

Creating a Wine Cave

By Jason Zignego

The perfect temperature for storing wine is between 58 and 61°F (14 and 16°C). In Springfield, MO, where temperatures vary 80°F (44°C) between January and July, there's only one way to assure those ideal wine storage temperatures: go underground. For one private homeowner, the appreciation for wine extends to the construction of a wine cave under his home for storage and enjoyment of his collection. Drawing on the talents of architects, engineers, cave contractors, and a wine cave consultant from Napa Valley, this personal tribute to fermented grapes is being built with extensive use of shotcrete.

Wine caves have been constructed for more than a hundred years in northern California's Napa Valley, where land values are high and the evaporation from wine kegs can result in up to

10% product loss in 2 years if humidity isn't properly controlled. Wine makers consider humidity over 75% for reds and over 85% for whites to be ideal for wine aging and barrel storage. Humidity in wine caves ranges naturally from 70 to 90%. "Ideal wine temperature is between 58 and 60°F (14 and 16°C)," explains wine cave consultant Brady Mitchell, a hands-on cave construction specialist from Napa (refer to Fig. 1). The temperature 45 ft (14 m) under the home of the Missouri wine aficionados' new home is 60°F (16°C). "Perfect," states Mitchell.

Excavation into a hillside below the home site began in 2012. Bacchus Caves (The Woodlands, TX) dug the tunnels, including a 150 ft (46 m) long shaft that will be used for wine storage. A 2 ft (0.6 m) diameter cutting head attached to a hydraulic excavator broke up the



Fig. 1: Brady Mitchell is a modern-day cave man who specializes in wine cave construction, having built many in the Napa, CA, area



Fig. 2: Dry-mix shotcrete was used for structural support during excavation

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limestone and red clay earth. A skid steer removed the spoils. Dry-mix shotcreting was used for soil stabilization. "Because they would excavate then shotcrete sporadically, they elected to use the dry-mix method because it could be applied on demand without a pump and ready mix truck standing by," Mitchell explained. The Quikrete product used for dry-mix shotcreting is a specially formulated microsilica-enhanced, portland cement-based, high-strength structural material (refer to Fig. 2).

Over the 2 years of excavation and shotcreting by Bacchus Caves, their efforts resulted in the 10 ft (3 m) diameter x 150 ft (46 m) cask storage tunnel, a 17 ft wide x 15 ft tall x 23 ft long (5.2 x 4.6 x 7 m) bottling storage room, an 18 x 15 x 40 ft (5.5 x 4.6 x 12 m) tasting room, a 17 x 15 x 48 ft (5.2 x 4.6 x 15 m) dining room with butler's pantry, and 10 x 10 x 30 ft (3 x 3 x 9 m) wine library. "The excavation and shotcreting moved pretty slowly because it is clay soil with huge suspended boulders interspersed throughout the area," Mitchell explained. "They did have a cave-in for an area we were calling the "Grotto," which was finally abandoned." The cave has two portals: the outside entrance, and an access point from the basement of the house with a spiral staircase and elevator (refer to Fig. 3). Hundreds of cubic yards of the dry-mix shotcrete were consumed during the process. "Every couple of feet, they would apply a structural coat of shotcrete and then reapply additional coats over previously applied shotcrete as they came back out," said Mitchell.

After excavating and structural shotcreting was completed, 4 x 4 in. (100 x 100 mm) welded wire reinforcement was applied to the entire interior surface and spaced off the walls. The electrical conduits were placed between the two layers of shotcrete. "We placed 6 in. (152 mm) of wet-mix shotcrete for the final tunnel liner, applied in 1.5 in. (38 mm) layers," Mitchell, who is also the nozzleman, explained. "This would result in about four passes to achieve 6 in. (150 mm) of wet shotcrete applied over as much as 14 in. (350 mm) of dry mix" (refer to Fig. 4). The wet mix sped up the process by spraying at a much higher rate than dry-mix shotcrete. Screed rakes were used to contour the larger radii such as the arches (refer to Fig. 5). Hand trowels were used to knock down any high points. Three color samples were test batched for the owner. Mitchell and co-worker Rich Lederer worked together to create the organic shapes. "Nature drives the design."



Fig. 3: Exterior portal leads to 150 ft (45 m) long tunnel and various chambers to create a wine cave 45 ft (14 m) under the owner's new home



Fig. 4: Wet-mix shotcrete was applied 6 in. (150 mm) thick over welded wire reinforcement in four passes



Fig. 5: Organic shape is sculpted wet shotcrete, hand-raked and troweled

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Fig. 6: Schwing S17 with 180-degree discharge serves as line pump for shotcreting up to 400 ft (120 m) inside the tunnel

Wet-mix shotcrete pumping was handled by Brundage-Bone from their Springfield location. “We have pumped steadily every day in March, April, and May,” Mitchell said. “The Brundage operators have been great and most of the time, the Springfield District Manager, Andy Baugh, is on-site to lend a hand.” The company has been using several of their pumps on the project, including a Schwing S17 boom pump discharging directly out the back, an SP 500, and an SPT 1000 truck-mounted pump (refer to Fig. 6). All pumps are equipped with fast-switching Rock Valves for surge-free operation at the hose. Pumping distances have exceeded 400 ft (120 m) with a line diameter at 2 in. (50 mm) where it enters the shotcrete nozzle. “At the end of the day, we wash out the 2 in. (50 mm) hose and blow out the 3 in. (75 mm) line back to the pump,” explained Mitchell. “Being that far from the pump, I need to trust the operator and Brundage-Bone’s crew is real good. I don’t feel like I have to look over my shoulder.”

Mitchell hand-formed 200 recesses for light fixtures, with some 8 in. (203 mm) deep. “There is an art to forming the arches and recesses for dramatic shadows,” explained Mitchell. “For utilitarian purposes, we can leave a naturally coarse finish, but this wine cave will be enjoyed by the owner and his guests so some rooms will have a smooth finish and some will be covered in plaster or woodwork.” A chandelier in the tasting room will appear like a tree root growing through the ceiling. The wine library houses the bottles in racks with sufficient lighting to easily read the labels. Wine of sufficient potential will

be sourced and the barrels aged in the cave to be rotated every few months so the sediment can be drawn off. After a couple of years of barrel aging, the wine will be blended and bottled. Humidity will be carefully controlled.

For Mitchell, a 40-plus-year veteran of the wine industry (he began cleaning tasting rooms at 13), it is a satisfying construction career in an area not many people have chosen. “Most of the people in the wine cave industry know each other,” explained Mitchell. “I have poured more than a million square feet of cave floors in my career. I still have a 1986 Schwing BP 750-15 back in Napa that pumped most of those cave floors and it still works fine.” Mitchell will add to his cave floor square footage when he pours the cave floors with Brundage-Bone pumps later this year.



Jason Zignego, Sales Manager, Stationary Pumps, with Schwing America, St. Paul, MN, is a 20-year employee of Schwing. He started in the company as a Sales Assistant and became Sales Manager 5 years ago. He is a hands-on specialist, having worked with shotcrete pump applications his entire career. He is always available to answer any questions regarding wet shotcreting with Schwing stationary pumps; contact him at Jzignego@schwing.com.

Project Details

Excavation

Bacchus Caves
The Woodlands, TX

Engineering

Brierley Associates
Denver, CO

Architects

Slone and Associates
Springfield, MO

Cave Finishing Contractor

Brady Mitchell
Napa, CA

Pumping Equipment

Schwing S17
SP 500 stationary pump
SPT 1000 truck-mounted pump