Winter 2025 Follow up on Early Strength Testing

By Christoph Goss, PhD, PE, PMP, F.ASCE

In my last column, I discussed the need for early strength testing in underground shotcrete, particularly to determine whether it was safe to enter a recently shotcreted heading. In the winter 2024 issue of *Shotcrete* magazine, my co-authors (Norbert Fuegenschuh, Lauro Lacerda, Kevin Robertson, and Shaun Radomski) and I published the paper "**Early Age Strength Testing for Shotcrete: 2024**". Our intent was to use that article as a starting point for an ASA position paper on early strength testing. We devoted the underground committee meeting at the ASA Shotcrete Convention in March 2025 to a discussion of the paper's conclusions.

There was a consensus that early strength testing was a good idea, but that it was not typically done in the North American market. This was blamed on the relatively high cost, time, and effort required for the beam-end test, as well as a lack of confidence in the other methods. Basically, if the specifications do not require it, early strength testing is not carried out. Regarding the testing methods: Beam-end testing was considered good for pre-construction testing but not production; Hilti BX 3 stud driver had neutral reviews; the needle penetrometer was quick, cheap, and generally okay; no experience with Hilti DX 450; soil penetrometer was acceptable only to check for setting; and the Schmidt Hammer was only adequate in looking for defects.

The discussion continued with what compressive strength was acceptable for entry, noting that requirements around the world varied from 75 – 435 psi with 145 psi (0.5 – 3 MPa with 1 MPa) becoming more common in the US and 290 psi (2 MPa) in Canadian mines. Underground committee members noted that minimum strength requirements were highly project-specific, based on ground conditions, shotcrete thickness, and the next operation in the area. Worse ground conditions (thicker shotcrete) would require a higher strength. If personnel were at the heading, that would require higher strength than just equipment. Given the variables, the strength for entry should be determined by the mine or the contractor's geotechnical engineer in charge of that project — not by a blanket rule.

The committee decided that there would be no ASA position paper on early strength testing, but that we should provide resources to tunnel contractors and underground mines to develop their own guidance and policies. Here are some thoughts:

- Read the various papers on the topic (see our **2024 paper** for a handy list of references).

- Include beam-end testing in the pre-construction phase to develop typical early strength curves for all mixtures and accelerator dosages you plan to use.
- Include some testing during construction to confirm the preconstruction results.
- Work with the geotechnical or mining engineer in charge of ground control to determine the minimum strength for temporary support for a specific project, location, or reach.

- Adjust the work plan/mine cycle to keep personnel away from the fresh shotcrete as long as possible.
- Make your underground crew aware of the dangers and limitations of fresh shotcrete.

I sincerely appreciated the community feedback on this. If you would like to get involved in the ASA Underground Committee, please contact me or Tosha at ASA. We would love to have you join us and lend your experience to advancing ASA and the underground community.