HOCHTIEF UK CONSTRUCTION

SNOWDONIA VISUAL IMPACT PROVISION PROJECT

SHAFT CONSTRUCTION (CILFOR)

C0233-HUK-GES-IS-PL-W-0001

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P01	23/03/2023	MGE	DGM	LBR	For Information
P02	22/05/2023	MGE	DGM	LBR	Section 5 updated
P03	23/05/2023	MGE	DGM	LBR	Section 4 updated

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ISO 9001 Quality Management Systems CERTIFIED FS 29825
ISO 14001 Environmental Management CERTIFIED EMS 70489
ISO 45001 Occupational Health and Safety Management CERTIFIED OHS 531558
ISO 50001 Energy Management CERTIFIED ENMS 632421
BIM Design & Construction Capital/Delivery VERIFIED VC 653436

Contents

1.0 Brief Method Statement & Sequence Drawings

The Cilfor shaft construction sequence is shown schematically in Figures 1 – 3 below. The shaft will be approximately 64m deep with an outer diameter of 16.3m and an inner diameter of 12.5m on completion.

Cilfor shaft-construction is considered in two phases:

- Phase one will construct a circular secant-pile-wall to cut off the soft and wet ground conditions in the superficial deposits (Peat, Clay, Sands and Gravel, 4 to 8m deep) overlying the competent mudstone;
- Phase two will excavate rock in the competent mudstone which will be pre-treated with grout injections to control potential water infiltration through possible fissures and voids.

At the start of the works a raised working platform 5.0m above ground level will be constructed made of unbound aggregates from local quarries.

The raised working platform will be used by two to four drilling-rigs to drill down into the bedrock to pressure-grout fissures or voids present in the underlying mudstone. This will create a grout curtain wall and shaft base with low permeability ground needed for shaft sinking (see Figure 1 below).

