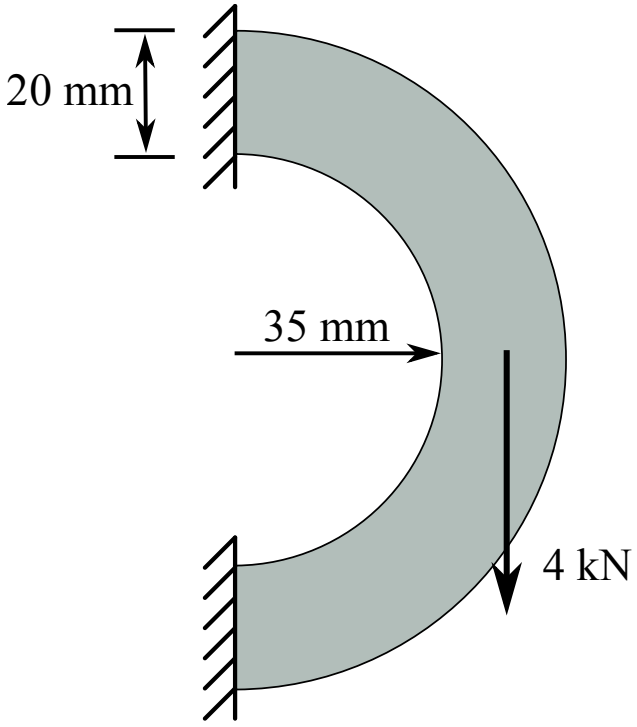
Institute for Aerospace Studies
UNIVERSITY OF TORONTO

AER 1403: Project 2
Due: 15 December 2023

Finite Element Solution for a Curved Bracket

Consider a semi-circular bracket, as shown below.



This bracket, which is in plane stress, is semi-circular; both its inner and outer surfaces are arcs of circles. The inner radius is 35 mm, and the bracket is 20 mm wide and 2 mm thick. It is made of a steel with Young's modulus 200 GPa and Poisson's ratio 0.3. At each end it is rigidly connected to a wall. The loading is vertically down through a point load of 4 kN that is applied at a point equidistant from the top and bottom supports and equidistant from the two edges of the bracket. Write a finite element code, using isoparametric quadrilateral elements, to calculate the displacements of the bracket. You must use enough elements to achieve convergence. Do not use any existing codes, commercial software, or online packages to do any of this project. All results must be the product of code that you have written yourself. To complete this project, submit the following:

i. the code you use to generate the solution in a form that can be run;

ii. an analysis showing that you have used enough elements for the solution to be considered accurate;

iii. a plot showing simultaneously the undeformed and deformed shape of the bracket using appropriate scaling (including the elements);

iv. a graph showing the distribution of vertical displacement through the centre line of the bracket (that is, along the horizontal line that runs through the point of the application of the load);

v. a contour plot of the strains in the bracket, one each for ϵ_{11}, ϵ_{22} and ϵ_{12};

vi. a contour plot of the von Mises equivalent stress in the bracket;

vii. an explanation of your code and the process that you used to find the solution;

viii. a discussion of the method you used to generate the contour plots and and errors the method has engendered; and

ix. comments on the results and how they might influence design decisions.