# LOAD RATING OF TRUSS BRIDGES

## JENNINGS RANDOLPH BRIDGE
## &
## NEW MARTINSVILLE BRIDGE
## OVER OHIO RIVER

By

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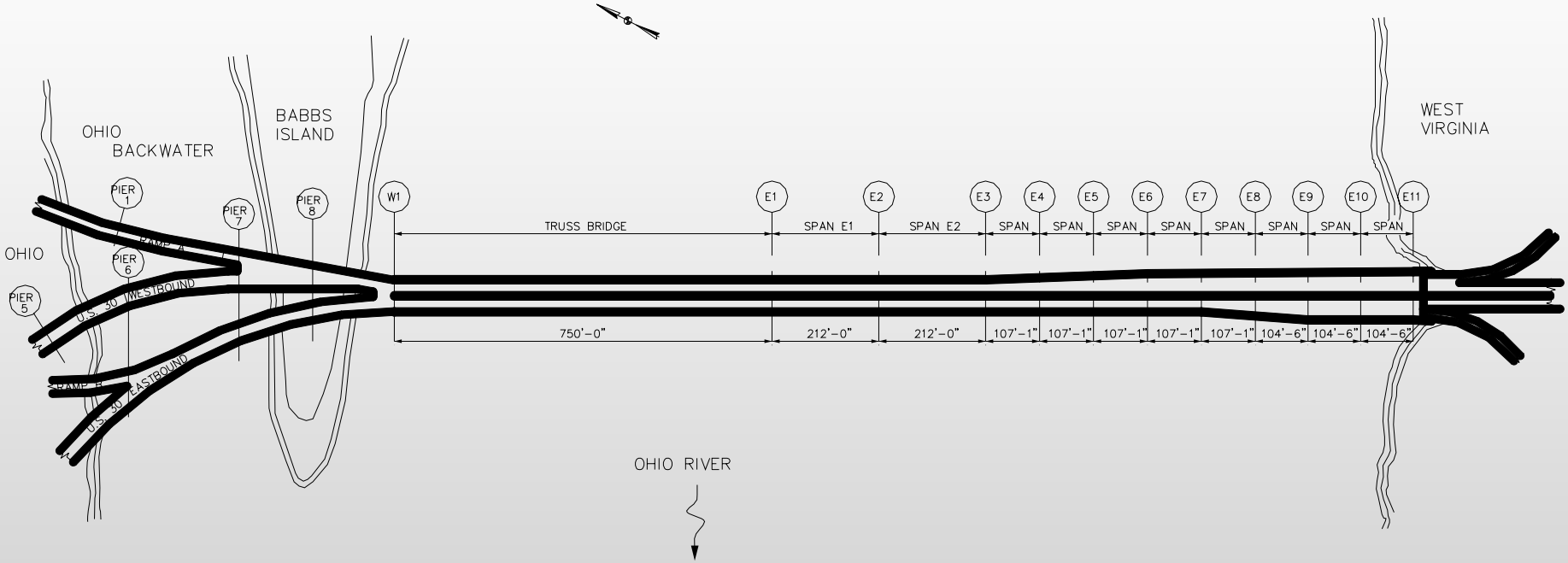
JENNINGS RANDOLPH BRIDGE

JENNINGS RANDOLPH BRIDGE

JENNINGS RANDOLPH BRIDGE

JENNINGS RANDOLPH BRIDGE (INSIDE)

JENNINGS RANDOLPH BRIDGE
(GENERAL PROFILE VIEW)




*SITE PLAN OF JENNINGS RANDOLPH BRIDGE*

# SITE PLAN, JENNINGS RANDOLPH BRIDGE

# JENNINGS RADOLPH BRIDGE

- ON U.S. 30
- NEAR CITY OF EAST LIVERPOOL, OHIO
- CONNECTS COLUMBIANA COUNTY, OHIO WITH HANDCOCK COUNTY, WEST VIRGINIA
- BUILT IN 1977
- ADT IN 2002 IS 15,000 WITH SIGNIFICANT AMOUNT OF COMMERCIAL TRUCKS
- FOUR LANE BRIDGE WITH A MEDIAN BARRIER

# JENNINGS RADOLPH BRIDGE

- MAIN SPAN 750 FEET BETWEEN CENTERLINE OF PIERS
- SINGLE-SPAN STEEL THROUGH PRATT TRUSS BRIDGE
- VERTICAL CLEARANCE 30′-0″
- TRUSS BRIDGE HAS HORIZONTAL CHORDS, VERTICALS, DIAGONALS, END PORTALS, SWAY FRAMES, AND STRUTS
- HAS A COMPOSITE DECK 7 1/2″ THICK WITH 1 1/2″ THICK CONCRETE OVERLAY

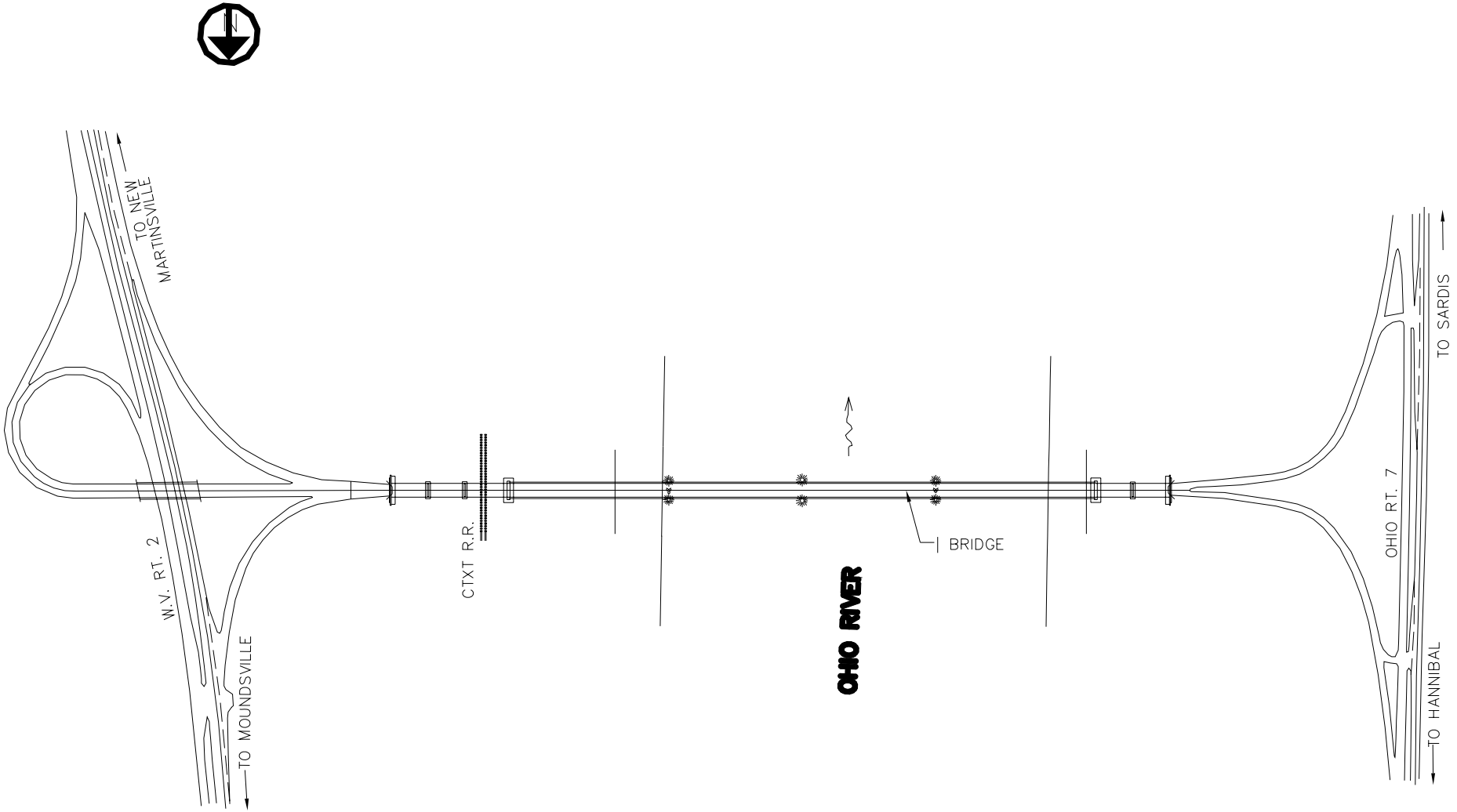
# JENNINGS RADOLPH BRIDGE

- DECK IS 64′-8″ WIDE WITH CURB-TO-CURB WIDTH 62′-0″
- HAS STRINGERS & FLOOR BEAMS IN THE FLOOR SYSTEM
- ON OHIO SIDE THERE ARE FOUR RAMPS WITH HORIZONTALLY CURVED GIRDERS AND ON WEST VIRGINIA SIDE MULTI-SPAN PLATE GIRDER APPROACH BRIDGES
- IS A SYMMETRIC TRUSS STRUCTURE

NEW MARTINSVILLE BRIDGE

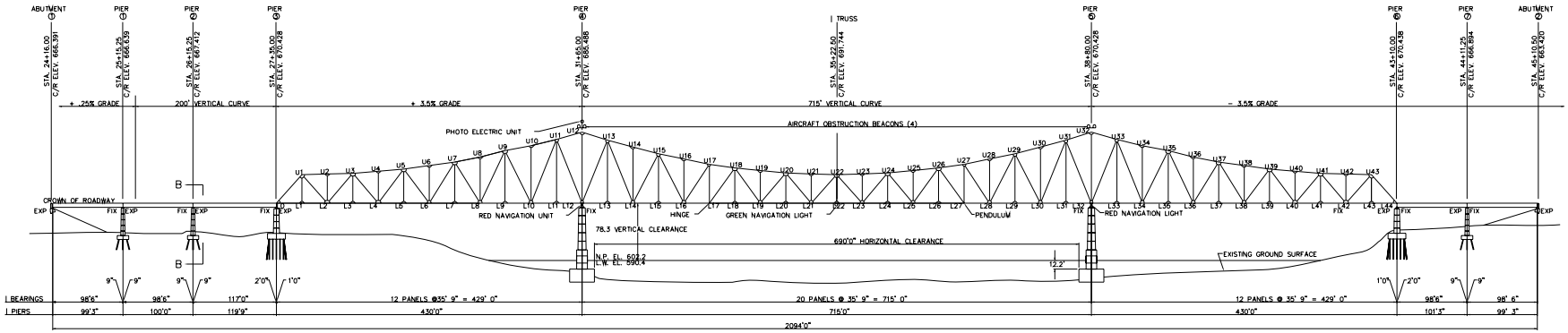
NEW MARTINSVILLE BRIDGE

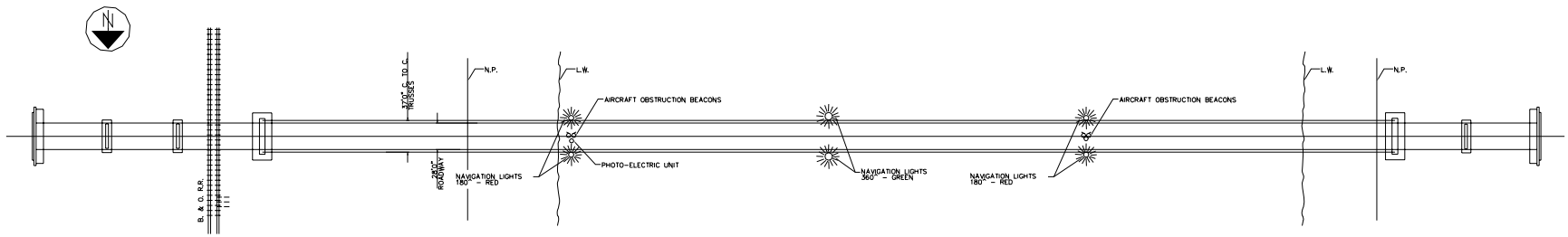
NEW MARTINSVILLE BRIDGE




SITE MAP

# SITE PLAN, NEW MARTINSVILLE BRIDGE




PLAN AND ELEVATION OF THE BRIDGE

# PLAN & ELEVATION, NEW MARTINSVILLE BRIDGE

# NEW MARTINSVILLE BRIDGE

- ALSO KNOWN AS KOREAN WAR VETERANS' MEMORIAL BRIDGE
- CONNECTS OHIO ROUTE 7 TO WEST VIRGINIA ROUTE 2
- CONNECTS MONROE COUNTY, OHIO AND WETZEL COUNTY, WEST VIRGINIA
- BUILT IN 1959
- THREE-SPAN STEEL THROUGH CANTILEVER WARREN TRUSS BRIDGE

# NEW MARTINSVILLE BRIDGE

- THE TWO SIDE SPANS ARE 429′-0″ EACH, BETWEEN BEARINGS. MIDDLE SPAN IS 715′-0″, OF WHICH CENTRAL 357′-6″ IS SUSPENDED
- TRUSS BRIDGE SPANS FROM PIERS 3 TO 6 OF THE BRIDGE SYSTEM
- MINIMUM VERTICAL CLEARANCE IS 20′-0″
- HAS HORIZONTAL CHORDS, VERTICALS, DIAGONALS, END PORTALS, AND SWAY FRAMES
- HAS TWO LANES WITH TRAFFIC IN EACH DIRECTION

# NEW MARTINSVILLE BRIDGE

- REINFORCED CONCRETE DECK IS 8″ THICK AND 34′-0″ WIDE. THERE IS A 1 1/2″ THICK BITUMINOUS WEARING SURFACE
- CURB-TO-CURB ROADWAY WIDTH IS 28′-0″ AND HORIZONTAL CLEARANCE BETWEEN TWO FACES OF CHAIN LINK FENCE IS 34′-0″
- HAS 3′-0″ WIDE SIDEWALKS ON BOTH SIDES
- HAS STRINGERS & FLOOR BEAMS IN THE FLOOR SYSTEM

# NEW MARTINSVILLE BRIDGE

- CONNECTED TO A THREE-SPAN PLATE GIRDER STRUCTURE ON THE EAST (WEST VIRGINIA) SIDE AND A TWO-SPAN PLATE GIRDER STRUCTURE ON THE WEST (OHIO) SIDE
- IS A SYMMETRIC STRUCTURE, WITH THE EXCEPTION OF A SINGLE POINT OF ASYMMETRY DUE TO A LINKAGE ASSEMBLY CONNECTION AT PANEL POINT 27
- TWO VERTICAL MEMBERS AT POINTS 17 AND 27 ARE HINGED FOR THE MIDDLE PART OF THE TRUSS IS SIMPLY SUPPORTED ON THESE TWO POINTS

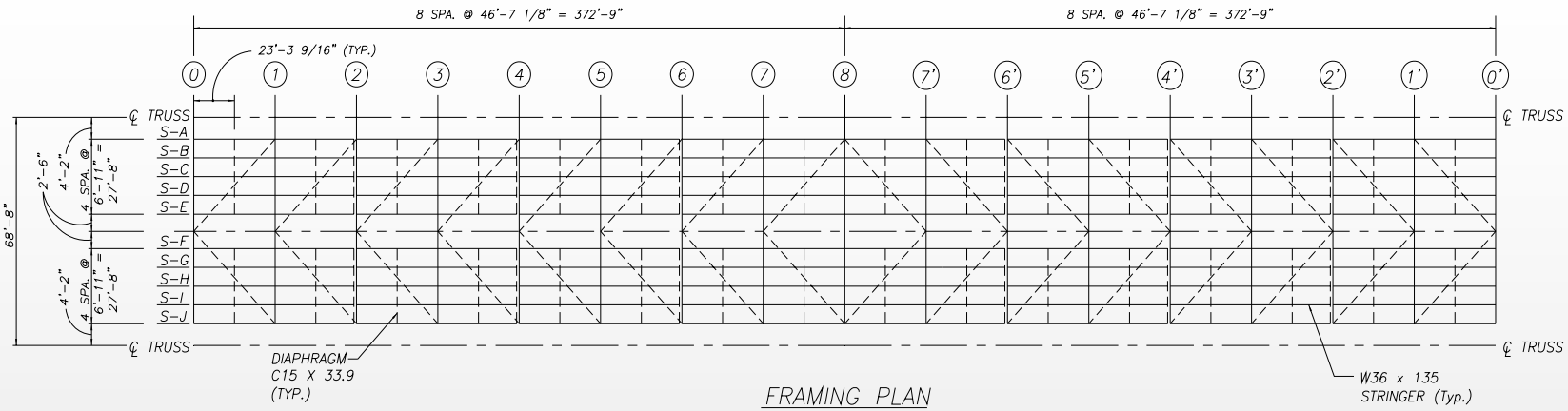
# NEW MARTINSVILLE BRIDGE

- TO MAINTAIN SIMPLE SUPPORT CONDITIONS, BOTH BOTTOM AND TOP CHORD MEMBERS (MEMBERS L16-L17, L27-L28, U17-U18, & U26-U27) CONNECTING THE PANEL POINTS 17 AND 27 TO THE CANTILEVERED ENDS ARE TREATED AS NON MEMBERS
- THESE MEMBERS ARE NOT RATED
- ADT OF THE BRIDGE IN 2002 IS 8,700 WITH 8 PERCENT COMMERCIAL TRUCKS

