2020-04-29

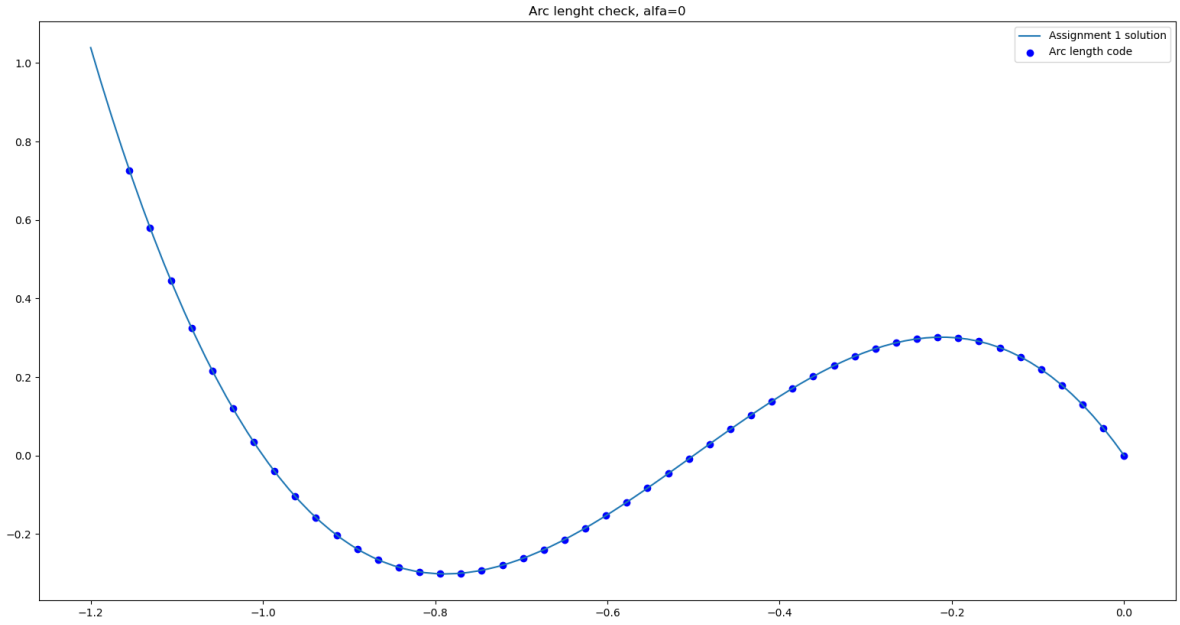
Assignment 3

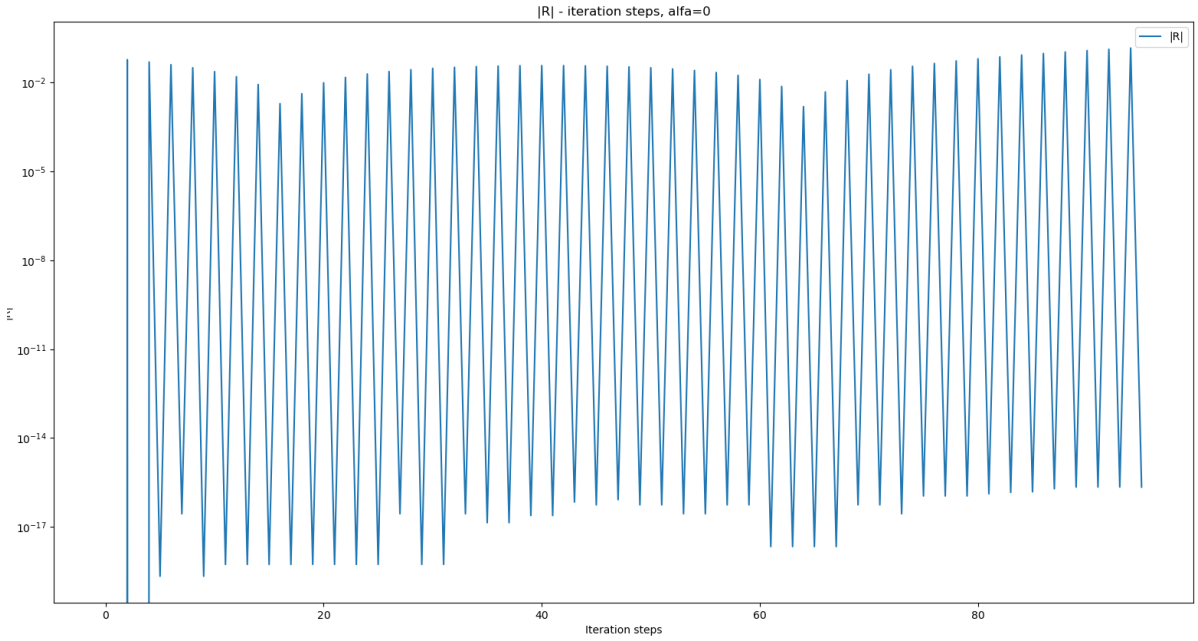
CESG 506

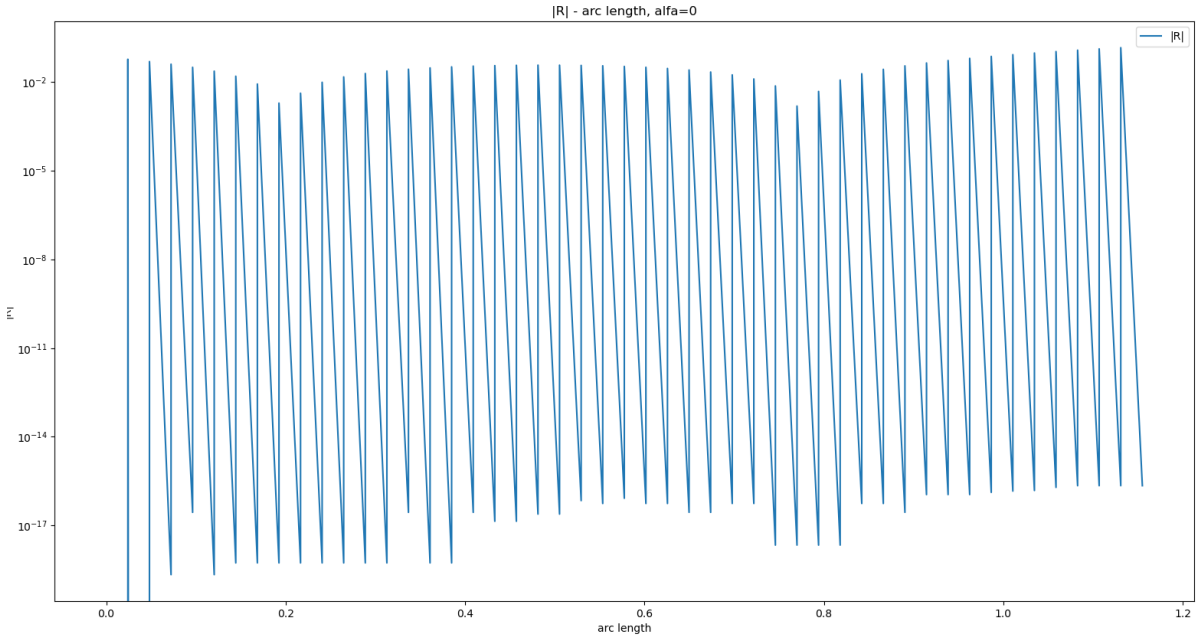
KRISTINN HLÍÐAR GRÉTARSSON

Problem 1

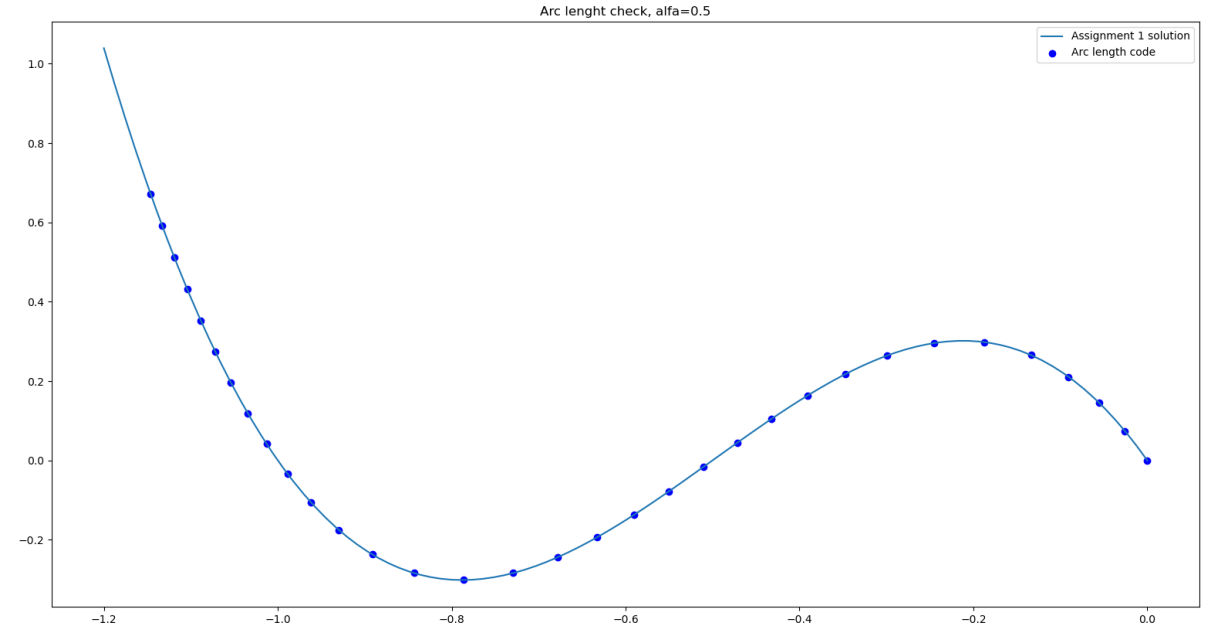
