



100

Field Solutions *in* Civil Engineering

Veerendra Kumar
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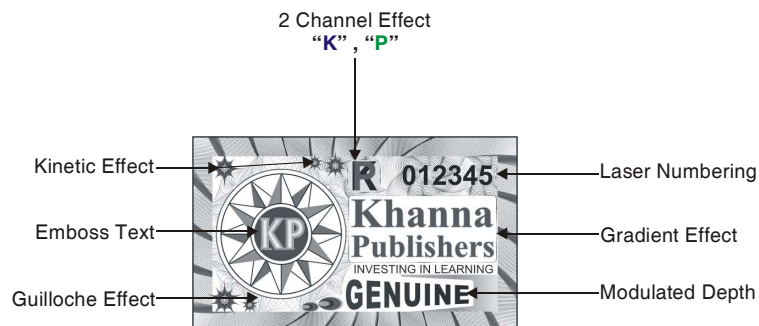
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Preface to the First Edition

Civil Engineers face many typical situations and problems in the course of their field activities of construction that require specific and practical solution. This book comprises of the problems faced by civil engineers during construction and post construction, the reasons behind the problem and their remedies. It aims to make readers familiar with on-site civil engineering projects (construction works/repair works of buildings, bridges etc.) along with their design, behavior and problems faced on field. It throws light on the sequencing of actual processes and the effect on the construction work in accordance with the latest codes of practice IS456:2000, IS800:2007, IS10262:2009 & 2019, IS1199-1959, IS383:2016, IS1893:2002 and IS13311-I & II:1992 based on concrete mix design, properties of constituents, workability of cement aggregate, types of loading, effect of earthquake forces and NDT tests.

'100 Field Solutions' is textbook for students and field engineers for exposure to field practices, problem identification and remedial measures and for interview reference. The book covers the fundamental aspects of analysis and design with practical outlook, feasibility and economy of structural elements. This textbook would also serve as an introduction to field engineers for training purpose, interview preparation for placement activity & to post graduate students for future scope and research work. Practicing civil engineers and consultants who are facing such problems can relate and understand the practical solution and implement the same with the current specification using the text as reference.

Salient features:

- Complete coverage as per the latest codal provisions.
- Elaborate discussions about the problem and its solution.
- Real field exposure with examples (images for reference and better understanding), worked out with tutorial approach intended at assisting the reader in the understanding of principles and basic concept.

We present this book with hope that the aspiring and practicing civil engineers will get benefitted with the exposure. We would also like to thank the publishers and the publication team for their efforts & corporation.

Feedback: All efforts have been made to keep errors to a minimum. Any suggestions for improvement of the book are highly appreciated.

—Authors

Contents

<i>Sl.No</i>	<i>Name of the Chapter</i>	<i>Page No.</i>
Part I - Environmental Engineering – Water Supply		
1.	Inspection of Site for construction of Basuhari Pump House	7-8
2.	Inspection Report Of CWC Pump House Area Of ATPP and Recommendation	9-12
3.	Inspection of under construction Intake Well at Karelabagh, Allahabad	13
4.	Inspection Report on the Construction Work of Intake Well at Karelabagh, Allahabad.	14-15
5.	Inspection Report of Intake Well at River side Hindalco	16-19
6.	Inspection Report on the construction work of Intake well of Basuhari Pump Canal, Basuhari Sonebhadra	20-21
Environmental Engineering – Sewage Treatment		
7.	Inspection of Digesters of Dinapur STP Varanasi	27-30
8.	Inspection and Structural Assessment report of Dinapur and Bhagwanpur STP Varanasi	31-33
9.	Inspection Report of Ongoing works of Sewerage Scheme under NGRBA at Allahabad	34-35
10.	Inspection Report of Ongoing works of Sewerage works in Sewerage District of Allahabad Under National Ganga River Basin Authority (NGRBA)	36-37
11.	Inspection Report on Ongoing works of Sewerage & Non Sewerage Scheme Under NGRBA at Allahabad	38-42
12.	Inspection Report of Morigate Flood Pumping Station Allahabad	43-46
13.	Inspection report of Buxi Bund Nala Silt Catch Pit at Allapur, Allahabad	47
14.	Inspection Report on the construction work of STP Naini and Pumping Station at Gaughat.	48-51
15.	Inspection Report on the construction work of Mumfordganj SPS and Rajapur STP.	52-54
16.	Inspection Report on ongoing works under JNNURM in Varanasi City	55-57
17.	Inspection Report on the construction work of 60 MLD STP at Rajpur, Allahabad.	58
18.	Inspection Report on the Construction Work of STP Naini and Numaya Dahi at Allahabad.	59-62

