

Long sightings with the digital level Zeiss Dini12

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Abstract

The digital levelling technique is commonly applied in precise levelling today. In Finland the sighting distances used in line levelling are typically from 35 to 50 m, but sometimes the longer sightings are needed, e.g., for water crossings. The Zeiss DiNi12 digital levelling system is capable to operate until to 100 m, but crossing the sea or valley we need long, more than 500 m, sightings. Basically, the bar code scale of the rod can be copied with a certain magnification. According to the preliminary tests in Finland the Zeiss DiNi12 is able to process rod readings from the rod, which scale is of 4 fold and the sighting distance even 400m.

Keywords

Levelling, digital leveling system, sight distance.

Main Goal

The digital leveling technique for
water crossings

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Problems

In water crossing :

- Asymmetric sightings, e.g. 10m onshore, 500m offshore
- Refraction: Onshore effect, random and systematic

Using digital levels

Level can see max 120 m

Digital level uses more than one graduation line of the rod scale

Possibilities

- 1) Magnifying optics
- 2) Use of digital zoom
- 3) Enlarging the bar code scale

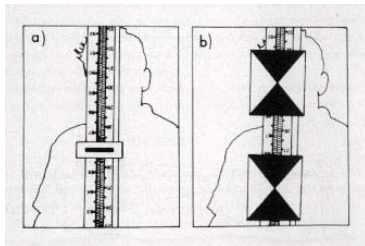
In Japan, have been made some promising tests concerning this issue:

Enlarging bar code 1,5-2x, 250 m sightings, uncertainty less than 0.5 mm

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Solutions in traditional water crossing

- 1) Magnification of single graduation line
Size of target, Fig a) is related to the distance
Sightings 100 – 900 m using Zeiss NiA spirit leveling instrument
- 2) Autocollimation method
Better method to correct collimation error
Valley crossing equipment, Fig b) Zeiss Ni2, 400 – 4000 m
Increasing accuracy and speed of measurement

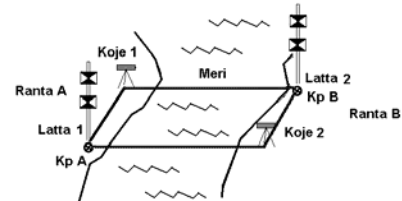


Measuring configuration

Parallelogram method

Problems: Collimation and refraction

Accuracy achieved in FIG: $\pm(0.44 + 1.98 s^2)$ mm, $s = [km]$



Vesiyllitysvaaitus: Suunnitustekniikka

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In digital levelling technique:

The enlarged bar code scale

Methods used:

- Copy and enlarge with copying machine
- Measure the length of code element and enlarge numerically

| No. | Production method | Magnification | Length of rod | Quality |
|-----|--|---------------|---------------|----------------|
| 1 | Direct paper copy | 4x | 2 m | low |
| 2 | Direct paper copy | 4x | 4 m | low |
| 3 | Hand made: A black tape on side of aluminium rod frame | 4x | 3 m | low |
| 4 | MS Excel supported: Printing on plastic tape | 4x | 1 m | high = 360 dpi |

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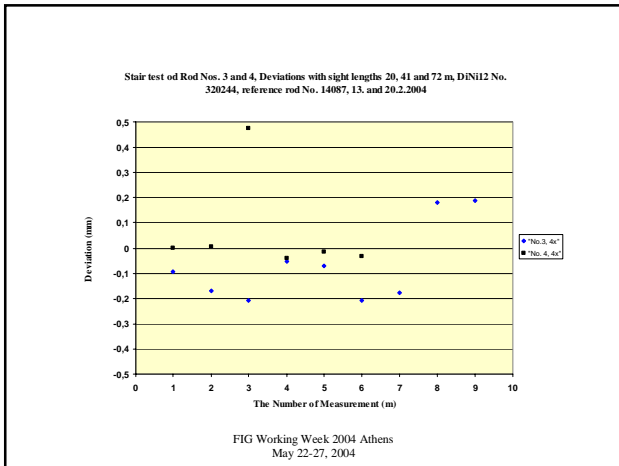
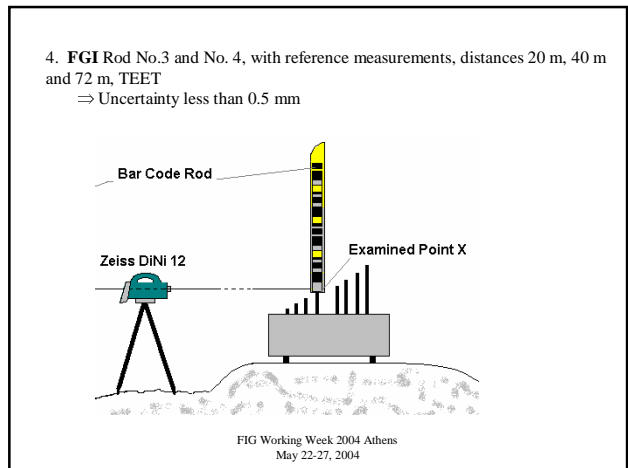
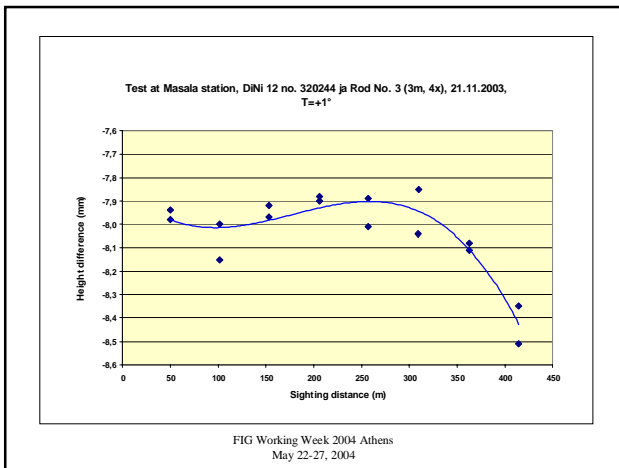
Field Tests

