COUNTY: SHELBY CROSSING: I-55/MALLORY AVENUE

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NOTES

FORCE EFFECTS TO BE CONSIDERED: 3.4.1

STRENGTH I

$\eta_D = 1.0$ 1.3.3
$\eta_R = 1.0$ 1.3.4
$\eta_I = 1.0$ 1.3.5

$\eta_i = 1.0$ 1.3.2.1

$Q = 1.25(DC) + 1.50(DW) + 1.75(LL+I) + 1.75(CE) + 1.75(BR) + 1.20^*(TU)$

$Q = 0.90(DC) + 0.65(DW) + 1.75(LL+I) + 1.75(CE) + 1.75(BR) + 1.20^*(TU)$

STRENGTH III

$Q = 1.25(DC) + 1.50(DW) + 1.40(WS) + 1.20^*(TU)$

$Q = 0.90(DC) + 0.65(DW) + 1.40(WS) + 1.20^*(TU)$

* USE γ_{TU} = 1.2 FOR $\Delta^{'s}$, 0.5 FOR FORCES

STRENGTH IV

$Q = 1.5(DC) + 1.5(DW) + 1.2(TU)$
$Q = 1.5(DC) + 0.65(DW) + 1.2^*(TU)$

STRENGTH V

$Q = 1.25(DC) + 1.50(DW) + 1.35(LL+I) + 1.35(CE) + 1.35(BR) + 1.20^*(TU) + 0.40(WS) + 1.0(WL)$
$Q = 0.90(DC) + 0.65(DW) + 1.35(LL+I) + 1.35(CE) + 1.35(BR) + 1.20^*(TU) + 0.40(WS) + 1.0(WL)$

EXTREME EVENT I

$Q = 1.25(DC) + 1.50(DW) + 0.50(LL+I) + 0.50(CE) + 0.50(BR) + 1.00(EQ)$

$Q = 0.90(DC) + 0.65(DW) + 0.50(LL+I) + 0.50(CE) + 0.50(BR) + 1.00(EQ)$

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COUNTY: CROSSING:

NOTES

SERVICE I

$$Q = DC + DW + LL + IM + CE + BR + 0.30WS + WL + 1.20^{*}TU$$

* USE $\gamma_{TU} = 1.2$ FOR Δ'S, 0.5 FOR FORCES

SERVICE II

$$Q = DC + DW + 1.3LL + 1.3IM + 1.3CE + 1.3BR + 1.2^{*}TU$$

FATIGUE

$$Q = 0.75LL + 0.75IM + 0.75CE + 0.75BR$$

NUMBER OF DESIGN LANES = 58/12 = 4.83
USE 4 DESIGN LANES

3.6.1.1.1

LIVE-LOAD DISTRIBUTION FACTORS

$S = 10.25$ FT

$L = 210$ FT, M^{+} SPAN 2
120 FT, M^{+} SPAN 1
165 FT, M^{-} AT BENT

NOTE: AVERAGE VALUES HAVE BEEN USED HERE FOR "L"

PRELIMINARY GIRDER SECTION:

WEB WITHOUT LONGITUDINAL STIFFENERS

6.10.2.1

$D/t_w \leq 150$
$t_w \geq 69/150 = 0.46"$

TRY $1/2"$ web in positive moment regions
$5/8"$ web in negative moment regions

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COUNTY: CROSSING:

NOTES
6.10.2.2
C6.10.3.4
6.10.2.2
4.6.2.2.2d
3.6.1.1.2

$b_f \geq D/6 = 69/6 = 11\frac{1}{2}''$

$b_{fc} \geq L/85$ ASSUME MAX. FIELD SECTION IS 140 FT

$140/85 = 1.65\,FT = 20''$

CHOOSE $b_f = 21''$

$t_f \geq \frac{b_f}{24} = \frac{21}{24} = 0.875$ $t_f \geq 7/8''$

DESCUS I WILL BE USED TO OBTAIN MOMENTS, SHEARS, REACTIONS, DEFLECTIONS.

SINCE DESCUS PERFORMS A GRILLAGE ANALYSIS, THE USE OF APPROXIMATE LIVE LOAD DISTRIBUTION FACTORS WOULD BE OVERLY CONSERVATIVE IF APPLIED TO ALL BEAMS SIMULTANEOUSLY.

THEREFORE, USE THE MOST SEVERE OF:

(1) RIGID ROTATION METHOD
(2) LEVER-RULE FOR EXTERIOR GIRDERS COMBINED WITH SIMPLE-SPAN DECK SLAB ASSUMPTION FOR INTERIOR GIRDERS

THE MULTIPLE PRESENCE FACTOR, m, WILL BE APPLIED ONLY IN CASES FOR WHICH A SINGLE LANE IS LOADED. ($m = 1.2$ FOR 1-LANE LOADED)

EXCEPTION: DO NOT APPLY $m = 1.2$ FOR FATIGUE LIMIT STATE

EFFECT OF CENTRIFUGAL FORCES ON WHEEL LOAD WILL BE CONSIDERED.

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COUNTY: CROSSING:

CENTRIFUGAL FORCES

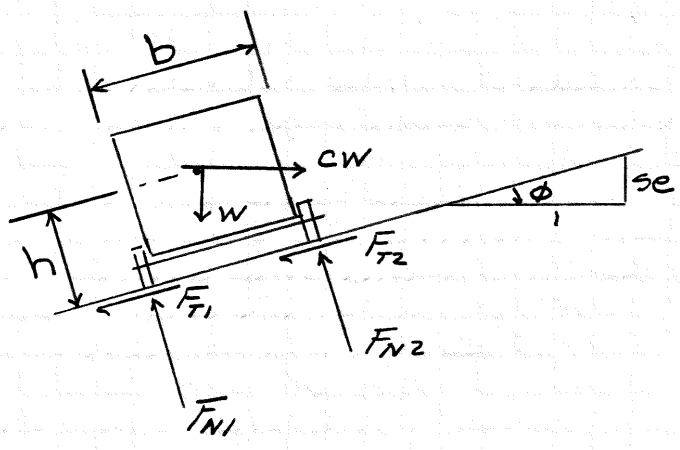
*USE $R = 2{,}291.8312' - 5.125' = 2{,}286.71$
SAY 2,286 FT

(OUTSIDE GIRDER OF SOUTHBOUND BRIDGE)

$$V = 60 \text{ mph} \times \frac{5{,}280}{3{,}600} = 88 \text{ FPS}$$

$$g = 32.2 \text{ FT/SEC}^2$$

$$C = \frac{4 \times 88^2}{3 \times 32.2 \times 2{,}286} = 0.14$$



$$\Sigma M_1 = 0: \quad F_{N2}(b) = W\cos\phi\left(\frac{b}{2}\right) + CW\cos\phi\,(h) - W\sin\phi\,(h) + CW\sin\phi\left(\frac{b}{2}\right)$$

$$F_{N2} = W\cos\phi\left(\frac{1}{2} + C\frac{h}{b}\right) - W\sin\phi\left(\frac{h}{b} - C\frac{1}{2}\right)$$

$$F_{N2} = W\cos\phi\left[\frac{1}{2} + C\left(\frac{h}{b} + \frac{1}{2}\tan\phi\right) - \frac{h}{b}\tan\phi\right]$$

$$\tan\phi = se$$

$$F_{N2} = W\cos\phi\left[\frac{1}{2} + C\left(\frac{h}{b} + \frac{se}{2}\right) - \frac{h}{b}\cdot se\right]$$

$$\Sigma F_N = 0: \quad F_{N1} = W\cos\phi + CW\sin\phi - F_{N2}$$

$$F_{N1} = W\cos\phi\,(1 + C\cdot se) - F_{N2}$$

NOTES

3.6.3

*NOTE: THE BEAM SPACING WAS LATER REVISED, RESULTING IN A SLIGHTLY DIFFERENT R-VALUE FOR THE EXTERIOR GIRDER. PAGE 26 SHOWS THE FINAL CONFIGURATION, FOR WHICH R = 2,287.456 FT. THE SMALL DIFFERENCE WAS DEEMED INSIGNIFICANT AND NO REVISION TO THE CALCULATIONS WAS MADE.

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COUNTY: CROSSING: NOTES

$\Sigma F_T = 0$:

$$CW\cos\phi - W\sin\phi = F_{T1} + F_{T2}$$
$$W(\cos\phi\,(C - se) = F_{T1} + F_{T2}$$

KINETIC FRICTION:

$$\frac{F_{T1}}{F_{N1}} = \frac{F_{T2}}{F_{N2}} \qquad F_{T1} = F_{T2}\cdot\frac{F_{N1}}{F_{N2}}$$

$$F_{T2}\cdot\frac{F_{N1}}{F_{N2}} + F_{T2} = W\cos\phi\,(C - \tan\phi)$$

$$F_{T2} = \frac{W\cos\phi\,(C - se)}{1 + F_{N1}/F_{N2}}$$

$b = 6\,FT$
$h = 6\,FT$ $\qquad h/b = 1.0$
$se = 0.065$
$C = 0.14$

$\therefore$ $F_{N2} = 0.578\,W$ $\qquad F_{T2} = 0.043\,W$

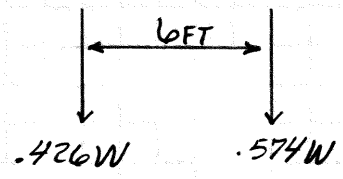
$F_{N1} = 0.429\,W$ $\qquad F_{T1} = 0.032\,W$

$F_{V1} = W(.429\cos\phi - .032\sin\phi)$

$F_{V1} = 0.426\,W$

$F_{V2} = W(.578\cos\phi - .043\sin\phi)$

$F_{V2} = 0.574\,W$



C.G. OF WHEEL LOADS
$= .574 \times 6$
$= 3.44\,FT$ FROM LEFT WHEEL

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SE = :	0.0650	ft/ft, Superelevation
ϕ = :	0.0649	surface angle, radians
R = :	2286	ft, Radius of curve
S = :	60	mph, Design speed
CF = :	14.0	%, Centrifugal force
B = :	6	ft, Transverse wheel spacing
H = :	6	ft, Height of CF
W = :	72	kips, Vehicle weight
L = :	10.25	ft, Beam spacing
F = :	1.062	Factor by which the LLDF should be multiplied to account for curvature effects in girder design

F_N : Force normal to contact surface

F_T : Friction force between tire and contact surface

F_V : Vertical force at contact surface

F_H : Horizontal force at contact surface

32.2 : acceleration due to gravity, ft/sec/sec

0.40 : μ_k, oefficient of kinetic friction, tire to pavement

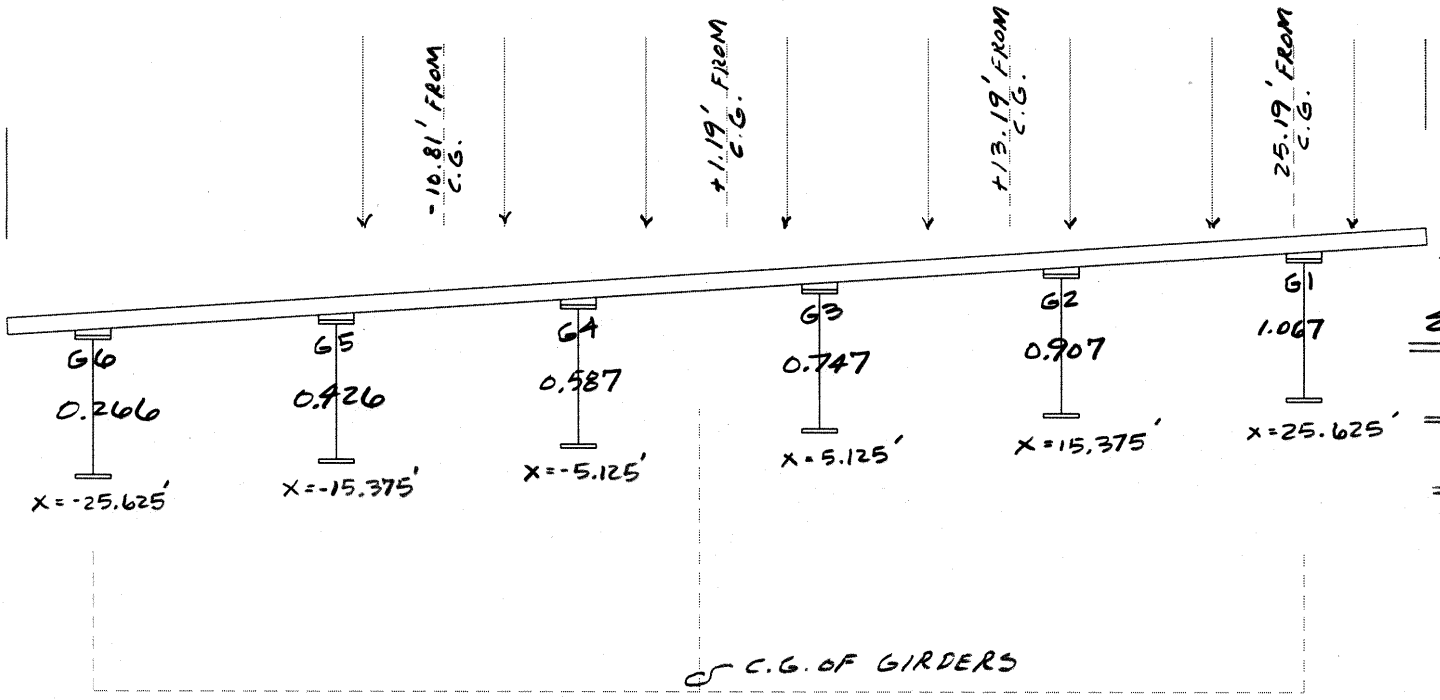
average tire on dry pavement

grooved tire on wet pavement

smooth tire on wet pavement

	F_N/W	F_T/W	F_V/W	F_H/W	F_T/F_N
Outside wheel	0.579	0.043	0.575	0.081	0.075
Inside wheel	0.428	0.032	0.425	0.060	0.075
		0.075	1.000	0.140	

	F_N	F_T	F_V	F_H
Outside wheel	41.7	3.1	41.4	5.8
Inside wheel	30.8	2.3	30.6	4.3
		5.4	72.0	10.1



$\Sigma e = 28.76$ FT

$\Sigma x^2 = 1{,}839$ FT^2

$N_L = 4$

$N_B = 6$

$$R_i = \frac{N_L}{N_B} + \frac{x_i \Sigma e}{\Sigma x^2}$$

CASE 1

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IF MULTIPLE PRESENCE FACTORS HAD BEEN APPLIED, THE CASE OF 3 LANES LOADED WOULD HAVE CONTROLLED.

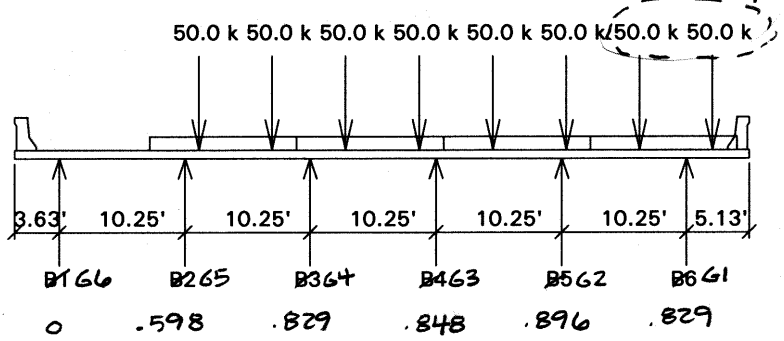
NOTE: THESE LANE FRACTIONS ON EACH GIRDER INCLUDE NO MULTIPLE PRESENCE FACTOR. STRICTLY SPEAKING, AASHTO 3.6.1.1.2 PERMITS A FACTOR OF 0.65 TO BE APPLIED TO THESE VALUES. FOR GAILLAGE ANALYSES, THE DIFFICULTY IN ESTABLISHING A CONTROLLING NO. OF LOADED LANES PROMPTED THE DESIGNER TO USE THE CONSERVATIVE CASE: 4 LANES, $m = 1.0$

LIVE LOAD LANE LOADING PROGRAM

("LEVER-RULE" CALCULATIONS)

Project: I-55 / Mallory Avenue
Designer: Huff

"DUMMY" LOADS: 100^K PER LANE. RESULTING "REACTIONS" WILL BE PERCENT LANES ON EACH GIRDER



Case No. 1 - 4 Lanes Loaded

NOTE: THE OVERHANG DIMENSIONS WERE LATER CHANGED TO A SYMMETRIC ARRANGEMENT: 4'4½" CANTILEVER ON EACH SIDE WITH 10'3" BEAM SPACING. THIS CALCULATION WAS BASED ON 5.13' CANTILEVER, IS CONSERVATIVE, AND WAS NOT REPEATED FOR THE FINAL CONFIGURATION.

Dead Load Service Load Reaction: 0.00k
Live Load Service Load Reaction: 100.00k
Live Load Distribution Factor: 2.000

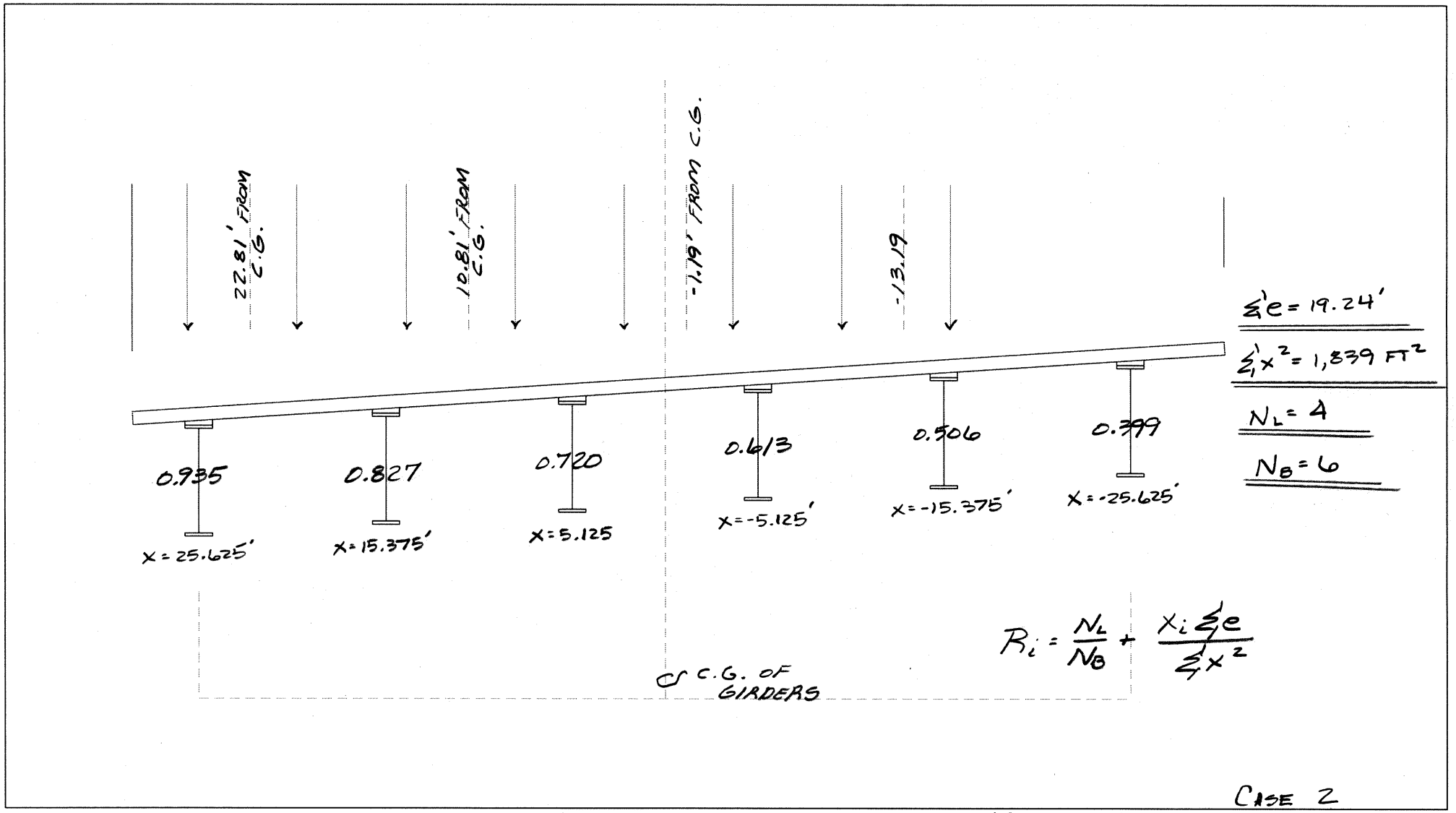
4 lanes loaded with no lane load reduction factor applied to live loads.

LANE NO.	DIST. FROM EDGE OF SLAB OR PREV. LANE	DIST. FROM EDGE OF LANE TO 1ST WHEEL LOAD
1	11.00	4.00
2	0.00	4.00
3	0.00	4.00
4	0.00	4.00

Out-To-Out Width of Slab: 60.000 Ft.

REACTION NUMBER	DISTRIBUTION FACTOR	SERVICE LOAD REACTION	LOAD FACTOR REACTION
1 G6	0.0000	0.000	0.000
2 G5	1.1951	59.756	129.472
3 G4	1.6585	82.927	179.675
4 G3	1.6951	84.756	183.638
5 G2	1.7927	89.634	194.207
6 G1	1.6585	82.927	179.675

TDOT TENNESSEE DEPARTMENT OF TRANSPORTATION



CASE 2

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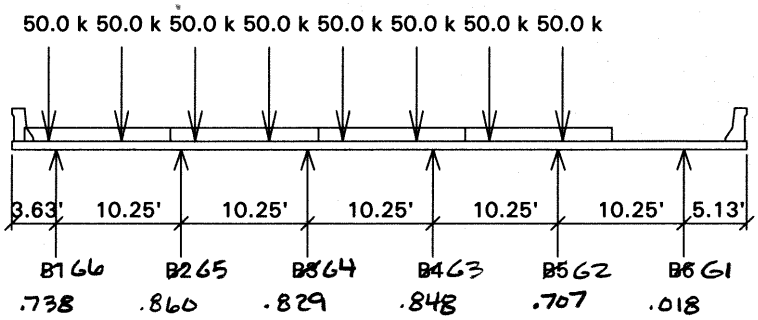
SEE NOTES ON PAGE 7.

THESE CALCULATIONS ARE BASED ON A 1 FT WIDE PARAPET (PARAPET WIDTH AT TOP) AND ARE, THUS, CONSERVATIVE. DESIGN OF THE DECK REINFORCEMENT (P. 22) WILL BE BASED ON A PARAPET WIDTH OF 1'9" (PARAPET WIDTH AT BASE).

LIVE LOAD LANE LOADING PROGRAM

Project: I-55 / Mallory Avenue
Designer: Huff



Case No. 2 - 4 Lanes Loaded

(SEE NOTES ON PAGE 8)

Dead Load Service Load Reaction: 0.00k
Live Load Service Load Reaction: 100.00k
Live Load Distribution Factor: 2.000

4 lanes loaded with no lane load reduction factor applied to live loads.

LANE NO.	DIST. FROM EDGE OF SLAB OR PREV. LANE	DIST. FROM EDGE OF LANE TO 1ST WHEEL LOAD
1	1.00	2.00
2	0.00	2.00
3	0.00	2.00
4	0.00	2.00

Out-To-Out Width of Slab: 60.000 Ft.

REACTION NUMBER	DISTRIBUTION FACTOR	SERVICE LOAD REACTION	LOAD FACTOR REACTION
1 G6	1.4756	73.780	159.858
2 G5	1.7195	85.976	186.280
3 G4	1.6585	82.927	179.675
4 G3	1.6951	84.756	183.638
5 G2	1.4146	70.732	153.252
6 G1	0.0366	1.829	3.963

TDOT TENNESSEE DEPARTMENT OF TRANSPORTATION

COUNTY: CROSSING: NOTES

MAXIMIZE G5:

$R_6 = [.426(8.875) + .574(2.875)] / 10.25$

$R_6 = 0.530$

$R_5 = \frac{.426(1.375+9.125) + .574(7.375+3.125)}{10.25}$

$R_5 = 1.024$

$R_4 = \frac{.426(1.125+7.375) + .574(7.125+1.375)}{10.25}$

$R_4 = 0.829$

$R_3 = \frac{.426(2.875+5.625) + .574(8.875)}{10.25}$

$R_3 = 0.850$

$R_2 = \frac{.426(4.625) + .574(9.875)}{10.25}$

$R_2 = 0.745$

$R_1 = .574(.375)/10.25$

$R_1 = 0.021$

MAXIMIZE G4:

$R_6 = .530$

$R_5 = \frac{.426(1.375+7.125) + .574(7.375+1.125)}{10.25}$

$R_5 = 0.828$

$R_4 = \frac{.426(3.125+7.375) + .574(9.125+1.375)}{10.25}$

$R_4 = 1.024$

$R_3 = .850$

$R_2 = .745$

$R_1 = .021$

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COUNTY: CROSSING: NOTES

D.F. FOR FATIGUE:

SINGLE TRUCK IN ONE LANE, CONSTANT SPACING OF 30FT BETWEEN 32^K AXLES. — 3.6.1.4.1

FATIGUE IMPACT = 15% — 3.6.2

ADT = 73,535
ADTT = 73,535 × .20 = 14,707 — 3.6.1.4.2

4 LANES AVAILABLE TO TRUCKS

$ADTT_{SL}$ = 0.80 × 14,707 = 11,765

CYCLES PER TRUCK PASSAGE, — 6.6.1.2.5
$n = 1.5$ OVER PIERS
$n = 1.0$ ELSE WHERE

$N = 365(75)(1.5)(11,765)$, OVER PIERS — 6.6.1.2.5
$N = 365(75)(1.0)(11,765)$, ELSEWHERE

$N = 483,100,312$, OVER PIERS
$N = 322,066,875$, ELSEWHERE

EVEN FOR CATEGORY A DETAILS:

$$\left(\frac{250 \times 10^8}{322,066,875}\right)^{1/3} = 4.3 \text{ksi} < \tfrac{1}{2}(\Delta F)_{TH}$$

USE $(\Delta F)_n = \frac{1}{2}(\Delta F)_{TH}$
FOR ALL DETAILS
$(\Delta F)_{TH}$ FROM TABLE
6.6.1.2.5-3

D.F. WILL BE TAKEN SO AS TO MAXIMIZE EACH GIRDER IN SUCCESSION WITH A SINGLE LOADED LANE.

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COUNTY: CROSSING: NOTES

RIGID ROTATION METHOD:

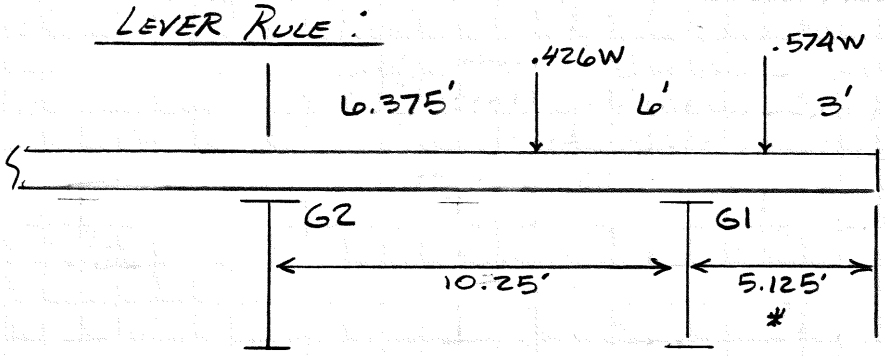
C.G. OF LANE @ 30.75 FT
- 1 FT
- 2 FT
- 6 FT
+ 3.44 FT
25.19 FT FROM GIRDER C.G.