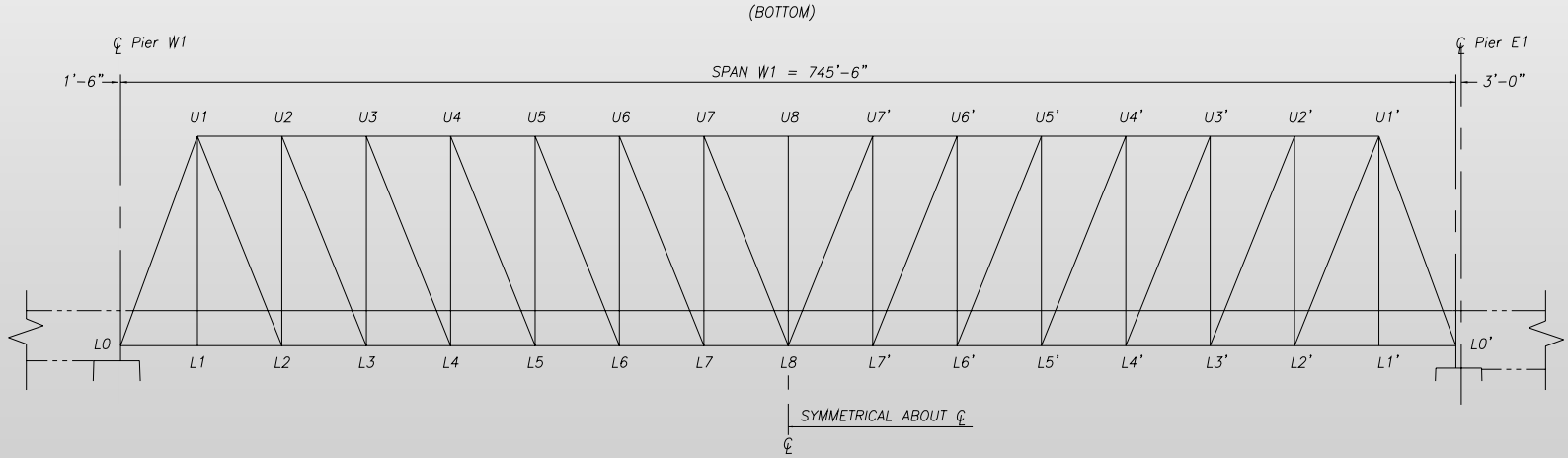
# LOAD RATING ANALYSIS WAS DONE FOR

- TRUSS MEMBERS:
  1. TOP CHORDS
  2. BOTTOM CHORDS
  3. VERTICALS
  4. DIAGONALS

- BRIDGE DECK SYSTEM:
  1. STRINGERS
  2. FLOOR BEAMS

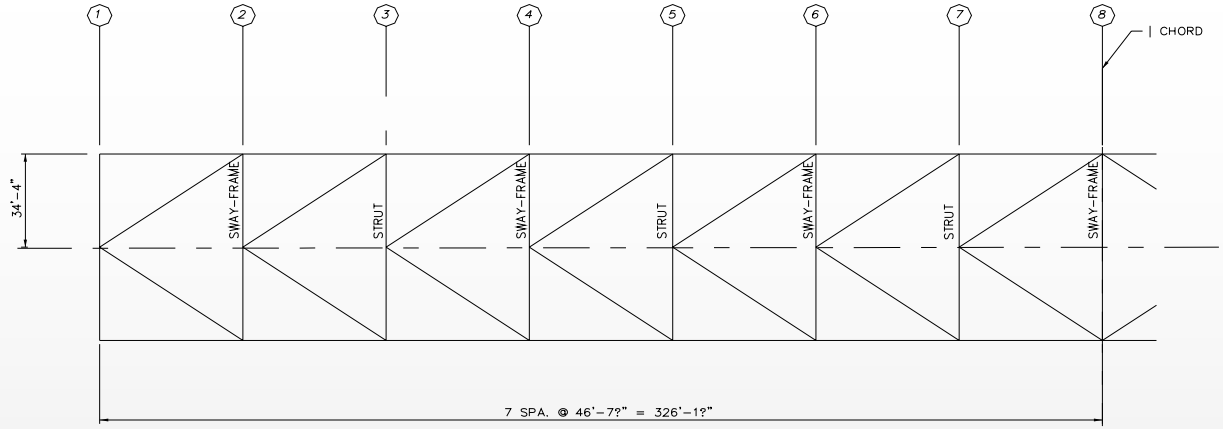



FRAMING PLAN

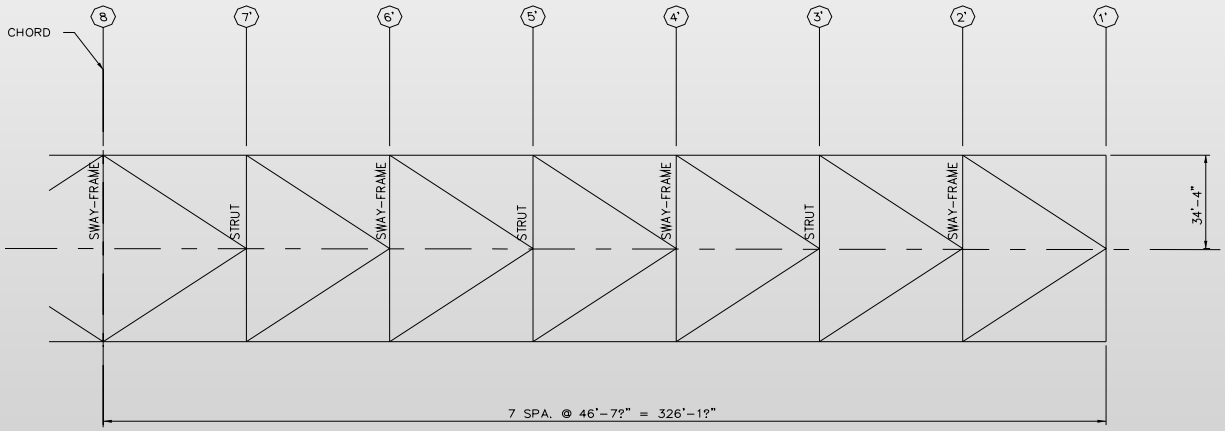



ELEVATION

# FRAMING PLAN AND ELEVATION OF JENNINGS RANDOLPH TRUSS BRIDGE




TRUSS SPAN TOP CHORD PLAN
(WEST HALF)




TRUSS SPAN TOP CHORD PLAN
(EAST HALF)

# TOP CHORD PLAN, JENNINGS RANDOLPH BRIDGE

# SOFTWARE USED FOR TRUSS ANALYSIS & RATING IS

# TRAP

## (TRUSS RATING & ANALYSIS PROGRAM)

From

The Bridge Engineering Software & Technology (BEST) Center of

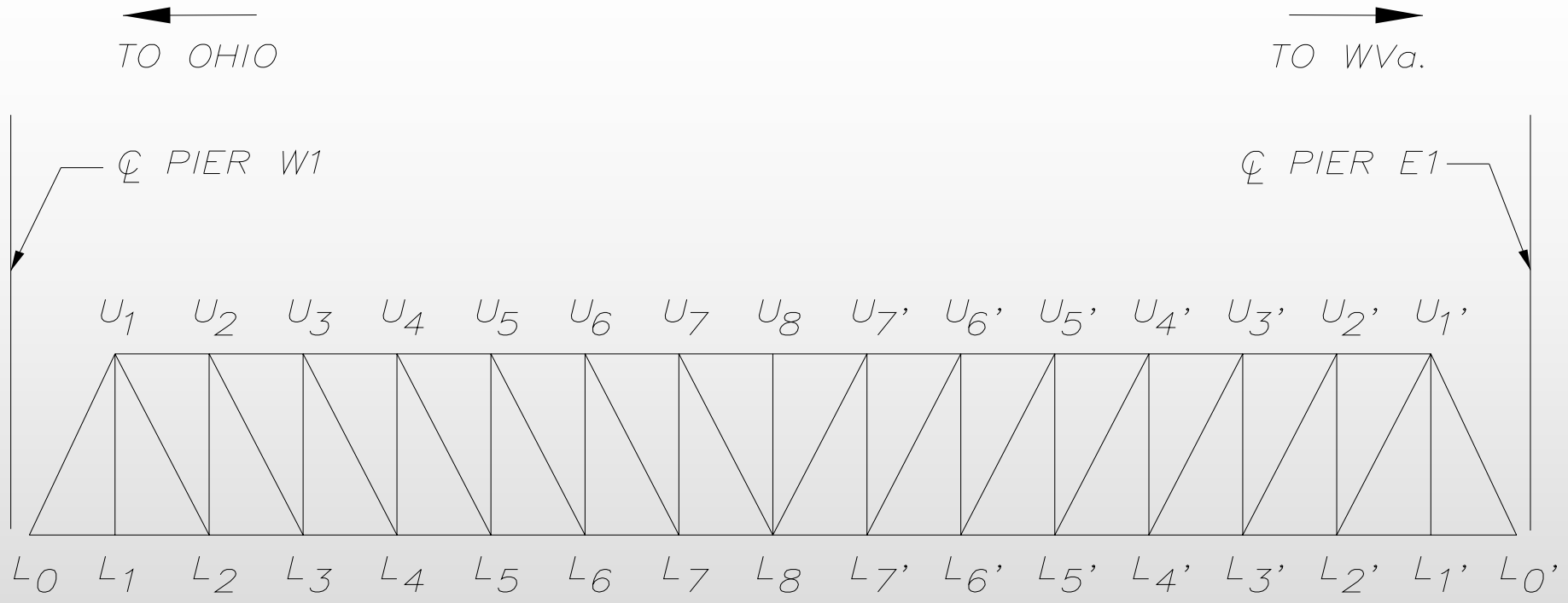
the University of Maryland

# LOAD RATING USING TRAP:

- TRAP DOES TWO-DIMENSIONAL ANALYSIS BY USING THE STIFFNESS METHOD
- TRAP GENERATES INFLUENCE LINES FOR MEMBER FORCES, SUPPORT REACTIONS, AND DEFLECTIONS FOR DEAD LOADS AND DIFFERENT VEHICULAR LIVE LOADS
- TRAP DOES LOAD RATING ANALYSIS OF TRUSS MEMBERS FOR INTENDED LOADS

# LOAD RATING USING TRAP:

- ONE BRIDGE TRUSS IS ANALYZED ASSUMING TWO BRIDGE TRUSSES SHARE THE TOTAL LOADS OF THE BRIDGE EQUALLY
- COORDINATES AND CONNECTIVITY OF THE TRUSS MEMBERS ALONG WITH LOADING, MEMBER, AND SECTIONAL PROPERTIES ARE SUPPLIED AS INPUT




TRUSS LINE DIAGRAM

# JENNINGS RANDOLPH TRUSS BRIDGE LINE DIAGRAM

# DEFINITION OF RATINGS

- INVENTORY RATING: INVENTORY RATING CHARACTERIZE A LIVE LOAD THAT CAN SAFELY UTILIZE THE STRUCTURE FOR AN INDEFINITE PERIOD OF TIME.
- OPERATING RATING: OPERATING RATING DESCRIBES THE MAXIMUM PERMISIBLE LIVE LOAD TO WHICH THE STRUCTURE MAY BE SUBJECTED. OPERATING LEVEL MAY SHORTEN THE LIFE OF THE STRUCTURE.

# INVENTORY RATING BY LFR (LOAD FACTOR RATING):

Inventory Rating of Truss Members =

$$\frac{\text{Axial Load Capacity} - 1.3 * \text{Axial Load due to Dead Load}}{1.3 * 1.67 * \text{Axial Load due to (Live Load + Impact)}}$$

# OPERATING RATING BY LFR (LOAD FACTOR RATING):

$$\text{Operating Rating of Truss Members} = \frac{\text{Axial Load Capacity} - 1.3 * \text{Axial Load due to Dead Load}}{1.3 * \text{Axial Load due to (Live Load + Impact)}}$$

# THE VALUES FOR AXIAL CAPACITY FOR MEMBERS AND THE AXIAL LOADS FOR DEAD LOAD AND LIVE LOAD CAN BE OBTAINED FROM TRAP

FOR TENSION MEMBERS:

AXIAL LOAD CAPACITY = $F_y A_{net}$

## FOR COMPRESSION MEMBERS:

AXIAL LOAD CAPACITY = $0.85\ A_{gross}\ F_{cr}$
(PER AASHTO STAND. SPEC, ARTICLE 10.54)

$$\text{If } \frac{K L_c}{r} \le \sqrt{\frac{2\pi^2 E}{F_y}}, \quad F_{cr} = F_y \left[ 1 - \frac{F_y}{4\pi^2 E} \left( \frac{K L_c}{r} \right)^2 \right]$$

$$\text{If } \frac{K L_c}{r} > \sqrt{\frac{2\pi^2 E}{F_y}}, \quad F_{cr} = \frac{\pi^2 E}{\left( \frac{K L_c}{r} \right)^2}$$

# MEMBER PROPERTIES & NOTATIONS

E = 29,000 ksi

$F_y$ IS BASED ON TYPE OF STEEL USED OR ON DATE BUILT

r = LEAST RADIUS OF GYRATION IN INCHES

$L_c$ = LENGTH OF THE MEMBER IN INCHES

# THE EFFECTIVE LENGTH FACTOR (K):

- MEMBERS WITH BOLTED OR WELDED CONNECTIONS AT ENDS ARE CONSIDERED 0.75 (PARTIALLY RESTRAINED)
- MEMBERS WITH HINGED ENDS ARE CONSIDERED 0.875 (FOR PIN FRICTION)

# LOAD RATING WAS DONE FOR

- INVENTORY & OPERATING RATING:
  HS-20 LOADING

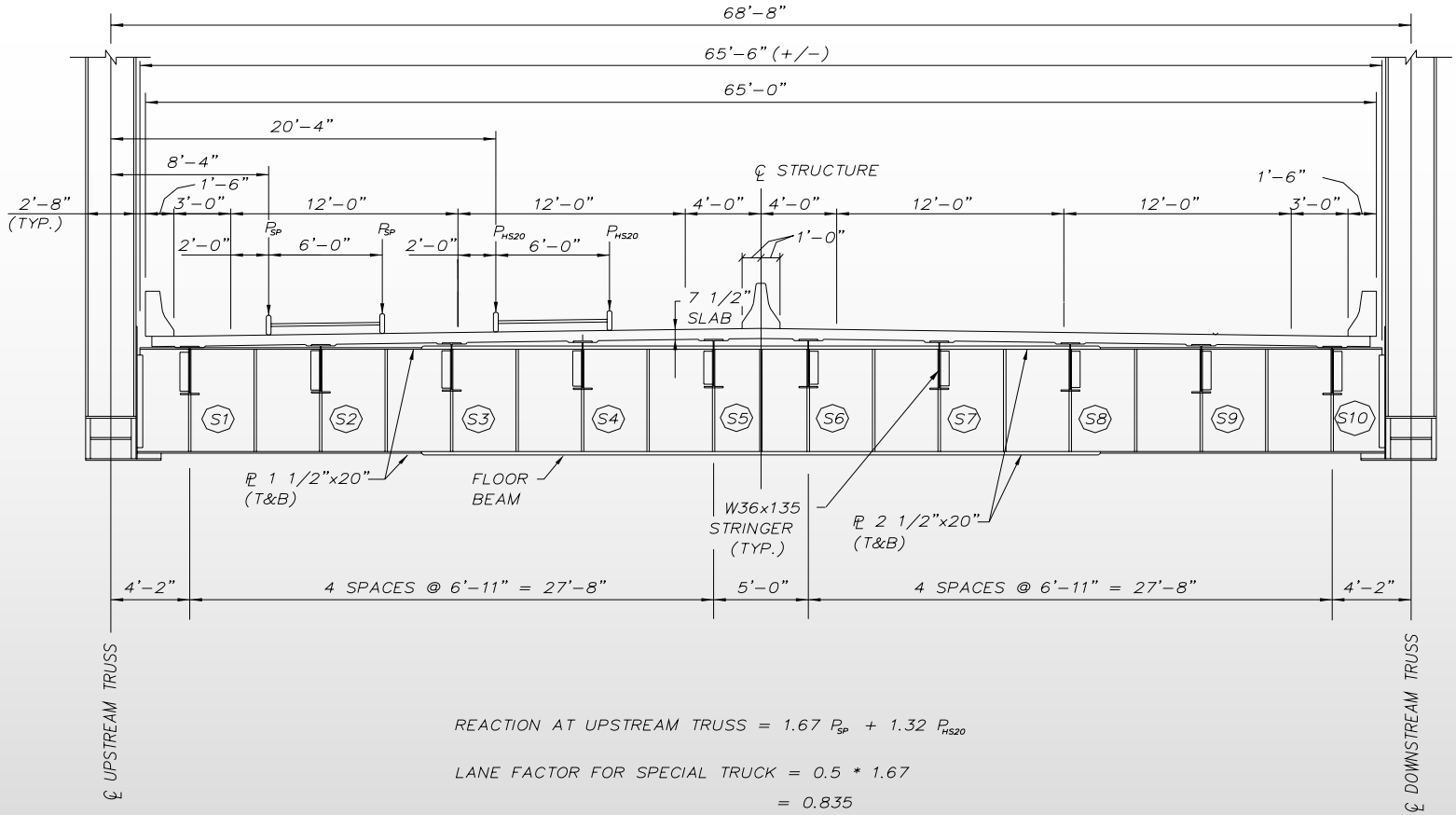
- OPERATING RATING FOR SPECIAL LOADS:
  1. HS-20 TRUCKS
  2. H-20 TRUCKS
  3. T-3 TRUCKS
  4. 3S2 TRUCKS
  5. SU4 TRUCKS

# RATING ANALYSIS IS BASED ON

- AASHTO MANUAL FOR CONDITION EVALUATION OF BRIDGES, 1994
- AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, 2002

# SPECIAL NOTES

- TRAP GENERATES THE INVENTORY AND OPERATING RATINGS FOR THE HS-20 LOADING BASED ON THE TWO FORMULAS
- FOR SPECIAL LOADING WE PLACED THE LOADS IN A SPECIAL WAY AS PRESENTED IN FIGURES SHOWN SUBSEQUENTLY
- FOR INVENTORY AND OPERATING RATING BY HS-20 LOADING, WE LET THE SOFTWARE GENERATE THE DISTRIBUTION FACTOR CALLED AS “LANE FACTOR”




