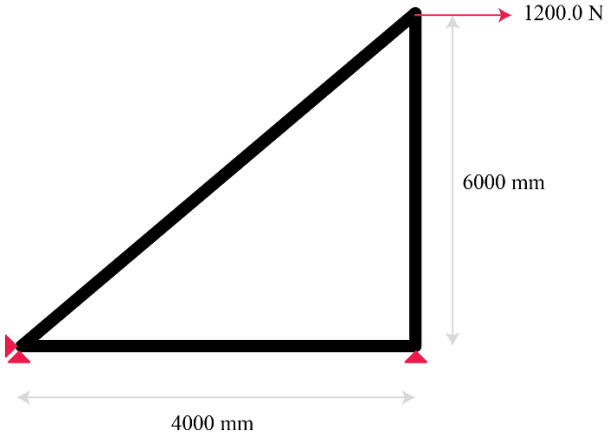
Documentation and Sample Problems

1. Introduction

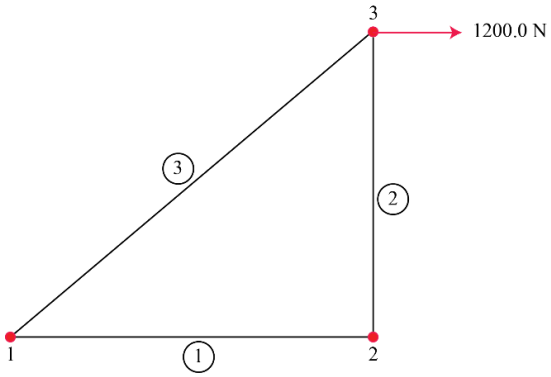
The problem involves solving the following truss using the 'SuGanaka Truss Solver'. The FEA software does not have a CAE associated with it and so the problem needs to be converted into an input file that contains all the data required by the solver. The input file can only contain numbers and thus can be confusing for a person who is not familiar with the format of the input file. Three problems are presented in this document which will aid the user to use the solver correctly with minimal hassles. The user is advised to go through at least the first problem before using the solver.

2. Problem 1



Material properties:
E = 200,000 N and cross sectional area = 2300 mm

This problem can be described as an assemblage of nodes and elements as shown below



The next page shows the input deck that was prepared for the problem.

```
3  number of nodes
3  number of elements
2  number of nodes on one element
2  number of degrees of freedom on one element

0.0, 0.0          Node 1
4000.0, 0.0       Node 2                    X,Y co-ordinates
4000.0, 6000.0    Node 3                    of each node

1, 2
2, 3                                        Element Connectivity
1, 3

200000.0, 2300.0
200000.0, 2300.0  (E, A)                    Material Properties
200000.0, 2300.0                            of each element

0.0, 0.0
0.0, 0.0          (Lx, Ly)                  Loads on
1200.0, 0.0                                 each Node

0.0, 0.0    Node 1
1.0, 0.0    Node 2      0 is Fixed          BCs for each node
1.0, 1.0    Node 3      1 is Free
```

