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. Having discussed the stability of elastic structures, an introduction to the theory of elastoplasticity will be given.

Dates, exam, lecture notes

<table>
<thead>
<tr>
<th>Lecture date</th>
<th>Mo., 14:00-15:30</th>
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<tr>
<td></td>
<td>AOC 101 Building 30.45</td>
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<tr>
<td>First lecture</td>
<td>Mo., 12.04.10</td>
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<tr>
<td>Tutorial</td>
<td>Fr., 09:45-11:15</td>
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<td>HS 101 Building 10.50</td>
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<tr>
<td>First tutorial</td>
<td>Fr., 16.04.10</td>
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<td>Lab course</td>
<td>Dates will be announced in the first lecture</td>
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<td>Lecture notes</td>
<td>Will be made available to all participants</td>
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<tr>
<td>Contact Person</td>
<td>Prof. Dr.-Ing. Thomas Böhlke, Dr.-Ing. Tom-Alexander Langhoff</td>
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<td>Dipl.-Ing. Stephan Wulfinghoff</td>
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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

- **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

- **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

- **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

- **Introduction to the description of an inelastic material behaviour**
  Classification of the mechanical material behaviour; theory of plasticity; identification of material parameters; elastoplastic beam bending; residual stresses