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DEWATERING OF FOUNDATIONS

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Dewatering is an important problem frequently encountered in engineering construction. The advantages of dewatering by tubewells or by well point method have been discussed and compared with open sump well pumping in this paper. Methods to estimate infiltration into an excavation pit and to plan dewatering by tubewells have been given. Seven different sites dewatered by tubewells as per laboratory suggestions have been discussed.

In Pakistan dewatering is usually done by an open or sump system of dewatering. The method involves a square caisson with perforated side walls and with a plugged bottom a few feet below the level to be excavated. Water seeping into the caisson through the side holes is pumped out. Dewatering can also be done by method of well point system not commonly used in Pakistan. For a proper planning of dewatering it is essential to have a knowledge of the weight of submerged soil, the velocity of flow causing boiling of soil, movement of fine particles through sand pores and permeability of the soil formation. Quantum of seepage from a formation can be estimated only if its permeability is known. Permeability can be determined in the laboratory or by Theim or Theis methods. If the site to be dewatered is beyond the influence of a line source, then full area is assumed as enclosed by s single well of that diameter and a number of formulae have been given to compute the discharge likely to be pumped. Darcy's formula can be used where tubewell formula is not applicable. If the site is long compared to its width then a number of tubewells are installed and seepage is calculated giving due consideration to mutual interference. Usually a low level water table exists in addition to a high level source which necessitates due consideration to the feeding source and its level in estimation of infiltration. Seepage can also be estimated by plotting flow lines from source to sink when more than one free water source exist at different levels. Infiltration is worked out by using Darcy's relation.

Deep turbine, or submersible pumps are specially suitable for dewatering because they can operate continuously during the construction period at a properly selected location. High initial cost and the limited availability are their disadvantages. Centrifugal pumps have low depression head of 15 to 20 ft. which requires them to be lowered as operation continues for deep dewatering. Another important component of tubewells is strainer. Its positioning and length is decided according to the deepest level to be dewatered and the discharge desired. As dewatering operations are essentially temporary arrangements, relatively inexpensive strainers should be used. Continuous pumping without any break is essential to create and sustain maximum depression head.

Some important dewatering sites involving different methods may be considered. At Chichoki Hydel site water table was lowered from R.L. 688 to RL 648. Permeability was estimated to be 0.002 ft/sec. The infiltration calculated through formulae came out to be 20 Cs from a planned dewatering area of 200 x 300 ft. Twelve tubewells were porposed with strainers starting at RS 650 and ending on a clay layer at RL 600. Submersible pumps were used and desired level was achieved in about two weeks of pumping. Water table was maintained at designed level by using only 10 pumps and discharge actually pumped was nearly equal to that given by the formula. Interference of wells was in the range of 13.5% 25%.

For the Ravi Syphon, area to be dewatered was 1800 x 350 ft. Water table was to be taken down to R.L. 670 from R.L. 700 and R.L. 710. For lack of permeability test, its value was assumed as 0.002 ft/sec. A mean seepage of 17 Cs was worked out by the formula. A four feet thick clay layer was encountered at R.L. 684, which proved to be very helpful in reducing infiltration from the river. The laboratory suggestion was to install 40 wells. Centrifugal pumps were suggested and used. The clay layer made the dewatering possible with only 26 wells, pumping 16 Cs.

The Shadiwal Hydel site is downstream of fall at R.D. 426 of Upper Jhelum Canal. The area to be dewatered was 250 x 150 ft. Watertable was to be lowered from R.L. 741.7 to R.L. 701. At R.L. 650 there was an impervious clay layer. Permeability of formation was found out to be 0.000B to 0.0016 ft/sec. The infiltration was calculated as 16 Cs. Twelve wells were suggested, but at the site dewatering was carried out by four settings of well points.

At Gujranwala Hydel site, concrete raft was to be laid in the bed of the Upper Chenab Canal. The F.S.L. in canal was at R.L. 755. Permeability was found out to be .0013 ft/sec. by infiltration tests. Watertable was to be lowered from R.L. 745 to R.L. 710. Ten tubewells were suggested for an expected infiltration of 21 Cs.

At Punjnad Headworks laboratory permeability coefficient of sand specimen was found out to be 0.0005 ft/sec. Infiltration was estimated to be 8.2 Cs from Dercy's relation. Water level was to be lowered from R.L. 336 to R.L. 316. Nine tubewells each with two strainers were suggested. The executing agency did nt stick to the dewatering plan suggested by the laboratory and dewatering could, therefore, be done to R.L. 319 only, with actual pumping discharge less than that calculated.

The site of Right Embankment of Guddu Barrage is near the river Indus. Area to be dewatered was 500 x 100 ft. The watertable was to be lowered by about 30 ft. to R.L. 218. Permeability was found to be 0.001 to 0.0001 ft/sec. Expected seepage of 14.4 Cs was calculated for which 12 tubewells were suggested. Dewatering was successfully completed as planned.

For out-fall of Chichoki Hydel project, the area to be dewatered was 250 x 200 ft. The calculated seepage was 6.7 Cs. A system of four tubewells each having four strainers was suggested. Nine tubewells were used to give a total discharge of 8.1 Cs, which was nearly equal to the calculated one. Small variation from the computed discharge was attributed to the greater length of strainers.

The well point system consists of a number of wells made of 1.50 inch diameter G.I pipe about 21 ft long with a 3.5 ft long filter at the end. Each well is pushed in sand by water pressure exerted through the same pipe. Spacing of wells is about 2.5 ft. All wells are connected to a common pipe. This pipe is then connected to a reciprocating pump run by diesel or electricity. A distinct advantage of tubewell system is that it can be indigenously built whereas all equipment of well point system has to be imported. Skilled manpower experienced in installation of well point system is not available in the country. A cost comparison of dewatering at Chichoki (with tubewells) and Shadiwal (with well point system) shows that cost incurred on well point system was Rs. 10,52,000 whereas expenditure on tubewells was only Rs. 189,024. Fuel cost was nearly the same on both. The well point system is reusable at any other place without repair, whereas only pumps can be reused in case of tubewells. Another disadvantage of the well point system installation is that it interferes with other activities at the construction site. Both methods are quite easy to work. Sump system of open pumping is defective because it causes reduction in the weight of formation, loss of compactness and the bearing capacity of the soil. Tubewells and well points are free from these defects. In Punjab, the formation comprises fine and medium grade with one or two clay layers appearing within 100 ft. The tubewells can be lowered upto the clay layers. Level inside the well must be kept 10 to 20 ft. below the level to be dewatered. The strainer should also be a few feet below the level to be dewatered.