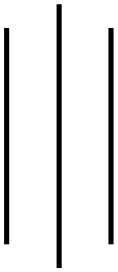
Yuwamai Khola Micro Hydro Project

Gumda VDC, Gorkha

(14 kW)

FEASIBILITY STUDY REPORT



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ACKNOWLEDGEMENT

Appropriate Engineering(AE) cordially extends its very sincere gratitude to Namaste Gumda Association, Gorkha for providing the opportunity of carrying out the feasibility study of YumawaiKhola Micro Hydro Project.

We would like to acknowledge the user's committee of Yuwamai Khola Micro Hydro Project for entrusting us to conduct Feasibility Study of Yuwamai Khola Micro Hydro Project located at Gumda VDC-4, Yamgaun of Gorkha district.

We would also like to thank the villagers of Yamgaun for providing us with their valuable time during the field survey. We specially thank Mr. MaanBahadurGurung and Mr. AshimGurung, the president and secretary of the user's committee for their sincere support and cooperation during the field visit in absence of whom it was not possible to complete this survey due to several circumstances. We hope the establishment of this project in the village will be supportive for increasing the life standard and thereby will continue to the economic growth of the village.

Last but not the least; we would like to thank AE team member Mr. Chandra BahadurRana (Ramesh) who deserves sincere appreciation for due completion of the study report in time.

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SAILENT FEATURES

Project Location

Name of Project	: Yuwamai Khola Micro Hydro Project
Name of River	: Yuwamai Khola
Location	: Gumda VDC, Ward no. - 4, Yamgaun
District	: Gorkha
Load centre	: Pokharidanda(18 HH's), Yamgaun(55 HH's), Lapsibot(95 HH's)
Total beneficiary households	: 168 HHs
Average Subscribes power	: 83watts/HH
Owner ship type	: Community
Nearest road head	: Baluwa Bazaar, Gorkha (June to September) : Yamgaun, Gorkha (October to May)
Distance from Road head	: About 1 day walk from Baluwabazaar, Gorkha (during June to September) : 3 hrs walk from Yamgaun up to site (during October to May)
Route to reach the site	: Butwal – BarhakiloGorkha – Chepetaar – Baluwa bazaar – Barpak – Larpak – Gumda and YamgaunProject site

Technical Features

Discharge measured	: 60 lps
Date of measured	: 25th March 2016
Designed Discharge	: 40lps
Net head	: 60 m
Design Capacity	: 14 kW
Overall efficiency	: 60 %
Headrace length	: 450m, HDPE pipe 250mm dia. 2.5kgf/cm sq.
Stone Masonry Canal	: 50m length, 0.40m x 0.35m

Electro mechanical

Turbine Type	: Pelton Turbine 250 PCD Double jet
Driving System	: Belt drive system (Habasite Belt)
Generator Type	: 3-Ph, Synchronous, Brushless, 30 kVA, 87 % efficiency, 1500 rpm.
Penstock	: 167mm ID, 3.5mm thick, MS pipe, 160m total length
Trans./Dist. Network	: Low Tension Line 230 / 400v

Transmission Details

Total length of T&D line	: 2500 m
Single Phase Line	: 1380 m
Three Phase Line	: 1120 m

Total length of Squirrel conductor : 12000 m
Total length of Weasel conductor : 3000 m
Total 9m Steel tubular poles : 50 nos

Financial Features

Summary of Project Cost

S.N.	Description	Amount (NRs.)	Remarks
I.	Civil works	3872466.22	
II.	Electrical works	3668149.5	
III.	Mechanical Works	2978115	
IV.	Tools & Spare Parts	103722.7	
V.	Transportation & Packing	410000	
VI.	Installation Works	275000	
	Grand Total	11307453.42	

Cost per kW :NRs. 807675.24

ACRONYMS AND ABBREVIATIONS

ACSR	: Aluminium Conductor Steel Reinforced
AE	: Appropriate Engineering
Amp	: Ampere
Cum	: Cubic meter
kg	: Kilogram
km	: Kilometer
kV	:Kilo Volt
kVA	: Kilo Volt Ampere
kW	: Kilo Watt
kWh	: Kilo Watt Hour
lps	: Litres per second
MHP	: Micro Hydro Project
MIP	: Medium Irrigation Project
mtr/m	: Meter
NRs	: Nepali Rupees
PCC	: Plain Cement Concrete
PCD	: Pitch Circle Diameter
RCC	: Reinforced Cement Concrete
RPM	: Revolution per minute
Sq.m	: Square meter
T & D	: Transmission and Distribution
VDC	: Village Development Committee

SUMMARY

The proposed project site is located at Yamgaun, ward no. 4 of Gumda VDC of Gorkha district. The total numbers of households in the project are is 168 with the total population of about 870. The potential load centres of the project include Pokharidanda, Yamgaun and Lapsibot of Gumda VDC in Gorkha district.

The main source of the project is Yuwamai Khola. The salt dilution method was performed to measure the discharge. The total discharge has been measured as 60 lps. The design discharge of the project is 40 lps and the available gross head is 60 meters. The project is designed for the installed capacity of 14 kW.

The total length of headrace is 500m (450m HDPE pipe and 50m stone masonry canal). Total length of penstock pipe is 160m and that of tailrace canal is 5m. The transmission and distribution network consists of low-tension line. The total length of T & D line is 2500m.

The total cost of the project is estimated as NRs.11307453. Thus, the cost per kilowatt becomes NRs. 807675. The cost of civil, mechanical and electrical works is estimated as NRs.3872466, NRs.2978115 and NRs.3668149 respectively. Similarly, the cost of other items (tools and spare parts, transportation and installation) is NRs.788722.

In general, it appears that the project is technically and financially feasible. It is also observed that the community people are exceedingly interested to install a Micro Hydro Project in their locality through their remarks and active involvement at the meeting as well as other surveying activities. Almost negligible negative environmental impact will occur due to the constructional activities of the MHP as the canal and penstock routes consists of stable terrain and no need of heavy tree cutting and massive construction.

As the project is going to provide the lightening along with the possibility of end use facilities for the people of the rural area of Gumda VDC, the project is strongly recommended for the installation. It is sure that the project will be able to provide a significant positive impact to the society and community in terms of awareness as well as other income generating activities.

INTRODUCTION

From the viewpoint of hydropower potential, Nepal comes in second position in the world after Brazil. This reality has till now become only a slogan and to convert the reality into actual, such Programme (Alternative energy) can have important role to improve the life standard and overall economic condition of Nepal. Hydropower projects launched till now has not qualitative impact to the people all over the country. The energy right now is in surplus condition. Because of higher investment in these projects,the price of electricity has become higher. In other hand, the distribution of energy in geologically remote area is costlier one. So, the concept of Micro Hydro power Project in Nepal has got more popularity. The consumer themselves have their involvement in such projects.

Apart from this, the production cost of large Hydro power schemes has been so expensive that the investment in this sector would be meaningless. So, the government is taking a strategy of developing micro hydro power project even in the involvement of private sectors. In our case, this programme operated by Namaste Gumda Association, Gorkhais the output of the above strategy.

From the viewpoint of consumption, thepower developed so far seems to be still surplus in one side and in the other side most of isolated villages of Nepal are still out of reach of energy.In the isolated areas, it is found economically unfeasible to access the national grid. For this reason, the concept of MHP (alternative energy) has got wider importance to fulfil their basic energy demands in these areas by utilizing isolated natural hydro resources. The government as well as private sectors is now working in the field of renewable energy with the assistance from international donor agencies including Denmark, Norway, Finland and others, especially in micro hydro sector, to provide cheap energy with the involvement of the local people so that sustainable energy can be developed in long run.

1. BACKGROUND

As per the understanding and agreement between Yuwamai Khola Micro Hydro Project users' committee and Appropriate Engineering (AE), AE has carried out the feasibility study of YuwamaiKhola MHP, Gumda VDC – 4, Yamgaun, Gorkha on March 2016. The survey team comprising of Mr. Chandra BahadurRana (Ramesh) has visited the site in order to gather technical as well as socio-economic information of the project.

Namaste Gumda Association has motivated and encouraged the community for the installation of micro hydro project. The team observed that the community is extremely interested to have a micro hydro project at their village. The settlements were very nicely formed with the groups of houses at different locations.

The project is named after the name of the river flowing through the community for the proposed Micro Hydro Project as "Yuwamai Khola Micro Hydro Project". This report contains the plant size, load demand, design for civil, mechanical and electrical components of the plant with construction details, bill of quantity, social and environmental considerations.

The main objective of this study is to assess the detail feasibility study of micro-hydro scheme in terms of technical, financial and socio-economic aspects.

2. METHODOLOGY

The general methodology includes the collection of the primary data from the site visit and conducting site survey and interview with the local people. A meeting was conducted in order to get the general view of the community before starting the site survey. At the first, the team conducted the reconnaissance survey with the help of local people then the detailed measurement of different components was taken.

The team measured the river discharge on 25th March 2016. The Salt Dilution Method was used for the discharge measurement.

The abney level, measuring tape and magnetic compass have been used in order to measure the intake, canal alignment, penstock alignment, and powerhouse and tail race as per necessary. The team has finalised the location of intakes, gravel trap / desilting basin and forebay area and measured the area available. The transmission / distribution network has been surveyed with the help of measuring tape and magnetic compass.

The team also collected the necessary socio-economic data with the help of the community people during the mass meeting as well as individual meeting in order to collect necessary information as per the format provided. Thus, collected information has been analysed for both technical and economical feasibility of the scheme. This detailed feasibility report is the outcome of this survey.

3. GENERAL PROJECT INFORMATION

3.1 Location and Accessibility

The proposed powerhouse site is located at the cultivated land of Gumda VDC ward number 4 of Gorkha district. The project will serve a total of 168 house-holds of ward number 4 and ward number 5 of Gumda VDC. The civil structures of the project are located along the Left Bank of Yuwamai Khola.

The potential load centres of the project comprise Pokharidanda, Yamgaun and Lapsibot of Gorkha district. The farthest load centre is within two kilometres from the powerhouse.

During the monsoon season the road head is only accessible up to Baluwaa bazaar. But, during other months, the project area is accessible for transporting of goods up to Yamgaun, Gumda VDC. (between the months October to May). From Yamgaun the normal trekker takes about 1 hours and loaded porter takes about 3 hours to reach the project site.

3.2 Topography and Geography

The project site is located at about 1 day walk from Baluwa Bazaar, Gorkha. The bus service is available up to Baluwa bazaar, Gorkha (during June to September). The topographical features of the project were judged to be favourable for the construction work of micro hydro project. The elevation of the powerhouse site is about 1290 metres from the mean sea level.

The civil structures are located at thin forest area as well as barren land while the penstock alignment is also passing along the barren land. According to the surface study, the terrain consists of stable and rocky land with some trees. The average slop of the penstock route is about 26^0. The stream can be generally described as gentle slope around the intake area.

3.3 Climates and Vegetation

The proposed project site is located at the Northern part of Gorkha district, which falls in the hilly region, according to the physiographic division of Nepal. The sub-tropical climate is available around the project area. The two seasons of the year are well marked with typical variations. The natural vegetation over the project area consists of bushes, cultivated land, forest and barren land.

4. PLANT SIZES

4.1 Water users

Before effective design of a hydro power project one must consider the coordinated use of the stream water for power generation as well as other local purposes. In case of this Yuwamai Khola Micro Hydro Project, the stream water at that section has not been used for any other purpose. There are no any water mills or any MHP schemes nearby; therefore, the proposed site does not affect the water users.

No any water right issues have been observed for the installation of the micro hydro project in the area.

4.2 Design Discharge

The team has measure about 60 lps discharge at Yuwamai Khola by using Salt Dilution method on 25th March 2016. As the headrace canal is about 450 m of open concrete canal and 50 m of HDPE pipe canal; considering the losses the discharge has been taken as 40 lps.

4.3 Proposed Plant Size

The proposed size of the micro hydro scheme is 14 kW with 40 lps design flow and available gross head of 60 metres with overall efficiency of 55%.

5. SCHEME LAYOUT

The source of the proposed scheme is Yuwamai Khola. The intake and other civil structures are proposed at the right bank of the stream. The discharge is proposed to deliver up to the forebay through the HDPE pipe canal. The penstock alignment is passed along the gentle slopped terrain. The penstock alignment is passing through only the barren land. The location of power house is also barren land. The tail water can pass safely to the stream with about 5 metre long tailrace canal.

5.1 Civil Structure

5.1.1 Intake structure

The location of intake is about half an hour walk from the proposed power house site. A coarse track rack has been proposed at the intake mouth of the source. The detail of intake and necessary arrangement for the diversion of water towards the canal has been provided in the drawing section and the estimate for this work has been provided in the BOQ.

5.1.2 Desilting basin

A desilting basin has been proposed at 50 meter distance from the intake source. The desilting basin has been designed in order to remove 0.3mm and above sized particles. The settling length of the desilting basin has been proposed as 6m with 2.5m width and 1m depth. A flushing cone of diameter 200mm and 1.2m height has been proposed for wash out provision. Similarly, a overflow provision of length 1.5m with collecting ditch and spillway has been proposed for the safe escaping of the wash out and overflow water. A fine trash rack of size 400mm x 500mm has been proposed at the intake of the pipe canal.

