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THE TECHNICAL ASPECTS OF PROTECTION OF INLAND NAVIGATION

ABSTRACT

In the article the problem of preserving geometric design conditions by devices of sluices is presented. The problem was illustrated by alignment of the shaft flap of the sluice on the Gliwicki Channel. Within changing the flap drive it was necessary also to perform the realignment of the flap. From the geodetic point of view, the problem was to perform coaxial setting of the two mutually invisible shafts flap within an accuracy not exceeding 0.5 mm. Thanks to first — class measuring equipment and aiding equipments (author's patents) it was possible to achieve this goal.

Keywords:
inland navigation, sluice, alignment.

INTRODUCTION

It is required that technical devices on sluices are permanently in order for their efficiency determines fluency of navigation not only on the concerned sluice, but on the whole water way [2, 3, 4]. Flaps are the most susceptible to damages both from the top and the bottom water. Generally the top water chamber flaps are more complicated than the bottom water flaps. As all devices, sluice flaps require relatively frequent conservation works due to operating in extreme conditions. In the article the problem of preserving geometric design conditions by devices of sluices is presented. The problem was illustrated by alignment of the shaft flap of the sluice on the Gliwicki Channel.

PROBLEM

From the geodetic point of view, the problem was to perform coaxial setting of the two mutually invisible shafts flap within an accuracy not exceeding 0.5 mm. Initially the investor required accuracy of 0.2 mm, however as a result of negotiations with the investor and the designer it was agreed that the accuracy should amount at 0.5 mm. The accuracy of 0.2 mm in this case was unattainable mainly due to lack of shaft adjustment that would be precise enough. The problem comprises two aspects:

— achieving the same level (H) for both shaft axes;
— coaxial setting of both the shafts in horizontal alignment (X, Y).

Setting of shaft axes in plane $X - Y$ is presented below.

METHODOLOGY

The difficulty in setting the axes mainly consisted in highly difficult access to the measured shafts due to their:

— being inbuilt into the sluice walls;
— location in flap sleeves;
— lack of precise enough adjustment of shaft setting.

Accessible points are:

— front surfaces from the internal side of the sluice (fig. 1);
— the upper surface of the shaft along the distance of 1 cm from the external side.

It was not possible to see all the measurement points from one measuring position. Therefore it was decided to apply an indirect measurement method with two measuring positions located above the shafts on both sides of the sluice chamber (fig. 2).

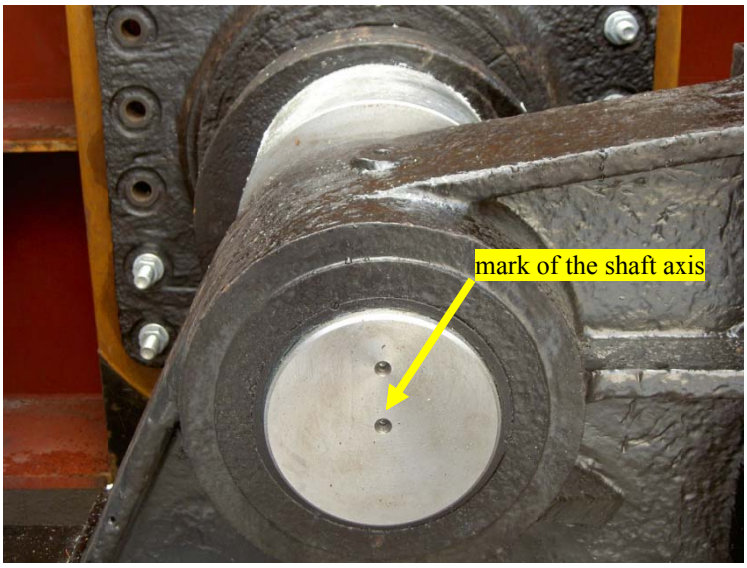

Fig. 1. Front surfaces from the internal side of the sluice

Source: own study.

