Calculation Submittal

CR 455 South Lake Trail

Lake County, Florida

PermaTrak Job #
2020-1427

September 20, 2024

Designed By: Kyle Alan Stanton 09/20/2024

Checked By: Andrea M. Craig 09/27/2024

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The Concrete Boardwalk Company

Job No.:	2020-1427	Sh. 1 of 1 Pg. 1	
Project:	CR 455 South Lake Trail		
By:	KAS	**Date:**	9/20/2024
Job Location:	Lake County, Florida		
Checked By:	AMC		

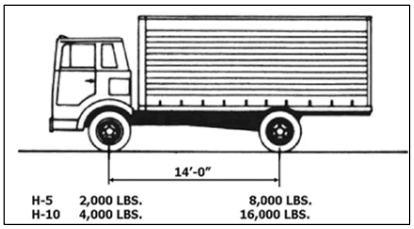
Loading Criteria

Design Loading Criteria:

American Association of State Highway and Transportation Officials LRFD Bridge Design Specifications & LRFD Guide Specifications for the Design of Pedestrian Bridges

Design Live Load

Uniform Loading	
Pedestrian	90.00 psf
Vehicular Loading	
H-5 Design Truck (10,000 lb. Vehicle)	
Front Axle	2.00 kips
Rear Axle	8.00 kips
Front Wheel	1.00 kips
Rear Wheel	4.00 kips
Wheel base (z)	14.00 ft
Axle width (y)	6.00 ft



Design Dead Load

*Worst Case Tread Size Provided For Calculations

Tread Size	
Other	
Lay Length (Tread width)	33.38 in.
Depth	5.50 in.
Length (Boardwalk Width)	9.00 ft

*Worst Case Beam Length Provided For Calculations

Beam Size	
Medium	
Width	10.50 in.
Depth	14.00 in.
Length	22.33 ft

Cantilver distance	2.00 ft

(distance from centerline of beam to the outside edge of tread)

Other Design Criteria	
Tread f'c =	5.0 ksi
Beam f'c =	5.0 ksi
LL Factor =	1.75
DL Factor =	1.25

Design Dead Load

Concrete Density	150.0 pcf

Tread Railing or Curb Data

Side Treatment Type	Railing
Load	15.75 plf
Vertical Post Spacing	5.58 ft

Design Procedure

1. Determing Dead Load Shear & Moment due to UNIFORM loading
2. Determing Live Load Shear & Moment due to:
   a. UNIFORM loading (Case 1)
   b. VEHICLE loading (Case 2 & 3)
3. Combine Dead Load with Live Load for maximum design Shear & Moment
4. Calculate required reinforcing for shear and flexure.
5. Check deflection under service loading

Pier Reactions

Service Dead Load	10.68 kips
Service DL+LL	19.72 kips
Factored Dead Load	13.35 kips
Factored DL + LL	29.18 kips

Abutment Reactions

Service Dead Load	5.34 kips
Service DL+LL	9.86 kips
Factored Dead Load	6.67 kips
Factored DL + LL	14.59 kips

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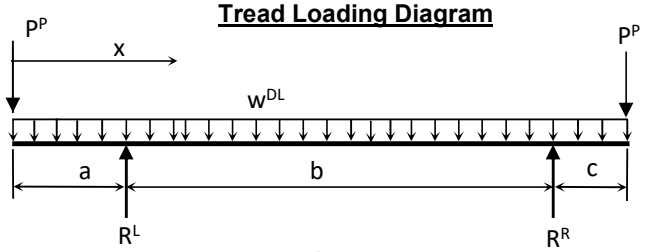
Job No.: 2020-1427 Sh. 1 of 8 Pg. 2
Project: CR 455 South Lake Trail
By: KAS Date: 9/20/2024
Checked By: AMC

TREAD Analysis - UNIFORM Dead Load & Rail Loads

Input Data

Tread Span Data	
Left Cantilever, a =	2.00 ft
Middle Span, b =	5.00 ft
Right Cantilever, c =	2.00 ft
Total Length, L =	9.00 ft

Tread Loading Diagram



Loading Data

Tread Dimensions	
Width	33.375 in
Depth	5.500 in
w^{DL}	0.191 k/ft
Tread DL	1720.9 lbs
Perimeter (rail)	
Load	15.75 plf
Vert. Post	5.58 ft
P^P	87.9 lbs
*Note: P^P not used for +M	
DL Load Factor	1.25

See input data from 'Load Criteria'

Service Reactions

R_s^L =	0.95 k	R_s^R =	0.95 k
M_s^L =	-0.56 k-ft	M_s^R =	-0.56 k-ft

Ult. Reactions

R_u^L =	1.19 k	R_u^R =	1.19 k
M_u^L =	-0.70 k-ft	M_u^R =	-0.70 k-ft

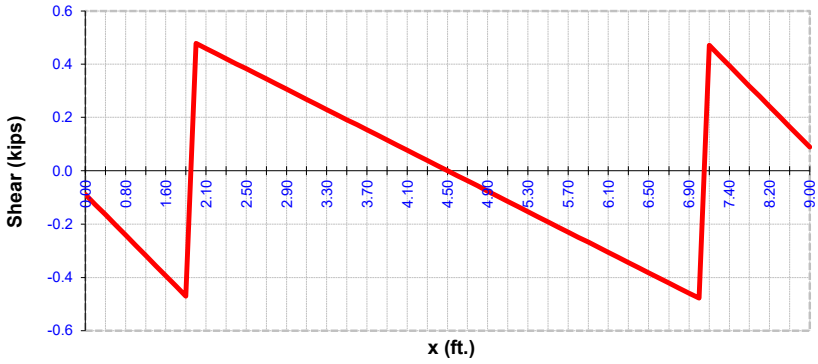
Service Shear

Vmax = 0.48 k
Vmin = -0.48 k

Ult. Shear

Vmax = 0.60 k
Vmin = -0.60 k

Shear Diagram



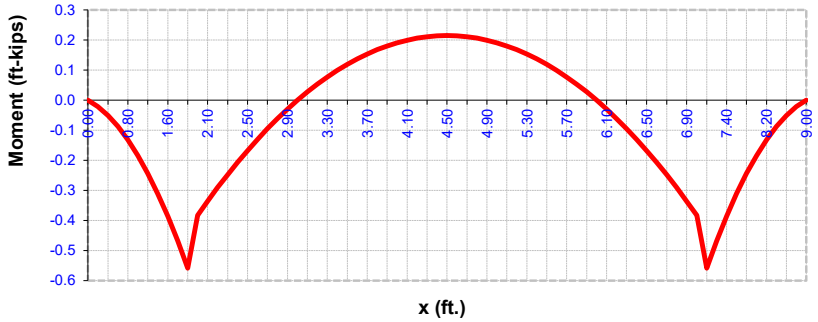
Service Moment

+Mmax = 0.22 k-ft @ x=4.50 ft
-Mmax = -0.56 k-ft @ x=7.00 ft

Ult. Moment

+Mmax = 0.27 k-ft @ x=4.50 ft
-Mmax = -0.70 k-ft @ x=7.00 ft

Moment Diagram



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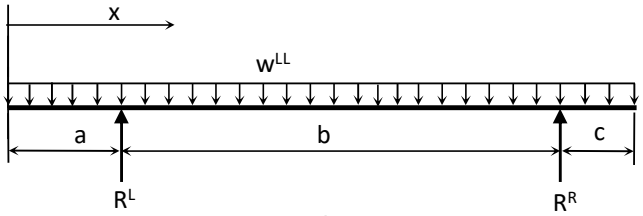
Job No.: 2020-1427 Sh. 2 of 8 Pg. 3
Project: CR 455 South Lake Trail
By: KAS Date: 9/20/2024
Checked By: AMC

