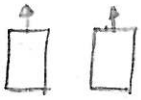
TranSystems

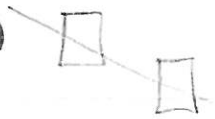
Made By: BKC	Date: 3/25/09	Job No: P410 07 0010	
Checked By: GHD	Date: 4/7/09	Sheet No.	1 / 9

COLUMBIA PARKWAY

LIVE LOADS

TRYING TWO TRUCK PATTERNS

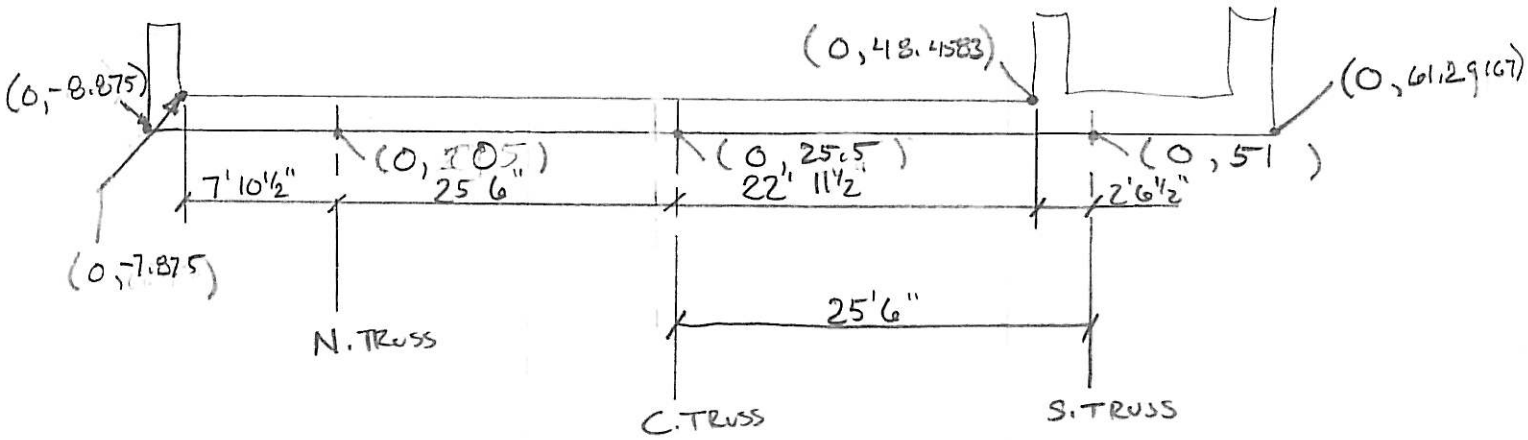
1)  TRUCKS ALIGNED AT SAME HORIZ. POINT (⊥ TO BRIDGE ℄)

2)  TRUCKS ALIGNED ALONG SKEW. SINCE BRIDGE IS AT 2 PANEL SKEW PLACE REAR WHEELS SO 2 PANEL POINTS APART.

BRIDGE WIDTH 56'4" CURB/CURB

$\frac{56.33'}{12'/\text{LANE}} = 4.69$ LANES USE 4 LANES. $56.33 - 48.00' = 8.33'$

(X, Z)

