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Feasibility Analysis of Drainage System for Hingangon Village

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***Abstract*: The aim of this paper is to discuss the problems of drainage of village and solutions provided to redevelop of drainage line. Use auto cad and quantity takeoff Software for drainage line mapping and for calculation of material quantity. Use different replacement materials in concrete work of drainage line and use different methods, concepts of drainage system. This drainage redevelopment construction cost is less. This amount collected very easy from village people and government also help for this work. The case study will take a macro level study on the entire drainage line construction.**

***Keywords*: Drainage Line, Stone Stabilization Pond, Estimation and Costing, Stone Drain.**

1. Introduction

The need for genuine and organized initiatives in the rural wastewater management has been regularly voiced in India. Waste water management is term consisting of collection, transport, processing, recycling or disposal of wastewater, usually produce by human activity. In city no. of facility provided but in village no. of facility provided that time Migration problems, Pollution decreases. Money problems in village for provided facilities so no. of facilities in minimum cost that time use new material, techniques. Government provided money for rural development for different facilities. Drainage system in provided in city same also in village so increases ground water level, not increases pollution and migration, reuse of waste water for agriculture. Building of collection systems for wastewater, placing outlets away from drinking water sources, and introduction of water closets were some of the means to achieve a better hygienic standard for people in rural areas.

2. Case study- hingangon village

A. Hingangon village

A practically affordable effort in wastewater management especially in the reuse of wastewater for agriculture purpose, ground level improvement in Hingangon village and Development, reconstruction the drainage system in low cost. Hingangon village located east side form sangli district. Taluka: Kavathe-Mahankal, District: Sangli, State:Maharashtra.

B. Problems in Hingangon village

- Development of village drainage system in low cost because in Hingangon village Gavbhag drainage system in poor condition.
- In new developed area, drainage system unavailable.
- Hingangon village is droughts area so economically poor people living in this village.
- Migration problems.
- Construction of Road work is over but drainage lines are not provided so water disease rate increase in village.

C. I was collecting all village data and prepare plan waste water system consider following objectives

- To prepare all necessary drawings with Auto cadd software for chamber, primary system, drainage line, etc.
- To Design of drainage line, primary system, chamber, manhole with new techniques (Fly ash, plastic fiber, foundry sand).
- To Estimate and costing with Quantity takeoff software used for drainage line, chambers, primary system with new techniques.
- To propose village drainage system in low cost.

D. Methodology

- In Methodology systematical solved problems following pattern literature survey, site visit and data collection, drawing and design, estimation and costing, report.
- Defined problem and site selection: I have visited a village that time realize problem and site selected as waste water system newly developed.
- *Literature survey:* Data collected form books, research papers.
- Site visit and data collection: I have visited in village and all data collected as population, rainfall, photos etc.
- *Mapping and drawing:* All drainage line distance calculated on map and draw all drawings.
- *Estimation and costing:* Use quantity takeoff software for estimation and calculate rate analysis after calculate all costing and total project cost.

E. Detail of village Information

Hingangon village area 233 acres and topography condition, slope area towards Aagrni river so village area divided in 2 phases. Easy to planning, construction, financial management.

- Population- 4,785 nos.
- Village area- 233 acres (0.9456sq.km)
- Rainfall (in mm) - 46mm
- Education facility- Primary school-1, secondary school-1
- Gov.Hospital name- Village Hospital, Deshig.
- Sub center- Hingangon.

Fig. 1. Hingangon google map view

Fig. 2. Hingangon photos

3. Design and drawings

A. Measurements of drainage line length

- *Google map:* On Google map all facilities are available. Google map available on mobile, computer and this is easy to use. Calculate drainage line lengths on google map, below in village plan and table all type of drainage line total distance is given.
- *Auto cad:* This is 2D and 3D software for drawings. This is open source software and easy to use. Any type of drawing draw on this software.
- Phase 1 and 2 calculate of drainage line length and used google map for calculate length. In project 3 types of drainage lines provided in plan.

