Figure 1: Tunneling construction site.

EXTENDING EARTH MOVING BUCKET LIFE

Earth moving equipment case study

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Earth moving equipment plays a crucial role in the laying the groundwork for modern infrastructure, operating under some of the most extreme conditions.

With constant exposure to abrasive materials, wear and tear on critical components such as buckets poses a major challenge in terms of efficiency and maintenance.

This paper presents a case study that addresses one such challenge, focusing on hardfacing solutions for tunneling applications. By comparing conventional repair methods with an optimized welding approach, it demonstrates how advanced materials and techniques can significantly improve the service life of equipment while reducing downtime and operating costs.

The study underscores the importance of innovations in wear protection and highlights the value of close collaboration between manufacturers, suppliers, and end users. The findings not only offer a practical solution to a long-standing issue, but also reinforce the impact of customized welding solutions in high-demand environments.

We commend the efforts of all involved and hope that industry professionals seeking to enhance the durability and performance of their equipment will find this work a valuable reference.

INTRODUCTION TO ROAD CONSTRUCTION AND TUNNELING

Companies involved in road construction and tunneling usually operate a fleet of earthmoving equipment for the different construction sites in which they are involved. (Figure 1)

Heavy equipment needs to clear the way, withstanding harsh conditions as it moves large amounts of earth material such as clay, sand, stones and rocks. The buckets on this equipment experience extreme abrasive wear, making regular repairs and hardfacing essential to maintain operational efficiency.

Regular repair work on the buckets with hardfacing material is essential to maintain the equipment in operation efficiently and on time.

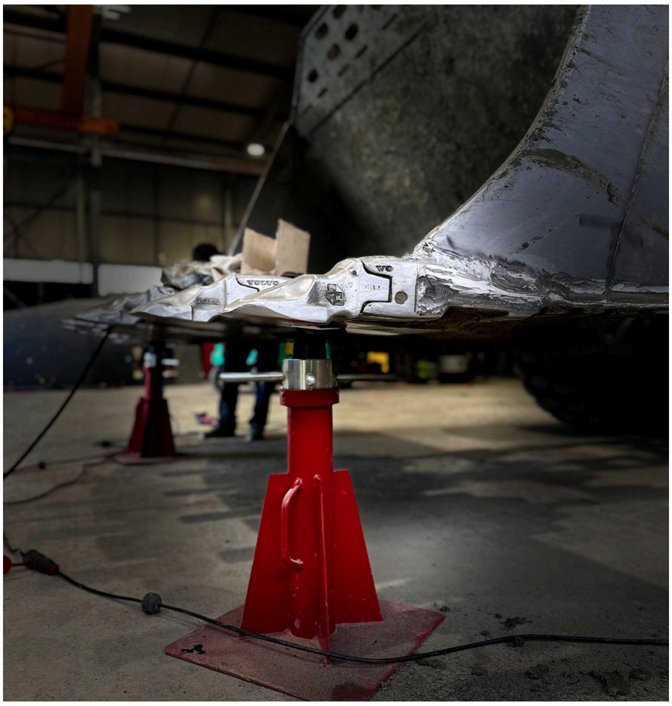


Figure 2: The high wear area of a bucket before repairs.

INITIAL CONDITION OF BUCKET SIDEWALLS AND CORNERS

In this case study, we would like to address a specific maintenance procedure of a particular customer and explain how we found a solution to even better manage the repair cycles and extend the life of the budget.

The most severe wear occurs mostly at the bottom and on the outer corners of the bucket sidewalls, just behind the teeth, specifically where the cutting edge meets the sidewalls (Figure 2).

To address this issue, the maintenance crews would frequently perform spot repairs. Their standard approach involved applying:

- two buffer layers using AISI 312 (29Cr / 9Ni) stainless steel solid wire.
- two overlay layers with a conventional 600 HB ferritic/martensitic weld metal, also in the form of solid wire.

This method resulted in a service life of approximately three to four months in this particular case before requiring another repair cycle.

Since repair work is naturally time consuming and the availablity of the drilling heads and buckets are needed for the construction site, special attention was paid to extending the service life of the bucket by means of optimized hardfacing solutions such as the repair time itself.

