

## Exercise 10: Adjustment Calculation - part V

- Levelling network -

Group:	Surname, First name:	Matriculation number:	Signature*:
* With my signature I declare that I was involved in the elaboration of this homework.			
Submission until: <b>19.01.2025</b>			

### Objective

This exercise deals with the adjustment of levelling networks.

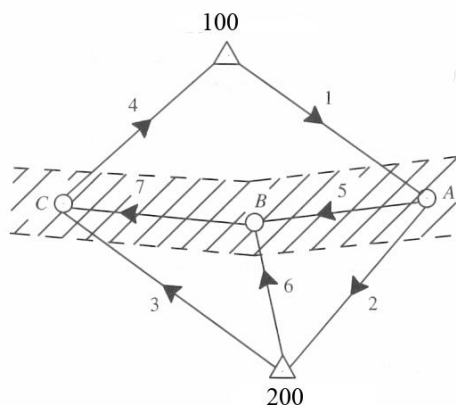


Figure 1: Interlocking levelling network

Table 1: Measured height differences

Line	Height differences [m]
1	5.10
2	2.34
3	-1.25
4	-6.13
5	-0.68
6	-3.00
7	1.70

Table 2: Benchmarks

Point	Height [m]
100	100.00
200	107.50

### Task 1:

The measurements of the levelling network depicted in Figure 1 are listed in Table 1. The points 100 and 200 are benchmarks (error free) and their heights are given in Table 2. Calculate the adjusted heights of points  $A$ ,  $B$  and  $C$  using least-squares adjustment.

- The measurements are uncorrelated and were obtained with the same standard deviation.
- Set up an appropriate functional model as well as the observation equations.
- Set up the stochastic model.
- Solve the normal equation system and determine the heights of points  $A$ ,  $B$  and  $C$  as well as their standard deviations.
- Calculate the residuals and the adjusted observations as well as their standard deviations.

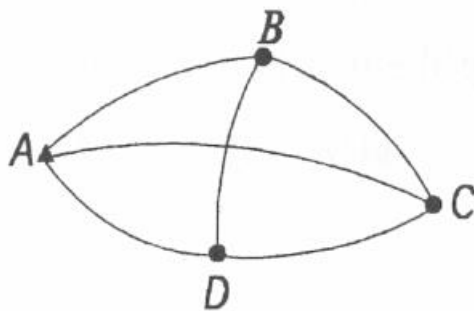


Figure 2: Levelling network

Table 3: Measured height differences and their standard deviations

From	To	$\Delta h_i$ [m]	$\sigma_{\Delta h_i}$ [mm]
A	B	10.509	6
B	C	5.360	4
C	D	-8.523	5
D	A	-7.348	3
B	D	-3.167	4
A	C	15.881	12

### Task 2 (Homework):

A levelling network is depicted in Figure 2 and the related measurements as well as their standard deviations are listed in Table 3. The measurements are uncorrelated.

- Perform two different adjustments for the given levelling network:
  - 1. Adjustment: Use point  $A$  as a benchmark and all other points as new points.
  - 2. Adjustment: Use point  $B$  as a benchmark and all other points as new points.
- The error free height for each benchmark is derived from your matriculation number (one per group)
  - e.g., Matr.-No.: 123456
    - 1. Adjustment (number forward):  $H_A = 123.456$  m.
    - 2. Adjustment (number backward):  $H_B = 654.321$  m.
- Set up an appropriate functional model as well as the observation equations.
- Set up the stochastic model.
- For the final check choose an appropriate value  $\delta$  and justify your decision.
- Solve the normal equation system and determine the heights for the remaining points as well as their standard deviations.
- Calculate the residuals and the adjusted observations as well as their standard deviations.
- Compare the adjusted unknowns, adjusted observations and residuals as well as their standard deviations of both adjustments. Present all results in one table and comment them.