Solid Mechanics1

Syllabus Number 2A101
Basic Major Subjects
Requisites 2 credit
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1. Course Description

Most machines and structures (such as aircraft, automobiles, transportation equipment, machine tools, buildings, etc.) use mostly solid materials. To make their function safe, excessive deformation and destruction should not occur during use. These evaluations need to be grasped at the design stage. In this subject, elasticity state, such as strain, stress and displacement, occurring when a force such as tension, compression, shearing, twisting and bending is externally applied to a member having a simplified shape.
In this lecture, students will acquire knowledge about DP1.

2. Course Objectives

The aims of this lecture are to understand the following items and to be able to resolve the exercise problem level at the end of the text chapter.
(1) Balance of force, stress, and strain when tensile or compressive elastic deformation are applied to the material
(2) Balance of force, stress, and strain when shearing or torsional elastic deformation are applied to the material
(3) Balance of forces and bending moment when bending elastic deformation are applied to the material
(4) Hook's law, moment inertia of area, polar moment of inertia of area, bending rigidity, and torsional rigidity which are need to analysis (1) to (3)

3. Grading Policy

The results are evaluated based on the intermediate test (30%) and the regular test (70%).
Basically, some exercise will be given in every lecture. It is a level that can be answered during class. It is important to solve by yourself, so if you are unable to complete in time, please submit your work in the next lecture. The answer and explanation of it will be done in subsequent lectures.

4. Textbook and Reference

Textbook
H. Nakayama Introduction to Strength of Materials to Form the Basics of Strength Design,
ISBN 978-4886615107 Taiga Publishing
Reference
T. Murakami Strength of Materials (New Edition),
ISBN 978-4627605121 Morikita Publishing
R. Ishida, T. Akita co-author Strength of Materials,
ISBN 978-4627640115 Morikita publishing

5. Requirements(Assignments)

In order to solve the exercise problems, scientific function calculator is needed. Please be able to calculate the trigonometric function, exponent, and logarithm. It is necessary to understand the meanings of trigonometric functions, exponential functions, logarithmic functions, differentiation, integration, and so on.

6. Note

7. Schedule

[1] Importance and history of solid mechanics: Understand the importance of solid mechanics in aerospace engineering
[2] Tensile stress: Understand balance of forces when loading tensile load on bar and the state of members
[3] Stress-strain diagram and Poisson's ratio: Understand the relationship between the stress generated inside and the strain of the member when the load is applied to the bar and learn about the strain in the perpendicular direction to the load generated when a tensile or compression force is applied to an object
[4] Shear force and shear stress: Understand the balance of forces and the state of the members when the object is deformed with angular distortion applied with shear force
[5] Contact stress, allowable stress: Learn about stress acting on the contact surface when an object is supported by another object and stress which is an indicator of breakage and breakage of the member
[6] Elongation of bars: About elongation / shrinkage of combination bars used different materials, learn statically indeterminate problem which cannot be calculated from balance of forces only
[7] Exercise (1): Conclusion of the previous survey and confirming comprehension level as the intermediate test
[8] Frame structure: Learn how to calculate a structure composed of pin joint about frame structures which is the basis of three-dimensional structure
[9] Torsion of bar: Understand the balance of forces of members subjected to torsional load, such as drive shaft and axle used for transmitting power
[10] Torsion of tube: Learn the difference between a hollow round bar which are generally used in a tubular form and a solid bar

[11] Bending of Beam, Shear Force Diagram and Bending Moment Diagram: Learn the balance of forces when receiving a load perpendicular to the longitudinal direction with a relatively long member such as a bridge or a main wing of an aircraft

[12] Typical Beams: Learn how to obtain shear force distribution and bending moment diagram of simple supporting beam and cantilever beam

[13] Bending deformation and section properties of Beam: Learn about characteristics indicated by cross-sectional shape of beam member

[14] Bending stress: Learn how to calculate the stress acting on a beam loaded with bending load

[15] Exercise (2): Shows the summary so far and the expansion to Solid Mechanics 2