Cammeray Vent Shaft Excavation

Location: Cammeray, NSW | Project Value: $4.24B | Client: Acciona | Duration: July to October 2024

KEYWORDS

Construction, Tunnel, Civil, Shaft, Excavation, Drilling, Ground Support, Rock Bolts, Shotcrete, surface miner, trench, footings

INTRODUCTION

SU Tunnel and Civil were awarded the Northern ventilation shaft package which comprised the excavation and ground support of the ME11 and ME16 shafts. The ME11 shaft began as a 12x21m excavation and reducing to 9mx16m once the footings had been reached approximately 1.5-2.5m below surface depth. While the ME16 Shaft was trapezoidal shaped approximately 21m long and 15/6m on the long and short side respectively. These dimensions reduced to 17m long by 12m/4.5m once the footing depth was passed. The excavation was completed in sandstone ranging from Class Iv to class I, ground support requirements were a single layer of fibre reinforced shotcrete and 1.2m CT-bolts.

CASE STUDY DETAIL

The excavation of shafts is challenging with limited space and the requirement to supply the excavation work front with various plant and materials based on the current activity often means large cranes to lift plant in and out of the shaft. The excavation of the shafts at Cammeray was required to be completed in a short timeframe and the site was situated in north Sydney creating access issues for large machinery and making surface space a premier. Considering these constraints SU developed a methodology that would maximise the excavation time and minimise the requirements for large cranes to remain on site.

Excavation in rock:
During the tender phase the client had expected the use of 24T Excavators to excavate the rock due to the small size of the shaft after the excavation continued beyond the footings. However, by using ShortBoom excavators the size of excavator available to be used in ME11 was able to be upsized to a 35T Excavator. This increased the production and shortened the program time. The hammer selected was a 3T hammer which allowed a balance of high production while also being capable of trimming the wall.
Additionally, by utilising a telescopic excavator with clamshell bucket the need for a crane and mucking kibble to load out rock was removed.

