

Solid Mechanics2

Syllabus Number

2A204

Basic Major Subjects

Elective Requisites 2
credit

HIRAMOTO, Takashi

1. Course Description

Continuing from Solid Mechanics 1, students will learn about stresses, strains, and displacements generated in a member made of solid material under elastic deformation. In actual machine design, not only simple conditions handled in Solid Mechanics 1, but also more complex stress, strain, deformation are acting. Students will study the way of thinking and problem solving methods in such a case. In this lecture, students will acquire knowledge about DP1.

2. Course Objectives

The aims are to understand the following items and to be able to analyze basic problems related to them.

- (1) Deflection analysis of statically elastic beam
- (2) Analytical method of statically indeterminate elastic beam
- (3) Solving method of combined stress problem
- (4) Buckling of long columns
- (5) Analysis method of thin-walled cylinder
- (6) Strain energy and analysis used energy method

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. Please be sure to submit. The answer and explanation of it will be done in subsequent lectures.

4. Textbook and Reference

Textbook

S. 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

J. Oda, T. Miyoshi Exercise for Strength of Materials (New Revised Edition),

ISBN 978-4781909752 Science Corporation

edited by the Japan Society of Mechanical Engineers Exercise for Strength of Materials,

ISBN 978-4888981989 Japan Society of Mechanical Engineers

5. Requirements(Assignments)

In the lecture, a scientific function calculator is required. In the latter lecture, grid papers, compass, ruler, and protractor may be needed as necessary.

It is necessary to understand trigonometric functions, exponential functions, logarithmic functions, meanings of differentiation / integration, etc. as in "Solid Mechanics 1".

Exercises will be given as appropriate. In preparation and review, it is important to understand the content of the lecture to solve the exercise problem at the end of the chapter. Also, please note that if you are absent from the lecture, it will be difficult to understand the content of the lesson.

6. Note

7. Schedule

- [1] Bending of beam (Review): Review shear force distribution, bending moment distribution diagram, cross section properties and so on which are studied in "Solid Mechanics 1"
- [2] Bending stress of beam: Consider the bending stress caused by the bending moment loading on the cross section of the beam
- [3] Shear stress of beam: Consider the stress in the cross section of the beam where bending moment and shear force are loaded
- [4] Deflection of beam: Consider the deformation of a beam subjected to a load. Shape of deflection, deflection curve with differential equation and learn its solution
- [5] Deflection Analysis of statically indeterminate elastic beam: Learn solving method of statically indeterminate elastic beam that cannot be solved by static mechanical balance alone
- [6] Exercises on deflection of beams: For statically determinate beam and statically indeterminate beam, analyze deflection under various conditions
- [7] Beam of uniform strength: Learn a solution method for a cross section beam whose section shape varies along the length direction of a beam
- [8] Combined stress and stress of arbitrary cross section: Learn about stress and deformation occurring in a planar member having a plate-like two-dimensional spread which cannot be approximated by linear members such as bars and beams
- [9] Principal stress and Principal shear stress: Learn about the principal stress which is one of the stresses independent of the coordinate system

- [10] Relationship between stress and strain in triaxle stress: Consider the relational expression of the basic stress and strain for the three-dimensional stress state which is the stress state in the actual structural member
- [11] Buckling of long column: Learn about buckling, which is a deformation perpendicular to the axis generated when a long column receives an axial compressive load
- [12] Thin-walled cylinder: As an application example of combinatorial stress concept, consider a state where internal pressure acts on a thin-walled cylinder similar to a pressurized aircraft fuselage structure
- [13] Strain energy and Castigliano's theorem: Learn about the idea of strain energy of an elastic body similar to well-known spring energy and solving elastic problem using it
- [14] Impact stress, Failure criteria: Understand the behavior against impact loads and typical fracture criteria
- [15] Summary and Exercise: Summarize what you have learned through solid mechanics 1 and 2 and check your understanding