" WIDENING OF 540m PORTION OF LINK ROAD(WAKNAGHAT TO DUMEHAR)"

A PROJECT

Submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision of

Dr. Ashish Kumar
Associate Professor

By

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to

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

WAKNAGHAT, SOLAN – 173 234

HIMACHAL PRADESH, INDIA

May-2017

CERTIFICATE

This is to certify that the work which is being presented in the project report titled **"WIDENING OF PORTION OF LINK ROAD "** in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Civil Engineering and submitted to the Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by **Ankush kaundal , Rishav Rana** during a period from July 2016 to May 2017 under the supervision of **Dr. Ashish Kumar Associate Professor**, Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of our knowledge.

Dr. Ashok Kumar Gupta   Dr. Ashish Kumar

Professor & Head of Department   Associate Professor

Civil Engineering Department   Civil Engineering Department

JUIT Waknaghat   JUIT Waknaghat

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In spite of his busy schedule, he provided help whenever needed giving useful proposition and holding discussions and correcting me at every step.

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ABSTRACT

Earthworks are engineering works created through the processing of parts of the earth's surface involving quantities of soil or unformed rock. A common road design problem is the widening and repair of existing road surfaces. Widening the lanes on a bend can reduce the risk of head-on crashes by giving drivers more room to get around the bend without crossing into the opposing lane. Similarly, widening turn lanes can improve safety, especially for larger vehicles. Widening traffic lanes on straight sections of multi-lane roads can reduce sideswipe crashes. In this scenario we wish to fill in the road shoulder and possibly widen the road on uphill side. To minimize the cost we don't want to change the existing pavement.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

Hilly regions generally, have extremes of climatic conditions, difficult and hazardous terrain, topography and vast high altitude areas. The region is sparsely populated and basic infrastructural facilities available in more developed plains of hinterland are mostly absent .The areas and, therefore the roads are affected by floods consequent to torrential rainfall , snowfall, landslides , avalanches etc. compelling certain roads to be kept closed for in part of a year. However, the areas are rich in natural resources, flora and fauna, and are important to launch developed projects, industries tourism etc.

Design of a hill road need not to be restricted to absolute minimum values set out further on. Where conditions are favorable and costs not excessive, use of more liberal values than the minimum should be preferred.

Providing good road network is very essential for the development of any country. In India, there are about more than 6 lakhs villages located in different terrain conditions, e.g., plains, hilly and mountainous region, deserts, swamps, coastal region, backwater area, tribal pockets, etc. The climatic conditions also vary from place-to-place to a great extent. Social, economical and educational development of these villages greatly depends on accessibility. A large number of villages in the rural India are still not connected with the all-weather roads. The employment opportunities and basic necessities, like, health, education cannot reach rural masses without a system of good road network. It has now been realised that for the development of rural areas, development of proper and communication system must be a priority. The rural roads are the basic infrastructure required for the development of rural areas. Rural roads have been planned and constructed under various Rural Development Programmes of the Government of India. Serious efforts through these programmes also could not make all-weather connectivity to more than 50 per cent of the 6 lakhs villages. On the other hand, many roads which have been built could not be sustained. Careful examination of these

has revealed that most efforts have not been effective due to the fact that in those Programmes, the roads were not understood to be engineering structures. These non-engineered structures, without back-up systems and facilities to sustain them with engineering inputs for repair and maintenance, have disappeared in no time. Many of the technical aspects of road making were never given due importance in rural roads; e.g., adequate compaction of sub grade, drainage, required cross drainage, and host of others. There must not be any inhibition about the technical details that are required to be understood for rural roads; these are required to be adopted necessarily. But, none of those are impossible to adopt for local agencies and authorities by any means. Moreover, there are plenty of appropriate technologies for rural road construction and maintenance using locally available materials as well as local agricultural implements. Substantial development has taken place in the expansion of rural road network in recent years. However, there has been admittedly neglect in proper maintenance of rural roads after their construction in the absence of uniform guidelines. The geometric standards, construction practices and maintenance policies differ from State-to-State. The rural roads continue to suffer from the lack of uniform standards also because of the fact that a number of agencies in the States have undertaken rural road construction under various schemes. Therefore, it is necessary to design and construct each and every road according to IRC to achieve planned and effective development of rural roads.

1.2 BRIEF INTRODUCTION TO PROJECT

The project deals with widening a portion of 5/7 m of rural road to 10/12m. The project deals with the calculation of earthwork in excavation in widening a 540 metre portion of link road from **Waknaghat** to **Dumehar** village in Solan district of Himachal Pradesh.

The work executed in the proposed project includes performing surveying with Total Station **SOKKIA SET-610** and further providing rate analysis of earthwork in excavation strictly according to **MORD** technical specifications and **MORD** - Standard data book for analysis of rates for Rural Roads. The work executed on above stated project is strictly according to IRC Codes, MORT&H specification for bridges and highways, MORD Schedule of rates.

1.3 WORK DONE FOR THE PROPOSED PROJECT

Surveying of 540 m stretch with total station SOKKIA **SET-610**.Calculation of Earth work in excavation for proposed 10/12.00 m wide road. Classification of strata according to technical specification provided by **MORD** and **IRC**. Rate analysis of earthwork for proposed 10/12.00m widening. Providing surface katcha drain (unlined) for the proposed road and calculating its cost strictly according according to **MORTH, MORD** specifications. Providing and laying a RCC HUME pipe culvert at RD 0/305 according to specifications laid by MORD and IRC.Providing general abstract of cost for the listed works according to MORD schedule of rates. The above specified work will be done according to relevant IRC Codes of practice.

1.4 BRIEF DESCRIPTION OF PRESENT ROAD

The existing road is link road from Waknaghat to Dumehar village in the Solan District of H.P. The existing road comes under a category of Village Road of formation width 5/7.00 m.

1.4.1 TERRAIN CLASSIFICATION

The geometric design of highway is influenced significantly by terrain conditions. Terrain is classified by general slope of the country across highway alignment. While classifying, short isolated stretches of varying terrain must not be taken into consideration.

S. No.	Terrain classification	Per cent cross slope of the country
1.	Plain	0—10
2.	Rolling	10—25
3.	Mountainous	25—60
4.	Steep	Greater than 60

Figure 1 Terrain classification

The conditions are mostly mountainous and sometimes steep with country slope > 25 % everywhere. The proposed project deals with widening of a portion of this road 10/12.00m.

Figure 2 satellite view

The above picture shows the satellite view of the proposed road that will be widened starting from Thank You gate of JUIT to 540m downside towards Dumehar Village.

CHAPTER 2

SURVEY DATA

2.1 GENERAL

The survey for proposed project was carried out **using Total Station SOKKIA SET 610.** At every 15m L-section and cross section readings were taken using Total Station .The RL of datum is assumed to be 600m. The datum for survey work is shown on plan of proposed road. The table shown below shows the survey data collected at site.

READINGS FROM TOTAL STATION

RD	C/S Area(m^2)	L-section	RL at side	RL				
				@1m	@2m	@3m	@4m	@5m
0/015	0	599.8	599.6					603.9
0/015	24.91	599.72	599.36	-	-	603.90	-	605.00
0/030	18.62	598.50	598.76	601.58	-	-	-	605.12
0/045	38.1	597.26	597.10	602.71	-	-	-	604.50
0/060	75.45	596.00	595.69	604.70	-	-	-	606.80
0/075	30.7	595.40	595.11	-	599.89	-	-	601.25
0/090	42.36	594.20	594.03	-	601.20	-	-	602.43
0/105	27.4	593.15	592.92	597.30	-	-	599.40	-
0/120	38.24	592.40	592.10	-	595.33	-	-	600.10
0/135	46	591.50	591.30	-	599.20	-	-	601.20
0//150	38.9	590.70	590.50	-	598.03	-	-	-
0/165	43.2	590.20	589.90	-	597.40	-	-	-
0/180	37.8	589.60	589.40	-	596.70	-	-	598.50
0/195	53.5	589.00	588.80	-	597.54	-	-	598.80
0/210	63.3	588.10	587.90	-	596.60	-	-	598.13
0/225	63.1	587.00	587.70	-	596.30	-	-	598.00
0/240	22	586.20	585.16	-	589.10	-	-	591.00
0/255	31.5	584.50	584.60	-	589.98	-	-	590.60
0/270	30.5	583.60	589.75	-	-	-	-	588.75

0/285	41.6	582.80	582.57	-	-	-	-	-
0/300	41.6	581.80	581.70	586.70	-	-	-	589.20
0/315	32.7	581.00	580.70	-	-	-	-	588.20
0/330	11.4	579.30	579.30	-	-	-	-	582.70
0/345	40.5	578.40	573.24	-	-	584.40	-	587.90
0/360	33.2	577.40	577.20	-	-	-	-	585.70
0/375	24.8	576.50	576.30	-	580.20	-	-	582.30
0/390	37.5	575.40	575.30	-	-	583.40	-	-
0/405	15.45	574.50	574.30	-	-	-	578.70	579.20
0/420	15.8	573.50	573.20	-	-	-	577.70	578.20
0/435	17.7	572.50	572.30	575.30	-	-	577.30	-
0/450	31.3	571.40	571.20	-	-	577.30	-	578.50
0/465	19.1	570.60	570.40	-	-	-	-	575.20
0/480	24.6	569.70	569.50	-	574.20	-	-	575.32
0/495	25.6	568.70	568.50	-	-	573.60	-	574.10
0/510	29.3	565.00	567.80	-	-	572.44	-	574.40
0/525	10.73	570.00	569.80	-	-	-	-	573.40
0/540	13.9	569.20	569.00	-	571.20	-	-	572.90

Figure 3 Readings from Total station (Table)

The data shown above will be used to plot cross- sectional details, L-sectional details and plan of the proposed road.

CHAPTER 3

DETAILS OF MEASURMENT FOR VARIOUS WORKS

3.1 PLAN & L-SECTION

The plan of the existing road and proposed road is shown below. The RL of datum i.e. 600m meters is shown on plan.
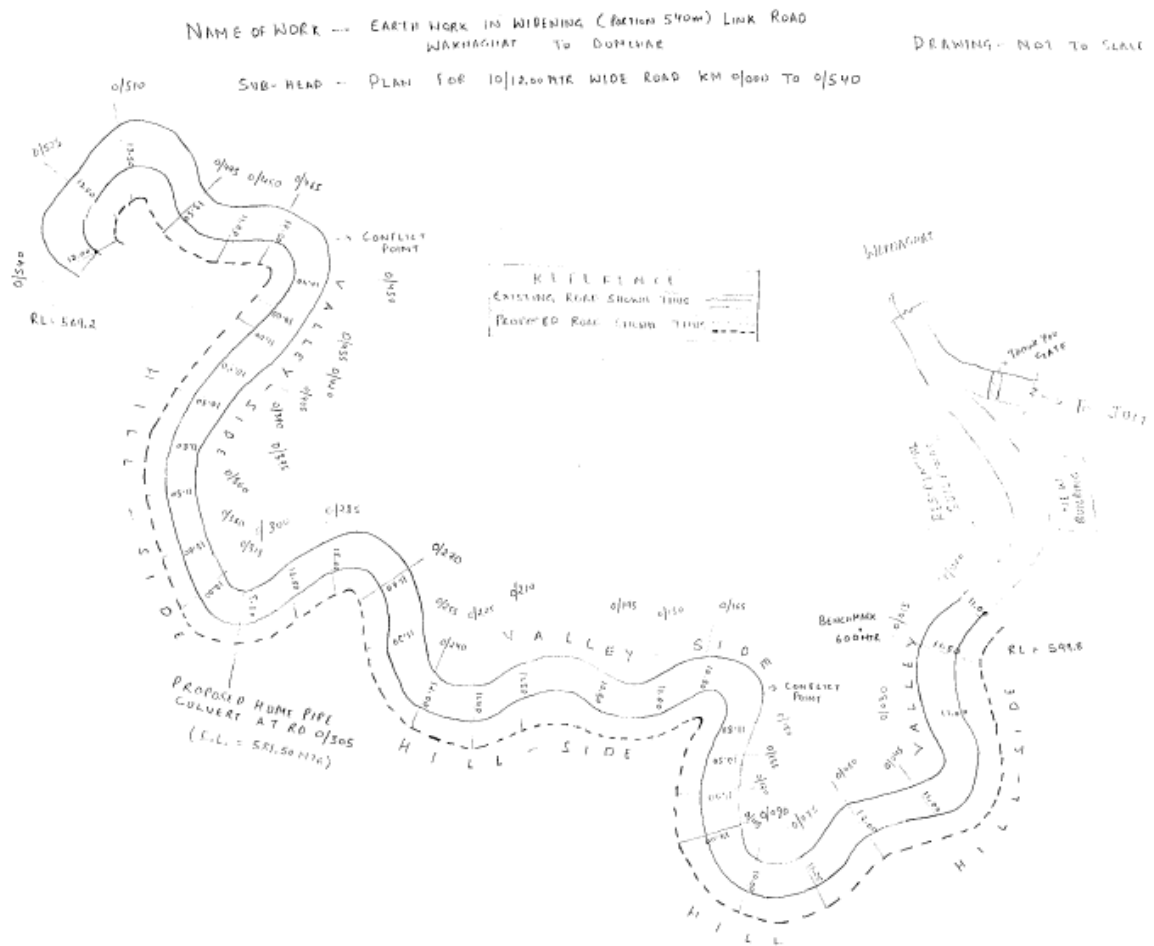
Figure 4 Plan

