LOADING

The section summarizes the design criteria to be used in the calculations, and goes on to evaluate Superloading, and preliminary Bending Moments for Dead load.

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STRESSES etc.

Prestressed Concrete - M.O.T. mix X 3/8" [Min Cube at transfer 6,500 p.s.i]

(a) at Transfer ⊁ 2,600 p.s.i
⊀ - 200 p.s.i

(b) Working ⊁ 2,500 p.s.i.
⊀ 0 p.s.i.

Principle tensile stress ⊀ -175 p.s.i

E at Transfer 5.25×10^6 p.s.i.

E at 28 days 5.75×10^6 p.s.i.

Max tension in 1/2" ϕ strand 25,900 lbf.

Reinforced Concrete - M.O.T. mix Z 3/4

Concrete in Bending ⊁ 1,400 p.s.i

mild steel reinforcement ⊁ 18,000 p.s.i.

modular ratio, m = 15

Structural Steelwork (mild steel)

Parts in bending ⊁ 10.5 tons/in²

Railings ⊁ $S \times f_y$ where S = plastic modulus
f_y = Yield Stress

Relevant parts of B.S. 153 and B.S. 15 were consulted for other stresses and criteria.

Soils Generally max. bearing pressure is 2 T/ft²
Reference is made where necessary to the Soils report By Legrand-Adoco for Beaconsfield By-Pass, and in particular to soils tests on Boreholes B3 + B5 made on this Bridge site

Loadings

(a) Live load — 6 ft wide @ 100 lb/ft² = 600 lb/ft run

(b) Super load.

(i) Asphalt. Ave thickness 1"

∴ wt/ft run = $1 \times 72' \times \frac{144}{144}$ = 72 lb/ft run

(ii) Coping, Area = $2\frac{1}{2} \times 8\frac{1}{2} + 2\frac{1}{2} \times 5"$

= 33.75 in²

wt/ft run (both sides)

= $\frac{33.75 \times 2 \times 150}{144}$ = 70 lb/ft run.

(iii) Railings

1 post	=	5.70 × 3	= 17.1 lbf
Top rail	=	3.98 × 6	= 23.88 lbf
bot. rail	=	1.88 × 6	= 11.88 lbf
Infill	=	$14 \times 2^2/3 \times \frac{3.4}{4}$	= 31.6 lbf.
			84.46 lbf.

∴ wt. / ft run = $\frac{84.46 \text{ lbf}}{6}$ = 14.06 lb/ft run.

Total Superload = 156.06 lb/ft run.

But in preliminary calcs, a value of 166 lb/ft run was used. For uniformity and prudence, Superload is deemed to be 166 lb/ft run

Total Superload and Liveload = 766 lb/ft run.

Temperature range = ± 50° F

Railing Loads. 100 lbf/ft at 3'-0" high

Calculations for Dead Load Moments. Long Span

(a) Suspended Span 33'-3½" long (between Crs. of Bearings 32'-6") (Span L)

x (of Section)	Area in²	Length in	Weight lb	Arm in	Moment lb.in	Mom. about root of Cant. Arm	Mom. about root of Cant. Moment
0·5	572	12	595·8	12·6	3576		
2·0	574	24	1196	24	28,704	504	151,200
4·0	579	24	1206	48	57,888	498	600,588
6·0	588	24	1225	72	88,200	474	580,650
8·0	600	24	1250	96	120,000	450	562,500
10·0	617	24	1285	120	154,200	426	547,410
12·0	634	24	1320	144	190,080	402	530,640
14·0	664	24	1383	168	232,344	378	522,774
15·625	684	15	890	187·5	166,875	358·5	319,065

Half Weight of Beam, ΣW= 10,351 lbf ΣM= 1,041,900 lb.in ΣM=3,814,827

Moment @ Centre, M = 10,351 × 62·5/12 = 1,041,900 = 976,600 lb.in

(Beam ℄)

(b) Cantilever 29'-3" long (span L)

16·625	707	9	552	346·5	191,268
18	735	24	1531	330	505,230
20	780	24	1625	306	497,250
22	833	24	1735	282	489,270
24	895	24	1865	258	481,170
26	968	24	2017	234	471,978
28	1056	24	2200	210	462,000
30	1147	24	2390	186	444,540
32	1256	24	2617	162	423,954
34	1380	24	2875	138	396,750
36	1521	24	3169	114	361,266
38	1680	24	3500	90	315,000
40	1859	24	3873	66	255,618
42	2059	24	4290	42	180,180
44	2284	24	4758	18	85,644
45·5	2,400	6	1250	3	3750

ΣW= 49,247 lbf. ΣM= 5,564,870 lb.in

(at cantilever root)

Calculations for Dead Load Moments — Short Span

(c) Suspended Span 31'-4" long (30'-6" between cs of bearings)

X (of section)	Area in²	Length in	Weight lbf.	Arm in	Moment
0·5	572	12"	596	6	3,576
2	573	24	1194	24	28,656
4	580	24	1208	48	57,984
6	590	24	1220	72	95,160
8	604	24	1258	96	120,768
10	624	24	1300	120	156,000
12	644	24	1341	144	193,104
14	679	24	1416	168	237,888
14·625	690	8"	180	175·5	31,590

