Final Exam - Lab

12/19/2017

Submit the compressed file as `(ID)_(name).zip` to [ftp://cdl.hanyang.ac.kr → CAE/Final_Lab] folder. It should contain the final results of each problem (equations and graphs) using PowerPoint `(ID.ppt)` and COMSOL files (`problem#-#.mph`).

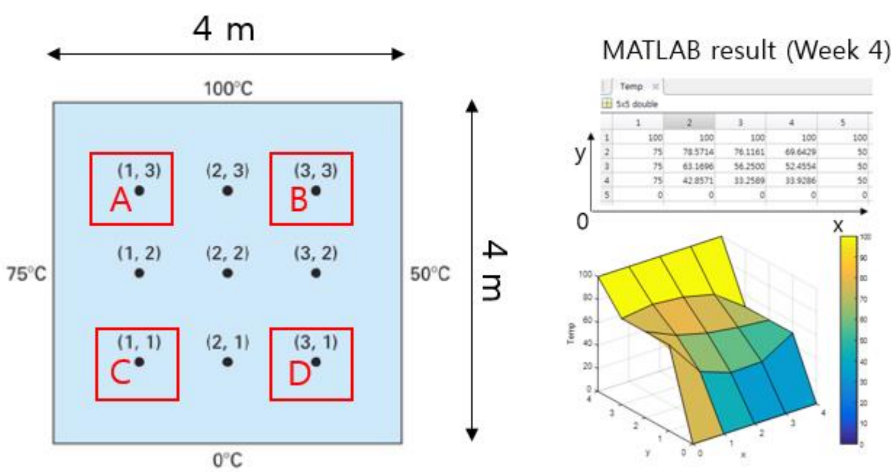
1. [Heat transfer PDE] Compute the temperatures of points A~ D. Show the surface of temperature from COMSOL result. The governing equation and boundary conditions are shown as following figure. (mesh option : normal)

   1) Use 2D Coefficient Form PDE module. (10 pts)

   2) Use 2D Heat Transfer in Solids module. (Thermal conductivity : 1 [W/(m·K)]) (10 pts)

Governing equation for heat transfer

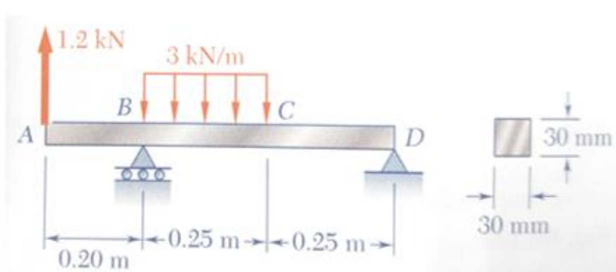
$$\frac{\partial^2 T}{\partial x^2}+\frac{\partial^2 T}{\partial y^2}=0$$



2. [Deflection of beam] For the beam and boundary conditions shown, compute the deflection at point A and slope at point B. (mesh option : normal)

   1) Use 2D Beam module. (10 pts)

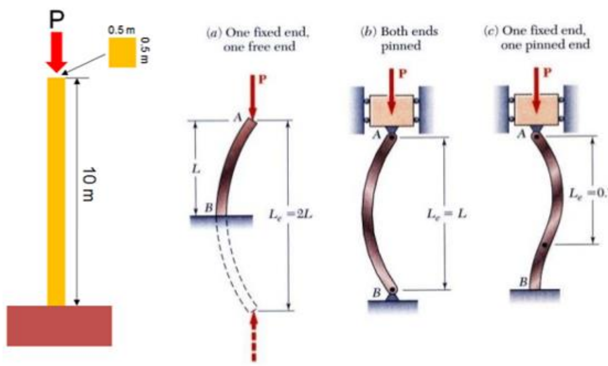
   2) Use 2D Solids Mechanics module. (only compute the deflection at point A) (10 pts)



