars. The prototype was painted in a modified version of TTC colours and numbered 4900, and it was tested in revenue service along the Queen route, starting on August 10, 1982. Taking a break for the CNE, revenue testing continued until February 25, 1983, whereupon it was stored at Wychwood carhouse on February 26, venturing out for occasional short demonstration trips. It was loaded onto a flatbed on March 7, 1987, and returned to the UTDC's Kingston facility where it has remained ever since.

Car 4900, as originally built, featured a pantograph instead of a trolley pole, hand controls instead of foot controls, was gauged at standard rather than TTC gauge (4 feet, 10 and 7/8 inches), and tested an electronic rollsign. For testing on the TTC, the vehicle had to be regauged and the pantograph was replaced by a trolley pole. The hand controls remained, and the TTC decided to test the effectiveness of the electronic rollsign (although electronic rollsigns are the norm now for TTC buses, the TTC has never replaced the streetcar 'linens', likely because the sign cavity is too small for an effective electronic sign). Revenue service proved effective, and the TTC agreed to purchase 52 modified ALRVs at $1.369 million per vehicle, with an option for 11 more, should they be needed on the proposed Harbourfront and Spadina LRT lines.

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Other than their extra long bodies and the bend in the middle, ALRVs have another feature which distinguishes it from its CLRV cousins, that of a large box that sits on the roof near the front of the vehicle. I believe this box houses some extra strong air-conditioning equipment, needed due to the extra space, and also in response to complaints regarding the inefficient air conditioners on CLRV cars. The ALRVs also never had any couplers, and the 'safety shield' came already installed, rather than being added later as in the case of the CLRVs.

Car 4200, the first of the current class of ALRVs, operated under its own power at the UTDC facilities on April 27, 1987 and was shipped to the TTC on June 11, 1987. After a static display at Toronto's City Hall, plus further tests and modifications, revenue service began with car 4204 on the Long Branch route on January 19, 1988. I made a special trip after school to see the ALRVs in service back then. Too bad I didn't bring a camera... With further deliveries, revenue service began on the Bathurst streetcar on July 17, 1988 and the Queen streetcar on January 23, 1989. Although ALRVs can travel throughout the system, they have not been placed in regular service on any other route. This makes photographs of ALRVs on these routes a rare prize indeed. Why do you think we went on an ALRV charter?

Update: August 6, 1999: A number of ALRVs have been placed on the Bloor-Queen's Quay portion of the 510 Spadina streetcar route. The crowds on Spadina may warrant the use of these vehicles but until enough ALRVs were freed up by construction on Queen Street, such an allocation was unfeasible. While construction continues, you may see more ALRVs on Spadina and, who knows? If the tests prove successful, perhaps the TTC will make room to put ALRVs on Spadina permanently...

Principal Specifications:

Fleet numbers: 4200-4251
Seating: 61
Capacity:
Normal: 155 passengers - 47,655 kg
Crush Load: 205 passengers - 51,165 kg
Empty streetcar weight: 36,745 kg (81,000 lbs)
Minimum horizontal curve radius: 10,973 mm (36' 0")
Minimum verticle curve radius - convex: 122 m
Minimum verticle curve radius - concave: 244 m
Motor rating: 4 x 87 HP (65KW) continuous, 4 x 123 HP (92KW) one hour.
Initial acceleration rate: 1.2 m/s/s (2.65 MPHPS)
Service Braking rate: 1.6 m/s/s (3.6 MPHPS)
Emergency Braking Rate: 3.13 m/s/s (7.0 MPHPS)

References

Toronto Transit Commission, ALRV: Articulated Canadian Light Rail Vehicle, The Toronto Transit Commission, Toronto (Ontario), October 1996.

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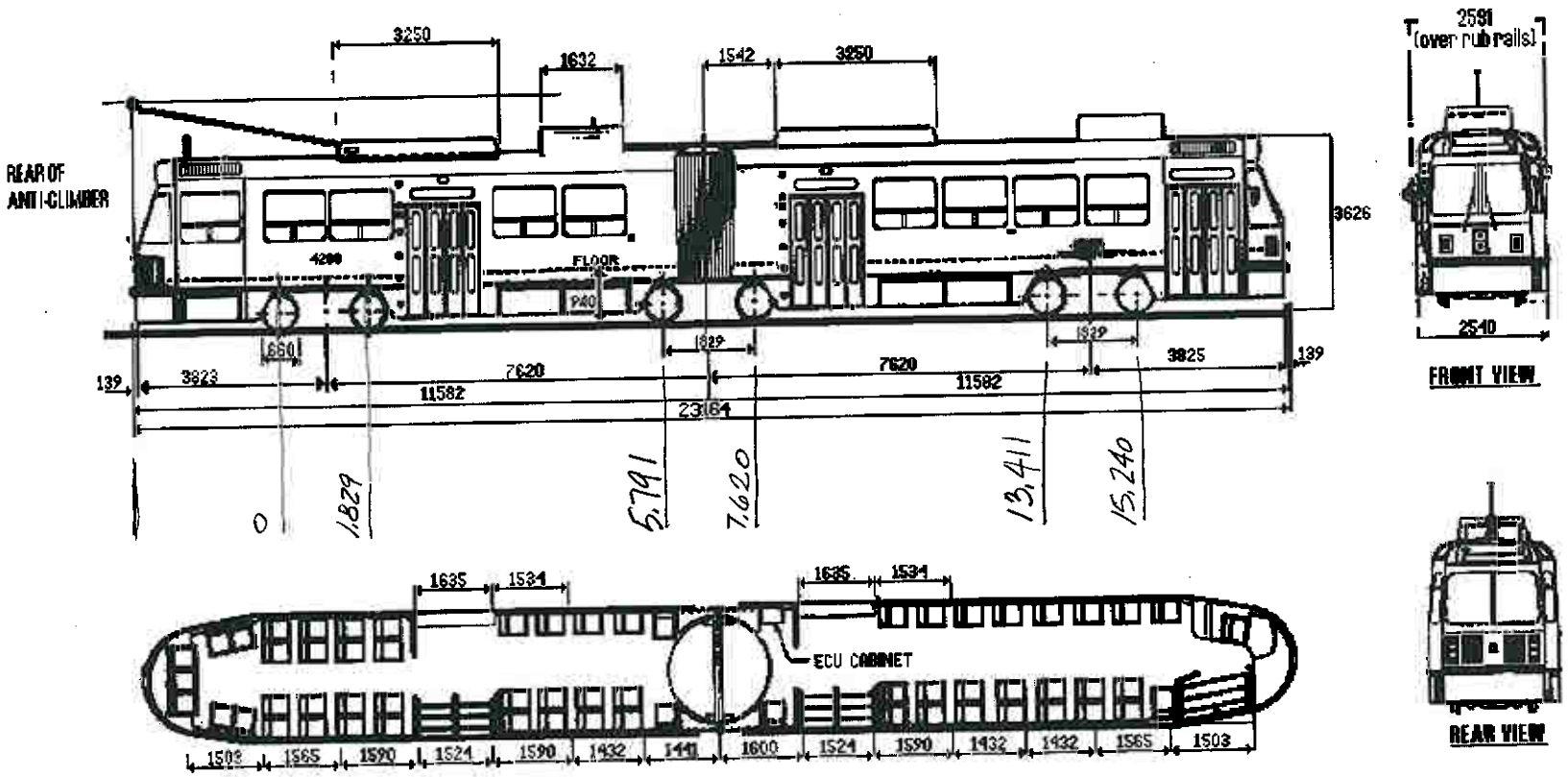

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REGIONAL TRANSIT

Other Sacramento photos are available

Car Specifics

Manufacturer/Model: Siemens Transportation System U2a
Vehicle type: Double ended Articulated
Developed by: DUEWAG AKTIENGESELLSCHAFT
Date in service:
Number of cars ordered:
Number of cars still in service (to date):
Number of trucks: 3
Number of axles: 6

Car Body

Manufacturer: Siemens Transportation Systems
Underframe: Low Alloy High Tensile Steel
Superstructure: Low Alloy High Tensile Steel
Interior Finish: melanine panels
Floor: Rubber over 16mm thick fire-retardant plywood
Steps: N/A

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Doors: Four high level doors per side (electro-mechanically operated)
Windows: tinted, laminated safety glass
Seats: vinyl covered neoprene foam pads
Disabled Access: Car-mounted foldable ramps that cover steps of front doors allowing access from raised platform at stations.

Suspension, Propulsion, Braking

Trucks/Bogies: Light weight steel, DUEWAG type mono-motor
Suspension: Rubber Chevron Springs (Primary), Coil Spring System (Secondary); Vertical and lateral oscillations are hydraulically dampened.
Truck centers:
Wheels:
Wheel base:
Track gauge: 4 feet, 8 1/2 inches (1,435 mm) AA Standard
Motors: Dual DC-Chopper, Monomotor; Two Motors per Car
Gear ratio: .
Gearbox: .
Slip/slide protection:
Service Brakes: Pneumatic Friction Brakes
Track Brakes:
Air compressor:
Traction Motor Performance: 2X189 kW one hour rating at 750 VDC

Vehicle Capacity

Seated Load: 64
Design Load: 144
Crush Load: 225

Passenger Comfort

Heating: N/A
Air-conditioning: Two HVAC systems on the roof, total air volume 75 cubic meters/min. One third of the circulated air is fresh.

Vehicle Dimensions

Length over couplers: 79 feet, 8 3/4 inches
Length over body ends: 76 feet, 8 inches
Width: 8 feet, 9 1/2 inches
Height (rail to roof): 12 feet, 4 1/4 inches
Height (rail to floor): 38 3/4 inches

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Pantograph operating range:
Empty weight per car: 77,162 lbs.
Interior headroom:
Interior width (articulated section):
Doorway width (minimum):
Doorway height:
Step height (1st step):

Vehicle Performance

Maximum design speed: 50 mph
Maximum operating speed: 50 mph
Maximum grade:
Service acceleration on level tangent track: 2.5 mphps
Service braking on level tangent track: 3.5 mphps
Emergency braking on level tangent track: 6.0 mphps
Minimum horizontal curve radius: 82 feet

Electrical and Control Systems

Power Supply: 750 VDC
Low voltage power supply:
Interior Lights:
Motor Control:
Amperage draw:

Updated May 26, 2000

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TRI-MET

D

Tri-Met operates 26 of these Bombardier cars. These cars cannot operate as singles on the Tri-Met system, as wheelchair assisted passengers would not be able to board these "high-floor cars".

Tri-Met Photos
Tri-Met's Existing System Map
Airport MAX Map
Interstate MAX Map

General Information

Manufacturer: Bombardier
Date Ordered: September, 1981
Date in service:
Number of cars ordered: 26
Number of trucks: 3

Fax from : 3055935337 PBSJ TRANSP PLANNING 05-30-06 16:55 Pg: 11

Number of axles: 12

Weight Data

Weight Empty: 92,150 pounds

Suspension, Propulsion, Braking

Track gauge: 4 feet, 8 1/2 inches (AA Standard)
Motors: Two (2) Front and rear trucks only
Gear ratio:
Gearbox:
Slip/slide protection:
Service Brakes:
Track Brakes:
Air compressor:

Vehicle Capacity

Seated Load (Passengers): 76
Design Load (Passengers): 211
Crush Load (Passengers: 256
Disabled Seating: 4
Doors: 4 double doors per side, swing plug type

Passenger Comfort

Heating: 2 x 12 kw forced convection overhead heaters
Air-conditioning: Forced Air

Vehicle Dimensions

Length over couplers: 89', 1 11/16"
Length over anti-climbers: 86', 11 3/4"
Length over body ends:
Width: 8', 8 1/4"
Height (rail to roof): 11', 1 3/4

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Height (rail to floor): 38 3/4"
Height (TOR to Coupler Centerline): 26 1/8"
Pantograph operating range: 12' 8-3/4&' - 22' 3
Empty weight per car: 92,150 pounds
Interior headroom (center aisle): 7' 1-5/8
Interior width (articulated section):
Doorway width (minimum): 4' 4
Doorway height: 6' 4-13/16"
Step height (1st step): 0" (Level with platform
Wheel Diameter (New): 28"
Wheel Diameter (Minimum): 26"
Truck Wheelbase: 6' 2-3/16"
Truck Centers: 29' 8"

Vehicle Performance

Traction Motors HP (Continuous Rating): 261
Traction Motors HP (One Hour Rating): 282
Maximum design speed: 55 mph
Maximum operating speed:
Maximum grade:
Service acceleration on level tangent track: 3.0 mphps
Service braking on level tangent track: 3.0 mphps
Emergency braking on level tangent track: 4.7 mphps
Minimum Horizontal curve radius: 82 feet
Minimum Vertical curve radius: 1,640 feet
Minimum Vertical Radius (Crest-Straight Track): 820 feet
Minimum Vertical Radius (Sag-Straight Track): 1,150 feet

Electrical and Control Systems

Power Supply: 750 VDC
Low voltage power supply: 10kw power converter
Interior Lights: Fluorescent
Motor Control:
Amperage draw:

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Other Specifications

Maximum # of cars capable of being trainlined: Four (4).
Maximum # of cars per consist: Two (2) - Length of stations allow only 2 cars.
Couplers: Automatic, self centering
Primary Suspension: Elastometric Spring
Secondary Suspension: Elastometric Spring
Disc Brakes: Spring applied/hydraulically released
Carbody Material: Corten Steel
Number of Trucks: Three (2 monomotor trucks at ends)

Send comments to the **Lightrail.com webmaster**.

Updated October 29, 2000

CAMPO RICO AVENUE
OVER LOIZA EXPWY

Puerto Rico Highway and Transportation Autho.

Bridge Engineering Office
Engineering Services Area

Structure Inventory and Appraisal Sheet

Bridge Key: 009991 Agency ID: 009991 Sufficiency Rating: 66.8

IDENTIFICATION

State 1:	72 Puerto Rico	Struc Num 8:	009991
Facility Carried 7:	CAMPO RICO AVENUE	Location 9:	4.5 KM N W OF CAROLINA
Rte.(On/Under)5A:	Route On Structure	Rte. Signing Prefix 5B:	5 City Street
Level of Service 5C:	0 None of the below	Rte. Number 5D:	00000
Directional Suffix 5E:	0 N/A (NBI)	% Responsibility :	NA
SHD District 2:	01	County Code 3:	031
Place Code 4:	14290	Kilometer Post 11:	02.8 km
Feature Intersected 6:	PR 26		
Latitude 16:	18d 24' 54"	Longitude 17:	065d 59' 12"
Border Bridge Code 98:	Unknown (P)		
Border Bridge Number 99:	Unknown		

INSPECTION

Frequency 91:	24 months	Inspection Date 90:	1/1/2004	Next Inspection:	01/01/2006
FC Frequency 92A:	NA	FC Inspection Date 93A:	NA	Next FC Inspection:	NA
UW Frequency 92B:	NA	UW Inspection Date 93B:	NA	Next UW Inspection:	NA
SI Frequency 92C:	NA	SI Date 93C:	NA	Next SI:	NA
Element Frequency:	24 months	Element Inspection Date:	01/01/1901	Next Elem. Insp. Due:	01/01/1901

CLASSIFICATION

Defense Highway 100:	0 Not a STRAHNET hwy	Parallel Structure 101:	No || bridge exists
Direction of Traffic 102:	2 2-way traffic	Temporary Structure 103:	Unknown (NBI)
Highway System 104:	0 Not on NHS	NBIS Length 112:	Long Enough
Toll Facility 20:	3 On free road	Functional Class 26:	16 Urban Minor Arterial
Historical Significance 37:	5 Not eligible for NRHP		
Owner 22:	01 State Highway Agency		
Custodian 21:	01 State Highway Agency		

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 3

Main Span Material/Design 43A/B:

5 Prestressed Concrete 02

Deck Type 107:	1 Concrete-Cast-in-Place
Wearing Surface 108A:	1 Monolithic Concrete
Membrane 108B:	0 None
Deck Protection 108C:	None

CONDITION

Deck 58:	5 Fair	Super 59:	5 Fair	Sub 60:	6 Satisfactory
Culvert 62:	N N/A (NBI)	Channel/Channel Protection 61:	N N/A (NBI)		

LOAD RATING AND POSTING

Inventory Rating Method 65:	1 LF Load Factor	Operating Rating Method 63:1 LF Load Factor	
Inventory Rating 66:	MS12.8 HS14.2	Operating Rating 64:	MS21.5
Design Load 31:	4 M 18 (H 20)	Posting 70:	4 0.1-9.9%below
Posting status 41:	B Posting Recommended		

AGE AND SERVICE

Year Built 27:	1965	Year Reconstructed 106:	Unknown
Type of Service on 42A:	5 Highway-pedestrian		
Type of Service under 42B:	1 Highway		
Lanes on 28A: 5	Lanes Under 28B: 8	Detour Length 19:	0.0 km
ADT 29: 34,900	Truck ADT 109: 4 %	Year of ADT 30:	2002

APPRAISAL

Bridge Rail 36A:	1 Meets Standards	Approach Rail 36C:	1 Meets Standards
Transition 36B:	0 Substandard	Approach Rail Ends 36D:	0 Substandard
Str. Evaluation 67:	5 Above Min Tolerable	Deck Geometry 68:	4 Tolerable
Underclearance, Vertical and Horizontal 69:	3 Intolerable - Correct		
Waterway Adequacy 71:	N Not applicable	Approach Alignment 72:	8 Equal Desirable Crit
Scour Critical 113:	N Not Over Waterway		

GEOMETRIC DATA

Length Max Span 48:	24.80 m	Structure Length 49:	62.20 m
Curb/Sdwlk Wdth L 50A:	1.50 m	Curb/Sidewalk Width R 50B:	1.50 m
Width Curb to Curb 51:	19.50 m	Width Out to Out 52:	26.30 m
Approach Roadway Width 32: (w/ shoulders)	22.50 m	Median 33:	2 Closed Med w/o Barrier
Deck Area:	1,835.86 m²		
Skew 34:	2.00 °	Structure Flared 35:	0 No flare
Minimum Vertical Clearance Over Bridge 53:		99.99 m	
Minimum Vertical Underclearance Reference 54A:		H Hwy beneath struct	
Minimum Vertical Underclearance 54B:		04.43 m	
Minimum Lateral Underclearance Reference R 55A:		H Hwy beneath struct	
Minimum Lateral Undrclearance R 55:		02.90 m	
Minimum Lateral Undrclearance L 56:		02.50 m	

PROPOSED IMPROVEMENTS

Bridge Cost 94:	$ 0	Type of Work 75:	35 Rehabilitate-gen.
Roadway Cost 95:	$ 0	Length of Improvment 76:	62.20 m
Total Cost 96:	$ 97,000	Future ADT 114:	58,500
Year of Cost Estimate 97:	2001	Year of Future ADT 115:	2019

NAVIGATION DATA

Navigation Control 38:	N NA-no waterway		
Vertical Clearance 39:	0.00 m	Horizontal Clearance 40:	0.00 m
Pier Protection 111:	Unknown (NBI)	Lift Bridge Vertical Clearance 116:	

ELEMENT CONDITION STATE DATA

PR 3 OVER RIO GRANDE DE LOIZA

Puerto Rico Highway and Transportation Autho.

Bridge Engineering Office
Engineering Services Area

Structure Inventory and Appraisal Sheet

Bridge Key: 012001 Agency ID: 012001 Sufficiency Rating: 55.0

IDENTIFICATION

State 1: 72 Puerto Rico
Struc Num 8: 012001
Facility Carried 7: PR 3
Location 9: 0.5 KM S E OF CAROLINA
Rte.(On/Under)5A: Route On Structure
Rte. Signing Prefix 5B: 1 Interstate Hwy
Level of Service 5C: 1 Mainline
Rte. Number 5D: 00003
Directional Suffix 5E: 0 N/A (NBI)
% Responsibility : NA
SHD District 2: 01
County Code 3: 031
Place Code 4: 51671
Kilometer Post 11: 10.8 km
Feature Intersected 6: GRANDE DE LOIZA RIVER
Latitude 16: 18d 22' 36"
Longitude 17: 065d 57' 18"
Border Bridge Code 98: Unknown (P)
Border Bridge Number 99: Unknown

INSPECTION

Frequency 91: 24 months
Inspection Date 90: 12/1/2003
Next Inspection: 12/01/2005
FC Frequency 92A: NA
FC Inspection Date 93A: NA
Next FC Inspection: NA
UW Frequency 92B: NA
UW Inspection Date 93B: NA
Next UW Inspection: NA
SI Frequency 92C: NA
SI Date 93C: NA
Next SI: NA
Element Frequency: 24 months
Element Inspection Date: 01/01/1901
Next Elem. Insp. Due: 01/01/1901

CLASSIFICATION

Defense Highway 100: 1 On Interstate STRAHNE
Parallel Structure 101: No || bridge exists
Direction of Traffic 102: 2 2-way traffic
Temporary Structure 103: Unknown (NBI)
Highway System 104: 1 On the NHS
NBIS Length 112: Long Enough
Toll Facility 20: 3 On free road
Functional Class 26: 11 Urban Interstate
Historical Significance 37: 5 Not eligible for NRHP
Owner 22: 01 State Highway Agency
Custodian 21: 01 State Highway Agency

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0
Number of Spans Main Unit 45: 8
Main Span Material/Design 43A/B:
4 Steel Continuous 02
Deck Type 107: 1 Concrete-Cast-In-Place
Wearing Surface 108A: 6 Bituminous
Membrane 108B: 0 None
Deck Protection 108C: None

CONDITION

Deck 58: 6 Satisfactory
Super 59: 6 Satisfactory
Sub 60: 5 Fair
Culvert 62: N N/A (NBI)
Channel/Channel Protection 61: 4 Protection Undermined

LOAD RATING AND POSTING

Inventory Rating Method 65: 2 AS Allowable Stress
Operating Rating Method 63:2 AS Allowable Stress
Inventory Rating 66: MS18.0
Operating Rating 64: MS18.0
Design Load 31: 5 MS 18 (HS 20)
Posting 70: 5 At/Above Legal Loads
Posting status 41: A Open, no restriction

AGE AND SERVICE

Year Built 27: 1970
Year Reconstructed 106: 1984
Type of Service on 42A: 5 Highway-pedestrian
Type of Service under 42B: 5 Waterway
Lanes on 28A: 8
Lanes Under 28B: 0
Detour Length 19: 8.0 km
ADT 29: 81,300
Truck ADT 109: 4 %
Year of ADT 30: 2002

APPRAISAL

Bridge Rail 36A: 1 Meets Standards
Approach Rail 36C: 1 Meets Standards
Transition 36B: 1 Meets Standards
Approach Rail Ends 36D: 1 Meets Standards
Str. Evaluation 67: 5 Above Min Tolerable
Deck Geometry 68: 2 Intolerable - Replace
Underclearance, Vertical and Horizontal 69: N Not applicable (NBI)
Waterway Adequacy 71: 6 Equal Minimum
Approach Alignment 72: 7 Above Min Criteria
Scour Critical 113: 3 SC - Unstable

GEOMETRIC DATA

Length Max Span 48: 35.00 m
Structure Length 49: 239.80 m
Curb/Sdwlk Width L 50A: 0.00 m
Curb/Sidewalk Width R 50B: 1.10 m
Width Curb to Curb 51: 27.50 m
Width Out to Out 52: 30.60 m
Approach Roadway Width 32: (w/ shoulders) 30.60 m
Median 33: 3 Closed Med w/Barriers
Deck Area: 7,337.86 m²
Skew 34: 0.00 °
Structure Flared 35: 0 No flare
Minimum Vertical Clearance Over Bridge 53: 99.99 m
Minimum Vertical Underclearance Reference 54A: N Feature not hwy or RR
Minimum Vertical Underclearance 54B: 00.00 m
Minimum Lateral Underclearance Reference R 55A: N Feature not hwy or RR
Minimum Lateral Undrclearance R 55: 00.00 m
Minimum Lateral Undrclearance L 56: 00.00 m

PROPOSED IMPROVEMENTS

Bridge Cost 94: $ 0
Type of Work 75: 35 Rehabilitate-gen.
Roadway Cost 95: $ 0
Length of Improvment 76: 239.80 m
Total Cost 96: $ 193,000
Future ADT 114: 93,452
Year of Cost Estimate 97: 2003
Year of Future ADT 115: 2020

NAVIGATION DATA

Navigation Control 38: 0 Permit Not Required
Vertical Clearance 39: 0.00 m
Horizontal Clearance 40: 0.00 m
Pier Protection 111: Unknown (NBI)
Lift Bridge Vertical Clearance 116:

ELEMENT CONDITION STATE DATA

AVE. DR SANCHEZ CASTAÑO OVER BLASINA EAST

Puerto Rico Highway Authority

Bridge Engineering Office
Engineering Services

Bridge Inspection Report

Bridge Key: 020731 Agency ID: 020731 Sufficiency Rating: 77.7

IDENTIFICATION

State 1:	72 Puerto Rico	Struc Num 8:	020731
Facility Carried 7:	~~DR SANCHEZ CASTAÑO~~	Location 9:	PLAZA CAROLINA EAST SIDE
Rte.(On/Under)5A:	Route On Structure	Rte Signing Prefix 5B:	5 City Street
Level of Service 5C:	0 None of the below	Rte. Number 5D:	00000
Directional Suffix 5E:	0 N/A (NBI)	% Responsibility :	NA
SHD District 2:	SAN JUAN	County Code 3:	Carolina
Place Code 4:	14290	Kilometer Post 11:	00.4 km
Feature Intersected 6:	BLASINA CREEK		
Latitude 16:	18d 23' 36"	Longitude 17:	065d 58' 18"
Border Bridge Code 98:	Unknown (P)		
Border Bridge Number 99:	NA		

INSPECTION

Frequency 91:	24 months	Inspection Date 90:	9/16/2005	Next Inspection	09/16/2007
FC Frequency 92A:	NA	FC Inspection Date 93A:	NA	Next FC Inspection	NA
UW Frequency 92B:	NA	UW Inspection Date 93B:	NA	Next UW Inspection:	NA
SI Frequency 92C:	NA	SI Date 93C:	NA	Next SI	NA
Element Frequency:	24 months	Element Inspection Date:	09/16/2005	Next Elem. Insp. Due:	09/16/2007

CLASSIFICATION

Defense Highway 100:	0 Not a STRAHNET hwy	Parallel Structure 101:	No || bridge exists
Direction of Traffic 102:	2 2-way traffic	Temporary Structure 103:	Unknown (NBI)
Highway System 104:	0 Not on NHS	NBIS Length 112:	Long Enough
Toll Facility 20:	3 On free road	Functional Class 26:	19 Urban Local
Historical Significance 37:	5 Not eligible for NRHP		
Owner 22:	04 04 City/Municipal Agenc		
Custodian 21:	04 04 City/Municipal Agenc		

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 1

Main Span Material/Design 43A/B:

5 Prestressed Concrete 02

Deck Type 107:	1 Concrete-Cast-in-Place
Wearing Surface 108A:	1 Monolithic Concrete
Membrane 108B:	8 Unknown
Deck Protection 108C:	8 Unknown

CONDITION

Deck 58:	6 Satisfactory	Super 59:	6 Satisfactory	Sub 60:	6 Satisfactory
Culvert 62:	N N/A (NBI)	Channel/Channel Protection 61:	6 Bank Slumping		

LOAD RATING AND POSTING

Inventory Rating Method 65: 2 AS Allowable Stress Operating Rating Method 63:2 AS Allowable Stress

Inventory Rating 66:	MS18.0	Operating Rating 64:	MS18.0
Design Load 31:	5 MS 18 (HS 20)	Posting 70:	5 At/Above Legal Loads
Posting status 41:	A Open, no restriction		

AGE AND SERVICE

Year Built 27:	1977	Year Reconstructed 106:	Unknown
Type of Service on 42A:	5 Highway-pedestrian		
Type of Service under 42B:	5 Waterway		
Lanes on 28A: 4	Lanes Under 28B: 0	Detour Length 19:	05 km
ADT 29: 11,000	Truck ADT 109: 4 %	Year of ADT 30:	2002

APPRAISAL

Bridge Rail 36A:	1 Meets Standards	Approach Rail 36C:	1 Meets Standards
Transition 36B:	1 Meets Standards	Approach Rail Ends 36D:	1 Meets Standards
Str. Evaluation 67:	6 Equal Min Criteria	Deck Geometry 68:	2 Intolerable - Replace
Underclearance, Vertical and Horizontal 69:	N Not applicable (NBI)		
Waterway Adequacy 71:	8 Equal Desirable	Approach Alignment 72:	8 Equal Desirable Crit
Scour Critical 113:	8 Stable Above Footing		

GEOMETRIC DATA

Length Max Span 48:	18.40 m	Structure Length 49:	17.80 m
Curb/Sdwlk Width L 50A:	1.40 m	Curb/Sidewalk Width R 50B:	1.40 m
Width Curb to Curb 51:	14.80 m	Width Out to Out 52:	18.50 m
Approach Roadway Width 32: (w/ shoulders)	14.50 m	Median 33:	0 No median
Deck Area:	329.30 m²		
Skew 34:	5.00 °	Structure Flared 35:	0 No flare
Minimum Vertical Clearance Over Bridge 53:	99.99 m		
Minimum Vertical Underclearance Reference 54A:	N Feature not hwy or RR		
Minimum Vertical Underclearance 54B:	00.00 m		
Minimum Lateral Underclearance Reference R 55A:	N Feature not hwy or RR		
Minimum Lateral Underclearance R 55:	00.00 m		
Minimum Lateral Underclearance L 56:	00.00 m		

PROPOSED IMPROVEMENTS

Bridge Cost 94:	$ 0	Type of Work 75:	36 Rehab Deck
Roadway Cost 95:	$ 0	Length of Improvment 76:	17.80 m
Total Cost 96:	$ 43,000	Future ADT 114:	15,000
Year of Cost Estimate 97:	2005	Year of Future ADT 115:	2020

NAVIGATION DATA

Navigation Control 38:	0 Permit Not Required		
Vertical Clearance 39:	0.00 m	Horizontal Clearance 40:	0.00 m
Pier Protection 111:	1 Not Required	Lift Bridge Vertical Clearance 116:	

ELEMENT CONDITION STATE DATA

Str Unit	Elm/Env	Description	Units	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4	% in 5	Qty. St. 5
2	13/3	Unp Conc Deck/AC Ovl	sq m.	259	100 %	259	0 %	0	0 %	0	0 %	0	0 %	0
2	109/3	P/S Conc Open Girder	m.	160	100 %	160	0 %	0	0 %	0	0 %	0	0 %	0
2	215/3	R/Conc Abutment	m.	61	100 %	61	0 %	0	0 %	0	0 %	0	0 %	0
2	302/3	Compressn Joint Seal	m.	29	0 %	0	100 %	29	0 %	0	0 %	0	0 %	0
2	310/3	Elastomeric Bearing	ea.	18	0 %	0	0 %	0	100 %	18	0 %	0	0 %	0
2	321/3	R/Conc Approach Slab	ea.	2	100 %	2	0 %	0	0 %	0	0 %	0	0 %	0

AVE. FRAGOSO OVER BLASINA CHANNEL

Puerto Rico Highway and Transportation Autho.

