Original Article
International Journal of Scientific Research in Civil Engineering
OPEN ACCESS
Available online at : www.ijsrce.com
© 2023 | IJSRCE | Volume 7 | Issue 4 | ISSN : 2456-6667

A Case study - Dewatering in Reactor Building CHNA Substation

Abid Bashir*[1], Venkatesh Viswanathan[2]
Transmission Engineering Department/Dubai Electricity and Water Authority, Dubai, United Arab Emirates
*Corresponding Author : abidbaba@gmail.com

ARTICLEINFO

Article History:

Accepted: 01 Aug 2023
Published: 16 Aug 2023

Publication Issue
Volume 7, Issue 4
July-August-2023

Page Number
115-119

ABSTRACT

Construction of buildings, powerhouses, dams, Bridges, and many other structures requires excavation below the water table into water-bearing soils. Such excavations require lowering the water table below the slopes and bottom of the excavation to prevent ravelling or sloughing of the slope and to ensure dry, firm working conditions for construction operations. Dewatering is a critical process in the construction industry to remove excess water from the soil or excavation site. There are several techniques for dewatering, including wellpoints, deep wells, sumps, and open pumping. Wellpoints are commonly used in shallow excavations and involve drilling small-diameter wells and installing wellpoint filters. Deep wells are used in deeper excavations and involve drilling large-diameter wells to reach the water table. Sumps involve excavating a pit at the lowest point of the site and pumping water out. Open pumping is used when there is a large amount of water to remove and involves pumping it to a discharge point. The selection of the dewatering technique depends on several factors, such as the depth of the excavation, soil type, and the amount of water to be removed. Proper dewatering is crucial for maintaining the stability and safety of the construction site

Keywords : Ground Water, Dewatering, Drawdown, Excavation, Formation Level

I. INTRODUCTION

Groundwater exerts pressure on the surrounding soil. When soil is removed below the level of the groundwater (static level), water may flow into the excavation. This may cause the walls of the pit or slope to fail leading to timeline delays, personnel safety hazards and equipment damage. Additionally, water pressure from under the excavation floor may cause sand boils or uplift of the soil which can lead to decrease excavation safety and settlement/subsidence of surrounding structures. Construction dewatering is the process of removing groundwater from a construction site to provide a safe and stable subgrade for excavation. Groundwater is removed from the site using deep wells, wellpoints, Eductors, or conventional "sump and pump" methods. Dewatering may be temporary during construction activities or permanent for the life of the facility. Safety is imperative at construction sites, workers don't like operating with wet feet; this includes workers in excavations, pipeline welders and any other workers at the construction site. Also keeping the bottom of the excavation dry reduces the potential for slipping and tripping hazards and can prevent equipment damage. If the groundwater at the site is contaminated with chemicals from a dry cleaner or a leaking fuel storage tank, removing the water from the site reduces workers exposure to the toxins. A stable work site is important. Proper removal of the groundwater before construction begins can eliminate excavation failures due to uncontrolled water entering the job site.

II. Background

The reactor building was the extension of old substation in a low-lying area. As UAE experiences varying ground conditions due to factors such as geological formations, aquifer types and proximity to water bodies. This area has shallow water tables, so it became essential to understand ground water conditions at site before selecting appropriate dewatering technique. Also, it was necessary to protect the existing 132/11kV live substation from the ingress of ground water.

III. Challenges

The main challenge faced by the construction team was the high-water table and congested space which made excavation and construction very difficult. Moreover, the adjacent existing substation building was live. If the water was not removed, it would create a hazardous and unsafe working environment.

IV. Analysis and Solutions

The construction team developed a comprehensive dewatering plan to remove the water from the site. The plan involved the use of well point system.

A. Prerequisites

Perimeter of the plot	42 LM
Ground water Depth	-1.15 M.
Existing Ground Level	+0.00 M
Excavation Level	-3.38 M

Based on the excavation depths and water table level, well point system was proposed to keep the area dry throughout the dewatering period.
A check was carried out for ongoing dewatering system in the near vicinity of the plot to access clear water depth or any fluctuations.