5.1.3 Headrace canal

The total length of the headrace is 500 meters. Out of which the first part of the canal (from intake to the desilting basin, 50m) has been proposed as a lined canal and for the remaining part (450m), HDPE pipe of diameter 250mm and 2.5 kgf/cm^2 has been proposed. It is proposed to bury the HDPE pipe 0.5m into the ground.

5.1.4 Forebay cum desilting basin

The forebay tank has been proposed at about 500m from the intake at barren land. The terrain of the proposed forebay is almost flat and sufficient area is available for the construction. The size of the forebay tank is 2.5 x 0.6 (settling zone only). A fine trash rack is also proposed at the entrance of the penstock pipe. A flushing cone of diameter 200mm and length 1.2m has been proposed for the wash out provision.

Similarly, a overflow provision of length 1.5m length with collecting ditch and a spillway of length 5m has been proposed for the safe escaping of the wash out and overflow water into the nearby gully. A fine trash rack of size 0.8m x 0.5m has also been proposed at the entrance of the penstock.

5.1.5 Penstock layout

The total length of the penstock pipe is 160m. Mild steel pipe have been proposed for the penstock. The diameter of the proposed penstock pipe is 167mm for the design discharge of 40lps. Similarly,

the thickness of the penstock is 3.5mm. Altogether 5 vertical bends has been proposed for penstock alignment.

Each length of penstock pipe is proposed of 3m. The flange thickness of 10mm for 3.5mm thick pipe has been proposed to connect the penstock segment. The penstock pipes are joined with 12mm dia., 1.5" long high tensile bolts. In every joint 8 umbers of bolts with nuts are proposed with 6mm diameter "O" ring gasket for sealing water.

The average natural slope of the terrain under the penstock pipe alignment is about 26^0. The geological composition of the terrain along the penstock route has been observed as stable terrain consisting of barren land.

Eight anchor blocks (5 at the each vertical bends and 3 at straight portion) followed by the respective 8 expansion joints have been proposed. It is proposed to erect the penstock pipe from bottom to top. Altogether 28 support piers have been proposed at an interval of about 4.5m to support the MS penstock pipe above the ground.

5.1.6 Power house

The proposed powerhouse is located at the barren land. The outside dimension of the powerhouse building including operator's quarter is 5m x 7.5m x 2.7m. The powerhouse has been proposed to construct in mud mortar and plaster with 1:6 c/s mortar on inside wall and pointing with 1:3 c/s mortar on the outside wall. 1:2:4 PCC has been proposed for flooring and CGI sheet for roofing.

5.1.7 Machine foundation/Tailrace

1:2:4 RCC has been proposed for the machine foundation. The size and type of machine foundation depends on the base frame provided by the turbine manufacturer.

The proposed tailrace is 5 meters in length and the constructional feature of which is stone masonry. However, the tailrace canal inside the powerhouse has been proposed to cover with precast slabs. The tail water can be exposed into the source river.

5.2 Electro-Mechanical Works

All the electromechanical components except generator and butterfly valve would be manufactured / fabricated in Nepal.

5.2.1 Valve

A butterfly valve of diameter 200mm (about 8") with adapter has been proposed ahead of turbine in order to regulate (to open or close) the flow of water in the penstock pipe.

5.2.2 Turbine / Generator unit

The turbine / generator unit is designed for a gross head of 60 meters and a discharge of 40 litres per second.

5.2.2.1 Turbine

For the available gross head of 60 meters and the design discharge 40 lps, a pelton turbine of 250mm PCD, double jet has been proposed. The turbine should be equipped with manually operated flow regulating valve with deflector system. The expected turbine shaft output at the expected

design head and flow should be at least 16 kW. The construction and bearings should be rated to withstand runaway speed of the turbine. The bearings should further take into account the static load exerted on it due to the drive system.

5.2.2.2 Drive system

Belt drive system has been proposed as a drive system in the design. A3 size Habasite belt is recommended for the drive system.

5.2.2.3 Generator

A generator rated to continuously deliver 14 kW power at the given site condition with the following specification is proposed.

- 30 kVA, Synchronous, 3 phase, Ins. Cls. – F
- 400/230 Volt
- 50 Hz
- 1500 rpm
- 0.8 power factor
- Brushless generator
- 90% efficiency

The generator size and type is compatible with the electronic regulating system. The construction and bearings should be rated to withstand runaway speed of the turbine. The bearings should further take into account the static load exerted on it due to the drive system.

5.2.3 Control system

A freestanding sheet control panel with instrumentation, control, protection and switchgears is proposed. Three immersion heaters (per phase of 6 kW) of the dummy load have been proposed with a separate water tank with continuous inlet and outlet flow of water. The instrumentation proposed are tree load ampere meters, one generator voltage meter with selector switch, three ballast volt meters (as the case may be depending upon the type of regulator), one frequency meter, and one out-going kWh meter. The protection system should include adequately sized fuses / MCCB's (MCCB 40 Amp. 10 KA breaking capacity) L & T of 2 nos. to protect against overload as well as short circuits without damaging the generator and other control equipment.

5.2.4 Powerhouse cabling

Armoured copper 25mm^2 power cables are proposed to connect generator, panel and dummy local bank inside the powerhouse. Similarly, 35mm^2, 4-core Armoured Aluminium cable is proposed for the connection between the main switch and the first pole. Cable ratings should be at least 170 percent of the required maximum current to be carried. At least 3, light points with incandescent lamps and one power point with necessary switches and fuses are proposed for the power house use.

5.3 Transmission / Distribution Network

The generated power is proposed to transmit the load centres via 3 phase, 11 kVA High Tension (HT), and over head lines. The design and construction has been simplified with an overview to reduce the project cost by using locally available resources as much as possible.

The total length of the transmission and distribution line is 2500 meters. The transmission and distribution network consists of poles, conductors and insulators.

5.3.1 Poles

Nine meters steel tubular poles are proposed for the transmission and distribution network. Altogether, 50 steel tubular poles have been proposed. At least 1.2m length of the pole should be inserted into the ground. The lower portion of the pole should be coated with bitumen paint in such a way that at least 0.3m painted length would be above the ground level. The average pole to pole distance in case of the pole is considered as 50m. However, in case of valley crossing etc, the double pole could be erected at both sides with 2 meters cross arms. The first, last and any poles at turns in the transmission line must be cable stayed.

5.3.2 Conductor

For the transmission / distribution of the generated power, the following Aluminium Conductor Steel Reinforced (ACSR) has been proposed.

- Weasel – 3 km
- Squirrel – 12 km

The conductor/cable sizes are indicated in the drawing section. The conductor sizing has been done by keeping in mind anticipated peak load demand in each of the branch. The line material has been designed in such a way that maximum voltage drop at peak hours at the end of each distribution line will not exceed by 10 percent.

5.3.3 Service lines

4 mm^2 concentric aluminium cables have been proposed for the service connection to the households. The internal wiring of each household should be connected through a suitable sized load limiting switch (MCB).

5.4 Protection System

5.4.1 Overhead line protection

The overhead ACSR transmission/distribution lines are to be protected from high voltage surge of atmospheric lightening with 0.5 kV and 11 kV lightening arrestors along the transmission line respectively. 30 numbers of lightening arrestors have been proposed for the transmission lines. The lightening arrestors should be installed at sending end (just near the power house) and at each 500 to 700 meters interval along the transmission distribution line.

5.4.2 System protection

One 50 Ampere MCCB is proposed at the powerhouse transformer and another 50 Ampere MCCB is proposed at the village load transformer. 40 Ampere MCCB is proposed at the Lapsibot village transformer. Care should be taken while earthing the distribution boards so as not to make the earth fault devices redundant. Care has been taken in the placement and sizing of MCB so as that fault isolation is easy and there is no nuisance trapping.

5.4.3 Earthing system

All exposed metal parts of the generating equipment must be earthen properly. The generator neutral terminal must also be connected to the separate earth point.

Altogether 30 sets of lightening arrestors are proposed whereas each arrestor is proposed to install in not more than 750m span which is more than sufficient according to Interim Micro Hydro Standards of ESAP. Each lightening arrestor station is proposed separately earthen by using 8 SWG copper conductors. 3mm x 600mm x 600mm copper earthing plates are to be used at main distribution board, each distribution box should be properly connected to earth. This should be affected by separate earthing of each distribution board. Earthing should be done with the same conductor and plates as mentioned earlier.

5.4.4 Consumer protection

All consumer connections should be protected through MCB/PTC of appropriate rating to suit consumer's peak wattage subscription. 0.5 Ampere MCB is proposed to install at consumer connections. These are to be installed in enamel painted, lockable metal enclosures. Adequate wiring and terminal connections should be provided for neat and efficient service cable connection.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

The total cost of the project is Rs.11307453.42 which results the cost per kW Rs.807675.24. the project cost distribution worked out about Rs. 3872466.22 for civil works, Rs. 3668149.5 for electrical works, Rs. 2978115 for mechanical works, Rs. 103722.7 for tools and spare parts, Rs. 410000 for transportation and packing and Rs. 275000 for installation works.

The civil works cost of the project seems comparatively high due to the wages of workers. In general, it seems that the project is technically and financially feasible. It is also observed that the community people are extremely interested to install a Micro Hydro Project in their locality through their remarks and active involvement at the meeting as well as other surveying activities.

Almost negligible negative environment impact will occur due to the constructional activities of the MH project the canal and penstock routes consist of stable terrain and no need of heavy tree cutting and massive construction. As the project is going to provide the lighting and other end use facilities for the people of the rural area of the country, the project is strongly recommended for the installation. It is believed that the project will be able to provide a significant positive impact to the society in terms of awareness as well as other income generating activities.

During installation experienced parties or technicians should be involved. The project will be successful with the assistance and supervision of reputed organisations like Appropriate Engineering, Himalayan Eco-environment Youth Club and Namaste Gumda Nepal.

6.2 Recommendations

i) Project implementation committee (Yuwamai Khola MHP) should have registered water rights in the District Water Resource Committee (DWRC) and arrange other necessary documents required at District Development Committee (DDC) and Village Development Committee (VDC).

ii) The committee should have to make a written arrangement with the landowners (private land using for civil structures) prior to the installation works.

iii) It is also recommended to organise operation and maintenance training for operators and manager before commissioning of the sustainable operation of the scheme.

