MEASUREMENT OF THE LENGTH OF SHORT SEGMENTS WITH USE OF A CODE LEVEL

Kazimierz Ćmielewski, Janusz Kuchmister, Krzysztof Mąkolski, Bartłomiej Ćmielewski

Wroclaw University of Environmental and Life Sciences

1. INTRODUCTION

Carry out control measurements made on engineering objects are proceeded with the use of horizontal and vertical controls which allow estimation of coordinates of points of objects. While measuring geometrical values on engineering objects one can meet inconveniences and limitations with application of traditional measurement methods and geodetic equipment. The above mentioned situation can be seen especially during montage of subassemblies of built up technological sequence, high gauge machines servicing in industrial halls and also with equipment which requires precise setting (paper machines, processing sockets in automatic technological lines, energy turbines, etc).

Photo 1. Subassembly, paper machines (source: www.pmpoland.pl)

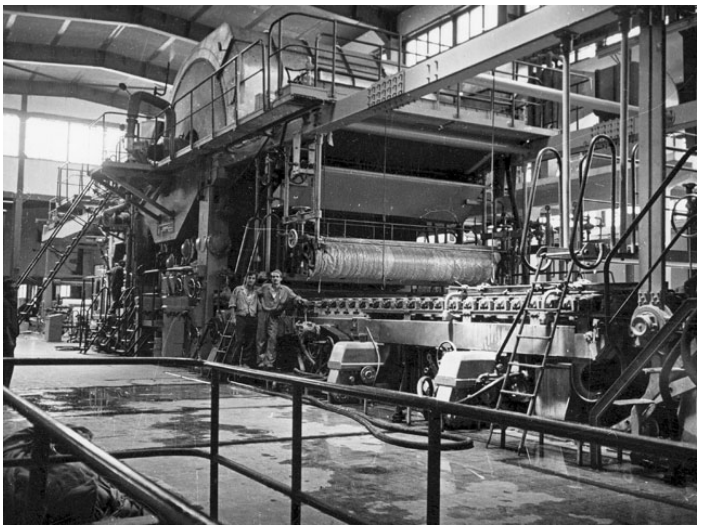

Photo 2. Technological line in industrial halls (source: www.pmpoland.pl)

In cases when carrying out measuring, the need for precise measuring or deposition of short lengths (from a few to a few dozen meters).

2. A SET FOR MEASUREMENTS OF HORIZONTAL LENGTHS WITH USE OF A CODE LEVEL

The set to measure horizontal distances between points A and B with use of a code level is shown in fig. 1.

