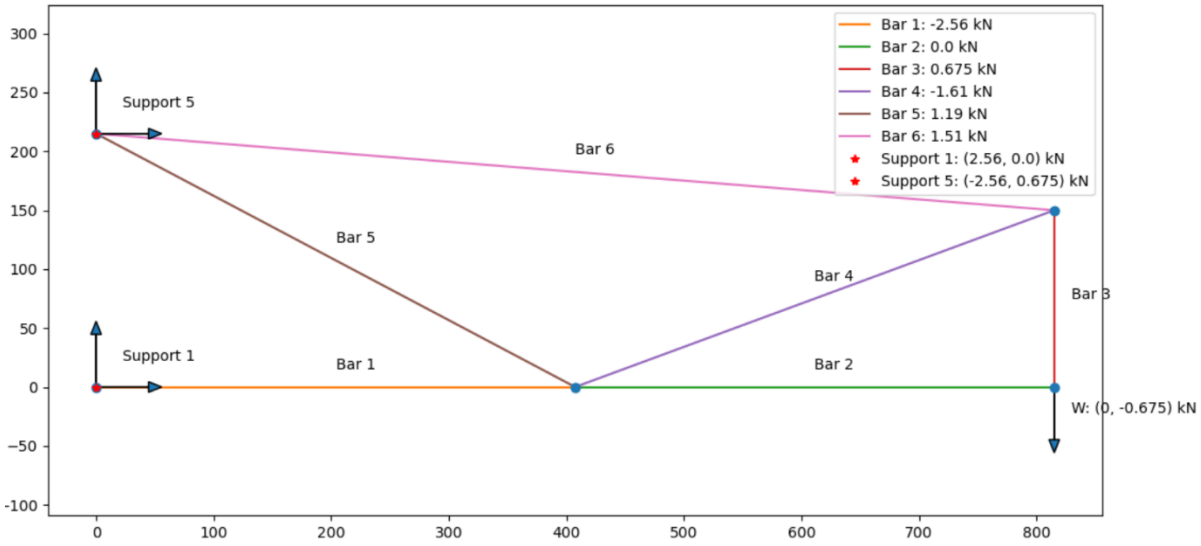
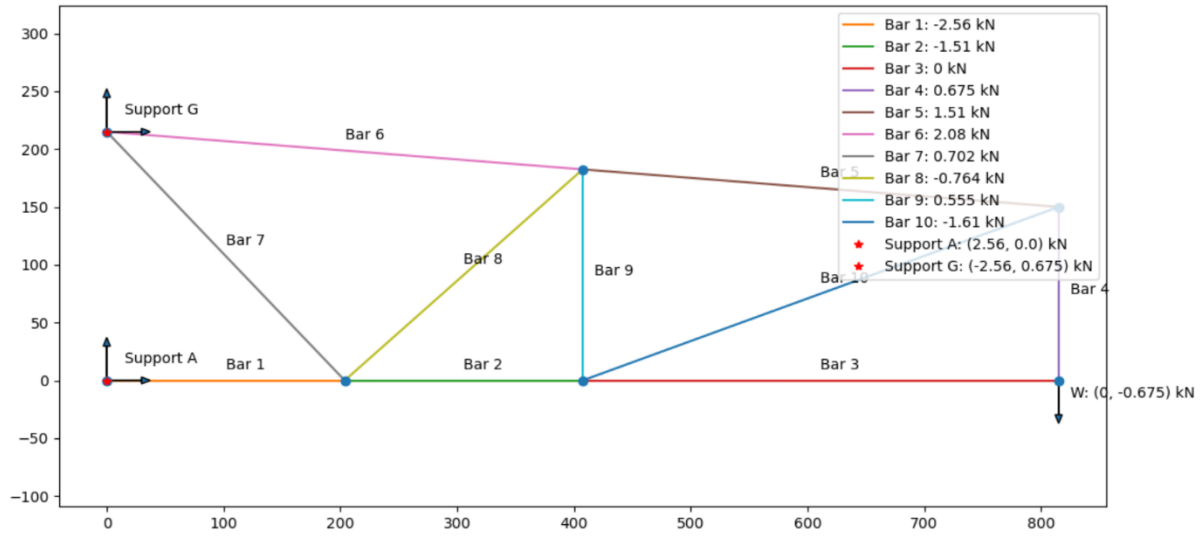
Structural Design Project