TREAD Analysis - Live Load (Uniform)

Input Data

Span Data	
Left Cantilever, a =	2.00 ft
Middle Span, b =	5.00 ft
Right Cantilever, c =	2.00 ft
Total Length, L =	9.00 ft

Loading Diagram



Loading Data

Uniform Live Load

Width 33.375 in
Pedestrian 90.00 psf

See input data from 'Load Criteria'

w^{LL}	0.250 k/ft

LL Load Factor	1.75

Service Reactions

R_s^L =	1.13 k	R_s^R =	1.13 k
M_s^L =	-0.50 k-ft	M_s^R =	-0.50 k-ft

Ult. Reactions

R_u^L =	1.97 k	R_u^R =	1.97 k
M_u^L =	-0.88 k-ft	M_u^R =	-0.88 k-ft

Service Shear

Vmax = 0.63 k
Vmin = -0.63 k

Ult. Shear

Vmax = 1.10 k
Vmin = -1.10 k

Service Moment

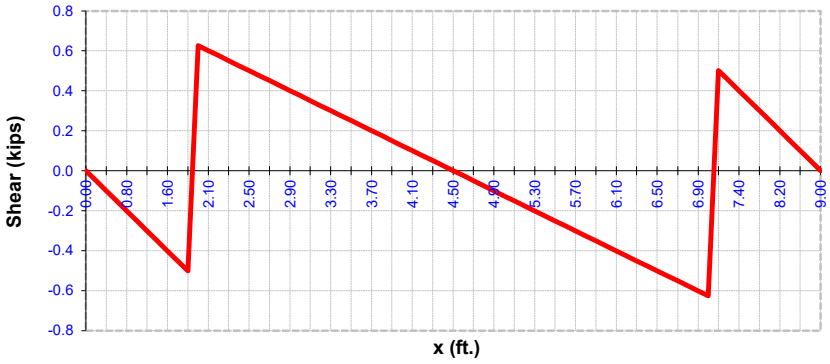
+Mmax = 0.28 k-ft @ x=4.50 ft
-Mmax = -0.50 k-ft @ x=2.00 ft

Ult. Moment

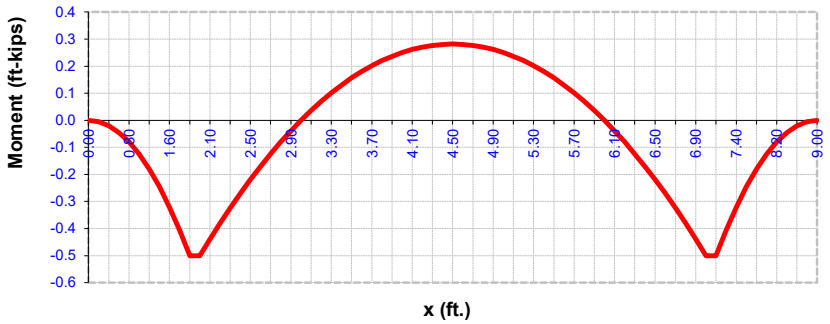
+Mmax = 0.49 k-ft @ x=4.50 ft
-Mmax = -0.88 k-ft @ x=2.00 ft

CASE 1: Uniform Live Load

Shear Diagram



Moment Diagram



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Job No.: 2020-1427 Sh. 3 of 8 Pg. 4
Project: CR 455 South Lake Trail
By: KAS Date: 9/20/2024
Checked By: AMC

Tread Analysis - Vehicular Load

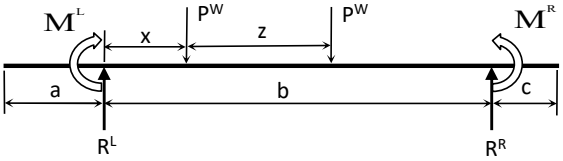
H-5 Design Truck (10,000 lb. Vehicle)

Input Data

Span Data	
Left Cantilever, a =	2.00 ft
Middle Span, b =	5.00 ft
Right Cantilever, c =	2.00 ft
Total Length, L =	9.00 ft

Loading Diagram

(assume loads do not act on cantilever)



Loading Data

Vehicular Loading	
Rear Wheel	4.00 kips
Rear Wheel	4.00 kips
'z' dimension (width) =	6.00 ft

See input data from 'Load Criteria'

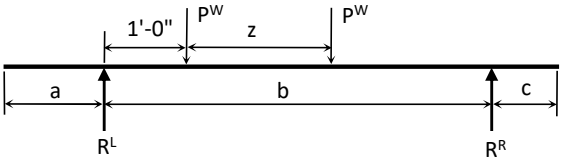
(axle width)

Consider wheel load on overhang? (Y/N)	y
	y

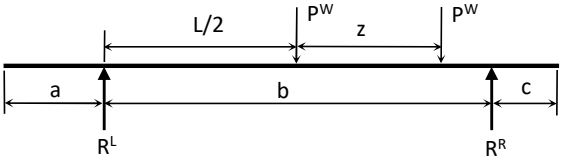
'a' end
'b' end

LL Load Factor	1.75

CASE 2: 'x'= 1'-0"



CASE 3: 'x'= L/2



Case 4 (max reaction): Pw occurs 6" from edge of tread

Max Service Reactions - (Live Load applied to Beams)

R_s^L = 3.20 k R_s^R = 0.80 k

Tread Design - Live Load (Vehicle)

CASE 2: 'x' = 1'-0"