Bridge Engineering Office
Engineering Services Area

Structure Inventory and Appraisal Sheet

Bridge Key: 020741 Agency ID: 020741 Sufficiency Rating: 76.2

IDENTIFICATION

State 1: 72 Puerto Rico Struc Num 8: 020741
Facility Carried 7: FRAGOSO AVENUE Location 9: AT EAST OF PLAZA CAROLINA
Rte.(On/Under)5A: Route On Structure Rte. Signing Prefix 5B: 5 City Street
Level of Service 5C: 0 None of the below Rte. Number 5D: 00000
Directional Suffix 5E: 0 N/A (NBI) % Responsibility : NA
SHD District 2: 01 County Code 3: 031
Place Code 4: 14290 Kilometer Post 11: 01.0 km
Feature Intersected 6: BLASINA CREEK
Latitude 16: 18d 23' 42" Longitude 17: 065d 58' 24"
Border Bridge Code 98: Unknown (P)
Border Bridge Number 99: Unknown

INSPECTION

Frequency 91: 24 months Inspection Date 90: 1/1/2004 Next Inspection: 01/01/2006
FC Frequency 92A: NA FC Inspection Date 93A: NA Next FC Inspection: NA
UW Frequency 92B: NA UW Inspection Date 93B: NA Next UW Inspection: NA
SI Frequency 92C: NA SI Date 93C: NA Next SI: NA
Element Frequency: 24 months Element Inspection Date: 01/01/1901 Next Elem. Insp. Due: 01/01/1901

CLASSIFICATION

Defense Highway 100: 0 Not a STRAHNET hwy Parallel Structure 101: No || bridge exists
Direction of Traffic 102: 2 2-way traffic Temporary Structure 103: Unknown (NBI)
Highway System 104: 0 Not on NHS NBIS Length 112: Long Enough
Toll Facility 20: 3 On free road Functional Class 26: 17 Urban Collector
Historical Significance 37: 5 Not eligible for NRHP
Owner 22: 01 State Highway Agency
Custodian 21: 01 State Highway Agency

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 3
Main Span Material/Design 43A/B:
5 Prestressed Concrete 02
Deck Type 107: 1 Concrete-Cast-In-Place
Wearing Surface 108A: 1 Monolithic Concrete
Membrane 108B: 0 None
Deck Protection 108C: None

CONDITION

Deck 58: 7 Good Super 59: 6 Satisfactory Sub 60: 7 Good
Culvert 62: N N/A (NBI) Channel/Channel Protection 61: 7 Minor Damage

LOAD RATING AND POSTING

Inventory Rating Method 65: 2 AS Allowable Stress Operating Rating Method 63:2 AS Allowable Stress
Inventory Rating 66: MS18.0 Operating Rating 64: MS18.0
Design Load 31: 5 MS 18 (HS 20) Posting 70: 5 At/Above Legal Loads
Posting status 41: A Open, no restriction

AGE AND SERVICE

Year Built 27: 1978 Year Reconstructed 106: Unknown
Type of Service on 42A: 5 Highway-pedestrian
Type of Service under 42B: 5 Waterway
Lanes on 28A: 4 Lanes Under 28B: 0 Detour Length 19: 2.0 km
ADT 29: 23,800 Truck ADT 109: 4 % Year of ADT 30: 2002

APPRAISAL

Bridge Rail 36A: 1 Meets Standards Approach Rail 36C: 0 Substandard
Transition 36B: 0 Substandard Approach Rail Ends 36D: 0 Substandard
Str. Evaluation 67: 6 Equal Min Criteria Deck Geometry 68: 2 Intolerable - Replace
Underclearance, Vertical and Horizontal 69: N Not applicable (NBI)
Waterway Adequacy 71: 9 Above Desirable Approach Alignment 72: 8 Equal Desirable Crit
Scour Critical 113: 4 Stable, needs action

GEOMETRIC DATA

Length Max Span 48: 21.70 m Structure Length 49: 63.70 m
Curb/Sdwlk Width L 50A: 1.80 m Curb/Sidewalk Width R 50B: 1.80 m
Width Curb to Curb 51: 14.50 m Width Out to Out 52: 18.50 m
Approach Roadway Width 32: (w/ shoulders) 14.50 m Median 33: 0 No median
Deck Area: 1,178.45 m²
Skew 34: 38.00 ° Structure Flared 35: 0 No flare
Minimum Vertical Clearance Over Bridge 53: 99.99 m
Minimum Vertical Underclearance Reference 54A: N Feature not hwy or RR
Minimum Vertical Underclearance 54B: 00.00 m
Minimum Lateral Underclearance Reference R 55A: N Feature not hwy or RR
Minimum Lateral Underclearance R 55: 00.00 m
Minimum Lateral Underclearance L 56: 00.00 m

PROPOSED IMPROVEMENTS

Bridge Cost 94: $ 0 Type of Work 75: 35 Rehabilitate-gen.
Roadway Cost 95: $ 0 Length of Improvment 76: 63.70 m
Total Cost 96: $ 112,000 Future ADT 114: 28,600
Year of Cost Estimate 97: 2001 Year of Future ADT 115: 2020

NAVIGATION DATA

Navigation Control 38: 0 Permit Not Required
Vertical Clearance 39: 0.00 m Horizontal Clearance 40: 0.00 m
Pier Protection 111: Unknown (NBI) Lift Bridge Vertical Clearance 116:

ELEMENT CONDITION STATE DATA

Structure Inventory and Appraisal Sheet

Bridge Key: 021561 Agency ID: 021561 Sufficiency Rating: 50.3

IDENTIFICATION

State 1: 72 Puerto Rico Struc Num 8: 021561
Facility Carried 7: ITURREGUI AVENUE Location 9: ITURREGUI AVENUE
Rte.(On/Under)5A: Route On Structure Rte. Signing Prefix 5B: 5 City Street
Level of Service 5C: 0 None of the below Rte. Number 5D: 00000
Directional Suffix 5E: 0 N/A (NBI) % Responsibility : NA
SHD District 2: 01 County Code 3: 031
Place Code 4: 14290 Kilometer Post 11: 00.2 km
Feature Intersected 6: ITURREGUI CHANNEL
Latitude 16: 18d 25' 24" Longitude 17: 065d 59' 30"
Border Bridge Code 98: Unknown (P)
Border Bridge Number 99: Unknown

INSPECTION

Frequency 91: 24 months Inspection Date 90: 8/2/2005 Next Inspection: 08/02/2007
FC Frequency 92A: NA FC Inspection Date 93A: NA Next FC Inspection: NA
UW Frequency 92B: NA UW Inspection Date 93B: NA Next UW Inspection: NA
SI Frequency 92C: NA SI Date 93C: NA Next SI: NA
Element Frequency: 24 months Element Inspection Date: 08/02/2005 Next Elem. Insp. Due: 08/02/2007

CLASSIFICATION

Defense Highway 100: 0 Not a STRAHNET hwy Parallel Structure 101: No || bridge exists
Direction of Traffic 102: 2 2-way traffic Temporary Structure 103: Unknown (NBI)
Highway System 104: 0 Not on NHS NBIS Length 112: Long Enough
Toll Facility 20: 3 On free road Functional Class 26: 16 Urban Minor Arterial
Historical Significance 37: 5 Not eligible for NRHP
Owner 22: 01 State Highway Agency
Custodian 21: 01 State Highway Agency

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 5
Main Span Material/Design 43A/B:
2 Concrete Continuous 01
Deck Type 107: 1 Concrete-Cast-In-Place
Wearing Surface 108A: 6 Bituminous
Membrane 108B: 0 None
Deck Protection 108C: None

CONDITION

Deck 58: 5 Fair Super 59: 5 Fair Sub 60: 6 Satisfactory
Culvert 62: N N/A (NBI) Channel/Channel Protection 61: 6 Bank Slumping

LOAD RATING AND POSTING

Inventory Rating Method 65: 5 No rating Operating Rating Method 63:5 No rating
Inventory Rating 66: MS12.5 HS13.9 Operating Rating 64: MS13.5
Design Load 31: Unknown (NBI) Posting 70: 5 At/Above Legal Loads
Posting status 41: A Open, no restriction

AGE AND SERVICE

Year Built 27: 1958 Year Reconstructed 106: Unknown
Type of Service on 42A: 5 Highway-pedestrian
Type of Service under 42B: 5 Waterway
Lanes on 28A: 4 Lanes Under 28B: 0 Detour Length 19: 2.0 km
ADT 29: 34,400 Truck ADT 109: 4 % Year of ADT 30: 2002

APPRAISAL

Bridge Rail 36A: 0 Substandard Approach Rail 36C: N N/A or not required
Transition 36B: N N/A or not required Approach Rail Ends 36D: N N/A or not required
Str. Evaluation 67: 5 Above Min Tolerable Deck Geometry 68: 2 Intolerable - Replace
Underclearance, Vertical and Horizontal 69: N Not applicable (NBI)
Waterway Adequacy 71: 4 Tolerable Approach Alignment 72: 7 Above Min Criteria
Scour Critical 113: Unknown (P)

GEOMETRIC DATA

Length Max Span 48: 4.40 m Structure Length 49: 21.50 m
Curb/Sdwlk Wdth L 50A: 2.70 m Curb/Sidewalk Width R 50B: 2.70 m
Width Curb to Curb 51: 12.10 m Width Out to Out 52: 18.30 m
Approach Roadway Width 32: (w/ shoulders) 12.10 m Median 33: 0 No median
Deck Area: 393.00 m²
Skew 34: 0.00 ° Structure Flared 35: 0 No flare
Minimum Vertical Clearance Over Bridge 53: 99.99 m
Minimum Vertical Underclearance Reference 54A: N Feature not hwy or RR
Minimum Vertical Underclearance 54B: 00.00 m
Minimum Lateral Underclearance Reference R 55A: N Feature not hwy or RR
Minimum Lateral Undrclearance R 55: 00.00 m
Minimum Lateral Undrclearance L 56: 00.00 m

PROPOSED IMPROVEMENTS

Bridge Cost 94: $ 547,000 Type of Work 75: 31 Repl-Load Capacity
Roadway Cost 95: $ 55,000 Length of Improvment 76: 29.70 m
Total Cost 96: $ 602,000 Future ADT 114: 42,036
Year of Cost Estimate 97: 2005 Year of Future ADT 115: 2020

NAVIGATION DATA

Navigation Control 38: 0 Permit Not Required
Vertical Clearance 39: 0.00 m Horizontal Clearance 40: 0.00 m
Pier Protection 111: 1 Not Required Lift Bridge Vertical Clearance 116:

ELEMENT CONDITION STATE DATA

Str Unit	Elm/Env	Description	Units	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4	% in 5	Qty. St. 5
2	39/4	Unp Conc Slab/AC Ovl	sq.m.	393	100 %	393	0 %	0	0 %	0	0 %	0	0 %	0
2	210/4	R/Conc Pier Wall	m.	74	97 %	72	3 %	2	0 %	0	0 %	0	0 %	0
2	215/4	R/Conc Abutment	m.	38	89 %	34	11 %	4	0 %	0	0 %	0	0 %	0
2	331/4	Conc Bridge Railing	m.	43	65 %	28	7 %	3	28 %	12	0 %	0	0 %	0
2	359/4	Soffit Smart Flag	ea.	1	0 %	0	100 %	1	0 %	0	0 %	0	0 %	0

PR17 BRIDGE OVER PR 26

Puerto Rico Highway Authority

Bridge Engineering Office
Engineering Services

Bridge Inspection Report

Bridge Key: 023311 Agency ID: 023311 Sufficiency Rating: 89.0

IDENTIFICATION

State 1: 72 Puerto Rico
Struc Num 8: 023311
Facility Carried 7: PR 17 (PINERO AVE)
Location 9: 9 KMS. NW. OF CAROLINA
Rte.(On/Under)5A: Route On Structure
Rte. Signing Prefix 5B: 3 State Hwy
Level of Service 5C: 1 Mainline
Rte Number 5D: 00017
Directional Suffix 5E: 0 N/A (NBI)
% Responsibility : NA
SHD District 2: 01
County Code 3: 031
Place Code 4: 14290
Kilometer Post 11: 13.0 km
Feature Intersected 6: PR 26 (BALDORIOTY AVE.)
Latitude 16: 18d 26' 18"
Longitude 17: 066d 01' 18"
Border Bridge Code 98: Unknown (P)
Border Bridge Number 99: Unknown

INSPECTION

Frequency 91: 24 months
Inspection Date 90: 8/8/2005
Next Inspection: 08/08/2007
FC Frequency 92A: NA
FC Inspection Date 93A: NA
Next FC Inspection: NA
UW Frequency 92B: NA
UW Inspection Date 93B: NA
Next UW Inspection NA
SI Frequency 92C: NA
SI Date 93C: NA
Next SI: NA
Element Frequency: 24 months
Element Inspection Date: 08/08/2005
Next Elem. Insp. Due: 08/08/2007

CLASSIFICATION

Defense Highway 100: 2 On Non-Interstate STRA
Parallel Structure 101: No || bridge exists
Direction of Traffic 102: 2 2-way traffic
Temporary Structure 103: Unknown (NBI)
Highway System 104: 0 Not on NHS
NBIS Length 112: Long Enough
Toll Facility 20: 3 On free road
Functional Class 26: 14 Urban Other Princ
Historical Significance 37: 5 Not eligible for NRHP
Owner 22: 01State Highway Agency
Custodian 21: 01 State Highway Agency

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0
Number of Spans Main Unit 45: 4
Main Span Material/Design 43A/B:
5 Prestressed Concrete 02
Deck Type 107: 2 Concrete Precast Panel
Wearing Surface 108A: 1 Monolithic Concrete
Membrane 108B: 0 None
Deck Protection 108C: None

CONDITION

Deck 58: 6 Satisfactory
Super 59: 7 Good
Sub 60: 7 Good
Culvert 62: N N/A (NBI)
Channel/Channel Protection 61: N N/A (NBI)

LOAD RATING AND POSTING

Inventory Rating Method 65: 2 AS Allowable Stress
Operating Rating Method 63:2 AS Allowable Stress
Inventory Rating 66: MS18.0
Operating Rating 64: MS18.0
Design Load 31: 5 MS 18 (HS 20)
Posting 70: 5 At/Above Legal Loads
Posting status 41: A Open, no restriction

AGE AND SERVICE

Year Built 27: 1994
Year Reconstructed 106: Unknown
Type of Service on 42A: 1 Highway
Type of Service under 42B: 1 Highway
Lanes on 28A: 6
Lanes Under 28B: 12
Detour Length 19: 0.0 km
ADT 29: 23,800
Truck ADT 109: 5 %
Year of ADT 30: 2002

APPRAISAL

Bridge Rail 36A: 1 Meets Standards
Approach Rail 36C: 1 Meets Standards
Transition 36B: 1 Meets Standards
Approach Rail Ends 36D: 1 Meets Standards
Str. Evaluation 67: 7 Above Min Criteria
Deck Geometry 68: 7 Above Min Criteria
Underclearance, Vertical and Horizontal 69: 3 Intolerable - Correct
Waterway Adequacy 71: N Not applicable
Approach Alignment 72: 8 Equal Desirable Crit
Scour Critical 113: N Not Over Waterway

GEOMETRIC DATA

Length Max Span 48: 25.20 m
Structure Length 49: 101.70 m
Curb/Sdwlk Width L 50A: 0.00 m
Curb/Sidewalk Width R 50B: 0.00 m
Width Curb to Curb 51: 27.20 m
Width Out to Out 52: 29.10 m
Approach Roadway Width 32: (w/ shoulders) 28.80 m
Median 33: 3 Closed Med w/Barriers
Deck Area: 2,959.47 m²
Skew 34: 0.00 °
Structure Flared 35: 0 No flare
Minimum Vertical Clearance Over Bridge 53: 99.99 m
Minimum Vertical Underclearance Reference 54A: H Hwy beneath struct
Minimum Vertical Underclearance 54B: 04.94 m
Minimum Lateral Underclearance Reference R 55A: H Hwy beneath struct
Minimum Lateral Underclearance R 55: 01.00 m
Minimum Lateral Underclearance L 56: 04.90 m

PROPOSED IMPROVEMENTS

Bridge Cost 94: $ 0
Type of Work 75: Not Applicable (P)
Roadway Cost 95: $ 0
Length of Improvment 76:
Total Cost 96: $ 0
Future ADT 114: 31,178
Year of Cost Estimate 97: 2002
Year of Future ADT 115: 2020

NAVIGATION DATA

Navigation Control 38: Unknown (NBI)
Vertical Clearance 39:
Horizontal Clearance 40:
Pier Protection 111: Not Applicable (P)
Lift Bridge Vertical Clearance 116:

ELEMENT CONDITION STATE DATA

Str Unit	Elm/Env	Description	Units	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4	% in 5	Qty. St. 5
1	12/1	Bare Concrete Deck	sq.m.	1	100 %	1	0 %	0	0 %	0	0 %	0	0 %	0
1	109/3	P/S Conc Open Girder	m.	1,016	100 %	1,016	0 %	0	0 %	0	0 %	0	0 %	0
1	202/1	Paint Stl Column	ea.	21	100 %	21	0 %	0	0 %	0	0 %	0	0 %	0
1	215/3	R/Conc Abutment	m.	74	100 %	74	0 %	0	0 %	0	0 %	0	0 %	0
1	234/3	R/Conc Cap	m.	87	100 %	87	0 %	0	0 %	0	0 %	0	0 %	0
1	303/3	Assembly Joint/Seal	m.	55	100 %	55	0 %	0	0 %	0	0 %	0	0 %	0

TEODORO MOSCOSO BRIDGE
OVER SAN JOSE LAGOON

Bridge Inspection Report

Bridge Key: 023321 Agency ID: 023321 Sufficiency Rating: 80.0

IDENTIFICATION

State 1: 72 Puerto Rico — Struc Num 8: 023321
Facility Carried 7: PR 17 (PIÑERO AV.) — Location 9: 8 KM N W OF CAROLINA
Rte.(On/Under)5A: Route On Structure — Rte. Signing Prefix 5B: 8 Other (incl toll n
Level of Service 5C: 1 Mainline — Rte. Number 5D. 00017
Directional Suffix 5E: 0 N/A (NBI) — % Responsibility NA
SHD District 2: SAN JUAN — County Code 3. Carolina
Place Code 4: 14290 — Kilometer Post 11: 10.0 km
Feature Intersected 6: PR 8, SAN JOSE LAGOON
Latitude 16: 18d 25' 30" — Longitude 17: 066d 01' 30"
Border Bridge Code 98: Not Applicable (P)
Border Bridge Number 99: NA

INSPECTION

Frequency 91: 24 months — Inspection Date 90. 5/17/2005 — Next Inspection: 05/17/2007
FC Frequency 92A: NA — FC Inspection Date 93A: NA — Next FC Inspection: NA
UW Frequency 92B: 24 months — UW Inspection Date 93B: 5/17/2005 — Next UW Inspection: 5/17/2007
SI Frequency 92C: NA — SI Date 93C: NA — Next SI: NA
Element Frequency: 24 months — Element Inspection Date: 05/17/2005 — Next Elem. Insp. Due: 05/17/2007

CLASSIFICATION

Defense Highway 100: 0 Not a STRAHNET hwy — Parallel Structure 101: No || bridge exists
Direction of Traffic 102: 2 2-way traffic — Temporary Structure 103: Not Applicable (P)
Highway System 104: 0 Not on NHS — NBIS Length 112: Long Enough
Toll Facility 20: 1 Toll bridge — Functional Class 26: 12 Urban Fwy/Expwy
Historical Significance 37: 5 Not eligible for NRHP
Owner 22: 01 01 State Highway Agency
Custodian 21: 01 01 State Highway Agency

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 48: 0 — Number of Spans Main Unit 45: 79
Main Span Material/Design 43A/8:
5 Prestressed Concrete 02
Deck Type 107: 2 Concrete Precast Panel
Wearing Surface 108A: 1 Monolithic Concrete
Membrane 108B: 0 None
Deck Protection 108C: None

CONDITION

Deck 58: 7 Good — Super 59: 7 Good — Sub 60: 8 Very Good
Culvert 62: N N/A (NBI) — Channel/Channel Protection 61: 9 No Deficiencies

LOAD RATING AND POSTING

Inventory Rating Method 65: 1 LF Load Factor — Operating Rating Method 63: 1 LF Load Factor
Inventory Rating 66: MS18.0 — Operating Rating 64: MS18.0
Design Load 31: 5 MS 18 (HS 20) — Posting 70: 5 At/Above Legal Loads
Posting status 41: A Open, no restriction

AGE AND SERVICE

Year Built 27: 1994 — Year Reconstructed 106: 0
Type of Service on 42A: 1 Highway
Type of Service under 42B: 6 Highway-waterway
Lanes on 28A: 4 — Lanes Under 28B: 4 — Detour Length 19: 14 km
ADT 29: 24,000 — Truck ADT 109: 5 % — Year of ADT 30: 2002

APPRAISAL

Bridge Rail 36A: 1 Meets Standards — Approach Rail 36C: 1 Meets Standards
Transition 36B: 1 Meets Standards — Approach Rail Ends 36D: 1 Meets Standards
Str. Evaluation 67: 7 Above Min Criteria — Deck Geometry 68: 9 Above Desirable Crit
Underclearance, Vertical and Horizontal 69: 6 Equal Minimum
Waterway Adequacy 71: 9 Above Desirable — Approach Alignment 72: 8 Equal Desirable Crit
Scour Critical 113: 8 Stable Above Footing

GEOMETRIC DATA

Length Max Span 48: 30.20 m — Structure Length 49: 2,245.38 m
Curb/Sdwlk Width L 50A: 0.00 m — Curb/Sidewalk Width R 50B: 0.00 m
Width Curb to Curb 51: 23.20 m — Width Out to Out 52: 24.10 m
Approach Roadway Width 32: (w/ shoulders) 42.30 m — Median 33: 3 Closed Med w/Barriers
Deck Area: 61,155.00 m²
Skew 34: 9.00 ° — Structure Flared 35: 1 Yes, flared
Minimum Vertical Clearance Over Bridge 53: 99.99 m
Minimum Vertical Underclearance Reference 54A: H Hwy beneath struct
Minimum Vertical Underclearance 54B: 05.84 m
Minimum Lateral Underclearance Reference R 55A: H Hwy beneath struct
Minimum Lateral Underclearance R 55: 04.10 m
Minimum Lateral Underclearance L 56: 01.00 m

PROPOSED IMPROVEMENTS

Bridge Cost 94: $ 0 — Type of Work 75: 35 Rehabilitate-gen.
Roadway Cost 95: $ 0 — Length of Improvment 76: 2,245.38 m
Total Cost 96: $ 756,648 — Future ADT 114: 30,000
Year of Cost Estimate 97: 2005 — Year of Future ADT 115: 2020

NAVIGATION DATA

Navigation Control 38: 0 Permit Not Required
Vertical Clearance 39: 0.00 m — Horizontal Clearance 40: 0.00 m
Pier Protection 111: 2 In-Place, Functioning — Lift Bridge Vertical Clearance 116: 0.00 m

ELEMENT CONDITION STATE DATA

Str Unit	Elm/Env	Description	Units	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4	% in 5	Qty. St. 5
2	12/3	Bare Concrete Deck	sq.m.	61,155	100 %	61,155	0 %	0	0 %	0	0 %	0	0 %	0
2	109/3	P/S Conc Open Girder	m.	21,084	100 %	21,084	0 %	0	0 %	0	0 %	0	0 %	0
2	215/3	R/Conc Abutment	m.	99	100 %	99	0 %	0	0 %	0	0 %	0	0 %	0
2	225/3	Unpnt Stl Submd Pile	ea.	475	100 %	475	0 %	0	0 %	0	0 %	0	0 %	0
2	234/3	R/Conc Cap	m.	2,131	100 %	2,131	0 %	0	0 %	0	0 %	0	0 %	0
2	302/3	Compressn Joint Seal	m.	444	100 %	444	0 %	0	0 %	0	0 %	0	0 %	0