Table 1
Drainage line length - phase 1 (New developed area)

S. No.	Drain Line Type	Part 1-Total Distance (m)	Part 2-Total Distance (m)
1	Main Line	906	756
2	Sub - Line -1	3380	1126
3	Sub – Line - 2	360	4380
4	Stone Drain Line	200	430
5	Circular Pipe	122	330
6	Waste Water Stone Stabilization Tank	2 Nos	1 No

Fig. 3. Hingangon drainage lines 2D Plan

Table 2
Drainage line length - phase 2 (Gavbhag area)

S. No.	Drain Line Type	Total Distance (m)
1	Main Line	3370
2	Sub - Line -1	1080
3	Sub – Line - 2	1180
4	Stone Drain Line	1520
5	Circular Pipe	150
6	Waste Water Stone Stabilization Tank	3 Nos

B. Drain design and drawing

1) Design of drainage line

The dry weather flow (D.W.F) is the flow through the sewers that would be available throughout the year, i.e., during non-rainy as well as rainy seasons. The storm water flow is the additional flow through the sewers that would occur during rainy season due to rainfall. The estimation of the total quantity involves the estimation of each of these two components.

Factors Affecting the Quantity of Dry Weather Flow

- Rate of water supply
- Population growth
- Type of area served
- Infiltration and exfiltration

For Open drain having discharge up to 15 cumec [2]

$$Y = 0.5 \sqrt{B}$$

Y is depth of drain

B is width of drain

1) OPEN DRAIN – B = 0.300m

Depth = Y + Free Board = 0.3 +0.4 =0.7 m

Open drain size = 0.3 x 0.7 m

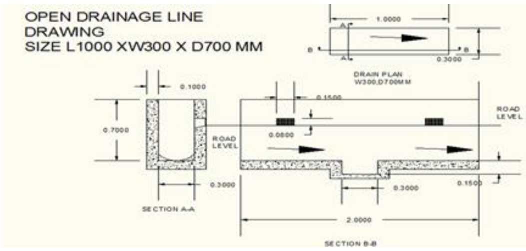

Fig. 4. Open drain RCC plan and section drawing (size 0.3x0.7m)

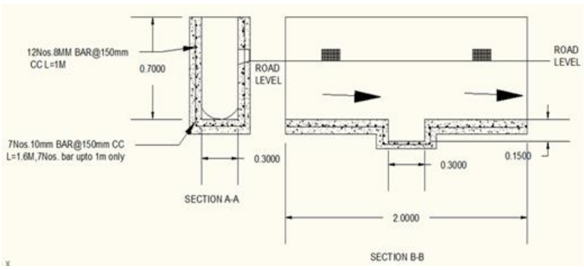

Fig. 5. Open drain steel drawing (size 0.3x0.7m)

2) OPEN DRAIN - B =0.500m

Depth = Y + Free Board = 0.35 +0.4 =0.75 m

Open drain size = 0.5 x 0.75 m

3) CLOSE DRAIN - B =0.500

Depth = Y + Free Board = 0.4 +0.4 =0.800 m Close drain size = 0.5 x 0.8 m

(Drain open cover 0.4x0.7m added qty. in estimation)