Service Shear

VL = 3.20 k
VR = -0.80 k

Ult. Shear

VL = 5.60 k
VR = -1.40 k

Service Moment

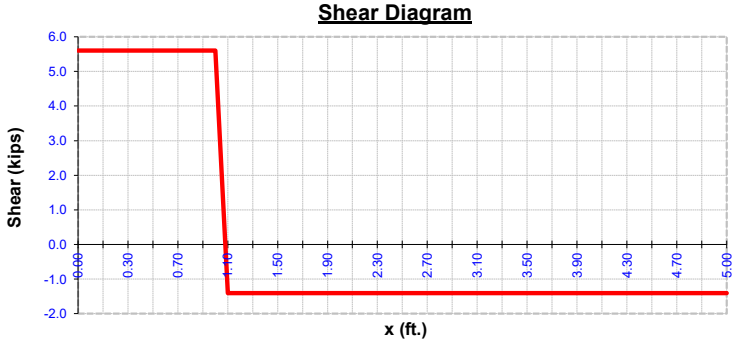
+Mmax = 3.2 k-ft @ x=1.00 ft
-Mmax = -2.00 k-ft @ x=0.00 ft

Ult. Moment

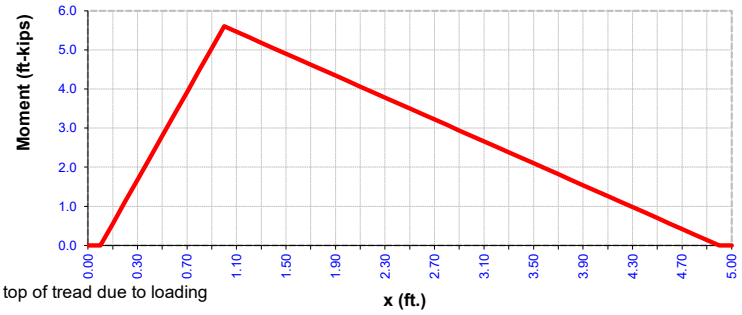
+Mmax = 5.60 k-ft @ x=1.00 ft
-Mmax = -3.50 k-ft @ x=0.00 ft

*Note (-) Moment indicates flexure in top of tread due to loading on overhang (if applicable)

Shear Diagram



Moment Diagram



CASE 3: 'x' = L/2

Service Shear

VL = 3.20 k
VR = -3.20 k

Ult. Shear

VL = 5.60 k
VR = -5.60 k

Service Moment

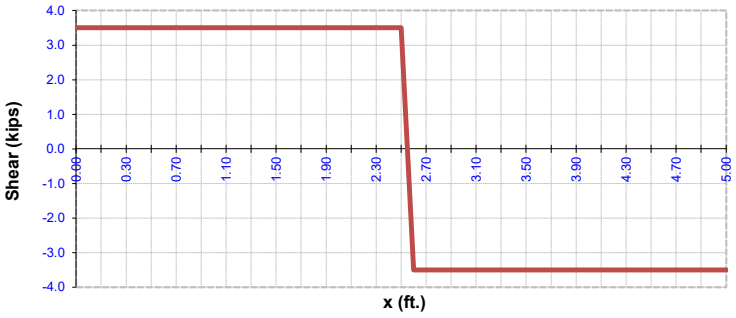
+Mmax = 5.0 k-ft @ x=2.50 ft
-Mmax = -2.00 k-ft @ x=0.00 ft

Ult. Moment

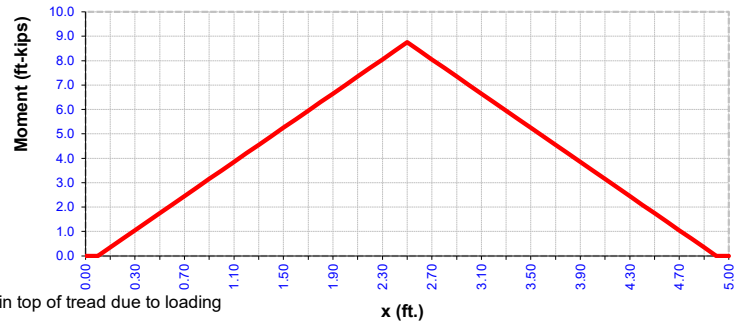
+Mmax = 8.75 k-ft @ x=2.50 ft
-Mmax = -3.50 k-ft @ x=0.00 ft

*Note (-) Moment indicates flexure in top of tread due to loading on overhang (if applicable)

Shear Diagram



Moment Diagram



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Job No.: 2020-1427 Sh. 5 of 8 Pg. 6
Project: CR 455 South Lake Trail
By: KAS Date: 9/20/2024
Checked By: AMC

Tread Analysis Load Summary

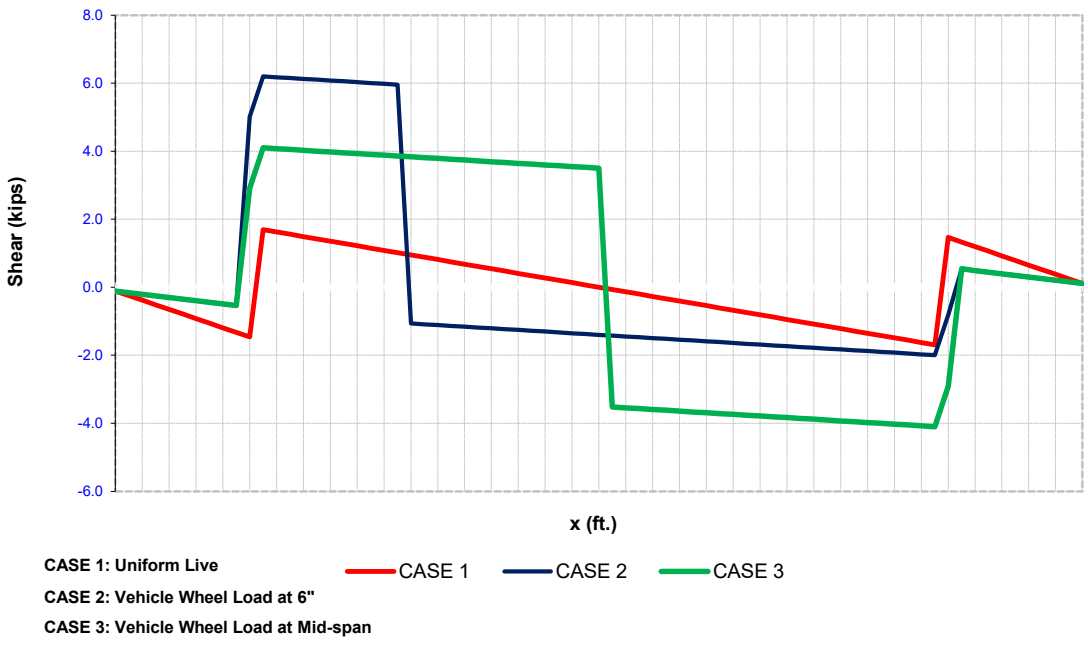
SHEAR DESIGN LOADS

Service	Ultimate
DEAD LOAD (ONLY)	DEAD LOAD (ONLY)
0.48 kips	0.60 kips
DL + LL (CASE 1)	DL + LL (CASE 1)
1.10 kips	1.69 kips
DL + LL (CASE 2)	DL + LL (CASE 2)
3.68 kips	6.20 kips
DL + LL (CASE 3)	DL + LL (CASE 3)
2.5 kips	6.2 kips

