

Sub Surface Profiler Case Study

Stability Assessment of a Railway Tunnel Using the Sub Surface Profiler

The Veresk arch bridge, along with multiple tunnels, was constructed in 1936 as part of a railway line. The bridge is located in a narrow valley surrounded by steep, rugged mountain terrain. The valley and surrounding slopes are the result of erosion, where rivers and glaciers have carved deep valleys through the rock over millions of years.



The Veresk Bridge (Completed in 1936)

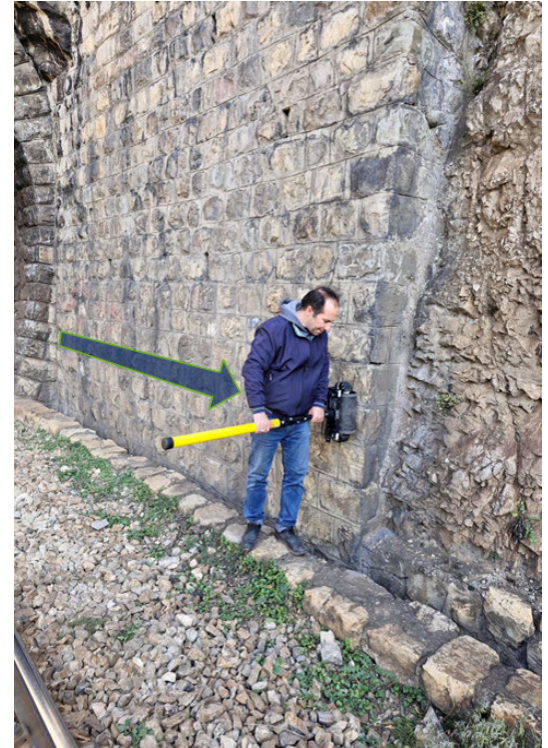
The geology of this region has been significantly influenced by the collision between the Eurasian and Arabian tectonic plates, which has resulted in the formation of complex fault lines and folds. This intricate geological framework plays a critical role in the stability of any excavations in the area. As a result, accurately mapping the location and extent of these geological features is essential for safe and effective planning. The challenge, however, lies in the historical significance of the bridge and tunnels, which necessitates the use of non-intrusive geotechnical assessment methods to avoid compromising the integrity of these structures during the evaluation process. Given these challenges, the Sub-Surface Profiler is the perfect tool for this task. Its advanced ground-penetrating radar (GPR) technology provides high-resolution imaging of subsurface structures, enabling precise identification of faults and other discontinuities without any disturbance to the historical site. This makes it an invaluable asset for non-intrusive geotechnical assessments, ensuring both accuracy and preservation of the structure's integrity. During a routine geotechnical assessment at the site, the SSP was used to determine the position of significant geological features.