GOBERNADORES AVE.
OVER PR 26

YourState Department of Transportation

Bureau of Bridges and Structures
Bridge Maintenance

Bridge Inspection Report

Bridge Key: 023721 Agency ID: 023721 Sufficiency Rating: 89.0

IDENTIFICATION

State 1:	72 Puerto Rico	Struc Num 8:	023721
Facility Carried 7:	PR 187	Location 9:	10 KM NW OF CAROLINA
Rte.(On/Under)5A:	Route On Structure	Rte. Signing Prefix 5B:	3 State Hwy
Level of Service 5C:	1 Mainline	Rte. Number 5D:	00187
Directional Suffix 5E:	0 N/A (NBI)	% Responsibility :	NA
SHD District 2:	SAN JUAN	County Code 3:	Carolina
Place Code 4:	14290	Kilometer Post 11:	00.0 km
Feature Intersected 6:	PR 26		
Latitude 18:	18d 26' 42"	Longitude 17:	066d 01' 30"
Border Bridge Code 98:	Unknown (P)		
Border Bridge Number 99:	NA		

INSPECTION

Frequency 91:	24 months	Inspection Date 90:	9/1/2002	Next Inspection:	01/01/2004
FC Frequency 92A:	NA	FC Inspection Date 93A:	NA	Next FC Inspection:	NA
UW Frequency 92B:	NA	UW Inspection Date 93B:	NA	Next UW Inspection:	NA
SI Frequency 92C:	NA	SI Date 93C:	NA	Next SI:	NA
Element Frequency:	24 months	Element Inspection Date:	01/01/1901	Next Elem. Insp. Due:	01/01/1901

CLASSIFICATION

Defense Highway 100:	1 STRAHNET hwy	Parallel Structure 101:	No ||| bridge exists
Direction of Traffic 102:	2 2-way traffic	Temporary Structure 103:	Unknown (NBI)
Highway System 104:	0 Not on NHS	NBIS Length 112:	Long Enough
Toll Facility 20:	3 On free road	Functional Class 26:	16 Urban Minor Arterial
Historical Significance 37:	5 Not eligible for NRHP		
Owner 22:	0101 State Highway Agency		
Custodian 21:	01 01 State Highway Agency		

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 3

Main Span Material/Design 43A/B:

5 Prestressed Concrete 02

Deck Type 107:	1 Concrete-Cast-In-Place
Wearing Surface 108A:	1 Monolithic Concrete
Membrane 108B:	0 None
Deck Protection 108C:	None

CONDITION

Deck 58:	7 Good	Super 59:	7 Good	Sub 60:	7 Good
Culvert 62:	N N/A (NBI)	Channel/Channel Protection 61:	N N/A (NBI)		

LOAD RATING AND POSTING

Inventory Rating Method 65: 2 AS Allowable Stress Operating Rating Method 63:2 AS Allowable Stress

Inventory Rating 66:	MS18.0	Operating Rating 64:	MS18.0
Design Load 31:	5 MS 18 (HS 20)	Posting 70:	5 At/Above Legal Loads
Posting status 41:	A Open, no restriction		

AGE AND SERVICE

Year Built 27:	1994	Year Reconstructed 106:	Unknown		
Type of Service on 42A:	1 Highway				
Type of Service under 42B:	1 Highway				
Lanes on 28A:	4	Lanes Under 28B:	11	Detour Length 19:	00 km
ADT 29:	42,300	Truck ADT 109:	5 %	Year of ADT 30:	2002

APPRAISAL

Bridge Rail 36A:	1 Meets Standards	Approach Rail 36C:	1 Meets Standards
Transition 36B:	1 Meets Standards	Approach Rail Ends 36D:	1 Meets Standards
Str. Evaluation 67:	7 Above Min Criteria	Deck Geometry 68:	9 Above Desirable Crit
Underclearance, Vertical and Horizontal 69:	3 Intolerable - Correct		
Waterway Adequacy 71:	N Not applicable	Approach Alignment 72:	9 Equal Desirable Crit
Scour Critical 113:	N Not Over Waterway		

GEOMETRIC DATA

Length Max Span 48:	28.10 m	Structure Length 49:	87.00 m
Curb/Sdwlk Width L 50A:	0.00 m	Curb/Sidewalk Width R 50B:	0.00 m
Width Curb to Curb 51:	21.30 m	Width Out to Out 52:	28.30 m
Approach Roadway Width 32: (w/ shoulders)	27.30 m	Median 33:	2 Closed Med w/o Barrier
Deck Area:	2,462.10 m²		
Skew 34:	8.00 °	Structure Flared 35:	0 No flare
Minimum Vertical Clearance Over Bridge 53:	99.99 m		
Minimum Vertical Underclearance Reference 54A:	H Hwy beneath struct		
Minimum Vertical Underclearance 54B:	95.15 m		
Minimum Lateral Underclearance Reference R 55A:	H Hwy beneath struct		
Minimum Lateral Underclearance R 55:	00.90 m		
Minimum Lateral Underclearance L 56:	00.30 m		

PROPOSED IMPROVEMENTS

Bridge Cost 94:	$ 0	Type of Work 75:	Unknown (P)
Roadway Cost 95:	$ 0	Length of Improvment 76:	00.00 m
Total Cost 96:	$ 0	Future ADT 114:	47,798
Year of Cost Estimate 97:	2002	Year of Future ADT 115:	2020

NAVIGATION DATA

Navigation Control 38:	N NA-no waterway		
Vertical Clearance 39:	0.00 m	Horizontal Clearance 40:	0.00 m
Pier Protection 111:	Unknown (NBI)	Lift Bridge Vertical Clearance 116:	

ELEMENT CONDITION STATE DATA

BRIDGE NOTES

PR 26 ENTRANCE TO
Los Angeles

Puerto Rico Highway and Transportation Autho.

Bridge Engineering Office
Engineering Services Area

Structure Inventory and Appraisal Sheet

Bridge Key: 024581 Agency ID: 024581 Sufficiency Rating: 69.8

IDENTIFICATION

State 1: 72 Puerto Rico
Struc Num 8: 024581
Facility Carried 7: PR 26
Location 9: 3.7 KMS OF CAROLINA
Rte.(On/Under)5A: Route On Structure
Rte. Signing Prefix 5B: 1 Interstate Hwy
Level of Service 5C: 1 Mainline
Rte. Number 5D: 00003
Directional Suffix 5E: 0 N/A (NBI)
% Responsibility : NA
SHD District 2: 01
County Code 3: 031
Place Code 4: 14290
Kilometer Post 11: 09.0 km
Feature Intersected 6: LOS ANGELES AVENUE
Latitude 16: 18d 26' 18"
Longitude 17: 066d 00' 48"
Border Bridge Code 98: Unknown (P)
Border Bridge Number 99: Unknown

INSPECTION

Frequency 91: 24 months
Inspection Date 90: 8/1/2005
Next Inspection: 08/01/2007
FC Frequency 92A: NA
FC Inspection Date 93A: NA
Next FC Inspection: NA
UW Frequency 92B: NA
UW Inspection Date 93B: NA
Next UW Inspection: NA
SI Frequency 92C: NA
SI Date 93C: NA
Next SI: NA
Element Frequency: 24 months
Element Inspection Date: 01/01/1901
Next Elem. Insp. Due: 01/01/1901

CLASSIFICATION

Defense Highway 100: 1 On Interstate STRAHNE
Parallel Structure 101: No || bridge exists
Direction of Traffic 102: 1 1-way traffic
Temporary Structure 103: Unknown (NBI)
Highway System 104: 1 On the NHS
NBIS Length 112: Long Enough
Toll Facility 20: 3 On free road
Functional Class 26: 11 Urban Interstate
Historical Significance 37: 5 Not eligible for NRHP
Owner 22: 01 State Highway Agency
Custodian 21: 01 State Highway Agency

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0
Number of Spans Main Unit 45: 12
Main Span Material/Design 43A/B:
5 Prestressed Concrete 02
Deck Type 107: 1 Concrete-Cast-in-Place
Wearing Surface 108A: 1 Monolithic Concrete
Membrane 108B: 0 None
Deck Protection 108C: None

CONDITION

Deck 58: 3 Serious
Super 59: 7 Good
Sub 60: 7 Good
Culvert 62: N N/A (NBI)
Channel/Channel Protection 61: N N/A (NBI)

LOAD RATING AND POSTING

Inventory Rating Method 65: 1 LF Load Factor
Operating Rating Method 63:1 LF Load Factor
Inventory Rating 66: MS17.6 HS19.6
Operating Rating 64: MS29.5
Design Load 31: 5 MS 13 (HS 20)
Posting 70: 5 At/Above Legal Loads
Posting status 41: A Open, no restriction

AGE AND SERVICE

Year Built 27: 1996
Year Reconstructed 106: Unknown
Type of Service on 42A: 1 Highway
Type of Service under 42B: 1 Highway
Lanes on 28A: 4
Lanes Under 28B: 2
Detour Length 19: 0.0 km
ADT 29: 111,500
Truck ADT 109: 5 %
Year of ADT 30: 2002

APPRAISAL

Bridge Rail 36A: 1 Meets Standards
Approach Rail 36C: 1 Meets Standards
Transition 36B: 1 Meets Standards
Approach Rail Ends 36D: 1 Meets Standards
Str. Evaluation 67: 7 Above Min Criteria
Deck Geometry 68: 2 Intolerable - Replace
Underclearance, Vertical and Horizontal 69: 3 Intolerable - Correct
Waterway Adequacy 71: N Not applicable
Approach Alignment 72: 8 Equal Desirable Crit
Scour Critical 113: N Not Over Waterway

GEOMETRIC DATA

Length Max Span 48: 23.10 m
Structure Length 49: 243.10 m
Curb/Sdwlk Width L 50A: 0.00 m
Curb/Sidewalk Width R 50B: 0.00 m
Width Curb to Curb 51: 14.20 m
Width Out to Out 52: 15.30 m
Approach Roadway Width 32: (w/ shoulders) 15.60 m
Median 33: 0 No median
Deck Area: 3,719.43 m²
Skew 34: 13.00 °
Structure Flared 35: 0 No flare
Minimum Vertical Clearance Over Bridge 53: 99.99 m
Minimum Vertical Underclearance Reference 54A: H Hwy beneath struct
Minimum Vertical Underclearance 54B: 05.23 m
Minimum Lateral Underclearance Reference R 55A: H Hwy beneath struct
Minimum Lateral Underclearance R 55: 00.40 m
Minimum Lateral Underclearance L 56: 00.50 m

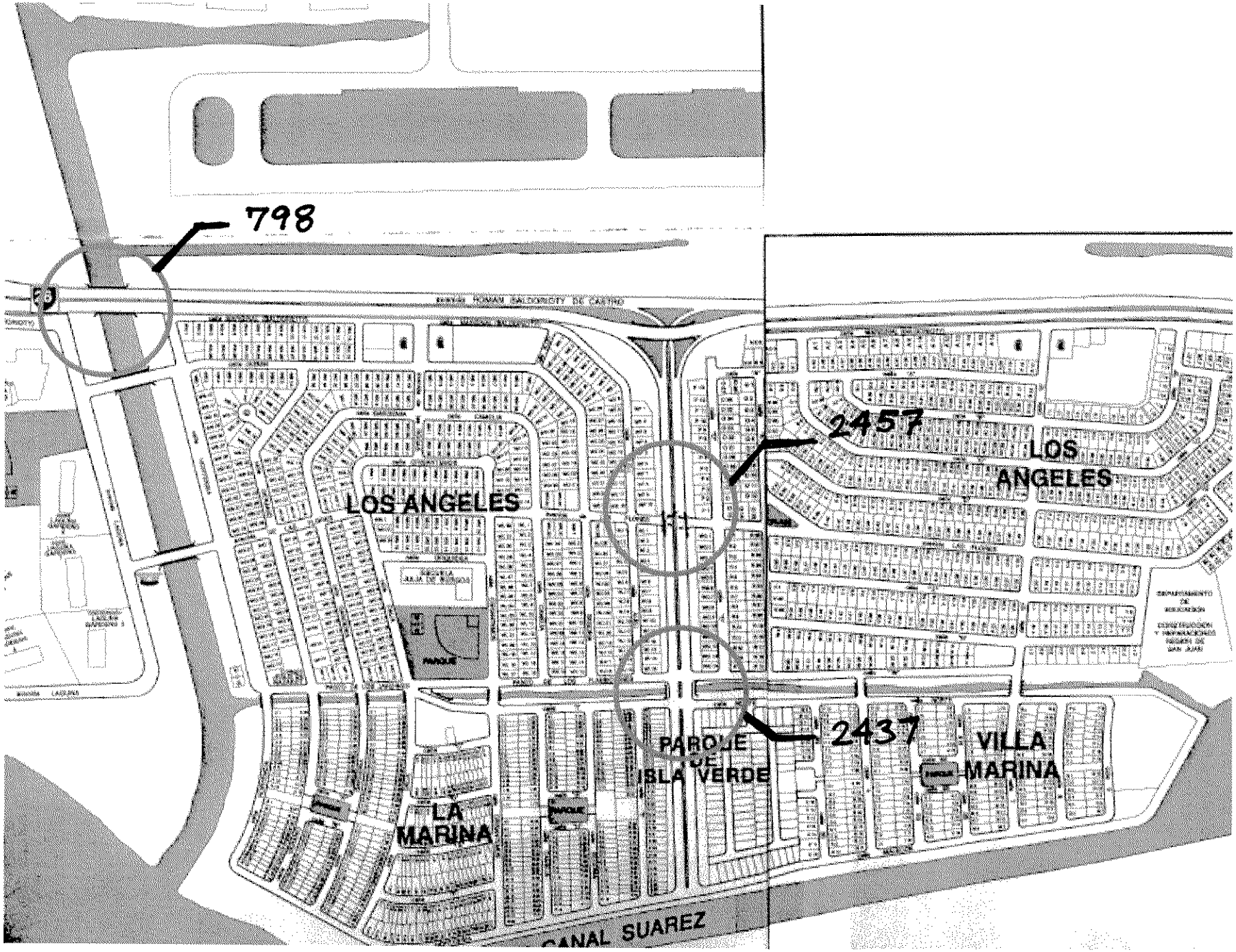
PROPOSED IMPROVEMENTS

Bridge Cost 94: $ 0
Type of Work 75: 35 Rehabilitate-gen.
Roadway Cost 95: $ 0
Length of Improvment 76: 243.10 m
Total Cost 96: $ 209,000
Future ADT 114: 133,800
Year of Cost Estimate 97: 2002
Year of Future ADT 115: 2020

NAVIGATION DATA

Navigation Control 38: N NA-no waterway
Vertical Clearance 39: 0.00 m
Horizontal Clearance 40: 0.00 m
Pier Protection 111: Unknown (NBI)
Lift Bridge Vertical Clearance 116:

ELEMENT CONDITION STATE DATA


798
2457
2437
LOS ANGELES
LOS ANGELES
PARQUE DE ISLA VERDE
VILLA MARINA
LA MARINA
CANAL SUAREZ

BRIDGE 798 (PR-26)

Puerto Rico Highway and Transportation Autho.

Bridge Engineering Office
Engineering Services Area

Structure Inventory and Appraisal Sheet

Bridge Key: 007981 Agency ID: 007981 Sufficiency Rating: 54.9

IDENTIFICATION

State 1: 72 Puerto Rico
Struc Num 8: 007981
Facility Carried 7: PR 26
Location 9: 3 KM SE OF SJ INT AIRPORT
Rte.(On/Under)5A: Route On Structure
Rte. Signing Prefix 5B: 1 Interstate Hwy
Level of Service 5C: 1 Mainline
Rte. Number 5D: 00003
Directional Suffix 5E: 0 N/A (NBI)
% Responsibility : NA
SHD District 2: 01
County Code 3: 031
Place Code 4: 14290
Kilometer Post 11: 08.3 km
Feature Intersected 6: DRAINAGE CHANNEL
Latitude 16: 18d 26' 18"
Longitude 17: 066d 00' 54"
Border Bridge Code 98: Unknown (P)
Border Bridge Number 99: Unknown

INSPECTION

Frequency 91: 24 months
Inspection Date 90: 12/1/2003
Next Inspection: 12/01/2005
FC Frequency 92A: NA
FC Inspection Date 93A: NA
Next FC Inspection: NA
UW Frequency 92B: NA
UW Inspection Date 93B: NA
Next UW Inspection: NA
SI Frequency 92C: NA
SI Date 93C: NA
Next SI: NA
Element Frequency: 24 months
Element Inspection Date: 01/01/1901
Next Elem. Insp. Due: 01/01/1901

CLASSIFICATION

Defense Highway 100: 1 On Interstate STRAHNE
Parallel Structure 101: No || bridge exists
Direction of Traffic 102: 2 2-way traffic
Temporary Structure 103: Unknown (NBI)
Highway System 104: 1 On the NHS
NBIS Length 112: Long Enough
Toll Facility 20: 3 On free road
Functional Class 26: 14 Urban Other Princ
Historical Significance 37: 5 Not eligible for NRHP
Owner 22: 01State Highway Agency
Custodian 21: 01 State Highway Agency

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0
Number of Spans Main Unit 45: 4
Main Span Material/Design 43A/B:
2 Concrete Continuous 01
Deck Type 107: 1 Concrete-Cast-in-Place
Wearing Surface 108A: 6 Bituminous
Membrane 108B: 0 None
Deck Protection 108C: None

CONDITION

Deck 58: 6 Satisfactory
Super 59: 6 Satisfactory
Sub 60: 6 Satisfactory
Culvert 62: N N/A (NBI)
Channel/Channel Protection 61: 6 Bank Slumping

LOAD RATING AND POSTING

Inventory Rating Method 65: 5 No rating
Operating Rating Method 63:5 No rating
Inventory Rating 66: MS12.5
Operating Rating 64: MS12.8
Design Load 31: 4 M 18 (H 20)
Posting 70: 5 At/Above Legal Loads
Posting status 41: A Open, no restriction

AGE AND SERVICE

Year Built 27: 1959
Year Reconstructed 106: 1996
Type of Service on 42A: 5 Highway-pedestrian
Type of Service under 42B: 5 Waterway
Lanes on 28A: 8
Lanes Under 28B: 0
Detour Length 19: 5.0 km
ADT 29: 65,700
Truck ADT 109: 2 %
Year of ADT 30: 2002

APPRAISAL

Bridge Rail 36A: 1 Meets Standards
Approach Rail 36C: 1 Meets Standards
Transition 36B: 1 Meets Standards
Approach Rail Ends 36D: 1 Meets Standards
Str. Evaluation 67: 5 Above Min Tolerable
Deck Geometry 68: 2 Intolerable - Replace
Underclearance, Vertical and Horizontal 69: N Not applicable (NBI)
Waterway Adequacy 71: 9 Above Desirable
Approach Alignment 72: 8 Equal Desirable Crit
Scour Critical 113: 7 Countermeasures

GEOMETRIC DATA

Length Max Span 48: 12.50 m
Structure Length 49: 46.60 m
Curb/Sdwlk Wdth L 50A: 0.00 m
Curb/Sidewalk Width R 50B: 4.10 m
Width Curb to Curb 51: 28.40 m
Width Out to Out 52: 34.50 m
Approach Roadway Width 32: (w/ shoulders) 29.10 m
Median 33: 1 Open median
Deck Area: 1,507.70 m²
Skew 34: 15.00 °
Structure Flared 35: 0 No flare
Minimum Vertical Clearance Over Bridge 53: 99.99 m
Minimum Vertical Underclearance Reference 54A: N Feature not hwy or RR
Minimum Vertical Underclearance 54B: 00.00 m
Minimum Lateral Underclearance Reference R 55A: N Feature not hwy or RR
Minimum Lateral Undrclearance R 55: 00.00 m
Minimum Lateral Undrclearance L 56: 00.00 m

PROPOSED IMPROVEMENTS

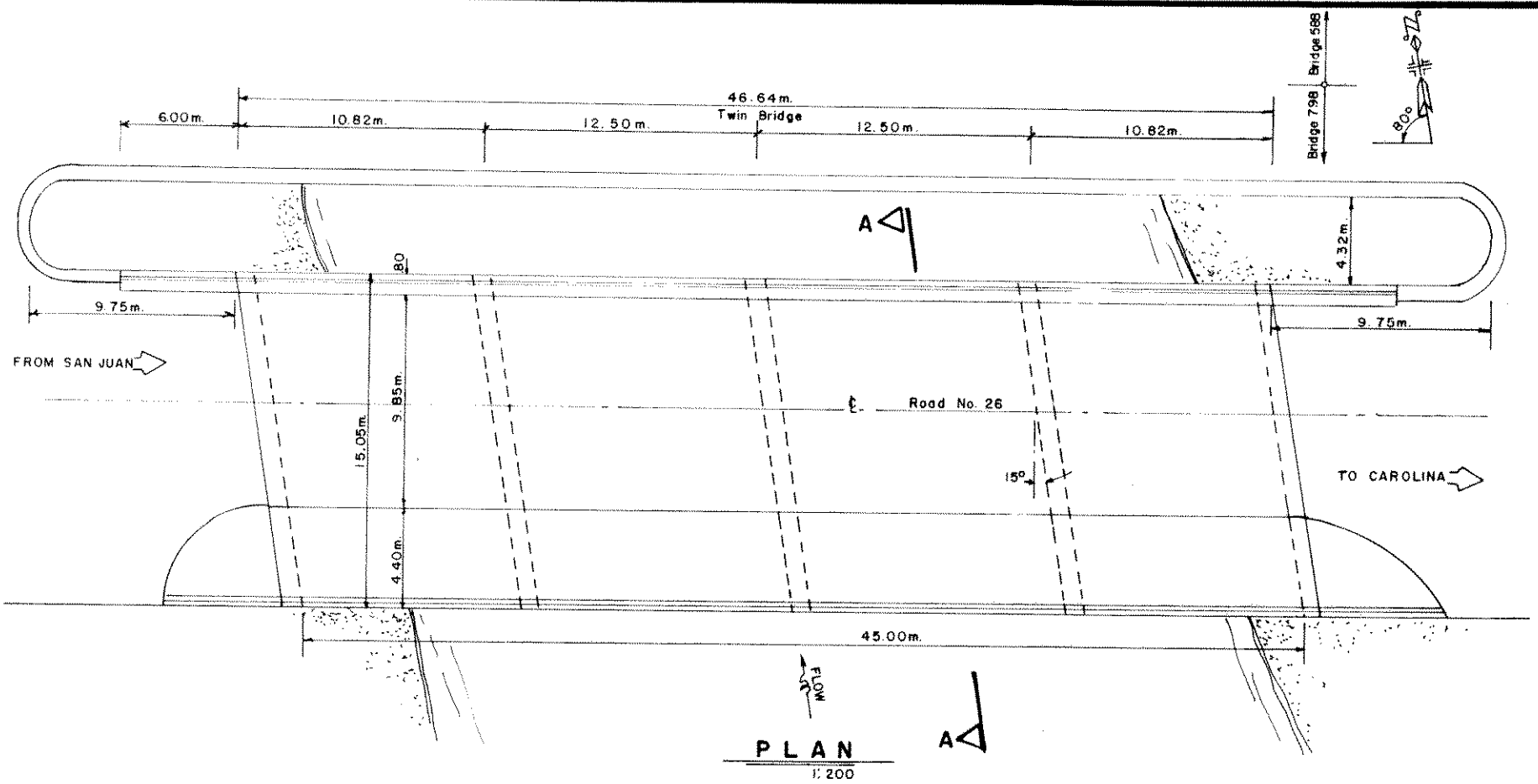
Bridge Cost 94: $ 0
Type of Work 75: 35 Rehabilitate-gen.
Roadway Cost 95: $ 0
Length of Improvment 76: 46.60 m
Total Cost 96: $ 225,000
Future ADT 114: 99,429
Year of Cost Estimate 97: 2003
Year of Future ADT 115: 2020

NAVIGATION DATA

Navigation Control 38: 0 Permit Net Required
Vertical Clearance 39: 0.00 m
Horizontal Clearance 40: 0.00 m
Pier Protection 111: Unknown (NBI)
Lift Bridge Vertical Clearance 116:

ELEMENT CONDITION STATE DATA

BRIDGE 798



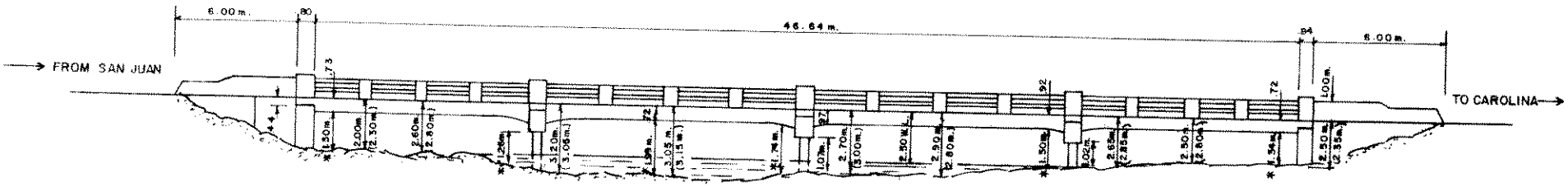
PLAN
1:200

HIGHWAY AUTHORITY
BRIDGE STUDIES AND EVALUATION OFFICE

BRIDGE OVER DRAINAGE CHANNEL
ROUTE NO. 26 KM. 8.3 CAROLINA, P.R.

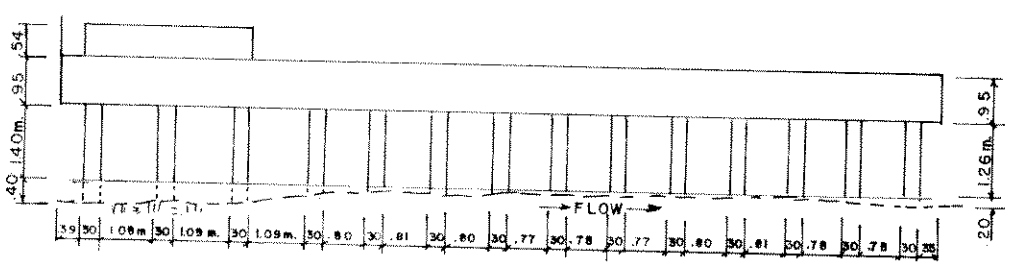
DRAWN BY	D. Monclova	AUGUST/1991	BRIDGE NO.	DRAWING NO.
CHECKED BY	E. Benitez	E. Benitez	798	1-2
APPROVED BY	Ing. R. Pizarro	R. Pizarro		

BRIDGE 798

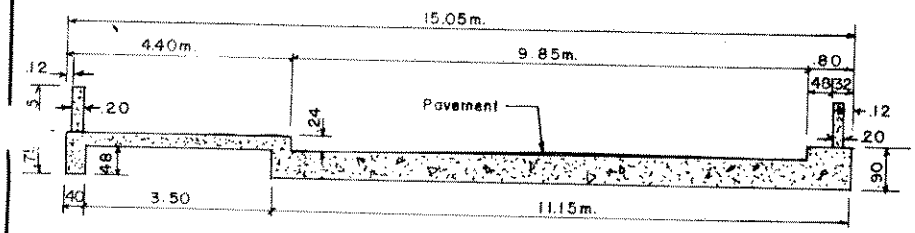


ELEVATION
1:200

NOTE:
Vertical clearence thus( ) indicates Airport site,
Lagoon site is from over. JUNE 3/1991.
Old vertical measure *.



