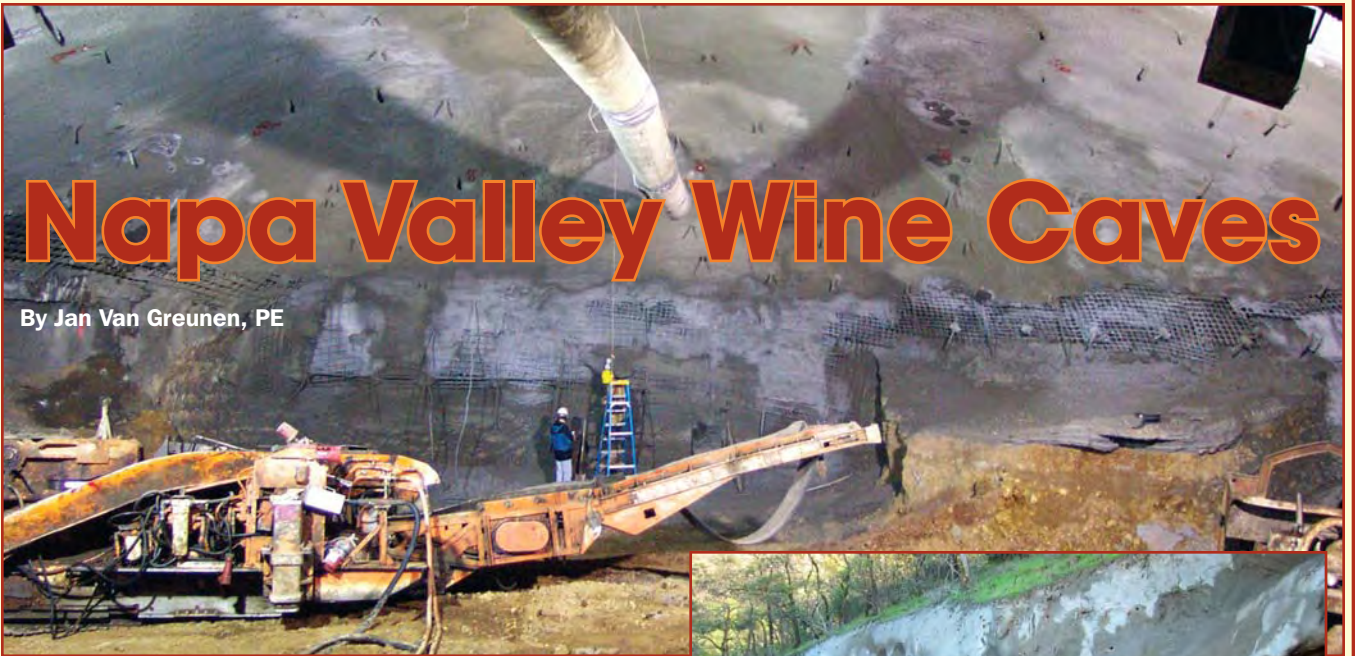


# Napa Valley Wine Caves

By Jan Van Greunen, PE



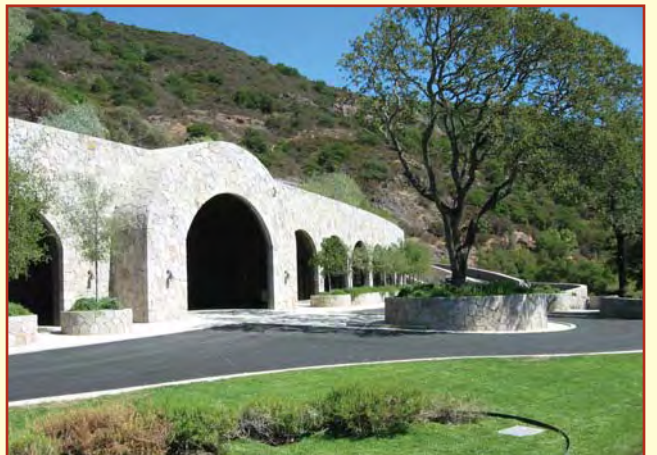
Napa Valley is the heart of the winemaking industry in Northern California. Growth in the region over the past 40 years has put a premium on land available for vineyards, driving many vintners to use underground space for wine facilities. Although the cost of constructing a wine cave is similar to the cost of constructing an aboveground facility, certain features of wine caves result in substantially lower overall costs when operating costs are considered.

Low temperatures and high humidity, combined with minimal seasonal variations, reduce utility costs and wine loss through evaporation. Savings from these factors alone can pay for wine cave construction in six to eight years. In addition, fewer environmental and permitting constraints are placed on underground construction than aboveground construction.

Typical wine caves vary in size from 6,000 to 15,000 sq ft of underground space. The wine cave shell generally consists of wire mesh reinforced shotcrete. Due to the factors mentioned above wine caves are mainly used for aging of wine in barrels. In addition, some wineries place their tasting and sales operations underground as part of their marketing strategy.

One of the largest and most complex of the underground facilities built in Napa recently is the Palmaz Family Vineyards wine cave and car museum. The 550-acre Palmaz property includes approximately 60,800 sq ft of underground space, 50,000 of which are devoted to winemaking and 10,800 of which house the car museum. The wine cave centers around a 75-ft diameter underground dome that is 50 feet high. It houses two levels of fermentation tanks. The upper tanks rest on a 60-foot-diameter rotating carousel that allows the tanks to be filled, in turn, with juice from the crushing and screening machines. The lower tanks store the wine before it is transferred to barrels for aging.

An interesting feature of the Palmaz winery is that only gravity is used to move wine from crushing to fermentation, aging, blending and bottling. This is thought to preserve more of the natural flavor of the grapes. To avoid pumping and utilize gravity, the winery was constructed on four levels. There are exterior entrances at each level, and vertical connection



The 10,800 sq ft car museum (shown top to bottom in stages of construction) houses more than 40 antique racing cars.

is achieved via a 150-ft high shaft that houses the stairs, tank elevator, passenger elevator and utility duct.

The underground dome was constructed using the sequential excavation method (SEM) with permanent rock dowels and an 18-in. reinforced shotcrete final lining. The ground above the dome slopes approximately 20 degrees, and ground cover averages 30 ft.

The car museum was designed to maximize open space for display of the family's exotic collection. SEM construction in-

cluded the excavation of six horseshoe-shaped tunnels, 13-ft wide by 16 ft-high and approximately 66-ft long, to install the main steel arch support frames and associated foundations. The final lining consisted of steel sections that were encased in reinforced concrete/shotcrete.

Jacobs Associates provided design services for the project, which was completed in December 2007.

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Temperature in the wine caves stays at a constant 60 degrees with 75 percent humidity; ideal conditions for aging wine.



The fermentation dome is the world's largest underground reinforced structure at 72-ft diameter and 54-ft high.



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