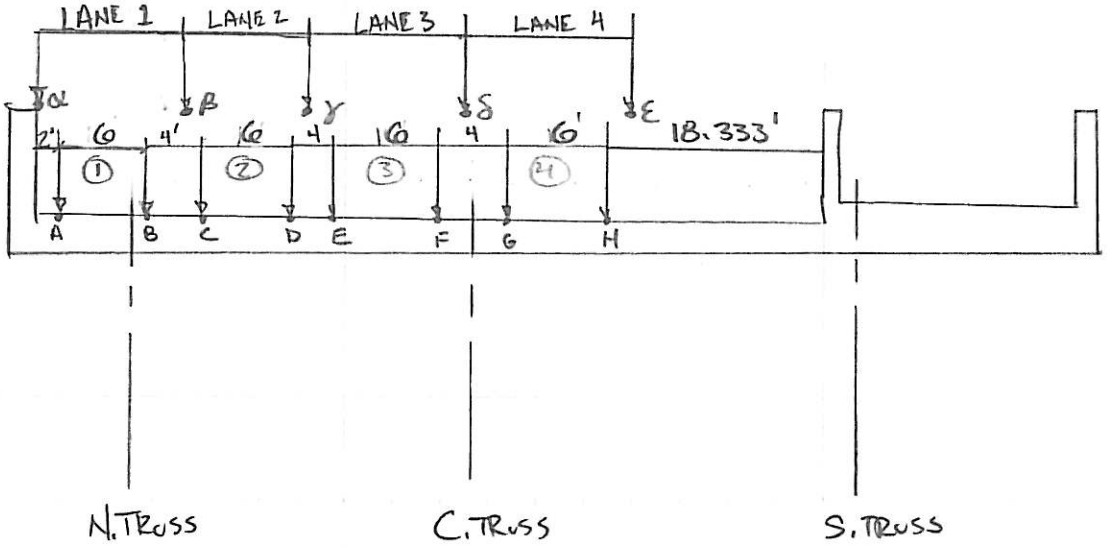


WILL HAVE 2 LANE CONFIGURATIONS

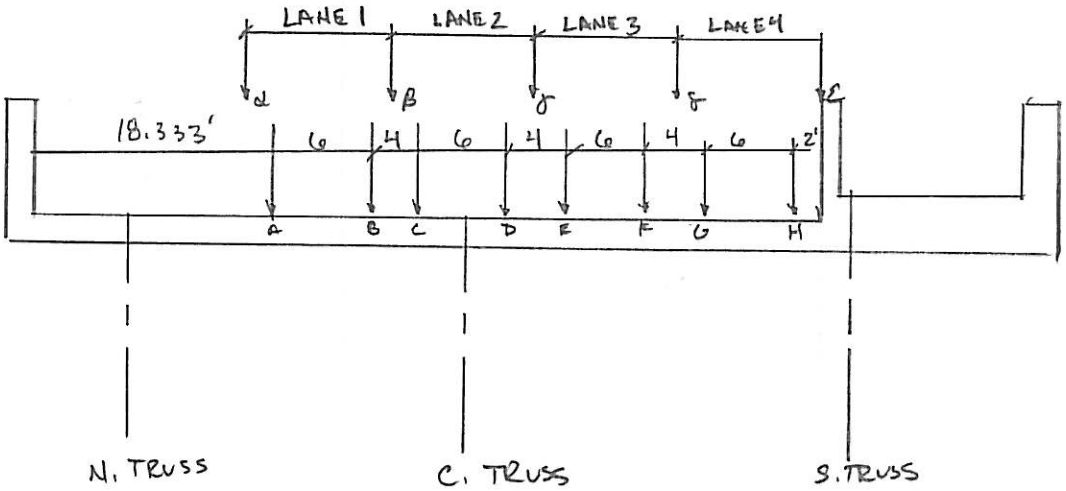
A) ADJUSTED TO FAR NORTH RAIL
B) ADJUSTED TO FAR SOUTH RAIL
C) ADJUSTED TO CENTER TRUSS