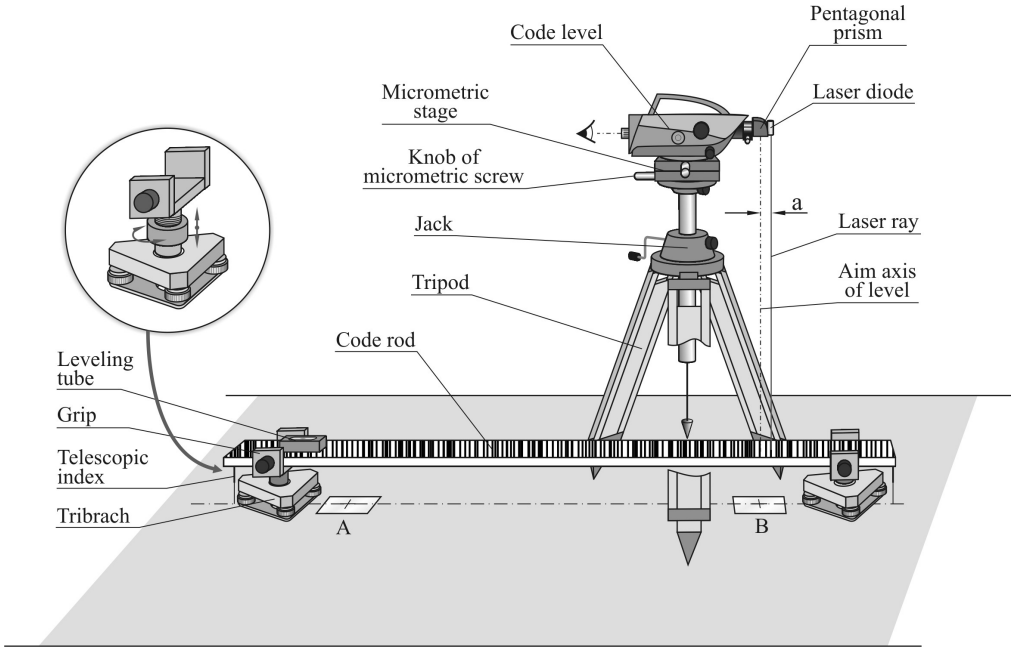

Fig. 1. Build of measurement set.

The measuring set includes a code level rod which is placed in a horizontal dimension and along section AB and a level with a stand and a jack. The edges of the rod are

supported with two grips which are placed in geodetic tribrach. Leveling of the rod is performed according to level tube indications by means of an outrigger and the tribrach's foot screws. The level is set over the rod at an appropriate height which allows setting a sharp division picture with the stand with a jack. To centre the instrument over the straight including the segment AB and division of a rod we use a plumb. Measurements of the division of a rod are possible because of the pentagonal prism which is connected to the instrument lens and which refracts beams of light at a right angle. Proper setting of the prism is possible due to a tubular level. To set the target axis of the level precisely over point A or parallel to that and moved by a segment "a" laser beam a micrometric table is used. After leveling its target axis which together with parallel to it, laser beam lies in a one plane with plumb. The value of shift of the instrument along segment AB is to be read from the division of micrometric screw of the stage.

3. AN EXAMPLE OF MEASUREMENT OF A SHORT SECTION

A course of measurement of short sections which do not exceed the length of the rod, presented in pictures 2 to 7, is as follows. The stand with an instrument fixed to it is to be placed over sector AB by the use of a plumb. Using a jack, we set an appropriate height of target axis of the level (the shortest targeting line) which allows us to check the readings on the rod division. After leveling the instrument, the optic axis of the level A is to be centered by turning the stage micrometric screw and write down the result from screw division (fig. 3) OAM. Next we should place the rod along the sector AB and level it by means of the grip and tribrach footing screw and watching the indication of the level tubes (fig. 4). After finishing setting the rod we should perform readings on division OA. After placing the instrument on the other side of the rod (fig. 4) we should level it and set it in such a way that the plumb is paced over the division of the rod but the level optic axis runs close to point B. After finishing the settings we should check the readings on the rod division OB. If after the rod is removed (fig. 5) it appears that the level optic axis does not meet we should correct its location by turning the micrometric screw of the stage. After centering (fig. 7) we should check readings on micrometric screw division OBM. The length of the sector AB is calculated with a formula