PIER DETAIL (Loocking to San Juan)
1:100



CROSS SECTION A-A
1:100

REVISED JUNE 1991.
REVISED NOV. 1982.

HIGHWAY AUTHORITY
BRIDGE STUDIES AND EVALUATION OFFICE

BRIDGE OVER DRAINAGE CHANNEL
ROUTE NO. 26 KM. 8.3 CAROLINA, P.R.

DRAWN BY	D. Monclova	AUGUST/1991	BRIDGE NO. 798	DRAWING NO. 2-2
CHECKED BY	E. Benítez	E. Benítez		
APPROVED BY	Ing. R. Pizarro	R. Pizarro		

Puerto Rico Highway Authority

BRIDGE 2437
(LOS ANGELES AVE.)

Bridge Engineering Office
Engineering Services

Bridge Inspection Report

Bridge Key: 024371 Agency ID: 024371 Sufficiency Rating: 92.9

IDENTIFICATION

State 1: 72 Puerto Rico Struc Num 8: 024371
Facility Carried 7: LOS ANGELES AVE. Location 9: 0.7KM E. OF S.JOSE LAGOON
Rte.(On/Under)5A: Route On Structure Rte. Signing Prefix 5B: 5 City Street
Level of Service 5C: 1 Mainline Rte. Number 5D: 00000
Directional Suffix 5E: 0 N/A (NBI) % Responsibility: NA
SHD District 2: SAN JUAN County Code 3: Carolina
Place Code 4: 14290 Kilometer Post 11: 00.3 km
Feature Intersected 6: CHANNEL
Latitude 16: 18d 25' 54" Longitude 17: 066d 00' 54"
Border Bridge Code 98: Unknown (P)
Border Bridge Number 99: NA

INSPECTION

Frequency 91: 24 months Inspection Date 90: 9/26/2005 Next Inspection: 09/26/2007
FC Frequency 92A: NA FC Inspection Date 93A: NA Next FC Inspection: NA
UW Frequency 92B: NA UW Inspection Date 93B: NA Next UW Inspection: NA
SI Frequency 92C: NA SI Date 93C: NA Next SI: NA
Element Frequency: 24 months Element Inspection Date: 09/26/2005 Next Elem. Insp. Due: 09/26/2007

CLASSIFICATION

Defense Highway 100: 0 Not a STRAHNET hwy Parallel Structure 101: No || bridge exists
Direction of Traffic 102: 2 2-way traffic Temporary Structure 103: Unknown (NBI)
Highway System 104: 0 Not on NHS NBIS Length 112: Long Enough
Toll Facility 20: 3 On free road Functional Class 26: 19 Urban Local
Historical Significance 37: 5 Not eligible for NRHP
Owner 22: 04 04 City/Municipal Agenc
Custodian 21: 04 04 City/Municipal Agenc

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 1
Main Span Material/Design 43A/B:
5 Prestressed Concrete 05
Deck Type 107: 1 Concrete-Cast-in-Place
Wearing Surface 108A: 6 Bituminous
Membrane 108B: 0 None
Deck Protection 108C: None

CONDITION

Deck 58: 6 Satisfactory Super 59: 6 Satisfactory Sub 60: 7 Good
Culvert 62: N N/A (NBI) Channel/Channel Protection 61: 6 Bank Slumping

LOAD RATING AND POSTING

Inventory Rating Method 65: 2 AS Allowable Stress Operating Rating Method 63: 2 AS Allowable Stress
Inventory Rating 66: MS18.0 Operating Rating 64: MS18.0
Design Load 31: 5 MS 18 (HS 20) Posting 70: 5 At/Above Legal Loads
Posting status 41: A Open, no restriction

AGE AND SERVICE

Year Built 27: 1996 Year Reconstructed 106: Unknown
Type of Service on 42A: 5 Highway-pedestrian
Type of Service under 42B: 5 Waterway
Lanes on 28A: 6 Lanes Under 28B: 0 Detour Length 19: 02 km
ADT 29: 800 Truck ADT 109: 2 % Year of ADT 30: 2002

APPRAISAL

Bridge Rail 36A: 0 Substandard Approach Rail 36C: 0 Substandard
Transition 36B: 0 Substandard Approach Rail Ends 36D: 0 Substandard
Str. Evaluation 67: 6 Equal Min Criteria Deck Geometry 68: 3 Intolerable - Correct
Underclearance, Vertical and Horizontal 69: N Not applicable (NBI)
Waterway Adequacy 71: 8 Equal Desirable Approach Alignment 72: 8 Equal Desirable Crit
Scour Critical 113: 8 Stable Above Footing

GEOMETRIC DATA

Length Max Span 48: 7.70 m Structure Length 49: 9.50 m
Curb/Sdwlk Wdth L 50A: 2.50 m Curb/Sidewalk Width R 50B: 2.50 m
Width Curb to Curb 51: 22.00 m Width Out to Out 52: 31.90 m
Approach Roadway Width 32: (w/ shoulders) 22.00 m Median 33: 2 Closed Med w/o Barrier
Deck Area: 303.05 m²
Skew 34: 0.00 ° Structure Flared 35: 0 No flare
Minimum Vertical Clearance Over Bridge 53: 99.99 m
Minimum Vertical Underclearance Reference 54A: N Feature not hwy or RR
Minimum Vertical Underclearance 54B: 00.00 m
Minimum Lateral Underclearance Reference R 55A: N Feature not hwy or RR
Minimum Lateral Undrclearance R 55: 00.00 m
Minimum Lateral Undrclearance L 56: 00.00 m

PROPOSED IMPROVEMENTS

Bridge Cost 94: $ 0 Type of Work 75: Unknown (P)
Roadway Cost 95: $ 0 Length of Improvment 76:
Total Cost 96: $ 0 Future ADT 114: 850
Year of Cost Estimate 97: 2005 Year of Future ADT 115: 2020

NAVIGATION DATA

Navigation Control 38: 0 Permit Not Required
Vertical Clearance 39: 0.00 m Horizontal Clearance 40: 0.00 m
Pier Protection 111: 1 Not Required Lift Bridge Vertical Clearance 116:

ELEMENT CONDITION STATE DATA

Str Unit	Elm/Env	Description	Units	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4	% in 5	Qty. St. 5
2	13/3	Unp Conc Deck/AC Ovl	sq.m.	304	0 %	0	100 %	304	0 %	0	0 %	0	0 %	0
2	104/3	P/S Conc Box Girder	m.	249	100 %	248	0 %	1	0 %	0	0 %	0	0 %	0
2	215/3	R/Conc Abutment	m.	36	100 %	36	0 %	0	0 %	0	0 %	0	0 %	0
2	302/3	Compressn Joint Seal	m	44	0 %	0	100 %	44	0 %	0	0 %	0	0 %	0
2	310/3	Elastomeric Bearing	ea.	64	100 %	64	0 %	0	0 %	0	0 %	0	0 %	0
2	331/3	Conc Bridge Railing	m	29	93 %	27	7 %	2	0 %	0	0 %	0	0 %	0

Bridge Inspection Report

Str Unit	Elm/Env	Description	Units	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4	% in 5	Qty. St. 5
2	359/3	Soffit Smart Flag	ea.	1	100 %	1	0 %	0	0 %	0	0 %	0	0 %	0

Str Unit	Elem/Env	Description	Element Notes
2	13/3	Concrete Deck - Unprotected w/ AC	ROUGH ASPHALT AND SMALL SPALLINGS ON SOUTHBOUND LANES.
2	104/3	P/S Conc Closed Web/Box Girder	SMALL SPALLING NEAR BY ABUTMENT PR 26
2	215/3	Reinforced Conc Abutment	PILES LIGHTLY EXPOSED BY LOOSE OF EMBANKMENT MATERIAL
2	302/3	Compression Joint Seal	LOOSE ANDGULAR JOINT ON NORTH MEMBER PRODUCE AN UNDESIRABLE IMPACT AND LEAKAGE
2	310/3	Elastomeric Bearing	
2	331/3	Reinforced Conc Bridge Railing	
2	359/3	Soffit of Concrete Deck or Slab	

BRIDGE NOTES

THE MEDIAN IS LOWEST LEVEL THAN THE ROADWAY ELEVATION (MONTABLE). SOME GROWTH RESTRICTING THE CHANNEL FLOW.

PAST INSPECTION

Inspection Date: 09/26/2005 Type: 1 Regular NBI

Inspector: Pontis Pontis User Key: Pontis - Pontis Po

Scope:

NBI: ☑ Other: ☐ Element: ☑

Underwater: ☐ Fracture Critical: ☐

INSPECTION NOTES

CREW: MAYRA I. ZAYAS-EIT, AT LOPEZ, JC OTERO, JL VIERA

Bridge Inspection Report

PAST INSPECTION

Inspection Date: 05/01/2003 Type: 1 Regular NBI

Inspector: -1 Pontis User Key: Pontis - Pontis Po

Scope:

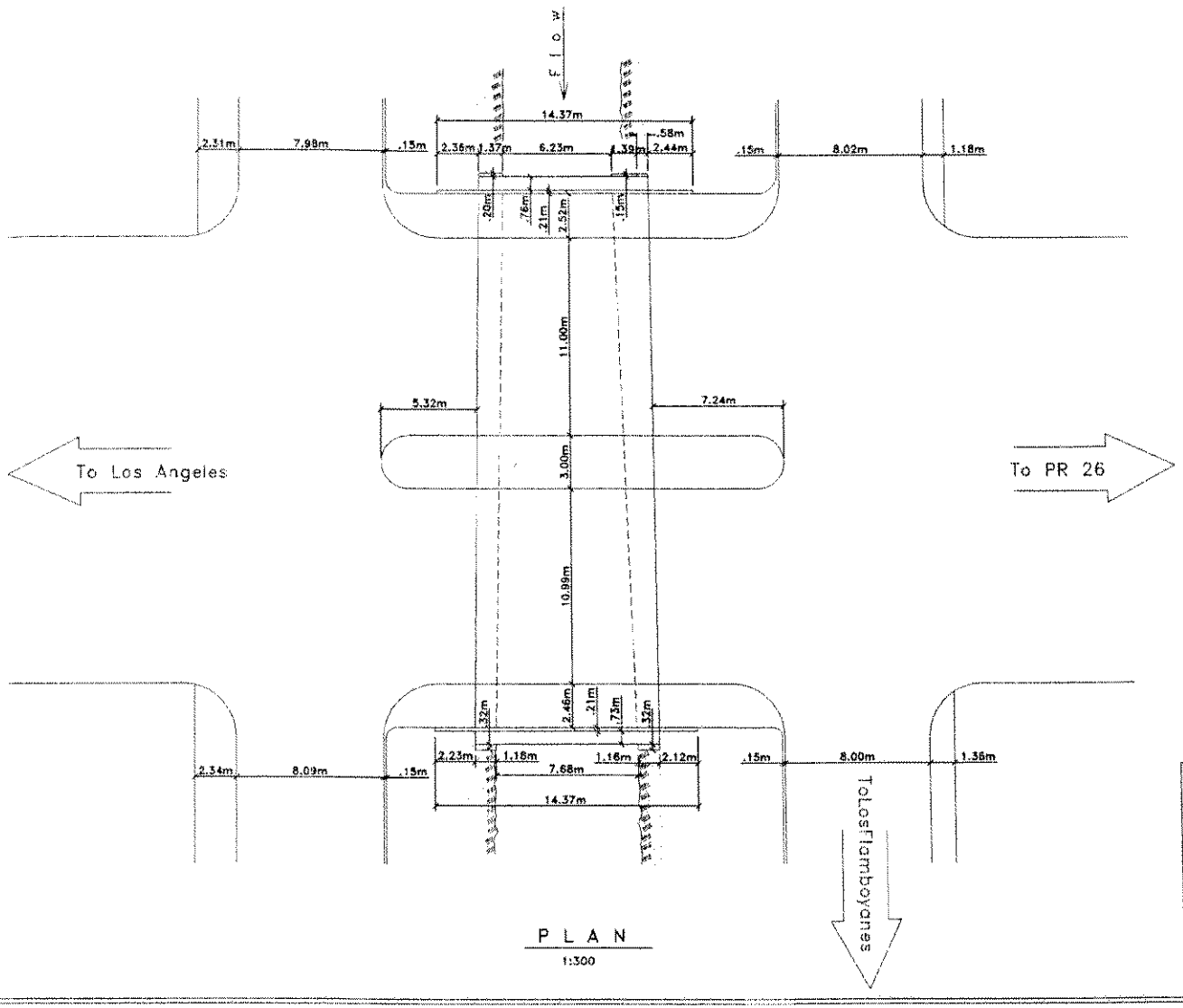
NBI: ☑ Other: ☐ Element:

Underwater: ☐ Fracture Critical: ☐

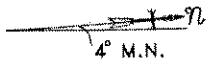
INSPECTION NOTES

INSPECTOR WORK CANDIDATES

BRIDGE 2437

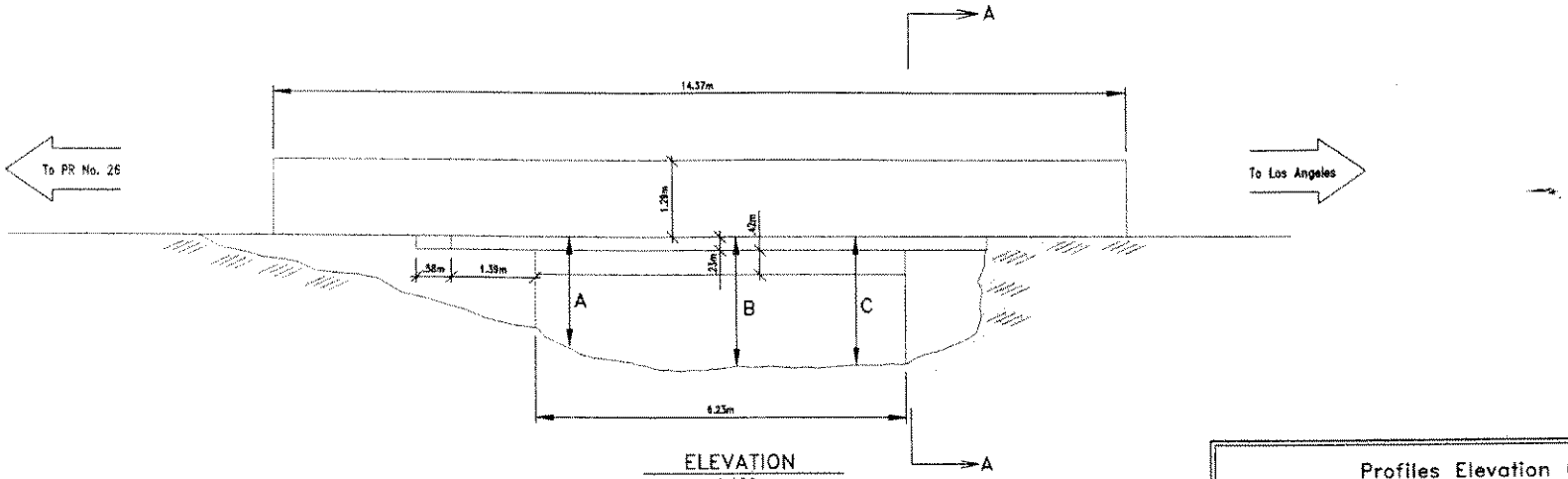


PLAN
1:300

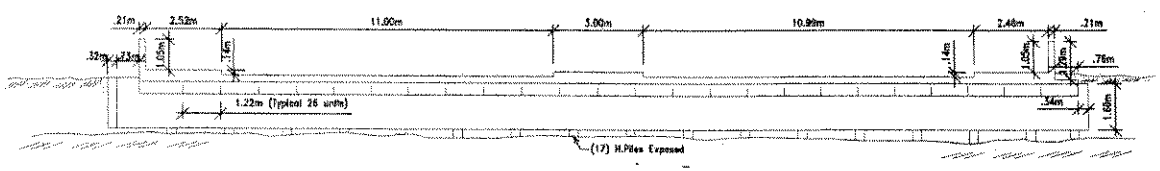


HIGHWAY AND TRANSPORTATION AUTHORITY BRIDGE AND STUDIES EVALUATION OFFICE				
BRIDGE OVER CHANNEL LOS ANGELES AVE., Km.0.30, CAROLINA, P.R.				
DRAWING BY:	C.Garcia	May 2000	BRIDGE NO.	DRAWING NO.
CHECKED BY:	M.Villafañe		2437	1/2
APPROVED BY:	Ing. R. Pizarro			
REVISED:	NEW			
DWG. NAME:	D:\DRAWINGS\2437B01.0.dwg		PLOTTING SCALE 1=0.30	

BRIDGE 2437



ELEVATION
1:100



SECTION A–A
1:200

Profiles Elevation Chart

Inspection Date	Up Stream A	Up Stream B	Up Stream C	Down Stream A	Down Stream B	Down Stream C	Water Deep
Apr. 1996	1.72	2.13	1.96	1.56	3.61	2.19	.35
June 1998	1.60	1.80	1.80	1.40	1.80	1.80	—

HIGHWAY AND TRANSPORTATION AUTHORITY
BRIDGE AND STUDIES EVALUATION OFFICE

BRIDGE OVER CHANNEL
LOS ANGELES AVE. Km. 0.30, CAROLINA, P.R.

DRAWING BY:	C. GARCIA	MAY 2000	BRIDGE NO.	DRAWING NO.
CHECKED BY:	M.VILLAFAÑE		2437	2/2
APPROVED BY:	Ing. R. Pizarro			
REVISED:	NEW			
DWG. NAME:	D:\DRAWINGS\2437B02.0.dwg		PLOTTING SCALE 1=0.20	

Puerto Rico Highway Authority

BRIDGE 2457
(LOS ANGELES AVE.)

Bridge Engineering Office
Engineering Services

Bridge Inspection Report

Bridge Key: 024571 Agency ID: 024571 Sufficiency Rating: 99.0

IDENTIFICATION

State 1: 72 Puerto Rico Struc Num 8: 024571
Facility Carried 7: LOS ANGELES AVENUE Location 9: 0 5 KM.E. SAN JOSE LAGOON
Rte.(On/Under)5A: Route On Structure Rte. Signing Prefix 5B: 3 State Hwy
Level of Service 5C: 1 Mainline Rte. Number 5D: 00000
Directional Suffix 5E: 0 N/A (NBI) % Responsibility : NA
SHD District 2: SAN JUAN County Code 3: Carolina
Place Code 4: 14290 Kilometer Post 11: 00.2 km
Feature Intersected 6: LAS FLORES STREET
Latitude 16: 18d 25' 48" Longitude 17: 066d 07' 00"
Border Bridge Code 98: Unknown (P)
Border Bridge Number 99: NA

INSPECTION

Frequency 91: 24 months Inspection Date 90: 9/26/2005 Next Inspection: 09/16/2007
FC Frequency 92A: NA FC Inspection Date 93A: NA Next FC Inspection: NA
UW Frequency 92B: NA UW Inspection Date 93B: NA Next UW Inspection: NA
SI Frequency 92C: NA SI Date 93C: NA Next SI: NA
Element Frequency: 24 months Element Inspection Date: 09/26/2005 Next Elem. Insp Due: 09/16/2007

CLASSIFICATION

Defense Highway 100: 0 Not a STRAHNET hwy Parallel Structure 101: No || bridge exists
Direction of Traffic 102: 2 2-way traffic Temporary Structure 103: Unknown (NBI)
Highway System 104: 0 Not on NHS NBIS Length 112: Long Enough
Toll Facility 20: 3 On free road Functional Class 26: 17 Urban Collector
Historical Significance 37: 5 Not eligible for NRHP
Owner 22: 04 04 City/Municipal Agenc
Custodian 21: 04 04 City/Municipal Agenc

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 1
Main Span Material/Design 43A/B:
5 Prestressed Concrete 06
Deck Type 107: 2 Concrete Precast Panel
Wearing Surface 108A: 6 Bituminous
Membrane 108B: 0 None
Deck Protection 108C: None

CONDITION

Deck 58: 5 Fair Super 59: 6 Satisfactory Sub 60: 7 Good
Culvert 62: N N/A (NBI) Channel/Channel Protection 61: N N/A (NBI)

LOAD RATING AND POSTING

Inventory Rating Method 65: 2 AS Allowable Stress Operating Rating Method 63: 2 AS Allowable Stress
Inventory Rating 66: MS18.0 Operating Rating 64: MS18.0
Design Load 31: 5 MS 18 (HS 20) Posting 70: 5 At/Above Legal Loads
Posting status 41: A Open, no restriction

AGE AND SERVICE

Year Built 27: 1996 Year Reconstructed 106: Unknown
Type of Service on 42A: 1 Highway
Type of Service under 42B: 1 Highway
Lanes on 28A: 6 Lanes Under 28B: 2 Detour Length 19: 00 km
ADT 29: 6,800 Truck ADT 109: 5 % Year of ADT 30: 2002

APPRAISAL

Bridge Rail 36A: 1 Meets Standards Approach Rail 36C: 1 Meets Standards
Transition 36B: 1 Meets Standards Approach Rail Ends 36D: 1 Meets Standards
Str. Evaluation 67: 7 Above Min Criteria Deck Geometry 68: 7 Above Min Criteria
Underclearance, Vertical and Horizontal 69: 6 Equal Minimum
Waterway Adequacy 71: N Not applicable Approach Alignment 72: 8 Equal Desirable Crit
Scour Critical 113: N Not Over Waterway

GEOMETRIC DATA

Length Max Span 48: 14.40 m Structure Length 49: 16.40 m
Curb/Sdwlk Wdth L 50A: 0.00 m Curb/Sidewalk Width R 50B: 0.00 m
Width Curb to Curb 51: 27.50 m Width Out to Out 52: 29.50 m
Approach Roadway Width 32: (w/ shoulders) 28.10 m Median 33: 2 Closed Med w/o Barrier
Deck Area: 483.80 m²
Skew 34: 6.00 ° Structure Flared 35: 0 No flare
Minimum Vertical Clearance Over Bridge 53: 99.99 m
Minimum Vertical Underclearance Reference 54A: H Hwy beneath struct
Minimum Vertical Underclearance 54B: 04.60 m
Minimum Lateral Underclearance Reference R 55A: H Hwy beneath struct
Minimum Lateral Undrclearance R 55: 03.10 m
Minimum Lateral Undrclearance L 56: 03.20 m

PROPOSED IMPROVEMENTS

Bridge Cost 94: $ 0 Type of Work 75: 35 Rehabilitate-gen.
Roadway Cost 95: $ 0 Length of Improvment 76: 16.40 m
Total Cost 96: $ 53,000 Future ADT 114: 10,950
Year of Cost Estimate 97: 2003 Year of Future ADT 115: 2020

NAVIGATION DATA

Navigation Control 38: 0 Permit Not Required
Vertical Clearance 39: 0.00 m Horizontal Clearance 40: 0.00 m
Pier Protection 111: Not Applicable (P) Lift Bridge Vertical Clearance 116:

ELEMENT CONDITION STATE DATA

Str Unit	Elm/Env	Description	Units	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4	% in 5	Qty. St. 5
2	13/3	Unp Conc Deck/AC Ovl	sq.m.	332	0 %	0	100 %	332	0 %	0	0 %	0	0 %	0
2	104/3	P/S Conc Box Girder	m.	376	100 %	376	0 %	0	0 %	0	0 %	0	0 %	0
2	205/3	R/Conc Column	ea.	20	100 %	20	0 %	0	0 %	0	0 %	0	0 %	0
2	234/3	R/Conc Cap	m.	59	100 %	59	0 %	0	0 %	0	0 %	0	0 %	0
2	302/3	Compressn Joint Seal	m.	59	0 %	0	75 %	44	25 %	15	0 %	0	0 %	0
2	310/3	Elastomeric Bearing	ea.	2	100 %	2	0 %	0	0 %	0	0 %	0	0 %	0

Bridge Inspection Report

Str Unit	Elm/Env	Description	Units	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4	% in 5	Qty. St. 5
2	321/3	R/Conc Approach Slab	ea.	4	100 %	4	0 %	0	0 %	0	0 %	0	0 %	0
2	331/3	Conc Bridge Railing	m	134	100 %	134	0 %	0	0 %	0	0 %	0	0 %	0

Str Unit	Elem/Env	Description	Element Notes
2	13/3	Concrete Deck - Unprotected w/ A	ROUGH ASPHALT WEARING SURFACE, EXPOSED AGGREGATE AND SOME SPALLINGS ON LANES TOWARD LOS ANGELES.
2	104/3	P/S Conc Closed Web/Box Girder	LEAKAGE BETWEEN BOX BEAM MEMBER JOINTS AND EFFLORECENCE, LARGE SPALLING ON BEAM #8.
2	205/3	Reinforced Conc Column or Pile E	HORIZONTAL AND VERTICAL CRACKS ON BOTH ABUTMENTS.FUTURE SPALLINGS.
2	234/3	Reinforced Conc Cap	
2	302/3	Compression Joint Seal	LEAKAGE AT JOINTS.
2	310/3	Elastomeric Bearing	
2	321/3	Reinforced Conc Approach Slab w	
2	331/3	Reinforced Conc Bridge Railing	

BRIDGE NOTES

PAST INSPECTION

Inspection Date: 09/26/2005 Type: 1 Regular NBI

Inspector: Pontis Pontis User Key: Pontis - Pontis Poı

Scope:

NBI: ✓ Other: ☐ Element: ✓

Underwater: ☐ Fracture Critical: ☐

INSPECTION NOTES

crew: MAYRA I. ZAYAS-EIT, AT LOPEZ, JC OTERO, JL VIERA

Bridge Inspection Report

PAST INSPECTION

Inspection Date: 12/01/2003 Type: 1 Regular NBI

Inspector: -1 Pontis User Key: Pontis - Pontis Po

Scope:

