HAM-50-0376 RATING ANALYSIS PROCEDURE

HAM-50-0376 TRUSS ANALYSIS

A DEAD LOADS →

(I) TRUSS →

1. DETAIL Factor calculations for
   - Vertical / Diagonal members
   - Lower chord members
   - Upper chord members.
2. Section Properties of members
3. Weight of truss
   - Length of each member
   - Horizontal sway bracing is divided between two trusses.

(II) RAILING, SLAB and Haunch Loads →

1. Railing load (applied compositely to each beam) — includes
   - 2W beams
   - Type 1 post
   - bolts and plates.
2. Slab loads (applied compositely to each beam) — includes wt. of Slab, haunch and curb.

(III) DIAPHRAGM LOADS → applied non compositely

(IV) Stringer Weights.

(V) Model railing, slabs, diaphragm loads on the stringer using STAAD to get Dead Load reactions on floor Beams at the stringer

HAM-50-0576 TRUSS ANALYSIS

locations and calculate panel point reactions (Dead load reactions from floor beams onto truss).

(B) DEAD LOADS FOR LARS INPUT →

(I) TRUSS INPUT → (1) Truss weight (as uniform load)

(2) Panel point reactions at floor beam locations

(II) Stringer INPUT → (1) Railing, Slab and Haunch Load (uniform load)

(2) Diaphragm load

NOTE: Stringer size is input in LARS and LARS computes self weight of stringer based on the input member size.

(III) FLOOR BEAM INPUT — (1) Floor Beam reactions from STAAD includes

(i) Slab loads

(ii) Diaphragm loads

(2) Haunch and/or Slab loads.

(3) Stringer Dead Loads

NOTE: Floor beam size is input in LARS and LARS computes self weight of Floor beams based on the input member size.

(C) DISTRIBUTION FACTORS → LARS takes no. of wheels as the input for Distribution factor:—

(I) D.F. for stringers

(II) D.F. due to two trucks placed close to one truss

(III) (1) D.F. due to one truck placed in lane closer to the truss

(2) D.F. due to one truck placed in the other lane.

HAM-50-0376 TRUSS ANALYSIS

D LIVE LOAD VEHICLES →

(I) INVENTORY → AASHTO HS-20-44 (Truck and Lane)

(II) OPERATING → 1 AASHTO HS-20-44 (Truck and Lane)

2 2F1

3 3F1

4 4F1

5 5C1

6 BDM article 911.2.2.2 states that place as many no. of 5C1 trucks (36' apart) as the span can accomodate fully in right lane and place a single 5C1 truck in the left lane so as to maximize the force in the member under consideration. (This applies to spans of 200' or more. However, we have used this for 191' truss as well)

E LARS RUNS →

(I) MAIN RUN → For Inv. level (HS20), Opr. level (HS20, 2F1, 3F1, 4F1, 5C1)

(II) Right lane Run – 250' truss — 3(5C1 trucks) seperated by 36' (5C1T)
191' truss — 2(5C1 trucks) seperated by 36' (5C1T2 in LARS)

(III) Left lane Run — Single 5C1 Truck in the right lane

* Results from (II) and (III) are combined to get Operating level rating of BDM 911.2.2.2

SPANS 1 AND 4
(191'-4" TRUSS)

WEIGHT OF TRUSS

1. SPANS 1 AND 4

Made By	PJP	Date	10/10/2008
Checked By	SSM	Date	10/13/2008

Job No. P402060028
Sheet No. 1/1

HAM-50-0376L

SELFWEIGHT OF TRUSS SPANS 1 AND 3

CALCULATION OF TRUSS MEMBER WEIGHT

Member	Description	Area (in^2)	Nominal Wt. plf	Number	Length ft.	Detail Factor	Weight (pounds)	
L0 U1	2-C15x50 1 PL 21x9/16	41.233	140	2	36.8240	1.23	12710	UPPER CHORD
U1 U2	2-C15x40 1 PL 21x1/2	33.900	115	2	24.4861	1.23	6950	
U2 U3	2-C15x40 1 PL 21x11/16	37.838	129	2	23.9806	1.23	7600	
U3 U4	2-C15x50 1 PL 21x9/16	41.233	140	2	23.9167	1.23	8260	
L0 L2	2 PL 15x3/4	22.500	77	2	47.8333	1.42	10410	LOWER CHORD
L2 L3	2 PL 15x11/16 2 PL 15x3/8	31.875	108	2	23.9167	1.42	7370	
L3 L4	2 PL 15x11/16 2 PL 15x9/16	37.50	128	2	23.9167	1.42	8670	
U1 L2	12WF58		58	2	36.8240	1.11	4750	DIAG.
U2 L3	12WF53		53	2	40.9582	1.11	4820	
U3 L4	12WF36		36	4	42.3911	1.11	6780	
U1 L1	12WF40		40	2	28.0000	1.11	2490	HANGERS
U2 L2	12WF65		65	2	33.2500	1.11	4800	
U3 L3	12WF36		36	2	35.0000	1.11	2800	
U4 L4	12WF36		36	1	35.0000	1.11	1400	
SUBSTRUTS	12WF36		36	2	23.9167	1.11	1920	
							0	
				SUBTOTAL 1 TRUSS =			91730	
				TOTAL 2 TRUSSES =		x2	183460	

CALCULATION OF SWAY BRACING WEIGHT

Member	Description	Nominal Wt. plf	Number	Length ft.	Detail Factor	Weight (pounds)
U1 & U7	8WF28	28	4	38.8333	1.22	5310
U2 & U6	8WF28	28	4	38.8333	1.22	5310
U3 & U5	8WF28	28	4	38.8333	1.22	5310
U4	8WF28	28	2	38.8333	1.22	2660
U1 & U7	8WF17	17	12	10.2000	1.22	2540
U2 & U6	8WF17	17	8	22.8180	1.22	3790
U3 & U5	8WF17	17	8	23.7217	1.22	3940
U4	8WF17	17	4	23.7217	1.22	1970
PANEL 2&7	ST8WF18	18	4	45.9057	1.22	4040
PANEL 3&6	ST8WF19	18	4	45.6381	1.22	4010
PANEL 4&5	ST8WF20	18	4	45.6046	1.22	4010
					TOTAL =	42890

TOTAL WEIGHT OF TRUSSES	226350 pounds
SPAN LENGTH	191.33 ft.
TRUSS WEIGHT PER FOOT	1183.1 plf
LOAD APPLIED TO EA TRUSS	$\boxed{591.55 \text{ plf}}$ ← Input into LARS

See 250' truss calculations for detail factors

RAILING, SLAB AND HAUNCH LOADS

1. RAILING LOAD
2. SLAB LOAD
3. DIAPHRAGM LOAD

TranSystems

Made By: [initials]	Date: 7/26/08	Job No:	
HAM-50-0376L Checked By: SSM	Date: 10/08/08	Sheet No: 1	

Load Rating of Stringers 19'-4" truss

WF21 x 62 - Non-composite (5 @ 7'-0" ±)

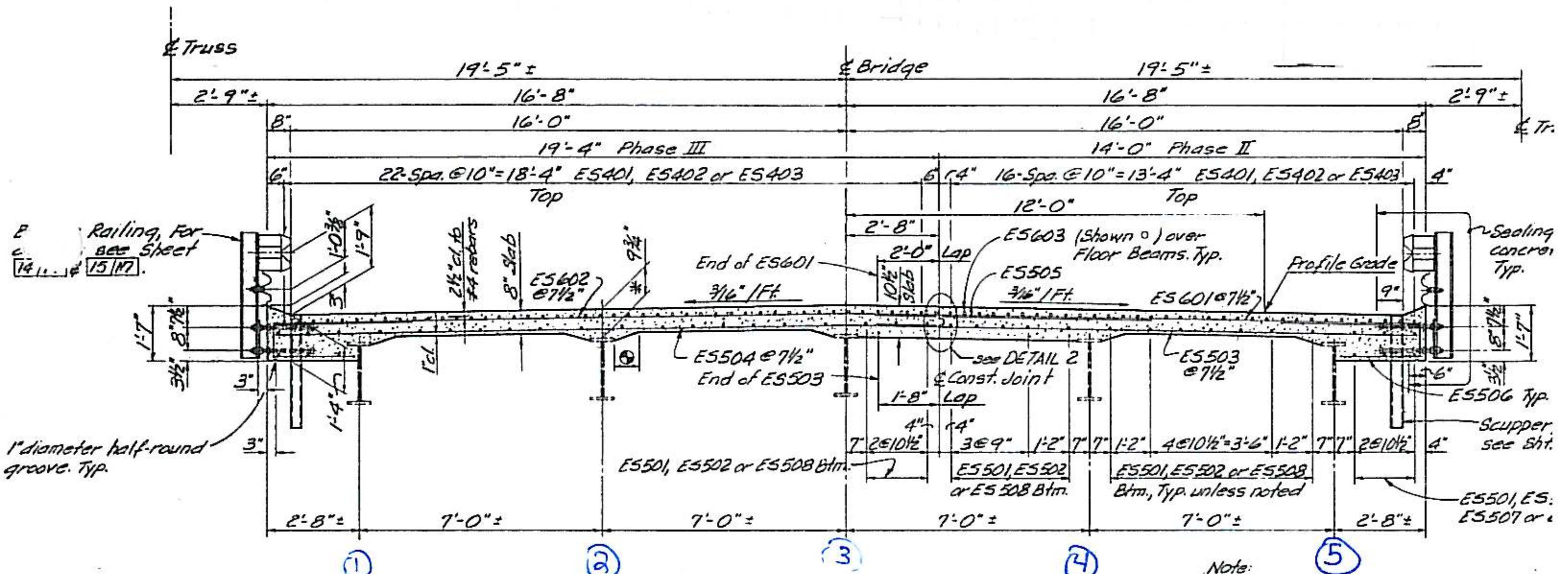
Width - - 33'-4" Spacing - 7'-0"

Railing - DBR-2-73 Overhang - 2'-8"

Slab = 8" nominal (see section) Lightweight conc. (120 pcf per LRFD Tbl. 3.5.1-1)

Loads - HS-20 (Lane & Truck)
- 2F1
- 3F1
- 4F1
- 5C1

8 spans @ 23'-11"



SECTION A-A

Dead Loads

Railing - rail is similar to DBR-2-73

AASHTO M180 Type 2 Class A

2 w-beams ≈ 7.25 plf × 2 = 14.5 plf

TS 8 × 4 × 3/16" = 14.54 plf

29.04 plf

Posts -

W6 × 25 × 3'-7¾" = 91.2 pounds ea

TS 8" × 4" × 3/16" × 1' × 14.54 plf = 14.54 #

PL ½ × 7½ × 14½" = 15.5 #

Anchors & Bolts : 0.75# + 1.06 # + 34.63 # = 36.44#

157.68# / 6.25' (spa.) = 25.23 #/ft

TOTAL = 25.23#/ft + 29.04 plf = 54.27 say 55 plf

Slab loads

Exterior stringers 1 & 5

Slab - $\frac{8''}{12} \times (3.5' + 2.67') \times 0.120\,kcf = 0.50\,klf$

Haunch - $\left[1.75'' \times 8\tfrac{1}{4}'' + \tfrac{1}{2}(2.375'' \times 9'')\right] \times \frac{1}{144} \times 0.120\,kcf = 0.021\,klf$
$\times 1.1 = 0.023\,klf$
($5/8 + 1\tfrac{3}{4}$)

Overhang - $\frac{8''}{12} \times 2.67' \times 0.120\,kcf = 0.21\,klf$

Curb - $\tfrac{1}{2}(3'' \times 8'')\frac{1}{144} \times 0.120\,kcf = 0.01\,klf$

Total = $0.50 + 0.023 + 0.21 + 0.01 = \boxed{0.743\,klf}$

Stringer 2

Slab - $8''/12 \times 7'\text{-}0' \times 0.120\,kcf = 0.56\,kcf$

Haunch - $\left[\frac{8\tfrac{1}{4}'' \times 1.75''}{144} + \frac{9'' \times 2.375}{144}\right] \times 0.120\,kcf \times 1.1 = 0.033\,klf$

Total = $0.56\,klf + 0.033\,klf = \boxed{0.593\,klf}$

Stringer 3 & 4 (thickened slab)

Slab - $\left[\frac{8''}{12} \times 3.5' + \frac{10.5''}{12} \times 3.5'\right] \times 0.120\,kcf = 0.65\,klf$

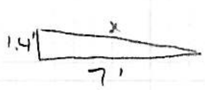
Haunch = $\left[\tfrac{1}{2} \times 9'' \times 2.375'' + 4'' \times 1.75''\right]\frac{1}{144} \times 0.12\,kcf \times 1.1 = 0.016\,klf$

