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TABLES OF STIFFNESS AND CARRY-OVER FACTOR

FOR STRUCTURAL MEMBERS UNDER AXIAL LOAD

By Eugene E. Lundquist and W. D. Kroll  
Langley Memorial Aeronautical Laboratory

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TECHNICAL NOTE NO. 552

TABLES OF STIFFNESS AND CARRY-OVER FACTOR  
FOR STRUCTURAL MEMBERS UNDER AXIAL LOAD

By Eugene E. Lundquist and W. D. Kroll

SUMMARY

Tables of stiffness and carry-over factor are presented for members in which the cross section and axial load do not vary along the length of the member. These tables are of use in solving problems in the stability of structural members under axial load as well as in applications of the Cross method of moment distribution when the effects of axial load in the members are considered. The interval between successive values of the argument is small enough to make interpolation unnecessary in engineering calculations.

INTRODUCTION

The method of moment distribution developed by Hardy Cross (reference 1) can frequently be used to advantage in the stress analysis of continuous beams, continuous frames, and rigid joint trusses, some cases of which occur in aeronautical structures. In reference 2 James summarized the principles of the Cross method and extended it to show how the effects of axial load in the members may be considered in a moment-distribution analysis. In reference 3 the Cross method was further extended to show how the principles of moment distribution may be used to solve problems in the stability of structural members under axial load.

In the stability calculations as well as in a moment-distribution analysis where the effects of axial load are considered, it is desirable to have tables giving the stiffness and carry-over factor as a function of the axial load and properties of the member. Such a set of tables is presented in this paper.

The tables apply to members for which the cross section and axial load do not vary along the length of the member. The interval between successive values of the argument was made so small that no interpolation will be necessary when the tables are used in engineering calculations.

#### DEFINITIONS AND SYMBOLS

The following definitions of stiffness and carry-over factor are the same as those given in reference 3, which parallel the definitions given in references 1 and 2 with some changes in wording.

##### Stiffness

If a member is on unyielding supports at each end, the moment at one end necessary to produce a rotation of one-fourth radian of that end is called the "stiffness." The stiffness of a member will depend upon the amount of restraint at the far end. In the derivation of the criterion for stability as given in reference 3, three types of restraint at the far end are considered. The symbols used to designate the stiffness for the different types of restraint are:

S, far end fixed.

S', far end elastically restrained.

S'', far end pinned.

The stiffness of a member computed according to the foregoing definition is one-fourth that computed according to the definition given in references 1 and 2. In the Cross method the relative stiffness of the members is of importance and not the absolute value. The foregoing definition was selected so that the stiffness of a member of constant cross section with no axial load and fixed at the far end would be  $\bar{E}I/L$  instead of  $4\bar{E}I/L$ .

##### Carry-Over Factor

If a member is on unyielding supports at each end and

a moment is applied at the near end, the ratio of the moment developed at the far end to the moment applied at the near end is called the "carry-over factor." As in the case of stiffness, the carry-over factor will depend upon the degree of restraint at the far end of the member. The symbols used to designate the carry-over factor for the different types of restraint are:

C, far end fixed.

C', far end elastically restrained.

C" = 0, far end pinned.

### Sign Convention

The sign convention used in this report is the same as that used in references 2 and 3. A clockwise moment acting on the end of a member is positive. A counter-clockwise moment acting on a joint is positive. An external moment applied at a joint is considered to act on the joint.

### Symbols

E, modulus of elasticity.

$\bar{E}$ , effective modulus of elasticity.

I, moment of inertia of cross section of member about a centroidal axis normal to the plane of bending.

L, length of member.

P, axial load in member (absolute value).

$$\alpha = 6 \frac{\frac{L}{j} \csc \frac{L}{j} - 1}{\left(\frac{L}{j}\right)^2}$$

$$\beta = 3 \frac{1 - \frac{L}{j} \cot \frac{L}{j}}{\left(\frac{L}{j}\right)^2}$$

For compression members

$$\alpha = 6 \frac{\frac{L}{j} \operatorname{csch} \frac{L}{j} - 1}{-\left(\frac{L}{j}\right)^2}$$

$$\beta = 3 \frac{1 - \frac{L}{j} \operatorname{coth} \frac{L}{j}}{-\left(\frac{L}{j}\right)^2}$$

For tension members

$$j = \sqrt{\frac{EI}{P}}$$

$$\frac{L}{j} = L \sqrt{\frac{P}{EI}}$$

$$\left(\frac{L}{j}\right)_{\text{eff}} = L \sqrt{\frac{P}{\bar{E}I}}$$

Effective values of  $\alpha$  and  $\beta$  are obtained by substitution of  $(L/j)_{\text{eff}}$  for  $L/j$ .

#### FORMULAS USED IN CALCULATION OF TABLES

In tables I and II for compression and tension, respectively, the far end of the member is considered as either pinned or fixed. The stiffness and carry-over factor that applies when the far end is elastically restrained is expressed in terms of these quantities by formulas given in reference 3.

The argument in tables I and II is  $(L/j)_{\text{eff}}$ . In the elastic range  $\bar{E} = E$  and  $(L/j)_{\text{eff}} = (L/j)$ . Above the elastic range, however, it is necessary to use a reduced modulus  $\bar{E}$ , which is called the "effective modulus." In reference 3 it is shown how the effective modulus can be

obtained from the accepted column formula for the material comprising the member.

The second, third, and fourth columns in tables I and II were computed by means of the following formulas:

$$c = \frac{\alpha}{2\beta} \quad (1)$$

$$\frac{s''}{\left(\frac{\bar{EI}}{L}\right)} = \frac{3}{4\beta} \quad (2)$$

$$\frac{s}{\left(\frac{\bar{EI}}{L}\right)} = \frac{s''}{\left(\frac{\bar{EI}}{L}\right)} \left[ \frac{1}{1 - c^2} \right] \quad (3)$$

These equations were first presented by James in reference 2 except that the more general form of equation (3) is taken from reference 3.

The last two columns in tables I and II were obtained from the preceding columns as indicated by their headings. These columns are included because of their convenience in stability calculations (reference 3).

#### ACCURACY OF TABLES

The tables of reference 4 were used in the preparation of tables I and II. All calculations were made using eight significant figures. Equations (1), (2), and (3) were used in the form and order given to calculate the second, third, and fourth columns. The fifth column was obtained by squaring the second column. The sixth column was obtained by squaring the fourth column and multiplying by the fifth column. The last column was therefore made to depend upon all preceding columns. All values were then tabulated to six significant figures and the differences for the last

column were studied; in some cases as much as the fourth difference was used. An independent check was also made for a series of values throughout the tables as well as where errors were suggested by irregular differences. In each case where errors were suspected, they were traced to the tables of reference 4.

Langley Memorial Aeronautical Laboratory,  
National Advisory Committee for Aeronautics,  
Langley Field, Va., May 12, 1938.

#### REFERENCES

1. Cross, Hardy: Analysis of Continuous Frames by Distributing Fixed-End Moments. A.S.C.E. Trans., vol. 96, 1932, pp. 1-10.
2. James, Benjamin Wylie: Principal Effects of Axial Load on Moment-Distribution Analysis of Rigid Structures. T.N. No. 534, N.A.C.A., 1935.
3. Lundquist, Eugene E.: Stability of Structural Members under Axial Load. T.N. No. 617, N.A.C.A., 1937.
4. Hayashi, Keiichi: Sieben- und mehrstellige Tafeln der Kresi- und Hyperbelfunktionen und deren Producte sowie der Gammafunktion. Julius Springer (Berlin), 1926.

