GNSS LEVELLING FOR 1ST CLASS LEVELLING NETWORK – A SECOND LOOK

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The presentation is the authors' second look at an adaptation of GNSS-levelling for establishing a national vertical network in Poland. The previous one was presented at last year's Geodynamics and Geospatial Research 2024. The new presentation results from the authors' reflections, primarily in balancing cost/quality (accuracy) effects. The reason for this consideration is the decision of the Polish Head Office of Geodesy and Cartography (HOGC) to commission new measurements for the basic vertical network (average accuracy not exceeding 1.5 mm/km). The first after the PL-EVRF2007-NH frame was adopted, in the HOGC and 380 powiat's geodetic data sets [1, 2]. It is visible that some powiats (second level of the Polish administrative division) remain without national vertical network benchmarks (Fig. 1). Therefore, establishing their own (detailed class, 4 mm/km) network is limited, as the height component of the datum cannot be transferred via short-range levelling sections. The solution is to commission (by powiat) some levelling works outside their administrative area (in practice: not allowed or limited acceptability) or to establish some points by GNSS levelling as a reference for the detailed levelling. HOGC considered the second solution a potentially efficient method, due to its relatively low cost, and the possibility of passing terrain obstacles [3]. So far, it hasn't been used in Poland for such works, and because of that, the measurement standard hasn't been adopted. Therefore, an analysis and measurement experiment was commissioned for four independent research teams in 2023. We are the authors of one of those analyses, and present its final results – standard recommendation, recently published [4]. Overall, the defined GNSS-levelling method shows potential as a cost-effective approach for extending the Polish 1st-class vertical control network.

Method of the experiment - height differences between 7 first-class geodetic network points (including 2 ASG-EUPOS stations' auxiliary points) were measured (vectors: 15-31 km) using typical surveying equipment to reflect the accuracy achievable by an average surveying company. SatLab Freya receivers and Trimble Business Centre 5 software were used, without high-end tools like individual antenna calibrations or Bernese GPS Software. Observations were performed over two days, with 12-hour sessions and a 5° elevation mask. Normal height differences were calculated using the PL-geoid2021 model. The data was analysed for session lengths of 2, 4, 6, 8, and 12 hours, and four satellite systems configurations. Two vector calculation methods were used: single vector solution (similar to geometric levelling) and each-to-each (connecting all points). A total of 40 scenarios were analysed.

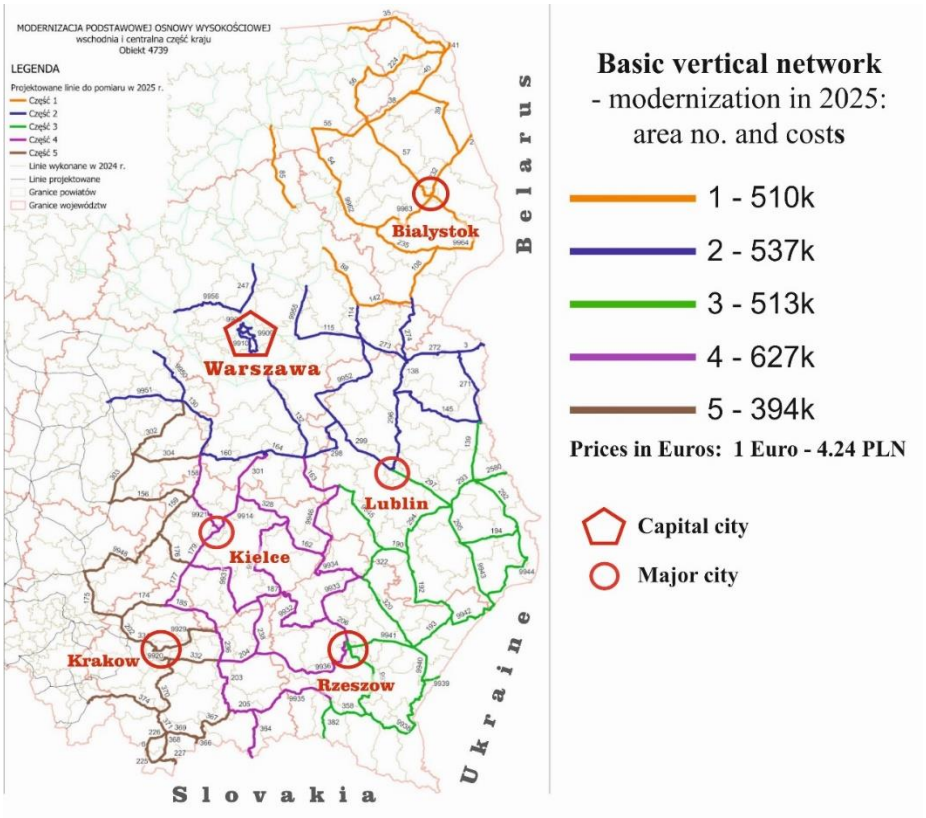

Fig. 1. Polish vertical network – a newly commissioned geometric levelling works: parts and their costs, figure and data based on [5]

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