Community Meeting

Flow measurement

Proposed site for Forebay Tank

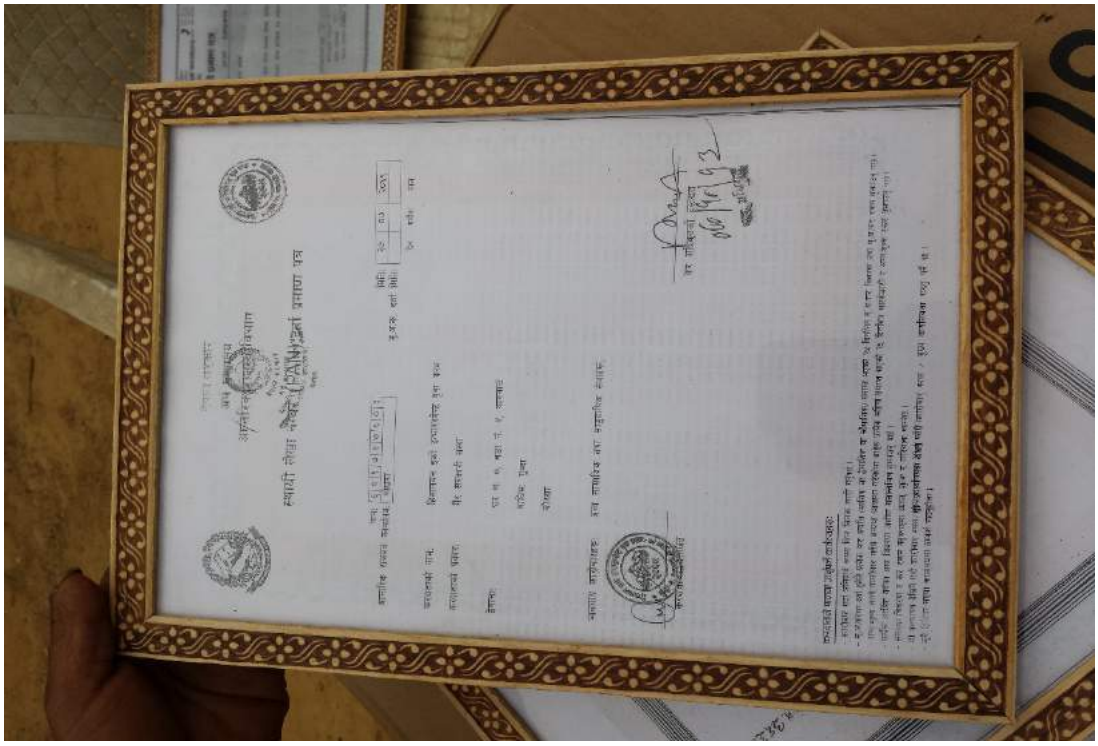
Head Measurement

Canal Alignment

Intake Canal

Transmission and Distribution

Village Load



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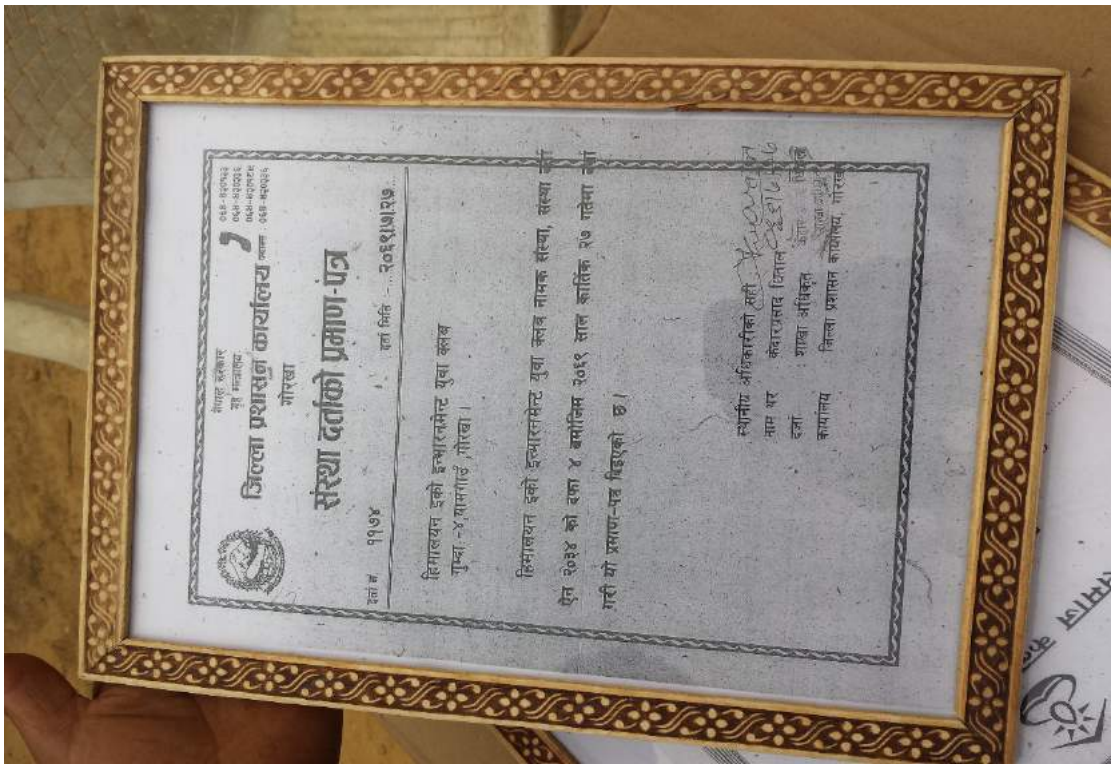
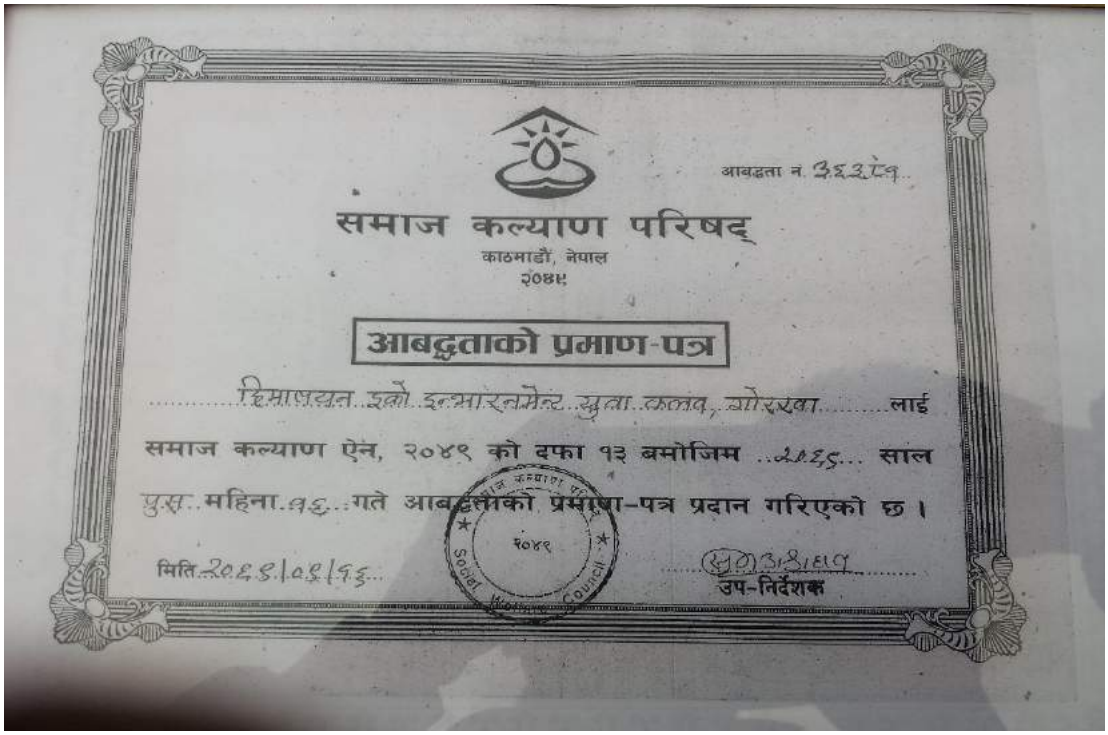


Registration Certificate



आबद्धता नं. ३६३८१

समाज कल्याण परिषद्

काठमाडौं, नेपाल

२०४९

आबद्धताको प्रमाण-पत्र

हिमाल्यन इको इन्भारनमेन्ट युवा क्लब, गोरखा लाई

समाज कल्याण ऐन, २०४९ को दफा १३ बमोजिम २०६८ साल

पुस महिना १६ गते आबद्धताको प्रमाण-पत्र प्रदान गरिएको छ ।

मिति २०६८।०९।१६

उप-निर्देशक

Involvement Certificate

Details Cost Estimation of
Yuwamai Khola MHP 15 kW
Gumda VDC, Yamgaun, Gorkha
Head: 60 meters, Flow: 40 lps, HH's no.: 160

I. Civil Works

1.0 Intake and Diversion work

S.N.	Description	Unit	Qty	Rate	Cost
1.1	Earth work in excavation (Boulder mix soil under water)	Cum	11.85	750	8887.5
1.2	Stone soling	Cum	2.32	950	2204
1.3	PCC (1:3:6)	Cum	0.62	7520.3	4662.58
1.4	PCC (1:2:4)	Cum	0.86	9772.2	8404.92
1.5	Bar work (10 mm dia. Bar)	Kg	21	160	3360
1.6	Stone masonry in 1: 6 c/s mortar	Cum	7.95	5260.3	41819.38
1.7	Gabion Construction (2m x 1m x 1m)	Nos	20	7520.3	150406
1.8	Course Trash rack (0.60m x 0.75m)	No	1	7500	7500
1.9	Wooden Stop log	No	1	5000	5000
1.10	Cement (50 kg)	Bag	18	1500	27000
	Sub Total- 1				**217466.89**

2.0 Desilting basin

S.N.	Description	Unit	Qty	Rate	Cost
1.1	Earth work in excavation (Boulder mix soil under water)	Cum	22.3	550	12265
1.2	Stone soling	Cum	25.56	950	24282
1.4	PCC (1:2:4)	Cum	5.8	9772.2	56678.76
1.6	Stone masonry in 1: 4 c/s mortar	Cum	20.3	5780.2	117338.06
1.7	1:4 c/s plastering	Sqm	72.9	380	27702
1.8	Sluice gate (1.3 m Height & 0.50 m x 0.50m opening)	Nos	1	25000	25000
1.9	Cement (50 kg)	Bag	75	1500	112500
	Sub Total- 2				**375766.52**

3.0 Headrace Canal (New Proposed Canal)

S.N.	Description	Unit	Qty	Rate	Cost
3.1	Excavation in (Gravel mix soil)	Cum	45.2	210	9492
3.2	Stone soling	Cum	45.2	950	42940
3.3	PCC (1:3:6)	Cum	7.3	7520.3	54898.19
3.4	Stone masonry in 1: 6 c/s mortar	Cum	45.2	5260.3	237765.56
3.5	1:6 c/s plastering	Sqm	270.3	260.5	70359.09
3.6	Form work	Sqm	36.3	350	12705
3.7	Cement (50 kg)	Bag	70	1500	105000
	Sub Total- 3				**533159.84**

4.0 Forebay cum desalting basin

S.N.	Description	Unit	Qty	Rate	Cost
4.1	Earth work in excavation (Common Soil)	Cum	26.8	150	4020
4.2	Stone soling	Cum	20.1	950	19095
4.3	PCC (1:2:4)	Cum	7.3	12500	91250
4.4	Stone masonry in 1: 4 c/s mortar	Cum	22.6	6500	146900
4.5	1:4 c/s plastering	Nos	165	380	62700
4.6	Sluice gate (1.3 m Height & 0.50 m x 0.50m opening)	Nos	1	25000	25000
4.7	Fine Trash rack (1.00 m x 1.00 m)	Nos	1	7500	7500
4.8	Airvent pipe (1" dia GI pipe, 1.5 m height)	Set	1	3500	3500
4.9	Cement (50 kg)	Bag	100	1500	150000
	Sub Total- 4				**509965**

5.0 Support piers (55 nos)

S.N.	Description	Unit	Qty	Rate	Cost
4.1	Earth work in excavation (Common Soil)	Cum	160.9	150	24135
4.3	PCC (1:3:6)	Cum	4.12	5260.3	21672
4.4	Stone masonry in 1: 6 c/s mortar	Cum	57	7520.3	428657.1
4.5	C' clamp & 2 Anchor rods with nut & washer	Set	55	370	20350
4.6	Penstock Base Plate	Nos	55	1800	99000
4.7	Bitumen Sheet	Roll	1.25	3750	4687.5
4.8	Cement (50 kg)	Bag	210	1500	315000
	Sub Total- 5				**913501.6**

6.0 Anchor blocks (8 nos)

S.N.	Description	Unit	Qty	Rate	Cost
4.1	Earth work in excavation (Common Soil)	Cum	8.49	150	1273.5
4.2	1:3:6 PCC with 40% with 40 % plumb	Cum	29.37	6530.2	191791.97
4.3	Bar work (10 mm dia. bar)	Kg	116	160	18500
4.4	Dry stone masonry	Cum	11.94	1900	22686
4.5	Form work	Sqm	39.69	350	13650
4.6	Cement (50 kg)	Bag	70	1500	105000
	Sub Total- 6				**352901.47**

7.0 Power House

S.N.	Description	Unit	Qty	Rate	Cost
7.1	Earth work in excavation (Common Soil)	Cum	30.5	150	4575
7.2	Stone Soling	Cum	9	950	8550
7.3	1:2:4 PCC	Cum	2.25	12500	28125
7.4	Stone masonry in mud mortar	Cum	61.29	1900	116451
7.5	Plaster with 1: 4 cement sand mortar	Cum	98.08	380	37270.4
7.6	Pointing with 1:3 c/s mortar	Sqm	69.83	250	17457.5
7.7	Doors and Windows				
7.7.1	Sal wood work 4" x 3" chaukosh	Cft	12.76	1050	13398
7.7.2	Sal wood shutter (11/2" thick Dina khapa of door)	Sqft	44.97	250	11242.5

7.7.3	Sal wood shutter (11/2" thick Sisa Khapa of window)	Sqft	67.46	240	16190.4
7.7.4	4 mm thick glass for window	Sqft	44.97	160	7195.2
7.7.5	Miscellaneous (Hing, Locker, Handle, Screw, Nail etc.)	L.S.	1	4500	4500
7.8	Sal wood for roofing truss	Cft	81.01	700	56707
7.9	26 SWG CGI sheet roofing	Sqm	69.36	3250	225420
7.10	CGI sheet ridging	Rm	9.45	350	3307.5
7.11	Cement (50 kg)	Bag	30	1500	45000
	Sub Total- 7				**478938.5**

8.0 Machine Foundation

S.N.	Description	Unit	Qty	Rate	Cost
8.1	Earth work in excavation (Common Soil)	Cum	10.5	150	1575
8.2	Stone Soling	Cum	2.1	950	1995
8.3	Dry Stone Masonry	Cum	5.6	1950	10920
8.4	1:1.5:3 RCC	Cum	7.3	13000	94900
8.5	10 mm dia. Bar work	Kg	150	160	24000
8.6	Plaster with 1:4 cement sand mortar	Sqft	8.3	280	2324
8.7	Form work	Sqft	9.7	350	3395
8.8	Cement (50 kg)	Bag	40	1500	60000
	Sub Total- 8				**199109**

9.0 Tailrace

S.N.	Description	Unit	Qty	Rate	Cost
8.1	Earth work in excavation (Common Soil)	Cum	48.38	150	7257
8.2	Stone Soling	Cum	10.5	950	9975
8.3	1: 2: 4 PCC	Cum	7	9772.2	68405.4
8.4	Bar work 10 mm dia. Bar	Cum	284	160	45000
8.5	Stone masonry in 1: 4 c/s mortar	Kg	9.45	6500	61425
8.6	Plaster with 1: 4 cement sand mortar	Sqft	61.89	380	23520
8.7	Form work	Sqft	24.5	350	8575
8.8	Cement (50 kg)	Bag	45	1500	67500
	Sub Total- 9				**291657.4**

Summary of Civil Costs (Component wise)

S.N.	Description	Amount	%
1	Intake and Diversion work	217466.89	
2	Desilting basin	375766.52	
3	Headrace Canal (New Proposed Canal)	533159.84	
4	Forebay cum desilting basin	509965	
5	Support pipes (22 nos)	913501.6	
6	Anchor Blocks	352901.47	
7	Power House	478938.5	
8	Machine Foundation	199109	
9	Tailrace	291657.4	
	Total of Civil Works (I)	**3872466.22**	

