Information about the Lecture

Engineering Mechanics II

Fig.: Joint bolt (left); Shear stresses (right) [1]

Content of the lecture

At the beginning of the term, elementary bending, torsion and shear theories of the straight beam will be discussed. Thereafter follows an introduction to the three-dimensional theory of elasticity. Hereby, it will be especially focused on multiaxial stress and strain states and Hooke’s law which will be followed up by a depiction of energy methods and the approximation procedures of elastostatics. The lectures conclude with a discussion of the stability of elastic structures.

Dates, exam, lecture notes

<table>
<thead>
<tr>
<th>Lecture date</th>
<th>Mo., 14:00-15:30, Bldg. 10.50, Kl. HS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tutorial</td>
<td>Wed., 11:30-13:00, Building 10.81 HS 62 (R153)</td>
</tr>
<tr>
<td>Lab course</td>
<td>Dates will be announced in the first lecture</td>
</tr>
<tr>
<td>Lecture notes</td>
<td>Will be made available to all participants</td>
</tr>
<tr>
<td>Contact</td>
<td>Dr.-Ing. Tom-Alexander Langhoff, Prof. Dr.-Ing. Thomas Böhlke</td>
</tr>
<tr>
<td></td>
<td>Dr. Konstantin Priesnitz, Dipl.-Ing. Eric Bayerschen</td>
</tr>
</tbody>
</table>

Literature

Content of the lectures

- **Beam bending**
  Bernoulli hypotheses; straight and unsymmetric bending of the straight beam; strains and stresses in the beam; moments of inertia of area; principle axes; technical bending theory; statically indeterminate problems; notch effect

- **Theory of torsion**
  Circular cross sections; thin-walled closed cross sections; thin-walled open cross sections; shear stress distribution; shear flow; twisting; polar moment of inertia of area; section modulus; notch effect

- **Shear force**
  Timoshenko-beam; estimation of the shear deformation and shear strain in the beam as a result of shear forces, statistical moment of an area; shear center

- **Three-dimensional stress and strain measures**
  Normal and shear stresses, stress tensor; principal stresses and their directions; effective stresses; normal and shear strains; strain tensor; principal strains and their directions; effective strains; strain measurement

- **The three-dimensional Hooke's law**
  Elastic and inelastic material behaviour; isotropy and anisotropy; elasticity and hyperelasticity; linear and nonlinear elastic material behaviour; Hooke's law; strain energy; complementary energy; stress theories

- **Basic equations of the three-dimensional elastostatics**
  Distributed forces and resulting forces; Gauss theorem; global and local equilibrium conditions; differential equation for displacements of linear elastostatic; stress and displacement boundary conditions

- **Energy methods of elastostatics**
  Theorems of Maxwell and Betti; theorems of Castigliano; principle of virtual displacements; principle of virtual forces

- **Approximation methods**
  Method of Ritz and Galerkin; introduction to the Finite-Element-method

- **Stability of elastic bars**
  Introduction to the theory of stability; bifurcation points; Euler’s buckling theory