TABLE I  
COMPRESSION

$\left(\frac{L}{J}\right)_{\text{eff}}$	C	$\frac{S''}{\left(\frac{EI}{L}\right)}$	$\frac{S}{\left(\frac{EI}{L}\right)}$	$C^2$	$\frac{S^2 C^2}{\left(\frac{EI}{L}\right)^2}$
0	0.500000	0.750000	1.000000	0.250000	0.250000
.1	.500243	.749505	.999664	.250243	.250075
.2	.501001	.747996	.998663	.251002	.250332
.3	.502260	.745488	.996996	.252265	.250752
.4	.504034	.741963	.994656	.254050	.251342
.5	.506333	.737410	.991639	.256373	.252104
.6	.509173	.731812	.987943	.259257	.253043
.7	.512572	.725149	.983561	.262780	.254163
.8	.516565	.717398	.978486	.266829	.255471
.9	.521146	.708528	.972709	.271593	.256971
1.0	.526380	.698505	.966221	.277075	.258673
1.01	.526940	.697438	.965532	.277665	.258854
1.02	.527506	.696358	.964837	.278268	.259038
1.03	.528080	.695267	.964134	.278884	.259224
1.04	.528661	.694164	.963424	.279512	.259411
1.05	.529249	.693049	.962707	.280104	.259602
1.06	.529843	.691921	.961982	.280734	.259794
1.07	.530445	.690782	.961250	.281372	.259988
1.08	.531054	.689630	.960511	.282018	.260185
1.09	.531669	.688466	.959764	.282672	.260383
1.10	.532293	.687289	.959011	.283336	.260584
1.11	.532923	.686100	.958249	.284007	.260787
1.12	.533561	.684899	.957481	.284687	.260992
1.13	.534205	.683685	.956705	.285375	.261200
1.14	.534855	.682459	.955922	.286073	.261410
1.15	.535517	.681220	.955131	.286779	.261621
1.16	.536185	.679968	.954333	.287494	.261836
1.17	.536859	.678704	.953527	.288218	.262052
1.18	.537542	.677427	.952715	.288951	.262271
1.19	.538232	.676137	.951894	.289693	.262492
1.20	.538929	.674834	.951066	.290445	.262715
1.21	.539635	.673518	.950231	.291206	.262941
1.22	.540348	.672190	.949388	.291976	.263169
1.23	.541069	.670848	.948538	.292765	.263399
1.24	.541798	.669493	.947680	.293565	.263632
1.25	.542535	.668125	.946814	.294374	.263867
1.26	.543279	.666744	.945941	.295193	.264104
1.27	.544033	.665350	.945061	.295971	.264344
1.28	.544794	.663942	.944173	.296800	.264586
1.29	.545563	.662521	.943277	.297639	.264830
1.30	.546341	.661086	.942374	.298485	.265078
1.31	.547127	.659638	.941462	.299347	.265327
1.32	.547921	.658176	.940544	.300217	.265579
1.33	.548724	.656701	.939618	.301098	.265833
1.34	.549535	.655212	.938683	.301989	.266090
1.35	.550355	.653707	.937742	.302890	.266350
1.36	.551183	.652192	.936792	.303803	.266611
1.37	.552021	.650661	.935835	.304727	.266876
1.38	.552867	.649116	.934870	.305662	.267143
1.39	.553722	.647557	.933897	.306608	.267412
1.40	.554585	.645984	.932917	.307565	.267684



TABLE I (Continued)  
COMPRESSION

$\left(\frac{L}{j}\right)_{\text{eff}}$	C	$\frac{S''}{\left(\frac{EI}{L}\right)}$	$\frac{S}{\left(\frac{EI}{L}\right)}$	$C^2$	$\frac{S^2 C^2}{\left(\frac{EI}{L}\right)^2}$
1.41	.555458	.644597	.931928	.308554	.267959
1.42	.556340	.642795	.930932	.309575	.268236
1.43	.557231	.641179	.929928	.310507	.268516
1.44	.558132	.639549	.928916	.311511	.268798
1.45	.559041	.637903	.927896	.312527	.269084
1.46	.559961	.636244	.926869	.313556	.269371
1.47	.560889	.634569	.925833	.314597	.269662
1.48	.561827	.632880	.924790	.315650	.269958
1.49	.562775	.631176	.923738	.316716	.270251
1.50	.563733	.629457	.922679	.317794	.270550
1.51	.564700	.627723	.921611	.318886	.270851
1.52	.565677	.625973	.920536	.319990	.271156
1.53	.566664	.624209	.919452	.321106	.271462
1.54	.567661	.622429	.918361	.322239	.271772
1.55	.568668	.620634	.917261	.323384	.272085
1.56	.569686	.618823	.916153	.324542	.272400
1.57	.570714	.616996	.915037	.325714	.272718
1.58	.571752	.615154	.913913	.326901	.273040
1.59	.572801	.613296	.912781	.328101	.273364
1.60	.573861	.611423	.911641	.329316	.273691
1.61	.574931	.609533	.910492	.330546	.274021
1.62	.576012	.607627	.909335	.331790	.274354
1.63	.577104	.605705	.908170	.333049	.274690
1.64	.578207	.603766	.906997	.334323	.275029
1.65	.579321	.601812	.905815	.335613	.275371
1.66	.580446	.599840	.904625	.336918	.275716
1.67	.581583	.597853	.903427	.338239	.276064
1.68	.582731	.595845	.902220	.339576	.276415
1.69	.583891	.593826	.901005	.340929	.276769
1.70	.585062	.591788	.899781	.342298	.277126
1.71	.586245	.589732	.898549	.343684	.277487
1.72	.587440	.587660	.897308	.345086	.277851
1.73	.588648	.585570	.896060	.346506	.278218
1.74	.589867	.583462	.894802	.347943	.278588
1.75	.591098	.581337	.893536	.349397	.278961
1.76	.592342	.579194	.892261	.350869	.279338
1.77	.593598	.577034	.890978	.352359	.279717
1.78	.594868	.574855	.889686	.353867	.280101
1.79	.596149	.572659	.888386	.355394	.280487
1.80	.597444	.570444	.887077	.356939	.280877
1.81	.598752	.568211	.885759	.358504	.281271
1.82	.600073	.565960	.884432	.360087	.281667
1.83	.601407	.563689	.883097	.361690	.282068
1.84	.602754	.561401	.881753	.363313	.282471
1.85	.604116	.559093	.880400	.364956	.282878
1.86	.605491	.556766	.879038	.366619	.283289
1.87	.606879	.554420	.877667	.368302	.283703
1.88	.608282	.552055	.876288	.370007	.284121
1.89	.609699	.549670	.874899	.371733	.284543

TABLE I (Continued)  
COMPRESSION

$\left(\frac{L}{J}\right)_{\text{eff}}$	C	$\frac{S^2}{\left(\frac{EI}{L}\right)}$	$\frac{S}{\left(\frac{EI}{L}\right)}$	C <sup>2</sup>	$\frac{S^2 C^2}{\left(\frac{EI}{L}\right)^2}$
1.90	0.611131	0.547266	0.873502	0.373460	0.254965
1.91	.612576	.544842	.872095	.375250	.255396
1.92	.614037	.542395	.870680	.377041	.255829
1.93	.615512	.539933	.869265	.378835	.256265
1.94	.617002	.537449	.867822	.380692	.256705
1.95	.618508	.534944	.866379	.382552	.257148
1.96	.620025	.532419	.864927	.384435	.257596
1.97	.621565	.529872	.863466	.386343	.258047
1.98	.623117	.527305	.861996	.388274	.258502
1.99	.624684	.524717	.860517	.390230	.258961
2.00	.626268	.522107	.859025	.392211	.259424
2.01	.627868	.519476	.857530	.394218	.259891
2.02	.629484	.516823	.856023	.396250	.260362
2.03	.631117	.514149	.854506	.398309	.260837
2.04	.632767	.511452	.852980	.400393	.261316
2.05	.634433	.508733	.851444	.402505	.261799
2.06	.636117	.505992	.849899	.404645	.262286
2.07	.637815	.503228	.848345	.406812	.262778
2.08	.639537	.500441	.846781	.409007	.263274
2.09	.641273	.497631	.845207	.411231	.263775
2.10	.643025	.494798	.843624	.413485	.264281
2.11	.644800	.491942	.842031	.415768	.264796
2.12	.646592	.489062	.840429	.418081	.265319
2.13	.648401	.486157	.838816	.420424	.265851
2.14	.650230	.483229	.837194	.422799	.266388
2.15	.652075	.480276	.835562	.425206	.266934
2.16	.653945	.477299	.833921	.427644	.267489
2.17	.655832	.474297	.832269	.430116	.268059
2.18	.657739	.471270	.830608	.432620	.268644
2.19	.659666	.468217	.828937	.435159	.269243
2.20	.661613	.465139	.827256	.437732	.269852
2.21	.663581	.462036	.825564	.440339	.270476
2.22	.665570	.458906	.823862	.442983	.271124
2.23	.667579	.455749	.822151	.445662	.271797
2.24	.669611	.452566	.820429	.448378	.272496
2.25	.671664	.449357	.818697	.451132	.273220
2.26	.673739	.446120	.816955	.453924	.273976
2.27	.675836	.442855	.815203	.456754	.274769
2.28	.677956	.439563	.813440	.459624	.275597
2.29	.680099	.436243	.811667	.462534	.276469
2.30	.682265	.432895	.809884	.465485	.277381
2.31	.684454	.429518	.808090	.468478	.278342
2.32	.686668	.426112	.806286	.471512	.279359
2.33	.688905	.422677	.804471	.474590	.280442
2.34	.691167	.419212	.802645	.477712	.281596
2.35	.693454	.415718	.800809	.480878	.282835
2.36	.695766	.412193	.798963	.484090	.284164
2.37	.698103	.408638	.797105	.487348	.285599
2.38	.700466	.405051	.795237	.490653	.287140
2.39	.702856	.401434	.793358	.494006	.288796
2.40	.705272	.397785	.791468	.497409	.290587