B. Equipment's, Machinery and materials

Dewatering pump model DR-150 fully automatic. Positive priming diesel engine drive pump and one number standby pump.
150 mm dia GI/PVC header pipes with quick action couplings leading the suction line to the pump.
Well point riser assembly uPVC units shatter proof with 1.0-meter-long slotted filter screen 50 mm dia.
Riser assembly coupled to suction header line with armoured flexible swings.
150 mm -200 mm discharge collectors.
Jetting pump and sedimentation tanks and diesel tanks.
Hammer, Auto level, and measuring tape.
Gloves and Hessen cloths.

C. Installation

The installation of well point system was carried in such a way that it is 30-50cm above water table. Once the required excavation was achieved well point system was installed around the periphery and inside the plot area (Figure 1 shows the installation of well point system). A high-pressure jet pump with jetting tube and hoses was used to create holes in soil strata. As the soil strata was dense pre-auguring was caried out to create voids (100-150 mm) diameter in the soil (Fig 2 shows the pre-auguring).

FIGURE 1. WELL POINT SYSTEM INSTALLED AROUND THE PERIPHERY

FIGURE 2. PRE-AUGURING TO CREATE VOIDS IN SOIL STRATA

A well point comprised of uPVC pipe having diameter of 50mm with one meter screen at bottom and required length is placed in jetting holes with 10mm crushed aggregates filled around the annular space between jetted hole and well point to act as a filter medium (Fig 3 shows the 50 mm uPVC pipe placed in jetting holes).

FIGURE 3. 50MM uPVC PIPE PLACED IN JETTING HOLES

Well points are connected to the headers through flex bows and headers in turn to the self-priming centrifugal pumps.

The required excavation was carried out near the well points and headers to ensure that there is no damage to these components. Once the required excavation for main foundation was achieved internal localized well point system was installed for deeper excavation areas as per site requirements in order to achieve required draw down with the pump placed on appropriate place.

Two numbers of piezometers were provided for monitoring the ground water table till the dewatering works are commissioned.

Once the required levels of excavations were achieved, the entire peripheral system was converted to an abandoned system , with the pump placed on appropriate place.

UPVC well points of diameter 50 mm and 6m length are connected to 150 mm diameter uPVC headers with flex bows for second stage system which is placed in appropriate trench provided approximately 30-50 cm below the maximum excavation level around the plot with proper support to avoid soil pressure from compaction.

Working pump and standby pump are kept on platform outside the construction area connected with the well points.

D. Discharge control plan

The annulus between the well point bore and uPVC well point pipe filled with suitable aggregate allows filtered drainage into the screen and prevents fine material passing through into the discharge system.

The pump water was fed into the discharge header and disposal of drawn water was pumped to the static tanker with 10,000 Gallon capacity. The static tanker was placed near to the construction area. The water from static tanker was removed by mobile tankers and the process continued till the uplift pressure was achieved to close the dewatering system (Fig 4 shows the layout & Fig 5 shows the sectional details).