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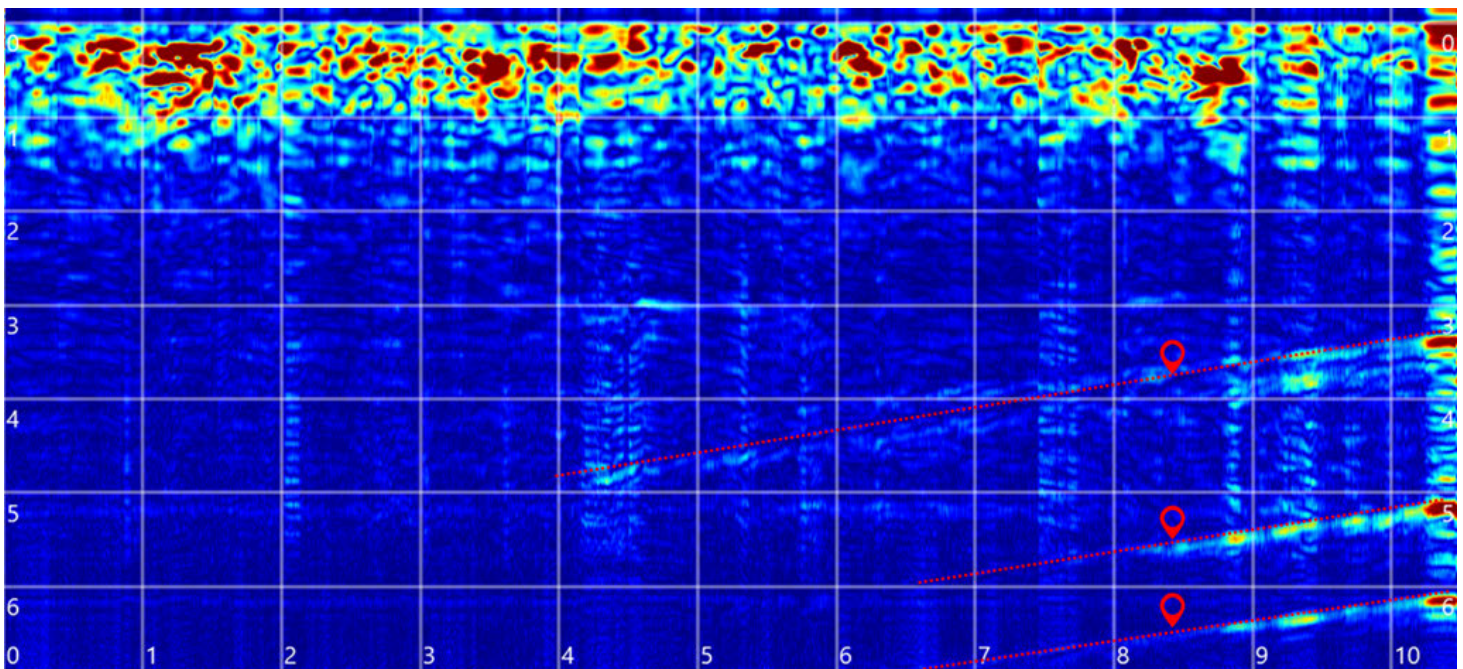
Structures behind stone masonry wall

The masonry walls at the tunnel entrances of the Veresk Bridge are an important structural and aesthetic feature of the bridge, providing both support and stability to the tunnel system. Their construction reflects the engineering methods and challenges of the time and highlights the integration of traditional stonework with the natural environment in this rugged mountainous region. The walls are still admired for their durability and historical significance.

The SSP was used to delineate the position of known geological structures behind the masonry walls. In the scan data indicated below, the masonry wall is clearly visible in the first meter. At a distance of 3m-7m behind the wall, three significant features were visible. The orientation of these structures is in line with the orientation of known faults in the area.



Scanning was conducted along a masonry wall near the entrance of a tunnel.



Three distinct features are visible in the scan data.