REF. TO PAGE 7

$$R_1 = R_{EXT} = \frac{1}{6} + \frac{25.625(25.19)}{1{,}839} = 0.518$$

$R_2 = 0.377$ $R_3 = 0.237$ $R_4 = 0.096$
$R_5 = -.044$ $R_6 = -.184$

LEVER RULE:



$1 - .958 = .042W$

$$\frac{.426W(6.375) + .574W(12.375)}{10.25} = 0.958W$$

USE 0.958 LANES ON G1
& 0.042 LANES ON G2
FOR FATIGUE ON G1

* NOTE: THE FINAL CONFIGURATION USED 4'4½" CANTILEVER INSTEAD OF 5.125'. THIS CALCULATION IS, THUS, CONSERVATIVE AND WAS NOT REPEATED.

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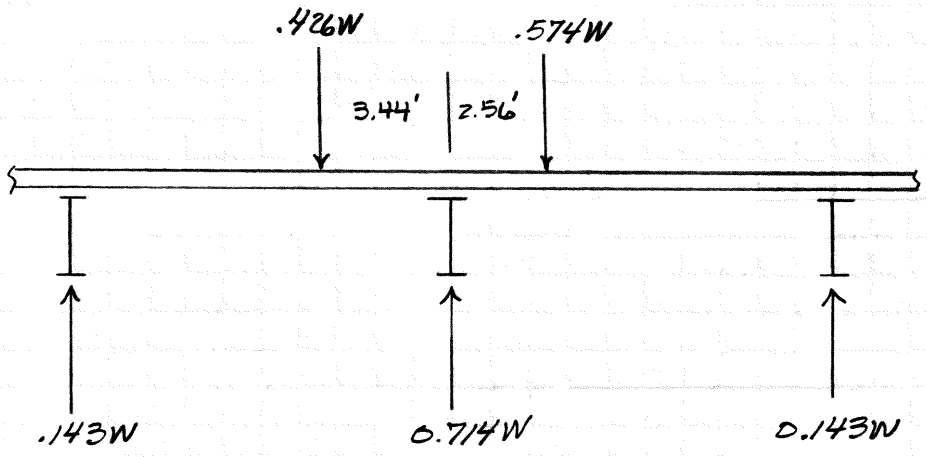
COUNTY: CROSSING:

NOTES

INTERIOR GIRDERS : FATIGUE



USE : .714 LANES ON G2 WITH
.143 LANES ON G1 & G3
FOR FATIGUE ON G2

.714 LANES ON G3 WITH
.143 LANES ON G2 & G4
FOR FATIGUE ON G3

.714 LANES ON G4 WITH
.143 LANES ON G3 & G5
FOR FATIGUE ON G4

.714 LANES ON G5 WITH
.143 LANES ON G4 & G6
FOR FATIGUE ON G5

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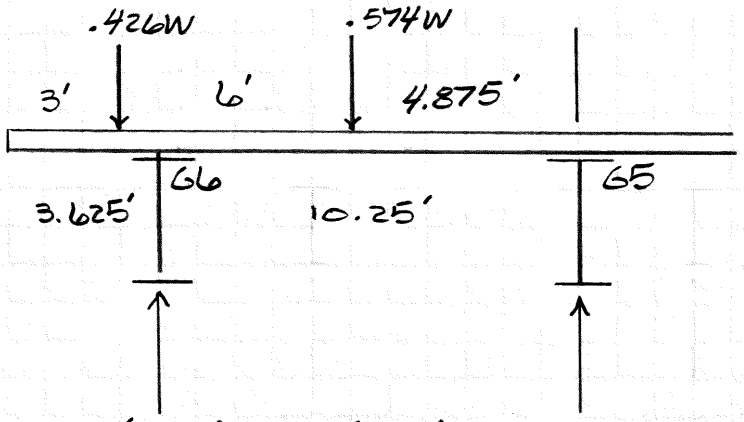
COUNTY: CROSSING: NOTES

GIRDER G: FATIGUE



$$\frac{.426(10.875)+.574(4.875)}{10.25} = 0.725 \qquad 1-0.725 = 0.275$$

USE 0.725 LANES ON G6
& 0.275 LANES ON G5
FOR FATIGUE ON G6

D.F. FOR DEFLECTIONS

USE DISTRIBUTION SHOWN ON PAGE 7 TO MAXIMIZE EXTERIOR GIRDER, G1

OTHER GIRDERS WILL BE OK

LIVE LOAD FOR DEFLECTION TO BE TAKEN AS THE LARGER OF: 3.6.1.3.2
(a) DESIGN TRUCK (WITH 33% IMPACT)
(b) 1/4 OF DESIGN TRUCK (WITH 33% IMPACT) PLUS DESIGN LANE LOAD.

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COUNTY: CROSSING: NOTES

LIVE LOADS:

DESIGN TRUCK $8^k, 32^k, 32^k$ (14FT, 14FT - 30FT *) — 3.6.1.2.2

DESIGN TANDEM $25^k, 25^k$ (4FT) — 3.6.1.2.3

DESIGN LANE 0.64 KLF — 3.6.1.2.4

EXTREME FORCE EFFECTS, STRENGTH & SERVICE — 3.6.1.3.1, 3.6.2.1

(1) DESIGN TANDEM WITH 33% IMPACT PLUS DESIGN LANE

(2) DESIGN TRUCK WITH 33% IMPACT PLUS DESIGN LANE

(3) FOR NEGATIVE MOMENT BETWEEN CONTRAFLEXURE POINTS & PIER REACTIONS,

.9 × 2 DESIGN TRUCKS, 50FT (MIN) BETWEEN LEAD AXLE OF BACK TRUCK & REAR AXLE OF FRONT TRUCK, CONSTANT 14FT SPACING BETWEEN 32^k AXLES, WITH 33% IMPACT PLUS .9 × DESIGN LANE

* FOR FATIGUE, A CONSTANT REAR AXLE SPACING IS TO BE USED (30FT) — 3.6.1.4.1

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COUNTY: CROSSING: NOTES

BRAKING FORCES — 3.6.4

BR = GREATER OF:

(a) 25% OF THE DESIGN TRUCK OR TANDEM AXLE WEIGHT

.25(8+32+32) = 18.0 KIPS — TRUCK
.25(25+25) = 12.5 KIPS — TANDEM

(b) 5% OF DESIGN TRUCK OR TANDEM WITH 5% OF DESIGN LANE

.05(8+32+32) = 3.6 KIPS — TRUCK
.05(.64 × 447 FT) = 14.3 KIPS — LANE
17.9 KIPS

(a) CONTROLS, BR = 18.0 K/LANE × 4 LANES

BR = 72.0 KIPS

MULTIPLE PRESENCE, m = 0.65 — 3.6.1.1.2

BR = 72 × .65

BR = 46.8 KIPS

÷ 2 BENTS = 23.4 K

WIND LOADS — 3.8

SUPERSTRUCTURE d = 69" (WEB) + 3" (BOTT. FL.) + 5¼" (TOP FL. + HAUNCH)
+ 8½" + 32" ← (slab + H(parapet))
+ .065(60 × 12) ← S.E. effect

d = 164.55" = 13.7 FT

MAX. F.G. ELEV. ≈ 260 FT
APPROX GROUND ≈ 232 FT
28 FT < 30 FT

NO VELOCITY ADJUSTMENT NECESSARY

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COUNTY: CROSSING: NOTES

WINDWARD LOAD ON SUPERSTRUCTURE = 0.050 KSF × 13.7 FT = 0.685 KLF — 3.8.1.2 — WITH WIND SKEW = 0°

NOTE:
INVESTIGATION OF SKEWED WIND ANGLES IS NOT WARRANTED FOR THIS BRIDGE SINCE BOTH ABUTMENTS ARE INTEGRAL

WIND ON LIVE LOAD = 0.100 KLF — 3.8.1.3

VERTICAL WIND PRESSURE = 0.02 KSF (UPWARD) × 60 FT = 1.2 KLF @ 15 FT FROM EDGE OF DECK — 3.8.2

EARTHQUAKE EFFECTS: EQ — 3.10

ACCELERATION COEFFICIENT, A = 0.22
SEISMIC ZONE = 3
SOIL PROFILE = II
SITE COEFFICIENT = 1.2

RESPONSE SPECTRUM: — 3.10.6

$$C_{sm} = \frac{1.2AS}{T_m^{2/3}} \leq 2.5A$$

$$C_{sm} = \frac{1.2 \times .22 \times 1.2}{T_m^{2/3}} \leq 2.5 \times .22$$

$$C_{sm} = \frac{0.32}{T_m^{2/3}} \leq 0.55$$

EXCEPTION:

IF $T_m > 4.0$ SEC.,

$$C_{sm} = \frac{3AS}{T_m^{4/3}} = \frac{0.79}{T_m^{4/3}}$$

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COUNTY: CROSSING:

NOTES

ELASTIC RESPONSE SPECTRUM:

PERIOD (SEC)	Csm (g)
0.01	0.55
0.44	0.55
.50	0.48
.60	0.45
.70	0.41
.80	0.37
.90	0.35
1.0	0.32
1.2	0.29
1.4	0.26
1.6	0.23
1.8	0.22
2.0	0.20
2.5	0.18
3.0	0.16
3.5	0.14
4.0	0.13
5.0	0.10

RESPONSE MODIFICATION FACTORS 3.10.7

BENTS - R = 3.5

SUPERSTRUCTURE - TO - ABUTMENT - R = 0.80

CAP - TO - SUPERSTRUCTURE - R = 1.0

COLUMN - TO - FOUNDATION - R = 1.0

NOTE: ALTERNATIVELY, CONNECTION POINTS MAY BE DESIGNED FOR THE MAXIMUM DEVELOPABLE INELASTIC HINGING FORCE WHERE APPLICABLE.

CONSIDER I55 "ESSENTIAL", BUT NOT "CRITICAL" AT THIS LOCATION

COMBINATION OF ORTHOGONAL EFFECTS (3.10.8)

100% EQ_{TRANS} + 30% EQ_{LONG}

30% EQ_{TRANS} + 100% EQ_{LONG}

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COUNTY: CROSSING: NOTES

UNIFORM TEMPERATURE EFFECTS — 3.12.2

T_{RANGE} = 0° TO 120°F

α_{STEEL} = 0.0000065 IN/IN/°F

OVERSTRENGTH CONSIDERATIONS FOR SEISMIC EFFECTS: — B3-1, 2

$f_y = 1.25 \times 60 = 75$ ksi

$f'_c = 1.50 \times 3 = 4.5$ ksi

$\varepsilon_{cu} = 0.01$

EFFECTIVE FLANGE WIDTH * — 4.6.2.6

INTERIOR GIRDERS:

TAKE EFFECTIVE SPAN = 120'
× .6
72 FT

(SINCE SPAN-RATIO IS HIGH)

(a) 1/4 × 72 = 18 FT
(b) 12 × 8½" + ½(21") = 9.375 FT ← CONTROLS
(c) 10.25 FT

EXTERIOR GIRDERS:

(a) $9.375(\frac{1}{2}) + \frac{1}{8}(72) = 13.69$ FT
(b) $9.375(\frac{1}{2}) + 6(8\frac{1}{2})/12 + \frac{1}{4}(\frac{21}{12}) = 9.375$ FT
(c) $9.375(\frac{1}{2}) + 4.375 = 9.063$ FT ← CONTROLS

* NOTE: SOME STATES DEDUCT ½" FROM THE DESIGNATED SLAB THICKNESS IN THESE EFN (AND ALL OTHER STRENGTH) CALCULATIONS TO ACCOUNT FOR SURFACE WEAR.

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COUNTY: CROSSING:

NOTES

LATERAL WIND LOAD DISTRIBUTION

4.6.2.7

FOR FRAME ACTION OF CROSS-FRAMES:

69" WEB
6" T+B FLG.

$$W = \frac{1.4\left(\frac{69+6}{12}\right)(0.050)}{2} = 0.22 \text{ KLF}$$

$$M_W = 0.22(20)^2/10 = 8.8 \text{ FT-K}$$

(ASSUME 20' MAX. SPACING OF CROSS-FRAMES)

FOR 18 x 3/4" FLANGE:

$$S = 3/4(18)^2/6 = 40.5 \text{ IN}^3$$

$$f_{bw} = 8.8 \times 12/40.5 = 2.6 \text{ KSI}$$

MATERIALS:

STRUCTURAL STEEL: M270 GRADE 50W

CONCRETE: $f'_c = 3$ KSI

LOAD-INDUCED FATIGUE CATEGORIES

6.6.1.2

ITEM	CATEGORY	$(\Delta F)_{TH}$
BASE METAL AT TOE OF STIFFENER-WEB WELD	C'	12.0 KSI
BASE & WELD METAL AT FLANGE-WEB WELD	B	16.0 KSI
BASE & WELD METAL AT FLANGE & WEB TRANSITIONS	C	10.0 KSI
BASE METAL AT GROOVE-WELDED DIAPHRAGM GUSSET	C	10.0 KSI
BASE METAL AT FILLET-WELDED GUSSET	C	10.0 KSI
BASE METAL AT GROSS SECTION OF SLIP-CRITICAL CONN.	B	16.0 KSI

SEE ALSO, PAGE 12

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COUNTY: CROSSING: NOTES

LRFD Slab Design

TOP OF SLAB CLEAR COVER = 2 1/2" — 5.12.3 & 9.7.1.1
BOTTOM OF SLAB CLEAR COVER = 1 1/2"
(BOTTOM OF SLAB CONSIDERED "INTERIOR" SINCE DECK PANELS WILL BE USED).

APPROXIMATE METHOD: — 4.6.2.1

EQUIVALENT STRIP WIDTHS:

OVERHANG: $W_e = 45.0 + 10.0X$
+M: $W_e = 26.0 + 6.6S$
-M: $W_e = 48.0 + 3.0S$

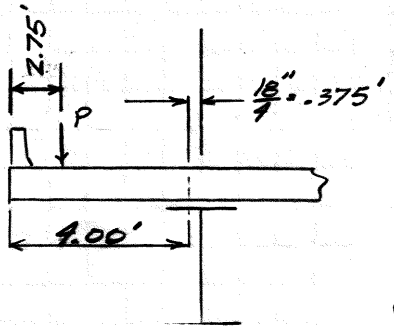
ALTERNATE METHOD FOR OVERHANG DESIGN: REPLACE WHEEL WITH 1.0 KLF LINE LOAD LOCATED 1.0 FT FROM FACE OF RAILING. — 3.6.1.3.4

OVERHANG DESIGN:

(a) WHEEL LOAD MOMENT:
IMPACT = 33%

P = 16 KIP WHEEL LOAD
× 1.33
= 21.3 KIPS

FOR SLAB DESIGN, THE WHEEL IS PLACED 1FT FROM THE BASE FACE OF PARAPET (= 1'9")



$W_e = 45.0 + 10.0(1.625) = 61.25"$
$= 5.10$ FT

$M_{LLI} = 21.3(1.25)/5.10$
$= 5.22$ FT-K/FT

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COUNTY: CROSSING: NOTES

(b) RAIL DL MOMENT:

.453 KLF AT 7.6" FROM EDGE OF SLAB

$M_{DL1} = .453(4.00 - 7.6/12)$
$= 1.53$ FT·K/FT

(c) SLAB + OVERLAY MOMENT:

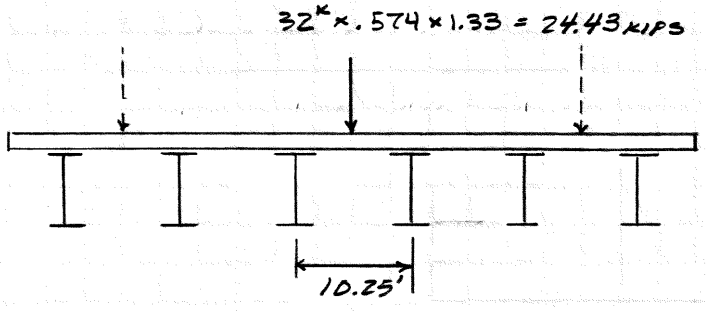
$.150(8\frac{1}{2}/12)(4.00)^2(\frac{1}{2}) = 0.85$ FT·K/FT
$.033(4.00)^2(\frac{1}{2}) = 0.26$ FT·K/FT

$M_{DL2} = 1.11$ FT·K/FT

$M_u^- =$	0.85×1.25	DC_1
	1.53×1.25	DC_2
	0.26×1.50	DW
	5.72×1.75	LL+I
	12.5 FT·K/FT CANTILEVER	

INTERIOR SLAB MOMENTS

PAGE 5



$W_u = 1.25 \times .110$
$1.50 \times .033$
0.187 KLF

SLAB
OVERLAY

M^+: $26.0 + 6.6(10.25) = 93.65" = 7.80$FT
$P_{WHEEL} = 24.43/7.80 = 3.13$ K/FT

M^-: $48.0 + 3.0(10.25) = 78.75" = 6.56$ FT
$P_{WHEEL} = 24.43/6.56 = 3.72$ K/FT

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COUNTY: CROSSING: NOTES

$M_u^+ \approx 0.187(10.25)^2(49/512)$
$+ 3.13 \times 1.75 \times 10.25 \times 13/64$
13.3 FT·K/FT

AISC 9TH PAGE 2-306

$M_u^- \approx 0.187(10.25)^2/8$
$+ 3.72 \times 1.75 \times 10.25 \times 3/16$
14.97 FT·K/FT

NEGATIVE MOMENT CONTROLS (SMALLER "d", HIGHER "M_u")

$d = 8\frac{1}{2} - 2\frac{1}{2} - \frac{3}{8} = 5.63"$
$\phi = 0.90$ 5.5.4.2.1

$a/2 = \frac{60A_s}{2 \times .85 \times 3 \times 12} = 0.98A_s$

$\phi M_n = .9 \times 60 \times A_s(5.63 - .98A_s)/12$
≥ 14.97

$4.41A_s^2 - 25.335A_s + 14.97 = 0$
$A_s = 0.67 \text{ IN}^2/\text{FT}$

NO. 6 @ 7" = 0.75 IN²/FT
TRANSVERSE SLAB BARS, TOP & BOTTOM

LONGITUDINAL BARS IN SLAB 6.10.3.7

$.01 \times 8\frac{1}{2} \times 12 \times \frac{2}{3} = .68 \text{ in}^2/\text{ft}$ TOP
$.34 \text{ in}^2/\text{ft}$ BOTTOM

$S_{EFF} = 10.25 - \frac{1}{2}(18/12) = 9.5 \text{ FT}$

$220/\sqrt{9.5} = 71.3$, USE 67% 9.7.3.2
DISTRIBUTION STEEL

$.67 \times .750 = 0.50 \text{ IN}^2/\text{FT}$

USE #5 @ 6" TOP = .62 (SAY OK)
#5 @ 7" BOTT = .53
LONGITUDINAL SLAB BARS

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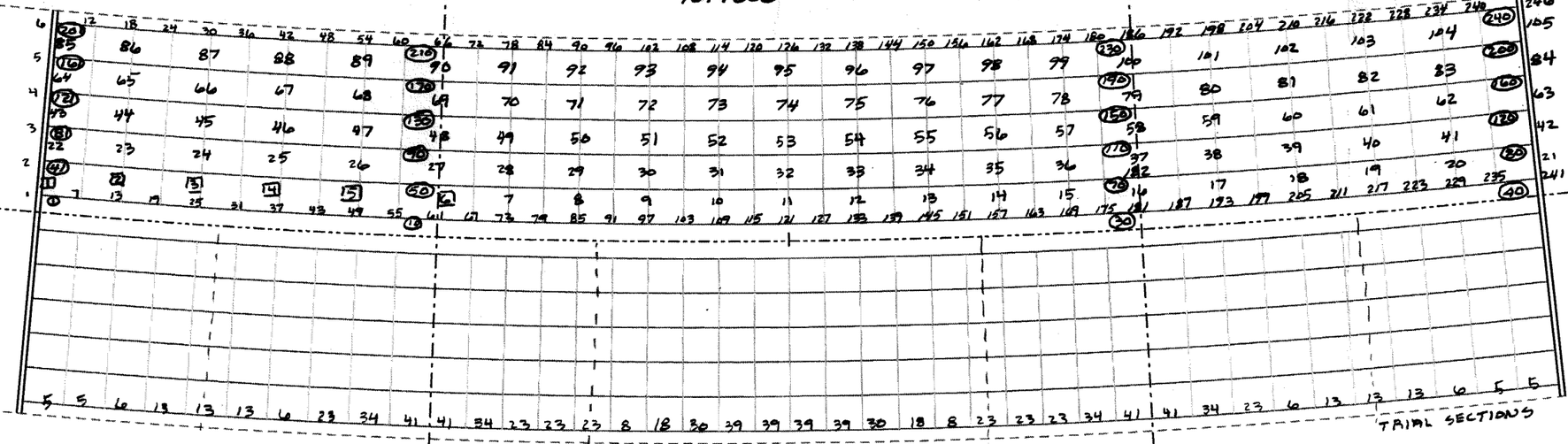
Girder sections	Top		Bottom		D=:	69
Section	bf	tf	bf	tf	tw=:	0.5
1	21	7/8	21	7/8		
2	21	7/8	21	1		
3	21	7/8	21	1 1/4		
4	21	7/8	21	1 1/2		
5	21	7/8	21	1 3/4		
6	21	7/8	21	2		
7	21	1	21	1		
8	21	1	21	1 1/2		
9	21	1	21	2		
10	21	1 1/4	21	1 1/4		
11	21	1 1/4	21	1 1/2		
12	21	1 1/4	21	1 3/4		
13	21	1 1/4	21	2		
14	21	1 1/4	21	2 1/4		
15	21	1 1/4	21	2 1/2		
16	21	1 1/2	21	1 1/2		
17	21	1 1/2	21	1 3/4		
18	21	1 1/2	21	2		
19	21	1 1/2	21	2 1/4		
20	21	1 1/2	21	2 1/2		
21	21	1 1/2	21	2 3/4		
22	21	3 1/4	21	3 1/4		
23	21	1 3/4	21	1 3/4		
24	21	1 3/4	21	2		
25	21	1 3/4	21	2 1/4		
26	21	1 3/4	21	2 1/2		
27	21	1 3/4	21	2 3/4		
28	21	3 1/2	21	3 1/2		
29	21	2	21	2		
30	21	2	21	2 1/4		
31	21	2	21	2 1/2		
32	21	2	21	2 3/4		
33	21	2	21	3		
34	21	2 1/4	21	2 1/4		
35	21	2 1/4	21	2 1/2		
36	21	2 1/4	21	2 3/4		
37	21	2 1/4	21	3		
38	21	2 1/2	21	2 1/2		
39	21	2 1/2	21	3		
40	21	2 3/4	21	2 3/4		
41	21	3	21	3		

x-brace sections

Section	Atop	Abot	Adiag	d
42	3	3	3	57
43	5	5	5	57

11.5624'
11.6154'
11.6684'
11.7214'
11.7744'
11.8274'

10.2452'
10.2921'
10.3391'
10.3860'
10.4330'
10.4800'



GIRDER 6 R = 2,236.2062'
GIRDER 5 R = 2,246.4562'
GIRDER 4 R = 2,256.7062'
GIRDER 3 R = 2,266.9562'
GIRDER 2 R = 2,277.2062'
GIRDER 1 R = 2,287.4562'

GIRDER 6 R = 2,296.2062'
GIRDER 5 R = 2,306.4562'
GIRDER 4 R = 2,316.7062'
GIRDER 3 R = 2,326.9562'
GIRDER 2 R = 2,337.2062'
GIRDER 1 R = 2,347.4562'

11.8726'
11.9256'
11.9786'
12.0316'
12.0846'
12.1376'

10.5200'
10.5670'
10.6140'
10.6609'
10.7079
10.7548

ALL RADII TO BE INPUT NEGATIVE

SOUTHBOUND BRIDGE
DESCUS MODEL

BEAM SPACING = 10'3"
4'4½" CANTILEVERS

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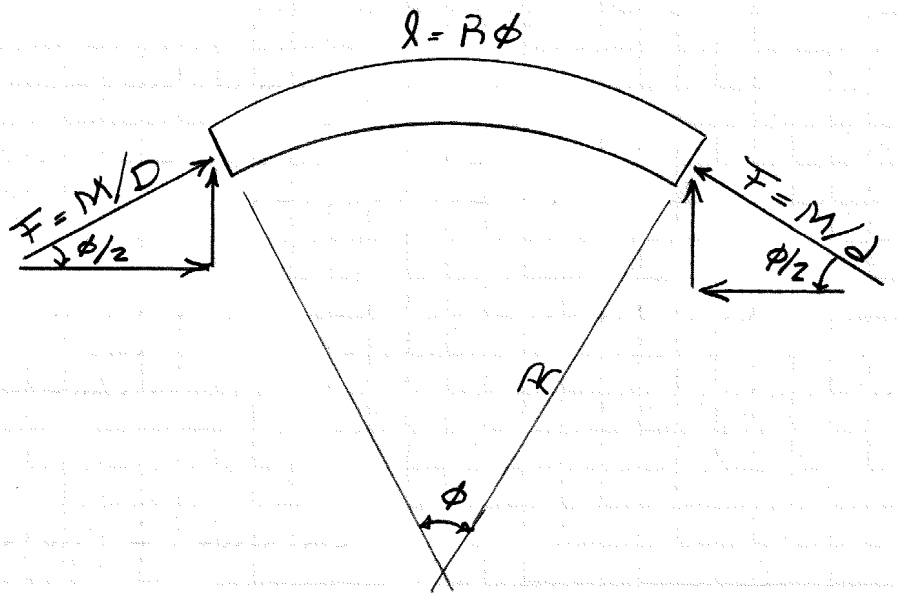
COUNTY: CROSSING: NOTES

LATERAL FLANGE BENDING MOMENTS WILL BE CALCULATED IN ACCORDANCE WITH:

$$M_{LAT} = \frac{M l^2}{10 R D}$$

D = GIRDER WEB DEPTH
l = UNBRACED LENGTH

RATIONALE:



TOTAL "OUTWARD" LOAD = $Q = \left(\frac{M}{D} \sin \phi/2\right) \times 2$

BUT FOR SMALL ϕ:
$\sin \phi/2 \approx \phi/2$

$$Q = \frac{M}{D} \frac{\phi}{2} \cdot 2 = \frac{M\phi}{D}$$
$$= \frac{Ml}{RD}$$

LOAD PER UNIT LENGTH = $q = \frac{Q}{l} = \frac{M}{RD}$

CONSIDER FLANGE CONTINUOUS @ BRACE POINTS SO THAT:

$$M_{LAT} \cong \frac{WL^2}{10} = \frac{M}{RD} \frac{(l^2)}{10}$$

USE $M_{LAT} = \frac{Ml^2}{10RD}$ (ON EACH FLANGE)

IN ACCORD WITH AASHTO GUIDE SPEC EQN. 4-1

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COUNTY: CROSSING:

NOTES

LATERAL FLANGE BENDING STRESSES TAKEN SOLELY BY FLANGE.

$$S = t_f b_f^2 / 6$$

b_f	t_f	S, in^3
21"	3/4"	55.1
	1"	73.5
	1 1/4"	91.9
	1 1/2"	110.3
	1 3/4"	128.6
	2"	147.0
	2 1/4"	165.4
	2 1/2"	183.8
	2 3/4"	202.1
	3"	220.5
	3 1/4"	238.9
	3 1/2"	257.2
	3 3/4"	275.6
	4"	294.0