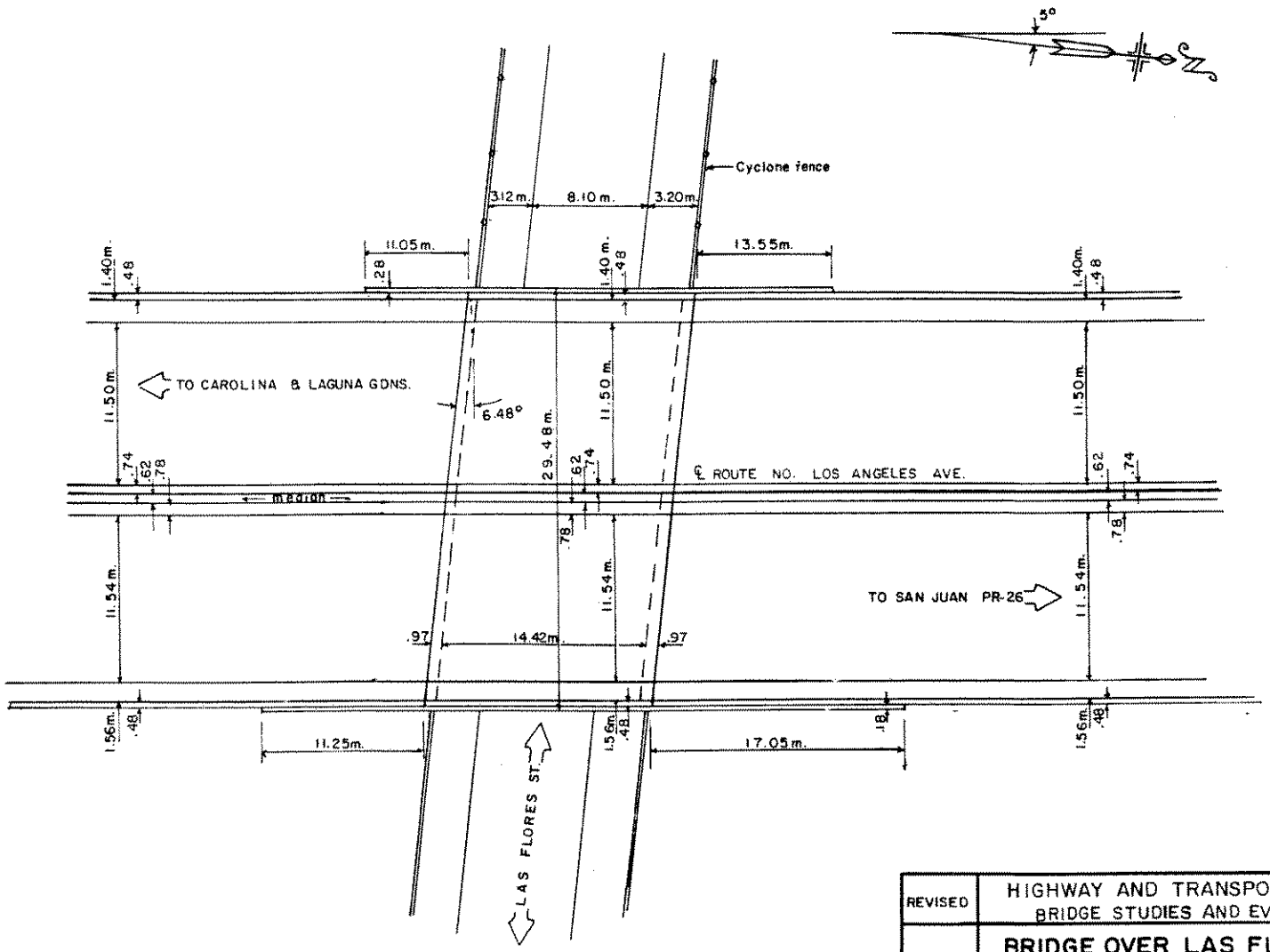
NBI: ☑ Other: Element: ☐

Underwater: ☐ Fracture Critical:

INSPECTION NOTES

INSPECTOR WORK CANDIDATES

BRIDGE 2457

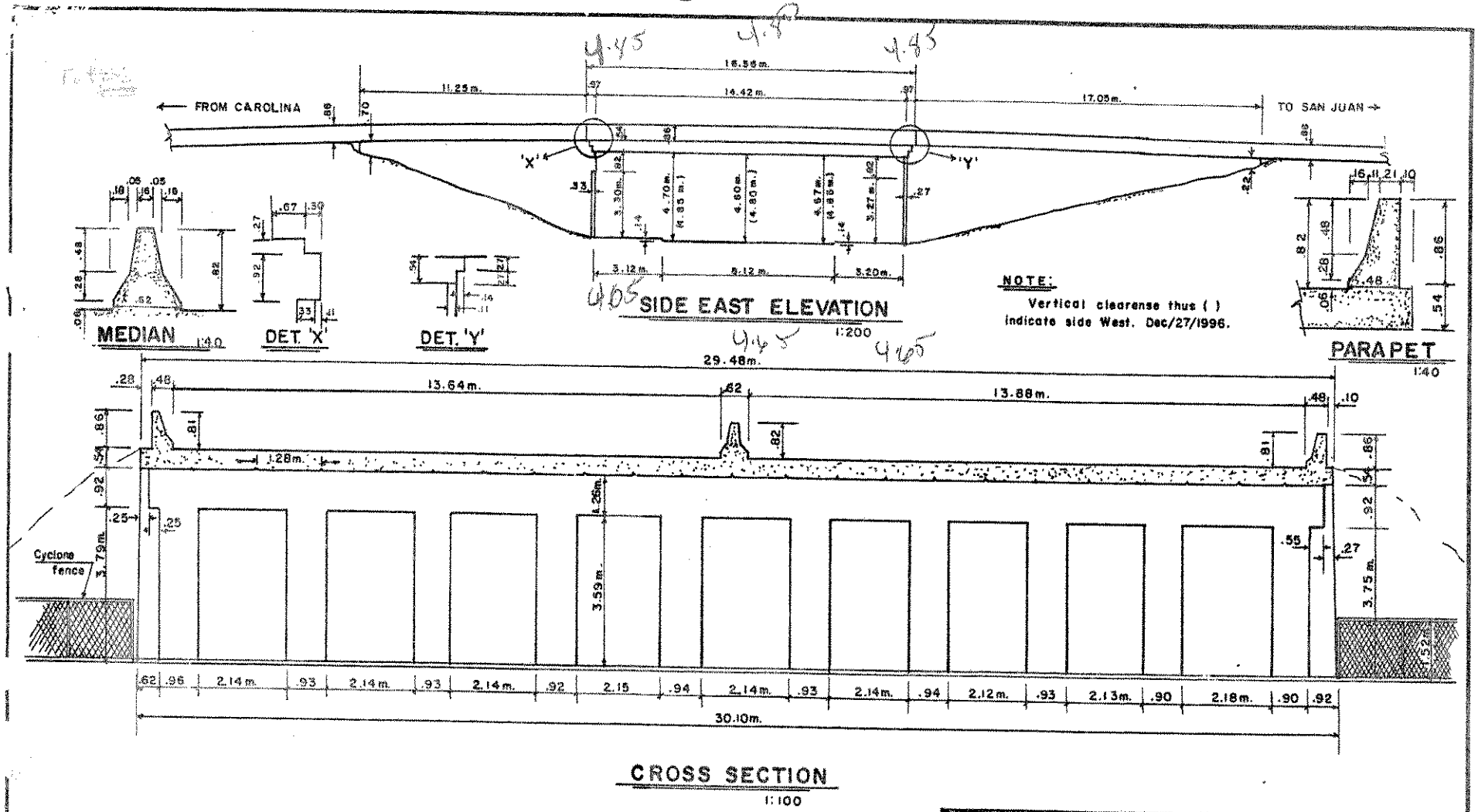


PLAN

1:33 1/3

REVISED	HIGHWAY AND TRANSPORTATION AUTHORITY BRIDGE STUDIES AND EVALUATION OFFICE				
	BRIDGE OVER LAS FLORES STREET LOS ANGELES AVE. Km. 0.2 CAROLINA, P.R.				
	DRAWN BY	D. Monclova	JANUARY 1998	BRIDGE NO.	DRAWING NO.
	CHECKED BY			2457	1-2
	APPROVED BY	Ing. R. Pizarro			

BRIDGE 2457



REVISED	HIGHWAY AND TRANSPORTATION AUTHORITY BRIDGE STUDIES AND EVALUATION OFFICE				
	BRIDGE OVER LAS FLORES STREET LOS ANGELES AVE. Km. 0.2 CAROLINA, P.R.				
	DRAWN BY	O. Monclova	JANUARY 1998	BRIDGE NO.	DRAWING NO.
	CHECKED BY			2457	2-2
	APPROVED BY	Ing. R. Pizarro			

GOBERNADORES AVE.
OVER PR 26

YourState Department of Transportation

Bureau of Bridges and Structures
Bridge Maintenance

Bridge Inspection Report

Bridge Key: 023721 Agency ID: 023721 Sufficiency Rating: 89.0

IDENTIFICATION

State 1:	72 Puerto Rico	Struc Num 8:	023721
Facility Carried 7:	PR 187	Location 9:	10 KM NW OF CAROLINA
Rte.(On/Under)5A:	Route On Structure	Rte. Signing Prefix 5B:	3 State Hwy
Level of Service 5C:	1 Mainline	Rte. Number 5D:	00187
Directional Suffix 5E:	0 N/A (NBI)	% Responsibility :	NA
SHD District 2:	SAN JUAN	County Code 3:	Carolina
Place Code 4:	14290	Kilometer Post 11:	00.0 km
Feature Intersected 6:	PR 26		
Latitude 16:	18d 26' 42"	Longitude 17:	066d 01' 30"
Border Bridge Code 98:	Unknown (P)		
Border Bridge Number 99:	NA		

INSPECTION

Frequency 91:	24 months	Inspection Date 90:	1/1/2002	Next Inspection	01/01/2004
FC Frequency 92A:	NA	FC Inspection Date 93A:	NA	Next FC Inspection	NA
UW Frequency 92B:	NA	UW Inspection Date 93B:	NA	Next UW Inspection	NA
SI Frequency 92C:	NA	SI Date 93C:	NA	Next SI:	NA
Element Frequency:	24 months	Element Inspection Date:	01/01/1901	Next Elem. Insp. Due	01/01/1901

CLASSIFICATION

Defense Highway 100:	1 STRAHNET hwy	Parallel Structure 101:	No || bridge exists
Direction of Traffic 102:	2 2-way traffic	Temporary Structure 103:	Unknown (NBI)
Highway System 104:	0 Not on NHS	NBIS Length 112:	Long Enough
Toll Facility 20:	3 On free road	Functional Class 26:	16 Urban Minor Arterial
Historical Significance 37:	5 Not eligible for NRHP		
Owner 22:	0101 State Highway Agency		
Custodian 21:	01 01 State Highway Agency		

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 3

Main Span Material/Design 43A/B:

5 Prestressed Concrete 02

Deck Type 107:	1 Concrete-Cast-in-Place
Wearing Surface 108A:	1 Monolithic Concrete
Membrane 108B:	0 None
Deck Protection 108C:	None

CONDITION

Deck 58:	7 Good	Super 59:	7 Good	Sub 60:	7 Good
Culvert 62:	N N/A (NBI)	Channel/Channel Protection 61:	N N/A (NBI)		

LOAD RATING AND POSTING

Inventory Rating Method 65: 2 AS Allowable Stress Operating Rating Method 63: 2 AS Allowable Stress

Inventory Rating 66:	MS18.0	Operating Rating 64:	MS18.0
Design Load 31:	5 MS 18 (HS 20)	Posting 70:	5 At/Above Legal Loads
Posting status 41:	A Open, no restriction		

AGE AND SERVICE

Year Built 27:	1994	Year Reconstructed 106:	Unknown
Type of Service on 42A:	1 Highway		
Type of Service under 42B:	1 Highway		
Lanes on 28A: 4	Lanes Under 28B: 11	Detour Length 19:	00 km
ADT 29: 42,300	Truck ADT 109: 5 %	Year of ADT 30:	2002

APPRAISAL

Bridge Rail 36A:	1 Meets Standards	Approach Rail 36C:	1 Meets Standards
Transition 36B:	1 Meets Standards	Approach Rail Ends 36D:	1 Meets Standards
Str. Evaluation 67:	7 Above Min Criteria	Deck Geometry 68:	9 Above Desirable Crit
Underclearance, Vertical and Horizontal 69:	3 Intolerable - Correct		
Waterway Adequacy 71:	N Not applicable	Approach Alignment 72:	8 Equal Desirable Crit
Scour Critical 113:	N Not Over Waterway		

GEOMETRIC DATA

Length Max Span 48:	28.10 m	Structure Length 49:	87.00 m
Curb/Sdwlk Wdth L 50A:	0.00 m	Curb/Sidewalk Width R 50B:	0.00 m
Width Curb to Curb 51:	21.30 m	Width Out to Out 52:	28.30 m
Approach Roadway Width 32: (w/ shoulders)	27.30 m	Median 33:	2 Closed Med w/o Barrier
Deck Area:	2,462.10 m²		
Skew 34:	8.00 °	Structure Flared 35:	0 No flare
Minimum Vertical Clearance Over Bridge 53:	99.99 m		
Minimum Vertical Underclearance Reference 54A:	H Hwy beneath struct		
Minimum Vertical Underclearance 54B:	05.15 m		
Minimum Lateral Underclearance Reference R 55A:	H Hwy beneath struct		
Minimum Lateral Undrclearance R 55:	00.90 m		
Minimum Lateral Undrclearance L 56:	00.30 m		

PROPOSED IMPROVEMENTS

Bridge Cost 94:	$ 0	Type of Work 75:	Unknown (P)
Roadway Cost 95:	$ 0	Length of Improvment 76:	00.00 m
Total Cost 96:	$ 0	Future ADT 114:	47,799
Year of Cost Estimate 97:	2002	Year of Future ADT 115:	2020

NAVIGATION DATA

Navigation Control 38:	N NA-no waterway		
Vertical Clearance 39:	0.00 m	Horizontal Clearance 40:	0.00 m
Pier Protection 111:	Unknown (NBI)	Lift Bridge Vertical Clearance 116:	

ELEMENT CONDITION STATE DATA

BRIDGE NOTES

TEODORO MOSCOSO BRIDGE
OVER SAN JOSE LAGOON

Bridge Inspection Report

Bridge Key: 023321 Agency ID: 023321 Sufficiency Rating: 80.0

IDENTIFICATION

State 1: 72 Puerto Rico Struc Num 8: 023321
Facility Carried 7: PR 17 (PIMERO AV.) Location 9 8 KM N W OF CAROLINA
Rte.(On/Under)5A: Route On Structure Rte. Signing Prefix 5B: 8 Other (incl toll r
Level of Service 5C: 1 Mainline Rte. Number 5D: 00017
Directional Suffix 5E: 0 N/A (NBI) % Responsibility : NA
SHD District 2: SAN JUAN County Code 3: Carolina
Place Code 4: 14290 Kilometer Post 11: 10.0 km
Feature Intersected 6: PR 8, SAN JOSE LAGOON
Latitude 16: 18d 25' 30" Longitude 17: 066d 01' 30"
Border Bridge Code 98: Not Applicable (P)
Border Bridge Number 99: NA

INSPECTION

Frequency 91: 24 months Inspection Date 90: 5/17/2005 Next Inspection: 05/17/2007
FC Frequency 92A: NA FC Inspection Date 93A: NA Next FC Inspection: NA
UW Frequency 92B: 24 months UW Inspection Date 93B: 5/17/2005 Next UW Inspection: 5/17/2007
SI Frequency 92C: NA SI Date 93C: NA Next SI: NA
Element Frequency: 24 months Element Inspection Date: 05/17/2005 Next Elem. Insp. Due: 05/17/2007

CLASSIFICATION

Defense Highway 100: 0 Not a STRAHNET hwy Parallel Structure 101: No || bridge exists
Direction of Traffic 102: 2 2-way traffic Temporary Structure 103: Not Applicable (P)
Highway System 104: 0 Not on NHS NBIS Length 112: Long Enough
Toll Facility 20: 1 Toll bridge Functional Class 26: 12 Urban Fwy/Expwy
Historical Significance 37: 5 Not eligible for NRHP
Owner 22: 01 01 State Highway Agency
Custodian 21: 01 01 State Highway Agency

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 79
Main Span Material/Design 43A/B:
5 Prestressed Concrete 02
Deck Type 107: 2 Concrete Precast Panel
Wearing Surface 108A: 1 Monolithic Concrete
Membrane 108B: 0 None
Deck Protection 108C: None

CONDITION

Deck 58: 7 Good Super 59: 7 Good Sub 60: 8 Very Good
Culvert 62: N N/A (NBI) Channel/Channel Protection 61: 9 No Deficiencies

LOAD RATING AND POSTING

Inventory Rating Method 65: 1 LF Load Factor Operating Rating Method 63:1 LF Load Factor
Inventory Rating 66: MS18.0 Operating Rating 64: MS18.0
Design Load 31: 5 MS 18 (HS 20) Posting 70: 5 At/Above Legal Loads
Posting status 41: A Open, no restriction

AGE AND SERVICE

Year Built 27: 1994 Year Reconstructed 106: 0
Type of Service on 42A: 1 Highway
Type of Service under 42B: 6 Highway-waterway
Lanes on 28A: 4 Lanes Under 28B: 4 Detour Length 19: 14 km
ADT 29: 24,000 Truck ADT 109: 5 % Year of ADT 30: 2002

APPRAISAL

Bridge Rail 36A: 1 Meets Standards Approach Rail 36C: 1 Meets Standards
Transition 36B: 1 Meets Standards Approach Rail Ends 36D: 1 Meets Standards
Str. Evaluation 67: 7 Above Min Criteria Deck Geometry 68: 9 Above Desirable Crit
Underclearance, Vertical and Horizontal 69: 6 Equal Minimum
Waterway Adequacy 71: 9 Above Desirable Approach Alignment 72: 8 Equal Desirable Crit
Scour Critical 113: 8 Stable Above Footing

GEOMETRIC DATA

Length Max Span 48: 30.20 m Structure Length 49: 2,245.38 m
Curb/Sdwlk Width L 50A: 0.00 m Curb/Sidewalk Width R 50B: 0.00 m
Width Curb to Curb 51: 23.20 m Width Out to Out 52: 24.10 m
Approach Roadway Width 32: (w/ shoulders) 42.30 m Median 33: 3 Closed Med w/Barriers
Deck Area: 61,155.00 m²
Skew 34: 9.00 ° Structure Flared 35: 1 Yes, flared
Minimum Vertical Clearance Over Bridge 53: 99.99 m
Minimum Vertical Underclearance Reference 54A: H Hwy beneath struct
Minimum Vertical Underclearance 54B: 05.94 m
Minimum Lateral Underclearance Reference R 55A: H Hwy beneath struct
Minimum Lateral Undrclearance R 55: 04.10 m
Minimum Lateral Undrclearance L 56: 01.00 m

PROPOSED IMPROVEMENTS

Bridge Cost 94: $ 0 Type of Work 75: 35 Rehabilitate-gen.
Roadway Cost 95: $ 0 Length of Improvment 76: 2,245.38 m
Total Cost 96: $ 756,648 Future ADT 114: 30,000
Year of Cost Estimate 97: 2005 Year of Future ADT 115: 2020

NAVIGATION DATA

Navigation Control 38: 0 Permit Not Required
Vertical Clearance 39: 0.00 m Horizontal Clearance 40: 0.00 m
Pier Protection 111: 2 In-Place, Functioning Lift Bridge Vertical Clearance 116: 0.00 m

ELEMENT CONDITION STATE DATA

Str Unit	Elm/Env	Description	Units	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4	% in 5	Qty. St. 5
2	12/3	Bare Concrete Deck	sq.m.	61,155	100 %	61,155	0 %	0	0 %	0	0 %	0	0 %	0
2	109/3	P/S Conc Open Girder	m.	21,084	100 %	21,084	0 %	0	0 %	0	0 %	0	0 %	0
2	215/3	R/Conc Abutment	m.	99	100 %	99	0 %	0	0 %	0	0 %	0	0 %	0
2	225/3	Unpnt Stl Submd Pile	ea.	475	100 %	475	0 %	0	0 %	0	0 %	0	0 %	0
2	234/3	R/Conc Cap	m.	2,131	100 %	2,131	0 %	0	0 %	0	0 %	0	0 %	0
2	302/3	Compressn Joint Seal	m.	444	100 %	444	0 %	0	0 %	0	0 %	0	0 %	0

PR17 BRIDGE OVER PR 26

Puerto Rico Highway Authority

Bridge Engineering Office
Engineering Services

Bridge Inspection Report

Bridge Key: 023311 Agency ID: 023311 Sufficiency Rating: 89.0

IDENTIFICATION

State 1: 72 Puerto Rico Struc Num 8: 023311
Facility Carried 7: PR 17 (PIÑERO AVE) Location 9: 9 KMS. NW. OF CAROLINA
Rte.(On/Under)5A: Route On Structure Rte. Signing Prefix 5B: 3 State Hwy
Level of Service 5C: 1 Mainline Rte. Number 5D: 00017
Directional Suffix 5E: 0 N/A (NBI) % Responsibility : NA
SHD District 2: 01 County Code 3: 031
Place Code 4: 14290 Kilometer Post 11: 13.0 km
Feature Intersected 6: PR 26 (BALDORIOTY AVE.)
Latitude 16: 18d 26' 18" Longitude 17: 066d 01' 18"
Border Bridge Code 99: Unknown (P)
Border Bridge Number 99: Unknown

INSPECTION

Frequency 91: 24 months Inspection Date 90: 8/8/2005 Next Inspection: 08/08/2007
FC Frequency 92A: NA FC Inspection Date 93A: NA Next FC Inspection: NA
UW Frequency 92B: NA UW Inspection Date 93B: NA Next UW Inspection: NA
SI Frequency 92C: NA SI Date 93C: NA Next SI: NA
Element Frequency: 24 months Element Inspection Date: 08/08/2005 Next Elem. Insp. Due: 08/08/2007

CLASSIFICATION

Defense Highway 100: 2 On Non-Interstate STRA Parallel Structure 101: No || bridge exists
Direction of Traffic 102: 2 2-way traffic Temporary Structure 103: Unknown (NBI)
Highway System 104: 0 Not on NHS NBIS Length 112: Long Enough
Toll Facility 20: 3 On free road Functional Class 26: 14 Urban Other Princ
Historical Significance 37: 5 Not eligible for NRHP
Owner 22: 01 State Highway Agency
Custodian 21: 01 State Highway Agency

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 4
Main Span Material/Design 43A/B:
5 Prestressed Concrete 02
Deck Type 107: 2 Concrete Precast Panel
Wearing Surface 108A: 1 Monolithic Concrete
Membrane 108B: 0 None
Deck Protection 108C: None

CONDITION

Deck 58: 6 Satisfactory Super 59: 7 Good Sub 60: 7 Good
Culvert 62: N N/A (NBI) Channel/Channel Protection 61: N N/A (NBI)

LOAD RATING AND POSTING

Inventory Rating Method 65: 2 AS Allowable Stress Operating Rating Method 63: 2 AS Allowable Stress
Inventory Rating 66: MS18.0 Operating Rating 64: MS18.0
Design Load 31: 5 MS 18 (HS 20) Posting 70: 5 At/Above Legal Loads
Posting status 41: A Open, no restriction

AGE AND SERVICE

Year Built 27: 1994 Year Reconstructed 106: Unknown
Type of Service on 42A: 1 Highway
Type of Service under 42B: 1 Highway
Lanes on 28A: 6 Lanes Under 28B: 12 Detour Length 19: 0.0 km
ADT 29: 23,800 Truck ADT 109: 5 % Year of ADT 30: 2002

APPRAISAL

Bridge Rail 36A: 1 Meets Standards Approach Rail 36C: 1 Meets Standards
Transition 36B: 1 Meets Standards Approach Rail Ends 36D: 1 Meets Standards
Str. Evaluation 67: 7 Above Min Criteria Deck Geometry 68: 7 Above Min Criteria
Underclearance, Vertical and Horizontal 69: 3 Intolerable - Correct
Waterway Adequacy 71: N Not applicable Approach Alignment 72: 8 Equal Desirable Crit
Scour Critical 113: N Not Over Waterway

GEOMETRIC DATA

Length Max Span 48: 25.20 m Structure Length 49: 101.70 m
Curb/Sdwlk Wdth L 50A: 0.00 m Curb/Sidewalk Width R 50B: 0.00 m
Width Curb to Curb 51: 27.20 m Width Out to Out 52: 29.10 m
Approach Roadway Width 32: (w/ shoulders) 28.80 m Median 33: 3 Closed Med w/Barriers
Deck Area: 2,959.47 m²
Skew 34: 0.00 ° Structure Flared 35: 0 No flare
Minimum Vertical Clearance Over Bridge 53: 99.99 m
Minimum Vertical Underclearance Reference 54A: H Hwy beneath struct
Minimum Vertical Underclearance 54B: 04.94 m
Minimum Lateral Underclearance Reference R 55A: H Hwy beneath struct
Minimum Lateral Undrclearance R 55: 01.00 m
Minimum Lateral Undrclearance L 56: 04.90 m

PROPOSED IMPROVEMENTS

Bridge Cost 94: $ 0 Type of Work 75: Not Applicable (P)
Roadway Cost 95: $ 0 Length of Improvment 76:
Total Cost 96: $ 0 Future ADT 114: 31,178
Year of Cost Estimate 97: 2002 Year of Future ADT 115: 2020

NAVIGATION DATA

Navigation Control 38: Unknown (NBI)
Vertical Clearance 39: Horizontal Clearance 40:
Pier Protection 111: Not Applicable (P) Lift Bridge Vertical Clearance 116:

ELEMENT CONDITION STATE DATA

Str Unit	Elm/Env	Description	Units	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4	% in 5	Qty. St. 5
1	12/1	Bare Concrete Deck	sq.m.	1	100 %	1	0 %	0	0 %	0	0 %	0	0 %	0
1	109/3	P/S Conc Open Girder	m.	1,016	100 %	1,016	0 %	0	0 %	0	0 %	0	0 %	0
1	202/1	Paint Stl Column	ea.	21	100 %	21	0 %	0	0 %	0	0 %	0	0 %	0
1	215/3	R/Conc Abutment	m.	74	100 %	74	0 %	0	0 %	0	0 %	0	0 %	0
1	234/3	R/Conc Cap	m.	87	100 %	87	0 %	0	0 %	0	0 %	0	0 %	0
1	303/3	Assembly Joint/Seal	m.	55	100 %	55	0 %	0	0 %	0	0 %	0	0 %	0

PR 26 ENTRANCE TO
Los Angeles

Puerto Rico Highway and Transportation Autho

Bridge Engineering Office
Engineering Services Area

Structure Inventory and Appraisal Sheet

Bridge Key: 024581 Agency ID: 024581 Sufficiency Rating: 69.8

IDENTIFICATION

State 1:	72 Puerto Rico	Struc Num 8:	024581
Facility Carried 7:	PR 26	Location 9:	3.7 KMS OF CAROLINA
Rte.(On/Under)5A:	Route On Structure	Rte. Signing Prefix 5B:	1 Interstate Hwy
Level of Service 5C:	1 Mainline	Rte. Number 5D:	00003
Directional Suffix 5E:	0 N/A (NBI)	% Responsibility :	NA
SHD District 2:	01	County Code 3:	031
Place Code 4:	14290	Kilometer Post 11:	09.0 km
Feature Intersected 6:	LOS ANGELES AVENUE		
Latitude 16:	18d 26' 18"	Longitude 17:	066d 06' 48"
Border Bridge Code 98:	Unknown (P)		
Border Bridge Number 99:	Unknown		

INSPECTION

Frequency 91:	24 months	Inspection Date 90:	8/1/2005	Next Inspection:	08/01/2007
FC Frequency 92A:	NA	FC Inspection Date 93A:	NA	Next FC Inspection:	NA
UW Frequency 92B:	NA	UW Inspection Date 93B:	NA	Next UW Inspection:	NA
SI Frequency 92C:	NA	SI Date 93C:	NA	Next SI:	NA
Element Frequency:	24 months	Element Inspection Date:	01/01/1901	Next Elem. Insp. Due:	01/01/1901

CLASSIFICATION

Defense Highway 100:	1 On Interstate STRAHNE	Parallel Structure 101:	No || bridge exists
Direction of Traffic 102:	1 1-way traffic	Temporary Structure 103:	Unknown (NBI)
Highway System 104:	1 On the NHS	NBIS Length 112:	Long Enough
Toll Facility 20:	3 On free road	Functional Class 26:	11 Urban Interstate
Historical Significance 37:	5 Not eligible for NRHP		
Owner 22:	01 State Highway Agency		
Custodian 21:	01 State Highway Agency		

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 12

Main Span Material/Design 43A/B:

5 Prestressed Concrete 02

Deck Type 107:	1 Concrete-Cast-in-Place
Wearing Surface 108A:	1 Monolithic Concrete
Membrane 108B:	0 None
Deck Protection 108C:	None

CONDITION

Deck 58:	3 Serious	Super 59:	7 Good	Sub 60:	7 Good
Culvert 62:	N N/A (NBI)	Channel/Channel Protection 61:	N N/A (NBI)		

LOAD RATING AND POSTING

Inventory Rating Method 65:	1 LF Load Factor	Operating Rating Method 63:	1 LF Load Factor
Inventory Rating 66:	MS17.6	Operating Rating 64:	MS29.5
Design Load 31:	5 MS 18 (HS 20)	Posting 70:	5 At/Above Legal Loads
Posting status 41:	A Open, no restriction		

AGE AND SERVICE

Year Built 27:	1996	Year Reconstructed 106:	Unknown
Type of Service on 42A:	1 Highway		
Type of Service under 42B:	1 Highway		
Lanes on 28A: 4	Lanes Under 28B: 2	Detour Length 19:	0.0 km
ADT 29: 111,500	Truck ADT 109: 5 %	Year of ADT 30:	2002

APPRAISAL

Bridge Rail 36A:	1 Meets Standards	Approach Rail 36C:	1 Meets Standards
Transition 36B:	1 Meets Standards	Approach Rail Ends 36D:	1 Meets Standards
Str. Evaluation 67:	7 Above Min Criteria	Deck Geometry 68:	2 Intolerable - Replace
Underclearance, Vertical and Horizontal 69:	3 Intolerable - Correct		
Waterway Adequacy 71:	N Not applicable	Approach Alignment 72:	8 Equal Desirable Crit
Scour Critical 113:	N Not Over Waterway		

GEOMETRIC DATA

Length Max Span 48:	26.10 m	Structure Length 49:	243.10 m
Curb/Sdwlk Wdth L 50A:	0.00 m	Curb/Sidewalk Width R 50B:	0.00 m
Width Curb to Curb 51:	14.20 m	Width Out to Out 52:	15.30 m
Approach Roadway Width 32: (w/ shoulders)	15.60 m	Median 33:	0 No median
Deck Area:	3,719.43 m²		
Skew 34:	13.00 °	Structure Flared 35:	0 No flare
Minimum Vertical Clearance Over Bridge 53:		99.99 m	
Minimum Vertical Underclearance Reference 54A:		H Hwy beneath struct	
Minimum Vertical Underclearance 54B:		05.23 m	
Minimum Lateral Underclearance Reference R 55A:		H Hwy beneath struct	
Minimum Lateral Undrclearance R 55:		00.40 m	
Minimum Lateral Undrclearance L 56:		00.50 m	

PROPOSED IMPROVEMENTS

Bridge Cost 94:	$ 0	Type of Work 75:	35 Rehabilitate-gen.
Roadway Cost 95:	$ 0	Length of Improvment 76:	243.10 m
Total Cost 96:	$ 209,000	Future ADT 114:	133,800
Year of Cost Estimate 97:	2002	Year of Future ADT 115:	2020

NAVIGATION DATA

Navigation Control 38:	N NA-no waterway		
Vertical Clearance 39:	0.00 m	Horizontal Clearance 40:	0.00 m
Pier Protection 111:	Unknown (NBI)	Lift Bridge Vertical Clearance 116:	

ELEMENT CONDITION STATE DATA

CAMPO RICO AVENUE
OVER LOIZA EXPWY

Puerto Rico Highway and Transportation Autho.

