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Eidgenössische Technische Hochschule Zürich
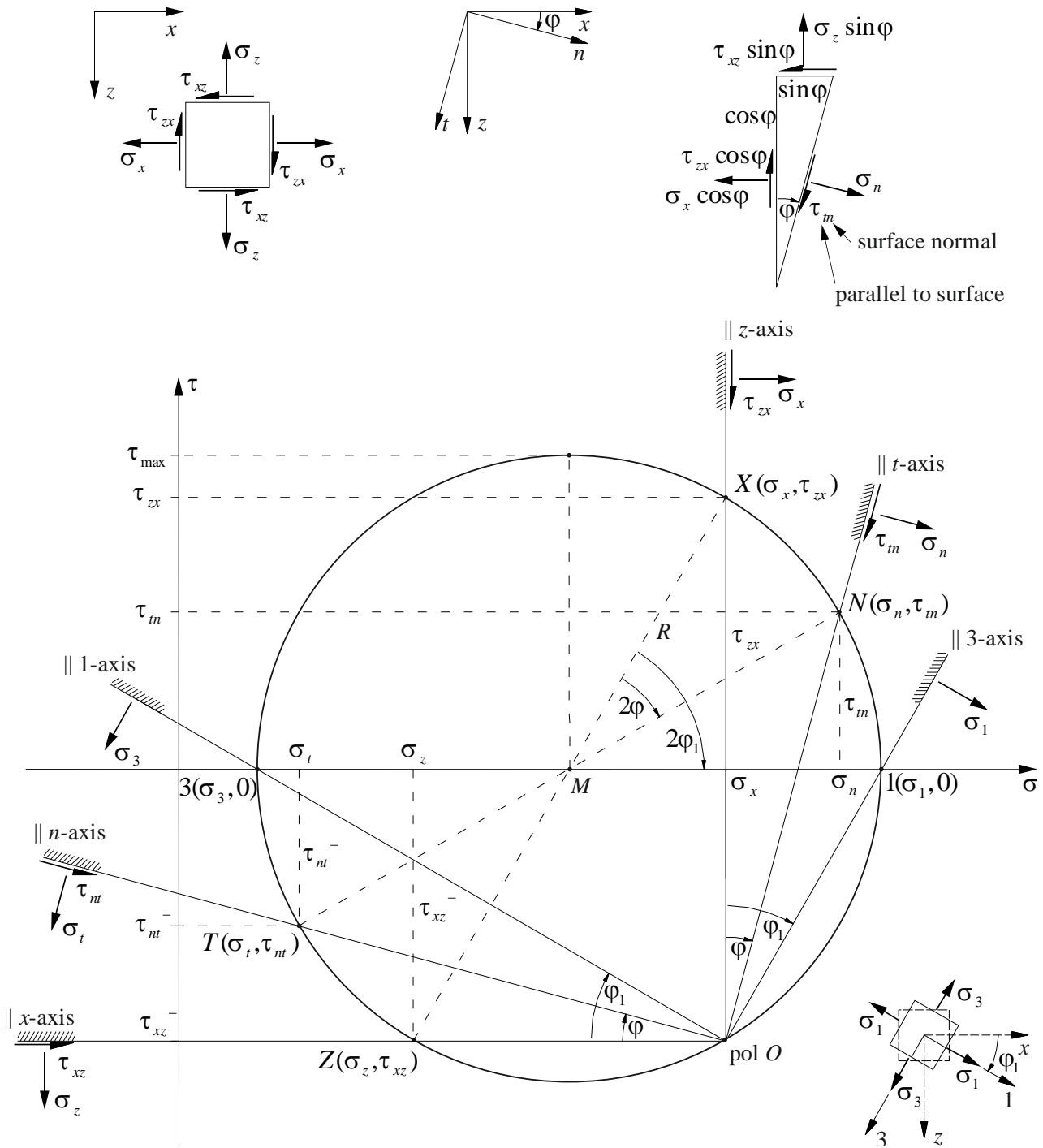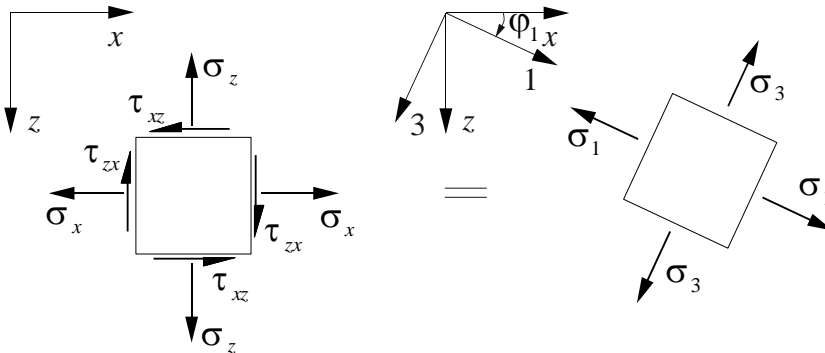**Swiss Federal Institute of Technology Zurich**

