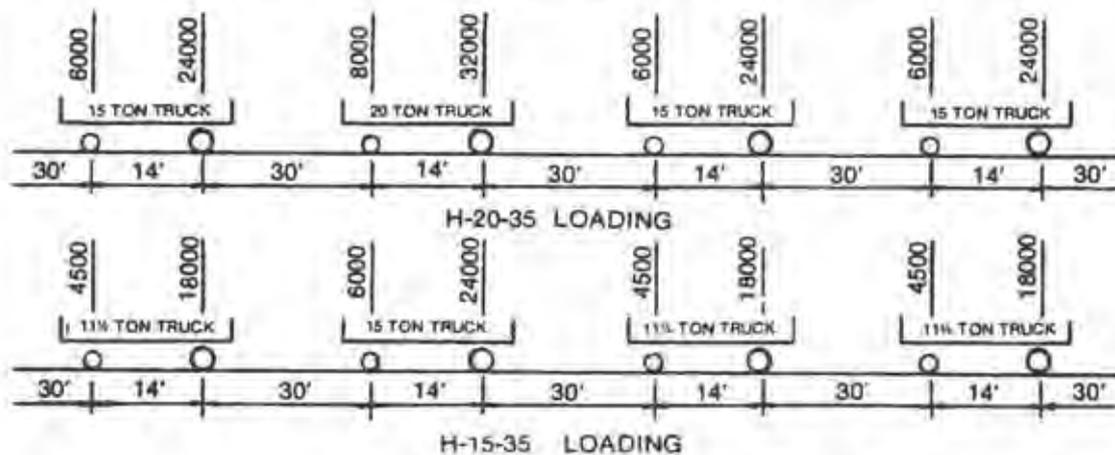
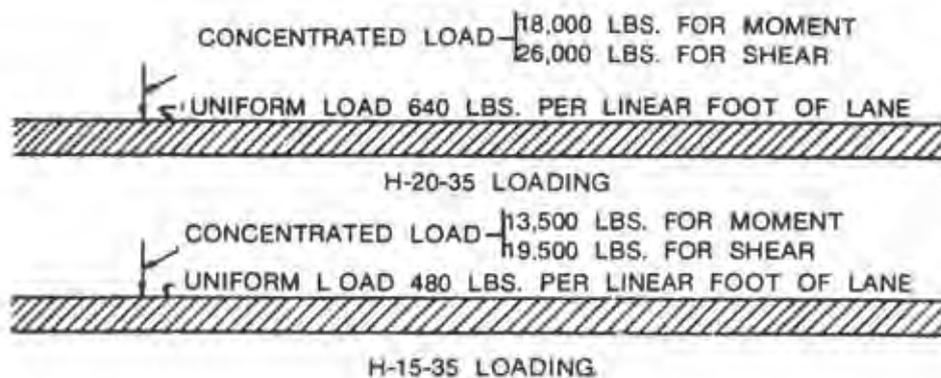