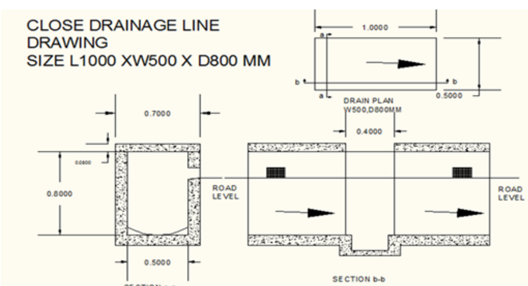

Fig. 6. Close drain RCC plan and section

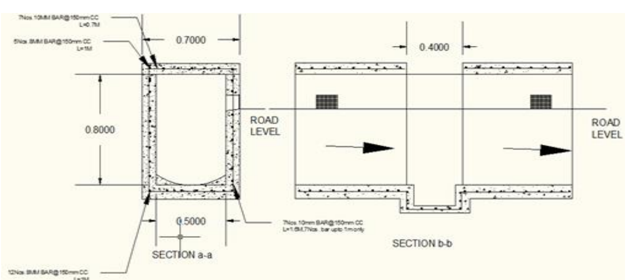

Fig. 7. Close drain steel drawing

Drainage line intersection point deep space provided 200 mm because waste water come to this point along with some soil, plastic particles settle down in this place and no disturb for waste water, no blockage in drain lines.

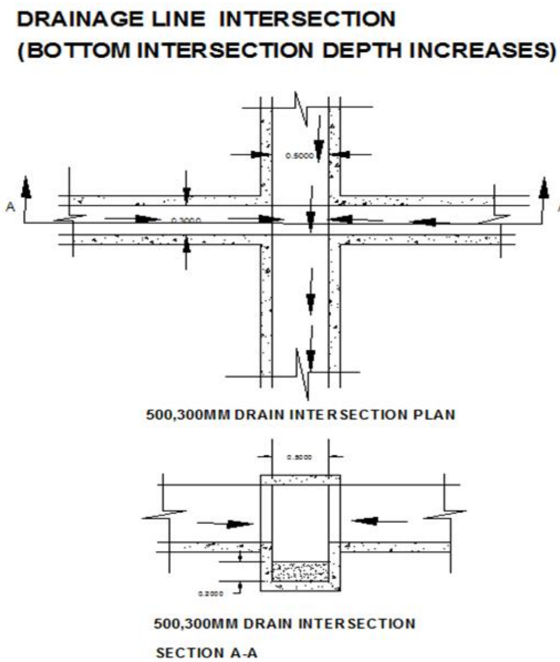

Fig. 8. Drainage line intersection

4) STONE DRAIN - Y = 1m

Stone drain size = 1.4 x 1 m

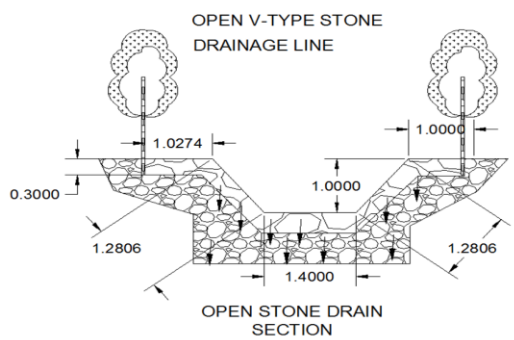

Fig. 9. Open stone waste water drains

5) Design of stone stabilization pond or tank

Stabilization ponds or waste stabilization ponds are open, flow through earthen basins specifically designed and constructed to treat sewage and biodegradable industrial wastes.

Construction details:

1) Site Selection: Pond sites should be located as far away as practicable (at least 200 m) from habitations or from any area likely to be built up within a reasonable future period.

2) Construction in stages: In cases where the design flow will materialize only in the course of time, it is important to design facultative ponds in multiple units and construct the units in stages. Otherwise the small flows in the initial years may not be able to maintain satisfactory water levels in the ponds and objectionable weed growths and mosquito breeding may develop in the installations. Construction in stages will also reduce initial costs and help in planning future stages based on

the performance data of first stage.

3) Multiple units: As indicated earlier when the required area of pond exceeds 0.5ha, multiple units should be provided. The multiple units may be either in parallel or in series or in parallel-series system.

4) Pond shape: It is not necessary that the pond shape should be of any particular type. It may be round, square or rectangular or polygonal depending on the site contours. Maximum pond length of 750m is generally adopted. Generally rectangular ponds are preferred with length not exceeding three times of round and square ponds.

