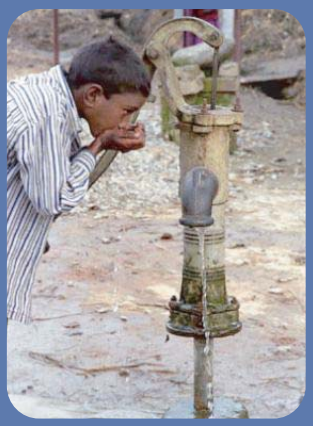

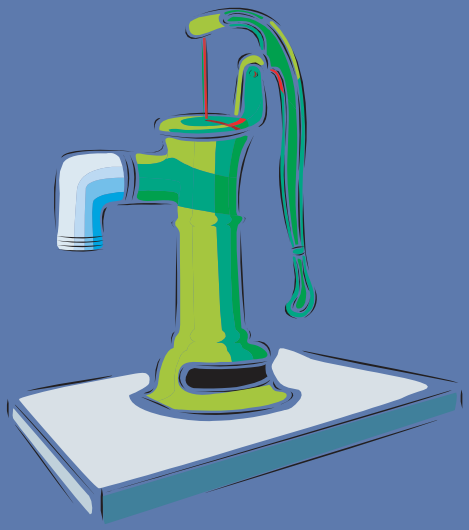

Guiding Principles for Design and Construction of
Deep Hand Tube Well (DHTW)
A CDMP Approach

For Disaster Prone Rural areas.

Ministry of Food and Disaster Management
Comprehensive Disaster Management Programme

October 2009

European Union

DFID Department for International Development

CDMP Comprehensive Disaster Management Programme

UNDP Bangladesh

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1. Introduction:

The Deep Hand Tube Well (DHTW) is necessarily a crucial option under RRAP implementation. Access to pure drinking water is a pre-requisite in ensuring healthy living around the world. But, in case of project intervened areas, the acute crisis of drinkable water, during disaster and even regular time, is an every-day cry and needs to be addresses properly and on an urgent basis. Nevertheless, this option came as a general output/demand of every CRA, conducted around the southern part of Bangladesh, where salinity intrusion is making the life more difficult over the time.

With this intervention, CDMP approached to help the southern dwellers (pre-dominantly) having access to improved drinking water source. However, nn improved drinking-water source is defined as one that, by nature of its construction or through active intervention, is protected from outside contamination, in particular from contamination with fatal matter/compounds.

2. Deep Hand Tube Well (DHTW)

2.1 Definition

In engineering point of view, when a tubewell penetrates at least one impermeable layer, it is known as Deep Tubewell. However, Deep hand tubewell (DHTW) operates in suction mode from deep aquifer[1].

But in Bangladesh when a tubewell is deeper than 75 meters that penetrates through an impermeable layer, is called Deep tubewell (as per DPHE). However, DHTW operates exactly in the same principle as a shallow hand tubewell and have same components but, only difference is that the depth of the tubewell is more than 75m that extracts water from deep aquifer.

2.2 Qualifying Parameters of a DHTW

Deep Hand Tube Well (DHTW), if after installation, can successfully meet the following parameters, can be taken as sustainable and reliable Improved source of safe drinking water.

- Produce adequate quantity of water having acceptable quality round the year.
- All necessary parts are in place.
- Good, clean and effective platform is available.
- Effective waste water disposal pit or drainage system is available.

[1] An aquifer is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be usefully extracted using a water well.

- Sanitary condition of TW surrounding is satisfactory.

2.3 Installation Guideline: Overall Structure

Installation of this DHTW shall be carried out accordance with the design and specification cited in this installation manual. The bore hole for deep tube-well shall be drilled to a required depth with a bore hole diameter 150 mm. diameter from 0 m. to 80 m. and for the rest depth not less than 100 mm. Deep tube-well shall be completed with a 38 mm diameter PVC sand trap, screen and blind pipes. The upper most 1.5m of the pipes shall be GI pipe fixed to the PVC pipes with a socket adaptor.