Half Weight of Beam, Σ W = 9,719 lbf. ΣM = 939,000 lb in

Moment at Centre, M = 9,719 × 183 − 939,000 = 847,500 lb in

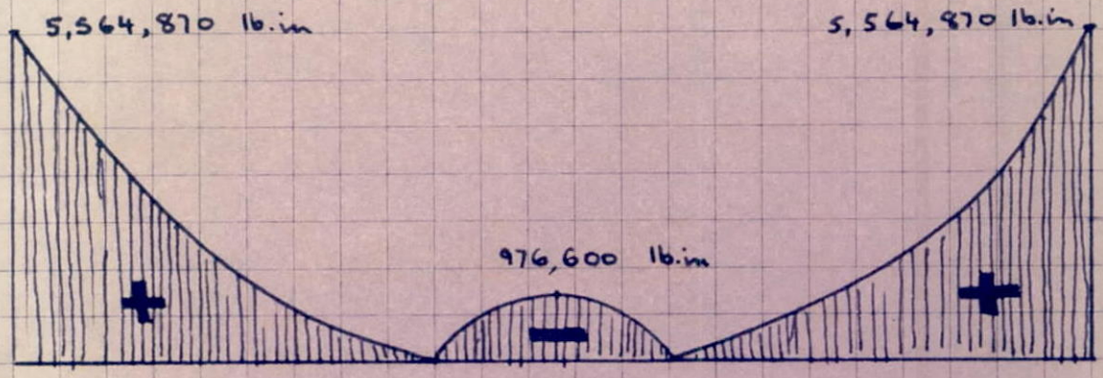
(at Beam ℄)

(d) Cantilever 27·3125' long

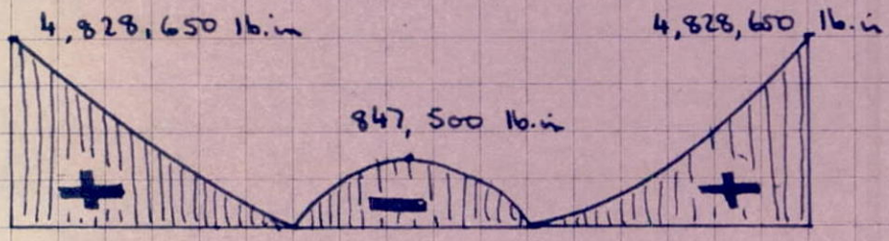
16·125	719	21	1311	317·25	415,915
18	762	24	1588	294·75	468,063
20	816	24	1700	270·75	460,275
22	880	24	1833	246·75	452,293
24	955	24	1989	222·75	443,050
26	1042	24	2108	198·75	418,965
28	1143	24	2381	174·75	416,080
30	1260	24	2625	150·75	395,719
32	1394	24	2904	126·75	368,082
34	1547	24	3223	102·75	331,163
36	1721	24	3555	78·75	282,319
38	1918	24	3996	54·75	218,781
40	2141	24	4460	30·75	137,145
41·79125	2363	18·75	2218	9·375	20,794
		ΣW	35,830		Σ M = 4,828,653 lb in

(at cantilever root)

Bending Moment Diagrams

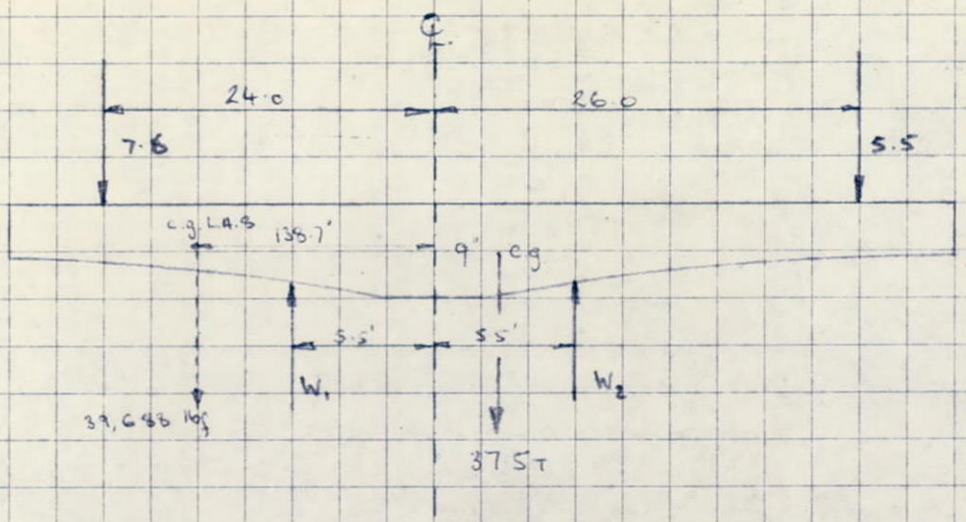


Long Span.



Short Span

Unit 3



T.M.A. W_1

$$(7\,6 \times 13\,5) - (37\,5 \times 6\,25) = 5\,5 \times 31\,5 + W_2 \times 11\,0$$

$$W_2 = 24.28\,T$$

Vert. Eq'b'lm.

$$W_1 = 7\,6 + 5\,5 + 37\,5 - 24.28 = 26.32\,T.$$

B.M. at ℄ (consdr L.H.S)

$$M = (7.6 \times 24.0 - 26.32 \times 5.5)\,2240 \times 12 + 39,685 \times 130.7$$

$$= 6,516,488 \text{ lb.in.}$$

check $\sigma_{bot} = \dfrac{6,516,488^{464}}{14,033.92} - 810 + 431 = +85.3$ p.s.i.

By inspection σ_{top} of Unit 3, and σ_{bot} and σ_{top} of Unit 5 are safe.

Continued