APPENDIX B

TRUCK TRAIN AND EQUIVALENT LOADINGS — 1935 SPECIFICATIONS AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS

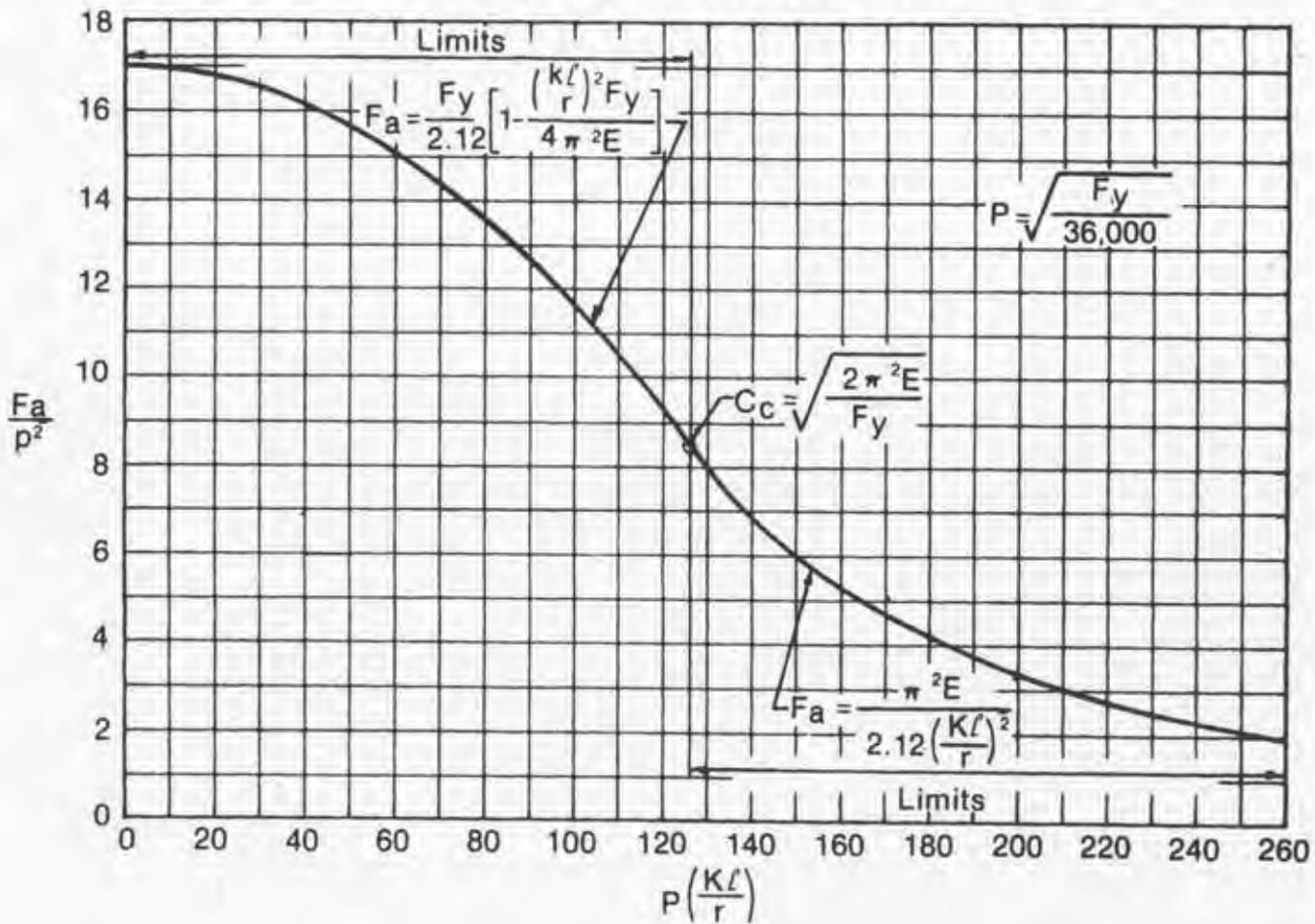


TRUCK TRAIN LOADING



EQUIVALENT LOADING LANE WIDTH 10 FEET

FORMULA FOR COMPRESSION IN
CONCENTRICALLY LOADED COLUMNS
(See Table 10.32.1A for Specific Values)



APPENDIX C

EFFECTIVE LENGTH FACTOR, K

The effective length of a compression member, KL , has been used to determine design strength of a compression member. K is a factor that when multiplied by the actual length of the end-restrained compression member, gives the length of an equivalent pin-ended compression member whose buckling load is the same as that of the end-restrained member. KL represents the length between inflection points of a buckled compression member. Restraint against rotation and translation of compression member ends influences the position of the inflection points. Theoretical values of K for some idealized compression member end conditions are given in Table C-1. Since compression member end conditions seldom comply fully with idealized conditions used in buckling analysis, the recommended values suggested by the Structural Stability Research Council are higher than the idealized values.

In trusses and frames where lateral stability is provided by diagonal bracing, shear walls, or other suitable means, the effective length factor, K , for compression members shall be taken as unity, unless structural analysis shows a smaller value may be used.

In the absence of a more refined analysis, the effective length factor K for the compression members in the braced plane in triangulated trusses, trusses, and frames may be taken as:

- For members riveted, or bolted or welded end conditions at both ends, $K = 0.75$

- For pinned connections at both ends: $K = 0.875$

Vierendell trusses shall be treated as unbraced frames

TABLE C-1

EFFECTIVE LENGTH FACTORS, K						
	(a)	(b)	(c)	(d)	(e)	(f)
BUCKLED SHAPE OF COLUMN IS SHOWN BY DASHED LINE						
THEORETICAL K VALUE	0.5	0.7	1.0	1.0	2.0	2.0
DESIGN VALUE OF K WHEN IDEAL CONDITIONS ARE APPROXIMATED ^(*)	0.65	0.80	1.2	1.0	2.1	2.0
END CONDITION CODE		ROTATION FIXED		TRANSLATION FIXED		
		ROTATION FREE		TRANSLATION FIXED		
		ROTATION FIXED		TRANSLATION FREE		
		ROTATION FREE		TRANSLATION FREE		

