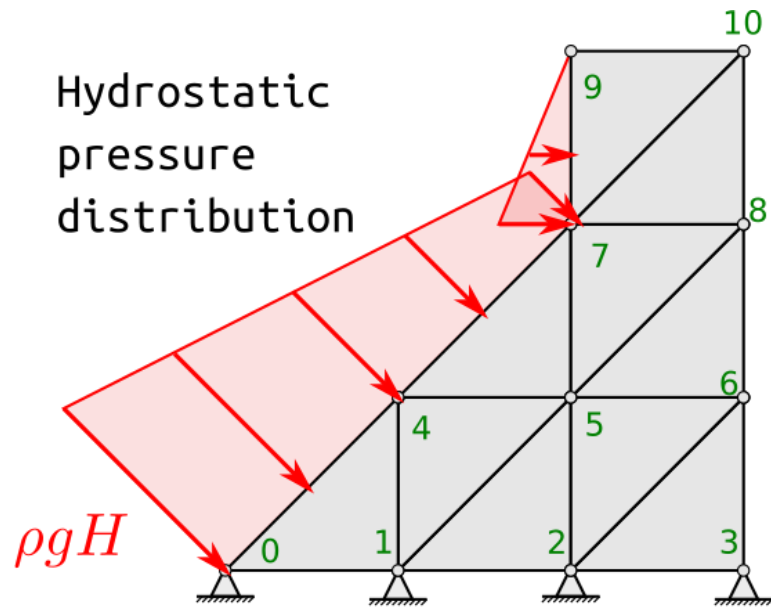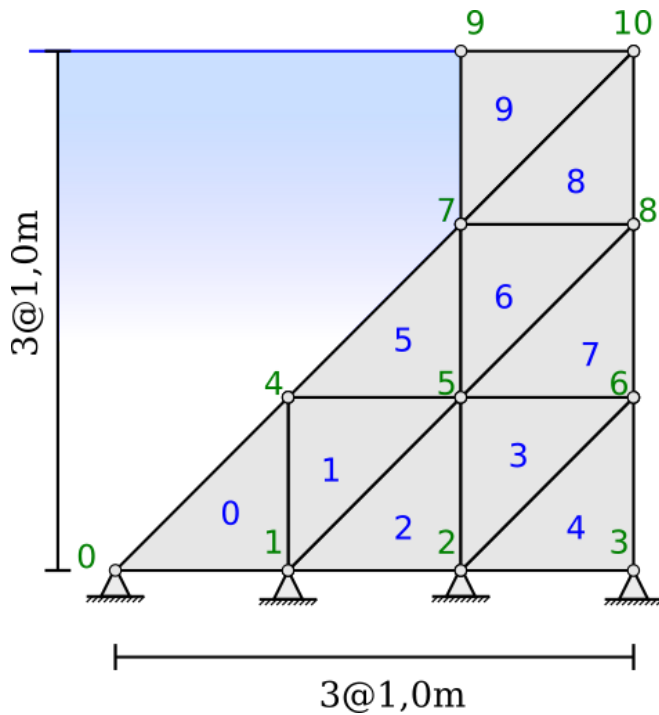# 2021 Midterm Exam # 1 - Part 1

Start Assignment

**Due** Jul 6 by 6pm   **Points** 0   **Submitting** a file upload   **File Types** pdf

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A small concrete dam is to be analyzed for stability using finite elements. The model is meshed with *plane-strain* CST elements as above and subjected to do hydrostatic forces coming from fluid pressure only (no gravity loading is to be considered).

A. **(5 pts)** Write down the nodal coordinate table, nodal DOF map, connectivity and elemental DOF maps for this problem.

B. **(20 pts)** Compute the global horizontal and vertical stiffnesses at node # 4 (diagonal entries of the stiffness matrix for the corresponding DOFs). Show your work.

C. **(20 pts)** Compute the right-hand-side of the stiffness equations ($\mathbf{f}$ vector in $\mathbf{Ku} = \mathbf{f}$) for this problem. Explain any assumptions you have to make.

D. **(10 pts)** Given the deformed shape and nodal displacement vector shown below, compute the full stress tensor on element 2, show it in matrix format.

E. **(5 pts)** Compute the reaction forces at node 0, indicating their direction.
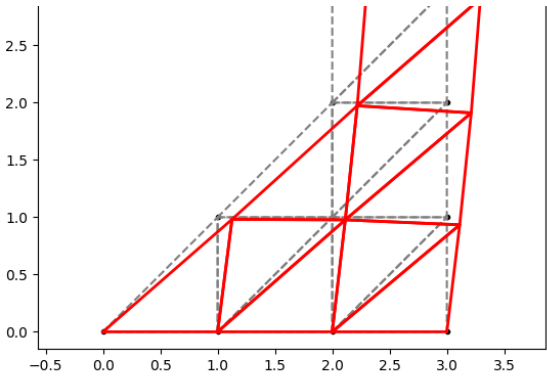
$$u = \begin{bmatrix} 0. \\ 0. \\ 0. \\ 0. \\ 0. \\ 0. \\ 0. \\ 0. \\ 18. \\ -2.6 \\ 16.2 \\ -3.2 \\ 16. \\ -9.5 \\ 31.2 \\ -3.8 \\ 30.4 \\ -12.8 \\ 43. \\ -2.9 \\ 41.8 \\ -13. \end{bmatrix} \times 10^{-7}(m)$$

Some Rubric

Criteria	Ratings					Pts
A. FEM Tables	**5 pts** **Full Marks**	**4 pts** 4	**3 pts** 3	**2 pts** 2	**0 pts** **No Marks**	5 pts
B. Stiffness Node # 4	**20 pts** **Full Marks**	**15 pts** 15	**10 pts** 10	**5 pts** 5	**0 pts** **No Marks**	20 pts
C. RHS of stiffness. f vector	**20 pts** **Full Marks**	**15 pts** 15	**10 pts** 10	**5 pts** 5	**0 pts** **No Marks**	20 pts
D. Stress Tensor e = 2	**10 pts** **Full Marks**		**5 pts** 5		**0 pts** **No Marks**	10 pts
E. Reaction node 0. indicate direction	**5 pts** **Full Marks**		**3 pts** 3		**0 pts** **No Marks**	5 pts
					Total Points: 60	