Bridge Engineering Office
Engineering Services Area

Structure Inventory and Appraisal Sheet

Bridge Key: 009991 Agency ID: 009991 Sufficiency Rating: 66.8

IDENTIFICATION

State 1:	72 Puerto Rico	Struc Num 6:	009991
Facility Carried 7:	CAMPO RICO AVENUE	Location 9:	4.5 KM N W OF CAROLINA
Rte.(On/Under)5A:	Route On Structure	Rte. Signing Prefix 5B:	5 City Street
Level of Service 5C:	0 None of the below	Rte. Number 5D:	00000
Directional Suffix 5E:	0 N/A (NBI)	% Responsibility :	NA
SHD District 2:	01	County Code 3:	031
Place Code 4:	14290	Kilometer Post 11:	02.6 km
Feature Intersected 6:	PR 26		
Latitude 16:	18d 24' 54"	Longitude 17:	065d 59' 12"
Border Bridge Code 98:	Unknown (P)		
Border Bridge Number 99:	Unknown		

INSPECTION

Frequency 91:	24 months	Inspection Date 90:	1/1/2004	Next Inspection:	01/01/2006
FC Frequency 92A:	NA	FC Inspection Date 93A:	NA	Next FC Inspection:	NA
UW Frequency 92B:	NA	UW Inspection Date 93B:	NA	Next UW Inspection:	NA
SI Frequency 92C:	NA	SI Date 93C:	NA	Next SI:	NA
Element Frequency:	24 months	Element Inspection Date:	01/01/1901	Next Elem. Insp. Due:	01/01/1901

CLASSIFICATION

Defense Highway 100:	0 Not a STRAHNET hwy	Parallel Structure 101:	No || bridge exists
Direction of Traffic 102:	2 2-way traffic	Temporary Structure 103:	Unknown (NBI)
Highway System 104:	0 Not on NHS	NBIS Length 112:	Long Enough
Toll Facility 20:	3 On free road	Functional Class 26:	16 Urban Minor Arterial
Historical Significance 37:	5 Not eligible for NRHP		
Owner 22:	01 State Highway Agency		
Custodian 21:	01 State Highway Agency		

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 3

Main Span Material/Design 43A/B:

5 Prestressed Concrete 02

Deck Type 107:	1 Concrete-Cast-in-Place
Wearing Surface 108A:	1 Monolithic Concrete
Membrane 108B:	0 None
Deck Protection 108C:	None

CONDITION

Deck 58:	5 Fair	Super 59:	5 Fair	Sub 60:	6 Satisfactory
Culvert 62:	N N/A (NBI)	Channel/Channel Protection 61:	N N/A (NBI)		

LOAD RATING AND POSTING

Inventory Rating Method 65:	1 LF Load Factor	Operating Rating Method 63:	1 LF Load Factor
Inventory Rating 66:	MS12.8	Operating Rating 64:	MS21.5
Design Load 31:	4 M 18 (H 20)	Posting 70:	4 0.1-9.9%below
Posting status 41:	B Posting Recommended		

AGE AND SERVICE

Year Built 27:	1965	Year Reconstructed 106:	Unknown
Type of Service on 42A:	5 Highway-pedestrian		
Type of Service under 42B:	1 Highway		
Lanes on 28A: 5	Lanes Under 28B: 8	Detour Length 19:	0.0 km
ADT 29: 34,900	Truck ADT 109: 4 %	Year of ADT 30:	2002

APPRAISAL

Bridge Rail 36A:	1 Meets Standards	Approach Rail 36C:	1 Meets Standards
Transition 36B:	0 Substandard	Approach Rail Ends 36D:	0 Substandard
Str. Evaluation 67:	5 Above Min Tolerable	Deck Geometry 68:	4 Tolerable
Underclearance, Vertical and Horizontal 69:	3 Intolerable - Correct		
Waterway Adequacy 71:	N Not applicable	Approach Alignment 72:	8 Equal Desirable Crit
Scour Critical 113:	N Not Over Waterway		

GEOMETRIC DATA

Length Max Span 48:	24.80 m	Structure Length 49:	62.20 m
Curb/Sdwlk Wdth L 50A:	1.60 m	Curb/Sidewalk Width R 50B:	1.50 m
Width Curb to Curb 51:	19.50 m	Width Out to Out 52:	26.30 m
Approach Roadway Width 32: (w/ shoulders)	22.50 m	Median 33:	2 Closed Med w/o Barrier
Deck Area: 1,635.86 m²			
Skew 34: 2.00 °	Structure Flared 35:	0 No flare	
Minimum Vertical Clearance Over Bridge 53:		99.99 m	
Minimum Vertical Underclearance Reference 54A:		H Hwy beneath struct	
Minimum Vertical Underclearance 54B:		04.43 m	
Minimum Lateral Underclearance Reference R 55A:		H Hwy beneath struct	
Minimum Lateral Undrclearance R 55:		02.90 m	
Minimum Lateral Undrclearance L 56:		02.50 m	

PROPOSED IMPROVEMENTS

Bridge Cost 94:	$ 0	Type of Work 75:	35 Rehabilitate-gen.
Roadway Cost 95:	$ 0	Length of Improvment 76:	62.20 m
Total Cost 96:	$ 97,000	Future ADT 114:	58,500
Year of Cost Estimate 97:	2001	Year of Future ADT 115:	2019

NAVIGATION DATA

Navigation Control 38:	N NA-no waterway		
Vertical Clearance 39:	0.00 m	Horizontal Clearance 40:	0.00 m
Pier Protection 111:	Unknown (NBI)	Lift Bridge Vertical Clearance 116:	

ELEMENT CONDITION STATE DATA

AVE. FRAGOSO OVER BLASINA CHANNEL

Puerto Rico Highway and Transportation Autho.

Bridge Engineering Office
Engineering Services Area

Structure Inventory and Appraisal Sheet

Bridge Key: 020741 Agency ID: 020741 Sufficiency Rating: 76.2

IDENTIFICATION

State 1:	72 Puerto Rico	Struc Num 8:	020741
Facility Carried 7:	FRAGOSO AVENUE	Location 9:	AT EAST OF PLAZA CAROLINA
Rte.(On/Under)5A:	Route On Structure	Rte. Signing Prefix 5B:	5 City Street
Level of Service 5C:	0 None of the below	Rte. Number 5D:	00000
Directional Suffix 5E:	0 N/A (NBI)	% Responsibility :	NA
SHD District 2:	01	County Code 3:	031
Place Code 4:	14290	Kilometer Post 11:	01.0 km
Feature Intersected 6:	BLASINA CREEK		
Latitude 16:	18d 23' 42"	Longitude 17:	065d 58' 24"
Border Bridge Code 98:	Unknown (P)		
Border Bridge Number 99:	Unknown		

INSPECTION

Frequency 91:	24 months	Inspection Date 90:	1/1/2004	Next Inspection:	01/01/2006
FC Frequency 92A:	NA	FC Inspection Date 93A:	NA	Next FC Inspection:	NA
UW Frequency 92B:	NA	UW Inspection Date 93B:	NA	Next UW Inspection:	NA
SI Frequency 92C:	NA	SI Date 93C:	NA	Next SI:	NA
Element Frequency:	24 months	Element Inspection Date:	01/01/1901	Next Elem. Insp. Due:	01/01/1901

CLASSIFICATION

Defense Highway 100:	0 Not a STRAHNET hwy	Parallel Structure 101:	No || bridge exists
Direction of Traffic 102:	2 2-way traffic	Temporary Structure 103:	Unknown (NBI)
Highway System 104:	0 Not on NHS	NBIS Length 112:	Long Enough
Toll Facility 20:	3 On free road	Functional Class 26:	17 Urban Collector
Historical Significance 37:	5 Not eligible for NRHP		
Owner 22:	01 State Highway Agency		
Custodian 21:	01 State Highway Agency		

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 3

Main Span Material/Design 43A/B:

5 Prestressed Concrete 02

Deck Type 107:	1 Concrete-Cast-in-Place
Wearing Surface 108A:	1 Monolithic Concrete
Membrane 108B:	0 None
Deck Protection 108C:	None

CONDITION

Deck 58:	7 Good	Super 59:	6 Satisfactory	Sub 60:	7 Good
Culvert 62:	N N/A (NBI)	Channel/Channel Protection 61:	7 Minor Damage		

LOAD RATING AND POSTING

Inventory Rating Method 65: 2 AS Allowable Stress Operating Rating Method 63:2 AS Allowable Stress

Inventory Rating 66:	MS18.0	Operating Rating 64:	MS18.0
Design Load 31:	5 MS 18 (HS 20)	Posting 70:	5 At/Above Legal Loads
Posting status 41:	A Open, no restriction		

AGE AND SERVICE

Year Built 27:	1978	Year Reconstructed 106:	Unknown
Type of Service on 42A:	5 Highway-pedestrian		
Type of Service under 42B:	5 Waterway		
Lanes on 28A: 4	Lanes Under 28B: 0	Detour Length 19:	2.0 km
ADT 29: 23,600	Truck ADT 109: 4 %	Year of ADT 30:	2002

APPRAISAL

Bridge Rail 36A:	1 Meets Standards	Approach Rail 36C:	0 Substandard
Transition 36B:	0 Substandard	Approach Rail Ends 36D:	0 Substandard
Str. Evaluation 67:	6 Equal Min Criteria	Deck Geometry 68:	2 Intolerable - Replace
Underclearance, Vertical and Horizontal 69:	N Not applicable (NBI)		
Waterway Adequacy 71:	9 Above Desirable	Approach Alignment 72:	8 Equal Desirable Crit
Scour Critical 113:	4 Stable, needs action		

GEOMETRIC DATA

Length Max Span 48:	21.70 m	Structure Length 49:	63.70 m
Curb/Sdwlk Wdth L 50A:	1.80 m	Curb/Sidewalk Width R 50B:	1.60 m
Width Curb to Curb 51:	14.50 m	Width Out to Out 52:	18.50 m
Approach Roadway Width 32: (w/ shoulders)	14.50 m	Median 33:	0 No median
Deck Area:	1,178.45 m²		
Skew 34:	36.00 °	Structure Flared 35:	0 No flare
Minimum Vertical Clearance Over Bridge 53:		99.99 m	
Minimum Vertical Underclearance Reference 54A:		N Feature not hwy or RR	
Minimum Vertical Underclearance 54B:		00.00 m	
Minimum Lateral Underclearance Reference R 55A:		N Feature not hwy or RR	
Minimum Lateral Undrclearance R 55:		00.00 m	
Minimum Lateral Undrclearance L 56:		00.00 m	

PROPOSED IMPROVEMENTS

Bridge Cost 94:	$ 0	Type of Work 75:	35 Rehabilitate-gen.
Roadway Cost 95:	$ 0	Length of Improvement 76:	63.70 m
Total Cost 96:	$ 112,000	Future ADT 114:	26,600
Year of Cost Estimate 97:	2001	Year of Future ADT 115:	2020

NAVIGATION DATA

Navigation Control 38:	0 Permit Not Required		
Vertical Clearance 39:	0.00 m	Horizontal Clearance 40:	0.00 m
Pier Protection 111:	Unknown (NBI)	Lift Bridge Vertical Clearance 116:	

ELEMENT CONDITION STATE DATA

AVE. DR SANCHEZ CASTAÑO OVER BLASINA EAST

Puerto Rico Highway Authority

Bridge Engineering Office
Engineering Services

Bridge Inspection Report

Bridge Key: 020731 Agency ID: 020731 Sufficiency Rating: 77.7

IDENTIFICATION

State 1:	72 Puerto Rico	Struc Num 8	020731
Facility Carried 7:	~~DR SANCHEZ CASTAÑO~~	Location 9:	PLAZA CAROLINA EAST SIDE
Rte.(On/Under)5A:	Route On Structure	Rte. Signing Prefix 5B:	5 City Street
Level of Service 5C:	0 None of the below	Rte Number 5D:	00000
Directional Suffix 5E:	0 N/A (NBI)	% Responsibility :	NA
SHD District 2:	SAN JUAN	County Code 3:	Carolina
Place Code 4:	14290	Kilometer Post 11:	00.4 km
Feature Intersected 6:	BLASINA CREEK		
Latitude 16:	18d 23' 36"	Longitude 17:	065d 58' 18"
Border Bridge Code 98:	Unknown (P)		
Border Bridge Number 99:	NA		

INSPECTION

Frequency 91:	24 months	Inspection Date 90:	9/16/2005	Next Inspection	09/16/2007
FC Frequency 92A:	NA	FC Inspection Date 93A:	NA	Next FC Inspection	NA
UW Frequency 92B:	NA	UW Inspection Date 93B:	NA	Next UW Inspection	NA
SI Frequency 92C:	NA	SI Date 93C:	NA	Next SI	NA
Element Frequency:	24 months	Element Inspection Date:	09/16/2005	Next Elem. Insp Due:	09/16/2007

CLASSIFICATION

Defense Highway 100:	0 Not a STRAHNET hwy	Parallel Structure 101:	No || bridge exists
Direction of Traffic 102:	2 2-way traffic	Temporary Structure 103:	Unknown (NBI)
Highway System 104:	0 Not on NHS	NBIS Length 112:	Long Enough
Toll Facility 20:	3 On free road	Functional Class 26:	19 Urban Local
Historical Significance 37:	5 Not eligible for NRHP		
Owner 22:	04 04 City/Municipal Agenc		
Custodian 21:	04 04 City/Municipal Agenc		

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 1

Main Span Material/Design 43A/B:

5 Prestressed Concrete 02

Deck Type 107:	1 Concrete-Cast-in-Place
Wearing Surface 108A:	1 Monolithic Concrete
Membrane 108B:	8 Unknown
Deck Protection 108C:	8 Unknown

CONDITION

Deck 58:	6 Satisfactory	Super 59:	6 Satisfactory	Sub 60:	6 Satisfactory
Culvert 62:	N N/A (NBI)	Channel/Channel Protection 61:	6 Bank Slumping		

LOAD RATING AND POSTING

Inventory Rating Method 65: 2 AS Allowable Stress Operating Rating Method 63:2 AS Allowable Stress

Inventory Rating 66:	MS18.0	Operating Rating 64:	MS18.0
Design Load 31:	5 MS 18 (HS 20)	Posting 70:	5 At/Above Legal Loads
Posting status 41:	A Open, no restriction		

AGE AND SERVICE

Year Built 27:	1977	Year Reconstructed 106:	Unknown
Type of Service on 42A:	5 Highway-pedestrian		
Type of Service under 42B:	5 Waterway		
Lanes on 28A: 4	Lanes Under 28B: 0	Detour Length 19:	05 km
ADT 29: 11,000	Truck ADT 109: 4 %	Year of ADT 30:	2002

APPRAISAL

Bridge Rail 36A:	1 Meets Standards	Approach Rail 36C:	1 Meets Standards
Transition 36B:	1 Meets Standards	Approach Rail Ends 36D:	1 Meets Standards
Str. Evaluation 67:	6 Equal Min Criteria	Deck Geometry 68:	2 Intolerable - Replace
Underclearance, Vertical and Horizontal 69:	N Not applicable (NBI)		
Waterway Adequacy 71:	8 Equal Desirable	Approach Alignment 72:	8 Equal Desirable Crit
Scour Critical 113:	8 Stable Above Footing		

GEOMETRIC DATA

Length Max Span 48:	16.40 m	Structure Length 49:	17.80 m
Curb/Sdwlk Wdth L 50A:	1.40 m	Curb/Sidewalk Width R 50B:	1.40 m
Width Curb to Curb 51:	14.60 m	Width Out to Out 52:	18.50 m
Approach Roadway Width 32: (w/ shoulders)	14.60 m	Median 33:	0 No median
Deck Area:	329.30 m²		
Skew 34:	5.00 °	Structure Flared 35:	0 No flare
Minimum Vertical Clearance Over Bridge 53:		99.99 m	
Minimum Vertical Underclearance Reference 54A:		N Feature not hwy or RR	
Minimum Vertical Underclearance 54B:		00.00 m	
Minimum Lateral Underclearance Reference R 55A:		N Feature not hwy or RR	
Minimum Lateral Undrclearance R 55:		00.00 m	
Minimum Lateral Undrclearance L 56:		00.00 m	

PROPOSED IMPROVEMENTS

Bridge Cost 94:	$ 0	Type of Work 75:	36 Rehab Deck
Roadway Cost 95:	$ 0	Length of Improvment 76:	17.80 m
Total Cost 96:	$ 43,000	Future ADT 114:	15,000
Year of Cost Estimate 97:	2005	Year of Future ADT 115:	2020

NAVIGATION DATA

Navigation Control 38:	0 Permit Not Required		
Vertical Clearance 39:	0.00 m	Horizontal Clearance 40:	0.00 m
Pier Protection 111:	1 Not Required	Lift Bridge Vertical Clearance 116:	

ELEMENT CONDITION STATE DATA

Str Unit	Elm/Env	Description	Units	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4	% in 5	Qty. St. 5
2	13/3	Unp Conc Deck/AC Ovl	sq.m.	259	100 %	259	0 %	0	0 %	0	0 %	0	0 %	0
2	109/3	P/S Conc Open Girder	m.	160	100 %	160	0 %	0	0 %	0	0 %	0	0 %	0
2	215/3	R/Conc Abutment	m.	61	100 %	61	0 %	0	0 %	0	0 %	0	0 %	0
2	302/3	Compressn Joint Seal	m.	29	0 %	0	100 %	29	0 %	0	0 %	0	0 %	0
2	310/3	Elastomeric Bearing	ea.	18	0 %	0	0 %	0	100 %	18	0 %	0	0 %	0
2	321/3	R/Conc Approach Slab	ea.	2	100 %	2	0 %	0	0 %	0	0 %	0	0 %	0

PR 3 OVER RIO GRANDE DE LOIZA

Puerto Rico Highway and Transportation Autho

Bridge Engineering Office
Engineering Services Area

Structure Inventory and Appraisal Sheet

Bridge Key: 012001 Agency ID: 012001 Sufficiency Rating: 55.0

IDENTIFICATION

State 1:	72 Puerto Rico	Struc Num 8:	012001
Facility Carried 7:	PR 3	Location 9:	0.5 KM S E OF CAROLINA
Rte.(On/Under)5A:	Route On Structure	Rte. Signing Prefix 5B:	1 Interstate Hwy
Level of Service 5C:	1 Mainline	Rte. Number 5D:	00003
Directional Suffix 5E:	0 N/A (NBI)	% Responsibility :	NA
SHD District 2:	01	County Code 3:	031
Place Code 4:	51571	Kilometer Post 11:	10.8 km
Feature Intersected 6:	GRANDE DE LOIZA RIVER		
Latitude 16:	18d 22' 36"	Longitude 17:	065d 57' 18"
Border Bridge Code 98:	Unknown (P)		
Border Bridge Number 99:	Unknown		

INSPECTION

Frequency 91:	24 months	Inspection Date 90:	12/1/2003	Next Inspection:	12/01/2005
FC Frequency 92A:	NA	FC Inspection Date 93A:	NA	Next FC Inspection:	NA
UW Frequency 92B:	NA	UW Inspection Date 93B:	NA	Next UW Inspection:	NA
SI Frequency 92C:	NA	SI Date 93C:	NA	Next SI:	NA
Element Frequency:	24 months	Element Inspection Date:	01/01/1901	Next Elem. Insp. Due:	01/01/1901

CLASSIFICATION

Defense Highway 100:	1 On Interstate STRAHNE	Parallel Structure 101:	No || bridge exists
Direction of Traffic 102:	2 2-way traffic	Temporary Structure 103:	Unknown (NBI)
Highway System 104:	1 On the NHS	NBIS Length 112:	Long Enough
Toll Facility 20:	3 On free road	Functional Class 26:	11 Urban Interstate
Historical Significance 37:	5 Not eligible for NRHP		
Owner 22:	01 State Highway Agency		
Custodian 21:	01 State Highway Agency		

STRUCTURE TYPE AND MATERIALS

Number of Approach Spans 46: 0 Number of Spans Main Unit 45: 8

Main Span Material/Design 43A/B:

4 Steel Continuous 02

Deck Type 107:	1 Concrete-Cast-in-Place
Wearing Surface 108A:	6 Bituminous
Membrane 108B:	0 None
Deck Protection 108C:	None

CONDITION

Deck 58:	6 Satisfactory	Super 59:	6 Satisfactory	Sub 60:	5 Fair
Culvert 62:	N N/A (NBI)	Channel/Channel Protection 61:	4 Protection Undermined		

LOAD RATING AND POSTING

Inventory Rating Method 65: 2 AS Allowable Stress Operating Rating Method 63:2 AS Allowable Stress

Inventory Rating 66:	MS18.0	Operating Rating 64:	MS18.0
Design Load 31:	5 MS 18 (HS 20)	Posting 70:	5 At/Above Legal Loads
Posting status 41:	A Open, no restriction		

AGE AND SERVICE

Year Built 27:	1970	Year Reconstructed 106:	1984		
Type of Service on 42A:	5 Highway-pedestrian				
Type of Service under 42B:	5 Waterway				
Lanes on 28A:	8	Lanes Under 28B:	0	Detour Length 19:	8.0 km
ADT 29:	61,300	Truck ADT 109:	4 %	Year of ADT 30:	2002

APPRAISAL

Bridge Rail 36A:	1 Meets Standards	Approach Rail 36C:	1 Meets Standards
Transition 36B:	1 Meets Standards	Approach Rail Ends 36D:	1 Meets Standards
Str. Evaluation 67:	5 Above Min Tolerable	Deck Geometry 68:	2 Intolerable - Replace
Underclearance, Vertical and Horizontal 69:	N Not applicable (NBI)		
Waterway Adequacy 71:	6 Equal Minimum	Approach Alignment 72:	7 Above Min Criteria
Scour Critical 113:	3 SC - Unstable		

GEOMETRIC DATA

Length Max Span 48:	35.00 m	Structure Length 49:	239.80 m
Curb/Sdwlk Wdth L 50A:	0.00 m	Curb/Sidewalk Width R 50B:	1.10 m
Width Curb to Curb 51:	27.50 m	Width Out to Out 52:	30.60 m
Approach Roadway Width 32: (w/ shoulders)	30.60 m	Median 33:	3 Closed Med w/Barriers
Deck Area:	7,337.88 m²		
Skew 34:	0.00 °	Structure Flared 35:	0 No flare
Minimum Vertical Clearance Over Bridge 53:	99.99 m		
Minimum Vertical Underclearance Reference 54A:	N Feature not hwy or RR		
Minimum Vertical Underclearance 54B:	00.00 m		
Minimum Lateral Underclearance Reference R 55A:	N Feature not hwy or RR		
Minimum Lateral Undrclearance R 55:	00.00 m		
Minimum Lateral Undrclearance L 56:	00.00 m		