The RL on center line of proposed road are taken at every 15m interval with reference to assumed datum i.e. 600m. The RL is provided on the table shown above. The RL is used

to plot the L-section of the proposed road. The L-section of the proposed road is shown below.
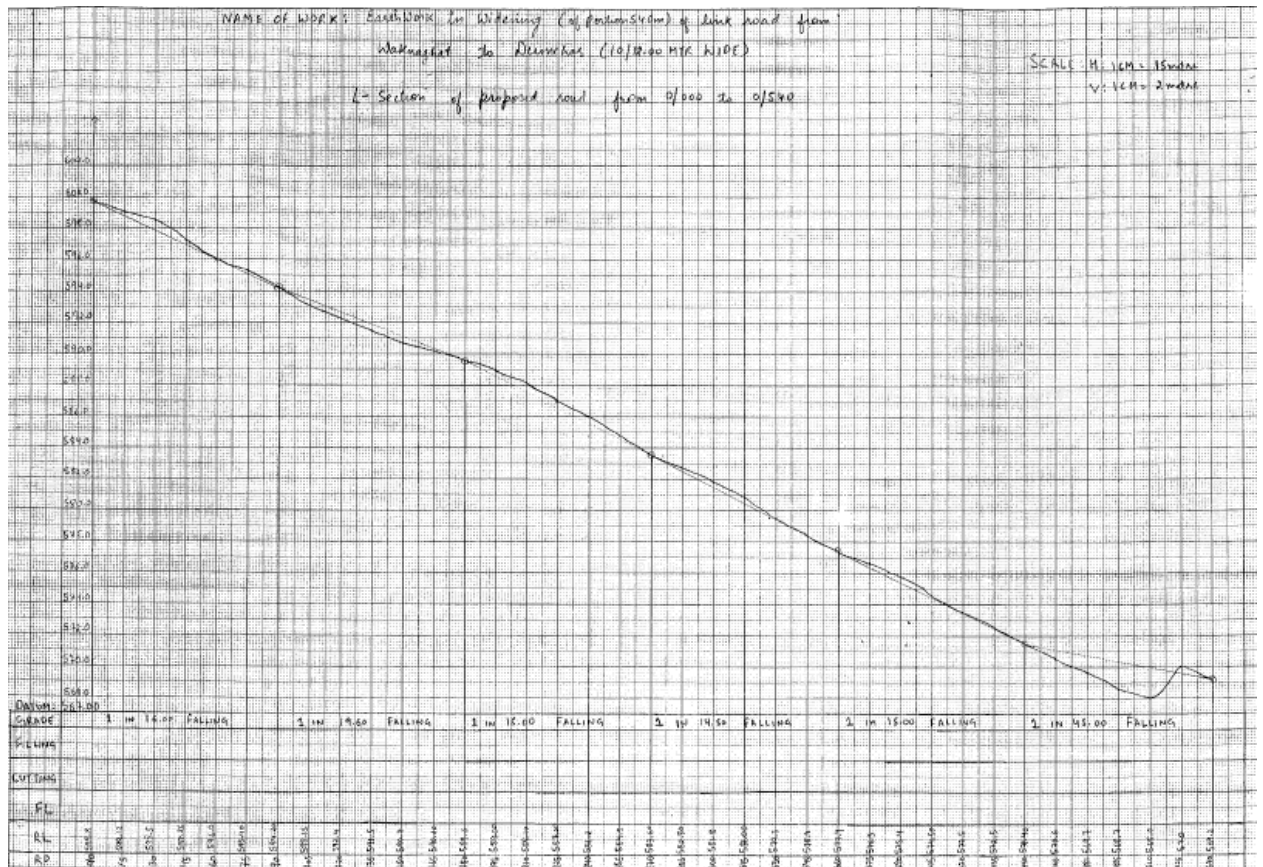
Figure 5 L-section

The graph shows **exceptional gradient** is provided for **90m from RD 0/270 to 0/360**

3.2 EXCAVATION COST

3.2.1 CLEARING & GRUBBING   (ANNEXURE C)

The site needs to be cleared before cross-sectional details can be taken. The area that is to be cleared is measured in sq. m. The cost for clearing and grubbing will be calculated using per unit rate provided by MORD clause no.201. The analysis of the unit rates are provided separately in chapter '**Analysis Of Rates**' Abstract of cost for clearing and grubbing is provided below. Abstract below shows cost of clearing and grubbing the site amounting **Rs. 25,417.80**

S.No.	Description	Qty.	Rate	Unit	Amount
1.	Clearing and Grubbing road land clearing and grubbing road land including uprooting wild vegetation, grass, bushes, shrubs, saplings and trees of girth up to 300mm, removal of stumps of such trees cut earlier and disposal of unserviceable materials and stacking of serviceable material to be used or auctioned , up to a lead of 1000m including removal and disposal of top organic soil not exceeding 150mm in thickness as per Technical specification clause 201 by Mechanical Means	2824.2	9.00	Per square meter	25417.8
				Total	**25,417.8**

3.2.2 EXCAVATION COST & CROSS-SECTIONAL DETAILS

The quantity of earthwork in excavation is calculated by performing extensive survey in the stretch .The cross-sectional details are taken at every interval of 15m with respect to assumed datum. The cross-sectional readings are provided in the above shown table. The cross-sectional details are used to plot advance cross – sections, so that volume of earth to be excavated for widening could be computed. The earth to be excavated is classified according to MORT&H technical specification Clause 301 and clause 302 &Annexure 301.1 by MORD technical specifications. Material is classified as Pick Work (P.W.), Jumper Work (J.W.) & Blasting Work (B.W.)

The cross-sectional graphs at every RD from 0/000 to 0/540 are provided below.
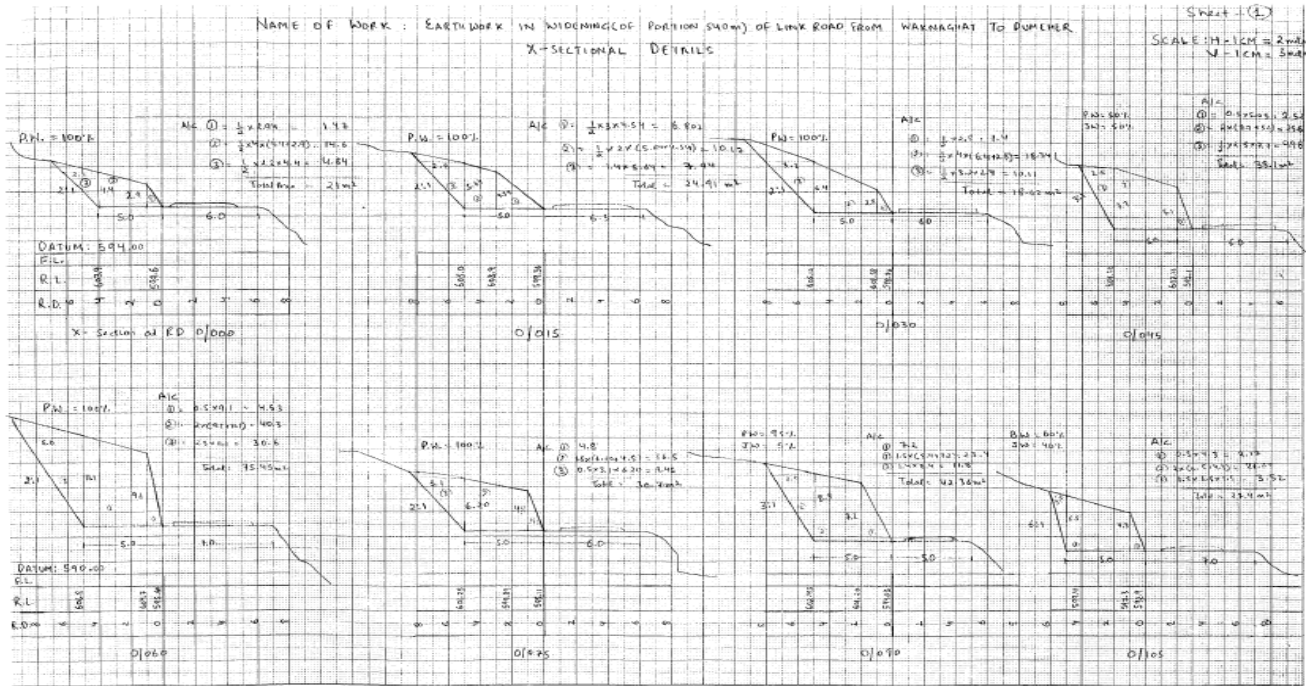
Figure 6 C/S drawings
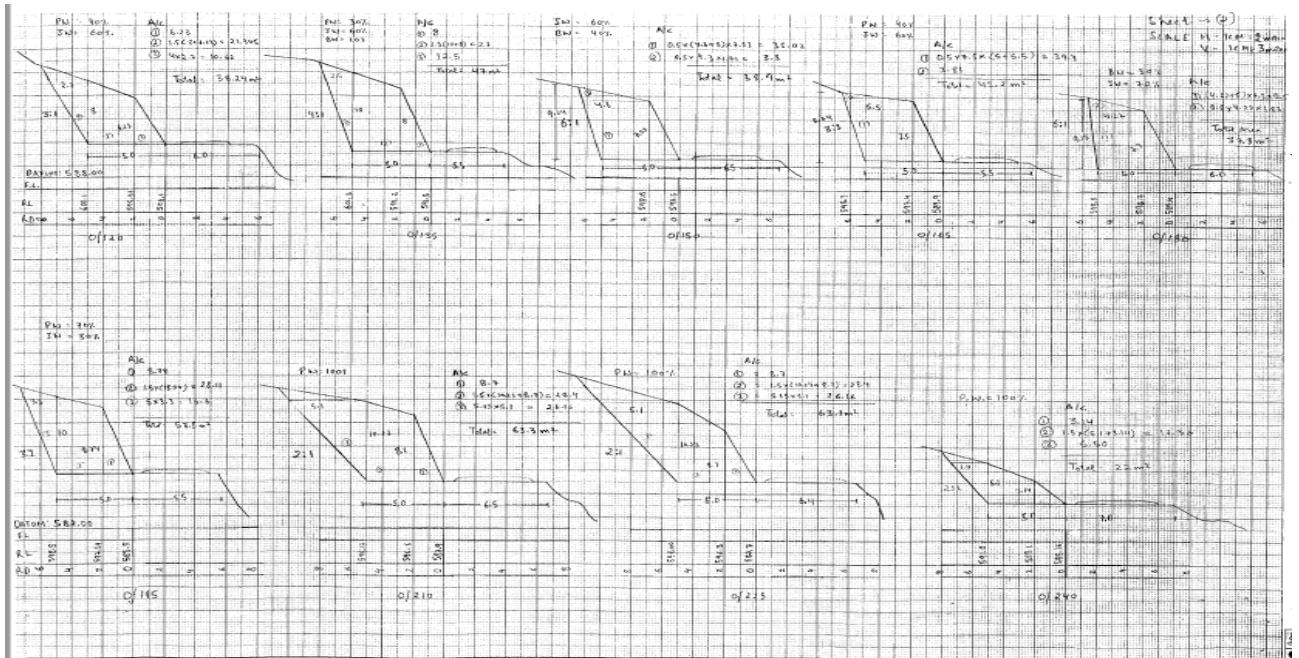
Figure 7 C/S drawing 2

