Concrete repairs after California tunnel fire

The fast response from the US specialist hydro-demolition contractor and rental company HydroPressure Cleaning (HPC) has contributed to the rapid repairs to a strategic road tunnel in the Newhall Pass on the major I-5 Interstate near Santa Clarita, California about 48km north-west of Los Angeles.

Lars-Göran Nilsson, Conjet, Haninge, Sweden

The California Department of Transportation (Caltrans) instigated the approximate US$19 million restoration, which included the removal of the entire concrete skin from both walls of the fire-damaged tunnel by HPC with its two Conjet hydro-demolition robots, followed by reskinning with a new sprayed concrete lining.

The approximately 183m-long, two-lane, rectangular box-shaped, reinforced concrete tunnel, known locally as the truck bypass tunnel, takes south-bound traffic only. It runs under a portion of the south-bound sections of the highway and is near the main intersection of the I-5 Golden State Freeway, and Antelope Valley Freeway.

After a collision of several trucks and cars, a massive fire erupted in the 12.2m-wide tunnel. The wind helped spread the flames from one end to the other, and the searing heat, with temperatures up to 1400°C, caused the concrete to split. The accident, involving around 31 vehicles, occurred late at night and entry to the tunnel was impossible while it was ablaze. It was allowed to burn itself out before emergency services were provided and engineers from Caltrans could start inspecting the damage in the late afternoon of the following day.

HPC saw the accident on the local news and immediately contacted Caltrans and its initial emergency repair and clean-up contractor Chumo Construction. HPC, based in Camarillo, about 80km from the tunnel, explained the benefits of using the hydro-demolition technique of high-pressure water jetting to selectively remove only damaged or unsound concrete.

"We went to site a week after the accident and removal of the debris from the tunnel, and were given the go-ahead to start with concrete removal tests with our Conjet 322 hydro-demolition robot," says HPC general manager Paul Phelps.

"We initially used different water pressures of 20,000, 15,000 and 12,000psi (1360, 1020 and 816bar) with the Conjet 322 Robot and our 500hp (373kW) high-pressure pump and removed concrete in 0.6m-wide, 1.5m-high patches every 15m from the walls. This enabled Caltrans engineers to see the difference in concrete condition and, together with core samples, allowed them to assess and verify the damage and develop the scope of work for the overall repair. We also did a test at 19,000psi (1290bar) using a nozzle with a narrow fan jet pattern instead of the normal straight jetting nozzle. This was great, especially in those areas where they just wanted to roughen up the existing concrete surface to get a bond for the new overlay."

(Photos: Conjet AB.)

Figure 1: The goal for specialist hydrodemolition contractor on the tunnel walls, which vary in height from about 4.88m to 7.3m, was to cut out damaged concrete to expose to the face side of the reinforcement, but in some areas concrete was selectively removed from behind the reinforcement as a means of inspection.

HPC also performed some tests on the tunnel ceiling using only hydro-demolition hand lances. From the results, Caltrans decided just to clean the soot off the tunnel soffit, except in one severely damaged area over the main fire, which had to be completely removed by a breaker mounted on an excavator and replaced with a new precast concrete beam section.

Caltrans senior bridge engineer Henry Kirzhner says, "I have used hand lances before but this was my first experience with hydro-demolition robots, which have worked well for the situation as we didn't know exactly how much concrete was damaged and needed to be removed. As we could use different pressures initially, we were able to determine how deep we should go just to remove the damaged concrete and quickly evaluate the extent of the damage, which was not consistent. This allowed us to determine the right pressure to use throughout the entire tunnel and just selectively remove the damaged and weak concrete. The biggest advantage for us was that it just took away the bad concrete and didn't damage any of the reinforcement or the good concrete left behind."

He continues, "It also created a very rough surface for a better bond for the new sprayed concrete overlay. Any conventional removal methods, such as jackhammers, could always damage reinforcement and it was vitally important for us to do removal without any damage to the portion of the structure