Part 3

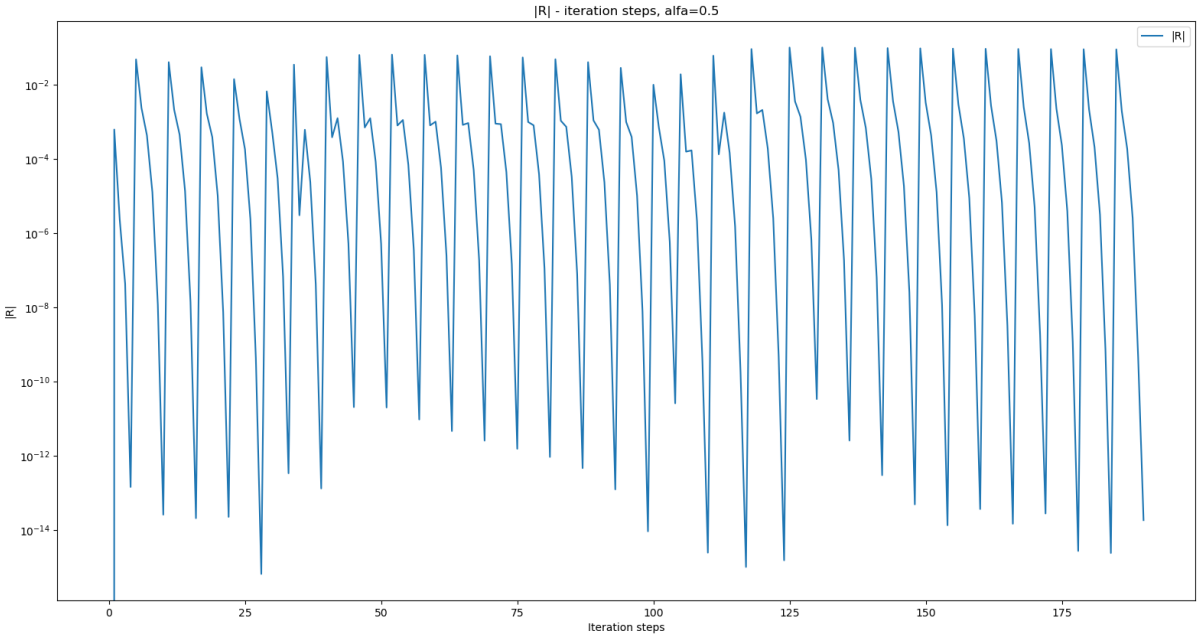


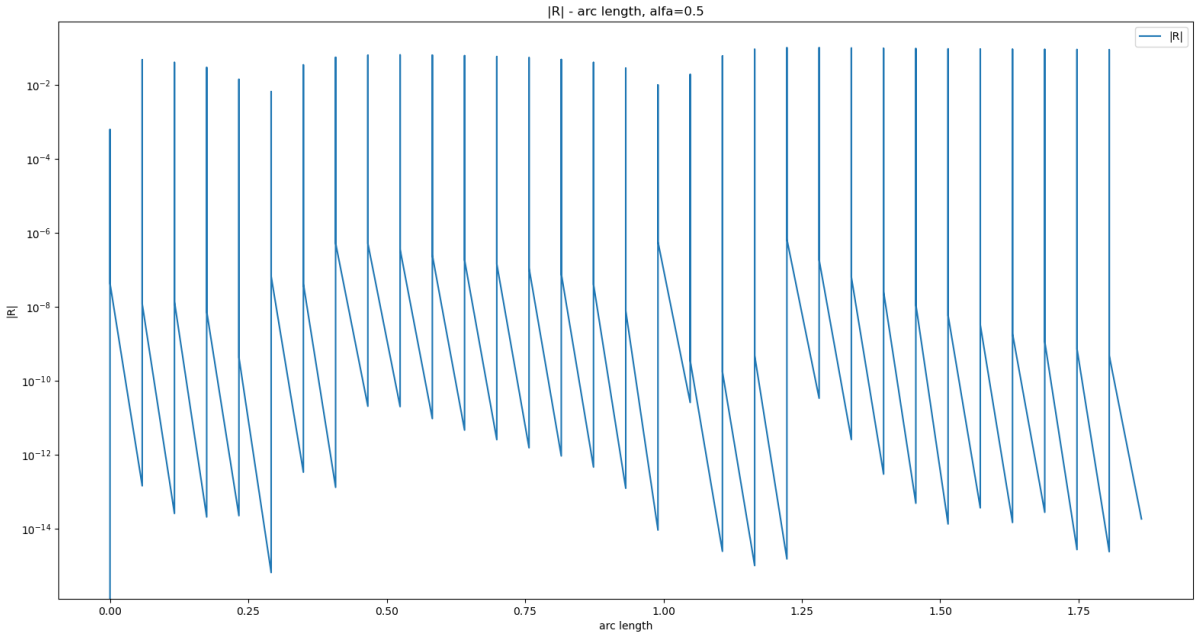



|R| - arc length, alfa=0
|R|
10^{-2}
10^{-5}
10^{-8}
10^{-11}
10^{-14}
10^{-17}
|R|
0.0
0.2
0.4
0.6
0.8
1.0
1.2
arc length

