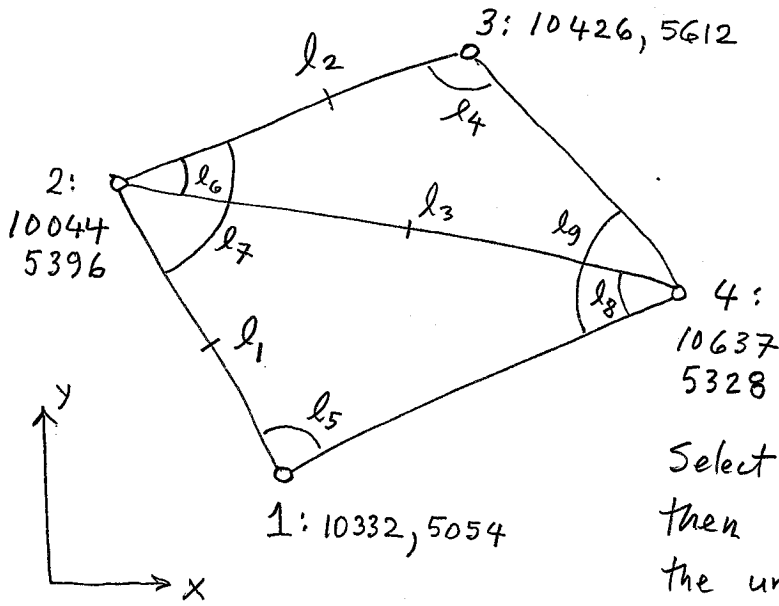


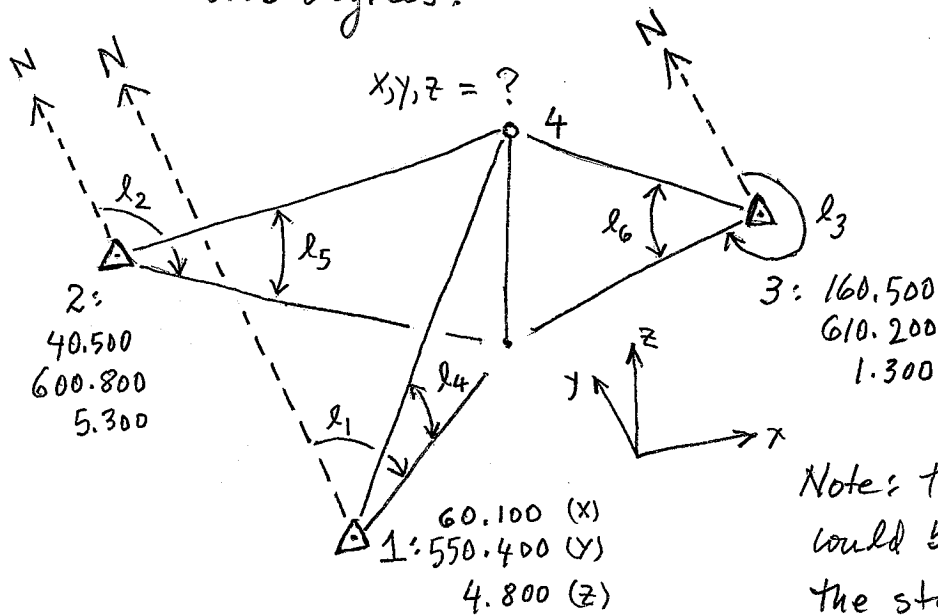
1. We have observations and nominal coordinates for a 2D horizontal network:



#	l	σ
1	447.49	0.2
2	439.78	0.2
3	596.94	0.2
4	97° 003	0.019
5	88° 249	"
6	36° 045	"
7	79° 287	"
8	48° 521	"
9	95° 475	"

angles are given in decimal degrees.
Select appropriate minimal constraints, and then adjust by indirect observations, with the unconstrained coordinates as parameters.

2. At each of 3 control points we observe azimuth and vertical angle to an unknown point. σ for all angle observations is 0.03 degrees.



#	l	σ	
azimuth	1	44.350	0.03
	2	103.415	"
	3	250.491	"
vert. angle	4	13.899	"
	5	12.075	"
	6	13.496	"

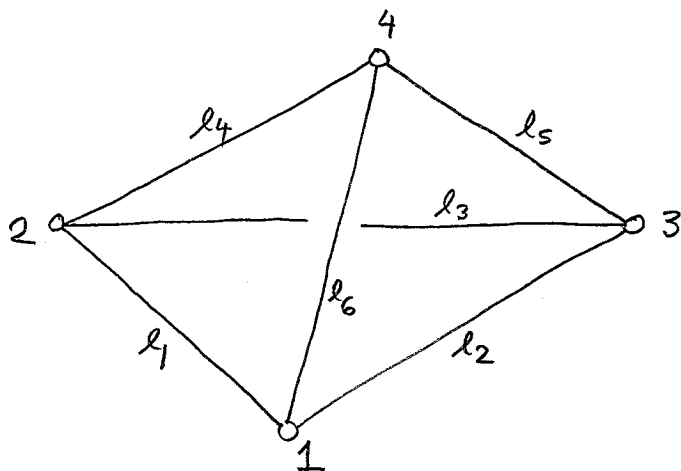
Notes: The reference direction, North, could be established by using the star, Polaris. The reference for the vertical angles is horizontal.

The unknown point 4 is higher than the points 1, 2, 3.

3. (i) For the 3D network, 6 distances are observed.

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- (a) for determining the shape & size of the figure, what is the redundancy?
- (b) If you wish to solve for the coordinates of the vertices, how many minimal constraints are needed?
- (c) How many free coordinate parameters remain, after fixing the number given in (b)?



point 4 is above the plane of 1, 2, 3.

(ii) For the same figure, in addition to the 6 distances, from each point we observe

- 3 vertical angles to the other 3 points
- 2 horizontal angles between the other 3 points

If we want to solve this figure using coordinates of the vertices, how many minimal constraints are needed?