SOLUTION TO EXTENT BUCKET LIFE AND TRIPLE THE SERVICE LIFE

An active bucket was repaired that was scheduled to return to operation immediately after hardfacing. The goal was to track performance improvements under real-world conditions.

After preparing the surface with manual grinding (using conventional manual grinders on both sides of the bucket [Figure 3. A]), the team set up a Böhler Terra NX500 PME power source with a WF 330 wire feeder.

SOLUTION FOR THE BUFFER LAYER

A FOXcore 309L-T1 cored wire was used for the buffer layer to achieve a significantly higher deposition rate than the 312 type solid wire. By using FOXcore 309L-T1, the welding speed when welding of the first layer in welding positions PC and PF was able to be doubled. In addition, a 5 mm buffer layer thickness was achieved in a single pass (Figure 3. B.), eliminating the need for a second layer. The result is improved efficiency and reduced cost for repair work.

Welding Parameters for FOXcore 309L-T1	Buffer Layer
Diameter	1.2 mm
Wire feed speed	7.6 m/min
Current	210 - 220
Voltage	24.5 V
Stick-out	20-25 mm
Shielding gas	M 21 (EN ISO 14175)
Polarity	DC+

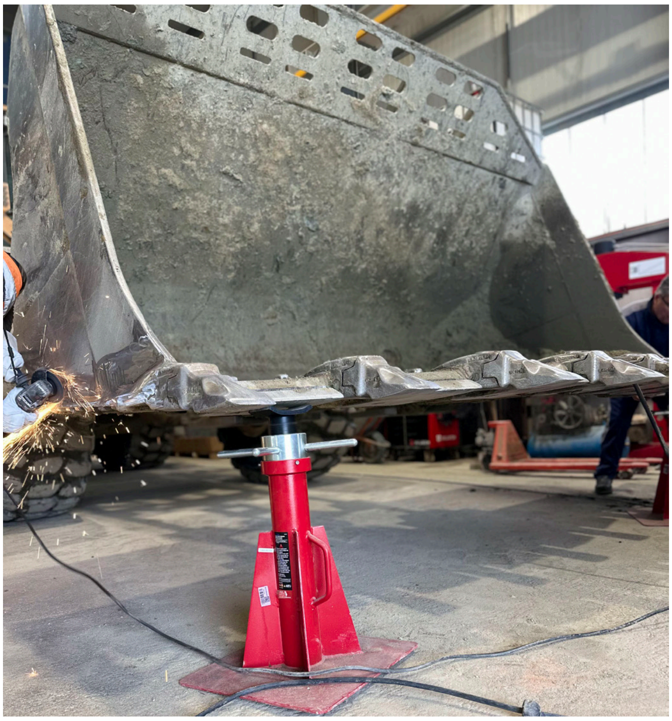