TABLE I (Continued)  
COMPRESSION

$\left(\frac{L}{J}\right)_{\text{eff}}$	C	$\frac{S''}{\left(\frac{EI}{L}\right)}$	$\frac{S}{\left(\frac{EI}{L}\right)}$	C <sup>2</sup>	$\frac{S^2 C^2}{\left(\frac{EI}{L}\right)^2}$
2.41	.707715	.394104	.789567	.500861	.312245
2.42	.710186	.390891	.787655	.504363	.312908
2.43	.712654	.386645	.785733	.507918	.313576
2.44	.715210	.382866	.783799	.511525	.314251
2.45	.717765	.379053	.781854	.515186	.314931
2.46	.720349	.375207	.779898	.518902	.315617
2.47	.722962	.371326	.777930	.522674	.316310
2.48	.725605	.367411	.775952	.526503	.317008
2.49	.728279	.363461	.773962	.530390	.317713
2.50	.730983	.359475	.771961	.534336	.318423
2.51	.733718	.355453	.769948	.538342	.319140
2.52	.736485	.351394	.767924	.542410	.319863
2.53	.739284	.347299	.765888	.546541	.320593
2.54	.742116	.343167	.763841	.550736	.321328
2.55	.744980	.338996	.761782	.554996	.322071
2.56	.747879	.334788	.759712	.559323	.322820
2.57	.750812	.330540	.757629	.563718	.323576
2.58	.753779	.326253	.755535	.568183	.324338
2.59	.756781	.321927	.753429	.572718	.325107
2.60	.759820	.317560	.751311	.577326	.325882
2.61	.762894	.313152	.749181	.582008	.326665
2.62	.766006	.308703	.747040	.586765	.327455
2.63	.769155	.304211	.744888	.591600	.328252
2.64	.772342	.299678	.742719	.596513	.329055
2.65	.775568	.295101	.740541	.601506	.329866
2.66	.778834	.290480	.738350	.606582	.330685
2.67	.782139	.285815	.736147	.611742	.331510
2.68	.785485	.281105	.733931	.616987	.332343
2.69	.788873	.276349	.731703	.622320	.333184
2.70	.792302	.271547	.729462	.627743	.334032
2.71	.795775	.266699	.727209	.633257	.334888
2.72	.799290	.261802	.724943	.638865	.335751
2.73	.802850	.256858	.722665	.644569	.336622
2.74	.806455	.251864	.720373	.650370	.337501
2.75	.810106	.246820	.718069	.656272	.338389
2.76	.813803	.241727	.715751	.662276	.339284
2.77	.817548	.236581	.713421	.668385	.340187
2.78	.821341	.231384	.711078	.674600	.341099
2.79	.825182	.226134	.708721	.680926	.342019
2.80	.829074	.220831	.706351	.687364	.342947
2.81	.833017	.215473	.703968	.693917	.343883
2.82	.837011	.210060	.701571	.700587	.344820
2.83	.841057	.204590	.699161	.707378	.345765
2.84	.845158	.199064	.696737	.714292	.346718
2.85	.849313	.193479	.694290	.721332	.347678
2.86	.853523	.187836	.691829	.728502	.348641
2.87	.857790	.182133	.689354	.735804	.349609
2.88	.862115	.176369	.686866	.743242	.350691
2.89	.866498	.170543	.684363	.750819	.351699

TABLE I (continued)

$\left(\frac{L}{J}\right)_{\text{eff}}$	C	$\frac{S^2}{EI}$	$\frac{S}{EI}$	$C^2$	$\frac{S^2 C^2}{EI^2}$
2.90	0.870941	0.164654	0.681906	0.758539	0.352718
2.91	.875446	.158701	.679386	.766408	.353746
2.92	.880012	.152683	.676850	.774421	.354783
2.93	.884642	.146599	.674301	.782591	.355830
2.94	.889336	.140448	.671738	.790919	.356888
2.95	.894096	.134228	.669160	.799408	.357955
2.96	.898923	.127959	.666567	.808063	.359032
2.97	.903819	.121579	.663960	.816888	.360119
2.98	.908784	.115147	.661338	.825889	.361216
2.99	.913821	.108641	.658702	.835068	.362326
3.00	.918930	.102060	.656050	.844432	.363444
3.01	.924113	.0954039	.653384	.853988	.364575
3.02	.929372	.0886698	.650701	.863738	.365715
3.03	.934708	.0818568	.648005	.873679	.366866
3.04	.940123	.0749633	.645292	.883800	.368028
3.05	.945618	.0679879	.642565	.894193	.369203
3.06	.951195	.0609290	.639822	.904772	.370389
3.07	.956856	.0537850	.637063	.915553	.371585
3.08	.962603	.0465543	.634289	.926604	.372793
3.09	.968437	.0392350	.631499	.937870	.374014
3.10	.974360	.0318257	.628694	.949376	.375248
3.11	.980375	.0243243	.625872	.961135	.376491
3.12	.986485	.0167291	.623035	.973149	.377749
3.13	.992687	.00903818	.620182	.985427	.379021
3.14	.998987	.00124960	.617242	.997979	.380316
$\pi$	1.00000	0	.616850	1.00000	.380504
3.15	1.00539	-.00663866	.614429	1.01080	.381602
3.16	1.01189	-.0146287	.611520	1.02392	.382703
3.17	1.01850	-.0227226	.608598	1.03734	.383821
3.18	1.02521	-.0309225	.605663	1.05106	.384956
3.19	1.03203	-.0392308	.602708	1.06509	.386102
3.20	1.03897	-.0476498	.599738	1.07945	.387263
3.21	1.04601	-.0561818	.596750	1.09416	.388437
3.22	1.05318	-.0648294	.593745	1.10919	.389626
3.23	1.06046	-.0735951	.590723	1.12456	.390828
3.24	1.06787	-.0824816	.587685	1.14035	.392044
3.25	1.07541	-.0914915	.584625	1.15650	.393275
3.26	1.08307	-.100628	.581551	1.17303	.394521
3.27	1.09086	-.109893	.578459	1.18998	.395783
3.28	1.09879	-.119290	.575348	1.20734	.397058
3.29	1.10686	-.128823	.572218	1.22513	.401149
3.30	1.11506	-.138494	.569072	1.24337	.402656
3.31	1.12342	-.148307	.565906	1.26207	.404178
3.32	1.13192	-.158266	.562723	1.28125	.405716
3.33	1.14058	-.168372	.559520	1.30092	.407270
3.34	1.14939	-.178632	.556299	1.32111	.408841
3.35	1.15837	-.189047	.553058	1.34182	.410427
3.36	1.16751	-.199622	.549799	1.36308	.412031
3.37	1.17682	-.210362	.546521	1.38491	.413652
3.38	1.18631	-.221270	.543223	1.40733	.415290
3.39	1.19597	-.232350	.539905	1.43035	.416945
3.40	1.20582	-.243607	.536569	1.45401	.418616

