# CIRCLE OF MOR. GRAPHICAL ILLUSTRATION OF TENSIONS.

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**Abstract:** *This article discusses graphical representations of stresses and the Mohr circle. To do this, at a certain point in a deformed body, we consider the stress acting on a flat surface element at that point, whose orientation changes. We represent the stress as a vector in a plane passing through this vector and the normal vector On to the plane.*

**Keywords:** *Mohr circle, vector, principal planes, principal stresses, normal stresses, tangent stresses, and limit states.*

Consider the stress acting on a flat surface element P at a certain point O of a deformed body, whose orientation changes. We will represent the voltage by the vector OT in the plane passing through this vector and the normal vector On to the plane P.

- The stress vector is parallel to the normal when the plane P coincides with one of the principal planes.

Let's plot the principal stresses $N_1$,$N_2$,$N_3$ along the normal and construct circles $C_1, C_2$,$C_3$ (as shown in Fig. 1). It can be shown that the end of the stress vector T is always located inside or on the contour of the shaded area.

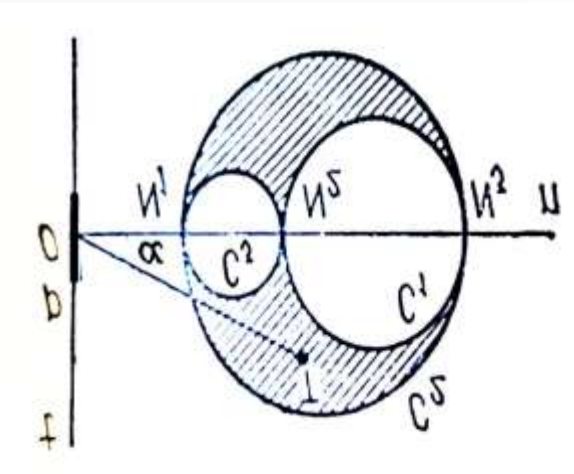


Fig. 1

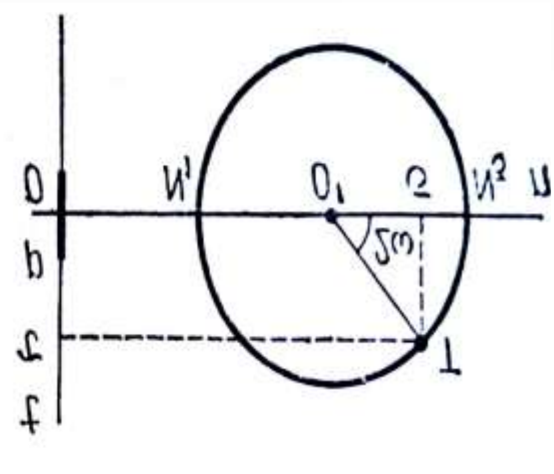


Fig. 2

The circle $C_2$, which corresponds to the limit values of the principal stresses, is called the Mohr circle.

When the plane P rotates relative to the middle principal axes, the point T describes a Mohr circle, and when this plane is rotated by an angle ω from the principal plane corresponding to the maximum principal stress $N_2$, the radius (vector) of the Mohr circle is rotated by an angle 2ω (Fig. 2).

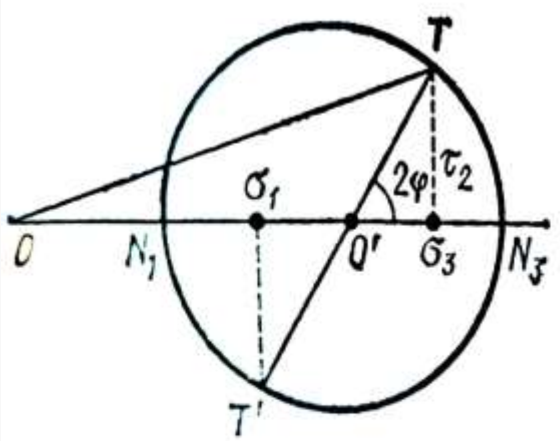
The normal and tangential components of the stress vector are given by the following formulas

$$\sigma = \frac{N_1+N_3}{2} - \frac{N_3-N_1}{2}\cos 2\,\omega \qquad (1)$$

$$\tau = \frac{N_3-N_1}{2}\sin 2\omega \qquad (2)$$

If you want to construct a Mohr circle using the known stresses σ_(1), σ_3, and τ_2, which are calculated relative to two orthogonal axes Ox and Oz, where the principal directions make angles with Ox$\varphi$ $\varphi + {}^{\pi}/_{2}$, where the angle is determined by the formula

$$\operatorname{tg} 2\varphi = \frac{2\tau_2}{\sigma_3 - \sigma_1}$$



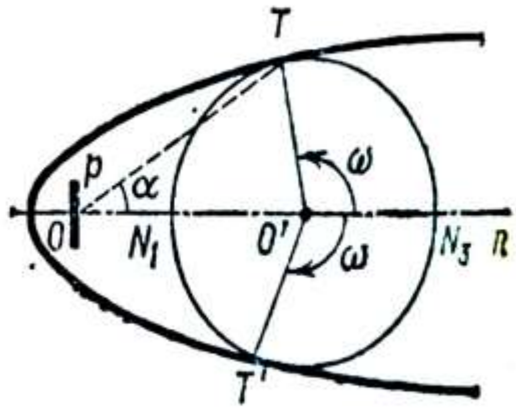




Fig. 3 Fig. 4

Then the main stresses will be

$$N_1 = \frac{\sigma_1+\sigma_3}{2} - \frac{\sigma_3-\sigma_1}{2}\frac{1}{\cos 2\varphi}; \qquad (3)$$

$$N_3 = \frac{\sigma_1+\sigma_3}{2} + \frac{\sigma_3-\sigma_1}{2}\frac{1}{\cos 2\varphi} \qquad (4)$$

With a given increase in external influences, the material can leave the elastic region at point O – a (irreversible) slip of some flat element at point O takes place relative to an adjacent infinitely close element.

The voltage acting on this element is shown in Fig.4. by the OT vector, which is inclined to the horizontal axis at an angle $\alpha$.

If the external influences change, the point T describes a curve that is symmetric with respect to the On axis and is the envelope of the Mohr circles corresponding to the onset of plastic flow or fracture. This curve is the characteristic curve of the material under study. If a Mora circle is given that touches the characteristic curve at points T and TI, then the surface P along which irreversible sliding occurs is inclined to the principal plane $N_2\,O\,N_3$ at an angle$\pm\,\omega/2$.

Let's consider ensuring the safe operation of a structure. The well-known method called the classical method involves checking that the elastic stresses at all points of the structure, calculated using In the most unfavorable combination of external influences, the permissible stresses do not exceed the allowable stresses obtained by dividing the conditional strength limits of the material by the corresponding safety factors, which depend on the nature of the stress state and external influences.

The limit state method ensures that the design provides a safe working environment while maintaining its functionality. By definition, a design fails when one or more of its components no longer functions properly. functions due to excessive elastic or plastic deformation, excessive cracking, rupture, and excessive displacement

In this method, the safety factor is determined by the ratio between the external force corresponding to the failure of the structure and the external force corresponding to the allowable load or overload during operation. Each failure criterion has its own safety factor.

Cyclic alternating external loads. Destruction of structural elements that are subjected to multiple alternating external loads can occur even in an area that is elastic under single-load conditions.

The region of pure elasticity, or the region of endurance, can be determined experimentally; by definition, it is assumed that the stress that does not cause failure after $10^8$ the loading cycles lie in the field of endurance.

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