17
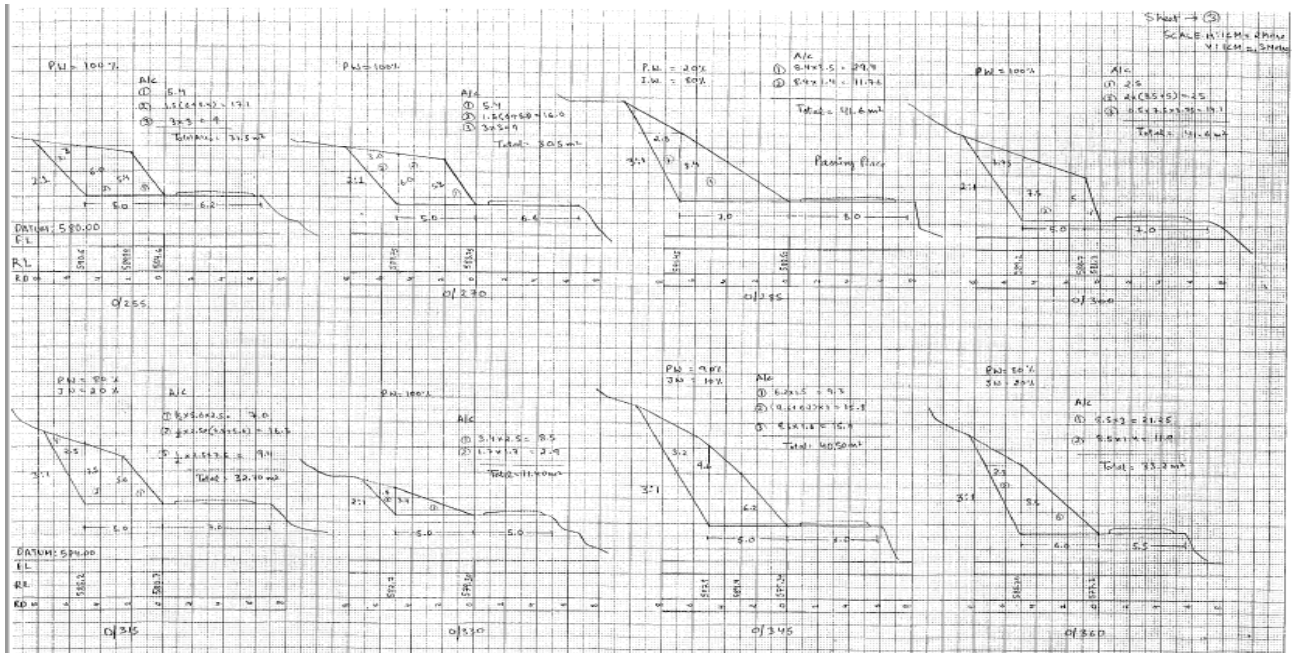
Figure 8 C/S drawing 3
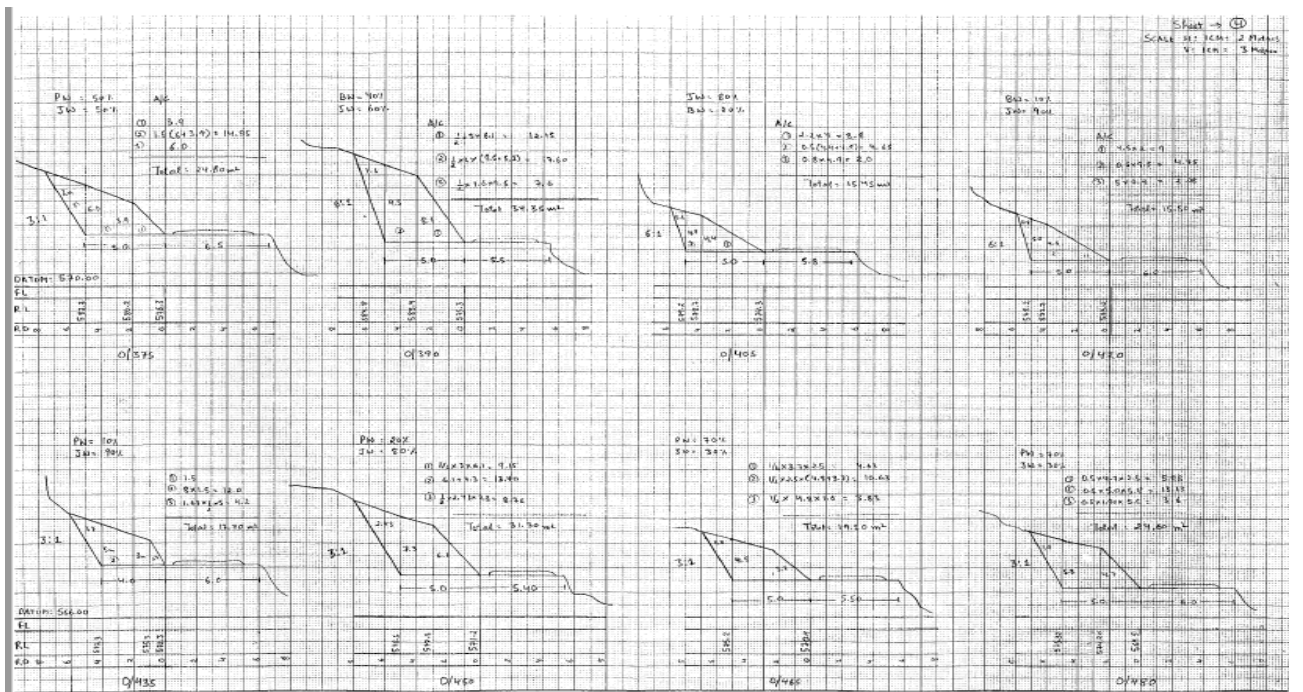
Figure 9 C/S drawing 4
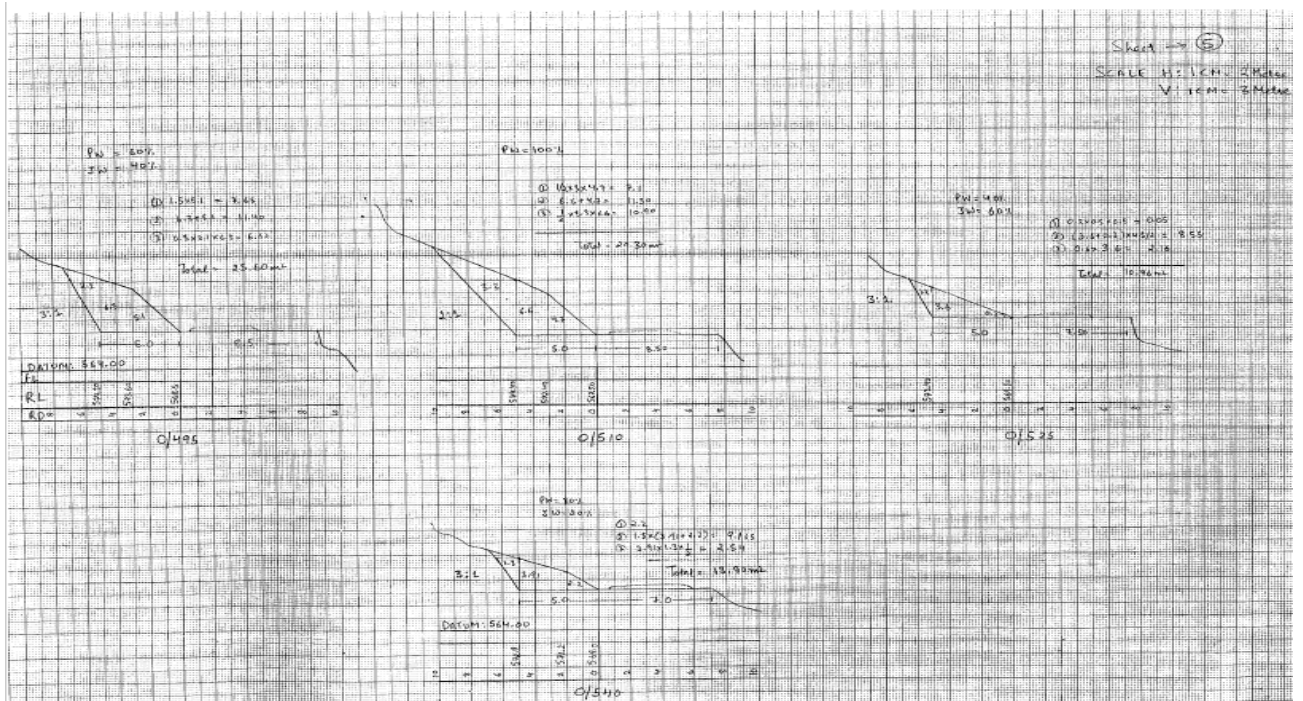
Figure 10 C/S drawing 5

The volume of earth to be excavated at every 15m section is to be calculated by calculating area of cross-section at every RD.

Details and Quantity of earthwork of different classification is provided in the table shown below. The total cost for earth excavation will be calculated by multiplying these quantities by there unit rates. The unit rates for PW, JW, BW are 176.40, 280.75, 405.25 respectively.The analysis of these rates are provided separately in chapter '**Analysis Of Rates**'. These rates are taken from MORD specification clauses 1600 & 300.