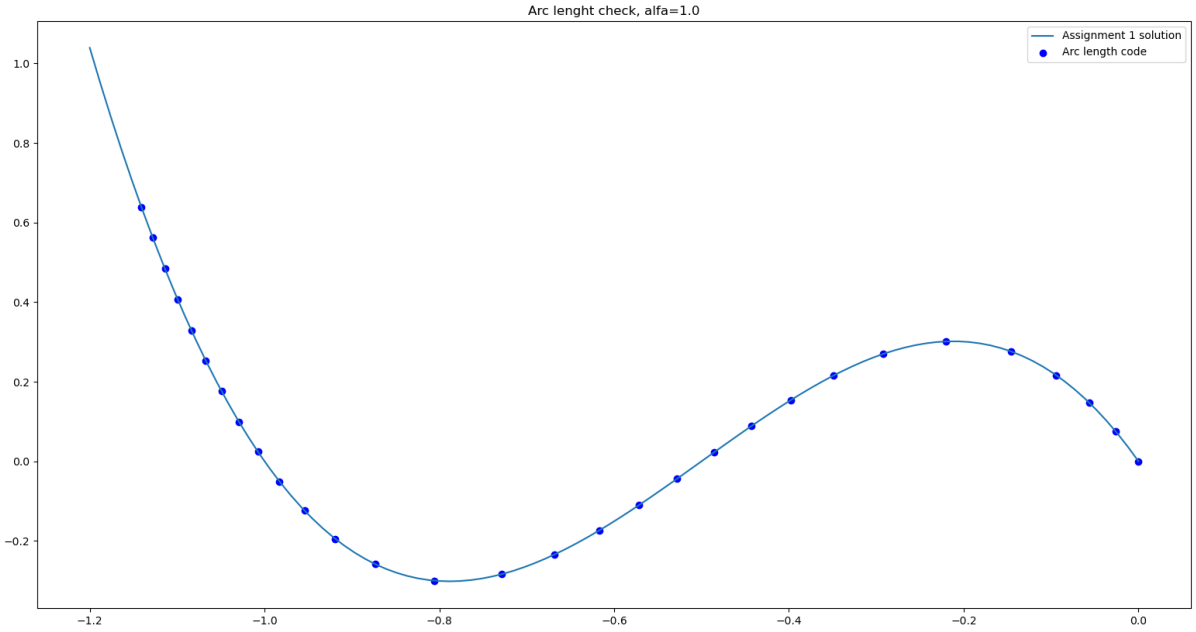
ALFA = 0.5

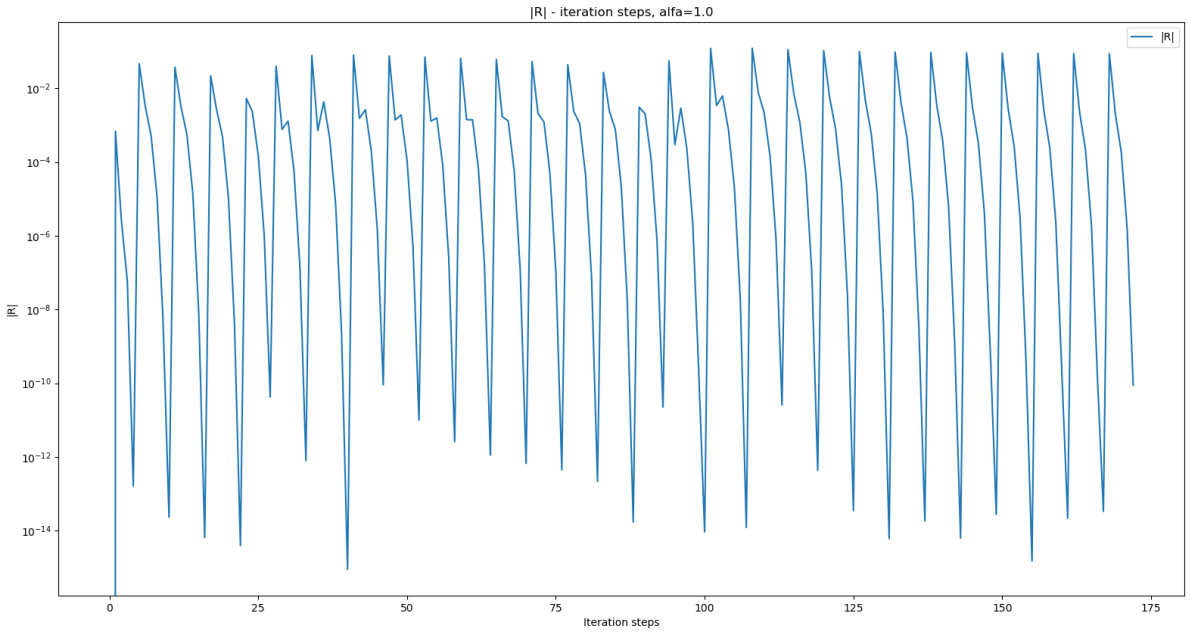

Arc lenght check, alfa=0.5
Assignment 1 solution
Arc length code
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−1.2
−1.0
−0.8
−0.6
−0.4
−0.2
0.0

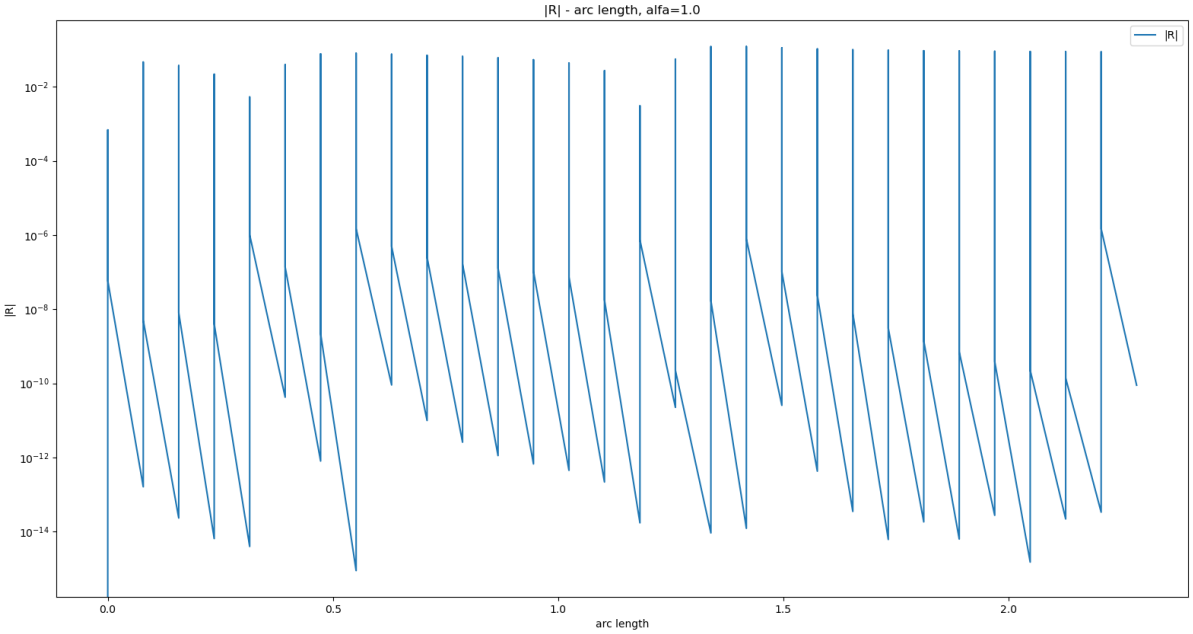

|R| - iteration steps, alfa=0.5
|R|
Iteration steps
0
25
50
75
100
125
150
175


|R| - arc length, alfa=0.5
|R|
arc length
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75