+ In frames where lateral stability depends on the bending stiffness of the rigidly connected beams or columns, the effective length factor, K , for compression members shall be determined by structural analysis. The effective length factor, K , is dependent on the amount of stiffness supplied by the beams at the compression member ends. If the amount of stiffness supplied by the beams is small, the value of K could exceed 2.0.

+ In the absence of a more refined analysis, the following formulas and charts may be used to determine the effective length factor K for compression members in braced frames.

+ It is assumed that when elastic action occurs and all compression members buckle simultaneously in a frame, it can be rationally shown that

$$\frac{G_a G_b (\pi / K)^2 - 36}{6(G_a + G_b)} = \frac{\pi / K}{\tan(\pi / K)} \quad (C-1)$$

+ where subscripts a and b refer to the two ends of the compression member under consideration.

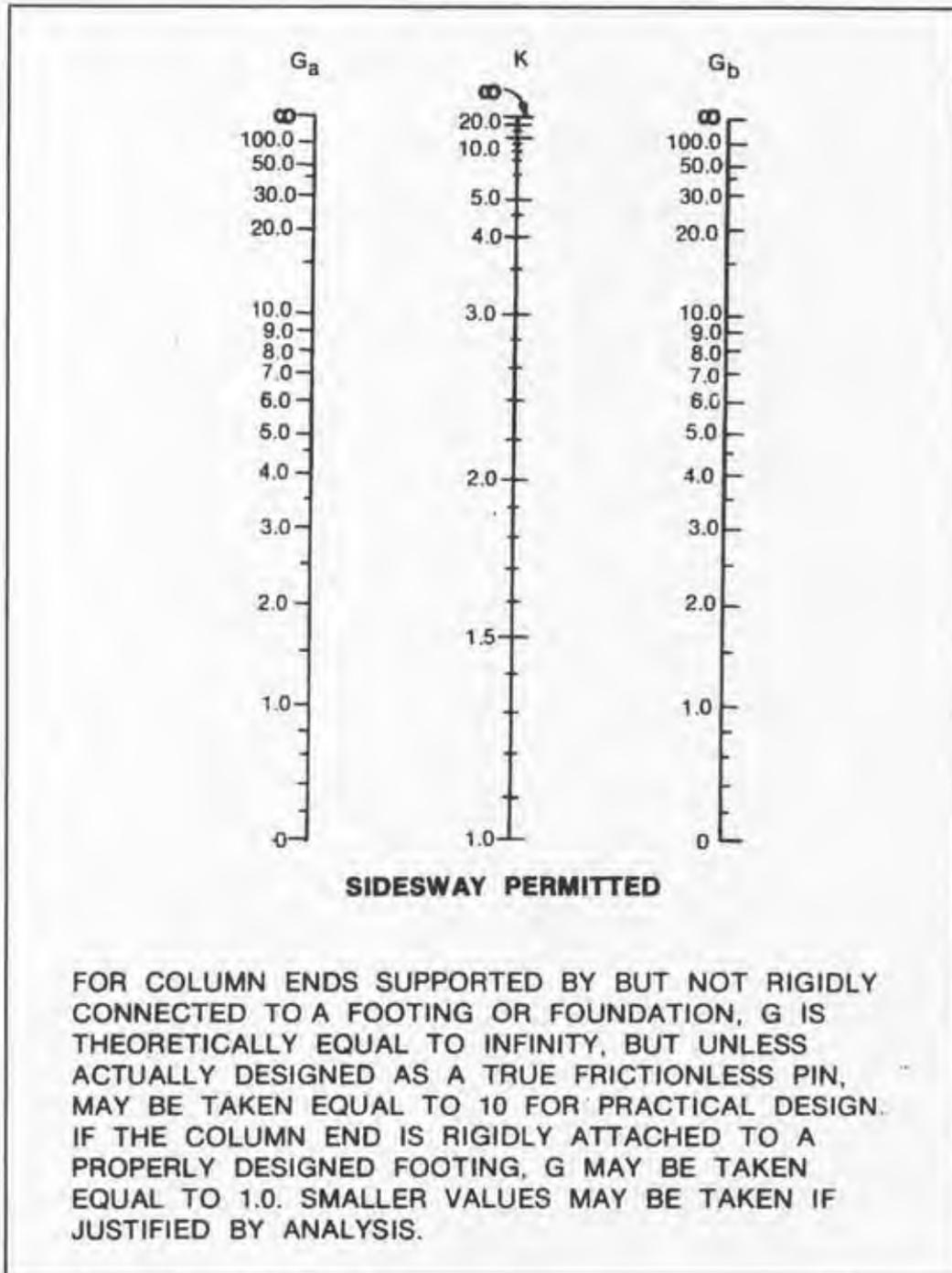
$$G = \frac{\sum (E_c I_c / L_c)}{\sum (E_r I_r / L_r)} \quad (C-2)$$