The deep tube-well to be installed with clay sealing, the diameter of boring will be 150 mm from 0 m to 80 m and the gap between the tube-well fixture and bore hole to be filled with approved quality coarse sand from bottom of the bore hole to 6m above the top portion of filter and in 2nd phase 6 m the bore hole to be filled up with dry clay balls of 3 to 5 mm diameter clay balls made of bentonite & local earth with proportion of 1:1 from top of filled up coarse sand rest of the bore hole to be filled up with local earth.

2.4 Design of the Well: Deep No. 6 Hand Tube-well

2.4.1 Tube-well components:

A 3m long 38 mm diameter PVC pipe shall be used as sand trap with the bottom end capped. 4 meters long or as per direction of the Engineer, 38 mm diameter PVC well screens shall be used. PVC Pipes of 38 mm with threaded or male/female joints shall be used with solvant cement.

A piece of 1.5 m long 38 mm diameter GI pipe shall be used as top pipe. The cement concrete platform shall be constructed for the tube-well with 19 mm down graded 1st class brick chips and coarse sand (FM-1.8) in proportion of 1:2:4 including neat cement finish.

2.4.2 Methods of Drilling

When sinking the tube-wells the Sub Implementing Agency (SIA) shall generally use the most common and indigenous method of well drilling i.e. the water jet system of drilling. But depending on the geological condition of the formation any other suitable method and approved by CDMP experts may also be employed.

2.4.3 Well Drilling Equipment

The SIA should contract local drilling team who with own arranged drilling equipment shall do drilling. The condition of the equipment shall be to standard sufficient to meet the demands without any delay caused by worn-out parts etc.

2.5 Well Drilling Procedure

2.5.1 Digging the Well

The wells shall be truly vertical to the extent require so that a hand pump can properly be installed in the completed well. In case no suitable water bearing strata is available within the stipulated depth, the matter should be communicated to SIA concerned who will give decision after study of the situation.

Boring shall be carried out down to the required depth through all kinds of soils such as consolidated or unconsolidated formation or formations containing gases. Casing pipes shall be used during boring where necessary at contractor's own cost.

The Engineer shall monitor the progress and resistance to drilling and the cutting samples brought to the surface and shall make a record of the strata penetrated and the location of any changes below the ground surface in a form approved by the CDMP.

If any event should occur within the bore hole, or if the drilling team should encounter any strata or accumulate any experience of sub-surface conditions which lead them to believe that progress with the work will be significantly impeded or which give rise to expectations that the yield required from the well will not be obtained, the Engineer shall immediately inform SIA management and the SIA shall decide on further works in accordance with respect to the well.

From 0-80 m depth, boring will be 150 mm dia and from 81 m to the desired depth, boring will be 100 mm dia. Sample of soil is to be collected at an interval of 3m and it will be kept in white cellophane bag.

From top of the filter up to 6 m upward, the space between tube well and bore hole is to be filled up by coarse sand. In next stage, from top of the filled up coarse sand and up to 6 m upward, the space is to be filled up by the balls of 3-5 mm dia, which are made of mixture of Bentonite and local clay of 1:1 ratio. As per instruction of Engineer-in-Charge, the remaining vacant space of borehole is to be filled by local clay.

As a crucial and mandatory element, Bentonite should be used during drilling as viscous material for boring which also helps to form a strong outer surface of the bore hole.

