Discussion

Steel Column Bending Amplification Factor

Paper presented by WILLIAM Y. LIU (April, 1965, Issue)

Discussion by **ALFRED SCHEINER**

MR. LIU'S curves for the column bending amplification factor provide a useful tool for the designer by reducing the number of calculations required for column design under the AISC Specification.

Some time ago, in connection with my work on the design of the 24-story residential structure, St. Paul's Towers, Oakland, Calif., I prepared a set of tables to eliminate the need for repeatedly calculating the amplification factors in this building, which had 30 different types of columns checked at eight different stories for three different loads, requiring over 500 calculations of the column formulas.

Figures 1 and 2, tabulations (to slide rule accuracy) for use in formula (7a), may be preferred to curves by some designers, particularly for use in the region where Mr. Liu's curves tend to converge. The tables are identified by the categories used in Table Cl.6.1.1 of the Commentary on the AISC Specification. Figure 1 covers Category A, and provides values of $C_m/(1 - f_a/F'_e)$, the same case covered by Mr. Liu's curves. Figure 2 covers Categories B and C, and provides values of $(1 - f_a/F'_e)$, the denominator of the amplification factor. These values may be used with values of $C_m = (0.4\ M_1/M_2 + 0.6)$ and $C_m = (1 + \psi f_a/F'_e)$, Categories B and C respectively.

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Figure 1

Values of $\dfrac{C_m}{\left(1 - \dfrac{f_a}{F'_e}\right)}$ *for Category A* $(C = 0.85)$.

(See Table C1.6.1.1 in Commentary on AISC Specification)

Figure 2

Values of $\left(1 - \dfrac{f_a}{F'_e}\right)$ *for Categories B and C*

For Category B, $C_m = \left(0.4\dfrac{M_1}{M_2} + 0.6\right)$;

for Category C, $C_m = \left(1 + \psi\dfrac{f_a}{F'_e}\right)$.

(See Table C1.6.1.1 in Commentary on AISC Specification)

f_a (ksi) \ Kl_b/r_b	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
3	.855	.86	.865	.87	.88	.89	.90	.91	.92	.93	.94	.96	.98	1.00	1.02	1.04	1.06	1.09	1.12	1.16	1.20
4	.86	.865	.87	.88	.89	.90	.91	.93	.94	.96	.98	1.00	1.03	1.05	1.09	1.12	1.16	1.21	1.26	1.32	1.39
5	.86	.87	.875	.89	.90	.91	.93	.95	.97	.99	1.02	1.05	1.08	1.12	1.17	1.22	1.28	1.35	1.43	1.52	1.65
6	.865	.87	.88	.90	.91	.93	.95	.97	1.00	1.02	1.06	1.10	1.15	1.20	1.26	1.34	1.42	1.53	1.66	1.82	2.02
7	.87	.875	.885	.90	.92	.94	.96	.99	1.02	1.06	1.10	1.15	1.21	1.29	1.37	1.47	1.61	1.76	1.97	2.24	2.63
8	.87	.88	.89	.91	.93	.95	.98	1.01	1.05	1.10	1.15	1.21	1.29	1.39	1.50	1.65	1.83	2.08	2.42	2.92	3.71
9	.87	.885	.90	.92	.94	.97	1.00	1.04	1.09	1.14	1.21	1.29	1.38	1.51	1.66	1.87	2.14	2.54	3.15	4.20	
10	.87	.89	.905	.93	.95	.99	1.02	1.07	1.12	1.19	1.27	1.36	1.49	1.65	1.86	2.15	2.58	3.26	4.48		
11	.875	.89	.91	.94	.97	1.00	1.04	1.10	1.16	1.24	1.33	1.45	1.61	1.82	2.11	2.54	3.24	4.52			
12	.875	.895	.915	.95	.98	1.02	1.06	1.12	1.20	1.29	1.40	1.56	1.75	2.03	2.43	3.09	4.36				
13	.88	.90	.92	.96	.99	1.03	1.09	1.15	1.24	1.35	1.48	1.67	1.92	2.30	2.88	3.98					
14	.88	.905	.93	.96	1.00	1.05	1.11	1.19	1.28	1.41	1.57	1.80	2.12	2.64	3.54						
15	.885	.91	.935	.97	1.01	1.07	1.14	1.22	1.33	1.48	1.67	1.96	2.40	3.12	4.59						
16	.89	.91	.94	.98	1.02	1.08	1.16	1.26	1.38	1.55	1.79	2.14	2.72	3.78							
17	.89	.915	.95	.99	1.04	1.11	1.19	1.30	1.44	1.64	1.92	2.36	3.15	4.85							
18	.895	.92	.955	1.00	1.05	1.12	1.22	1.34	1.51	1.73	2.08	2.68	3.73								
19	.90	.925	.96	1.01	1.07	1.15	1.25	1.38	1.58	1.85	2.27	3.01	4.60								
20	.90	.93	.97	1.02	1.08	1.17	1.28	1.43	1.65	1.97	2.48	3.47									
21	.90	.935	.975	1.03	1.10	1.19	1.31	1.48	1.73	2.10	2.74	4.09									
22	.905	.94	.98	1.04	1.11	1.21	1.35	1.54	1.82	2.25	3.09	5.00									
23	.905	.94	.985	1.05	1.13	1.24	1.38	1.60	1.92	2.45	3.50										
24	.91	.945	.995	1.06	1.14	1.26	1.42	1.66	2.02	2.66	4.02										
25	.91	.95	1.000	1.07	1.16	1.29	1.46	1.72	2.15	2.91	4.77										
26	.915	.955	1.010	1.08	1.18	1.31	1.50	1.80	2.29	3.20											
27	.915	.96	1.015	1.09	1.20	1.34	1.55	1.88	2.45	3.62											
28	.92	.965	1.020	1.10	1.21	1.37	1.60	1.97	2.64	4.11											