Results and comparison with Abaqus FE

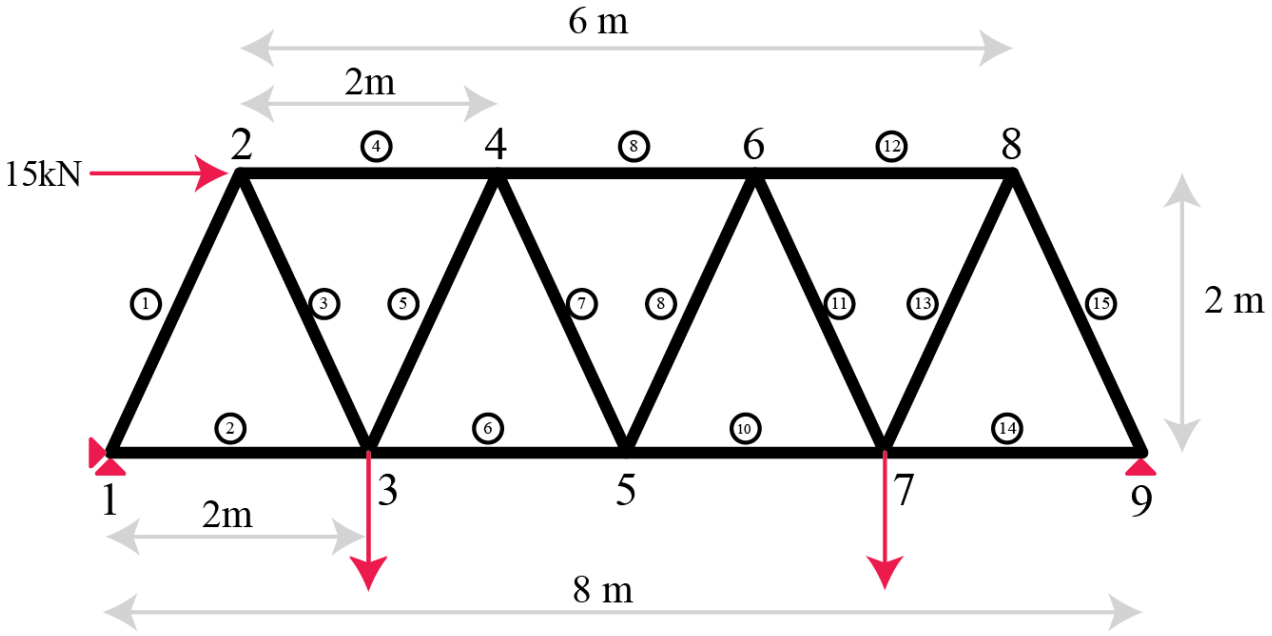
Deflections at the nodes

Node Number	SuGanaka		Abaqus	
	X (mm)	Y (mm)	X (mm)	Y (mm)
1	0.2171E-37	0.0000E+00	1.20000E-33	1.80000E-33
2	-0.6330E-06	0.0000E+00	1.20000E-33	-1.80000E-33
3	0.9635E-01	-0.2348E-01	0.96355E-01	-0.234783E-01

Forces in the nodes

Element Number	SuGanaka	Abaqus
	(MPa)	(MPa)
1	0.2171E-37	1.20000E-33
2	-0.6330E-06	1.20000E-33
3	0.9635E-01	0.96355E-01

3. Problem 2



Material Properties:

For Horizontal members E = 30 x 10^6 kN/m^2 and A = 0.045 m^2
For Vertical members E = 30 x 10^6 kN/m^2 and A = 0.020 m^2

Input file:

```
9
15
2
2
0.0, 0.0
1.0, 2.0
2.0, 0.0
3.0, 2.0
4.0, 0.0
5.0, 2.0
6.0, 0.0
7.0, 2.0
8.0, 0.0
1, 2
1, 3
2, 3
2, 4
3, 4
3, 5
4, 5
```

4, 6
5, 6
5, 7
6, 7
6, 8
7, 8
7, 9
8, 9
30000000, 0.02
30000000, 0.045
30000000, 0.02
30000000, 0.045
30000000, 0.02
30000000, 0.045
30000000, 0.02
30000000, 0.045
30000000, 0.02
30000000, 0.045
30000000, 0.02
30000000, 0.045
30000000, 0.02
30000000, 0.045
30000000, 0.02
0.0, 0.0
15.0, 0.0
0.0, -5.0
0.0, -7.0
0.0, 0.0
0.0, 0.0
0.0, -10.0
0.0, 0.0
0.0, 0.0
0.0, 0.0
0.0, 0.0
0.0, 0.0
0.0, 0.0
0.0, 0.0
0.0, 0.0
0.0, 0.0
1.0, 1.0
1.0, 1.0
1.0, 1.0
1.0, 1.0
1.0, 1.0
1.0, 1.0
1.0, 1.0