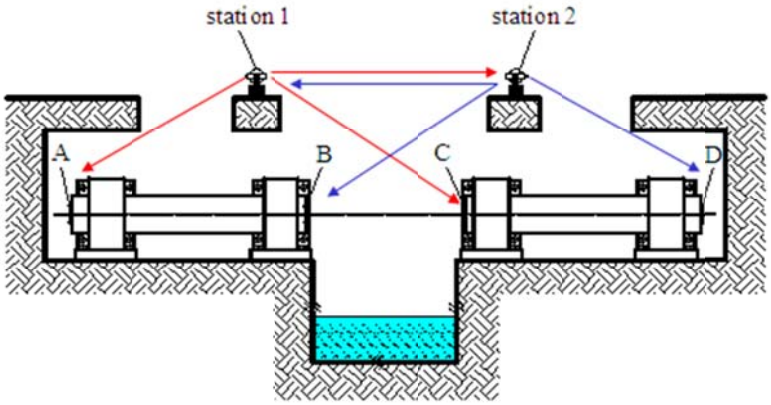

Fig. 2. Cross vertical profile through flap axes: A – B & C – D — axis of the shafts, left (L) and right (R); B, C — mark of the shaft axis, from the internal side of the sluice; A, D — measured (moved) points from the external side

Source: own study.

Indentation marks (remains from turning process) situated on the internal side of the sluice chamber were accepted to mark the reference line. The choice resulted from explicitness of the points and good visibility from the other side of the sluice chamber, as well as from the certainty that they mark the shaft axis.

Measurement scheme is presented in figures 3 and 4.

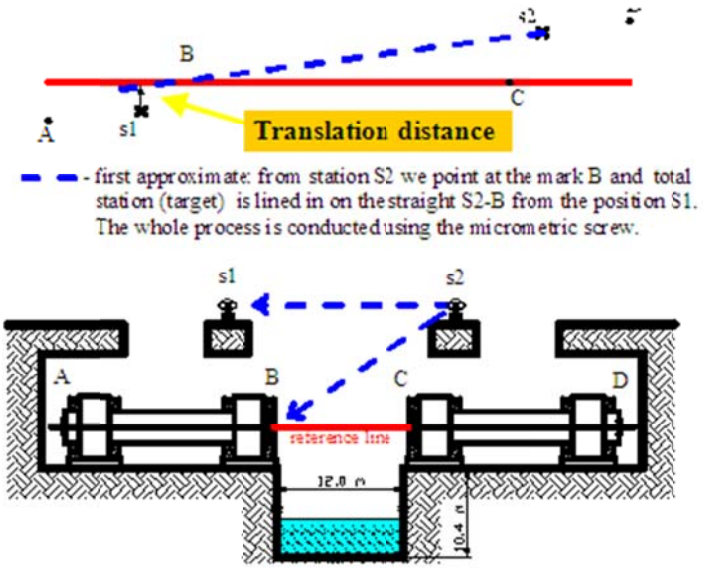

Fig. 3. Measurement from station II. Translation station I

Source: own study.

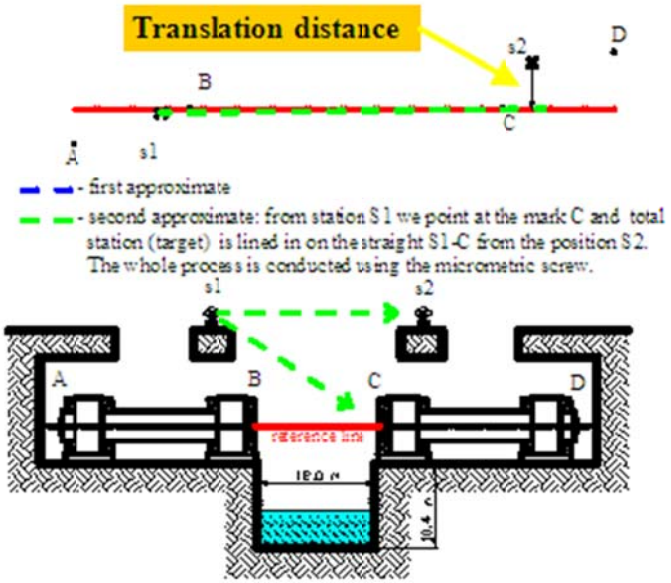

Fig. 4. Measurement from station I. Translation station II

Source: own study.

The problem was reduced to shifting the external ends of the shafts (A, D) to the line marked by points C, D. First, positions of the instruments (total station) were set into the C – D line. Then, from these positions points A and B were being set out from positions I and II respectively until satisfactory accordance was obtained.

MEASUREMENT RESULTS

Figures 5 and 6 shows results from before and after the correction of the shaft axis setting.