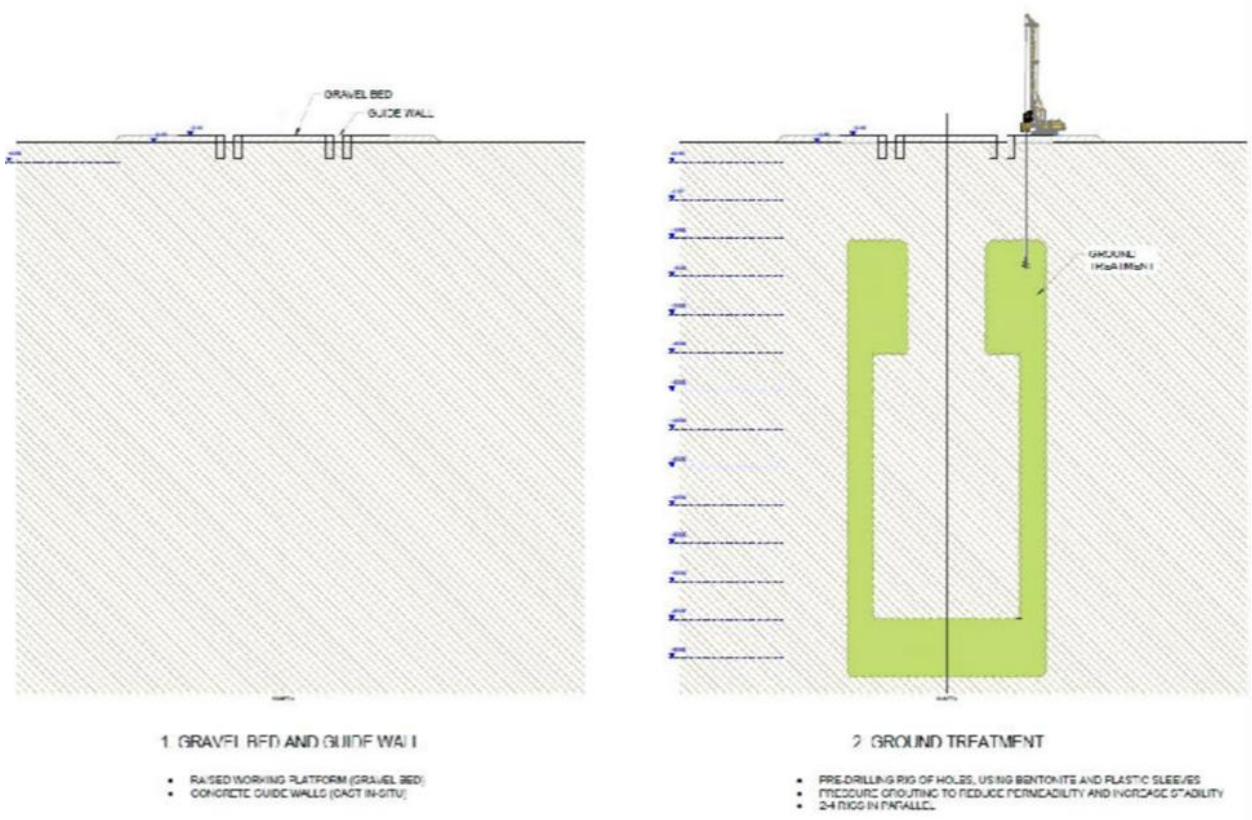

Figure 1

A minimum 10% of the grout injection holes will be re-drilled for post grouting permeability testing. Drilling of grout injection holes and permeability testing holes shall be by water flush methods only (i.e, rotary, rotary percussive or down hole hammer). The grouting shall be by means of open hole injections only.

After ground treatment a circular secant-pile wall will be constructed tied together by a capping-beam at the top. This will limit groundwater ingress during shaft excavation through water logged superficial deposits. The concrete secant piles will be made with full length temporary steel casings to contain liquid concrete while it hardens (see Figure 2 below).

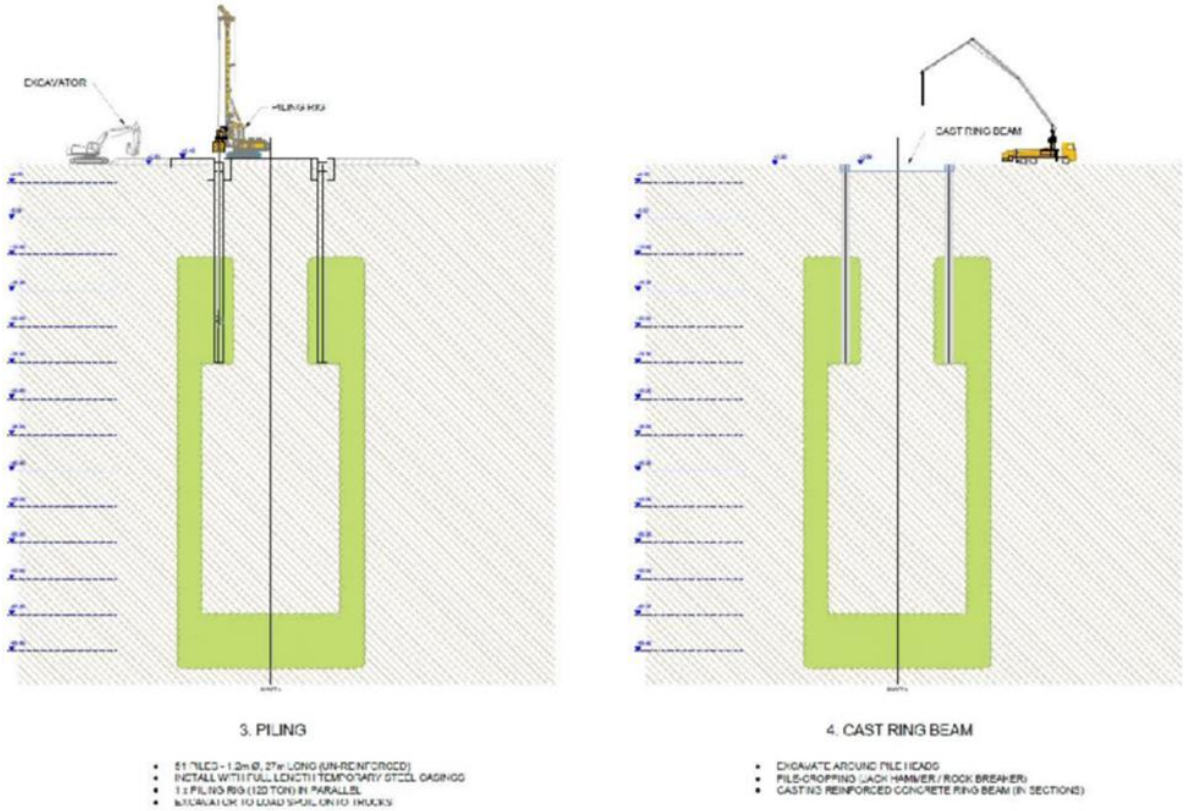

Figure 2

A pump-test will be undertaken inside the cut-off shaft prior to excavation. The expected volume of water-seepage during the excavation is between 2 - 5m3/hr (increasing with depth). The resulting permeability of the mudstone is tested by re-drilling some of the holes during the grouting,

The phase one excavation of the upper part of the shaft (within the secant piles):

- will be progress downwards in vertical increments of up to 4m. A smoothing layer of sprayed concrete (shotcrete) will be applied to the secant pile wall in the shaft and a cast in situ reinforced concrete lining constructed;
- the shaft base perimeter will be strengthened with a reinforced concrete circular support beam tied into the grouted zone by sub-horizontal rock bolts.