$$D_{AB} = O_A + O_{Am} - (O_B + O_{Bm}).$$

Photo 3. View of the instrument with connected pentagonal prism

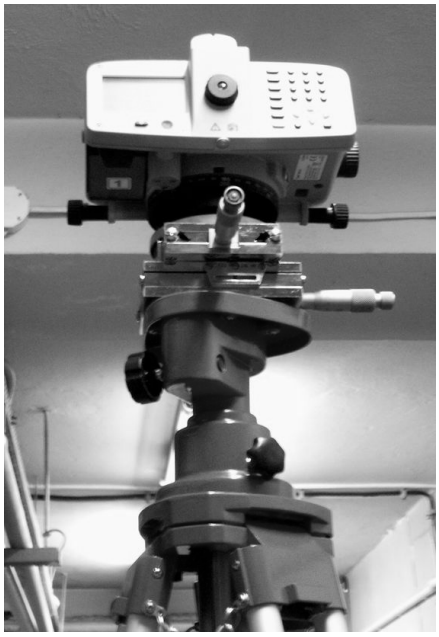

Photo 4. View of instrument placed on micrometric stage

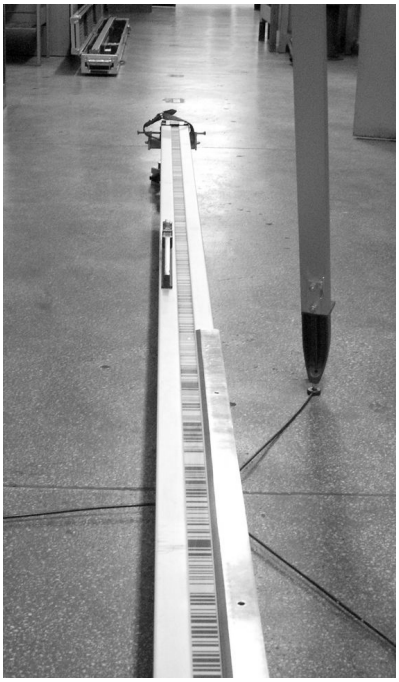

Photo 5. View of leveled code rod on measured sector

Performing measurements of short sectors which do not exceed the length of the rod, presented in fig. 2 to 7 is conducted according to stages.

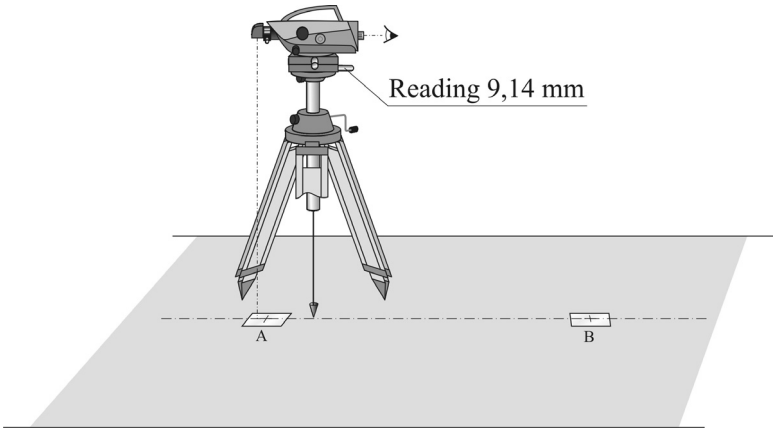

Fig. 2. Stage I – setting the level in the line of the measured sector and reading results on micrometric screw of the stage.

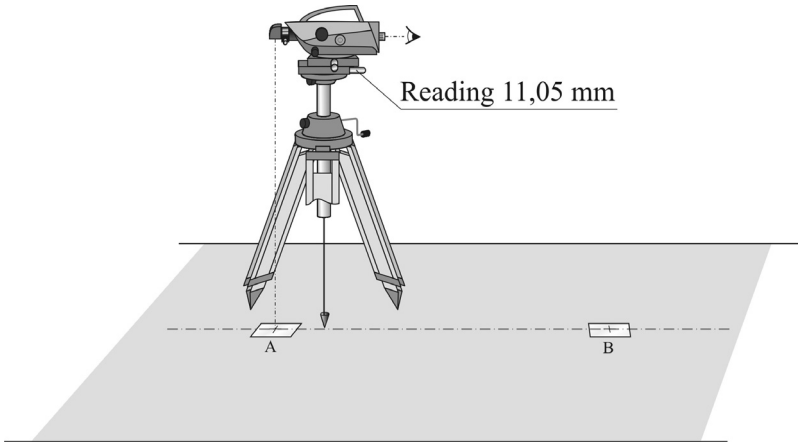

Fig. 3. Stage II – setting the level with the stage over the beginning of the measured sector and performing the second reading on the micrometric screw of the stage.

