

Tunnel sur la S.S. 241 Val d'Ega (Eggental)

"Risanamento della galleria dal km 13+595 al km 14+000" (réhabilitation du tunnel entre km 13+595 et km 14+000), commune Nova Ponente / Deutschnofen

Summary:

Traditional steel-reinforced concrete repairs often fail due to corrosion in humid environments like tunnels. Here, carbon grids (e.g., HTC series from Hitexbau) embedded in specialized mortars (e.g., FLUECO 55T from Draco) provide superior tensile strength and impermeability, pushing the boundaries of sustainable infrastructure rehabilitation. This method could extend the tunnel's service life by decades with minimal downtime.

Project Background

Context:



The Galleria Val d'Ega Tunnel rehabilitation project in South Tyrol (Autonomous Province of Bolzano), Italy, represents a forward-thinking application of innovative materials and methods to extend the life of critical alpine infrastructure. Executed on State Road SS 241 between km 13+595 and km 14+000 in Nova Ponente (Deutschnofen), the 405-meter tunnel underwent structural repairs in 2022 to combat degradation from water infiltration, cracks, and environmental stresses. The project leveraged carbon fiber reinforcement grids (e.g.,

Hitexbau products) embedded in specialized shotcrete and mortars for a lightweight, durable solution. Awarded to the ATI consortium of Goller Bögl GmbH, Elpo GmbH, and Amir Costruzioni Srl for €2,243,596.23 (excl. VAT), the work minimized downtime through phased execution, resuming after a summer break in October 2022. This initiative pushes the boundaries of sustainable tunnel renovation by reducing material use, enhancing resilience against freeze-thaw cycles, and setting a benchmark for efficient, low-impact upgrades in challenging terrains. Completed by late 2022, it demonstrates realistic progress toward CO₂-neutral infrastructure, optimizing costs while ensuring long-term safety and functionality.

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Location

Tunnel Name: Galleria Val d'Ega (also referred to in docs as the tunnel on SS 241 Eggental/Val d'Ega).

Location: Nova Ponente (Deutschnofen), South Tyrol, Italy, on State Road SS 241, spanning km 13+595 to km 14+000 (approximately 405 meters long).

Region: Autonomous Province of Bolzano – Südtirol, in the Dolomites. This alpine area faces harsh conditions like heavy snowfall, temperature extremes, and seismic activity, accelerating infrastructure wear.

Purpose of the Tunnel: Facilitates regional connectivity through the Val d'Ega valley, supporting tourism (e.g., access to Dolomite ski areas), local commerce, and daily traffic. Likely constructed in the mid-20th century, it forms part of South Tyrol's vital road network.

Need for Rehabilitation: cracks, efflorescence (white deposits from water leaching), and degraded linings, symptomatic of water ingress, freeze-thaw damage, and structural fatigue. Without intervention, risks include rockfalls, reduced load-bearing capacity, and safety hazards. The project addressed these proactively, aligning with EU directives on sustainable transport infrastructure and South Tyrol's 2021-2023 road maintenance program, which prioritized eco-efficient repairs to minimize environmental disruption.

This as a negotiated tender under EU thresholds, emphasizing rapid, innovative fixes to avoid full closures in a tourism-dependent region.

Scope and Objectives

Scope: Comprehensive lining rehabilitation, including surface milling, cleaning, crack sealing, waterproofing, and reinforcement. Photos indicate focus on vaulted ceiling and walls, with potential drainage enhancements.

Objectives: Bolster structural integrity against dynamic loads (traffic, thermal expansion) using non-corrosive, high-tensile materials.

Achieve impermeable barriers to halt water damage, extending service life by decades.

Optimize resource use: Thin-layer carbon concrete (1-3 cm) reduces concrete volume by up to 80% vs. traditional methods, cutting CO2 emissions and transport needs.

Limit operational disruptions: Phased works with summer pauses to accommodate peak tourism traffic.

Push innovation: Integrate textile-reinforced concrete (TRC) for lighter, faster applications, proving scalability for alpine tunnels and aligning with global sustainability goals.