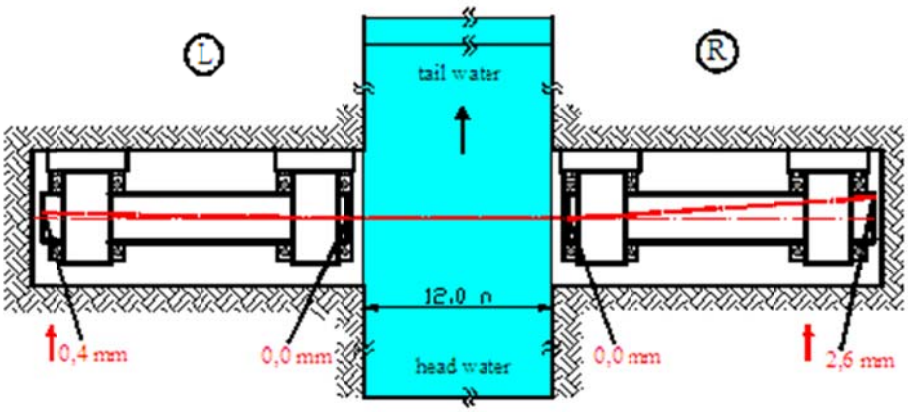

Fig. 5. Position of the shaft axes before the repair, cross horizontal profile

Source: own study.

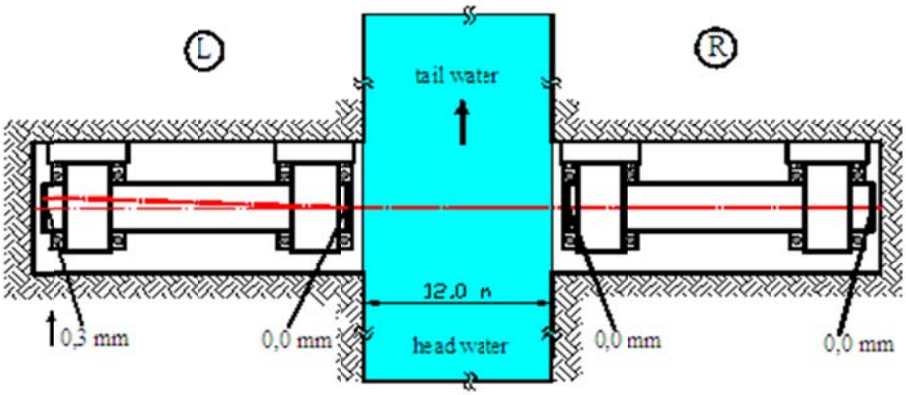

Fig. 6. Position of the shaft axes after the repair, cross horizontal profile

Source: own study.

CONCLUSIVE REMARKS

Thanks to first — class measuring equipment and aiding equipments (author's patents) [1] it was possible to achieve this goal. Using laser equipment was also considered, however the idea was abandoned due to the fact that it was not possible to see the whole line indirectly. From geometric point of view the problem seems easy. The shaft axes need to become coaxial. At the time of works no calculations were carried out. The measured point either was within the line or it was not. If it was not, the shaft end needed to be shifted to the correct position. The correction of shaft setting was performed many times until satisfactory result was obtained. The first test of correctness of shaft setting is measurement of forces on hydraulic actuators, one on each side of the flap. The results of this test were successful. Another very important test is trouble-free service. The flap has been working reliably for three years so far. Due to the fact that the sluice has two chambers, the time factor, i.e. the time of excluding a chamber from operation, was of minor importance. The other chamber was used for navigation. The following were used: a total station of direction measurement 0.5" and movable tribrachs with micrometric screws of accuracy 0.005 mm which was the accuracy of measurement. The obtained accuracy of shaft setting of 0.5 mm resulted from mechanical and constructional limitations (lack of flexible, precise enough adjustment of shaft setting) not from measuring possibilities.

REFERENCES

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TECHNICZNE ASPEKTY ZABEZPIECZENIA ŻEGLUGI ŚRÓDLĄDOWEJ

STRESZCZENIE

W artykule przedstawiono problem zachowania projektowych warunków geometrycznych przez urządzenia śluz, co zilustrowano osiowaniem klapy śluzy na Kanale Gliwickim. Przy okazji zmiany sposobu napędu klapy zaszła konieczność jej ponownego osiowania. Z geodezyjnego punktu widzenia problem polegał na współosiowym ustawieniu dwóch wzajemnie niewidocznych wałów klapy z dokładnością nieprzekraczającą 0,5 mm. Dzięki zastosowaniu sprzętu pomiarowego najwyższej klasy oraz urządzeń wspomagających (patentów autora) udało się osiągnąć zamierzony cel.

Słowa kluczowe:

żegluga śródlądowa, śluza, osiowanie.