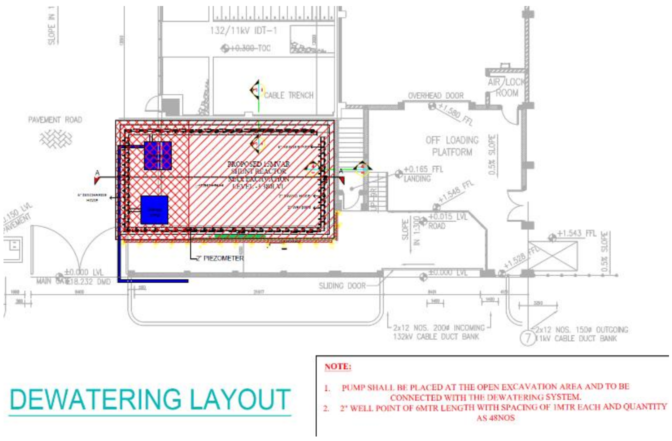

FIGURE 4. DEWATERING LAYOUT

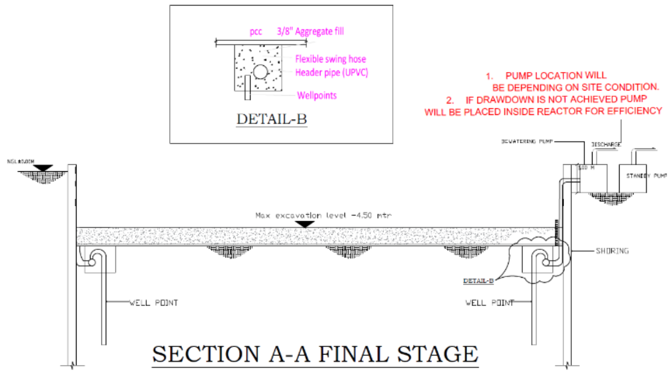

FIGURE 5. DETAILED SECTIONS

E. Design Calculations

Area of dewatering	42LM
Required dewatering depth	
Existing Ground level	+0.00
Min Ground water Level	-1.15m
Max Excavation Level	-3.38m

Required Draw Down= Min ground water level - Max excavation level + 1.00m

= -1.15-(-3.38) +1.00= +3.23m

Permeability of sub soil: - The permeability of the soil is the ground water flow towards suction point.

The permeability is taken as $5.0 x 10^{-4}$ m/s (Obtained from soil investigation report)

Expected discharge: -

The quantity of water to be pumped to dewater an excavation using the gravity flow calculation is:

Q = π*k* (H2 -hw2)/ ln (R/rw)

Whereas,

K= Coefficient of permeability at approx.. = 5.0 x 10-4 m/sec = 1.8 mt/hr (This doesn't remain constant through out the plot area and depth and may result in variations in Q)

H= Length of well point (6.0 m)

hW= required draw down = -1.15 – (-3.38) +1.00= 3.23 meter

rw = √l *b/ π, √ 13.75*7.5/3.143 =5.72 mt, say 5.50.

R = Radius of influence taken as 100m (appr. constant) + rw

=100 + 5.5= 105.5mt

Q = 3.143* 1.8 *(6^2 –5.50^2) / ln (105.5/ 5.5)

Q = 11.02 m3/hr

V. CONCLUSION

In conclusion, dewatering in UAE conditions where the water table is excessively high presents a critical challenge that requires careful planning and implementation. Given the arid climate and limited freshwater resources in the region, effective dewatering techniques are essential for construction and infrastructure projects. By employing a combination of engineering methods such as wellpoints, deep wells, and sump pumps, it is possible to lower the water table and create a stable foundation for construction. However, it is crucial to consider the environmental impact of dewatering activities, such as potential saltwater intrusion or groundwater depletion. Therefore, a comprehensive approach that includes sustainable water management practices and constant monitoring is necessary to ensure the long-term viability and sustainability of dewatering efforts in the UAE.

VI. REFERENCES

[1]. Quinion, D.W. and Quinion, G.R. (1987), Control of Groundwater, ICE Works Construction Guides, Thomas Telford Pub. Co., London.

[2]. Somerville, S.H. (1986), Control of Groundwater for Temporary Works, CIRIA (Construction Industry Research and Information Association) Report No.113.

[3]. Mansur, C.I. and Kaufman, R.I. (1962) Dewatering, in Foundation Engineering Ed.by G.A. Leonards pp.241-350, Mc Graw-Hill Book Co.

Cite this article as :

Abid Bashir, Venkatesh Viswanathan, "A Case Study - Dewatering in Reactor Building CHNA Substation ", International Journal of Scientific Research in Civil Engineering (IJSRCE), ISSN : 2456-6667, Volume 7, Issue 4, pp.115-119, July-August.2023

URL : https://ijsrce.com/IJSRCE237413