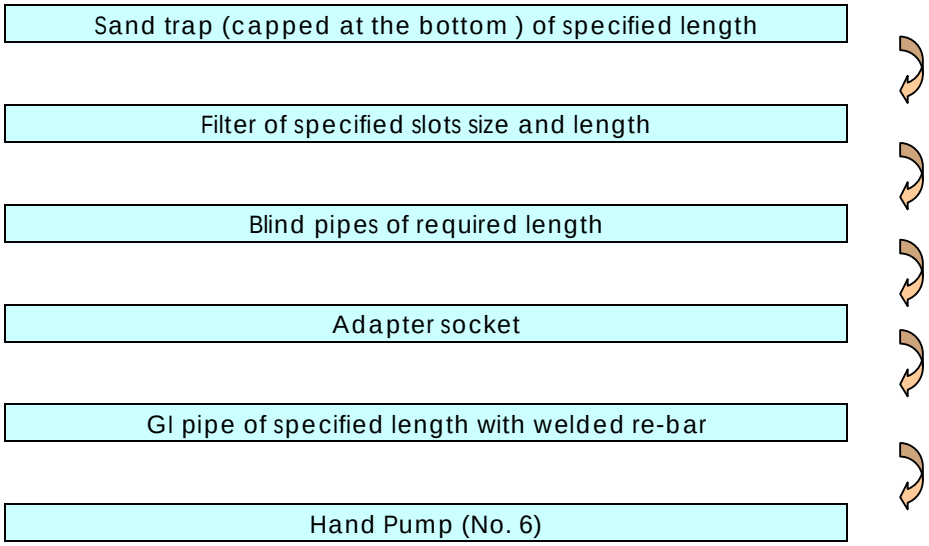
2.5.2 Depth of Well

Successful drilling of the well is a joint responsibility of the contracted SIA and the drilling team. Project Engineer of the SIA shall install the screen at the most suitable strata within the specified depth. If no good layer is encountered within the specified depth, the engineer can decide, to drill beyond this depth. If a good water bearing strata is encountered above the specified or actual drilled depth the engineer in charge may also decide to install the screen there. The SIA/drilling team will be paid for the actual installed length of the well fixed.

2.5.3 Installation of Well

Prior to installation all the well fixtures are to be checked for any leakage, crack, damage, uneven bell mouth and manufacturing defects. Before joining with solvent cement inside of the female end and outside of the male end should be cleaned properly by acetone. Solvent cement should be applied in thin layer to male (out side) and female (inside) ends. The surface must be cleaned and dry. In any case no heating will be allowed during jointing the pipes.

The following sequence shall be followed while sinking Deep Hand Tube-well



2.5.4 Testing of Water Quality and Well Discharge

The water quality of the well shall be tested the installed tube-well under the contract shall be done in the nearest Laboratory and all the cost will be borne by the SIA.

The quality of water should have to be conform with the Bangladesh drinking water quality standard for Arsenic and Iron content in water as follows.

If water quality satisfies the following limit only then the SIA shall approach constructing the platform.

Sl. No.	Parameter	Maximum allowable Limit
1.	Arsenic	0.05 mg/Liter
2.	Iron	5.00 mg/Liter

If the quality does not conform with the above standard no payment should be made to the contractor for the tube-well.

2.5.5 Construction of Platform

Construction of platform will take place only if the well has been found acceptable in respect of water quality as per design & types of well. In case water is found non potable, the well head will be taken off and the well top capped.

The contractor shall remove the top soil and ram the earth under the platform before casting to provide a stable foundation. The site shall be raised on sand or brick chips as necessary to obtain sufficient height for platform drainage.

The platform shall be constructed as per approved drawing and design. Care must be taken to ensure that the welded bar to the top G.I Pipe is embedding properly in the concrete bed of platform as per drawing. The platform shall be cured properly for a minimum period of 7 days. The well shall remain capped during the period of curing and the pump head shall be refitted to the well after the curing is over.

2.6 Technical Specification of the DHTW Component

2.6.1 Technical Specification for Cast Iron Hand Pump no. 6

The pump shall be made of cast iron and is meant to be fitted on drilled tube wells of 38mm (1½ inch) diameter PVC pipe with G.I. top pipe of same diameter for pumping water for domestic purposes. It is a ragged, heavy duty type pump called the modified No.-6 pump.