II. Electrical Works

S.N.	Description	Unit	Qty	Rate	Amount
1	Generator: Synchronous, 3 Ph. 30 KVA, Brushless	Set	1	280000	280000
2	Governing System (Control):				
	ELC 18 KW	Set	1	200000	200000
3	Heater for ballast load 18 KW with water tank	Set	1	60000	60000
4	Transmission Cable:				
	Squirrel	Mtr	12000	26.5	318000
	Weasel	Mtr	3000	36.8	110400
	Rabbit	Mtr			
	Dog	Mtr			
5	Main Switch				
	HRC fuse type, 3 Phase 63 amp, Havells	Nos	1	18500	18500
6	MCCB				
	MCCB 50 Amp, 10 KA breaking capacity	Set	2	15000	30000
	MCCB 40 Amp, 10 KA breaking capacity	Set	1	15000	15000
8	Insulator				
	Medium sackle insulator with 'D' iron, nut, bolt etc	Set	230	250	57500
11	Lighting Arrestors				
	0.5 kVA	Nos	18	1800	32400
	11 kVA	Nos	12	4500	54000
14	Earthing Arrangement				
	Cupper: plate 600x600x3 mm including 8 SWG wire	Set	9	18000	162000
15	Stay set				
	1.5 m rod including wire	Set	50	1850	92500
16	6 mm^2 service wire (Concentric cable, 25m x 262 house)	Mtr	3000	26	78000
17	Power cable:				
	Power Cable: 25 mm^2 armoured copper (4 core)	Mtr	20	1850	37000
	35 mm^2 armored aluminium cable	Mtr	25	970	24250
18	50 kVA Transformer H.T	Nos	1	430000	430000
	50 kVA Transformer L.T	Nos	1	430000	430000
19	DO fuse	Set	2	15000	30000
20	Cross Arm 1200mm	Nos	40	1250	50000
	Cross Arm 2000mm	Nos	14	2500	35000
21	Pin Insulators	Set	120	560	67200
22	Disk Insulators	Set	24	1350	32400
23	Brazing sheet	Nos	80	250	20000
24	Power house wiring	LS	1	7000	7000
25	Pole:				
	Wooden pole 7 meter long	Nos			
	Steel pole 9 meter long	Nos	50	11500	575000
	Sub - Total – II				**3246150**
	13 % VAT included				421999.5
	Total of Electrical Works (II)				**3668149.5**

III. Mechanical Work

S.N.	Description	Unit	Qty	Rate	Amount
1	Turbine :				
	Double Jet Pelton (runner dia . 300 mm) with safety guard	Set	1	350000	350000
2	Base Frame	Set	1	35000	35000
3	Butterfly valve: 200mm (8" standard) mm Dia.	No	1	65000	65000
4	Adaptor	No	1	15000	15000
5	Power Transmission :				
	Habasit Belt type A3	Set	1	75000	75000
6	Pulley for turbine and generator	Set	2	15000	30000
7	MS Penstock pipe. 200 mm Dia , 3.5 mm thick	Mtr	160	2800	448000
8	Expansion joins. 200 mm Dia.	Set	8	10000	80000
9	Bend pipe	Nos	5	7500	37500
10	HDPE pipe (head race canal) 250mm dia.	Mtr	500	3000	1500000
	Sub Total III			**2635500**	
	13 % VAT included			342615	
	Total of Mechanical Works (III)			**2978115**	

IV. Tools & Spare Parts

S.N.	Description	Unit	Qty	Rate	Amount
	Tools				
	Clamp meter	Nos	1	7000	7000
	Open wrench 6mm to 30 mm	Set	1	8850	8850
	Ring wrench 10mm to 30mm	Set	1	8850	8850
	Allan key wrench	Set	1	2500	2500
	Screw driver	Set	1	500	500
	Hammer 2.5 LBS	Nos	1	500	500
	Insulation tape	Nos	6	15	90
	Sub Total				28290
	Spare Parts				
	Volt meter	Nos	2	2500	5000
	Glass fuse and HRC fuse	Nos	3	1500	4500
	Thyrister	Nos	2	7000	14000
	Aluminum Ladder	Nos	2	20000	40000
	Sub Total				63500
	Total			**91790**	
	13 % VAT included			11932.7	
	Total - IV			**103722.7**	

V. Transportation & Packing

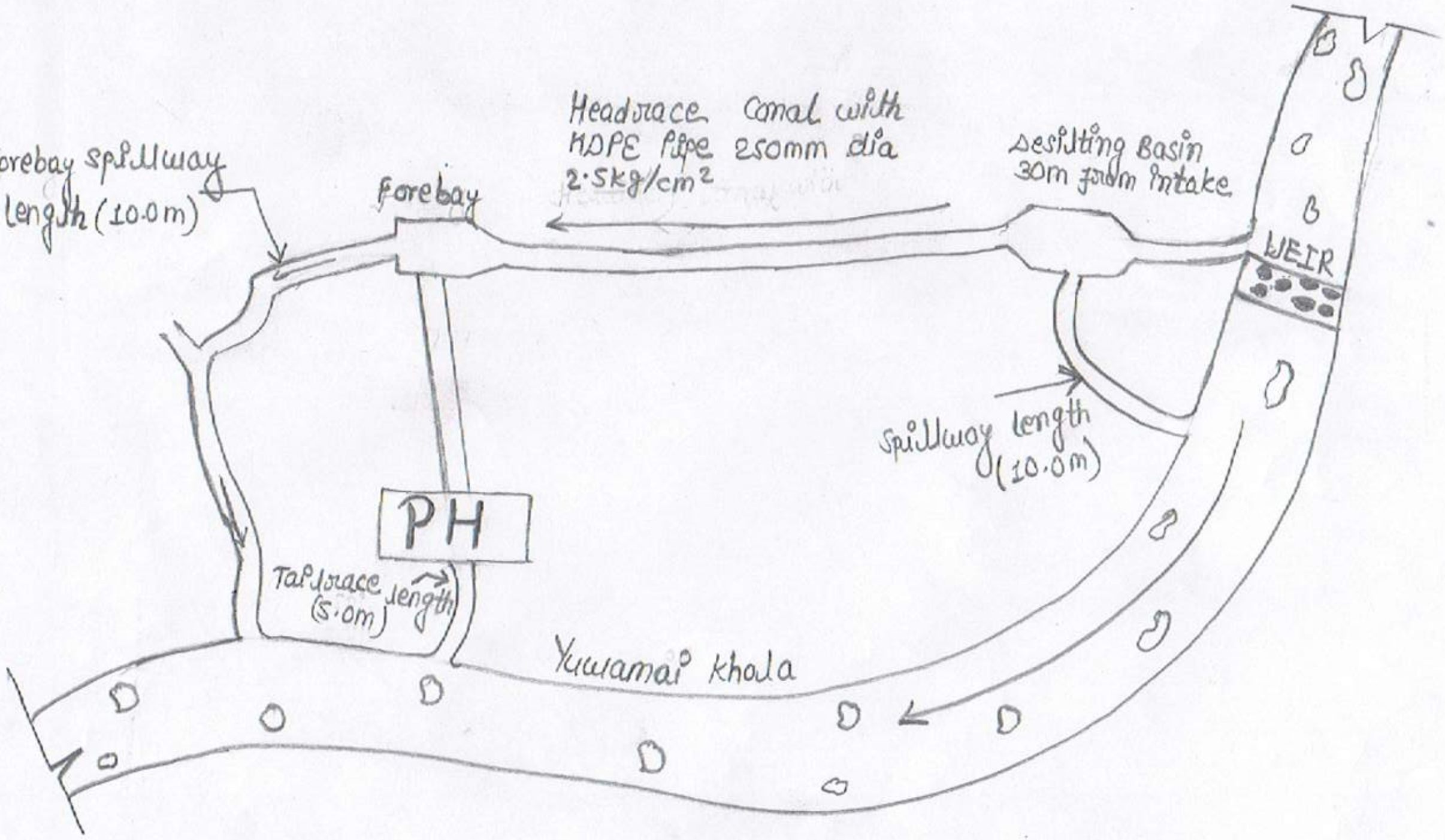
S.N.	Description	Unit	Qty	Rate	Amount
1.	Packing charge of Electro Mechanical Equipment	L,S.	1	20000	20000
2.	Transportation by Truck				
2.1.	*Butwal to Gorkha*	Trip	1	60000	60000
2.2	*Gorkha to Lapu*	Trip	1	180000	180000
3.	Transportation by porter from the Road head				
3.1	Easy Load	Kg	3000	10	30000
3.2	Uneasy Load	Kg	6000	20	120000
	Sub Total-IV				**410000**

VI. Installation Works

S.N.	Description	Unit	Qty	Rate	Amount
1	Labour for Electro- Mechanical installation works	LS	1	150000	150000
3	Super vision (Electro-Mechanical)	LS	1	75000	75000
3	*Testing and commissioning*	LS	1	50000	50000
	Sub Total - VI				**275000**

Summary of Total Project Cost

S.N.	Description	Amount (NRs.)	%
I.	Civil works	**3872466.22**	
II.	Electrical works	**3668149.5**	
III.	Mechanical Works	**2978115**	
IV.	Tools & Spare Parts	**103722.7**	
V.	Transportation & Packing	**410000**	
VI.	Installation Works	**275000**	
	Grand Total	**11307453.42**	



Yuwamai Khola MHP GENERAL LAYOUT

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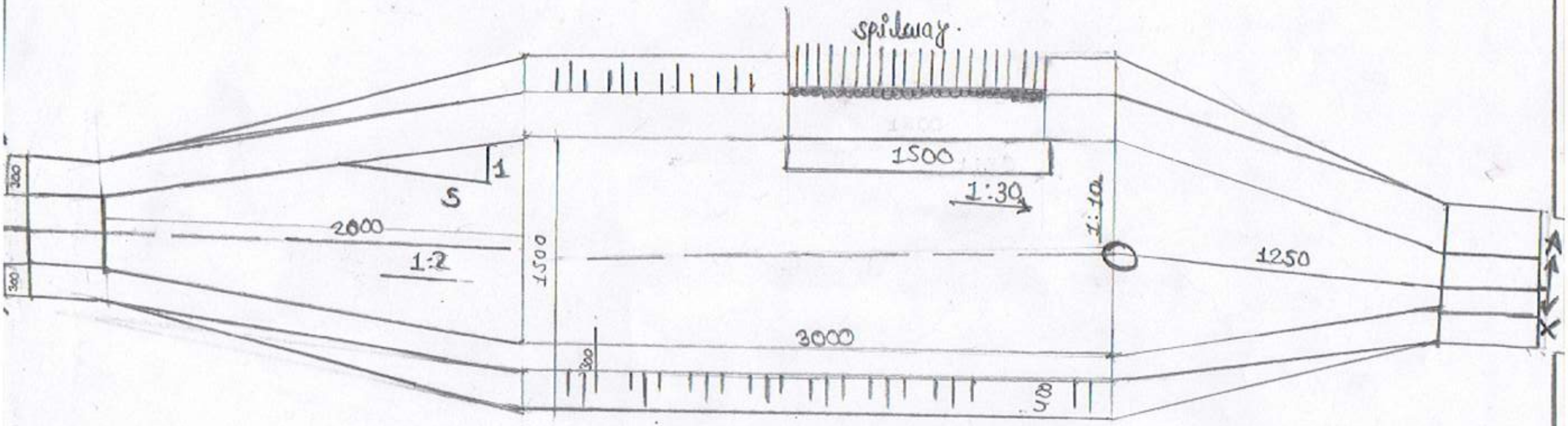
Butwal-11.
Drawing no-1.



Plan of Gravel Trap Desettling basin.