REACTION AT UPSTREAM TRUSS = $1.67\ P_{SP} + 1.32\ P_{HS20}$

LANE FACTOR FOR SPECIAL TRUCK = 0.5 * 1.67

= 0.835

LANE FACTOR FOR HS20 TRUCK = 0.5 * 1.32

= 0.66

TWO LANE LOADING

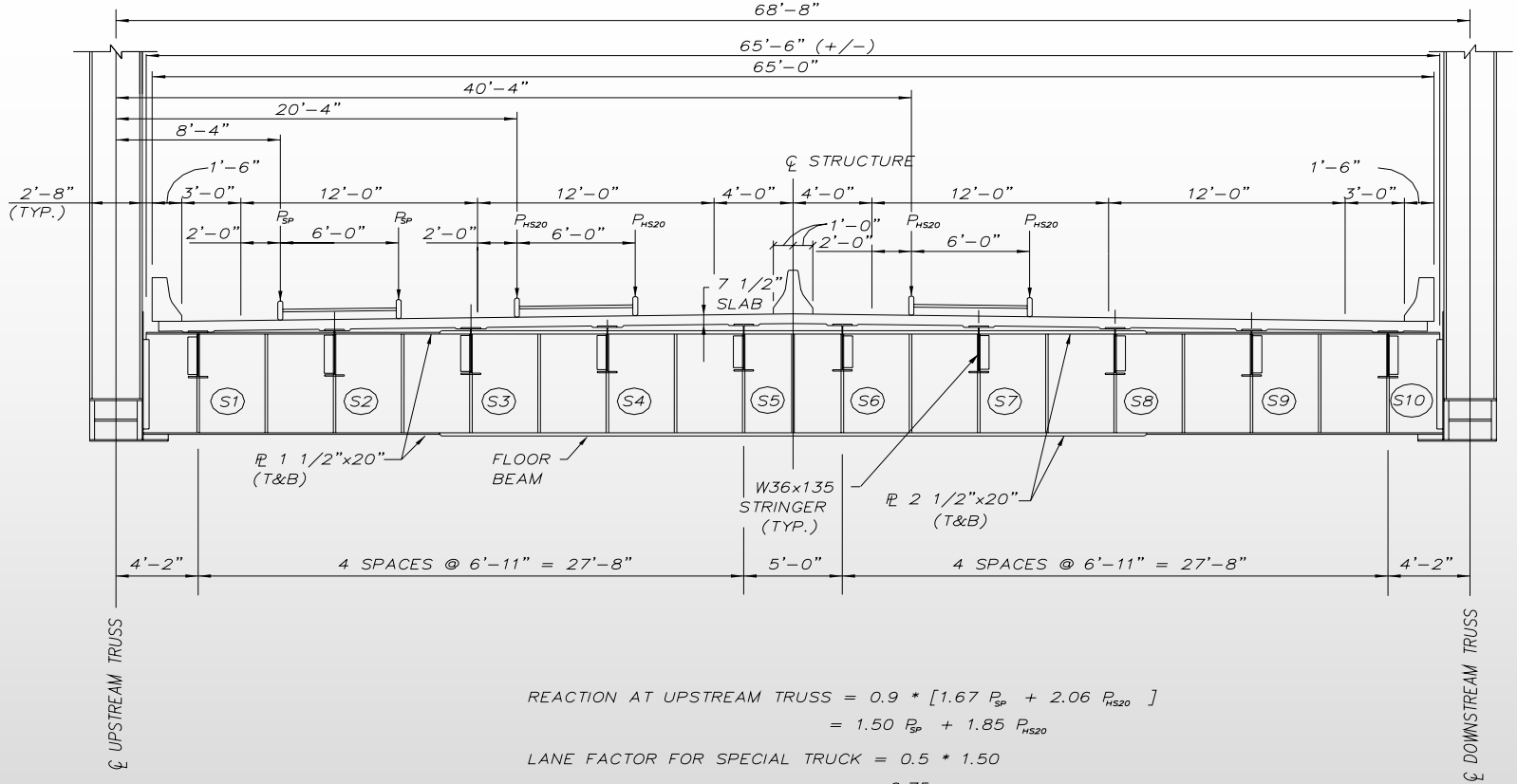
WHEEL LOAD PLACEMENT FOR SPECIAL LOADING FOR RATING OF TRUSS

(DOES NOT CONTROL)

$P_{HS20}$ – HS20 WHEEL LOAD

$P_{SP}$ – SPECIAL VEHICLE WHEEL LOAD

# TWO LANE LOADING FOR TRUSS




REACTION AT UPSTREAM TRUSS = 0.9 * [1.67 $P_{SP}$ + 2.06 $P_{HS20}$ ]

= 1.50 $P_{SP}$ + 1.85 $P_{HS20}$

LANE FACTOR FOR SPECIAL TRUCK = 0.5 * 1.50

= 0.75

LANE FACTOR FOR HS20 TRUCK = 0.5 * 1.85

= 0.925

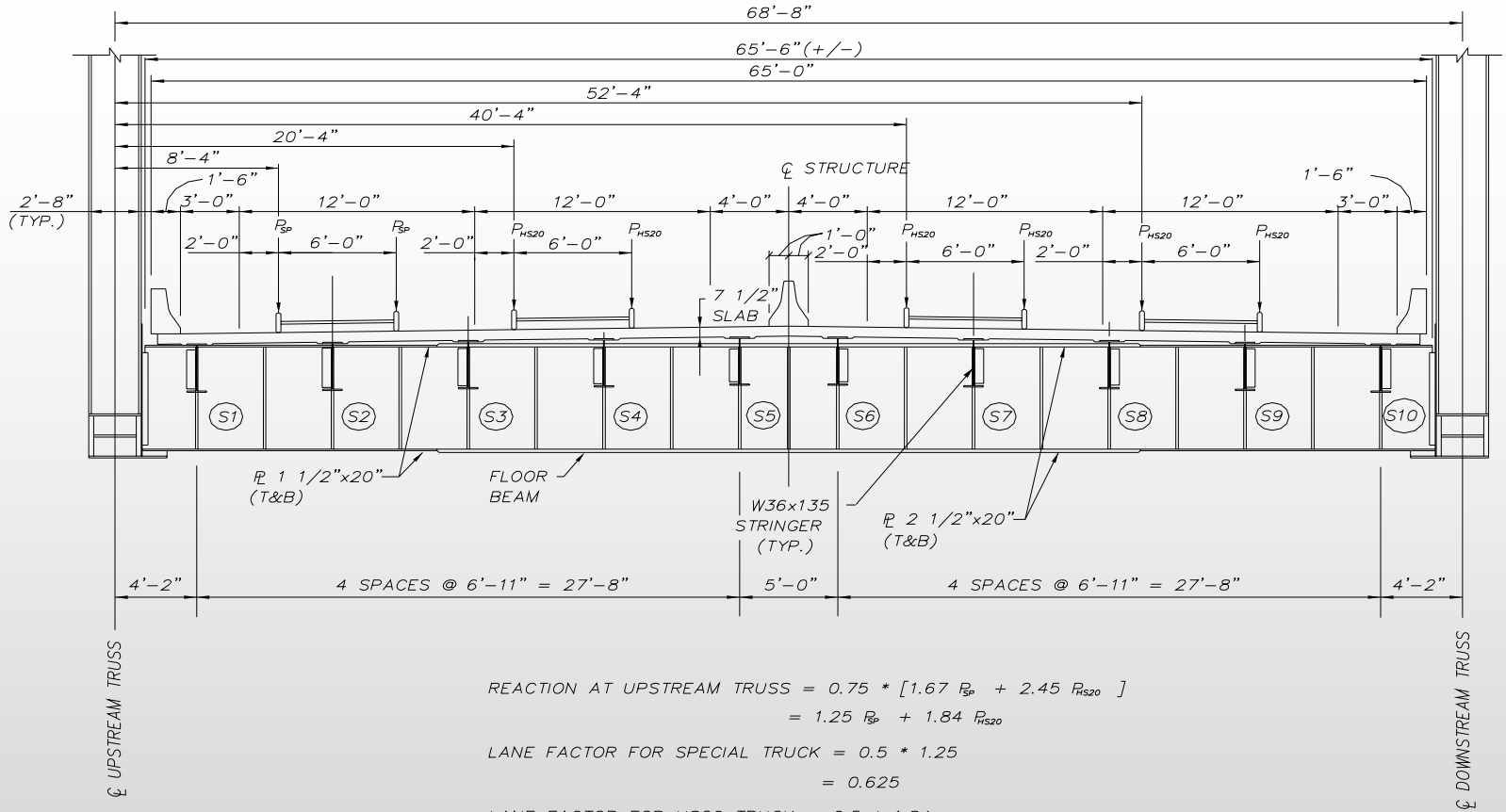
THREE LANE LOADING

WHEEL LOAD PLACEMENT FOR SPECIAL LOADING FOR RATING OF TRUSS (CONTROLS)

$P_{HS20}$ – HS20 WHEEL LOAD

$P_{SP}$ – SPECIAL VEHICLE WHEEL LOAD

# THREE LANE LOADING FOR TRUSS (CONTROLS)




REACTION AT UPSTREAM TRUSS = 0.75 * [1.67 $P_{SP}$ + 2.45 $P_{HS20}$ ]

= 1.25 $P_{SP}$ + 1.84 $P_{HS20}$

LANE FACTOR FOR SPECIAL TRUCK = 0.5 * 1.25

= 0.625

LANE FACTOR FOR HS20 TRUCK = 0.5 * 1.84

= 0.92

FOUR LANE LOADING

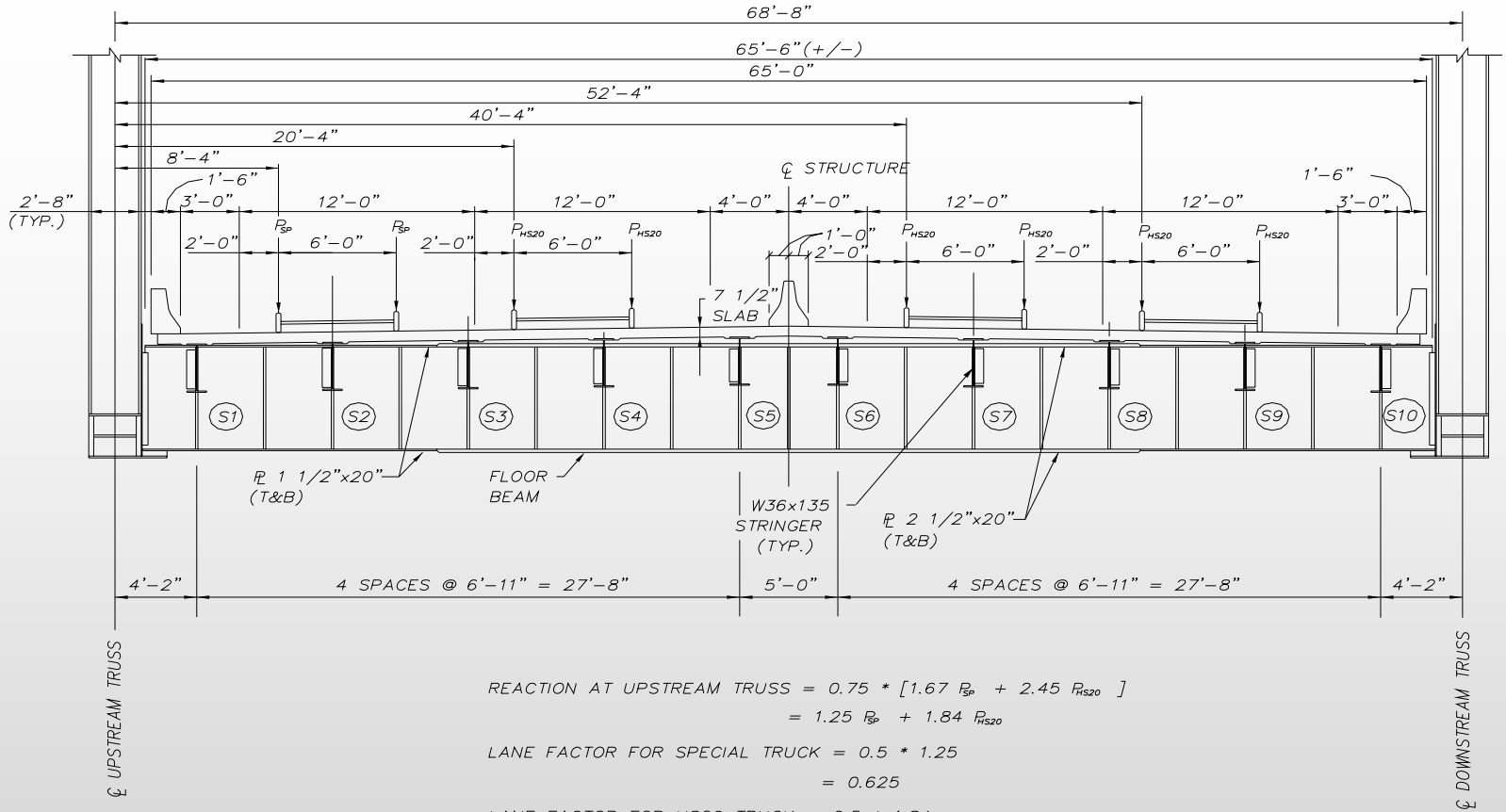
WHEEL LOAD PLACEMENT FOR SPECIAL LOADING FOR RATING OF TRUSS

(DOES NOT CONTROL)

$P_{HS20}$ – HS20 WHEEL LOAD

$P_{SP}$ – SPECIAL VEHICLE WHEEL LOAD

# FOUR LANE LOADING FOR TRUSS




REACTION AT UPSTREAM TRUSS = 0.75 * [1.67 $P_{SP}$ + 2.45 $P_{HS20}$ ]

= 1.25 $P_{SP}$ + 1.84 $P_{HS20}$

LANE FACTOR FOR SPECIAL TRUCK = 0.5 * 1.25

= 0.625

LANE FACTOR FOR HS20 TRUCK = 0.5 * 1.84

= 0.92

FOUR LANE LOADING

WHEEL LOAD PLACEMENT FOR SPECIAL LOADING FOR RATING OF TRUSS

(DOES NOT CONTROL)

$P_{HS20}$ – HS20 WHEEL LOAD

$P_{SP}$ – SPECIAL VEHICLE WHEEL LOAD

# FOUR LANE LOADING FOR TRUSS

# OVERALL RATINGS FOR THE CONTROLLING TRUSS ELEMENTS, JENNINGS RANDOLPH

| Member | Load | Inventory Rating | | Operating Rating | |
|---|---|---|---|---|---|
| | | Factor | Load (Tons) | Factor | Load (Tons) |
| U6-L7<br>L7′-U6′ | HS 20 Critical Loading | 1.52 | 55 | 2.54 | 91 |
| L1-U1<br>L1′-U1′ | HS 20 Special Loading | N.A. | N.A. | 3.09 | 111 |

| Member | Load | Inventory Rating | | Operating Rating | |
|---|---|---|---|---|---|
| | | Factor | Load (Tons) | Factor | Load (Tons) |
| L1-U1<br>L1′-U1′ | H 20 Sp. Loading | N.A. | N.A. | 3.71 | 74 |
| L1-U1<br>L1′-U1′ | T-3 Sp. Loading | N.A. | N.A. | 3.53 | 88 |
| L1-U1<br>L1′-U1′ | 3S2 Sp. Loading | N.A. | N.A. | 3.30 | 119 |
| L1-U1<br>L1′-U1′ | SU4 Sp. Loading | N.A. | N.A. | 3.09 | 108 |

SOFTWARE USED FOR RATING ANALYSIS OF STRINGERS IS

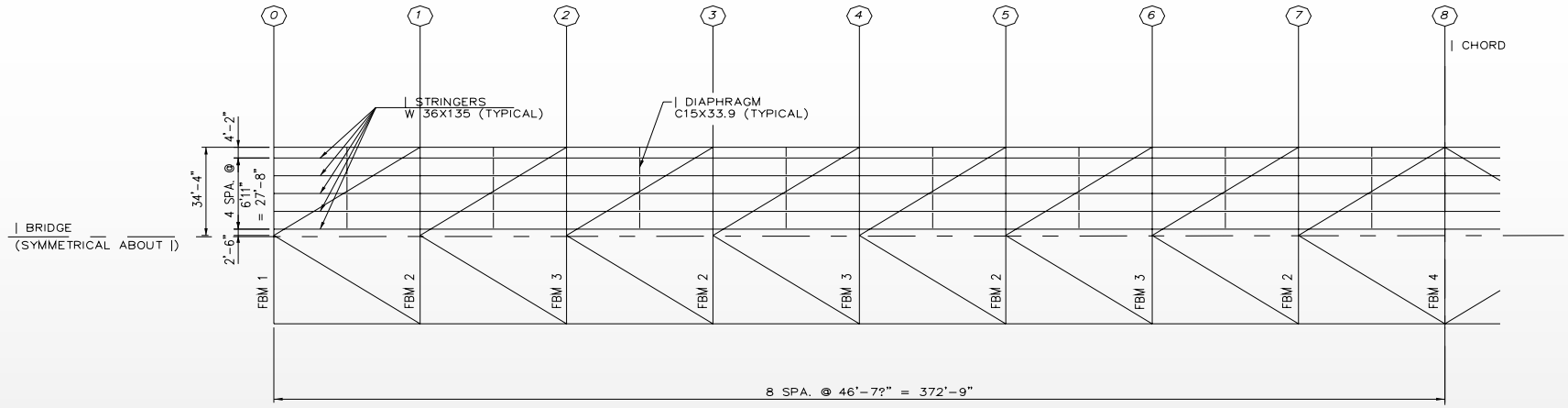
# MERLIN DASH

From

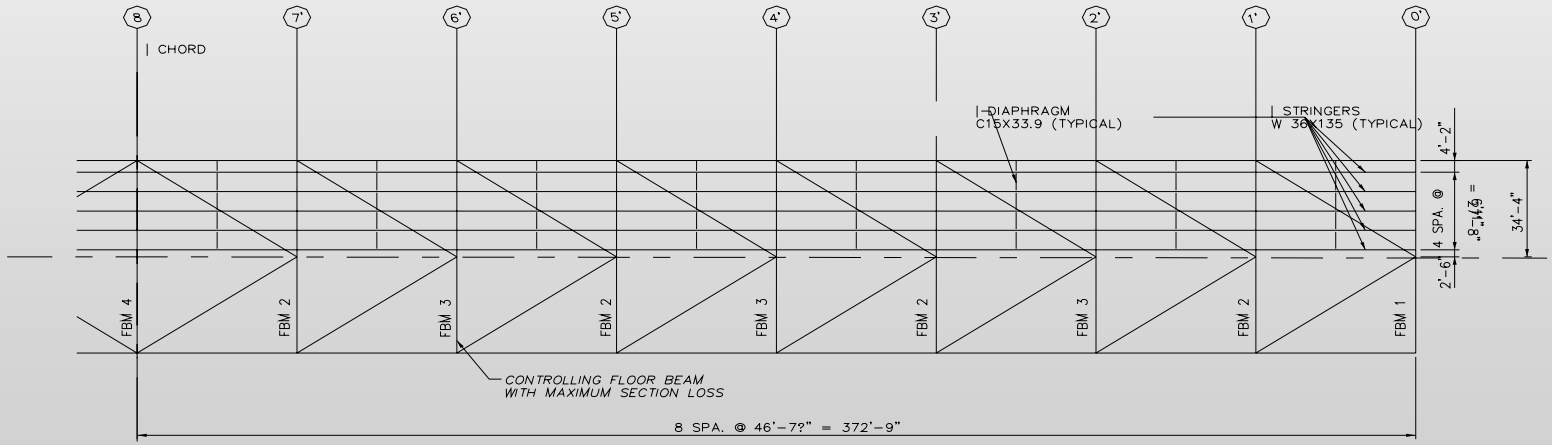
The Bridge Engineering Software & Technology (BEST) Center of

