for bridges in unusually exposed situations is to be assumed as fifty lbs. for spans of one hundred feet and under, forty-five lbs. for spans between one hundred and one hundred and fifty feet, and forty lbs. for spans above one hundred and fifty feet.

For bridges in positions not unusually exposed, these numbers can each be diminished by ten.

The total area exposed to the wind is to be determined by adding together the areas of the floor, joists, and lower lateral rods, and twice the area of the truss, hand-rail, hub plank, guard rail and the rectangles circumscribed about the ends of the floor beams.

Limiting Length of Span for Different Clear Roads.—The maximum lengths of span for the different clear roadways are to be one hundred and forty feet for twelve feet roadways, one hundred and ninety feet for fourteen feet roadways, two hundred and sixty feet for sixteen feet roadways and three hundred and fifty feet for eighteen feet roadways. By 'clear roadway' is meant the distance between the inner edges of the batter brace plates.

Limit of Clear Headway.—The least allowable clear headway is to be fourteen feet, unless some local consideration cause this number to be increased. By 'clear headway' is meant the vertical distance from the upper face of the flooring to the lowest part of the portal or overhead bracing.

Limiting Length of Span for Pony Trusses.—The greatest allowable length of span measured from centre to centre of end pins, or, in case of rivetted connections at the shoes, between the intersections of the centre lines of lower chord and batter braces, is to be sixty-five feet for pony trusses or bridges without overhead bracing.

Limiting Depth of Pony Trusses.—The greatest allowable depth measured from centre to centre of chords for pony trusses without side bracing is to be six feet, and that for pony trusses with side bracing nine feet.

Limiting Slope for Batter Braces of Pony Trusses.—The least allowable slope for batter braces of pony trusses is to be two horizontal to one vertical.

Limiting Length of Span for Double Intersection Bridges.*—The least allowable depth of span measured from centre to centre of end pins, or in case of rivetted shoe-connections, between the intersections of the centre lines of chord and batter braces for double intersection bridges is to be one hundred and fifty feet.

Side Braces.—The least allowable batter for side braces in pony truss bridges is to be five inches to the foot, and all side braces are to be made to resist both tension and compression. In no case are they to have less strength than that of a $2\frac{1}{2}'' \times 2\frac{1}{2}'' = 5$ lb to foot angle iron.

Limiting Sizes of Sections.—No rods less than three-quarters of an inch in diameter are to be used in a bridge. No channels less than five inches in depth are to be used for chords, batter braces or posts, or less than inches four in depth for lateral struts. No bars less than one-half inch thick are to be used for diagonals, nor any iron less than one-quarter inch thick anywhere in the bridge.

Expansion.—Any span above fifty feet in length, resting on stone, concrete or iron foundations, shall be provided with some means of allowing the bridge to expand and contract longitudinally with the variations of temperature; and, in spans of fifty feet and under, care must be taken especially when the bridge is erected in cold weather, to see that the stonework of the abutments will not prevent a little sliding of the shoes.

Anchorage.—At least one end of every bridge must be anchored to the foundations. If the overturning moment of the greatest assumed wind pressure be more than half the resisting moment of the weight of the bridge, the latter must be anchored at the roller end also, but in such a manner as not to interfere with the expansion.

Sliding.—At the roller end of a bridge, if the frictional resistance to the sliding of the shoe in the direction of the length of the rollers be not more than double the tendency to slide, produced by the wind pressure, a resistance equal to the difference of these two quantities with a factor of safety of two must be provided.

Continuous Spans.—Except in the case of swing bridges, consecutive spans are not to be made continuous over the points of support.

Cambre.—The cambre of all bridges must be such that when they are subjected to their heaviest loads, the middle point of the centre line of the bottom chord shall be at least one inch above the line joining the centre of end pins.

Vertical Sway Bracing.—In all deck bridges and in all through bridges, where the depth from centre to centre of chords is twenty-four feet or over, vertical sway bracing is to be used, and is to be proportioned so as to carry all the wind pressure concentrated at the upper and intermediate panel points (if there be intermediate struts), on the windward side and at the upper panel point on the leeward side to the lower panel point on the leeward side.

Portal Bracing.—The portal bracing is to be proportioned not only to resist the direct thrust caused by the wind pressure, but also the bending caused by the stresses in the knee bracing, according to the method given in Burr's work on "Stresses in Bridge and Roof Trusses." Portal struts subjected to bending must first be proportioned for direct stress due to both wind pressure and the initial tensions on the rods meeting at the end of the strut, and then to their section must be added sufficient area to resist the bending.

Bending Effect on Posts and Batter Braces.—But the bending effect in the posts and batter braces caused by the stresses in the intermediate struts or knee braces need not be considered to occur when the bridge is fully loaded; so unless the dead load stresses and the bending together call for more section than the dead and live loads combined, the bending in these members may be neglected.

Bending Effect on Lateral Struts.—Nor need there be any bending supposed to be caused by stresses in the knees connecting upper or intermediate lateral struts to posts, as the use of these knees may be considered simply to prevent vibration, and as, owing to the fact that these struts resist bending in the planes of their greatest dimensions, there is already a surplus of strength.

Stresses in Upper Lateral Struts.—The stresses in the upper lateral struts are to be calculated for the wind

* For later investigations concerning this limiting length, see "Economy in Highway Bridges," in the Proceedings of the Engineers' Club of Philadelphia.