Buckling of Hyperbolic Paraboloids

Paper presented by KENNETH P. BUCHERT (April 1972 issue)

Discussion by **BENJAMIN KOO**

THE AUTHOR is to be commended for deriving the equations for the critical load and the critical length which are important in analyzing the hyperbolic paraboloids. The writer extended the author's method by developing a graphic solution in a family of design curves which simplify calculations and provide the practical office engineers with a visual picture showing the relationship of the critical values with the geometry of the structure and the structural properties of the members.

By means of Eqs. (3) and (4) and using the values of E equal to 29×10^6 psi, Eqs. (5) and (6) can be rewritten as follows:

$$p_{cr} = (116 \times 10^6)/[(d/A)(\sqrt{A/I})(a \times b/c)^2] \quad (7)$$

$$l_{cr} = [36\pi^4(I/A)(a \times b/c)^2]^{1/4} \quad (8)$$

where the units are as follows: p_{cr}, lbs/sq ft; l_{cr}, in., a, b and c, ft; d, in.; A, in.^{2}; and I, in.^{4}

The above two equations show that the critical values vary with a geometric parameter of hyperbolic paraboloids $(a \times b)/c$ and the parameter of the structural member properties of I and A. Based on the two unique parameters, a family of design curves is constructed.

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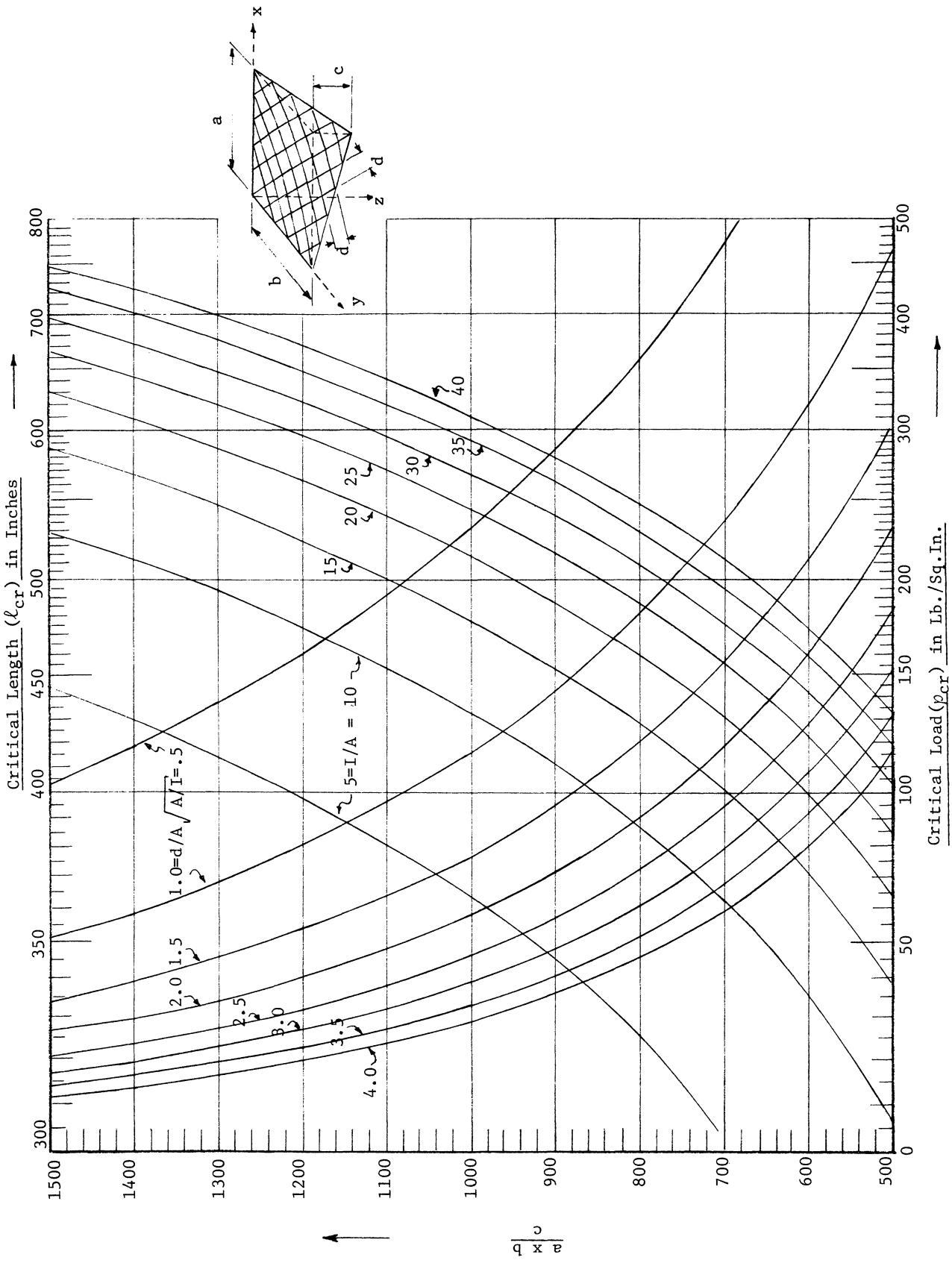

Fig. 1. Critical load and critical length diagrams

Design Example—Using the author's example and referring to Fig. 1:

$a = b = 150$ ft; $c = 20$ ft; $d = 4$ ft $= 48$ in.

Members are C12×25:

$A = 7.35$ sq in.; $I = 144$ in.^{4}

For Critical Load:

$$\frac{a \times b}{c} = \frac{150 \times 150}{20} = 1125$$

$$(d/A)\sqrt{A/I} = (48/7.35)\sqrt{7.35/144} = 1.48$$

From the Design Curves:

$$p_{cr} = 64 \text{ lbs/sq ft}$$

For Critical Length:

$$\frac{a \times b}{c} = 1125$$

$$I/A = 144/7.35 = 19.6$$

From the Design Curves:

$$l_{cr} = 542 \text{ in.}$$

From the above answers, the graphic solution is very close to the results obtained from the hand calculation.