the University of Maryland

HAND CALCULATIONS ALONG WITH MERLIN DASH WERE USED FOR RATING ANALYSIS OF FLOOR BEAMS

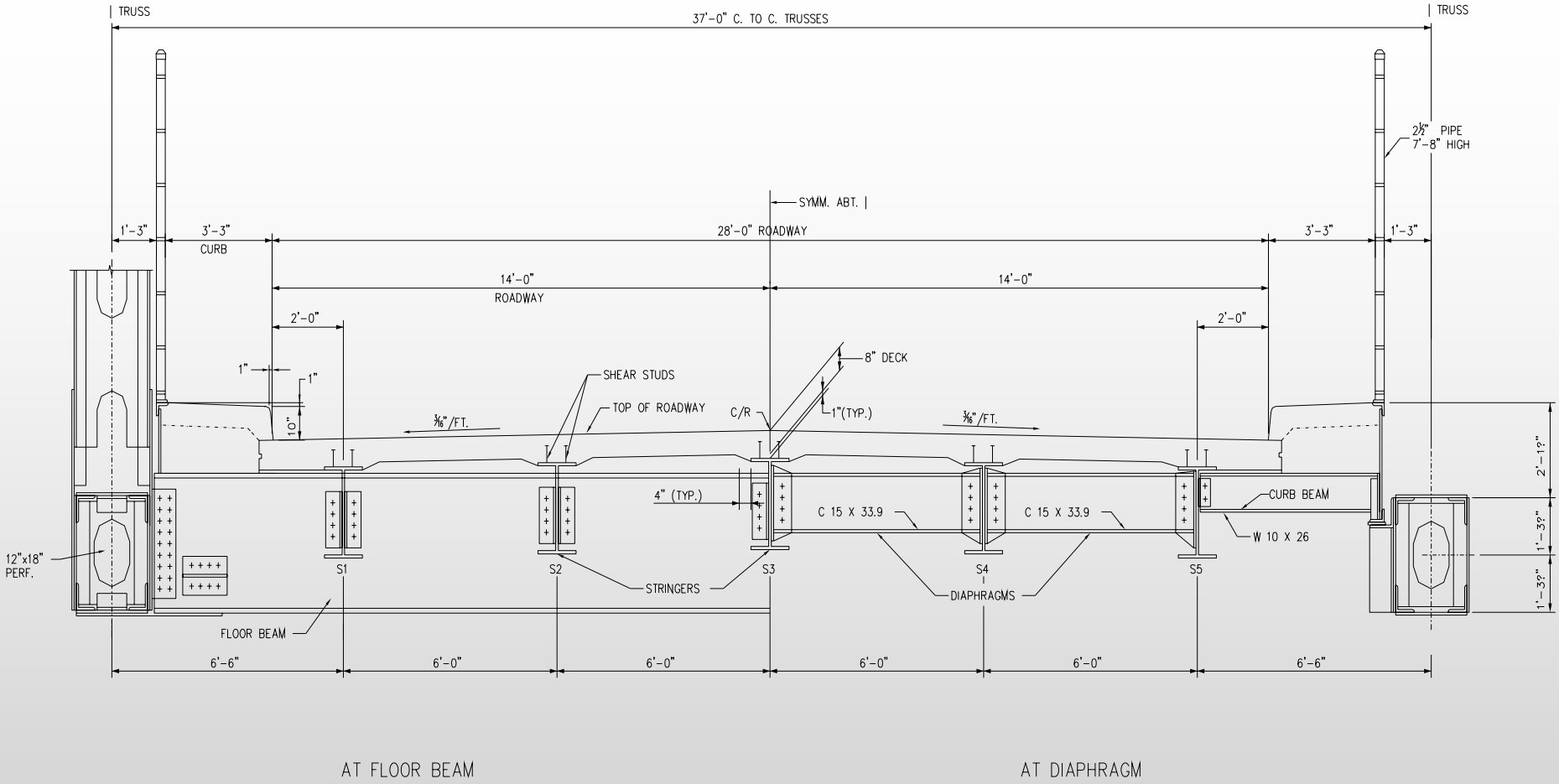



TRUSS SPAN BOTT. CHORD PLAN
(WEST HALF)




TRUSS SPAN BOTT. CHORD PLAN
(EAST HALF)

# BOTTOM CHORD PLAN, JENNINGS RANDOLPH TRUSS BRIDGE




AT FLOOR BEAM

AT DIAPHRAGM

TYPICAL TRANSVERSE HALF SECTIONS
OF THE TRUSS BRIDGE AT FLOOR BEAM
AND DIAPHRAGM

# TYPICAL TRANSVERSE SECTION, JENNINGS RANDOLPH TRUSS BRIDGE

# INVENTORY RATING OF STRINGERS & FLOOR BEAMS FOR MOMENTS

Inventory Rating for Moment =

$$\frac{\text{Moment Capacity} - 1.3 * \text{Moment for Dead Load}}{1.3 * 1.67 * \text{Moment for (Live Load + Impact)}}$$

# OPERATING RATING OF STRINGERS & FLOOR BEAMS FOR MOMENTS

Operating Rating for Moment =

$$\frac{\text{Moment Capacity} - 1.3 * \text{Moment for Dead Load}}{1.3 * \text{Moment for (Live Load} + \text{Impact)}}$$

# INVENTORY RATING OF STRINGERS & FLOOR BEAMS FOR SHEAR

$$\text{Inventory Rating for Shear} = \frac{\text{Shear Capacity} - 1.3 * \text{Shear for Dead Load}}{1.3 * 1.67 * \text{Shear for (Live Load + Impact)}}$$

# OPERATING RATING OF STRINGERS & FLOOR BEAMS FOR SHEAR

Operating Rating for Shear =

$$\frac{\text{Shear Capacity} - 1.3 * \text{Shear for Dead Load}}{1.3 * \text{Shear for (Live Load} + \text{Impact)}}$$

# INVENTORY RATING OF STRINGERS FOR SERVICEABILITY REQUIREMENTS (COMPOSITE BEAM)

Inventory Rating for Serviceability =

$$\frac{0.95 * F_y \text{ - Bending Stress for Dead Load}}{1.67 * \text{Bending Stress for (Live Load + Impact)}}$$

# OPERATING RATING OF STRINGERS FOR SERVICEABILITY REQUIREMENTS (COMPOSITE BEAM)

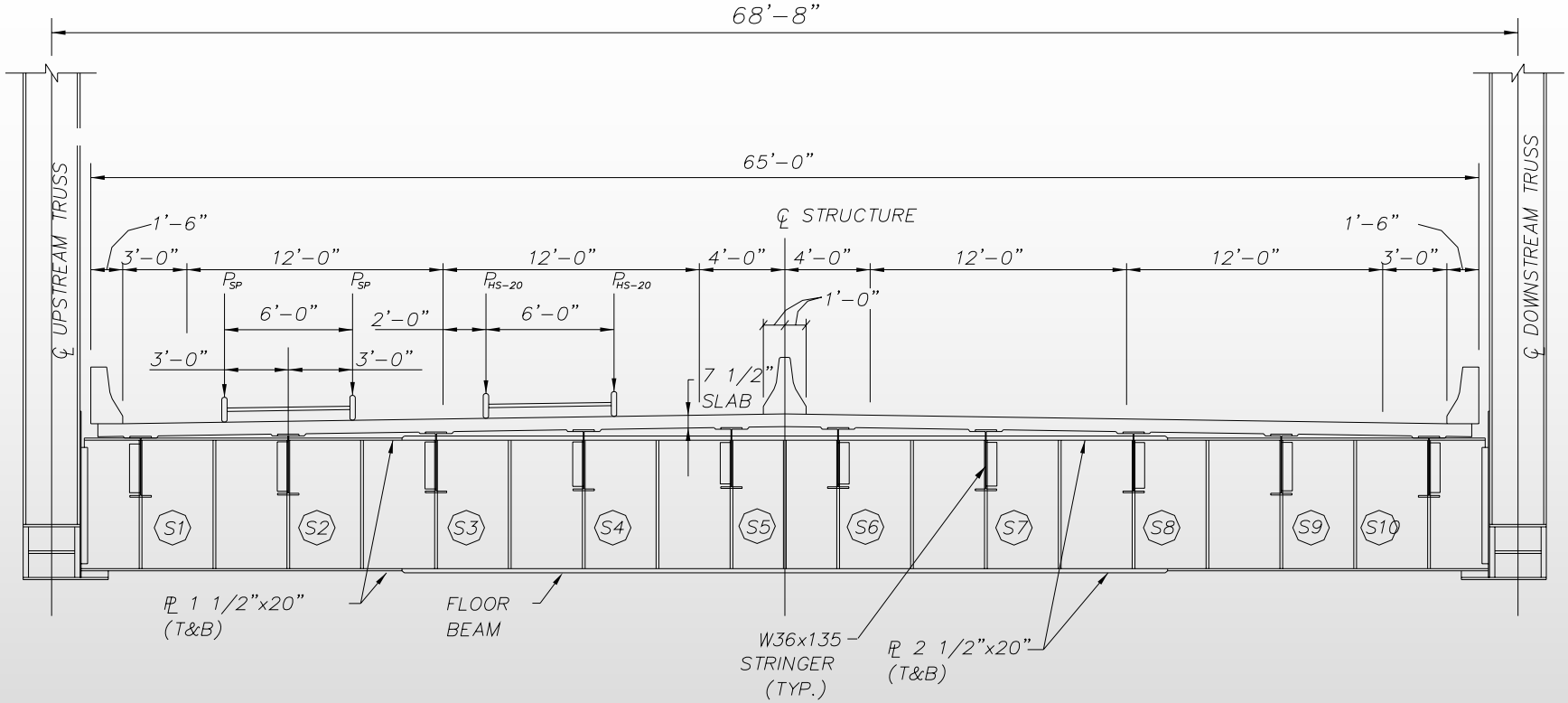
$$\text{Operating Rating for Serviceability} = \frac{0.95 * F_y - \text{Bending Stress for Dead Load}}{\text{Bending Stress for (Live Load + Impact)}}$$

# INVENTORY RATING OF FLOOR BEAMS FOR SERVICEABILITY REQUIREMENTS (NON-COMPOSITE BEAM)

$$\text{Inventory Rating for Serviceability} = \frac{0.8 * F_y - \text{Bending Stress for Dead Load}}{1.67 * \text{Bending Stress for (Live Load + Impact)}}$$

# OPERATING RATING OF FLOOR BEAMS FOR SERVICEABILITY REQUIREMENTS (NON-COMPOSITE BEAM)

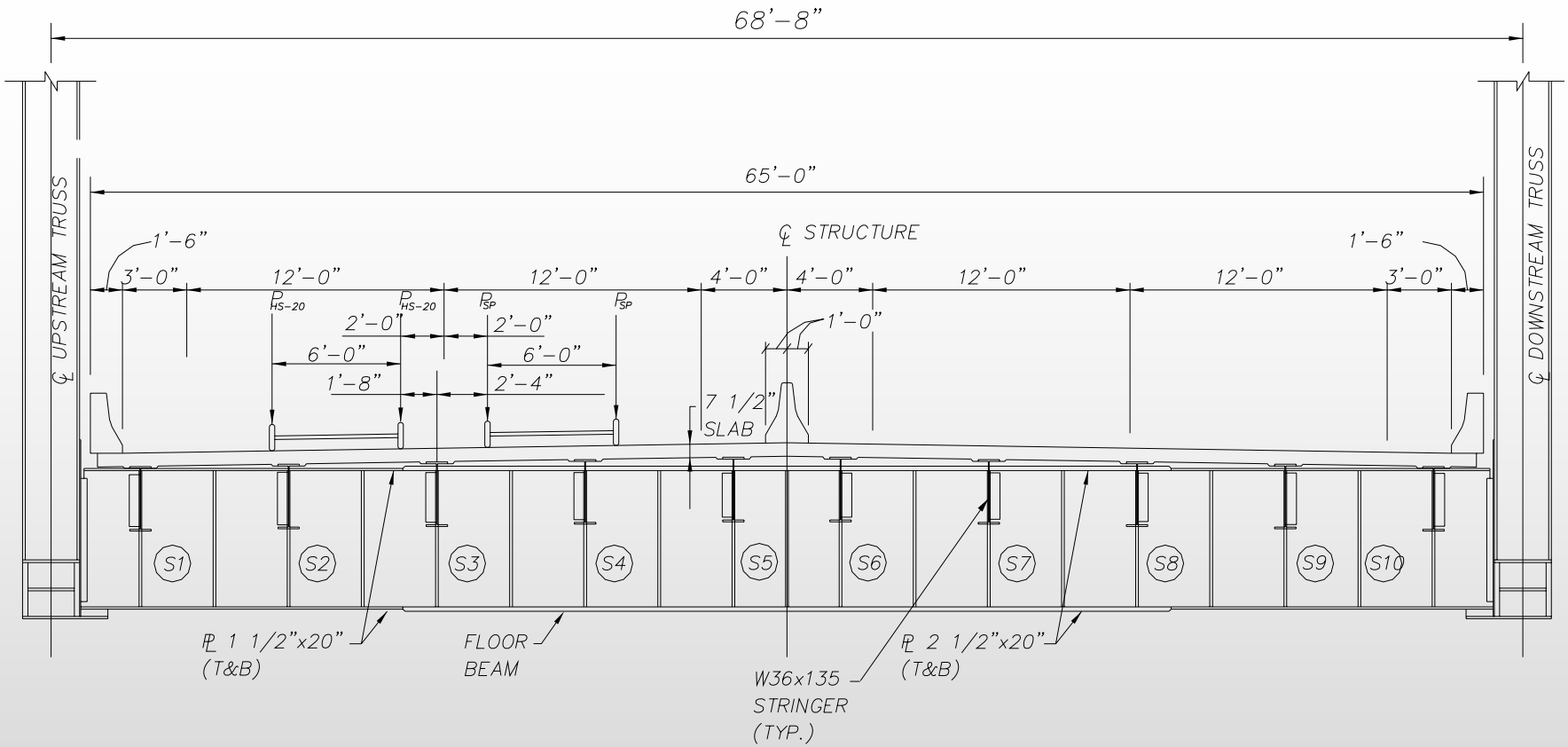
$$\text{Operating Rating for Serviceability} = \frac{0.8 * F_y - \text{Bending Stress for Dead Load}}{\text{Bending Stress for (Live Load + Impact)}}$$




TOTAL LIVE LOAD ON STRINGER S2 = 1.13 $P_{SP}$ + 0.0 $P_{HS-20}$

CRITICAL LIVE LOAD POSITION FOR STRINGER S2 FOR SPECIAL TRUCK ON CRITICAL LANE AND HS 20 TRUCK ON THE OTHER LANE

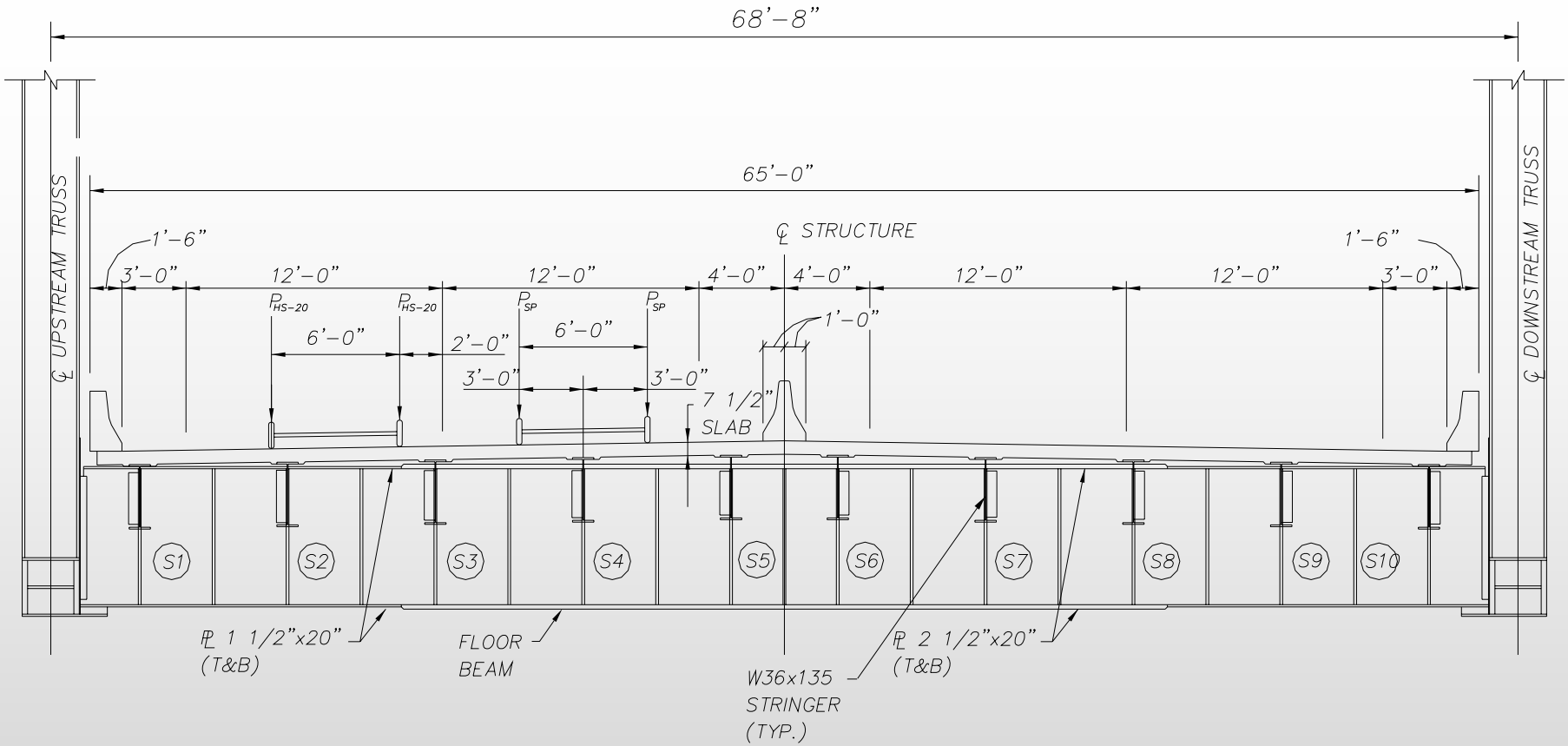
# TWO LANE LOADING FOR STRINGER S2




TOTAL LIVE LOAD ON STRINGER S3 = 0.76 $P_{SP}$ + 0.66 $P_{HS-20}$
(CONTROLS)

CRITICAL LIVE LOAD POSITION FOR STRINGER S3 FOR SPECIAL TRUCK ON CRITICAL LANE AND HS 20 TRUCK ON THE OTHER LANE

# TWO LANE LOADING FOR STRINGER S3




TOTAL LIVE LOAD ON STRINGER S4 = 1.13 $P_{SP}$ + 0.0 $P_{HS-20}$

CRITICAL LIVE LOAD POSITION FOR STRINGER S4 FOR SPECIAL TRUCK ON CRITICAL LANE AND HS 20 TRUCK ON THE OTHER LANE

# TWO LANE LOADING FOR STRINGER S4

# OVERALL RATINGS FOR THE CRITICAL STRINGER, S3 (J.R. Br.)

| Load Type | Inventory Rating | | Operating Rating | |
|---|---|---|---|---|
| | Factor | Load (Tons) | Factor | Load (Tons) |
| AASHTO HS 20 Loading | 1.89 | 68.0 | 3.15 | 113.6 |
| HS 20 Special Loading | N.A. | N.A. | 2.79 | 100.6 |
| H 20 Special Loading | N.A. | N.A. | 3.26 | 65.1 |