TABLE I (continued)

$\left(\frac{L}{J}\right)_{\text{eff}}$	C	$\frac{S''}{\left(\frac{EI}{L}\right)}$	$\frac{S}{\left(\frac{EI}{L}\right)}$	$C^2$	$\frac{S^2 C^2}{\left(\frac{EI}{L}\right)^2}$
3.41	1.21586	-.255047	.533212	1.47832	.420309
3.42	1.22610	-.266673	.529836	1.50931	.422018
3.43	1.23653	-.278491	.526438	1.52901	.423746
3.44	1.24717	-.290505	.523021	1.55544	.425492
3.45	1.25802	-.302722	.519584	1.58262	.427257
3.46	1.26909	-.315147	.516126	1.61060	.429041
3.47	1.28039	-.327785	.512648	1.63940	.430846
3.48	1.29192	-.340644	.509148	1.66905	.432670
3.49	1.30368	-.353728	.505627	1.69958	.434514
3.50	1.31569	-.367045	.502085	1.73104	.436378
3.51	1.32795	-.380602	.498522	1.76346	.438262
3.52	1.34048	-.394405	.494937	1.79688	.440168
3.53	1.35327	-.408463	.491330	1.83134	.442095
3.54	1.36634	-.422782	.487701	1.86689	.444044
3.55	1.37970	-.437371	.484051	1.90356	.446014
3.56	1.39335	-.452238	.480377	1.94142	.448007
3.57	1.40731	-.467392	.476682	1.98051	.450022
3.58	1.42158	-.482841	.472963	2.02089	.452061
3.59	1.43618	-.498597	.469222	2.06260	.454122
3.60	1.45111	-.514668	.465457	2.10572	.456207
3.61	1.46639	-.531064	.461670	2.15031	.458315
3.62	1.48204	-.547798	.457859	2.19643	.460448
3.63	1.49805	-.564879	.454024	2.24416	.462606
3.64	1.51445	-.582321	.450165	2.29357	.464789
3.65	1.53126	-.600135	.446282	2.34474	.466997
3.66	1.54847	-.618335	.442375	2.39776	.469231
3.67	1.56612	-.636934	.438443	2.45272	.471491
3.68	1.58420	-.655946	.434486	2.50971	.473778
3.69	1.60276	-.675387	.430505	2.56883	.476091
3.70	1.62179	-.695273	.426498	2.63019	.478432
3.71	1.64131	-.715619	.422465	2.69391	.480801
3.72	1.66136	-.736445	.418407	2.76011	.483199
3.73	1.68194	-.757767	.414323	2.82895	.485628
3.74	1.70308	-.779606	.410213	2.90049	.488080
3.75	1.72480	-.801982	.406077	2.97495	.490565
3.76	1.74718	-.824916	.401914	3.05247	.493080
3.77	1.77009	-.848432	.397723	3.13322	.495625
3.78	1.79371	-.872553	.393506	3.21738	.498202
3.79	1.81801	-.897304	.389261	3.30514	.500810
3.80	1.84302	-.922712	.384989	3.39672	.503451
3.81	1.86878	-.948807	.380689	3.49234	.506124
3.82	1.89532	-.975617	.376360	3.59224	.508830
3.83	1.92268	-.100318	.372003	3.69669	.511570
3.84	1.95088	-.103151	.367617	3.80695	.514343
3.85	1.97998	-.106067	.363202	3.92234	.517154
3.86	2.01002	-.109069	.358758	4.04401	.519999
3.87	2.04103	-.112159	.354284	4.16581	.522879
3.88	2.07307	-.115344	.349780	4.29763	.525797

TABLE I (continued)

$\left(\frac{L}{J}\right)_{\text{eff}}$	C	$\frac{S''}{\left(\frac{EI}{L}\right)}$	$\frac{S}{\left(\frac{EI}{L}\right)}$	$C^2$	$\frac{S^2 C^2}{\left(\frac{EI}{L}\right)^2}$
3.89	2.10619	-1.18628	0.345245	4.43605	0.528752
3.90	2.14045	-1.22015	.340680	4.58151	.531744
3.91	2.17589	-1.25511	.336085	4.73480	.534775
3.92	2.21259	-1.29121	.331458	4.89555	.537846
3.93	2.25061	-1.32852	.326799	5.06524	.540956
3.94	2.29002	-1.36709	.322109	5.24419	.544107
3.95	2.33090	-1.40701	.317386	5.43311	.547299
3.96	2.37334	-1.44834	.312631	5.63273	.550533
3.97	2.41741	-1.49116	.307848	5.84388	.553810
3.98	2.46323	-1.53556	.303022	6.06748	.557130
3.99	2.51088	-1.58165	.298167	6.30452	.560495
4.00	2.56049	-1.62948	.293279	6.55610	.563905
4.01	2.61217	-1.67922	.288355	6.82343	.567361
4.02	2.66606	-1.73096	.283398	7.10787	.570863
4.03	2.72230	-1.78482	.278405	7.41090	.574413
4.04	2.78104	-1.84097	.273376	7.73418	.578011
4.05	2.84246	-1.89953	.268312	8.07955	.581659
4.06	2.90673	-1.96069	.263212	8.44909	.585356
4.07	2.97407	-2.02462	.258076	8.84310	.589105
4.08	3.04469	-2.09153	.252900	9.27016	.592906
4.09	3.11885	-2.16163	.247689	9.72720	.596760
4.10	3.19680	-2.23517	.242439	10.2195	.600668
4.11	3.27885	-2.31241	.237151	10.7508	.604631
4.12	3.36532	-2.39366	.231824	11.3254	.608650
4.13	3.45656	-2.47924	.226457	11.9479	.612726
4.14	3.55304	-2.56952	.221051	12.6241	.616861
4.15	3.65515	-2.66491	.215605	13.3602	.621054
4.16	3.76343	-2.76587	.210118	14.1634	.625308
4.17	3.87843	-2.87290	.204590	15.0422	.629624
4.18	4.00082	-2.98660	.199020	16.0065	.634003
4.19	4.13130	-3.10762	.193408	17.0677	.638445
4.20	4.27073	-3.23670	.187753	18.2391	.642953
4.21	4.42004	-3.37471	.182055	19.5367	.647527
4.22	4.58031	-3.52261	.176313	20.9793	.652170
4.23	4.76280	-3.68159	.170527	22.5891	.656881
4.24	4.96898	-3.85276	.164696	24.3893	.661663
4.25	5.19045	-4.03787	.158820	26.3843	.666517
4.26	5.35927	-4.23858	.152897	28.7218	.671445
4.27	5.59774	-4.45701	.146928	31.3347	.676448
4.28	5.85861	-4.69664	.140912	34.3333	.681527
4.29	6.14320	-4.95746	.134847	37.7634	.686684
4.30	6.46148	-5.24004	.128735	41.7508	.691921
4.31	6.81233	-5.56579	.122573	46.4079	.697240
4.32	7.20372	-5.92207	.116362	51.8937	.702641
4.33	7.64310	-6.32159	.110100	58.4170	.708127
4.34	8.13964	-6.77281	.103787	66.2370	.713780
4.35	8.70395	-7.28634	.0974220	75.7956	.719611
4.36	9.35704	-7.87684	.0910048	87.5541	.725612
4.37	10.1157	-8.56231	.0845344	102.288	.730955
4.38	11.0040	-9.36812	.0780101	121.089	.736893
4.39	12.0666	-10.3292	.0714311	145.603	.742927
4.40	13.3569	-11.4953	.0647967	178.406	.749059

TABLE I (continued)