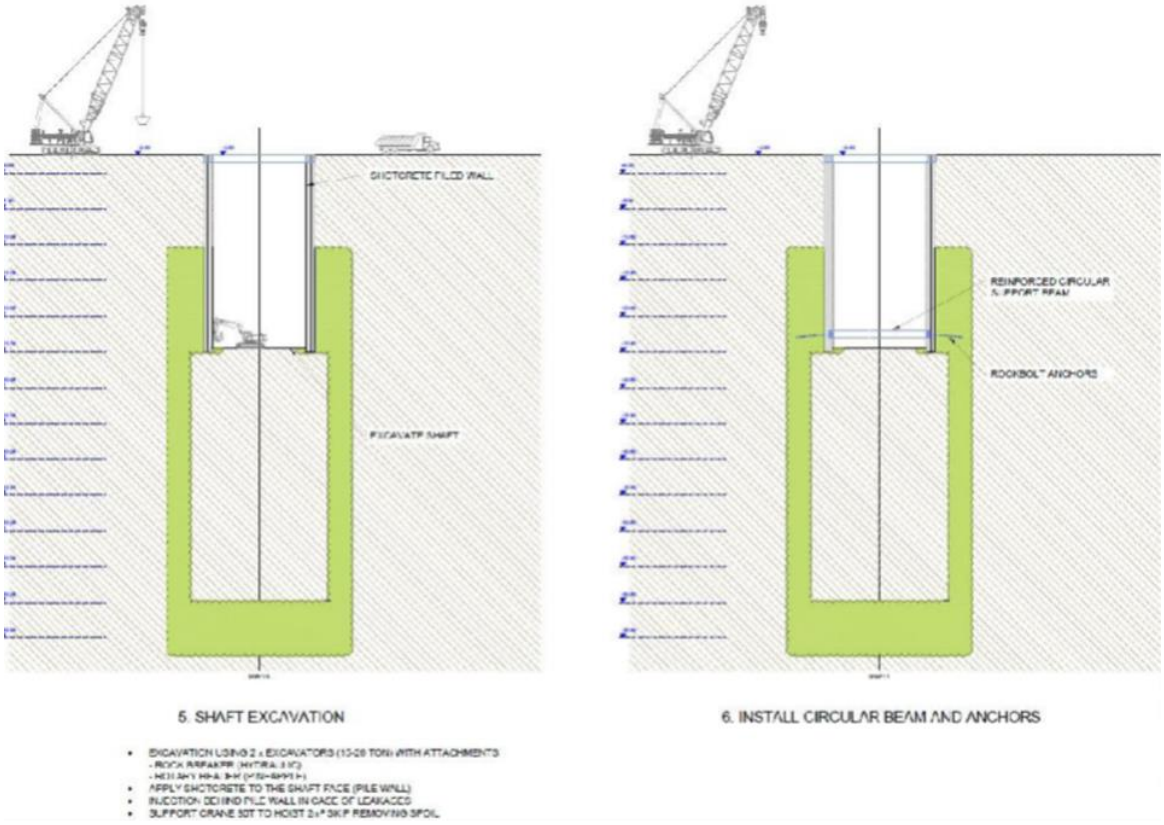

Figure 3

The phase two excavation of pre-treated rock (see Figure 4 and 5 below):

- will be progress downwards in vertical increments of up to 4m;
- to 40.0m below ground level the shaft sides will be supported by spot rock bolting as required;
- from 40.0m to 60.0m below ground level the shaft sides will be supported by sub-horizontal rock bolting on a regular grid;
- on reaching the base of the shaft a cast in situ reinforced concrete base slab will be constructed. This will have an underlying drainage layer and blinding and overlaying mass concrete fill. The underside of the concrete slab will be approximately 63.3m below ground level;
- after casting the permanent base-slab the sides of the excavation will receive a watertight membrane and geotextile, and a cast in situ reinforced concrete lining will be constructed (slip-forming up to the top).