# OVERALL RATINGS FOR THE CRITICAL STRINGER, S3 J.R. Br. (Continued)

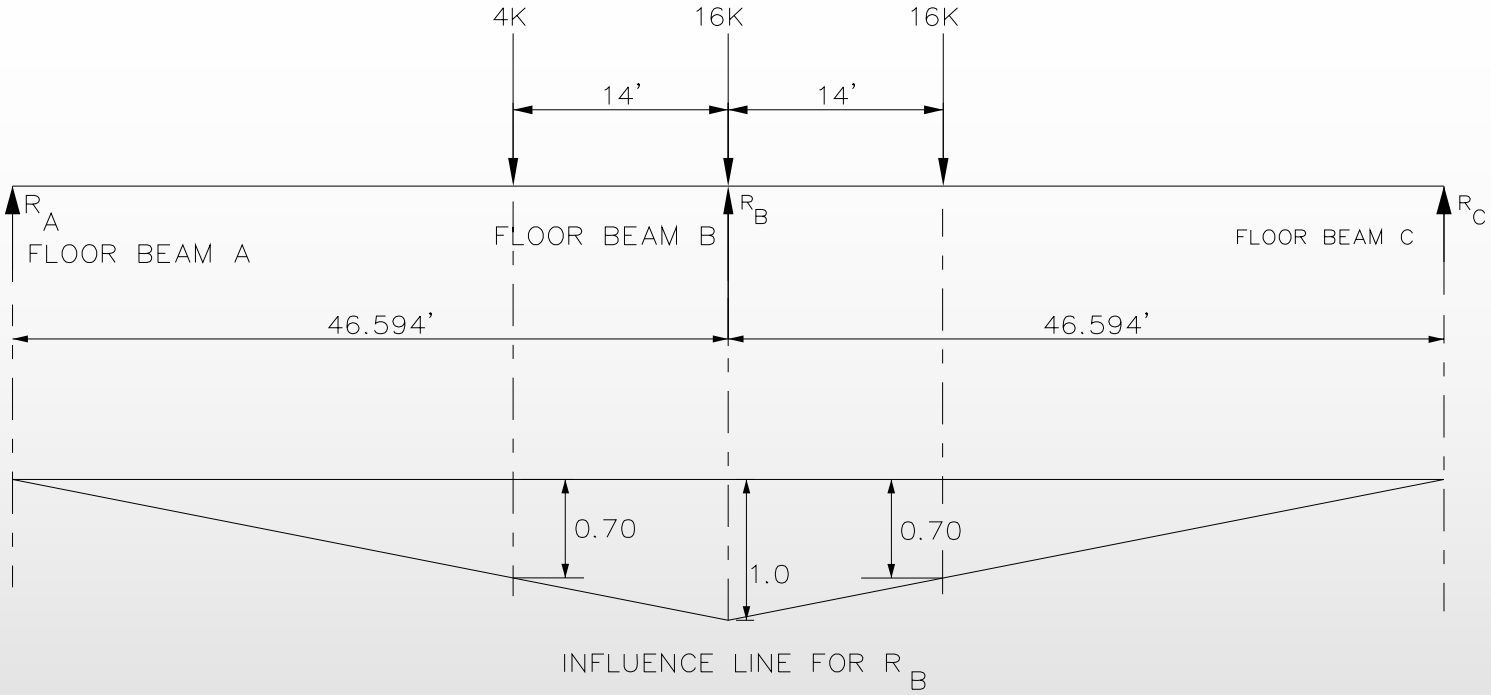
| Load Type | Inventory Rating | | Operating Rating | |
|---|---|---|---|---|
| | Factor | Load (Tons) | Factor | Load (Tons) |
| T-3 Special Loading | N.A. | N.A. | 3.19 | 79.8 |
| 3S2 Special Loading | N.A. | N.A. | 3.32 | 119.7 |
| SU4 Special Loading | N.A. | N.A. | 2.72 | 95.2 |

# RATING OF FLOOR BEAMS J.R. Br.

- FLOOR BEAMS ARE PLACED TRANSVERSE TO THE DIRECTION OF TRAFFIC
- FLOOR BEAMS ARE CONNECTED TO THE NODAL POINTS OF THE TWO VERTICAL TRUSSES
- FLOOR BEAMS ARE HYBRID SECTIONS WITH WEB PLATES WITH YIELD STRESS 36 KSI AND FLANGE PLATES WITH YIELD STRESS 50 KSI
- DEAD AND LIVE LOADS FROM STRINGERS ACT AS POINT LOADS ON FLOOR BEAMS
- FLOOR BEAMS ARE CONSIDERED AS SIMPLY SUPPORTED BEAMS

# RATING OF FLOOR BEAMS J. R. Br.

- MAXIMUM SECTIONAL LOSS IS 5/16″ AT THE BOTTOM FLANGE THICKNESS
- MERLIN DASH CANNOT BE USED FOR LOAD RATING CALCULATION DIRECTLY AS NO LIVE LOAD CAN BE USED
- MERLIN DASH ANALYSIS ARE DONE WITH BOTH DEAD AND LIVE LOADS SEPARTELY AS POINT LOADS WITHOUT ANY LIVE LOADS



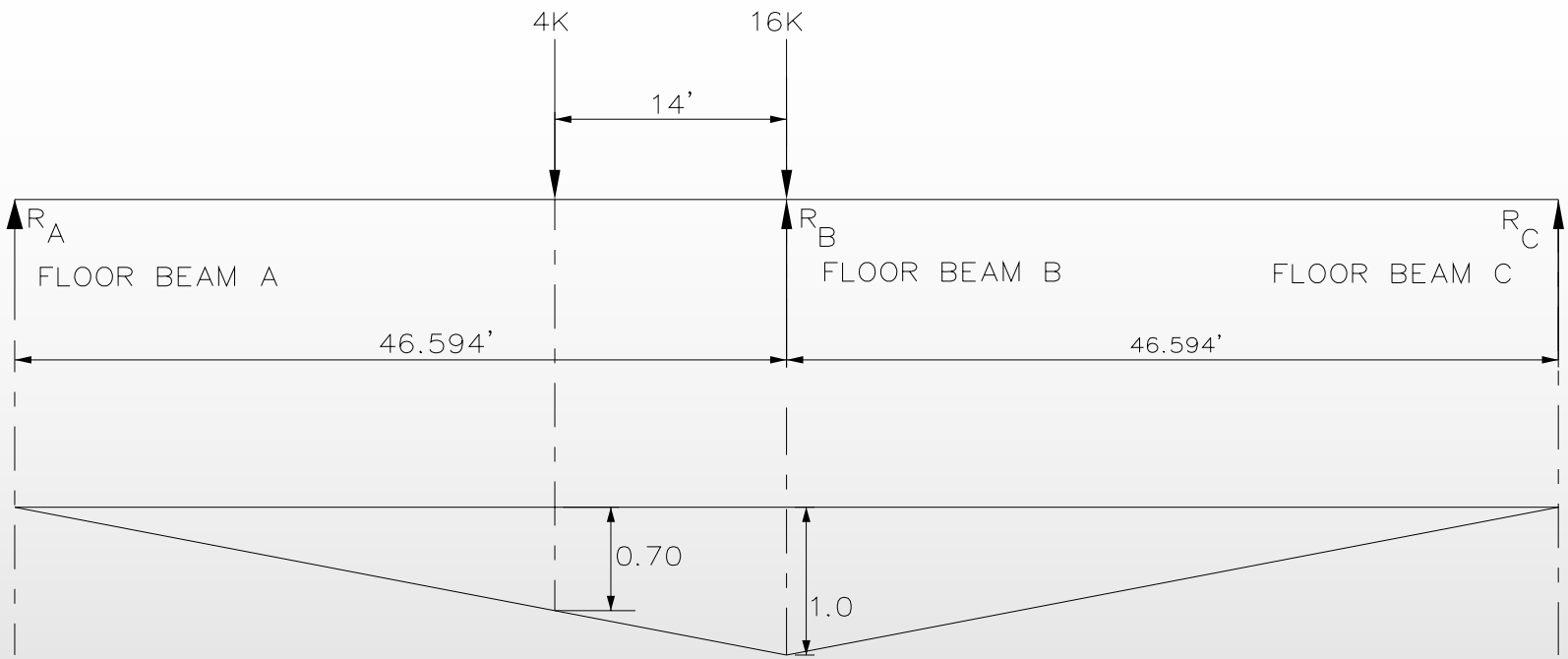

$R_B$ = 4 * 0.70 + 16 * 1.0 + 16 * 0.70 = 30.0 KIP

$R_B$ FOR (LL + I) = 1.26 * 30.0 = 37.8 KIP

IMPACT FACTOR = 50/(65.5+125) = 0.26

(LENGTH OF FLOOR BEAM = 65.5 FT.')

# LONGITUDINAL PLACEMENT OF HS–20 TRUCKS FOR MAXIMUM FLOORBEAM LOAD




INFLUENCE LINE FOR $R_B$

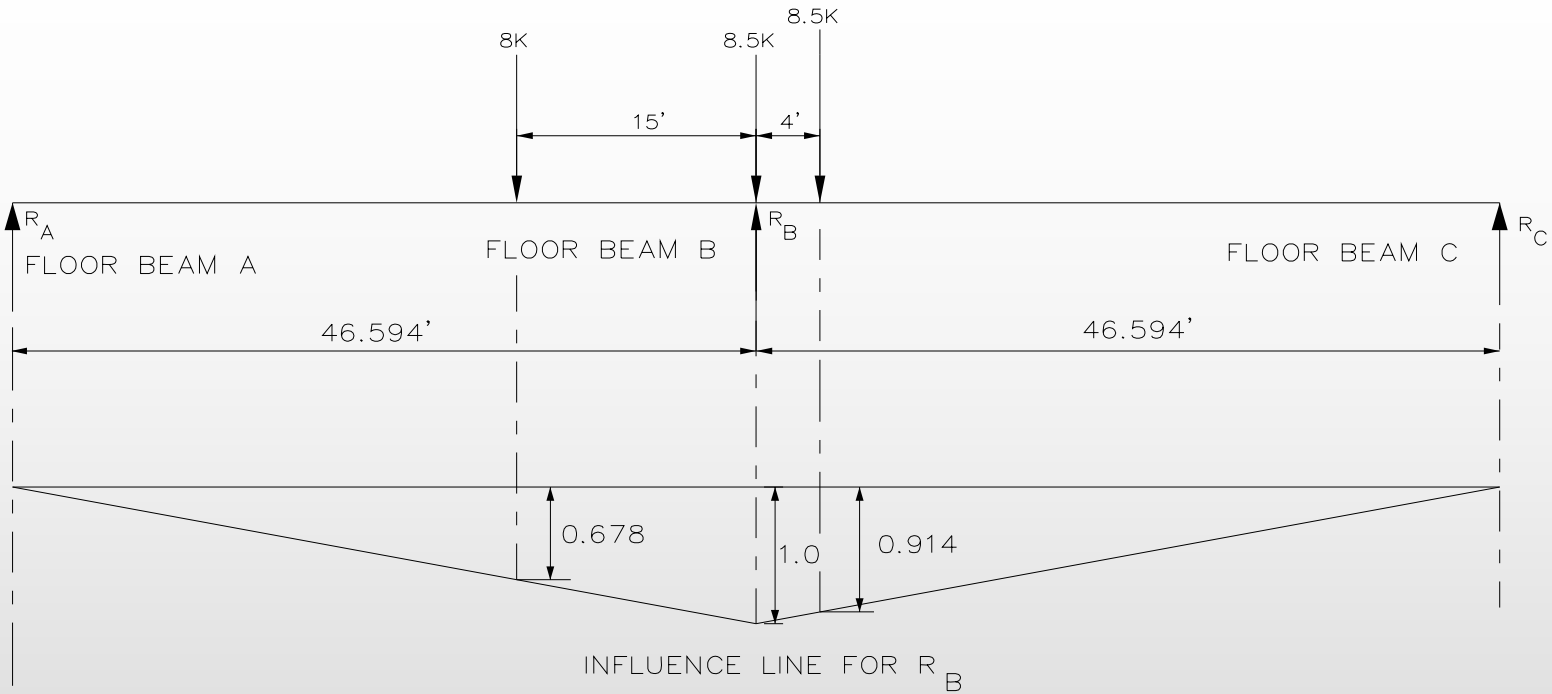
$R_B = 4 * 0.70 + 16 * 1.0 = 18.8$ KIP

$R_B$ FOR (LL + I) = 1.26 * 18.8 = 23.7 KIP

IMPACT FACTOR = 50/(65.5+125) = 0.26

(LENGTH OF FLOOR BEAM = 65.5 FT.')

# LONGITUDINAL PLACEMENT OF H–20 TRUCKS FOR MAXIMUM FLOORBEAM LOAD



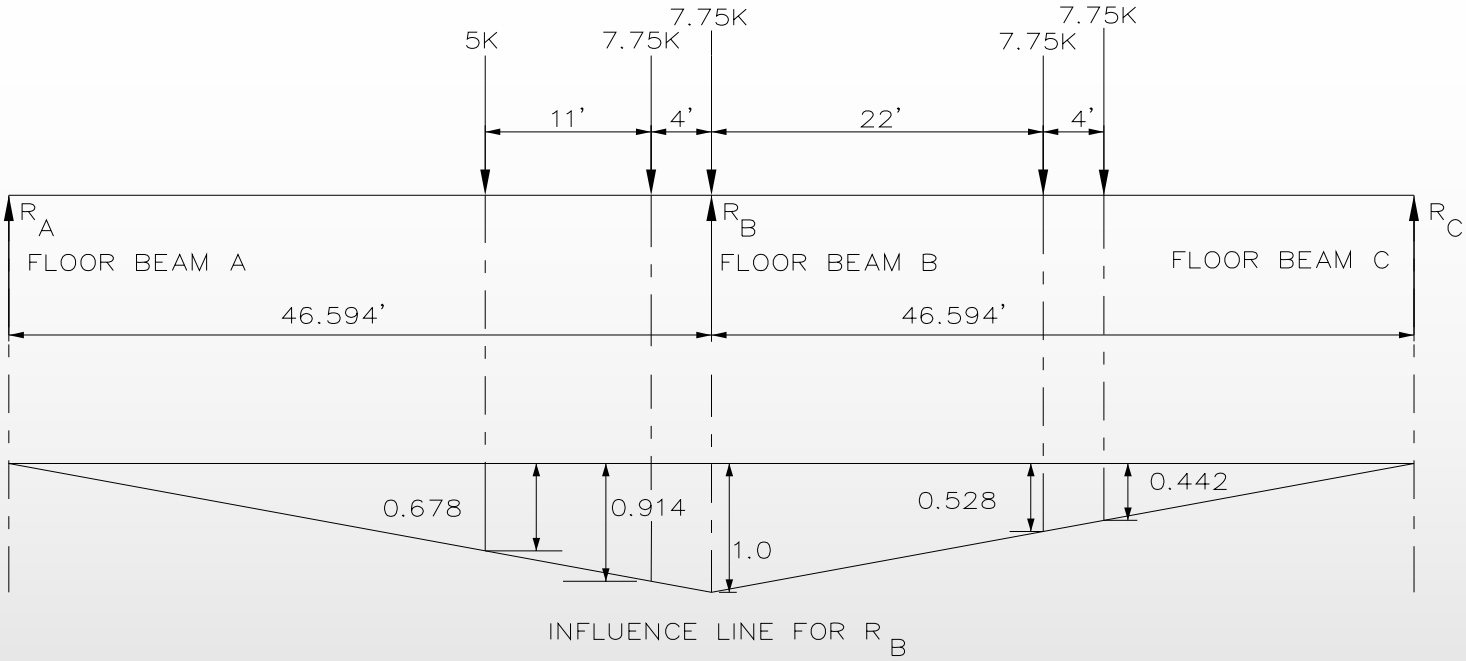

$R_B = 8 * 0.678 + 8.5 * 1.0 + 8.5 * 0.914 = 21.69$ KIP

$R_B$ FOR (LL + I) = 1.26 * 21.69 = 27.33 KIP

IMPACT FACTOR = 50/(65.5+125) = 0.26

(LENGTH OF FLOOR BEAM = 65.5 FT.')

# LONGITUDINAL PLACEMENT OF T-3 TRUCKS FOR MAXIMUM FLOORBEAM LOAD



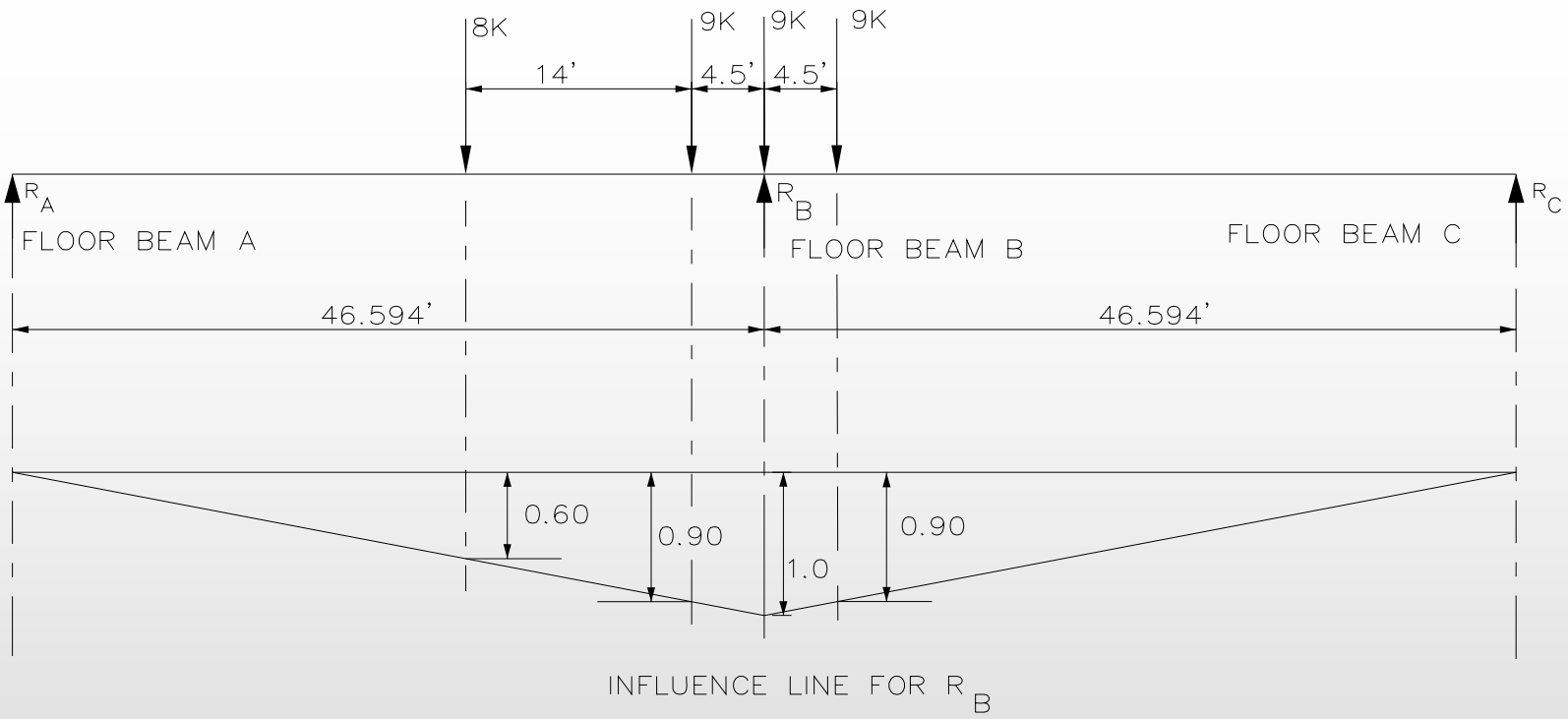

$R_B$ = 5 * 0.678 + 7.75 * 0.914 + 7.75 * 1.0 + 7.75 * 0.528 + 7.75 * 0.442 = 25.74 KIP

$R_B$ FOR (LL + I) = 1.26 * 25.74 = 32.43 KIP

IMPACT FACTOR = 50/(65.5+125) = 0.26

(LENGTH OF FLOOR BEAM = 65.5 FT.')