Calculations for 1/4 US Grid

LANE CONFIGURATION A



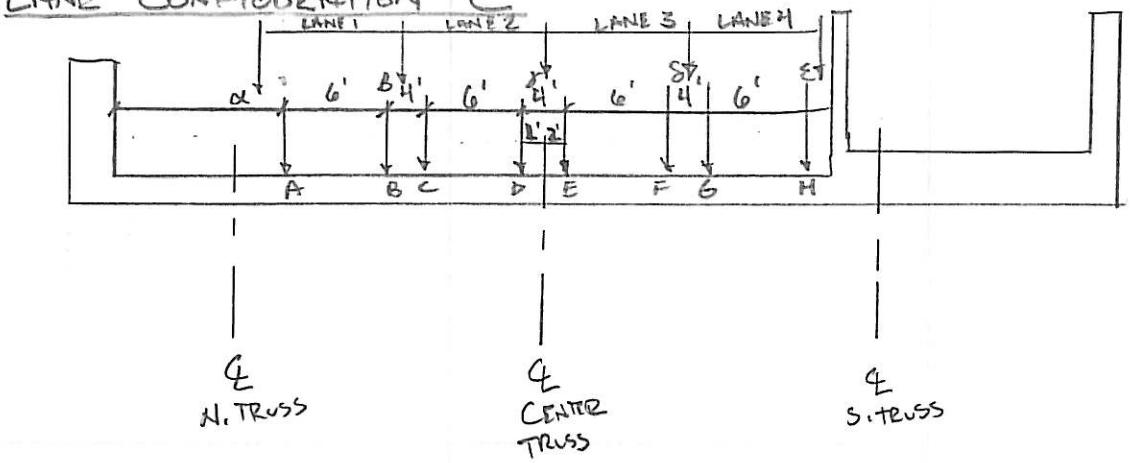
LANE CONFIGURATION B



	CONFIG. A	CONFIG B
A	(0, -5.875)	(0, 10.45833)
B	(0, 0.125)	(0, 16.45833)
C	(0, 4.125)	(0, 20.45833)
D	(0, 10.125)	(0, 26.45833)
E	(0, 16.125)	(0, 30.45833)
F	(0, 20.125)	(0, 36.45833)
G	(0, 24.125)	(0, 40.45833)
H	(0, 30.125)	(0, 46.45833)

	CONFIG A	CONFIG. B
α	(0, -7.875)	(0, 8.4583)
β	(0, 2.125)	(0, 18 4583)
γ	(0, 12.125)	(0, 28.4583)
δ	(0, 22.125)	(0, 38.4583)
ε	(0, 32.125)	(0, 48.4583)

LANE CONFIGURATION C



CONFIG. C

A (0, 7.5)
B (0, 13.5)
C (0, 17.5)
D (0, 23.5)
E (0, 27.5)
F (0, 33.5)
G (0, 37.5)
H (0, 43.5)

CONFIG C

α (0, 5.5)
β (0, 15.5)
γ (0, 25.5)
δ (0, 35.5)
ε (0, 45.5)

HS-20 TRUCK POSITION STARTING POINTS

RIGHT WHEEL POINTS B, D, F, H $\hat{Y} = 24 + 0.03037 \times \hat{X}$

N. TRUSS STARTS $\overset{X}{(0}, \overset{Z}{0)}$ C. TRUSS STARTS (21.6251, 25.5) S. TRUSS STARTS (42.5, 51)

INCREMENTING TRUCKS BY 1 PANEL POINT $\Delta X = 10.1625$ $\Delta Y = 0.32268125$

LANE A CONFIGURATION

PATTERN 1 (SIDE BY SIDE)

TRUCK 1 (-28, 0.125)
TRUCK 2 (-28, 10.125)
TRUCK 3 (-28, 20.125)
TRUCK 4 (-28, 30.125)

PATTERN 2 (STAGGERED)

TRUCK 1 (-28, 0.125)
TRUCK 2 (-19.5196, 10.125)
TRUCK 3 (-11.0392, 20.125)
TRUCK 4 (-2.5588, 30.125)

SKEW $= \frac{21.625'}{25.5'} \frac{(\hat{X})}{(\hat{Z})} = 0.84804 \left(\frac{\hat{X}}{\hat{Z}}\right)$

$0.84804 = \frac{(-28 - x_2)}{(0.125 - 10.125)}$

ΔX

$-1(8.4804 + 28) = x_2$

HS-20 TRUCK POSITION - CONT'D

LANE B CONFIGURATION

PATTERN 1 (SIDE BY SIDE)

TRUCK 1	(-14.04267, 16.45833)
TRUCK 2	(-14.04267, 26.45833)
TRUCK 3	(-14.04267, 36.45833)
TRUCK 4	(-14.04267, 46.45833)

PATTERN 2 (STAGGERED)

TRUCK 1	(-14.04267, 16.45833)
TRUCK 2	(-5.56227, 26.45833)
TRUCK 3	(2.91813, 36.45833)
TRUCK 4	(11.39853, 46.45833)

LANE C CONFIGURATION

PATTERN 1 (SIDE BY SIDE)

TRUCK 1	(-16.55146 13.5)
TRUCK 2	(-16.55146 23.5)
TRUCK 3	(-16.55146 33.5)
TRUCK 4	(-16.55146 43.5)

PATTERN 2 (STAGGERED)

TRUCK 1	(-16.55146 13.5)
TRUCK 2	(-8.0742 23.5)
TRUCK 3	(0.41062 33.5)
TRUCK 4	(8.8866 43.5)