MAXIMUM REACTIONS

SERVICE		ULTIMATE	
$R_s^L =$	4.1 kips	$R_u^L =$	6.8 kips
$R_s^R =$	4.1 kips	$R_u^R =$	6.8 kips

Shear Diagram (Factored Loads)



CASE 1: Uniform Live
CASE 2: Vehicle Wheel Load at 6"
CASE 3: Vehicle Wheel Load at Mid-span

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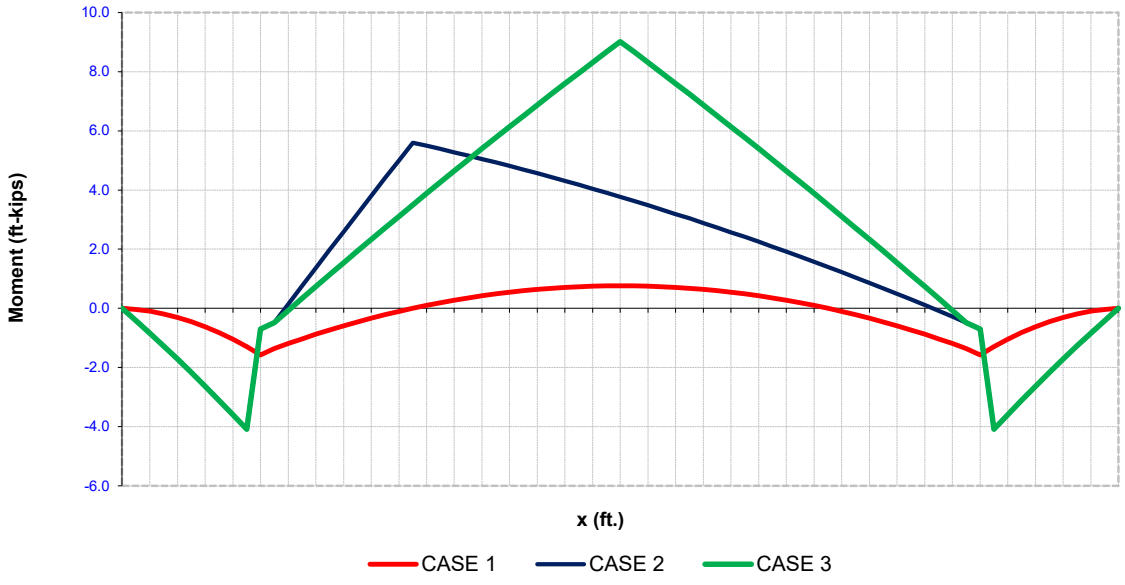
Job No.: 2020-1427 Sh. 6 of 8 Pg. 7
Project: CR 455 South Lake Trail
By: KAS Date: 9/20/2024

Analysis Load Summary

FLEXURAL DESIGN LOADS

	Service Moment		Ult. Moment	
DEAD LOAD (ONLY)				
$(+)M_s^{DL}$ =	0.22 k-ft	@ x=4.50 ft	$(+)M_u^{DL}$ = 0.27 k-ft	@ x=4.50 ft
$(-)M_s^{DL}$ =	-0.56 k-ft	@ x=7.00 ft	$(-)M_u^{DL}$ = -0.70 k-ft	@ x=7.00 ft
DL + LL (CASE 1)				
$(+)M_s^{LL}$ =	0.50 k-ft	@ x=4.50 ft	$(+)M_u^{LL}$ = 0.76 k-ft	@ x=4.50 ft
$(-)M_s^{LL}$ =	-1.06 k-ft	@ x=7.00 ft	$(-)M_u^{LL}$ = -1.57 k-ft	@ x=7.00 ft
DL + LL (CASE 2)				
$(+)M_s^{LL}$ =	3.20 k-ft	@ x=3.00 ft	$(+)M_u^{LL}$ = 5.60 k-ft	@ x=3.00 ft
$(-)M_s^{LL}$ =	-2.47 k-ft	@ x=7.20 ft	$(-)M_u^{LL}$ = -4.09 k-ft	@ x=7.20 ft
DL + LL (CASE 3)			**DL + LL (CASE 3) <==CONTROLS**	
$(+)M_s^{LL}$ =	5.22 k-ft	@ x=4.50 ft	$(+)M_u^{LL}$ = 9.02 k-ft	@ x=4.50 ft
$(-)M_s^{LL}$ =	-2.47 k-ft	@ x=7.20 ft	$(-)M_u^{LL}$ = -4.09 k-ft	@ x=7.20 ft

Moment Diagram (Factored Loads)



CASE 1: Uniform Live CASE 2: Vehicle Wheel Load at 1'-0" CASE 3: Vehicle Wheel Load at Mid-span

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Job No.: 2020-1427 Sh. 7 of 8 Pg. 8
Project: CR 455 South Lake Trail
By: KAS Date: 9/20/2024
Checked By: AMC

Tread Concrete Design

Controlling Flexural Design Parameters		
+Ms =	5.2 k-ft	Positive Flexure
+Mu =	9.0 k-ft	Positive Flexure
-Ms =	-2.5 k-ft	Cantilever Flexure
-Mu =	-4.1 k-ft	Cantilever Flexure

Shear Design Parameters	
Vs =	3.68 kips
Vu =	6.20 kips

Input value from Summary

Design Parameters		
ϕ =	0.90	(5.5.4.2)
fy =	60 ksi	
f'c =	5.0 ksi	
β =	0.8	

Effective Depth	
d1 =	3.63 in
d2 =	3.19 in

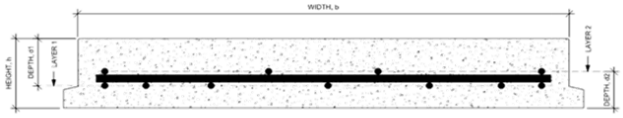
Tread	properties
Cover (Bottom)=	1.50 in
b =	33.38 in
h =	5.50 in

See 2.0 Loading Criteria

Flexural Reinforcing Size		# of Bars
Top Rein.	#5	3
Bottom Rein.	#6	4

+As provided =	1.77 in.^2
-As provided =	0.92 in.^2

Lateral Reinforcement	#5	18 in. oc



TREAD

STRENGTH LIMIT STATE REINFORCING CHECK per AASHTO LRFD 5.6.2.1 / 5.6.3.2

Positive Mid-span flexure

+Mu =	9.0 k-ft
c =	0.93 in
d =	3.63 in
c/d =	0.26
Tension Controlled Failure	
As req'd =	0.62 in.^2
As provided =	1.77 in.^2
$\phi M_n = \phi A_s f_y(d-a/2)$ =	25.9 k-ft
OK, phi*Mn>Mu	

