Practical Benefits of Shotcrete on Geotechnical Projects

By Michael Klemp

This article covers the advantages of using shotcrete placement for soil nail projects. In permanent soil nail structures, shotcrete offers a wide variety of architectural finishes that can be produced economically and efficiently. This is in stark contrast to the limited options offered by using traditional form-and-pour or precast concrete panels.

DISADVANTAGES OF FORM-AND-POUR AND PRECAST PANELS

Let's look at the disadvantages of the alternatives to shotcrete placement:

PRECAST CONCRETE PANELS

When using precast panels, the lead time and scheduling requirements can add significant time and coordination to a project. The panels must be designed not only for the in-place loads but also for loads from transportation and erection. Additionally, the precast must be transported from the plant to the job sites. This incurs trucking costs, as well as costs for staging or on-site storage. Many soil nail job sites are in relatively remote areas and may have limited or difficult access that complicates the transportation.

Areas under bridges can be hard to access with lifting equipment. This results in making the setting of precast concrete panels under bridges very difficult and time-consuming. When setting the precast panels, you typically need a leveling pad to support them or backfilling behind the panels. This requires a low-strength concrete to either be delivered or mixed on-site.

Finally, using precast entails using more heavy equipment. This includes cranes and off-road forklifts that would not be needed for a shotcrete placement project.

FORM-AND-POUR PANELS

Form-and-pour methods of constructing concrete panels require double-sided forms. These forms need to be shipped to the site or fabricated on-site. The forms need to withstand the liquid pressure of wet concrete when pouring the concrete into the form, which requires the formwork to be heavy to carry the internal pressures. The time just erecting or building the forms on-site can be time consuming and expensive. Additionally, after pouring the panel, the forms need to be stripped and then disposed of or transported to storage. Soil nail walls are built to tight tolerances and form-and-pour doesn't provide the flexibility or bond of shotcrete placement against the surface.

Figs. 1 and 2: Soil nail wall in progress

Another consideration after stripping the form-and-pour forms is that there are bug holes and sometimes voids from improper vibration. Preparing the surface and patching these areas are time-consuming tasks that require close attention to surface preparation, materials used, and application to get a good bond of the repair materials.

As in the precast panels, the form-and-pour option requires a leveling pad of low-strength concrete. This essentially acts as a firm base to set the forms (and subsequent placement of concrete) upon. Anchoring the panels to the soil nail wall is also time-consuming, and there is always patching required.

THE MANY ADVANTAGES OF USING SHOTCRETE PLACEMENT

Shotcrete placement significantly reduces the time on the job, and on construction jobs, time is money. It reduces time on-site and exposure to changing weather conditions.

SO WHY IS SHOTCRETE PLACEMENT SO ADVANTAGEOUS?

- There is little or no formwork to erect, strip, and transport. Not only does this save time and cost, but it also means that using shotcrete is more sustainable, using less lumber and transportation.

Figs. 3 and 4: Soil nail wall in progress

- Shotcrete placement can easily adapt to varying soil surface profiles.
- Smaller equipment is needed on-site and can reduce mobilization to a minimum.
- Shotcrete placement requires less of a footprint during the installation. Wherever we can run the delivery hose, we can place quality concrete.
- A leveling pad is not required, which reduces both cost and schedule. With no leveling pad, the wait time needed for curing and strength gain is totally eliminated.
- There are no anchoring requirements besides the Nelson studs on the bearing plate that is attached to the soil nail. You simply install the required reinforcing steel onto the Nelson studs, install piano wire for thickness control, then shotcrete and sculpt the fresh concrete surface of the panels.
- The tolerance on the soil-nail section of the wall is less critical to the overall construction, as there is room for slight imperfections of the wall face.

Overall, shotcrete placement is more than twice as fast for soil nail panel construction when compared to traditional panel installation, regardless of whether this is form-and-pour or precast. Thus, using shotcrete placement is more efficient, saves money, and provides more flexibility in scheduling field operations.

Michael E. Klemp *is the CEO and Business Development Officer of Thorcon Shotcrete and Shoring, LLC, a geotechnical construction firm based in Littleton, Colorado. With a strong background in construction management, Klemp has led Thorcon in delivering complex design-build solutions involving micro-piles, soil nails, tie-backs, rock anchors, and sculpted shotcrete. The company is responsible for a project at West Point Military Academy involving 80,000 ft² (7400 m³) of reinforced sculpted shotcreted facing, as well as a significant shoring wall in El Paso TX, including a grouted slurry wall, soil nails, tie-backs, and alignment shotcrete, summing up to $21M in work. Beyond Thorcon, Klemp is involved in several other ventures, including GeoCraft Builders, BDM Capital Time Investments, Sentry Siren, TSS Equipment Leasing, and MK Ranch.*