LANE LOAD APPLICATION

NORTH PORK CHOP	-8.875 ← Z → 0	L = 8.875	(STARTS Z = 0)
NORTH FLOORBEAM	0 ← Z → 25.5	L = 25.5	(STARTS Z = 25.5)
SOUTH FLOORBEAM	25.5 ← Z → 51	L = 25.5	(STARTS Z = 51)

ASSUMING IN LANE LOAD INTERIOR (IE NOT BY LIMITS)

LL = LANE LOAD LOT @ FB, DIST FROM MEM START TO START LOAD, LENGTH OF LOAD

LANE A CONFIGURATION

NORTH PORK CHOP	LL, 0', 7.875'
NORTH FLOORBEAM	LL, 0', 25.5'
SOUTH FLOORBEAM	LL, 19.04167, 6.4583'

LANE B CONFIGURATION

NORTH PORK CHOP	0, 0, 0
NORTH FB	LL, 0, 17.04167'
SOUTH FB	LL, 0, 25.5

LANE C CONFIGURATION

NORTH PORK CHOP	0, 0, 0
NORTH FB	LL, 0, 20'
SOUTH FB	LL, 5.5, 20

Calculations for 1/4 US Grid

LIVE LOADS

IMPACT WILL BE TAKEN INTO ACCOUNT IN THE RATING SHEETS, MODEL WILL USE UNFACTORED AXLE LOADS

FOR RATING SHEETS

STRUCTURE 1 (SPANS 5-7)

SPAN 5-6 L = 86' $I = \frac{50}{86+125} = 0.237$

SPAN 6-7 L = 127'6" $I = \frac{50}{127.5+125} = 0.198$

STRUCTURE 2 (SPANS 7-10)

SPAN 7-8 L = 148'9" $I = \frac{50}{148.75+125} = 0.183$

SPAN 8-9 L = 170'0" $I = \frac{50}{170+125} = 0.169$

SPAN 9-10 L = 148'9" $I = 0.183$

STRUCTUR 3 (SPANS 10-12)

SPAN 10-11 L = 127'6" $I = 0.198$

SPAN 11-12 L = 86' $I = 0.237$

Calculations for 1/4 US Grid

LANE LOADS

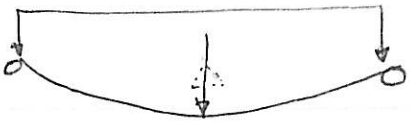
SPANS 5-7 / 10-12



MAX NEG MOMENT AT PIER

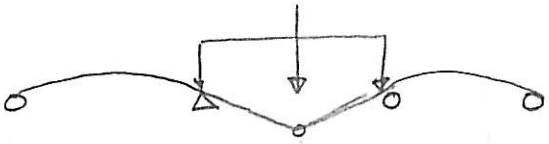


MAX NEG. MOM. MID SPAN (UNLOADED)
MAX POS. MOM. MIDSPAN (LOADED)



MAX SHEAR AT PIER

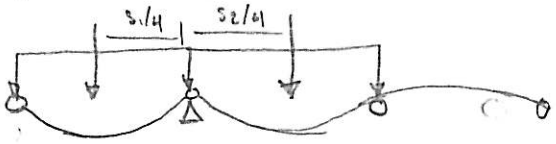
SPANS 7-10



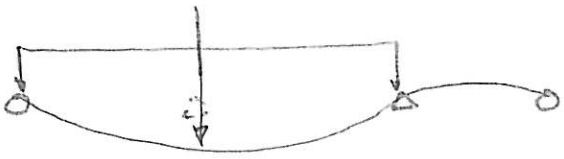
MAX NEG. MOM. END SPANS / POS. MOM. MAIN SPAN



MAX NEG. MOM. MAIN SPAN / POS. MOM END SPANS



MAX NEG MOM @ PIER
(NEED DO SYM.)

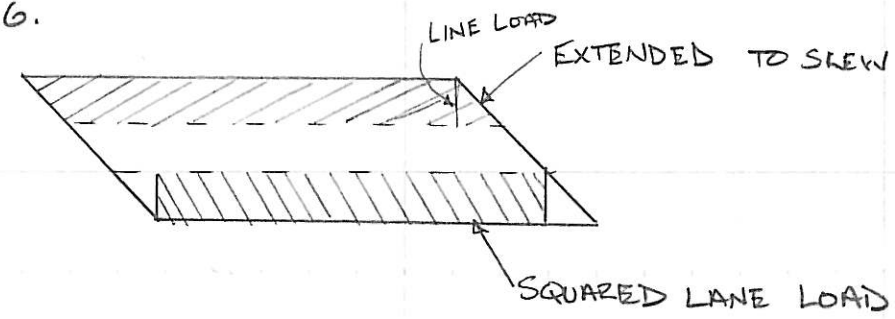


MAX SHEAR @ PIER
(NEED DO SYM.)

