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ACCURACY ASSESSMENT OF A TOPOGRAPHIC CONTROL NETWORK THROUGH GEODETIC OBSERVATION ADJUSTMENT: A CASE STUDY OF THE PONEASCA DAM WATER CONVEYANCE SYSTEM, ROMANIA

Raul-Florian PATRU, Răzvan GUI BACHNER, Adrian ȘMULEAC, Laura ȘMULEAC
University of Life Sciences „King Mihai I" from Timișoara

Introduction

Accurate topographic control networks are essential for surveying, cadastral documentation, and the development of hydrotechnical infrastructure. In areas with complex terrain and extensive engineering facilities, reliable geodetic measurements are necessary to ensure consistent positioning and accurate spatial representation. This study evaluates the positional accuracy of a topographic control network developed for the Poneasca Dam water conveyance system in Caraș-Severin County, Romania. The research focuses on the adjustment of geodetic observations, the determination of network coordinates, and the assessment of positional errors. Particular attention is given to the reliability of the control network and its contribution to topographic mapping, infrastructure documentation, and analytical area determination.

Material and method

The study is based on existing topographic documentation prepared in 2001 for the Poneasca Dam water conveyance system, covering approximately 8.93 ha. Field measurements were performed using three Leica TC 307 total stations, recording horizontal directions, zenith angles, and distances. The control network was developed from three existing reference points, with 47 additional points determined through weighted least-squares adjustment. The processing integrated 102 horizontal directions, 100 measured distances, and 22 coordinate differences in the Stereographic 1970 coordinate system. The documentation also included 2,352 detail points used for mapping infrastructure elements and calculating land areas. Positional accuracy was evaluated using the adjustment results, with particular attention to the distribution of errors and the verification of the reported survey data.

Result and discussions

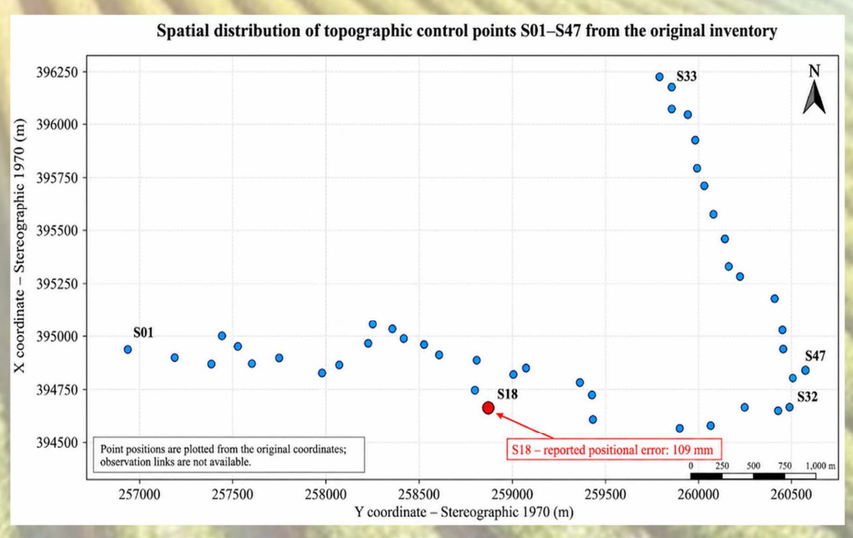

Fig. 1 – Topographic control points (S01–S47)

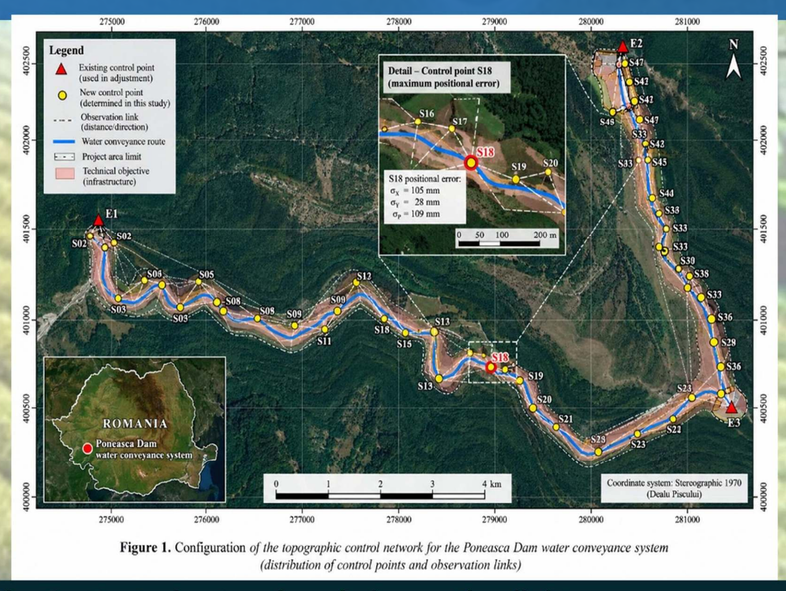

Figure 1. Configuration *of the topographic control network for the Poneasca Dam water conveyance system (distribution of control points and observation links)*