$E = 200$ GPa

$\nu = 0.3$

3. [Linear bucking] For the effective length(L_e) of column for the various end conditions shown, compute the critical load for each of end conditions. Use 2D solid mechanics module.
    1) Compare with the analytic solutions and fill the table. (mesh option : normal) (15 pts)
    2) Use the mapped mesh option(5 X 100) and fill the table. How do you think about the mesh dependency of linear bucking analysis? (5 pts)



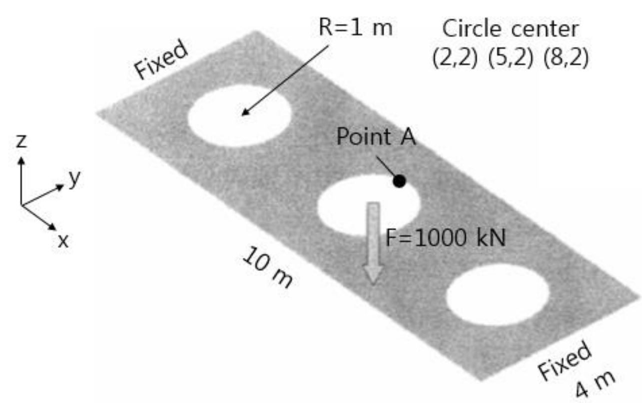
$$E = 200\ GPa$$

$$I = \frac{1}{12} b l^3$$

$$P_{cr} = \frac{\pi^2 EI}{L_e^2}$$

P_{cr} [kN]	(a)	(b)	(c)
anal.			
pb. (1)			
pb. (2)			

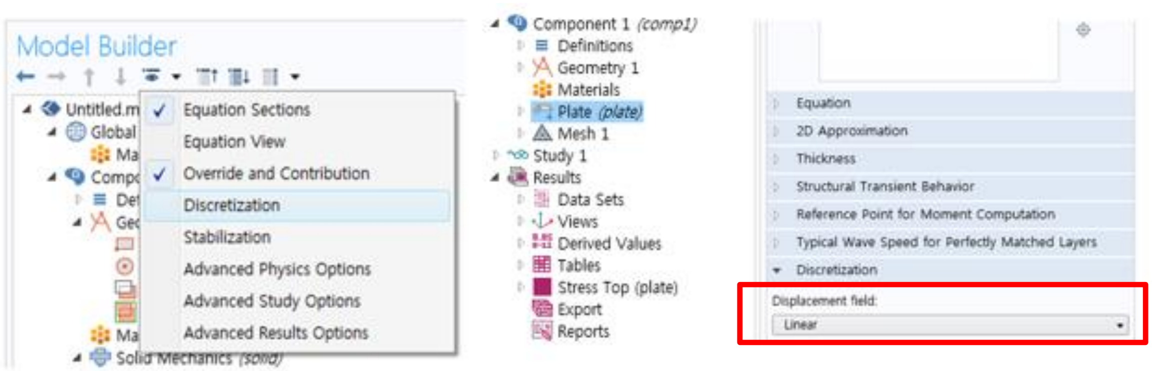
4. [Plate in bending] For the plate and boundary conditions shown, set the element type following discretization option.