2.6.2 Technical Specification of G.I. Top Piece

The nominal diameter of the pipe will be 38 mm and made of galvanized steel pipe as BS 1387: 1985 medium series class B. The wall thickness will be minimum 3.25 mm. mm & outside diameter shall be within the range 48.1 mm to 48.4 mm. All the pipes must be new without having any defect (hole, rust, pitted etc.)

2.6.3 Technical Specifications of 38 mm uPVC pipes

The base material from which the pipe is to be produced shall be un plasticized polyvinyl chloride (uPVC) with additives as necessary for the manufacture of pipe in accordance with the British standard & to satisfy colour requirements.

The nominal diameter of the pipe is 1 ½. inch (38mm) and conform to BS 4205:1986, the outside diameter will range from 48.1 mm to 48.4 mm. The class of the pipe will be 'D' of wall thickness 2.5 mm-3.00 mm.

2.6.4 Technical Specification of Robo Screen

These are to made from rigid PVC pipe 38 mm nominal diameter class 'D' manufactured in accordance with BS 4205: 1986 extruded with ribs.

Outer diameter	:	from 48.10 mm to 48.40 mm
Wall thickness	:	2.5 mm to 3.0
Overall length	:	2.375 M ± 10 mm
No. of ribs	:	8 nos.
Rib to rib distance	:	38.5 mm (max)
Slotting	:	Continuous helicall slotting.
Slot width	:	0.20 ± 0.02 mm
Slot pitch	:	1.5 mm
Ends	:	Both ends plain spigot and clear from slots over a length of 125 mm ±5 mm
Mid condition	:	Plain, length of 125 mm ± 5 mm
Colour	:	Blue or any specified colour.

2.6.5 uPVC fittings and Accessories (fitting accessories)

- Threaded socket adaptor
- Straight coupling
- PVC Sand Trap

2.7 Maintenance of installed DHTW:

Once installed, maintenance of the Tube well will be carried out by the respective community. The boarder maintenance aspect includes:

- Plat form has to be kept clean and hygienic round the year.
- Drainage system has to be kept operable and free from all obstacles.
- It has to make sure, no sanitation facility (latrines) is installed near-by (not with in 30 feet radius).
- Kit box for minor repairing has to be kept near the installed facility.

