NEW SOLUTIONS FOR IMPROVING GEODETIC WORK BASED ON AUTOCAD IN CREATING LONGITUDINAL AND TRANSVERSE PROFILES OF HYDROTECHNICAL STRUCTURES IN THE KASHKADARYA REGION USING DRONES AND GIS

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Abstract. This paper presents a scientific and technological approach to improving geodetic work in the design of longitudinal and transverse profiles of hydrotechnical structures. Utilizing AutoCAD software, drone-based data collection, and Geoinformation Systems (GIS), this study provides a structured methodology for precise and efficient terrain modeling in the Kashkadarya region of Uzbekistan. The implementation of this integrated system demonstrates significant improvements in accuracy, efficiency, and decision-making capabilities. Results of the innovative method are discussed and validated through field experiments.

Introduction. Geodetic work is foundational in the design and maintenance of hydrotechnical structures such as canals, dams, and water pipelines. Traditional surveying techniques often face limitations in speed, accuracy, and accessibility. In recent years, integrating advanced technologies like drones, AutoCAD, and GIS has opened new avenues for improving these processes.

This study investigates the implementation of a novel geodetic workflow in the Kashkadarya region, where terrain complexity and project requirements demand high precision. The aim is to develop and apply new solutions based on AutoCAD for longitudinal and transverse profile drawing of hydrotechnical structures, supported by UAV data and geospatial analysis tools.

Methodology.

Use of Drone Technology .A DJI Phantom 4 RTK drone was employed to collect high-resolution topographic imagery over the target area. The drone was programmed to follow a grid flight path with overlapping images (80% frontal, 70% side) to ensure complete terrain coverage. RTK technology ensured centimeter-level accuracy.

Image Processing and Model Generation. Captured images were processed using photogrammetry software (Pix4D Mapper), which generated:
- A high-resolution orthomosaic
- A Digital Elevation Model (DEM)
- A 3D point cloud
- Contour maps

The processed data was exported in formats compatible with AutoCAD Civil 3D for profile design.

Profile Drawing in AutoCAD. AutoCAD Civil 3D was used for generating the geodetic profiles [1,5]. The following stages were conducted:
- Stage 1: Base Alignment Setup
- Stage 2: Surface and Sample Line Creation
- Stage 3: Profile Generation
- Stage 4: Annotation and Detailing

GIS Integration. The generated profiles and geospatial data were transferred to ArcGIS. Here, further spatial analysis was performed, including:
- Hydrological modeling
- Environmental impact overlays
- Infrastructure network planning

GIS allowed multi-layered visualization and decision support.

Case Study: Kashkadarya Region. A pilot project was conducted on a proposed irrigation canal in the Kashkadarya region. Data collection and processing followed the methodology described above. The terrain consisted of rolling hills and flat valleys, which required a precise understanding of elevation changes for proper water flow and channel design.

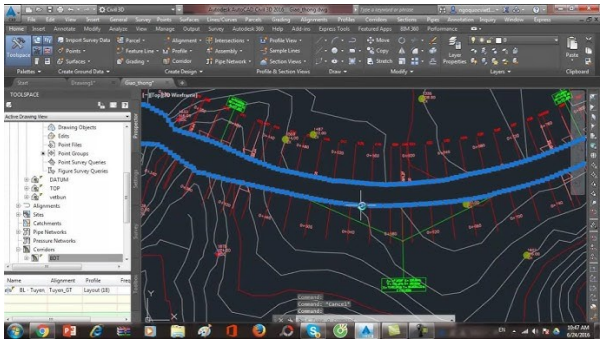
Outcomes:

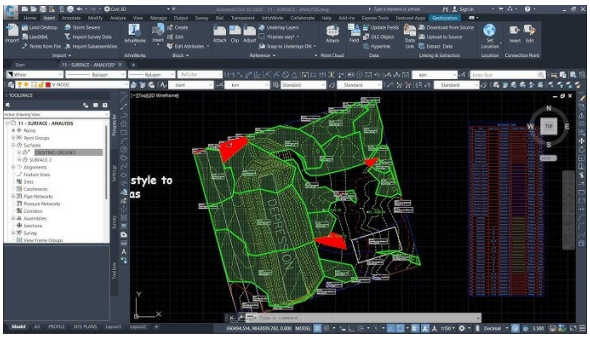
Table 1

Indicator	Traditional Surveying	Drone-Based + AutoCAD + GIS

Profile Drawing Time	10–12 days	4–5 days
Elevation Accuracy	±15 cm	±3–5 cm
Field Crew Requirement	5–6 people	2–3 people
Data Integration with GIS	Manual	Seamless
Cost Reduction	–	~35%

The combination of UAV photogrammetry, AutoCAD profile generation, and GIS analysis provided a highly efficient and accurate system for geodetic work in hydrotechnical engineering. The drone significantly reduced field time and risks. AutoCAD facilitated rapid and automated profile generation. GIS added a broader analytical and planning capacity.[2,6]





This innovation is particularly important for regions like Kashkadarya, where terrain variability and water infrastructure modernization require fast and reliable survey solutions.[3,7]

Scientific and Technical Contributions

- Innovation in Profile Drawing: Fully automated generation of profiles using drone data.
- Geospatial Integration: Enhanced decision-making via GIS-based visualization and modeling.
- Precision: Improved accuracy compared to traditional tools.
- Efficiency: Reduction in time and resources, leading to more cost-effective project planning.[4,8,9]

Conclusion. The proposed method marks a significant advancement in geodetic work for hydrotechnical structures. By integrating drones, AutoCAD, and GIS, this approach increases accuracy, reduces costs, and speeds up the design process. It is especially suitable for large-scale or remote infrastructure projects in Uzbekistan and beyond.

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