5) Embankment: Ponds are usually constructed partly in excavation and partly in embankment. The volume of cutting and the volume of embankment should be balanced to the maximum extent possible in order to economize construction costs. The embankment should be compacted sufficiently. The top width of the embankment should be at least 1.5 m to facilitate inspection and maintenance. In case access to vehicles is desired for maintenance purposes, the minimum width should be 3m. Outer slopes are generally 2 to 2.5 horizontal to 1 vertical. Inner slopes are made 1 to 1.5 horizontal to 1 vertical when the face is fully pitched. Pitching may be rough stone revetment or with plain concrete slabs or flag stones with adequate gravel packing. When complete pitching is not possible, at least partial pitching from a height 0.3m to 0.5m above water line to 0.3m below water line is necessary. A minimum free board of 0.6m should be provided.

6) Pond bottom: The pond bottom should be level, with finished elevations not more than 0.10m from the average elevation. Gravel and fractured rock areas must be avoided.

Depth of pond = 2.5 m

2.5/t = 0.137, t = 18.24 days

Determine the surface area = (flow x time)/ depth = (0.54 x 10 3 x 18.24)/ 2.5

surface area = 3939 m^2 =4,500 m2 for all village

In village slope is 3 side so 6 numbers of stone new stabilization tank provide

Tank area all village = 4500 m_2 = 4500/6 =750 m^2 per tank.

2 tank Parallel system is provided,

1 tank size = 25 x15 m^2

Depth of pond =1.5m

Present condition 1 tank is sufficient so 1 tank constructed size = 25 x 15 x 2.5m, area =25x15=375 m^2

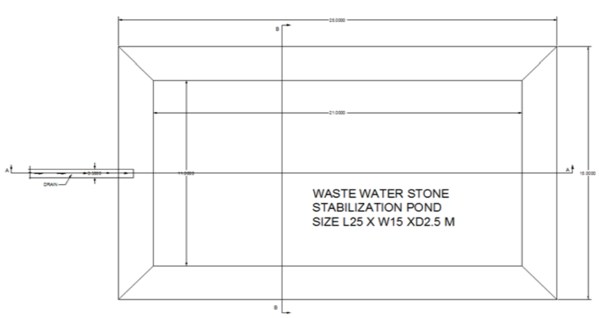

Fig. 10. Waste water stone stabilization tank plan

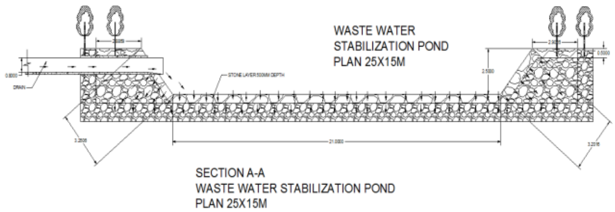

Fig. 11. Waste water stone stabilization tank A-A section

Fig. 12. 3D photo waste water stone stabilization tank [3]

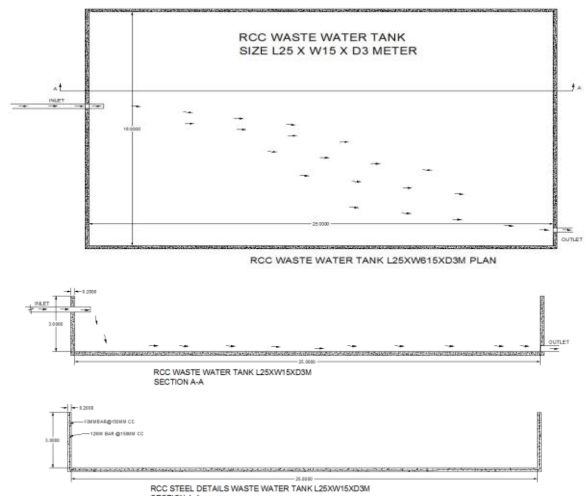

Fig. 13. RCC waste water tank section and plan

4. Estimation and Costing

A. Estimation of Drains, waste water treatment RCC tank and Stone Tank (stabilization pond)

Used estimation and costing software (Quantity takeoff software) for estimation. This software is open source so any one used this software. Inputs in software-2D cadd drawing or 3DRevit drawing in DWF(2D/3D) or DWFx (2D) formats. Output in software: MS-Excel format.