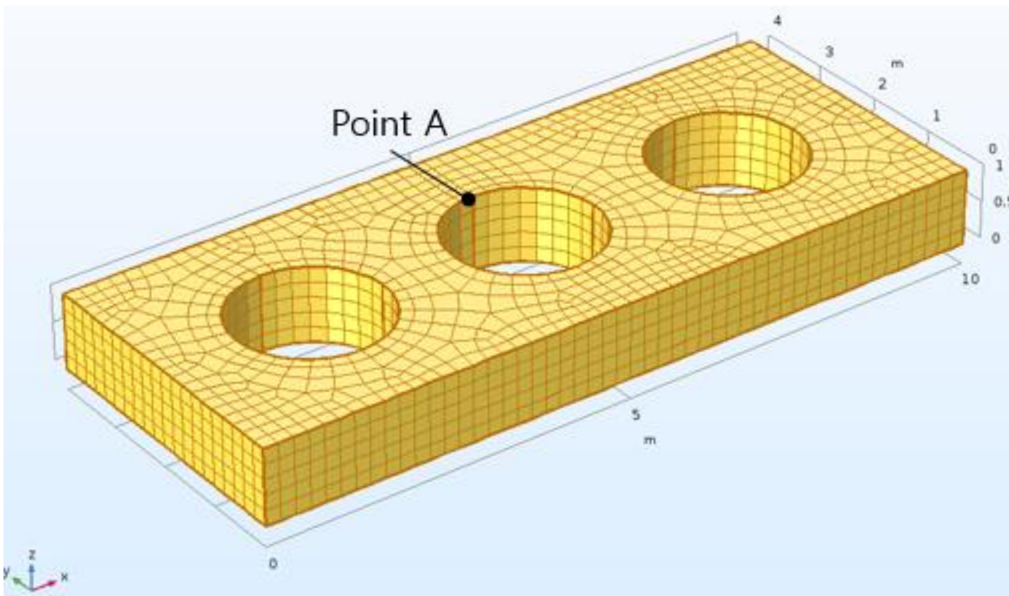
$$E = 200\ \text{GPa}$$

$$\nu = 0.3$$

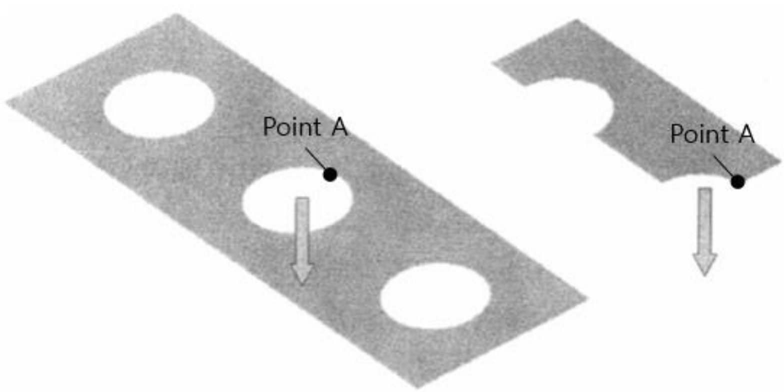
$$t = 1\ \text{m}$$



1) Compute the von Mises stress(`plate.mises`) at point A. Check the stress by mesh dependency applying free triangular and quad elements(linear). Plot the graph as D.O.F vs stress changing mesh size with two cases. (mesh option : normal ~ extremely fine) (15 pts)
2) Use 3D Soild mechanics module for the same analysis and compute the von Mises stress(`solid.mises`) at point A. (mesh options : free quad, extremely fine, number of swept elements: 5) From the comparison of stress result between plate and solid model, suggest your opinion to the validity of plate model for this analysis. (15 pts)