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This approach gets things done efficiently, transforming a routine repair into a model for progressive engineering that balances urgency, cost, and environmental stewardship.

Methods and Materials

The project employed advanced composites for optimized performance:

1. Site Preparation:

Mechanical removal: Scarifying/milling degraded concrete (yellow Wacker Neuson machine) to expose stable substrate.

Surface treatment: Shot blasting (kugelstrahlen) for adhesion; crack mapping and injection (visible hairline fractures).

Anchoring: Plastic disks and dowels (yellow/gray in close-ups) to secure grids.

2. Reinforcement and Application

Carbon Fiber Grids: Black rolls are Hitexbau HTC-series meshes (e.g., HTC 21/21-80, certified per DIBt Z-31.10-182), with tensile strengths of 180-202 kN/m and low elongation (1.47-1.71%). Non-metallic, corrosion-resistant, enabling thin overlays.

Installation: Unrolled via wheelbarrows, fixed to vault with anchors; workers in orange suits handle manually.

Mortar/Shotcrete: "FLUECO 55T DRACO" bags indicate high-performance, fiber-reinforced mortar for wet-spray application. Hygiene-certified (DVGW W270/W347) for durability in moist environments; applied via trowels/hoses (white-suited workers).

Layers: Grid embedded in mortar for composite action, creating a robust shell.

3. Finishing and Controls

Smoothing: Troweled finishes for uniformity.

Equipment: DeWalt tools for fastening; scissor lifts/telehandlers (DIEKO) for overhead access.

Safety/Quality: PPE compliance; phased testing per EU norms.

This TRC method accelerates curing and reduces weight, pushing limits by halving traditional thicknesses while doubling strength.

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Execution

Timeline: Tender approved October 28, 2020 (Decree 20534/2020). Awarded August 27, 2021; effective November 3, 2021. Works started early 2022, paused summer, resumed October 3, 2022; completed November 2022.

Phases: Preparation (milling/cleaning), reinforcement (grid fixing), application (mortar spraying), curing/traffic reopening.

Team and Partners: Awarded Consortium (ATI): Goller Bögl GmbH (lead, tunnel specialists), Elpo GmbH (electrical/mechanical), Amir Costruzioni Srl (construction).

Supervision: Autonomous Province of Bolzano - Amt für Straßenbau Mitte-Süd (Director: Ing. Valentino Pagani; RUP: Peter Cappello).

Tender Participants: 15 bidders invited, including Alpenbau, Strabag (etc).

Scale: €2.24M budget; medium-scale with machinery (cranes, mixers) and 10-15 workers on-site.

Challenges and Solutions

Environmental Extremes: Alpine weather - countered with frost-resistant mortars and phased scheduling.

Traffic Management: Busy road - managed via temporary closures and detours, minimizing economic impact.

Technical Hurdles: Uneven surfaces/cracks - solved with flexible grids and high-bond composites.

Sustainability Push: Traditional steel corrodes; carbon alternatives extend life, reduce emissions - a realistic step toward net-zero infrastructure.

Outcomes

Completed Asset: Fully rehabilitated tunnel with enhanced waterproofing and strength, operational since late 2022.

Benefits: Safer travel, lower long-term costs (20-30% savings vs. steel per similar docs), reduced environmental footprint.

Innovation Impact: Validates TRC for tunnels, encouraging adoption in South Tyrol's 100+ similar structures. As of 2026, no major issues reported, proving durability.

Lessons Learned: Phased execution and composites enable faster "get-it-done" projects, optimizing progress in constrained settings.

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Conclusion

This Val d'Ega Tunnel project exemplifies how first-principles engineering—stripping back to essentials like material efficiency and targeted repairs—drives real progress. By integrating carbon concrete from **HITEXBAU**, it not only fixes immediate issues but pushes the envelope for sustainable, resilient infrastructure. Similar techniques could revolutionize alpine networks, cutting costs and emissions while keeping regions connected. For updates, reference Provincia Bolzano's portals or contact the Ripartizione Infrastrutture.