Total = $0.65 + 0.016\,klf = \boxed{0.666\,klf}$

Diaphragm Loads

$\angle 3 \times 3 \times 5/16$ - 6.10 #/ft

Lower $\angle$ - $7'\text{-}0'' \times 6.10\,\#/ft = 42.7\,\#$

Diagonals - 

$x = 7.14'$ weight = $2 \times 7.14' \times 6.10 = 87.11\,\#$

Total = $42.7 + 87.11 = 129.81$ say $0.13\,k$ int

$/2$ ext = $0.065\,k$ ext

STRINGER INPUT

Calculate Load on Stringers

Exterior Stringers 1 & 5

Rail - Dist equally to all beams

$$\frac{55\ \text{plf} \times 2\ \text{sides}}{5} = 22\ \text{plf each stringer}$$

Slab & Haunch = 0.743 k/ft

Total = 0.022 k/ft + 0.853 k/ft = 0.765 k/ft

Diaphragm - 0.065 k @ mid panel each panel

Stringer 2

Rail - 22 plf

Diaphragm - 0.13 k @ mid panel

Slab & Haunch - 0.593 k/ft

Total - 0.593 k/ft + 0.022 k/ft = 0.615 k/ft

Stringers 3 & 4

Rail - 22 plf

Slab & Haunch - 0.666 klf

Total - 0.688 k/ft

TRUSS AND FLOOR BEAM INPUT

1. STAAD ANALYSIS FOR SLAB, HAUNCH AND DIAPHRAGM LOADS (FOR PANEL POINT REACTION ON THE TRUSS)
2. STRINGER WEIGHT AND HAUNCH WEIGHT FOR FLOOR BEAM INPUT

```
****************************************************
*                                                  *
*           STAAD.Pro                              *
*           Version  2007    Build 02              *
*           Proprietary Program of                 *
*           Research Engineers,  Intl.             *
*           Date=    OCT  1, 2008                  *
*           Time=     8:14:47                      *
*                                                  *
*      USER ID: TranSystems                        *
****************************************************
```

SSM 10/08/08

```
     1. STAAD SPACE
INPUT FILE: Span 1 Stringer DL.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 09-30-08
     4. JOB NAME HAM-50-0367L
     5. JOB CLIENT ODOT D-8
     6. JOB NO P402080073
     7. JOB REV REV 0
     8. JOB REF 191'-4" STRINGER DEAD LOADS
     9. ENGINEER NAME PJP
    10. JOB COMMENT DL FOR 8 SPAN CONT STRINGER
    11. END JOB INFORMATION
    12. INPUT WIDTH 79
    13. UNIT FEET KIP
    14. JOINT COORDINATES
    15. 10 0 0 1; 11 23.92 0 1; 12 47.83 0 1; 13 71.75 0 1; 14 95.67 0 1
    16. 15 119.58 0 1; 16 143.5 0 1; 17 167.42 0 1; 18 191.33 0 1; 20 0 0 2
    17. 21 23.92 0 2; 22 47.83 0 2; 23 71.75 0 2; 24 95.67 0 2; 25 119.58 0 2
    18. 26 143.5 0 2; 27 167.42 0 2; 28 191.33 0 2; 30 0 0 3; 31 23.92 0 3
    19. 32 47.83 0 3; 33 71.75 0 3; 34 95.67 0 3; 35 119.58 0 3; 36 143.5 0 3
    20. 37 167.42 0 3; 38 191.33 0 3; 40 0 0 4; 41 23.92 0 4; 42 47.83 0 4
    21. 43 71.75 0 4; 44 95.67 0 4; 45 119.58 0 4; 46 143.5 0 4; 47 167.42 0 4
    22. 48 191.33 0 4; 50 0 0 5; 51 23.92 0 5; 52 47.83 0 5; 53 71.75 0 5
    23. 54 95.67 0 5; 55 119.58 0 5; 56 143.5 0 5; 57 167.42 0 5; 58 191.33 0 5
    24. MEMBER INCIDENCES
    25. 10 10 11; 11 11 12; 12 12 13; 13 13 14; 14 14 15; 15 15 16; 16 16 17; 17 17 18
    26. 20 20 21; 21 21 22; 22 22 23; 23 23 24; 24 24 25; 25 25 26; 26 26 27; 27 27 28
    27. 30 30 31; 31 31 32; 32 32 33; 33 33 34; 34 34 35; 35 35 36; 36 36 37; 37 37 38
    28. 40 40 41; 41 41 42; 42 42 43; 43 43 44; 44 44 45; 45 45 46; 46 46 47; 47 47 48
    29. 50 50 51; 51 51 52; 52 52 53; 53 53 54; 54 54 55; 55 55 56; 56 56 57; 57 57 58
    30. DEFINE MATERIAL START
    31. ISOTROPIC STEEL
    32. E 4.176E+006
    33. POISSON 0.3
    34. DENSITY 0.489024
    35. ALPHA 6.5E-006
    36. DAMP 0.03
    37. END DEFINE MATERIAL
    38. MEMBER PROPERTY AMERICAN
    39. 10 TO 17 20 TO 27 30 TO 37 40 TO 47 50 TO 57 TABLE ST W21X62
    40. CONSTANTS
```

```
41. MATERIAL STEEL ALL
42. SUPPORTS
43. 10 TO 17 20 TO 27 30 TO 37 40 TO 47 50 TO 57 PINNED
44. 18 28 38 48 58 FIXED BUT FX MZ
45. LOAD 1 LOADTYPE DEAD  TITLE DEAD LOAD
**WARNING- THIS STRUCTURE IS DISJOINTED. IGNORE IF
          MASTER/SLAVE OR IF UNCONNECTED JOINTS.
46. SELFWEIGHT Y -1.1
47. MEMBER LOAD
48. 10 TO 17 50 TO 57 UNI GY -0.765 0 23.92
49. 20 TO 27 UNI GY -0.615 0 23.92
50. 30 TO 37 40 TO 47 UNI GY -0.688 0 23.92
51. 20 TO 27 30 TO 37 40 TO 47 CON GY -0.13 11.96 0
52. 10 TO 17 50 TO 57 CON GY -0.065 11.96 0
53. PERFORM ANALYSIS
```

P R O B L E M   S T A T I S T I C S

```
NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    45/    40/    45

      SOLVER USED IS THE OUT-OF-CORE BASIC SOLVER

ORIGINAL/FINAL BAND-WIDTH=     1/      1/       6 DOF
TOTAL PRIMARY LOAD CASES =     1, TOTAL DEGREES OF FREEDOM =    130
SIZE OF STIFFNESS MATRIX =         1 DOUBLE  KILO-WORDS
REQRD/AVAIL. DISK SPACE  =     12.1/ 623191.2 MB
```

```
54. PRINT SUPPORT REACTION LIST 10 TO 18
```

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
10	1	0.00	7.91	0.00	0.00	0.00	0.00
11	1	0.00	22.62	0.00	0.00	0.00	0.00
12	1	0.00	19.32	0.00	0.00	0.00	0.00
13	1	0.00	20.18	0.00	0.00	0.00	0.00
14	1	0.00	19.91	0.00	0.00	0.00	0.00
15	1	0.00	20.17	0.00	0.00	0.00	0.00
16	1	0.00	19.33	0.00	0.00	0.00	0.00
17	1	0.00	22.62	0.00	0.00	0.00	0.00
18	1	0.00	7.90	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

55. *DL REACTIONS FROM STRINGER 1 ABOVE
56. PRINT SUPPORT REACTION LIST 20 TO 28

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
20	1	0.00	6.51	0.00	0.00	0.00	0.00
21	1	0.00	18.64	0.00	0.00	0.00	0.00
22	1	0.00	15.92	0.00	0.00	0.00	0.00
23	1	0.00	16.63	0.00	0.00	0.00	0.00
24	1	0.00	16.40	0.00	0.00	0.00	0.00
25	1	0.00	16.62	0.00	0.00	0.00	0.00
26	1	0.00	15.92	0.00	0.00	0.00	0.00
27	1	0.00	18.64	0.00	0.00	0.00	0.00
28	1	0.00	6.51	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

57. *DL REACTIONS FROM STRINGER 2 ABOVE
58. PRINT SUPPORT REACTION LIST 30 TO 38

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
30	1	0.00	7.20	0.00	0.00	0.00	0.00
31	1	0.00	20.62	0.00	0.00	0.00	0.00
32	1	0.00	17.60	0.00	0.00	0.00	0.00
33	1	0.00	18.39	0.00	0.00	0.00	0.00
34	1	0.00	18.14	0.00	0.00	0.00	0.00
35	1	0.00	18.38	0.00	0.00	0.00	0.00
36	1	0.00	17.61	0.00	0.00	0.00	0.00
37	1	0.00	20.61	0.00	0.00	0.00	0.00
38	1	0.00	7.20	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

59. *DL REACTIONS FROM STRINGER 3 ABOVE
60. PRINT SUPPORT REACTION LIST 40 TO 48

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
40	1	0.00	7.20	0.00	0.00	0.00	0.00
41	1	0.00	20.62	0.00	0.00	0.00	0.00
42	1	0.00	17.60	0.00	0.00	0.00	0.00
43	1	0.00	18.39	0.00	0.00	0.00	0.00
44	1	0.00	18.14	0.00	0.00	0.00	0.00
45	1	0.00	18.38	0.00	0.00	0.00	0.00
46	1	0.00	17.61	0.00	0.00	0.00	0.00
47	1	0.00	20.61	0.00	0.00	0.00	0.00
48	1	0.00	7.20	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

61. *DL REACTIONS FROM STRINGER 4 ABOVE
62. PRINT SUPPORT REACTION LIST 50 TO 58

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
50	1	0.00	7.91	0.00	0.00	0.00	0.00
51	1	0.00	22.62	0.00	0.00	0.00	0.00
52	1	0.00	19.32	0.00	0.00	0.00	0.00
53	1	0.00	20.18	0.00	0.00	0.00	0.00
54	1	0.00	19.91	0.00	0.00	0.00	0.00
55	1	0.00	20.17	0.00	0.00	0.00	0.00
56	1	0.00	19.33	0.00	0.00	0.00	0.00
57	1	0.00	22.62	0.00	0.00	0.00	0.00
58	1	0.00	7.90	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

63. *DL REACTIONS FROM STRINGER 5 ABOVE
64. FINISH

*********** END OF THE STAAD.Pro RUN ***********

**** DATE= OCT 1,2008 TIME= 8:14:48 ****

```
*************************************************************
*        For questions on STAAD.Pro, please contact        *
*  Research Engineers Offices at the following locations  *
*                                                           *
*              Telephone                 Email              *
*  USA:      +1 (714)974-2500      support@bentley.com      *
*  CANADA    +1 (905)632-4771      detech@odandetech.com    *
*  UK        +44(1454)207-000      support@reel.co.uk       *
*  FRANCE    +33(0)1 64551084      support@reel.co.uk       *
*  GERMANY   +49/931/40468-71      info@reig.de             *
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*                                                           *
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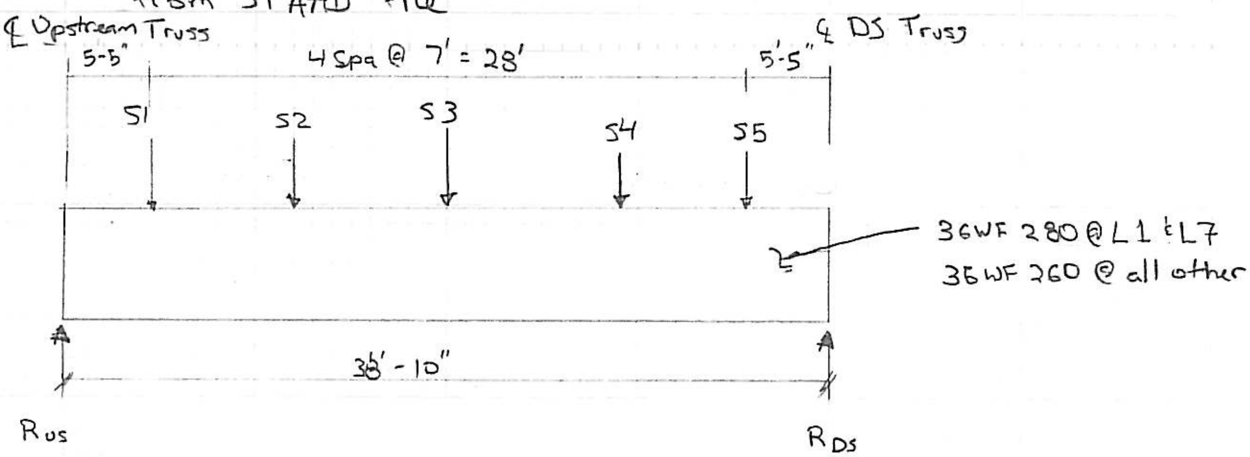
*  Europe                         support@bentley.com      *
*  Asia                           support@bentley.com      *
*************************************************************
```

Calculate floor beam reactions to Panel Pts.

Stringer Reactions (k)

Stringer	Floorbeam L0 & L8	L1 & L7	L2 & L6	L3 & L5	L4
S1 & S5	7.91	22.62	19.33	20.18	19.91
S2	6.51	18.64	15.92	16.63	16.40
S3 & S4	7.20	20.62	17.61	18.39	18.14

from STAAD file



Self weight & ~~Deck Haunch~~

S.W. L1 & L7 = 38'-10" × 280#/ft × 1.1 = 11.96 k total weight

others 38'-10 × 260#/ft × 1.1 = 11.11 k total weight

Haunch & Deck: Include 1'-3" of additional slab @ end floor beams (conservative @ abuts) and estimated haunch over each floor beam.