OK

Mu:Mn = 0.35

Negative Cantilever flexure (if applicable)

-Mu =	-4.1 k-ft
c =	0.49 in.
d =	3.19 in
c/d =	0.15
Tension Controlled Failure	
As req'd =	0.30 in.^2
As provided =	0.92 in.^2
$\phi M_n = \phi A_s f_y(d-a/2)$ =	12.4 k-ft
OK, phi*Mn>Mu	

OK

Mu:Mn = 0.33

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Job No.: 2020-1427 Sh. 8 of 8 Pg. 9
Project: CR 455 South Lake Trail
By: KAS Date: 9/20/2024

Tread Concrete Design

SHEAR DESIGN (AASHTO 5.7.3.3)

Tread Shear

Vu =	**6.2 kips**
ϕv =	**0.90**
dv =	**3.96 in.**
(Per AASHTO 5.7.3.3-3) 'β =	**2**
ϕVc = ϕ0.0316*β*sqrt(f'c)*b*d =	**16.8 kips**
ϕVs =	**0.0 kips**

Shear OK (AASHTO 5.7.3.3-3)
Shear by concrete only

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Job No.: 2020-1427 Sh. 1 of 8 Pg. 10
Project: CR 455 South Lake Trail
By: KAS Date: 9/20/2024
Checked By: AMC

Beam Analysis - Dead Load

Input Data

Beam Span Data	
Left Cantilever, a =	0.00 ft
Middle Span, b =	22.33 ft
Right Cantilever, c =	0.00 ft
Total Beam Length, L =	22.33 ft
Beam Width,=	10.50 in.
Beam Depth =	14.00 in.

Loading Data

Tread DL	0.325 k/ft
Beam DL	0.153 k/ft
Total DL	0.478 k/ft

w^{DL}	0.478 k/ft

Beam Weight	3419.3 lbs

*Note: P^P not used for +M

DL Load Factor	1.25

Service Shear

Vmax = 5.34 k
Vmin = -5.34 k

Ult. Shear

Vmax = 6.67 k
Vmin = -6.67 k

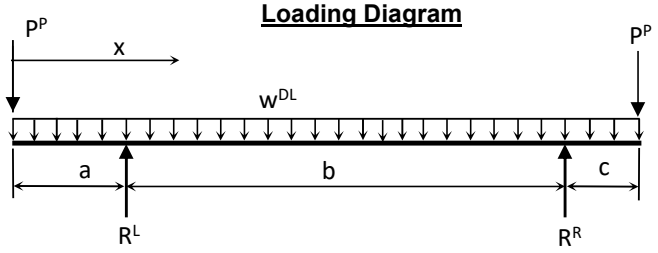
Service Moment

+Mmax = 29.81 k-ft
@ x=11.17 ft
-Mmax = 0.00 k-ft
@ x=0.00 ft

Ult. Moment

+Mmax = 37.26 k-ft
@ x=11.17 ft
-Mmax = 0.00 k-ft
@ x=0.00 ft

Loading Diagram



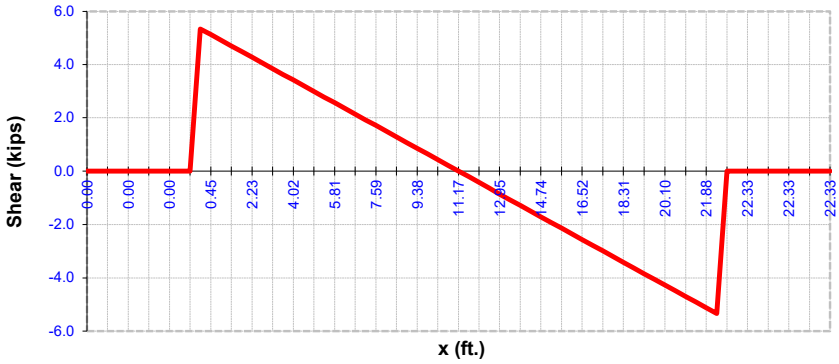
Service Reactions

R_s^L = 5.34 k, M_s^L = 0.00 k-ft
R_s^R = 5.34 k, M_s^R = 0.00 k-ft

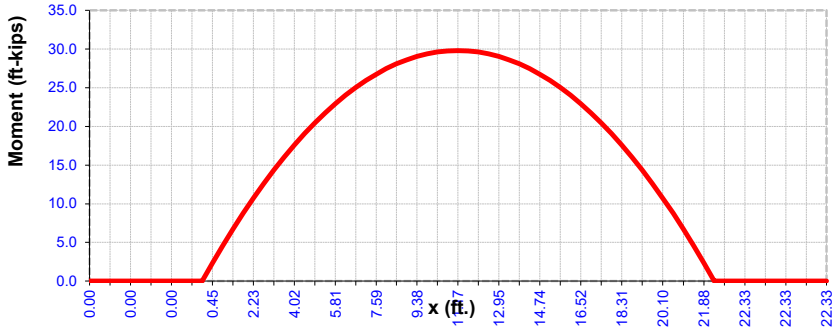
Ult. Reactions

R_u^L = 6.67 k, M_u^L = 0.00 k-ft
R_u^R = 6.67 k, M_u^R = 0.00 k-ft

Shear Diagram



Moment Diagram



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Job No.: 2020-1427 Sh. 2 of 8 Pg. 11
Project: CR 455 South Lake Trail
By: KAS Date: 9/20/2024
Checked By: AMC

Beam Analysis - Live Load (Uniform)

Input Data

Span Data	
Left Cantilever, a =	0.00 ft
Middle Span, b =	22.33 ft
Right Cantilever, c =	0.00 ft
Total Length, L =	22.33 ft

Loading Data

Uniform Live Load	
Pedestrian	90.00 psf
Tributary Width	4.50 ft
Beam Length	22.33 ft
Tributary Area	100.49 ft^2