Part II - Water Resources

19.	Inspection report of under construction Aqueduct at Km. 46.615, Bansagar	67-69
20.	Inspection and Non-Destructive Test Report of Aqueduct at Km 46.615 of Bansagar Feeder Canal.	70-75
21.	Inspection Report of Gomti Aqueduct.	76-79
22.	Inspection Report of Latifshah Weir	80
23.	Inspection Report of Construction Site of Head Regulator of Meja Jirgo Link Channel.	81-82

Part III - Soil and Foundation

24.	Inspection Report of Caustic Unit, F.O. Tank and Red Mud Dam	87-92
25.	Inspection Report of Dyke for Storing of Red Mud at Hindalco Industries Ltd., Renukoot Plant	93-96
26.	Inspection Report of Turbo Generator Foundation of 210 MW, Unit No 1 or Anpara Thermal Power Plant	97-101
27.	Inspection of the construction site of special foundation of Inter-connector Transmission Line Tower from Anpara B to Anpara D	102-103
28.	Inspection Report on Foundation of Unit No. 4 Turbine of Rihand Power Station	104-105
29.	Inspection and Non-Destructive Testing Report of Tower Foundation of 220 KV Single Circuit Transmission Line of 6 x 105 MW CPP of Mahan Aluminium Project between Sidhi to Mahan.	106-113

Part IV – Transportation 127-128

30.	Inspection and technical solution / opinion of structures whose rebars have been cut on six laning of Varanasi-Aurangabad section of NH2	114-120
31.	Inspection Report on the Construction Work of 5-span Bridge on Chunar – Nuwan Chaukiya Road, Mirzapur.	121-133
32.	Inspection report on the construction work of 3-span Bridge on Gaurah – Sirsiya Marg, Sonebhadra.	123-125

Part V - Structural Engineering

33.	Inspection Report of Collectorate (Non-residential) Building, Sant Ravidas Nagar, Bhadohi	129-133
34.	Inspection Report on the construction work of District Jail, Azamgarh	134-137
35.	Inspection Report on the construction work of District Jail, Ambedkar Nagar	138-139
36.	Inspection Report of Government Allopathic Medical College, Azamgarh	140-146
37.	Inspection Report on the Quality of Construction Work of Government Medical College at Azamgarh	147-149

Part—1

Environmental Engineering—Water Supply

VARIOUS SOURCES OF WATER

A. Surface Water Source

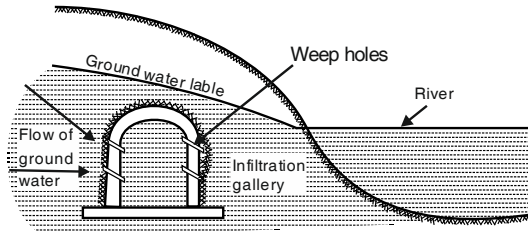
- Surface sources are those sources of water in which the water flows over the surface of earth, and is thus directly available for water supplies.
- Important surface sources of water are:
 - Natural lakes and ponds
 - Streams and Rivers
 - Impounding Reservoirs



