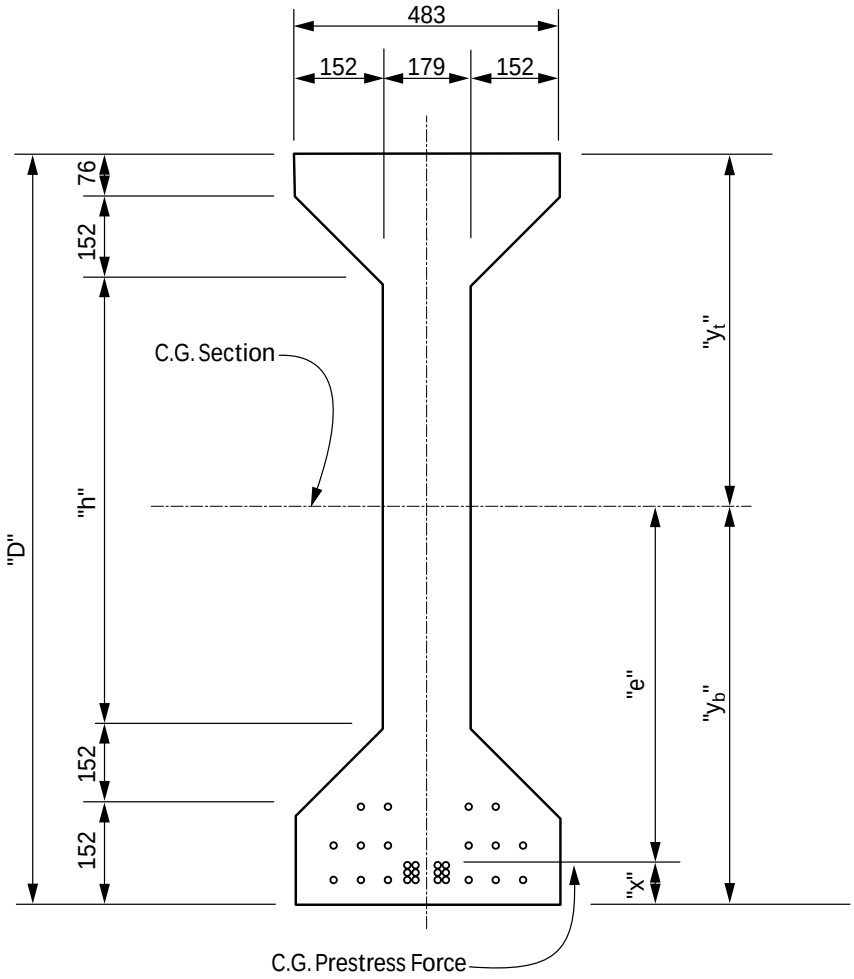
6-1 PRECAST PRESTRESSED GIRDERS

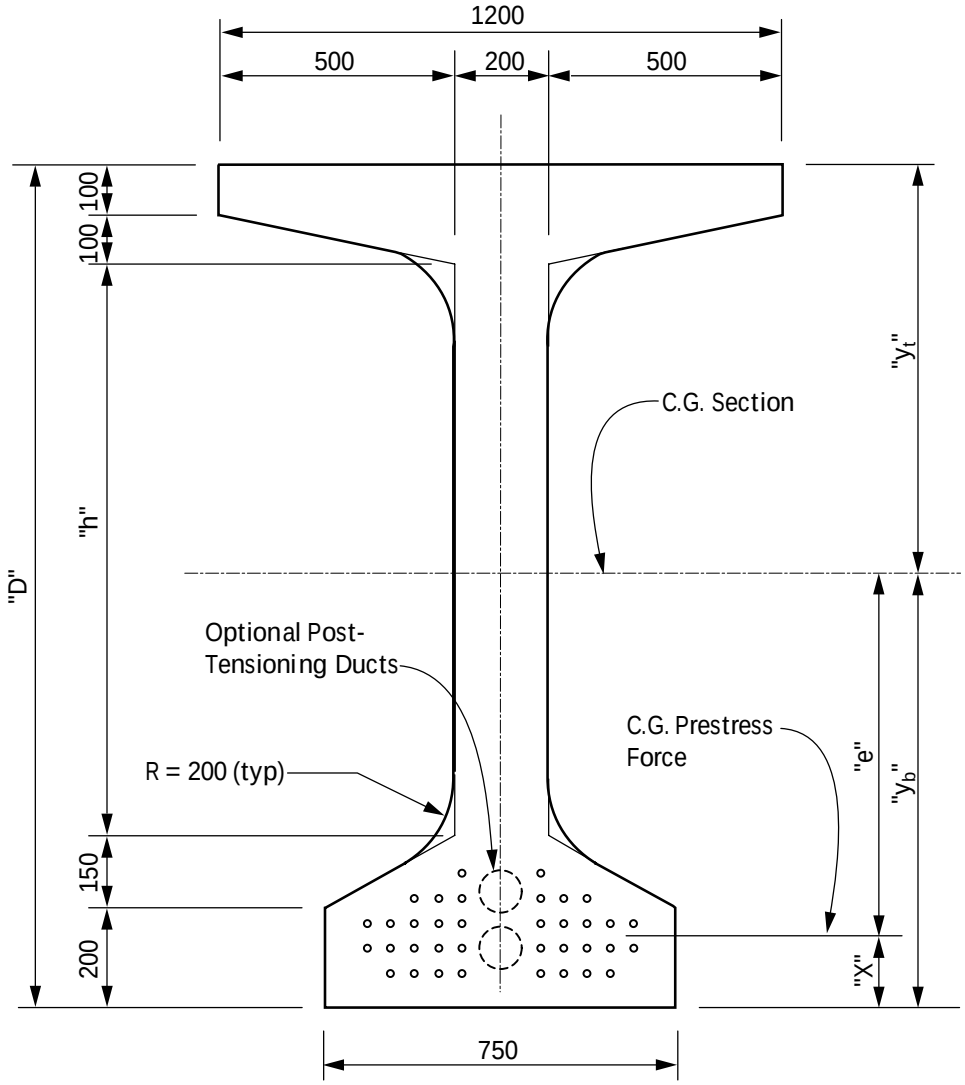
Caltrans Standard "I" Girder



Section Properties

"D" (mm)	"h" (mm)	Area (mm2)	I (mm4)	yb (mm)	yt (mm)	Sb (mm3)	St (mm3)	r (mm)	Force (N/m)	Mass (Kg/m)
914	382	279 200	26 200 E6	435	479	60.3 E6	54.7 E6	306	6580	671
1067	535	306 500	39 800 E6	508	559	78.3 E6	71.1 E6	360	7223	736
1219	687	333 700	56 800 E6	580	639	97.9 E6	89.0 E6	413	7866	802
1372	840	361 000	77 800 E6	654	718	118.9 E6	108.4 E6	464	8509	867
1524	992	388 300	102 900 E6	728	796	141.4 E6	129.3 E6	515	9152	933
1676	1144	415 600	132 600 E6	802	874	165.3 E6	151.6 E6	565	9795	998