Yuwamai Khola MHP
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Appropriate Engineering Butwal-11.
Drawing no. 2. A

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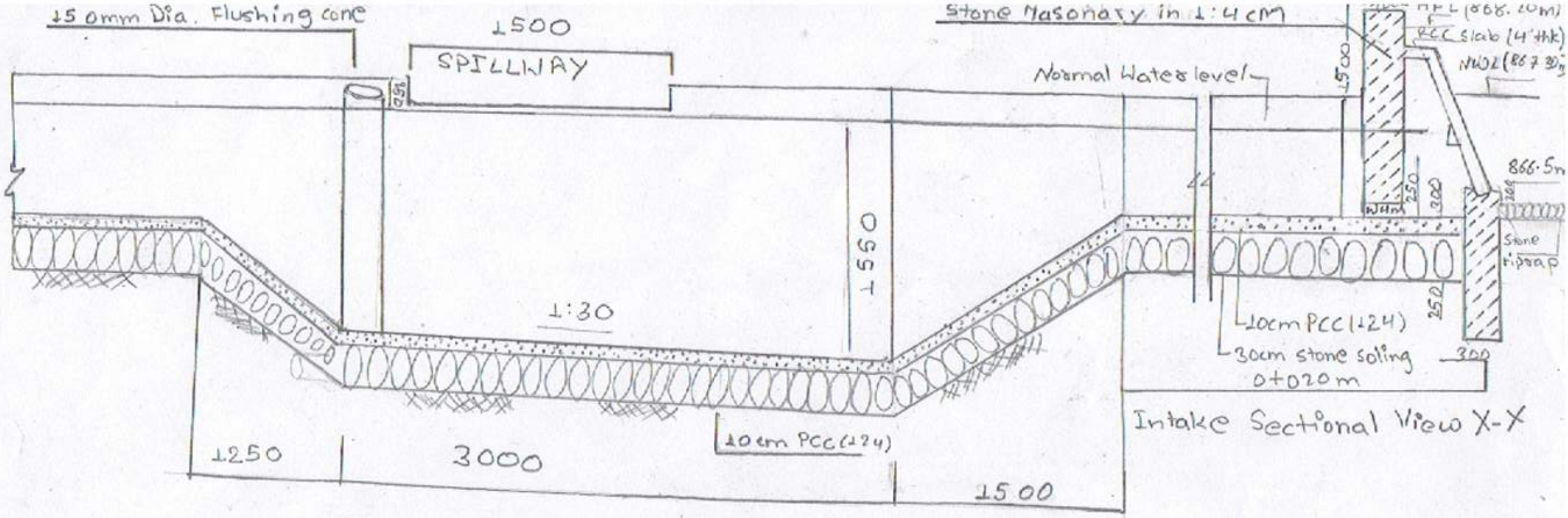
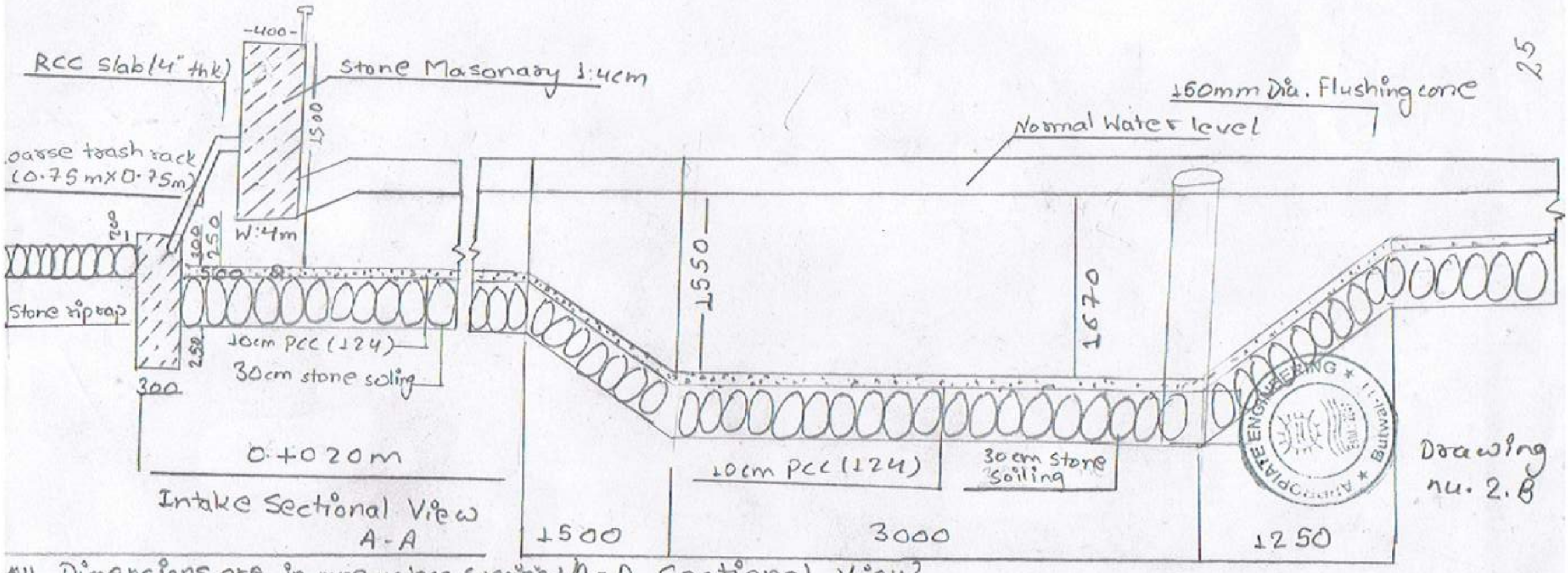
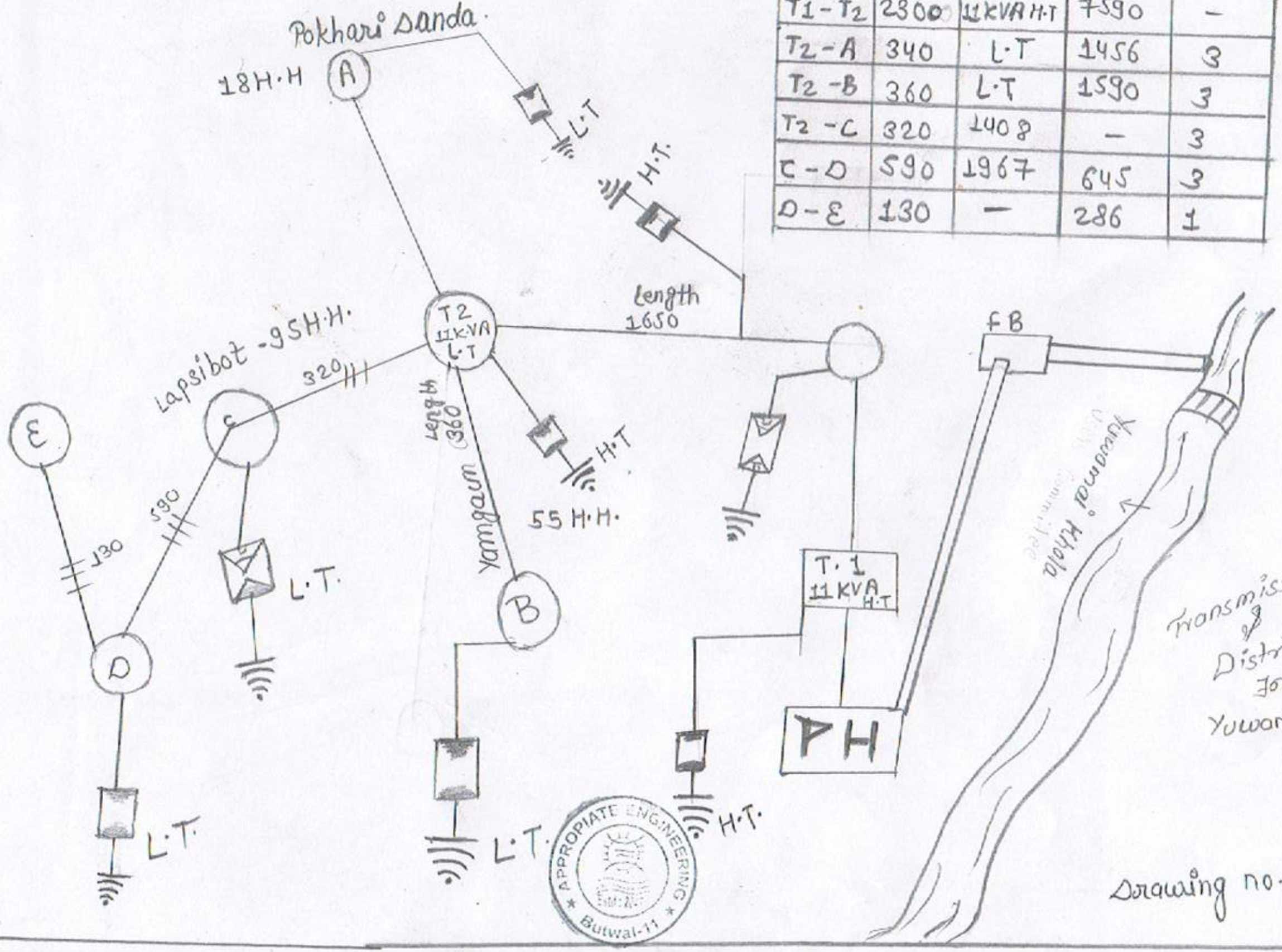




All Dimensions are in mm unless specified

From-To	Length	Weaseal	squirrel	Phase
T1 - T2	2300	11KVA H.T	7590	-
T2 - A	340	L.T	1456	3
T2 - B	360	L.T	1590	3
T2 - C	320	1408	-	3
C - D	590	1967	645	3
D - E	130	-	286	1



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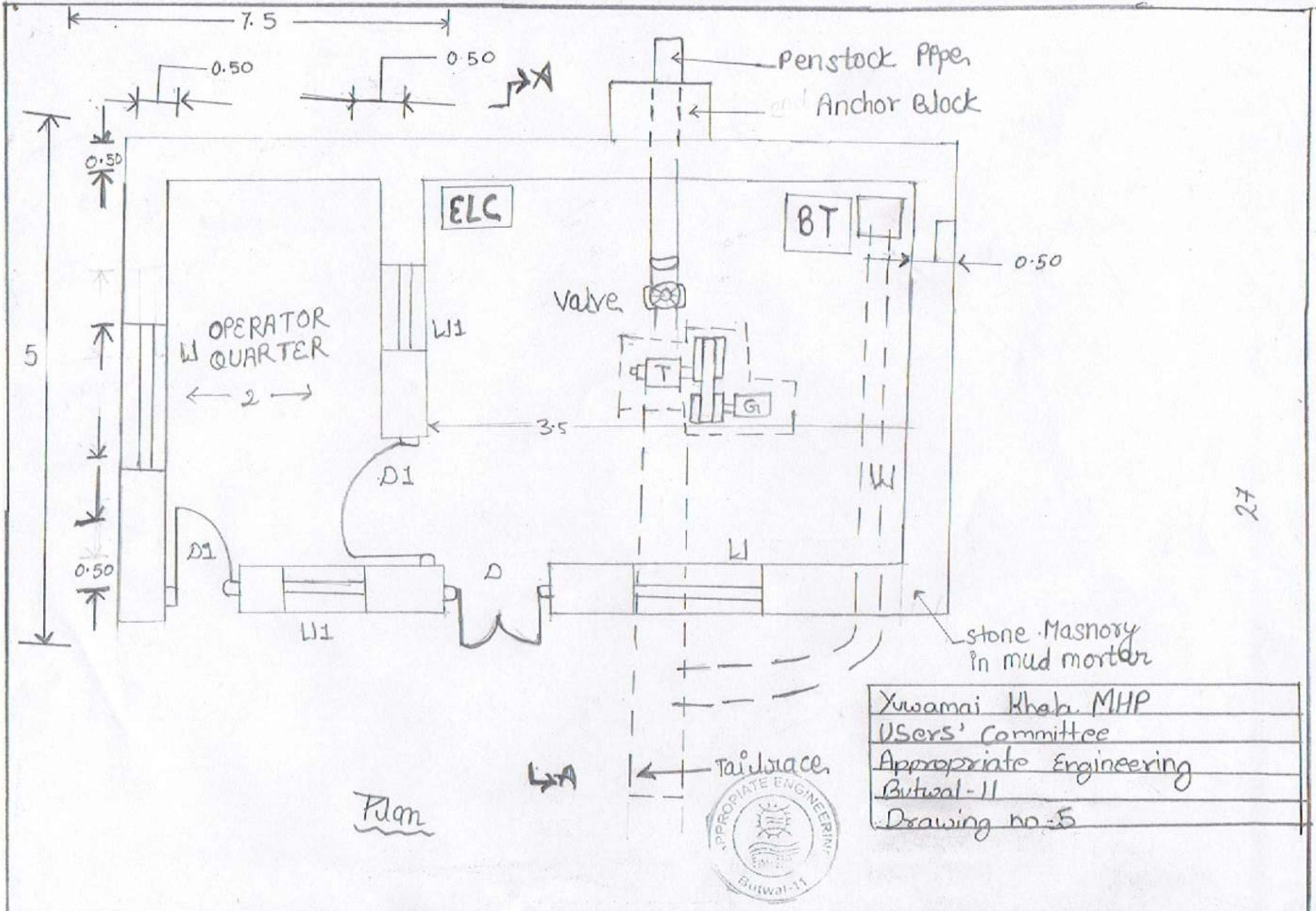