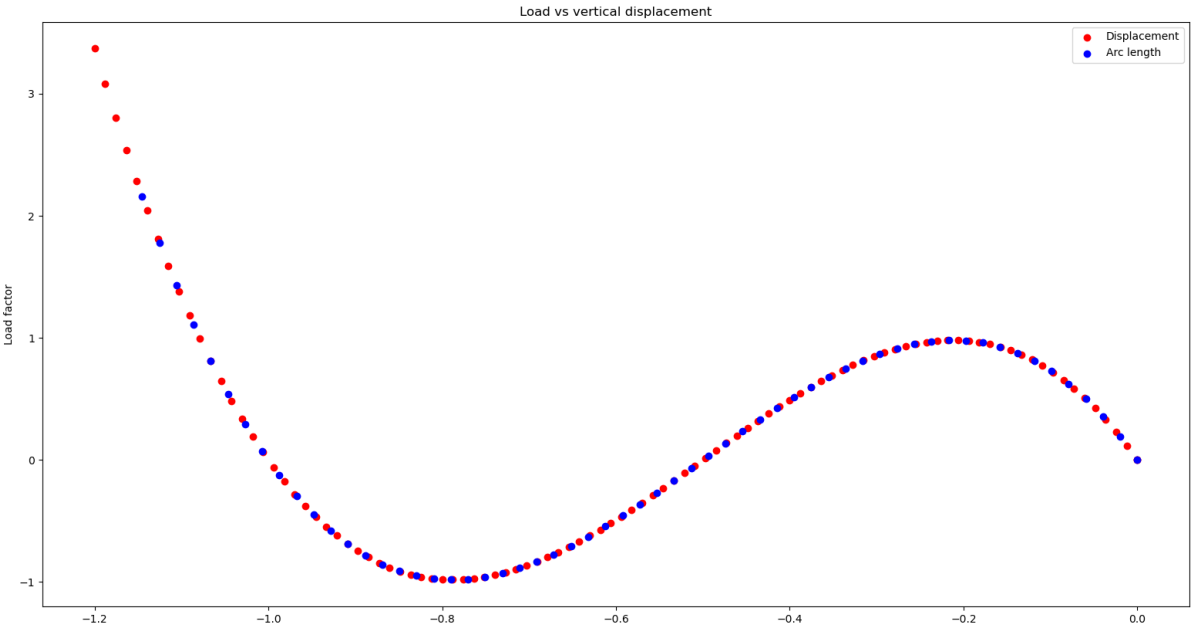
ALFA = 1.0

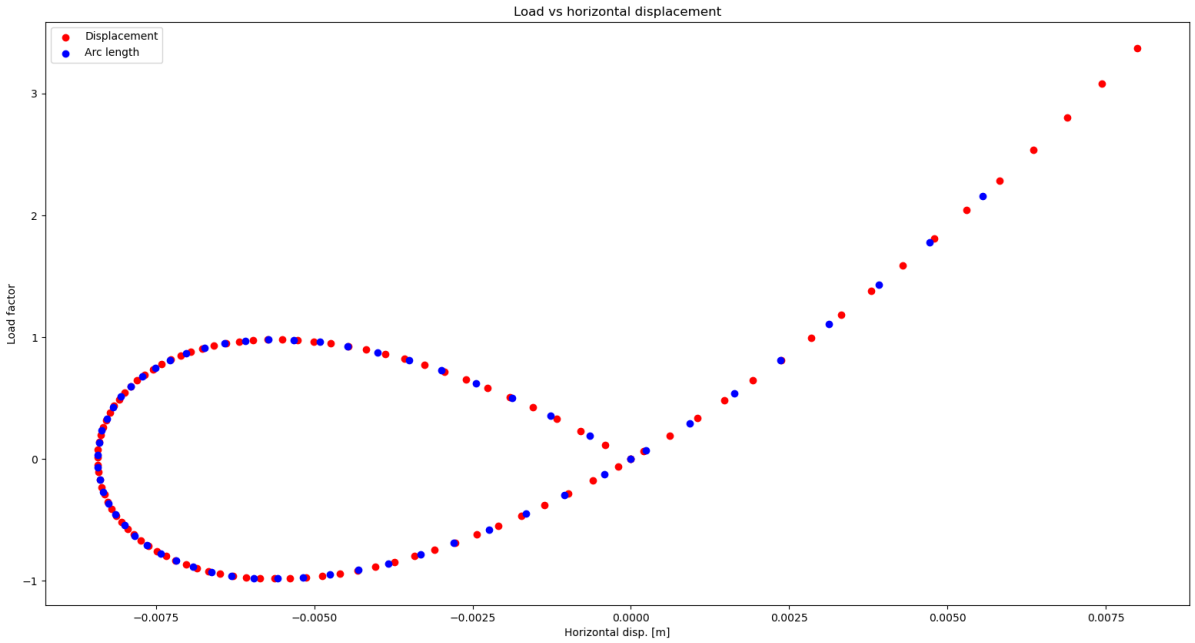

Arc lenght check, alfa=1.0
Assignment 1 solution
Arc length code
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−1.2
−1.0
−0.8
−0.6
−0.4
−0.2
0.0


|R| - iteration steps, alfa=1.0
|R|
10^{-2}
10^{-4}
10^{-6}
10^{-8}
10^{-10}
10^{-12}
10^{-14}
0
25
50
75
100
125
150
175
Iteration steps


|R| - arc length, alfa=1.0
|R|
10^{-2}
10^{-4}
10^{-6}
10^{-8}
10^{-10}
10^{-12}
10^{-14}
|R|
0.0
0.5
1.0
1.5
2.0
arc length

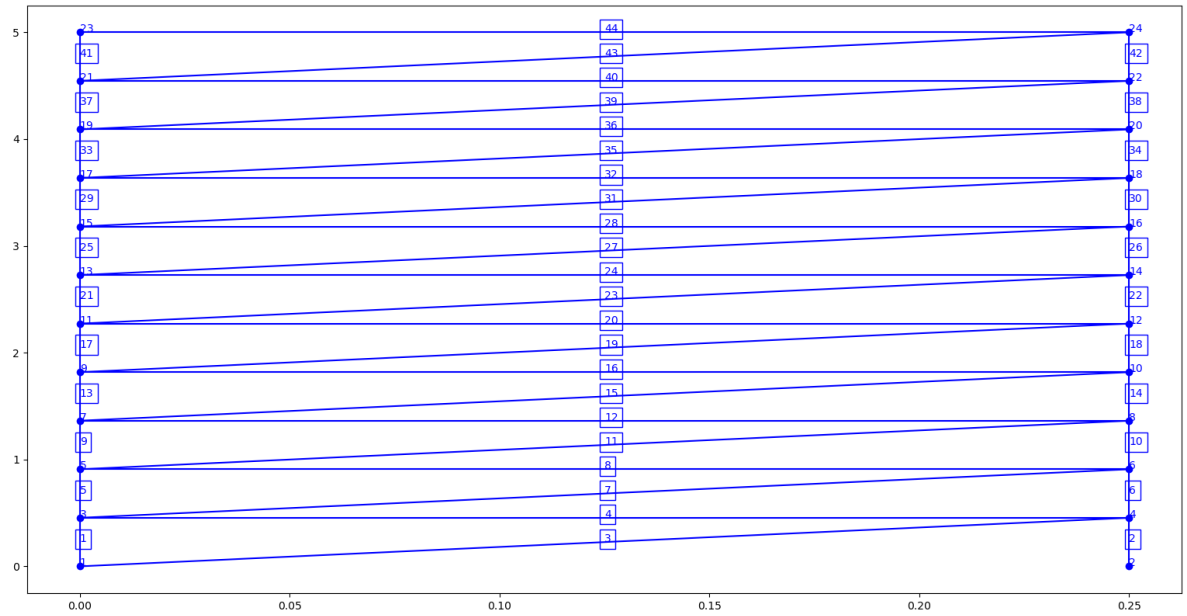
Problem 2


Load vs vertical displacement
Displacement
Arc length
Load factor
3
2
1
0
−1
−1.2
−1.0
−0.8
−0.6
−0.4
−0.2
0.0