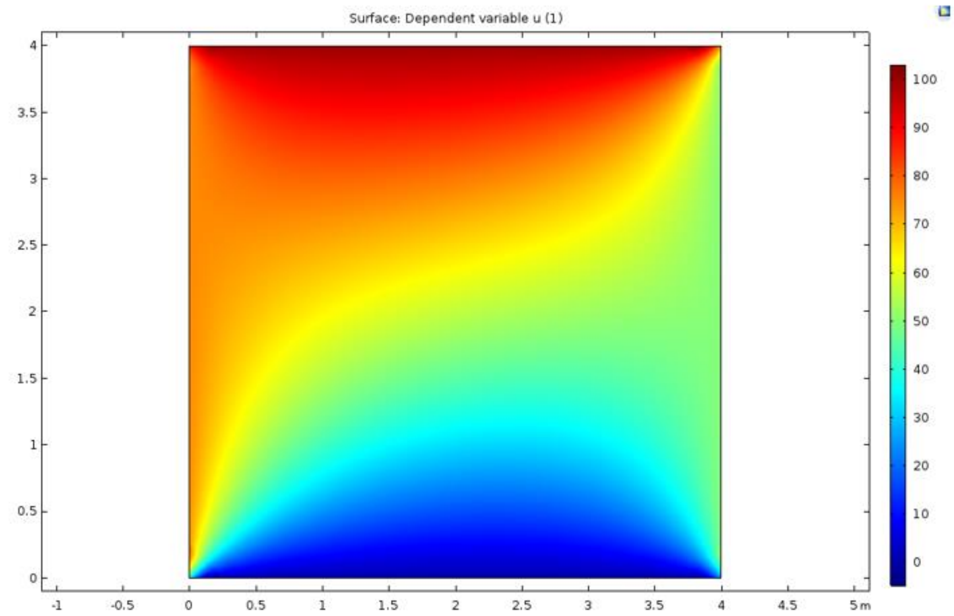


3) Construct the quarter model of plate and check the von Mises stress at point A. (mesh option : free quad, extremely fine) Compare the stress and number of D.O.F between quarter model and full model. (10 pts)



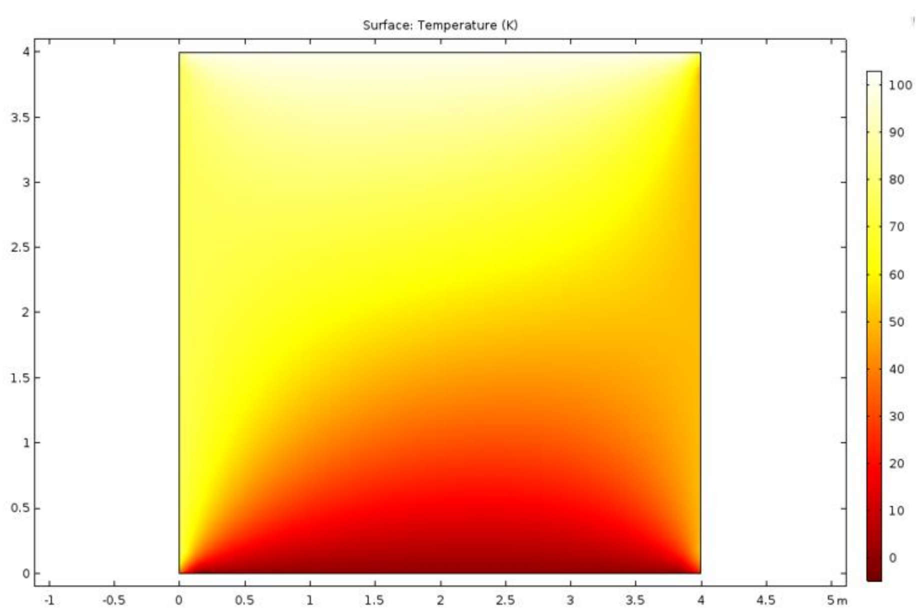
1. [Heat transfer PDE]

1) (10 pts)



Dependent variable u (1), Point: 4	Dependent variable u (1), Point: 6	Dependent variable u (1), Point: 3	Dependent variable u (1), Point: 5
79.004	69.902	42.598	33.496

