

Lecture 1

BASIS HYPOTHESES OF MECHANICS OF MATERIALS AND STRUCTURES

Plan

1. Purpose and objectives of the course.
2. Basis definitions of mechanics of materials and structures
3. Basis hypotheses of mechanics of materials and structures

1.1 Purpose and objectives of the course.

Mechanics of materials and structures is the science about engineering methods to design the structure elements applying the restraining conditions about the strength, stiffness and stability of the structure when the definite durability as well as economy is given.

In view of the above, the basic concepts of the discipline are strength, stiffness, stability and durability. We characterize each of these concepts.

On beginning

1.2. Basis definitions of mechanics of materials and structures

Strength is the ability of the structure to resist the influence of the external forces acting upon it.

Stiffness is the ability of the structure to resist the strains caused by the external forces acting upon it.

Stability is the property of the structure to keep its initial position of equilibrium.

Durability is the property of the structure to save its strength, stiffness and stability during the exploitation time.

Mechanics of materials and structures consider the deformable body. It is a body, which is consisting of particles the distances between which change. A deformable body is a rigid one only to the definite loading.

On beginning

1.3. Basis hypotheses of mechanics of materials and structures

In Mechanics of materials and structures to examine the real object a correct corresponding computational scheme must be chosen. The computational scheme is a real body for which the unessential attributes are eliminated. To choose the correct computational scheme the main

hypotheses of Mechanics of materials and structures have to be introduced. We will consider only five main of them.

Hypothesis of the material continuity is the case, when the material is uniformly distributed in a whole body volume.

Hypothesis of the material homogeneity is the case, when all points of the body have the same material properties. Homogeneous means that something is uniform throughout. Homogeneity depends on the context which it is based on. A homogeneous material means a material which has uniform composition and uniform properties throughout. Metals, alloys, ceramics are examples of homogeneous materials.

Hypothesis of the material isotropy is the case, when the material properties are the same in each direction of a body. Isotropic means that the properties of materials are the same in all directions. In processes, the rate of process is the same in all directions. Isotropy comes in many subjects like materials, physics, cosmology, chemistry, etc. It should be distinguished depending on the subject. In an isotropic material, physical and mechanical properties are equal in all orientations or directions. The isotropic nature of the material depends on its crystal structure. If the grains of the material are not oriented uniformly in all directions, it is not an isotropic material.

Hypothesis of the elasticity. In Mechanics of materials and structures, elasticity is the ability of a body to resist a distorting influence and to return to its original size and shape, when that influence or force is removed. Solid objects will deform when adequate forces are applied to them. If the material is elastic, the object will return to its initial shape and size when these forces are removed.

Hypothesis of the initial and final position of equilibrium. Let the initial position of the beam to be the position of equilibrium. If the applied external forces cause the small deformations the final position of the beam is also position of equilibrium. Then, investigating the beam, the assumption that the initial position of equilibrium coincides with the final one is made.

The latter hypothesis simplifies the mathematical equations that are discussed in Mechanics of materials and structures.

On begining