End floor beams

Haunch Depth ≈ 1.75" min to cross slope 14' × 3/16"/ft + 1.75" = 4.375"

$avg = \frac{1.75" + 4.375"}{2}$ 3.0625" + flange = 1½" = 4.5625"

Haunch weight = $35' \times \frac{4.5625"}{12} \times 2.5' \times 0.12\,kcf \times 1.1 = 4.39k$

L H × W

Floor Bm. Reactions (cont')

Add'l slab @ end FB

$1'-3" \times 35' \times \frac{8"}{12} \times 0.12\,kcf \times 1.1 = 3.85\,k$

Interior Floor Beams

Haunch - avg depth 4.5625"

length = 33'-4"

width = 16.5" + 12" taper on each side = 28.5" = 2.375'

$\text{weight} = \frac{4.5625"}{12} \times 33.33' \times 2.375' \times 0.12\,kcf \times 1.1 = 3.97K$

Total Self Weight & Deck Weight on FB

End FB L0 & L8 - 11.11k + 3.85k + 4.39k = 19.35k

L1 & L7 = 11.96k + 3.97k = 15.93k

L2 - L6 = 11.11k + 3.97k = 15.08k

Reactions to Panel Points

• End FB U.S. L0 & L8 $\Sigma M = 0$

$$= \frac{19.35^k}{2} + \frac{7.91^k(38.83')}{38.83'} + \frac{7.20^k(31.84')}{38.83'} + \frac{6.51^k(26.42')}{38.33'}$$

$R_{US} = 27.92k$

$R_{DS} = 28.16k$

small difference less than 0.5% say average = $28.04k = R_{US} = R_{DS}$

• L1 & L7 U.S.

$$= 15.93^k/2 + \frac{22.62^k(38.83')}{38.83'} + \frac{20.62^k(31.84')}{38.83'} + \frac{18.64^k(26.42')}{38.33}$$

$R_{US} = 58.26k$

$R_{DS} = 62.79k$

small difference less than 0.5% use average 60.53k

- L2 & L6

$$R_{US} = R_{DS} = \frac{15.08^k + 2(19.33^k) + 15.92^k + 2(17.61^k)}{2}$$

$$= 52.44^k$$

- L3 & L5

$$R_{US} = R_{DS} = \frac{15.08^k + 2(20.18^k) + 16.63^k + 2(18.39^k)}{2}$$

$$= 54.97^k$$

- L4

$$R_{US} = R_{DS} = \frac{15.08^k + 2(19.91^k) + 16.4^k + 2(18.14^k)}{2} =$$

$$= 53.79^k$$

TRUSS DISTRIBUTION FACTORS

1. DUE TO TWO TRUCK LOADS
2. DUE TO A SINGLE TRUCK LOAD:
    a. IN RIGHT LANE
    b. IN LEFT LANE

TranSystems

Made By: SSM	Date: 10/20/08	Job No: HAM-50-0576
Checked By: MSL	Date: 5/29/09	Sheet No: 1

DISTRIBUTION FACTORS

(I) STRINGERS — S01 → External stringer 1; S02, S03 → Interior Stringers

1. MAIN ANALYSIS → $\frac{S}{5.5} = 1.2727$ for stringers ~~S02~~ S02, S05.

$= 1.143$ for S01

2. Right Lane analysis → For 5C1 train of trucks:

   a. Stringer S01 → Page 2 Case I

   b. Stringer S02 → Page 3, Case I

   c. Stringer S05 → Page 4, Case I

3. Left Lane Analysis → For single 5C1 truck:

   a. Stringer S01 → Page 2, Case II

   b. Stringer S02 → Page 3, Case II

   c. Stringer S03 → Page 4, Case III

(II) TRUSS — T01 → Downstream Truss

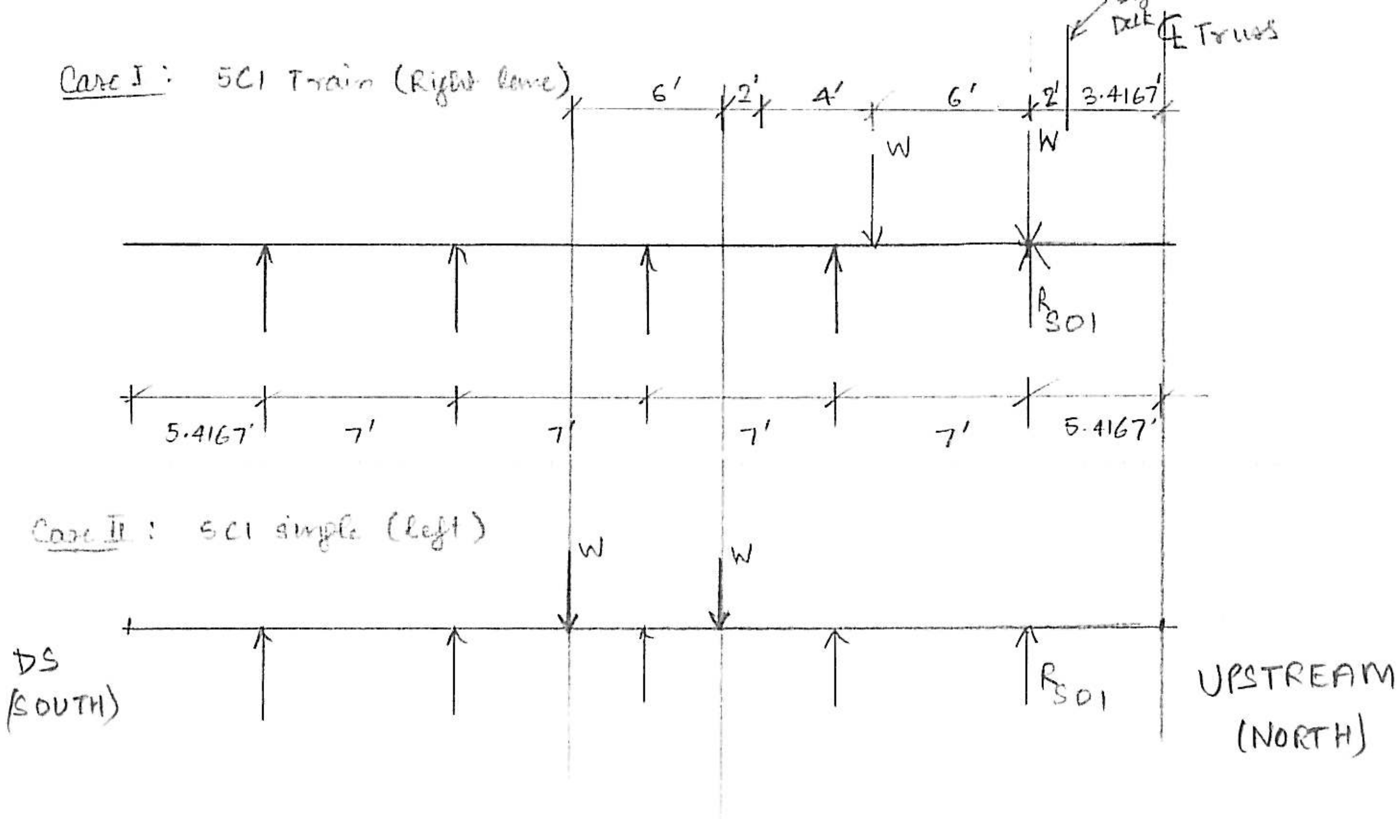
1. Main Analysis → Page 5

2. Right Lane Analysis → Page 6

3. Left Lane Analysis → Page 6

Calculations for 1/10 US Grid

DISTRIBUTION FACTOR FOR S01



Case I:

$$R_{S01} = W + \frac{W}{7} = \frac{8}{7}W = 1.143W$$

Case II:

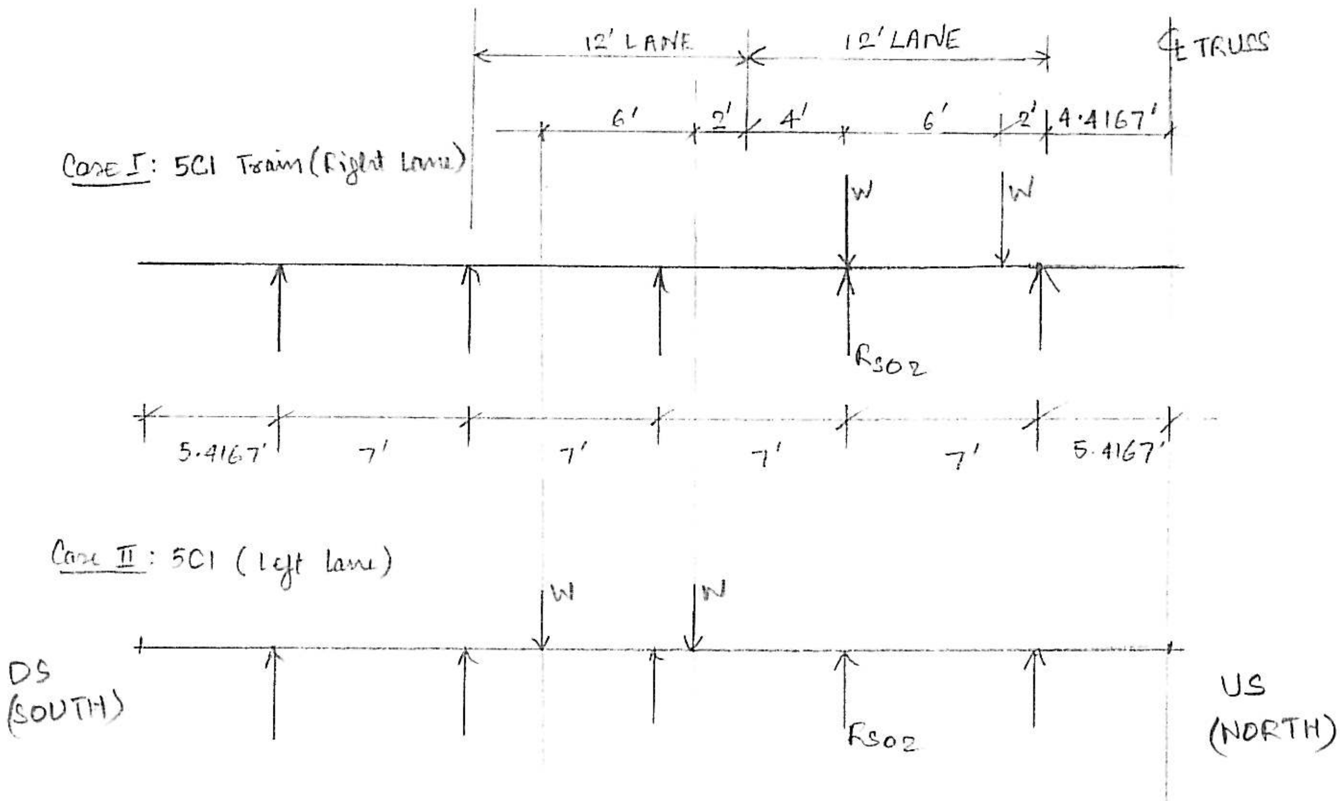
$$R_{S01} = 0$$

TranSystems

Made By:	Date: 10/17/08	Job No: HAM-50.0276
Checked By:	Date:	Sheet No: 3

DISTRIBUTION FACTOR FOR S02

Case I: 5C1 Train (Right Lane)



Case II: 5C1 (Left Lane)

Case I:

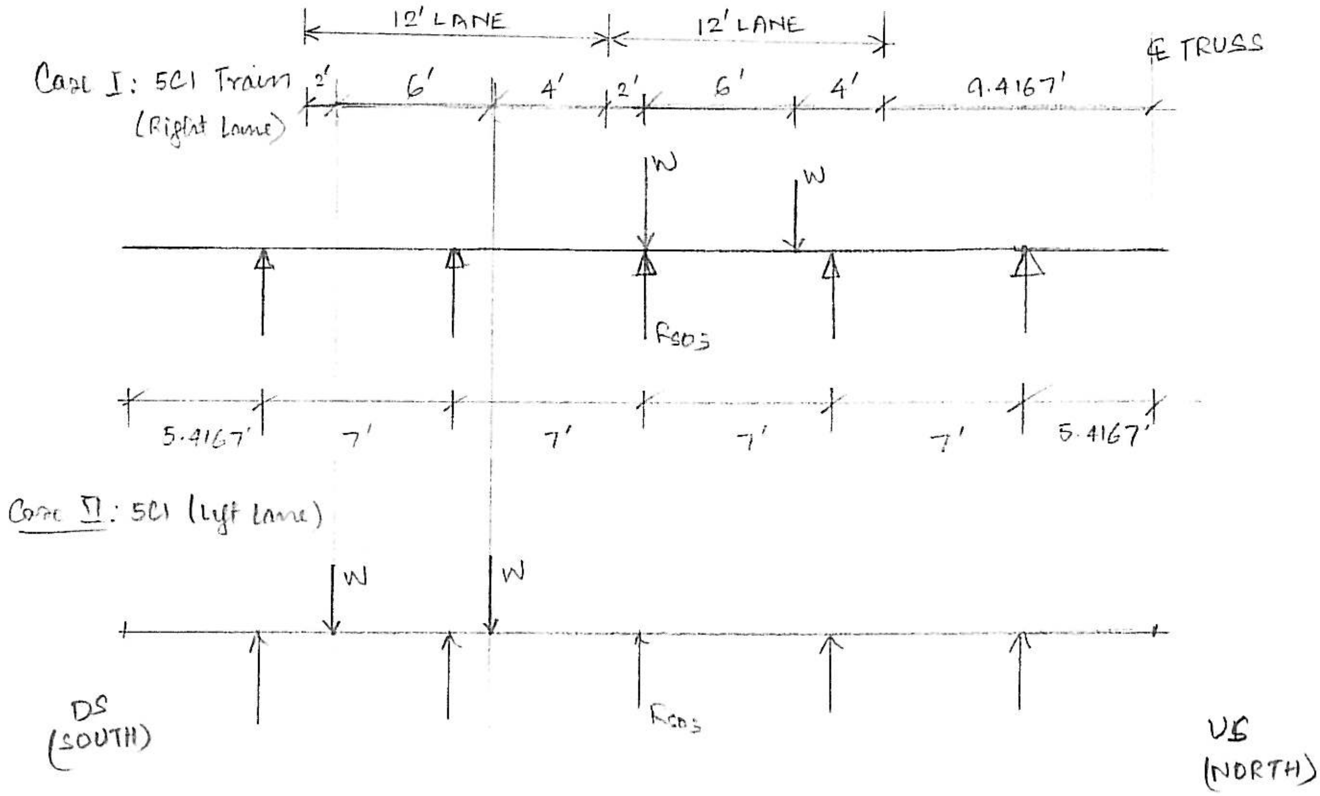
$$R_{S02} = W + \frac{W}{7} = \frac{8}{7}W = 1.143W$$

Case II:

$$R_{S02} = \frac{W}{7} = 0.143W$$

Calculations for 1/10 US Grid

DISTRIBUTION FACTOR FOR S03



Case I:

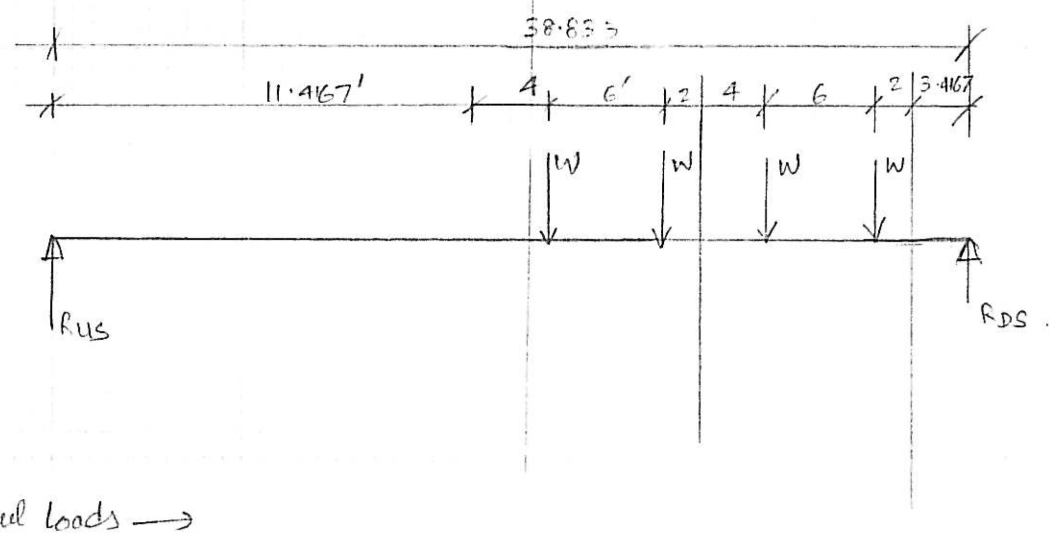
Case I:

$$R_{S03} = W + \frac{W}{7} = \frac{8}{7} W = 1.143\,W$$

Case II:

$$R_{S03} = \frac{W}{7} = 0.143\,W$$

DISTRIBUTION FACTOR DUE TO TWO TRUCK LOADS.



Wheel Loads →

$$R_{DS} = \left[\frac{33.4167}{38.4167} + \frac{(27.4167')}{(38.4167')} + \left(\frac{21.4167}{38.4167}\right) + \frac{15.4167}{38.4167}\right] W$$

$$= 2.54\,W$$

$$R_{US} = 1.46\,W$$

Distribution factor →

$$\text{Truss DS} = \frac{2.54W}{4W} = 0.635$$

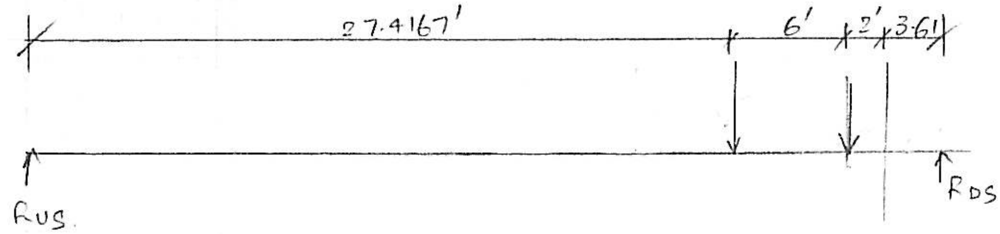
$$\text{Truss US} = \frac{1.46W}{4W} = 0.365$$

Calculations for 1/10 US Grid

TranSystems

Made By: SSM	Date: 10/10/08	Job No: HAM-50-0376
Checked By:	Date:	Sheet No: 6

Right Truss Distribution factor due to a single truck load ⟶

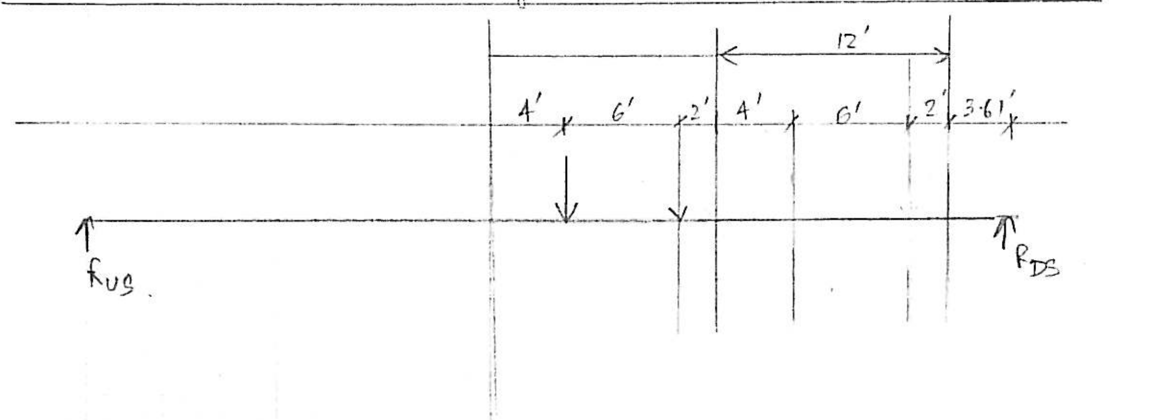


Wheel Loads ⟶

$$R_{DS} = \left[\frac{33.4167}{38.4167} + \frac{27.4167}{38.4167}\right] W = 1.584\ W$$

$$R_{US} = 0.416\ W.$$

Wheel Load distribution on Right Truss due to truck in left lane :⟶



Wheel loads ⟶

$$R_{DS} = \left[\frac{21.225}{38.835} + \frac{15.225}{38.835}\right] W = 0.937\ W$$

SPANS 2 AND 3
(250' TRUSS)

TRUSS DETAIL FACTOR

1. SPAN 2 VERTICAL MEMBER L1U1
2. SPAN 2 LOWER CHORD MEMBER L2L3
3. SPAN 2 UPPER CHORD MEMBER L2L3

Member L_1U_1 exact wt.

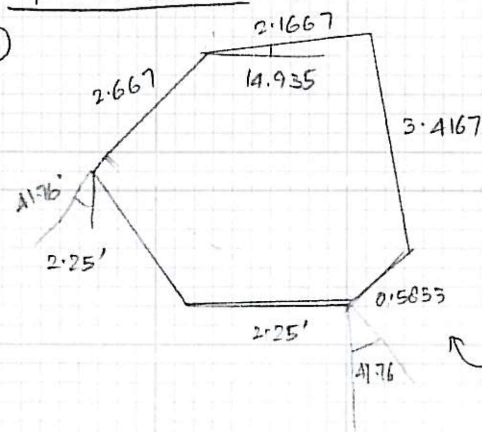
Length, l = 28'

WF 12 x 40 = 25.5' Wt. = (40 lbs/ft)(25.5') = 1020 lbs

~~[illegible]~~

GUSSET PLATE →

1



scaled from elevation on sheet 280

Area = 12.865 ft²

Thickness = (9/16)"

Volume = $\left(\frac{12.865}{12} \times \frac{9}{16}\right) = 0.603\ ft^3$

Wt. on U_1L_1 = $\frac{(490\ lb/ft^3)(0.603\ ft^3)}{4}$ = $\boxed{73.87\ lbs}$ x 2(#) = 147.74 lbs

2 Area of gusset at bottom

Chord = 3.3 ft²

Thickness = $\frac{9}{16}$"

Volume = $(3.3\ ft^2)\left(\frac{9}{16 \times 12}\right)'$

= 0.1547 ft³

Wt. = $\frac{(490\ lb/ft^3)(0.1547\ ft^3)}{4} \times 2$

= (37.9) x 2(#)

= $\boxed{75.8\ lbs}$

BOLTS WT.

Wt. of $\left(\frac{7}{8}"\right)$ rivets, 1.29" long ≅ $\frac{60}{100}$ lbs

Wt. of 35 bolts = $\frac{60}{100} \times 35$ = $\boxed{21\ lbs}$ x 2 = 42 lbs

Total wt. = 1020 lbs +
147.74 lbs +
75.8 lbs +
42 lbs +
12.1 lbs +
25.783 lbs
= 1247.64

Total wt/ft = $\frac{1247.64\ lbs}{28\ ft}$

= 44.56 lb/ft

Wt. of Dia. @ panel pt.

Plate → (1/2")(10")(17") = 85 in³

Wt. of Plate = $\left(\frac{85\ in^3}{1728\ in^3/ft^3}\right)\left(\frac{2}{4}\right)(490\ lbs/ft^3)$ = $\boxed{12.1\ lbs/ft.}$

Angles → 4 Ls (4" x 3.5" x 0.375") 17" long.

Wt. of angles = $\frac{4 \times (9.1\ lbs/ft)(1.4167)}{2}$ = $\boxed{25.783\ lbs}$

Det. factor = $\frac{44.56\ lb/ft}{40\ lb/ft}$

= $\boxed{1.11}$

MEMBER $L_2 - L_3$ exact weight

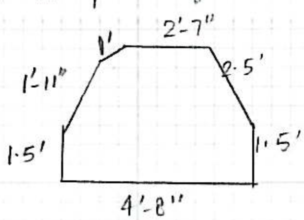
Member length = 25'

2 Plates $18'' \times \frac{3}{4}''$ $= 2 \times (490\ \text{lbs/ft}^3) \times \left(\frac{18 \times 0.75\ \text{in}^2}{144\ \text{in}^2/\text{ft}^2}\right)(25') = \boxed{2297\ \text{lbs.}}$

2 Plates $18'' \times \frac{3}{8}''$ $= 2 \times (490\ \text{lbs/ft}^3) \times \left(\frac{18 \times 0.375\ \text{in}^2}{144\ \text{in}^2/\text{ft}^2}\right)(25') = \boxed{1149\ \text{lbs}}$

GUSSET PLATE

1. At panel pt. L2



1'-2"

Area = $16.19\ \text{ft}^2$

Thickness = $\frac{9}{16}'' = 0.0468\ \text{ft}.$

Wt. = $(16.19\ \text{ft}^2)(0.046\ \text{ft})(490\ \text{lbs/ft}^3)$

= 364.922 lbs × 2#

2. At panel pt. L5.

1.75'

3

2'-1"

1.5

1.5

4'-10"

1'-1"

Area = $12.51\ \text{ft}^2$

Thickness = $\left(\frac{9}{16}\right)'' = 0.0468\ \text{ft}.$

Wt. = $(12.51\ \text{ft}^2)(0.0468\ \text{ft})(490\ \text{lbs/ft}^3)$

= 286.88 lbs. × 2#

Total wt. due to gusset on $L_2 L_3$ = $\frac{1}{4}(364.922 + 286.88) = 162.95\ \text{lbs} \times 2\#$
$= \boxed{325.9\ \text{lbs}}.$

Wt. of Dia.