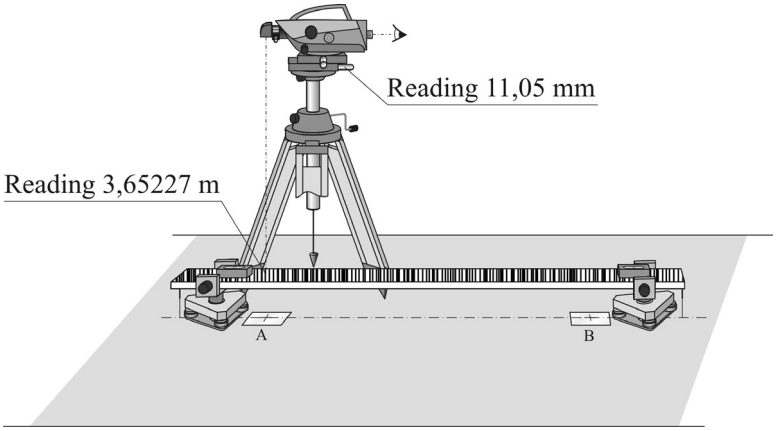

Fig. 4. Stage III – placing the rod horizontally and along the line of the measured sector and performing electronic reading by means of the level on a code division of the rod.

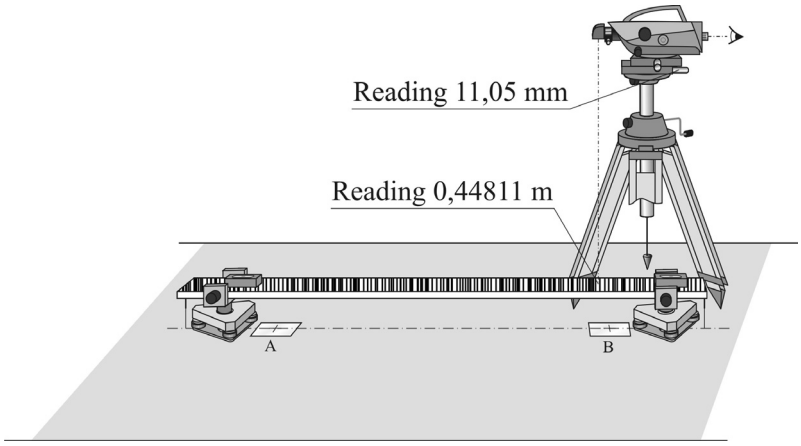

Fig. 5. Stage IV – moving the level to the other end of the measured sector and placing it along the line of the measured sector and performing an electronic reading by means of the level on a code division of the rod.

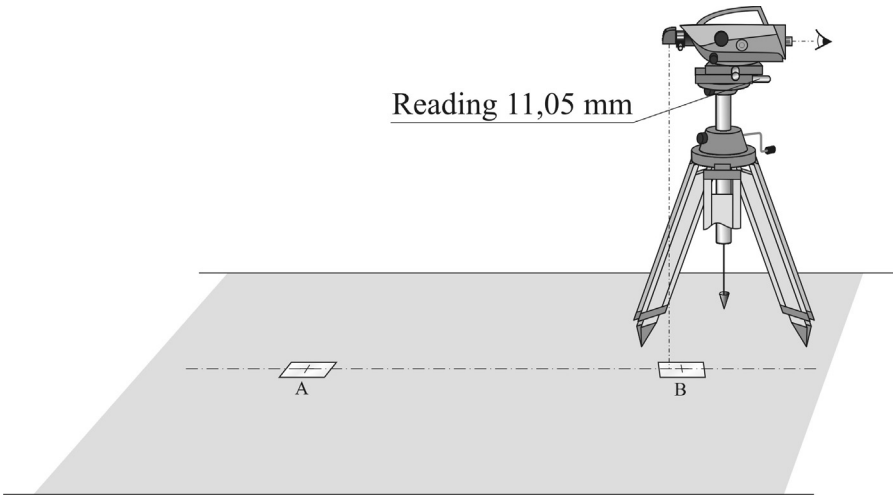

Fig. 6. Stage V – removing the rod from the line of measured sector.

