1.050 Engineering Mechanics

Lecture 4: Stresses and Strength

Stresses and Equilibrium

Discrete Model

1.050 – Content overview

I. Dimensional analysis

1. On monsters, mice and mushrooms
2. Similarity relations: Important engineering tools

Lectures 1-3
Sept.

II. Stresses and strength

2. Stresses and equilibrium
3. Strength models (how to design structures, foundations.. against mechanical failure)

Lectures 4-15
Sept./Oct.

III. Deformation and strain

4. How strain gages work?
5. How to measure deformation in a 3D structure/material?

Lectures 16-19
Oct.

IV. Elasticity

5. Elasticity model – link stresses and deformation
6. Variational methods in elasticity

Lectures 20-31
Nov.

V. How things fail – and how to avoid it

7. Elastic instabilities
8. Plasticity (permanent deformation)
9. Fracture mechanics

Lectures 32-37
Dec.

1.050 – Content overview

I. Dimensional analysis

II. Stresses and strength

Lecture 4: Newton's laws, fall of the WTC towers
Lecture 5: Stress vector and stress tensor
Lecture 6: Hydrostatic problem ← Applications
Lecture 7: Soil mechanics / geostatics problem
Lecture 8: Beam stress model
Lecture 9: Beam model II and summary
Lecture 10: Strength models
…

III. Deformation and strain

IV. Elasticity

V. How things fail – and how to avoid it

Content lecture 5

1. **3-scale continuum model:** Molecular scale, representative volume element (REV), macro-scale

2. **Stress vector, stress matrix and stress tensor**
   - Definition of stress vector
   - Generalized expression as stress matrix
   - Definition of stress tensor

3. **Implement dynamic resultant theorem for REV**
   - Use Gauss theorem (divergence theorem)
   - Develop differential equilibrium: Partial differential equation