Figure 3 A.) Manual grinding of the bucket side

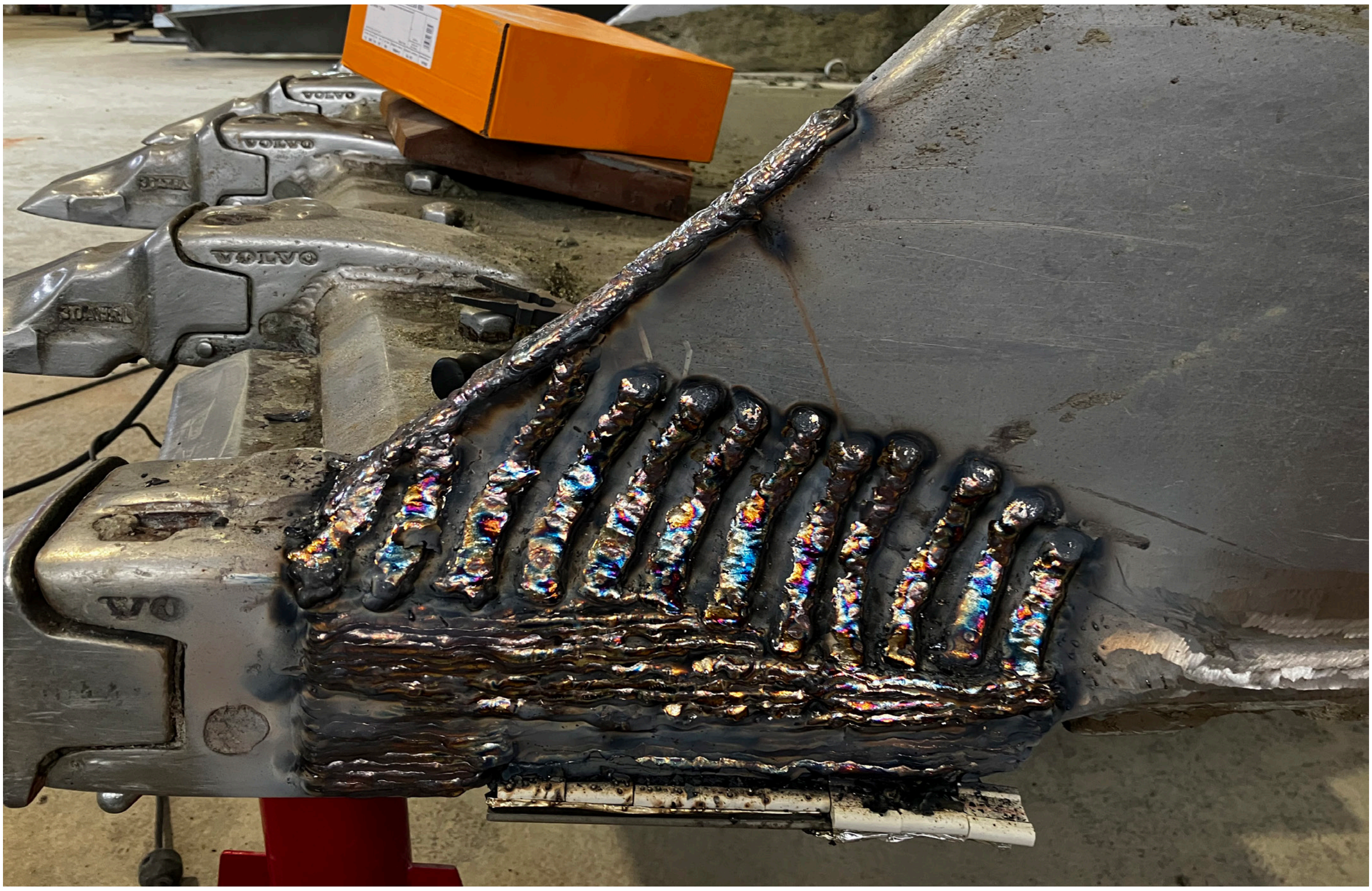


Figure 3 B.) - Buffer layer applied using the all-positional rutile Böhler FOXcore 309L-T1 welding wire.

SOLUTION FOR OVERLAY LAYER

For the overlay layer, we recommended a martenisic alloy to avoid high-Cr (VI) exposure in the welding fumes. High Cr content welding consumables with 25Cr-5C chromium-carbide-based solutions require extensive protection of the welder to avoid exposure to Cr (VI). For this reason, we opted for a 600 HB martensitic alloy, selecting UTP ROBOTIC CHROMELESS 600 instead of our conventional 600 HB filler metal.

This provided an additional 25% producivity increase in overlay welding compared to the customer's previous solution.

This seamless cored wire delivered outstanding results.

- On the bucket's exterior, we applied a globular arc transfer with horizontal stringer beads (Figure 4 A).
- On the sidewall edges, we used a pulse technique with an oscillating motion from bottom to top (Figure 4 B).

Welding Parameters for UTP ROBOTIC CHROMELESS 600	Overlay Layer
Diameter	1.2 mm
Wire feed speed	6.0 m/min
Current	200 A
Voltage	24.0 V
Stick-out	25 mm
Shielding gas	M 21 (EN ISO 14175)
Polarity	DC+