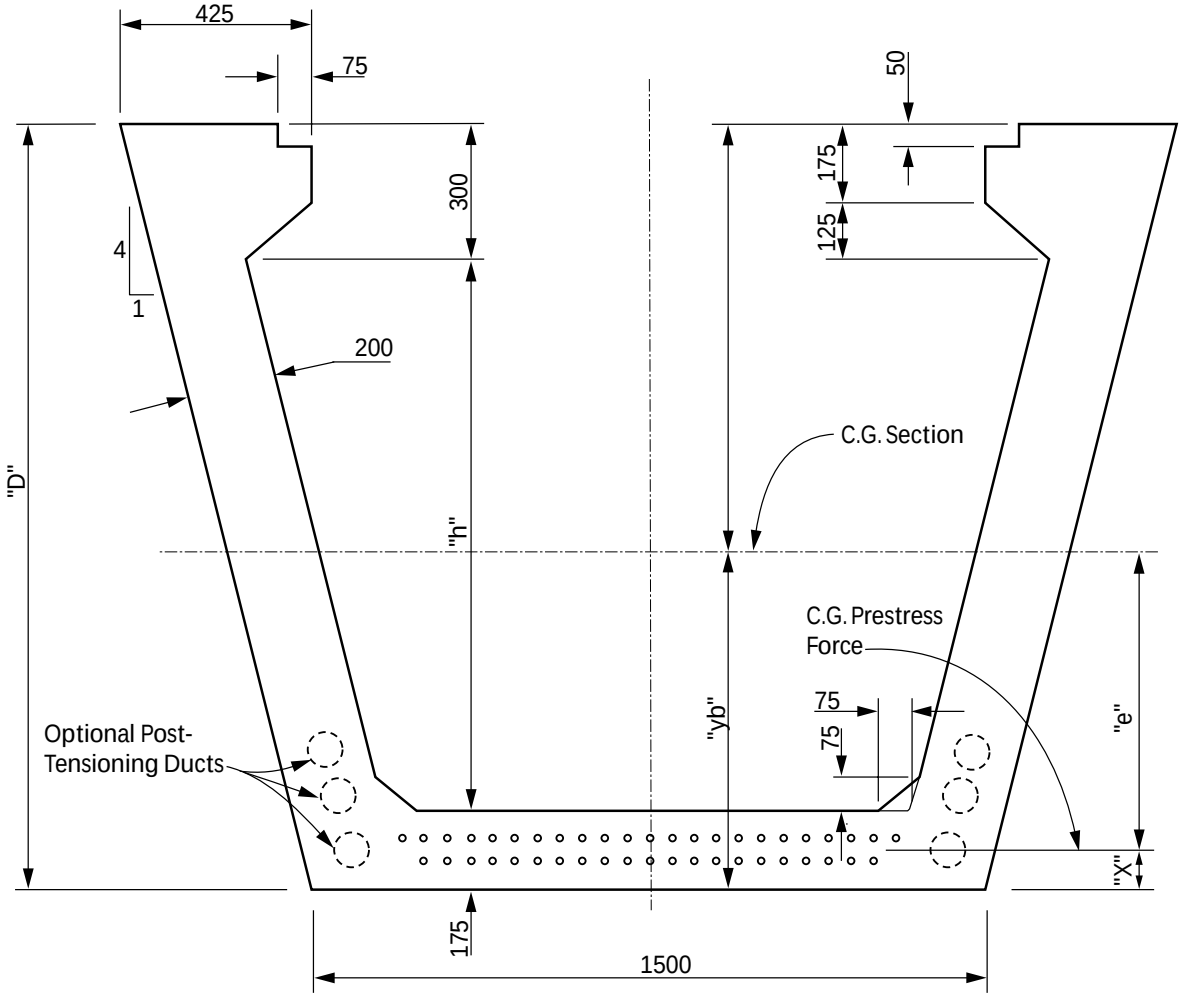
Caltrans Standard “Bulb-Tee” Girder



Section Properties

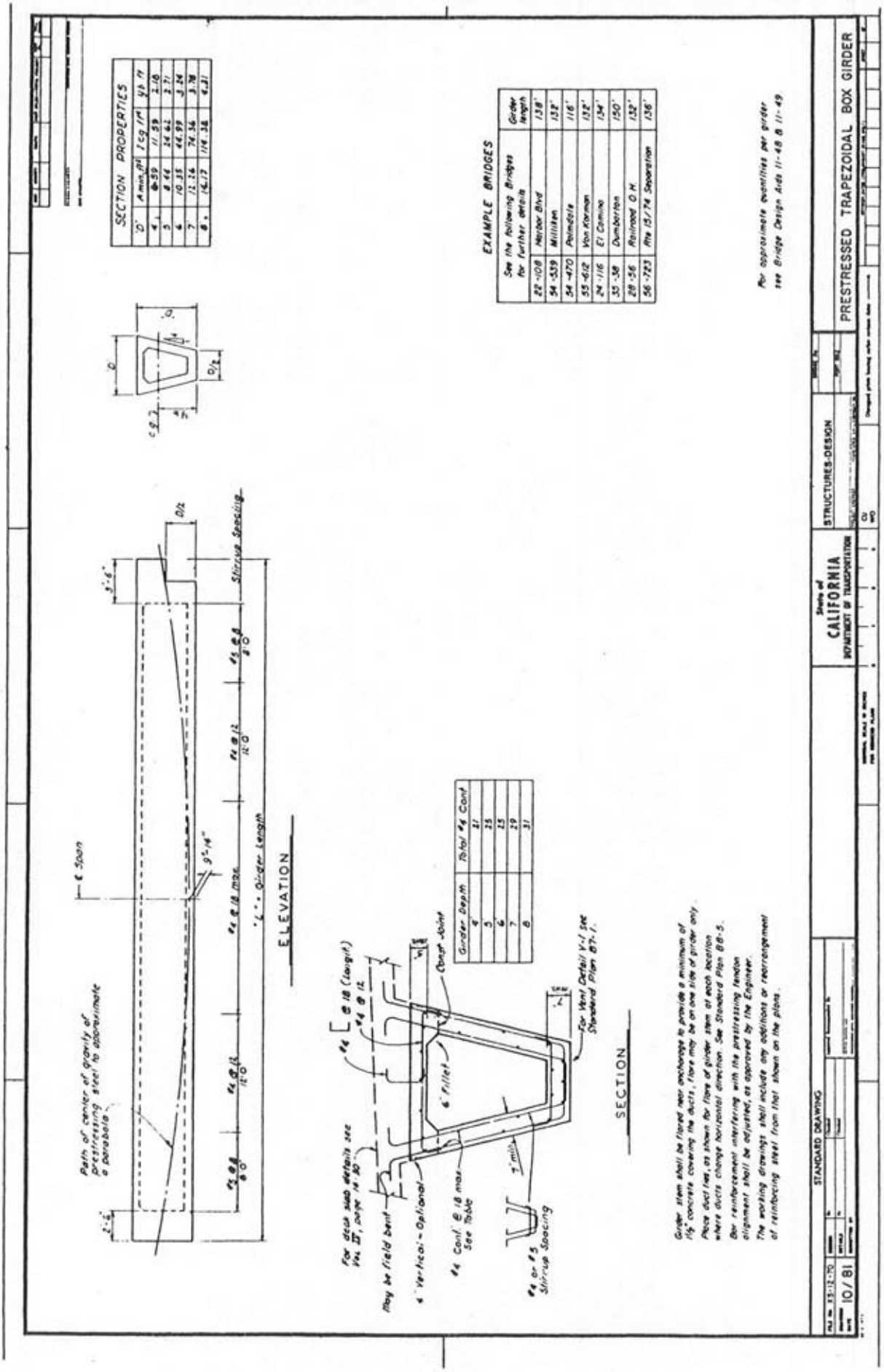
"D" (mm)	"h" (mm)	Area (mm2)	I (mm4)	yb (mm)	yt (mm)	Sb (mm3)	St (mm3)	r (mm)	Force (N/m)	Mass (Kg/m)
1400	850	596 500	155 400 E6	721	679	215.5 E6	228.8 E6	510	14 060	1433
1550	1000	626 500	201 200 E6	795	755	253.0 E6	266.5 E6	567	14 770	1505
1700	1150	656 700	254 200 E6	870	830	292.1 E6	306.2 E6	622	15 480	1577
1850	1300	686 100	314 500 E6	945	905	333.0 E6	347.5 E6	677	16 180	1650
2000	1450	716 300	382 600 E6	1019	981	375.4 E6	390.0 E6	731	16 890	1722
2150	1600	746 500	458 800 E6	1094	1056	419.4 E6	434.5 E6	784	17 600	1794