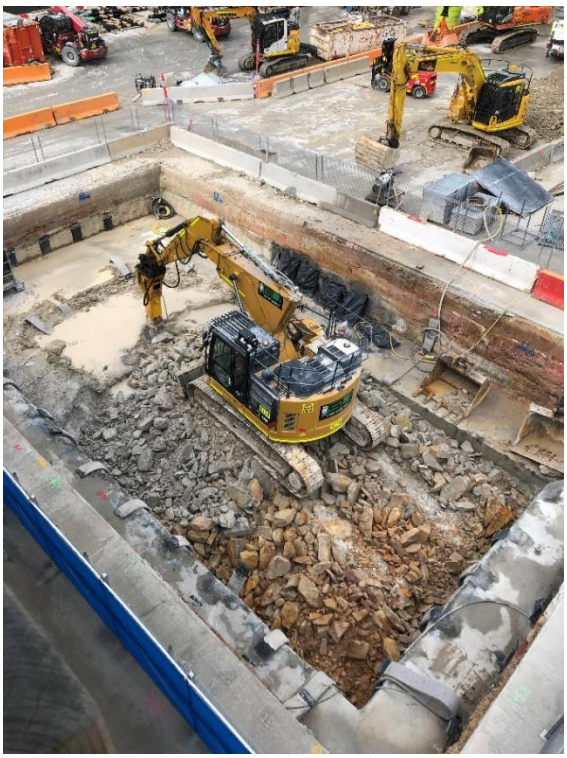

Figure 1. Excavation ME 11, 35T Shortboom

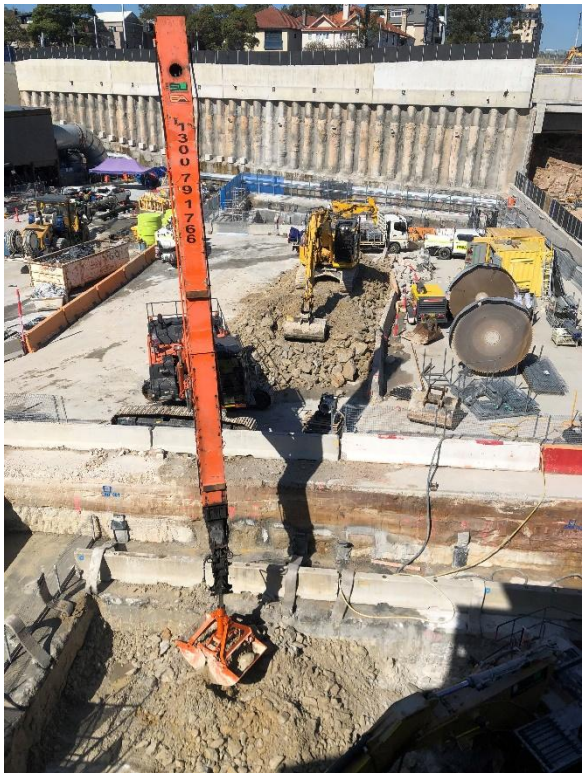

Figure 2. Telescopic Excavator Mucking Out

Access/Space constraints

The available surface space on the site was limited due the location in the inner-city suburbs. Due to these space constraints, it was not ideal to have any large cranes come onto site for any extended period. SU opted to use a drill attachment that could be connected to both the 35T Excavator and 24T Excavator, rather than an independent drill rig. This allowed a smaller Franna to be used to lift the drill attachment into the shaft. This kept the requirement for large cranes to a minimum, only required to lift the excavator out at completion of the Shaft excavation.

