

Construction Solution for Cylinder Well in Aluminum Cast House

Author: Su Zewei

China Nonferrous Metal Industry's Foreign Engineering and Construction Co.,Ltd, P.R.China

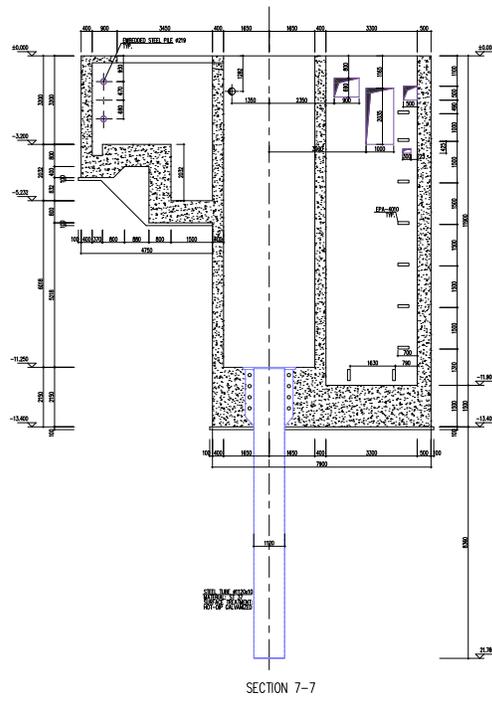
Abstract: The products for aluminium smelter are mainly divided into 3 categories, ingot, slab and billet. The billet shall be produced by the vertical casting machine. Referring to the requirement of the casting machine, a cylinder well shall be prepared before the equipment erection. Usually the well is more than 20m underground. So some necessary action shall be considered during the construction. For example the collapse of the soil, decreasing the underground water, geotechnical condition etc. In this paper, SALCO project, as a typical aluminium under construction now in Iran, is introduced and the author analysis different solution such as cast in-site pile, jet grouting, steel sheet pile.

Keywords: Aluminium Construction; Casthouse; Billet; Cylinder Well.

Introduction

The products for SALCO project is including slab, ingot, billet. For billet, the production capacity is 86kt/a. vertical casting machine is adopted for the billet production.

According to the vendor document of the equipment, the cylinder diameter is 1120mm, the top of the cylinder is -11.250m and the bottom is -21.760m. the vertical control for the cylinder is ± 30 mm. the section drawing for the vertical casting machine is shown in Dwg1. [1]



Dwg 1

The soil condition is shown in the geotechnical report as in table 1. [2]

ORIGIN	UNIT NAME	DEPTH (m)	DESCRIPTION
RECENT ALLUVIUM	UNIT I	0 to -5	(CL, CL/ML, CL/CH) LEAN CLAY; very stiff to hard consistency, dry, overconsolidated, organics (e.g. decomposed plants and tree roots) for 10 to 15 cm.
	UNIT II	-5 to -15	(CL, CL/ML, CL/CH) LEAN CLAY; occasionally ML medium stiff to stiff to very stiff consistency, light brown, moist, low plasticity, overconsolidated to slightly overconsolidated.
	UNIT III	-15 to -25	(CL, CL/ML, CL/CH) LEAN CLAY; occasionally ML stiff, very stiff to hard, consistency. Light brown, moist, low plasticity.
	UNIT IV	-25 to EOB - 50	(CL, CL/ML, CL/CH) LEAN CLAY; occasionally ML hard consistency. Light brown, moist, low plasticity.

Table 1

The following words in Table 1 is defined in the geotechnical report.

Hard: Indented with difficulty by thumb nail.

Very Stiff: Readily indented by thumb nail

Stiff: Readily indented by thumb but penetrated only with great effort.

Medium Stiff: Can be penetrated several inches by thumb with moderate effort.

The underground water depth from ground surface between -3.8m and 6.4m for the whole site. In the construction proposal, the underground water level is assumed in -4.5m. [2]

Based on the above mentioned vendor requirement and soil condition, two construction method will be discussed in the following paragraph.