Trial designs

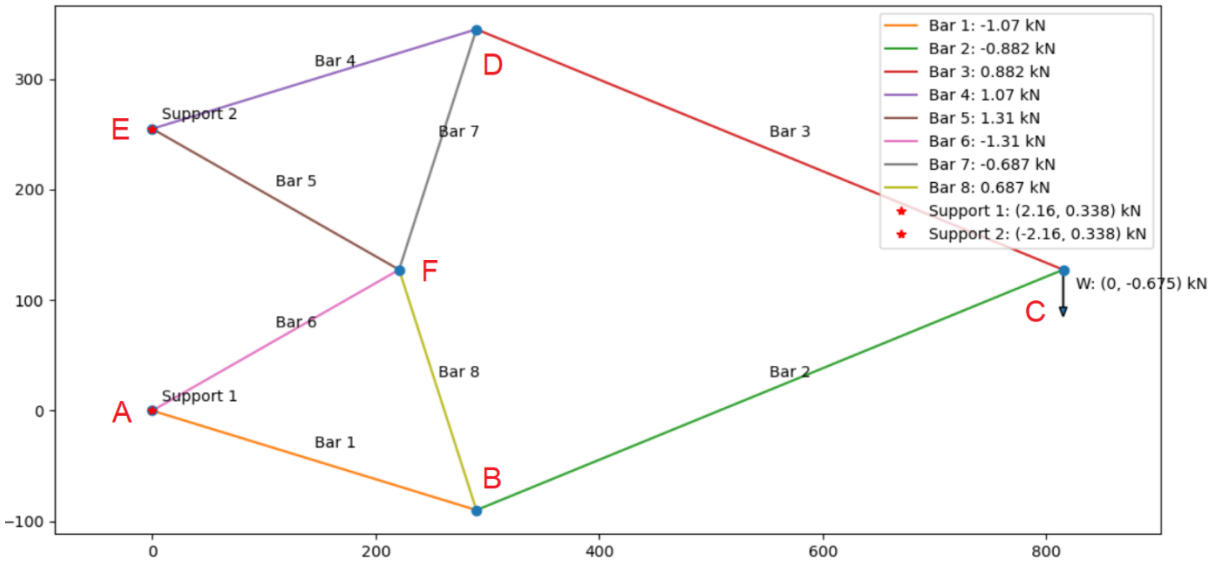
Plan 1: Fails by buckling mode A in bar 1 which cannot feasibly be stopped without changes to the truss geometry.



Plan 2: Also fails by buckling in Bar 1. Too expensive to prevent its collapse.



Final design



Bar 1 (AB): 16 mm x 16 mm, 1.1 mm thickness (length: 303.64 mm)

Bar 2 (BC): 19 mm x 19 mm, 1.1 mm thickness, double member (length: 568.27 mm)

Bar 3 (CD): 16 mm x 16 mm, 0.9 mm thickness (length: 568.27 mm)

Bar 4 (DE): 16 mm x 16 mm, 0.9 mm thickness (length: 303.64 mm)

Bar 5 (EF): 16 mm x 16 mm, 0.9 mm thickness (length: 255 mm)

Bar 6 (AF): 16 mm x 16 mm, 1.1 mm thickness, double member (length: 255 mm)

Bar 7 (DF): 16 mm x 16 mm, 0.9 mm thickness (length: 228.23 mm)

Bar 8 (BF): 12.5 x 12.5 mm, 0.7 mm thickness (length: 228.23 mm)

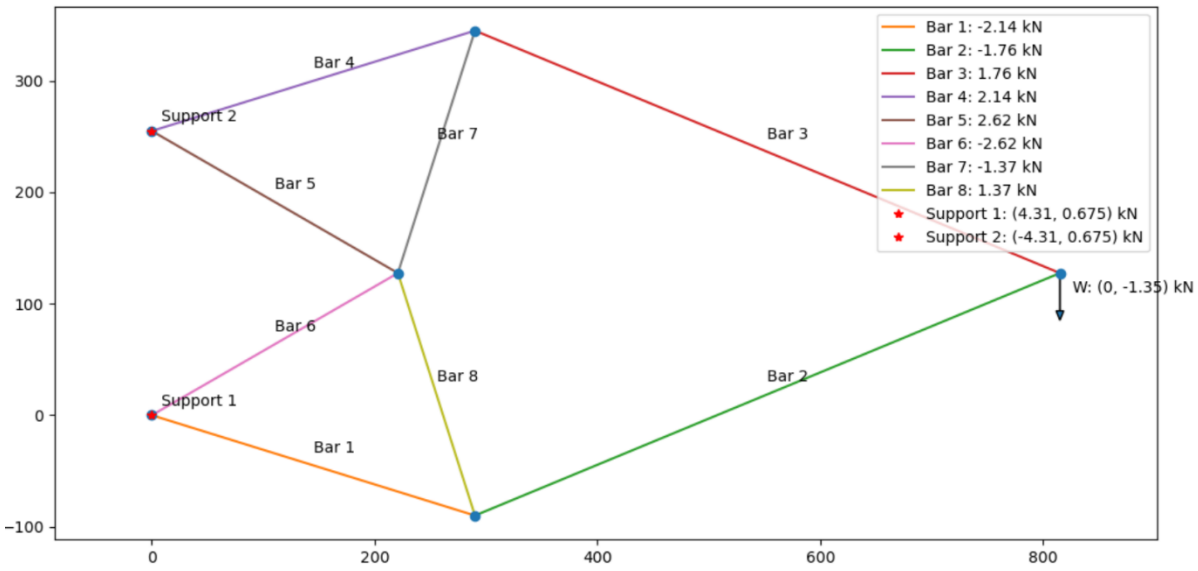
Coordinates of the joints relative to A = (0, 0) [x: positive to the right, y: positive upwards]:

B = (290, -90), C = (815, 127.5), D = (290, 345), E = (0, 255), F = (220.84, 127.5)

Load is applied through spreader bar at joint C. Parallel bracing bars will be put in at D and B. Length of spreader bar is 115 mm.

Largest strain is in bar 5 (0.000405 = 0.04%). With a length of 255 mm, the extension will be about 0.1 mm which is not a visible deflection.

Loading state at 2W:



Member	Force at 2W (N), mode	Stress at 2W (MPa)	Limiting stress
1	-2140 (compression)	-114	-148
2	-1760 (compression)	-75.8	-112
3	1760 (tension)	115	216
4	2140 (tension)	139	216
5	2620 (tension)	170	216
6	-2620 (compression)	-139	-200
7	-1370 (compression)	-89.3	-165
8	1370 (tension)	137	216

We expect no failure at a load of 2W. The first failure is predicted to be bar 1 (buckling mode B) or bar 8 (yielding).