$l_{max} = 25$ FT $R_{MIN} = 2,235.4562$*
$D = 69$ IN. $= 5.75$ FT

$$M_{LAT} = \frac{M(25)^2}{10(2,235.4562)(5.75)} = \frac{M}{205.66}$$

(WORST CASE)

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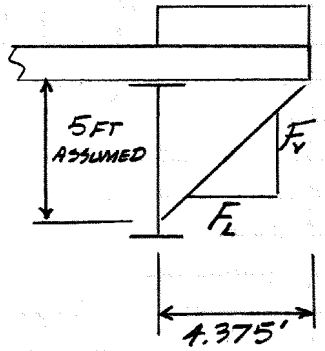
* THIS WAS CHANGED TO 2,236.2062 IN FINAL DESIGN. THIS CALCULATION WAS NOT REVISED AS IT IS ONLY, VERY SLIGHTLY, CONSERVATIVE (SEE PAGE 26)

COUNTY: CROSSING:

NOTES

LATERAL FLANGE BENDING DUE TO CONSTRUCTION LOADS ON EXTERIOR GIRDER:

Clo. 10.3.4-2



DECK = $(8.5/12)(5.125)(.15)$
= 0.545 KIPS/LF
TOTAL

1/2 TO BRACKET = 0.272 KLF

$F_L = F_V (4.375/5) = 0.875 F_V$

	SERVICE	
DECK OVERHANG	0.272	UNIFORM
FORMS	0.040	↓
RAILING	0.025	
SCREED RAIL	0.085	
WALKWAY	0.125	UNIFORM
FINISHING MACHINE	3.0	CONCENTRATED

UNIFORM LOADS: $M_{LAT} = F_L L_b^2 / 12$

CONCENTRATED LOADS: $M_{LAT} = P_L L_b / 8$

ASSUMES FIXED - FIXED END CONDITIONS

STRENGTH I:

$F_V = 1.25(0.272) + 1.5(.04 + .025 + .085 + .125)$

$F_V = 0.753$ KLF

$F_L = 0.875 \times 0.753 = 0.659$ KLF

$P_L = 1.5 \times (0.875 \times 3.0)$ 3.94 KIPS

STRENGTH IV:

$F_V = 1.5(.272 + .04 + .025 + .085 + .125)$
$= 0.821$ KLF

$F_L = 0.875 \times 0.821 = 0.718$ KLF

$P_L = 0$

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D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'$_c$, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	108.75

$= 9.063'$ (P. 20)

L_b, ft	A_s, in^2	d, inches	f_y, ksi	$n = E_s/E_c$	3n	Top Flange	b_f	t_f
25.00	5.9	2.75	60	9.29	27.9		21	7/8

	Bottom flange b_f	21	21	21	21	21	21	21	
	Bottom flange t_f	7/8	1	1 1/4	1 3/8	1 1/2	1 3/4	2	
I, in^4	Girder w/ rebar	69,829	73,674	80,721	83,962	87,036	92,742	97,932	
	Girder	58,548	61,728	67,517	70,163	72,664	77,284	81,465	
	Composite (n)	142,985	153,045	172,467	181,848	191,022	208,776	225,790	
	Composite (3n)	109,657	116,524	129,465	135,571	141,455	152,610	163,026	
S_{top}, in^3	Girder w/ rebar	2,189	2,221	2,273	2,295	2,315	2,351	2,381	VALUES USED ON P. 47
	Girder	1,655	1,685	1,735	1,756	1,775	1,809	1,838	
	Composite (n)	16,874	16,389	15,674	15,404	15,175	14,810	14,533	
	Composite (3n)	5,748	5,756	5,770	5,777	5,783	5,796	5,808	
S_{bot}, in^3	Girder w/ rebar	1,797	1,954	2,267	2,422	2,576	2,883	3,186	
	Girder	1,655	1,803	2,096	2,242	2,386	2,673	2,957	
	Composite (n)	2,296	2,487	2,869	3,059	3,249	3,629	4,008	
	Composite (3n)	2,122	2,301	2,659	2,837	3,015	3,369	3,721	
A, in^2	Girder w/ rebar	77.150	79.775	85.025	87.650	90.275	95.525	100.775	
	Girder	71.250	73.875	79.125	81.750	84.375	89.625	94.875	
	Composite (n)	186.555	189.180	194.430	197.055	199.680	204.930	210.180	
	Composite (3n)	113.618	116.243	121.493	124.118	126.743	131.993	137.243	
Elastic Y_b, in	Girder w/ rebar	38.855	37.699	35.614	34.670	33.785	32.171	30.739	
	Girder	35.375	34.241	32.211	31.299	30.449	28.908	27.551	
	Composite (n)	62.276	61.536	60.121	59.445	58.787	57.528	56.338	
	Composite (3n)	51.674	50.630	48.687	47.781	46.915	45.294	43.807	
Plastic Y_b, in	Girder w/ rebar	42.455	39.955	34.955	32.455	29.955	24.955	19.955	
	Girder	35.375	32.875	27.875	25.375	22.875	17.875	12.875	
	Composite (n)	70.456	70.519	70.644	70.706	70.769	70.894	71.019	USED ON P. 47
	Composite (3n)	70.456	70.519	70.644	70.706	70.769	70.894	71.019	
M_p, ft-k	Girder w/ rebar	9,067	9,518	10,337	10,706	11,047	11,648	12,139	
	Girder	7,829	8,203	8,867	9,158	9,422	9,868	10,204	
	Composite (n)	12,530	13,301	14,845	15,618	16,392	17,941	19,493	USED ON P. 48
	Composite (3n)	12,530	13,301	14,845	15,618	16,392	17,941	19,493	
M_y, ft-k	Girder w/ rebar	7,804	8,483	9,834	10,507	11,176	12,507	12,842	
	Girder	6,896	7,021	7,229	7,318	7,398	7,538	7,658	
	Composite (n)	9,567	10,363	11,953	12,746	13,539	15,121	16,699	
	Composite (3n)	8,842	9,589	11,080	11,822	12,563	14,039	15,506	
$M_{y'}$, ft-k	Girder								
	Composite (n)	11,774	12,523	14,021	14,770	15,519	17,019	18,518	
	Composite (3n)	11,669	12,409	13,890	14,631	15,371	16,852	18,332	
Q/I Top of Web	Girder w/ rebar	0.01183	0.01163	0.01132	0.01119	0.01108	0.01088	0.01072	
	Girder	0.01096	0.01077	0.01047	0.01035	0.01024	0.01005	0.00990	
	Composite (n)	0.01444	0.01424	0.01393	0.01380	0.01369	0.01349	0.01332	
	Composite (3n)	0.01371	0.01351	0.01319	0.01306	0.01294	0.01274	0.01257	
Q/I Bottom of Web	Girder w/ rebar	0.01011	0.01060	0.01138	0.01169	0.01196	0.01240	0.01275	
	Girder	0.01096	0.01148	0.01228	0.01260	0.01287	0.01333	0.01369	
	Composite (n)	0.00795	0.00838	0.00906	0.00933	0.00957	0.00997	0.01029	
	Composite (3n)	0.00859	0.00903	0.00974	0.01003	0.01028	0.01070	0.01103	
Depth of Web above n.a. (Elastic)	Girder w/ rebar	31.02	32.30	34.64	35.70	36.71	38.58	40.26	
	Girder	34.50	35.76	38.04	39.08	40.05	41.84	43.45	
	Composite (n)	7.60	8.46	10.13	10.93	11.71	13.22	14.66	
	Composite (3n)	18.20	19.37	21.56	22.59	23.58	25.46	27.19	
Depth of Web above n.a. (Plastic)	Girder w/ rebar	27.42	30.04	35.29	37.92	40.54	45.79	51.04	
	Girder	34.50	37.13	42.38	45.00	47.63	52.88	58.13	
	Composite (n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Composite (3n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'$_c$, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	108.75
L_b, ft	A_s, in^2	d, inches	f_y, ksi	n = E_s/E_c	3n	Top Flange	b_f	t_f
25.00	5.9	2.75	60	9.29	27.9		21	1

	Bottom flange b_f	21	21	21	21	21	21	21
	Bottom flange t_f	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4
	Girder w/ rebar	76,481	80,315	83,943	87,384	90,653	93,764	96,731
	Girder	65,141	68,351	71,376	74,235	76,942	79,510	81,952
I, in^4	Composite (n)	153,249	163,112	172,750	182,174	191,392	200,411	209,240
	Composite (3n)	117,546	124,259	130,720	136,944	142,947	148,742	154,340
	Girder w/ rebar	2,372	2,402	2,428	2,452	2,473	2,493	2,511
	Girder	1,835	1,863	1,889	1,912	1,932	1,951	1,969
S_{top}, in^3	Composite (n)	16,393	16,018	15,709	15,451	15,231	15,043	14,880
	Composite (3n)	5,896	5,905	5,914	5,922	5,930	5,938	5,945
	Girder w/ rebar	1,973	2,131	2,289	2,445	2,601	2,757	2,911
	Girder	1,835	1,984	2,133	2,281	2,428	2,575	2,720
S_{bot}, in^3	Composite (n)	2,486	2,677	2,867	3,057	3,248	3,437	3,627
	Composite (3n)	2,302	2,481	2,660	2,838	3,016	3,194	3,371
	Girder w/ rebar	82.400	85.025	87.650	90.275	92.900	95.525	98.150
	Girder	76.500	79.125	81.750	84.375	87.000	89.625	92.250
A, in^2	Composite (n)	191.523	194.148	196.773	199.398	202.023	204.648	207.273
	Composite (3n)	118.774	121.399	124.024	126.649	129.274	131.899	134.524
	Girder w/ rebar	38.758	37.684	36.679	35.736	34.849	34.015	33.228
Elastic	Girder	35.500	34.445	33.462	32.544	31.685	30.880	30.125
Y_b, in	Composite (n)	61.651	60.942	60.253	59.584	58.934	58.302	57.688
	Composite (3n)	51.063	50.083	49.146	48.251	47.395	46.576	45.791
	Girder w/ rebar	42.580	40.080	37.580	35.080	32.580	30.080	27.580
Plastic	Girder	35.500	33.000	30.500	28.000	25.500	23.000	20.500
Y_b, in	Composite (n)	70.578	70.640	70.703	70.765	70.828	70.890	70.953
	Composite (3n)	70.578	70.640	70.703	70.765	70.828	70.890	70.953
	Girder w/ rebar	9,843	10,295	10,719	11,117	11,487	11,829	12,145
	Girder	8,605	8,979	9,327	9,646	9,939	10,204	10,442
M_p, ft-k	Composite (n)	13,305	14,077	14,850	15,624	16,398	17,173	17,949
	Composite (3n)	13,305	14,077	14,850	15,624	16,398	17,173	17,949
	Girder w/ rebar	8,527	9,207	9,885	10,561	11,234	11,905	12,573
	Girder	7,646	7,764	7,870	7,966	8,052	8,131	8,203
M_y, ft-k	Composite (n)	10,357	11,152	11,946	12,739	13,531	14,323	15,113
	Composite (3n)	9,592	10,338	11,083	11,826	12,567	13,306	14,044
	Girder							
M_{yr}, ft-k	Composite (n)	12,534	13,283	14,033	14,783	15,533	16,283	17,033
	Composite (3n)	12,423	13,164	13,905	14,647	15,388	16,129	16,870
	Girder w/ rebar	0.01197	0.01180	0.01166	0.01153	0.01141	0.01131	0.01121
Q/I	Girder	0.01128	0.01112	0.01097	0.01084	0.01073	0.01063	0.01054
Top	Composite (n)	0.01427	0.01410	0.01395	0.01383	0.01371	0.01361	0.01351
of Web	Composite (3n)	0.01360	0.01343	0.01328	0.01315	0.01303	0.01292	0.01283
	Girder w/ rebar	0.01050	0.01092	0.01127	0.01158	0.01185	0.01208	0.01229
Q/I	Girder	0.01128	0.01171	0.01208	0.01239	0.01266	0.01290	0.01312
Bottom	Composite (n)	0.00838	0.00875	0.00906	0.00934	0.00958	0.00979	0.00998
of Web	Composite (3n)	0.00903	0.00942	0.00974	0.01003	0.01028	0.01050	0.01069
	Girder w/ rebar	31.24	32.44	33.57	34.64	35.65	36.61	37.52
Depth of	Girder	34.50	35.68	36.79	37.83	38.81	39.74	40.63
Web above n.a.	Composite (n)	8.35	9.18	10.00	10.79	11.57	12.32	13.06
(Elastic)	Composite (3n)	18.94	20.04	21.10	22.12	23.10	24.05	24.96
	Girder w/ rebar	27.42	30.04	32.67	35.29	37.92	40.54	43.17
Depth of	Girder	34.50	37.13	39.75	42.38	45.00	47.63	50.25
Web above n.a.	Composite (n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(Plastic)	Composite (3n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'$_c$, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	108.75

L_b, ft	A_s, in^2	d, inches	f_y, ksi	n = E_s/E_c	3n	Top Flange	b_f	t_f
25.00	5.9	2.75	60	9.29	27.9		21	1 1/4

	Bottom flange b_f	21	21	21	21	21	21	21
	Bottom flange t_f	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2
I, in^4	Girder w/ rebar	89,906	93,730	97,373	100,850	104,174	107,356	110,405
	Girder	78,467	81,735	84,840	87,794	90,610	93,299	95,872
	Composite (n)	173,316	182,824	192,130	201,240	210,162	218,904	227,472
	Composite (3n)	133,123	139,575	145,807	151,831	157,659	163,302	168,770
S_{top}, in^3	Girder w/ rebar	2,736	2,763	2,787	2,810	2,830	2,849	2,866
	Girder	2,195	2,221	2,245	2,267	2,287	2,305	2,322
	Composite (n)	15,773	15,537	15,336	15,163	15,014	14,883	14,768
	Composite (3n)	6,197	6,209	6,220	6,231	6,241	6,250	6,260
S_{bot}, in^3	Girder w/ rebar	2,327	2,486	2,645	2,803	2,960	3,117	3,273
	Girder	2,195	2,347	2,498	2,649	2,799	2,948	3,096
	Composite (n)	2,864	3,054	3,244	3,434	3,623	3,813	4,001
	Composite (3n)	2,662	2,840	3,018	3,196	3,373	3,550	3,727
A, in^2	Girder w/ rebar	92.900	95.525	98.150	100.775	103.400	106.025	108.650
	Girder	87.000	89.625	92.250	94.875	97.500	100.125	102.750
	Composite (n)	201.457	204.082	206.707	209.332	211.957	214.582	217.207
	Composite (3n)	129.086	131.711	134.336	136.961	139.586	142.211	144.836
Elastic Y_b, in	Girder w/ rebar	38.640	37.701	36.816	35.981	35.191	34.443	33.734
	Girder	35.750	34.826	33.958	33.142	32.373	31.648	30.963
	Composite (n)	60.512	59.858	59.222	58.603	58.002	57.417	56.847
	Composite (3n)	50.018	49.145	48.308	47.506	46.737	45.998	45.288
Plastic Y_b, in	Girder w/ rebar	42.830	40.330	37.830	35.330	32.830	30.330	27.830
	Girder	35.750	33.250	30.750	28.250	25.750	23.250	20.750
	Composite (n)	70.822	70.884	70.947	71.009	71.072	71.134	71.197
	Composite (3n)	70.822	70.884	70.947	71.009	71.072	71.134	71.197
M_p, ft-k	Girder w/ rebar	11,401	11,856	12,283	12,683	13,056	13,402	13,720
	Girder	10,163	10,541	10,891	11,213	11,509	11,777	12,017
	Composite (n)	14,863	15,638	16,414	17,190	17,967	18,745	19,523
	Composite (3n)	14,863	15,638	16,414	17,190	17,967	18,745	19,523
M_y, ft-k	Girder w/ rebar	9,978	10,660	11,340	12,018	12,693	13,366	14,036
	Girder	9,145	9,255	9,354	9,444	9,527	9,604	9,675
	Composite (n)	11,934	12,726	13,518	14,308	15,097	15,886	16,673
	Composite (3n)	11,090	11,834	12,576	13,317	14,056	14,793	15,528
M_r, ft-k	Girder							
	Composite (n)	14,060	14,811	15,562	16,313	17,065	17,817	18,569
	Composite (3n)	13,937	14,681	15,424	16,167	16,909	17,652	18,395
Q/I Top of Web	Girder w/ rebar	0.01221	0.01207	0.01196	0.01185	0.01175	0.01167	0.01159
	Girder	0.01175	0.01162	0.01150	0.01139	0.01130	0.01121	0.01113
	Composite (n)	0.01400	0.01387	0.01376	0.01365	0.01356	0.01348	0.01340
	Composite (3n)	0.01344	0.01330	0.01319	0.01308	0.01298	0.01290	0.01282
Q/I Bottom of Web	Girder w/ rebar	0.01110	0.01140	0.01167	0.01190	0.01211	0.01229	0.01245
	Girder	0.01175	0.01206	0.01233	0.01257	0.01278	0.01296	0.01313
	Composite (n)	0.00907	0.00935	0.00959	0.00980	0.00999	0.01016	0.01031
	Composite (3n)	0.00974	0.01002	0.01027	0.01049	0.01069	0.01086	0.01102
Depth of Web above n.a. (Elastic)	Girder w/ rebar	31.61	32.67	33.68	34.64	35.56	36.43	37.27
	Girder	34.50	35.55	36.54	37.48	38.38	39.23	40.04
	Composite (n)	9.74	10.52	11.28	12.02	12.75	13.46	14.15
	Composite (3n)	20.23	21.23	22.19	23.12	24.01	24.88	25.71
Depth of Web above n.a. (Plastic)	Girder w/ rebar	27.42	30.04	32.67	35.29	37.92	40.54	43.17
	Girder	34.50	37.13	39.75	42.38	45.00	47.63	50.25
	Composite (n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Composite (3n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'$_c$, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	108.75
L_b, ft	A_s, in^2	d, inches	f_y, ksi	n = E_s/E_c	3n	Top Flange	b_f	t_f
25.00	5.9	2.75	60	9.29	27.9		21	1 1/2
	Bottom flange b_f	21	21	21	21	21	21	21
	Bottom flange t_f	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4
	Girder w/ rebar	103,499	107,325	110,990	114,506	117,883	121,131	124,258
	Girder	91,981	95,305	98,482	101,523	104,438	107,235	109,923
I, in^4	Composite (n)	192,863	202,062	211,077	219,913	228,578	237,077	245,416
	Composite (3n)	148,516	154,760	160,808	166,671	172,359	177,881	183,245
	Girder w/ rebar	3,098	3,123	3,146	3,168	3,187	3,206	3,223
	Girder	2,555	2,580	2,602	2,623	2,642	2,660	2,677
S_{top}, in^3	Composite (n)	15,432	15,275	15,139	15,020	14,915	14,822	14,740
	Composite (3n)	6,504	6,517	6,530	6,543	6,554	6,565	6,576
	Girder w/ rebar	2,682	2,842	3,002	3,161	3,319	3,477	3,634
	Girder	2,555	2,709	2,863	3,015	3,167	3,318	3,469
S_{bot}, in^3	Composite (n)	3,241	3,431	3,620	3,809	3,998	4,186	4,375
	Composite (3n)	3,021	3,199	3,377	3,554	3,730	3,907	4,083
	Girder w/ rebar	103.400	106.025	108.650	111.275	113.900	116.525	119.150
	Girder	97.500	100.125	102.750	105.375	108.000	110.625	113.250
A, in^2	Composite (n)	211.392	214.017	216.642	219.267	221.892	224.517	227.142
	Composite (3n)	139.397	142.022	144.647	147.272	149.897	152.522	155.147
	Girder w/ rebar	38.596	37.764	36.975	36.226	35.515	34.839	34.195
Elastic	Girder	36.000	35.180	34.404	33.671	32.976	32.317	31.691
Y_b, in	Composite (n)	59.502	58.897	58.307	57.733	57.175	56.631	56.100
	Composite (3n)	49.164	48.379	47.625	46.900	46.203	45.531	44.885
	Girder w/ rebar	43.080	40.580	38.080	35.580	33.080	30.580	28.080
Plastic	Girder	36.000	33.500	31.000	28.500	26.000	23.500	21.000
Y_b, in	Composite (n)	71.065	71.128	71.190	71.253	71.315	71.378	71.440
	Composite (3n)	71.065	71.128	71.190	71.253	71.315	71.378	71.440
	Girder w/ rebar	12,971	13,428	13,858	14,261	14,637	14,985	15,306
	Girder	11,733	12,113	12,466	12,791	13,089	13,360	13,603
M_p, ft-k	Composite (n)	16,432	17,209	17,988	18,767	19,546	20,327	21,108
	Composite (3n)	16,432	17,209	17,988	18,767	19,546	20,327	21,108
	Girder w/ rebar	11,435	12,119	12,801	13,480	14,156	14,830	15,501
	Girder	10,646	10,748	10,843	10,929	11,010	11,085	11,155
M_y, ft-k	Composite (n)	13,505	14,295	15,084	15,871	16,658	17,443	18,227
	Composite (3n)	12,587	13,329	14,069	14,807	15,544	16,278	17,011
	Girder							
M_r, ft-k	Composite (n)	15,594	16,347	17,099	17,852	18,606	19,359	20,112
	Composite (3n)	15,462	16,206	16,951	17,696	18,440	19,185	19,929
	Girder w/ rebar	0.01238	0.01228	0.01218	0.01209	0.01201	0.01193	0.01187
Q/I	Girder	0.01207	0.01196	0.01187	0.01178	0.01169	0.01162	0.01155
Top	Composite (n)	0.01380	0.01370	0.01360	0.01352	0.01344	0.01337	0.01330
of Web	Composite (3n)	0.01333	0.01322	0.01312	0.01304	0.01296	0.01288	0.01282
	Girder w/ rebar	0.01152	0.01175	0.01195	0.01213	0.01230	0.01244	0.01258
Q/I	Girder	0.01207	0.01231	0.01251	0.01270	0.01286	0.01301	0.01314
Bottom	Composite (n)	0.00960	0.00981	0.01000	0.01017	0.01032	0.01046	0.01058
of Web	Composite (3n)	0.01027	0.01049	0.01068	0.01086	0.01101	0.01116	0.01128
	Girder w/ rebar	31.90	32.86	33.77	34.65	35.48	36.29	37.06
Depth of	Girder	34.50	35.45	36.35	37.20	38.02	38.81	39.56
Web above n.a.	Composite (n)	11.00	11.73	12.44	13.14	13.83	14.49	15.15
(Elastic)	Composite (3n)	21.34	22.25	23.12	23.97	24.80	25.59	26.37
	Girder w/ rebar	27.42	30.04	32.67	35.29	37.92	40.54	43.17
Depth of	Girder	34.50	37.13	39.75	42.38	45.00	47.63	50.25
Web above n.a.	Composite (n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(Plastic)	Composite (3n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'c, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	108.75
L_b, ft	A_s, in^2	d, inches	f_y, ksi	n = E_s/E_c	3n	Top Flange	b_f	t_f
25.00	5.9	2.75	60	9.29	27.9		21	1 3/4

	Bottom flange b_f	21	21	21	21	21	21	21
	Bottom flange t_f	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2
I, in^4	Girder w/ rebar	117,266	121,102	124,794	128,351	131,781	135,093	138,292
	Girder	105,684	109,063	112,308	115,429	118,433	121,329	124,123
	Composite (n)	211,984	220,913	229,673	238,269	246,708	254,994	263,134
	Composite (3n)	163,803	169,878	175,777	181,510	187,086	192,511	197,793
S_{top}, in^3	Girder w/ rebar	3,460	3,484	3,505	3,526	3,545	3,563	3,580
	Girder	2,915	2,939	2,960	2,981	3,000	3,017	3,034
	Composite (n)	15,256	15,149	15,055	14,971	14,897	14,831	14,772
	Composite (3n)	6,814	6,829	6,844	6,857	6,870	6,883	6,895
S_{bot}, in^3	Girder w/ rebar	3,037	3,199	3,359	3,519	3,678	3,837	3,994
	Girder	2,915	3,071	3,226	3,380	3,534	3,686	3,838
	Composite (n)	3,617	3,806	3,995	4,183	4,371	4,559	4,747
	Composite (3n)	3,380	3,558	3,735	3,911	4,088	4,263	4,438
A, in^2	Girder w/ rebar	113.900	116.525	119.150	121.775	124.400	127.025	129.650
	Girder	108.000	110.625	113.250	115.875	118.500	121.125	123.750
	Composite (n)	221.327	223.952	226.577	229.202	231.827	234.452	237.077
	Composite (3n)	149.709	152.334	154.959	157.584	160.209	162.834	165.459
Elastic Y_b, in	Girder w/ rebar	38.607	37.861	37.150	36.473	35.827	35.211	34.621
	Girder	36.250	35.513	34.814	34.149	33.516	32.913	32.339
	Composite (n)	58.605	58.042	57.494	56.960	56.439	55.932	55.437
	Composite (3n)	48.462	47.751	47.066	46.406	45.769	45.155	44.563
Plastic Y_b, in	Girder w/ rebar	43.330	40.830	38.330	35.830	33.330	30.830	28.330
	Girder	36.250	33.750	31.250	28.750	26.250	23.750	21.250
	Composite (n)	71.309	71.371	71.434	71.496	71.559	71.621	71.684
	Composite (3n)	71.309	71.371	71.434	71.496	71.559	71.621	71.684
M_p, ft-k	Girder w/ rebar	14,551	15,011	15,444	15,850	16,228	16,579	16,902
	Girder	13,313	13,696	14,052	14,380	14,680	14,954	15,200
	Composite (n)	18,011	18,791	19,572	20,354	21,136	21,919	22,703
	Composite (3n)	18,011	18,791	19,572	20,354	21,136	21,919	22,703
M_y, ft-k	Girder w/ rebar	12,898	13,583	14,265	14,945	15,623	16,297	16,969
	Girder	12,148	12,245	12,335	12,419	12,498	12,572	12,641
	Composite (n)	15,072	15,859	16,645	17,430	18,213	18,996	19,777
	Composite (3n)	14,084	14,823	15,561	16,297	17,032	17,764	18,494
M_r ft-k	Girder							
	Composite (n)	17,137	17,891	18,645	19,400	20,155	20,909	21,664
	Composite (3n)	16,995	17,742	18,488	19,234	19,980	20,726	21,472
Q/I Top of Web	Girder w/ rebar	0.01252	0.01243	0.01235	0.01227	0.01220	0.01214	0.01208
	Girder	0.01230	0.01221	0.01213	0.01205	0.01198	0.01191	0.01185
	Composite (n)	0.01365	0.01356	0.01348	0.01341	0.01335	0.01329	0.01323
	Composite (3n)	0.01325	0.01316	0.01308	0.01301	0.01294	0.01288	0.01282
Q/I Bottom of Web	Girder w/ rebar	0.01182	0.01201	0.01217	0.01231	0.01244	0.01256	0.01267
	Girder	0.01230	0.01248	0.01265	0.01279	0.01292	0.01304	0.01315
	Composite (n)	0.01001	0.01018	0.01033	0.01047	0.01059	0.01071	0.01081
	Composite (3n)	0.01068	0.01085	0.01101	0.01115	0.01128	0.01139	0.01150
Depth of Web above n.a. (Elastic)	Girder w/ rebar	32.14	33.01	33.85	34.65	35.42	36.16	36.88
	Girder	34.50	35.36	36.19	36.98	37.73	38.46	39.16
	Composite (n)	12.15	12.83	13.51	14.17	14.81	15.44	16.06
	Composite (3n)	22.29	23.12	23.93	24.72	25.48	26.22	26.94
Depth of Web above n.a. (Plastic)	Girder w/ rebar	27.42	30.04	32.67	35.29	37.92	40.54	43.17
	Girder	34.50	37.13	39.75	42.38	45.00	47.63	50.25
	Composite (n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Composite (3n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'c, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	108.75
L_b, ft	A_s, in^2	d, inches	f_y, ksi	$n = E_s/E_c$	3n	Top Flange	b_f	t_f
25.00	5.9	2.75	60	9.29	27.9		21	2