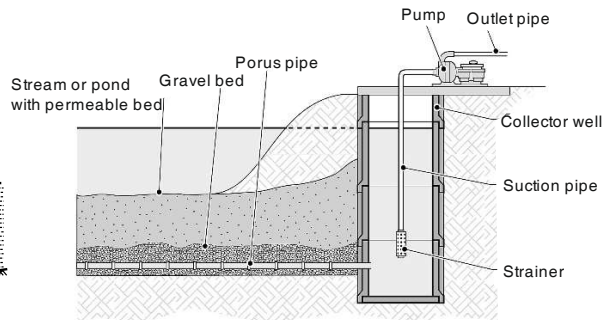
River -A Surface Source of Water

B. Ground Water Source

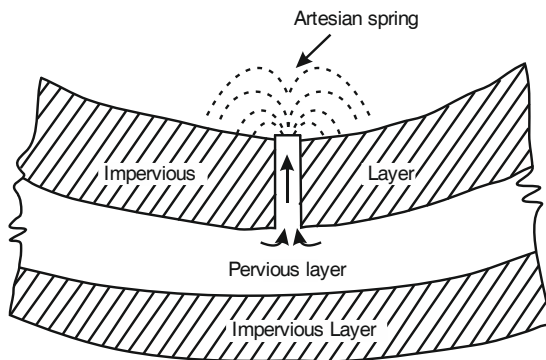
- Important ground water sources are:
 - Infiltration galleries
 - Infiltration wells
 - Springs
 - Wells



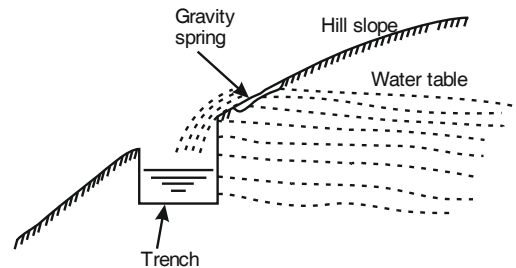
Infiltration Gallery



Infiltration wells



Artesian Spring



Gravity Spring

INTAKES FOR COLLECTING SURFACE WATER

Whenever the water is withdrawn from surface source such as a lake or a river and the entrance of the withdrawal conduit is not an integral part of a dam or any other related structure, then an intake structure must be constructed at the entrance of the conduit.

Site for location of intake

- Intake work should provide purer water so that its treatment may be less exhaustive
- Heavy water currents should not strike the intake directly.
- Intake should be located at such a situation where sufficient quantity of water remains available under all the circumstances.
- Site should be such that intake should be in a position to provide more water, if required to do so.
- Site should not be located in navigation channels, the reason being water in such channels are generally polluted.
- During floods, the intake should not be submerged by the flooding waters.
- As far as possible, the site should be located on the upstream side of the town/city.
- The intake should be so located that good foundation conditions are prevalent and the possibility of scouring is minimal.

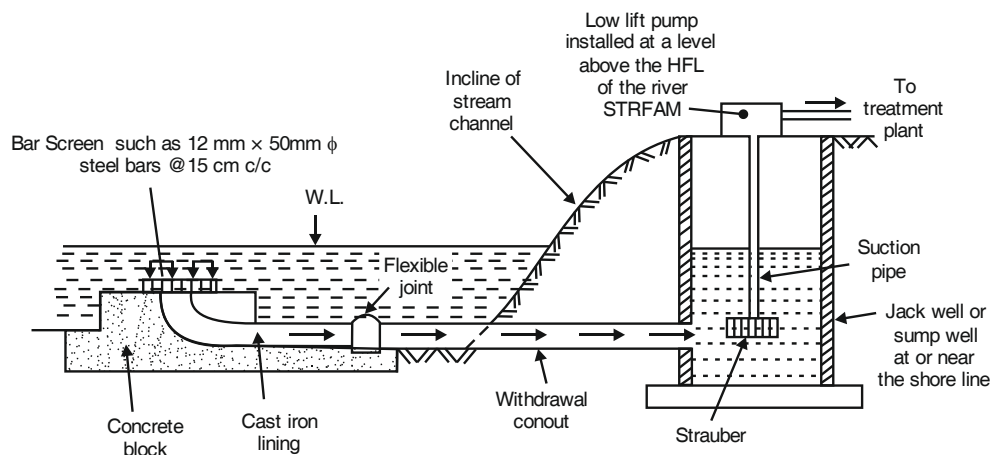
Design of Intake

An intake should be designed keeping in mind the following considerations:

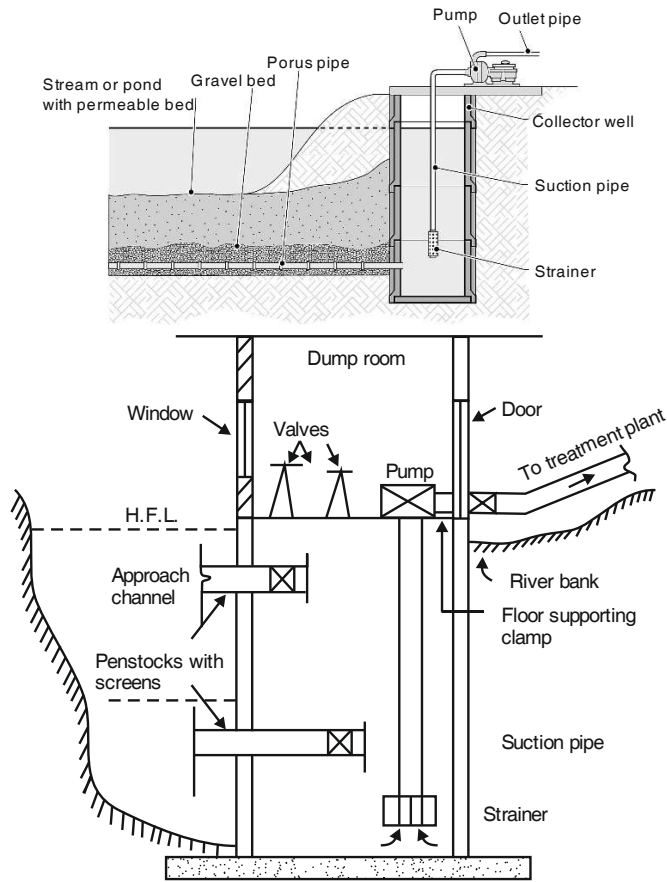
- Intake should be sufficiently heavy so that it may not start floating due to upthrust of water.
- All the forces which are expected to work on intake should be carefully analyzed and intake should be designed to withstand all these forces.
- The foundation of the intake should be taken sufficiently deep to avoid overturning.
- Strainers in the form of wire mesh should be provided on all the intake inlets to avoid entry of large floating objects.
- Intake should be of such size and so located that sufficient quantity of water can be obtained from the intake in all circumstances.

Types of Intake

A. *Submerged intake* -Submerged intake is the one which is constructed entirely under water. Such an intake is commonly used to obtain supply from a lake. An exposed intake is in the form of a well or tower constructed near the bank of a river, or in some cases even away from the river banks. Exposed intakes are more common due to ease in its operation. A wet intake is that type of intake tower in which the water level is practically the same as the water level of the sources of supply. Such an intake is sometimes known as jack well and is most commonly used. In the case of dry intake, however, there is no water in the water tower. Water enters through entry point directly into the conveying pipes. The dry tower is simply used for the operation of valves etc.



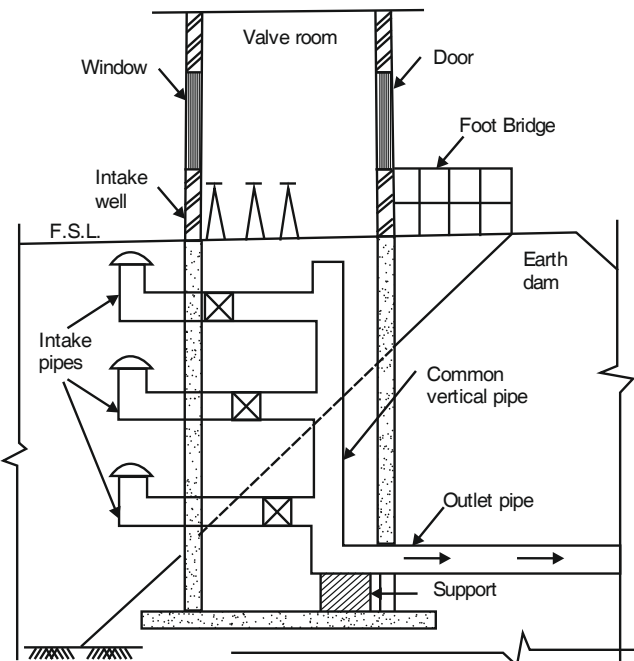
B. *River intake* -A river intake is located to the upstream of the city so that pollution is minimized. They are either located sufficiently inside the river so that demands of water are met with in all the seasons of the year, or they may be located near the river bank where a sufficient depth of water is available. Sometimes, an approach channel is constructed and water is led to the intake tower. If the water level in the river is low, a weir may be constructed across it to raise the water level and divert it to the intake tower.