LANE LOADS

PER DISCUSSION WITH MDP 3/29/09 10:30 AM; IT WOULD BE MORE CONSERVATIVE TO ASSUME LL EXTEND IN SKEWED DIMENSIONS. RATHER THAN USING SQUARED CORNERS.

E.G.



TO BE MORE CONSERVATIVE WE WILL USE A SKEW LANE LOAD BUT WILL APPLY LINE LOADS ⊥ TO LANE

FROM ODOT MEETING IN FEB. 2009, THE LINE LOADS WILL HAVE 2 DIFFERENT VALUES - ONE FOR CHECKING TOP/BOT CHORDS 18 kips (1.8 K/ft)
- ONE FOR CHECKING WEBS (VERTS/DIAG) 26 K (2.6 K/ft)

LANE LOAD 0.640 ksf

WITH THE TAPERED ENDS THERE WILL BE DIFFERENT LOADING AT END LOCATIONS.

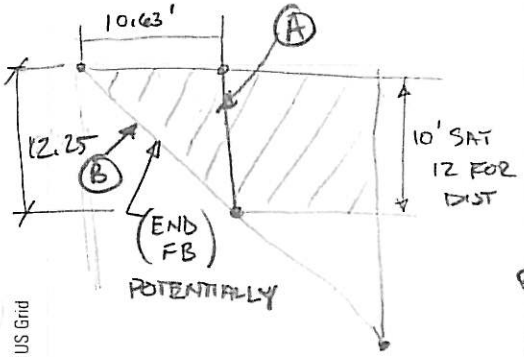
INT. FB. PP(10.6302) x 0.640 ksf = 6.803 K/ft

K/ft

INCORRECT SHOULD BE 0.0640 ksf x 10.6302 ∴ 0.6803 K/ft

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EXT. FB

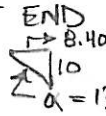


AT INT. PIER (A) WOULD TAKE 1/2 IN SQUARE TO RIGHT
ASSUME IT WOULD TAKE ENTIRE TRIANGULAR LOAD TO LEFT.

AT END. PIER (A) WOULD TAKE 1/2 OF SQUARE TO RIGHT AND WILL TAKE 1/2 OF TRIANGLE (1/4 OF LOAD)
(B) WOULD TAKE OTHER 1/2 OF TRIANGLE

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0.51025
0.1302

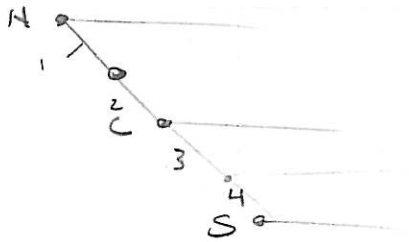
AT END DETAIL (A) 3/4 x 10.6302' x 0.640 ksf = 5.1025 K/ft (FOR 10' ALONG FB)



(B) 1/4 x 10.6302' x 0.640 ksf x 10' = 1.302 K/ft (FOR 13.0624' ALONG FB)

Calculations for 1/4 US Grid

APPLICATION OF LANE LOADS TO END DETAILS



LANE CONFIGURATION A

N. PORK CHOP – END FB 1/2 LOAD
N FB – 3/4 @ END
S FB – 9 3/4 @ ENDS (
N FB END – 1/4 FOR FULL LENGTH (1,2)
S FB END – 1/4 FOR LENGTH 8.69' STARTING 7.910 (TOT L 16.59678)

LANE CONFIGURATION B

N. P. C. – NONE
N. FB – 3/4 @ END
S. FB – 3/4 @ ENDS
N. FB END – 1/4 FOR ① LENGTH 5.16638 STARTING 0 ② FULL LENGTH (TOTAL L=16.59678)
S. FB END – 1/4 FOR FULL LENGTH (3,4)

