

Vertical Setting Up of Shaft Axes in a Lock Flap at Assembly Stage

Wojciech Anigacz and Maciej Andrzej Jakubiec

Abstract—The following paper presents problems related to vertical setting up of the flap shaft axes. Difficulties in maintaining coaxial relation of the shafts consists, among others, in: lack of variable adjustment and incongruity of standard measurement equipment with this type of measurement tasks. Maintaining the design geometrical conditions is crucial for durability and safety of hydrotechnical structures. The maximum allowable deviation in coaxiality shafts was set at 0.5 mm. Given the extremely difficult conditions of measurement and lack of direct visibility between the measured points retaining a specified range of tolerance was very difficult. With our vast experience of performing measurements and technical service of lock and application of innovative solutions of patents was achieved to the desired accuracy.

Index Terms—Lock flap, measurement, high accuracy requirements, assembly stage.

I. DESCRIPTION OF THE STRUCTURE

The subject of examination was a twin chamber lock flap (Fig. 1) located on Gliwice Channel in southern Poland.

It was built in the years 1933–1939. The channel has its beginning in the pool of Kozle harbour, it ends in the pool of the Gliwice harbour and it is 40.6 km long (including the port pool – 41.2 km). The difference in water level between the Kozle harbour and the Gliwice harbour is 43.6 m and it comprises 6 water stages. The flap undergoing setting up of its axis is 10.20 m wide, it is about 40 tones and it is moved by two shafts situated at its ends (Fig. 2).

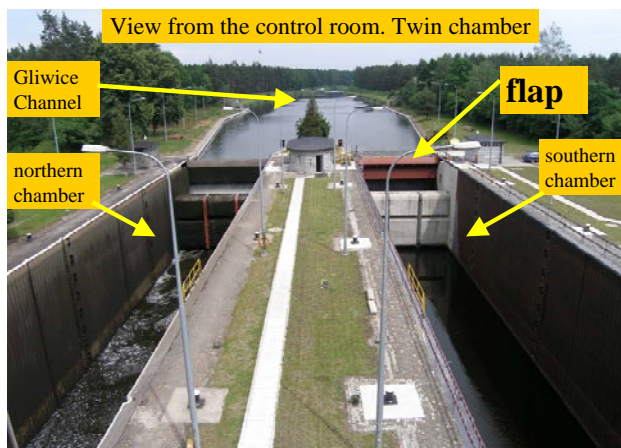


Fig. 1. Front view on the twin chamber lock flap located on Gliwice Channel in Poland.

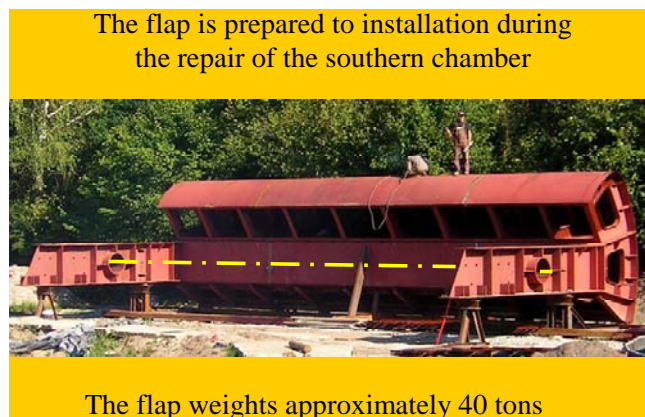


Fig. 2. Side view on the lock flap.

II. METHODOLOGY AND RESULTS OF MEASUREMENTS

The measurement of location of the lock shafts was held with use of a digital level NA3003 [1]. The difficulty in measurement consisted in high length variability of the target axes. And that was because there was no possibility to locate the measurement position between the lock walls. Selection of the measuring equipment was made in accordance with AS/NZS ISO 10012:2004 [4]. The level has been checked and rectified before measurement according to ISO 17123-2 [3].

Correct positioning of the lock flap is very important for proper functioning of the whole of the lock. A crucial element for working of the flap is positioning of the propeller shafts. The shaft axes should constitute one line, i.e. they should be coaxial, and this axis needs to be perpendicular towards the lock axis and levelled. Setting up of the flap shafts is performed in the following cases:

- 1) Construction of the lock,
- 2) Replacement of the lock,
- 3) Periodical overhaul and renovation.

A case of setting up flap shafts axes at its replacement has been presented below. The whole of the setting up process is complicated and time-consuming, hence only a part of works related to horizontal setting up of the shaft axis has been presented below. The problems frequently faced by the contractors are as follows:

- 1) High accuracy requirements. The investor agreed the permissible scope of tolerance of the shaft axis setting at 0.5 mm. To meet these requirements the measurement error should not exceed 0.1 mm. Therefore the most accurate measurement equipment needed to be used, in this case a level.
- 2) Hardly accessible measurement points. The shafts moving the flap are nearly totally built up. The propeller

Manuscript received April 20, 2012; revised August 7, 2012.

W. Anigacz is with the Faculty of Civil Engineering at the Opole University of Technology, Opole, Poland (e-mail: w.anigacz@po.opole.pl).

M. A. Jakubiec is with the District Survey Enterprise from Opole, Poland (e-mail: jakubiec@opgk.opole.pl)

shaft is made of eccentric elements (Fig. 2). For vertical measurement the A, B, C, D points shown in Fig. 3 are accessible. For the time of lock flap replacement the walls were partially demolished leaving the reinforcement off (Fig. 4).