3. Conclusion

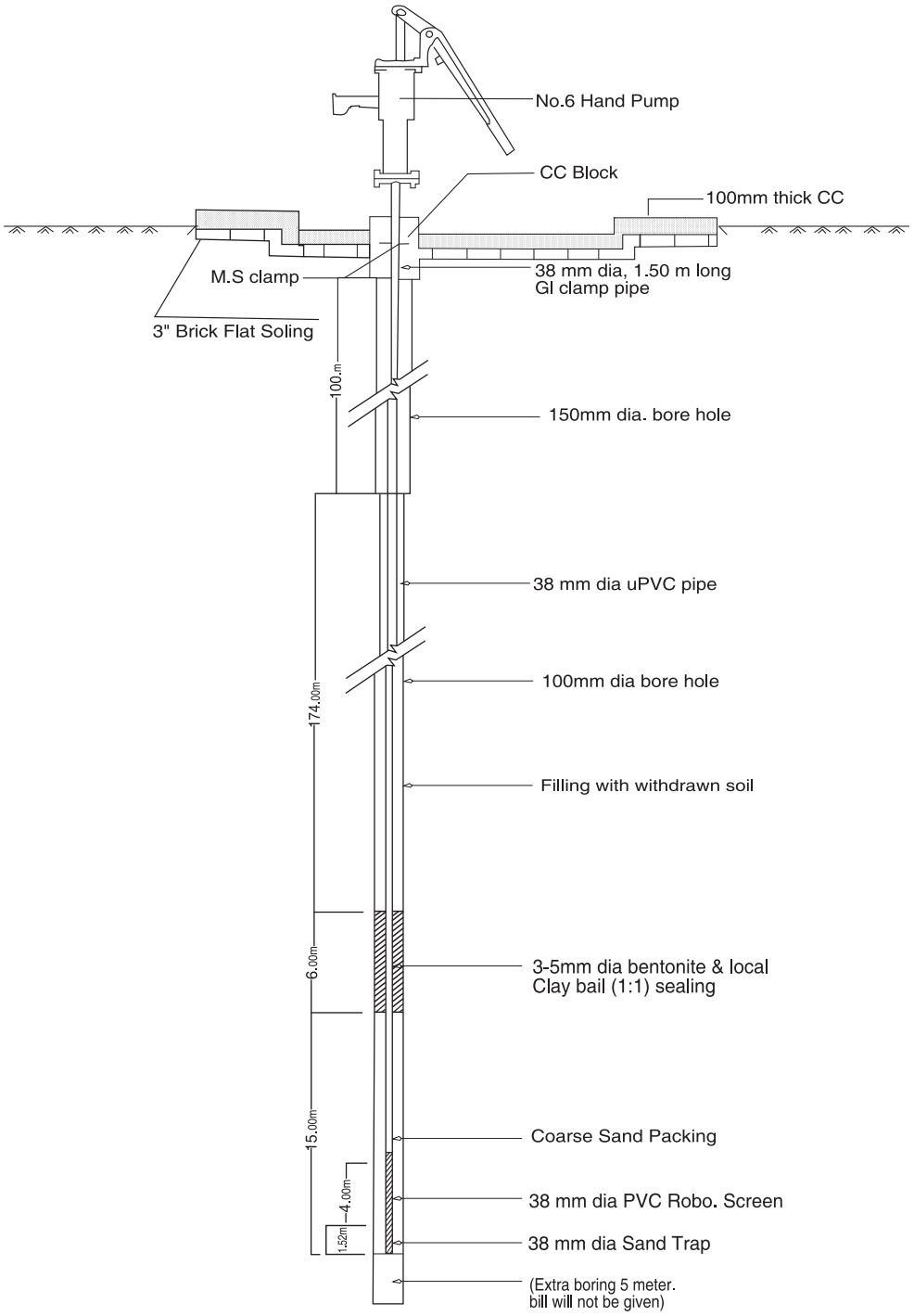
Crisis of pure drinking water is a round-the-year cry for the disaster prone southern part of Bangladesh. Not only for salinity intrusion, but also for Arsenic contamination, a lot of tube-wells already installed in the first aquifer, has become unusable.

Through ensuring access to safe drinking water, poverty stricken village population can be aided in their fight against poverty and hunger, high child mortality rate, low maternal health along with ensuring environmental sustainability.

So, through ensuring access to safe drinking water, CDMP can add significant to value to her beneficiaries' life style that in consequently will aid the country initiative in achieving Millennium Development Goals.

