Calculator for Beam-column Design

EA-LU TING

THE CALCULATION of interaction equations in beam-column design is always tedious and time consuming. The author has designed a special calculator, as shown in Fig. 1, for calculating the interaction equations. By using this special calculator, the divisions, multiplications and summations of all terms appearing in the interaction equations can be performed without any longhand operations. The author has found it very handy and especially time saving during the trial-and-error operations in the selection of a proper section.

As shown in Fig. 1, the calculator consists of four parts: a stationary graph, a movable graph, a rotary cursor and a slide cursor. The movable graph and slide cursor can be slid along the inside and outside, respectively, of the stationary graph. The rotary cursor is attached to and can be rotated about the origin of the horizontal **Km** scale on movable graph. The horizontal **Ks** scale on the stationary graph is identical to the horizontal **Km** scale on the movable graph. Both scales are dimensionless, and indicate the percentages of actual stresses to allowable stresses, axial or bending. The vertical **Am** scale on the movable graph, in kips per square inch, indicates the allowable stresses, axial or bending. On the slide cursor there are two scales. One is the **As** scale, in kips per square inch, which is identical to the **Am** scale on the movable graph, but indicates the actual stresses, axial or bending. The **B** scale is dimensionless, representing C_m or $(1 - f_a/F'_e)$.

Example—The following example demonstrates the function of the calculator.

$$\frac{12.0}{24.0} + \frac{15.0 \times 0.6}{25.0 \times 0.8} = 0.95 < 1.0$$

Ea-Lu Ting is Structural Engineer, Canron Ltd., Toronto, Canada.

The calculation of the first term is shown in Fig. 1. In the initial position the origins of the **Ks** scale and the **Km** scale are coincident. Set the rotary cursor at 24.0 ksi on the **Am** scale. Adjust the slide cursor to the position where the two cursor lines intersect at 12.0 ksi on the **As** scale. Both the **Ks** scale and the **Km** scale read 0.50.

The calculation of the second term is shown (final result only) in Fig. 2. The operations will be explained step by step. To continue the previous calculation:

Step 1—Pull the movable graph to the right and set the origin of the **Km** scale to coincide with the origin on the slide cursor, that is at 0.50 on the **Ks** scale on the stationary graph.

Step 2—Set the rotary cursor at 25.0 ksi on the **Am** scale. Move the slide cursor to the position where the two cursor lines intersect at 1.0 on the **B** scale, and move down the rotary cursor to 0.8 on the **B** scale. Now, the **Am** scale reads 20.0 ksi (=25.0 × 0.8).

Step 3—Move the slide cursor to the position where the two cursor lines intersect at 15.0 ksi on the **As** scale. Move the rotary cursor down to 1.0 on the **B** scale and move the slide cursor to the left to the position where the two cursor lines intersect at 0.6 on the **B** scale. Now, the **Km** scale reads 0.45 and the **Ks** scale reads 0.95, the final result.

By the same operation, a beam-column under biaxial bending can readily be calculated. The horizontal scales, **Ks** and **Km**, are from 0.00 to 1.35. Thus, the combined wind stress can be calculated directly without reduction of other stresses before hand.