1. At panel pt. L_2

4 angles $4'' \times 3.5'' \times 0.375''$ (17" long)

Wt. = $\frac{4 \times (9.1\ \text{lbs/ft})(1.416')}{4} = \boxed{12.92\ \text{lbs}}.$

Wt. of 10" plate = $\frac{0.5'' \times 10'' \times 17'' \times 490}{1728 \quad 4}$

$= \boxed{6.03\ \text{lbs}}$

2. At panel pt. L3

4 angles $4'' \times 3.5'' \times 0.375''$ (17" long) ⇒ Wt. = $\frac{4 \times (9.1\ \text{lbs/ft})}{4} = 12.89\ \text{lbs}.$

$\boxed{\text{Wt. of plate} = 6.03\ \text{lbs}}$

3. Diaphragm @ splice pl. and intermediate @ 3-0 c/c.

4 angles 3.5" x 3.5" x 0.375" ⟶ $4 \times (8.5\ \text{lbs/ft})(1.5') = \boxed{51\ \text{lbs.}}$

Diaphragm plate ⟶ $\left[\frac{(0.5'')(18'')(10'')}{1728\ \text{in}^3/\text{ft}^3}\right](490\ \text{lbs/ft}^3) = \boxed{25.5\ \text{lbs.}}$

Wt. of Splice Plates & Fill plates

Fill plate ⟶ length = 3.17'
ht. = 1.5'
Thickness = $\frac{0.25''}{12}$ =

Wt. = $2(3.17' \times 1.5' \times 0.0208')(490\ \text{lbs/ft}^3)$
= $\boxed{97.1\ \text{lbs.}}$

Splice plate ⟶ length = 4'-9"
ht. = 1.5'
Thickness = 0.03125'

Wt. = $2(4.75')(1.5')(0.03125')(490\ \text{lbs/ft}^3)$
= $\boxed{218.2\ \text{lbs}}$

Wt. of Bolts.

No. of rivets (7/8") = 134 x 2

Av. Bolt length = 1.4" (say)

Wt. = $\frac{65\ \text{lbs}}{100\ \text{bolts}} \times 2 \times 134\ \text{bolts} = \boxed{174.2\ \text{lbs.}}$

Total wt. = (2797 + 1149 + 325.9 + 12.92 + 6.03 + 12.92 + 6.03 +
8(51lbs + 25.5lbs) + 97.1lbs + 218.2lbs + 174.2lbs)

= $\frac{4911.5\ \text{lbs}}{25'}$ = 196.45 lbs/ft.

Tran Systems

Made By:	[illegible]	Date:	10/3/08	Job No:	HAM-50-0367L
Checked By:	SSM	Date:	10/07/08	Sheet No:	1

Calculate detail factor for upper chord members

Use member $U_4 - U_5$ as a representative top chord member

Basic member weight

$A = 55.36 \text{ in}^2$

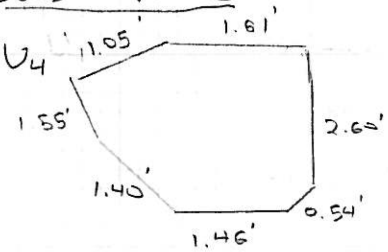
weight $= \frac{55.36 \text{ in}^2}{144} \times 490 \text{ pcf} \times 25' = 4709.4$ #

Detailed Weight

Basic member weight $= 4709.4$ #

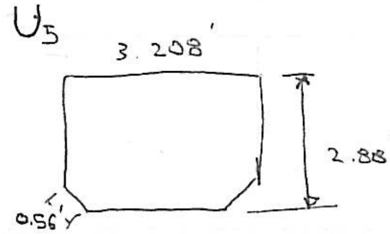
Gusset Plates

U_4



scaled from sheet 281 of orig. plans.

U_5



area $= 6.95 \text{ ft}^2$

weight $= 6.95 \text{ ft}^2 \times \frac{1/2''}{12} \times 490 \text{ pcf} = 141.90$ #

$\times 2 = 283.8$ #

each side

area $= 9.12$ sf

$= 9.12 \text{ sf} \times \frac{1/2''}{12} \times 490 \text{ pcf} = 186.2$

$= \times 2 = 372.4$ # each

Divide the plate into quarters and assign the weight to the members in each quadrant

$\frac{372.4\#}{4} = 93.1$ #

$\frac{283.8\#}{4} = 70.95$ #

Gusset Bolts - divide up similar to PL weight

54 bolts in elevation $\times$ 2 PL $= 108$ bolts

/4 = 27 bolts per quad.

60 bolts $\times 2 = 120$ bolts

/4 = 30 each quad

weight $= (30 + 27) \frac{74.4\#}{100} = 42.4$ #

Calculations for 1/10 US Grid

Made By: [illegible] | Date: 10/6/08 | Job No:
Checked By: SSM | Date: 07/10/08 | Sheet No: 2

Weight of Diaphragm @ Panel Pt.

4∠ $3\frac{1}{2} \times 3\frac{1}{2} \times 3/8" \times 18"$ lg

weight = $1.5' \times 8.5\#/ft \times 4 = 51\#$

$\frac{1}{2}"$ PL × 11.5' wide × 18" tall

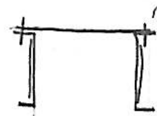
Weight = $\frac{\frac{1}{2} \times 11.5 \times 18}{1728\ in^3/ft^3} \times 490\ pcf =$

$= 29.35\#$

Total weight = $51\# + 29.35\# = 80.35\#$

80.35# each location
there is one @ each panel point say ½ weight is accounted for in each member. $\boxed{= 80.35\#}$

Connection Bolts/Rivets



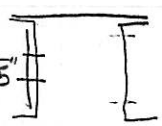
Top PL bolts to each channel
spacing scales as 4"

7/8" rivets - assume weight similar to min Length 7/8" bolt

# of bolts per foot = 8

weight/ft = $\frac{74.4\#}{100} \times \frac{8\ bolts}{ft} = \boxed{5.95\#/ft}$

Web Plate Stitch rivets



Spacing scales @ 4.75"

# of Spaces per foot = 2.526

# of bolts per foot = $(2.526 + 1) \times 2$ per space $\times 2$ sides $= 14.105$

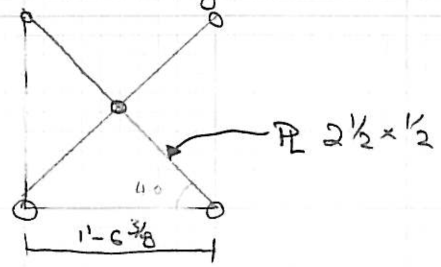
weight/ft = $\frac{74.4\#}{100} \times 14.105 = \boxed{10.50\ \#/ft}$

Calculations for 1/10 US Grid

Made By:	Date: 10/6/08	Job No:	
Checked By: SSM	Date: 07/10/08	Sheet No: 3	

Lacing Weight

Double lacing @ 45°



Length of lacing bars = $\frac{1.53125'}{\cos 45} = 2.166'$

weight = $2.166' \times \frac{2.5}{12} \times \frac{0.5}{12} \times 490\,pcf = 9.21$ #

× 2 bars = 18.42 #

3 - 7/8" rivets = $3 \times \frac{74.4}{100} = 2.23$ #

Total Weight of one lacing panel = 18.42# + 2.23# = 20.65#

Weight/ft = 20.65#/1.53125 = $\boxed{13.49\ \#/ft}$

Tie plates

Weight/ft = $\frac{3/8" \times 22"}{144} \times 490\,pcf = 28.07$ #/ft

bolts/rivets are at the same spacing as the top PL connection

w = 5.95#/ft

Total Detailed weight

Gusset PL Connect. – 70.95 + 93.1 + 42.4 = 206.45#

Diaphragm @ Panel Pt. – 80.35#

Built up member connections - 25'(5.95#/ft + 10.5) 411.25#

Lacing on bot - 13.49#/ft × 18.375' = 247.88#

Tie plate - 4' × (28.07 + 5.95#/ft) = 136.08#

Basic Section Wt 4709.4 #

TOTAL = 5791.41#

$$\text{Detail Factor} = \frac{5791.41}{4709.4} = 1.23$$

WEIGHT OF TRUSS

1. SPANS 2 AND 3

TranSystems

Made By: SSM	Date: 09/29/08	Job No: HAM-50-0376L
Checked By: PJP	Date: 10/8/08	Sheet No: 1

Span 2,3 TRUSS (250' TRUSS)

	Members	Area (in^2)	Wt. including bolts, gusset plates & splices	Nominal wt.	Detail factor	Wt (lbs)	ℓ (ft)
U	L_0U_1	55.36		188.39 lb/ft	1.23	8698	37.557'
	U_1U_2	44.96		153 lbs/ft		4870	25.871'
	U_2-U_3	51.76		176.13 lb/ft		5485	25.318'
	U_3-U_4	55.36		188.39 lb/ft		5802	25.036'
	U_4-U_5	55.36		188.39 lb/ft		5793	25'
L	L_0-L_1	29.25		99.53 lb/ft.	1.42	3534	25'
	L_2-L_3	40.5	196.45 lb/ft	137.81 lbs/ft.		4893	25'
	L_3-L_4	49.5		168.4375 lb/ft		5980	25'
	L_4 L_5	54.0		183.75 lb/ft.		6524	25'
D	U_1L_2	19.11		65.027 lb/ft.	1.11	2710	37.557'
	U_2L_3	15.59		53.05 lb/ft.		2517	42.74'
	U_3L_4	13.24		45.05 lb/ft		2303	46.045'
	U_4L_5	13.24		45.05 lb/ft		2359	47.17' ×2 (U_5L_4)
V	U_1L_1	11.77	44.56 lbs/ft.	40. lbs/ft.		1248	28.667'
	U_2L_2	19.11		65.03		2502	34.667'
	U_3L_3	11.77		40 lb/ft		1717	38.667'
	U_4L_4	11.77		40 lb/ft.		1776	40'
L	L_1L_2	29.25		99.53 lb/ft.	1.42	3533	25'
H	(Substrut 1)			36 lb/ft.	1.11	999	25'
	(Substrut 2)			36 lb/ft.	1.11	999	25'

4 × (76601 lbs) = 306404 lbs

[2 symm × 2 (U_s, D_s)]

Calculations for 1/10 US Grid

SPAN 2/3

Sway Bracing Hor. Member	Area (in^2)	Length	Member	Nominal wt (lbs/ft)	Detail factor	Wt.
U_0U_0'				28		1327
U_1U_1'				28		1327
U_2U_2'		38.833'	WF 8×28	28	1.22	1327
U_3U_3'				28		1327
U_4U_4'				28		1327
U_0U_1'		(10.34)(6ft)	WF 8×17	17	1.22	1287
U_1U_0'		= 62.04	WF 8×17			
U_1U_2'		46.67'		18		1025
U_2U_1'		46.67'		18		1025
U_2U_3'		46.56'		18		1018
U_3U_2'		46.56'	WF 8×18	18		1018
U_3U_4'		46.21'		18	1.22	1015
U_4U_3'		46.21'		18		1015
U_4U_5'		46.19'		18		1015
U_5U_4'		46.19'		18		1015
M_2M_2'		38.833'		28		1327
M_3M_3'		38.833'	WF 8×28	28	1.22	1327
M_4M_4'		38.833'		28		1327

$2 \times (20049) = \boxed{40098 \text{ lbs}}$

SPAN 2/3

Sway Bracing Vertical Member	Area	Length	Member	Nominal Wt (lbs/ft)	Detail factor	Wt. (lbs)
$U_2 - M_{2m}$		23.19'		17		481
$M_2 - U_{2m}$		23.19'		17		481
$U_3 - M_{3m}$		25.17'	WF 8x17	17	1.22	522
$M_3 - U_{3m}$		25.17'		17		522
$U_4 - M_{4m}$		26.49'		17		550
$M_4 - U_{4m}$		26.49'		17		550

4 (3106) = 12424 lbs

Member 5	Area	Length	Member	Nominal Wt. (lbs/ft)	Detail factor	Wt.
U_5L_5		40'	WF12X40	40		1952 (2#)
U_5U_5'		38.833'	WF 8X28	28		1327
M_5M_5'		38.83'	WF 8X28	28	1.22	1327
U_5M_{5m}		26.49'	WF 8X17	17		550 (2#)
M_5U_{5m}		26.49'	WF 8X17	17		550 x (2#)

8758 lbs.

Total wt. of two trusses = (306404 + 40098 + 12424 + 8758) lbs.
= 367684 lbs.