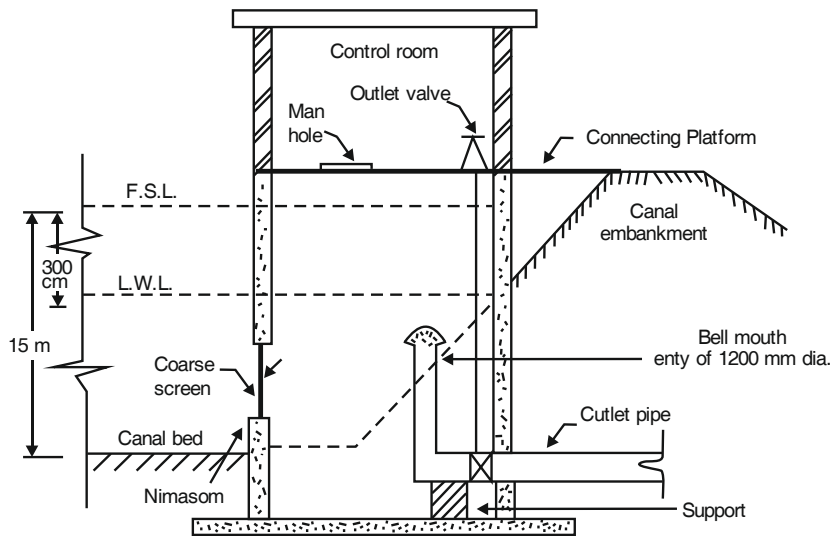
C. *Reservoir intake* -When the flow in the river is not guaranteed throughout the year a dam is constructed across it to store water in the reservoir so formed. The reservoir intakes are practically similar to the river intake, except that these are located near the upstream face of the dam where maximum depth of water is available.

D. *Lake Intake* -Lake intakes are similar to reservoir intakes if the depth of the water near the banks is reasonable. If, however, the depth of the water near the banks is shallow, and greater depth is available only at its center, a submerged intake is provided.

E. *Canal intake* -Sometimes, the source of water supply to a small town may be an irrigation canal passing near the town. The canal intake essentially



consists of concrete or masonry intake chamber of rectangular shape, admitting water through a coarse screen. A fine screen is provided over the bell mouth entry of the outlet pipe. The bell mouth entry is located below the expected low water level in the canal. Water may flow from outlet pipe under gravity if the filter house is situated at a lower elevation. Otherwise, the outlet pipe may serve as suction pipe, and the pump house may be located on or near the canal bank. The intake chamber is so constructed that it does not offer any appreciable resistance to normal flow in the canal. Otherwise, the intake chamber is located inside the canal bank. Near the location of the intake work, canal is lined.



WATER TREATMENT

The available raw waters must be treated and purified before they can be supplied to the public for their domestic, industrial or any other uses. The extent of treatment required to be given to the particular water depends upon the characteristics and quality of the available water, and also upon the quality requirements for the intended use. Raw water may contain suspended, colloidal and dissolved impurities. The purpose of water treatments is to remove all those impurities which are objectionable either from taste and odour perspective or from public health perspective. For surface waters, following are the treatment processes that are generally adopted

Screening -This is adopted to remove all the floating matter from surface waters. It is generally provided at the intake point

Aeration -This is adopted to remove objectionable tastes and colour and also to remove the dissolved gases such as carbon-dioxide, hydrogen sulphide etc. The iron and manganese present in water also oxidized to some extent. This process is optional and is not adopted in cases where water does not contain objectionable taste and odour.