# LONGITUDINAL PLACEMENT OF 3S2 TRUCKS FOR MAXIMUM FLOORBEAM LOAD




INFLUENCE LINE FOR $R_B$

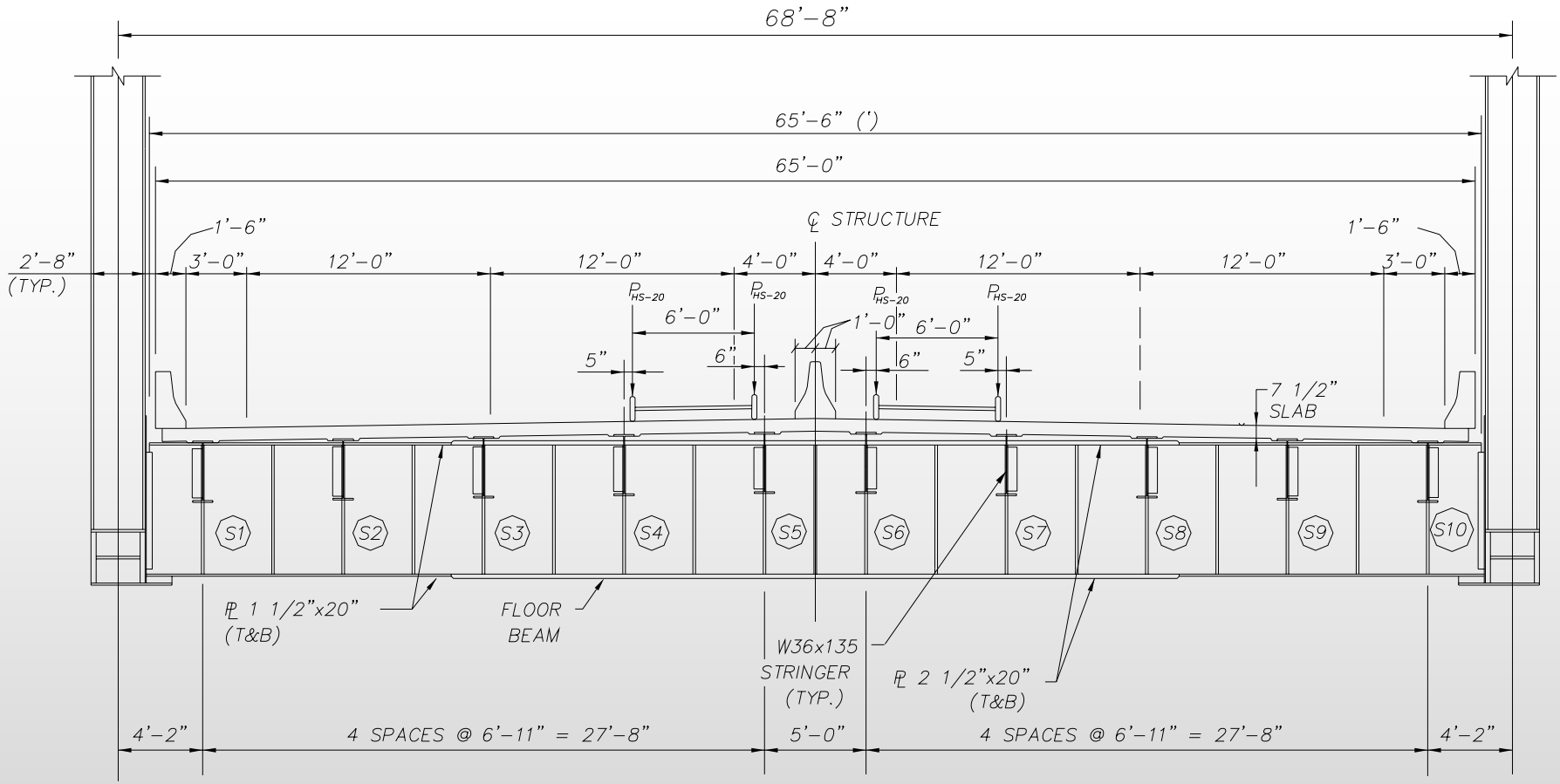
$R_B = 8 * 0.60 + 9 * 0.90 + 9 * 1.0 + 9 * 0.90 = 30.0$ KIP

$R_B$ FOR (LL + I) = 1.26 * 30.0 = 37.8 KIP

IMPACT FACTOR = 50/(65.5+125) = 0.26

(LENGTH OF FLOOR BEAM = 65.5 FT.')

# LONGITUDINAL PLACEMENT OF SU4 TRUCKS FOR MAXIMUM FLOORBEAM LOAD




REACTIONS ON STRINGERS

$R_{S1} = 0.0$

$R_{S2} = 0.0$

$R_{S3} = 0.0$

$R_{S4} = 1.012\ P_{HS-20}$

$R_{S5} = 0.988\ P_{HS-20}$

TWO LANE LOADING

$P_{HS-20}$ – HS20 WHEEL LOAD

REACTIONS ON STRINGERS

$R_{S6} = 0.988\ P_{HS-20}$

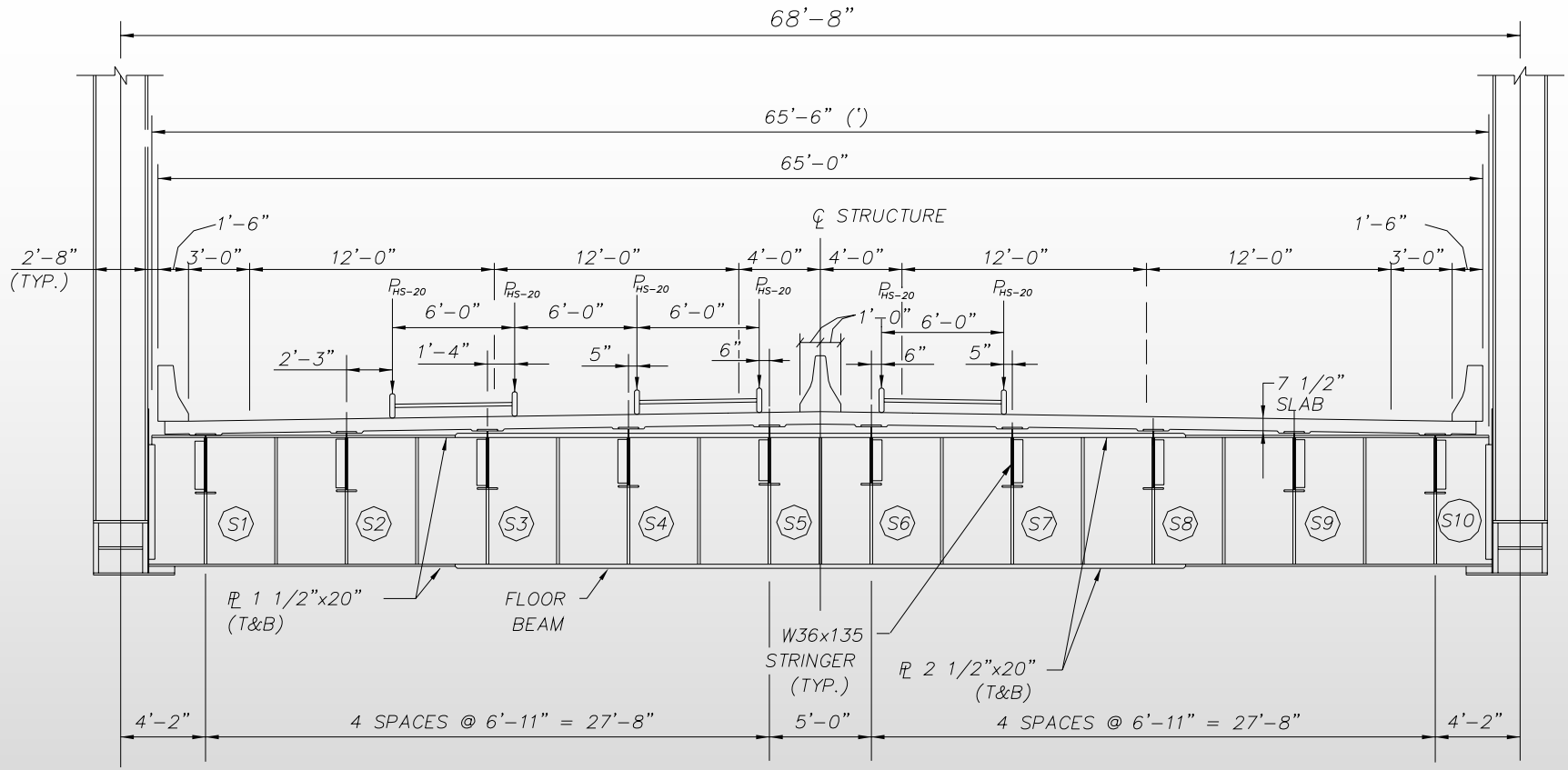
$R_{S7} = 1.012\ P_{HS-20}$

$R_{S8} = 0.0$

$R_{S9} = 0.0$

$R_{S10} = 0.0$

# WHEEL LOAD PLACEMENT
# FOR AASHTO HS-20 CRITICAL LOADING IN FLOOR BEAMS




℄ UPSTREAM TRUSS

REACTIONS ON STRINGERS

$R_{S1} = 0.0$

$R_{S2} = 0.90 * (0.675)\ P_{HS-20} = 0.61\ P_{HS-20}$

$R_{S3} = 0.90 * (1.132)\ P_{HS-20} = 1.02\ P_{HS-20}$

$R_{S4} = 0.90 * (1.205)\ P_{HS-20} = 1.08\ P_{HS-20}$

$R_{S5} = 0.90 * (0.988)\ P_{HS-20} = 0.89\ P_{HS-20}$

THREE LANE LOADING (CONTROLS)

REACTIONS ON STRINGERS

$R_{S6} = 0.90 * (0.988)\ P_{HS-20} = 0.89\ P_{HS-20}$

$R_{S7} = 0.90 * (1.012)\ P_{HS-20} = 0.91\ P_{HS-20}$

$R_{S8} = 0.0$

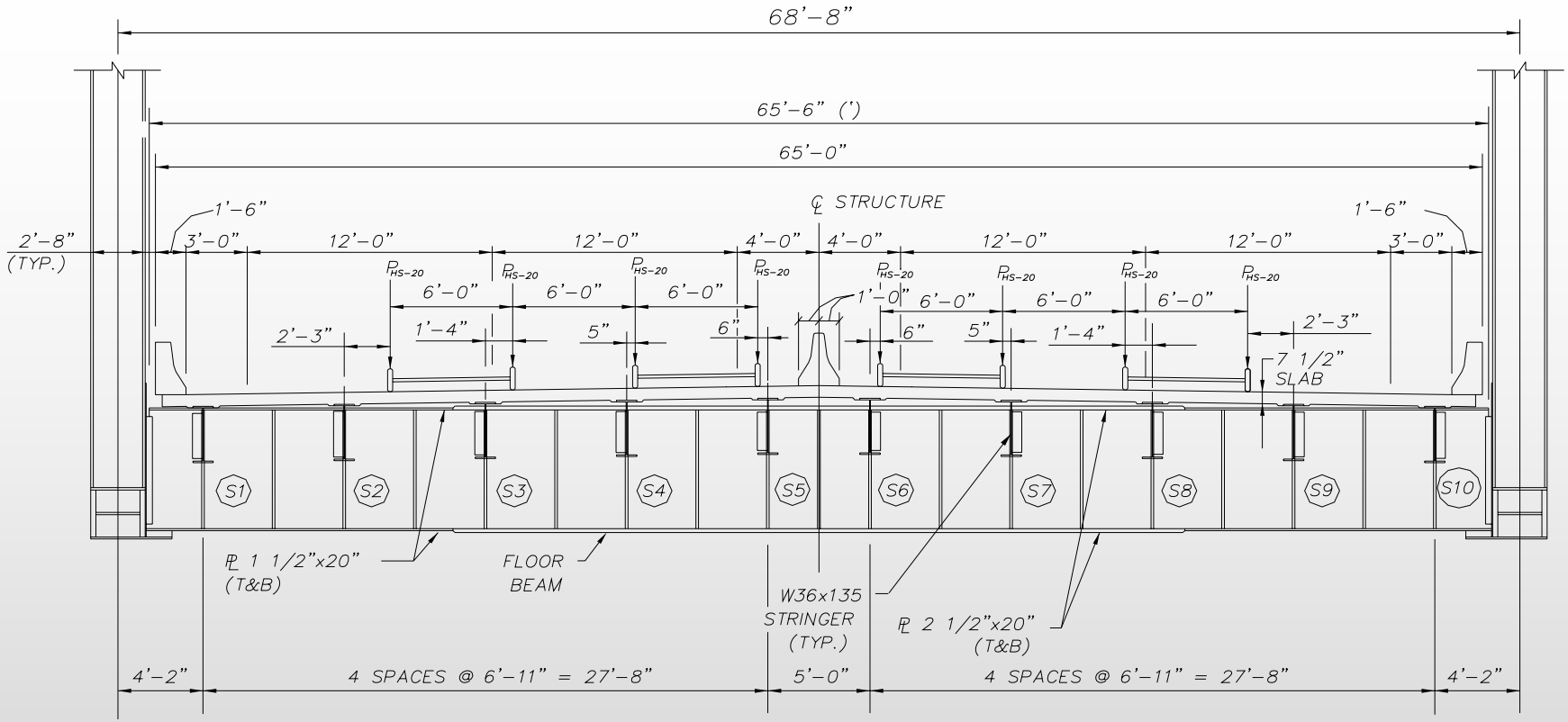
$R_{S9} = 0.0$

$R_{S10} = 0.0$

℄ DOWNSTREAM TRUSS

$P_{HS-20}$ – HS20 WHEEL LOAD

# WHEEL LOAD PLACEMENT
# FOR AASHTO HS-20 CRITICAL LOADING IN FLOOR BEAMS




REACTIONS ON STRINGERS

$R_{S1} = 0.0$

$R_{S2} = 0.75 * (0.675)\ P_{HS-20} = 0.51\ P_{HS-20}$

$R_{S3} = 0.75 * (1.132)\ P_{HS-20} = 0.85\ P_{HS-20}$

$R_{S4} = 0.75 * (1.205)\ P_{HS-20} = 0.90\ P_{HS-20}$

$R_{S5} = 0.75 * (0.988)\ P_{HS-20} = 0.74\ P_{HS-20}$

REACTIONS ON STRINGERS

$R_{S6} = 0.75 * (0.988)\ P_{HS-20} = 0.74\ P_{HS-20}$

$R_{S7} = 0.75 * (1.205)\ P_{HS-20} = 0.90\ P_{HS-20}$

$R_{S8} = 0.75 * (1.132)\ P_{HS-20} = 0.85\ P_{HS-20}$

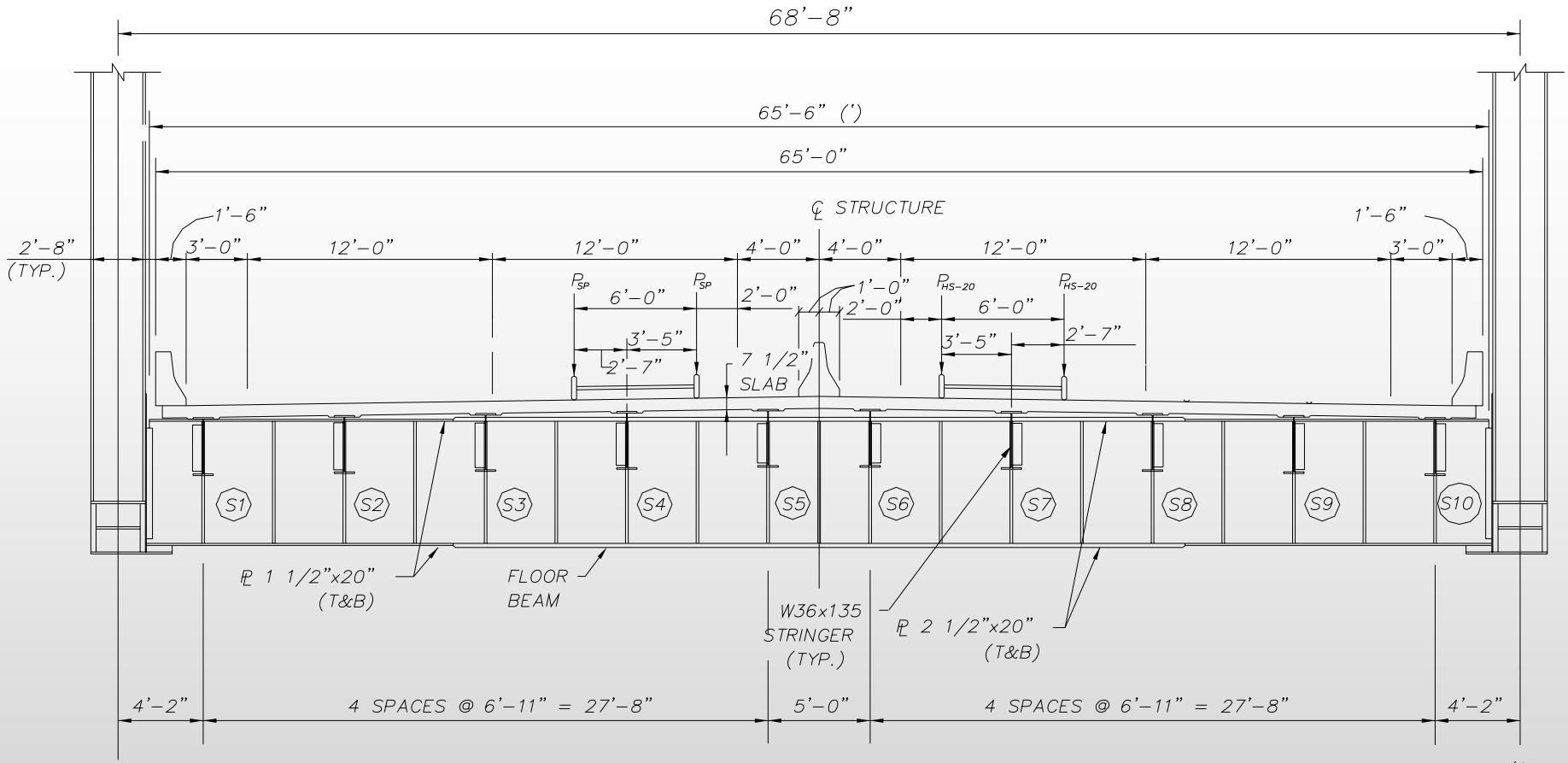
$R_{S9} = 0.75 * (0.675)\ P_{HS-20} = 0.51\ P_{HS-20}$