Construction Method 1 (CM1), steel sheet and jacking system will be combined together for supporting. Also the steel sheet can stop the underground water partially.

Construction Method 2 (CM2), jet grouting and cast in-site pile will be combined together. The function of the cast in-site pile can support the surrounding soil and the jet grouting will stop the underground water.

* Corresponding author: Tel./Fax: +98 910 1977858
 E-mail address: suzewei@nfc-china.com

0.8 inch left margin

0.8 inch right margin

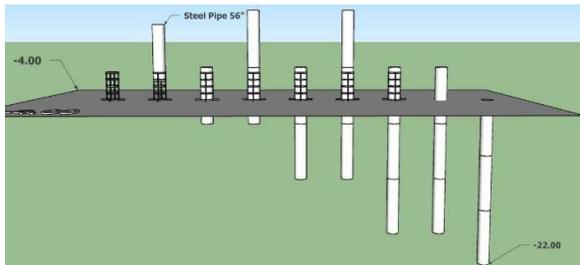
The sleeve for the both methods statement will be applied for the cylinder erection in the middle up to -21.760m.

Construction Methods

Two construction methods are introduced in this section in detail.

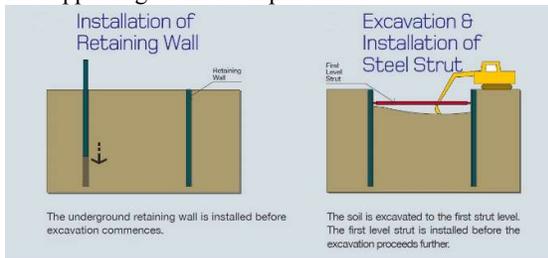
Construction method 1 (CM1)[3]

In the first step, the area around the shaft foundation is excavated to the elevation of 4m. A steel sleeve with 1400mm is to be embedded by the assistant of steel form work under ground for vertical control. This pipe is used as the sleeve for the shaft. It will be driven by a vibration machine.



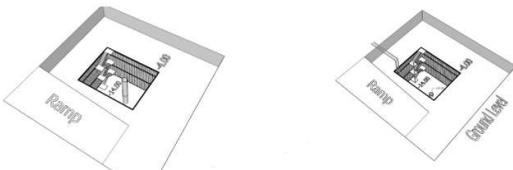
Dwg 2

Around the deep foundation, steel sheet pile is adopted for the permeation of underground water. Because of around -12m depth, so the depth of the steel pile is embedded to the depth of -16m. after the steel piling, excavation will be started. During the excavation, a steel strut will be applied for supporting of the steel pile sheet.



Dwg 3

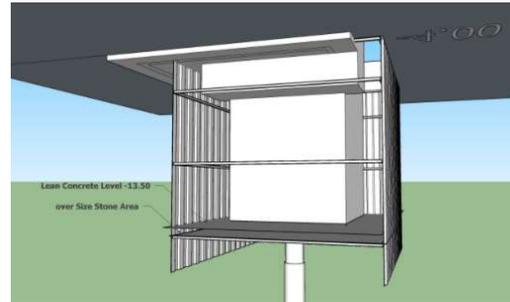
The excavation will reach to the elevation of -14m. and then a drain will be executed in the bottom for cleaning the underground water. Then the pipe will be cut.



Dwg 4

The excavation inside the pipe will be carried by manpower from -13.5m up to -22m. The isolation for corrossions shall be painted in the sleeve pipe. The shaft will be placed by manpower and crane. After unloading into the pipe in a perfect and complete way, the bottom blockage of the excavation area would be covered by lean

concrete from -14m up to -13.5m, and the shaft is fixed there in its right place.



