Final
Evaluation Criteria

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CDL Computational Design Lab

CONTENTS

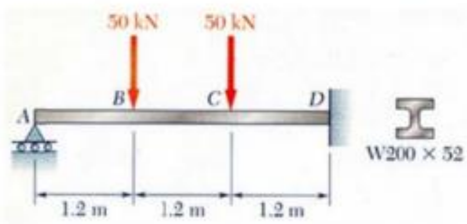
- **Final Problem**

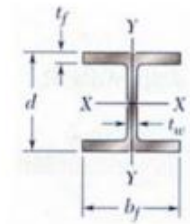
- **Problem Solution and Evaluation Criteria**

FINAL PROBLEM

1. [Beam deflection] For the beam and boundary conditions shown, compute the deflection at point B.

   Analytic solution : $d_B = 3.19mm$ (24 pts total)





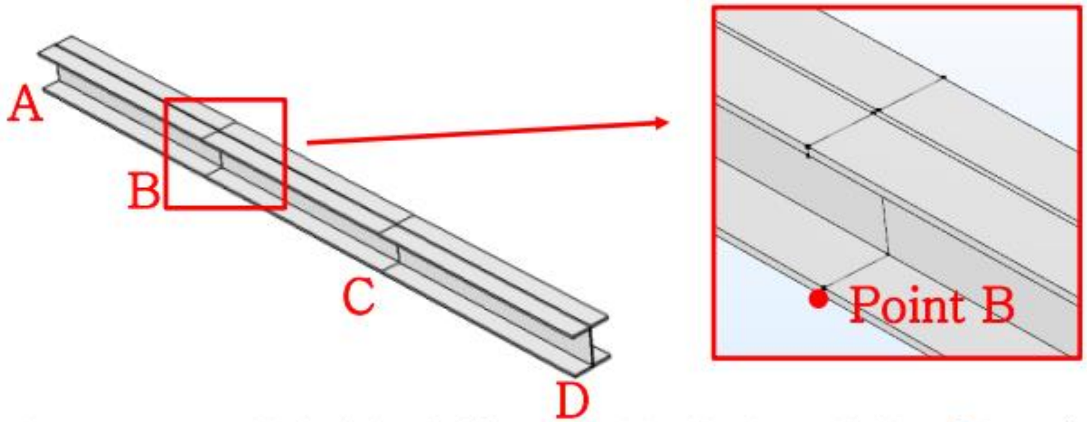
$E = 200\,GPa,\ \nu = 0.33$

$d = 206\,mm, b_f = 204\,mm$

$t_f = 12.6\,mm, t_w = 7.9\,mm$

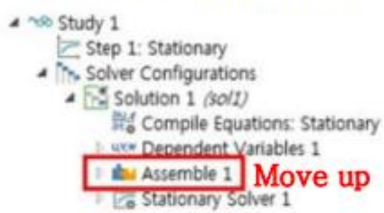
1) Use 2D Beam (beam) module (number of elements : 30) (8 pts)

2) Use 3D Solid Mechanics (solid) module (mesh option : normal) (8 pts)



3) Use "MATLAB" with the eliminated stiffness matrix (K) and load vector (f) of 2D Beam (beam) results from "assemble" option. (The number of elements is 9) (8 pts)

Hint :



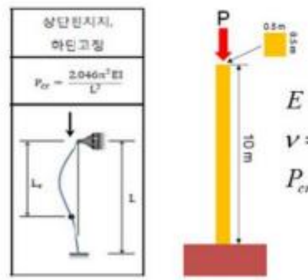
$$u = K^{-1} f$$

FINAL PROBLEM

2. [Linear buckling] For the column and boundary condition shown, compute critical load for the column. (16 pts)

   1) Use 2D Solid Mechanics (solid) module and show mode shape using Mode Shape (solid) (8 pts)

   2) Use 3D Solid Mechanics (solid) module and show mode shape using Mode Shape (solid) (8 pts)

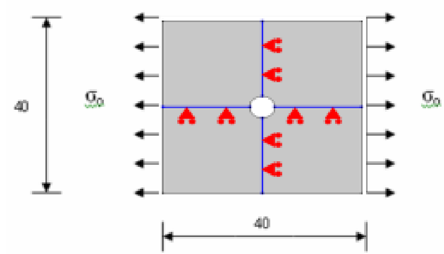


$E = 200\,GPa$

$\nu = 0.33$

$P_{cr} = 2.1e8\,N$

3. [Plane stress] Consider portion of plate within concentric circle so that stress field is not perturbed by hole. (20 pts total)