$R_{S10} = 0.0$

$P_{HS-20}$ – HS20 WHEEL LOAD

FOUR LANE LOADING

# WHEEL LOAD PLACEMENT
# FOR AASHTO HS-20 CRITICAL LOADING IN FLOOR BEAMS




REACTIONS ON STRINGERS

$R_{S1} = 0.0$

$R_{S2} = 0.0$

$R_{S3} = 0.37\ P_{SP}$

$R_{S4} = 1.13\ P_{SP}$

$R_{S5} = 0.49\ P_{SP}$

TWO LANE LOADING

$P_{HS-20}$ – HS20 WHEEL LOAD

$P_{SP}$ – SPECIAL VEHICLE WHEEL LOAD

REACTIONS ON STRINGERS

$R_{S6} = 0.49\ P_{HS-20}$

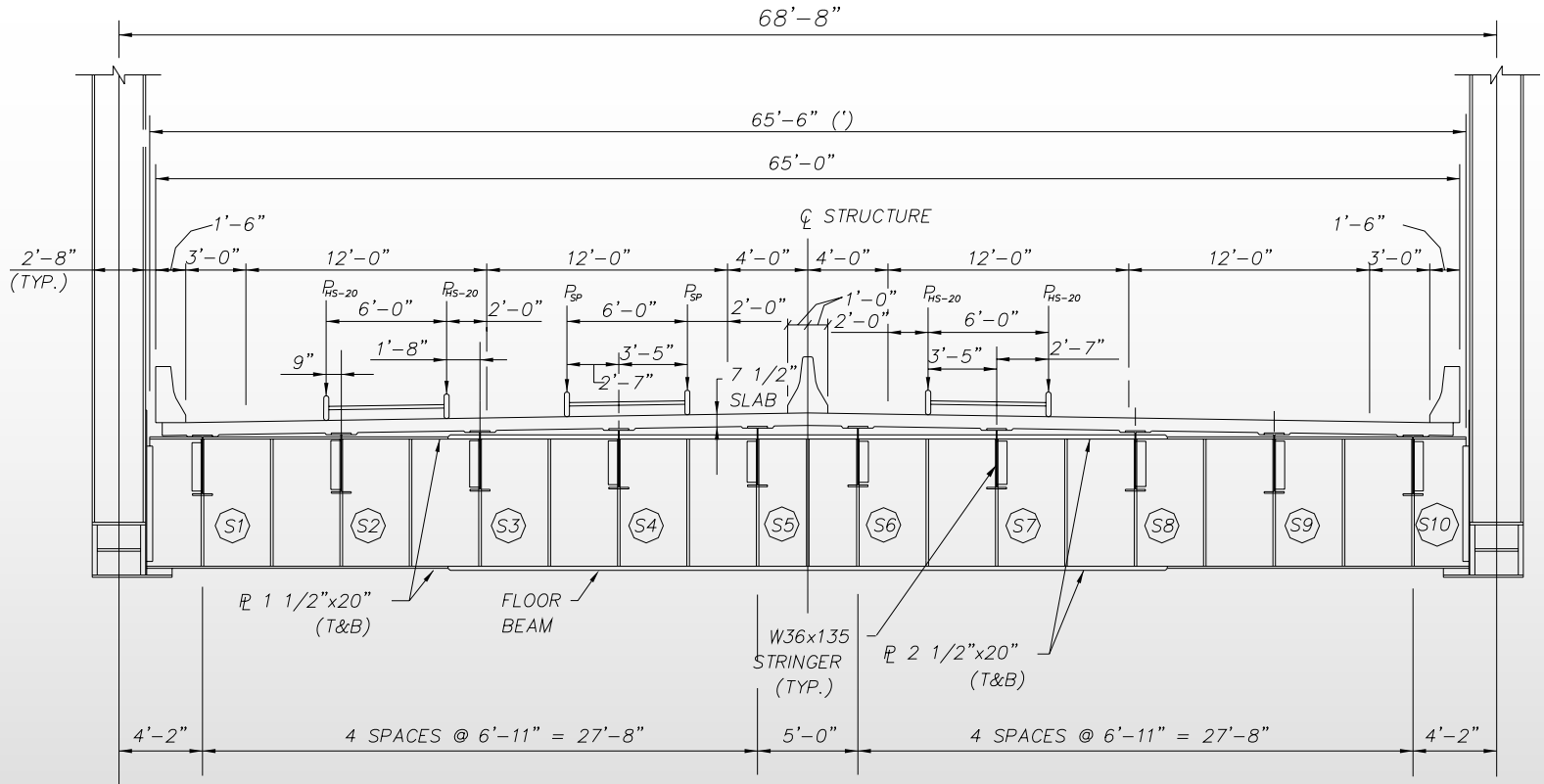
$R_{S7} = 1.13\ P_{HS-20}$

$R_{S8} = 0.37\ P_{HS-20}$

$R_{S9} = 0.0$

$R_{S10} = 0.0$

# WHEEL LOAD PLACEMENT FOR SPECIAL LOADING IN FLOOR BEAMS




REACTIONS ON STRINGERS

$R_{S1} = 0.90 * (0.108)\ P_{HS-20} = 0.097\ P_{HS-20}$

$R_{S2} = 0.90 * (1.133)\ P_{HS-20} = 1.02\ P_{HS-20}$

$R_{S3} = 0.90 * (0.373)\ P_{SP} + 0.90 * (0.759)\ P_{HS-20}$

$= 0.336\ P_{SP} + 0.683\ P_{HS-20}$

$R_{S4} = 0.90 * (1.133)\ P_{SP} = 1.02\ P_{SP}$

$R_{S5} = 0.90 * (0.494)\ P_{SP} = 0.445\ P_{SP}$

REACTIONS ON STRINGERS

$R_{S6} = 0.90 * (0.494)\ P_{HS-20} = 0.445\ P_{HS-20}$

$R_{S7} = 0.90 * (1.133)\ P_{HS-20} = 1.02\ P_{HS-20}$

$R_{S8} = 0.90 * (0.373)\ P_{HS-20} = 0.336\ P_{HS-20}$

$R_{S9} = 0.0$

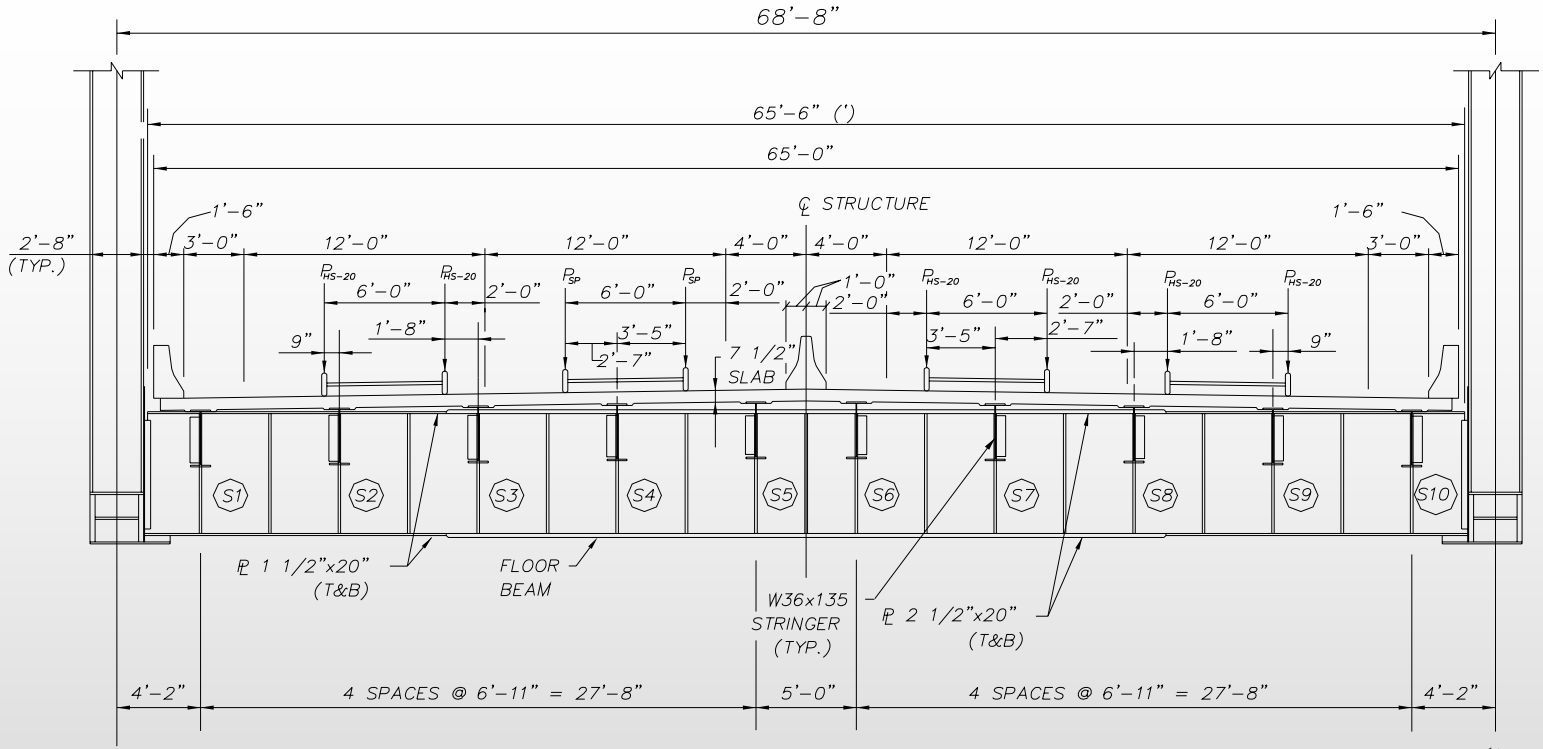
$R_{S10} = 0.0$

THREE LANE LOADING (CONTROLS)

$P_{HS-20}$ – HS20 WHEEL LOAD

$P_{SP}$ – SPECIAL VEHICLE WHEEL LOAD

# WHEEL LOAD PLACEMENT FOR SPECIAL LOADING IN FLOOR BEAMS




REACTIONS ON STRINGERS

$R_{S1} = 0.75 * (0.108)\ P_{HS-20} = 0.08\ P_{HS-20}$

$R_{S2} = 0.75 * (1.133)\ P_{HS-20} = 0.85\ P_{HS-20}$

$R_{S3} = 0.75 * (0.373)\ P_{SP} + 0.75 * (0.759)\ P_{HS-20}$
$= 0.28\ P_{SP} + 0.57\ P_{HS-20}$

$R_{S4} = 0.75 * (1.133)\ P_{SP} = 0.85\ P_{SP}$

$R_{S5} = 0.75 * (0.494)\ P_{SP} = 0.37\ P_{SP}$

REACTIONS ON STRINGERS

$R_{S6} = 0.75 * (0.494)\ P_{HS-20} = 0.37\ P_{HS-20}$

$R_{S7} = 0.75 * (1.133)\ P_{HS-20} = 0.85\ P_{HS-20}$

$R_{S8} = 0.75 * (1.133)\ P_{HS-20} = 0.85\ P_{HS-20}$

$R_{S9} = 0.75 * (1.133)\ P_{HS-20} = 0.85\ P_{HS-20}$

$R_{S10} = 0.75 * (0.108)\ P_{HS-20} = 0.08\ P_{HS-20}$

FOUR LANE LOADING

$P_{HS-20}$ – HS20 WHEEL LOAD

$P_{SP}$ – SPECIAL VEHICLE WHEEL LOAD

## WHEEL LOAD PLACEMENT
## FOR SPECIAL LOADING IN FLOOR BEAMS

# OVERALL RATINGS FOR FLOOR BEAMS J.R. Br.

| Load Type | Inventory Rating | | Operating Rating | |
|---|---|---|---|---|
| | Factor | Load (Tons) | Factor | Load (Tons) |
| AASHTO HS 20 Loading | 1.82 | 65.5 | 3.03 | 109.1 |
| HS 20 Special Loading | N.A. | N.A. | 2.95 | 106.3 |
| H 20 Special Loading | N.A. | N.A. | 3.40 | 68.1 |

# OVERALL RATINGS FOR FLOOR BEAMS, J.R. Br. (Continued)

| Load Type | Inventory Rating | | Operating Rating | |
|---|---|---|---|---|
| | Factor | Load (Tons) | Factor | Load (Tons) |
| T-3 Special Loading | N.A. | N.A. | 3.27 | 81.8 |
| 3S2 Special Loading | N.A. | N.A. | 3.11 | 111.9 |
| SU4 Special Loading | N.A. | N.A. | 2.96 | 103.4 |

# LOAD RATING OF NEW MARTINSVILLE BRIDGE

- RATING ANALYSIS IS DONE SIMILAR TO THAT OF JENNINGS RANDOLPH BRIDGE
- THERE IS NO SIGNIFICANT SECTIONAL LOSS ON ANY OF THE TRUSS MEMBERS, STRINGERS, OR FLOOR BEAMS
- RATING IS DONE FOR HS-20 CRITICAL LOADING FOR BOTH INVENTORY AND OPERATING RATINGS, AND ONLY OPERATING RATING FOR SPECIAL LOADING WITH H-20, T-3 AND 3S2 LOADING

# OVERALL RATINGS FOR CONTROLLING TRUSS ELEMENTS, NEW MARTINSVILLE BRIDGE

| Member | Load | Inventory Rating | | Operating Rating | |
|---|---|---|---|---|---|
| | | Factor | Load (Tons) | Factor | Load (Tons) |
| U7-U8, U8-U9, U35-U36, U36-U37 | HS 20 Critical Loading | 1.33 | 47.9 | 2.22 | 79.9 |
| | H 20 Special Loading | N.A. | N.A. | 2.36 | 47.2 |

# OVERALL RATINGS FOR CONTROLLING TRUSS ELEMENTS, NEW MARTINSVILLE BRIDGE (CONTINUED)

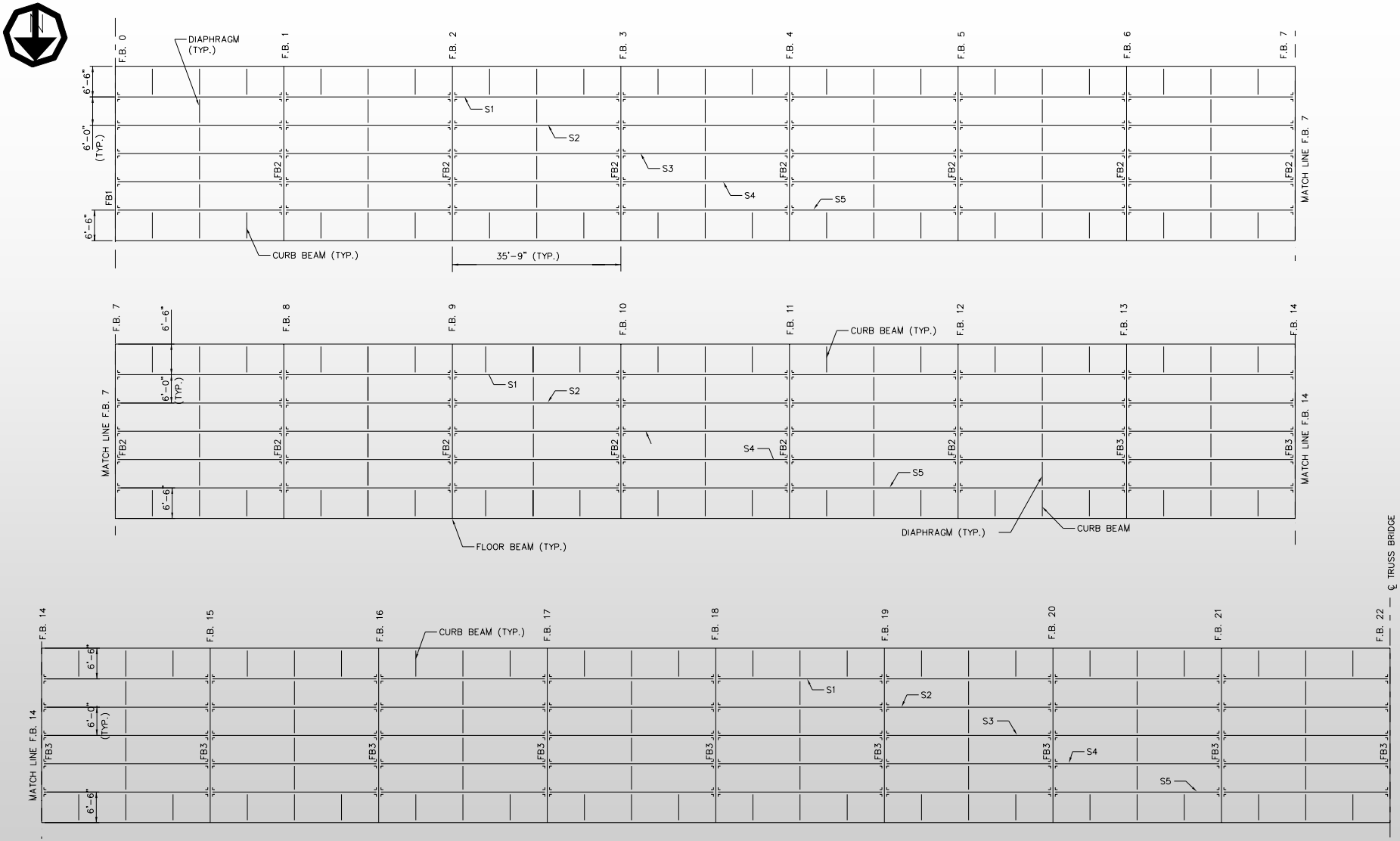
| Member | Load | Inventory Rating | | Operating Rating | |
|---|---|---|---|---|---|
| | | Factor | Load (Tons) | Factor | Load (Tons) |
| U7-U8, U8-U9, U35-U36, U36-U37 | T-3 Special Loading | N.A. | N.A. | 2.21 | 55.3 |
| | 3S2 Special Loading | N.A. | N.A. | 1.94 | 69.8 |