See input data from 'Load Criteria'

w^{LL}	0.405 k/ft

LL Load Factor	1.75

Service Shear

Vmax = 4.52 k
Vmin = -4.52 k

Ult. Shear

Vmax = 7.91 k
Vmin = -7.91 k

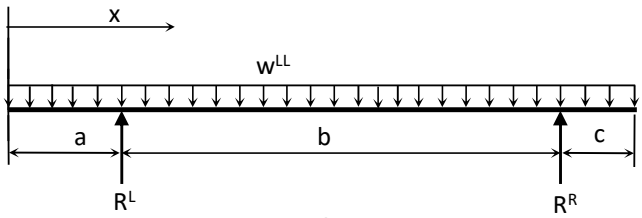
Service Moment

+Mmax = 25.24 k-ft @ x=11.17 ft
-Mmax = 0.00 k-ft @ x=0.00 ft

Ult. Moment

+Mmax = 44.18 k-ft @ x=11.17 ft
-Mmax = 0.00 k-ft @ x=0.00 ft

Loading Diagram



Service Reactions

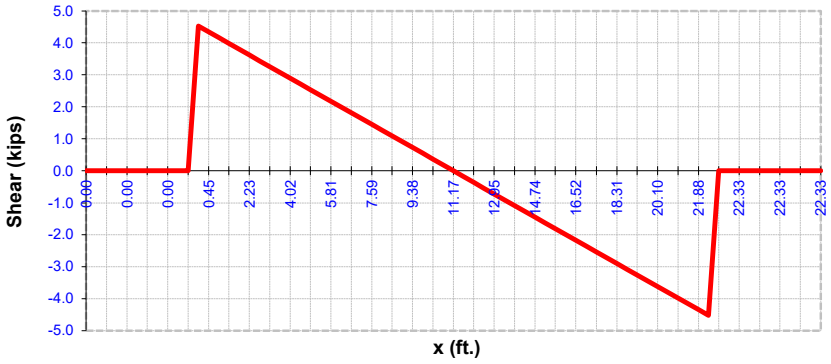
R_s^L = 4.52 k, M_s^L = 0.00 k-ft
R_s^R = 4.52 k, M_s^R = 0.00 k-ft

Ult. Reactions

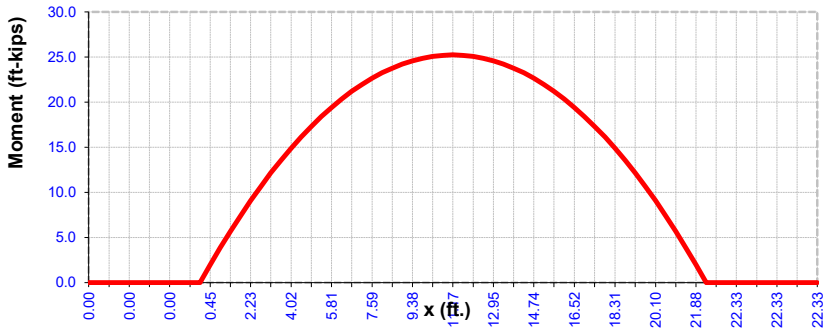
R_u^L = 7.91 k, M_u^L = 0.00 k-ft
R_u^R = 7.91 k, M_u^R = 0.00 k-ft

CASE 1: Uniform Live Load

Shear Diagram



Moment Diagram



PermaTrak
The Concrete Boardwalk Company

Job No.: 2020-1427 Sh. 3 of 8 Pg. 12
Project: CR 455 South Lake Trail
By: KAS Date: 9/20/2024
Checked By: AMC

Beam Analysis - Live Load (Vehicle)

H-5 Design Truck (10,000 lb. Vehicle)

Input Data

Span Data	
Left Cantilever, a =	0.00 ft
Middle Span, b =	22.33 ft
Right Cantilever, c =	0.00 ft
Total Length, L =	22.33 ft

Loading Data

Vehicular Loading	
Rear Wheel	4.00 kips
Front Wheel	1.00 kips
'z' dimension (width) =	14.00 ft

See input data from 'Load Criteria'

(axle width)

Contribution to Beam from entire axle load

Front Wheel	0.80 kips
Rear Wheel	3.20 kips
'z' dimension (width) =	14.00 ft

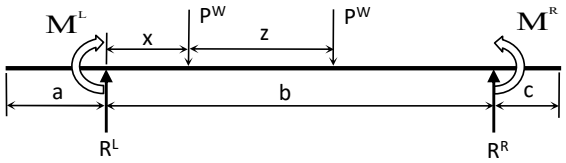
See Max Reaction data from 'Tread Load Summary'

(axle width)

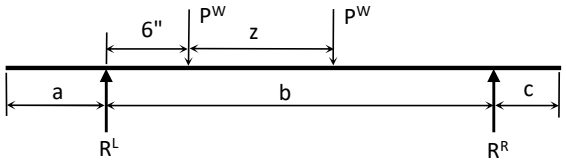
LL Load Factor 1.75

Loading Diagram

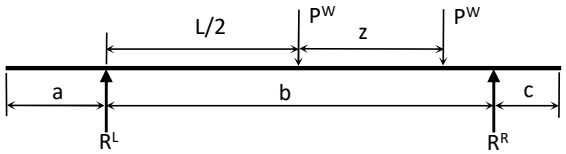
(assume loads do not act on cantilever)



CASE 2: 'x'= 0'-6"



CASE 3: 'x'= L/2



Case 4 (max reaction): Pw occurs 6" from edge of beam

Beam Design - Live Load (Vehicle)

CASE 2: 'x' = 0'-6"

Service Shear

VL = 5.49 k
VR = -5.49 k

Ult. Shear

VL = 9.61 k
VR = -9.61 k

Service Moment

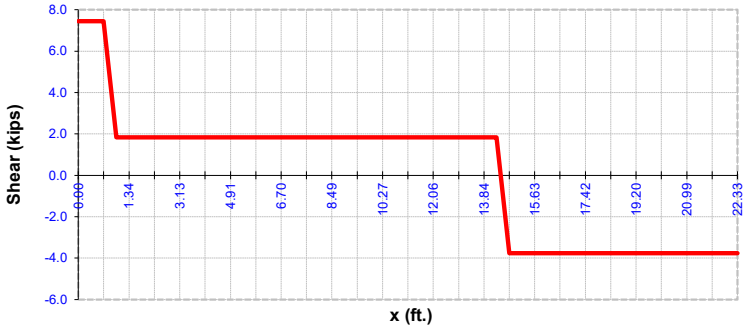
+Mmax = 22.3 k-ft
@ x=14.29 ft
-Mmax = 0.00 k-ft
@ x=0.00 ft

Ult. Moment

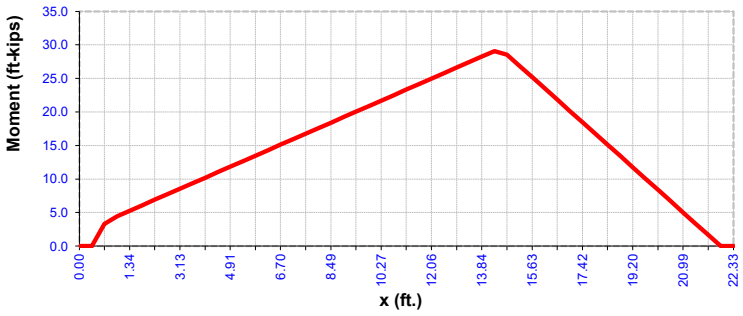
+Mmax = 39.08 k-ft
@ x=14.29 ft
-Mmax = 0.00 k-ft
@ x=0.00 ft