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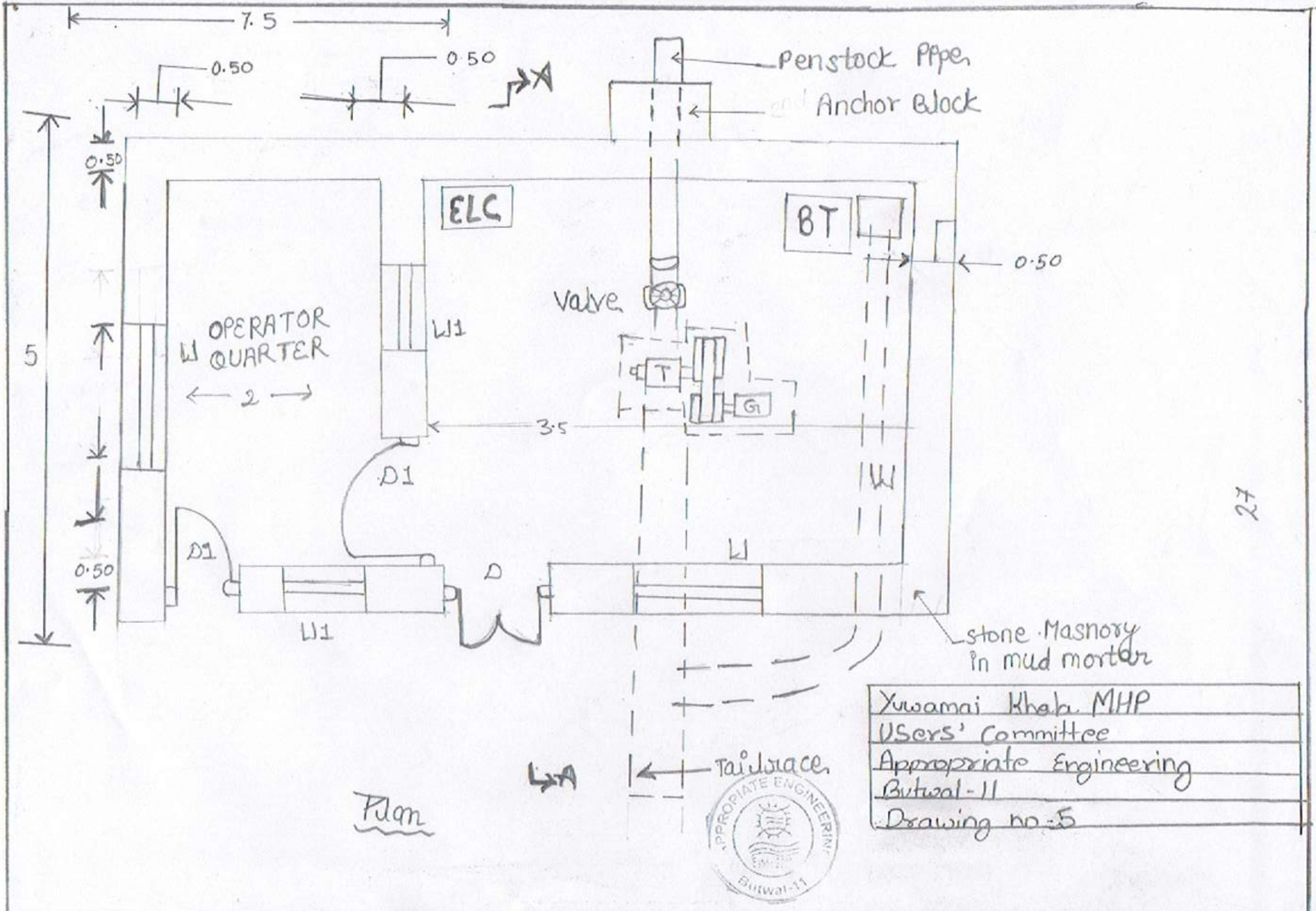
Drawing no-5



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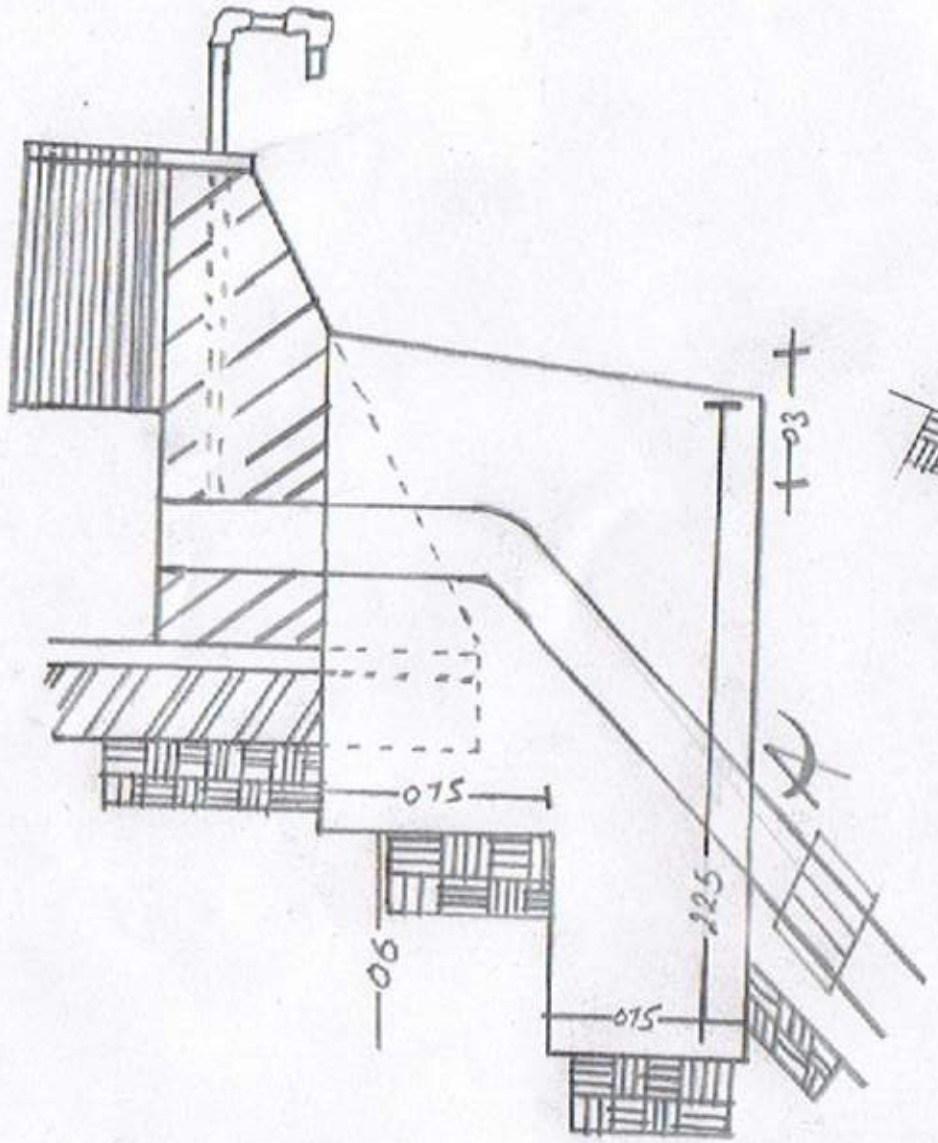
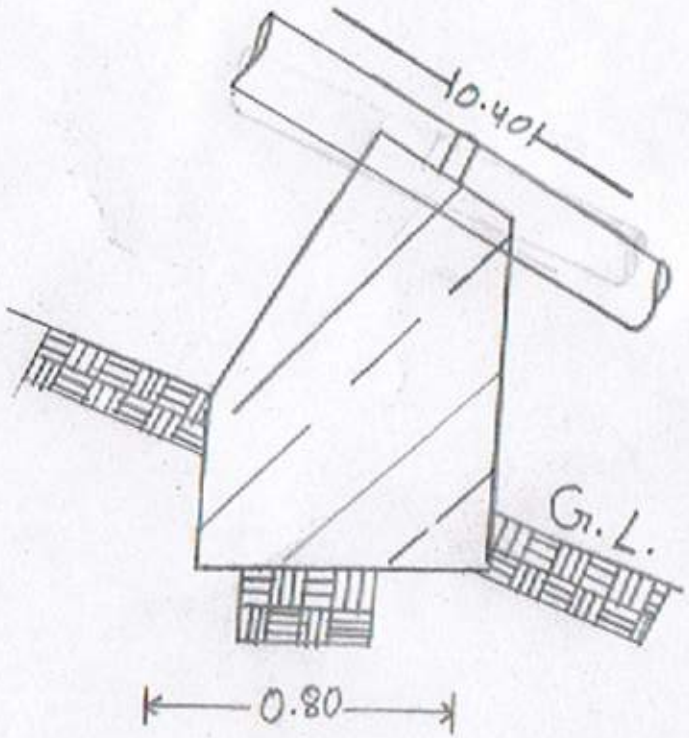
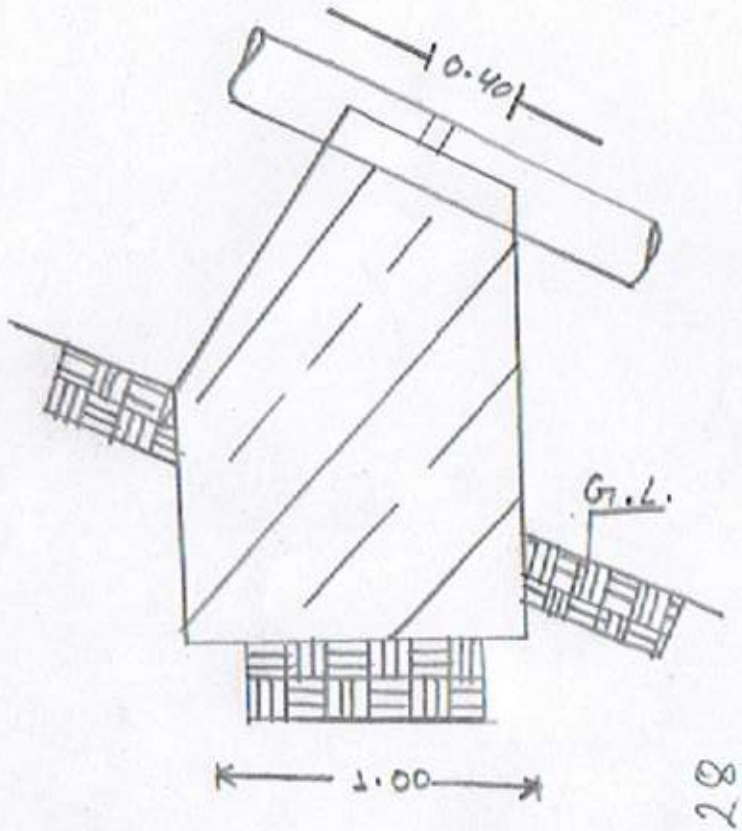
Drawing no-5







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PENSTOCK ARRAGEMENT ON SUPPORT PIER
And
Anchor blocks

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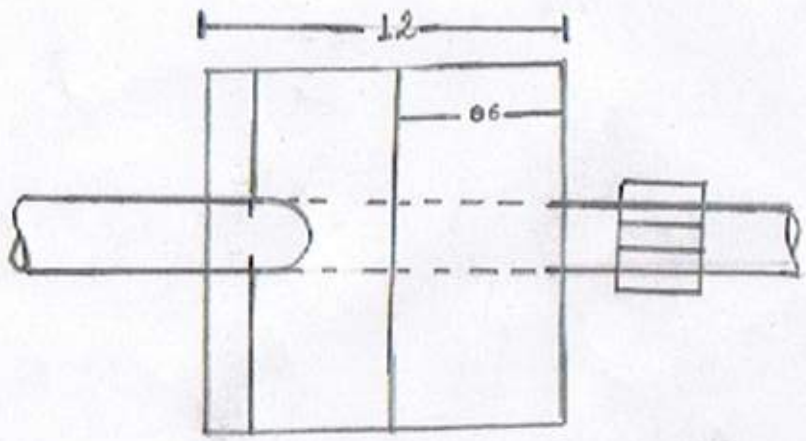
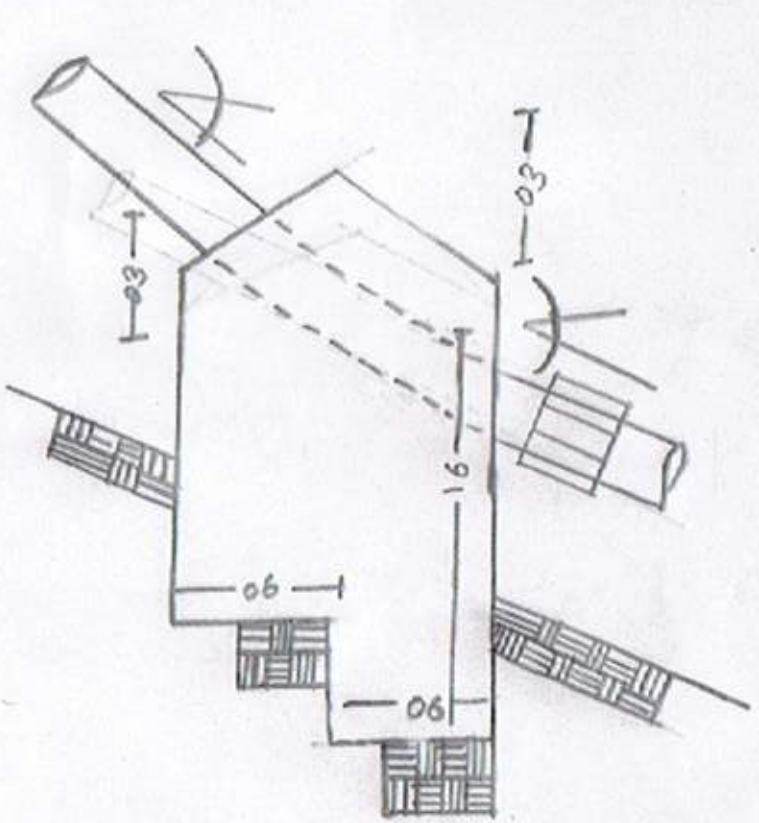
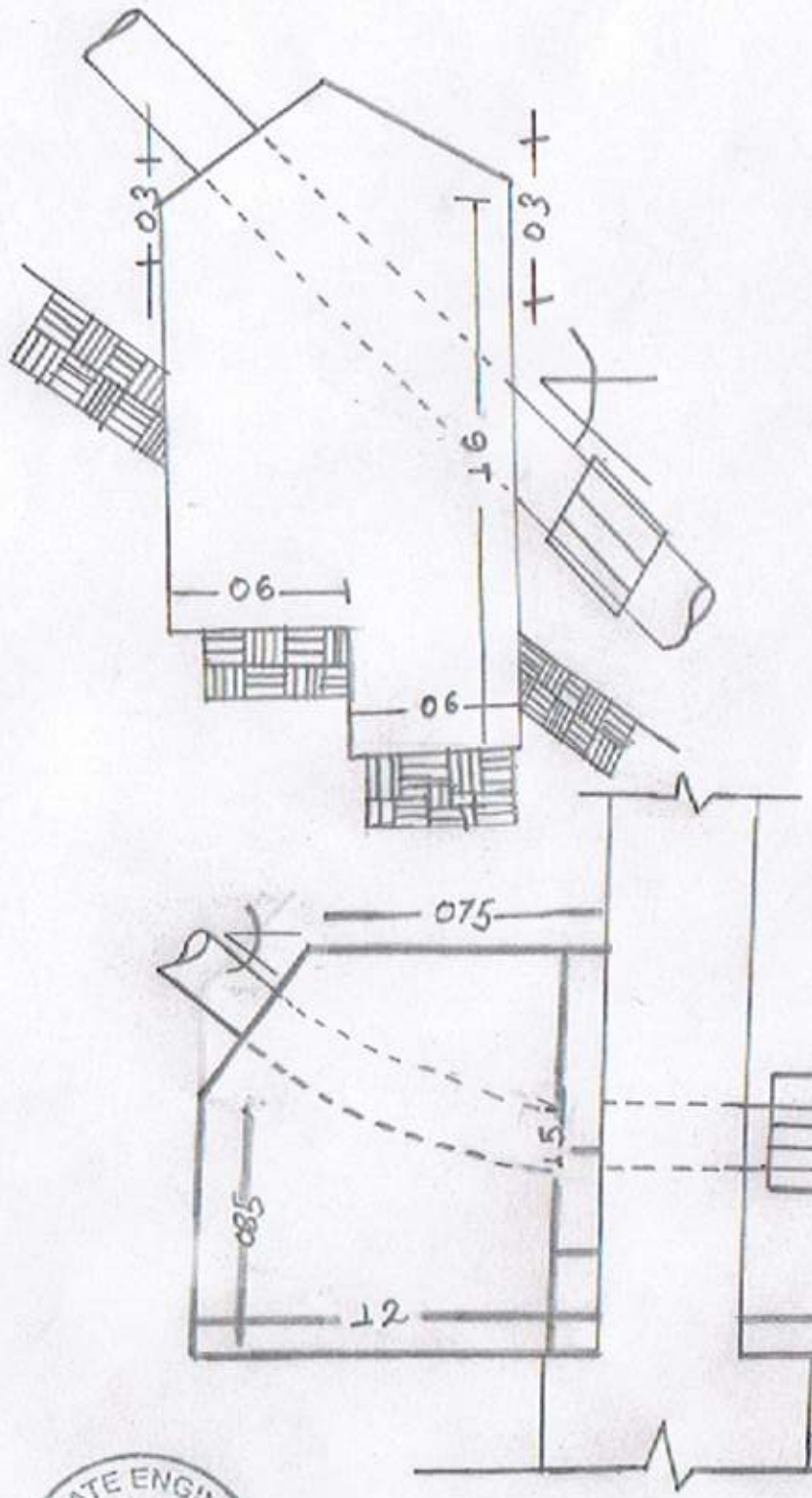
Drawing no. 4 "a"







