Homework 6

Problem 1 (150 points)

Consider a slightly asymmetric wellbore in an otherwise symmetric and homogenous medium in which the interior pressure p_0 is held constant. Assuming steady-state, plane-strain and *undrained* conditions, compute the displacements and pressures on the given mesh. The mesh information is provided in the following files with short descriptions of thier contents.

coords.csv - the geometric node locations for all nodes. They are listed in x, y pairs with each line corresponding to a global node index starting with 1 and proceding in sequence.

connect.csv - the connectivity arrays. Each line contains the global node numbers of an element with local node numbering as specified in the schematic. For the pressue interpolates, only use the first 4 which will correspond to the corners of the element.

nodeset1.csv - the nodes on the interior boundary. Use these nodes to specify the interior pressure, p_0.

nodeset2.csv - the nodes on the exterior boundary. Use these nodes to specify the far-field pressure, p_∞.

nodeset3.csv - the nodes on the horizontal symmetric boundary (indicated in blue in the schematic).

nodeset4.csv - the nodes on the horizontal symmetric boundary (indicated in red in the schematic).

Assume zero fluid compressibility, i.e. $1/Q = 0$ and the following dimensionless properties $\alpha = 1, \nu = 0.3, \mu = 1$ for Biot's coefficient, Poisson's ratio, and shear modulus, respectively. Apply an interior pressue $p_0 = 1$ and far field pressue $p_\infty = 0$. Assume the far field boundary is stress-free as well. Create plots of the stress fields for σ_{xx}, σ_{yy}, and σ_{xy} as well as the pressures.

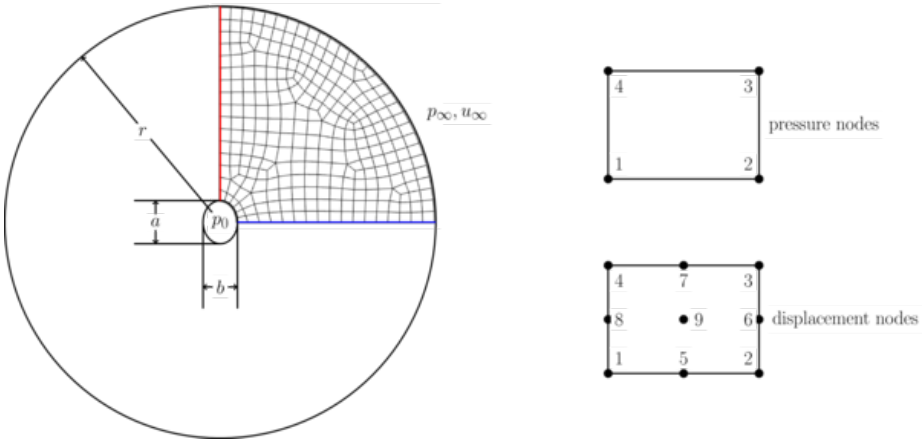
p_∞, u_∞
r
a
p_0
b
4
3
1
2
pressure nodes
4
7
3
8
9
6
1
5
2
displacement nodes

Figure 1: png