

MATHEMATICAL ANALYSIS

Find bending moment and thrust at certain sections, and the resulting stresses on the concrete.

Bending Moment = $M_c + H_c y + V_c x - \Sigma(PL)$

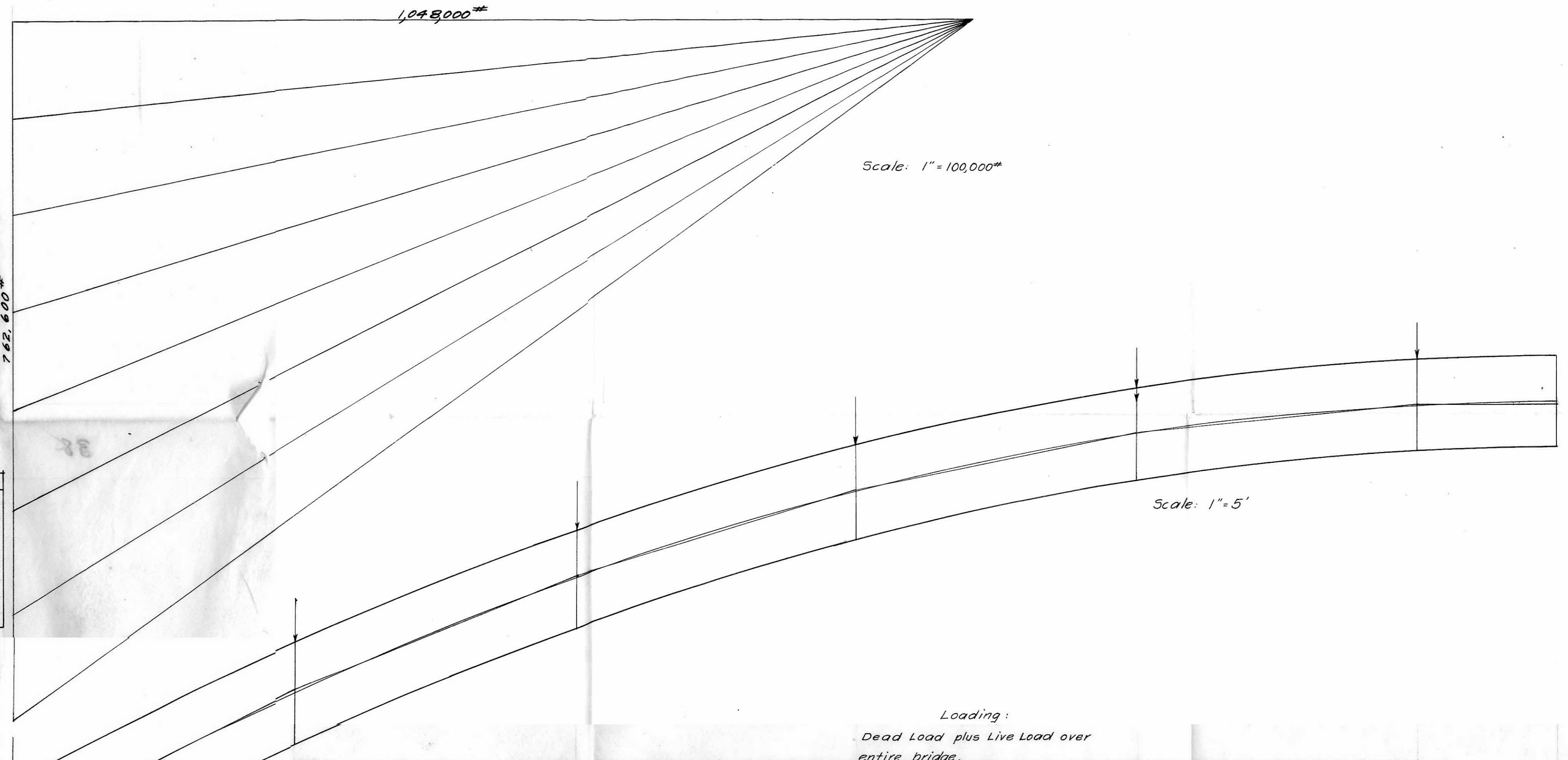
| Section | $\Sigma(PL)$ |
|---------|---|
| 0 | |
| 15.33 | $43 \times 767 = 329.81$ |
| 30.67 | $43 \times (767 + 23.00) = 1318.81$ |
| 46.00 | $43 \times (30.67 + 38.33) = 2967.00$ |
| 61.33 | $43 \times (69.00 + 53.67) = 5274.81$ |
| 76.67 | $43 \times (122.67 + 69.00) = 8241.81$ |
| 92.00 | $43 \times (191.67 + 84.33) = 11868.00$ |
| 107.33 | $43 \times (276.00 + 99.67) = 16153.81$ |
| 115.00 | |

| Section | y | M_c | $H_c y$ | $V_c x$ | $\Sigma(PL)$ | M_L | F_c |
|---------|-------|-------|---------|---------|--------------|--------|-------|
| 0 | 0 | -172 | 0 | 0 | 0 | -172.0 | -56 |
| 15.33 | .7818 | " | 33.05 | " | 329.8 | -171.3 | -55 |
| 30.67 | 3.129 | " | 1323.9 | " | 1318.8 | -160.2 | -52 |
| 46.00 | 7.040 | " | 2978.8 | " | 2967.0 | -153.6 | -50 |
| 61.33 | 12.51 | " | 5274.8 | " | 5274.8 | -137.6 | -45 |
| 76.67 | 19.56 | " | 8276.2 | " | 8241.8 | -125.0 | -41 |
| 92.00 | 28.16 | " | 11915 | " | 11868.0 | -107.6 | -35 |
| 107.33 | 38.33 | " | 16218 | " | 16153.8 | | |
| 115.00 | 47.00 | " | | | | | |