DETECTS OF MEASUREMENT

DETAILS OF MEASUREMENT

NAME OF WORK**: Earthwork in widening(portion 540m) of link road from Waknaghat to Dumehar**

Sub-head : **Earth work in Excavation (cutting hill side) meters 0/0 to 0/540**

R.D	C/S	Mean	Length	Quantity	Classification			Quantity		
	Area	Area			P.W.	J.W.	B.W.	P.W.	J.W.	B.W.
0/0	0.0	0.0	0.00	0.0	0	0	0	0.0	0	0
0/15	24.91	22.90	15.00	343.5	100%	0%	0%	342.5	0	0
0/30	18.62	21.70	15.00	325.5	100%	0%	0%0	325.5	0	0
0/45	38.1	28.36	15.00	425.4	50%	50%	0%	212.7	212.7	0
0/60	75.45	56.70	15.00	850.5	100%	0%	0%	850.5	0	0
0/75	30.7	53.0	15.00	795	100%	0%	0%	795	0	0
0/90	42.36	36.50	15.00	547.5	95%	5%	0%	520.1	27.4	0
0/105	27.4	34.90	15.00	523.5	0%	40%	60%	0	209.4	314.1
0/120	38.24	32.80	15.00	492	40%	60%	0%	196.8	295.2	0
0/135	46	42.12	15.00	631.8	30%	60%	10%	189.5	379.1	63.2
0/150	38.9	42.45	15.00	636.75	0%	60%	40%	0	382.1	254.7
0/165	43.2	41	15.00	615	40%	60%	0%	246	369	0
0/180	37.8	40.5	15.00	607.5	0%	70%	30%	0	425.25	182.2
0/195	53.5	45.65	15.00	684.7	70%	30%	0%	479.3	205.4	0
0/210	63.3	58.4	15.00	876	100%	0%	0%	876	0	0
0/225	63.1	63.2	15.00	948	100%	0%	0%	948	0	0
0/240	22	42.5	15.00	638.2	100%	0%	0%	638.2	0	0
0/255	31.5	26.75	15.00	401.2	100%	0%	0%	401.2	0	0
0/270	30.5	31	15.00	465	100%	0%	0%	465	0	0
0/285	41.6	36	15.00	540	20%	80%	0%	108	432	0

0/300	41.6	41.6	15.00	824	100%	0%	0%	624	0	0
0/315	32.7	37.1	15.00	556.5	80%	20%	0%	445.2	111.3	0
0/330	11.4	22.0	15.00	330	100%	0%	0%	330	0	0
0/345	40.5	25.95	15.00	389.2	90%	10%	0%	350.3	38.9	0
0/360	33.2	36.85	15.00	552.7	80%	20%	0%	442.2	110.5	0
0/375	24.8	29	15.00	435	50%	50%	0%	217.5	217.5	0
0/390	37.5	31.5	15.00	467.25	0%	60%	40%	0	280.35	186.9
0/405	15.45	26.47	15.00	397.1	0%	80%	20%	0	317.7	79.4
0/420	15.8	15.6	15.00	234	0%	90%	10%	0	210.6	21.06
0/435	17.7	16.75	15.00	251.25	10%	90%	0%	25.1	226.13	0
0/450	31.3	24.5	15.00	367.5	20%	80%	0%	73.5	294	0
0/465	19.1	25.2	15.00	378	70%	30%	0%	264.6	113.4	0
0/480	24.6	21.85	15.00	327.7	70%	30%	0%	229.4	98.31	0
0/495	25.6	25.1	15.00	376.5	60%	40%	0%	225.9	150.6	0
0/510	29.3	27.45	15.00	411.7	100%	0%	0%	411.7	0	0
0/525	10.76	20.03	15.00	300.45	40%	60%	0%	120.2	180.3	0
0/540	13.9	12.3	15.00	184.5	80%	20%	0%	147.6	36.9	0
			Total Quantity =18087.9cum					11660 cum	5324.04	1101.6 cum

Figure 11 Detail of measurement (Table)

3.3 ABSTRACT OF COST FOR EXCAVATION WORKS (ANNEXURE A)

S.No	Description	Qty	Rate	Unit	Amount(Rs.)
1	Excavation in soil in hilly area by mechanical means including cutting and trimming of side slope disposing of excavated earth with a lift up to 1.5m and a lead up to 20m as per Technical Specification clause 1603.2 .	11660	176.40	Per cubic meter	2056824
2	Excavation in hilly area in ordinary rock not requiring blasting by mechanical means including cutting and trimming of slope sand disposal of cut material with lift up to 1.5m and lead up to 20m as per clause 1603.2 .	5324.04	280.75	Per cubic meter	1494724.23
3	Excavation in hilly areas in hard rock requiring blasting by mechanical means, lift up to 1.5m and disposal of excavated rock up to 20m as per clause 1603.2 .	1101.6	405.25	Per cubic meter	446423.4
				TOTAL	**Rs. 39,97,971.63**

Figure 12 Abstract of excavation (Table)

The above abstract shows total cost for excavation amounting Rs**. 39,97,971.63**

CHAPTER: 4

UNLINED SIDE DRAIN

The road side drains are designed on the principle of open channel flow. In hilly terrain, when the road is built on cut section, side drains are provided on the hill side. Parabolic is hydraulically the best and most erosion resistant. U shaped drains are generally deeper and are provided when huge discharge is to be catered.
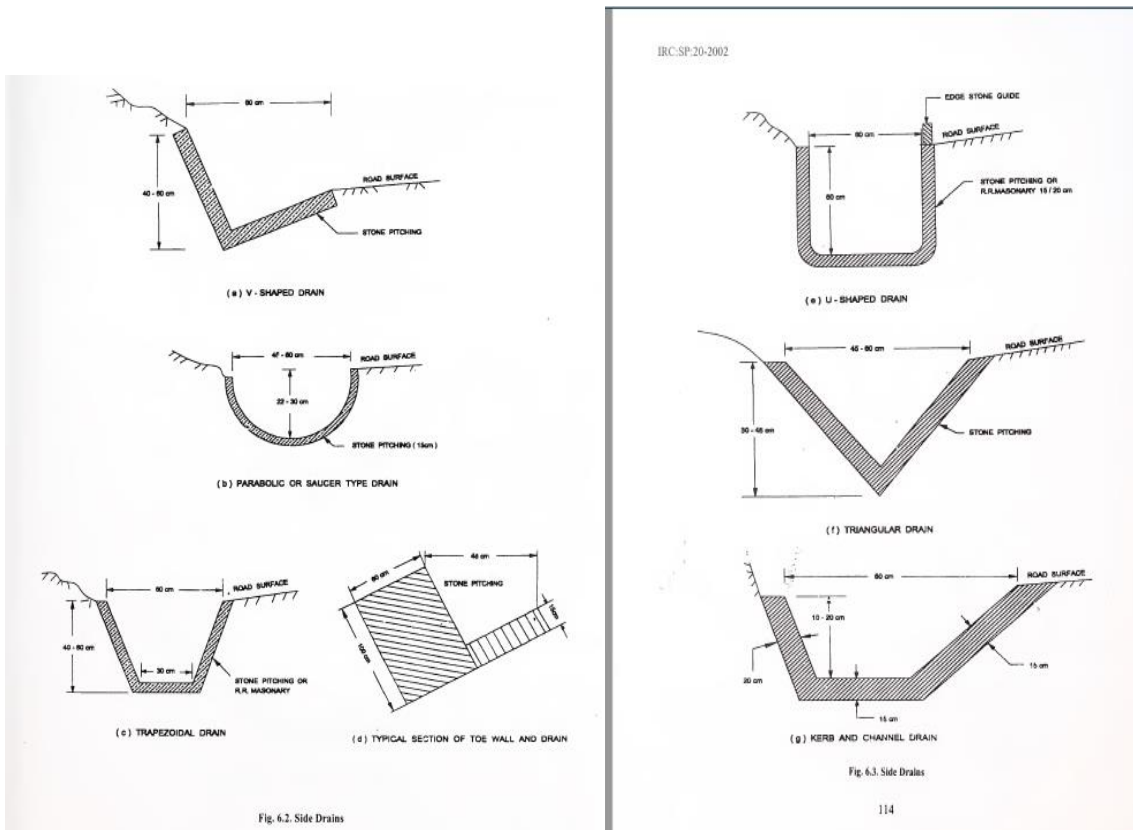
Figure 13 Drainage designs

The above drain sections are taken from **IRC: SP:20 – Article 6.5.2**

The rectangular & trapezoidal section side drains pose sense of danger to motorists travelling close to it, so triangular section is most apt. & widely used.

4.1 DESIGN SPECIFICATIONS FOR SIDE DRAIN

The runoff or discharge from the catchment area is calculated from Rational formula (up to 50 sq.km)

$$Q = 0.028 \text{ PAI}$$

Value of P – table 6.2 **IRC: SP :20 – 2002**

The selection of roadside drain is based on magnitude and duration of flow. The hydrological data required for design of gutter are drainage area, water shed delineation, direction of flow, location of outfalls, ditches, other surface drainage facilities, ground surface condition, rainfall and flood frequencies. **Using manning's formula**

$$V = (1\backslash n)R^{2\backslash 3}S^{1/3}$$

The value of Manning's coefficient and permissible velocity of flow to prevent erosion are given in Table 6.3 (IRC : SP-20). Slope of bed can be found from manning's formula. Using Q = AV , area of c/s can be found for the side drain. According to **IRC :SP : 48 (Hill Road Manual)** section 8.4.1 , road side drain of V-shape of x-sectional area 60x60 sq.cm. must be provided. To disperse floating debris, self cleansing velocity must be developed , so gradient of 1:23 should be provided to drains.Road side drain must be provided below 300mm from road surface so that draining water does not cause weakening of sub-grade. The length of side drain provided on the proposed road is **536.40m**. Cost of providing drain per Rmt. is calculated **Rs. 49.20** according MORD technical specification section 307 (provided in the hard copy).Total cost for providing the side drain is estimated to be **Rs 26390.9**

4.2 ABSTRACT OF COST FOR SIDE DRAIN (ANNEXURE B)

S.No.	Description	Qty	Rate	Unit	Amount
1	Construction of unlined surface drains of average cross- sectional are a 0.40 sqm. in soil to specified lines, grades, levels and dimensions. Excavated material to be used in embankments with a lift up to 3m and lead of 50 m(average lead 25m) as per Technical specification clause 307 by manual means .	536.40	49.20	Per Rmt	26390.88
				Total	**26,390.88**

Figure 14 Abstract for side drain (Table)

The Abstract of cost shows cost for providing side drain equal to **Rs, 26,390.88**

CHAPTER: 5

RCC HUME PIPE CULVERT AT 0/305

5.1 INTRODUCTION

Uncontrolled water is the primary cause of problems like soft surfaces, pot holes, rutting washed out shoulders and even failure of complete section of roadway structures. The Hume pipe culvert is provided at R.D. 0/305. Closed investigation of site shows there is a need of cross- drainage structure. At 0/305 a nallah was encountered, where efficient cross drainage is required specially during rainy seasons.

A Culvert is a cross drainage structure having a total length of 6 m or less between the interface of dirt walls or extreme vent way boundaries. A minor bridge is a bridge having a total length up to 60 m.
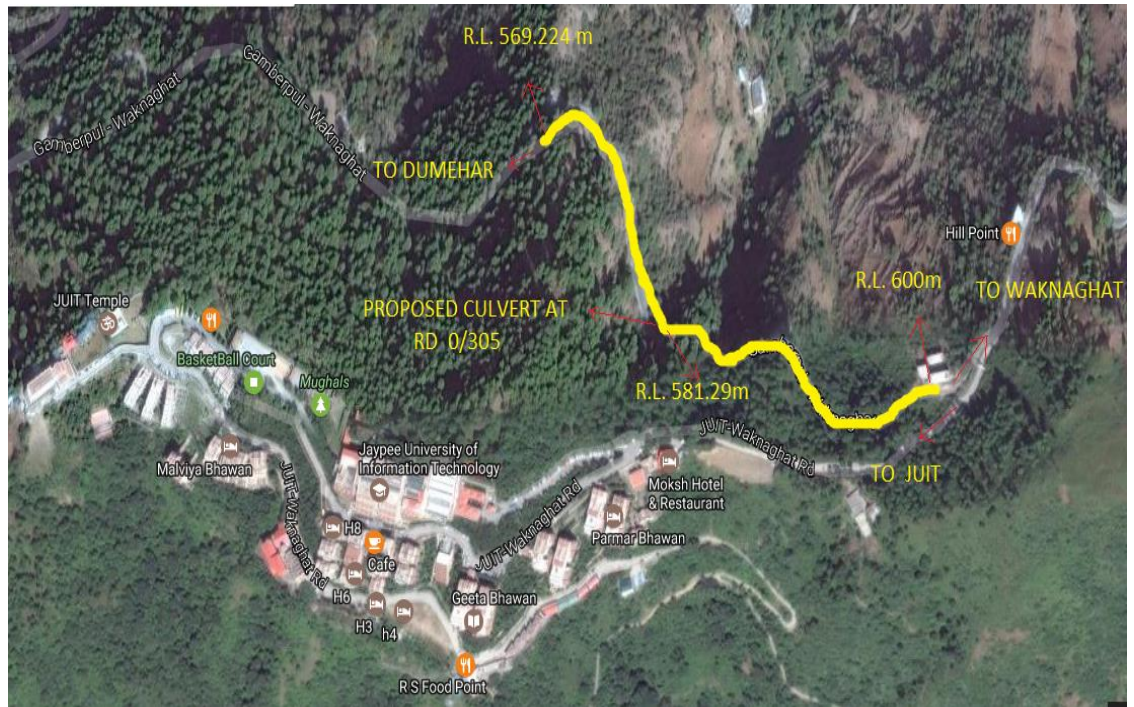
Figure 15 Plan view

The above image shows satellite view of site for proposed RCC HUME PIPE culvert at RD 0/305.At the shown location Hume culvert is proposed for cross drainage operations.