Caltrans Standard “Bathtub” Girder

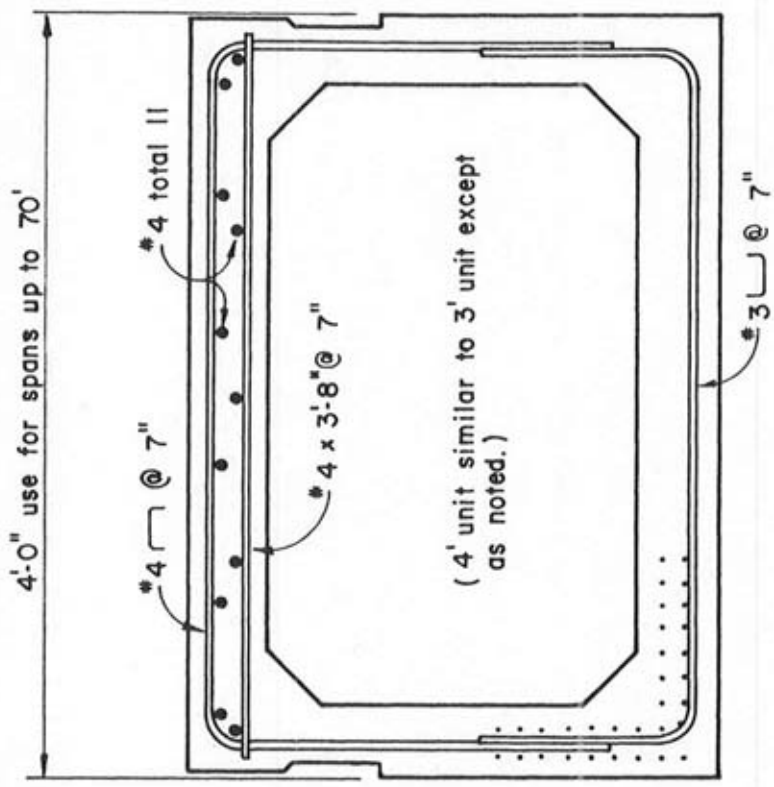


Section Properties

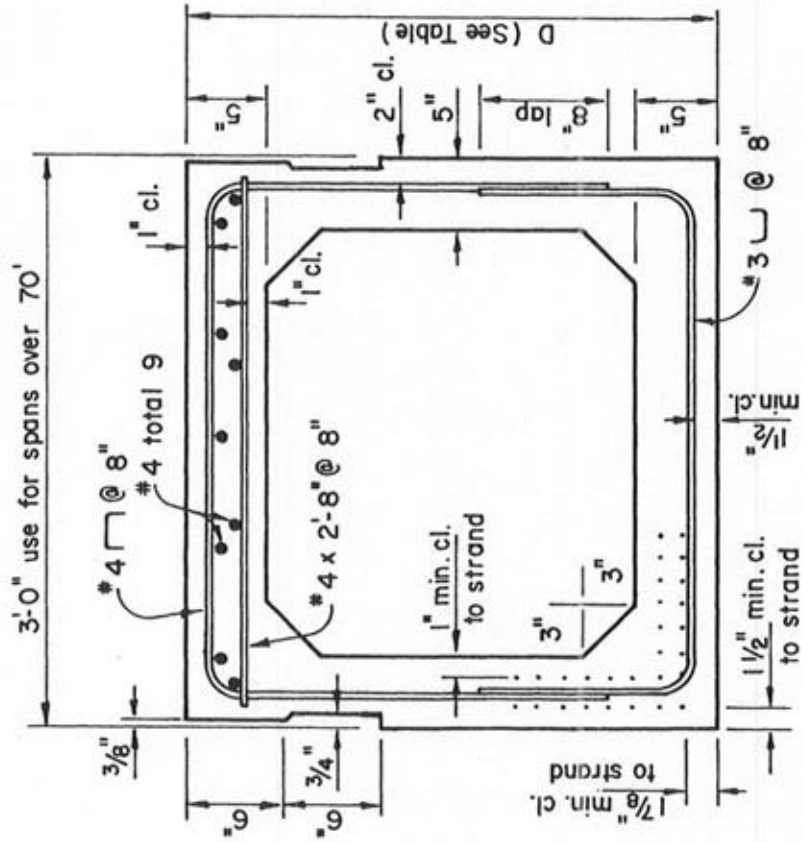
"D" (mm)	"h" (mm)	Area (mm^2)	I (mm^4)	y_b (mm)	y^t (mm)	S_b (mm^3)	S_t (mm^3)	r (mm)	Force (N/m)	Mass (Kg/m)
1400	925	864 000	191 500 E6	612	788	313.0 E6	243.1 E6	471	20 370	2076
1550	1075	925 900	251 500 E6	683	867	368.2 E6	290.0 E6	521	21 820	2225
1700	1225	987 700	321 800 E6	755	945	426.2 E6	340.5 E6	571	23 280	2374
1850	1375	1 049 600	403 200 E6	827	1023	487.5 E6	394.1 E6	620	24 740	2522
2000	1525	1 111 400	496 400 E6	899	1101	552.2 E6	450.9 E6	668	26 200	2671
2150	1675	1 173 300	602 100 E6	972	1178	619.4 E6	511.1 E6	716	27 660	2819



NOTE TO DESIGNERS: Details shown are for preliminary design only.