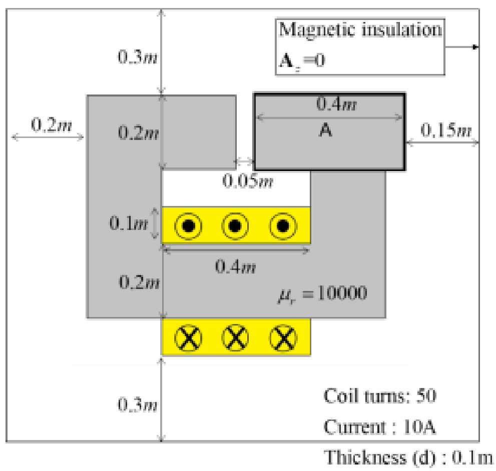
- 2D approximation
  - Plane stress
- Material Properties
  - E = 200 x 10^9
  - ν = 0.3
- Element Properties
  - Thickness = 1
- Loads: σ_0 = 1 Nm

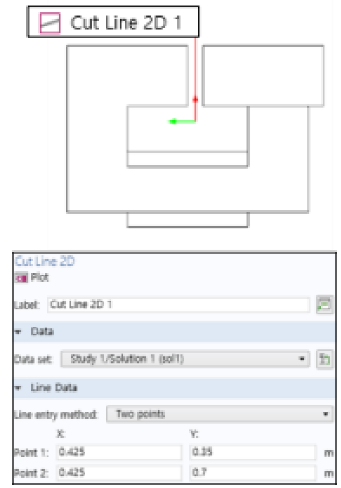
   1) Compute the maximum normal stress (solid.sx) with hole radius = 2.5. Check the stress by mesh dependency applying free triangular and quad elements (linear order). Plot the graph using MATLAB as d.o.f vs stress changing mesh size with two cases.(mesh option : normal ~ extremely fine) (10 pts)

   2) Perform the analysis using only the quarter model with the symmetric boundary condition, and show the full model result through mirror 2d post-processing. (10 pts)

FINAL PROBLEM

4. [Magnetic Actuator] For the actuator and boundary conditions shown, solve the Poisson equation by Magnetic Fields *(mf)*. (Use **Fine** discretization level.) (40 pts total)



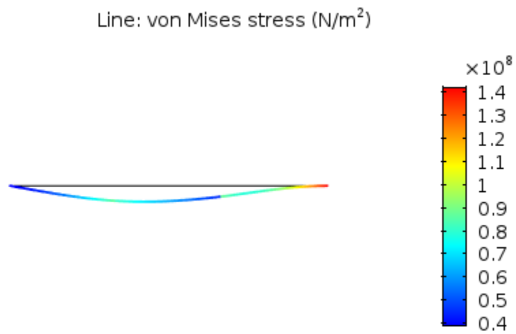


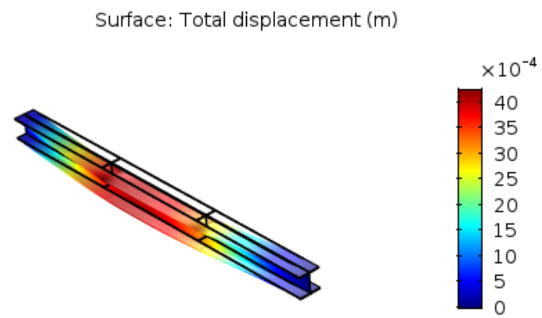
1) Draw a Magnetic flux density norm distribution along the Cut Line 2D 1 by 1D Plot Group / Line Graph (10 pts total)

2) Evaluate the magnetic force using Maxwell stress tensor method by Boundary Probe 1 *(bnd1)*, Boundary Probe 2 *(bnd2)*, Global Variable Probe 2 *(var2)* (15 pts total) Analytic solution : 1.4289 N

3) Solve the Dirichlet Boundary Condition 1 problem for Poisson equation by Weak Form PDE (w)
Plot a difference error with Magnetic Fields *(mf)* and Weak Form PDE (w) by using 2D Plot Group / Surface 1
Show that both solutions are equal. (15 pts total)

