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Title: Computational Solid Mechanics Lab Task 1 and 2 Report.

Task 1

Methodology

The truss lattice below (Figure 1) was designed in the ANSYS application with a linear elastic isotropic material (E = 20GPa, v = 0.2), a circular cross-section (r = 0.0001m). The mesh was generated so as to allow one finite element for each truss member. The bottom left and right corners were pinned (i.e. set to zero displacements in all directions). A downward force P = 10 KN was applied to each of the top nodes. The reaction forces from the pinned nodes and the directional deformation of the truss lattice were extracted using the probe tool. The data for the directional deformation was exported to an excel file to derive the vertical displacement of each node.

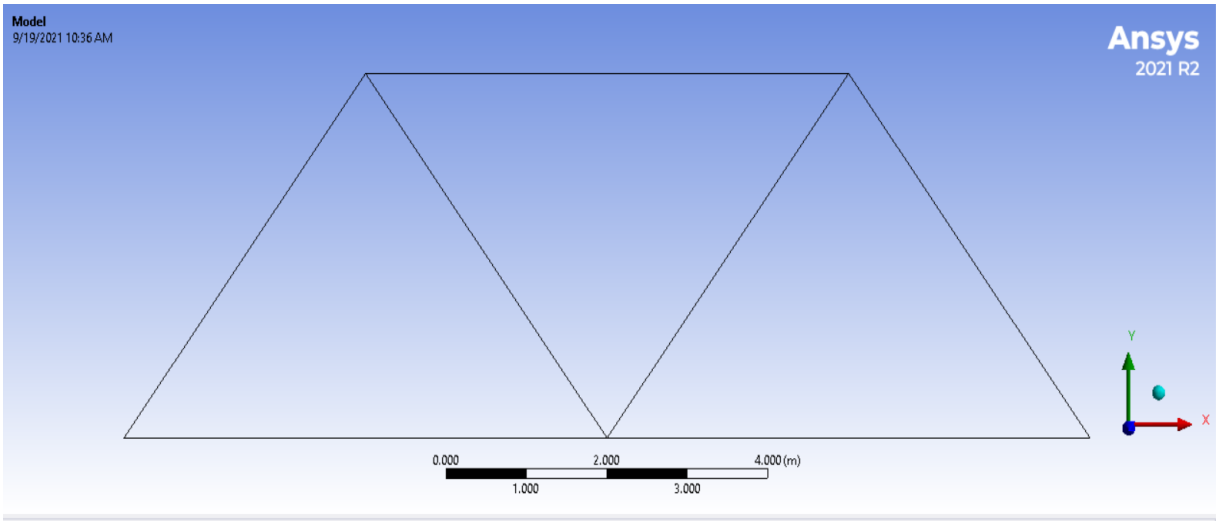

Figure 1: Diagram Showing Structure of Truss Lattice in Task 1

Results

The reaction forces from the pinned nodes are shown in Table 1 below. The negative sign signifies the force vector pointing towards the left on the x-axis and downwards on the y-axis.

Table 1: Table Showing Force Reactions on Pinned Nodes

Node	**Force Reaction X-Component (KN)**	**Force Reaction Y-Component (KN)**	**Total Force Reaction (KN)**
Bottom Left	7.5	10.0	12.5
Bottom Right	-7.5	10.0	12.5

The vertical displacement of each node is shown in Table 2 below. The negative sign signifies the force vector pointing downwards.

Table 2: Table Showing Vertical Displacement of All Nodes

Node	**Vertical Displacement (m)**
Top Left	-151.31
Top Right	-151.31
Bottom Left	0
Bottom Middle	-178.19
Bottom Right	0

Observation

The maximum vertical displacement is seen in the bottom middle node with a vertical displacement of -178.19m. Both pinned nodes were not vertically displaced as defined in the initial conditions.

Task 2

Methodology

The truss lattice below (Figure 2) was designed in the ANSYS application with a linear elastic isotropic material (E = 20GPa, v = 0.2), a circular cross-section (r = 0.0001m) and a truss member length of 0.01m. The mesh was generated so as to allow two finite elements for each truss member. All outermost nodes (labeled in Figure 2) were pinned (i.e. set to zero displacements in all directions). An upward vertical displacement of 0.0001m was applied to the node highlighted in red in Figure 3. The reaction forces from all the pinned nodes were extracted using the probe tool.