# OVERALL RATINGS FOR THE CRITICAL STRINGER N. M. Br. (S3)

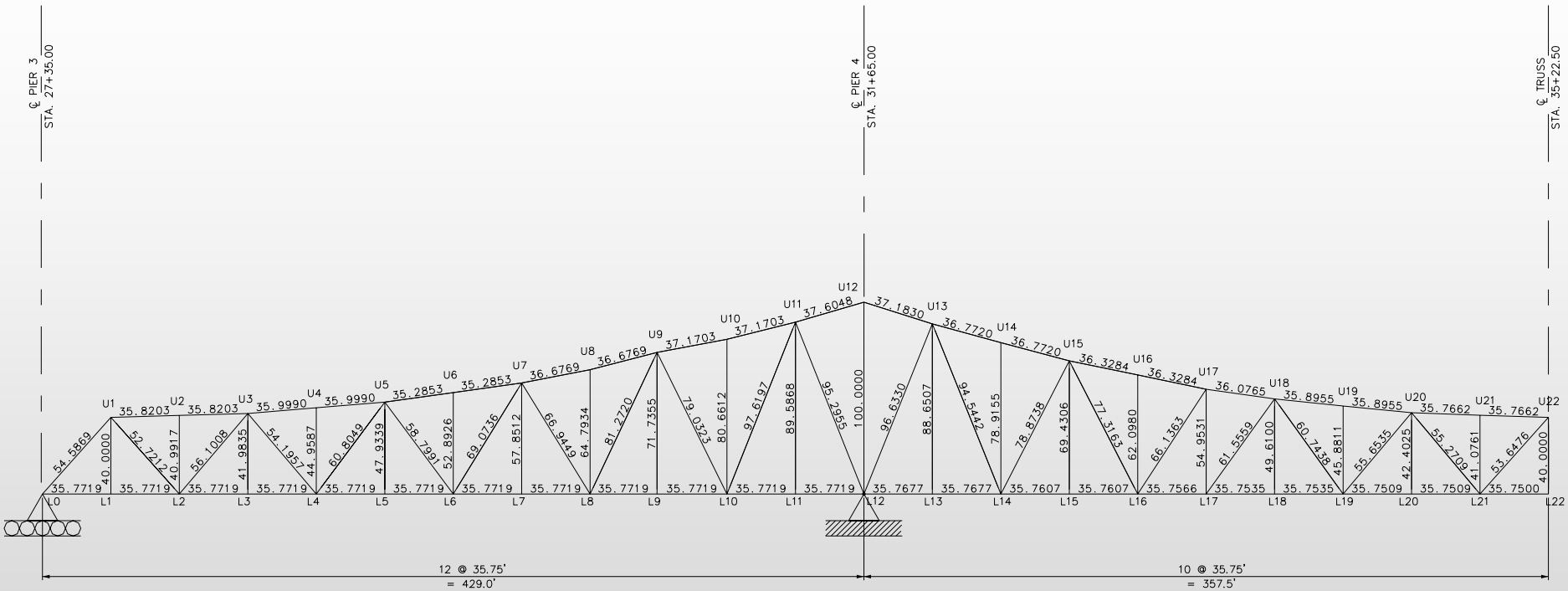
| Load Type | Inventory Rating | | Operating Rating | |
|---|---|---|---|---|
| | Factor | Load (Tons) | Factor | Load (Tons) |
| AASHTO HS 20 Loading | 2.04 | 73.5 | 3.41 | 122.8 |
| H 20 Special Loading | N.A. | N.A. | 2.53 | 91.2 |
| T-3 Special Loading | N.A. | N.A. | 2.58 | 92.9 |
| 3S2 Special Loading | N.A. | N.A. | 2.70 | 97.3 |

# OVERALL RATINGS FOR CRITICAL FLOOR BEAM (N. M. Br.)

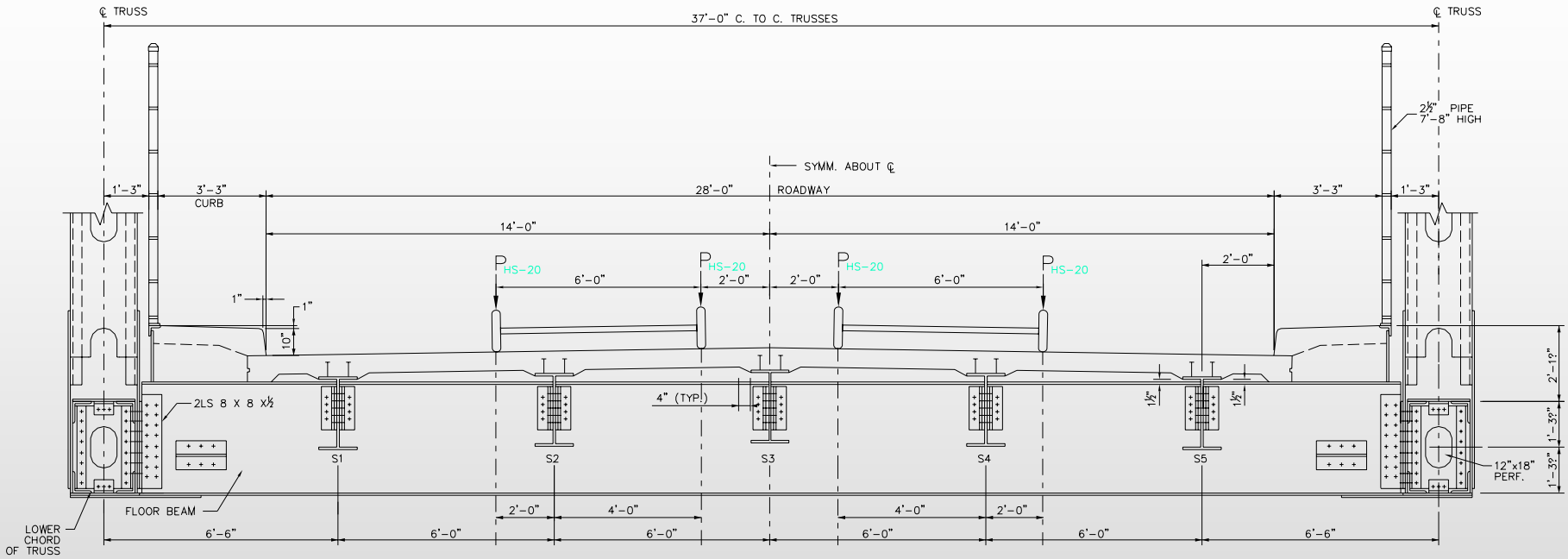
| Load Type | Inventory Rating | | Operating Rating | |
|---|---|---|---|---|
| | Factor | Load (Tons) | Factor | Load (Tons) |
| AASHTO HS 20 Loading | 1.33 | 47.9 | 2.22 | 80.0 |
| H 20 Special Loading | N.A. | N.A. | 2.69 | 53.7 |
| T-3 Special Loading | N.A. | N.A. | 2.56 | 64.1 |
| 3S2 Special Loading | N.A. | N.A. | 2.47 | 88.7 |



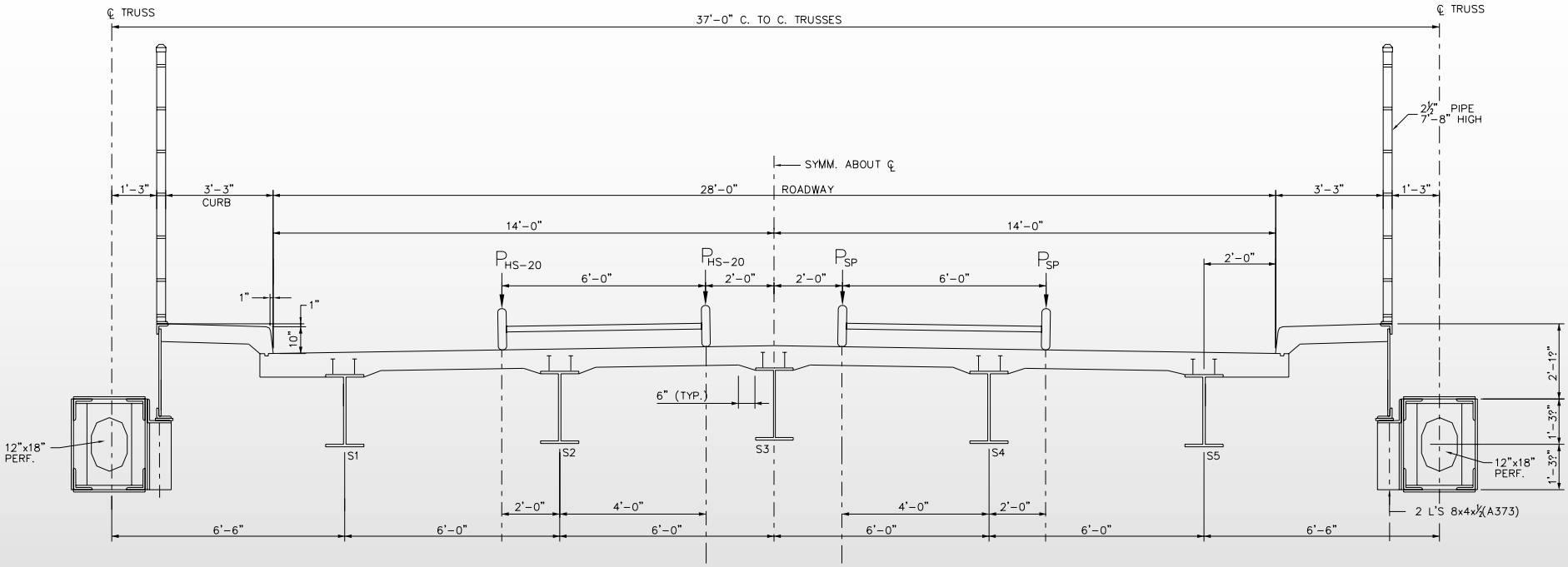

# DECK PLAN OF N.M. BR.




# LINE DIAGRAM FOR ANALYSIS (N. M. Br.)




# MAXIMUM WHEEL LOAD EFFECT ON A FLOOR BEAM (N. M. Br.)

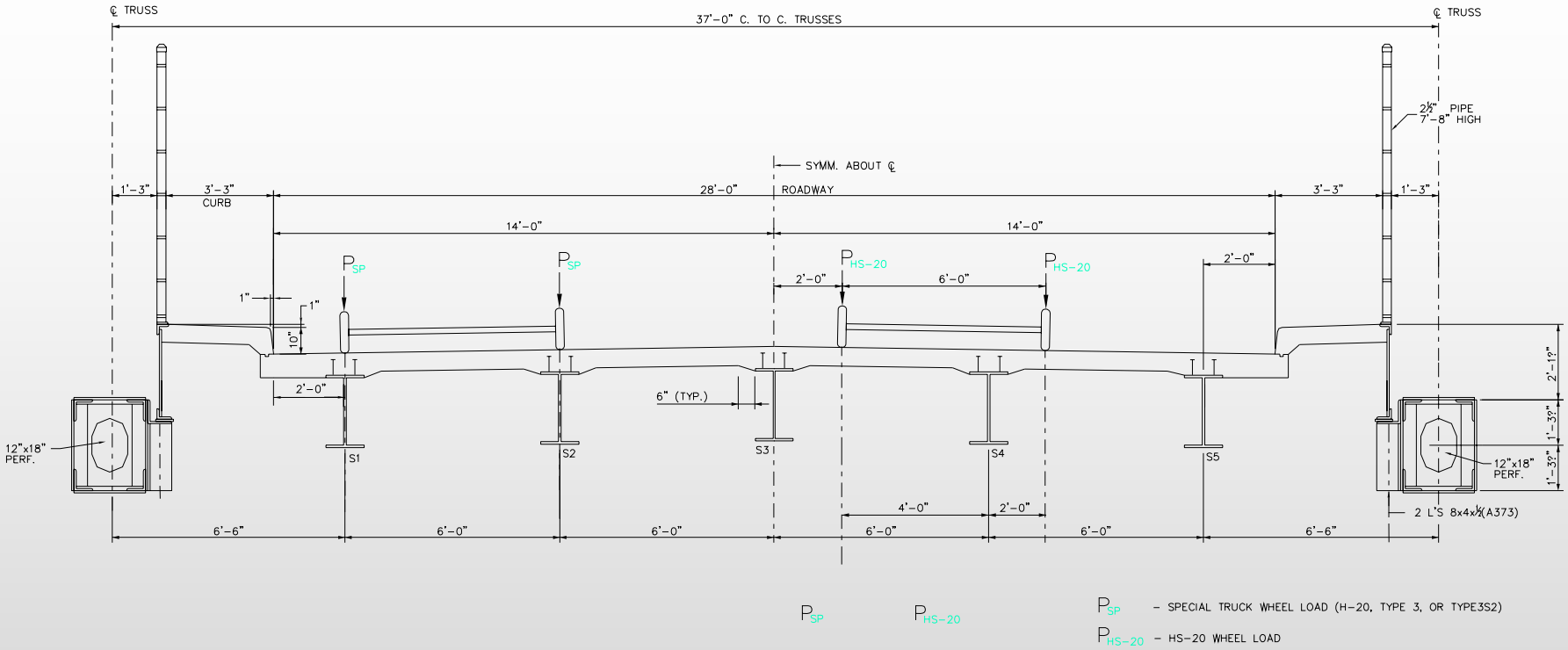



REACTION ON S3 = 0.67 X $P_{SP}$ + 0.67 X $P_{HS-20}$

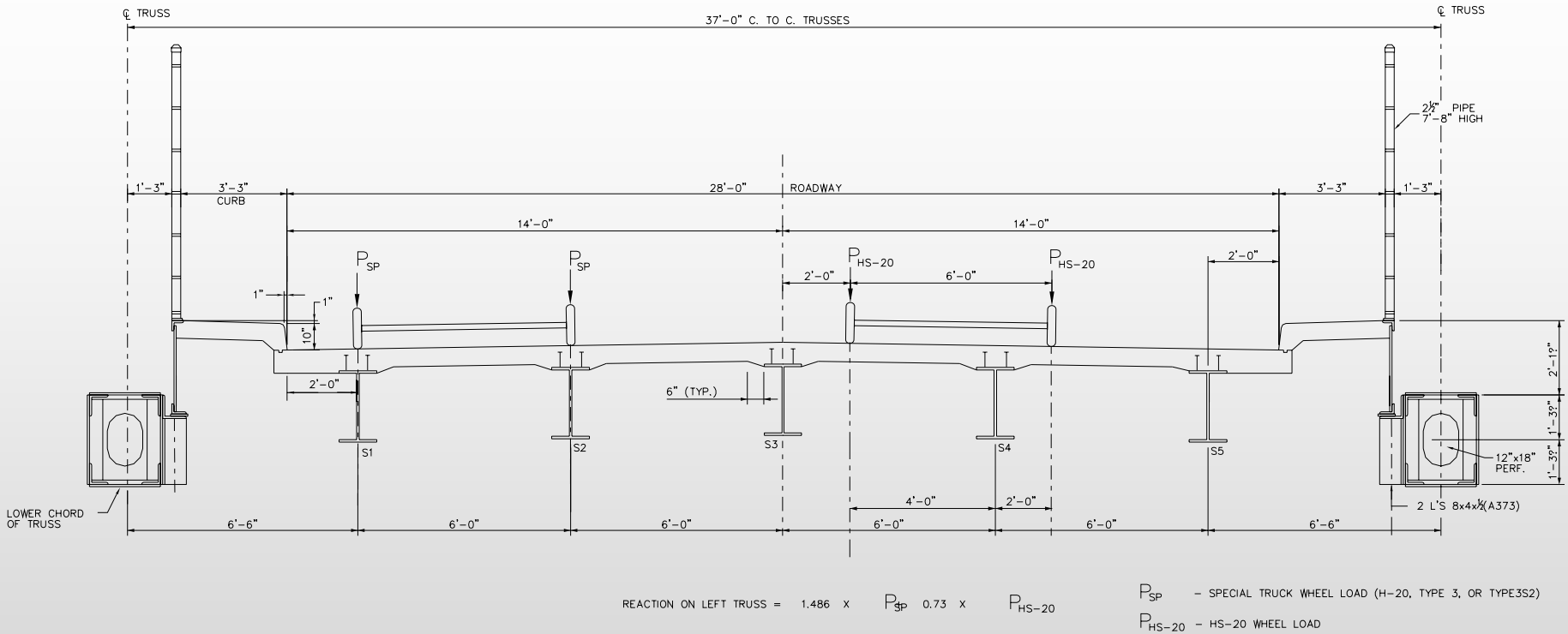
$P_{SP}$ – SPECIAL TRUCK WHEEL LOAD (H-20, TYPE 3, OR TYPE3S2)

$P_{HS-20}$ – HS-20 WHEEL LOAD

# MAXIMUM WHEEL LOAD EFFECT ON STRINGER S3 (N. M. Br.)




# MAXIMUM WHEEL LOAD EFFECT ON STRINGER S1 & S2 (N. M. Br.)




REACTION ON LEFT TRUSS = 1.486 X $P_{SP}$ 0.73 X $P_{HS-20}$

$P_{SP}$ – SPECIAL TRUCK WHEEL LOAD (H-20, TYPE 3, OR TYPE3S2)

$P_{HS-20}$ – HS-20 WHEEL LOAD

# MAXIMUM WHEEL LOAD EFFECT ON LEFT TRUSS (N. M. Br.)