THE AUSTIN ADVANTAGE

OPTIMIZED BLASTING METHODS FOR TBM LAUNCHING SHAFT CONSTRUCTION BENEATH THE PANAMA CANAL

GENERAL **INFORMATION**

Location: Panama Canal, Panama

Industry: Tunnelling

Products Used: Paradigm, E*STAR

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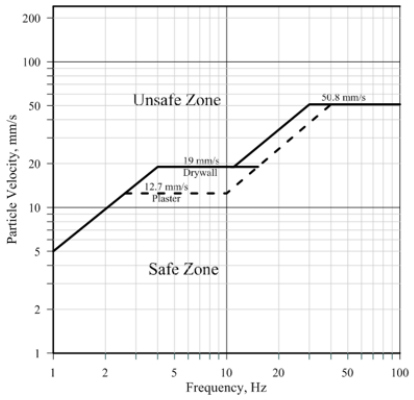
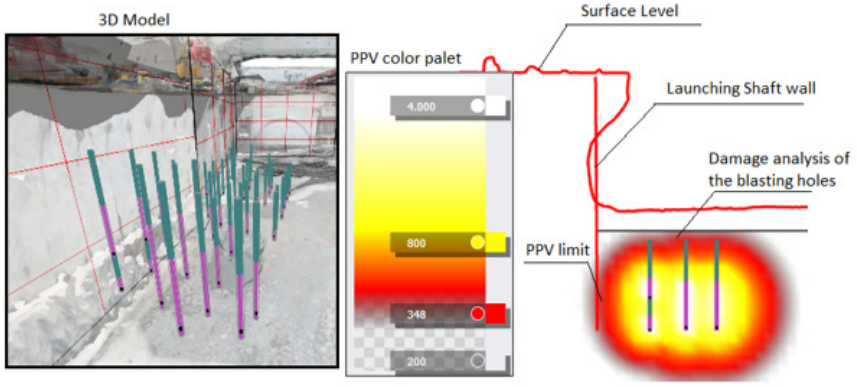
THE **HISTORY**

The Panama Metro System's Network expansion involves excavating a launching shaft for a tunnel boring machine (TBM) to traverse beneath the Panama Canal. Austin Powder Panama was tasked with executing controlled blasts within the TBM launching shaft, located adjacent to massive concrete encircling the excavation. These walls must remain intact throughout construction and the tunnel's future operation. Given the sensitivity of the structure, traditional blasting standards were insufficient. A tailored, science-based approach was necessary to ensure structural integrity while meeting excavation objectives.





THE **GOALS**

1. Propose and validate safe vibration thresholds for blasting near the TBM launching shaft walls.
2. Design and execute controlled blasts with structural protection in mind.
3. Compile data and evaluate results to ensure safety and performance.
4. Generate technical insights applicable to future civil construction and tunneling projects

CUSTOMER **CHALLENGE**

Standard practices for blasting vibrations, such as the USBM RI 8507 guideline, proved unsuitable due to high peak particle velocity (PPV) values expected in the shaft area. Applying these standards would have made blasting unfeasible, threatening both the project timeline and feasibility.

The challenge was twofold:

- Develop a site-specific approach for safe PPV limits considering the shaft's reinforced concrete structure.
- Design blasts capable of fragmenting tough rock formations—ranging from weathered sandstone to gray basalt—while ensuring zero structural damage

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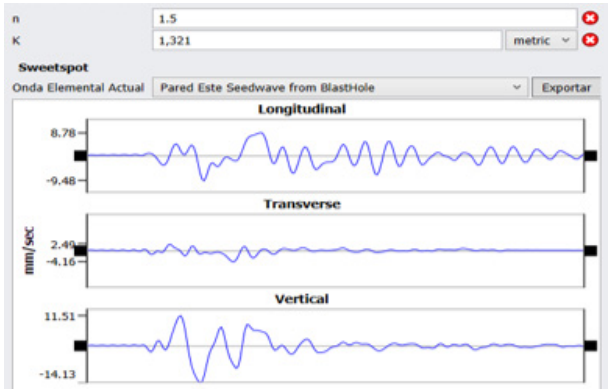
1. Establishing Tailored PPV Thresholds

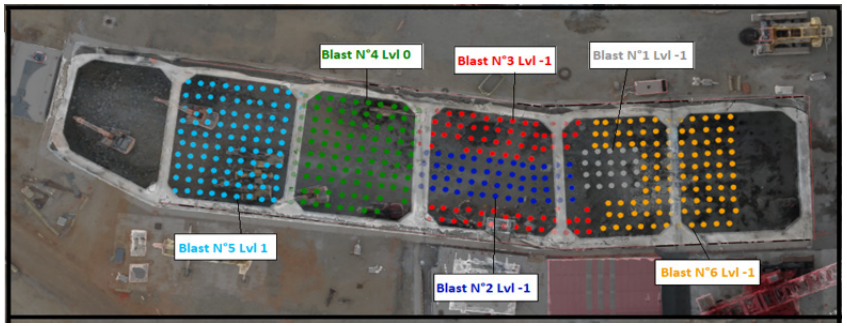
Austin's technical team began by reviewing literature on near-field blasting in sensitive civil environments (e.g., dam bases, tunnel linings). They referenced key resources including Explosives Engineering and Construction Vibrations and Geotechnology by Lewis Oriard, as well as technical databases such as OneMine.org.

Based on the theoretical stress relationship for compressional waves—where stress is the product of material density and wave velocity—they estimated safe vibration limits:

- Compressive strength of the concrete: 35 MPa (5,000 psi)
- Ultimate tensile strength (UTS): estimated at 9% of compressive strength

This allowed the team to define practical and protective PPV thresholds for the blasting plan.





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2. Advanced Blast Design

With these limits in hand, Austin used modeling software and electronic detonators to precisely plan the blasts. The strategy included:

- Geological considerations: Blasting through sandstones, siltstones, and basalt (60–220 MPa).
- Charge selection: Using two explosive diameters—50 mm (2 in) and 38 mm (1.5 in).
- Blast geometry: Hole diameter of 76 mm (3 in), spacing of 2 meters (6.5 ft), with decked blastholes to control vibration and fragmentation.
- Predictive controls: Seed wave analysis and vibration modeling supported timing and sequencing of the blasts.

3. Trial Blast Execution

Before proceeding to full-scale excavation, a trial blast was conducted:

- Monitoring stations were installed to record vibrations.
- Seed wave testing helped calibrate blast timing.
- Operational protocols were developed to address fly rock prevention and safety.

THE **OUTCOME**

Austin Powder Panama successfully executed the blasting campaign within the sensitive shaft environment without compromising the structure.

Key outcomes included:

- Safe Excavation: No damage to the TBM launching shaft walls; successful fragmentation of rock.
- Vibration Compliance: All measured PPVs remained within the newly established site-specific thresholds.
- Knowledge Generation: The data and methodology contributed to a new reference framework for controlled blasting in civil works involving reinforced concrete.
- Customer Satisfaction: The project proceeded on schedule with minimized risk and high technical confidence.

This case stands as a benchmark in precision blasting, showcasing how innovative thinking, scientific rigor, and technical excellence can safely solve complex engineering challenges—especially under one of the world's most iconic water routes.

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