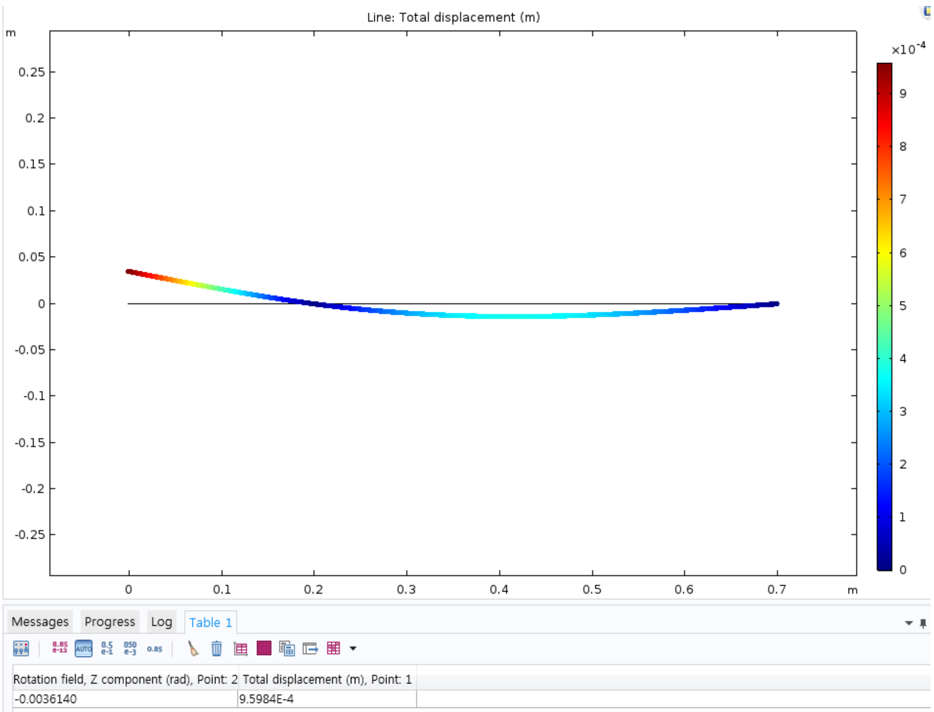
2) (10 pts)



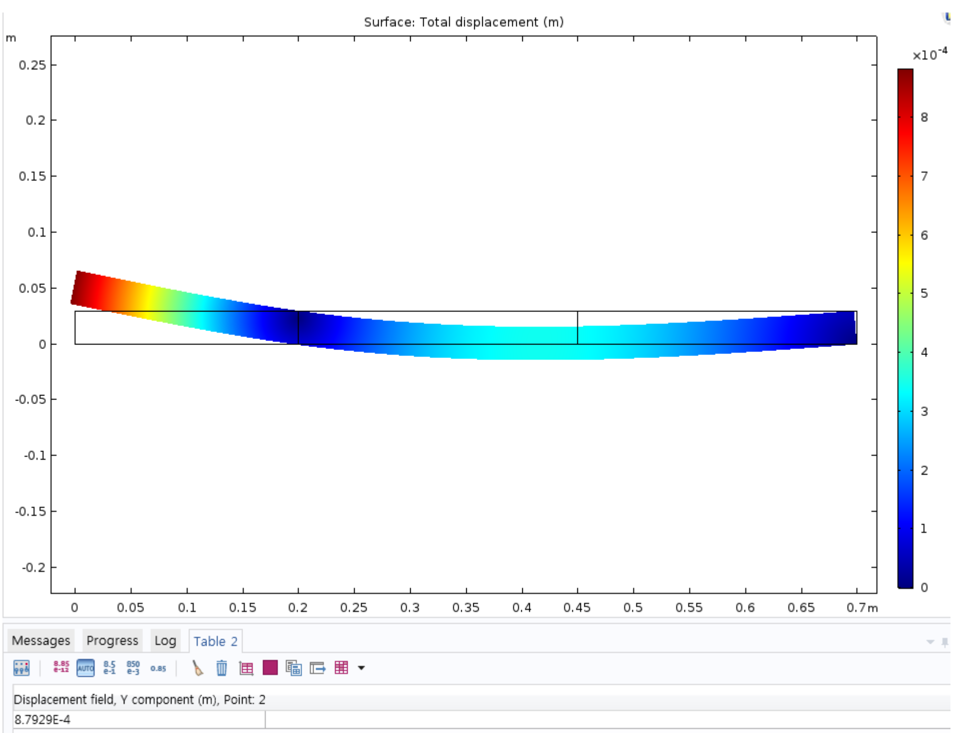
Temperature (K), Point: 4	Temperature (K), Point: 6	Temperature (K), Point: 3	Temperature (K), Point: 5
79.004	69.902	42.598	33.496

