Stepped Shaft - Exercises

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Exercises

Exercise 1:

a) Look up the expected stress concentration for a stepped bar without a fillet, i.e. a discontinuity in the cross-sectional area. Using one-dimensional link or bar elements, create a one-dimensional mesh for the stepped shaft using elements with different cross-sectional areas. Note predictions for the stress in the vicinity of the discontinuity at the sharp re-entrant corner. What do you notice?

b) Refine the mesh in the vicinity of the step and report your results for the stress variation across the step. What conclusion might you draw from this exercise?

Exercise 2:

Re-run the SimCafe tutorial refining the two-dimensional axisymmetric mesh in the vicinity of the fillet. Using h-convergence mesh refinement, optimize the ratio of element edge length to fillet radius, i.e. determine the ratio of element edge length to fillet radius that will result in a converged solution for the stress concentration to within the accuracy of the reported formula (5%).

Exercise 3:

Using an axisymmetric model (as opposed to a full three-dimensional model), qualitatively confirm the relaxation of the stress concentration illustrated in Figure 3.4 of the text.

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