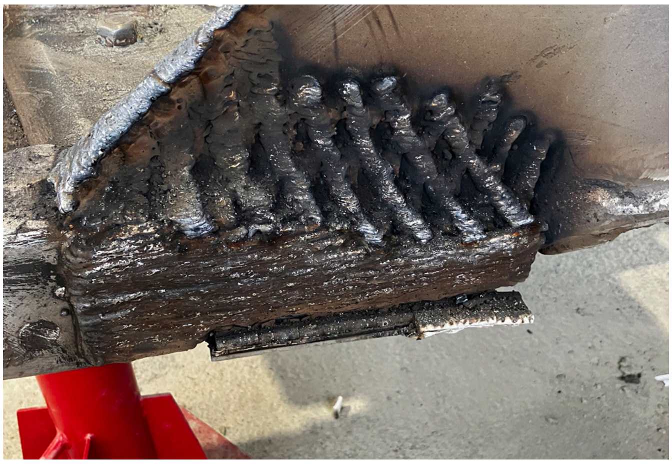


Figure 4 A.) UTP ROBOTIC CHROMELESS 600 weld overlay welded in PF position with oscillated beads and using pulse technique

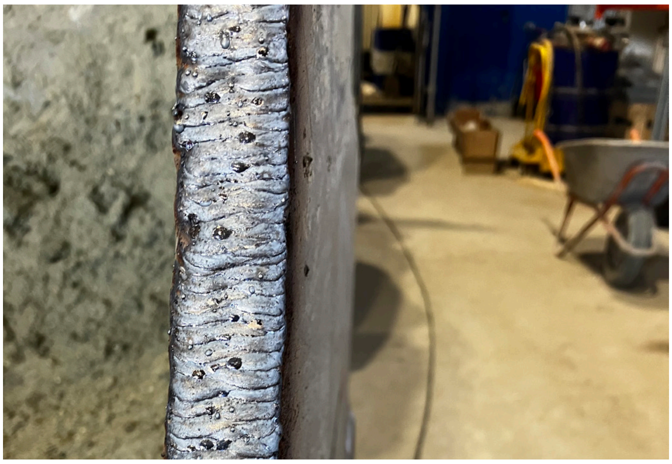


Figure 4 B.) Buffer layer applied using the all-positional rutile Böhler FOXcore 309L-T1 welding wire

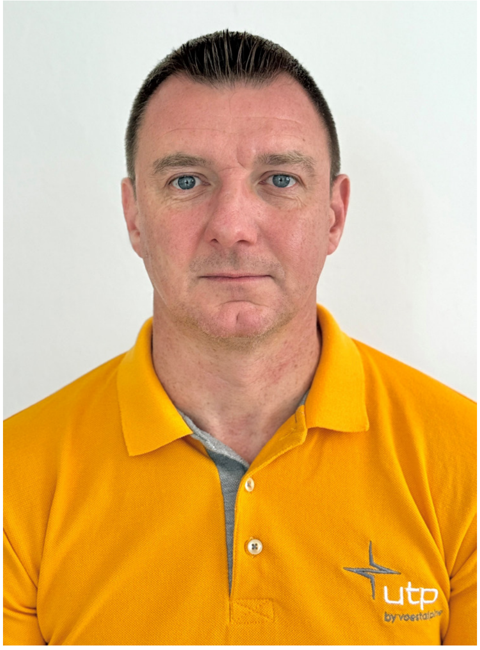
LONGER BUCKET SERVICE LIFE THROUGH INCREASED WELDING PRODUCTIVITY AND IMPROVED HEALTH AND SAFETY CONDITIONS

Böhler Welding and UTP solutions significantly outperformed the previous welding process in both efficiency and application speed. After further operational testing, the new process has more than tripled the bucket's service life.

UTP ROBOTIC CHROMELESS 600 delivers more than three times higher wear resistance than conventional 600 HB martensitic-ferritic alloys and, as a bonus, has no harmful effects on the welder's health, as Cr (VI) in the welding fume is avoided.

FOXcore 309L-T1 versus 312 solid wire results in cost savings on the filler metal of the buffer layer.

The all-positional FOXcore 309L-T1 reduces welding time by half while depositing twice the weld metal thickness compared to the 312 solid wire, which leads to four times greater efficiency for buffer layer welding.



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Tamás conducted his studies at the Budapest University of Technology and Economics, at the Faculty of Mechanical Engineering, and Welding Science, which was followed by the International Welding Engineer postgraduate study. In 2014, he acquired his PhD degree from Welding Science.

Working in the industry from 2003, Tamás has more than 20 years of experience in the areas of mechanical engineering, product-, sales- and marketing management as well as welding laboratory management with special focus and expertise in various hardfacing industry segments.