PROBLEM.1 EVALUATION CRITERIA





0.0018
0.0000
−0.0004
0.0026
0.0000
−0.0013
0.0023
0.0000
−0.0023
0.0014
0.0000
−0.0031
0.0003
0.0000
−0.0034
−0.0012
0.0000
−0.0032
−0.0024
0.0000
−0.0025
−0.0032
0.0000
−0.0013
−0.0035
0.0000

채점 기준

Total displacement (mm), Point: 2
3.2289

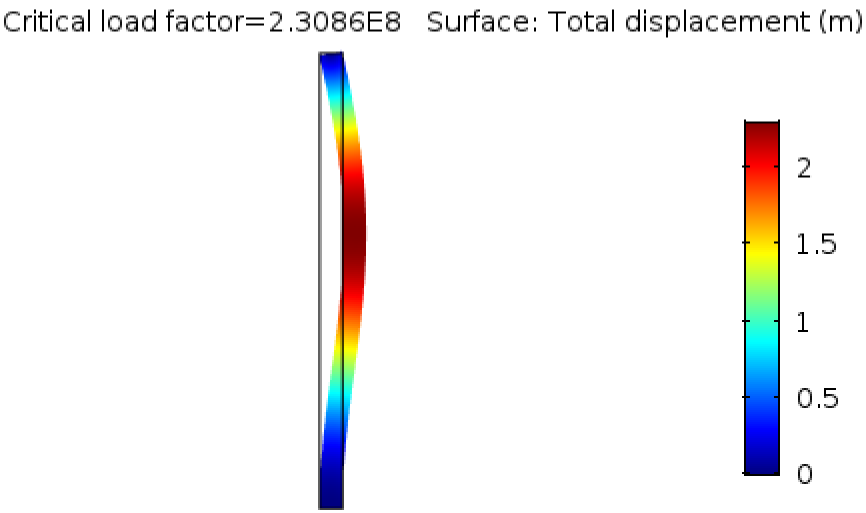
1.(1) COMSOL 모델
(Geomtry−2/ B.C−1/재료물성−1/ 요소 차수 −1) −5점
/ 결과 – 3점

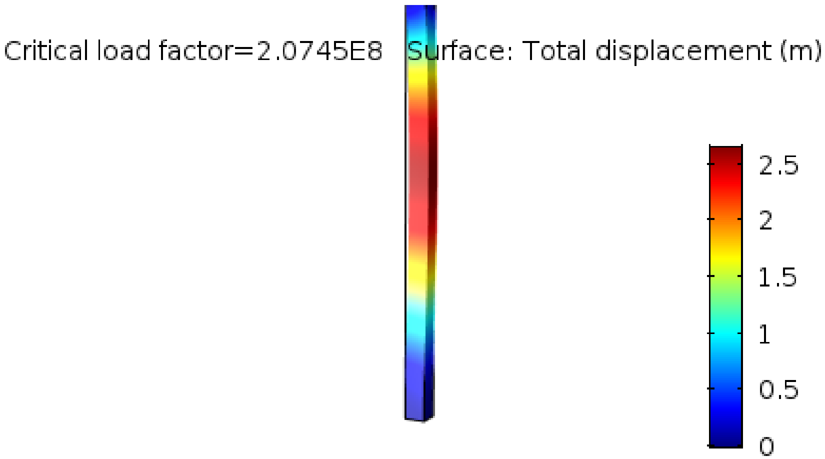
Total displacement (m), Point: 53
0.0038338