Figure 1

f_a (ksi) \ Kl_b/r_b	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
3	.992	.987	.982	.975	.968	.959	.950	.939	.927	.915	.901	.887	.871	.855	.837	.819	.800	.778	.757	.734	.710
4	.989	.983	.976	.967	.957	.946	.933	.919	.903	.887	.869	.849	.828	.806	.782	.758	.732	.704	.676	.645	.614
5	.987	.979	.970	.959	.946	.932	.916	.899	.879	.858	.836	.811	.785	.758	.728	.698	.665	.630	.595	.556	.517
6	.984	.975	.964	.951	.936	.918	.899	.878	.855	.830	.803	.774	.742	.710	.674	.636	.598	.557	.514	.467	.420
7	.981	.971	.958	.942	.925	.905	.883	.858	.830	.802	.770	.736	.700	.661	.620	.577	.531	.484	.433	.380	.323
8	.979	.968	.952	.934	.914	.892	.866	.838	.806	.774	.738	.699	.657	.613	.565	.515	.464	.409	.352	.290	.229
9	.976	.962	.945	.926	.904	.878	.849	.817	.782	.745	.704	.660	.614	.564	.512	.455	.397	.335	.270	.202	
10	.973	.958	.940	.918	.893	.864	.832	.797	.758	.716	.672	.623	.570	.515	.458	.395	.330	.261	.190		
11	.970	.954	.934	.909	.882	.850	.815	.776	.734	.688	.639	.585	.528	.468	.402	.335	.262	.188			
12	.968	.950	.928	.901	.871	.837	.799	.756	.710	.660	.606	.547	.485	.418	.349	.275	.195				
13	.965	.946	.922	.893	.860	.824	.782	.737	.686	.631	.573	.510	.442	.370	.295	.214					
14	.962	.941	.915	.885	.850	.810	.765	.716	.662	.604	.540	.472	.400	.322	.240	.152					
15	.960	.937	.910	.877	.839	.796	.748	.696	.638	.575	.508	.434	.355	.272	.185						
16	.957	.933	.903	.869	.828	.783	.732	.676	.613	.547	.475	.396	.312	.225							
17	.954	.929	.898	.860	.818	.769	.715	.656	.589	.518	.442	.360	.270	.175							
18	.952	.925	.891	.852	.807	.756	.698	.634	.564	.490	.408	.320	.228								
19	.949	.920	.885	.844	.796	.742	.681	.615	.540	.461	.375	.282	.185								
20	.946	.916	.879	.836	.786	.729	.665	.595	.515	.433	.342	.245									
21	.943	.912	.873	.827	.775	.715	.648	.575	.492	.405	.310	.208									
22	.941	.908	.867	.819	.764	.701	.630	.553	.467	.377	.275	.170									
23	.938	.904	.861	.811	.753	.687	.614	.533	.444	.347	.243										
24	.935	.900	.855	.802	.743	.674	.598	.514	.420	.320	.211										
25	.933	.895	.849	.795	.732	.660	.581	.493	.395	.292	.178										
26	.930	.891	.843	.786	.721	.647	.565	.474	.371	.265											
27	.927	.887	.837	.778	.710	.633	.547	.452	.347	.235											
28	.925	.883	.831	.770	.700	.620	.530	.431	.322	.207											

Figure 2