Wt. of individual truss = $\frac{367684 \text{ lbs}}{2} = \frac{183842 \text{ lbs}}{250 \text{ ft}} = \boxed{735.37 \text{ lbs/ft}}$

Weight of floor Beams. (SPAN 2/3)

Panel Point	Area	Length (ft)	Member	Nominal wt.	Detail factor	Wt.
L_0L_0'		38.83	36 WF 280	280	1.10	11960
L_1L_1'		38.83	36 WF 300	300	1.10	12814
L_2L_2'		38.83	36 WF 280	280	1.10	11960
L_3L_3'		38.83	36 WF 280	280	1.10	11960
L_4L_4'		38.83	36 WF 280	280	1.10	11960
L_5L_5'		38.83	36 WF 280	280	1.10	11960

RAILING, SLAB AND HAUNCH LOADS

1. RAILING LOAD
2. SLAB LOAD
3. DIAPHRAGM LOAD

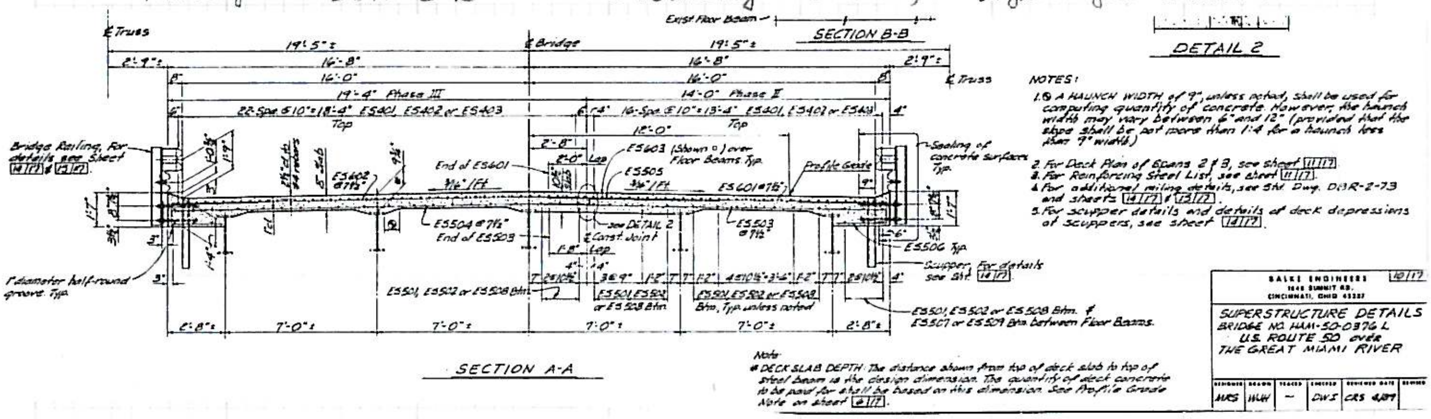
STRINGER LOAD RATING FOR 250'-0" TRUSS

WF 21 X 73 – Outside Panel Points
WF 21 X 62 – Interior Panel Points

Non composite – 5 stringers @ 7'±

Deck width – 33'-4"   Deck thickness = 8" (nominal); 10.25" (thickened)

Railing – DBR-2-73   Overhang – 2'-8",   Lightweight Structural Concrete



DEAD LOADS

① RAILING LOADS ⟶

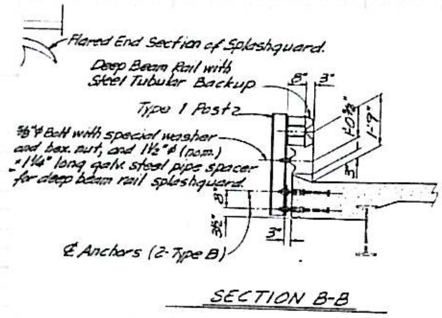
RAIL → DBR-2-73.

(i) TS $8 \times 4 \times \frac{3}{16}$ = 14.5 plf

(ii) 2 W Beams = 7.25 plf × 2 = 14.5 plf

$\left(\frac{19\text{" wide} \times 0.11\text{" thick}}{144\ in^2/ft^2} \times 490\ lbs/ft^3 = 7.11 \approx 7.25\ plf \right)$

AASHTO M180 Type 2 Class A



(iii) Type 1 Post ⟶

(W6 × 25) × 3'-7¾" = 91.2 pounds each.

2 (TS 8" × 4" × $\frac{3}{16}$") section × 6" long = 2 × 14.5 plf × 0.5' = 14.5 lbs/each

PL ½ × 7½ × 14½ = 15.5 lbs/each

(iv) 2 Type B Anchors ($1\frac{1}{4}''\phi \times 8''$) $= 2\left[\frac{689 + (20.75-9)49.7}{100}\right] + 5 = 30.46$ lbs

2 $\frac{5}{8}''\phi \times 1''$ long bolt $2 \times \frac{29.4}{100} = 0.588$ lbs.

1 $\frac{5}{8}''\phi \times 10''$ long bolt $\frac{106.4}{100} = 1.064$

1 $\frac{5}{8}''\phi \times 2''$ long bolt with ($1\frac{1}{2}''\phi$ and $1\frac{1}{4}''$ long steel pipe spacer) $= \frac{37.4}{100} = 0.374$

≈ 33 lbs/each.

Total wt. $= (14.5\text{plf} + 14.5\text{plf}) + \frac{91.2\text{ lbs} + 14.5\text{ lbs} + 15.5\text{ lbs} + 33\text{ lbs}}{6.25'}$

$= 53.67$ plf ≈ $\boxed{54 \text{ plf.}}$ ✓ say 55 plf

SLAB LOADS

EXTERIOR STRINGERS 1 & 5

Slab → $(3.5')(0.667')(0.12\ k/ft^3) = 0.28$ klf.

Overhang → $(2.667')(1.35')(0.12\ k/ft^3) = 0.43$ klf

Haunch → $\left[\frac{1}{2} \times 9'' \times (1.75'' + 0.625'') + 1.75'' \times 8.25''\right] \frac{1}{144\ in^2/ft^2} \times \frac{120}{1000} = 0.021$ klf

$\times 1.1 = 0.023$ klf

Curb → $\left(\frac{1}{2} \times 3'' \times 8''\right) \frac{1}{144\ in^2/ft^2} \times \frac{120\ lbs/ft^3}{1000} = 0.01$ klf

Total $= (0.28 + 0.43 + 0.023 + 0.01)$ klf $= 0.743$ klf

STRINGER – 2

Slab – $(7')(0.667')(0.12\ k/ft^3) = 0.56$ Klf.

Haunch – $\left[8.25'' \times 1.75'' + (1.75'' + 0.625'')(9'')\right] \frac{1}{144\ in^2/ft^2} \times \frac{120\ lbs/ft^3}{1000} \times 1.1 = 0.033$ Klf

Total = 0.56 Klf + 0.03 = 0.593

STRINGER 3 and 4 (Thickend slab)

Slab — $\left[(3.5' \times 0.667') + (3.5' \times 0.875')\right](0.12\ k/ft^3) = 0.648$ Klf

Haunch – $\left[\frac{1}{2} \times 9'' \times (1.75 + 0.625) + 1.75'' \times 4''\right] \frac{1}{144\ in^2/ft^2} \times \frac{120}{1000} \times 1.1 = 0.016$ Klf

Total = 0.648 Klf + 0.016 Klf = 0.664 Klf.

DIAPHRAGM LOADS

$\angle\ 3 \times 3 \times \frac{5}{16}$ = 6.04 lbs/ft.

Lower angle = 7' × 6.04 lbs/ft = 42.28 lbs

Diagnal angles = $\left(\sqrt{1.4^2 + 7^2}\right)$ ft × 2 (6.1 lbs/ft) = 87.1 lbs

Total = 42.28 lbs + 87.1 lbs = 129.4 lbs = 0.129 Kips ≈ 0.13 Kips

Interior stringer wt. = 0.13 Kips

Exterior stringer wt = 0.065 Kips.

Calculations for 1/10 US Grid

STRINGER INPUT

Calculate loads on stringers.

Exterior Stringers 1 and 5 ⟶

Railing load = $\frac{(54 \text{ plf}) \times (2 \text{ rails})}{5}$ = 21.6 plf each stringer.

Slab and Haunch = 0.743 klf

Total = 0.743 klf + 0.022 klf = $\boxed{0.765 \text{ klf}}$

Diaphragm load = $\boxed{0.065 \text{ kips}}$

Interior stringer 2 ⟶

Railing load = 0.0216 klf.

Slab and Haunch = 0.593 klf.

Total = $\boxed{0.615 \text{ klf}}$

Diaphragm load = $\boxed{0.13 \text{ kips}}$

Interior stringer 3 & 4 ⟶

Railing load = 0.022 klf.

Slab & Haunch = 0.666 klf.

Total = $\boxed{0.688 \text{ klf}}$

Diaphragm load = $\boxed{0.13 \text{ kips}}$

TRUSS AND FLOOR BEAM INPUT

1. STAAD ANALYSIS FOR SLAB, HAUNCH AND DIAPHRAGM LOADS (FOR PANEL POINT REACTION ON THE TRUSS)
2. STRINGER WEIGHT AND HAUNCH WEIGHT FOR FLOOR BEAM INPUT

```
**************************************************
*                                                *
*           STAAD.Pro                            *
*           Version  2007    Build 02            *
*           Proprietary Program of               *
*           Research Engineers,  Intl.           *
*           Date=    OCT 10, 2008                *
*           Time=    10:26:34                    *
*                                                *
*      USER ID: TranSystems                      *
**************************************************
```

```
     1. STAAD PLANE
INPUT FILE: FLOOR BEAM REACTIONS.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 03-OCT-08
     4. JOB NAME HAM-50-0376L
     5. JOB CLIENT ODOT D-8
     6. JOB NO P402080073
     7. JOB REV 0
     8. JOB REF 250' STRINGER REACTIONS
     9. ENGINEER NAME SSM
    10. CHECKER NAME PJP - PJP 10/10/08
    11. CHECKER DATE 10-OCT-08
    12. JOB COMMENT 250' DL STRINGER REACTIONS
    13. END JOB INFORMATION
    14. INPUT WIDTH 79
    15. UNIT FEET KIP
    16. JOINT COORDINATES
    17. 1 0 0 0; 2 25 0 0; 3 50 0 0; 4 75 0 0; 5 100 0 0; 6 125 0 0; 7 150 0 0
    18. 8 175 0 0; 9 200 0 0; 10 225 0 0; 11 250 0 0
    19. MEMBER INCIDENCES
    20. 1 1 2; 2 2 3; 3 3 4; 4 4 5; 5 5 6; 6 6 7; 7 7 8; 8 8 9; 9 9 10; 10 10 11
    21. DEFINE MATERIAL START
    22. ISOTROPIC STEEL
    23. E 4.176E+006
    24. POISSON 0.3
    25. DENSITY 0.489024
    26. ALPHA 6.5E-006
    27. DAMP 0.03
    28. END DEFINE MATERIAL
    29. MEMBER PROPERTY AMERICAN
    30. 1 10 TABLE ST W21X73
    31. 2 TO 9 TABLE ST W21X62
    32. CONSTANTS
    33. MATERIAL STEEL ALL
    34. SUPPORTS
    35. 1 TO 10 PINNED
    36. 11 FIXED BUT FX MZ
    37. LOAD 1 LOADTYPE DEAD  TITLE S 1 _5
    38. MEMBER LOAD
    39. 1 TO 10 CON GY -0.065 12.5
    40. 1 TO 10 UNI GY -0.765
```

```
41. LOAD 2 LOADTYPE DEAD  TITLE S 2
42. MEMBER LOAD
43. 1 TO 10 UNI GY -0.615
44. 1 TO 10 CON GY -0.13 12.5
45. LOAD 3 LOADTYPE DEAD  TITLE S 3 _4
46. MEMBER LOAD
47. 1 TO 10 UNI GY -0.688
48. 1 TO 10 CON GY -0.13 12.5
49. PERFORM ANALYSIS


       P R O B L E M   S T A T I S T I C S
       -----------------------------------

 NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =     11/     10/     11

      SOLVER USED IS THE OUT-OF-CORE BASIC SOLVER

 ORIGINAL/FINAL BAND-WIDTH=      1/      1/       3 DOF
 TOTAL PRIMARY LOAD CASES =     3, TOTAL DEGREES OF FREEDOM =      12
 SIZE OF STIFFNESS MATRIX =        1 DOUBLE  KILO-WORDS
 REQRD/AVAIL. DISK SPACE  =     12.0/ 617892.1 MB


50. PRINT SUPPORT REACTION ALL
```