*Note (-)

Shear Diagram



Moment Diagram



CASE 3: 'x' = L/2

Service Shear

VL = 1.19 k
VR = -2.01 k

Ult. Shear

VL = 2.09 k
VR = -3.51 k

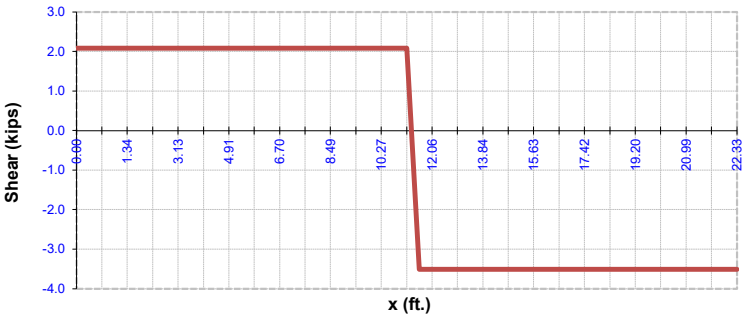
Service Moment

+Mmax = 22.3 k-ft
@ x=11.17 ft
-Mmax = 0.00 k-ft
@ x=0.00 ft

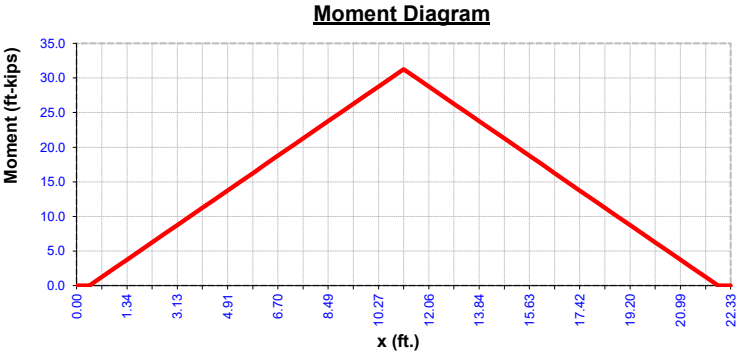
Ult. Moment

+Mmax = 39.08 k-ft
@ x=11.17 ft
-Mmax = 0.00 k-ft
@ x=0.00 ft

Shear Diagram



Moment Diagram



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Project: CR 455 South Lake Trail
By: KAS Date: 9/20/2024
Checked By: AMC

Beam Analysis Load Summary

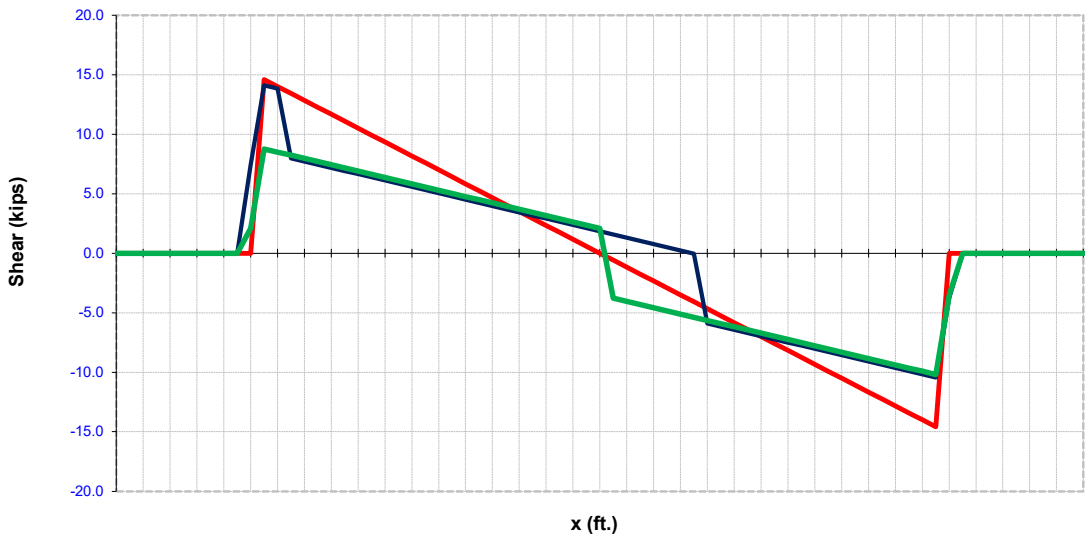
SHEAR DESIGN LOADS

Service	Ultimate
DEAD LOAD (ONLY)	DEAD LOAD (ONLY)
5.34 kips	6.67 kips
DL + LL (CASE 1)	DL + LL (CASE 1)
9.86 kips	14.59 kips
DL + LL (CASE 2)	DL + LL (CASE 2)
9.59 kips	14.11 kips
DL + LL (CASE 3)	DL + LL (CASE 3)
7.3 kips	10.2 kips

MAXIMUM REACTIONS

SERVICE		ULTIMATE	
$R_s^L =$	9.9 kips	$R_u^L =$	14.6 kips
$R_s^R =$	9.9 kips	$R_u^R =$	14.6 kips

Shear Diagram (Factored Loads)



CASE 1: Uniform Live
CASE 2: Vehicle Wheel Load at 6"
CASE 3: Vehicle Wheel Load at Mid-span

PermaTrak
The Concrete Boardwalk Company

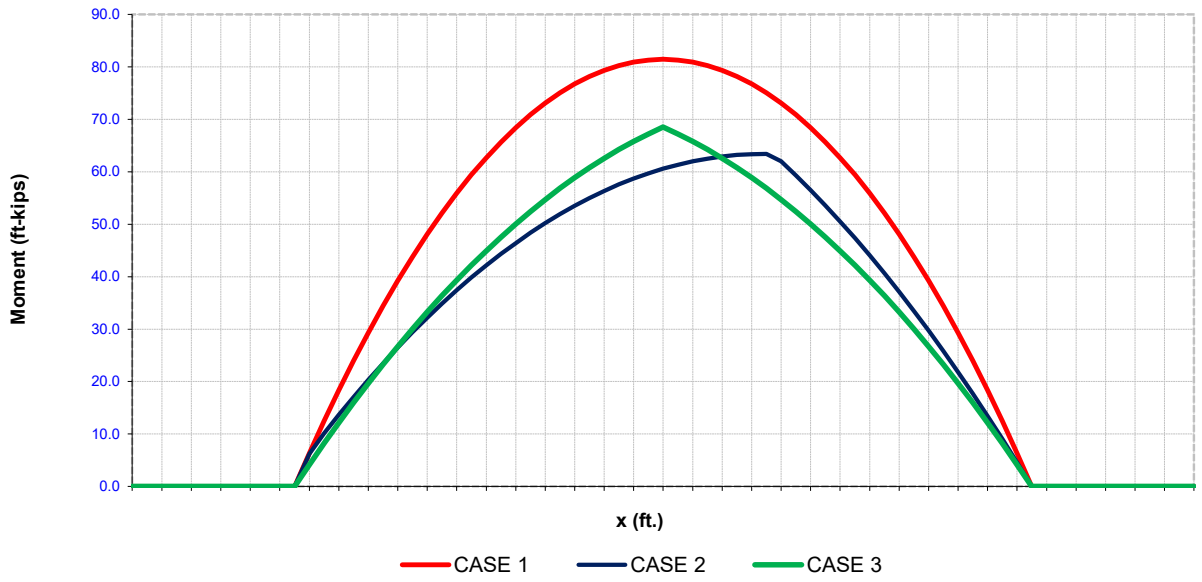
Job No.: 2020-1427 Sh. 6 of 8 Pg. 15
Project: CR 455 South Lake Trail
By: KAS Date: 9/20/2024