Dwg 5

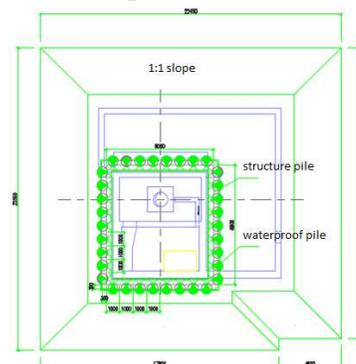
After the waterproof is applied in the bottom, the concrete wall with reinforcement will be constructed up to 0.00m. the steel sheet piling will be removed and backfilling will be done ultimately.

Construction method 2 (CM2)

In CM2, the same sleeve is considered for positioning the cylinder. However the hole for positing the sleeve is made by drilling machine. According to the geotechnical report, for the soil of clay is easy for making the hole without collapse.

The diameter of hole is 1800mm, the depth of hole is calculated based on the ground elevation, and the bottom elevation of hole is -25,0m. The bottom elevation of hole will be lower than the bottom elevation of oil cylinder casing pipe about 3.24m and the deviation of verticality shall be controlled.

Casting in-site pile as the structure pile and jet grouting pile as water proof pile is constructed refer to Dwg 6. The excavation depth of foundation pit is -13.5m and will use slope, row piles, top beams, pit bottom reinforcing for support and protection method. The gradient shall be 1:1 for the depth that is less than -4.50m; piles, top beams, pit bottom reinforcing shall be used for support and protection, that the depth is under -4.50m.



Dwg 6

Waterproof curtain, pit bottom reinforcing and exposed drainage method is used to control the underground water. High pressure jet grouting pile will be constructed between

* Corresponding author: Tel./Fax: +98 910 1977858
E-mail address: suzewei@nfc-china.com

piles for waterproof curtain to stop water, and the high pressure jet grouting pile will be used for reinforcing the pit bottom.[4]

The distance between the external of support pile and concrete pit wall is 100mm. The soil between piles shall be protected by shotcrete through hanging mesh, and the support pile can also be used as formwork for casting concrete of pit wall.

Cutting and removing the sleeve at the elevation of -12.4m after the foundation pit is excavated to the bottom of trench. Cylinder will be installed on the sleeve pipe. Before positioning the cylinder, a special seat made by steel shall be located to the bottom of the sleeve.

The grouted cement can be used as good anti-corrosion measure at strong corrosion area.

Discussion

Considering the depth of the well, the difficulties for the construction of cylinder well is mainly in 3 points.

1. Structure support for any collapse happen during construction.
2. Waterproof and de-watering from the foundation pit. Specially for the bottom of the pit.
3. Driven the sleeve for the cylinder into the correct position.

In CM1, the steel sheet with supporting system is adopted for the structure support. Because the supporting system shall be put into the middle of the pit, so the construction area is limited by this system. In CM2, the cast in-site pile is suggested. The cast in-site pile can be designed by calculation with different diameter.

For waterproof, the jet grouting pile is applied for the surrounding wall adjacent the cast in-site pile and also in the bottom of level of -13.5m. By overlapping, the jet grouting pile can work properly for fully closing the pit.

In CM2, the sleeve is driven by the drilling rig, while in CM1, the sleeve is driven by loading and excavated by manpower, the construction time and HSE control is more difficult than CM2.

Conclusion

The above mentioned construction methods are based on the site geotechnical condition of SALCO project. **Jet grouting, cast in-site piling are more reliable for the construction.** The soil pressure, shear pressure, soil solidity shall be calculated based on the geotechnical report. Based on these calculation, the piling can be designed. However the steel sheet piling can be recycled and used again, it has the advantage of cost control for construction.

References

[1] Vendor document for vertical casting machine from Gautschi Company

* Corresponding author: Tel./Fax: +98 910 1977858

E-mail address: suzewei@nfc-china.com

[2] Geotechnical Report for SALCO Project. SES Company

[3] Construction proposal for SALCO Project. Safa Foulad Sephan Company.

[4] Mr. Zhang Bing "Quality Control for the Jet Grouting pile", 1672-4011-(2012)05-0080-02