systems as one finds in the majority of highway bridges. I beams are not fit for upper lateral struts, especially when they have jaws their ends, nor should ⅝″ rods be employed anywhere in a bridge.

Some of the most flourishing highway bridge companies never figure at all upon the effect of wind pressure, but content themselves with using rods from ⅝″ to 1″ in diameter for all spans under 150′ in length and I beams or even pieces of gas pipe for lateral struts. It is not necessary to add any area to the section of the bottom chord to resist the tension due to wind pressure, unless this tension exceed that due to the live load, for, as before stated, there is no likelihood of travel during heavy winds, nor are any loads ever supposed to remain upon a bridge for any length of time.

For this same reason the bending effect of the wind upon posts and batter braces is neglected, unless it produce a greater stress than that due to the live load.

But the bending effect upon portal and lateral struts where no vertical sway bracing is used, is much greater than the effect of the direct pull of the lateral rods. It is only lately that the writer has fully appreciated the magnitude of the bending stresses in these members.

The area of bridge per lineal foot was calculated from a number of diagrams of stresses and sections, and was divided between the upper and lower lateral system by supposing a horizontal plane to pass through the middle of the posts and assuming that all the pressure above this plane is carried by the upper lateral system and all below by the lower lateral system.

This may be a correct assumption and may not, but it is as likely to be correct as any other. Where vertical sway bracing is used, the division of wind pressure becomes still more ambiguous, but as before the same assumption is as likely to be correct as any other.

As the stress thus found for the upper portal strut is only a little in access of that found for the lower, the size of the latter has been made equal to that of the former in the table. When there is no vertical sway bracing, stiffness is obtained by the use of knee braces or brackets A B, C D, Fig. 2, making angles of about forty-five degrees with the vertical. Let the notation be as shown in the figure, V being as before the relief of weight at F. P is the sum of the pressures at K and G.

Taking the centre of moments at E gives $Vb = Pd$ and $V = \frac{Pd}{b}$

Again taking centre of moments at A gives the value of the bending moment M on the strut at that point, thus

$$C = M = \frac{Pd}{2b}(b-2s)$$

Let h = the distance between the centres of gravity of the two channels of which the upper lateral strut is composed, then the bending stress

$$C = M = \frac{Pd}{2bh}(b-2s)$$

The intensity of working bending stress for this case was taken equal to six tons, so that

$$\frac{C}{6} = \frac{Pd}{12bh}(b-2s)$$

the number of square inches of area to be added to each channel in order to resist bending.

The intensity of direct working stress was taken from the well-known formula,

$$P\left(4 \div \frac{H}{30}\right) = \frac{f}{1 + \left(\frac{H}{c}\right)^2}$$

which is a little too strong for lateral systems; but this will be a grand fault, as it will add a little stiffness to the bridge. The total area of each channel is equal to sum of the areas required to resist bending and that to resist direct compression.

The stress in the knee-brace A B is calulated by taking the centre of moments at G and making the moment of its stress equal to the algebraic sum of the moments of V and $\frac{1}{2}P$. As before to make these formulæ applicable to a portal make d equal to the length of the batter brace and P one-half of the sum of the pressures concentrated at the upper panel points. All lateral and vibration rods were proportioned by using the following table, which gives the allowable stresses—in tons of 2,000 pounds upon the rods after the initial tensions have been deducted, also the initial tensions.

Dia.	Working Stresses.		Initial Tensions.		Dia.	Working Stresses.		Initial Tensions.	
in.	....	....	....	....	in.	....	....	....	....
¾	2.815	3.574	0.500	0.635	1.11-16	14.399	18.342	2.375	3.016
13-16	3.261	4.157	0.625	0.794	1¾	15.540	19.794	2.500	3.175
⅞	3.760	4.789	0.050	0.953	1.13-16	16.726	21.305	2.625	3.334
15-16	4.303	5.481	0.875	1.111	1⅞	17.959	22.874	2.740	3.493
1	4.890	6.230	1.000	1.270	1.15-16	19.237	24.503	2.875	3.651
1.1-16	5.525	7.038	1.125	1.429	2	20.562	26.190	3.000	3.810
1⅛	6.205	7.904	1.250	1.588	2.1-16	21.933	27.935	3.125	3.969
1.3-16	6.931	8.830	1.375	1.746	2⅛	23.349	29.739	3.250	4.128
1¼	7.704	9.814	1.500	1.905	2.3-16	24.812	31.603	3.375	4.286
1.5-16	8.523	10.856	1.625	2.064	2¼	26.321	33.524	3.500	4.445
1⅜	9.387	11.956	1.750	2 223	2.5-16	28.875	35.504	3.625	4.604
1.7-16	10.298	13.117	1.875	2.381	2⅜	29.476	37.541	3.750	4.763
1½	11.253	14.335	2.000	2.540	2.7-16	31.123	39.640	3.875	4.921
1.9-16	12.256	15.611	2.125	2.699	2½	32.815	41.795	4.000	5.080
1⅝	13.304	16.947	2.250	2.858	2.9-16	34.554	44.009	4.125	5.239

The distance G A = s, Fig, 2, was assumed equal to 4 feet for narrow roadways, and 6 feet for wide ones, values for intermediate roadways being interpolated. Curved brackets are used in bridge-designing, but if anyone will calculate the stress in a bracket, he will no longer think of curving it for the sake of appearance.

Brackets are also used below intermediate struts both for appearance and to aid the I beam strut to resist bending in its weakest direction, so that in proportioning it the length may be taken as the distance between the points of attachment of the brackets.

The details used for the lateral systems are shown on the accompanying plate. As can be seen there, the upper lateral strut is composed of two channel bars, either laced or latticed, the upper resting on the chord plate and rivetted thereto, and the lower attached to the lower flange of the inner chord channel by a connecting plate in the form of the letter T.

The upper lateral rods are connected by bent eyes to the