Delft University of Technology

Linear modeling

AE4ASM004

Assignment: Homework Assignment 2

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Question 2

Forces for trusses are applied only at the nodes/edges of the members. This doesn't give valid results when the forces/loads are applied at the nodes with boundary conditions.

For Example: In the problem given, the force F3 = - 3000 N is applied on node 3 in the negative X-direction. As node 3, has no horizontal displacement allowed, the force has negligible effect on the results. This can be verified by equating force F3 = 0 in our Python code and then we can still see the results to be the same as with Force F3 = - 3000 N (except for the reaction force at Node 3 in x-direction).

Parameter Comparison	With F3 = -3000 N	With F3 = 0 N
Stress	Element 1: 35.83 MPa Element 2: -97.01 MPa Element 3: -157.52 MPa Element 4: -183.56 MPa Element 5: -9.97 MPa Element 6: -10.37 MPa Element 7: -66.10 MPa	Element 1: 35.83 MPa Element 2: -97.01 MPa Element 3: -157.52 MPa Element 4: -183.56 MPa Element 5: -9.97 MPa Element 6: -10.37 MPa Element 7: -66.10 MPa
Displacement (X,Y) in mm	Node 1: (0.074,0.00) Node 2: (0.421,-0.193) Node 3: (0.00,-0.712) Node 4: (0.00,-0.262) Node 5: (0.00,0.00)	Node 1: (0.074,0.00) Node 2: (0.421,-0.193) Node 3: (0.00,-0.712) Node 4: (0.00,-0.262) Node 5: (0.00,0.00)

Question 3

Node No.	Displacement from code (u,v) (mm)	Displacement from Abaqus (u,v) (mm)	Element No.	Stress from code (MPa)	Stress from Abaqus (MPa)
1	(0.074,0.00)	(0.074, 0.00)	1	35.83	35.83
2	(0.421,-0.193)	(0.42,-0.193)	2	-97.01	-97.01
3	(0.00,-0.712)	(0.00,-0.712)	3	-157.52	-157.52
4	(0.00,-0.262)	(0.00,-0.262)	4	-183.56	-183.56
5	(0.00,0.00)	(0.00,0.00)	5	-9.97	-9.97
			6	-10.37	-10.37
			7	-66.10	-66.1

Value for Attached elements:

Part Instance	Node ID	Orig. Coords	Def. Coords	Attached elements	U, U1
PART-1-1	2	-500, -50, 0	-499.926, -50,	1, 2, 4	0.0740812
PART-1-1	1	-350, 100, 0	-349.579, 99.8	1, 5, 6	0.420789
PART-1-1	5	0, 150, 0	1.92071e-33, 1	6, 7	1.92071e-33
PART-1-1	3	0, -50, 0	2.13372e-33, -	2, 3, 5, 7	2.13372e-33
PART-1-1	4	0, -150, 0	1.95576e-34, -	3, 4	1.95576e-34

Figure 1: Results pertaining to displacement in the X-direction from ABAQUS

Value for Attached elements:

Part Instance	Node ID	Orig. Coords	Def. Coords	Attached elements	U, U2
PART-1-1	2	-500, -50, 0	-499.926, -50,	1, 2, 4	5.45832e-34
PART-1-1	1	-350, 100, 0	-349.579, 99.8	1, 5, 6	-0.193149
PART-1-1	5	0, 150, 0	1.92071e-33, 1	6, 7	-0.712283
PART-1-1	3	0, -50, 0	2.13372e-33, -	2, 3, 5, 7	-0.262225
PART-1-1	4	0, -150, 0	1.95576e-34, -	3, 4	-5.54583e-33

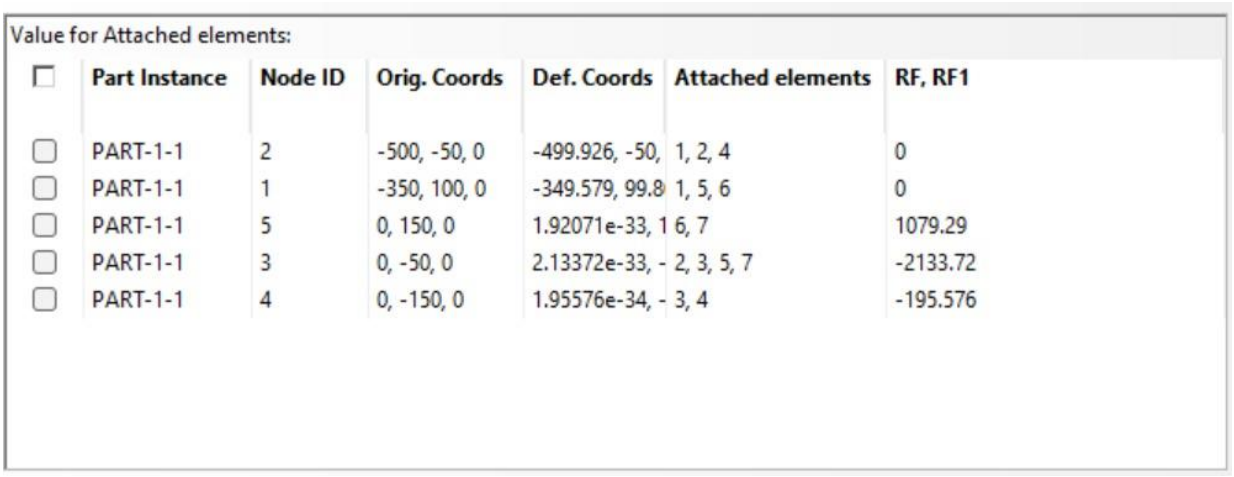
Figure 2: Results pertaining to displacement in the Y-direction from ABAQUS