	Bottom flange b_f	21	21	21	21	21	21	21
	Bottom flange t_f	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4
I, in^4	Girder w/ rebar	131,212	135,066	138,789	142,388	145,870	149,243	152,512
	Girder	119,577	123,010	126,320	129,516	132,604	135,590	138,481
	Composite (n)	230,759	239,450	247,986	256,372	264,612	272,711	280,674
	Composite (3n)	179,042	184,979	190,757	196,385	201,870	207,217	212,434
S_{top}, in^3	Girder w/ rebar	3,821	3,843	3,865	3,885	3,903	3,921	3,938
	Girder	3,276	3,299	3,320	3,339	3,358	3,375	3,392
	Composite (n)	15,187	15,113	15,048	14,989	14,937	14,890	14,847
	Composite (3n)	7,128	7,144	7,160	7,175	7,189	7,202	7,215
S_{bot}, in^3	Girder w/ rebar	3,394	3,556	3,717	3,878	4,037	4,196	4,355
	Girder	3,276	3,433	3,589	3,744	3,899	4,053	4,206
	Composite (n)	3,992	4,180	4,368	4,556	4,743	4,931	5,117
	Composite (3n)	3,739	3,916	4,093	4,269	4,445	4,620	4,794
A, in^2	Girder w/ rebar	124.400	127.025	129.650	132.275	134.900	137.525	140.150
	Girder	118.500	121.125	123.750	126.375	129.000	131.625	134.250
	Composite (n)	231.262	233.887	236.512	239.137	241.762	244.387	247.012
	Composite (3n)	160.021	162.646	165.271	167.896	170.521	173.146	175.771
Elastic Y_b, in	Girder w/ rebar	38.658	37.983	37.337	36.720	36.130	35.564	35.021
	Girder	36.500	35.833	35.196	34.589	34.009	33.454	32.924
	Composite (n)	57.806	57.281	56.770	56.271	55.784	55.309	54.846
	Composite (3n)	47.882	47.233	46.607	46.002	45.418	44.854	44.308
Plastic Y_b, in	Girder w/ rebar	43.580	41.080	38.580	36.080	33.580	31.080	28.580
	Girder	36.500	34.000	31.500	29.000	26.500	24.000	21.500
	Composite (n)	71.552	71.615	71.677	71.740	71.802	71.865	71.927
	Composite (3n)	71.552	71.615	71.677	71.740	71.802	71.865	71.927
M_p, ft-k	Girder w/ rebar	16,143	16,605	17,041	17,449	17,830	18,184	18,510
	Girder	14,905	15,290	15,648	15,979	16,283	16,559	16,808
	Composite (n)	19,601	20,384	21,167	21,952	22,737	23,522	24,309
	Composite (3n)	19,601	20,384	21,167	21,952	22,737	23,522	24,309
M_y, ft-k	Girder w/ rebar	14,365	15,051	15,734	16,414	17,092	17,768	18,440
	Girder	13,650	13,744	13,831	13,913	13,991	14,064	14,133
	Composite (n)	16,633	17,418	18,201	18,983	19,765	20,544	21,323
	Composite (3n)	15,580	16,318	17,054	17,788	18,519	19,249	19,977
M_r, ft-k	Girder							
	Composite (n)	18,688	19,444	20,200	20,956	21,712	22,469	23,225
	Composite (3n)	18,538	19,286	20,034	20,782	21,530	22,277	23,025
Q/I Top of Web	Girder w/ rebar	0.01262	0.01255	0.01247	0.01241	0.01235	0.01229	0.01224
	Girder	0.01247	0.01239	0.01232	0.01225	0.01219	0.01213	0.01208
	Composite (n)	0.01352	0.01345	0.01339	0.01333	0.01327	0.01322	0.01316
	Composite (3n)	0.01319	0.01312	0.01305	0.01298	0.01293	0.01287	0.01282
Q/I Bottom of Web	Girder w/ rebar	0.01205	0.01220	0.01233	0.01245	0.01255	0.01265	0.01274
	Girder	0.01247	0.01261	0.01274	0.01286	0.01297	0.01307	0.01316
	Composite (n)	0.01034	0.01048	0.01060	0.01072	0.01082	0.01091	0.01100
	Composite (3n)	0.01100	0.01114	0.01127	0.01138	0.01149	0.01158	0.01167
Depth of Web above n.a. (Elastic)	Girder w/ rebar	32.34	33.14	33.91	34.65	35.37	36.06	36.73
	Girder	34.50	35.29	36.05	36.79	37.49	38.17	38.83
	Composite (n)	13.19	13.84	14.48	15.10	15.72	16.32	16.90
	Composite (3n)	23.12	23.89	24.64	25.37	26.08	26.77	27.44
Depth of Web above n.a. (Plastic)	Girder w/ rebar	27.42	30.04	32.67	35.29	37.92	40.54	43.17
	Girder	34.50	37.13	39.75	42.38	45.00	47.63	50.25
	Composite (n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Composite (3n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'$_c$, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	108.75
L_b, ft	A_s, in^2	d, inches	f_y, ksi	n = E_s/E_c	3n	Top Flange	b_f	t_f
25.00	5.9	2.75	60	9.29	27.9		21	2 1/4
	Bottom flange b_f	21	21	21	21	21	21	21
	Bottom flange t_f	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3
	Girder w/ rebar	145,342	149,219	152,975	156,617	160,152	163,584	166,920
	Girder	133,662	137,148	140,521	143,788	146,954	150,026	153,008
I, in^4	Composite (n)	249,253	257,736	266,075	274,274	282,339	290,273	298,080
	Composite (3n)	194,276	200,101	205,781	211,324	216,735	222,021	227,186
	Girder w/ rebar	4,181	4,203	4,224	4,244	4,262	4,280	4,297
	Girder	3,637	3,659	3,679	3,699	3,717	3,735	3,751
S_{top}, in^3	Composite (n)	15,191	15,140	15,095	15,055	15,018	14,986	14,956
	Composite (3n)	7,444	7,461	7,478	7,494	7,509	7,523	7,537
	Girder w/ rebar	3,752	3,914	4,076	4,237	4,397	4,556	4,715
	Girder	3,637	3,795	3,952	4,108	4,264	4,419	4,573
S_{bot}, in^3	Composite (n)	4,366	4,553	4,741	4,928	5,115	5,301	5,488
	Composite (3n)	4,098	4,275	4,451	4,627	4,802	4,976	5,151
	Girder w/ rebar	134.900	137.525	140.150	142.775	145.400	148.025	150.650
	Girder	129.000	131.625	134.250	136.875	139.500	142.125	144.750
A, in^2	Composite (n)	241.197	243.822	246.447	249.072	251.697	254.322	256.947
	Composite (3n)	170.332	172.957	175.582	178.207	180.832	183.457	186.082
	Girder w/ rebar	38.740	38.124	37.534	36.968	36.424	35.902	35.401
Elastic	Girder	36.750	36.141	35.558	35.000	34.465	33.952	33.460
Y_b, in	Composite (n)	57.092	56.602	56.123	55.656	55.200	54.755	54.320
	Composite (3n)	47.403	46.807	46.231	45.675	45.136	44.614	44.109
	Girder w/ rebar	43.830	41.330	38.830	36.330	33.830	31.330	28.830
Plastic	Girder	36.750	34.250	31.750	29.250	26.750	24.250	21.750
Y_b, in	Composite (n)	71.796	71.859	71.921	71.984	72.046	72.109	72.171
	Composite (3n)	71.796	71.859	71.921	71.984	72.046	72.109	72.171
	Girder w/ rebar	17,745	18,211	18,649	19,060	19,444	19,800	20,129
	Girder	16,507	16,895	17,256	17,590	17,896	18,175	18,427
M_p, ft-k	Composite (n)	21,201	21,987	22,773	23,560	24,348	25,136	25,925
	Composite (3n)	21,201	21,987	22,773	23,560	24,348	25,136	25,925
	Girder w/ rebar	15,836	16,522	17,206	17,887	18,565	19,240	19,913
	Girder	15,154	15,245	15,331	15,411	15,488	15,561	15,630
M_y, ft-k	Composite (n)	18,191	18,973	19,754	20,533	21,312	22,089	22,865
	Composite (3n)	17,077	17,812	18,546	19,278	20,008	20,735	21,461
	Girder							
M_r ft-k	Composite (n)	20,248	21,006	21,763	22,521	23,279	24,037	24,795
	Composite (3n)	20,091	20,841	21,590	22,340	23,089	23,838	24,587
	Girder w/ rebar	0.01270	0.01263	0.01257	0.01252	0.01246	0.01241	0.01236
Q/I	Girder	0.01259	0.01253	0.01246	0.01241	0.01235	0.01230	0.01225
Top	Composite (n)	0.01343	0.01336	0.01331	0.01325	0.01320	0.01316	0.01311
of Web	Composite (3n)	0.01315	0.01308	0.01302	0.01297	0.01292	0.01287	0.01282
	Girder w/ rebar	0.01223	0.01235	0.01245	0.01255	0.01264	0.01272	0.01279
Q/I	Girder	0.01259	0.01271	0.01282	0.01291	0.01300	0.01308	0.01316
Bottom	Composite (n)	0.01061	0.01072	0.01083	0.01092	0.01101	0.01109	0.01116
of Web	Composite (3n)	0.01126	0.01137	0.01148	0.01157	0.01166	0.01174	0.01182
	Girder w/ rebar	32.51	33.25	33.97	34.66	35.33	35.97	36.60
Depth of	Girder	34.50	35.23	35.94	36.63	37.28	37.92	38.54
Web above n.a.	Composite (n)	14.16	14.77	15.38	15.97	16.55	17.12	17.68
(Elastic)	Composite (3n)	23.85	24.57	25.27	25.95	26.61	27.26	27.89
	Girder w/ rebar	27.42	30.04	32.67	35.29	37.92	40.54	43.17
Depth of	Girder	34.50	37.13	39.75	42.38	45.00	47.63	50.25
Web above n.a.	Composite (n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(Plastic)	Composite (3n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'$_c$, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	108.75
L_b, ft	A_s, in^2	d, inches	f_y, ksi	n = E_s/E_c	3n	Top Flange	b_f	t_f
25.00	5.9	2.75	60	9.29	27.9		21	2 1/2

	Bottom flange b_f	21	21	21	21	21	21	21
	Bottom flange t_f	2 1/2	2 5/8	2 3/4	2 7/8	3	3 1/8	3 1/4
I, in^4	Girder w/ rebar	159,658	163,561	167,354	171,040	174,627	178,118	181,519
	Girder	147,939	151,478	154,913	158,248	161,489	164,641	167,709
	Composite (n)	267,523	275,821	283,986	292,021	299,930	307,718	315,389
	Composite (3n)	209,540	215,273	220,873	226,347	231,700	236,938	242,064
S_{top}, in^3	Girder w/ rebar	4,542	4,563	4,584	4,603	4,621	4,639	4,656
	Girder	3,998	4,020	4,040	4,059	4,077	4,095	4,111
	Composite (n)	15,247	15,214	15,183	15,156	15,132	15,110	15,091
	Composite (3n)	7,762	7,781	7,798	7,814	7,830	7,846	7,861
S_{bot}, in^3	Girder w/ rebar	4,110	4,273	4,435	4,596	4,757	4,916	5,076
	Girder	3,998	4,157	4,315	4,472	4,628	4,784	4,939
	Composite (n)	4,739	4,926	5,113	5,299	5,485	5,671	5,857
	Composite (3n)	4,458	4,634	4,809	4,985	5,159	5,333	5,507
A, in^2	Girder w/ rebar	145.400	148.025	150.650	153.275	155.900	158.525	161.150
	Girder	139.500	142.125	144.750	147.375	150.000	152.625	155.250
	Composite (n)	251.131	253.756	256.381	259.006	261.631	264.256	266.881
	Composite (3n)	180.644	183.269	185.894	188.519	191.144	193.769	196.394
Elastic Y_b, in	Girder w/ rebar	38.846	38.281	37.738	37.216	36.713	36.229	35.763
	Girder	37.000	36.440	35.903	35.388	34.893	34.416	33.958
	Composite (n)	56.455	55.995	55.546	55.107	54.679	54.260	53.851
	Composite (3n)	47.006	46.457	45.925	45.410	44.910	44.426	43.956
Plastic Y_b, in	Girder w/ rebar	44.080	41.580	39.080	36.580	34.080	31.580	29.080
	Girder	37.000	34.500	32.000	29.500	27.000	24.500	22.000
	Composite (n)	72.040	72.102	72.165	72.227	72.290	72.352	72.415
	Composite (3n)	72.040	72.102	72.165	72.227	72.290	72.352	72.415
M_p, ft-k	Girder w/ rebar	19,358	19,827	20,268	20,681	21,068	21,427	21,759
	Girder	18,120	18,511	18,875	19,211	19,520	19,802	20,056
	Composite (n)	22,813	23,601	24,390	25,180	25,970	26,761	27,553
	Composite (3n)	22,813	23,601	24,390	25,180	25,970	26,761	27,553
M_y, ft-k	Girder w/ rebar	17,311	17,997	18,681	19,362	20,040	20,716	21,260
	Girder	16,660	16,749	16,833	16,912	16,988	17,061	17,131
	Composite (n)	19,745	20,524	21,303	22,080	22,855	23,630	24,403
	Composite (3n)	18,574	19,308	20,039	20,769	21,497	22,222	22,946
M_r ft-k	Girder							
	Composite (n)	21,817	22,577	23,336	24,095	24,855	25,614	26,374
	Composite (3n)	21,653	22,404	23,156	23,907	24,658	25,408	26,159
Q/I Top of Web	Girder w/ rebar	0.01276	0.01270	0.01265	0.01260	0.01255	0.01250	0.01246
	Girder	0.01269	0.01263	0.01257	0.01252	0.01247	0.01242	0.01238
	Composite (n)	0.01334	0.01329	0.01324	0.01319	0.01315	0.01310	0.01306
	Composite (3n)	0.01311	0.01306	0.01300	0.01295	0.01291	0.01286	0.01282
Q/I Bottom of Web	Girder w/ rebar	0.01236	0.01246	0.01255	0.01263	0.01270	0.01277	0.01284
	Girder	0.01269	0.01278	0.01287	0.01295	0.01303	0.01310	0.01316
	Composite (n)	0.01083	0.01093	0.01102	0.01110	0.01117	0.01124	0.01130
	Composite (3n)	0.01146	0.01156	0.01165	0.01173	0.01180	0.01187	0.01194
Depth of Web above n.a. (Elastic)	Girder w/ rebar	32.65	33.34	34.01	34.66	35.29	35.90	36.49
	Girder	34.50	35.18	35.85	36.49	37.11	37.71	38.29
	Composite (n)	15.05	15.63	16.20	16.77	17.32	17.86	18.40
	Composite (3n)	24.49	25.17	25.83	26.47	27.09	27.70	28.29
Depth of Web above n.a. (Plastic)	Girder w/ rebar	27.42	30.04	32.67	35.29	37.92	40.54	43.17
	Girder	34.50	37.13	39.75	42.38	45.00	47.63	50.25
	Composite (n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Composite (3n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'c, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	108.75
L_b, ft	A_s, in^2	d, inches	f_y, ksi	n = E_s/E_c	3n	Top Flange	b_f	t_f
25.00	6.9	2.75	60	9.29	27.9		21	2 3/4

	Bottom flange b_f	21	21	21	21	21	21	21
	Bottom flange t_f	2 3/4	2 7/8	3	3 1/8	3 1/4	3 3/8	3 1/2
I, in^4	Girder w/ rebar	174,163	178,097	181,927	185,659	189,297	192,846	196,310
	Girder	162,411	166,003	169,497	172,898	176,211	179,440	182,589
	Composite (n)	285,617	293,751	301,762	309,651	317,424	325,083	332,631
	Composite (3n)	224,861	230,519	236,054	241,474	246,781	251,981	257,077
S_{top}, in^3	Girder w/ rebar	4,902	4,923	4,943	4,963	4,981	4,999	5,016
	Girder	4,360	4,381	4,401	4,420	4,438	4,456	4,472
	Composite (n)	15,342	15,321	15,302	15,285	15,271	15,258	15,246
	Composite (3n)	8,082	8,101	8,119	8,137	8,153	8,170	8,186
S_{bot}, in^3	Girder w/ rebar	4,469	4,632	4,794	4,956	5,117	5,277	5,436
	Girder	4,360	4,519	4,678	4,835	4,992	5,149	5,304
	Composite (n)	5,111	5,297	5,484	5,669	5,855	6,040	6,225
	Composite (3n)	4,817	4,993	5,168	5,343	5,517	5,690	5,863
A, in^2	Girder w/ rebar	155.900	158.525	161.150	163.775	166.400	169.025	171.650
	Girder	150.000	152.625	155.250	157.875	160.500	163.125	165.750
	Composite (n)	261.066	263.691	266.316	268.941	271.566	274.191	276.816
	Composite (3n)	190.955	193.580	196.205	198.830	201.455	204.080	206.705
Elastic Y_b, in	Girder w/ rebar	38.972	38.451	37.948	37.464	36.997	36.546	36.112
	Girder	37.250	36.733	36.236	35.758	35.297	34.853	34.425
	Composite (n)	55.884	55.452	55.030	54.617	54.213	53.819	53.433
	Composite (3n)	46.679	46.170	45.677	45.198	44.733	44.282	43.844
Plastic Y_b, in	Girder w/ rebar	44.330	41.830	39.330	36.830	34.330	31.830	29.330
	Girder	37.250	34.750	32.250	29.750	27.250	24.750	22.250
	Composite (n)	72.283	72.346	72.408	72.471	72.533	72.596	72.658
	Composite (3n)	72.283	72.346	72.408	72.471	72.533	72.596	72.658
M_p, ft-k	Girder w/ rebar	20,982	21,454	21,897	22,314	22,703	23,065	23,399
	Girder	19,745	20,138	20,505	20,844	21,155	21,440	21,697
	Composite (n)	24,435	25,225	26,017	26,809	27,602	28,396	29,190
	Composite (3n)	24,435	25,225	26,017	26,809	27,602	28,396	29,190
M_y, ft-k	Girder w/ rebar	18,789	19,475	20,159	20,840	21,518	22,193	22,593
	Girder	18,167	18,254	18,337	18,417	18,492	18,565	18,635
	Composite (n)	21,295	22,073	22,848	23,623	24,396	25,168	25,938
	Composite (3n)	20,072	20,803	21,533	22,261	22,986	23,710	24,431
M_f, ft-k	Girder							
	Composite (n)	23,396	24,156	24,917	25,678	26,439	27,200	27,961
	Composite (3n)	23,225	23,978	24,731	25,484	26,236	26,988	27,741
Q/I Top of Web	Girder w/ rebar	0.01281	0.01276	0.01271	0.01266	0.01262	0.01257	0.01253
	Girder	0.01276	0.01270	0.01265	0.01261	0.01256	0.01252	0.01248
	Composite (n)	0.01327	0.01322	0.01318	0.01314	0.01310	0.01306	0.01302
	Composite (3n)	0.01308	0.01303	0.01299	0.01294	0.01290	0.01286	0.01282
Q/I Bottom of Web	Girder w/ rebar	0.01247	0.01255	0.01262	0.01269	0.01275	0.01281	0.01287
	Girder	0.01276	0.01284	0.01291	0.01298	0.01304	0.01310	0.01315
	Composite (n)	0.01102	0.01110	0.01118	0.01124	0.01131	0.01137	0.01142
	Composite (3n)	0.01164	0.01172	0.01179	0.01186	0.01192	0.01198	0.01203
Depth of Web above n.a. (Elastic)	Girder w/ rebar	32.78	33.42	34.05	34.66	35.25	35.83	36.39
	Girder	34.50	35.14	35.76	36.37	36.95	37.52	38.08
	Composite (n)	15.87	16.42	16.97	17.51	18.04	18.56	19.07
	Composite (3n)	25.07	25.70	26.32	26.93	27.52	28.09	28.66
Depth of Web above n.a. (Plastic)	Girder w/ rebar	27.42	30.04	32.67	35.29	37.92	40.54	43.17
	Girder	34.50	37.13	39.75	42.38	45.00	47.63	50.25
	Composite (n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Composite (3n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'$_c$, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	108.75
L_b, ft	A_s, in^2	d, inches	f_y, ksi	n = E_s/E_c	3n	Top Flange	b_f	t_f
25.00	5.9	2.75	60	9.29	27.9		21	3

	Bottom flange b_f	21	21	21	21	21	21	21
	Bottom flange t_f	3	3 1/8	3 1/4	3 3/8	3 1/2	3 5/8	3 3/4
	Girder w/ rebar	188,860	192,826	196,696	200,474	204,164	207,770	211,296
	Girder	177,078	180,722	184,275	187,741	191,123	194,426	197,654
I, in^4	Composite (n)	303,575	311,564	319,437	327,198	334,849	342,394	349,835
	Composite (3n)	240,261	245,858	251,342	256,717	261,989	267,160	272,235
	Girder w/ rebar	5,263	5,284	5,304	5,323	5,341	5,359	5,376
	Girder	4,722	4,743	4,763	4,782	4,800	4,817	4,834
S_{top}, in^3	Composite (n)	15,467	15,455	15,445	15,437	15,429	15,423	15,419
	Composite (3n)	8,404	8,423	8,442	8,460	8,478	8,495	8,511
	Girder w/ rebar	4,829	4,992	5,154	5,316	5,477	5,637	5,797
	Girder	4,722	4,882	5,041	5,199	5,356	5,513	5,669
S_{bot}, in^3	Composite (n)	5,482	5,668	5,854	6,039	6,224	6,409	6,593
	Composite (3n)	5,177	5,352	5,527	5,701	5,875	6,048	6,220
	Girder w/ rebar	166.400	169.025	171.650	174.275	176.900	179.525	182.150
	Girder	160.500	163.125	165.750	168.375	171.000	173.625	176.250
A, in^2	Composite (n)	271.001	273.626	276.251	278.876	281.501	284.126	286.751
	Composite (3n)	201.267	203.892	206.517	209.142	211.767	214.392	217.017
	Girder w/ rebar	39.113	38.630	38.163	37.712	37.277	36.856	36.449
Elastic	Girder	37.500	37.021	36.558	36.112	35.682	35.267	34.865
Y_b, in	Composite (n)	55.373	54.966	54.568	54.179	53.798	53.425	53.061
	Composite (3n)	46.411	45.938	45.478	45.031	44.597	44.176	43.765
	Girder w/ rebar	44.580	42.080	39.580	37.080	34.580	32.080	29.580
Plastic	Girder	37.500	35.000	32.500	30.000	27.500	25.000	22.500
Y_b, in	Composite (n)	72.527	72.589	72.652	72.714	72.777	72.839	72.902
	Composite (3n)	72.527	72.589	72.652	72.714	72.777	72.839	72.902
	Girder w/ rebar	22,618	23,091	23,538	23,957	24,349	24,714	25,051
	Girder	21,380	21,776	22,145	22,487	22,802	23,089	23,348
M_p, ft-k	Composite (n)	26,067	26,861	27,655	28,450	29,246	30,042	30,839
	Composite (3n)	26,067	26,861	27,655	28,450	29,246	30,042	30,839
	Girder w/ rebar	20,270	20,956	21,640	22,320	22,998	23,673	23,928
	Girder	19,675	19,762	19,844	19,924	20,000	20,073	20,143
M_y, ft-k	Composite (n)	22,843	23,618	24,391	25,163	25,934	26,703	27,471
	Composite (3n)	21,570	22,300	23,028	23,754	24,477	25,199	25,918
	Girder							
M_y, ft-k	Composite (n)	24,983	25,745	26,508	27,270	28,033	28,795	29,558
	Composite (3n)	24,806	25,561	26,316	27,070	27,824	28,578	29,332
	Girder w/ rebar	0.01284	0.01280	0.01275	0.01271	0.01267	0.01263	0.01259
Q/I	Girder	0.01281	0.01276	0.01272	0.01267	0.01263	0.01259	0.01255
Top	Composite (n)	0.01321	0.01317	0.01313	0.01309	0.01305	0.01302	0.01298
of Web	Composite (3n)	0.01306	0.01301	0.01297	0.01293	0.01289	0.01285	0.01282
	Girder w/ rebar	0.01255	0.01262	0.01268	0.01274	0.01279	0.01284	0.01289
Q/I	Girder	0.01281	0.01288	0.01294	0.01300	0.01305	0.01310	0.01314
Bottom	Composite (n)	0.01118	0.01125	0.01131	0.01137	0.01142	0.01148	0.01152
of Web	Composite (3n)	0.01178	0.01184	0.01191	0.01197	0.01202	0.01207	0.01212
	Girder w/ rebar	32.89	33.50	34.09	34.66	35.22	35.77	36.30
Depth of	Girder	34.50	35.10	35.69	36.26	36.82	37.36	37.88
Web above n.a.	Composite (n)	16.63	17.16	17.68	18.20	18.70	19.20	19.69
(Elastic)	Composite (3n)	25.59	26.19	26.77	27.34	27.90	28.45	28.98
	Girder w/ rebar	27.42	30.04	32.67	35.29	37.92	40.54	43.17
Depth of	Girder	34.50	37.13	39.75	42.38	45.00	47.63	50.25
Web above n.a.	Composite (n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(Plastic)	Composite (3n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'$_c$, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	108.75
L_b, ft	A_s, in^2	d, inches	f_y, ksi	n = E_s/E_c	3n	Top Flange	b_f	t_f
25.00	5.9	2.75	60	9.29	27.9		21	3 1/4
	Bottom flange b_f	21	21	21	21	21	21	21
	Bottom flange t_f	3 1/4	3 3/8	3 1/2	3 5/8	3 3/4	3 7/8	4
	Girder w/ rebar	203,750	207,751	211,662	215,486	219,228	222,891	226,479
	Girder	191,943	195,639	199,250	202,778	206,228	209,603	212,906
I, in^4	Composite (n)	321,432	329,293	337,045	344,691	352,234	359,678	367,024
	Composite (3n)	255,758	261,305	266,748	272,090	277,335	282,486	287,547
	Girder w/ rebar	5,623	5,644	5,664	5,684	5,702	5,720	5,737
	Girder	5,085	5,105	5,125	5,144	5,162	5,180	5,197
S_{top}, in^3	Composite (n)	15,615	15,611	15,608	15,606	15,605	15,604	15,605
	Composite (3n)	8,727	8,747	8,766	8,785	8,804	8,821	8,839
	Girder w/ rebar	5,189	5,352	5,515	5,677	5,838	5,998	6,158
	Girder	5,085	5,245	5,404	5,562	5,720	5,878	6,034
S_{bot}, in^3	Composite (n)	5,853	6,039	6,224	6,408	6,593	6,777	6,960
	Composite (3n)	5,537	5,711	5,886	6,059	6,233	6,405	6,578
	Girder w/ rebar	176.900	179.525	182.150	184.775	187.400	190.025	192.650
	Girder	171.000	173.625	176.250	178.875	181.500	184.125	186.750
A, in^2	Composite (n)	280.936	283.561	286.186	288.811	291.436	294.061	296.686
	Composite (3n)	211.579	214.204	216.829	219.454	222.079	224.704	227.329
	Girder w/ rebar	39.268	38.817	38.382	37.961	37.553	37.159	36.777
Elastic	Girder	37.750	37.303	36.872	36.455	36.052	35.662	35.285
Y_b, in	Composite (n)	54.915	54.531	54.155	53.788	53.428	53.075	52.730
	Composite (3n)	46.193	45.751	45.322	44.904	44.497	44.102	43.717
	Girder w/ rebar	44.830	42.330	39.830	37.330	34.830	32.330	29.830
Plastic	Girder	37.750	35.250	32.750	30.250	27.750	25.250	22.750
Y_b, in	Composite (n)	72.771	72.833	72.896	72.958	73.021	73.083	73.146
	Composite (3n)	72.771	72.833	72.896	72.958	73.021	73.083	73.146
	Girder w/ rebar	24,264	24,740	25,190	25,612	26,006	26,373	26,713
	Girder	23,026	23,425	23,797	24,141	24,459	24,748	25,011
M_p, ft-k	Composite (n)	27,710	28,507	29,303	30,101	30,899	31,698	32,498
	Composite (3n)	27,710	28,507	29,303	30,101	30,899	31,698	32,498
	Girder w/ rebar	21,754	22,440	23,123	23,803	24,481	25,156	25,264
	Girder	21,186	21,272	21,354	21,433	21,510	21,584	21,655
M_y, ft-k	Composite (n)	24,389	25,161	25,932	26,702	27,470	28,237	29,002
	Composite (3n)	23,070	23,798	24,524	25,247	25,969	26,689	27,406
	Girder							
M_r ft-k	Composite (n)	26,579	27,343	28,107	28,871	29,636	30,400	31,164
	Composite (3n)	26,398	27,154	27,910	28,666	29,422	30,178	30,933
	Girder w/ rebar	0.01287	0.01282	0.01278	0.01274	0.01271	0.01267	0.01264
Q/I	Girder	0.01285	0.01280	0.01276	0.01272	0.01268	0.01265	0.01261
Top	Composite (n)	0.01316	0.01312	0.01308	0.01305	0.01301	0.01298	0.01295
of Web	Composite (3n)	0.01303	0.01299	0.01295	0.01292	0.01288	0.01285	0.01281
	Girder w/ rebar	0.01261	0.01267	0.01272	0.01277	0.01282	0.01286	0.01290
Q/I	Girder	0.01285	0.01290	0.01296	0.01301	0.01305	0.01309	0.01313
Bottom	Composite (n)	0.01132	0.01137	0.01143	0.01148	0.01153	0.01157	0.01161
of Web	Composite (3n)	0.01189	0.01195	0.01201	0.01206	0.01210	0.01215	0.01219
	Girder w/ rebar	32.98	33.56	34.12	34.66	35.20	35.72	36.22
Depth of	Girder	34.50	35.07	35.63	36.17	36.70	37.21	37.72
Web above n.a.	Composite (n)	17.33	17.84	18.34	18.84	19.32	19.80	20.27
(Elastic)	Composite (3n)	26.06	26.62	27.18	27.72	28.25	28.77	29.28
	Girder w/ rebar	27.42	30.04	32.67	35.29	37.92	40.54	43.17
Depth of	Girder	34.50	37.13	39.75	42.38	45.00	47.63	50.25
Web above n.a.	Composite (n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(Plastic)	Composite (3n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'c, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	108.75
L_b, ft	A_s, in^2	d, inches	f_y, ksi	$n = E_s/E_c$	3n	Top Flange	b_f	t_f
25.00	5.9	2.75	60	9.29	27.9		21	3 1/2