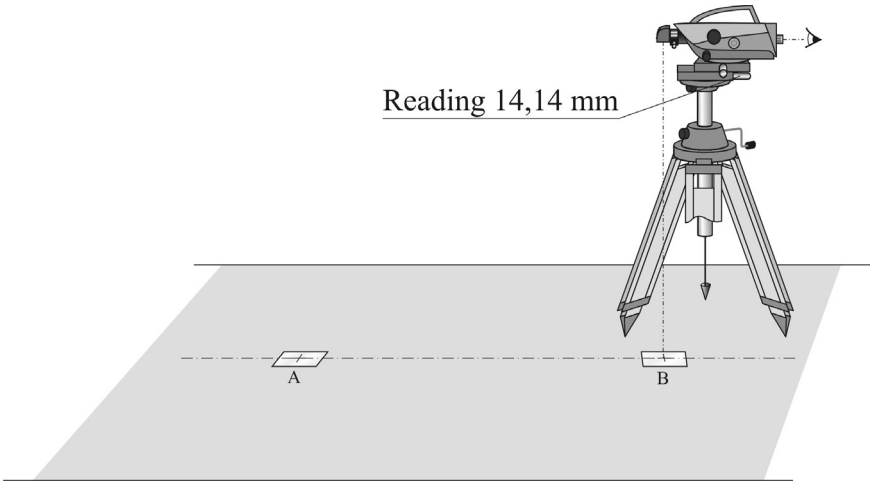

Fig. 7. Stage VI – centering the instrument by means of the stage over the other end of the measured sector and performing the second reading on the micrometric screw of the stage.

The initial researches which were carried out allowed elaboration of the method of tuning the set for measuring distances with the use of the rods and the Leica code level DNA03. After tuning the measuring set, the distance measurements were made in a few places with division of 3 m. of a precise invar rod (Fig. 1).

4. SUMMARY

Instruments and measuring devices offered by the companies producing geodetic equipment require, often in cases of engineering objects, application of additional, supporting equipment which allows widening of observation possibilities.
Researches have proven the usefulness of the measuring set to measure short sectors. Error of a measurement of three distances: 1.2345m, 2.0117 and 2.7921m fluctuates within +/- 0.10 mm to +/- 0.12mm. Multiple readings by the level on a horizontal rod do not differ by more than 0,07 mm.

REFERENCES

Bryś H., Przewłocki S., 1998. Geodezyjne metody pomiarów przemieszczeń budowli. Wydawnictwo Naukowe PWN, Warszawa.

Gil J., 2007. Pomiary geodezyjne w praktyce inżynierskiej. Uniwersytet Zielonogórski, Zielona Góra.

Gocał J., 1993. Metody i instrumenty geodezyjne w precyzyjnych pomiarach maszyn i urządzeń mechanicznych. Wydawnictwo AGH, Kraków.

Janusz W., 1978. Methods of precision measurements of horizontal and vertical distances. FIG, International Symposium on Deformation Measurements by Geodetic Methods. Part 2, Bonn.

Janusz W., Ostrowski R., Zykubek S., 1984. Metoda precyzyjnego pomiaru krótkich odległości. Prace IGiK, T. XXIX, Z. 1/74/.

Pawłowski W., 2005. Procedury terenowe oceny dokładności instrumentów geodezyjnych według standardów ISO. VII Konferencja Naukowo-Techniczna pt.: „Aktualne Problemy Geodezji Inżynieryjnej", Warszawa.

Płatek A., 1995. Elektroniczna technika pomiarowa w geodezji. Wydawnictwo AGH, Kraków.

Prospekty firm: Topcon, Leica, Zeiss, Kern.