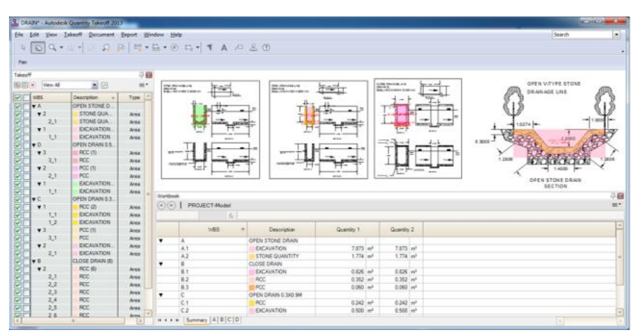

Fig. 14. Waste water Drain line quantity

1. Drains

Calculate quantity of stone drain, close drain, open drain (0.3x0.9m) and open drain (0.5x0.95m) in software. (Drain open cover 0.4x0.7m added qty. in estimation).

Table 3
Quantity of Drainage Line

DRAINAGE LINE QUNTITY

WBS	Description	Items	Quantity1	Quantity2
A	OPEN STONE DRAIN			
A\1	OPEN STONE DRAIN	EXCAVATION	7.148 m²	7.148 m³
A\2	OPEN STONE DRAIN	STONE QTY	1.986 m²	1.986 m³
B	CLOSE DRAIN			
B\1	CLOSE DRAIN	EXCAVATION	0.743 m²	0.743 m³
B\2	CLOSE DRAIN	PCC	0.045 m²	0.045 m³
B\3	CLOSE DRAIN	RCC	0.302 m²	0.302 m³
C	OPEN DRAIN 0.3X0.7M			
C\1	OPEN DRAIN 0.3X0.7M	EXCAVTION	0.431 m²	0.431 m³
C\2	OPEN DRAIN 0.3X0.7M	PCC	0.029 m²	0.029 m³
C\3	OPEN DRAIN 0.3X0.7M	RCC	0.188 m²	0.188 m³
D	OPEN DRAIN 0.5X0.75			
D\1	OPEN DRAIN 0.5X0.75	EXCAVATION	0.628 m²	0.628 m³
D\2	OPEN DRAIN 0.5X0.75	PCC	0.048 m²	0.048 m³
D\3	OPEN DRAIN 0.5X0.75	RCC	0.220 m²	0.220 m³

2. Waste water RCC Tank

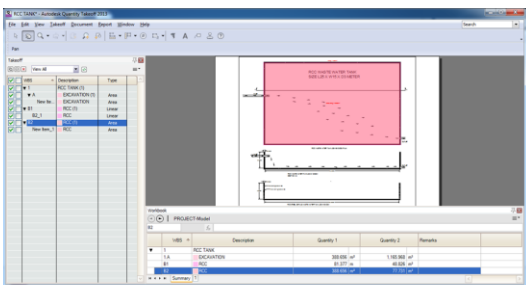

Fig. 15. Waste water RCC tank quantity

Table 4
Quantity of RCC Tank

RCC TANK QUANTITY

WBS	Description	Items	Quantity1	Quantity2	TOTAL
1	RCC TANK				
1\A	RCC TANK	EXCAVATION	388.656 m²	1,165.968 m³	1,165.968 m³
B1		RCC	81.377 m	48.826 m³	
B2		RCC	388.656 m²	77.731 m³	126.557 m³