Load vs horizontal displacement
Displacement
Arc length
Load factor
3
2
1
0
−1
−0.0075
−0.0050
−0.0025
0.0000
0.0025
0.0050
0.0075
Horizontal disp. [m]

Problem 3

Plot of structure



Nodes

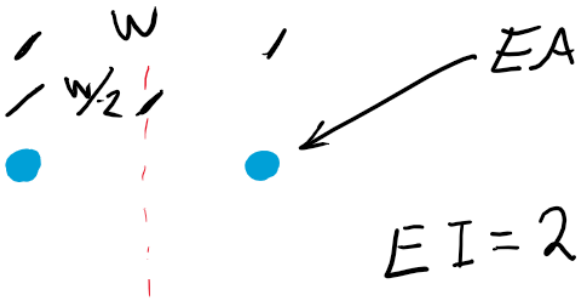
[['no.' 'State' '[x, y, z]']
 [1 array([0, 0]) array([0., 0.])]
 [2 array([0, 0]) array([0.25, 0.])]
 [3 array([1, 1]) array([0.   , 0.45454545])]
 [4 array([1, 1]) array([0.25   , 0.45454545])]
 [5 array([1, 1]) array([0.   , 0.90909091])]
 [6 array([1, 1]) array([0.25   , 0.90909091])]
 [7 array([1, 1]) array([0.   , 1.36363636])]
 [8 array([1, 1]) array([0.25   , 1.36363636])]
 [9 array([1, 1]) array([0.   , 1.81818182])]
 [10 array([1, 1]) array([0.25   , 1.81818182])]
 [11 array([1, 1]) array([0.   , 2.27272727])]
 [12 array([1, 1]) array([0.25   , 2.27272727])]
 [13 array([1, 1]) array([0.   , 2.72727273])]
 [14 array([1, 1]) array([0.25   , 2.72727273])]
 [15 array([1, 1]) array([0.   , 3.18181818])]
 [16 array([1, 1]) array([0.25   , 3.18181818])]
 [17 array([1, 1]) array([0.   , 3.63636364])]
 [18 array([1, 1]) array([0.25   , 3.63636364])]
 [19 array([1, 1]) array([0.   , 4.09090909])]
 [20 array([1, 1]) array([0.25   , 4.09090909])]
 [21 array([1, 1]) array([0.   , 4.54545455])]
 [22 array([1, 1]) array([0.25   , 4.54545455])]
 [23 array([1, 1]) array([0., 5.])]
 [24 array([1, 1]) array([0.25, 5.])]]

Elements

[['no.' 'i-node' 'j-node' 'element']
 [1 1 3 <truss.TrussElement object at 0x000001A77DD1C240>]
 [2 2 4 <truss.TrussElement object at 0x000001A70D996EF0>]
 [3 1 4 <truss.TrussElement object at 0x000001A70DBCE470>]
 [4 3 4 <truss.TrussElement object at 0x000001A70DDB3D30>]
 [5 3 5 <truss.TrussElement object at 0x000001A70D9E58D0>]
 [6 4 6 <truss.TrussElement object at 0x000001A70D9E5128>]
 [7 3 6 <truss.TrussElement object at 0x000001A70CCA0358>]
 [8 5 6 <truss.TrussElement object at 0x000001A70CC9AEF0>]
 [9 5 7 <truss.TrussElement object at 0x000001A70DF13860>]
 [10 6 8 <truss.TrussElement object at 0x000001A70DF13898>]
 [11 5 8 <truss.TrussElement object at 0x000001A70DF138D0>]
 [12 7 8 <truss.TrussElement object at 0x000001A70DF13908>]
 [13 7 9 <truss.TrussElement object at 0x000001A70DF139B0>]
 [14 8 10 <truss.TrussElement object at 0x000001A70DF13C50>]
 [15 7 10 <truss.TrussElement object at 0x000001A70DF13C88>]
 [16 9 10 <truss.TrussElement object at 0x000001A70DF13CC0>]
 [17 9 11 <truss.TrussElement object at 0x000001A70DF13CF8>]
 [18 10 12 <truss.TrussElement object at 0x000001A70DF13D30>]
 [19 9 12 <truss.TrussElement object at 0x000001A70DF13D68>]
 [20 11 12 <truss.TrussElement object at 0x000001A70DF13DA0>]
 [21 11 13 <truss.TrussElement object at 0x000001A70DF13DD8>]
 [22 12 14 <truss.TrussElement object at 0x000001A70DF13E10>]
 [23 11 14 <truss.TrussElement object at 0x000001A70DF13E48>]
 [24 13 14 <truss.TrussElement object at 0x000001A70DF13E80>]
 [25 13 15 <truss.TrussElement object at 0x000001A70DF13EB8>]
 [26 14 16 <truss.TrussElement object at 0x000001A70DF13EF0>]
 [27 13 16 <truss.TrussElement object at 0x000001A70DF13F28>]
 [28 15 16 <truss.TrussElement object at 0x000001A70DF13F60>]
 [29 15 17 <truss.TrussElement object at 0x000001A70DF13F98>]
 [30 16 18 <truss.TrussElement object at 0x000001A70DF13FD0>]
 [31 15 18 <truss.TrussElement object at 0x000001A70DC74E48>]
 [32 17 18 <truss.TrussElement object at 0x000001A70DF2D048>]
 [33 17 19 <truss.TrussElement object at 0x000001A70DF2D080>]
 [34 18 20 <truss.TrussElement object at 0x000001A70DF2D0B8>]
 [35 17 20 <truss.TrussElement object at 0x000001A70DF2D0F0>]
 [36 19 20 <truss.TrussElement object at 0x000001A70DF2D128>]
 [37 19 21 <truss.TrussElement object at 0x000001A70DF2D160>]
 [38 20 22 <truss.TrussElement object at 0x000001A70DF2D198>]
 [39 19 22 <truss.TrussElement object at 0x000001A70DF2D1D0>]
 [40 21 22 <truss.TrussElement object at 0x000001A70DF2D208>]
 [41 21 23 <truss.TrussElement object at 0x000001A70DF2D240>]
 [42 22 24 <truss.TrussElement object at 0x000001A70DF2D278>]
 [43 21 24 <truss.TrussElement object at 0x000001A70DF2D2B0>]
 [44 23 24 <truss.TrussElement object at 0x000001A70DF2D2E8>]]