Thrust = $\Sigma P \sin \alpha + H_c \cos \alpha$

| Section | x^2 | $2y$ | $\tan \alpha$ | $\sin \alpha$ | $\cos \alpha$ | ΣP | $\Sigma P \sin \alpha$ | $H_c \cos \alpha$ | N_L | F_c |
|---------|-------|--------|---------------|---------------|---------------|------------|------------------------|-------------------|-------|-------|
| 0 | | | | | | | | | | |
| 15.33 | 235.0 | 1.5636 | .102 | .101 | .995 | 43 | 4.34 | 421 | 425 | 143 |
| 30.67 | 940.6 | 6.2580 | .204 | .199 | .980 | 86 | 17.1 | 415 | 432 | 145 |
| 46.00 | 2116 | 14.080 | .306 | .292 | .956 | 129 | 37.7 | 405 | 443 | 149 |
| 61.33 | 3761 | 25.02 | .408 | .378 | .926 | 172 | 65.0 | 392 | 457 | 153 |
| 76.67 | 5878 | 39.12 | .511 | .455 | .890 | 215 | 97.8 | 377 | 475 | 159 |
| 92.00 | 8464 | 56.32 | .612 | .553 | .853 | 258 | 134.7 | 361 | 496 | 166 |
| 107.33 | 11520 | 76.66 | .714 | .581 | .814 | 301 | 174.9 | 344 | 519 | 174 |
| 115.00 | | | | | | | | | | |

| Section | F_c | | | |
|---------|-------------|-------------|------------|------------|
| | $N_D + N_L$ | $M_D + M_L$ | Upper Edge | Lower Edge |
| 0 | | | | |
| 15.33 | 354 | -48 | 306 | 402 |
| 30.67 | 359 | -33 | 326 | 392 |
| 46.00 | 368 | -13 | 355 | 381 |
| 61.33 | 379 | +3 | 382 | 376 |
| 76.67 | 395 | +19 | 414 | 376 |
| 92.00 | 413 | +10 | 423 | 403 |
| 107.33 | 431 | -14 | 417 | 445 |
| 115.00 | | | | |



Scale: 1"=100,000"

Scale: 1"=5'

Loading:
Dead Load plus Live Load over entire bridge.

GRAPHICAL ANALYSIS

H_c of Dead Load = 625, with no eccentricity. See sheet.....
 H_c of Live Load = $9.84 \times 43 = 423$. Total $H_c = 625 + 423 = 1048$.
 Total $M_c = -400 \times 43 = -172$
 Eccentricity of total $H_c = -172 \div 1048 = -0.164'$ below the crown.

DATA TAKEN FROM THRUST LINE

| Loaded Columns | Thousand-Pounds | | | Ordinates | |
|----------------|-----------------|-----------|-------|-----------|-------|
| | Dead Load | Live Load | Total | M_c | H_c |
| A | 61.7 | 43 | 104.7 | +7.53 | 118 |
| B | 62.4 | " | 105.4 | +1.62 | 113 |
| C | 63.1 | " | 106.1 | -1.91 | 0.97 |
| D | 64.8 | " | 107.8 | -3.22 | 0.76 |
| E | 66.8 | " | 109.8 | -3.35 | 0.53 |
| F | 69.9 | " | 112.9 | -2.00 | 0.27 |
| G | 72.9 | " | 115.9 | -0.67 | 0.08 |
| Total | | | 762.6 | -2.00 | 4.92 |
| | | | | -4.00 | 9.84 |

| Section | Thrust | | | Eccen. | Mom. | #/sq.in. | F_c | |
|---------|--------|----------|---------|--------|------|----------|------------|------------|
| | Total | #/sq.in. | | | | | Upper edge | Lower edge |
| 0.00 | 1048 | 351 | -0.164' | -172 | 56 | 295 | 407 | |
| 7.67 | 1053 | 354 | +0.08 | +84 | 24 | 378 | 330 | |
| 23.00 | 1070 | 359 | 0.00 | 0 | 0 | 359 | 359 | |
| 38.33 | 1095 | 367 | +0.07 | +77 | 25 | 392 | 342 | |
| 53.67 | 1132 | 380 | +0.10 | +113 | 37 | 417 | 343 | |
| 69.00 | 1178 | 395 | +0.16 | +188 | 61 | 456 | 334 | |
| 84.33 | 1234 | 414 | +0.18 | +222 | 73 | 487 | 341 | |
| 99.67 | 1297 | 435 | +0.12 | +150 | 49 | 484 | 386 | |
| 115.00 | 1297 | 435 | +0.00 | 0 | 0 | 435 | 435 | |