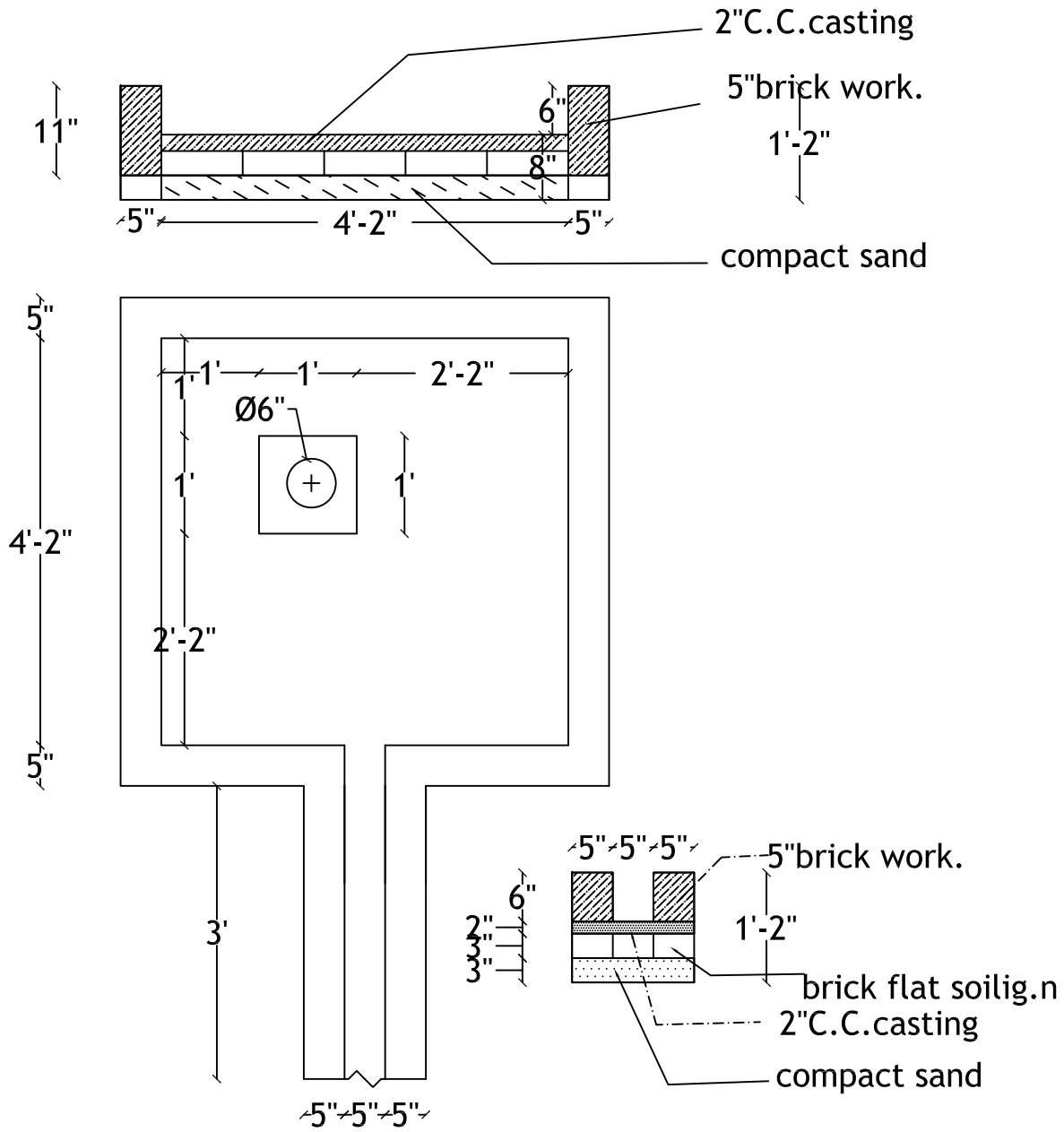
(a) Scheme Design

Deep Hand Tube Well (DHTW)



Drawing of deep Tube Well
With No. 6 Hand Pump

Figure: Deep Hand Tube Well


2"C.C.casting
5"brick work.
11"
6"
8"
1'-2"
5"
4'-2"
5"
compact sand
5"
1'
1'
1'
2'-2"
Ø6"
1'
1'
4'-2"
2'-2"
5"
3'
5"5"5"
5"5"5"
5"brick work.
6"
2"
3"
3"
1'-2"
brick flat soilig.n
2"C.C.casting
compact sand

Cost Estimation:

Estimated cost for DHTW installation

Budget summary sheet (for 300 M depth)

