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

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

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

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

V. How things fail – and how to avoid it
   7. Elastic instabilities
   8. Plasticity (permanent deformation)
   9. Fracture mechanics
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
   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