Value for Attached nodes:

Part Instance	Element ID	Type	Attached nodes	S, S11
PART-1-1	1	T2D2	1, 2	35.8303
PART-1-1	6	T2D2	5, 1	-97.0104
PART-1-1	7	T2D2	3, 5	-157.52
PART-1-1	3	T2D2	4, 3	-183.557
PART-1-1	4	T2D2	2, 4	-9.97247
PART-1-1	2	T2D2	2, 3	-10.3714
PART-1-1	5	T2D2	3, 1	-66.0968

Figure 3: Results pertaining to stresses in various elements in ABAQUS

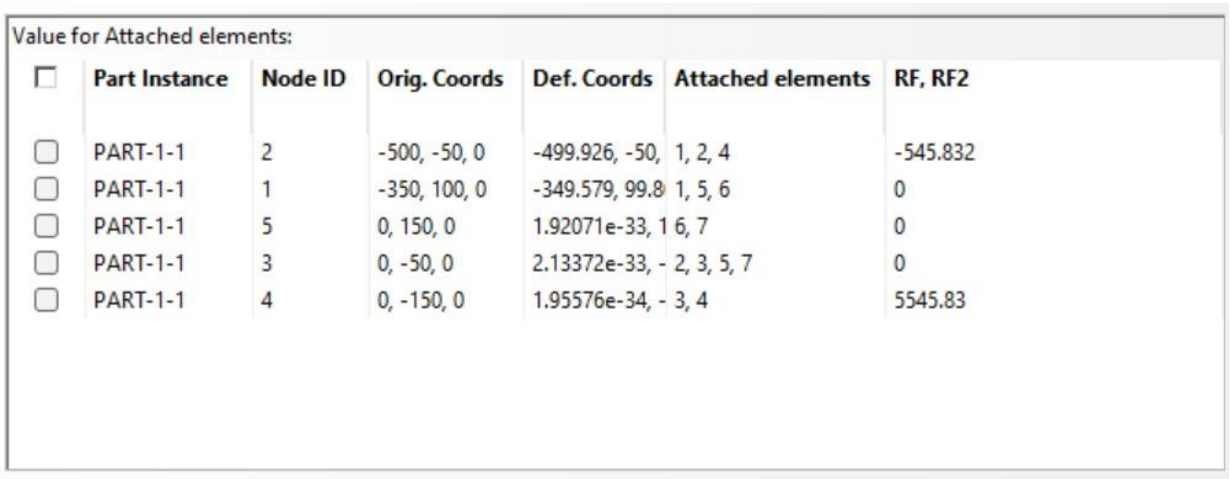
Node No.	Reaction Forces from code (Fx,Fy) (N)	Reaction Forces from Abaqus (Fx,Fy) (N)
1	(0.00,-546)	(0.00,-545.83)
2	(0.00,0.00)	(0.00,0.00)
3	(1079,0.00)	(1079.29,0.00)
4	(-2134,0.00)	(-2133.72,0.00)
5	(-196,5546)	(-195.57,5545.83)



Value for Attached elements:

Part Instance	Node ID	Orig. Coords	Def. Coords	Attached elements	RF, RF1
PART-1-1	2	-500, -50, 0	-499.926, -50,	1, 2, 4	0
PART-1-1	1	-350, 100, 0	-349.579, 99.8	1, 5, 6	0
PART-1-1	5	0, 150, 0	1.92071e-33, 1	6, 7	1079.29
PART-1-1	3	0, -50, 0	2.13372e-33, -	2, 3, 5, 7	-2133.72
PART-1-1	4	0, -150, 0	1.95576e-34, -	3, 4	-195.576

Figure 4: Results pertaining to reaction forces at nodes in X-direction in ABAQUS



Value for Attached elements:

Part Instance	Node ID	Orig. Coords	Def. Coords	Attached elements	RF, RF2
PART-1-1	2	-500, -50, 0	-499.926, -50,	1, 2, 4	-545.832
PART-1-1	1	-350, 100, 0	-349.579, 99.8	1, 5, 6	0
PART-1-1	5	0, 150, 0	1.92071e-33, 1	6, 7	0
PART-1-1	3	0, -50, 0	2.13372e-33, -	2, 3, 5, 7	0
PART-1-1	4	0, -150, 0	1.95576e-34, -	3, 4	5545.83

Figure 5: Results pertaining to reaction forces at nodes in Y-direction in ABAQUS

***Ignore Node/Element IDs in the figure and read them in ascending order or compare with coordinates**

Question 4

Ropes are members that can carry a load under tension only. If a rope is under compression its stiffness along the axial direction becomes zero. I would first calculate the stresses using the same logic as now to find the stress in each of the members.

If the stress is negative in element 6 or 7, I would use an if condition to make the stiffness of those elements with compression zero (only in 6 or 7) and then subsequently calculate displacements, strains, and stresses.