3. Waste water stone Tank (stabilization pond)

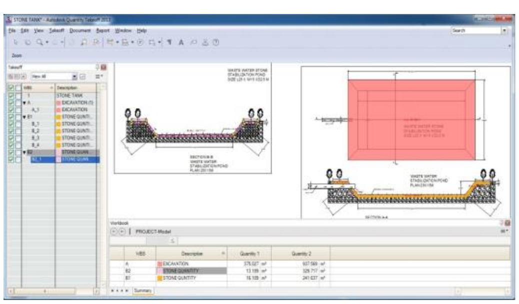

Fig. 16. Waste water stone tank quantity

Table 5
Quantity of stone oxidation tank

Quantity of stone oxidation pond tank

WBS	Description	Items	Quantity1	Quantity2	TOTAL
A	STONE TANK	EXCAVATION	375.027 m²	937.569 m³	937.569 m³
B1		STONE QUNTITY	16.109 m²	241.637 m³	
B2		STONE QUANTITY	13.189 m²	329.717 m³	571.354 m³

B. Rate analysis

Many tests have shown that the addition of fly ash can increase the compressive strength of concrete. Researchers at the UWM-CBU decided to combine fly ash with used foundry sand to see if the fly ash improved the strength of the concrete.

Table 6
Mix and test data [Naik, Singh, Kraus, Ramme, and Domann 2001] [5]

All quantities in kg/M^3, all mixes designed for 31MPa (4.5ksi)							
Mix	1	2	3	4	5	6	7
cement	336	327	332	207	323	327	329
water	163	161	160	155	158	157	162
Fly ash	0	68	82	94	106	53	54
19 mm Agg.	997	969	983	971	956	970	972
New sand	797	694	599	539	460	619	460
Used foundry sand	0	77	158	231	307	155	312
Slump(mm)	133	127	102	102	102	127	95
Tested compressive strength (MPa) (1 MPa=0.145ksi)							
Control Mix 1 Tested Mixes 2 to 7							
3 days	23			22 to 26			
7 days	26			25 to 30			
28 days	32			31 to 37			
91 days	38			41 to 49			
182 days	40			42 to 51			

Rate analysis (1 m^3 Quantity):
All materials rate collected to near cities Kavathe-mahankal, Kolhapur, Sangli, Pune.

Table 7
PCC AS RCC Used M15 (1:1.5:3) concrete without fly ash and foundry sand

	Mix 1 in kg	Bags in nos.(50kgbags)	CUM	RATE(Rs.)	TOTAL
Cement	336	6.72		280/-	1882/-
19 mm agg.	997		0.77	706/-cum	544/-
New sand	797		0.62	2,120/-cum	1314/-
Fly ash	0			1.6/-	0/-
Used foundry sand	0			3.5/-	0/-
				Total	**3,740/-**

Table 8
PCC AS RCC USED M15 concrete with fly ash and foundry sand

	Mix 1 in kg	Bags in nos.(50kgbags)	CUM	RATE(Rs.)	TOTAL
Cement	207	4.14		280/-	1159/-
19 mm agg.	971		0.74	706/- cum	522/-
New sand	539		0.42	2,120/-cum	1038/-
Fly ash	94	1.88		1.6/-kg	150/-
Used foundry sand	231	4.62		3.5/-kg	693/-
				Total	**3,562/-**

3,740 > 3,562
10.50% less cost
Labours rate (Rs.40/-cu.feet) = Rs. 1410/- cu.m
Total amount = concrete amount + labours amount = 3562 + 1410 = 4972/-per cum.

Table 9
PCC M5 (1:5:10) concrete with fly ash and foundry sand

	Mix 1 in kg	Bags in nos.(50kgbags)	CUM	RATE(Rs.)	TOTAL
Cement	104	2.08		280/-	582/-
19 mm agg.	995		0.78	706/- cum	550/-
New sand	560		0.44	2120/-cum	932.80/-
Fly ash	110	2.20		1.6/-kg	176/-
Used foundry sand	241	4.82		3.5/-kg	843/-
Labours				800/-	800/-
				Total	**3884/-**