Part 2

Estimated P.cr = 6.1685 kN



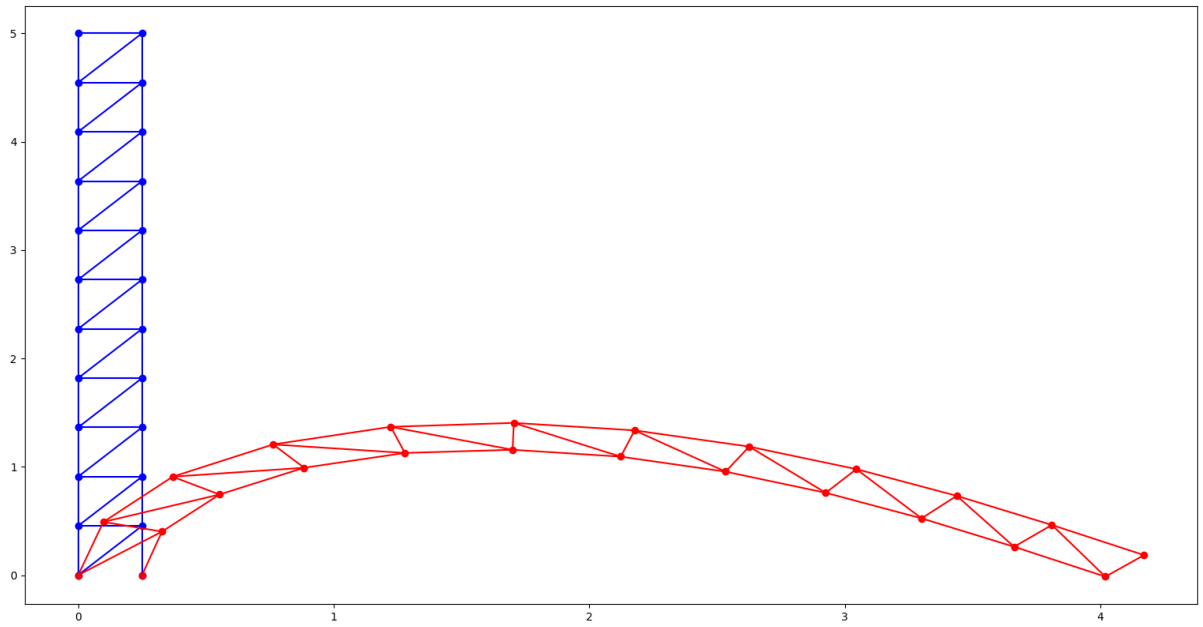
$$EI = 2 \cdot EA \left(\frac{W}{2}\right)^2$$