$(\frac{L}{J})_{eff}$	C	$\frac{S''}{(\frac{EI}{L})}$	$\frac{S}{(\frac{EI}{L})}$	C <sup>2</sup>	$\frac{S^2 C^2}{(\frac{EI}{L})^2}$
4.41	14.9567	-12.9404	.0581061	223.703	.758892
4.42	16.9926	-14.7783	.0513585	288.747	.761627
4.43	19.6708	-17.1948	.0445531	386.739	.768067
4.44	23.3522	-20.5151	.0376891	545.324	.774615
4.45	28.7300	-25.3636	.0307656	825.413	.781272
4.46	37.3277	-33.1126	.0237817	1393.335	.788041
4.47	53.2714	-47.4793	.0167367	2337.84	.794925
4.48	92.9960	-83.2686	.00962948	8648.26	.801926
4.49	365.751	-328.980	.00245924	132774	.809047
4.50	<del>189.213</del> <del>168.680</del>	<del>170.465</del> <del>170.465</del>	<del>747</del> <del>747</del> <del>-.00478948</del>	<del>35801.6</del> <del>35801.6</del>	.816291
4.51	-75.1653	68.2048	-0.120741	5644.83	.823660
4.52	-46.8989	42.7873	-0.194392	2199.51	.831138
4.53	-34.0830	31.1882	-0.268713	1161.65	.838787
4.54	-26.7689	24.3953	-0.343712	716.677	.846551
4.55	-22.0401	20.3312	-0.419402	485.765	.854452
4.56	-18.7317	17.3467	-0.495793	350.878	.862495
4.57	-16.2875	15.1406	-0.572895	265.283	.870682
4.58	-14.4080	13.4433	-0.650721	207.590	.879016
4.59	-12.9178	12.0966	-0.729281	166.871	.887502
4.60	-11.7074	11.0020	-0.808587	137.864	.896148
4.61	-10.7048	10.0946	-0.888681	114.593	.904943
4.62	-9.86073	9.32975	-0.969487	97.2340	.913906
4.63	-9.14036	8.67647	-1.05110	83.5462	.923036
4.64	-8.51839	8.11180	-1.13352	72.5638	.932337
4.65	-7.97597	7.61877	-1.21674	63.6161	.941813
4.66	-7.49578	7.18447	-1.30079	56.2316	.951469
4.67	-7.07572	6.79892	-1.38567	50.0639	.961309
4.68	-6.69811	6.45429	-1.47141	44.8647	.971338
4.69	-6.35901	6.14431	-1.55801	40.4370	.981561
4.70	-6.05282	5.86397	-1.64549	36.6367	.991984
4.71	-5.77499	5.60914	-1.73386	33.3506	1.00261
4.72	-5.52177	5.37645	-1.82315	30.4899	1.01346
4.73	-5.29003	5.16309	-1.91336	27.9844	1.02450
4.74	-5.07716	4.96671	-2.00452	25.7775	1.03577
4.75	-4.88096	4.78531	-2.09664	23.8237	1.04727
4.76	-4.69954	4.61722	-2.18974	22.0857	1.05900
4.77	-4.53132	4.46097	-2.28383	20.5329	1.07097
4.78	-4.37490	4.31534	-2.37894	19.1398	1.08318
4.79	-4.22910	4.17924	-2.47507	17.8853	1.09565
4.80	-4.09288	4.05174	-2.57227	16.7516	1.10838
4.81	-3.96532	3.93202	-2.67058	15.7237	1.12137
4.82	-3.84563	3.81937	-2.76988	14.7889	1.13464
4.83	-3.73312	3.71315	-2.87035	13.9362	1.14819
4.84	-3.62716	3.61280	-2.97196	13.1563	1.16203
4.85	-3.52721	3.51784	-3.07471	12.4412	1.17617
4.86	-3.43276	3.42781	-3.17865	11.7837	1.19062
4.87	-3.34339	3.34232	-3.28379	11.1782	1.20538
4.88	-3.25869	3.26102	-3.39013	10.6191	1.22047

TABLE I (continued)

$\left(\frac{L}{J}\right)_{\text{eff}}$	C	$\frac{S''}{\left(\frac{EI}{L}\right)}$	$\frac{S}{\left(\frac{EI}{L}\right)}$	$C^2$	$\frac{S^2 C^2}{\left(\frac{EI}{L}\right)^2}$
4.89	-3.17535	3.18358	-0.349777	10.1018	1.23589
4.90	-3.10197	3.10973	-.360666	9.62219	1.25165
4.91	-3.02932	3.03919	-.371685	9.17680	1.26777
4.92	-2.96014	2.97175	-.382837	8.76244	1.28426
4.93	-2.89418	2.90717	-.394124	8.37628	1.30112
4.94	-2.83122	2.84527	-.405550	8.01583	1.31837
4.95	-2.77108	2.78587	-.417117	7.67886	1.33602
4.96	-2.71356	2.72880	-.428829	7.36339	1.35408
4.97	-2.65850	2.67393	-.440687	7.06763	1.37257
4.98	-2.60576	2.62110	-.452697	6.78997	1.39150
4.99	-2.55519	2.57020	-.464860	6.52898	1.41088
5.00	-2.50666	2.52111	-.477180	6.28335	1.43073
5.01	-2.46006	2.47373	-.489661	6.05191	1.45106
5.02	-2.41528	2.42794	-.502307	5.83358	1.47188
5.03	-2.37222	2.38367	-.515120	5.62741	1.49323
5.04	-2.33077	2.34083	-.528106	5.43281	1.51510
5.05	-2.29087	2.29924	-.541267	5.24807	1.53752
5.06	-2.25241	2.25912	-.554607	5.07337	1.56052
5.07	-2.21534	2.22011	-.568132	4.90774	1.58409
5.08	-2.17958	2.18225	-.581845	4.75037	1.60828
5.09	-2.14506	2.14547	-.595752	4.60129	1.63309
5.10	-2.11173	2.10973	-.609855	4.45939	1.65855
5.11	-2.07952	2.07496	-.624161	4.32440	1.68469
5.12	-2.04838	2.04112	-.638675	4.19587	1.71152
5.13	-2.01827	2.00817	-.653400	4.07341	1.73907
5.14	-1.98913	1.97606	-.668344	3.95665	1.76737
5.15	-1.96093	1.94475	-.683511	3.84523	1.79644
5.16	-1.93361	1.91420	-.698906	3.73883	1.82632
5.17	-1.90715	1.88436	-.714536	3.63721	1.85702
5.18	-1.88150	1.85526	-.730408	3.54004	1.88859
5.19	-1.85663	1.82681	-.746526	3.44707	1.92106
5.20	-1.83251	1.79898	-.762898	3.35809	1.95446
5.21	-1.80910	1.77176	-.779531	3.27286	1.98881
5.22	-1.78639	1.74513	-.796432	3.19118	2.02416
5.23	-1.76433	1.71904	-.813607	3.11286	2.06058
5.24	-1.74291	1.69349	-.831065	3.03773	2.09807
5.25	-1.72210	1.66844	-.848813	2.96561	2.13668
5.26	-1.70187	1.64388	-.866860	2.89636	2.17646
5.27	-1.68221	1.61978	-.885214	2.82982	2.21746
5.28	-1.66309	1.59614	-.903884	2.76586	2.25973
5.29	-1.64449	1.57292	-.922879	2.70436	2.30332
5.30	-1.62640	1.55011	-.942210	2.64518	2.34828
5.31	-1.60880	1.52769	-.961884	2.58823	2.39468
5.32	-1.59166	1.50565	-.981914	2.53348	2.44258
5.33	-1.57498	1.48398	-.100231	2.48086	2.49203
5.34	-1.55873	1.46266	-.102305	2.42965	2.54311
5.35	-1.54291	1.44166	-.104424	2.38057	2.59589
5.36	-1.52750	1.42098	-.106581	2.33325	2.65044
5.37	-1.51248	1.40062	-.108778	2.28769	2.70685
5.38	-1.49784	1.38055	-.111019	2.24353	2.76519
5.39	-1.48358	1.36077	-.113303	2.20100	2.82537
5.40	-1.46967	1.34126	-.115634	2.15993	2.88807



TABLE I (continued)