SUPPORT REACTIONS -UNIT KIP FEET STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	0.00	7.62	0.00	0.00	0.00	0.00
	2	0.00	6.15	0.00	0.00	0.00	0.00
	3	0.00	6.88	0.00	0.00	0.00	0.00
2	1	0.00	21.63	0.00	0.00	0.00	0.00
	2	0.00	17.48	0.00	0.00	0.00	0.00
	3	0.00	19.54	0.00	0.00	0.00	0.00
3	1	0.00	18.60	0.00	0.00	0.00	0.00
	2	0.00	15.03	0.00	0.00	0.00	0.00
	3	0.00	16.80	0.00	0.00	0.00	0.00
4	1	0.00	19.34	0.00	0.00	0.00	0.00
	2	0.00	15.63	0.00	0.00	0.00	0.00
	3	0.00	17.47	0.00	0.00	0.00	0.00
5	1	0.00	19.15	0.00	0.00	0.00	0.00
	2	0.00	15.47	0.00	0.00	0.00	0.00
	3	0.00	17.29	0.00	0.00	0.00	0.00
6	1	0.00	19.21	0.00	0.00	0.00	0.00
	2	0.00	15.52	0.00	0.00	0.00	0.00
	3	0.00	17.35	0.00	0.00	0.00	0.00
7	1	0.00	19.15	0.00	0.00	0.00	0.00
	2	0.00	15.47	0.00	0.00	0.00	0.00
	3	0.00	17.29	0.00	0.00	0.00	0.00
8	1	0.00	19.34	0.00	0.00	0.00	0.00
	2	0.00	15.63	0.00	0.00	0.00	0.00
	3	0.00	17.47	0.00	0.00	0.00	0.00
9	1	0.00	18.60	0.00	0.00	0.00	0.00
	2	0.00	15.03	0.00	0.00	0.00	0.00
	3	0.00	16.80	0.00	0.00	0.00	0.00
10	1	0.00	21.63	0.00	0.00	0.00	0.00
	2	0.00	17.48	0.00	0.00	0.00	0.00
	3	0.00	19.54	0.00	0.00	0.00	0.00
11	1	0.00	7.62	0.00	0.00	0.00	0.00
	2	0.00	6.15	0.00	0.00	0.00	0.00
	3	0.00	6.88	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