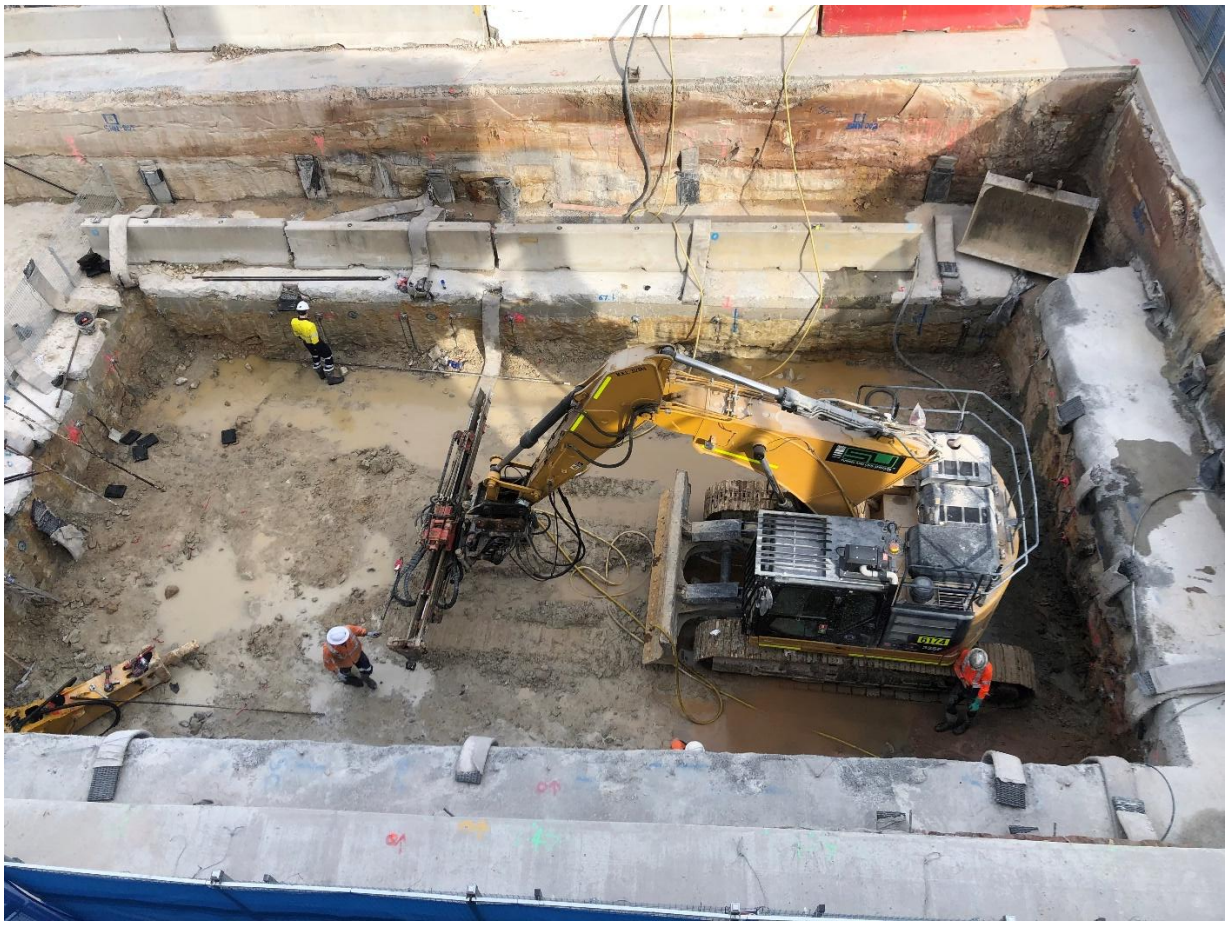

Figure 3. Drill Attachment on excavator

Shotcreting

A self-powered midjet was used to allow easy manoeuvring between both shafts. Hand spraying was opted for so the rig could remain on the surface and have concrete agitators feed directly into the hopper of the midjet. This minimised the requirement to bring a larger crane in to lift the shotcrete rig in, as well as the requirement to either have a crane and kibble supplying the shotcrete or a boom pump.