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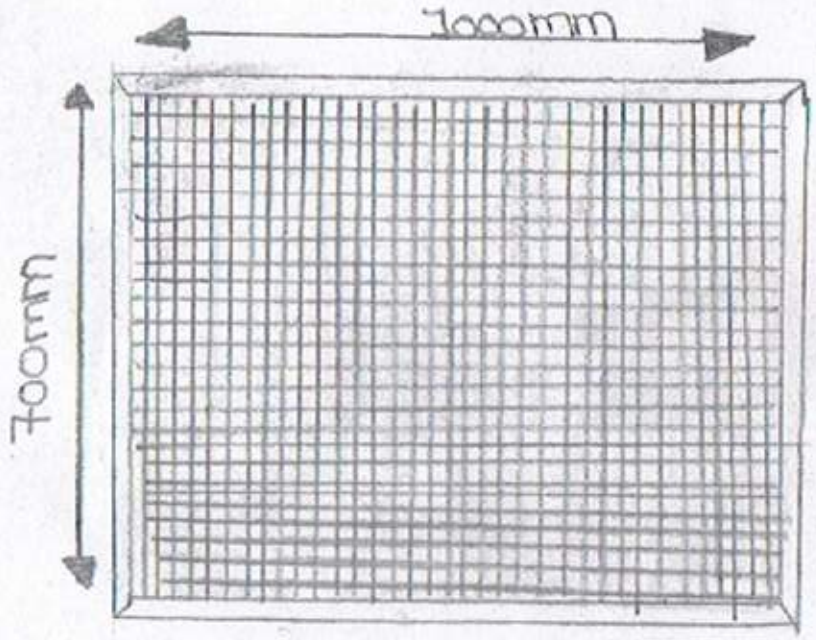
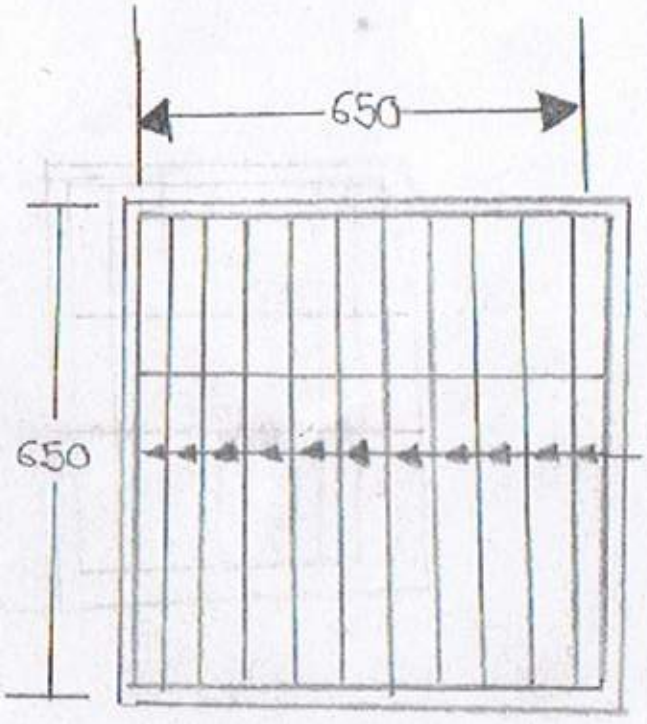
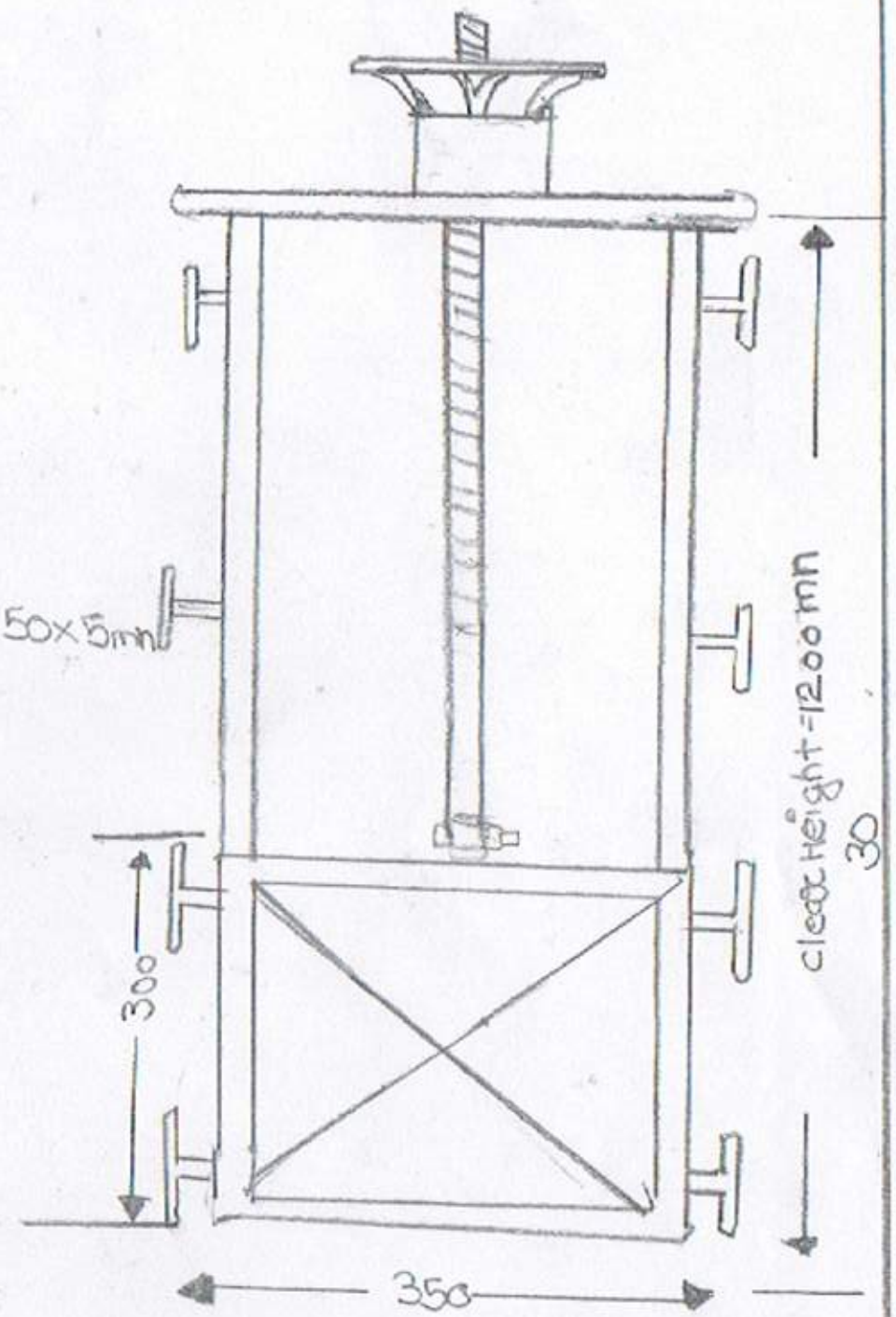


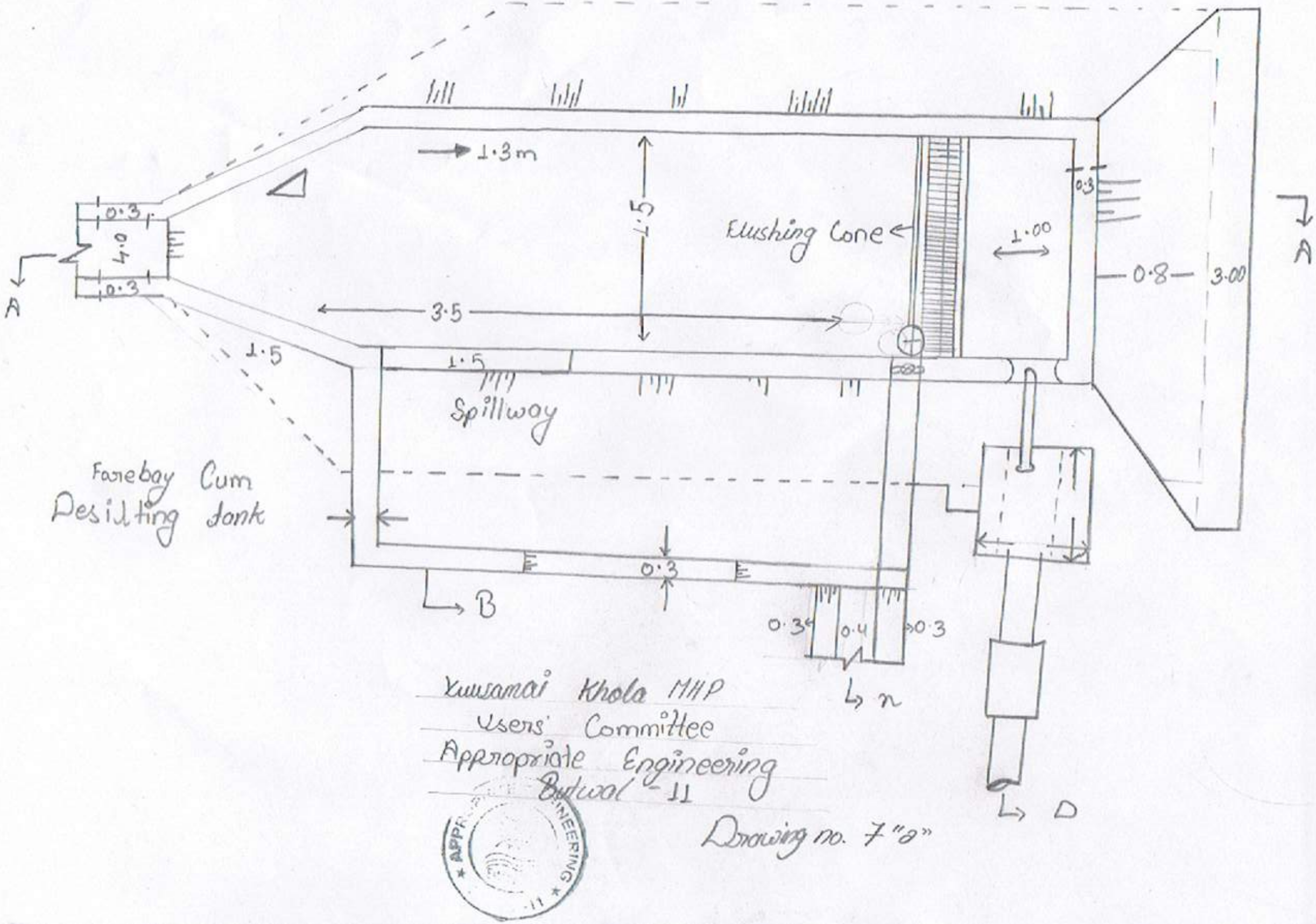
Fine Trashrack
(For FOREBAY)