Advanced Structural Concrete

Information Sheet: Mohr's Stress Circle

(101-0127-00L)

Overview

**Construction of the Mohr's stress circle and determining the principal stresses**

Approach

1. Draw stress points: $X(\sigma_x, \tau_{zx})$ and $Z(\sigma_z, \tau_{xz})$

2. Mohr's stress circle through

   X and Z: Center: $M = \dfrac{\sigma_x + \sigma_z}{2}$ with the radius: $R = \sqrt{\left(\dfrac{\sigma_x - \sigma_z}{2}\right)^2 + \tau_{xz}^2}$

3. Pol O: Intersection point of the line parallel to the z-axis through the stress point X and the line parallel to x-axis through the stress point Z

4. Principal stresses σ_1 and σ_3

   ($\tau = 0$): Points 1 and 3 on σ-axis

   Axes 1 and 3: Straight line through Pol O and Point 1 = parallel to 3-axis

   Straight line through Pol O and Point 3 = parallel to 1-axis

   Principal direction φ_1: Angle between x-axis and 1-axis

5. Stress point $N(\sigma_n, \tau_{tn})$: Intersection point of the line parallel to t-axis (= parallel to surface, orthogonal to n-axis) through Pol O and the Mohr's stress circle

6. Stress point $T(\sigma_t, \tau_{nt})$: Intersection point of the line parallel to n-axis (surface normal) through Pol O and the Mohr's stress circle

Keep in mind:

1. The straight line through Pol O and the stress points on the Mohr's stress circle is **parallel** to the corresponding surfaces of the section.

2. The **angle** φ is defined positive in the **clockwise** direction.

3. The larger principal stress is always σ_1: $\sigma_1 > \sigma_3$
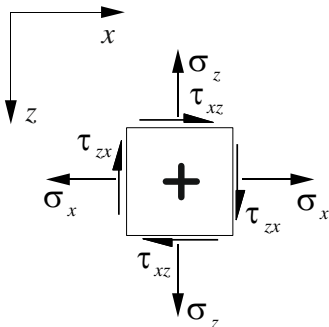
Sign convention for σ and τ at the element:
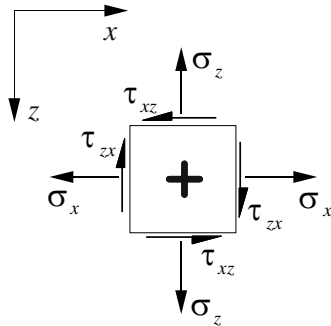
Convention

1. Normal stress: Tensile stress is defined **positive**.

2. Shear stress: If the surface normal is oriented in the positive axis direction, then the shear stress is defined positive in the coordinate direction. For example, the shear stress τ_{xz} acting on the surface with the normal vector pointing in the positive z-direction is defined positive if it is pointing in the positive x-direction.

Sign convention for σ and τ in the Mohr's stress circle:

Convention

1. Normal stress: Tensile stress is defined **positive**.

2. Shear stress: The shear stress is defined positive if it rotates clockwise around the element centre point. Note that the positive shear stress τ_{xz} in the Mohr's stress circle sign convention is pointing into the opposite direction of the positive τ_{xz} in the sign convention at the element.