Fig. 2 – Control network and observation links

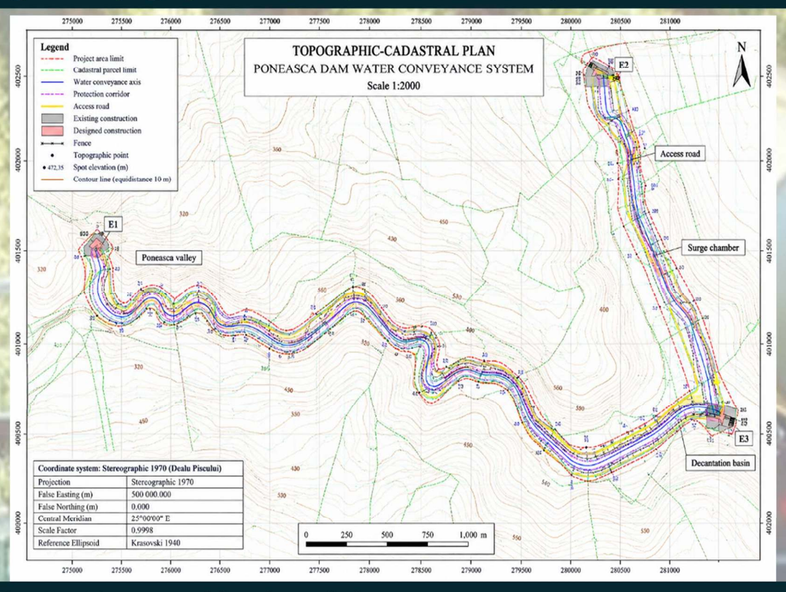

Fig. 3 – Topographic plan of the conveyance route

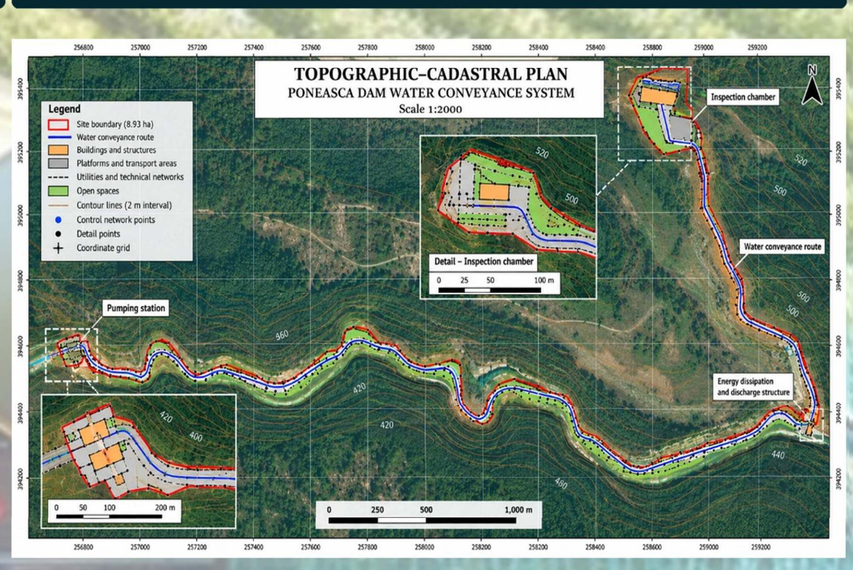

Fig. 4 – Topo-cadastral infrastructure plan

The spatial distribution of the 47 newly determined control points illustrates the configuration of the geodetic network developed for the Poneasca Dam water conveyance system (Fig. 1). The cartographic representation highlights the observation network, the infrastructure route, and the location of point S18, which recorded the highest positional error (Fig. 2). The weighted least-squares adjustment produced a mean point determination error of 49 mm and a maximum positional error of 109 mm at point S18, with error components of 105 mm along the X-axis and 28 mm along the Y-axis. The topographic and topo-cadastral plans illustrate the sinuous conveyance route, terrain configuration, and associated infrastructure elements (Figs. 3 and 4). The survey included 2,352 detail points and covered an area of 89,340.5821 m^2, approximately 8.93 ha. The analytical verification confirmed consistency between the total area and the sum of the functional categories, highlighting the importance of rigorous geodetic adjustment and spatial documentation.

Conclusions

The study demonstrates the importance of geodetic observation adjustment in evaluating the positional accuracy of topographic control networks used for hydrotechnical infrastructure. The analysis of 47 newly determined control points revealed a mean positional error of 49 mm and a maximum error of 109 mm at point S18. These results highlight variations in network accuracy and the importance of identifying points with higher positional uncertainty. The determination of 2,352 detail points enabled the representation of the Poneasca Dam water conveyance system and the analytical verification of approximately 8.93 ha of associated land. Overall, the integration of geodetic adjustment, coordinate analysis, and topo-cadastral mapping provides a reliable technical basis for evaluating historical survey documentation and supporting infrastructure management.

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