	Bottom flange b_f	21	21	21	21	21	21	21
	Bottom flange t_f	3 1/2	3 5/8	3 3/4	3 7/8	4	4 1/8	4 1/4
I, in^4	Girder w/ rebar	218,835	222,873	226,826	230,698	234,492	238,212	241,859
	Girder	207,005	210,754	214,422	218,012	221,527	224,972	228,348
	Composite (n)	339,219	346,965	354,610	362,155	369,603	376,957	384,220
	Composite (3n)	271,365	276,874	282,285	287,602	292,828	297,966	303,019
S_{top}, in^3	Girder w/ rebar	5,984	6,005	6,025	6,045	6,063	6,082	6,099
	Girder	5,448	5,468	5,488	5,507	5,526	5,543	5,561
	Composite (n)	15,781	15,783	15,786	15,789	15,793	15,798	15,803
	Composite (3n)	9,051	9,072	9,092	9,111	9,130	9,149	9,167
S_{bot}, in^3	Girder w/ rebar	5,550	5,713	5,876	6,038	6,199	6,360	6,520
	Girder	5,448	5,608	5,767	5,926	6,085	6,242	6,399
	Composite (n)	6,224	6,408	6,593	6,777	6,961	7,144	7,327
	Composite (3n)	5,897	6,071	6,245	6,418	6,591	6,763	6,935
A, in^2	Girder w/ rebar	187.400	190.025	192.650	195.275	197.900	200.525	203.150
	Girder	181.500	184.125	186.750	189.375	192.000	194.625	197.250
	Composite (n)	290.871	293.496	296.121	298.746	301.371	303.996	306.621
	Composite (3n)	221.890	224.515	227.140	229.765	232.390	235.015	237.640
Elastic Y_b, in	Girder w/ rebar	39.432	39.012	38.604	38.210	37.827	37.456	37.096
	Girder	38.000	37.582	37.178	36.787	36.408	36.041	35.686
	Composite (n)	54.505	54.142	53.787	53.439	53.098	52.763	52.436
	Composite (3n)	46.019	45.605	45.202	44.810	44.428	44.056	43.694
Plastic Y_b, in	Girder w/ rebar	45.080	42.580	40.080	37.580	35.080	32.580	30.080
	Girder	38.000	35.500	33.000	30.500	28.000	25.500	23.000
	Composite (n)	73.014	73.077	73.139	73.202	73.264	73.327	73.389
	Composite (3n)	73.014	73.077	73.139	73.202	73.264	73.327	73.389
M_p, ft-k	Girder w/ rebar	25,921	26,400	26,852	27,277	27,674	28,044	28,387
	Girder	24,683	25,085	25,459	25,807	26,127	26,419	26,684
	Composite (n)	29,364	30,163	30,963	31,763	32,564	33,366	34,168
	Composite (3n)	29,364	30,163	30,963	31,763	32,564	33,366	34,168
M_y, ft-k	Girder w/ rebar	23,241	23,926	24,609	25,289	25,966	26,527	26,603
	Girder	22,698	22,784	22,866	22,946	23,023	23,098	23,170
	Composite (n)	25,932	26,702	27,470	28,238	29,003	29,768	30,531
	Composite (3n)	24,570	25,296	26,021	26,743	27,463	28,181	28,896
M_y, ft-k	Girder							
	Composite (n)	28,185	28,951	29,716	30,482	31,248	32,013	32,779
	Composite (3n)	27,999	28,757	29,514	30,272	31,030	31,787	32,544
Q/I Top of Web	Girder w/ rebar	0.01288	0.01284	0.01281	0.01277	0.01273	0.01270	0.01267
	Girder	0.01287	0.01283	0.01279	0.01276	0.01272	0.01269	0.01265
	Composite (n)	0.01311	0.01307	0.01304	0.01301	0.01298	0.01295	0.01292
	Composite (3n)	0.01301	0.01297	0.01294	0.01290	0.01287	0.01284	0.01281
Q/I Bottom of Web	Girder w/ rebar	0.01266	0.01271	0.01275	0.01279	0.01283	0.01287	0.01290
	Girder	0.01287	0.01292	0.01297	0.01301	0.01305	0.01308	0.01312
	Composite (n)	0.01143	0.01148	0.01153	0.01157	0.01161	0.01165	0.01169
	Composite (3n)	0.01199	0.01204	0.01209	0.01213	0.01217	0.01221	0.01224
Depth of Web above n.a. (Elastic)	Girder w/ rebar	33.07	33.61	34.15	34.67	35.17	35.67	36.15
	Girder	34.50	35.04	35.57	36.09	36.59	37.08	37.56
	Composite (n)	17.99	18.48	18.96	19.44	19.90	20.36	20.81
	Composite (3n)	26.48	27.02	27.55	28.07	28.57	29.07	29.56
Depth of Web above n.a. (Plastic)	Girder w/ rebar	27.42	30.04	32.67	35.29	37.92	40.54	43.17
	Girder	34.50	37.13	39.75	42.38	45.00	47.63	50.25
	Composite (n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Composite (3n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

USED ON P. 50 & P. 60

USED ON P. 60

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'$_c$, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	108.75
L_b, ft	A_s, in^2	d, inches	f_y, ksi	n = E_s/E_c	3n	Top Flange	b_f	t_f
25.00	5.9	2.75	60	9.29	27.9		21	3 3/4

	Bottom flange b_f	21	21	21	21	21	21	21
	Bottom flange t_f	3 3/4	3 7/8	4	4 1/8	4 1/4	4 3/8	4 1/2
I, in^4	Girder w/ rebar	234,117	238,194	242,191	246,111	249,957	253,732	257,439
	Girder	222,267	226,068	229,793	233,444	237,024	240,536	243,984
	Composite (n)	356,963	364,608	372,156	379,612	386,975	394,251	401,439
	Composite (3n)	287,097	292,576	297,963	303,262	308,476	313,606	318,657
S_{top}, in^3	Girder w/ rebar	6,346	6,367	6,387	6,406	6,425	6,444	6,462
	Girder	5,811	5,831	5,851	5,871	5,889	5,907	5,925
	Composite (n)	15,963	15,970	15,978	15,985	15,993	16,002	16,010
	Composite (3n)	9,377	9,398	9,419	9,439	9,458	9,477	9,496
S_{bot}, in^3	Girder w/ rebar	5,911	6,074	6,237	6,399	6,561	6,722	6,882
	Girder	5,811	5,971	6,131	6,290	6,449	6,607	6,764
	Composite (n)	6,594	6,778	6,962	7,145	7,329	7,511	7,694
	Composite (3n)	6,257	6,431	6,605	6,777	6,950	7,122	7,293
A, in^2	Girder w/ rebar	197.900	200.525	203.150	205.775	208.400	211.025	213.650
	Girder	192.000	194.625	197.250	199.875	202.500	205.125	207.750
	Composite (n)	300.806	303.431	306.056	308.681	311.306	313.931	316.556
	Composite (3n)	232.202	234.827	237.452	240.077	242.702	245.327	247.952
Elastic Y_b, in	Girder w/ rebar	39.606	39.212	38.830	38.459	38.098	37.749	37.409
	Girder	38.250	37.858	37.479	37.111	36.754	36.408	36.072
	Composite (n)	54.138	53.795	53.458	53.128	52.804	52.487	52.176
	Composite (3n)	45.882	45.493	45.114	44.745	44.386	44.035	43.693
Plastic Y_b, in	Girder w/ rebar	45.330	42.830	40.330	37.830	35.330	32.830	30.330
	Girder	38.250	35.750	33.250	30.750	28.250	25.750	23.250
	Composite (n)	73.258	73.320	73.383	73.445	73.508	73.570	73.633
	Composite (3n)	73.258	73.320	73.383	73.445	73.508	73.570	73.633
M_p, ft-k	Girder w/ rebar	27,589	28,071	28,526	28,953	29,353	29,726	30,071
	Girder	26,351	26,755	27,133	27,483	27,805	28,101	28,369
	Composite (n)	31,029	31,830	32,632	33,435	34,239	35,043	35,848
	Composite (3n)	31,029	31,830	32,632	33,435	34,239	35,043	35,848
M_y, ft-k	Girder w/ rebar	24,731	25,415	26,097	26,776	27,453	27,867	27,944
	Girder	24,212	24,298	24,381	24,461	24,539	24,614	24,688
	Composite (n)	27,473	28,241	29,007	29,772	30,536	31,298	32,058
	Composite (3n)	26,072	26,797	27,519	28,240	28,958	29,674	30,388
M_r, ft-k	Girder							
	Composite (n)	29,800	30,567	31,334	32,102	32,869	33,636	34,403
	Composite (3n)	29,609	30,369	31,129	31,888	32,647	33,406	34,165
Q/I Top of Web	Girder w/ rebar	0.01289	0.01286	0.01282	0.01279	0.01275	0.01272	0.01269
	Girder	0.01289	0.01285	0.01282	0.01278	0.01275	0.01272	0.01269
	Composite (n)	0.01307	0.01303	0.01300	0.01297	0.01294	0.01291	0.01289
	Composite (3n)	0.01299	0.01295	0.01292	0.01289	0.01286	0.01283	0.01280
Q/I Bottom of Web	Girder w/ rebar	0.01269	0.01273	0.01277	0.01281	0.01284	0.01288	0.01291
	Girder	0.01289	0.01293	0.01297	0.01301	0.01304	0.01307	0.01310
	Composite (n)	0.01153	0.01157	0.01161	0.01165	0.01169	0.01172	0.01175
	Composite (3n)	0.01207	0.01211	0.01215	0.01219	0.01223	0.01226	0.01229
Depth of Web above n.a. (Elastic)	Girder w/ rebar	33.14	33.66	34.17	34.67	35.15	35.63	36.09
	Girder	34.50	35.02	35.52	36.01	36.50	36.97	37.43
	Composite (n)	18.61	19.08	19.54	20.00	20.45	20.89	21.32
	Composite (3n)	26.87	27.38	27.89	28.38	28.86	29.34	29.81
Depth of Web above n.a. (Plastic)	Girder w/ rebar	27.42	30.04	32.67	35.29	37.92	40.54	43.17
	Girder	34.50	37.13	39.75	42.38	45.00	47.63	50.25
	Composite (n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Composite (3n)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

COUNTY:	CROSSING:	NOTES

POINTS OF CONTRAFLEXURE
INITIAL DESCUS RUN:

GIRDER 1 : 121.38 FT , 215.10 FT — SPANS

67.6 FT LEFT, BENT 1
45.9 FT RIGHT, BENT 1

GIRDER 2 : 120.85 FT , 214.16 FT

63.3 FT LEFT, BENT 1
45.2 FT RIGHT, BENT 1

GIRDER 3 : 120.32 FT , 213.22 FT

61.8 FT LEFT, BENT 1
45.1 FT RIGHT, BENT 1

GIRDER 4 : 119.79 FT , 212.28 FT

61.0 FT LEFT, BENT 1
44.9 FT RIGHT, BENT 1

GIRDER 5 : 119.26 FT , 211.34 FT

60.2 FT LEFT, BENT 1
44.7 FT RIGHT, BENT 1

GIRDER 6 : 118.73 FT , 210.40 FT

60.8 FT LEFT, BENT 1
44.2 FT RIGHT, BENT 1

DESIGN	DATE
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CHECK	DATE

COUNTY: CROSSING:

NOTES

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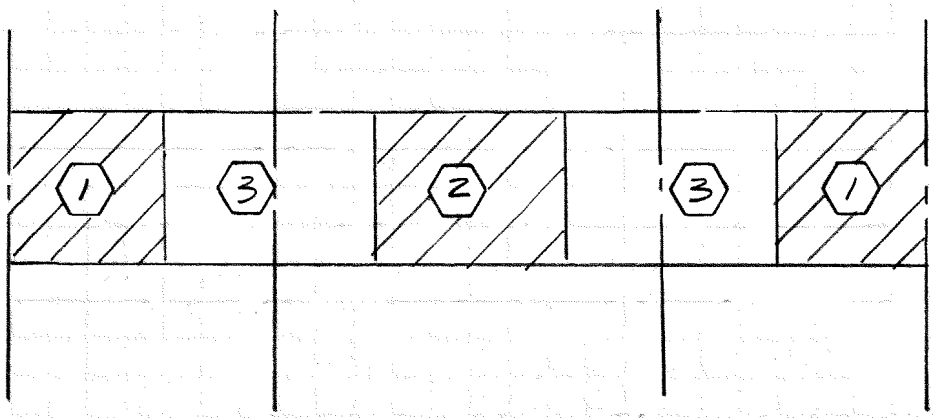
PROPOSED CASTING SEQUENCE:



POUR NO. 1:

GIRDER 1 NODES:	1 TO 31	211 TO 241
GIRDER 2 NODES:	2 TO 32	212 TO 242
GIRDER 3 NODES:	3 TO 33	213 TO 243
GIRDER 4 NODES:	4 TO 34	214 TO 244
GIRDER 5 NODES:	5 TO 35	215 TO 245
GIRDER 6 NODES:	6 TO 36	216 TO 246

POUR NO. 2:

GIRDER 1 NODES:	85 TO 157
GIRDER 2 NODES:	86 TO 158
GIRDER 3 NODES:	87 TO 159
GIRDER 4 NODES:	88 TO 160
GIRDER 5 NODES:	89 TO 161
GIRDER 6 NODES:	90 TO 162

POUR NO. 3:

GIRDER 1 NODES:	31 TO 85	157 TO 211
GIRDER 2 NODES:	32 TO 86	158 TO 212
GIRDER 3 NODES:	33 TO 87	159 TO 213
GIRDER 4 NODES:	34 TO 88	160 TO 214
GIRDER 5 NODES:	35 TO 89	161 TO 215
GIRDER 6 NODES:	36 TO 90	162 TO 216

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COUNTY: CROSSING:

NOTES

MODEL FOR STRENGTH GAIN VS. TIME:

AGE DAYS	$\frac{f_c}{f_c'}$	E_c, ksi
1	0.25	1,802
2	0.35	2,133
3	0.45	2,418
4	0.50	2,549
7	0.70	3,016
14	0.80	3,224
28	1.00	3,605

REFERENCE, DESIGN OF CONCRETE STRUCTURES
NILSON, ET. AL., 11TH ED., P. 44

$f_c' = 4$ ksi $\quad E_c = 57\sqrt{4,000} = 3,605$ ksi

$$E_{ci} = E_c\sqrt{\frac{f_c}{f_c'}}$$

3,000 psi CONCRETE WAS USED ON PP. 30-42 TO BE CONSERVATIVE IN STRENGTH CALCULATIONS. 4,000 psi CONCRETE WILL BE SPECIFIED & USED HERE FOR E_c CALCULATIONS

DESCUS MATERIALS

MAT'L ID	PROPERTIES
0	STEEL ALONE
1	$E_c = 0$
2	$E_c = 1,802$
3	$E_c = 2,133$
4	$E_c = 2,418$
5	$E_c = 3,605$

DL No. 1, STAGE No. 0
DL No. 2, POUR 1 IS FRESH CONCRETE
DL No. 3, POUR 1 IS 1-DAY CONCRETE
POUR 2 IS FRESH CONCRETE
DL No. 4, POUR 1 IS 2-DAY CONCRETE
POUR 2 IS 1-DAY CONCRETE
POUR 3 IS FRESH CONCRETE
DL No. 5, ALL POURS AT EACH 28-DAY

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CHECK	DATE

COUNTY: CROSSING: NOTES

STRENGTH I LIMIT STATE — 6.10.6

$Q = 1.25(DC) + 1.50(DW) + 1.75(LL+I)$

NOTE: DESCUS CURRENTLY USES A FACTOR OF 1.25 FOR ALL DEAD LOAD. THEREFORE, THE WEARING SURFACE WEIGHT INPUT TO DESCUS WAS:
33 PSF (1.5/1.25) = 40 PSF

POSITIVE MOMENT SECTIONS — 6.10.7

FOR STRENGTH I, THE GIRDERS ARE COMPOSITE & THE POSITIVE MOMENT COMPRESSION FLANGE IS FULLY BRACED BY THE SLAB.

SINCE $L_b = 0$, FIRST-ORDER LATERAL FLANGE BENDING STRESSES WITH NO AMPLIFICATION ARE APPROPRIATE FOR STRENGTH I LIMIT STATE, COMPOSITE REGION. — 6.10.1.6

* $D_t = 2 + 69 + 5\frac{1}{4} + 8\frac{1}{2} = 84.75''$
$D_p = 84.75 - 71.166 = 13.58''$ — 6.10.7.1.2 (PAGE 30)

MAXIMUM POSITIVE MOMENT, SPAN 2, GIRDER 1:

TAY 21" × 7/8" TOP FLANGE
21" × 2" BOTTOM FLANGE

$M_{DL} = 5,388$ FT·K
$M_{SDL} = 1,755$ FT·K
$M_{LL+I} = 9,670$ FT·K
$M_u = 16,813$ FT·K

* 2" BOTTOM FLANGE
69" WEB
5¼" TOP FLANGE + HAUNCH
8½" SLAB THICKNESS

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COUNTY: CROSSING:

NOTES

$$M_{LAT} = \frac{M_u l^2}{10RD} = \frac{16,813(25)^2}{10(2,347)(5.75)} = 77.9 \text{ FT·K (BOTT. FLG.)}$$

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$M_{LAT} = 0$ (TOP FLANGE)

$$S_{LAT} = 2 \times 21^2/6 = 147 \text{ IN}^3$$

$$f_l = 77.9 \times 12/147 = 6.36 \text{ KSI}$$

LATERAL FLANGE BENDING DUE TO CURVATURE

CHECK COMPACTNESS:

6.10.7.1

(1) $F_{yw} = F_{yf} = 50 \text{ KSI} < 70 \text{ KSI}$, OK

(2) $D/t_w = 69/(\frac{1}{2}) = 138 < 150$, OK

(3) $\frac{2D_{cp}}{t_w} = \frac{2(0)}{1/2} = 0 < 3.76\sqrt{\frac{29,000}{50}} = 91$, OK

$\therefore$ SECTION IS COMPACT.

SEE P. 30 FOR S-VALUES

$$50 \text{ KSI} = 12\left(\frac{5,388}{1,838} + \frac{1,755}{5,808} + \frac{M_{AD}}{14,533}\right)$$

$$M_{AD} = 13,560 \text{ FT·K}$$

6.10.2.2 COMPR. FLANGE (TOP)

$$50 = 12\left(\frac{5,388}{2,957} + \frac{1,755}{3,721} + \frac{M_{AD}}{4,008}\right)$$

$$M_{AD} = 7,507 \text{ FT·K}$$

TENSION FLANGE (BOTTOM)

$$M_{yt} = 5,388 + 1,755 + 7,507 = 14,650 \text{ FT·K}$$

$$S_{xt} = 14,650 \times 12/50 = 3,516 \text{ IN}^3$$

$$D_t = 69 + 2 + 5\tfrac{1}{4} + 8\tfrac{1}{2} = 84.75 \text{ IN}$$

$$D_p = 84.75 - 71.019 = 13.73 \text{ IN.} \quad (\text{P. } 30)$$

$$D_p/D_t = 13.73/84.75 = 0.16 > 0.10$$

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COUNTY: CROSSING: NOTES

$M_n = M_p (1.07 - 0.70 \times 0.16)$
$= M_p (0.958)$
$= 19,493 (.958)$
$= 18,674$ FT·K

M_p FROM P. 30

$M_u + \frac{1}{3} f_e S_{xt} = 16,813 + \frac{\frac{1}{3}(6.36)(3,532)}{12}$

M_u FROM P. 46

$= 17,437$ FT·K $< 18,674$ FT·K OK

MAXIMUM M^+
GIRDER 1, SPAN 2
STRENGTH I L.S.
21" x 7/8" TOP
21" x 2" BOTTOM
69" x 1/2" WEB
50W STEEL

NEGATIVE MOMENT, GIRDER 1:

6.10.8

$M_{DL}^- = -7,134$ FT·K
$M_{SDL}^- = -2,323$ FT·K (STRENGTH I)
$M_{LL+I}^- = -9,973$ FT·K
$M_u^- = -19,430$ FT·K

$M_{LAT} = \frac{19,430(25)^2}{10(2,347)(5.75)} = 90.0$ FT·KIPS

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TRY 21" x 3½" TOP & BOTTOM FLANGES

LOCAL BUCKLING RESISTANCE:

6.10.8.2.2

$\lambda_f = \frac{21}{2 \times 3\frac{1}{2}} = 3.00$

$\lambda_{pf} = 0.38\sqrt{\frac{29,000}{50}} = 9.15$

$\lambda_f < \lambda_{pf}$

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COUNTY: CROSSING:

NOTES

R_b = WEB LOAD-SHEDDING FACTOR — 6.10.1.10.2

$$\lambda_{rw} = 5.7\sqrt{\frac{29{,}000}{50}} = 137.3$$

$$D_c = 69 - 34.50 = 34.50$$

THIS CALC. IGNORES DECK REBAR. SOME STATES INCLUDE THE DECK STEEL IN M⁻ PROPERTY CALCULATIONS.

$$a_{wc} = \frac{2 \times 34.50 \times 1/2}{21 \times 3\,1/2} = 0.47$$

$$R_b = 1 - \left(\frac{0.47}{1{,}200 + 300(.47)}\right)\left(\frac{2 \times 34.5}{1/2} - 137.3\right)$$

$$\underline{R_b = 0.999}$$

R_h = HYBRID FACTOR = 1.0

$F_{nc} = 0.999 \times 1.0 \times 50 = 49.99$ ksi (LOCAL BUCKLING)

LATERAL TORSIONAL BUCKLING

* $$r_T = \frac{21}{\sqrt{12\left(.954 + \frac{34.5(\frac{1}{2})(69)^2}{3(21)(3\,1/2)(72.5)(76)}\right)}}$$ — C6.10.8.2.3-1

$d = 76$
$h = 72.5$
$D = 69$

$r_T = 6.00$ IN.

$L_p = 6.00\sqrt{29{,}000/50} = 144''$

$F_{yr} = 0.7 \times 50 = 35.0$ ksi

$L_r = \pi(6.00)\sqrt{29{,}000/35} = 542''$

$L_b = 25$ FT $= 300''$

$C_b = 1.0$

$L_p < L_b < L_r$

* NOTE: THE SIMPLIFIED EQN 6.10.8.2.3-9 MAY BE USED FOR THE CALCULATION OF r_T.

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COUNTY: CROSSING:

NOTES

$$\frac{F_{nc}}{R_b R_h F_{yc}} = 1.0\left[1-\left(1-\frac{35}{1.0\times 50}\right)\left(\frac{300-144}{542-144}\right)\right]$$

$F_{nc} = 1.0(.999)(50)(.882)$

$= 44.08$ ksi (LTB) — CONTROLS

$S_{LAT} = 3\frac{1}{2}(21)^2/6 = 257\ in^3$

$f_l = 90.0\ ft\cdot k\ (12)/257 = 4.20$ ksi — PAGE 48

$f_{bu} = 19,430\ (12)/5,448 = 42.80$ ksi — PAGE 41

$f_{bu} + \frac{1}{3} f_l =$ 44.19 ksi $\approx$ 44.08 ksi SAY OK

MAXIMUM M⁻
GIRDER 1
STRENGTH I L.S.
21" x 3½" FLANGES
69" x ½" WEB
50W STEEL

REMAINING STRENGTH I LIMIT STATE DESIGN SECTIONS WERE DONE WITH SPREADSHEETS. RESULTS ARE GIVEN ON PAGES 51-56.