1.(2) COMSOL 모델
(Geomtry−2/ B.C−1/재료물성−1)− 4 점
/ 결과 – 4점

1.(3) 시스템 매트릭스 추출− 4점
/결과 – 4점

PROBLEM.2 EVALUATION CRITERIA



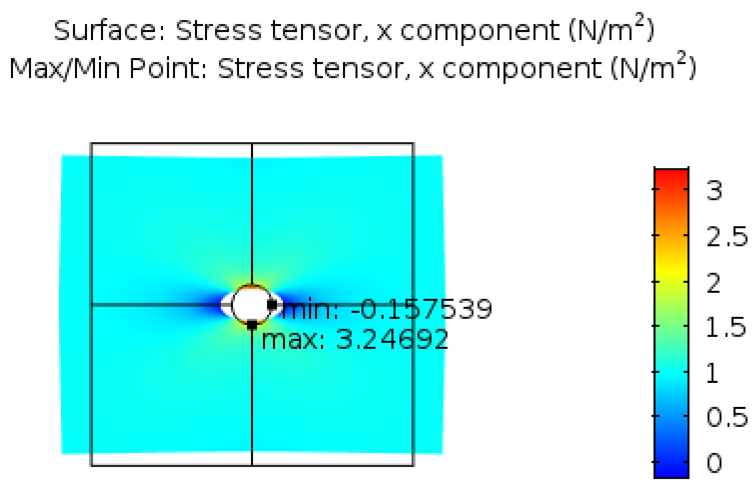


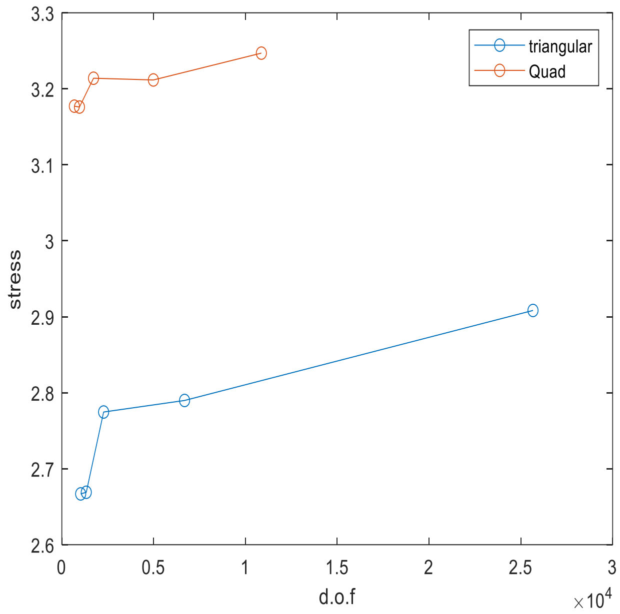
채점 기준

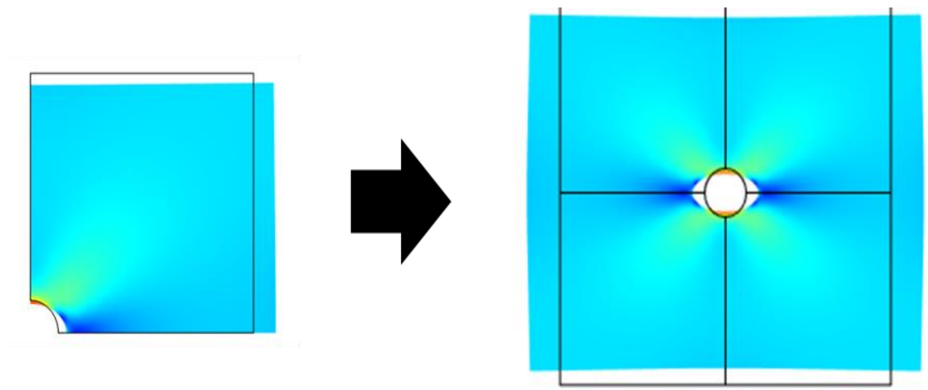
2.(1) COMSOL 모델 생성
(Geomtry-2/ B.C-1/재료물성-1)-4 점
결과 - 4점