$\left(\frac{L}{J}\right)_{eff}$	C	$\frac{S''}{\left(\frac{EI}{L}\right)}$	$\frac{S}{\left(\frac{EI}{L}\right)}$	C <sup>2</sup>	$\frac{S^2 C^2}{\left(\frac{EI}{L}\right)^2}$
5.41	-1.45611	1.32202	-1.18011	2.12025	2.95278
5.42	-1.44289	1.30303	-1.20437	2.08192	3.01963
5.43	-1.42999	1.28428	-1.22913	2.04487	3.08931
5.44	-1.41741	1.26577	-1.25442	2.00905	3.16136
5.45	-1.40514	1.24745	-1.28024	1.97441	3.23609
5.46	-1.39316	1.22940	-1.30662	1.94090	3.31363
5.47	-1.38148	1.21154	-1.33358	1.90848	3.39414
5.48	-1.37008	1.19387	-1.36115	1.87711	3.47775
5.49	-1.35895	1.17640	-1.38933	1.84674	3.56466
5.50	-1.34809	1.15911	-1.41816	1.81733	3.65496
5.51	-1.33748	1.14200	-1.44766	1.78886	3.74894
5.52	-1.32713	1.12506	-1.47785	1.76126	3.84678
5.53	-1.31703	1.10828	-1.50877	1.73456	3.94854
5.54	-1.30716	1.09166	-1.54044	1.70867	4.05441
5.55	-1.29753	1.07519	-1.57289	1.68358	4.16516
5.56	-1.28812	1.05887	-1.60616	1.65924	4.28047
5.57	-1.27894	1.04269	-1.64027	1.63566	4.40079
5.58	-1.26997	1.02664	-1.67527	1.61282	4.52641
5.59	-1.26121	1.01071	-1.71119	1.59065	4.65767
5.60	-1.25266	.994913	-1.74806	1.56915	4.79489
5.61	-1.24431	.979230	-1.78594	1.54830	4.93843
5.62	-1.23615	.963660	-1.82487	1.52807	5.08870
5.63	-1.22819	.948198	-1.86489	1.50848	5.24609
5.64	-1.22041	.932838	-1.90605	1.48944	5.41108
5.65	-1.21282	.917677	-1.94842	1.47093	5.58416
5.66	-1.20541	.902410	-1.99204	1.45301	5.76585
5.67	-1.19817	.887332	-2.03697	1.43561	5.95674
5.68	-1.19111	.872339	-2.08329	1.41873	6.15744
5.69	-1.18421	.857427	-2.13106	1.40235	6.36864
5.70	-1.17748	.842593	-2.18036	1.38648	6.59107
5.71	-1.17090	.827831	-2.23124	1.37102	6.82554
5.72	-1.16449	.813139	-2.28382	1.35604	7.07290
5.73	-1.15824	.798512	-2.33818	1.34151	7.33415
5.74	-1.15213	.783947	-2.39441	1.32741	7.61031
5.75	-1.14618	.769440	-2.45263	1.31372	7.90253
5.76	-1.14037	.754987	-2.51293	1.30044	8.21206
5.77	-1.13471	.740586	-2.57545	1.28756	8.54029
5.78	-1.12918	.726233	-2.64021	1.27506	8.88875
5.79	-1.12380	.711924	-2.70766	1.26293	9.25909
5.80	-1.11856	.697656	-2.77765	1.25117	9.65219
5.81	-1.11345	.683427	-2.85045	1.23976	10.0731
5.82	-1.10847	.669232	-2.92623	1.22870	10.5211
5.83	-1.10362	.655069	-3.00419	1.21798	10.9998
5.84	-1.09890	.640934	-3.08456	1.20759	11.5119
5.85	-1.09431	.626825	-3.16754	1.19752	12.0606
5.86	-1.08984	.612787	-3.25342	1.18776	12.6493
5.87	-1.08550	.598872	-3.34247	1.17831	13.2822
5.88	-1.08128	.585023	-3.43499	1.16916	13.9644

TABLE I (concluded)

$\left(\frac{L}{J}\right)_{\text{eff}}$	C	$\frac{S''}{\left(\frac{EI}{L}\right)}$	$\frac{S}{\left(\frac{EI}{L}\right)}$	C <sup>2</sup>	$\frac{S^2 C^2}{\left(\frac{EI}{L}\right)^2}$
5.89	-1.07710	0.570587	-3.55933	1.16031	14.6998
5.90	-1.07319	.566562	-3.66787	1.16174	15.4946
5.91	-1.06932	.562546	-3.78201	1.14345	16.3555
5.92	-1.06557	.528635	-3.90222	1.13544	17.2898
5.93	-1.06193	.514527	-4.02902	1.12771	18.3061
5.94	-1.05841	.500518	-4.16298	1.12023	19.4140
5.95	-1.05500	.486507	-4.30474	1.11302	20.6250
5.96	-1.05169	.472491	-4.45502	1.10606	21.9521
5.97	-1.04850	.458466	-4.61463	1.09935	23.4105
5.98	-1.04541	.444431	-4.78450	1.09289	25.0178
5.99	-1.04244	.430382	-4.96569	1.08667	26.7953
6.00	-1.03956	.416317	-5.15938	1.08069	28.7471
6.01	-1.03680	.402234	-5.36694	1.07495	30.8828
6.02	-1.03413	.388129	-5.58995	1.06943	33.2171
6.03	-1.03158	.373999	-5.83026	1.06415	35.7724
6.04	-1.02912	.359843	-6.08996	1.05909	38.5790
6.05	-1.02677	.345658	-6.37157	1.05423	42.7993
6.06	-1.02452	.331441	-6.67502	1.04963	48.6093
6.07	-1.02236	.317189	-7.01282	1.04523	56.4041
6.08	-1.02031	.302899	-7.38513	1.04104	66.7018
6.09	-1.01837	.288570	-7.78502	1.03707	80.2531
6.10	-1.01651	.274197	-8.23357	1.03330	97.6494
6.11	-1.01476	.259780	-8.73351	1.02975	118.5430
6.12	-1.01311	.245314	-9.29412	1.02639	143.6607
6.13	-1.01156	.230797	-9.92736	1.02325	174.844
6.14	-1.01010	.216227	-10.6483	1.02031	214.688
6.15	-1.00874	.201600	-11.4768	1.01757	265.031
6.16	-1.00749	.186914	-12.4392	1.01503	328.068
6.17	-1.00632	.172166	-13.5707	1.01269	405.501
6.18	-1.00526	.157353	-14.9205	1.01055	499.970
6.19	-1.00429	.142472	-16.5591	1.00860	614.565
6.20	-1.00342	.127521	-18.5908	1.00686	754.990
6.21	-1.00265	.112495	-21.1758	1.00531	926.798
6.22	-1.00198	.0973934	-24.5774	1.00396	1136.443
6.23	-1.00140	.0822118	-29.2572	1.00281	1390.388
6.24	-1.00093	.0669474	-36.1085	1.00185	1706.24
6.25	-1.00055	.0515970	-47.0647	1.00110	2117.51
6.26	-1.00027	.0361576	-67.4745	1.00054	2655.25
6.27	-1.00009	.0206258	-118.806	1.00017	34117.2
6.28	-1.00001	.00499841	-490.041	1.00001	240142
2π	-1.00000	0	-∞	1.00000	∞