LANE CONFIGURATION C

N. FB – 3/4 @ END
S. FB – 3/4 @ END
N. END FB 1/4 x ② FULL LENGTH ① LENGTH 9.625 STARTING 0 (TOTAL L=16.5978)
S. END FB 1/4 x ③ FULL LENGTH ③ LENGTH 9.625 STARTING 6.97206 (TOTAL L=16.5978)

LANE LOAD LOAD CASES

✓ LOAD 1 : CONFIG. A - STRUCT 1/3 NEG MOM. PIER (UC/LC AXLE)
2 " " B – " " "
3 " " C – " "
✓ LOAD 4-6: CONFIG A-C STRUCT 1/3 NEG MOM. PIER (WEB AXLE)
✓ LOAD 7-9: CONFIG A-C STRUCT 1/3 ANTI-SYM. SPAN 5-6 (UC/LC AXLE)
✓ LOAD 10-12: CONFIG A-C STRUCT 1/3 ANTI-SYM SPAN 5-6 (WEB AXLE)
✓ LOAD 13-15: CONFIG A-C STRUCT 1/3 ANTI SYM SPAN 6-7 (UC/LC AXLE)
✓ LOAD 16-18: CONFIG A-C STRUCT 1/3 ANTI SYM SPAN 6-7 (WEB AXLE)
✓ LOAD 19-21: CONFIG A-C STRUCT 1/3 PIER SHEAR (WEB AXLE)

✓ LOAD 22-24: CONFIG A-C STRUCT 2 MAIN SPAN LOAD (UC/LC AXLE)
✓ LOAD 25-29: CONFIG A-C STRUCT 2 MAIN SPAN LOAD (WEB AXLE)
✓ LOAD 28-30: CONFIG A-C STRUCT 2 END SPAN LOAD (UC/LC AXLE)
✓ LOAD 31-33: CONFIG A-C STRUCT 2 END SPAN LOAD (UC/LC AXLE)
✓ LOAD 34-36: CONFIG A-C STRUCT 2 MAX NEG MOM PI (UC/LC AXLE)
✓ LOAD 37-39: CONFIG A-C STRUCT 2 MAX NEG MOM PI (WEB AXLE)

Calculations for 1/4 US Grid

LANE LOADS APPLICATION CONT'D

LANE LOAD - LOAD CASES CONT'D

✓LOAD 42-44 : CONFIG A-C STRUCT 2 MAX NEG MOM P2 (UC/LC AXLE)
✓LOAD 45-47 : CONFIG A-C STRUCT 2 MAX NEG MOM. P2 (WEB AXLE)
✓LOAD 48-50 : CONFIG A-C STRUCT 2 MAX SHEAR P1 (WEB AXLE)
LOAD 51-53 : CONFIG A-C STRUCT 2 MAX SHEAR P2 (WEB AXLE)

LANE LINE LOAD (DIST. START NODE TO START LOAD, DIST. START NODE TO END OF LOAD)

CONFIGURATION A

	N. PORK CHOP	N. FLOORBEAM	S. FLOORBEAM
LANE 1	(0, 7.875)	(23.375, 25.5)	—
LANE 2	—	(13.375, 23.375)	—
LANE 3	—	(3.375, 13.375)	—
LANE 4	—	(0, 3.375)	(18.875, 25.5)

CENTER LANES 1/2 ABOUT N. TRUSS, 3/4 ABOUT CENTER TRUSS

CONFIGURATION B

	N. FLOORBEAM	S. FLOORBEAM
LANE 1	(7.0417, 17.0417)	—
LANE 2	(0, 7.0417)	(22.5417, 25.5)
LANE 3	—	(12.5417, 22.5417)
LANE 4	—	(2.5417, 12.5417)

CENTER LANES 1-2 ABOUT C. TRUSS, 3/4 ABOUT S. TRUSS

CONFIGURATION C

	N. FLOORBEAM	S. FLOORBEAM
LANE 1	(10, 20)	—
LANE 2	(0, 10)	—
LANE 3	—	(15.5, 25.5)
LANE 4	—	(5.5, 15.5)

CENTER LANES 1-H ABOUT C. TRUSS

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Made By: BKC Date: 04/03/09 Job No: P4P 070010