$$= \frac{EA}{2} W^2$$

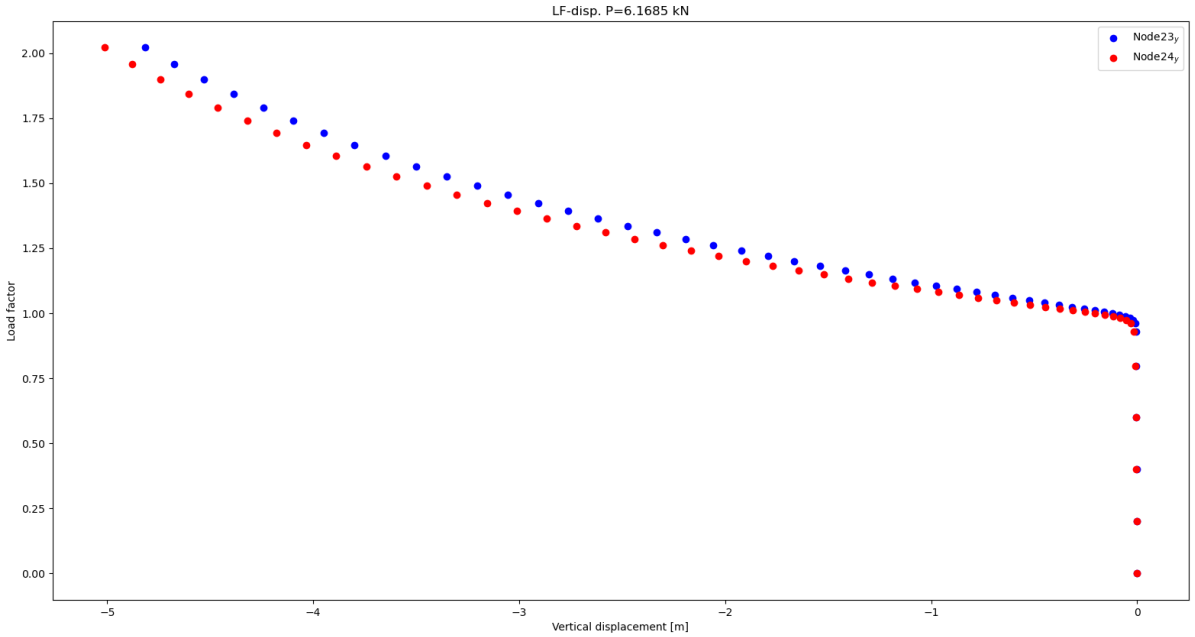
$$= 62{,}5\ kN\,m^2$$

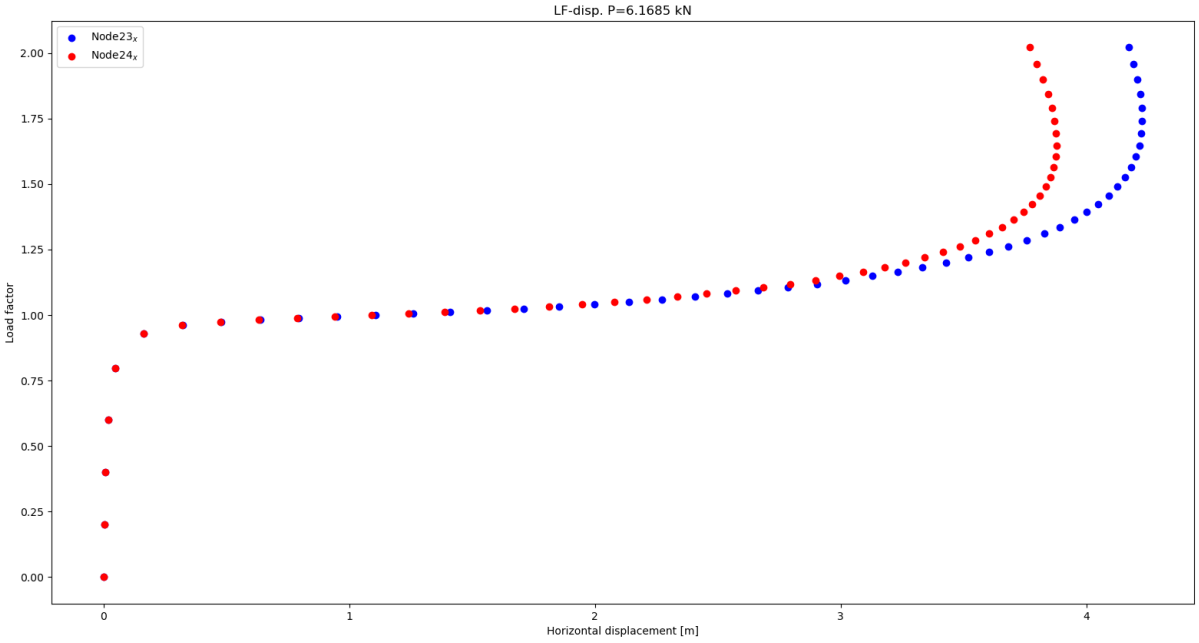
$$P_{cr} = \frac{EI \cdot \pi^2}{L^2} = \frac{62{,}5\ kN m^2 \cdot \pi^2}{(10\,m)^2} = 6.1685\ kN$$

Part 3

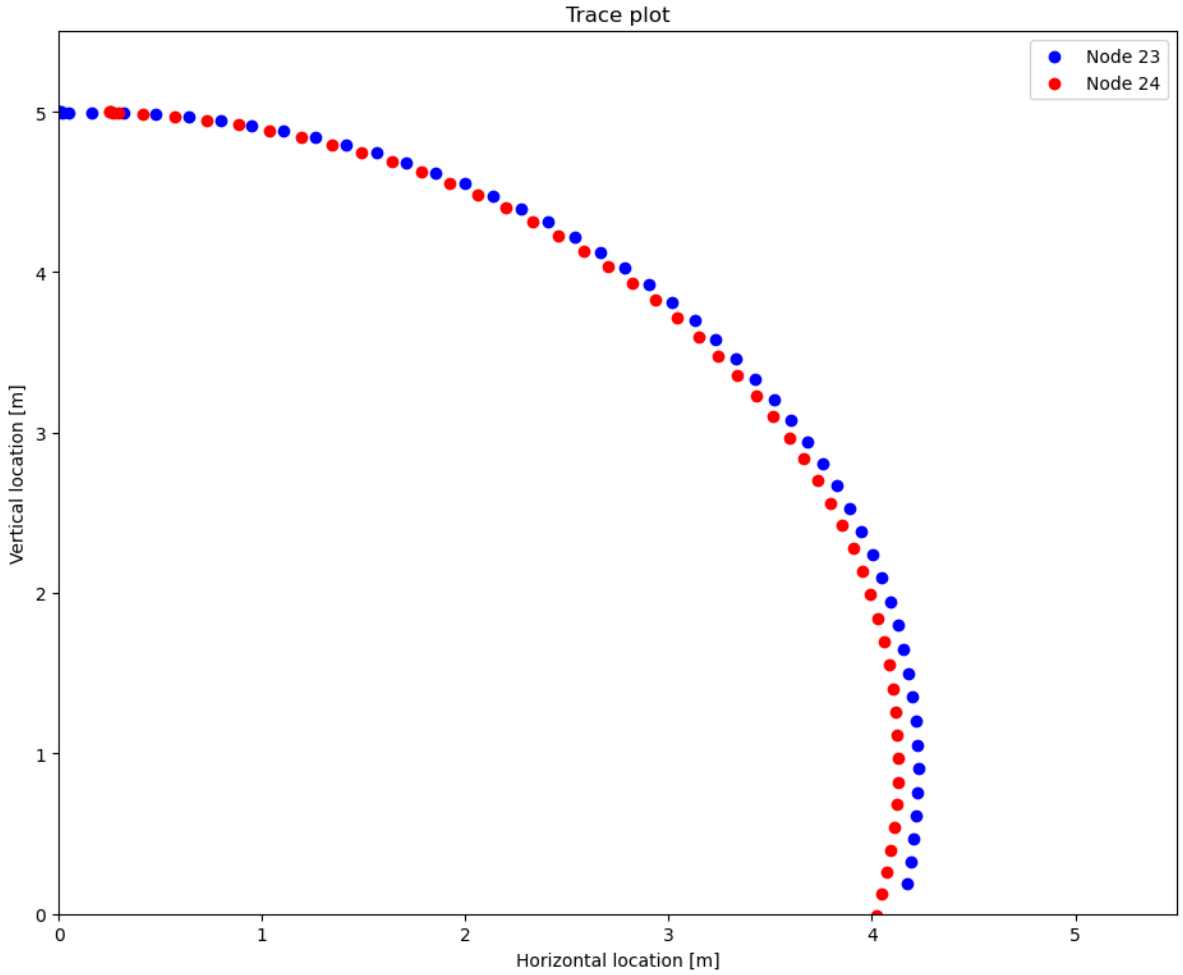


Part 4


LF-disp. P=6.1685 kN
Node23$_y$
Node24$_y$
Load factor
Vertical displacement [m]


LF-disp. P=6.1685 kN
Node23$_x$
Node24$_x$
Load factor
Horizontal displacement [m]

Part 5


Trace plot
Node 23
Node 24
Vertical location [m]
Horizontal location [m]
0
1
2
3
4
5

Part 6 – Deflected structure