Steel quantity
Vol. of steel 1% of concrete = 1% of -----m^3
Steel in tons = (----- x7850)/1000 = -------tons
Steel rate = 35000/- per tons
Total amount steel = steel rate x steel qty. = Rs.------------

C. Costing

1. Tanks Costing

Which tank is useful and minimum cost?
11,43,169.8 > 1,73,745.0 65.80% less cost
So STONE TANK (STABILAZATION POND) used and cost is Rs.1,73,745.0/-

Table 10
RCC Tank Costing

S. No	Description	Unit	Quanti-ty	Rate (Rs.)	Amount	Total Amount (RS.)
1	Excavation	Cum	1165.96	100/-	1,16,596	**11,43,169**
2	RCC	Cum	126.55	4972/-	6,29,206	
3	STEEL (1%RCC X 7850)	KG	9934.18	40/-	3,97,367	

Table 11
Stone Tank (STABILAZATION POND) Cost

S. No.	Description	Unit	Quanti-ty	Rate (Rs.)	Amount	Total Amount (RS.)
1	Excavation	Cum	937.56	100/-	93,756.0	**1,73,745.0**
2	Stone	Cum	571.35	140/-	79,989.0	

5. Results

- Total Hingangon Drainage line system cost as per Phase

6. Conclusion

- For drainage line fly ash (30%) and foundry sand (29%) in concrete so 10.50 % cost less that is Rs.11,45,000/- and increases strength. Material is easily available in country.
- In drainage system waste water RCC tank and stone stabilization pond tank in difference Rs. 9,69,424/-, this stone stabilization pond tank is minimum cost that is 65.80% cost less in stone stabilization pond tank and it's very useful to agriculture and ground water improvement.

Table 12
Drainage line costing

S. No	Description	Length (m)	Unit	Total Amount (Rs.)
1	Close main line (a) 0.8x0.5m	906		**91,59,938.8**
2	Sub-line-1(b)0.3x0.7m	3380	cum	
3	Sub-line-2 (c) 0.5x0.75m	360	cum	
4	Stone drain line(d)	200	cum	
5	Circular pipe(p)300mm	121	meter	
1	Main line (a)0.8x0.5m	756	cum	**1,36,12,769.0**
2	Sub-line-1(b)0.3x0.7m	1126	cum	
3	Sub-line-2 (c) 0.5x0.75m	4380	cum	
4	Stone drain line (d)	430	cum	
5	Circular pipe (p)	330	meter	
1	Main line (a)0.8x0.5m	3370	cum	**1,47,84,135.1**
2	Sub-line-1(b)0.3x0.7m	1080	cum	
3	Sub-line-2 (c) 0.5x0.75m	1080	cum	
4	Stone drain line (d)	1520	cum	
5	Circular pipe (p)	150	meter	

Table 13
Total Hingangon Drainage line system cost as per Phase

PHASE 1 COST			
SR.NO.	**DESCRIBTION**	**AMOUNT**	**TOTAL AMOUNT**
PART A			
1	Drainage line	91,59,938.8/-	**93,33,683.8/-**
2	Stone stabilization tank	1,73,745.0/-	
PART B			
1	Drainage line	1,36,12,769.0/-	**1,37,86,514.0/-**
2	Stone stabilization tank	1,73,745.0/-	
PHASE 2 COST			
SR.NO.	**DESCRIBTION**	**AMOUNT**	**TOTAL AMOUNT**
1	Drainage line	1,47,84,135.1/-	**1,49,57,880.1/-**
2	Stone stabilization tank	1,73,745.0/-	

A. Recommendation

- Total project work start in different phase so main important phase is phase 2 (Gavbhag). Frist start work in this phase because in gavbhag old drainage lines in stone masonry work so it's collapses in different location and 60% people living in this phase and market area.
- Phase 1 work after population increases in future. Finance condition available that time next 5 to 6 Year phase 1 in part 1 and 2 slowly work start. This drainage system age 30 year in future and drainage line, waste water tank is less maintenance so maintenance cost less.

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