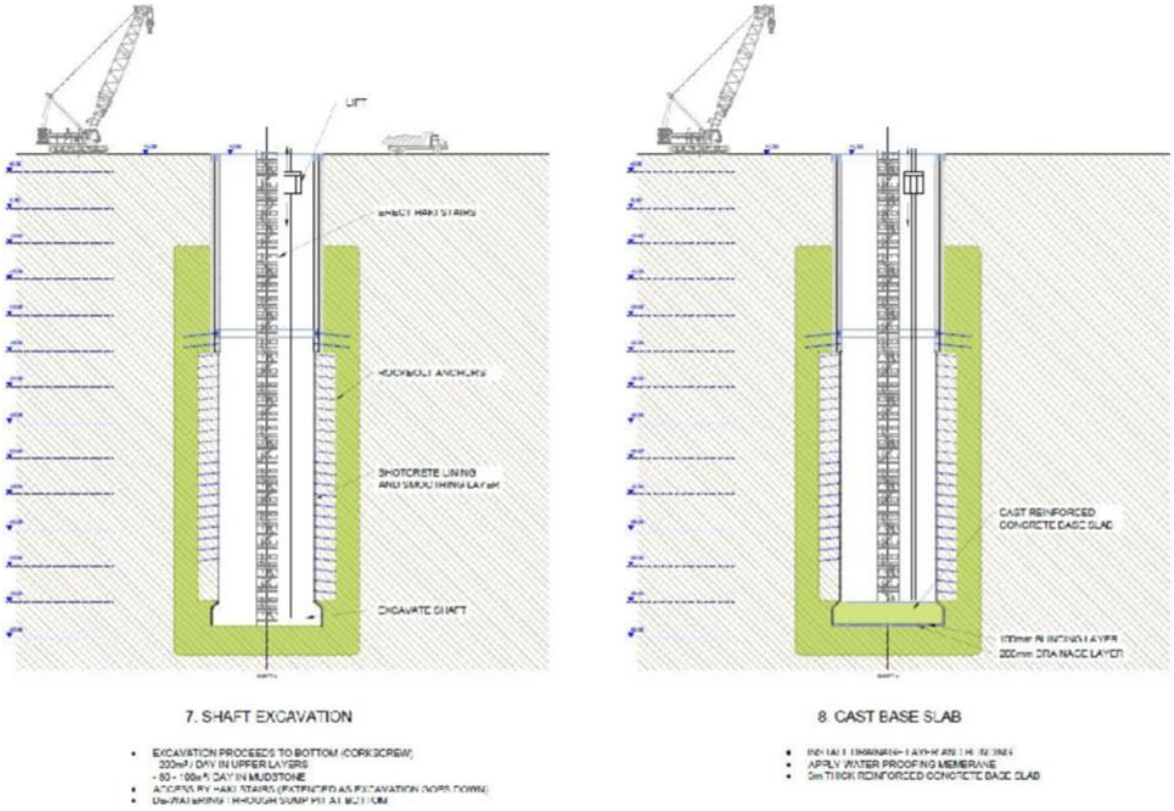

Figure 4

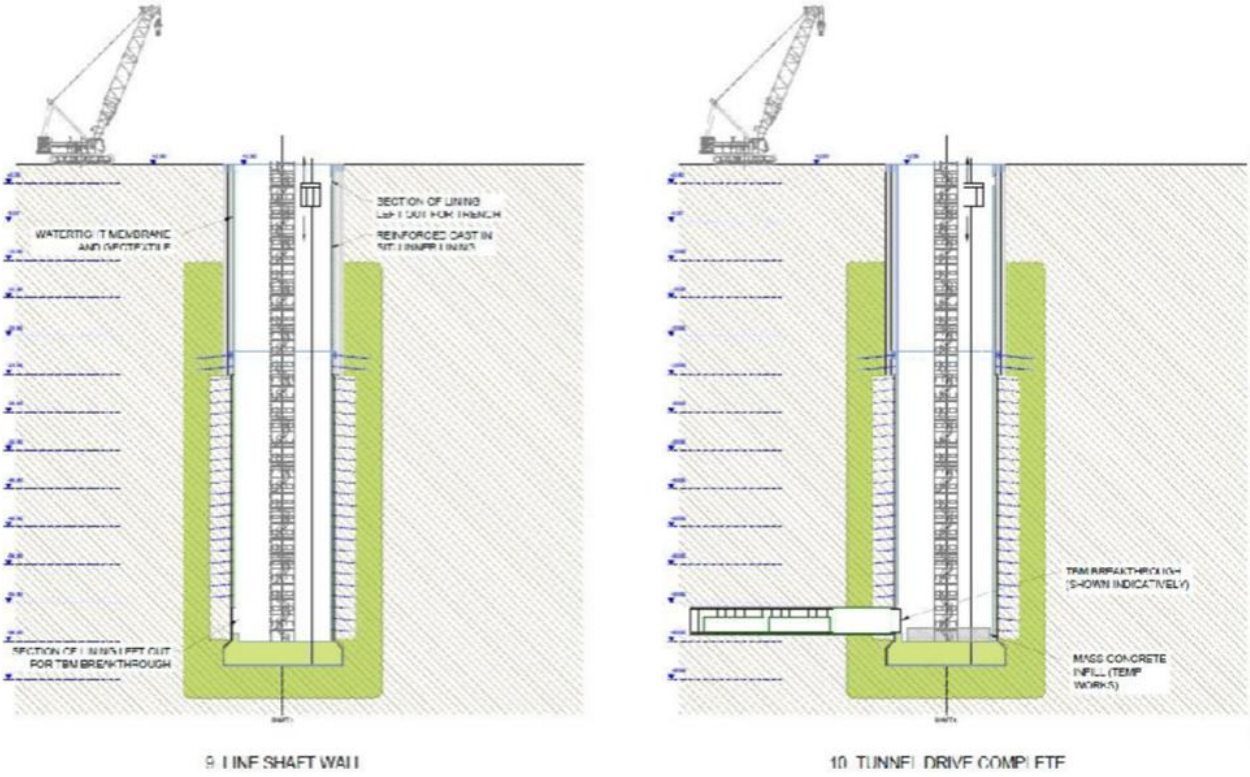

Figure 5

2.0 Cilfor Shaft Construction Materials

	Use	Material	Quantity	Specifications	Method of use	Contact with soil / gndwater	Programme
1	Ground improvement Shaft	Grout **(note 1)**	**411 m^3**	Ultra Fine Cement	Jet Grouting (Injections) from above ground.	**Y**	Start 08.2023 End 02.2024
2	Ground improvement TBM reception	Grout **(note 1)**	**66 m^3**	Ultra Fine Cement	Jet Grouting (Injections) from above ground.	**Y**	Start 08.2023 End 02.2024
3	Secant pile wall	Concrete **(note 2)**	**1939 m^3**	Male pile: C32/40 Female pile:C8/10	Bored piles in-situ concreted.	**Y**	Start 02.2024 End 06.2024
4	Excavation	Shotcrete **(note 3)**	**1930 m²**	Shotcrete. 24m - 69 m = 35m Area Ø17.5m	Spraying against Ground improvement	**N**	Start 07.2024 End 10.2024
5	Mass Concrete Base slab	Concrete **(note 2)**	**240 m²**	C28/35 Area approximately 240 m²	Base slab in-situ concreted.	**Y**	Start 11.2024 End 11.2024

Notes.
1. The ground improvement grouts will be supplied by Zublin AG UK
2. The concrete will be supplied by TG Concrete and Cambrian Services
3. The annulus grout and shotcrete concrete additives supplied by Normet

3.0 Estimated water abstraction during shaft construction

The Cilfor shaft construction will involve extensive ground improvement works to reduce the permeability of the ground that the shaft is excavated into.