- + Σ = summation of all members rigidly connected to the end of the compression member under consideration in the plane of bending
- + E_c = modulus of elasticity of compression member
- + I_c = moment of inertia of compression member
- + L_c = unbraced length of compression member
- + E_r = modulus of elasticity of beam or other restraining member
- + I_r = moment of inertia of beam or other restraining member
- + L_r = unbraced length of beam or other restraining member
- + K = effective length factor

+ Table C-2 is a graphical representation between K , G_a , and G_b , and can be used to obtain the value of K easily. Equation C1 and the alignment chart in Table C-2 are based on the assumptions of idealized conditions. The development of the chart and formulas can be found in textbooks such as Salmon and Johnson (1996) and Chen and Lui (1991). When actual structural conditions differ from these assumptions, unrealistic design may result. The modification procedures proposed by Galambos

(1988), Yura (1971), Disque (1973), Duan and Chen (1989, 1996), Essa (1997), LeMessurier (1977) and AISC-LRFD (1993) may be used to evaluate K -factors more accurately.

TABLE C-2



In computing effective length factors for monolithic connections, it is important to properly evaluate the degree of fixity in the foundation. The following values can be used:

G_n			
1.5	Footing anchored on Rock	5.0	Footing on Soil
3.0	Footing not anchored on Rock	1.0	Footing on Multiple Rows of End Bearing Piles

The following alternative K -factor equations [Duan, King and Chen 1993] may be used.

For braced frames

$$K = 1 - \frac{1}{5 + 9G_a} - \frac{1}{5 + 9G_b} - \frac{1}{10 + G_a G_b} \quad (C-3)$$

For unbraced frames
for $K < 2$

$$K = 4 - \frac{1}{1 + 0.2G_a} - \frac{1}{1 + 0.2G_b} - \frac{1}{1 + 0.01G_a G_b} \quad (C-4)$$

for $K \geq 2$

$$K = \frac{2\pi a}{0.9 + \sqrt{0.81 + 4ab}} \quad (C-5)$$

where:

$$a = \frac{G_a G_b}{G_a + G_b} + 3 \quad (C-6)$$

$$b = \frac{36}{G_a + G_b} + 6 \quad (C-7)$$

where G_a and G_b are defined by Eq. (C-2).

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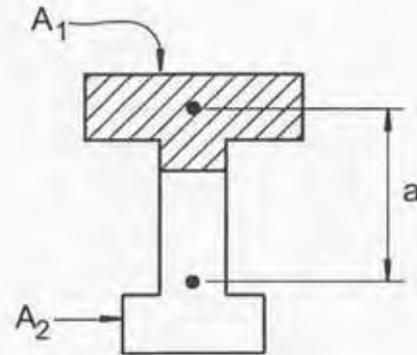
APPENDIX D

COMPUTATION OF PLASTIC SECTION MODULUS Z^*

The plastic modulus Z is the statical first moment of one half-area of the cross section about an axis through the centroid of the other half are when a section is made of same steel material.

When a section is built up from plates or shapes of more than one yield strength, the plastic moment should be computed on the basis of equilibrium on the cross section with all fibers stressed to the appropriate yield strength in either tension or compression.

*Information in this Appendix is obtained from the Commentary of AISI Bulletin 15. Values of Z for rolled sections are listed in the Manual of Steel Construction, Eighth Edition, 1980, American Institute of Steel Construction.



$$A_1 \text{ (shaded)} = A_2 \text{ (clear)} = A/2$$

$$a = \text{distance between centroid of } A_1 \text{ and } A_2$$

$$Z = aA_1 = aA_2$$