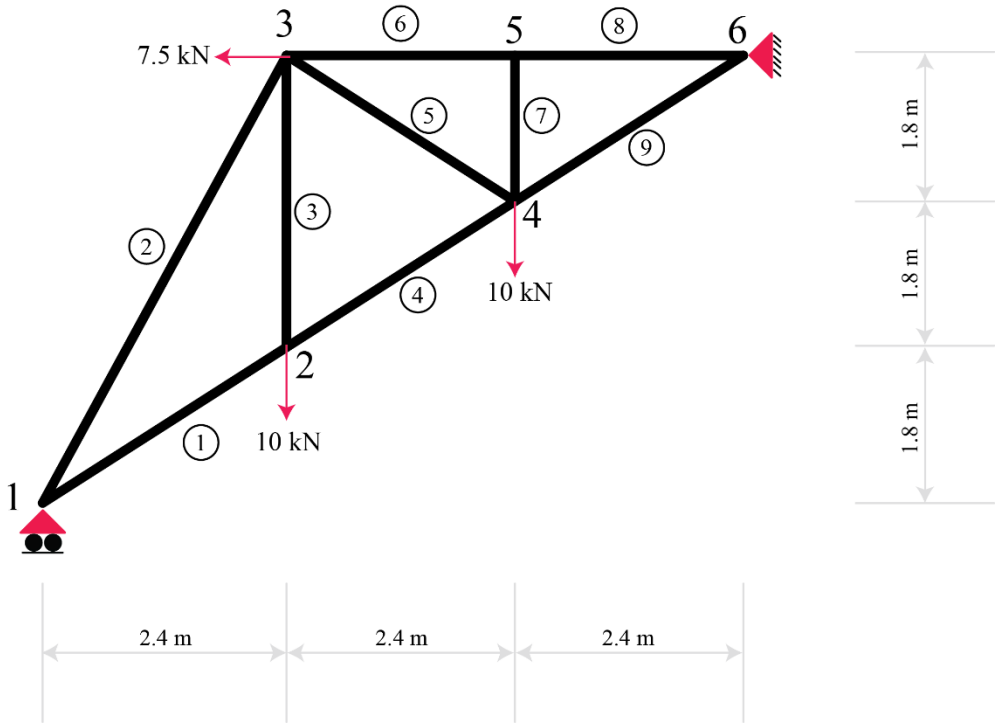
1.0, 0.0
1.0, 1.0
1.0, 1.0
1.0, 1.0
1.0, 1.0
1.0, 1.0
1.0, 1.0

Results:

Node Num	X	Y
1	0.1336E-37	0.3383E+39
2	0.1361E-03	-0.1001E-03
3	0.2732E-04	-0.1865E-03
4	0.1037E-03	-0.2334E-03
5	0.6112E-04	-0.2308E-03
6	0.7370E-04	-0.2132E-03
7	0.8732E-04	-0.1825E-03
8	0.5130E-04	-0.9407E-04
9	0.9852E-04	-0.6718E-19

Element	Magnitude	Nature
1	-0.7683E+01	Compression
2	0.1844E+02	Tension
3	0.7684E+01	Tension
4	-0.2187E+02	Compression
5	-0.2095E+01	Compression
6	0.2281E+02	Tension
7	-0.5731E+01	Compression
8	-0.2025E+02	Compression
9	0.5730E+01	Tension
10	0.1769E+02	Tension
11	-0.5730E+01	Compression
12	-0.1512E+02	Compression
13	0.1691E+02	Tension
14	0.7562E+01	Tension
15	-0.1691E+02	Compression

4. Problem 3



Material Properties:
E = 30, 000 MPa and A = 20, 000 mm^2

Input file:

6
9
2
2
0.0, 0.0
2400.0, 1800.0
2400.0, 5400.0
4800.0, 3600.0
4800.0, 5400.0
7200.0, 5400.0
1, 2
1, 3
2, 3
2, 4
3, 4
3, 5

4, 5
5, 6
4, 6
30000.0, 20000.0
30000.0, 20000.0
30000.0, 20000.0
30000.0, 20000.0
30000.0, 20000.0
30000.0, 20000.0
30000.0, 20000.0
30000.0, 20000.0
30000.0, 20000.0
0.0, 0.0
0.0, -10000.0
-7500.0, 0.0
0.0, -10000.0
0.0, 0.0
0.0, 0.0
1.0, 0.0
1.0, 1.0
1.0, 1.0
1.0, 1.0
1.0, 1.0
0.0, 0.0

Results:

Node Num	X	Y
1	-0.2083E+00	0.0000E+00
2	0.1065E+00	-0.3502E+00
3	0.4667E-01	-0.2902E+00
4	0.1061E+00	-0.2803E+00
5	0.2333E-01	-0.2803E+00
6	0.0000E+00	0.0000E+00

Element	Magnitude	Nature
1	0.8331E+04	Tension
2	-0.1641E+05	Compression
3	0.1000E+05	Tension
4	0.8329E+04	Tension
5	0.8332E+04	Tension
6	-0.5833E+04	Compression
7	0.1134E+01	Tension
8	-0.5834E+04	Compression
9	0.1666E+05	Tension