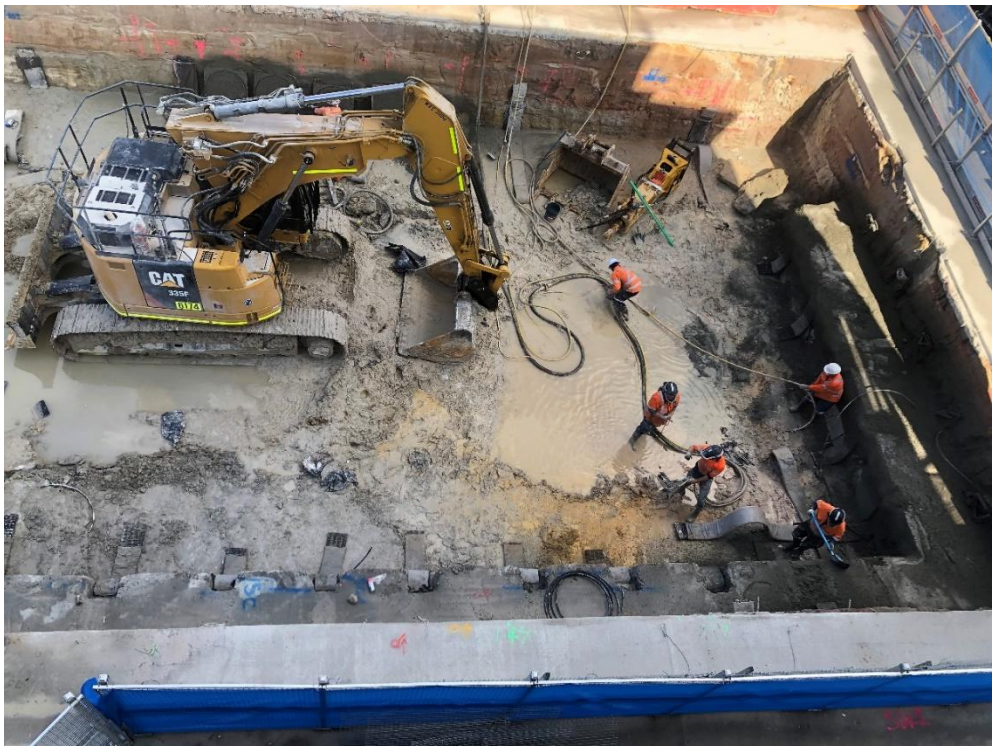

Figure 4. Hand spraying Shotcrete

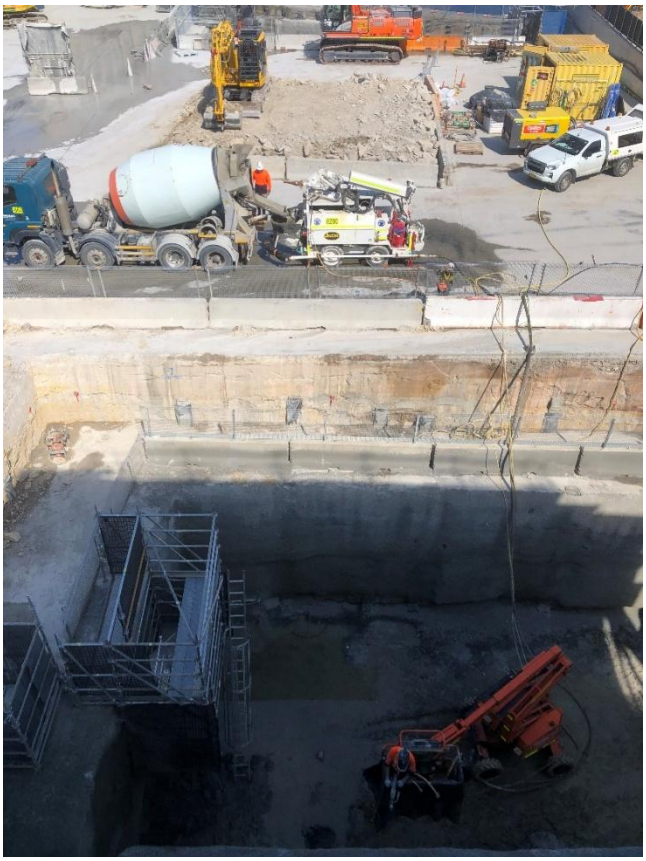

Figure 5 Shotcrete direct feed and handspray from kibble

Sawcutting and Trimming

The trimming of the shaft walls also requires some time to meet tolerances. An effective method for meeting tolerance is by using a diamond saw, or similar, to cut the C-line of the shaft walls. However, this takes a large amount of time to sawcut the faces of each lift. SU opted to cut the first lift in each shaft and use that cut as a reference for the following lifts to then trim with a hammer. This greatly reduced the program as only one excavator was able to be operating in the shaft due to the smaller dimension size.