UNDER 70' SPAN



OVER 70' SPAN

SPANS	"D"
46' to 58'	27"
58' to 70'	33"
70' to 83'	42"

Notes :

1. All strands to be straight.
2. Detailed analysis for diagonal tension near supports must be made. Additional reinforcement in stems will probably be necessary.
3. Post-tensioning will not be permitted.
4. Strand spacing to be 4 x diameter, min., measured center to center of strands.
5. "D" values shown should be used if possible, however variations to suit particular job conditions are acceptable.

PRECAST PRESTRESSED CONCRETE BOX GIRDER

NOMOGRAPH FOR FRICTIONAL LOSS AND CABLE ELONGATION

Solution for : $T_x = T_o e^{-(\mu\phi + K\ell)}$ $\qquad T_{av} = T_x \dfrac{e^{(\mu\phi + K\ell)} - 1}{(\mu\phi + K\ell)}$

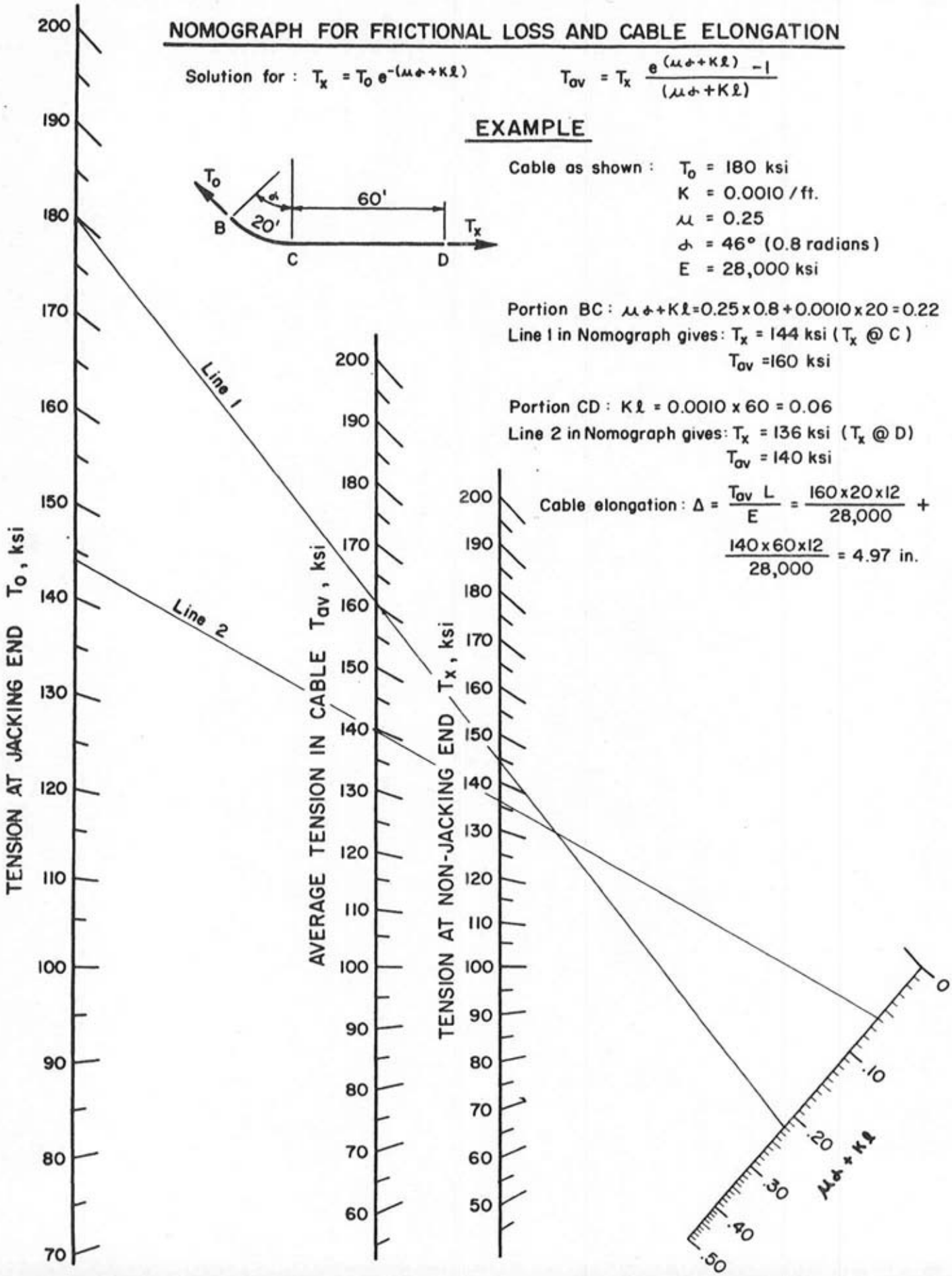
EXAMPLE

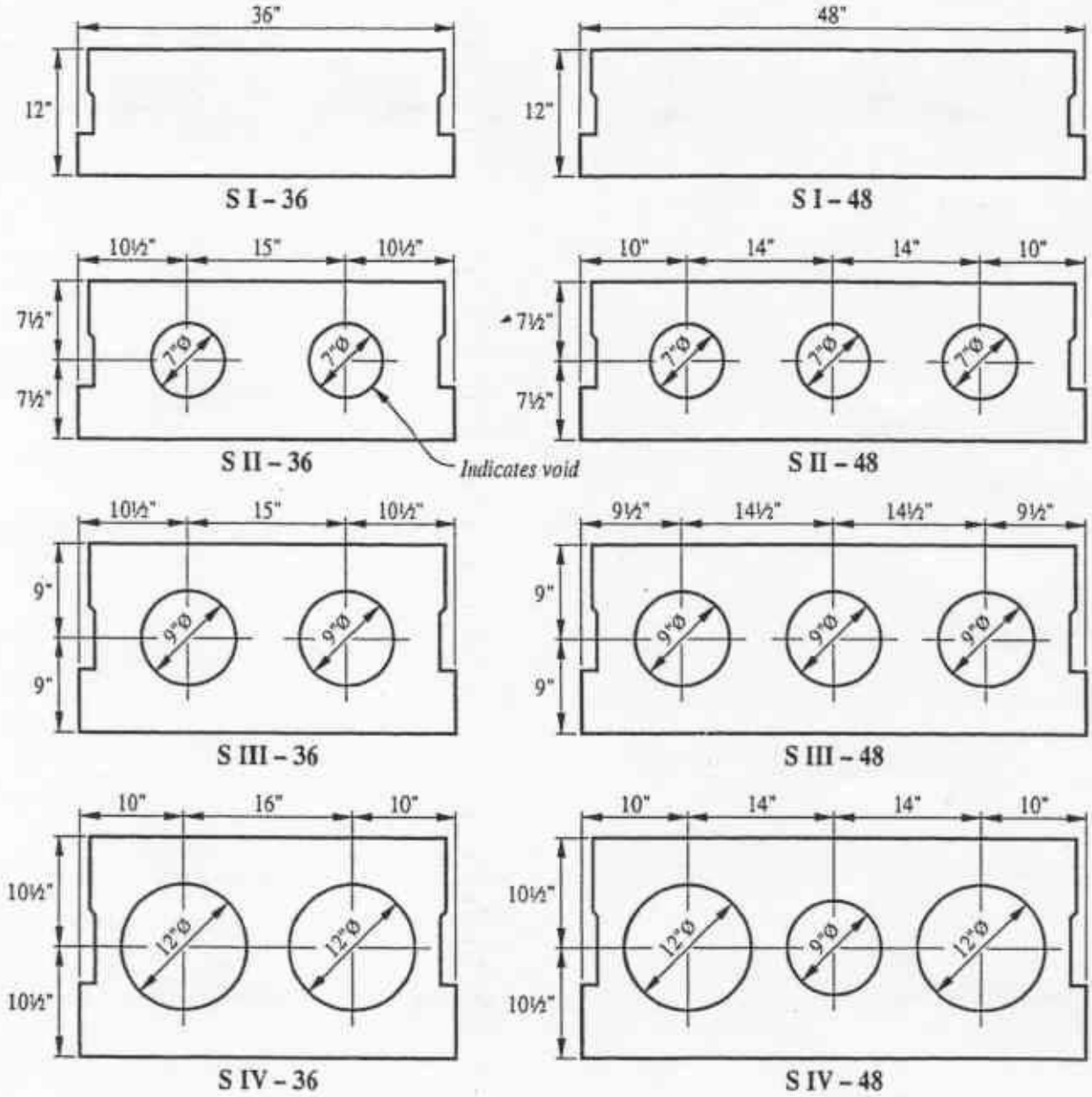
Cable as shown : T_o = 180 ksi
K = 0.0010 / ft.
μ = 0.25
ϕ = 46° (0.8 radians)
E = 28,000 ksi

