3D TUNNEL INSPECTION WITH PHOTOGRAMMETRIC AND HYBRID SYSTEMS

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The trend in tunnel assessment is towards comprehensive 3D measurement, either based on high quality digital imagery (photogrammetric systems) or the combination of laser and photo systems (hybrid systems). With digital 3D data, quantification and categorization of damage to the tunnel surface as well as the determination of thickness or volumes of layers (e.g. shotcrete) can performed in a comprehensive, fast and economic way.

The faster such tunnel assessment can be executed on site, the lower are the tunnel block times and environmental impairments related to the building measures. The costs for the operating companies can be significantly reduced as well as the personnel efforts and risks of accidents. Furthermore, tunnel safety is increased due to faster test cycles which result in a more comprehensive overall monitoring.

Dibit has developed two photogrammetric 3D measuring systems for tunnel inspections with a continuous movement. One system is pushed by hand and reaches a walking speed of around 2 mph. The other system, operates at a speed which is unique worldwide:

- The 3D surveying system can record the tunnel with high quality in terms of geometry and detail at a speed of up to 50 mph (Figure 1).
- The system uses state-of-the-art high-speed industrial cameras and a specially developed flash technology to illuminate the (predominantly dark) tunnel structures.

Both dibit systems enable up-to-date tunnel inspection:

- The photorealistic texturing of the 3D model enables the identification and analysis of even the smallest material damage (e.g. cracks <0.3 mm wide; Figure 2).
- The 3D tunnel data and measurements of tunnel objects (cracks, damaged areas, installations, thickness and volumes of shotcrete layers etc.) can be managed in the database Dibit-TIS (Tunnel Information System), which is the "proto"-BIM (building information modeling) for tunnel applications.

The presentation introduces the technique of the 3D measuring systems of dibit and illustrates the quality of the measurements based on conducted projects.

Figure 1 – Highspeed 3D system mounted on a crane

Figure 2 – Tunnel damages analyzed in software "Dibit