ME-621 Advanced Finite Element Method

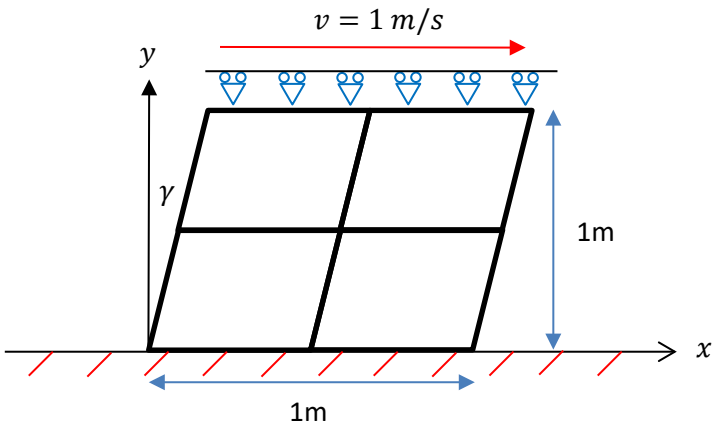
Assignment 3

Due Date: Wednesday April 3, 2024 at 10:00am

Make groups of 2

Problem

Use an Updated Lagrangian Formulation and four 4-node quadrilateral elements to simulate simple shear loading. The bottom edge of the specimen is fixed in place while a constant velocity is applied to the top in the *x* direction.



The material is made out of aluminum with density $\rho_0 = 2700\ kg/m^3$, Young's modulus $E = 70\ GPa$ and Poisson's ratio $v = 0.3$.

Under the loading condition of $v = 1\ m/s$ applied to the top three nodes,

I. Plot the average shear stress σ_{12} as a function of shear strain until $\gamma = 0.07$. Use the Truesdell objective rate to update stress, $\boldsymbol{\sigma}^{oT} = \boldsymbol{c}\colon \boldsymbol{D}$.
II. Plot the position of the nodes before and after loading the system.
III. The loading speed, $v = 1\ m/s$, was intentionally high for the sake of computation time. If the velocity is more realistic, such as $v = 0.001\ m/s$, what can be done to further reduce the computation time?

Make reasonable assumptions and state your assumptions in your solution.