2. [Deflection of beam]

1) (10 pts)

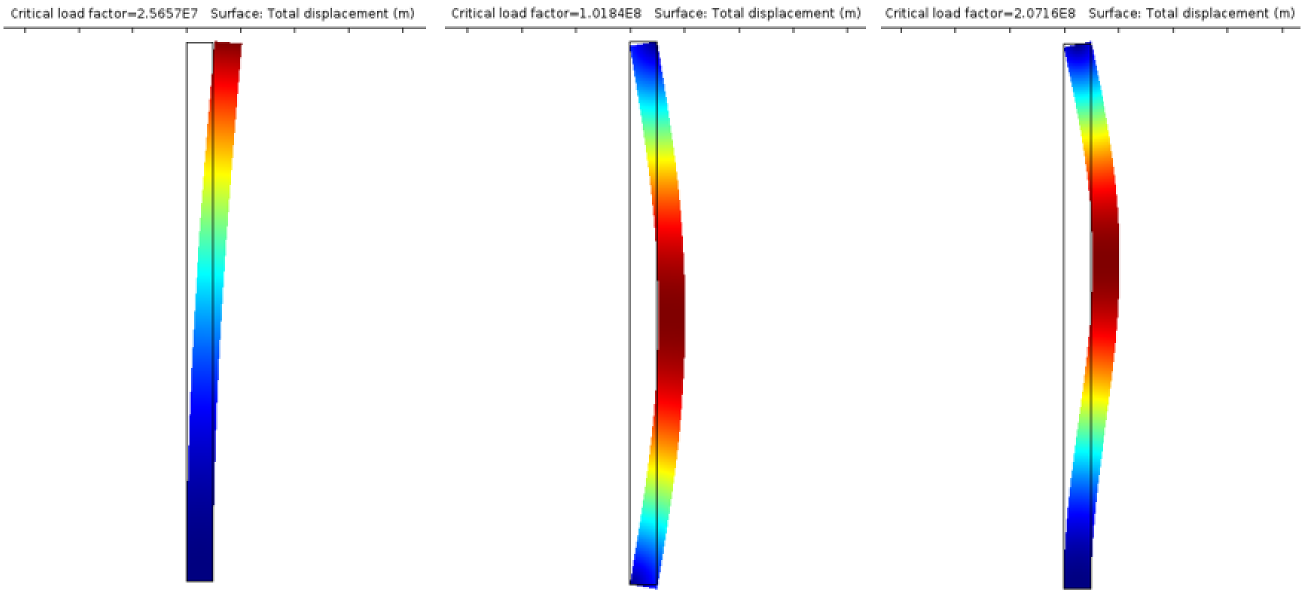


2) (10 pts)



3. [Linear bucking]

1) (15 pts)



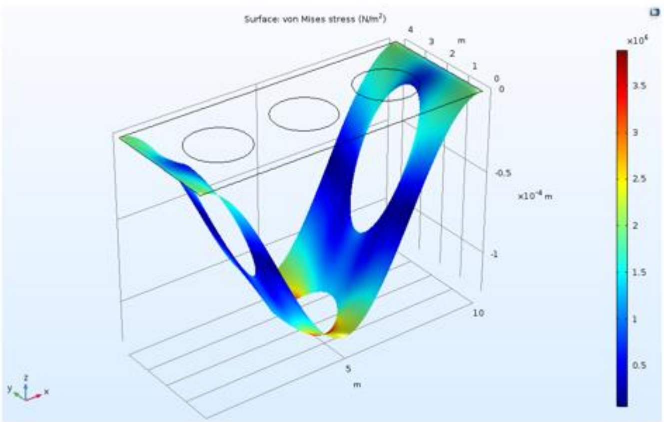
Pcr [kN]	(a)	(b)	(c)
anal.	25,702	102,808	209,813
pb. (1)	25,671	102,120	208,120
pb. (2)	25,657	101,840	207,160