Checked By: GHD Date: 4/7/09 Sheet No. 1

COLUMBIA PARKWAY – SIDEWALK LOAD

SIDEWALK ON SOUTH SIDE OF BRIDGE. → 10'8" (W) WIDE F/F RAILS

		L	LOADING	INT FB	EXT FB
SPAN LENGTHS	5-6	85'	60psf	6.78K	3.39K
	6-7	127'6"	47.5psf	5.37K	2.68K
	7-8	148'9"	44.5psf	5.03K	2.52K
	8-9	170'	42.25 psf	4.78K	2.39K
	9-10	148'9"	44.5 psf	5.03K	2.52K
	10-11	127'6"	47.5psf	5.37K	2.68K
	11-12	85'0"	60psf	6.78K	3.39K

$L > 100'$

$$\left(30 + \frac{3{,}000}{L}\right)\left(\frac{55 - W}{50}\right) \leq 60psf \quad \text{AASHTO } 3.14.1.1 \quad (3\text{-}3)$$

FLOOR BEAMS ARE SPACED @ 10.579 OC (10'7 3/16") ALONG DECK

INT FB = LOADING x SW WIDTH x FB SPACING

EXT FB = " " x 1/2

THE SIDE WALK IS ALMOST ENTIRELY OVER THE S. CANTILEVER WILL ASSUME THE LOAD IS REPRESENTED AS A DISTRIBUTED LOAD OVER 10.292'

SPAN	INT FB	EXT FB
5-6	0.659 K/ft	0.329 K/ft
6-7	0.522 K/ft	0.261 K/ft
7-8	0.489 K/ft	0.244 K/ft
8-9	0.464 K/ft	0.232 K/ft
9-10	0.489 K/ft	0.244 K/ft
10-11	0.522 K/ft	0.261 K/ft
11-12	0.659 K/ft	0.329 K/ft

PER ODOT BDM 906 USE 50%

INT FB	EXT FB
0.330 K/ft	0.165 K/ft
0.261 K/ft	0.131 K/ft
0.245 K/ft	0.122 K/ft
0.232 K/ft	0.116 K/ft
0.245 K/ft	0.122 K/ft
0.261 K/ft	0.131 K/ft
0.330 K/ft	0.165 K/ft

BKC 4/16/09

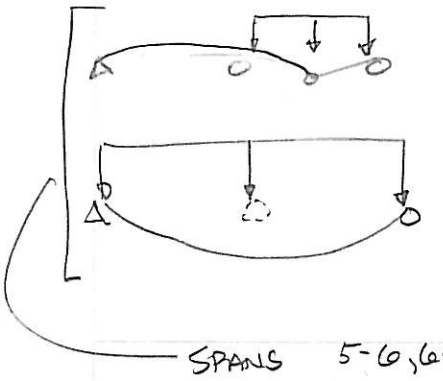
Calculations for 1/4 US Grid

TranSystems

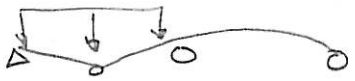
Made By:	BKC	Date:	04/03/09	Job No:	9110 07 0010
Checked By:	GHD	Date:	4/7/09	Sheet No.	2

COLUMBIA PARKWAY - SW LOAD

THE SW LOADING PATTERNS WILL MIMIC LANE LOAD PATTERNS



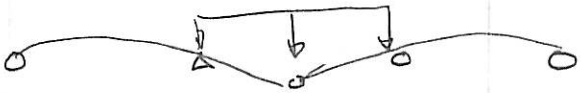
OR



MAX POS. MOM LOADED SPAN
NEG MOM. OPPOSITE SPAN

MAXIMIZE SHEAR

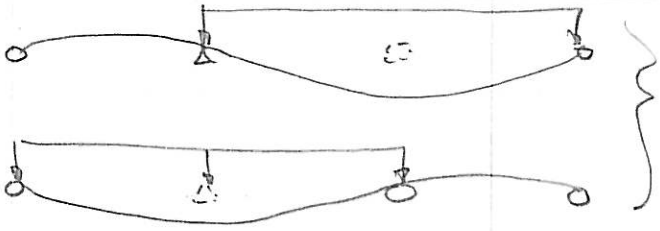
SPANS 5-6, 6-7 & 10-11, 11-12



MAX. POS. MOMENT MAIN
MAX NEG MOM. END



MAX POS. END SPANS
MAX NEG MAIN



MAX SHEAR

Calculations for 1/4 US Grid