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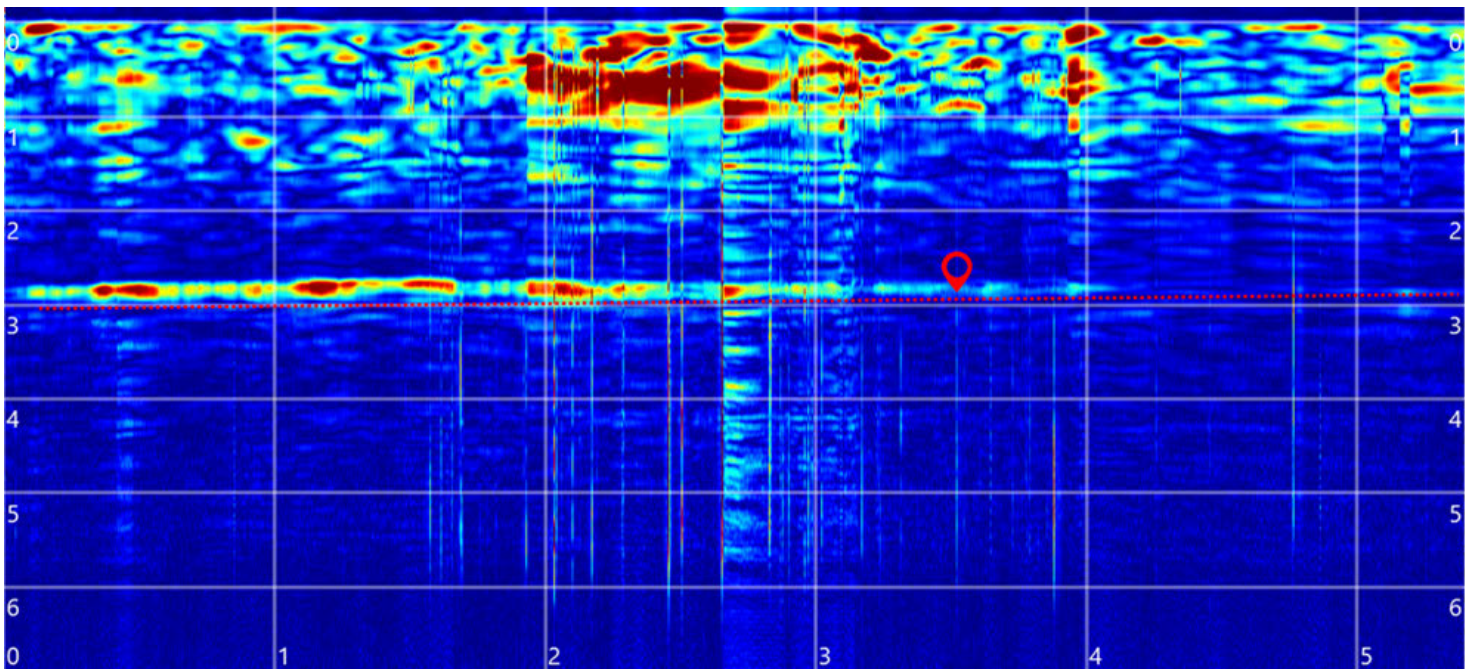
Structures behind tunnel lining



The original masonry tunnel linings (composed of brick and stone) were initially effective at providing structural integrity, but over the decades, earthquakes and ground movement would have necessitated repair and reinforcement to prevent tunnel collapse or dangerous structural failures. Modern techniques in tunnel repair have reinforced the masonry linings by adding new layers of materials such as concrete or steel.

An SSP scan along the tunnel lining clearly delineated the position of a known drainage pipe behind the lining. The drainage system in the tunnels played a vital role in ensuring the long-term integrity and safety of the tunnel infrastructure.

A scan was conducted along the tunnel lining, again keeping the SSP perpendicular to the wall.



A distinct feature is visible at around 3m behind the tunnel lining.

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Conclusion

The Sub-Surface Profiler's advanced GPR technology offers a precise and non-intrusive solution for mapping the complex geological features at the site, ensuring both the accuracy of the geotechnical assessment and the preservation of the historically significant bridge and tunnels.

The light-weight and ergonomic design of the SSP allowed for scans to be conducted with ease across the tunnel. Data collected was processed in real time, giving instant feedback on rock structures while scanning. The historical significance of the structure being assessed makes it challenging to assess and monitor the excavation stability through intrusive methods. The SSP is therefore a handy tool for these type of stability investigations.

At a glance

Material Type

A combination of stone masonry walls and structurally complex sedimentary rocks.

Challenge

Delineating position of civil and geological structures behind masonry walls and tunnel linings.

Results

Structures were clearly delineated using the SSP.



REUTECH AUSTRALIA,
PTY LTD.

6 Babel Road, Welshpool,
WA, 6106
Australia

T +1300 899 235

E info@reutechaustralia.com
www.reutechaustralia.com.au

REUTECH
AUSTRALIA