TABLE II  
TENSION

$\left(\frac{L}{J}\right)_{\text{eff}}$	C	$\frac{S''}{\left(\frac{EI}{L}\right)}$	$\frac{S}{\left(\frac{EI}{L}\right)}$	C <sup>2</sup>	$\frac{S^2 C^2}{\left(\frac{EI}{L}\right)^2}$
0	0.500000	0.750000	1.00000	0.250000	0.250000
.1	.499757	.750512	1.00036	.249757	.249756
.2	.499001	.751998	1.00133	.249002	.249665
.3	.497760	.754488	1.00300	.247765	.249253
.4	.496033	.757964	1.00532	.246049	.248675
.5	.493831	.762412	1.00831	.243869	.247937
.6	.491167	.767818	1.01194	.241245	.247042
.7	.488057	.774165	1.01623	.238200	.245994
.8	.484519	.781431	1.02116	.234759	.244798
.9	.480575	.789595	1.02672	.230953	.243469
1.0	.476246	.798632	1.03291	.226810	.241983
1.1	.471556	.808615	1.03971	.222365	.240376
1.2	.466530	.819215	1.04712	.217651	.238666
1.3	.461194	.830703	1.05513	.212700	.236879
1.4	.455575	.842949	1.06372	.207548	.234984
1.5	.449699	.855921	1.07289	.202229	.232985
1.6	.443594	.869556	1.08262	.196775	.230883
1.7	.437286	.883915	1.09290	.191219	.228696
1.8	.430802	.898873	1.10371	.185590	.226431
1.9	.424167	.914429	1.11505	.179918	.224097
2.0	.417408	.930653	1.12699	.174229	.221701
2.1	.410548	.947214	1.13923	.168550	.219251
2.2	.403610	.964380	1.15205	.162901	.216755
2.3	.396616	.982024	1.16534	.157305	.214221
2.4	.389588	1.00012	1.17908	.151779	.211656
2.5	.382544	1.01863	1.19325	.146340	.209066
2.6	.375502	1.03754	1.20785	.141002	.206459
2.7	.368480	1.05683	1.22287	.135777	.203842
2.8	.361492	1.07646	1.23827	.130677	.201219
2.9	.354553	1.09642	1.25406	.125708	.198597
3.0	.347676	1.11665	1.27022	.120878	.195982
3.1	.340871	1.13722	1.28673	.116193	.193378
3.2	.334149	1.15803	1.30358	.111656	.190790
3.3	.327520	1.17909	1.32076	.107269	.188222
3.4	.320990	1.20037	1.33826	.103034	.185679
3.5	.314566	1.22188	1.35606	.0989519	.183163
3.6	.308255	1.24358	1.37416	.0950214	.179679
3.7	.302062	1.26547	1.39253	.0912413	.176229
3.8	.295990	1.28754	1.41117	.0876098	.172816
3.9	.290042	1.30976	1.43007	.0841242	.169442
4.0	.284221	1.33214	1.44921	.0807815	.166116
4.1	.278529	1.35466	1.46859	.0775783	.162841
4.2	.272967	1.37731	1.48820	.0745108	.159616
4.3	.267535	1.40009	1.50802	.0715749	.156442
4.4	.262234	1.42297	1.52805	.0687666	.153326
4.5	.257063	1.44597	1.54828	.0660813	.150269
4.6	.252022	1.46907	1.56870	.0635181	.147270
4.7	.247110	1.49225	1.58930	.0610631	.144329
4.8	.242324	1.51553	1.61008	.0587210	.141455
4.9	.237664	1.53899	1.63101	.0564863	.138640
5.0	.233128	1.56252	1.65211	.0543486	.135884

TABLE II (continued)

$\left(\frac{L}{J}\right)_{\text{eff}}$	C	$\frac{S''}{\left(\frac{EI}{L}\right)}$	$\frac{S}{\left(\frac{EI}{L}\right)}$	$C^2$	$\frac{S^2 C^2}{\left(\frac{EI}{L}\right)^2}$
5.1	.228713	1.58583	1.67936	.0522097	.146435
5.2	.224418	1.60940	1.69476	.0503634	.144654
5.3	.220239	1.63304	1.71629	.0485064	.142880
5.4	.216176	1.65674	1.73793	.0467319	.141153
5.5	.212224	1.68049	1.75974	.0450388	.139472
5.6	.208381	1.70429	1.78166	.0434225	.137836
5.7	.204645	1.72814	1.80368	.0418794	.136246
5.8	.201012	1.75204	1.82582	.0404059	.134698
5.9	.197481	1.77599	1.84806	.0389987	.133193
6.0	.194048	1.79997	1.87040	.0376547	.131731
6.1	.190711	1.82400	1.89284	.0363706	.130310
6.2	.187466	1.84806	1.91537	.0351437	.128930
6.3	.184312	1.87215	1.93799	.0339710	.127588
6.4	.181245	1.89628	1.96069	.0328499	.126285
6.5	.178264	1.92044	1.98348	.0317799	.125020
6.6	.175364	1.94463	2.00633	.0307526	.123771
6.7	.172544	1.96885	2.02927	.0297715	.122597
6.8	.169802	1.99310	2.05227	.0288326	.121438
6.9	.167134	2.01737	2.07534	.0279338	.120312
7.0	.164539	2.04166	2.09847	.0270730	.119218
7.1	.162013	2.06598	2.12167	.0262484	.118157
7.2	.159556	2.09032	2.14493	.0254582	.117125
7.3	.157164	2.11468	2.16824	.0247007	.116124
7.4	.154836	2.13906	2.19160	.0239743	.115151
7.5	.152570	2.16346	2.21502	.0232775	.114207
7.6	.150363	2.18788	2.23849	.0226089	.113289
7.7	.148213	2.21231	2.26200	.0219671	.112398
7.8	.146119	2.23676	2.28556	.0213507	.111532
7.9	.144079	2.26123	2.30917	.0207586	.110690
8.0	.142090	2.28571	2.33281	.0201897	.109872
8.1	.140152	2.31021	2.35650	.0196427	.109078
8.2	.138263	2.33472	2.38022	.0191167	.108305
8.3	.136421	2.35925	2.40399	.0186107	.107554
8.4	.134625	2.38378	2.42778	.0181238	.106824
8.5	.132872	2.40833	2.45162	.0176550	.106114
8.6	.131162	2.43289	2.47548	.0172035	.105428
8.7	.129494	2.45747	2.49938	.0167686	.104752
8.8	.127865	2.48205	2.52331	.0163495	.104098
8.9	.126275	2.50665	2.54724	.0159454	.103462
9.0	.124722	2.53125	2.57125	.0155557	.102843
9.1	.123206	2.55586	2.59526	.0151797	.102241
9.2	.121724	2.58049	2.61930	.0148169	.101654
9.3	.120277	2.60512	2.64336	.0144666	.101083
9.4	.118862	2.62976	2.66745	.0141283	.100527
9.5	.117480	2.65441	2.69156	.0138015	.099984
9.6	.116125	2.67907	2.71569	.0134857	.099457
9.7	.114806	2.70374	2.73985	.0131804	.098943
9.8	.113513	2.72841	2.76402	.0128852	.098446
9.9	.112248	2.75309	2.78822	.0125996	.0979515

TABLE II (continued)

$\left(\frac{L}{J}\right)_{\text{eff}}$	C	$\frac{S''}{\left(\frac{EI}{L}\right)}$	$\frac{S}{\left(\frac{EI}{L}\right)}$	C <sup>2</sup>	$\frac{S^2 C^2}{\left(\frac{EI}{L}\right)^2}$
10.0	0.111010	2.77778	2.81244	0.0123233	0.0774746
10.1	.109799	2.80247	2.83667	.0120558	.0770094
10.2	.108613	2.82717	2.86092	.0117968	.0765887
10.3	.107452	2.85188	2.88519	.0115460	.0761139
10.4	.106316	2.87668	2.90948	.0113030	.0756810
10.5	.105202	2.90152	2.93379	.0110675	.0752892
10.6	.104112	2.92604	2.95811	.0108392	.0748475
10.7	.103043	2.95077	2.98244	.0106179	.0744454
10.8	.101996	2.97551	3.00679	.0104032	.0740827
10.9	.100969	3.00026	3.03115	.0101948	.0737691
11.0	.0999633	3.02500	3.05553	.00999265	.0734942
11.1	.0989767	3.04975	3.07992	.00979638	.0732579
11.2	.0980092	3.07451	3.10433	.00960580	.0730698
11.3	.0970602	3.09927	3.12875	.00942069	.07292196
11.4	.0961295	3.12404	3.15318	.00924084	.07281778
11.5	.0952169	3.14881	3.17762	.00906607	.0727424
11.6	.0943196	3.17358	3.20207	.00889618	.0726948
11.7	.0934398	3.19836	3.22654	.00873100	.0726743
11.8	.0925762	3.22315	3.25101	.00857036	.0726806
11.9	.0917283	3.24794	3.27550	.00841408	.0727136
12.0	.0908957	3.27273	3.29999	.00826208	.0727730
12.1	.0900780	3.29752	3.32450	.00811404	.0728587
12.2	.0892748	3.32232	3.34901	.00796998	.0729704
12.3	.0884857	3.34712	3.37354	.00782971	.0731081
12.4	.0877103	3.37193	3.39807	.00769310	.0732714
12.5	.0869484	3.39674	3.42261	.00756008	.0734603
12.6	.0861996	3.42155	3.44717	.00743037	.0736747
12.7	.0854638	3.44637	3.47172	.00730400	.0739142
12.8	.0847398	3.47119	3.49629	.00718083	.0741789
12.9	.0840282	3.49601	3.52087	.00706074	.0744685
13.0	.0833284	3.52083	3.54545	.00694363	.0747830
13.1	.0826402	3.54566	3.57004	.00682940	.0751242
13.2	.0819632	3.57049	3.59464	.00671797	.0754928
13.3	.0812972	3.59533	3.61925	.00660923	.0758897
13.4	.0806419	3.62016	3.64386	.00650311	.0763144
13.5	.0799970	3.64500	3.66848	.00640053	.0767680
13.6	.0793624	3.66984	3.69310	.00629959	.0772508
13.7	.0787377	3.69469	3.71773	.00619963	.0777635
13.8	.0781226	3.71953	3.74237	.00610137	.0783071
13.9	.0775174	3.74438	3.76702	.00600465	.0788819
14.0	.0769213	3.76923	3.79167	.00590968	.0794884
14.1	.0763343	3.79408	3.81632	.00582643	.0801261
14.2	.0757561	3.81894	3.84098	.00574489	.0807961
14.3	.0751866	3.84380	3.86565	.00566503	.0814986
14.4	.0746257	3.86866	3.89032	.00558689	.0822345
14.5	.0740730	3.89352	3.91500	.00551041	.0829975
14.6	.0735284	3.91838	3.93968	.00543564	.0837917
14.7	.0729918	3.94325	3.96437	.00536278	.0846180
14.8	.0724630	3.96812	3.98906	.00529188	.0854765
14.9	.0719417	3.99299	4.01376	.00522296	.0863683
15.0	.0714279	4.01786	4.03846	.00515605	.0872935