2.(2) COMSOL 모델
(Geomtry-2/ B.C-1/재료물성-1)-4 점
결과 - 4점

PROBLEM.3 EVALUATION CRITERIA





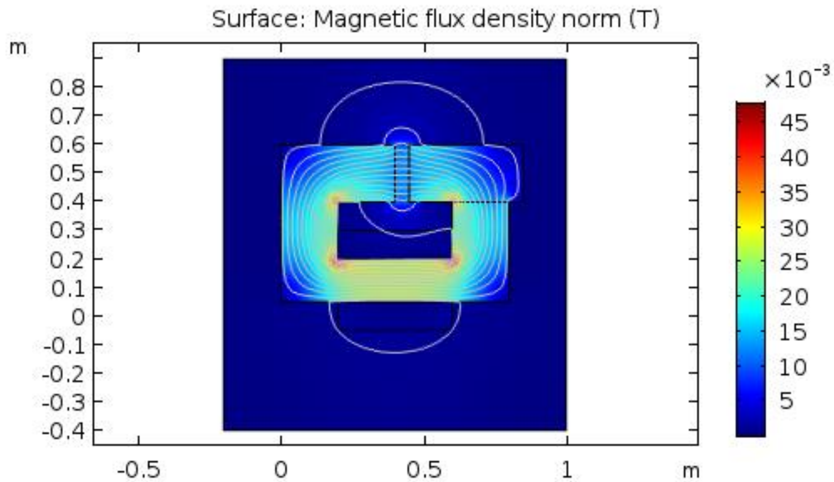


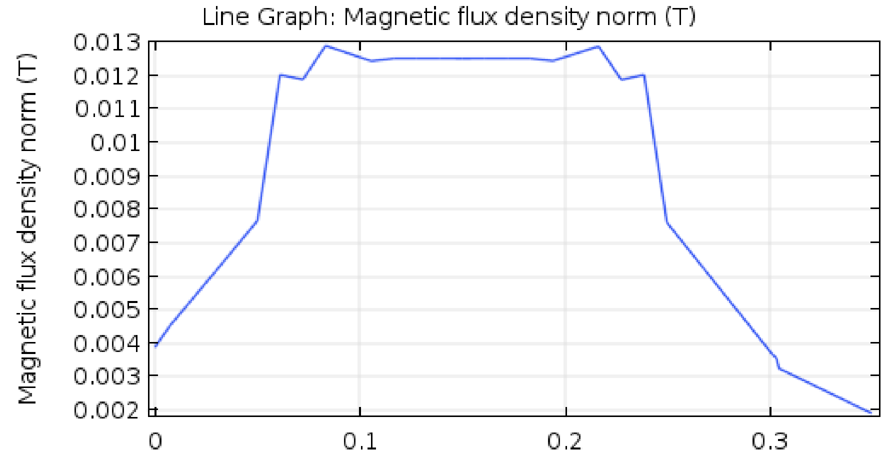
채점 기준

3.(1) COMSOL 모델
(Geomtry–2/ B.C–2/재료물성–1)– 5 점
MATLAB Plot 결과 – 5

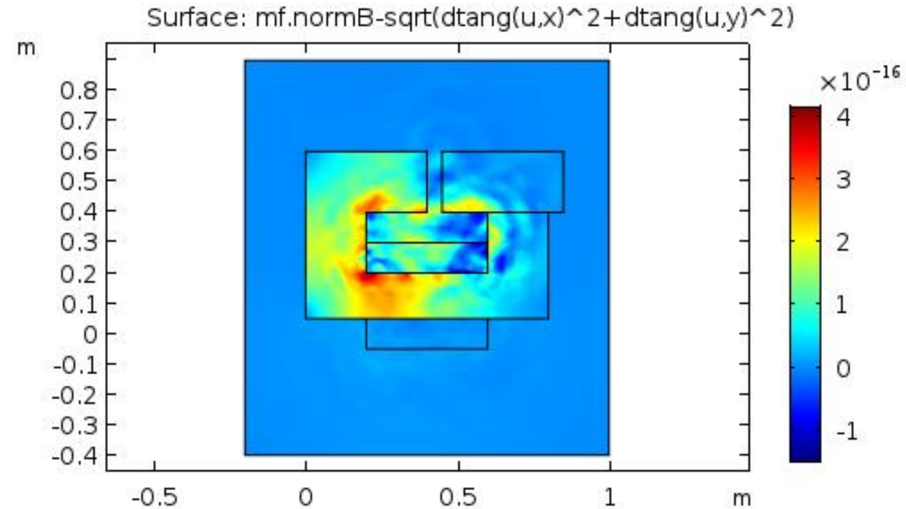
3.(2) COMSOL 모델
(Geomtry–2/ B.C–2/재료물성–1)– 5 점
/ 후처리 결과 – 5

PROBLEM.4 EVALUATION CRITERIA





0.1*(bnd1+bnd2)
1.4121



채점 기준

4.(1) 올바른 모델링(Geomtry-2/ B.C-2/재료물성-1) 5 / 올바른 플롯5
4.(2) 수식 설정-5/ 적분 영역 설정-5 / 결과-5
4.(3) Weak form PDE 설정5/올바른 경계조건5/ 올바른 플롯5