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3D Reconstruction of the Extinct Vlašim – Dolní Kralovice Railway in Czechia

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Abstract:

The local railway connecting Vlašim with Dolní Kralovice represents a very interesting case study in Czechia. The line can be divided into three sections reflecting distinct operational fates: the Benešov – Vlašim section remains in regular service, the Vlašim – Trhový Štěpánov section operates only seasonally, and the final section from Trhový Štěpánov to Dolní Kralovice was permanently demolished in 1975 due to the construction of the Švihov water reservoir on the Želivka river. Traces of the extinct infrastructure are still partially visible in the contemporary landscape, making this corridor an ideal subject for digital reconstruction. Within a broader research project focused on the cultural, social, and technical history of Czech railways, the 3D documentation and visualisation of this corridor is a large part of the whole research project, and now includes a web ArcGIS Online 3D scene, a more realistic virtual scene created in Unreal Engine and a 3D-printed reconstruction of the extinct railway station Dolní Kralovice. Examples of these visualizations are depicted in Figure 1.

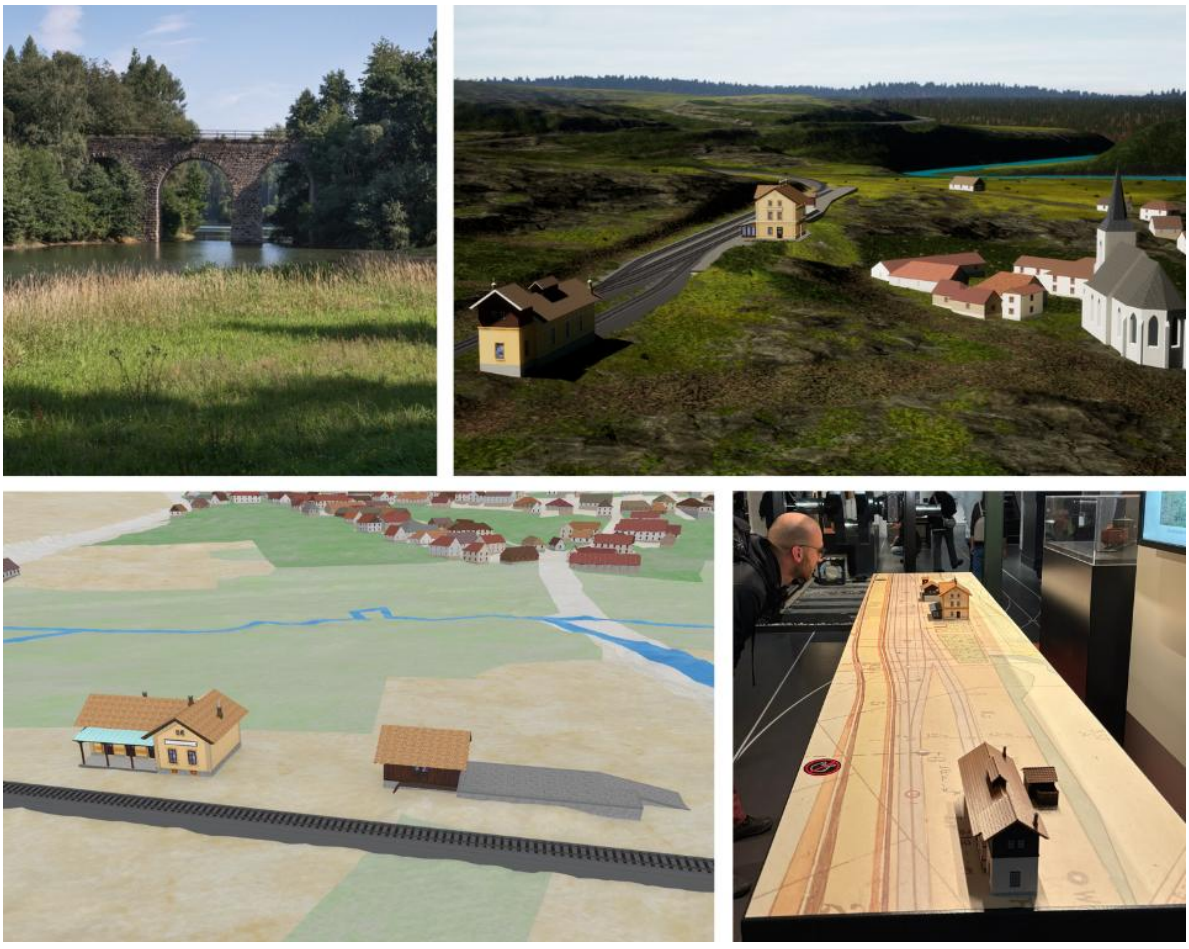

Figure 1. Examples of different 3D representation of the extinct railway

Both two main 3D visualisations (ArcGIS and Unreal scenes) share the same reconstruction of the historical terrain. The current airborne LiDAR-derived digital terrain model (DMR5G) served as the base, from which modern anthropogenic features, absent in the historical period (highway or quarry), were removed. Special approach was required for the valley now submerged under the Švihov water reservoir. Contour lines were vectorized from georeferenced State Map 1:5,000-derived from the 1950s and used to calculate a separate historical elevation model of the flooded area, which was then merged with the modified LiDAR model. Then, the railway was integrated using detailed longitudinal profiles and construction plans at scales of 1:1,000 and 1:2,880. Land cover for the surrounding area was generated on the data derived from the old maps and plans. Building footprints extracted from the same source were used for procedural generation of houses within a one-kilometre buffer around the track.

The primary output is an ArcGIS Online 3D Scene. The scene integrates reconstructed historical terrain, procedurally generated data based on the georeferenced historical maps and manually modelled 3D structures including station buildings, platforms or engineering structures such as bridges. Users are allowed to compare the pre-dam landscape with the current state and to explore the flooded railway. Pop-ups are linked to individual structures with the opportunity to view archival sources, photographs, and construction documentation. For more immersive presentation, the virtual exhibition in Unreal Engine 5 is being developed, which allows photorealistic walkthroughs of selected sections of the railway corridor in virtual reality.

Selected sections of the reconstructed railway were also produced as physical models using FDM (Fused Deposition Modeling) 3D printing. In Figure 1 can be seen a part of this visualisation consisting of a visualisation of Dolní Kralovice station, which was an exhibit in the National Technical Museum in Prague. Key challenges addressed during this phase included the appropriate level of generalisation at the chosen scale (1:100) as the printed buildings needed to be both interesting to inspect and historically accurate.

The presented workflow demonstrates an approach for a detailed 3D reconstruction of an extinct railway. This work is an example of combining different methods of historical data processing, which results in three unique ways of 3D visualisation. All 3D models and visualisations are based on old maps, historical building plans and historical photographs.

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