

Shotcrete for Wine Storage

by Larry Rowland

What do northern California grapes and shotcrete have in common? Fine wine of course! Think of the California wine country with its pristine hillsides carpeted with vineyards and picturesque wineries. Nestled in the mountains of Napa County, the O'Shaughnessy Vineyard is just that kind of place. One of the things that make the O'Shaughnessy Vineyard so special is owner Betty O'Shaughnessy's decision to store her wine underground.

The O'Shaughnessy wine cave was constructed by contractor Glen Ragsdale Underground Associates of Angwin, California. The shotcrete was supplied and delivered to the site by Harold Smith and Son. Glen Ragsdale and his Vice President of Construction, Vincent Georges, worked with the geotechnical engineering firm Condor Earth Technologies and the owner to create a welcoming space that impresses visitors with majestic curves and warm lighting washing over light-colored walls.

Shotcrete was the product of choice because it eliminates formwork and can be placed with relative ease. The New Austrian Tunneling

Method was used exclusively for this application. White cement shotcrete was chosen as a finish coat to lighten up the cave walls, creating the desired aesthetic effect.

A new market segment is emerging. There are some 130 to 150 wine tunnels or "caves" in northern California's wine country. Shotcrete is used extensively in the construction of these caves and their access portals. Vincent Georges of Glen Ragsdale Underground Associates has made the following observations:

- Shotcrete is the product of choice because it eliminates formwork and provides ease of placement in construction. The New Austrian Tunneling Method is used exclusively;
- White cement is used in about 50% of the finishes. Smooth to coarse finishes are available;
- Many owners want to reduce energy costs. Going underground not only saves on energy expenses, but additional savings result from reduced wine loss and improved process control;
- We are seeing more complex underground structures. More owners are interested in putting the entire winery underground and building high-end spaces such as wine libraries, entertainment rooms, and special event rooms. Some caves have scheduled events up to 300 days a year;
- Due to the increased functional complexities, spaces are wider and taller, and must accommodate tanks and complex mechanical systems for winemaking;
- Special requests enable our firm to demonstrate our experience and creative talents; and
- In this small but rapidly growing market, a good reputation is critical and is our best marketing tool.

Typical wine caves are constructed as tunnels using standard tunneling equipment. Frequently standard shotcrete approximately 2 in. (50 mm) thick is applied over welded wire fabric. Structural shotcrete is 4 to 8 in. (100 to 200 mm) thick depending on span and ground considerations. The O'Shaughnessy project consisted of an 8 in. (200 mm) double mat of welded wire fabric and 8 ft (2.4 m) rock bolts with 1 in. (25 mm) diameter 3 in. (75 mm) holes on 6 ft (1.8 m) centers. The finish coating was 3/8 to 1/2 in. (10 to 13 mm) in thickness.



Beautiful double doors greet visitors at the O'Shaughnessy Wine Cave

Lighting was a very important consideration. Betty O'Shaughnessy wanted to avoid an industrial look. All lights have sconces that wash light up and down. The lighting was all done to create a quiet mood. The lighter colors help create a friendly environment. The softened coloration makes people want to be there and helps create a "Wow!" factor into the huge space.

It was important to avoid creating a claustrophobic environment. The 26 ft (7.9 m) wide by 20 ft (6.1 m) high tunnel needed to convey a friendly, inviting atmosphere even at 65 ft (19.8 m) below ground level. A sense of infinity was created by constructing a semi-circle so the ends could not be seen at the same time. Humidity is a constant 70% with a temperature of 58 to 60 °F (14 to 15 °C).

Wine makers in Napa, Sonoma, and in other famous wine producing regions have turned to underground storage because of the many unique advantages provided by an industry that prides itself on excellence. Man-made wine tunnels, or caves, make ideal storage venues for aging some of the world's best wine. Modern caves are more energy efficient and secure than surface storage warehouses. They provide the constant, or near constant, temperature and humidity levels ideal for aging the region's most famous product.

Fine wine is aged in oak barrels for one to three years depending on the winemaker's whim. Most white wines spend only a year in barrels while most red wines are barrel-aged for at least 2 years. Housing barrels in a surface warehouse can result in evaporation through the barrel in excess of four gallons/barrel/year compared to a single gallon loss, which is more typical of underground storage. Wineries with annual production of thousands of barrels have a lot to lose via surface storage.

The success of wineries depends heavily on public perception. When it comes to marketing, vintners are finding that shotcrete wine caves create the cool, quiet ambiance useful in creating an environment conducive to relaxing and enjoying the wine selection process.

Initial excavation at the portals requires the application of shotcrete every 2 to 4 ft (0.6 to 1.2 m). Depending on ground conditions, excavation can ultimately proceed at distances up to a maximum of approximately 20 ft (6 m) before receiving the initial application of shotcrete. Very weak or unstable soils may require shotcrete reinforcement every foot (0.3 m) or so.

White portland cement is used in batching the final stage of the process, producing a reflective surface on the cave's interior walls. This is where the structural advantages of shotcrete become secondary to the architectural versatility of the product. Finishes ranging from rough unaltered shotcrete to smooth plaster-like textures and everything in between are possible depending on



Access portals lead to the main chamber



The main chamber is open and impressive



A curved layout and soft lighting give the impression of infinity



White cement shotcrete with a standard finish was carefully selected



Soft lighting washes up light-colored shotcrete finish

the owner’s preference. Both large and small wine making operations use underground wine storage. Shotcrete made with white cement is ideally suited to this final stage of the process. It is strong, fast setting, and much more reflective than standard gray cement shotcrete. White cement shotcrete can be tinted with integral pigments with ease because there is no dark gray cement paste to battle with.

Optimizing land-use is an additional benefit associated with wine caves. Prime wine growing

land is valuable. Having underground storage allows the vintner to maximize surface activity for grape production. The versatility of shotcrete is proving to be the perfect solution to an owner’s desire for strength and beauty to provide a unique atmosphere to enjoy the fruits of their vineyard.

<p>Project O’Shaughnessy Vineyard, Wine Storage, Angwin, California</p> <p>Description Construct Underground Wine Storage Cave for Napa County Wine producer.</p> <p>Contractor Glen Ragsdale Underground Associates Inc., Angwin, California</p> <p>Geotechnical Engineering Condor Earth Technologies Inc.</p> <p>Shotcrete Supplier Harold Smith & Sons</p>



Larry Rowland, Marketing and Technical Services Manager for Lehigh White Cement, is responsible for white cement marketing and technology services for North America. His primary focus is customer

service and promoting the use of white cement in architectural applications. Rowland has 20 years of experience in the construction and material sales industries and enjoys providing material to solve unique engineering and design challenges. He regularly speaks to producers, architects, engineers, and students about how to best apply material practices that yield finished products that are beautiful and practical. Rowland has lived in northern California since 1983.