1. Kustavi (9/03) Rod No.1, 120 m, rod readings, no reference
⇒ Dini12 is able to operate

2. Mankki (10/03) Rod No.2, 50 m, ..., 450 m step 50 m, rod readings, no reference
⇒ Dini12 is able to operate
⇒ Repeatability is better than 0,5 mm

3. Masala (11/03) Rod No. 3, 50 m, ..., 400 m step 50 m, height differences, no reference
⇒ uncertainty less than 0.6 mm
⇒ Shorter sighting quicker readings
⇒ 3 m long rod (4x) enough for 400 m sightings

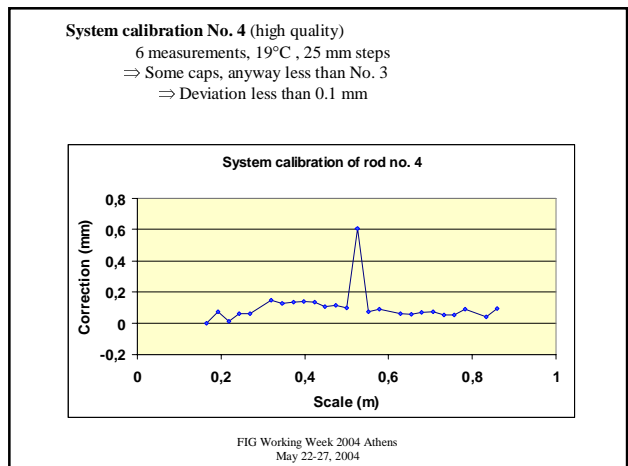
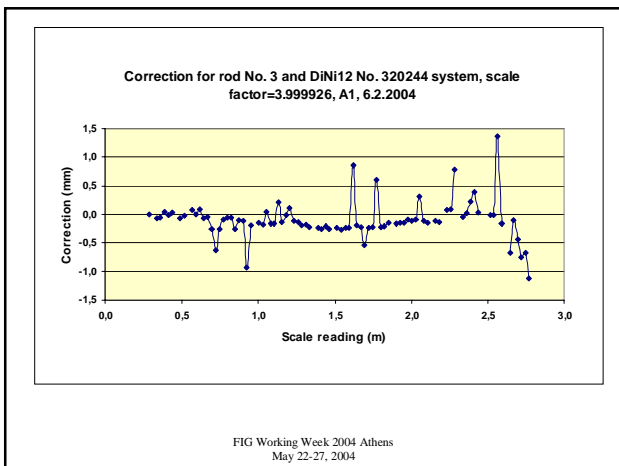
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Calibrations
In FGI we able to control the quality of the rod scales using both vertical laser rod comparator or system calibration comparator for digital levels

- Rod calibration of rod no. 3 (low quality)
 - Manually using vertical laser rod comparator 0,5 m steps, corrections less than 0.5 mm
 - Thermal expansion coefficient, 24 ppm/ °C
- System calibration of no. 3 (low quality)
 - 6 measurements, 19°C , 25 mm steps
 - ⇒ Some caps i.e. no observations in calibration
 - ⇒ Some big deviations, reason unknown
 - ⇒ Correction of rodreading less than 0.5 mm

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Estimated uncertainty

In good measuring conditions we can achieve uncertainty less than $1 \text{ mm}/\sqrt{\text{km}}$, which means precise levelling

Conclusion

Method selected seems to be really promising

Future works

Construction of proper 4x magnified bar code scale on invar 3 m long tape
Accuracy tests
Field tests comparing result with conventional and trigonometric levelling

Thank You for your attention !!!!

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