Pipe culvert will be very efficient according to site & terrain conditions. Some of the advantages being:

Speedy construction (normally 15 days)

Good quality factory pipes available

Very economical when foundations are deeper or   Black Cotton soil is present.

Figure 16 Culvert

Above image shows actual location of site where 900mm dia HUME PIPE CULVERT is proposed.

Figure 17 Culvert 2

Image above shows u/s side of the location where culvert is proposed.

5.2 DESIGN STANDARDS AND SPECIFICATIONS FOR PROVIDED CULVERT

The culvert has been designed according to specifications laid by:

IRC: SP - 20 (Rural Road Manual)

IRC: SP -13 (Design of culverts & small bridges)

IRC: SP - 48 (Hill Road Manual)

IRC: SP - 42 (Guidelines of Road Drainage)

IRC: SP – 7 (Recommended Practices for Numbering Culverts & Bridges)

IRC:6 -2014 Standard Specifications & Code of Practice For Road Bridges

IS:1124, 1597, 458, 783

MORD - Specifications for Rural Roads, 2014

MORT&H - Specification for Bridges &Road, 2013

MORD - Standard Data Book for Analysis of Rates for Rural Roads According to **IRC: SP-13 Section 7.6.1,**

Waterway Area, $A = Q/10.9$ (A in sq. m.) (Q is watershed area in Hectares)

A = 125/10.9 = 11.467 m^2

Linear Water (2m depth of water)

L_w = 11.467/2 = 5.74 m .Section 7.6.1 shows, A culvert is required for catchment area less than 125 hectares & minor bridge is provided for watershed area more than 125 hectares.   To be on the conservative side, if we assume catchment area for our proposed culvert at 0/305 to be 10 hectares , then according to **IRC:SP:20 Section 7.7.2.1** , Table 7.4

TABLE 7.4. DIAMETER OF PIPE

Catchment Area (Hectares)	Diameter of Pipe (mm)
Up to 10	1000 single row
10 to 20	1200 single row
20 to 50	1000 or 1200 (2 to 3 rows)
50 to 60	1000 or 1200 (4 rows)

- 1000mm dia. Hume **NP₃** pipe will be sufficient to drain out the water from watershed efficiently. According to **IRC: SP:20, Section 7.2.1,** overall width of cross drainage work should be equal to formation width of road. So, width of the proposed culvert would be 10m.Further, according to the Section 7.2.1 **NP₃** should be used. **NP₃** pipes are generally available in lengths 2.5 to 3.0 m, So 4 pipes are provided to cover length of 10m.

- According to **Section 7.7.2.3** of **IRC: SP:20,** The pipes shall strictly conform to **IS:458-1989** (**Specification for concrete pipes**) and shall be laid strictly as per relevant **IS:783-1985** (**laying of concrete pipes**).

- According to **section 7.3**, **IRC: SP:20** the proposed culvert at RD 0/305 is designed for **IRC Class A Two Lane** loading with impact. (**IRC :06 -2014** must be referred for details)
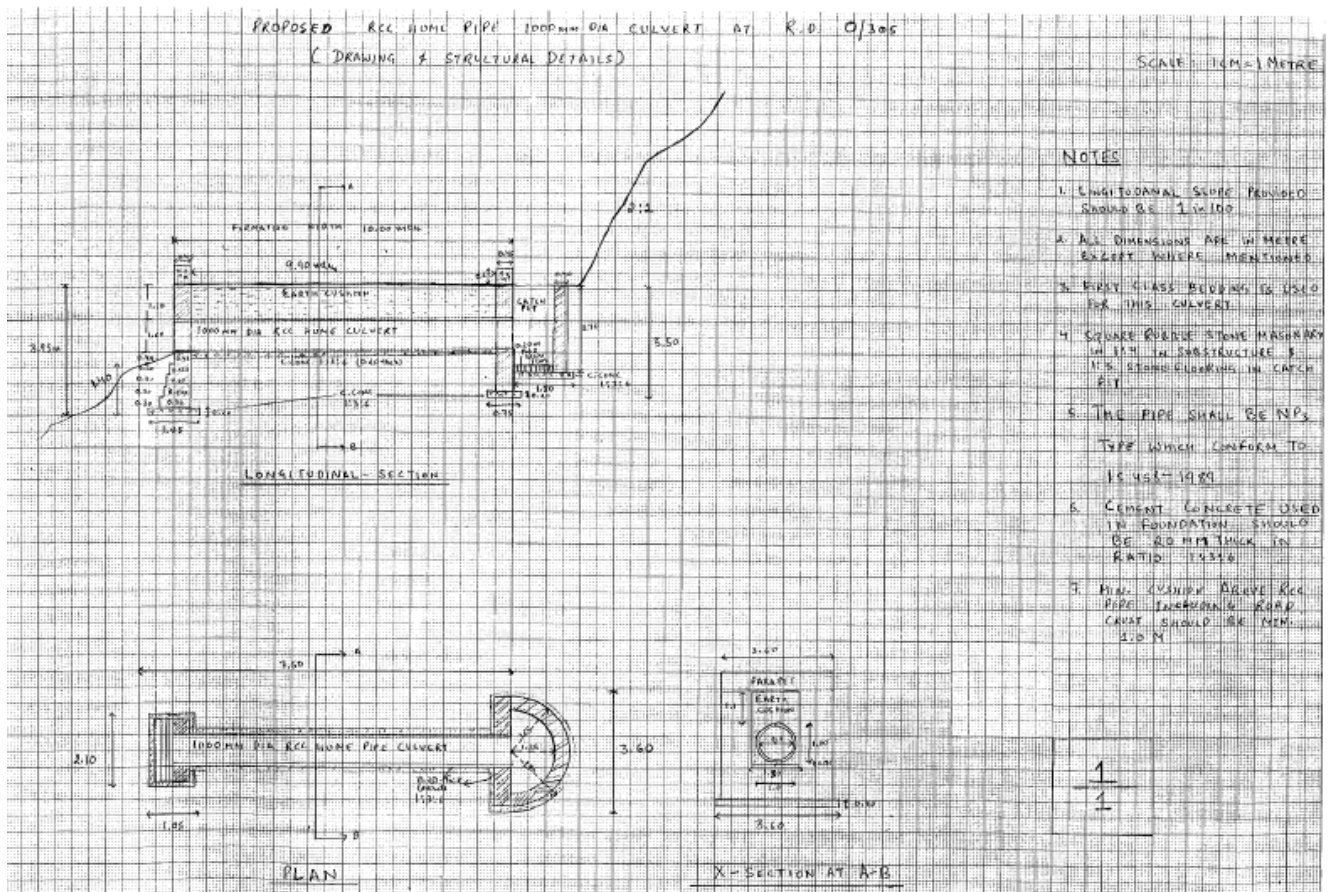
Figure 18 Culvert design

Drawing of 900mm RCC Hume Pipe Culvert at RD 0/305 (Showing Dimensional Details, Plan , C/S , L-section)

According to Table 7.3, **Section 7.7.1 IRC: SP:20** Min. Height of formation of the road from the bed level should be :

TABLE 7.3. MINIMUM HEIGHT OF FORMATION

Diameter (NP₂ pipes), mm	Height of Formation, m
For 1000 (900 mm internal dia)	1.75
For 1200	2.15

In the proposed culvert it is kept equal to 2.**00 m**.The RTL is fixed according to the alignment of existing road , so as to avoid bumps. The min. Earth cushion/Fill is kept equal to **1m**. According to **IRC: SP:20 Article 7.7.2.3 type B** bedding must be used in laying of pipe & C:M should be **1:2** in joining. The pipes shall be joined either by collar joint or the flush joint. The collar shall be of RCC 150 mm to 200 mm wide having strength as that of pipes.

According to **IRC: SP:13 Article 14**, top of the floor of pipe must be kept 0.3m below the bed level. Foundation of abutment must be kept min. 1.25m below top of floor of pipe. In the proposed culvert it is kept equal to 1.50m. According to **Article 14 of IRC: SP:13,** depth of u/s& d/s curtain walls from top floor must be **1to 1.5m** & **1.5 to 2.5m** respectively. In the provided culvert, u/s & d/s curtain walls are provided **1.55** & **1.90m** deep respectively. The RCC pipe must be laid in the bed slope of **1 in 100**, according to **IRC: SP:48 Section 8.10.5.6**

- **MORE SPECIFICATIONS: SR** Masonry must be used in construction of curtain walls with **C:M 1:4** strictly according to **Clauses 702, 704, 1202,1204** of **MORD – specifications for rural roads.** All the materials used in the construction of culvert must conform to **Section 2000** of **MORD-Technical Specifications.** Mortar used in masonry shall conform to **IS :2250**. Stones used in construction of curtain walls must be according to **Section 2004.1** of **MORD technical specifications**. Dressing of stones & laying shall conform to **IS:1597** & **Section 704** of **MORD-Specifications for Rural Road**. According to **IS:1124** water absorption of the stones should not be greater than 5%. Length of the stones should not be greater than ¾ of the width of stone. Moreover, width of base must be between 150mm & ¾(of thickness of wall).

5.3 MEASUREMENT DETAILS FOR 900MM DIA. RCC HUME PIPE CULVERT
Figure 19 RCC Culvert unit calculation (Table)

NAME OF WORK: **Earthwork in widening(portion 540m) of link road from Waknaghat to Dumehar**		
Sub-head : **Construction 900mm dia. RCC Hume pipe Culvert at RD 0/305**		
S.No	Description of items	Calculations	Quantity
DETAILS OF MEASUREMENT			
1	Earth work in excavation for structure as per drawing and technical specifications clause 305.1 including setting out, construction of shoring and bracing ,		

	removal of stumps and other deleterious material and disposal up to a lead of 50m , dressing of sides and bottom and backfilling in trenches with excavated suitable materials		
	D/S Curtain wall	(.45+.15)(3.95x2.10)+0.5x.45x(1.85+1.40)+(1.20x.90x.5x2.10)	7.64
	U/S dwarf wall	3.50x.75x3.60	9.45
	Catch pit	$0.5x3.14x2.90x1.65^2$	12.39
	For pipe	9.60x2.10x3.10	26.208
		Total	**55.70cum**
2	Providing concrete for plain/reinforced concrete in open foundation complete P.C.C grade M 10 (i)Nominal mix 1:3:6 Mechanical Mixed		
	D/S Curtain wall	0.20x2.10x1.05	0.441
	U/S curtain wall	0.20x3.60x0.75	0.54
	Catch pit	$0.5x3.14x1.80^2x0.20$	1.02
	For pipe	9.90x0.20x1.30	2.574
		Total	**4.575 cum**
3	Providing and laying Reinforced Cement concrete pipe NP2 900MM Dia RCC Hume Pipe	1x10	10 Rmt.
4	Stone masonry in cement mortar for substructure complete as per drawing and technical specifications clauses 702,704,1202 and 1204 in cement mortar 1:4(one cement: four sand).		
	D/S Curtain wall		
	1st step	1.80x0.75x0.30	0.405
	2nd step	1.80x0.675x0.30	0.3645
	3rd step	1.80x0.60x0.30	0.324
	4th step	1.80x0.525x0.30	0.2835
	5th step up to R Level	1.80x0.525x0.30	1.845
	U/S curtain wall	3.30x0.45x3.30	4.901