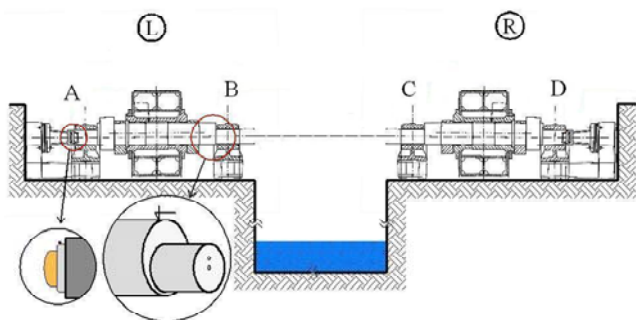


Fig. 3. The cross vertical profile. Points A, B, C and D should be coaxial.

- 3) Unfavourable measurement conditions (elevated works, working on catwalks, high air humidity, etc.). The flap shafts are situated several meters below the ground level and a couple of meters above the lock bottom (Fig. 1). There are no permanent catwalks between the lock walls, so there is no possibility to carry out measurement works from there. For the time of flap replacement the lock chamber was out of operation by making a water stop called a Larsen wall. The measurements were carried out at highly variable air humidity. The temporary catwalks needed to be of appropriate stiffness.



Fig. 4. Levelling measurement of the shaft axis – the last one – point D.

- 4) Lack of variable adjustment of bearings. Another factor influencing the technology of measurement was lack of variable adjustment of flap bearings. The shaft turns in two bearings. One bearing is fixed to the concrete structure by means of eight screws. Adjustment consists in unscrewing the eight fixing screws and inserting or extracting distance washers, and then re-screwing. Attention should be drawn to strict order of unscrewing and re-screwing the screws. First washers are used to adjust the bearings vertically, after that - horizontally.
- 5) Incongruity of standard measurement equipment with this type of measurement tasks. Companies producing measurement equipment do not offer proper equipment

for this type of tasks. Therefore the contractor involved in measurement works used supporting patent equipment of their own make [2].

- 6) required high qualifications for people do the work. The above described actions need to be performed by people of high experience. The action of bearing relocation by 0.1–0.2 mm in a structure weighting 40 tones requires more than average qualifications and skills of the whole team.

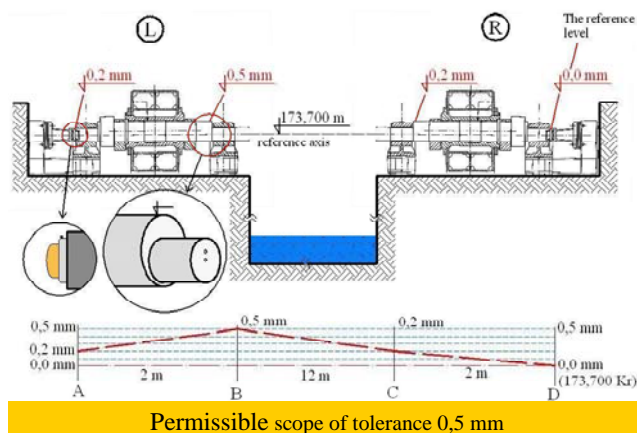


Fig. 5. The results of measurement height differences of shaft axes.

III. CONCLUSIONS

As a result of the conducted examination of the twin chamber lock flap, the following conclusions can be drawn:

- 1) Since the shaft axis was set up, the lock flap has been working infallibly.
- 2) The target accuracy was reached. This is a very good result (Fig. 5).
- 3) The given values take into consideration the following eccentricity 104.5 mm.
- 4) The lowest point was taken as the reference level i.e. the axis of the right shaft on the north side, i.e. the lock wall.

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Prof. Wojciech Anigacz is working as an Associate Professor (1995) on the Faculty of Civil Engineering at Opole University of Technology, Opole, Poland. The author of 3 monographs, more than one hundred publications, as well as several dozen patents, utility models, and implementations of the above mentioned. The author is a member of International Association of Computer Science and Information Technology (IACSIT). Research interests: engineering surveying, geodesy metrology (positioning of machines, engines, and devices), geodesy calculations, adjustment computation, electronic measuring techniques, and

environmental protection. Honors and achievements: (i) an authorized expert of The Association of Polish Geodesists in the field of engineering surveying measurements and surveying of building engineering, Warsaw, 1986. (ii) received first degree in engineering specialization in the field of engineering-economic geodesy, Warsaw, 1988, (iii) license to execute independent functions in geodesy, Warsaw, 1990. Hobby: Downhill skiing (licensed instructor of Polish Ski Association, cross-country skiing, hiking (licensed mountain guide of Sudety and Opole voivodeship terrain guide), cycling tourism. 2012-08-30



Geodesist Maciej Jakubiec is Head of many projects in The District Survey Enterprise in Opole, Poland. Graduated from AGH University of Science and Technology Faculty of Mining Surveying specialization – industrial engineering (1969). Manager of geodesy service in following investments (e.g.): Modernization of the Olympic Stadium (athletics stadium) in Wroclaw, Poland, including the appointment of sporting distances for running competition – Award of the Polish Minister of Public Utilities, Ring Road of Wroclaw, Realization of Surveying and documentation of underground utilities in Rudna Mine, Poland. Periodic tests of the vertical displacement of buildings and installation of technological equipment (Opole Power Station), construction of flue gas desulphurization in Power Station in Opole and Belchatow, Poland.