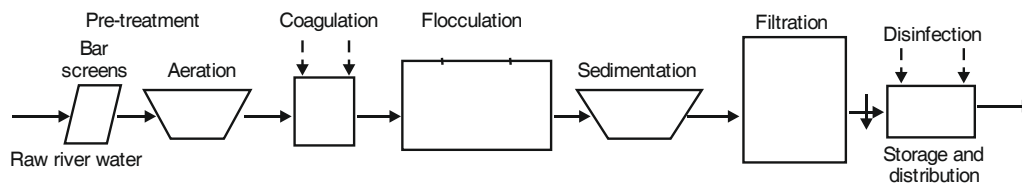
Sedimentation with or without coagulants -The purpose of sedimentation is to remove the suspended impurities. With the help of plain sedimentation, silt, sand etc. can be removed. However, with the help of sedimentation with coagulants, very fine suspended particles and some bacteria can be removed.

Filtration -The process of filtration forms the most important stage in the purification of water. Filtration removes very fine suspended impurities and colloidal impurities that may

have escaped the sedimentation tanks. In addition to this, the micro-organisms present in the water are largely removed.

Disinfection -It is carried out to eliminate or reduce to a safe minimum limit, the remaining micro-organisms and to prevent the contamination of water during its transit from the treatment plant to the place of its consumption

Miscellaneous processes -These include water softening, desalination, removal of iron, manganese and other harmful constituents.



Chapter—1

Inspection of Site for Construction of Basuhari Pump House

Description:

The Pump House is to be constructed for irrigation on the bank of river Sone near Basuhari. The proposed site was inspected and observed that the site is on the bank of river Sone on concave side. The river is slightly curved. The bank near the site is vertical and water is available near the bank throughout the year as reported by the locals and also observed from the site situation. On the convex side of the river sand is deposited in a stretch of Kilometers.

Observations:

One storm water drain originating from hillock on the down stream of the site carries boulders and pebbles in the river during rain and depositing it in river bed resulting into a natural spur construction (Figure-1).



Figure 1: Natural spur at the mouth of drain



Figure 2: Suitable site for intake well

Recommendations:

Therefore, the proposed site (Figure-2) for the construction of intake well for the pump house is suitable in my opinion. However, since the bank is steep, the protection of bank on both side of the well in a stretch of around 50 m should be done. Also before designing the well, proper soil investigation should be got conducted because rock / boulders are expected to be encountered during sinking of well.

Chapter—2

Inspection Report of CWC Pump House Area of ATPP and Recommendation

Inspection and Observations:

The area around the existing dyke was very low where rain water or water leaking from ducts / pumps was accumulating and through sump it was again entering to the dyke for reuse. During last six to seven months Lanco has used this area to dump the over burden for reclaiming this area for their construction of pump house etc. As reported, the height of the filled up earth reached above the height of boundary wall.

The sump is situated between the filled up earth and dyke wall through which the leaking water is entering in the dyke at present. Therefore, in such situation during rain soil from the filled up earth may flow with water and inter in duke through manhole. Since, the clay in the water gets deposited over pipe and hampers the production as reported by ATPP officials, it is necessary to protect the dyke from the contamination by clay during rain.

Recommendations:

In the vicinity of existing UPRVUNL dyke, the new filled up earth should be removed up to a distance of 15 m from edge of existing stone pitching. The level of earth in this 10 m strip in the down stream of retaining wall is to be kept 100 mm below the top of manhole. 100 mm PCC (1:4:8) shall be done in this lower portion.