	Catch pit	$0.5 \times 3.14 \times 2.70(1.65^2 - 1.25^2)$	4.91724
		Total	13.1797cum
	Deduction for pipe	$2 \times 3.14 \times 0.45 \times 0.50^2$	(-)0.7065
	Drain	$0.40 \times 2 \times 0.30^2$	(-)0.07
		Net Total	**12.403cum**
5	Providing and laying flooring over cement concrete Rubble stone laid in cement mortar1:3		
	Catch pit	$0.5 \times 3.14 \times 0.20 \times 1.25^2$	0.49
		Total	**0.49cum**
6	Providing and laying cement concrete 1:5:10(one cement :five sand :ten graded,crushed/broken stone aggregate 40mm nominal size) with 15% plum and curing complete including cost of form work in Retaining walls/ Breast walls. The size of plum shall usually be 150mm to 300mm as per H.P.P.W.D specifications		
	Parapet Over U/S curtain wall	$1 \times 3.30 \times 0.45 \times 0.60$	0.891
	Parapet over D/S curtain wall	$1.80 \times 0.45 \times 0.60$	0.49
		Net total	**1.38cum**

5.4 ABSTRACT OF COST FOR PROPOSED CULVERT (ANNEXURE D)

	Description of items	Quantity	Rate	Unit	Amount
1	Earth work in excavation for structure as per drawing and technical specifications clause 305.1 including setting out, construction of shoring and bracing , removal of stumps and other deleterious material and disposal upto a lead of 50m , dressing of sides and bottom and backfilling in trenches with excavated suitable materials	55.70	289.40	Per cubic metre	16119.58
2	Providing concrete for plain/reinforced concrete in open foundation complete P.C.C grade M 10 (i)Nominal mix 1:3:6 Mechanical Mixed as per clauses 802,803,1202 & 1203	4.575	5737.40	Per cubic metre	26248.61
3	Providing and laying Reinforced Cement concrete pipe NP2 900MM Dia RCC Hume Pipe	10	4454.90	Per Rmt.	44549.00
4	Stone masonry in cement mortar for substructure complete as per drawing and technical specifications clauses 702,704,1202 and 1204 in cement mortar 1:4(one cement: four sand).	12.403	4835.10	Per cubic metre	59969.75
5	Providing and laying flooring over cement concrete Rubble stone laid in cement mortar1:3	0.49	2473.80	Per cubic metre	1212.16
6	Providing and laying cement concrete 1:5:10(one cement :five sand :ten graded, crushed/broken stone aggregate 40mm nominal size) with 15% plum and curing complete including cost of form work in Retaining walls/ Breast walls. The size of plum shall usually be 150mm to 300mm as per H.P.P.W.D specifications	1.38	4506.25	Per cubic metre	6218.63
The abstract show cost of culvert amounting **Rs. 154317.73**				**Total**	**Rs. 154317.7**

CHAPTER 6

ANALYSIS OF PER UNIT RATES USED IN ESTIMATES

6.1 ANALYSIS OF RATE FOR PER UNIT EXCAVATION OF PICK WORK (P.W.)

Figure 20 Analysis of per unit rates (Table)

S.No.	Reference to MORD specification	Description of item	Unit	Qty.	Rate	Amount
1	**1600 & 300**	Excavation in hilly area in soil by mechanical means including cutting and trimming of slopes and disposal of cut material with a lift upto 1.5m and lead upto 20m as per clause 1603.1 **(PW)**				
	Unit = cum Taking output=260cum					
	a) Labour					
		Mate	Day	0.80	198.33	158.66
		Mazdoor(unskilled)	Day	20.00	198.33	3966.6
						4125.26
		Add extra @47% for labour on market rate				1938.87
						6064.14
	b) Machinery					
		Dozer D-50 @43.28 cum per hour	Hour	6.00	2,463.00	14778.00
		Front end loader	Hour	6.00	1051.00	6306
						21084.00
		Add hike on machinery @ 50%				10542.00
						31626.00
	c) Add contractor profit, over head , water charges (10%+2.5%) i.e 12.5% on A+B				37690.14	4711.27

					42401.41
	d)Add escalation for gestation period @5%				2120.07
					44521.48
	Add1% labour cess on a+b+c.			445.21	
	Cost for 260cum= a+b+c+d			44966.69	
	Rate per cum =(a+b+c+d)/260			172.95	
				Say Rs. 172.95	
	Add 2% for removal of slips after 1st rainy season			3.46	
				176.41	
			Say Rs.	**176.40/- only**	

Per cubic metre excavation rate for Pick Work is **Rs.176.40**

6.2 ANALYSIS OF RATE FOR PER CUBIC METRE JUMPER WORK (JW) EXCAVATION

S.No.	Reference to MORD specification	Description of item	Unit	Qty.	Rate	Amount
1	**1600 & 300**	Excavation in hilly area in ordinay rock not requiring blasting by mechanical means including cutting and trimming of slopes and disposal of cut material with a lift upto 1.5m and lead upto 20m as per clause 1603.2 **(JW)**				
	Unit = cum Taking output=170cum					
	a) Labour					
		Mate	Day	0.68	198.33	134.86
		Mazdoor(unskilled)	Day	9.00	198.33	1784.97
		Mazdoor for disposal of earth upto 20m	Day	17.00	198.33	3371.61
						5291.44

		Add extra @47% for labour on market rate				2486.98
						7778.42
	b) Machinery					
		Dozer D-50 @28.32 cum per hour	Hour	6.00	2,463.00	14778.00
		Hydraulic Excavator 0.9cum	Hour	4.25	1455.00	6183.75
		Bucket capacity @40cum per hour				
						20961.75
		Add hike on machinery @ 50%				10480.88
						31442.63
	c) Add contractor profit, over head , water charges (10%+2.5%) i.e 12.5% on A+B				37221.05	4902.63
						44123.68
	d)Add escalation for gestation period @5%					2206.18
						46329.86
	Add1% labour cess on a+b+c+d.				463.30	
	Cost for 170cum= a+b+c+d+e				46793.16	
	Rate per cum =(a+b+c+d)/170				275.25	
					Say Rs. 275.25	
	Add 2% for removal of slips after 1st rainy season				5.50	
					Rs. 280.75/-	

Rate per cubic metre excavation for Jumper Work is **Rs. 280.75**

6.3 ANALYSIS OF RATE FOR BLASTING WORKS (B.W.)

S.No.	Reference to MORD specification	Description of item	Unit	Qty.	Rate	Amount
1	**1600 & 300**	Excavation in hilly area in hard rock requiring blasting by mechanical mean, lift upto 1.5m and disposal of excavated rock upto a lead of 20m as per clause 1603.2 **(BW)**				
	Unit = cum Taking output=170cum					
	a) Labour					
		Mate	Day	1.36	198.33	269.73
		Mazdoor(unskilled)	Day	22.00	198.33	4363.26
		Driller	Day	2.00	198.33	396.66
		Blaster	Day	10.00	247.33	2473.30
						7502.95
		Add extra @47% for labour on market rate				3526.39
						11029.33
	b) Machinery					
		Dozer D-50 @56.67 cum per hour (blasted rock)	Hour	3.00	2,463.00	7389.00
		Hydraulic Excavator 0.9cum Bucket capacity @34cum per hour	Hour	5.00	1455.00	7275.00
		Air compressor 210 cfm with per hour	Hour	28.00	362	10136.00
						24800.00
		Add hike on machinery @ 50%				12400.00
						37200.00
	c) Materials					
		Gelatine 80 per cent	kg	67	83.00	5561.00

		Electric detonators @ 1detonator for 1	Nos.	235	12.00	2820.00
						8381.00
	d) Add contractor profit, over head , water charges (10%+2.5%) i.e 12.5% on a+b+c				56610.33	7076.29
						63686.63
	d)Add escalation for gestation period @5%					3184.33
						66870.96
	Add1% labour cess on a+b+c				668.71	
	Cost for 260cum= a+b+c+d				67539.67	
	Rate per cum =(a+b+c+d)/170				397.29	
					Say Rs. 397.30	
	Add 2% for removal of slips after 1st rainy season				7.95	
					Rs. 405.25/-	

6.4 ANALYSIS OF RATE FOR PER METRE SQUARE CLEARING AND GRUBBING ROAD LAND

Figure 21 Analysis of rate for clearing and grubbing (Table)

S.No.	Reference to MORD specification	Description of item	Unit	Qty.	Rate	Amount
1	201	**Clearing and grubbing road** land including uprooting wild vegetation, grass, bushes, shrubs, saplings, trees of girth upto 300mm, removal of stumps of such trees cut earliar and disposal of unserviceable materials and stacking of serviceable material to be used or auctioned , upto a lead of 1000m including removal and disposal of top organic soil not exceeding 150mm in thickness as per technical Specification clause 201				
	By Mechanical Means In area of non-thorny jungle					
	a) Labour					
		Mate	Day	0.16	198.33	31.73
		Mazdoor(unskilled)	Day	4.00	198.33	793.32
						825.05
		Add extra @47% for labour on market rate				387.77
						1212.83
	b) Machinery					
		Dozer D-50 with attachment or suitable machinery for removal of trees &	Hour	10.00	4971.00	49710.00
		Tractor with trolley	Hour	1.00	438.00	438.00
						50148.00
		Add hike on machinery @ 50%				25074.00
						75222.00
	c) Add contractor profit, over head , water charges (10%+2.5%) i.e 12.5% on				76434.83	9554.35

	A+B					
						84776.35
	d)Add escalation for gestation period @5%					4238.82
						89015.17
	Add1% labour cess on a+b+c.					890.15
	Rate per Hectare					89905.32
	Cost for 1 sqm.					8.99
						Say Rs. 9.00

Rate for clearing per square metre road land is **Rs. 9.00**

6.5 ANALYSIS OF RATE FOR EARTHWORK IN EXCAVATION FOR STRUCTURES

Figure 22 Analysis of Culvert laying (Table)

S.No.	Reference to MORD specification	Description of item	Unit	Qty.	Rate	Amount
1	300	Earth work in excavation for structures as per drawing and technical specifications clause 305.1 including setting out, construction of shoring and bracing , removal of stumps and other deleterious material of disposal any lead and dressing of sides and bottom and backfilling in trenches with excavated suitable material ordinary soil				
	Ordinary soil Unit= cum Taking output 10cum					
	a) Labour					

		Mate	Day	0.32	198.33	63.47
		Mazdoor(unskilled)	Day	8.00	198.33	1586.64
						1650.11
		Add extra @47% for labour on market rate				775.55
						2425.66
	b) Add contractor profit, over head , water charges (10%+2.5%) i.e 12.5%					303.21
						2728.86
	d)Add escalation for gestation period @5%					136.44
						2865.31
	Add1% labour cess on a+b+c.					28.65
	Cost for 260cum= a+b+c+d					2893.96
	Rate per cum=(a+b+c+d)/260					289.40
						Say Rs. 289.40

6.6 ANALYSIS OF RATE FOR PROVIDING CEMENT CONCRETE IN OPEN FOUNDATION.

S.No.	Reference to MORTH specification	Description of item	Unit	Qty.	Rate	Amount
1	800&1200	Providing a concrete for plain/reinforced concrete in open foundation complete as per drawing technical specification clause 802,803,1202,&1203 PCC grade M-10 nominal mix 1:3:6				
	Unit = cum Taking output=1cum					
	a) Labour					
		Mate	Day	0.08	198.33	15.87
		Mazdoor(unskilled)	Day	1.63	198.33	323.28
		Mason 1st class	Day	0.10	303.33	30.33
		Bhishti	Day	0.27	198.33	53.55
						423.03
		Add extra @47% for labour on market rate				198.82
						621.85
	b) Materials					
		cement	Tonne	0.25	7000.00	1750.00
		Coarse sand	cum	0.48	837.00	401.76
		40mm aggregate	cum	0.576	933.00	537.41
		20mm aggregate	cum	0.288	1042.00	300.10
		10mm aggregate	cum	0.096	1068.00	102.53
						3091.80
	c) Machinery					

