LOSS OF STABILITY OF ARCHES AND RINGS

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Annotation: This article discusses the loss of stability of arches and rings. Examples are provided, including an arch with a constant reduced moment of inertia, an arc-shaped arch, a ring with a constant cross-section, a circular tube with a constant thickness, and the loss of stability of a rectangular plate.

Keywords: *stability, arch, pipe, moment of inertia, thrust value, arc, intensity value, ring*

An arch with a constant reduced moment of inertia, whose middle fiber is a cable curve for a given system of loads.

a) An arch that is hinged at the edges (Fig. 1). The critical value of the распор

$$Q_c = \frac{4\pi^2 EI}{l^2} \quad (1)$$

where I is the reduced moment of inertia of the arch.

b) An arch with rigidly clamped edges. Here

$$Q_c = 8{,}18\frac{\pi^2 EI}{l^2} \quad (2)$$

An arc in the shape of a circular arc, loaded with a uniformly distributed radial load of intensity ρ

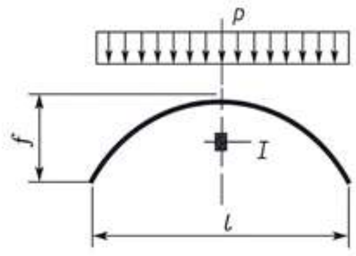

Fig.1

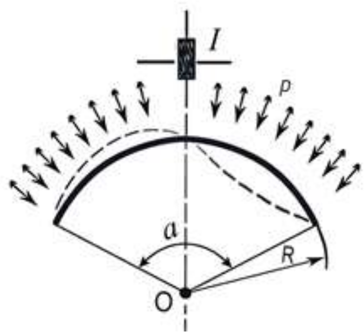

Fig.2

a) An arch with hinged edges (Fig. 2). The shape of the loss of stability is shown in the figure as a dotted line; the critical value of the intensity

$$\rho_c = \left(\frac{4\pi^2}{\alpha^2} - 1\right)\frac{EI}{R^2} \quad (3)$$

b) An arch with rigidly clamped edges. Here

$$\rho_c = (k^2 - 1)\frac{EI}{R^2} \quad (4)$$

The values of k are given in Table 1.

Table 1.

α, degree	60	120	180	240	300	360
k	8,62	4,37	3	2,36	2,07	2

A ring of constant cross-section, loaded along the outer contour by a uniformly distributed radial load of intensity ρ (Fig. 3)

$$\rho_c = \frac{3EI}{R^3} \quad (5)$$

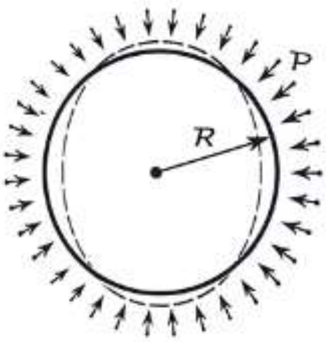

Fig.3

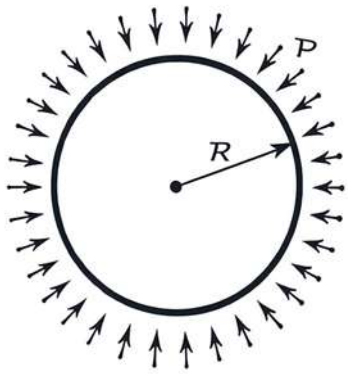

Fig.4

the corresponding value of the compressive force in the cross-section is equal to

$$N_c = \frac{3EI}{R^2} \quad (6)$$

A circular tube of constant thickness, loaded with evenly distributed intensity pressure ρ (fig.4)

Critical pressure value

$$\rho_c = \frac{E}{4(1-\nu^2)}\left(\frac{h}{R}\right)^3 \quad (7)$$

where h – pipe thickness

Loss of stability of a rectangular plate

Consider a plate of thickness h, free at the edges, loaded with a compressive normal load of intensity N (per unit of height b) (Fig. 5).

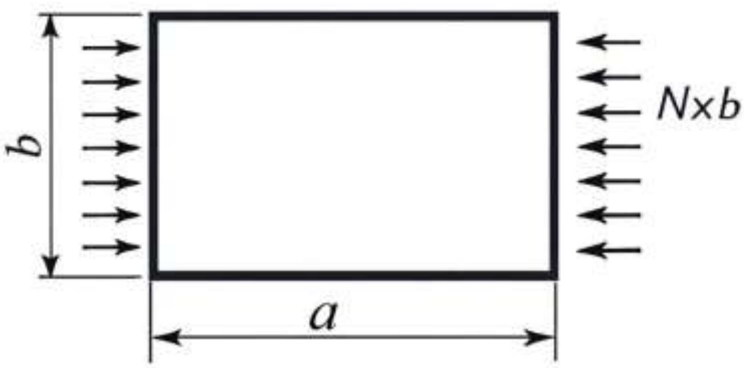

Fig.5

If a/b>1, the critical value of N is close to the value determined by the formula

$$N_c = \frac{4\pi^2 D}{b^2} \qquad (8)$$

where

$$D = \frac{Eh^3}{12(1-\nu^2)} \qquad (9)$$

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