Analysis Load Summary

FLEXURAL DESIGN LOADS

	Service Moment		Ult. Moment	
DEAD LOAD (ONLY)				
$(+)M_s^{DL}$ =	29.81 k-ft	@ x=11.17 ft	$(+)M_u^{DL}$ = 37.26 k-ft	@ x=11.17 ft
$(-)M_s^{DL}$ =	0.00 k-ft	@ x=0.00 ft	$(-)M_u^{DL}$ = 0.00 k-ft	@ x=0.00 ft
DL + LL (CASE 1)			**DL + LL (CASE 1) <==CONTROLS**	
$(+)M_s^{LL}$ =	55.05 k-ft	@ x=11.17 ft	$(+)M_u^{LL}$ = 81.44 k-ft	@ x=11.17 ft
$(-)M_s^{LL}$ =	0.00 k-ft	@ x=0.00 ft	$(-)M_u^{LL}$ = 0.00 k-ft	@ x=0.00 ft
DL + LL (CASE 2)			**DL + LL (CASE 2)**	
$(+)M_s^{LL}$ =	44.29 k-ft	@ x=13.40 ft	$(+)M_u^{LL}$ = 76.34 k-ft	@ x=0.00 ft
$(-)M_s^{LL}$ =	0.00 k-ft	@ x=0.00 ft	$(-)M_u^{LL}$ = 0.00 k-ft	@ x=0.00 ft
DL + LL (CASE 3)			**DL + LL (CASE 3)**	
$(+)M_s^{LL}$ =	47.67 k-ft	@ x=11.17 ft	$(+)M_u^{LL}$ = 68.52 k-ft	@ x=11.17 ft
$(-)M_s^{LL}$ =	0.00 k-ft	@ x=0.00 ft	$(-)M_u^{LL}$ = 0.00 k-ft	@ x=0.00 ft

Moment Diagram (Factored Loads)



CASE 1: Uniform Live

CASE 2: Vehicle Wheel Load at 6"

CASE 3: Vehicle Wheel Load at Mid-span

PermaTrak
The Concrete Boardwalk Company

Job No.: 2020-1427 Sh. 7 of 8 Pg. 16
Project: CR 455 South Lake Trail
By: KAS Date: 9/20/2024
Checked By: AMC

Beam Concrete Design

Controlling Flexural Design Parameters		
+Ms =	55.1 k-ft	Positive Flexure
+Mu =	81.4 k-ft	Positive Flexure
-Ms =	0.0 k-ft	Cantilever Flexure
-Mu =	0.0 k-ft	Cantilever Flexure

Shear Design Parameters	
Vs =	9.86 kips
Vu =	14.59 kips

Input value from Summary

Design Parameters		
ϕ =	0.90	(5.5.4.2)
fy =	60 ksi	
f'c =	5.0 ksi	
β =	0.8	

Effective Depth	
d1 =	11.75 in
d2 =	11.00 in
d avg =	11.38 in
d3 =	11.81 in

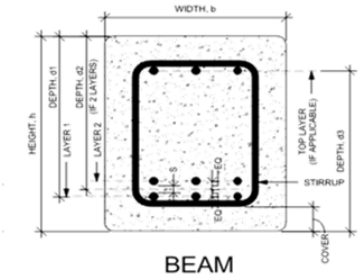
Beam properties	
Cover =	1.50 in
b =	10.50 in
h =	14.00 in

See 2.0 Loading Criteria

Flexural Reinforcing Size	# of Bars
Layer 1	#6	3
Layer 2	#6	2
Top Layer	#5	2
Space, s	0 in.	

+As provided =	2.21 in.^2
- As provided =	0.61 in.^2

Shear Reinforcing Size	Spacing
Stirrup	#3	6 in. oc



BEAM

STRENGTH LIMIT STATE REINFORCING CHECK per AASHTO LRFD 5.6.2.1 / 5.6.3.2

Positive Mid-span flexure

+Mu =	81.4 k-ft
c	3.71 in
d =	11.38 in
c/d =	0.33
Tension Controlled Failure	
As req'd =	1.91 in.^2
As provided =	2.21 in.^2
$\phi M_n = \phi A_s f_y(d-a/2)$ =	98.3 k-ft
OK, phi*Mn>Mu	

OK

Mu:Mn = 0.83

Negative Cantilever flexure (if applicable)

$\phi M_n = \phi A_s f_y(d-a/2)$ =	N/A

Beam Concrete Design

SHEAR DESIGN (AASHTO 5.7.3.3)

Beam Shear		
Vu =	14.6 kips	
ϕv =	0.90	
(AASHTO 5.7.3.3-3) 'β =	2	*Per AASHTO 5.7.3.3-3*
ϕVc =	13.7 kips	
ϕVs =	20.4 kips	
Shear Reinf. Req ?	YES	
Av (min) =	0.009 in.^2	
vu =	0.151 ksi	*<0.125fc'*
dv =	10.24 in.	
smax =	8.19 in.	
s =	6.00 in.	
Av =	0.22 in.^2	
ϕVc + ϕVs =	34.0 kips	*Shear OK*

Service Deflection (AASHTO 5.6.3.5.2)

Midspan Deflection		
n =	7.20	
$\rho = A_{sprov}/bd$ =	0.0185	
k =	0.400	
jd =	9.86	
fr =	0.537 ksi	
Ig =	2401.0 in.^4	
Mcr =	15.3 k-ft	
Icr =	1070.0 in.^4	
Ie =	1098.8 in.^4	
Δ limit = L/360 =	*0.744*	
Δ (uniform)=	0.512 in.	*OK*
Δ (wheel)=	0.362 in.	*OK*