TABLE II (continued)

$\left(\frac{L}{j}\right)_{\text{eff}}$	C	$\frac{S''}{\left(\frac{EI}{L}\right)}$	$\frac{S}{\left(\frac{EI}{L}\right)}$	C <sup>2</sup>	$\frac{S^2 C^2}{\left(\frac{EI}{L}\right)^2}$
15.1	.0709214	4.04278	4.06317	.00502187	.0530394
15.2	.0704220	4.04761	4.08768	.00498926	.0528719
15.3	.0699296	4.09248	4.11259	.00496016	.0527091
15.4	.0694440	4.11736	4.13731	.00493247	.0525480
15.5	.0689651	4.14224	4.16204	.00490619	.0523893
15.6	.0684920	4.16712	4.18676	.00488126	.0522331
15.7	.0680267	4.19201	4.21150	.00485766	.0520794
15.8	.0675673	4.21689	4.23623	.00483534	.0519280
15.9	.0671138	4.24178	4.26097	.00481427	.0517789
16.0	.0666664	4.26667	4.28571	.00479441	.0516321
16.1	.0662249	4.29156	4.31046	.00477574	.0514874
16.2	.0657893	4.31645	4.33521	.00475823	.0513450
16.3	.0653593	4.34134	4.35996	.00474184	.0512046
16.4	.0649349	4.36623	4.38472	.00472654	.0510664
16.5	.0645160	4.39113	4.40948	.00471231	.0509301
16.6	.0641024	4.41603	4.43423	.00469912	.0507958
16.7	.0636941	4.44092	4.45901	.00468694	.0506634
16.8	.0632910	4.46582	4.48378	.00467575	.0505330
16.9	.0628930	4.49072	4.50856	.00466553	.0504043
17.0	.0624999	4.51562	4.53333	.00465624	.0502775
17.1	.0621117	4.54053	4.55811	.00464787	.0501528
17.2	.0617283	4.56543	4.58289	.00464039	.0500292
17.3	.0613496	4.59034	4.60768	.00463378	.0499077
17.4	.0609756	4.61524	4.63247	.004627802	.0497878
17.5	.0606060	4.64015	4.65726	.00462259	.0496692
17.6	.0602409	4.66506	4.68205	.00461817	.0495528
17.7	.0598802	4.68997	4.70685	.00461454	.0494377
17.8	.0595238	4.71488	4.73165	.00461168	.0493241
17.9	.0591716	4.73979	4.75645	.00460957	.0492121
18.0	.0588235	4.76471	4.78125	.00460820	.0491015
18.1	.0584793	4.78962	4.80606	.00460755	.0489923
18.2	.0581393	4.81453	4.83086	.00460760	.0488846
18.3	.0578034	4.83944	4.85567	.00460834	.0487783
18.4	.0574712	4.86437	4.88049	.00460974	.0486733
18.5	.0571428	4.88929	4.90530	.00461179	.0485697
18.6	.0568182	4.91420	4.93012	.00461448	.0484674
18.7	.0564972	4.93912	4.95494	.00461780	.0483664
18.8	.0561798	4.96405	4.97976	.00462174	.0482667
18.9	.0558659	4.98897	5.00459	.00462630	.0481682
19.0	.0555553	5.01389	5.02941	.00463148	.0480709
19.1	.0552486	5.03881	5.05424	.00463724	.0479748
19.2	.0549450	5.06374	5.07907	.00464356	.0478799
19.3	.0546448	5.08866	5.10390	.00465043	.0477861
19.4	.0543478	5.11359	5.12874	.00465784	.0476935
19.5	.0540540	5.13851	5.15357	.00466584	.0476020
19.6	.0537634	5.16344	5.17841	.00467441	.0475116
19.7	.0534759	5.18837	5.20325	.00468354	.0474223
19.8	.0531915	5.21330	5.22809	.00469321	.0473340
19.9	.0529100	5.23823	5.25293	.00470341	.0472467

TABLE II (concluded)

$(\frac{L}{J})_{\text{eff}}$	C	$\frac{S''}{(\frac{EI}{L})}$	$\frac{S}{(\frac{EI}{L})}$	C <sup>2</sup>	$\frac{S^2 C^2}{(\frac{EI}{L})^2}$
20	.0526916	5.26916	5.27778	.00277008	.07771603
21	.0500000	5.51250	5.52432	.00250000	.0763504
22	.0476190	5.76190	5.77509	.00226757	.0756358
23	.0454545	6.01136	6.02301	.00206612	.0749716
24	.0434753	6.26087	6.27273	.00189036	.0743502
25	.0416667	6.51042	6.52174	.00173611	.0738423
26	.0400000	6.76000	6.77083	.00160000	.0733507
27	.0384615	7.00962	7.02000	.00147929	.0729000
28	.0370370	7.25926	7.26923	.00137174	.0724862
29	.0357143	7.50893	7.51852	.00127381	.0721022
30	.0344828	7.75862	7.76786	.00118906	.0717474
31	.0333333	8.00833	8.01724	.00111111	.0714180
32	.0322261	8.25806	8.26667	.00104058	.0711111
33	.0312500	8.50781	8.51613	.000976563	.0708247
34	.0303030	8.75758	8.76563	.000918274	.0705566
35	.0294118	9.00735	9.01515	.000865082	.0703053
36	.0285714	9.25714	9.26471	.000816326	.0700692
37	.0277778	9.50694	9.51427	.000771606	.0698469
38	.0270270	9.75676	9.76387	.000730440	.0696374
39	.0263158	10.0066	10.0135	.000692521	.0694394
40	.0256410	10.2564	10.2632	.000657462	.0692521
41	.0250000	10.5063	10.5128	.000626000	.0690746
42	.0243902	10.7561	10.7625	.000594884	.0689063
43	.0238095	11.0060	11.0122	.000564893	.0687465
44	.0232558	11.2558	11.2619	.000534083	.0685941
45	.0227273	11.5057	11.5116	.000503529	.0684492
46	.0222222	11.7556	11.7614	.000473227	.0683110
47	.0217391	12.0054	12.0111	.000443259	.0681790
48	.0212766	12.2553	12.2609	.000413694	.0680527
49	.0208333	12.5052	12.5106	.000384028	.0679323
50	.0204082	12.7551	12.7604	.000354493	.0678168