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STRENGTH I LIMIT STATE

Girder: 1

	Span Pt.	X, ft	M_{dl}, ft-k	M_{sdl}, ft-k	M_{ll+I}, ft-k	Top Flange	Bottom Flange	DESCUS Section
	0	0.00	0	0	0	18x3/4	18x3/4	1
	1	12.14	489	191	2,517	↓	↓	1
x	2	24.28	710	282	4,370			1
	3	36.41	630	267	5,515			1
x	4	48.55	282	153	6,123	18x3/4	18x3/4	1
	5	60.69	-377	-68	-5,470	21x1	21x1	7
x	6	72.83	-1,308	-389	-6,568	21x1 1/2	21x1 1/2	9
	7	84.96	-2,519	-805	-7,588	21x2	21x2	11
x	8	97.10	-4,031	-1,320	-8,641	21x2 1/2	21x2 1/2	13
	9	109.24	-5,794	-1,914	-9,837	21x3 1/4	21x3 1/4	16
BENT	10	121.38	-7,893	-2,607	-11,447	21x4	21x4	19
	1	10.75	-5,671	-1,842	-8,073	21x3	21x3	15
x	2	21.51	-3,710	-1,155	-5,678	21x2	21x2	11
	3	32.26	-1,927	-527	-3,803	21x1	21x1	7
x	4	43.02	-361	23	3,458	18x3/4	18x3/4	1
	5	53.77	984	496	4,922	18x3/4	18x3/4	1
x	6	64.53	2,119	892	6,435	18x3/4	18x3/4	1
	7	75.28	2,996	1,198	7,664	18x3/4	18x1 1/4	3
x	8	86.04	3,655	1,426	8,604	18x3/4	18x1 1/2	4
	9	96.79	4,023	1,554	9,110	18x3/4	18x1 3/4	5
MIDSPAN	x 10	107.55	4,170	1,605	9,302	18x3/4	18x1 3/4	5 20

change to 18x1 top (see p. 57-58)

STRENGTH I LIMIT STATE

Girder: 2

	Span Pt.	X, ft	M_{dl}, ft-k	M_{sdl}, ft-k	M_{ll+I}, ft-k	Top Flange	Bottom Flange	DESCUS Section
	0	0.00	0	0	0	18 x 3/4	18 x 3/4	1
	1	12.08	513	192	2,055	18 x 3/4	18 x 3/4	1
	2	24.17	747	286	3,356	18 x 3/4	18 x 3/4	1
	3	36.25	722	284	4,214	18 x 3/4	18 x 3/4	1
	4	48.34	418	185	4,518	18 x 3/4	18 x 3/4	1
	5	60.42	-130	-6	-3,609	21 x 7/8	21 x 7/8	6
	6	72.51	-957	-296	-4,299	21 x 7/8	21 x 7/8	6
	7	84.59	-2,085	-687	-5,057	21 x 1 1/2	21 x 1 1/2	9
	8	96.68	-3,512	-1,176	-5,859	21 x 2	21 x 2	11
	9	108.76	-5,289	-1,771	-6,870	21 x 2 1/2	21 x 2 1/2	13
BENT	10	120.85	-7,406	-2,464	-8,224	21 x 3 1/2	21 x 3 1/2	17
	1	10.71	-5,224	-1,719	-5,721	21 x 2 1/4	21 x 2 1/4	12
	2	21.42	-3,302	-1,051	-4,024	21 x 1 1/2	21 x 1 1/2	9
	3	32.12	-1,670	-474	-2,725	21 x 7/8	21 x 7/8	6
	4	42.83	-261	26	2,655	18 x 3/4	18 x 3/4	1
	5	53.54	933	445	3,663	18 x 3/4	18 x 3/4	1
	6	64.25	1,907	788	4,537	18 x 3/4	18 x 3/4	1
	7	74.96	2,679	1,054	5,347	18 x 3/4	18 x 3/4	1
	8	85.66	3,228	1,243	5,844	18 x 3/4	18 x 3/4	1
	9	96.37	3,568	1,359	6,232	18 x 3/4	18 x 1	2
MIDSPAN	10	107.08	3,683	1,397	6,280	18 x 3/4	18 x 1	2

STRENGTH I LIMIT STATE

Girder: 3

	Span Pt.	X, ft	M_{dl}, ft-k	M_{sdl}, ft-k	M_{ll+I}, ft-k	Top Flange	Bottom Flange	DESCUS Section
	0	0.00	0	0	0	18x 3/4	18x 3/4	1
	1	12.03	533	195	2,089	18x 3/4	18x 3/4	1
	2	24.06	789	293	3,436	18x 3/4	18x 3/4	1
	3	36.09	774	296	4,283	18x 3/4	18x 3/4	1
	4	48.13	482	200	4,588	18x 3/4	18x 3/4	1
	5	60.16	-77	11	4,570	21x 7/8	21x 7/8	6
	6	72.19	-914	-277	-3,950	21x 7/8	21x 7/8	6
	7	84.22	-2,005	-655	-4,680	21x 1 1/4	21x 1 1/4	8
	8	96.25	-3,391	-1,131	-5,462	21x 1 3/4	21x 1 3/4	10
	9	108.28	-5,081	-1,703	-6,505	21x 2 1/2	21x 2 1/2	13
BENT	10	120.32	-7,099	-2,372	-7,848	21x 3 1/4	21x 3 1/4	16
	1	10.66	-5,041	-1,664	-5,713	21x 2 1/4	21x 2 1/4	12
	2	21.32	-3,238	-1,032	-4,091	21x 1 1/2	21x 1 1/2	9
	3	31.98	-1,641	-472	-2,831	21x 7/8	21x 7/8	6
	4	42.64	-266	12	2,697	18x 3/4	18x 3/4	1
	5	53.30	900	422	3,525	18x 3/4	18x 3/4	1
	6	63.97	1,849	755	4,266	18x 3/4	18x 3/4	1
	7	74.63	2,586	1,012	4,995	18x 3/4	18x 3/4	1
	8	85.29	3,105	1,194	5,426	18x 3/4	18x 3/4	1
	9	95.95	3,422	1,303	5,755	18x 3/4	18x 1	2
MIDSPAN	10	106.61	3,517	1,337	5,775	18x 3/4	18x 1	2

STRENGTH I LIMIT STATE

Girder: 4

	Span Pt.	X, ft	M_{dl}, ft-k	M_{sdl}, ft-k	M_{ll+I}, ft-k	Top Flange	Bottom Flange	DESCUS Section
	0	0.00	0	0	0	18x3/4	18x3/4	1
	1	11.98	540	198	2,079	↓	↓	1
	2	23.96	805	299	3,422			1
	3	35.94	797	303	4,263			1
	4	47.91	513	210	4,566	18x3/4	18x3/4	1
	5	59.89	-50	20	4,543	21x7/8	21x7/8	6
	6	71.87	-887	-267	-3,910	21x7/8	21x7/8	6
	7	83.85	-2,005	-651	-4,658	21x1 1/4	21x1 1/4	8
	8	95.83	-3,415	-1,132	-5,459	21x1 3/4	21x1 3/4	10
	9	107.81	-5,105	-1,703	-6,497	21x2 1/2	21x2 1/2	13
BENT	10	119.79	-7,120	-2,372	-7,831	21x3 1/4	21x3 1/4	16
	1	10.61	-5,044	-1,663	-5,713	21x2 1/4	21x2 1/4	12
	2	21.23	-3,221	-1,031	-4,087	21x1 1/2	21x1 1/2	9
	3	31.84	-1,634	-474	-2,824	21x7/8	21x7/8	6
	4	42.46	-267	7	2,702	18x3/4	18x3/4	1
	5	53.07	890	415	3,540	18x3/4	18x3/4	1
	6	63.68	1,831	747	4,296	18x3/4	18x3/4	1
	7	74.30	2,571	1,007	5,063	18x3/4	18x3/4	1
	8	84.91	3,094	1,191	5,501	18x3/4	18x3/4	1
	9	95.53	3,414	1,303	5,839	18x3/4	18x1	2
MIDSPAN	10	106.14	3,513	1,339	5,872	18x3/4	18x1	2

STRENGTH I LIMIT STATE

Girder: 5

	Span Pt.	X, ft	M_{dl}, ft-k	M_{sdl}, ft-k	M_{ll+I}, ft-k	Top Flange	Bottom Flange	DESCUS Section
	0	0.00	0	0	0	18x3/4	18x3/4	1
	1	11.93	531	197	1,992	↓	↓	1
	2	23.85	789	298	3,233			1
	3	35.78	784	304	4,060			1
	4	47.70	508	215	4,346	18x3/4	18x3/4	1
	5	59.63	-25	31	4,362	21x7/8	21x7/8	6
	6	71.55	-830	-249	-4,041	21x7/8	21x7/8	6
	7	83.48	-1,910	-627	-4,764	21x1 1/4	21x1 1/4	8
	8	95.40	-3,277	-1,099	-5,529	21x1 3/4	21x1 3/4	10
	9	107.33	-4,976	-1,673	-6,492	21x2 1/2	21x2 1/2	13
BENT	10	119.26	-6,999	-2,342	-7,791	21x3 1/4	21x3 1/4	16
	1	10.57	-4,963	-1,644	-5,550	21x2 1/4	21x2 1/4	12
	2	21.13	-3,179	-1,021	-3,957	21x1 1/2	21x1 1/2	9
	3	31.70	-1,610	-469	-2,694	21x7/8	21x7/8	6
	4	42.27	-260	8	2,571	18x3/4	18x3/4	1
	5	52.84	882	411	3,521	↓	↓	1
	6	63.40	1,810	739	4,341			1
	7	73.97	2,537	994	5,118			1
	8	84.54	3,050	1,175	5,593	18x3/4	18x3/4	1
	9	95.10	3,370	1,286	5,967	18x3/4	18x1	2
MIDSPAN	10	105.67	3,473	1,322	6,012	18x3/4	18x1	2

STRENGTH I LIMIT STATE

Girder: 6

	Span Pt.	X, ft	M_{dl}, ft-k	M_{sdl}, ft-k	M_{ll+I}, ft-k	Top Flange	Bottom Flange	DESCUS Section
	0	0.00	0	0	0	18 x 3/4	18 x 3/4	1
	1	11.87	504	193	2,060			1
	2	23.75	752	291	3,529			1
	3	35.62	740	298	4,435			1
	4	47.49	472	209	4,866	18 x 3/4	18 x 3/4	1
	5	59.36	-66	27	4,827	21 x 7/8	21 x 7/8	6
	6	71.24	-861	-250	-4,813	21 x 1	21 x 1	7
	7	83.11	-1,941	-625	-5,679	21 x 1 1/2	21 x 1 1/2	9
	8	94.98	-3,294	-1,095	-6,571	21 x 2	21 x 2	11
	9	106.85	-4,973	-1,674	-7,749	21 x 2 3/4	21 x 2 3/4	14
BENT	10	118.73	-6,958	-2,347	-9,259	21 x 3 1/2	21 x 3 1/2	17
	1	10.52	-4,913	-1,636	-6,441	21 x 2 1/2	21 x 2 1/2	13
	2	21.04	-3,106	-999	-4,502	21 x 1 1/2	21 x 1 1/2	9
	3	31.56	-1,563	-451	-3,003	21 x 7/8	21 x 7/8	6
	4	42.08	-225	23	2,888	18 x 3/4	18 x 3/4	1
	5	52.60	897	421	3,999			1
	6	63.12	1,817	744	5,127			1
	7	73.64	2,533	995	6,029	18 x 3/4	18 x 3/4	1
	8	84.16	3,046	1,173	6,681	18 x 3/4	18 x 1	2
	9	94.68	3,350	1,280	7,060	18 x 3/4	18 x 1 1/4	3
MIDSPAN	10	105.20	3,450	1,314	7,172	18 x 3/4	18 x 1 1/4	3

COUNTY: CROSSING: NOTES

CONSTRUCTABILITY — 6.10.3

PRIOR TO HARDENING OF THE SLAB, THE TOP FLANGE IN POSITIVE MOMENT REGIONS IS DISCRETELY BRACED INSTEAD OF CONTINUOUSLY BRACED.

GIRDER 1, SPAN 2

$M_{DL} = 4{,}170$ FT·KIPS — DESCUS OUTPUT FROM STRENGTH I

WITH $18 \times \frac{3}{4}$ TOP
$18 \times 1\frac{3}{4}$ BOTTOM

$$f_{bu} = \frac{4{,}170 \times 12}{1{,}484} = 33.72 \text{ ksi}$$

WITH L.F. = 1.25

$$M_{LAT} = \frac{4{,}170\,(25)^2}{10 \times 2{,}347 \times 5.75} = 19.3 \text{ FT·K}$$

DUE TO CURVATURE W/ L.F. = 1.25 — PAGE 27

$$M_{LAT} = \frac{F_L L_b^2}{12} + \frac{P_L L_b}{8}$$

DUE TO CANTILEVER CONSTRUCTION — PAGE 29 BASED ON FIXED-FIXED END CONDITIONS

STRENGTH I: $f_{bu} = 33.72$ ksi

$$M_{LAT} = 19.3 + \frac{.659\,(25)^2}{12} + \frac{3.94\,(25)}{8}$$

$$= 65.9 \text{ FT·KIPS}$$

$$f_l = \frac{65.9\,(12)}{\frac{3}{4} \times 18^2/6} = 19.54 \text{ ksi}$$

$f_{bu} + f_l = 53.26$ ksi $> F_y = 50$ ksi NO GOOD

NOTE: THIS CHECK IS FROM EQ'N 6.10.3.2.1-1. SINCE AN OVERSTRESS IS INDICATED, EQ'NS 6.10.3.2.1-2,-3 WERE NOT CHECKED. ALL 3 EQ'NS SHOULD BE INVESTIGATED WHEN APPLICABLE.

DESIGN	DATE
TEK	
CHECK	DATE
CHECK	DATE

COUNTY: CROSSING: NOTES

TRY 18" x 1" TOP FLANGE
18" x 1 3/4" BOTTOM FLANGE

STRENGTH I:

$$f_{bu} = \frac{4{,}170 \times 12}{1{,}754} = 28.53 \text{ ksi}$$

$$f_l = \frac{65.9 \times 12}{1 \times 18^2/6} = 14.64 \text{ ksi}$$

F_{nc} = 48.60 ksi FOR LOCAL BUCK. SEE BELOW
38.99 ksi FOR LTB

$f_{bu} + \frac{1}{3} f_l = 33.41 \text{ ksi} < 38.99 \text{ ksi}$ OK

$f_{bu} = 28.53 < F_{crw} = 36.22 \text{ ksi}$ SEE BELOW
OK

Go To 18" x 1" TOP
18" x 1 3/4" BOTTOM
GIRDER 1, SPAN 2
M^+_{MAX}

$\bar{Y} = 30.48"$
$D_c = 69 + 1\frac{3}{4} - 30.48 = 40.27"$

$D_c/D = 40.27/69 = 0.583$
$R_b = 9/(.583)^2 = 26.43$
$F_{crw} = \frac{0.9 \times 29{,}000 \times 26.43}{(69/.5)^2} = 36.22 \text{ ksi}$ 6.10.1.9.1-1 1-2

$\lambda_f = \frac{18}{2 \times 1} = 9$ $\lambda_{pf} = 0.38\sqrt{\frac{29{,}000}{50}} = 9.15$ 6.10.8.2

$\lambda_{rf} = .56\sqrt{\frac{29{,}000}{.7 \times 50}} = 16.12$ $\lambda_f < \lambda_{pf}$ THUS:

$F_{nc} = R_b R_h F_{yc}$ $R_h = 1.0$ $\lambda_{rw} = 5.7\sqrt{\frac{29{,}000}{50}} = 137$

$2D_c/t_w = 161 > 137$ THUS:

$a_{wc} = \frac{2 D_c t_w}{b_{fc} t_{fc}} = \frac{2 \times 40.27 \times .5}{18 \times 1} = 2.237$

$R_b = 1 - \left(\frac{a_{wc}}{1200 + 300 a_{wc}}\right)\left(\frac{2D_c}{t_w} - 137\right)$

$R_b = 0.971$

$F_{nc} = .971 \times 50 = 48.6 \text{ ksi}$

DESIGN	DATE
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CHECK	DATE

COUNTY: CROSSING:

NOTES

FOR LATERAL-TORSIONAL BUCKLING:

$$r_T = \frac{18}{\sqrt{12\left(1+\frac{40.27\times.5}{3\times18\times1}\right)}} = 4.435"$$ 6.10.8.2.3-9

$$L_p = 1.0\times4.435\sqrt{\frac{29{,}000}{50}} = 107"$$ 6.10.8.2.3-4

$$L_b = 25' = 300"$$

$$L_r = \pi\times4.435\sqrt{\frac{29{,}000}{.7\times50}} = 401"$$ 6.10.8.2.3-5

$L_p < L_b < L_r$ THUS:

$$F_{nc} = \left[1-\left(1-\frac{.7\times50}{1.0\times50}\right)\left(\frac{300-107}{401-107}\right)\right](.971\times50)$$ 6.10.8.2.3-2 WITH $C_b = 1$

$$F_{nc} = 0.78\times50 = \boxed{38.99\ ksi\ (LTB)}$$

DESIGN	DATE
TEH	
CHECK	DATE
CHECK	DATE

PAGE 58-A

COUNTY: CROSSING: NOTES

GIRDER 2, SPAN 2: 18" x 3/4" TOP FL. 18" x 1" BOTT. FL.

M_{DL} = 3,683 FT·K, STRENGTH I — PAGE 52

$M_{LAT} = \frac{3,683\,(20.5)^2}{10 \times 2,337 \times 5.75} = 11.52$ FT·K DUE TO CURVATURE

$f_{bu} = \frac{3,683 \times 12}{1,375} = 32.14$ ksi

$f_\ell = \frac{11.5 \times 12}{3/4 \times 18^2/6} = 3.41$ ksi

F_{nc} = 39.58 ksi, LOCAL BUCKLING — PAGE 59-A
42.06 ksi, LTB

$f_{bu} + \frac{1}{3} f_\ell$ = 33.28 ksi < 39.58 ksi OK

18 x 3/4" TOP
18 x 1" BOTTOM

GIRDER 6: SPAN 2: 18" x 3/4" TOP FL. 18" x 1 1/4" BOTT. FL.

M_{DL} = 3,450 FT·K, STRENGTH I — PAGE 56

$M_{LAT} = \frac{3,450\,(21)^2}{10 \times 2,296 \times 5.75} = 11.52$ FT·K DUE TO CURVATURE — PAGE 27

$M_{LAT} = \frac{.659 \times 21^2}{12} + \frac{3.94 \times 21}{8} = 34.56$ FT·K DUE TO CANTILEVER CONSTRUCTION — PAGE 29

$f_{bu} = \frac{3,450 \times 12}{1,418} = 29.20$ ksi

$f_\ell = \frac{34.56 \times 12}{3/4 \times 18^2/6} = 10.24$ ksi

$f_{bu} + \frac{1}{3} f_\ell$ = 32.61 ksi < 39.09 ksi = F_{nc} OK

(SEE PAGE 59-B FOR F_{nc})

18" x 3/4" TOP
18" x 1 1/4" BOTTOM

DESIGN	DATE
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CHECK	DATE
CHECK	DATE

PAGE 59

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'c, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	109
L_b, ft	A_s, in^2	d, inches	f_y, ksi	$n = E_s/E_c$	3n		b_f	t_f
20.50	5.9	2.75	60	9.29	27.9	Top Flange	18	3/4
R, ft.	λ_{rw}	λ_{pf}	λ_{rf}			Bottom Flange	18	1
2,337	137	9.15	13.49					

STRENGTH I L.S.

		Brace Pt. "A"	Brace Pt. "B"	
Factored Moments:	DL	3,683	0	Note: Values at brace point "B"
(ft-kips)	SDL	0	0	are not used at this time but are
	LL + I	0	0	maintained for future revisions to
	STRENGTH I	3,683	0	the spreadsheet
	M_{lat}, ft-k	11.52	0.00	(lateral flange M due to curvature)

Properties for Girder alone: Use for negative moment region design

I, in^4	51,776	h, in.	69.88	f_n, ksi	43.93	F_{nc}, ksi	39.58
S_{top}, in^3	1,375	d, in.	70.75	ρ	1.00	LTB F_{nc}, ksi	42.06
S_{bot}, in^3	1,565	t_{fc}, in.	3/4	β	2.73	C_b	1.00
A, in^2	66.000	t_{ft}, in.	1	R_h	1.00	F_{cr}, ksi	88.26
Y_{be}, in	33.088	b_{fc}, in.	18	F_{yr}, ksi	35.00	f_{bu}, ksi	32.15
Y_{bp}, in	31.000	b_{ft}, in.	18	a_{wc}	2.734	f_l, ksi	3.41
M_p, ft-k	7,024	D_c, in.	36.91	R_b	0.99	$f_{bu} + 1/3\ f_l$	33.29
M_y, ft-k	5,728	D_P, in.	39.00	r_T, in.	4.35	$\lambda_{pw(Dcp)}$	76
$(Q/I)_T$	0.00972	f_c, ksi	32.15	λ_f	12	$2D_{cp} / t_w$	156
$(Q/I)_B$	0.01133	f_t, ksi	-28.24	L_p, in.	105	R_{pc}	0.931
D_{CT}, in.	36.91	D_n, in.	36.91	L_r, in.	393	F_{crw}, ksi	43.10
D_{CPT}, in.	39.00	A_{fn}, in^2	13.50	L_b, in.	246	Stress Ratio	0.84

D, in.	t_w, in.	F_{yf}, ksi	F_{yw}, ksi	E, ksi	t_{slab}, in.	f'c, ksi	e, in.	b_{eff}, inches
69	1/2	50	50	29,000	8.50	3	5.25	109
L_b, ft	A_s, in^2	d, inches	f_y, ksi	$n = E_s/E_c$	3n		b_f	t_f
21.00	5.9	2.75	60	9.29	27.9	Top Flange	18	3/4
R, ft.	λ_{rw}	λ_{pf}	λ_{rf}			Bottom Flange	18	1 1/4
2,296	137	9.15	13.49					

STRENGTH I L.S.

		Brace Pt. "A"	Brace Pt. "B"	
Factored Moments:	DL	3,450	0	Note: Values at brace point "B"
(ft-kips)	SDL	0	0	are not used at this time but are
	LL + I	0	0	maintained for future revisions to
	STRENGTH I	3,450	0	the spreadsheet
	M_{lat}, ft-k	11.52	0.00	(lateral flange M due to curvature)

Properties for Girder alone: Use for negative moment region design

I, in^4	56,423	h, in.	70.00	f_n, ksi	39.24	F_{nc}, ksi	39.09
S_{top}, in^3	1,418	d, in.	71.00	ρ	1.00	LTB F_{nc}, ksi	41.14
S_{bot}, in^3	1,807	t_{fc}, in.	3/4	β	2.89	C_b	1.00
A, in^2	70.500	t_{ft}, in.	1 1/4	R_h	1.00	F_{cr}, ksi	81.85
Y_{be}, in	31.218	b_{fc}, in.	18	F_{yr}, ksi	35.00	f_{bu}, ksi	29.19
Y_{bp}, in	26.750	b_{ft}, in.	18	a_{wc}	2.891	f_l, ksi	3.41
M_p, ft-k	7,566	D_c, in.	39.03	R_b	0.97	$f_{bu} + 1/3\ f_l$	30.33
M_y, ft-k	5,910	D_p, in.	43.50	r_T, in.	4.32	$\lambda_{pw(Dcp)}$	69
$(Q/I)_T$	0.00943	f_c, ksi	29.19	λ_f	12	$2D_{cp} / t_w$	174
$(Q/I)_B$	0.01220	f_t, ksi	-22.91	L_p, in.	104	R_{pc}	0.850
D_{CT}, in.	39.03	D_n, in.	39.03	L_r, in.	391	F_{crw}, ksi	38.55
D_{CPT}, in.	43.50	A_{fn}, in^2	13.50	L_b, in.	252	Stress Ratio	0.78

COUNTY: CROSSING:

NOTES

FATIGUE CONSIDERATIONS

GIRDER 1, OVER BENT : 21" x 3½" FLANGES

MOMENT RANGE = 1,145 FT·KIPS
SHEAR RANGE = 50.6 KIPS

DESCUS PAINTOUT PAGE 41

$Q/I = 0.0129\ IN^{-1}$
$S = 5,448\ IN^3$

BASE METAL, UNPAINTED WEATHERING STEEL, IS: CATEGORY "B"

TABLE 6.6.1.2.3-1

$(\Delta F)_{TH} = 16.0$ KSI, CATEGORY "B"

TABLE 6.6.1.2.5-3

$(\Delta F)_n = \frac{1}{2} \times 16 = 8.0$ KSI

PAGE 12

$\Delta f = 1,145 \times 12 / 5,448 = 2.52$ KSI
< 8.0, OK

$V_r Q/I = 50.6 \times .0129$
$= 0.653$ K/IN
$\div$ 2 WELDS
$= 0.33$ K/IN/WELD

$(t_{WELD})_{REQ'D} = \frac{0.33}{.707 \times 8} = 0.058"$

$(t_{WELD})_{MIN} = 5/16"$

6.13.3.4

@ STRENGTH I : $V_u = 222$, DL
76, SDL
328, LL+I
626 KIPS

$\phi_{es} = 0.80$ (6.5.4.2)

6.13.3.2.4b :

$(t_{WELD})_{REQ'D} = \frac{(626 \times .0129)/2}{.707 \times .6 \times .8 \times 70}$

$= 0.17" < 5/16" = .3125"$
OK

DESIGN	DATE
TEH	
CHECK	DATE
CHECK	DATE

COUNTY: CROSSING:

NOTES

GIRDER 1, SPAN 2, POSITIVE MOMENT

MOMENT RANGE = 1,100 FT·K
SHEAR RANGE = 43 KIPS

18" × 1" TOP
18" × 1 3/4" BOTTOM
69" × 1/2" WEB

$S_{BOTTOM} = 2,613\ IN^3$
$Q/I = .0142\ IN^{-1}$

$VQ/I = 43 \times .0142 = 0.611\ K/IN$

$< 0.653\ K/IN$

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$\Rightarrow$ MIN. WELD OK

$\Delta f = 1,100 \times 12 / 2,613 = 5.1\ ksi$

$(\Delta F)_n = \frac{1}{2} \times 16 = 8.0\ ksi$

PAGE 12, CATEGORY "B"

$\Delta f < (\Delta F)_n$, OK FOR FATIGUE

DESIGN	DATE
TCK	
CHECK	DATE
CHECK	DATE

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COUNTY: CROSSING:

NOTES

TRANSVERSE STIFFENERS GIRDER 1

STRENGTH I LIMIT STATE SHEARS:

SHEARS ARE FROM THE DESCLLS OUTPUT AND ARE FACTORED VALUES.