51. FINISH

```
*********** END OF THE STAAD.Pro RUN ***********

  **** DATE= OCT 10,2008   TIME= 10:26:35 ****

************************************************************
*        For questions on STAAD.Pro, please contact        *
*   Research Engineers Offices at the following locations  *
*                                                          *
*               Telephone                 Email            *
*  USA:      +1 (714)974-2500      support@bentley.com     *
*  CANADA    +1 (905)632-4771      detech@odandetech.com   *
*  UK        +44(1454)207-000      support@reel.co.uk      *
*  FRANCE    +33(0)1 64551084      support@reel.co.uk      *
*  GERMANY   +49/931/40468-71      info@reig.de            *
*  NORWAY    +47 67 57 21 30       staad@edr.no            *
*  SINGAPORE +65 6225-6158         support@bentley.com     *
*  INDIA     +91(033)4006-2021     support@bentley.com     *
*  JAPAN     +81(03)5952-6500      eng-eye@crc.co.jp       *
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*                                                          *
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*  Europe                         support@bentley.com      *
*  Asia                           support@bentley.com      *
************************************************************
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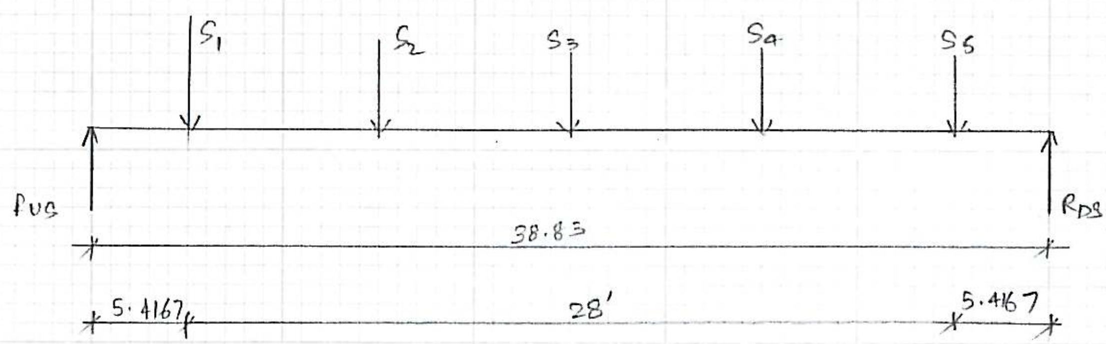
FLOOR BEAM REACTIONS ⟶

from STAAD

	L_0-L_{10}	L_1/L_9	L_2/L_8	L_3/L_7	L_4/L_6	L_5
S_1 & S_5	7.62	21.63	18.60	19.34	19.15	19.21
S_2	6.15	17.48	15.03	15.63	15.47	15.52
S_3 & S_4	6.88	19.54	16.80	17.47	17.29	17.35



Floor Beam Weight = Beam wt + Haunch wt, + Slab wt. (only for L_0 & L_{10})

END FLOOR BEAMS L_0 and L_{10} ⟶

Beam wt. $= (280 \text{ lbs/ft})(38.83')(1.1) = 11.96$ kips

Haunch wt ⟶

Depth $= 1.75''$ min. to $1.75'' + \left(\frac{3}{16} \times 14\right)'' = 4.375''$

$= \frac{1.75'' + 4.375''}{2} = 3.0625'' + 1\frac{1}{2}''$ flange $= 4.5625''$

Wt. $= (35')\left(\frac{4.5625}{12}\right)'(2.5')(0.12)(1.1) = 4.391$ K

Slab wt. ⟶ Applicable only to end floorbeams @ pts. L0 and L10

$\left(\frac{15''}{12}\right) \times 35' \times \left(\frac{8}{12}\right)(0.12)(1.1) = 3.85$ K

Total ⟶ $11.96^K + 4.391^K + 3.85^K = 20.2^K$

Floor Beam Reactions →

Floor Beam L_1 and L_9 →

Beam wt. = (500 lbs/ft) (38.83') (1.1) = 12.82 Kips.

Haunch wt. → length = 33.33'

width = 29"

$$\text{wt.} = \frac{4.5625''}{12} \times 33.33' \times \left(\frac{29''}{12}\right)(0.12\ \text{kcf}) \times 1.1$$

= 4.04 Kips.

Total → 16.86 Kips.

Floor Beam $L_2 - L_8$ →

Beam wt. = (280 lb/ft) (38.83') (1.1) = 11.96 Kips.

Haunch wt. = 4.39 K.

Total = 16.35 Kips.

REACTIONS TO PANEL PTS. →

Floorbeams L_0 and L_{10} →

$$R_{US} = \frac{20.2^K}{2} + \frac{7.62^K (38.83')}{(38.83)} + \frac{6.15^K (26.413')}{38.83} + \frac{6.88^K (19.41' + 12.4167)}{38.83'}$$

$$= 27.54^K$$

$$R_{DS} = (55.35^K - 27.54^K) = 27.81^K$$

Floor beams L_1 and L_9

$$R_{US} = \frac{16.86^K}{2} + \frac{21.63^K(38.83')}{38.83'} + \frac{(17.48^K)(26.415')}{38.83'} + \frac{(19.54^K)(31.85')}{38.83'}$$

$$= 57.96^K$$

$$R_{DS} = (116.68 - 57.96^K) = 58.72^K$$

Floor Beams L_3 and L_7

$$R_{US} = \frac{16.35^K}{2} + \frac{(19.34^K)(38.83')}{(38.83')} + \frac{(15.63^K)(26.415')}{38.83'} + \frac{(17.47^K)(31.85')}{38.83'}$$

$$= 52.47^K$$

$$R_{DS} = 105.60^K - 52.47^K = 53.13^K$$

Floor Beams L_2 and L_8

$$R_{US} = \frac{16.35^K}{2} + \frac{(18.60^K)(38.83')}{(38.83')} + \frac{(15.03^K)(26.415')}{38.83'} + \frac{(16.8^K)(31.85')}{38.83'}$$

$$= 50.77^K$$

$$R_{DS} = 102.18^K - 50.77^K = 51.41^K$$

Floor Beam L_4 and L_6

$$R_{US} = \frac{16.35^K}{2} + \frac{(19.15^K)(38.83')}{(38.83')} + \frac{(15.47^K)(26.415')}{(38.83')} + \frac{(17.29^K)(31.85')}{38.83'}$$

$$= 52.021^K$$

$$R_{DS} = 104.7^K - 52.021^K = 52.68^K$$

L_5 $\rightarrow$ $R_{US} = \frac{16.35}{2} + \frac{19.21^K(38.83')}{38.83'} + \frac{(5.52^K)(26.415')}{38.83'} + \frac{(17.35^K)(31.85')}{38.83'} = 52.16^K$

$$R_{DS} = 104.99^K - 52.16^K = 52.83^K$$

Calculations for 1/10 US Grid

TRUSS DISTRIBUTION FACTORS

1. DUE TO TWO TRUCK LOADS
2. DUE TO A SINGLE TRUCK LOAD:
    a. IN RIGHT LANE
    b. IN LEFT LANE

DISTRIBUTION FACTORS

(I) STRINGERS — S01 → External stringer 1; S02, S03 → Interior Stringers

1. MAIN ANALYSIS → $\frac{S}{5.5} = 1.2727$ for stringers S02, S03
   = 1.143 for stringer S01 (Ext stringer) Lever Rule

2. Right Lane analysis → For 5C1 train of trucks:

   a. Stringer S01 → Page 2 Case I
   b. Stringer S02 → Page 3, Case I
   c. Stringer S03 → Page 4, Case I

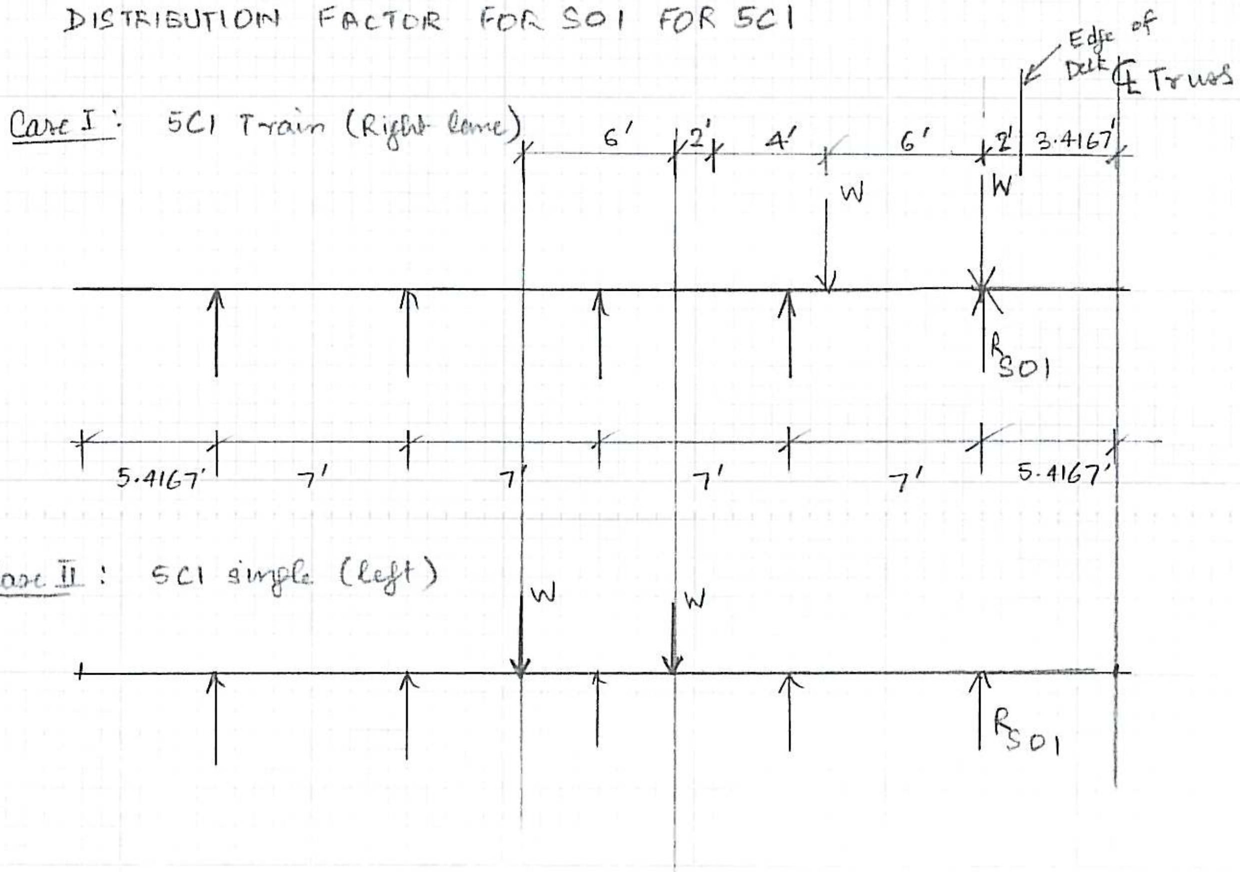
3. Left Lane Analysis → For single 5C1 truck:

   a. Stringer S01 → Page 2, Case II
   b. Stringer S02 → Page 3, Case II
   c. Stringer S03 → Page 4, Case III

(II) TRUSS — T01 → Downstream Truss

1. Main Analysis → Page 5
2. Right Lane Analysis → Page 6
3. Left Lane Analysis → Page 6

DISTRIBUTION FACTOR FOR S01 FOR 5C1



Case I:

$$R_{S01} = W + \frac{W}{7} = \frac{8}{7}W = 1.143W$$

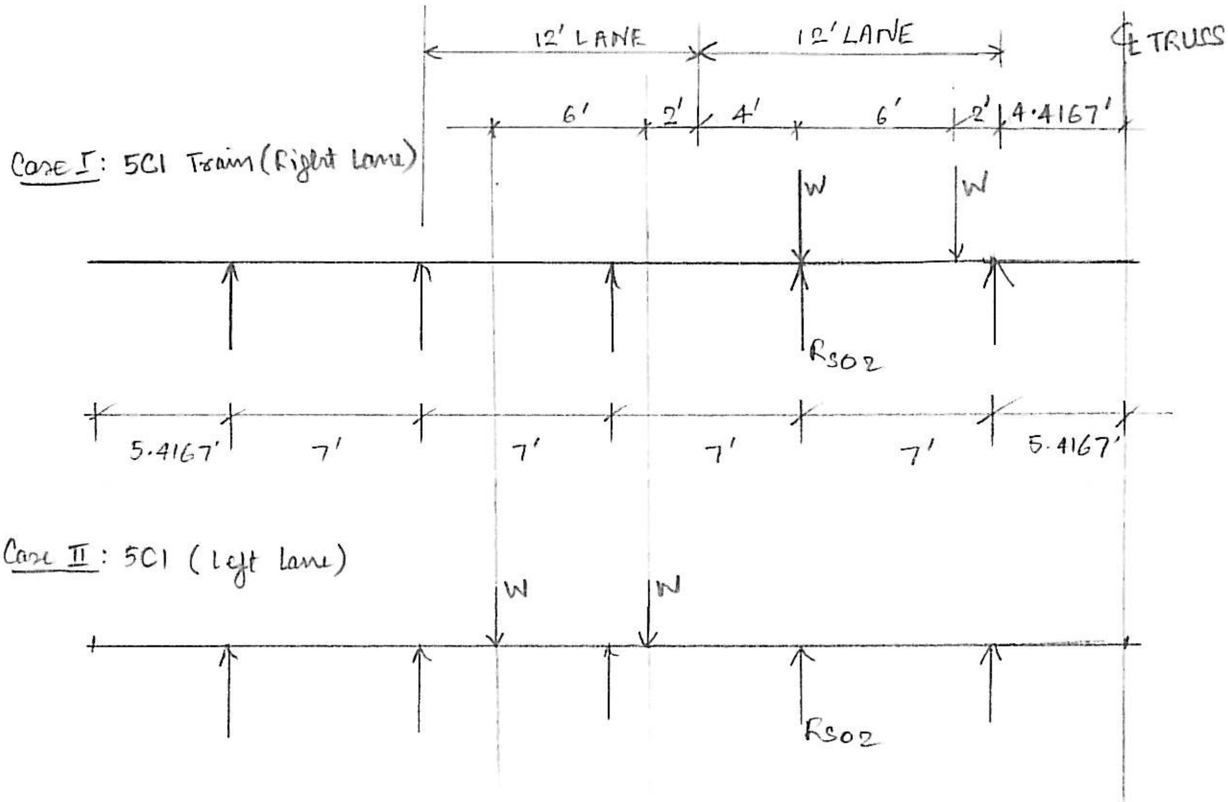
Case II:

$$R_{S01} = 0$$

TranSystems

Made By:	Date: 10/17/08	Job No: HAM-50-0376
Checked By: MSL	Date: 5/27/09	Sheet No: 3

DISTRIBUTION FACTOR FOR S02 FOR 5C1



Case I:

$$R_{S02} = W + \frac{W}{7} = \frac{8}{7}W = 1.143W$$

Case II:

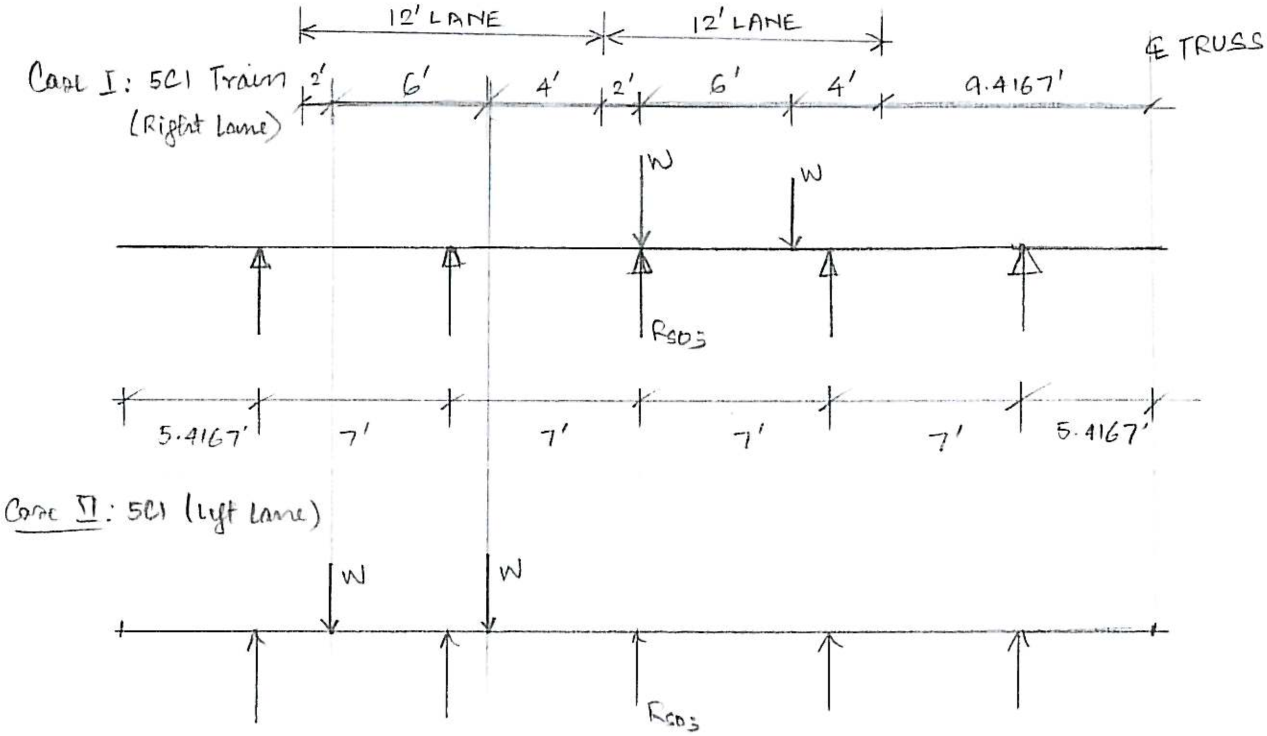
$$R_{S02} = \frac{W}{7} = 0.143W$$

Calculations for 1/10 US Grid

TranSystems

Made By: SSM	Date: 10/17/08	Job No: HAM-50-0376
Checked By: HSL	Date: 5/29/09	Sheet No: 4

DISTRIBUTION FACTOR FOR SO3 FOR 5C1



Case I:

$DF = 5/5.5 = 7/5.5 = 1.272$ for Interior stringers

Case I:

$$R_{SO3} = W + \frac{W}{7} = \frac{8}{7} W = 1.143\,W$$

Case II:

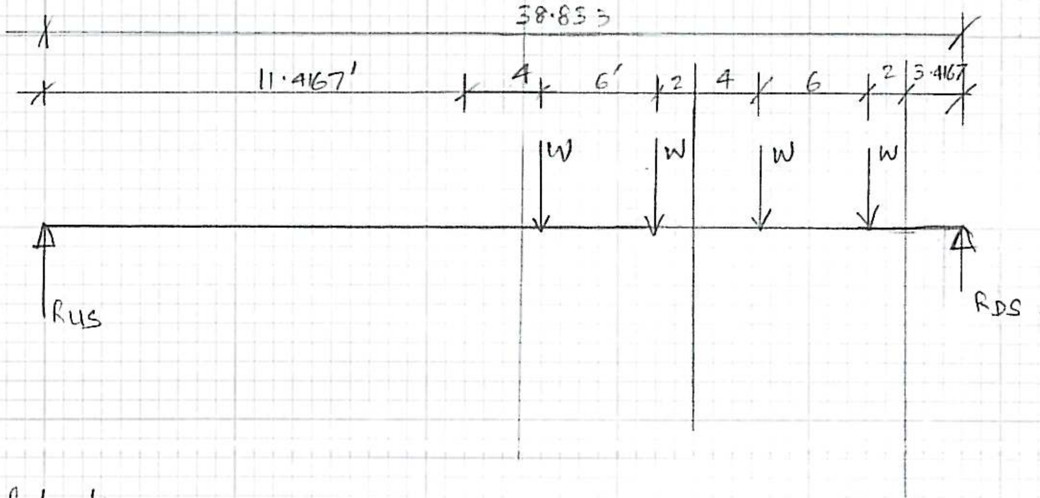
$$R_{SO3} = \frac{W}{7} = 0.143\,W$$

TranSystems

Made By: SSM | Date: 10/10/08 | Job No: HAM-50-0576

Checked By: MSL | Date: 5/18/09 | Sheet No: 5

DISTRIBUTION FACTOR DUE TO TWO TRUCK LOADS.



Wheel loads →

$$R_{DS} = \left[\frac{33.4167}{38.4167} + \frac{(27.4167')}{(38.4167')} + \left(\frac{21.4167}{38.4167}\right) + \frac{15.4167}{38.4167}\right] W$$

38.8333'

$= 2.54\,W$

2.515 W but say OK (conservative)

$R_{US} = 1.46\,W$

1.485 W, but say OK

Distribution factor →

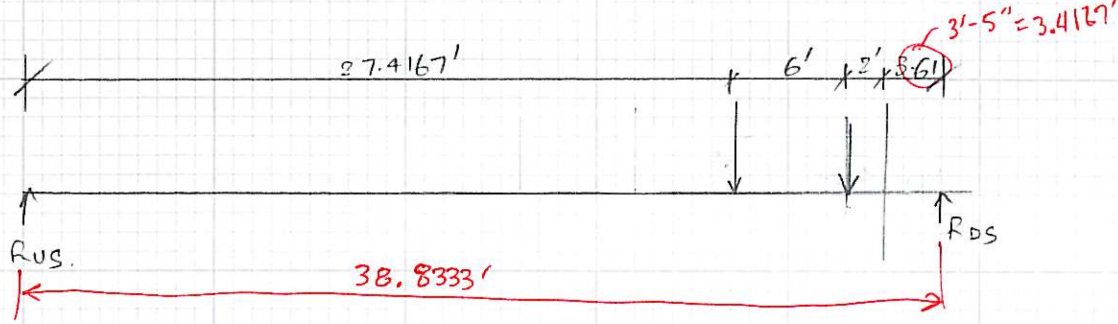
$$\text{Truss DS} = \frac{2.54W}{4W} = 0.635$$

$$\text{Truss US} = \frac{1.46W}{4W} = 0.365$$

TranSystems

Made By: SSM	Date: 10/10/08	Job No: HAM-50-0376
Checked By: MSL	Date: 5/18/09	Sheet No: 6

Right Truss Distribution factor due to a single truck load ⟶



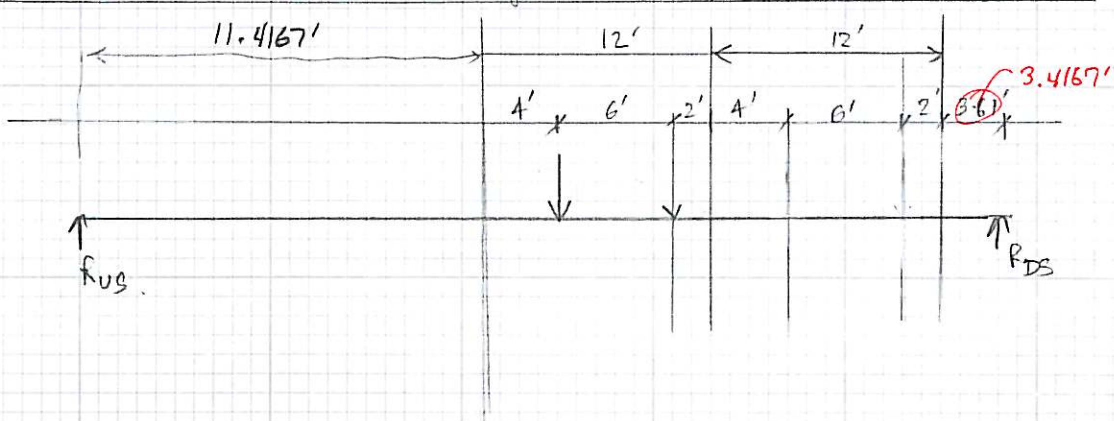
Wheel Loads ⟶

$$R_{DS} = \left[\frac{33.4167}{\underbrace{38.4167}_{38.833'}} + \frac{27.4167}{38.4167}\right] W = 1.584\, W$$

1.567W but say OK (Conservative)

$R_{US} = 0.416\, W$.

Wheel Load distribution on Right Truss due to truck in Left lane :⟶



Wheel loads ⟶

$$R_{DS} = \left[\frac{21.\cancel{225}^{\,4167}}{38.833} + \frac{15.\cancel{225}^{\,4167}}{38.833}\right] W = 0.937\, W$$

0.974 W