Part A

Item No	Brief Description of Item	Unit	Quantity	Unit rate (in Tk)	Amount in Tk
1	Boring by using 100 mm dia from 0.0 to 300m=300.00	m			
	(a) 0-50	m	50.00	75.00	3750.00
	(b) 51-100	m	50.00	82.00	4100.00
	(c) 101-150	m	50.00	89.00	4450.00
	(d) 151-200	m	50.00	96.00	4800.00
	(e) 201-250	m	50.00	107.00	5350.00
	(f) 251-300	m	50.00	118.00	5900.00
2	38 mm dia pvc pipe (Aziz/RFL Brand) including cost of solvent cement and fitting etc	m	292.35	66.52	19447.12
3	38mm dia. Gi pipe	m	1.50	425.00	637.50
4	38mm dia.socket adapter	No	1.00	80.00	80.00
5	38mm dia.pvc strainer	m	6.15	110.00	676.50
6	38mm dia.pvc end cap	m	1.00	58.00	58.00
7	Red oxide (2 Coats)	kg	0.50	600.00	300.00
8	Synthetic Enamel Paint (2 Coats Burger)	Litre	0.25	680.00	170.00
9	16 mm dia rod 1.00 m length=1.56 kg (including making charge)	No	1.00	185.00	185.00
10	No. 6 Hand Pump set (EPL/RFL Brand)	each	1.00	2650.00	2650.00
11	Carrying charge with Bentonyte (3 sacks)				7000.00
Sub-total Tk					**59554.12**

Part B **Sign Board and Arsenic test**

Item No	Brief Description of Item	Unit	Quantity	Unit rate (in Tk)	Amount in Tk
1	Cost for Platform				3893.44
2	Test for Arsenic	LS	1	300	300
3	Sign board & message writing	each	1	600	600
Sub-total					**4793.44**

Total taka (A+B) for hand tubewell (including platform)	**64347.56**

Item No	Brief Description of Item	Unit	Quantity	Unit rate (in Tk)	Amount in Tk
1	**Total set of tubewell in Barguna sadar upazila**	nos	10	64347.56	643475.62
Grand total (tk)					**643475.62**

Details Calculation for Tubewell Platform (5×5 feet)

1. Earth Work in Excavation		
a) Platform:	5'X5'X.6"=	12.5 **cft**
b) Drain:	1.25'X3'X6"=	1.875 **cft**
Total Earth Work	**(a+b) =**	**14.375 cft**
2. Sand Filling (FM=0.5)		
a) Platform:	5'X5'X3"=	6.250 **cft**
b) Drain:	1.25'X3'X3"=	0.938 **cft**
Total Volume	**(a+b) =**	**7.19 cft**
3. Single Layer Brick Flat Soling		
a) Platform:	4.17'X4.17'=	17.389 **sft**
b) Drain:	3'X1.25'=	3.750 **sft**
Total Volume	**(a+b) =**	**21.139 sft**
4. 75 mm Mass Concrete Work (1:2:4)		
a)Tube Well (Base):	1'X1'X1'=	1.000 **cft**
b) Platform	4.17'x4.17'x2"	2.956 **cft**
c) Drain	1.25'x3'x2"	0.638 **cft**
Total Volume	**(a+b+c) =**	**4.6 cft**
5. Edge wall		
a) Platform	20'x1.17'	23.4 **sft**
b) Drain	6'x1.7'	10.2 **sft**
Total Volume	**(a+b) =**	**33.6 sft**
6. Plaster work (1/2")		
a) Edge wall	26'x11"	23.92 **sft**
Total Volume	**(a)**	23.92 **sft**

Details Cost Estimation for Platform (5×5 feet)
Requirement of Material

SI No	Name Of Item	Unit	Quantity	Rate/Unit	Total Amount(BDT)
1	Earth Excavation		14.4	2.5	36
2	Brick 1st class	nos	185	6.5	1202.5
3	Sand (Local)	cft	7.2	10	72
4	Sand	cft	5	24	120
5	Brick Chips	cft	4	60	240
6	Cement	bag	4	380	1520
					3190.5

Labor Cost Estimation

SI No	Name Of Item	Unit	Quantity	Rate/Unit	Total Amount(BDT)
1	Single Layer Brick Flat Soling	sft	21.2	5	106
2	Plaster work (1/2") with NCF	sft	23.92	8	191.36
3	Edge wall	sft	33.6	10	336
4	Mass Concrete Work (1:2:4)	cft	4.6	12	55.2
5	Sand Filling (FM=0.5)	cft	7.19	2	14.38
	Sub total				**702.94**
	Grand Total (a+b)				**3893.44**