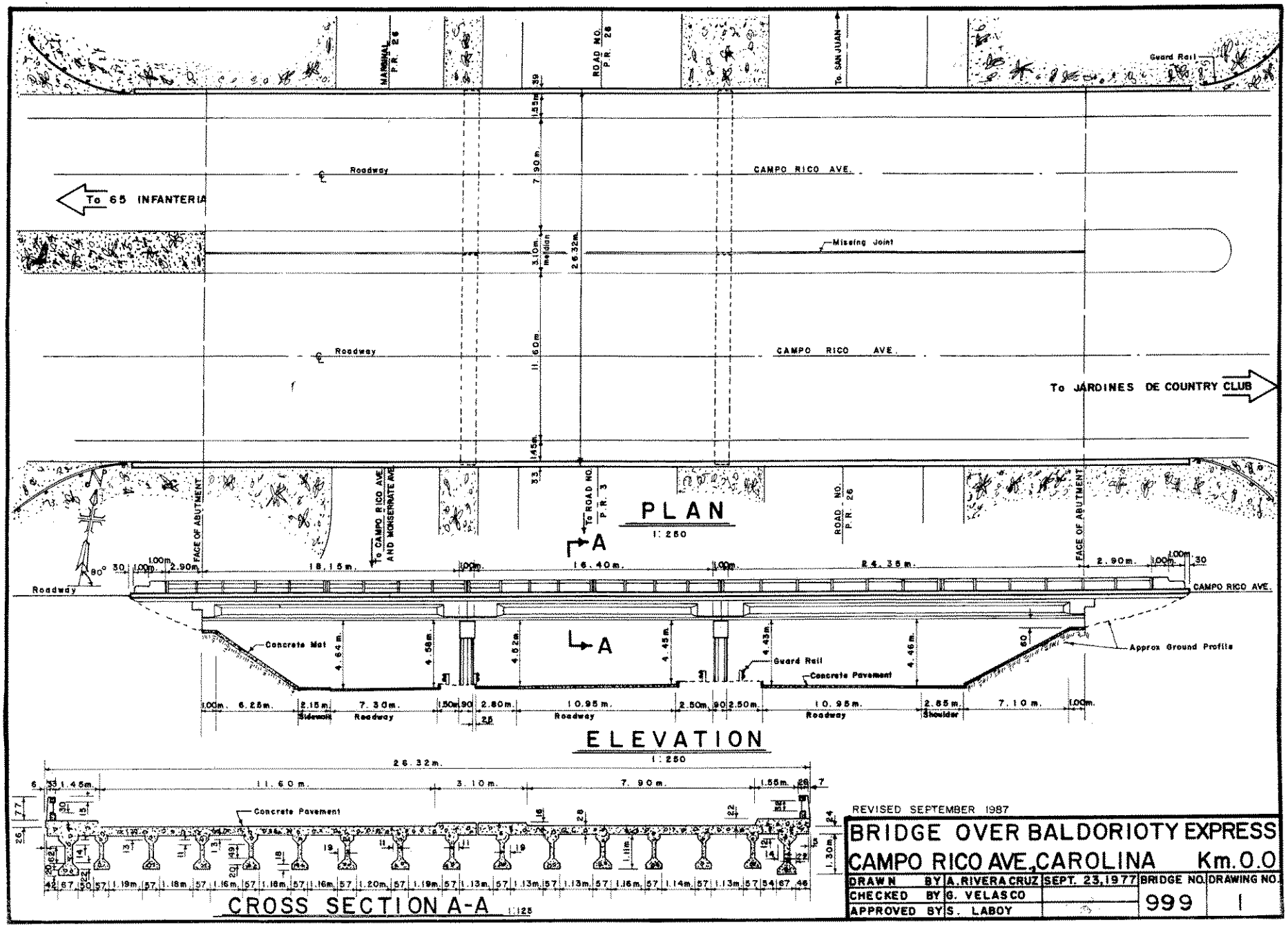
PROPOSED IMPROVEMENTS

Bridge Cost 94:	$ 0	Type of Work 75:	35 Rehabilitate-gen.
Roadway Cost 95:	$ 0	Length of Improvment 76:	239.90 m
Total Cost 96:	$ 193,000	Future ADT 114:	93,452
Year of Cost Estimate 97:	2003	Year of Future ADT 115:	2020

NAVIGATION DATA

Navigation Control 38:	0 Permit Not Required		
Vertical Clearance 39:	0.00 m	Horizontal Clearance 40:	0.00 m
Pier Protection 111:	Unknown (NBI)	Lift Bridge Vertical Clearance 116:	

ELEMENT CONDITION STATE DATA


PLAN
1:250
ELEVATION
1:250
CROSS SECTION A-A
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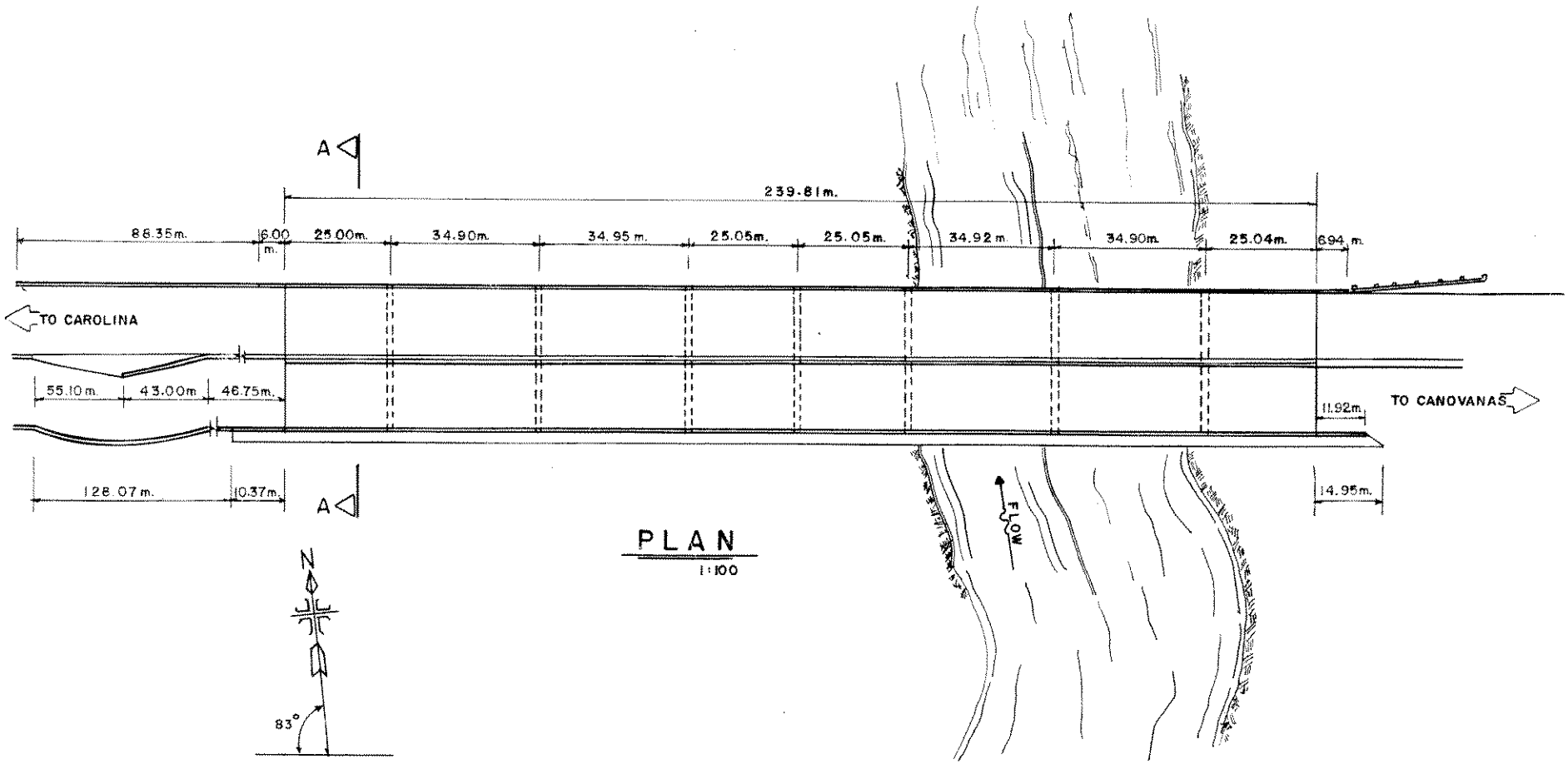
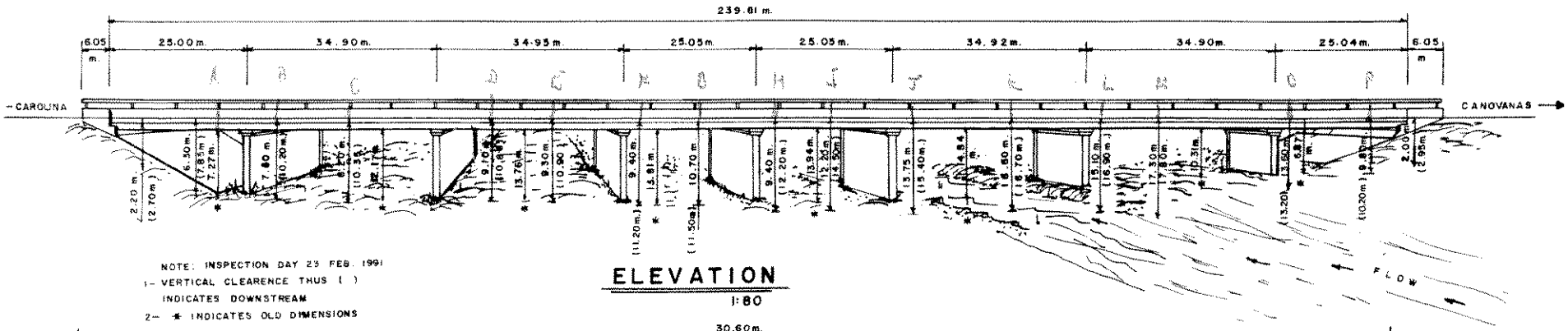
Roadway
CAMPO RICO AVE.
To 65 INFANTERIA
To JARDINES DE COUNTRY CLUB
Missing Joint
Guard Rail
Concrete Mat
Concrete Pavement
Approx Ground Profile
FACE OF ABUTMENT
To CAMPO RICO AVE. AND MONSERRATE AVE.
To ROAD NO. P.R. 3
ROAD NO. P.R. 26
To SAN JUAN
Sidewalk
Shoulder
26.32m.
11.60m.
3.10m.
7.90m.
1.55m.
1.45m.
18.15m.
16.40m.
24.35m.
2.90m.
REVISED SEPTEMBER 1987
BRIDGE OVER BALDORIOTY EXPRESS
CAMPO RICO AVE., CAROLINA Km. 0.0
DRAWN BY A. RIVERA CRUZ SEPT. 23, 1977
CHECKED BY G. VELASCO
APPROVED BY S. LABOY
BRIDGE NO. 999
DRAWING NO. 1



PLAN
1:100

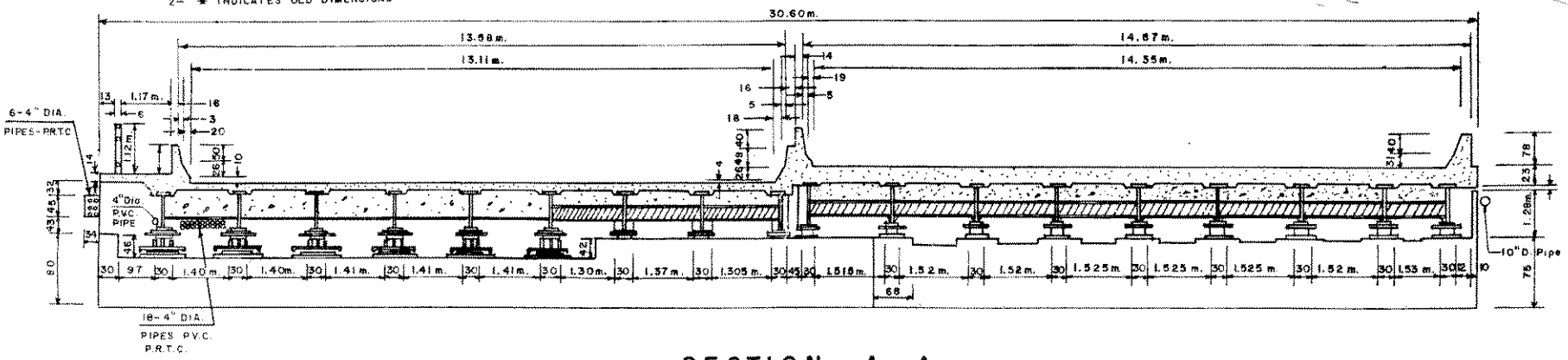
REVISED	HIGHWAY AUTHORITY BRIDGE STUDIES AND EVALUATION OFFICE				
25/FEB/1986	BRIDGE OVER RIO GRANDE DE LOIZA PR-3 KM. 10.80 LOIZA, P.R.				
	DRAWN BY	D. Monclova	NOV. 1985	BRIDGE NO.	DRAWING NO.
	CHECKED BY	Ing. L.M. Abadia		1200	1 - 2
	APPROVED BY	Ing. S. Laboy			

15

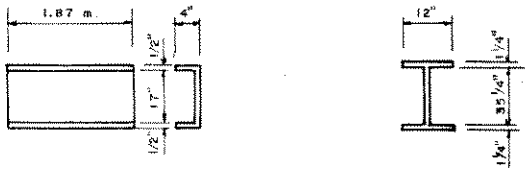


NOTE: INSPECTION DAY 23 FEB. 1991
1- VERTICAL CLEARENCE THUS ( ) INDICATES DOWNSTREAM
2- * INDICATES OLD DIMENSIONS

ELEVATION
1:80

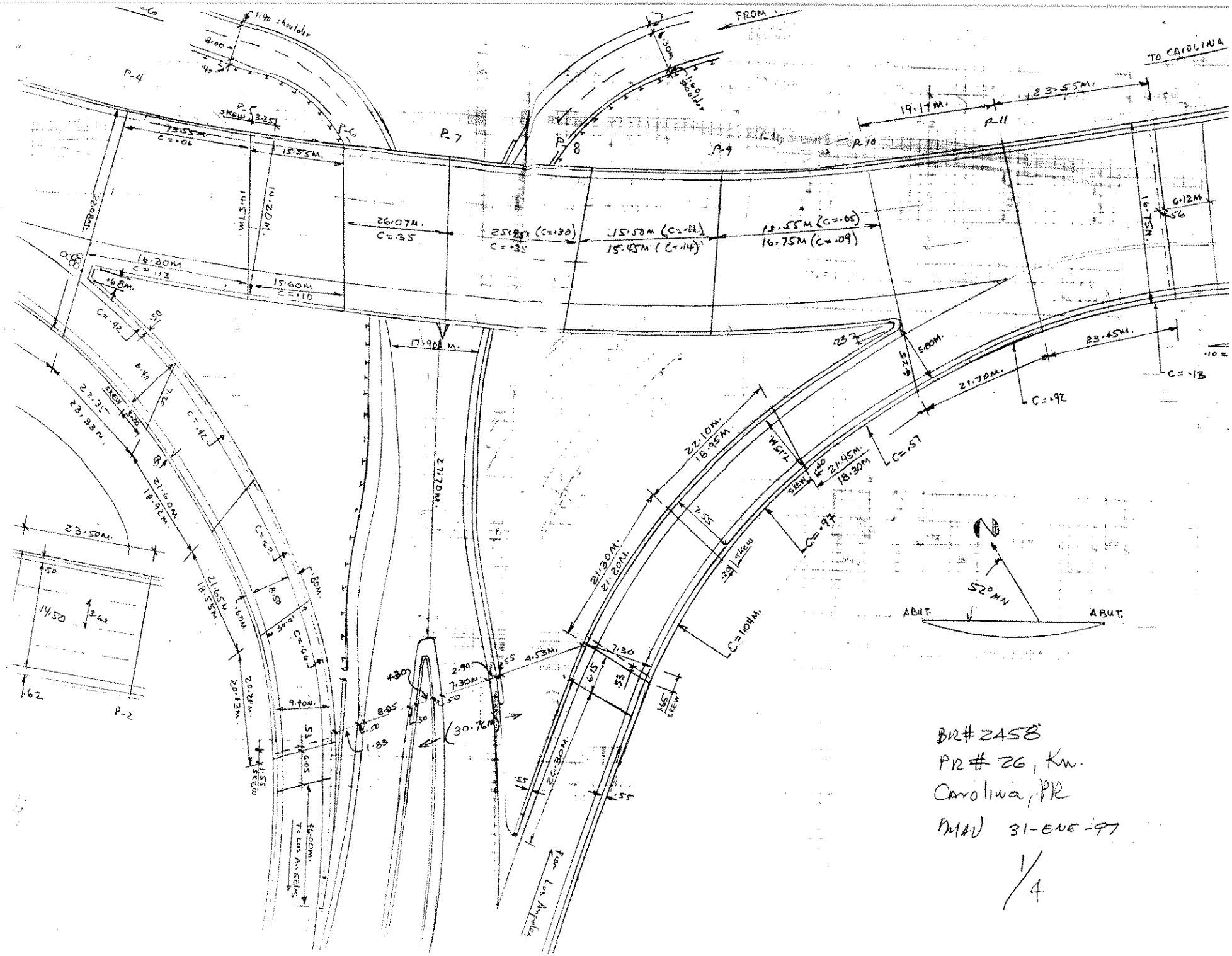


SECTION A-A
Not to Scale



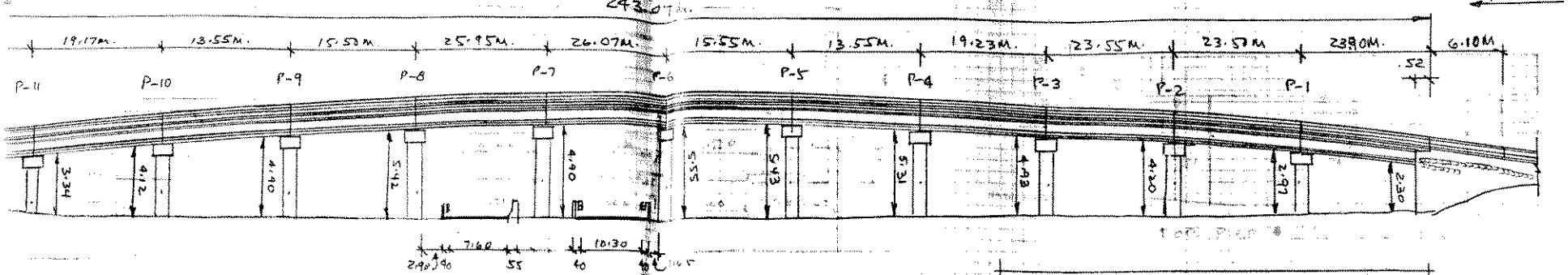
BEAM DETAIL

BRIDGE OVER RIO GRANDE DE LOIZA PR-3 KM. 10.80 LOIZA, P.R.				
DRAWN BY	D. Monclova	NOV. 1985	BRIDGE NO.	DRAWING NO.
CHECKED BY	Ing. L.M. Abadia		1200	2-2
APPROVED BY	Ing. S. Laboy			



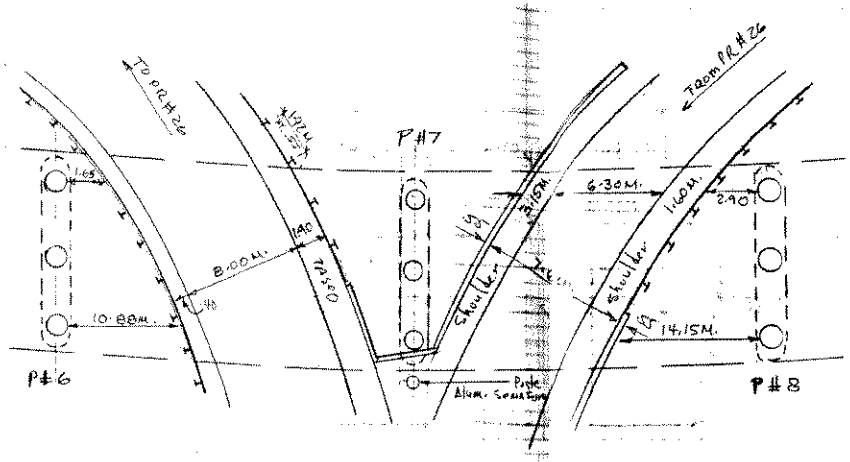
BR# 2458
PR# 26, Km.
Carolina, PR
MAN 31-ENE-97

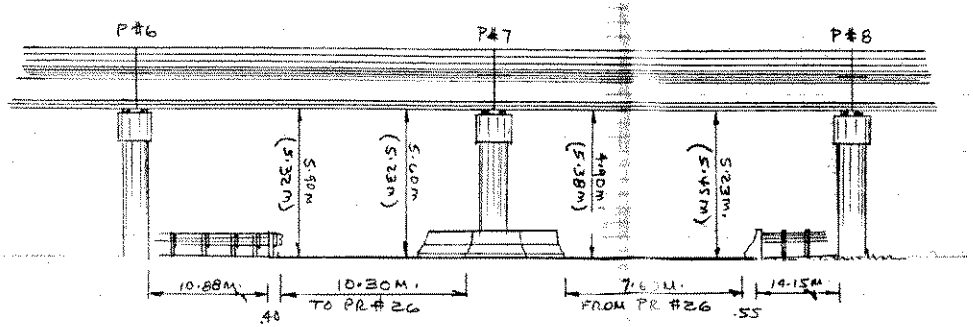
1/4



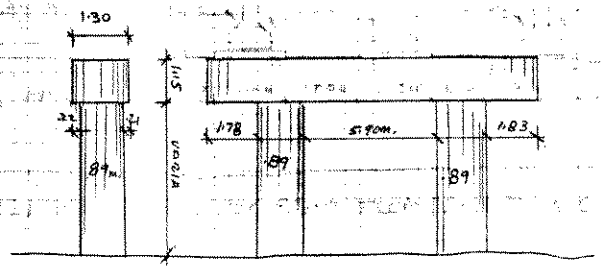
ELEVACION LADO NORTE

Under clearances tomados bajo las VIGAS (miguel)





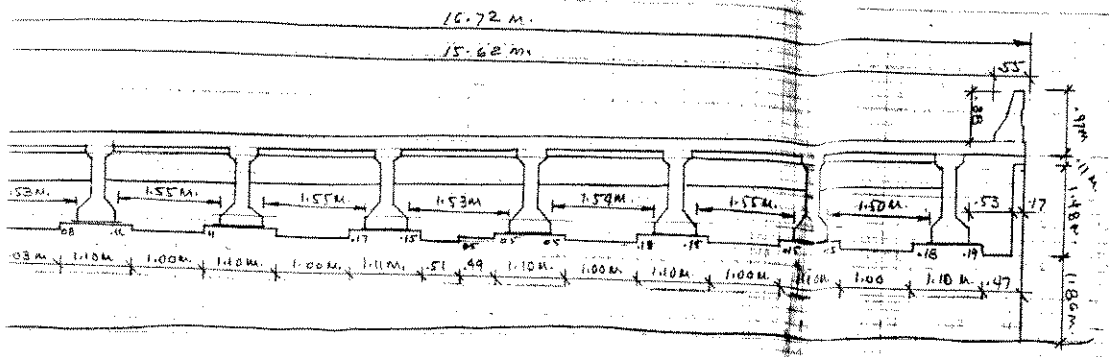
( ) = Lado PR#26



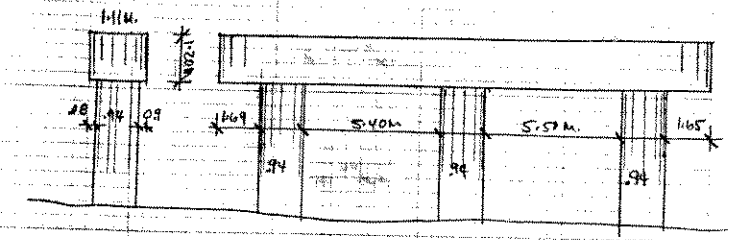
PIER DETAILS FOR RAMPS

BR#2458
Carolina

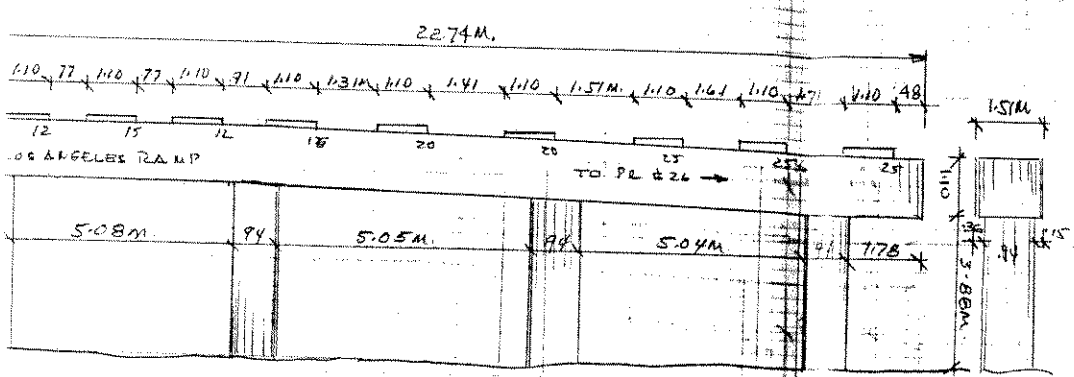
2/4



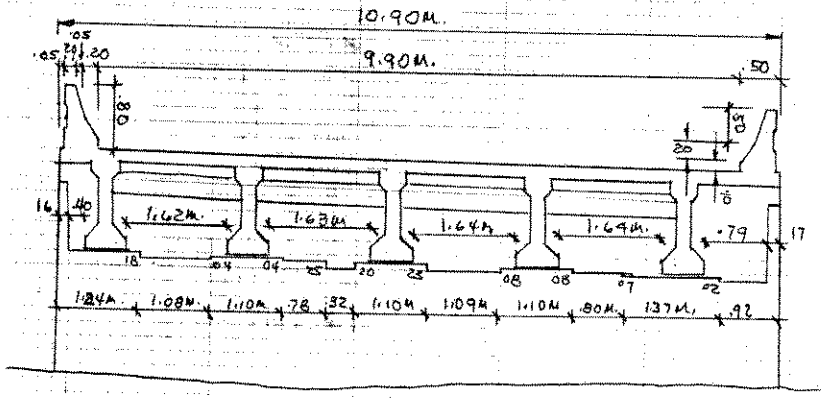
SAN JUAN ABUTMENT DETAIL



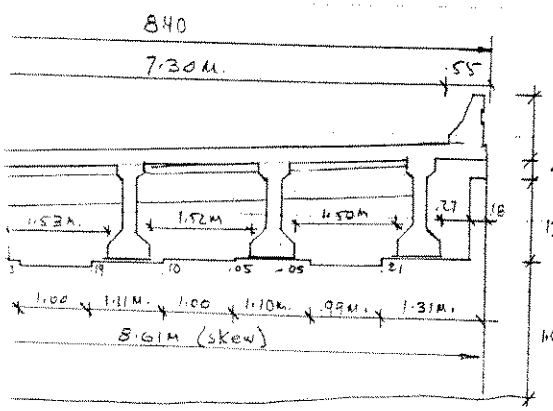
DETAILS FOR PIER # 1, 2, 3, 5, 4, 7, 8 & 9



PIER #4 DETAIL

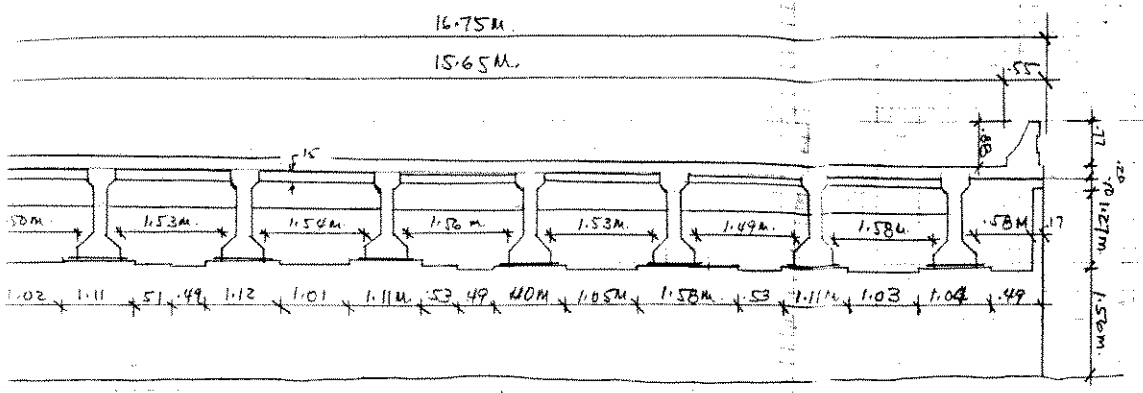


ABUTMENT DETAIL FOR RAMP FROM PR-26 TO AVE. LOS ANG

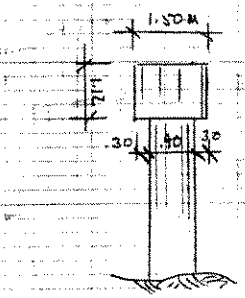


FOR RAMP FROM LOS Angeles TO PR #26

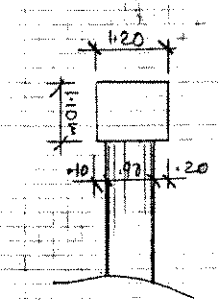
BR# 2458
PR #26, Km ?
Carolina, PR.
MAD 31-ENE-97