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		Concrete mixer (cap. 0.40/0.28 cum)	hour	0.40	290.00	116.00
		Add hike for machinery @50%				58.00
						174.00
	d) Form work, @4% on cost of material, labour, and machinery				3887.65	155.51
	Add contractor profit, over head , water charges (10%+2.5%) i.e 12.5%				4043.16	505.40
						4548.56
	Add 1% labour cess					45.49
				total		4594.04
	Carriage of material					
		cement	tonne	0.25	291.25	72.81
		Course Sand	Cum	0.48	185.05	88.82
		40mm aggregate	Cum	0.576	764.70	440.47
		Below 40mm aggregate	Cum	0.376	712.85	268.03
						870.13
	Add escalation for gestation period @5%				5464.17	273.21
						5737.38
					Say Rs	**5737.40**

6.7 ANALYSIS OF RATE FOR STONE MASONARY IN FOUNDATION

S.No.	Reference to MORTH specification	Description of item	Unit	Qty.	Rate	Amount
1	700&1200	Stone masonry work in cement mortar in foundation complete as per drawing and technical specifications clauses 702,704,1202,&1203				
	In 1:4 cement mortar UNIT = cum					
	a) Material					
		Stone for C.R masonry 1st sort	cum	1.10	1061.00	1167.10
		Through bond stone (7nos 024*024*0.39=0.16cum)	No.	7.00	23.00	161.00
		Cement mortar 1:4 (Rate as in item 11.5)	cum	0.30	3702.30	1110.69
	b) Labour					
		Mate	Day	0.14	198.33	27.77
		Mazdoor(unskilled)	Day	2.10	198.33	416.49
		Mason 1st class	Day	1.50	303.33	455.00
		Bhishti	Day	0.08	198.33	15.87
						915.12
		Add extra @47% for labour on market rate				430.11
						1345.23
	c) Add contractor profit, over head , water charges (10%+2.5%) i.e 12.5%				3784.02	473.00
						4257.02

	Add 1% labour cess					42.57
						4299.59
					Say Rs.	4299.60
	Carriage of material					
		Stone	cum	1.26	242.25	305.24
					Total	4604.84
	Add escalation for gestation period @5%					230.24
						4835.08
					Say Rs	**4835.10**

6.8 ANALYSIS FOR PROVIDING DRY RUBBLE FLOORING

S.No.	Reference to MORD specification	Description of item	Unit	Qty.	Rate	Amount
1		Providing and laying of dry rubble flooring complete as per drawing and technical specification **clause 1303.3**				
	UNIT = cum Taking output =1cum					
	a) Material					
		Stone for rubble flooring 15mm thick	cum	1.00	1008.00	1008.10
		Stone spalls	cum	0.20	601.00	120.20
	b) Labour					
		Mate	Day	0.10	198.33	19.83
		Mazdoor(unskilled)	Day	1.50	198.33	297.50
		Mason 1st class	Day	0.50	303.33	151.67
						469.00

		Add extra @47% for labour on market rate				220.43
						689.43
	c) Add contractor profit, over head , water charges (10%+2.5%) i.e 12.5%				1817.63	227.20
						2044.83
	Add 1% labour cess					20.45
						2065.28
					Say Rs.	2065.28
	Carriage of material					
		Stone	cum	1.20	242.25	290.70
					Total	2355.98
	Add escalation for gestation period @5%					117.80
						2473.78
					Say Rs	**2473.8**

6.9 ANALYSIS FOR PROVIDING CONCRETE IN PARAPETS

S.No.	Reference to MORTH specification	Description of item	Unit	Qty.	Rate	Amount
1	**800&1200**	Providing and laying cement concrete 1:5:10 with 15% plums and curing complete including the cost of formwork for plain/reinforced concrete in retaining walls, breast walls, the size of plum should be 150 to 300mm as per drawing and technical specifications.				
	UNIT = cum					
	a) Material					
		Aggregate 40mm	cum	0.60	933.00	559.80
		Aggregate 20mm	cum	0.22	1042.00	229.24
		Coarse sand	cum	0.47	837.00	393.39
		Cement	T	0.13	7000.00	910.00
		Plum	cum	0.15	574.00	86.10

	b) Labour					
		Mate	Day	0.80	198.33	15.87
		Mason 1st class	Day	0.10	303.33	30.33
		Mazdoor (unskilled)	Day	1.63	198.33	323.28
		Bhishti	Day	0.27	198.33	53.55
						423.03
		Add extra @47% for labour on market rate				198.82
						621.85
	c)Machinery					
		Mechanical Concrete mixer 0.40/0.28 cum cap. Fitted with water measuring device and preferably also with load cell	hour	0.40	290.00	116.00
		Add hike 50% for machinery				58.00
						174.00
	d) Form work, @4% on cost of material, labour, and machinery				2974.38	118.98
						3093.35
	e) Add contractor profit, over head , water charges (10%+2.5%) i.e 12.5%				.	386.67
						3480.02
	Add 1% labour cess					34.80

						3514.82
	Carriage of material					
		Aggregate 40mm	cum	0.60	764.70	458.82
		Aggregate 20mm	cum	0.22	712.85	156.83
		Coarse sand	cum	0.47	185.05	86.97
		Cement	T	0.13	291.55	37.90
		Plum	cum	0.15	242.25	36.34
						776.86
						4291.68
	Add escalation for gestation period @5%					214.58
						4506.27
					Say Rs	**4506.25**

CHAPTER 7

GENERAL ABSTRACT OF COST FOR ALL PROVIDED WORKS

The total cost for all provided work is estimated to be Rs**. 42,04,098.04.**

S.No.	Description	Amount
1.	Cost of Earthwork in excavation (As per Annexure A)	3997971.63
2.	Cost of providing Unlined surface drain (As per Annexure B)	26390.88
3.	Cost of Clearing and grubbing work (As per Annexure C)	25417.8
4.	Cost of providing RCC Hume Pipe Culvert (As per Annexure D)	154317.73
	Total Project cost	**Rs. 42,04,098.04**

Figure 23 General Abstract (Table)

CHAPTER – 8
FLEXIBLE PAVEMENT DESIGN

Pavement for the proposed project is designed according to **IRC: 37 (2012).**

The guidelines in the above said code recommend following aspects should be given due consideration while designing to achieve better performance, durability and life.

1 Pavement must be designed for period of atleast 10-15 years.

2. Effective CBR must be found for designing of pavement.

3. Rut resistant surface layer must be used.

4. Fatigue resistant bottom layer must be used.

5.Stabalized sub-base and base of locally available soil and aggregates should be considered.

6.Design of design layer.

However, only design for flexible pavement for proposed road project is provided in this phase.

Rate analysis for flexible pavement for the road project is not done.

8.1 DESIGN CRITERIA OF FLEXIBLE PAVEMENTS

Three main type of distresses are considered to be critical:

1. Rutting due to permanent deformation in the subgrade.
2. Rutting due to permanent deformation in the bituminous layer.
3. Fatigue cracking in bituminous layer: crocodile cracking

Fatigue failure in bituminous pavement - cracking in 20% of the paved area is considered critical

Rutting Failure – Average rut depth of 20mm is considered critical situation.

The thickness of layers and materials selected for layers must be in such a way that rutting and fatigue failure does not occur.

8.2 TRAFFIC

The IRC method considers design traffic in terms of cumulative no. of standard axles (80KN) to be carried by pavement in the entire design life.

The information required for estimation of design traffic is provided below:

1. Initial traffic after construction of pavement in terms of number of commercial vehicles per day.
2. Growth rate of traffic in the design life.
3. Design life in no. of years
4. Axle load spectrum
5. Vehicle damaging factor.
6. Commercial vehicle distribution over the carriageway.

Number of Commercial vehicles having gross vehicle weight of 30kN or more and their axle loading is considered for purpose of design of flexible pavement.

Present day average traffic is assessed according to IRC: 9-1972 "Traffic Census on Non- Urban Roads"
According to IRC: 9-1972 Following traffic studies have been conducted.

Traffic Studies on the proposed road

Commercial Vehicles Per Day
Traffic studies were conducted on the road for estimation of road traffic.
Traffic Census report of the road is provided below according to IRC-9-1972 "Traffic census on Non- Urban Roads"
According to Traffic studies conducted No. Of Commercial Vehicles Per Day for the existing road is approximately 160.

Keeping in mind future growth of the road, cumulative no. Of standard axles are found using CVD = 300 per day.

The traffic data provided below is 1 day only. However, full 1 week – 24hour data will be provided in a Compact Disk with this report along with all the drawings and rate estimation data of the project.

PLATE 1(IRC:9-1972)

TRAFFIC CENSUS FIELD DATA SHEET								
DATE AND DAY OF WEEK:- 28/04/2017 SATURDAY DIRECTION OF TRAFFIC (DOWN): WAKNAGHAT –DUMEHAR DUMEHAR					ROAD CLASSIFICATION: ODR KILOMETER: 0/000 TO 0/500 ROUTE NO. : WAKNAGHAT- DISTT. SOLAN STATE: HIMACHAL PRADESH			
TYPE OF VEHICLES HOUR OF COUNT	CARS, JEEPS,VANS, THREE WHEELERS ETC	BUSES	TRUCKS	MOTORCYCLES AND SCOOTERS	ANIMAL DRAWN VEHICLES	CYCLES	OTHERS (Specify)	REMARKS, INCLUDING WEATHER CONDITIONS
1	2	3	4	5	6	7	8	9
FROM 09:00 HRS TO 15:00HRS								
HOURLY TOTAL	22	03	10	12	00	01	00	
FROM 15:00HRS TO 21:00HRS								
HOURLY TOTAL	20	02	06	09	00	00	00	
FROM 21:00HRS TO 03:00HRS								
HOURLY TOTAL	07	00	04	05	00	00	00	
FROM 03:00HRS TO 09:00HRS								

HOURLY TOTAL	09	02	04	07		02		

PLATE 1 (IRC:9-1972)

TRAFFIC CENSUS

FIELD DATA SHEET

DATE AND DAY OF WEEK:-28/04/2017 SATURDAY
DIRECTION OF TRAFFIC (UP) : DUMEHAR TO WAKNAGHAT

ROAD CLASSIFICATION:- ODR
KILOMETER: 0/000 TO 0/500
ROUTE : WAKNAGHAT-DUMEHAR
DISTRICT : SOLAN
STATE: HIMACHAL PRADESH

TYPE OF VEHICLES → HOUR OF COUNT ↓	CARS, JEEPS,VANS, THREE WHEELERS ETC	BUSES	TRUCKS	MOTORCYCLES AND SCOOTERS	ANIMAL DRAWN VEHICLES	CYCLES	OTHERS (Specify)	REMARKS, INCLUDING WEATHER CONDITIONS
1	2	3	4	5	6	7	8	9
FROM 09:00HRS TO 15:00HRS								
HOURLY TOTAL	35	03	13	09	00	00	00	
FROM 15:00HRS TO 21:00HRS								
HOURLY TOTAL	21	02	09	09	00	00	00	
FROM 21:00HRS TO 03:00HRS								
HOURLY TOTAL	03	00	01	02	00	00	00	
FROM 03:00HRS TO 09:00HRS								

HOURLY TOTAL	11	02	04	08	00	00	00A	

NOTES:-

1. RECORD TRAFFIC VOLUME IN COLUMNS 2 TO 8 BY MAKING TALLIES IN THE FORM OF VERTICAL STROKES FOR FIRST FOUR VEHICLES AND DRAWING AN OBLIQUE STROKE FOR EVERY 5TH AS SHOWN WITHIN BRACKETS.
2. SOME ROADS CARRY APPRECIABLE VOLUME OF OTHER TRAFFIC LIKE CYCLE RIKSHAWS, RECORD THE VOLUME OF SUCH VEHICLES IN COLUMN 8 AFTER SPECIFYING THE VEHICLE TYPE.