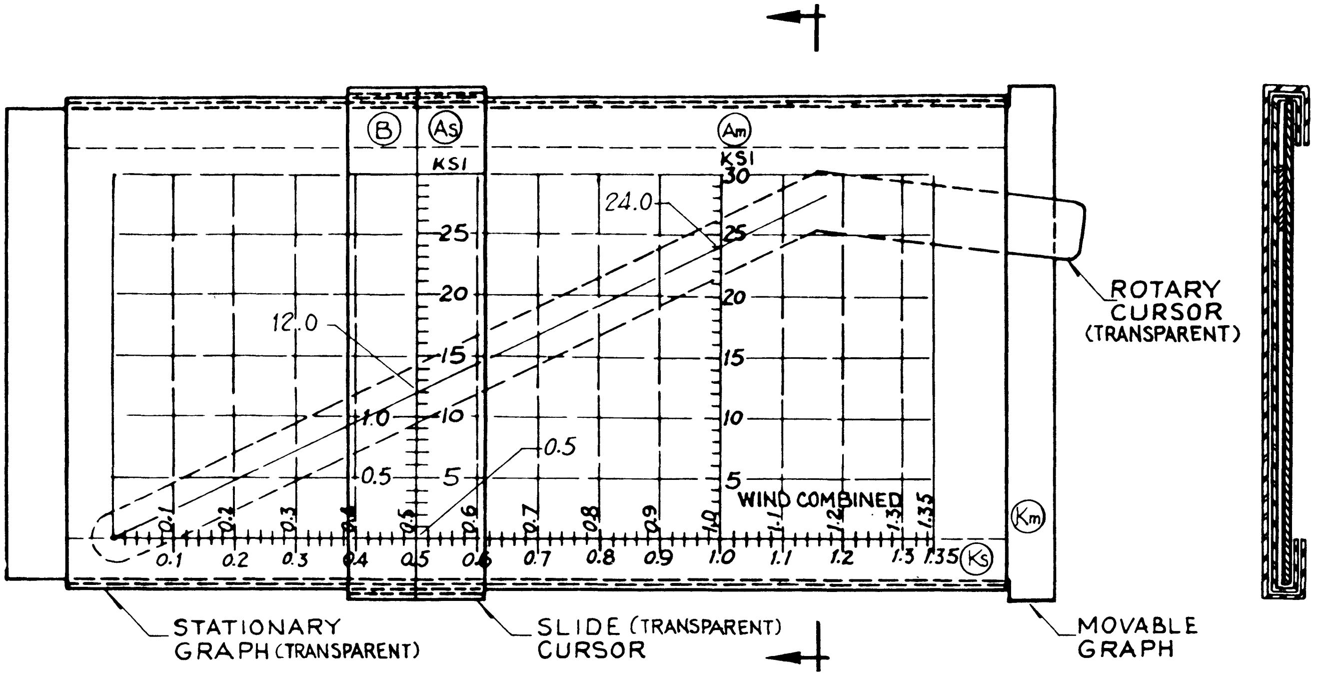

Figure 1

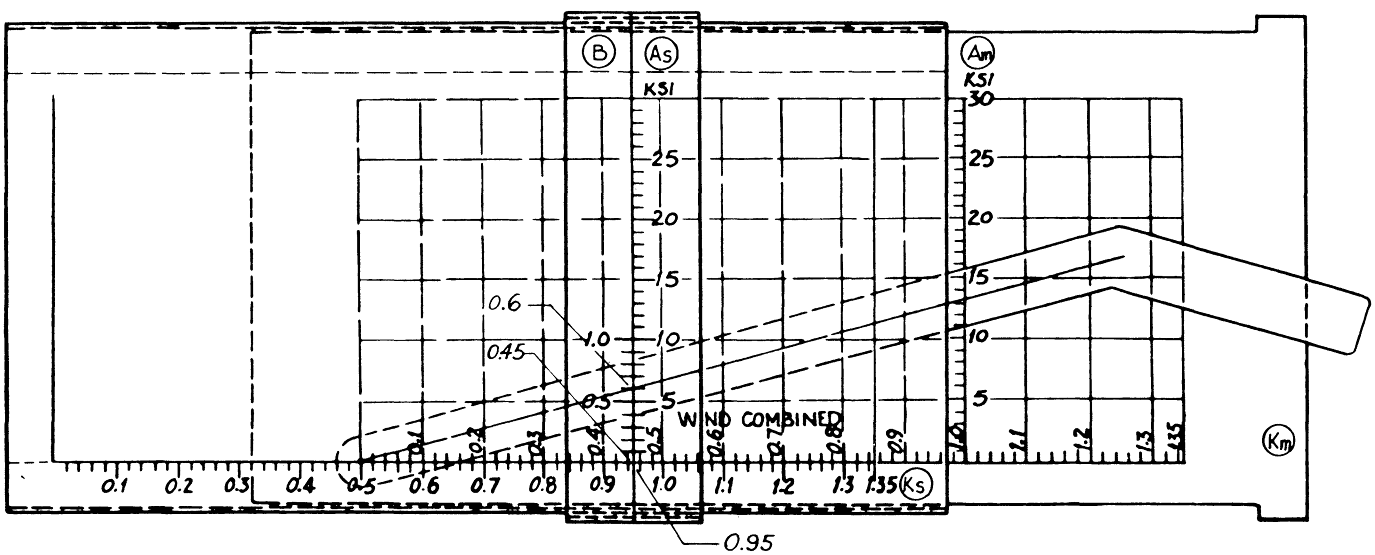

Figure 2