SPAN PT.	V_{DL} KIPS	V_{SDL} KIPS	V_{LLIJ} KIPS	V_u KIPS
1.0	48	19	236	303
1.1	26	11	202	239
1.2	5	3	185	193
1.3	-21	-7	-112	-140
1.4	-46	-16	-137	-199
1.5	-69	-24	-151	-244
1.6	-93	-32	-191	-316
1.7	-118	-41	-205	-364
1.8	-144	-49	-243	-436
1.9	-167	-55	-262	-484
	-197	-63	-321	-581
2.0				
	223	76	328	627
2.05	197	69	309	575
2.10	178	64	303	545
2.15	156	56	276	488
2.20	137	49	273	459
2.25	116	42	236	394
2.30	97	35	232	364
2.35	74	26	190	290
2.40	54	19	186	259
2.45	26	9	141	176
2.50	6	2	128	136

MAX STIFFENER SPACING = $3D = 3 \times 69$
$= 207''$
$= 17.25$ FT

6.10.9.1

STRENGTH OF UNSTIFFENED WEB:

6.10.9.2

CHECK DIMENSIONS:

$$\left[\frac{2Dt_w}{(b_{fc}t_{fc} + b_{ft}t_{ft})}\right]_{MAX} = \frac{2 \times 69 \times \frac{1}{2}}{2 \times 18 \times \frac{3}{4}} = 2.55 > 2.50$$

∴ NO TFA PERMITTED FOR SECTIONS WITH 18" x 3/4" TOP & BOTTOM FLANGES

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COUNTY: CROSSING:

NOTES

UNSTIFFENED WEB, $K = 5$ — 6.10.9.3

$$\sqrt{\frac{29{,}000 \times 5}{50}} = 54$$

$$D/t_w = 69 \times 2 = 138$$

$$> 1.4 \times 54 = 75$$

$$C = \frac{1.57}{138^2} \times \frac{29{,}000 \times 5}{50} = 0.239$$

$$V_p = .58 \times 50 \times 69 \times \tfrac{1}{2} = 1{,}001 \text{ KIPS}$$

$$V_n = CV_p = .239 \times 1{,}001 =$$

239 KIPS
NO STIFFENERS
NO TFA

USE THIS VALUE IN AREAS WITH NO TRANSV. STIFFENERS (18 x 3/4" T & B FLANGES ONLY)

WITH STIFFENERS / NO TFA:

AT $d_o = 3D$, $K = 5 + 5/9 = 5.55$

$$\sqrt{\frac{29{,}000 \times 5.55}{50}} = 57$$

$$C = \frac{1.57}{138^2} \times \frac{29{,}000 \times 5.55}{50}$$

$$C = 0.266$$

$$V_n = .266 \times 1001 = 266^K$$

$d_o/D = 3$
NO TFA

(18" x 3/4" T & B FLANGES ONLY)

AT $d_o = 12.5 \text{ FT} = 2.17D$, $K = 6.058$
$C = 0.290$

USE THIS VALUE IN AREAS W/ T. STIFFENERS SPACED @ 3D

$V_n = 290$ KIPS
$d_o/D = 2.17$
NO TFA

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COUNTY: CROSSING:

NOTES

AT $d_o = 8.33$ FT $= 1.45D$, $k = 7.38$, $C = .353$

$V_n = .353 \times 1{,}001 = 353$ KIPS

$d_o/D = 1.45$

NO TFA

USE THESE VALUES FOR STIFFENED WEBS WITH 18" x 3/4" TOP & BOTTOM FLANGES.

AT $d_o = 6.25$ FT $= 1.087D$, $k = 9.232$, $C = 0.441$

$V_n = 0.441 \times 1{,}001 = 441$ KIPS

$d_o/D = 1.09$

NO TFA

WITH TFA (TENSION-FIELD ACTION) PERMITTED:

AT $d_o = 3D$, $C = 0.266$

$$V_n = 1{,}001\left[0.266 + \frac{.87(.734)}{\sqrt{1+3^2}}\right] = 468\text{K}$$

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AT $d_o/D = 2.17$, $C = 0.290$ (2 SP.)

$$V_n = 1{,}001\left[.29 + \frac{.87(.71)}{\sqrt{1+2.17^2}}\right] = 549\text{K}$$

AT $d_o/D = 1.45$, $C = .353$ (3 SP.)

$$V_n = 1{,}001\left[.353 + \frac{.87(.647)}{\sqrt{1+1.45^2}}\right] = 673\text{K}$$

USE THESE VALUES FOR STIFFENED WEBS, ALL SECTIONS EXCEPT: 18" x 3/4" TOP & BOTTOM FLANGES

AT $d_o/D = 1.09$, $C = 0.441$ (4 SP.)

$$V_n = 1{,}001\left[.441 + \frac{.87(.559)}{\sqrt{1+1.09^2}}\right] = 770\text{K}$$

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STRENGTH I LIMIT STATE

Girder: 1

Span Pt.	X, ft	V_{dl}, kips	V_{sdl}, kips	POSITIVE V_{ll+I}, kips	NEGATIVE V_{ll+I}, kips	V_u, kips	STIFFENERS
0	0.00	47	19	235	-37	301	
1	12.14	26	10	202	-69	238	3 EQ. SP.
2	24.28	4	2	184	-84	191	
3	36.41	-20	-7	137	-112	139	NONE
4	48.55	-46	-16	115	-137	199	
5	60.69	-68	-24	82	-151	243	2 EQ. SP.
6	72.83	-93	-32	65	-190	315	
7	84.96	-118	-40	47	-204	362	2 EQ. SP.
8	97.10	-144	-48	27	-242	434	
9	109.24	-167	-55	15	-261	483	3 EQ. SP.
10	121.38	-197	-63	6	-321	580	
BENT							
0	0.00	223	76	328	-7	627	
1	10.75	197	69	308	-22	573	3 EQ. SP.
2	21.51	178	63	302	-30	544	
3	32.26	156	56	275	-51	487	2 EQ. SP.
4	43.02	136	49	273	-55	458	
5	53.77	116	42	236	-70	394	2 EQ. SP.
6	64.53	97	34	231	-82	363	
7	75.28	73	26	190	-84	289	2 EQ. SP.
8	86.04	54	19	185	-98	258	
9	96.79	26	9	141	-104	175	2 EQ. SP.
MIDSPAN 10	107.55	5	2	127	-131	134	

STRENGTH I LIMIT STATE

Girder: 2

Span Pt.	X, ft	V_{dl}, kips	V_{sdl}, kips	POSITIVE V_{ll+I}, kips	NEGATIVE V_{ll+I}, kips	V_u, kips	STIFFENERS
0	0.00	50	19	204	-25	274	
1	12.08	28	11	164	-71	202	2 EQ. SP.
2	24.17	7	3	160	-82	170	
3	36.25	-16	-5	111	-100	121	NONE
4	48.34	-38	-13	99	-122	173	
5	60.42	-58	-21	76	-122	201	2 EQ. SP.
6	72.51	-81	-29	69	-156	266	
7	84.59	-104	-37	56	-158	298	2 EQ. SP.
8	96.68	-131	-45	34	-199	375	
9	108.76	-158	-53	20	-215	426	2 EQ. SP.
10	120.85	-188	-61	4	-282	531	
BENT							
0	0.00	210	72	283	-5	565	
1	10.71	184	65	250	-28	499	3 EQ. SP.
2	21.42	160	58	246	-39	464	
3	32.12	134	49	207	-64	389	2 EQ. SP.
4	42.83	114	42	211	-71	367	
5	53.54	94	34	169	-76	297	2 EQ. SP.
6	64.25	74	27	175	-85	276	
7	74.96	54	20	136	-82	210	2 EQ. SP.
8	85.66	38	14	144	-94	195	
9	96.37	17	7	110	-91	134	NONE
MIDSPAN 10	107.08	-3	-1	104	-115	119	

STRENGTH I LIMIT STATE

Girder: 3

	Span Pt.	X, ft	V_{dl}, kips	V_{sdl}, kips	POSITIVE V_{ll+I}, kips	NEGATIVE V_{ll+I}, kips	V_u, kips	STIFFENERS
	0	0.00	52	20	206	-21	278	
	1	12.03	30	11	167	-69	208	2 EQ. SP.
	2	24.06	9	4	164	-84	176	
	3	36.09	-14	-5	112	-99	117	NONE
	4	48.13	-36	-13	102	-124	173	
	5	60.16	-58	-20	76	-124	202	2 EQ. SP.
	6	72.19	-81	-28	69	-160	269	
	7	84.22	-104	-36	56	-162	302	2 EQ. SP.
	8	96.25	-129	-45	34	-205	379	
	9	108.28	-157	-53	20	-219	429	2 EQ. SP.
	10	120.32	-185	-61	3	-287	533	
	BENT							
	0	0.00	202	70	284	-4	556	
	1	10.66	177	62	249	-30	487	3 EQ. SP.
	2	21.32	155	56	246	-38	457	
	3	31.98	133	48	206	-67	387	2 EQ. SP.
	4	42.64	114	42	213	-78	369	
	5	53.30	94	35	170	-79	299	2 EQ. SP.
	6	63.97	77	28	180	-87	284	
	7	74.63	57	21	140	-86	218	2 EQ. SP.
	8	85.29	39	14	151	-99	204	
	9	95.95	19	7	113	-95	139	NONE
MIDSPAN	10	106.61	1	0	111	-117	116	

STRENGTH I LIMIT STATE

Girder: 4

	Span Pt.	X, ft	V_{dl}, kips	V_{sdl}, kips	POSITIVE V_{ll+I}, kips	NEGATIVE V_{ll+I}, kips	V_u, kips	STIFFENERS
	0	0.00	53	20	206	-21	278	
	1	11.98	31	12	167	-69	209	2 EQ. SP.
	2	23.96	9	4	164	-83	176	
	3	35.94	-14	-4	112	-99	117	NONE
	4	47.91	-36	-13	101	-124	172	
	5	59.89	-59	-21	77	-124	204	2 EQ. SP.
	6	71.87	-82	-29	69	-161	271	
	7	83.85	-105	-37	55	-163	305	2 EQ. SP.
	8	95.83	-131	-45	33	-206	381	
	9	107.81	-157	-53	20	-220	430	2 EQ. SP.
	10	119.79	-186	-61	3	-287	533	
BENT	BENT							
	0	0.00	204	70	285	-4	559	
	1	10.61	179	63	249	-29	491	3 EQ. SP.
	2	21.23	155	56	246	-38	457	
	3	31.84	134	49	206	-67	388	2 EQ. SP.
	4	42.46	114	42	214	-78	369	
	5	53.07	94	35	171	-78	300	2 EQ. SP.
	6	63.68	77	28	180	-86	285	
	7	74.30	57	21	141	-86	219	2 EQ. SP.
	8	84.91	39	14	151	-99	205	
	9	95.53	19	7	114	-95	140	NONE
MIDSPAN	10	106.14	-1	0	104	-123	124	

STRENGTH I LIMIT STATE

Girder: 5

Span Pt.	X, ft	V_{dl}, kips	V_{sdl}, kips	POSITIVE V_{ll+I}, kips	NEGATIVE V_{ll+I}, kips	V_u, kips	STIFFENERS
0	0.00	52	20	202	-23	273	
1	11.93	30	12	161	-67	202	ZEQ. SP.
2	23.85	8	4	157	-79	169	
3	35.78	-14	-5	110	-98	117	NONE
4	47.70	-36	-13	100	-120	169	
5	59.63	-58	-20	76	-121	199	ZEQ. SP.
6	71.55	-80	-28	69	-155	264	
7	83.48	-104	-36	56	-157	297	ZEQ. SP.
8	95.40	-129	-44	33	-197	370	
9	107.33	-155	-52	20	-212	419	ZEQ. SP.
10	119.26	-184	-60	4	-277	521	
BENT							
0	0.00	201	69	278	-4	547	
1	10.57	175	62	244	-28	481	ZEQ. SP.
2	21.13	155	55	241	-38	450	
3	31.70	133	48	204	-64	385	ZEQ. SP
4	42.27	115	41	210	-71	366	
5	52.84	95	34	171	-75	300	ZEQ. SP.
6	63.40	76	27	176	-83	279	
7	73.97	56	20	139	-81	214	ZEQ. SP.
8	84.54	39	14	145	-93	197	
9	95.10	19	7	111	-91	136	NONE
MIDSPAN 10	105.67	-1	-1	104	-114	116	

STRENGTH I LIMIT STATE

Girder: 6

Span Pt.	X, ft	V_{dl}, kips	V_{sdl}, kips	POSITIVE V_{ll+I}, kips	NEGATIVE V_{ll+I}, kips	V_u, kips	STIFFENERS
0	0.00	49	19	200	-28	267	
1	11.87	28	11	169	-55	207	2 EQ. SP.
2	23.75	7	3	154	-68	164	
3	35.62	-15	-5	113	-92	112	NONE
4	47.49	-39	-13	96	-115	166	
5	59.36	-60	-21	70	-126	207	2 EQ. SP.
6	71.24	-84	-29	57	-161	274	
7	83.11	-108	-37	42	-173	317	2 EQ. SP.
8	94.98	-136	-47	25	-209	392	
9	106.85	-163	-55	14	-226	444	2 EQ. SP.
10	118.73	-191	-63	5	-280	534	
BENT							
0	0.00	213	73	286	-6	572	
1	10.52	188	66	266	-20	520	3 EQ. SP.
2	21.04	166	59	257	-26	481	
3	31.56	139	50	229	-44	419	2 EQ. SP.
4	42.08	120	43	226	-49	389	
5	52.60	98	35	191	-61	325	2 EQ. SP.
6	63.12	80	29	188	-71	296	
7	73.64	60	21	153	-74	235	2 EQ. SP.
8	84.16	41	14	151	-85	206	
9	94.68	20	7	116	-89	143	NONE
MIDSPAN 10	105.20	1	0	107	-109	108	

COUNTY: CROSSING:

TRANSVERSE STIFFENER REQ'TS:

$$b_t \geq 2.0 + \frac{69+4+4}{30} = 4.6''$$

$$b_t \geq b_f/4 = 21/4 = 5.25''$$

$$t_p \geq b_t/16 = 5.25/16$$

TAKE $t_p = 3/8''$

$d_o = 17.25$ FT, MAX. $(= 3D)$

$$J = 2.5(1/3)^2 - 2.0 = -1.72 < 0$$

$\therefore J = 0.50$

$$I_t \geq d_o t_w^3 J = (17.25 \times 12)(1/2)^3(.50) = 12.94 \text{ in}^4, \text{ REQ'D}$$

$$(I_t)_{\text{PROVIDED}} = 3/8\,(5\tfrac{1}{4})^3/3 = 18.1 \text{ in}^4 > 12.94 \text{ in}^4 \text{ OK}$$

$$F_{crs} = \frac{0.31 \times 29{,}000}{(5.25/(3/8))^2} = 45.9 \text{ ksi}$$

$B = 2.4$

$C_{min} = 0.266$ (WITH STIFFENERS)

(SEE NOTE BELOW)

$$A_s \geq \left[\frac{0.15(2.4)(69)(1-.266)}{1/2} - 18\right]\frac{50\,(1/2)^2}{45.9}$$

$$A_s \geq 5.03 \text{ in}^2$$

USE $5\tfrac{1}{4}'' \times 1''$ TRANSVERSE STIFFENERS

WELD TO WEB

TIGHT-FIT AT C-FLANGE

No. NOT PERMITTED FOR CURVED GIRDERS. → CUT SHORT AT TENSION FLANGE IF DESIRED.

CUT SHORT $5t_w = 2\tfrac{1}{2}''$

NOTE:
IN THE CALCULATION OF A_s, THE TERM $\left(\frac{V_u}{\phi V_n}\right)$ HAS BEEN SET = 1.0 TO GET A VALUE THAT WILL WORK ANYWHERE ALONG THE GIRDER.

NOTES

6.10.11

IN THIS CALCULATION, 4" TOP & BOTT. FLANGES WERE ASSUMED, RESULTING IN A CONSERVATIVE VALUE FOR b_t.

ALSO, EVEN THOUGH SOME SECTIONS USE 18" WIDE FLANGES, b_f IS TAKEN HERE AS 21", AGAIN TO ARRIVE AT A CONSERVATIVE LOWER BOUND ON b_t.

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CONTROLS DESIGN

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COUNTY: CROSSING:

NOTES

BEARING STIFFENERS

6.10.11.2

$$b_t \le 0.48\, t_p \left(\frac{29{,}000}{50}\right)^{1/2} = 11.56\, t_p$$

TRY FOR $b_t = 9''$ $t_p = 7/8''$ (AT BENTS, FL. WIDTH = 21')

REACTIONS: GIRDER 1, 1,098 KIPS FACTORED — DESCUS OUTPUT (SEE P. 74 OF THIS CALC.)

$\phi_b = 1.0$

$A_{pn} = (9'' - 1/2'')(7/8'')(2) = 14.88\ in^2$

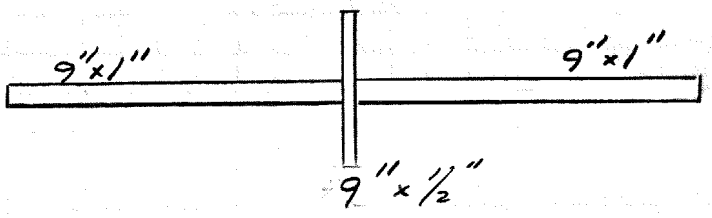
$(R_{sb})_n = 1.4 \times 14.88 \times 50\ ksi$
$= 1{,}041\ KIPS < 1{,}098\ KIPS$
NO GOOD

@ $t_p = 1''$ $A_{pn} = 17.0\ in^2$

$(R_{sb})_n = 1.4 \times 17.0 \times 50 = 1{,}190\ KIPS > 1{,}098\ KIPS$ OK

WEB EFFECTIVE AS "COLUMN"
$= 2 \times 9 \times 1/2 = 9''$

"COLUMN" SECTION: $L_e = .75 \times 69 = 52''$



$A_{col} = 2(9 \times 1) + 9(1/2) = 22.50\ in^2$

$I_{col} = 1(18\frac{1}{2})^3/12 = 528\ in^4$

$r = (528/22.5)^{1/2} = 4.84\ in.$

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COUNTY: CROSSING:

NOTES

$\frac{b}{t} = \frac{9}{1} = 9 \leq 0.56\sqrt{\frac{29{,}000}{50}} = 13.5$, OK — 6.9.4.2

$\lambda = \left(\frac{52}{\pi \times 4.84}\right)^2 \frac{50}{29{,}000} = 0.020 < 2.25$

$P_n = 0.66^{0.020} F_y A_s$

$= 0.992 F_y A_s$

$= 0.992 (50)(22.50)$

$= 1{,}116$ KIPS $> 1{,}098$ KIPS OK

USE 2 - 9" x 1" BEARING STIFFENERS AT BENTS, GR 50W

MILL TO BEAR AT BOTH FLANGES

ABUTMENTS: 344 KIPS, MAX. FACTORED R. — DESCUS OUTPUT (SEE P. 74 OF THIS CALC.)

18" FLANGES

7" x 5/8"

$A_{pn} = (7 - \frac{1}{2})(\frac{5}{8})(2) = 8.12 \text{ in}^2$

$(R_{sb})_n = 1.4 \times 8.12 \times 50 = 569^K > 344^K$, OK

$A_{col} = 2(7 \times \frac{5}{8}) + 4\frac{1}{2}(\frac{1}{2}) = 11.0 \text{ in}^2$

$I_{col} = \frac{5}{8}(14\frac{1}{2})^3/12 = 159 \text{ in}^4$

$r_{col} = (159/11)^{1/2} = 3.8$ in.

$\lambda = 0.033$

$P_n = .66^{.033}(50 \times 11.0)$

$= .986 \times 550 = 542^K > 344^K$, OK

USE 2 - 7" x 5/8" BEARING STIFFENERS AT ABUTMENTS, GR 50W

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Shelby County

TABLE 8.1 REACTIONS (KIPS) (FACTORED)

GD NO	SUPP NO	DL LOAD (1)	SDL	LIVE LOAD MAX (2)	TYPE	LIVE LOAD MIN (3)	TYPE	MAX+I (4)	MIN+I (5)	TOTAL (1+2)	TOTAL (1+4+X)	TOTAL (1+5+X)
1	1	47.4	18.6	194.7	HL	-70.0	HL	235.3	-80.8	260.6	301.2	-14.8
1	2	408.3	135.3	472.2	HL	-20.6	HL	554.3	-24.5	1015.8	1098.0	519.1
1	3	408.4	135.3	468.6	HL	-20.6	HL	549.5	-24.5	1012.2	1093.1	519.1
1	4	47.4	18.6	226.3	HL	-70.0	HL	277.3	-80.8	292.2	343.3	-14.8
2	1	50.4	18.9	167.8	HL	-46.9	HL	204.7	-54.2	237.1	274.1	15.2
2	2	401.8	134.2	415.5	HL	-16.4	HL	491.7	-19.6	951.6	1027.7	516.5
2	3	401.8	134.2	413.5	HL	-16.4	HL	489.0	-19.5	949.5	1025.0	516.5
2	4	50.4	18.9	188.8	HL	-46.9	HL	232.7	-54.1	258.1	302.0	15.2
3	1	52.4	19.5	169.2	HL	-39.9	HL	206.6	-46.1	241.1	278.4	25.8
3	2	388.0	130.3	413.9	HL	-12.8	HL	490.2	-15.3	932.2	1008.5	503.0
3	3	388.1	130.4	412.4	HL	-12.8	HL	488.2	-15.3	930.9	1006.7	503.1
3	4	52.4	19.5	189.2	HL	-39.9	HL	233.1	-46.1	261.1	305.0	25.8
4	1	53.0	19.7	169.1	HL	-39.4	HL	206.4	-45.6	241.8	279.2	27.2
4	2	390.0	130.7	413.5	HL	-12.1	HL	489.8	-14.5	934.2	1010.5	506.2
4	3	389.9	130.6	412.3	HL	-12.1	HL	488.1	-14.5	932.9	1008.7	506.1
4	4	53.0	19.7	188.8	HL	-39.4	HL	232.6	-45.5	261.5	305.4	27.2
5	1	52.0	19.6	165.7	HL	-43.1	HL	202.5	-49.8	237.3	274.1	21.7
5	2	381.1	128.1	406.1	HL	-13.7	HL	481.8	-16.4	915.3	991.0	492.8
5	3	381.1	128.1	404.8	HL	-13.7	HL	480.0	-16.4	914.0	989.3	492.8
5	4	52.0	19.6	185.1	HL	-43.1	HL	228.3	-49.9	256.6	299.9	21.7
6	1	48.5	19.0	161.4	HL	-49.1	HL	196.2	-56.8	229.0	263.7	10.8
6	2	413.1	139.0	425.4	HL	-20.4	HL	499.2	-24.4	977.5	1051.4	527.7
6	3	413.1	139.0	421.0	HL	-20.4	HL	493.5	-24.4	973.2	1045.6	527.7
6	4	48.5	19.0	183.5	HL	-49.1	HL	225.6	-56.8	251.1	293.2	10.8

NOTE: X IS DUE TO THE EXTRA USER-INPUT LOADS.

COUNTY: CROSSING:

NOTES

6.10.10

SHEAR STUDS:

$\alpha = 34.5 - 4.28 \log N$

$N = 483,100,312$ PAGE 12

$\therefore \alpha = -2.67$

$\therefore Z_r = 5.5 d^2/2$

$d = 7/8"$ STUD DIA.

$Z_r = 5.5(7/8)^2/2$

$= 2.11$ KIPS / STUD

$\times$ 3 STUDS

$= 6.32$ KIPS

pitch $p = 6.32 / V_{sr}$

$V_{sr} = V_r Q / I$

GIRDER 1, $V_r = 43.7$ KIPS MAX — DESCUS OUTPUT

FATIGUE SHEAR RANGE WITH LOAD FACTOR OF 0.75 & CONSTANT REAR AXLE SPACING OF 30FT.

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COUNTY: CROSSING:

NOTES

18" x 3/4" FLANGES:

COMPOSITE $I = 126,472\ IN^4$

$Y_b = 64.654\ IN$

$\tilde{y} = 83.5 - 64.654 - 8.5/2$
$= 14.6"$

$A = 123" \times 8\frac{1}{2}" \div 9$
$+ 4.5" \times 30" \div 9$
$131\ IN^2$

$Q = \tilde{y}A = 1,915\ IN^3$

$Q/I = 1,915/126,472$
$= 0.0151$

GIRDER	V_r	V_{sr}	p
1 NB	43.7^K	0.66$^K/_{IN}$	9"
2 NB	29.7^K	0.45$^K/_{IN}$	13"
3 NB	28.7^K	0.43$^K/_{IN}$	13"
4 NB	28.5^K	0.43$^K/_{IN}$	13"
5 NB	29.7^K	0.45$^K/_{IN}$	13"
6 NB	35.6^K	0.54$^K/_{IN}$	11"

$V_{sr} = 0.0151\ V_r$

$p = 6.32/V_{sr}$

DESIGN	DATE
TEK 06	
CHECK	DATE
CHECK	DATE

COUNTY: CROSSING:

NOTES

ADDITIONAL STUDS NEAR CONTRAFLEXURE POINTS

6.10.10.3

$M = 1{,}017$ FT·K, FATIGUE MAX. @ SUPPORT, GIRDER No. 1.