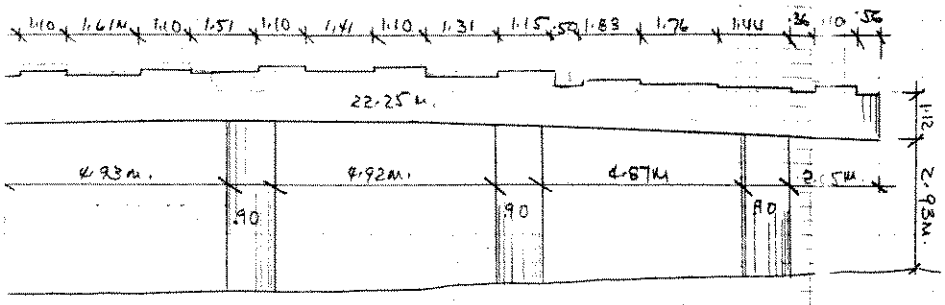
CAROLINA ABUTMENT DETAIL



PIER # 10

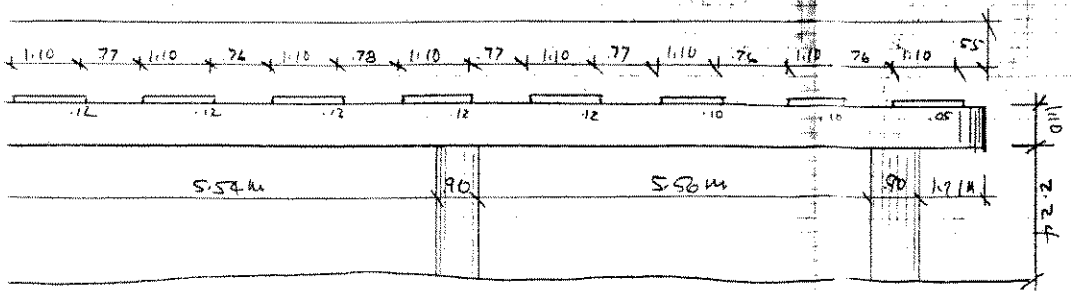


PIER # 11



DETAIL FOR PIER #10

Los Angeles



DETAIL FOR PIER # 11

BR # 2458
Carolina
MMU 31-ENE-97

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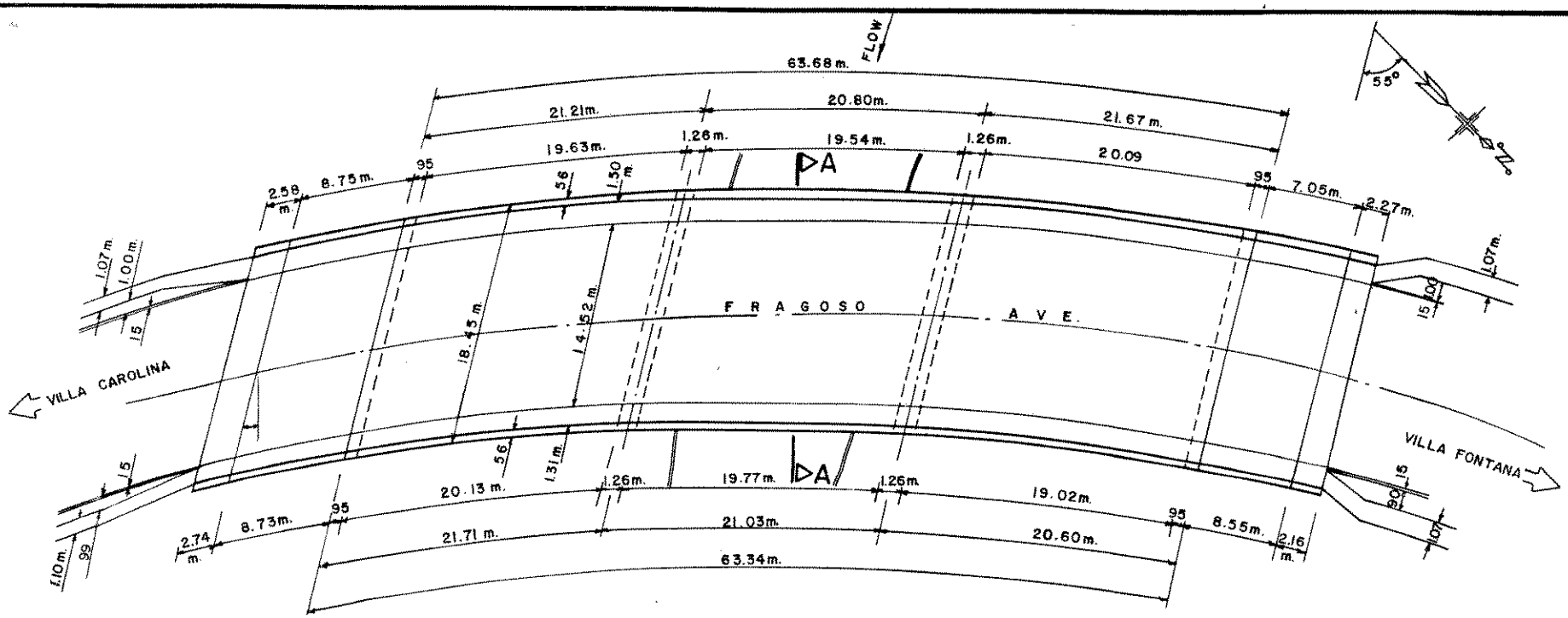
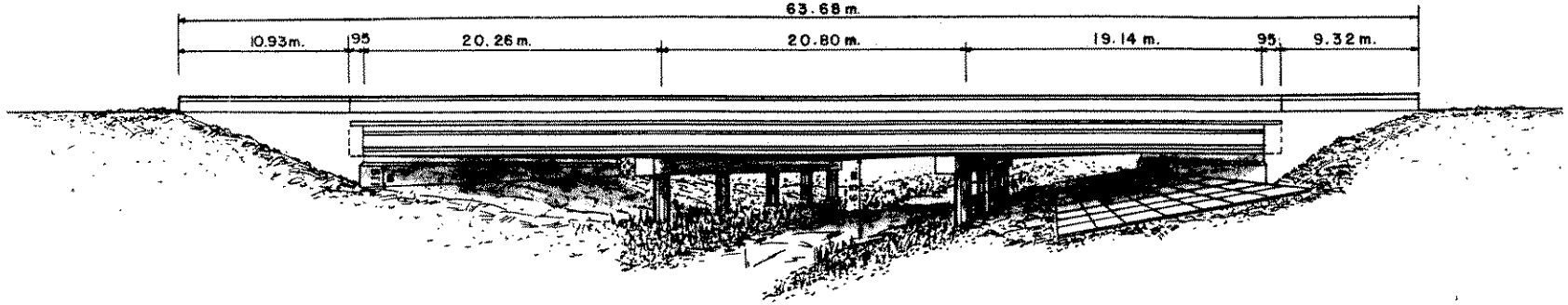


PLAN

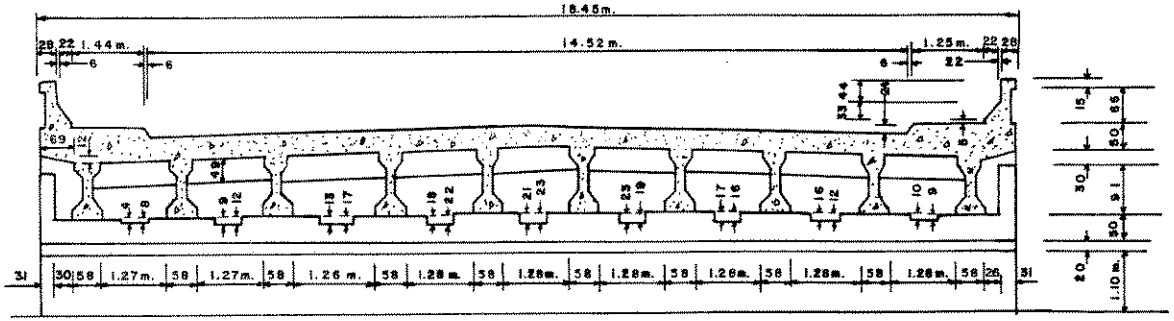
1: 33

BRIDGE OVER BLASINA CREEK FRAGOSO AVE. CAROLINA, P.R.				
DRAWN BY	D. Monclova	NOV. 1984	BRIDGE NO.	DRAWING NO.
CHECKED BY	R. Rodriguez		2074	1 - 2
APPROVED BY	Ing. S. Laboy			



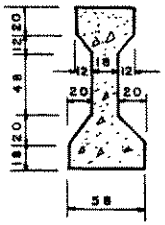
ELEVATION

1:33 1/3



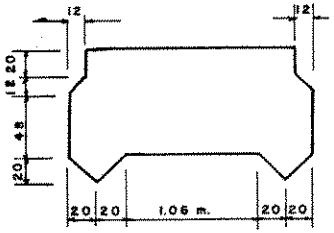
CROSS SECTION A - A

1:100



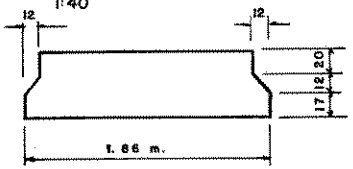
BEAM DETAIL

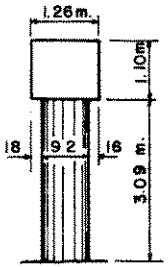
1:40

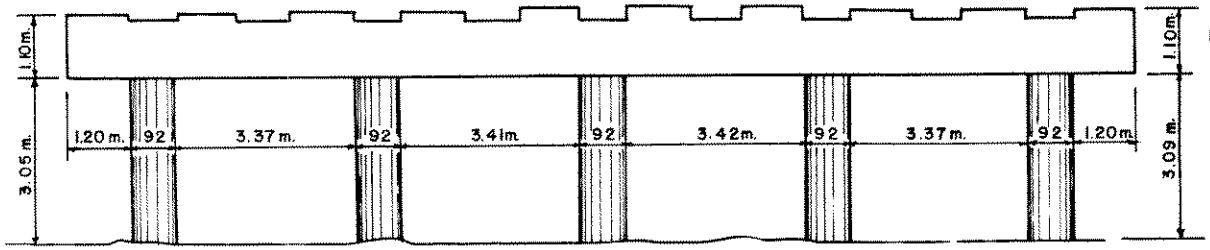


DIAPHRAGM

1:40



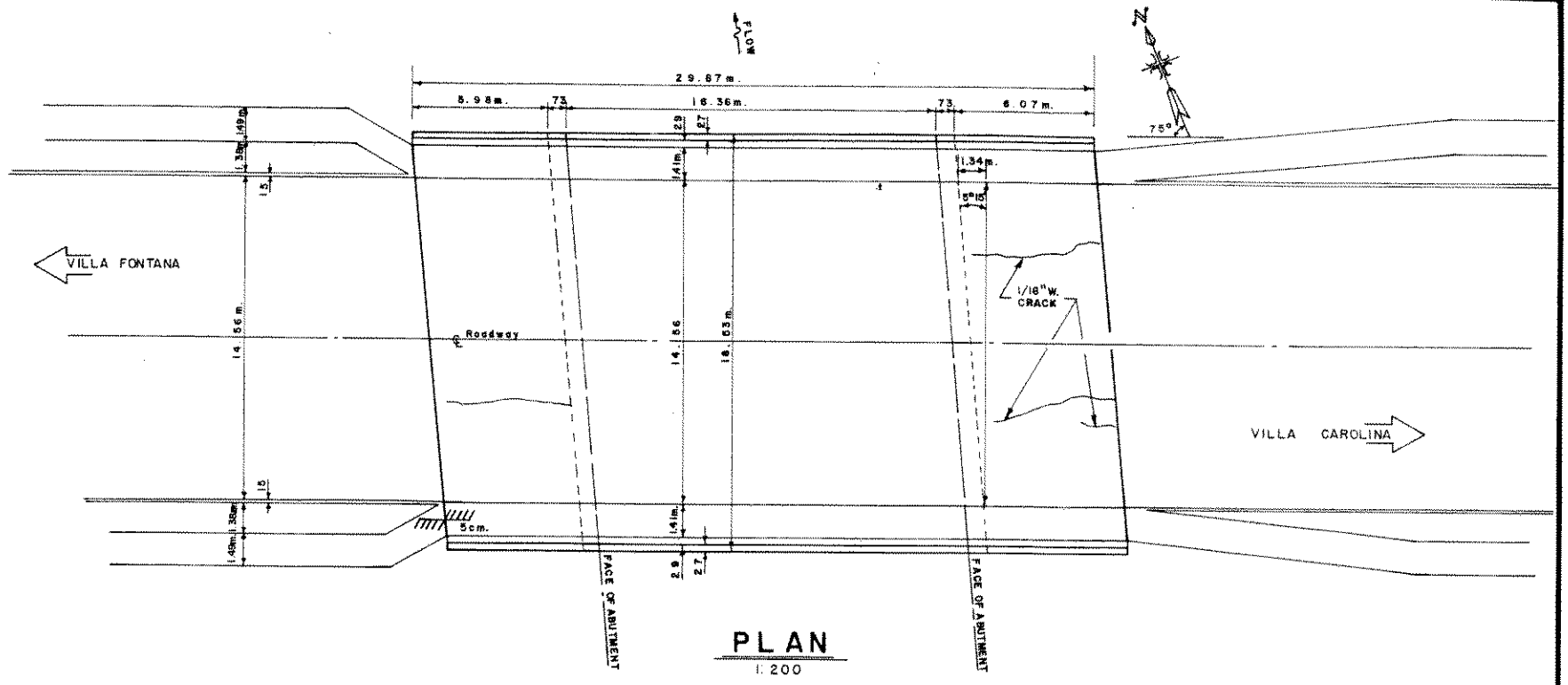


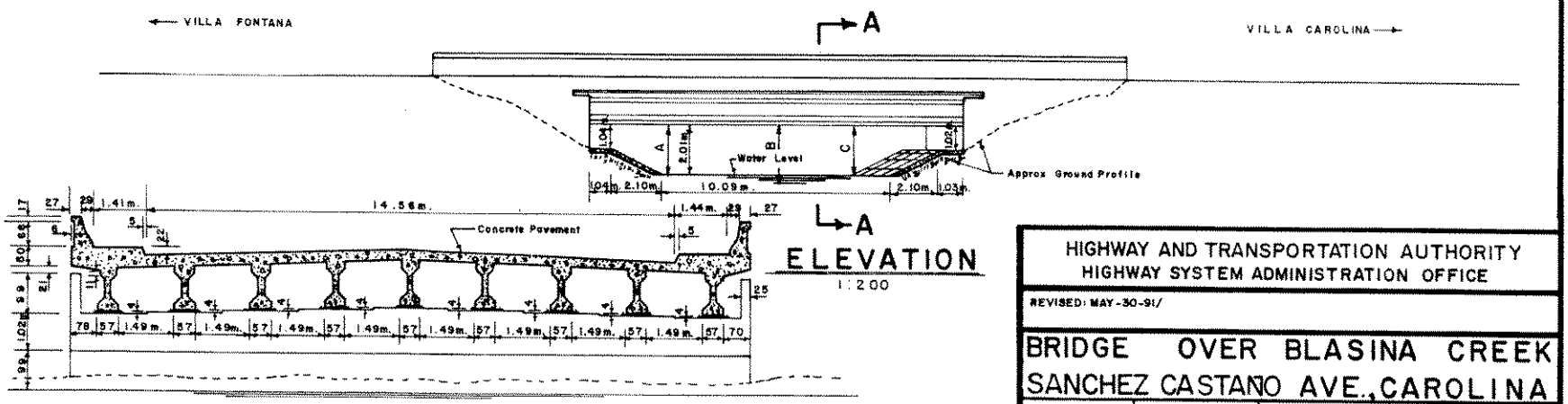


PIER DETAIL

1:100

BRIDGE OVER BLASINA CREEK FRAGOSO AVE. CAROLINA, P.R.				
DRAWN BY	D. Manclova	NOV. 1984	BRIDGE NO.	DRAWING NO.
CHECKED BY	R. Rodríguez		2074	2 - 2
APPROVED BY	Ing S. Laboy			





PROFILE CHART

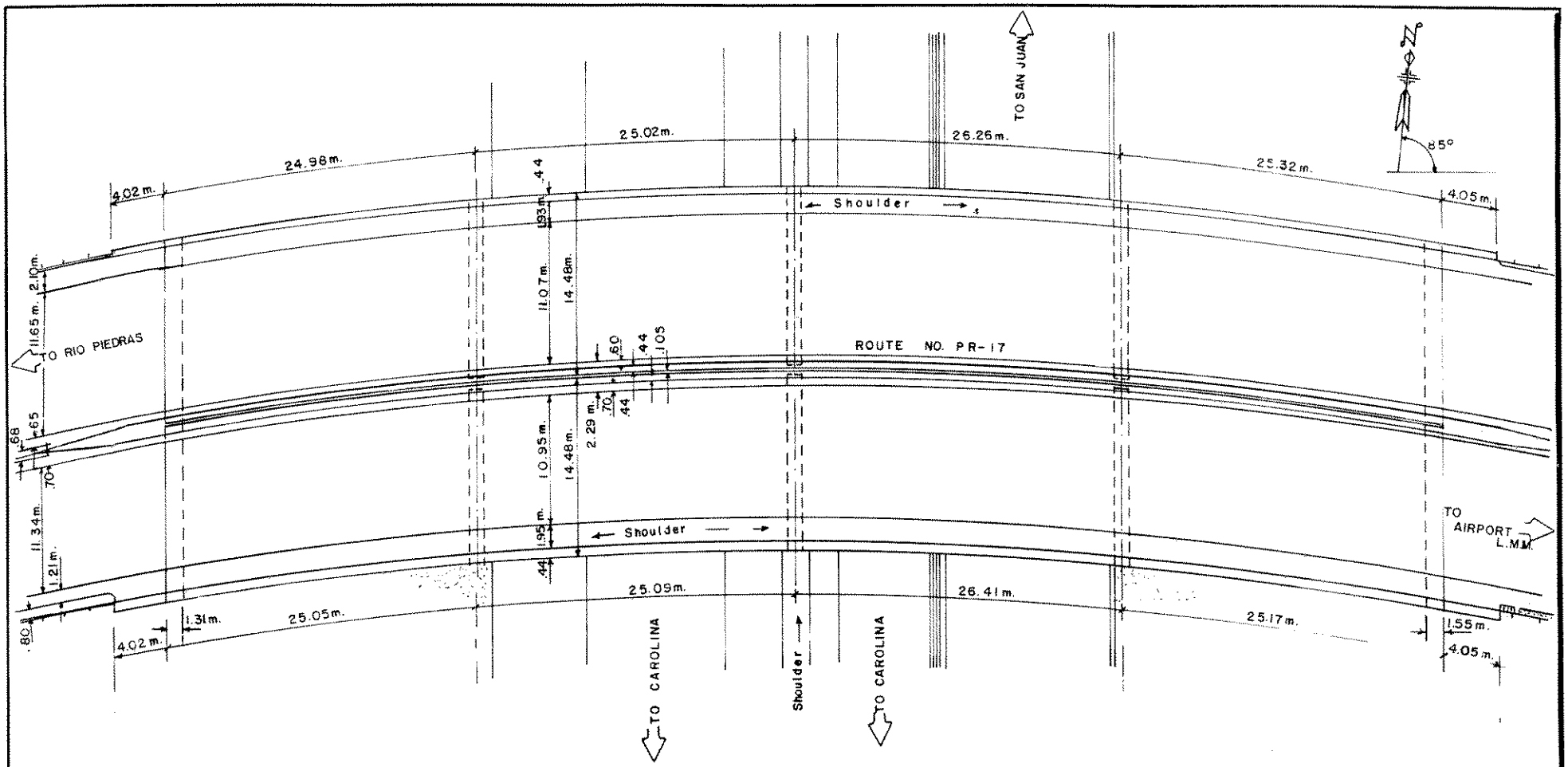
INSPECTION DATE / ELEVATION	UP-ST.	DW-ST.
JUNE-23-69		
A	2.30m.	2.30m.
B	3.00m.	3.70m.
C	1.60m.	2.60m.
WATER DEEP		0.10m.

HIGHWAY AND TRANSPORTATION AUTHORITY
HIGHWAY SYSTEM ADMINISTRATION OFFICE

REVISED: MAY-30-91

BRIDGE OVER BLASINA CREEK
SANCHEZ CASTANO AVE., CAROLINA

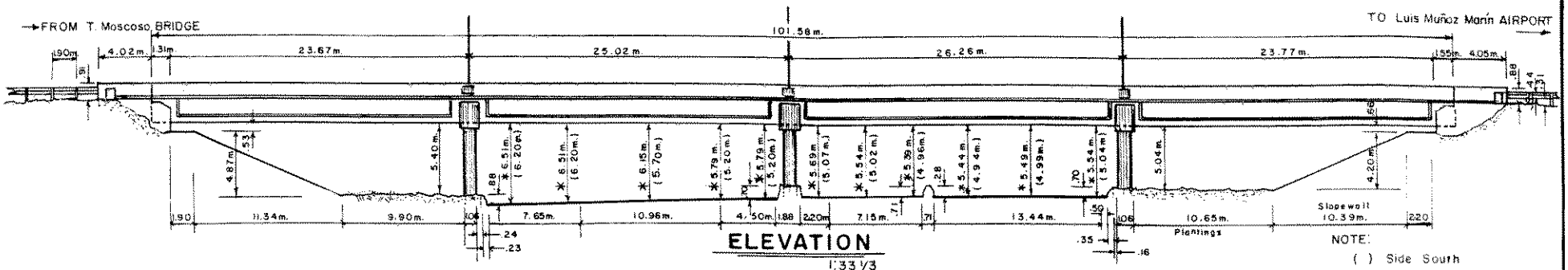
DRAWN BY	A. RIVERA CRUZ	OCTOBER 1, 1979	BRIDGE NO.	DRAWING NO.
CHECKED BY	N. ZAYAS		2073	1
APPROVED BY	S. LABOY			



PLAN

E 33 1/3

REVISED	HIGHWAY AND TRANSPORTATION AUTHORITY HIGHWAY SYSTEM ADMINISTRATION OFFICE				
	BRIDGE OVER P R - 26 Route PR-17 Km.13.0 CAROLINA, PR.				
	DRAWN BY	D. Monclova	AUGUST 1994	BRIDGE NO.	DRAWING NO.
	CHECKED BY	Ing. Glass		2331	1-2
	APPROVED BY	Ing. R. Pizarro			



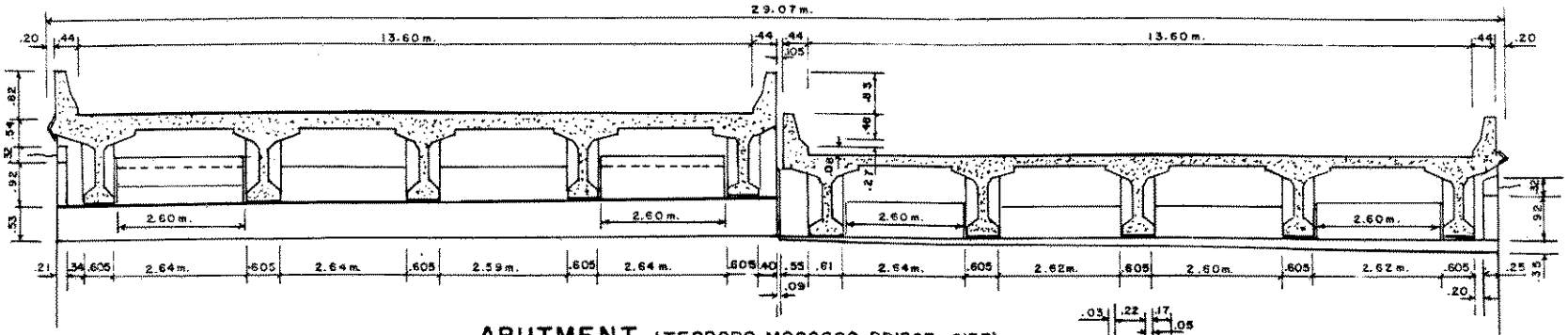
ELEVATION

1:33 1/3

NOTE:

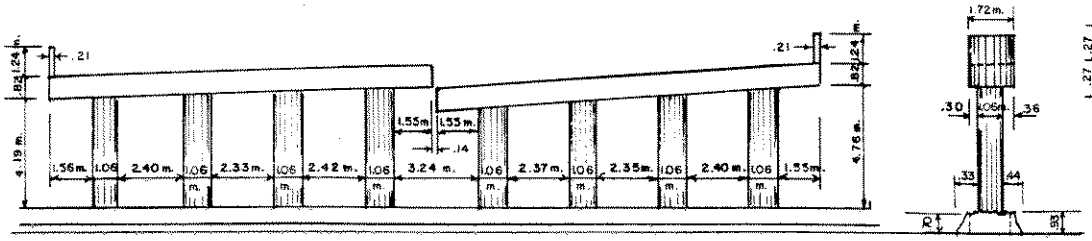
( ) Side South

✱ Under clearence in North side under the bridge.



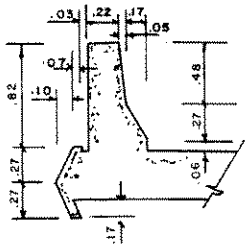
ABUTMENT (TEODORO MOSCOSO BRIDGE SIDE)

1:100

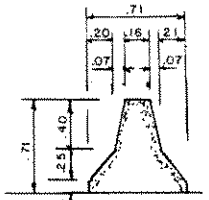


PIER

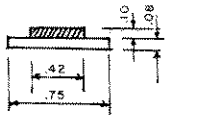
1:20



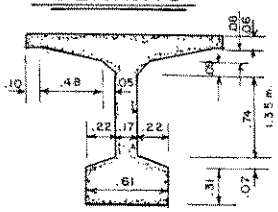
PARAPET



MEDIAN



BEARING



BEAM

REVISED	HIGHWAY AND TRANSPORTATION AUTHORITY HIGHWAY SYSTEM ADMINISTRATION OFFICE				
	BRIDGE OVER PR-26 Route PR-17 Km. 13.0 CAROLINA, P.R.				
	DRAWN BY	D. Monclova	AUGUST 1994	BRIDGE NO.	DRAWING NO.
	CHECKED BY	Ing. Glass		2331	2-2
	APPROVED BY	Ing. R. Pizarro			