A RCC retaining wall shall be constructed at a distance of 10 m from stone masonry edge up to a height of 2.0 m above top of manhole pit. The founding level of RCC shall be kept 1.5 m below the top of manhole pit as per attached design. The retaining wall shall start from a distance from 5.0 m on the south-eastern side on the upstream of drain already existing. This retaining wall shall continue on the alignment stated above up to a distance of about 40 m i.e. the edge of sand bags towards Anpara 'B' chimney as per enclosed layout map.

For embankment beyond this edge, wire crate 2.0 m height using stone shall be provided up to a distance of about 30 m. Earthen bench shall be created to provide base for stone crate along pond area. Base width of wire crate shall be 2 m up to a height of 1m & 1m width for balance height i.e. 1m. A stone filler wall shall be created across the water path between the proposed retaining wall at its north end and existing forebay dyke wall, so that fine particles should not contaminate the dyke.

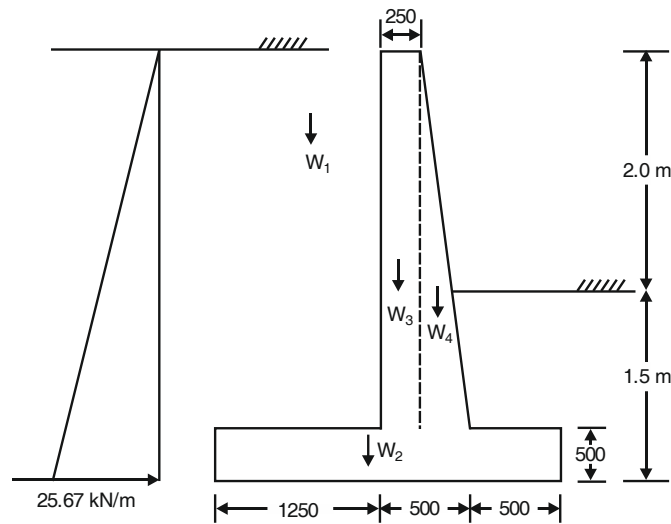
Design of Retaining Wall:

Net Bearing Capacity (over-compacted earth)	: : 60 kN/m ²
Assume ϕ	: 300
Height above top of manhole Pit <i>i.e.</i> above C.C.	: 2.0 m

Founding level below top C.C. : 1.50 m
 Depth of P.C.C. below Retaining wall : 100 mm

Weep holes is to be provided at 1.0 m c/c at about 1000 mm from top of 100 mm dia with proper filter. The soil level on the W/S of retaining wall should be kept at 450 mm below top and this level will be maintained up to 3.0 to 4.0 m beyond that. After this the slope of 2H: V should be provided in the soil. However, for design purpose the soil height behind retaining wall is assumed up to top.

Density of saturated soil = 22 kN/m³ ka= 1/3
 Total height above C.C. = 3.5 m
 Pressure due to soil at base Level (Ka γ h) = 25.67 kN/m²



$$H_1 = \frac{1}{2} \times 3.5 \times 25.67 = 44.92$$

$$W_1 = 1.25 \times 3 \times 22 = 82.5 \text{ kN/m}$$

$$W_2 = 0.5 \times 2.25 \times 25 = 28.13 \text{ kN/m}$$

$$W_3 = 0.25 \times 3 \times 25 = 18.75 \text{ kN/m}$$

$$W_4 = \frac{1}{2} \times 0.25 \times 3 \times 25 = 9.375$$

$$W_{total} = 138.76 \text{ kN/m}$$

Overturning moment

$$= 52.4 \text{ kN-m/m}$$

Balancing moment

$$= 134.06 + 31.64 + 16.4 + 6.25$$

$$= 188.365 \text{ kN-m/m}$$

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About the Book:

'100 Field Solutions' is textbook for students and field engineers for exposure to field practices, problems identification and remedial measures and for interview reference. The book covers the fundamental aspects of analysis and design with practical outlook, feasibility and economy of structural elements. This textbook would also serve as an introduction to field engineers for training purpose, interview preparation for placement activity and to postgraduate students for future scope and research work. Practicing civil engineers and consultants who are facing such problems can relate and understand the practical solution and implement the same with the current specification using the text as reference.

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