Portion BC : $\mu\phi + K\ell = 0.25 \times 0.8 + 0.0010 \times 20 = 0.22$
Line 1 in Nomograph gives: T_x = 144 ksi (T_x @ C)
T_{av} = 160 ksi

Portion CD : $K\ell = 0.0010 \times 60 = 0.06$
Line 2 in Nomograph gives: T_x = 136 ksi (T_x @ D)
T_{av} = 140 ksi

Cable elongation : $\Delta = \dfrac{T_{av}\ L}{E} = \dfrac{160 \times 20 \times 12}{28{,}000} + \dfrac{140 \times 60 \times 12}{28{,}000} = 4.97$ in.





Typical Sections

General Notes:

1. P_f is the force required at center of span after all losses.
2. Slabs designed for pretensioning.
3. Concrete strength at time of stressing 4,000 psi f'_c – 4,000 psi at 28 days.
4. Live Loading = HS 20-44, Alternative and permit Design load.
5. Design 35 lbs. per square foot for surfacing.
6. Keyways to be filled with mortar.
7. See other sheets for railing requirements.
8. Barrier rail load not included.

Prestressing Steel Requirements *(To be used with Bridge Standard Detail Sheet XS 12-48)*

Typical Section	"L" Feet	36" Wide Units – Structure Width						48" Wide Units – Structure Width					
		4 to 7 Units		8 to 11 Units		12 or More Units		3 to 5 Units		6 to 8 Units		9 or More Units	
		P_f (kips)	½" Strands (each)	P_f (kips)	½" Strands (each)	P_f (kips)	½" Strands (each)	P_f (kips)	½" Strands (each)	P_f (kips)	½" Strands (each)	P_f (kips)	½" Strands (each)
S I	20	206	11	178	9	174	8	275	14	238	12	232	11
	21	226	12	195	10	190	9	301	15	260	13	254	12
	22	148	8	127	7	124	6	194	10	166	9	161	8
	23	162	9	139	8	135	7	210	11	182	10	177	9
	24	176	9	151	8	147	7	232	12	200	10	195	9
	25	190	10	164	9	160	8	251	12	216	10	211	9
	26	205	11	177	9	172	8	270	13	235	11	227	10
S II	27	219	11	190	10	185	9	289	14	250	12	244	11
	28	234	12	204	10	198	9	309	15	268	13	261	12
	29	250	13	217	11	212	10	329	16	286	14	278	13
	30	264	14	231	12	225	11	349	17	404	15	296	14
	31	281	15	245	12	239	11	370	18	323	16	314	15
	32	296	15	259	13	253	12	391	20	341	17	332	16
	33	227	11	197	10	191	9	300	15	260	13	250	12
	34	240	12	209	10	203	9	314	16	273	13	265	12
	35	252	12	221	11	215	10	331	16	289	14	281	13
	36	267	13	233	11	227	10	349	17	305	15	296	14
S III	37	281	14	245	12	239	11	367	18	321	15	312	14
	38	294	14	258	12	251	11	385	19	338	16	328	15
	39	311	15	273	13	266	12	407	20	357	17	347	16
	40	329	16	287	14	281	13	431	21	378	18	368	17
	41	347	17	305	15	297	14	454	22	400	19	388	18
	42	273	13	239	12	232	11	367	18	321	15	312	14
	43	288	14	252	12	245	11	386	19	340	16	330	15
	44	302	15	266	12	258	11	406	20	357	17	346	16
S IV	45	318	16	279	13	271	12	426	21	375	18	364	17
	46	332	16	292	14	284	13	446	22	393	19	382	18
	47	346	17	305	15	296	14	465	23	410	20	400	19
	48	361	18	319	15	310	14	488	24	430	20	418	19