The construction of the shaft's secant wall and grout block will displace some groundwater. This displaced water will be collected and pumped to a treatment plant to neutralise the pH and remove settleable solids. The volume of groundwater displaced is assumed to be equal to the volume of the secant piles (56 No. 0.6m diameter 24m long). The estimated daily volume of water abstracted as a consequence of this work is assumed to be up to 40m^3/day. The treated water will be discharged off site in accordance with NRW requirements.

A groundwater pumping test will be undertaken using a test borehole in the shaft to demonstrate that the shaft walls are sufficiently well sealed prior to excavation. The maximum volume of groundwater expected to be pumped from the shaft during the pumping test is 100m^3/day. If the volume of groundwater pumped during the test approaches this volume further grouting will be undertaken to further seal the shaft walls until the pumping test abstracts less than 60m^3 /day. Once the pumping test demonstrates that the shaft is sufficiently well sealed then shaft excavation will begin.

During the 5 month excavation the volume of water expected to seep into the shaft will range between 50 - 120m3/day. During excavation the flow into the shaft will be controlled by:

- only exposing a small section of rock-face as we excavate down;
- apply rocknails and shotcrete, and possibly do additional injections when required.

Once the shaft is excavated a waterproofing membrane and permanent inner lining will be installed from the bottom of the shaft to the top of the shaft. Once the shaft is lined it is expected to be effectively water tight.

4.0 Cilfor Shaft Construction Programme Summary