COURSE TRASHRACK
(FOR INTAKE)



Drawing
no. 6



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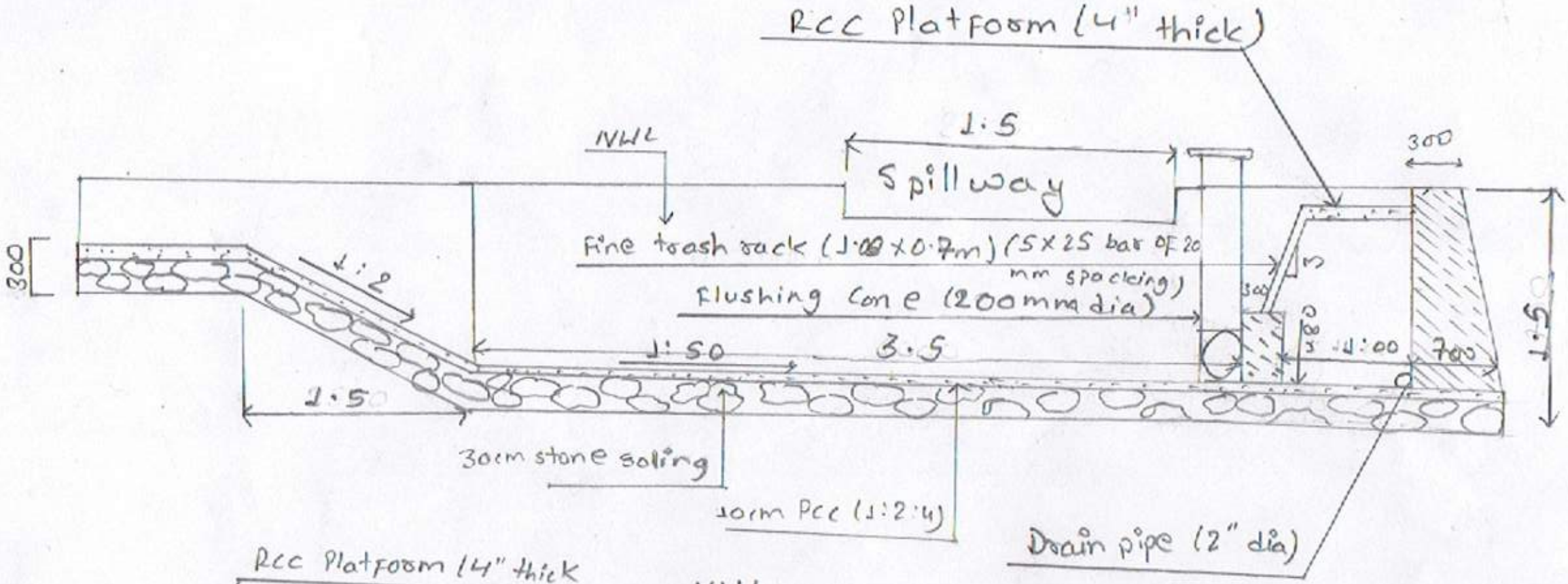
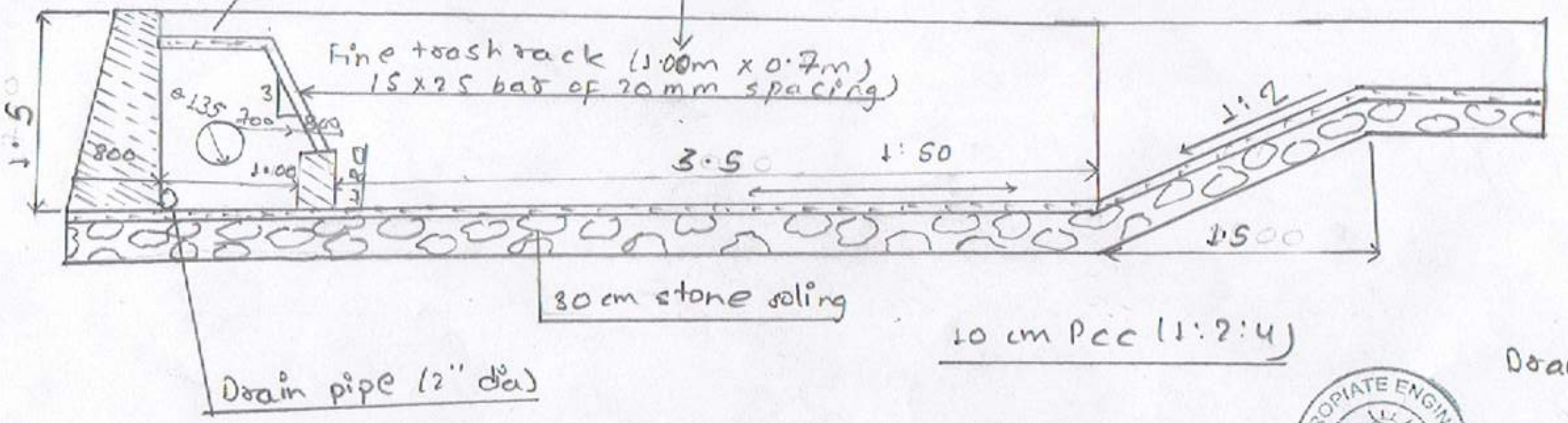
Butwal - 11

Drawing no. 7 "a"

L- SECTION OF FOREBAY





FOREBAY SECTION AT A-A

Drawing no. 7'B'

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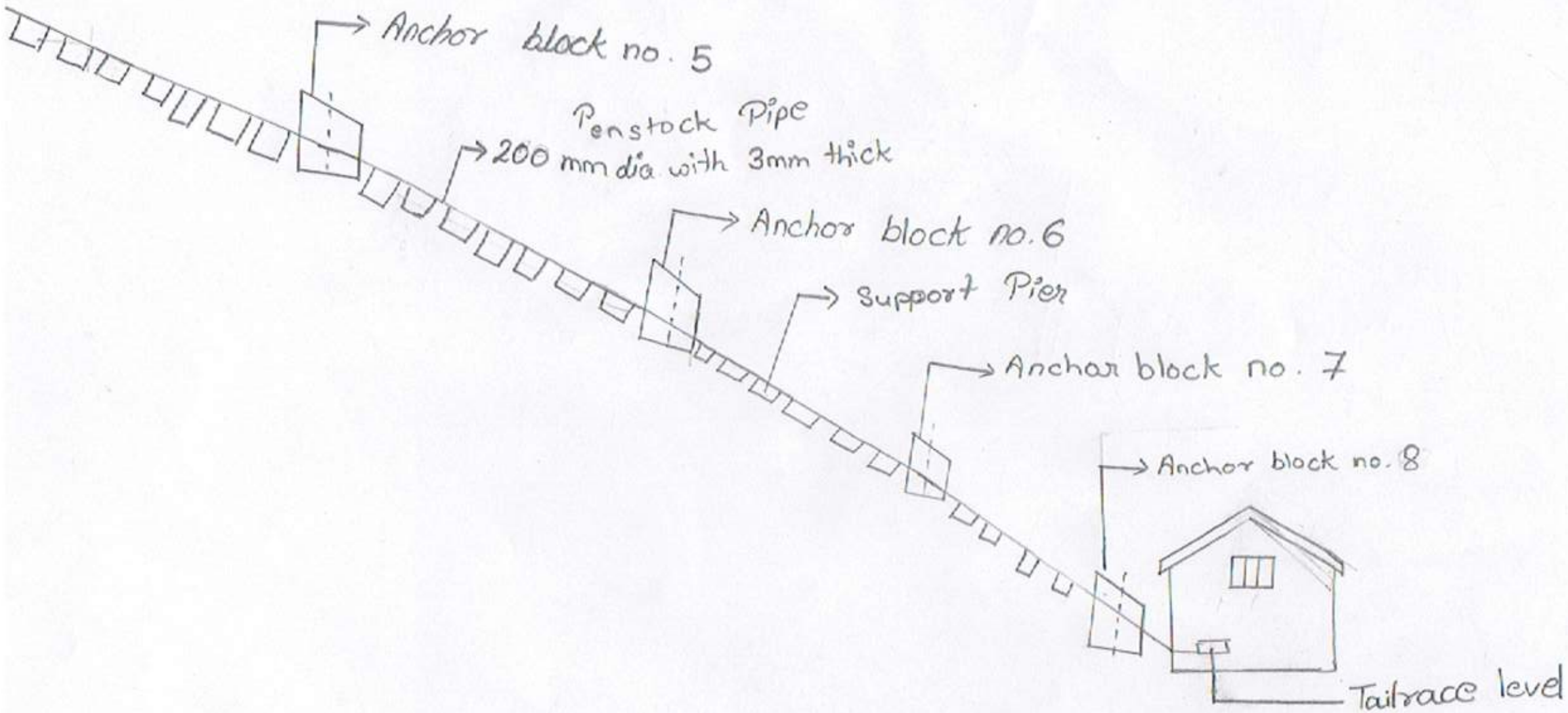

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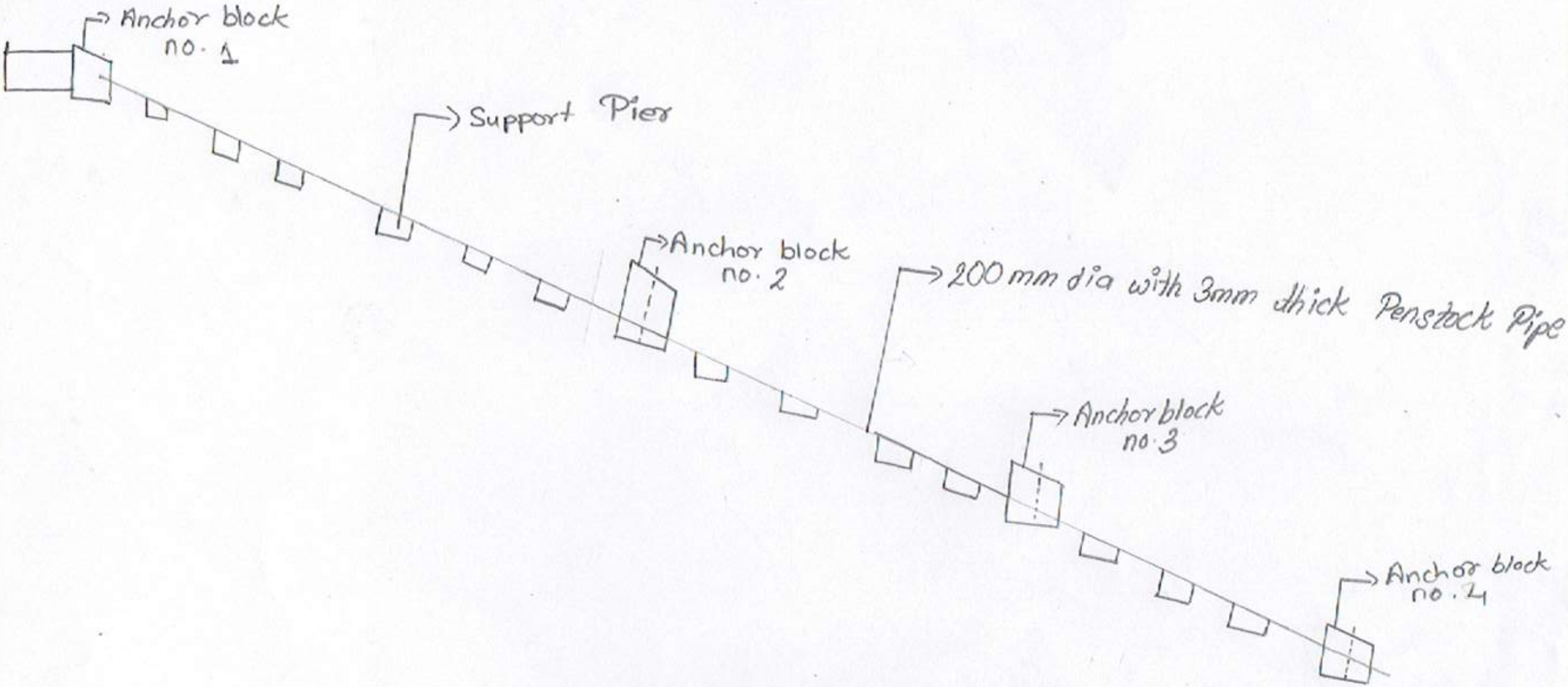
Penstock Alignment

Drawing no. 8 "a"



APPROPIATE

Drawing no. 8 "b"