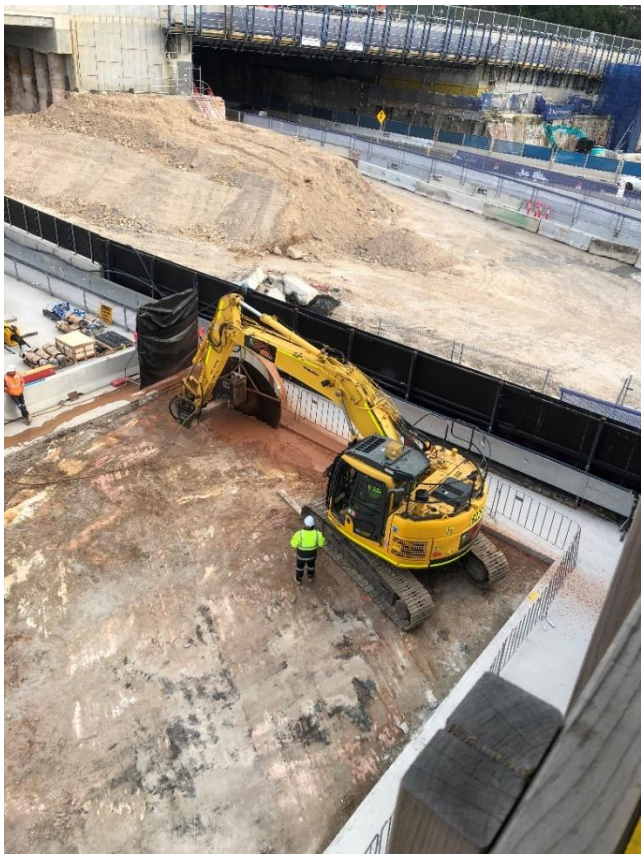

Figure 6. Sawcutting ME11

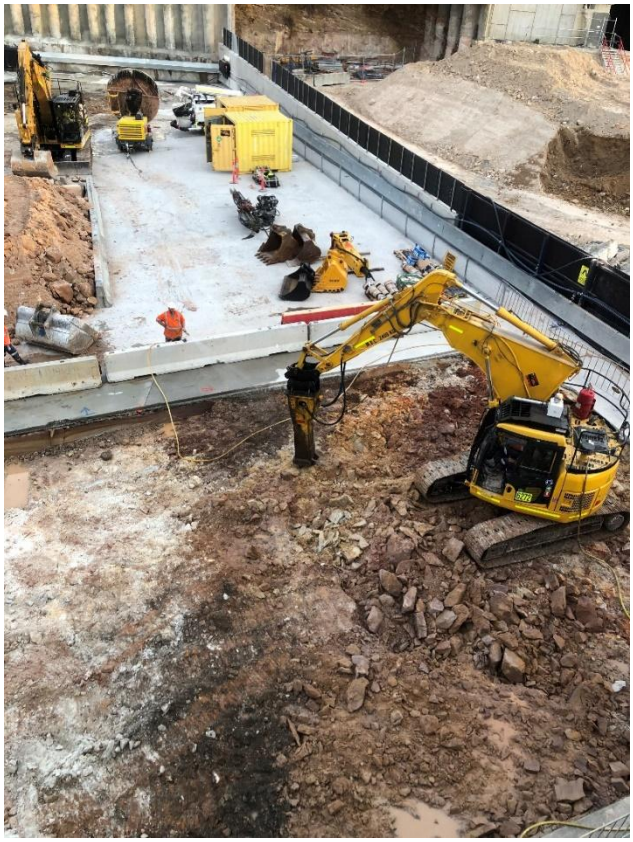

Figure 7. Trimming along saw cut

Surface Mining

During the works the client had a need to excavate the surrounding ground down approximately one metre. Given the site location was in a built-up city location, dust generation was a large concern as well as noise generation. On this project we were able to use the T1255 direct drive surface miner which allowed works to progress throughout the day without need for respite periods. The onboard dust scrubber also kept dust generation down to a minimum because the dust shroud effectively stopped the dust generation while operating. The periods where the most dust was generated was when first excavating into the surface before the cutting head was fully encapsulated by the ground and dust shroud, this dust generation was further mitigated by piling loose rubble under the cutting head when starting to allow the head to bury itself in the material before generating dust in the solid rock.

Figure 8. Surface miner excavating material

Trenching/Footing Excavation

In addition to the shaft excavation there were surrounding trenches and footings that were required to be excavated for the building footings. Given the trenches were joining directly into the shaft and the multiple crossing that the trenches had with each other, a trencher was not a good fit for the works, instead the same machines used throughout the shaft excavation and the saw cutting were used again to cut the trenches. Some trenches required two cuts to achieve depth as the saws were only capable of cutting 1.2m deep per cut. An additional 15T Excavator with Knuckle boom was used to clean the trenches out as it could access the trenches without straddling them.

Figure 9. Saw cutting the trenches for building footings

Figure 10. Hammering and mucking out trenches for building footings