

Numerical Methods in Rock Engineering

- Other numerical methods of interest

(Week 14, 7 June 2021)

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Introduction Assessment



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- Assessment

- Home Assignment : 50 %

- ㉠ #1 summary of selected papers on numerical analysis 10%

- ㉠ #2 1D coding of FEM/FDM (use excel, matlab, or other codes) 20%

- ㉠ #3 Exercise with FEM code (comsol multiphysics) 10%

- ㉠ #4 Paper reading (DEM) – classical paper of your choice 10%

- ~~– Final Exam : 20 %~~

- Term paper : 40 %

- ㉠ Proposal 6%

- ㉠ Proposal presentation 6%

- ㉠ Final Report 14%

- ㉠ Final Presentation 14%

- Participation : 10 %

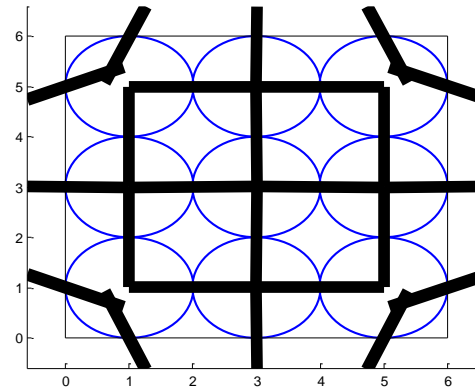
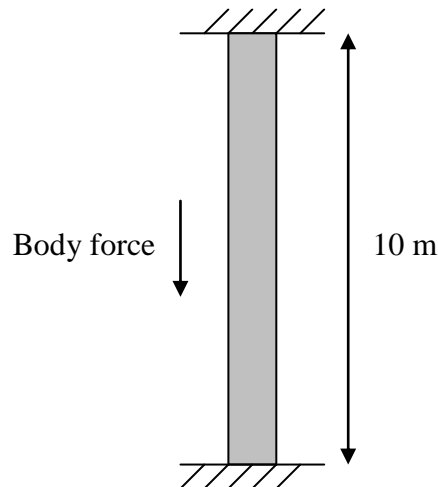
Introduction

Home Assignments (40%)



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- #1 1 page summary of selected papers on numerical analysis
- #2 1D(or 2D) coding of FEM/FDM (use excel, matlab, or other codes)
- #3 Exercise with FEM code (comsol multiphysics)
- #4 Paper reading (DEM) – classical paper of your choice
- #5 Exercise with UDEC/PFC



- Select a subsurface engineering problem of your interest and conduct a numerical analysis using any available codes.
- Term paper must include;
 - ❧ Clear objectives
 - ❧ One or two verification cases
 - ❧ Thorough formulation of the chosen numerical method
 - ❧ Concise presentation and discussion on the results
- Timeline
 - ❧ 31 May Proposal (1 page) & 10 minutes presentation
 - ❧ 7 June Consultation with instructor
 - ❧ 14 June Presentation and submission of Term Paper (

- List of topics
 - Numerical investigation on the roughness of hydraulic fractures: influence of intact rock properties and in-situ stress ()
 - Investigation of the effect of Transverse Isotropy of rock on Borehole Stability: Focusing on the bedding angle of shale ()
 - Borehole stability in granite under thermo-mechanical coupling ()
 - Numerical investigation of mechanical stability perturbation in a geologic formation during cold water injection ()
 - Analysis for Thermal Effect of the Geological Repository: CFS and Ground Heave ()
 - The ratio of thermal stress due to thermal effect under completely constrained conditions ()
 - Stability analysis of a homogeneous embankment dam built on deformable foundation () –
Calculation reduction for discontinuous featuring using FEM ()
 - Determination of Mode I Stress Intensity Factor for Cracks in Various Geometries Using Finite Element Method ()

- In Final report and presentation, followings will be critically evaluated;
 - Think of **A, B, & C**. Is the whole report Accurate, Brief, and Clear?
 - Are there convincing verification cases presented? Therefore, is the numerical code and the analysis by the modeler is reliable and suitable for the purpose of the work?
 - Are the plots presented in a clear manner? Are all plots necessary?
 - Do the explanations contain meaningful description of what are shown?
 - Is the report structured in a way people who is reasonably familiar with can read easily and understand the presented work?

- Finite Element Method
 - Theory (1D) and Exercise (Comsol)
- Finite Difference Method
- Discrete Element Method
 - Distinct Element Method (Blocky and Particulate)
 - Discontinuous Deformation Analysis (DDA)
 - Theory and Exercise (UDEEC/3DEC)
- Boundary Element Method
- Finite Element – Discrete Element Method