

ROAD MANAGEMENT IN BERN, SWITZERLAND

THE OPTIMAL MAINTENANCE AND MANAGEMENT OF THE 2200KM LONG CANTONAL ROAD NETWORK OF THE CANTON BERN (SWITZERLAND) REQUIRES REGULAR ROAD CONDITION MONITORING. FOR THE FIRST TIME GRUNDER INGENIEURE AG, USING THE 3D MOBILE MAPPING SYSTEM LEICA PEGASUS: TWO ULTIMATE, WAS COMMISSIONED TO PERFORM THIS MONITORING, INSTEAD OF A COMPANY WITH A CONVENTIONAL MEASURING VEHICLE. INSTEAD OF SCANNING ONLY THE ROAD SURFACE WITH A BAR, A HIGHLY ACCURATE 3D POINT CLOUD AND HIGH-RESOLUTION 360°-IMAGES WERE CAPTURED. THE ORBIT 3DM PUBLISHER WAS INTEGRATED INTO THE EXISTING ROAD-GIS SYSTEM OF CANTON BERN TO DELIVER THE BENEFITS OF THE NEW TECHNOLOGY TO THE CUSTOMER.

All employees of the different departments of the cantonal authority now have the possibility to move along the whole road network and retrieve the desired geoinformation safely and without any restrictions. Until the realisation of the herein presented solution, it was inconceivable to view several thousand kilometres of point cloud and over 1.4 million images using standard computers at a public authority. Any obstacles were overcome successfully thanks to the close collaboration of the responsible engineers of Grunder Ingenieure AG and Orbit GT.

Introduction

Switzerland is divided into 26 cantons, Bern being the second largest in terms of area. Switzerland's capital Bern is located in the heart of the canton of Bern. The road network in the

sovereignty of the cantonal authority comprises a total length of 2200 km. To optimally maintain and manage the road network, a condition analysis of the entire road network is carried out every 4 years. For the analysis in 2018, for the first time Grunder Ingenieure AG using the 3D Mobile Mapping System Leica Pegasus: Two Ultimate was commissioned. A highly accurate 3D point cloud and high-resolution 360°-images were captured.

Although this new and innovative method initially has brought major challenges for the project team, it delivers a lot of added value. Many added values however require additional computer power, so Grunder Ingenieure AG decided to build a new computer centre at the company's headquarters in Burgdorf to store the over 4400km of point cloud data and over 10 million images. Beforehand, no

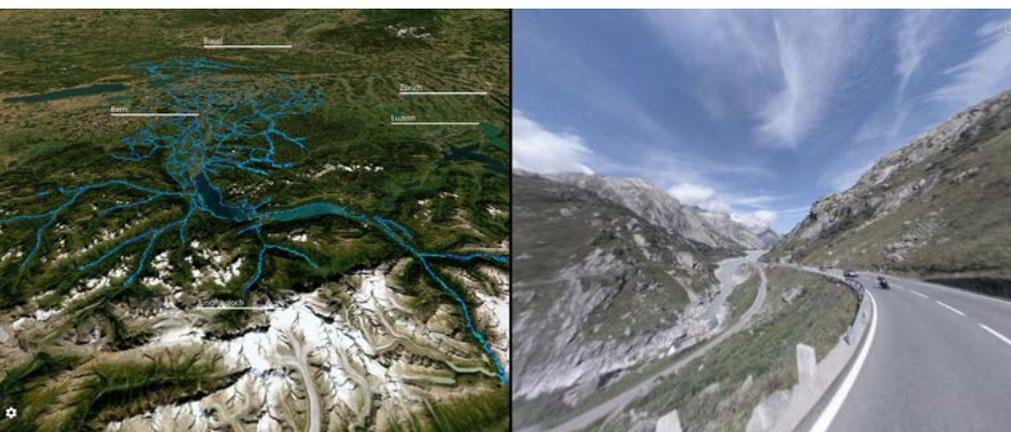
one was aware of the huge challenge to sensibly provide the acquired data to the customer. Furthermore, the strict time schedule was challenging: only six months were available to complete the whole project as the results of the condition analysis were to be included in the annual report and the new budget proposals of the customer.