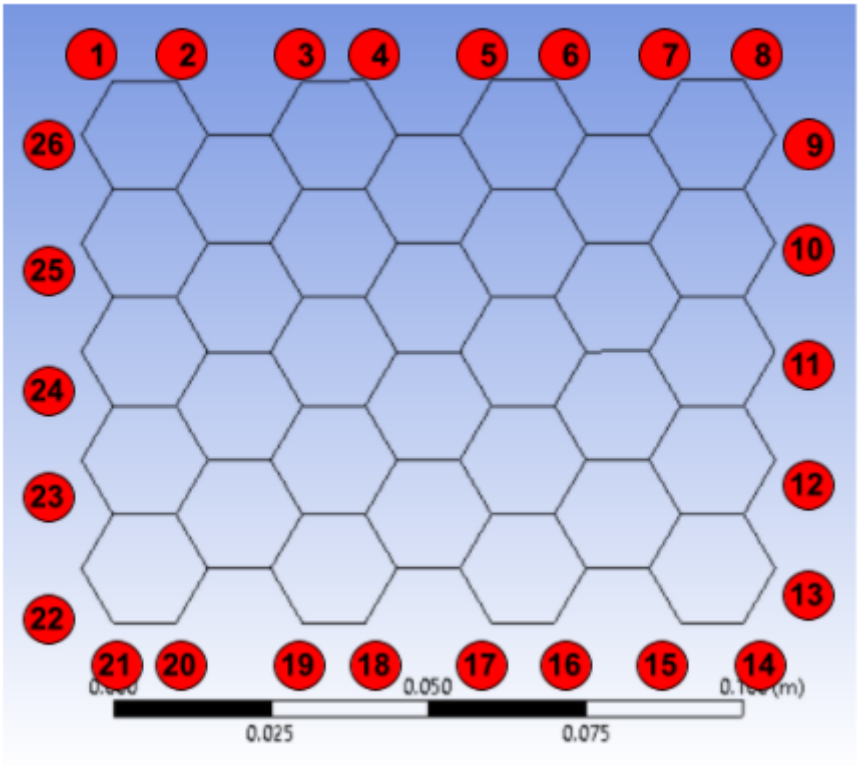

Figure 2: Diagram Structure of Truss Lattice in Task 2 and Position of Pinned Nodes

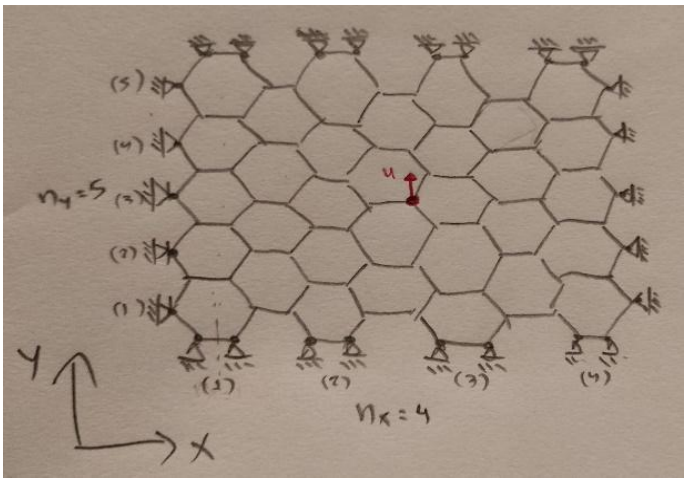

Figure 3: Diagram Showing Position of Initial Vertically Displaced Nodes

Results

The reaction forces from the pinned nodes are shown in Table 3 below. The negative sign signifies the force vector pointing towards the left on the x-axis, downwards on the y-axis, and into the page on the z-axis. The pinned nodes are labeled clockwise as seen in Figure 2.

Table 3: Table Showing Force Reactions on All Pinned Nodes

Node	**Force Reaction X-Component (10^{-5} N)**	**Force Reaction Y-Component (10^{-5} N)**	**Force Reaction Z-Component (10^{-20} N)**	**Total Force Reaction (10^{-5} N)**
1	1.2892	-5.1232	-2.4274	5.283
2	30.101	-25.816	2.3281	39.655
3	-6.6809	-26.253	2.479	27.09
4	72.255	-74.263	0.1328	103.61
5	-61.051	-198.78	2.5181	207.95
6	45.095	-58.055	-4.2755	73.511
7	-50.379	-63.834	-3.7611	81.32
8	-0.90953	-4.332	3.7281	4.4264
9	-78.146	-137.27	-0.84983	157.96
10	-69.62	110.08	-2.5951	130.25
11	9.855e-8	118.87	-1.1998e-9	118.87
12	69.62	110.08	2.5951	130.25
13	78.146	-137.27	0.84983	157.96
14	0.90953	-4.332	-3.7281	4.4264
15	50.379	-63.834	3.7611	81.32
16	-45.095	-58.055	4.2755	73.511
17	61.051	-198.78	-2.5181	207.95
18	-72.255	-74.263	-0.1328	103.61
19	6.68095	-26.253	-2.479	27.09
20	-30.101	-25.816	-2.3281	39.655
21	-1.2892	-5.1232	2.4274	5.283
22	-27.544	-52.386	-0.62826	59.186

23	-27.679	39.239	-1.233	48.019
24	-3.3567e-8	83.783	6.6744e-10	83.783
25	27.679	39.239	1.233	48.019
26	27.544	-52.386	0.62826	59.186

Observation

The maximum reaction forces are observed in nodes 5 and 17 with a force reaction of 2.08 x 10^{-3} N.

References

[1] DrDalyO, ANSYS 17.0 Tutorial - 3D Bridge Truss with Surface Body Platform, Jun. 13, 2016. Accessed on: 19 September 2021. [Video file]. Available: https://www.youtube.com/watch?v=J0cCA1PAINU