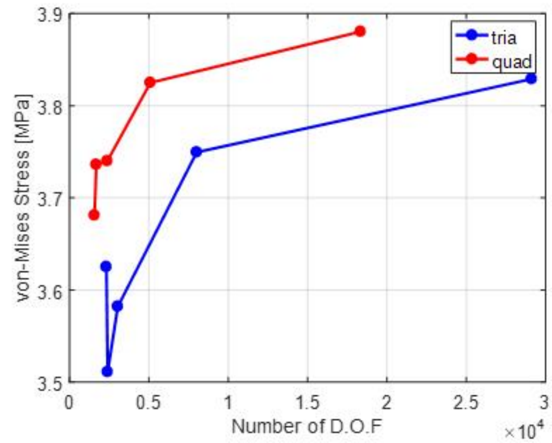
2) (5 pts)

On the buckling analysis, the mesh dependency is negligible.

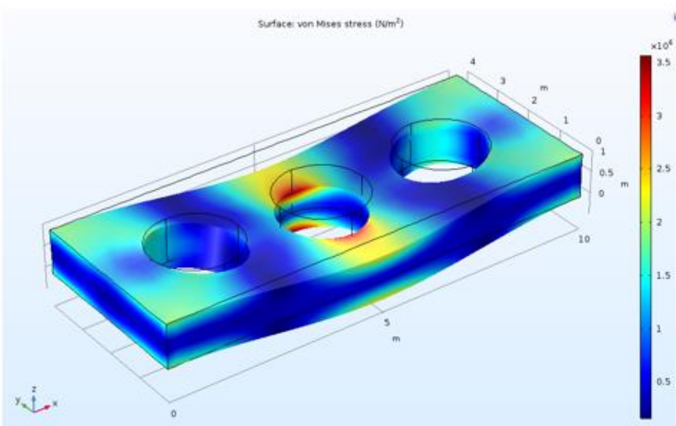
4. [Plate in bending]

1) (15 pts)



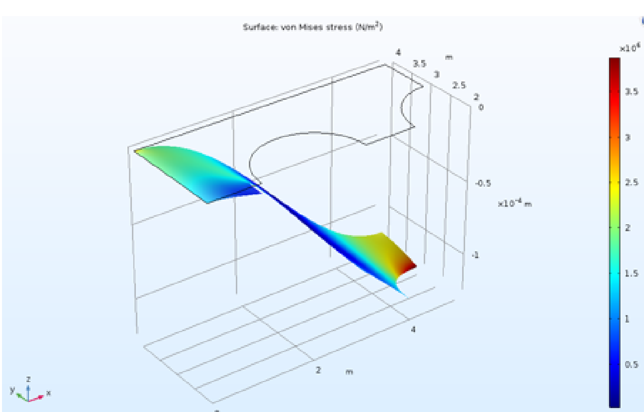


2) (15 pts)



The result of von-Mises stress in 3-D model is about 3.82 MPa. This value is almost same as 2-D plate model with sufficiently fine mesh. Therefore, the using plate model for this analysis is reasonable and more efficient than 3-D model.

3) (10 pts)



The result of von-Mises stress in the quarter model is about 3.88 Mpa and the number of D.O.F is 17,220. From the comparison of stress and D.O.F with the full model, the stress is almost same and the number of D.O.F is slightly decreased. Because the mesh is more fine, therefore, the quarter model can be considered for improving accuracy and cost efficiency of the analysis.