DESCUS OUTPUT

21" x 4" FLANGES

$I = 249{,}599 \text{ IN}^4$ (GIRDER + REBAR)

$Y_b = 39.79"$

$C = 86.75 - 39.79 - 2.75 = 44.21"$

$f_{sr} = (1{,}017 \times 12) \times 44.21 / 249{,}599$

$f_{sr} = 2.2$ ksi

$A_s = 5.9 \text{ IN}^2$

$n_{ac} = 5.9 \times 2.2 / 6.32 = \underline{2.0}$

SHEAR STUDS - STRENGTH LIMIT STATE

6.10.10.4

6.5.4.2

$\phi_{sc} = 0.85$

$A_{sc} = \pi (7/8)^2/4 = 0.601 \text{ IN}^2$

$Q_n = 0.5 (0.601)(3 \times 3{,}122)^{\frac{1}{2}}$
$= 148.4 (0.601)$
$= 29.1$ KIPS

$Q_r = \phi_{sc} Q_n = 24.7$ KIPS

$b_s = 123"$
$t_s = 8\frac{1}{2}"$

$P_{1p} = 0.85 (3)(123 \times 8\frac{1}{2}) = 2{,}666$ KIPS

$P_{2p} = 50 (18 \times 1\frac{3}{4} + 18 \times 1 + 69 \times \frac{1}{2}) = 4{,}200$ KIPS

$P = P_p = 2{,}666$ KIPS

DESIGN	DATE
TEHoff	
CHECK	DATE
CHECK	DATE

COUNTY: CROSSING:

NOTES

GIRDER 1:

SPAN 1: 50.89 FT TO CONTRA-FLEX
48.55 FT TO MAX. POSITIVE LL+I MOMENT

$n = P/Q_r = \frac{2,666^{K}}{24.7\,K/STUD}$

= 108 STUDS, EACH SIDE OF M_{MAX}

108/3 = 36 ROWS, 3 STUDS/ROW

100 SP. @ 9" = 750"

35 SP. @ 9" = 26'3"

"0" TOTAL M^+ AT ≈ 90FT

48.55 + 26.25 = 74.8FT

SPAN 2: 49.77 FT TO CONTRA-FLEX.
107.55 FT TO $(M^+_{MAX})_{LL+I}$

107.55 - 49.77 = 57.78 FT
> 26.25 FT
OK

57.78 × 2 = 115.56 FT

154 SP. @ 9" = 115'6"

DESIGN	DATE
TEHoff	
CHECK	DATE
CHECK	DATE

COUNTY: CROSSING:

NOTES

GIRDER 2 :

SPAN 1 : 54.69 FT TO CONTRA-FLEX.
60.42 FT TO $(M^+_{MAX})_{LL+I}$

STILL NEED 36 ROWS
SPACING IS 13"

$36 \times 13/12 = 39'0"$

$60.42 + 39 = 99.42$ FT

92 SP. @ 13" = 99'8"

SPAN 2 : 49.05 FT TO CONTRA-FLEX.
107.08 FT TO $(M^+_{MAX})_{LL+I}$

$107.08 - 49.05 = 58.03$ FT
> 39 FT, OK

$58.03 \times 2 = 116.06$ FT

108 SP. @ 13" = 117'0"

GIRDERS 3, 4, 5 : P = 13" AS WELL

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GIRDER	DIST. TO CONTRA-FLEX	DIST. TO $(M^+_{MAX})_{LL+I}$
3 - SPAN 1	56.52'	60.16'
SPAN 2	48.94'	106.61'
4 - SPAN 1	56.56'	59.89'
SPAN 2	48.75'	106.14'
5 - SPAN 1	55.77'	59.63'
SPAN 2	48.53'	105.67'

DESIGN	DATE
TEH 86	
CHECK	DATE
CHECK	DATE

COUNTY: CROSSING:

NOTES

GIRDER 6:

SPAN 1: 53.48', TO CONTRAFLEX
59.36' TO $(M^+_{MAX})_{LL+I}$

SPAN 2: 48.17' TO CONTRAFLEX
105.20' TO $(M^+_{MAX})_{LL+I}$

STUD PITCH, P = 11"

NEED 36 ROWS

$36 \times 11/12 = 33'$

$59.36 + 33 = 92.36'$

101 SP. @ 11" = 92'7"
(SPAN 1)

$105.20 - 48.17 = 57.03$ FT
> 33 FT, OK

$57.03 \times 2 = 114.06$ FT

125 SP. @ 11" = 114FT 7IN.
(SPAN 2)

PAGE 76

PAGE 78

DESIGN	DATE
TEK	
CHECK	DATE
CHECK	DATE

GIRDER	SPAN PT.	DL DEFLECTION, INCHES STEEL	SLAB+STEEL	SLAB	SDL	TOTAL
1 NB	1.00	0.000	0.000	0.000	0.000	0.000
	1.10	-0.029	-0.012	0.017	-0.002	-0.014
	1.20	-0.045	0.038	0.083	0.009	0.046
	1.30	-0.041	0.174	0.215	0.037	0.211
	1.40	-0.016	0.381	0.397	0.082	0.463
	1.50	0.021	0.602	0.581	0.133	0.734
	1.60	0.058	0.770	0.712	0.174	0.944
	1.70	0.084	0.834	0.750	0.194	1.028
	1.80	0.089	0.748	0.659	0.178	0.926
	1.90	0.064	0.478	0.414	0.116	0.594
	2.00	0.000	0.000	0.000	0.000	0.000
	2.05	-0.094	-0.614	-0.520	-0.154	-0.768
	2.10	-0.221	-1.395	-1.174	-0.350	-1.746
	2.15	-0.378	-2.336	-1.958	-0.583	-2.919
	2.20	-0.564	-3.427	-2.863	-0.842	-4.269
	2.25	-0.768	-4.600	-3.833	-1.107	-5.707
	2.30	-0.964	-5.718	-4.754	-1.350	-7.067
	2.35	-1.132	-6.665	-5.533	-1.550	-8.216
	2.40	-1.259	-7.376	-6.117	-1.700	-9.076
	2.45	-1.336	-7.807	-6.471	-1.792	-9.599
	2.50	-1.361	-7.948	-6.587	-1.823	-9.771

(SYMMETRIC WITH RESPECT TO MIDSPAN OF SPAN NO. 2)

GIRDER	SPAN PT.	DL DEFLECTION, INCHES STEEL	SLAB+STEEL	SLAB	SDL	TOTAL
2 NB	1.00	0.000	0.000	0.000	0.000	0.000
	1.10	-0.030	-0.049	-0.020	-0.008	-0.058
	1.20	-0.046	-0.034	0.012	-0.004	-0.038
	1.30	-0.043	0.075	0.118	0.020	0.094
	1.40	-0.020	0.270	0.290	0.061	0.331
	1.50	0.018	0.502	0.485	0.111	0.613
	1.60	0.056	0.696	0.640	0.156	0.852
	1.70	0.083	0.784	0.701	0.180	0.964
	1.80	0.089	0.723	0.634	0.170	0.892
	1.90	0.064	0.470	0.406	0.113	0.582
	2.00	0.000	0.000	0.000	0.000	0.000
	2.05	-0.093	-0.607	-0.514	-0.151	-0.757
	2.10	-0.218	-1.391	-1.173	-0.345	-1.736
	2.15	-0.376	-2.349	-1.974	-0.578	-2.928
	2.20	-0.561	-3.454	-2.893	-0.837	-4.291
	2.25	-0.759	-4.625	-3.866	-1.101	-5.726
	2.30	-0.950	-5.746	-4.796	-1.347	-7.092
	2.35	-1.116	-6.710	-5.594	-1.554	-8.264
	2.40	-1.241	-7.435	-6.194	-1.708	-9.143
	2.45	-1.319	-7.883	-6.564	-1.802	-9.685
	2.50	-1.345	-8.034	-6.690	-1.834	-9.869

(SYMMETRIC WITH RESPECT TO MIDSPAN OF SPAN NO. 2)

GIRDER	SPAN PT.	DL DEFLECTION, INCHES STEEL	SLAB+STEEL	SLAB	SDL	TOTAL
3 NB	1.00	0.000	0.000	0.000	0.000	0.000
	1.10	-0.030	-0.074	-0.044	-0.013	-0.087
	1.20	-0.048	-0.081	-0.033	-0.012	-0.093
	1.30	-0.045	0.013	0.058	0.008	0.021
	1.40	-0.022	0.203	0.225	0.047	0.250
	1.50	0.016	0.440	0.425	0.098	0.538
	1.60	0.055	0.652	0.597	0.145	0.797
	1.70	0.084	0.762	0.678	0.172	0.934
	1.80	0.089	0.709	0.620	0.164	0.874
	1.90	0.063	0.463	0.399	0.110	0.573
	2.00	0.000	0.000	0.000	0.000	0.000
	2.05	-0.093	-0.608	-0.516	-0.149	-0.758
	2.10	-0.218	-1.396	-1.178	-0.343	-1.739
	2.15	-0.374	-2.355	-1.981	-0.575	-2.930
	2.20	-0.555	-3.458	-2.903	-0.832	-4.290
	2.25	-0.750	-4.629	-3.879	-1.095	-5.724
	2.30	-0.937	-5.750	-4.813	-1.341	-7.091
	2.35	-1.100	-6.718	-5.618	-1.549	-8.267
	2.40	-1.223	-7.448	-6.225	-1.704	-9.152
	2.45	-1.300	-7.900	-6.601	-1.799	-9.699
	2.50	-1.326	-8.054	-6.728	-1.831	-9.885

(SYMMETRIC WITH RESPECT TO MIDSPAN OF SPAN NO. 2)

GIRDER	SPAN PT.	DL DEFLECTION, INCHES STEEL	SLAB+STEEL	SLAB	SDL	TOTAL
4 NB	1.00	0.000	0.000	0.000	0.000	0.000
	1.10	-0.030	-0.080	-0.050	-0.014	-0.094
	1.20	-0.048	-0.092	-0.044	-0.015	-0.107
	1.30	-0.045	-0.002	0.043	0.004	0.001
	1.40	-0.022	0.186	0.208	0.042	0.228
	1.50	0.015	0.424	0.409	0.092	0.516
	1.60	0.054	0.638	0.583	0.140	0.777
	1.70	0.083	0.750	0.667	0.168	0.918
	1.80	0.088	0.701	0.613	0.161	0.862
	1.90	0.063	0.458	0.396	0.108	0.566
	2.00	0.000	0.000	0.000	0.000	0.000
	2.05	-0.092	-0.603	-0.512	-0.147	-0.751
	2.10	-0.215	-1.385	-1.170	-0.338	-1.723
	2.15	-0.368	-2.336	-1.968	-0.567	-2.903
	2.20	-0.547	-3.430	-2.883	-0.821	-4.251
	2.25	-0.737	-4.590	-3.853	-1.081	-5.671
	2.30	-0.921	-5.702	-4.781	-1.323	-7.026
	2.35	-1.081	-6.662	-5.582	-1.529	-8.191
	2.40	-1.202	-7.387	-6.185	-1.682	-9.069
	2.45	-1.277	-7.835	-6.559	-1.776	-9.612
	2.50	-1.302	-7.987	-6.685	-1.808	-9.796

(SYMMETRIC WITH RESPECT TO MIDSPAN OF SPAN NO. 2)

GIRDER	SPAN PT.	DL DEFLECTION, INCHES STEEL	SLAB+STEEL	SLAB	SDL	TOTAL
5 NB	1.00	0.000	0.000	0.000	0.000	0.000
	1.10	-0.029	-0.069	-0.040	-0.014	-0.083
	1.20	-0.047	-0.073	-0.026	-0.014	-0.087
	1.30	-0.044	0.020	0.065	0.004	0.025
	1.40	-0.022	0.206	0.228	0.042	0.249
	1.50	0.014	0.438	0.423	0.091	0.529
	1.60	0.053	0.643	0.591	0.137	0.781
	1.70	0.080	0.748	0.668	0.165	0.913
	1.80	0.086	0.695	0.609	0.158	0.853
	1.90	0.061	0.452	0.392	0.106	0.558
	2.00	0.000	0.000	0.000	0.000	0.000
	2.05	-0.089	-0.593	-0.504	-0.144	-0.737
	2.10	-0.210	-1.361	-1.151	-0.331	-1.692
	2.15	-0.360	-2.294	-1.934	-0.554	-2.848
	2.20	-0.534	-3.368	-2.834	-0.803	-4.171
	2.25	-0.721	-4.508	-3.787	-1.056	-5.564
	2.30	-0.901	-5.599	-4.698	-1.293	-6.892
	2.35	-1.057	-6.540	-5.482	-1.493	-8.033
	2.40	-1.175	-7.249	-6.073	-1.642	-8.891
	2.45	-1.248	-7.687	-6.439	-1.734	-9.421
	2.50	-1.273	-7.836	-6.562	-1.765	-9.600

(SYMMETRIC WITH RESPECT TO MIDSPAN OF SPAN NO. 2)

GIRDER	SPAN PT.	DL DEFLECTION, INCHES STEEL	SLAB+STEEL	SLAB	SDL	TOTAL
6 NB	1.00	0.000	0.000	0.000	0.000	0.000
	1.10	-0.028	-0.046	-0.018	-0.012	-0.058
	1.20	-0.044	-0.033	0.012	-0.011	-0.043
	1.30	-0.042	0.070	0.112	0.009	0.079
	1.40	-0.020	0.255	0.275	0.046	0.301
	1.50	0.014	0.475	0.461	0.093	0.568
	1.60	0.050	0.659	0.609	0.136	0.796
	1.70	0.076	0.745	0.669	0.161	0.906
	1.80	0.081	0.684	0.603	0.153	0.837
	1.90	0.058	0.443	0.385	0.103	0.546
	2.00	0.000	0.000	0.000	0.000	0.000
	2.05	-0.086	-0.579	-0.493	-0.140	-0.719
	2.10	-0.203	-1.323	-1.120	-0.321	-1.644
	2.15	-0.348	-2.230	-1.882	-0.538	-2.768
	2.20	-0.519	-3.281	-2.762	-0.780	-4.060
	2.25	-0.702	-4.397	-3.695	-1.026	-5.424
	2.30	-0.879	-5.463	-4.584	-1.255	-6.717
	2.35	-1.030	-6.371	-5.341	-1.446	-7.816
	2.40	-1.144	-7.051	-5.907	-1.586	-8.637
	2.45	-1.215	-7.473	-6.259	-1.673	-9.146
	2.50	-1.239	-7.617	-6.378	-1.702	-9.319

(SYMMETRIC WITH RESPECT TO MIDSPAN OF SPAN NO. 2)

GIRDER	SPAN PT.	DL DEFLECTION, INCHES STEEL	SLAB+STEEL	SLAB	SDL	TOTAL
1 SB	1.00	0.000	0.000	0.000	0.000	0.000
	1.10	-0.026	-0.011	0.016	-0.002	-0.012
	1.20	-0.041	0.034	0.075	0.008	0.041
	1.30	-0.037	0.156	0.193	0.033	0.190
	1.40	-0.015	0.342	0.357	0.074	0.416
	1.50	0.018	0.541	0.523	0.119	0.660
	1.60	0.052	0.692	0.641	0.157	0.849
	1.70	0.075	0.750	0.675	0.174	0.924
	1.80	0.080	0.673	0.593	0.160	0.833
	1.90	0.057	0.430	0.373	0.105	0.534
	2.00	0.000	0.000	0.000	0.000	0.000
	2.05	-0.085	-0.552	-0.468	-0.138	-0.691
	2.10	-0.199	-1.255	-1.056	-0.315	-1.571
	2.15	-0.340	-2.102	-1.761	-0.525	-2.626
	2.20	-0.508	-3.084	-2.576	-0.758	-3.841
	2.25	-0.691	-4.139	-3.448	-0.996	-5.134
	2.30	-0.868	-5.144	-4.276	-1.214	-6.358
	2.35	-1.019	-5.996	-4.977	-1.395	-7.391
	2.40	-1.133	-6.635	-5.502	-1.529	-8.164
	2.45	-1.202	-7.023	-5.820	-1.612	-8.635
	2.50	-1.225	-7.150	-5.925	-1.640	-8.790

(SYMMETRIC WITH RESPECT TO MIDSPAN OF SPAN NO. 2)

GIRDER	SPAN PT.	DL DEFLECTION, INCHES STEEL	SLAB+STEEL	SLAB	SDL	TOTAL
2 SB	1.00	0.000	0.000	0.000	0.000	0.000
	1.10	-0.027	-0.045	-0.019	-0.008	-0.053
	1.20	-0.042	-0.032	0.010	-0.004	-0.036
	1.30	-0.039	0.065	0.105	0.017	0.083
	1.40	-0.018	0.241	0.259	0.054	0.296
	1.50	0.016	0.450	0.435	0.100	0.550
	1.60	0.050	0.625	0.575	0.140	0.765
	1.70	0.075	0.705	0.630	0.162	0.867
	1.80	0.080	0.650	0.570	0.153	0.803
	1.90	0.057	0.423	0.365	0.101	0.524
	2.00	0.000	0.000	0.000	0.000	0.000
	2.05	-0.083	-0.546	-0.463	-0.136	-0.682
	2.10	-0.197	-1.252	-1.056	-0.311	-1.563
	2.15	-0.339	-2.115	-1.777	-0.521	-2.636
	2.20	-0.505	-3.110	-2.605	-0.754	-3.864
	2.25	-0.683	-4.165	-3.482	-0.991	-5.156
	2.30	-0.856	-5.174	-4.319	-1.213	-6.387
	2.35	-1.005	-6.043	-5.038	-1.399	-7.442
	2.40	-1.118	-6.697	-5.579	-1.538	-8.235
	2.45	-1.187	-7.100	-5.912	-1.623	-8.723
	2.50	-1.211	-7.236	-6.025	-1.652	-8.889

(SYMMETRIC WITH RESPECT TO MIDSPAN OF SPAN NO. 2)

GIRDER	SPAN PT.	DL DEFLECTION, INCHES STEEL	SLAB+STEEL	SLAB	SDL	TOTAL
3 SB	1.00	0.000	0.000	0.000	0.000	0.000
	1.10	-0.027	-0.067	-0.040	-0.012	-0.079
	1.20	-0.043	-0.074	-0.031	-0.011	-0.085
	1.30	-0.041	0.010	0.051	0.007	0.017
	1.40	-0.020	0.181	0.201	0.042	0.223
	1.50	0.014	0.395	0.381	0.088	0.483
	1.60	0.050	0.586	0.537	0.130	0.717
	1.70	0.075	0.685	0.610	0.155	0.840
	1.80	0.080	0.639	0.558	0.148	0.787
	1.90	0.057	0.417	0.360	0.099	0.516
	2.00	0.000	0.000	0.000	0.000	0.000
	2.05	-0.084	-0.548	-0.465	-0.135	-0.683
	2.10	-0.196	-1.258	-1.061	-0.309	-1.567
	2.15	-0.337	-2.122	-1.785	-0.518	-2.640
	2.20	-0.500	-3.116	-2.616	-0.750	-3.866
	2.25	-0.675	-4.171	-3.496	-0.987	-5.158
	2.30	-0.844	-5.182	-4.338	-1.208	-6.390
	2.35	-0.991	-6.055	-5.064	-1.396	-7.450
	2.40	-1.102	-6.713	-5.611	-1.536	-8.249
	2.45	-1.171	-7.120	-5.950	-1.621	-8.742
	2.50	-1.194	-7.259	-6.065	-1.651	-8.909

(SYMMETRIC WITH RESPECT TO MIDSPAN OF SPAN NO. 2)

GIRDER	SPAN PT.	DL DEFLECTION, INCHES STEEL	SLAB+STEEL	SLAB	SDL	TOTAL
4 SB	1.00	0.000	0.000	0.000	0.000	0.000
	1.10	-0.027	-0.072	-0.045	-0.013	-0.085
	1.20	-0.043	-0.083	-0.040	-0.014	-0.097
	1.30	-0.041	-0.003	0.038	0.003	0.000
	1.40	-0.020	0.167	0.186	0.038	0.205
	1.50	0.014	0.381	0.367	0.083	0.464
	1.60	0.049	0.574	0.525	0.126	0.700
	1.70	0.074	0.675	0.601	0.151	0.827
	1.80	0.079	0.632	0.552	0.145	0.777
	1.90	0.056	0.413	0.356	0.097	0.510
	2.00	0.000	0.000	0.000	0.000	0.000
	2.05	-0.082	-0.544	-0.461	-0.133	-0.676
	2.10	-0.194	-1.248	-1.054	-0.305	-1.553
	2.15	-0.332	-2.105	-1.773	-0.511	-2.616
	2.20	-0.492	-3.091	-2.599	-0.740	-3.831
	2.25	-0.664	-4.137	-3.473	-0.974	-5.111
	2.30	-0.830	-5.139	-4.310	-1.193	-6.332
	2.35	-0.974	-6.005	-5.031	-1.378	-7.383
	2.40	-1.083	-6.658	-5.575	-1.516	-8.174
	2.45	-1.150	-7.062	-5.912	-1.601	-8.663
	2.50	-1.173	-7.199	-6.026	-1.630	-8.829

(SYMMETRIC WITH RESPECT TO MIDSPAN OF SPAN NO. 2)

GIRDER	SPAN PT.	DL DEFLECTION, INCHES STEEL	SLAB+STEEL	SLAB	SDL	TOTAL
5 SB	1.00	0.000	0.000	0.000	0.000	0.000
	1.10	-0.026	-0.062	-0.035	-0.012	-0.074
	1.20	-0.042	-0.065	-0.023	-0.013	-0.078
	1.30	-0.040	0.019	0.059	0.004	0.024
	1.40	-0.019	0.187	0.206	0.038	0.225
	1.50	0.013	0.395	0.382	0.083	0.478
	1.60	0.048	0.581	0.533	0.124	0.705
	1.70	0.072	0.675	0.602	0.149	0.823
	1.80	0.077	0.626	0.549	0.142	0.769
	1.90	0.055	0.408	0.353	0.095	0.503
	2.00	0.000	0.000	0.000	0.000	0.000
	2.05	-0.080	-0.535	-0.454	-0.130	-0.664
	2.10	-0.189	-1.226	-1.037	-0.298	-1.524
	2.15	-0.324	-2.067	-1.743	-0.500	-2.566
	2.20	-0.481	-3.034	-2.553	-0.723	-3.757
	2.25	-0.649	-4.060	-3.411	-0.952	-5.012
	2.30	-0.812	-5.043	-4.232	-1.165	-6.208
	2.35	-0.952	-5.890	-4.938	-1.345	-7.236
	2.40	-1.058	-6.529	-5.471	-1.480	-8.009
	2.45	-1.124	-6.924	-5.800	-1.562	-8.486
	2.50	-1.147	-7.058	-5.911	-1.590	-8.648

(SYMMETRIC WITH RESPECT TO MIDSPAN OF SPAN NO. 2)

GIRDER	SPAN PT.	DL DEFLECTION, INCHES STEEL	SLAB+STEEL	SLAB	SDL	TOTAL
6 SB	1.00	0.000	0.000	0.000	0.000	0.000
	1.10	-0.025	-0.040	-0.015	-0.010	-0.050
	1.20	-0.040	-0.027	0.013	-0.009	-0.036
	1.30	-0.037	0.067	0.104	0.008	0.075
	1.40	-0.018	0.233	0.251	0.042	0.275
	1.50	0.013	0.431	0.418	0.084	0.515
	1.60	0.045	0.596	0.551	0.123	0.719
	1.70	0.068	0.673	0.604	0.145	0.818
	1.80	0.073	0.617	0.543	0.138	0.755
	1.90	0.052	0.399	0.347	0.092	0.492
	2.00	0.000	0.000	0.000	0.000	0.000
	2.05	-0.078	-0.521	-0.444	-0.126	-0.647
	2.10	-0.182	-1.191	-1.008	-0.289	-1.480
	2.15	-0.313	-2.007	-1.694	-0.484	-2.491
	2.20	-0.467	-2.952	-2.485	-0.702	-3.654
	2.25	-0.632	-3.957	-3.325	-0.924	-4.881
	2.30	-0.791	-4.915	-4.124	-1.129	-6.044
	2.35	-0.927	-5.732	-4.805	-1.301	-7.033
	2.40	-1.030	-6.344	-5.314	-1.427	-7.771
	2.45	-1.093	-6.724	-5.631	-1.505	-8.229
	2.50	-1.115	-6.853	-5.738	-1.532	-8.385

(SYMMETRIC WITH RESPECT TO MIDSPAN OF SPAN NO. 2)

COUNTY: CROSSING: NOTES

SUBSTRUCTURES:

	BENT	ABUTMENT	
R_{DL}	413.0 KIPS	53.0 KIPS	(FACTORED) PER BEAM
R_{SDL}	139.0 KIPS	20.0 KIPS	
R_{LL+I}	472.0 KIPS	226.0 KIPS	
Θ_{DL+SDL}	0.0041 RAD	0.0006 RAD	(UN-FACTORED)
Θ_{LL+I}	0.0017 RAD	0.0003 RAD	

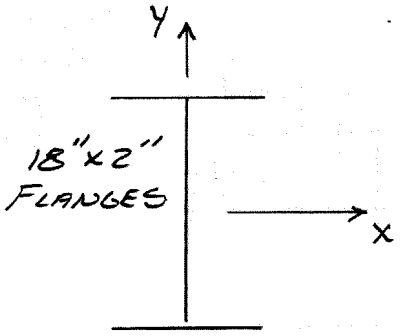
GLOBAL PROPERTIES:

USE "AVG." SECTION:

0.365 KLF, SPAN 1
0.344 KLF, SPAN 2

0.365 KLF: 69" × ½" WEBS
18" × 2" FLANGES

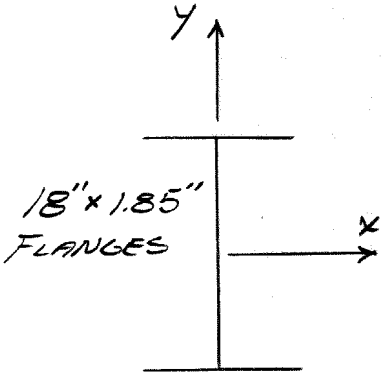
0.344 KLF: 69" × ½" WEBS
18" × 1.85" FLANGES



$A = 106.5\ IN^2$

$I_x = 104,450\ IN^4$

$I_y = 1,944\ IN^4$



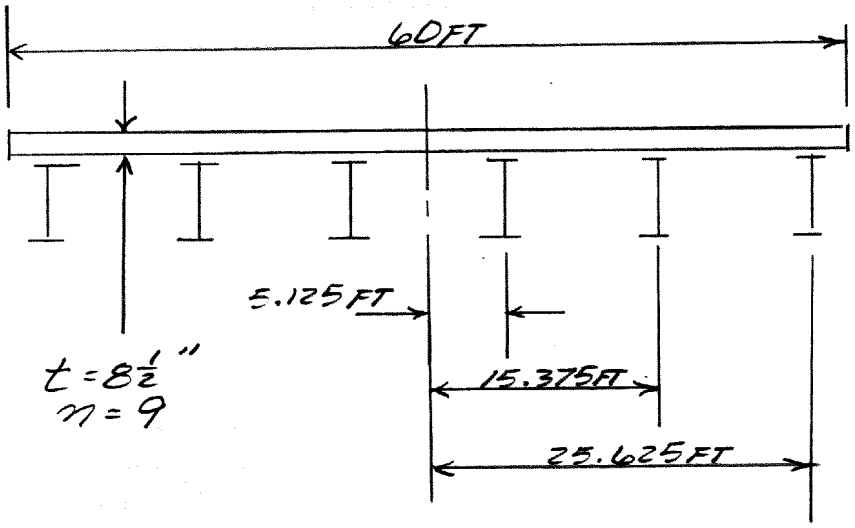
$A = 101.1\ IN^2$

$I_x = 97,285\ IN^4$

$I_y = 1,798\ IN^4$

DESIGN	DATE
TEHoff	
CHECK	DATE
CHECK	DATE

COUNTY: CROSSING: NOTES



SPAN 1:

$A = (60 \times 12 \times 8\tfrac{1}{2})(\tfrac{1}{9}) + 6(106.5)$

$= 1,319\ in^2$

$\bar{y} = \dfrac{(6 \times 106.5 \times 36.5) + (680 \times 80.5)}{1,319}$

$= 59.2"$

$I_x = 6(104,450) + 6(106.5)(22.7)^2 + (60 \times 12/9)(8.5)^3/12 + 680(21.3)^2$

$= 1,268,574\ in^4$

$I_y = 6(1,944) + (8.5/9)(60 \times 12)^3/12 + 2(106.5)(5.125)^2 + 2(106.5)(15.375)^2 + 2(106.5)(25.625)^2$

$= 29,583,474\ in^4$

$E = E_{STEEL} = 29,000\ ksi$

EQUIVALENT WT

$= 6(106.5/144)(.490) + 60(8.5/12)(.150) + 6(2)(3.25/12)(.150)$

9.04 KLF STRUCTURE
1.92 KLF OVERLAY
0.91 KLF PARAPETS
11.87 KLF

DESIGN	DATE
CHECK	DATE
CHECK	DATE

COUNTY: CROSSING:

NOTES

SPAN 2 : $A = 1,287\ IN^2$

$\bar{y} = 59.6\ IN.$

$I_x = 1,208,492\ IN^4$

$I_y = 29,572,670\ IN^4$

$W = 11.78\ KLF$

CAP WEIGHT ESTIMATE

8 FT AVG. HEIGHT
× 4 FT WIDTH
× 56 FT LENGTH
1,792 CF
× .15
269 KIPS

COLUMN ESTIMATES:

2, 6'ϕ COLUMNS / BENT
$W = 4.24$ KLF / COLUMN
$= 8.48$ KLF / BENT

NB BRIDGE, BENT 1

254.90
+ 22 × .065
− 230
26.33 FT
EST. DIST. TO BOTTOM OF COLUMN

NB BRIDGE, BENT 2 , 25.69 FT

SB BRIDGE, BENT 1 , 28.24 FT

SB BRIDGE, BENT 2 , 26.89 FT

DESIGN	DATE
CHECK	DATE
CHECK	DATE

COUNTY: CROSSING:

NOTES

ABUTMENT WT = 60 x 3 x 3 x .15 = 81 K — BEAM
60 x 7.3 x 1.5 x .15 = 99 K — WALL
60 x 1.5 x 1.5 x .15 = 21 K — BRACKET
201 KIPS

ASSUME WINGS BREAK AWAY; DON'T INCLUDE THEIR MASS IN EQ.

ABUTMENT STIFFNESS:

200 K/IN PER FT x 60 FT = 12,000 K/IN — WALL
20 K/IN PER PILE x 12 = 240 K/IN — PILES

ONLY 1 BACKWALL IS EFFECTIVE AT ANY GIVEN INSTANT:

TOTAL STIFFNESS OF 2 ABUTMENTS = 12,000 K/IN
+ 2 x 240 K/IN
= 12,480 K/IN

K = 6,240 K/IN
PER ABUTMENT
LONGITUDINAL

K = 240 K/IN
PER ABUTMENT
TRANSVERSE

PILES ONLY (ASSUME WINGS FAIL)

EQUIVALENT COLUMN @ BENTS:

2, 4'ϕ COLS A = 3,619 IN²
I = 521,152 IN⁴

E = 1,000 KSI
(CRACKED CONCRETE)

DESIGN	DATE
CHECK	DATE
CHECK	DATE