Data acquisition

The entire road network was acquired within 30 days in autumn 2018. To guarantee that the entire road surface was captured without visual obstructions, all roads were driven back and forth. The measurements could be carried out without obstructions by the normal traffic thanks to the installation of the measurement system on a standard car. The daily recording performance led to several 1TB internal memory hard disks of the 3D Mobile Mapping system being filled. In parallel to the data acquisition, a second team at the headquarters of Grunder Ingenieure AG developed the basis for a new evaluation method. Within less than 2 months a software was developed which enables the import of road surface orthophotos for the analysis and evaluation of each square metre.

Data processing and data delivery

The data was divided into 100m long



The project perimeter of the project Kanton Bern in the GrunderMapsViewer of Orbit GT



Measurement run in the Swiss Mountains

Road condition analysis, with georeferenced damage patterns

sections. Three different indices were evaluated. The visual evaluation (i1) was carried out according to the German standard (ZTV ZEB-StB 2006), the computational evaluations in longitudinal and transverse direction (i2 and i3) according to the Swiss standards (SN 640 520a and SN 640 925b).

The Grunder Ingenieure AG chose Orbit GT's services and software to provide full access to the acquired data according to the motto "We bring reality into the office". The chosen solution offers the unique possibility to provide the immense amount of data via browser without any loss. A remarkable point is that the public authority of the canton Bern already operates a road management software which plays a key role in the daily work of the civil engineering office. The viewer had consequently to be integrated in this software. Thanks to experiences of similar projects, this proved to be no problem. However, the real challenge was only revealed during in the daily routine: the employees of the Bernese administration work in a virtual environment which they access via Citrix. This challenge required an update or the Orbit GT technology to meet the high consumption demands of the customer. Thanks to the close collaboration of the responsible engineers of Grunder Ingenieure AG and Orbit GT, the civil engineering department of the canton of Bern now have "The reality on their screen".

Added value through 3D mobile mapping

Thanks to the 360° scan and the 360° images of the entire road space, the data can now be used for an uncountable number of other projects. Exemplarily, three examples are explained in brief:

- *Evaluation of retaining walls:* the department of civil engineering used the newly acquired data to create an inventory of all retaining walls along their streets.
- *Terrain models for road construction projects:* in order plan out road construction projects it is no longer necessary to carry out surveying works on site. The breaking edges can be derived from the point cloud and the terrain model is easily calculated. This offers a higher level of safety as there is no need for surveyors being on the road under traffic.
- *Clearance analyses:* to plan heavy or overload transports, the clearance of bridges and tunnels can be analysed.

Orbit GT's web-based viewer has also a high importance for additional projects. Often, companies planning a road project, or a heavy vehicle route are not familiar with the location. The viewer offers all project stakeholders the possibility of a virtual on-site inspection and, if necessary, to measure objects and distances. This way of working is a real time-saver as it can avoid numerous on-site inspections, and thanks to the 'Reality in the office', no

details are overlooked.

Conclusion

Thanks to the innovative data acquisition method and the powerful viewer, the client can be provided with a result that covers many other needs in addition to road condition analysis. Grunder Ingenieure AG is convinced that this combination will bring great added value to many cantons, provinces, cities and municipalities in the future.

ABOUT THE AUTHOR

Marc Keller is Geomatics Engineer and has been working for Grunder Ingenieure AG for over 10 years. Since the acquisition of the mobile mapping system in 2015, he has been working as project manager for many different projects, such as the road condition monitoring of the Canton Bern.

ABOUT GRUNDER INGENIEURE AG

Grunder Ingenieure AG, based in Burgdorf, is one of the market leaders in Switzerland in the fields of engineering, railway, cadastral and special surveying. Using drone surveying, laser scanning and 3D mobile mapping, they work highly efficiently. Not only innovative spirit and quality awareness are part of their philosophy, they are also one of Switzerland's largest training companies in the field of geomatics.