- THE HOUR OF COUNT SHOULD BE ENTERED BEFORE THE START OF ENUMERATION. PM HOUR SHOULD BE RECORDED AFTER ADDING 12 TO THE ACTUAL HOUR, FOR EXAMPLE 2 PM SHOULD BE RECORDED AS 14:00 HRS
- IF FELT NECESSARY BY HIGHWAY AUTHORITY, THIS COLUMN COULD BE SUB-DIVIDED INTO TWO FOR RECORDING THE VOLUME OF "PNEUMATIC- TYRED" AND "IRON-TYRED" VEHICLES SEPARATELY.

NAME AND SIGNATURE OF ENUMERATOR

Ankush Kaundal , Rishav Rana

Figure 24 Traffic Census

TRAFFIC CENSUS PLATE 2

IRC:9.:1972

DAILY TRAFFIC SUMMARY

FROM_____HRS.ON_____TO_____HRS.ON___ FULL DAY ROAD CLASSIFICATION:-ODR
DIRECTION OF TRAFFIC:- FROM: DUMEHAR-WAKNAGHAT(Up) KM/MILEAGE : 0/000 TO O/500
             FROM: WAKNAGHAT-DUMEHAR (DOWN) ROUTE NO.   : WAKNAGHAT -
DUMEHAR

DISTRICT: -SOLAN
STATE : HIMACHAL PRADESH

COUNT HOUR	FAST VEHICLES											SLOW VEHICLES									REMARKS
	CARS, JEEPS, VANS ETC		BUSES		TRUCKS		MOTOR CYCLES AND SCOOTER		TOTAL FAST			ANIMAL DRAWN VEHICLE		CYCLES		OTHERS (SPECIFY)		TOTAL SLOW			
	Up	DOWN	Up	D	Up	D	Up	D	Up	D	TOTAL COL. 10 & 11	Up	D	Up	D	Up	D	Up	D	TOTAL COL. 19 & 20	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
0600-0700	1	1	0	0	0	0	1	1	3	2	5										
0700-0800	3	2	1	1	1	2	2	2	7	3	14				1			0	1	1	
0800-0900	5	3	1	1	2	2	4	3	12	9	21				1			0	1	1	
0900-1000	8	5	1	1	2	2	3	3	14	11	25										
1000-1100	5	6	1	1	2	1	3	4	1	12	23										
1100-1200	6	2	0	0	3	1	0	1	9	4	13				1						
1200-1300	4	4	1	0	2	2	2	2	9	8	17										
1300-1400	7	3	0	1	0	3	1	1	8	8	16										
1400-1500	5	2	0	1	2	1	0	1	7	5	12										
1500-1600	4	3	0	0	2	1	2	2	8	5	13										

Time																		
1600-1700	3	5	1	1	1	2	1	1	6	9	15							
1700-1800	3	4	1	0	2	1	2	3	8	8	16							
1800-1900	5	2	0	1	2	0	0	3	7	6	13							
1900-2000	4	3	0	0	3	1	3	0	10	3	13							
2000-2100	2	3	0	0	1	1	1	0	4	4	8							
2100-2200	1	2	0	0	1	2	1	2	3	6	9							
2200-2300	1	1	0	0	0	1	1	2	2	4	6							
2300-2400	0	1	0	0	0	1	0	0	0	2	2							
0000-0100	1	2	0	0	0	0	0	1	1	3	4							
0100-0200	0	1	0	0	0	0	0	2	0	3	3							
0200-0300	0	0	0	0	0	0	0	0	0	0	0							
0300-0400	0	0	0	0	0	0	0	0	0	0	0							
0400-0500	0	1	0	0	0	0	0	0	0	1	1							
0500-0600	2	2	0	0	1	0	1	1	4	3	7							
TOTAL	70	58	7	8	27	24	28	35	133	123	256				3			
TOTAL UP&DOWN FOR VEHICLE TYPE	128		15		51		53		256		256				3			

08/04/2017, saturday

Ankush kaundal, rishav rana

Figure 25 Daily Traffic Summary

TRAFFIC CENSUS
WEEKLY TRAFFIC SUMMARY

FROM _____TO_____ (DATE)   ROAD CLASSIFICATION:-ODR
DETAILS OF CENSUS POINT:-   KM/MILEAGE:- 0/000 TO 0/500
     ROUTE : WAKNAGHAT-DUMEHAR
     DISTRICT: SOLAN H.P.

PERIOD				FAST VEHICLES					SLOW VEHICLES				REMARKS
FROM		TO		CARS, JEEPS, VANS ETC	BUSES	TRUCKS	MOTOR CYCLES & SCOOTERS	TOTAL (COL. 5 TO 8)	ANIMAL DRAWN VEH.	CYCLES	OTHERS (SPECIFY)	TOTAL (COL.10 TO 12)	
DATE	HOUR	DATE	HOUR										
1	2	3	4	5	6	7	8	9	10	11	12	13	14

TOTAL FOR THE WEEK									
AVERAGE DAILY TRAFFIC FOR THE WEEK									

NAME AND SIGNATURE OF THE SUPERVISOR

The spaces left in plate1 and plate to be taken as 0.

8.3 TRAFFIC GROWTH RATE:

Annual traffic growth rate of 5% is considered according to IRC: SP:84-2009, IRC:37-2012

Design Life
The proposed road is designed for design life of 15 years according to the same code.

Vehicle Damaging Factor: The code uses Vehicle Damaging Factor in assessing cumulative msa for finding thickness of flexible pavement layers.
Vehicle damaging factor is a multiplier to change number of commercial vehicles of different axle loads and axle configuration into the number of repetition of standard axle load of 80Kn.

Due to lack of sufficient information on axle loads and because of the small size project the default VDF value is taken from table 4.2 of IRC:37-2012

The default value taken is 1.5 for hilly terrain.
Lane distribution factor: The present rural road (5/7m) is widened to 10/12m with divided carriage way. So lane distribution factor would be 75% vehicles in each direction.

8.4 ESTIMATION OF DESIGN TRAFFIC

The design traffic in terms of cumulative no. of standard axles to catered by the road in the entire design period is assessed by following formula:

$N = 365 \times ((1+r)^n - 1) \times A \times D \times F \times 1/r$

N = Cumulative no. Of standard axles in msa to be carried by pavement in the entire design life.

A = Initial traffic in the year of completion of road in term of CVD per day

D = Lane distribution factor = 0.75

F = Vehicle Damaging Factor (VDF) = 1.5 (table 4.2, IRC-37)

r = Annual growth rate of traffic considered as 5% for this project.

Traffic in year of completion would $A = P(1+r)^x$

P = No. Of vehicles during last count.

x = No. Of years between year of completion and last count.

According to above formula, number of cumulative standard axles to be catered by pavement of the proposed road for the entire design period will be 2.65msa, say 4.00 msa. Pavement will be designed for **4msa**

8.5 SUBGRADE

According to IRC method of design of pavement, CBR value of sub grade of the pavement is required. Sub grade is the top 50cm layer of the embankment just below the layers of flexible pavement. Sub grade is made up of selected soil, in situ material or stabilized soil that forms the foundation of the pavement. It is required that sub grade should be well compacted so that there is no possibility of rutting of pavement during design life due to additional densification of the below sub grade. Moreover, it is also required

to compact sub grade at min. 97% of the dry density of sub grade sample achieved in the laboratory with heavy compaction. The stated proctor compaction test should conform to IS: 2720 (Part 8). Sub grade compaction in fields is obtained by compacting sub grade at OMC found in the laboratory during performing proctor test.

The design would be based on 80th percentile CBR value obtained from laboratory test.

According to series CBR test performed on the sub grade sample brought from field along the alignment of the proposed road, the value of CBR for 2.5mm penetration comes out to be **09%.**
Hence, subsequent pavement layers will be designed according to this value.

8.6 PAVEMENT THICKNESS DESIGN

According to the chart from IRC-37 shown below, total pavement thickness for Sub grade CBR of 9% and Design Traffic of 4 msa can be found out.
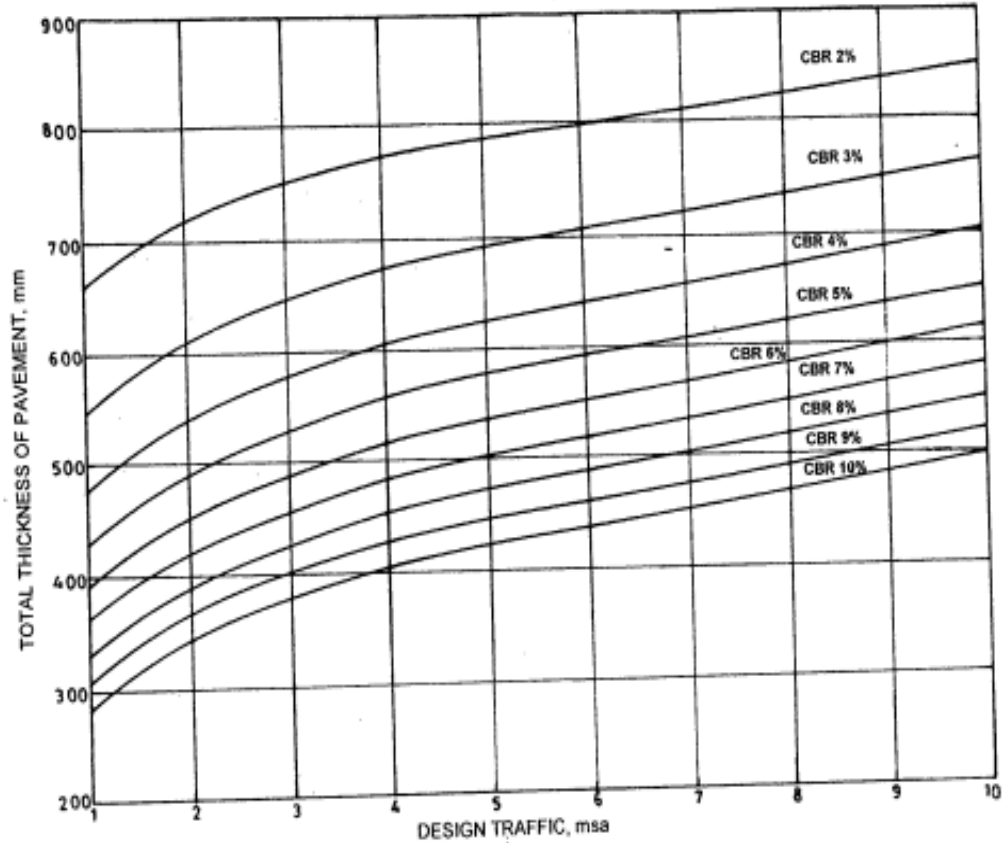So total pavement thickness of **475mm** according to chart listed below

Fig. 1. Pavement Thickness Design Chart for Traffic 1-10 msa

Figure 26 Pavement Thickness Design Chart

IRC:37 -2001 (CHART-1)

Pavement Composition Design

The subsequent pavements can be easily designed reffering to charts provided in IRC 37. Reffering to Plate -1 IRC-37, pavement composition for traffic 4msa can be interpolated from design table listed below.

Checking the designed Pavement for Fatigue and Rutting Failure

PAVEMENT DESIGN CATALOGUE
PLATE 1 – RECOMMENDED DESIGNS FOR TRAFFIC RANGE 1-10 msa

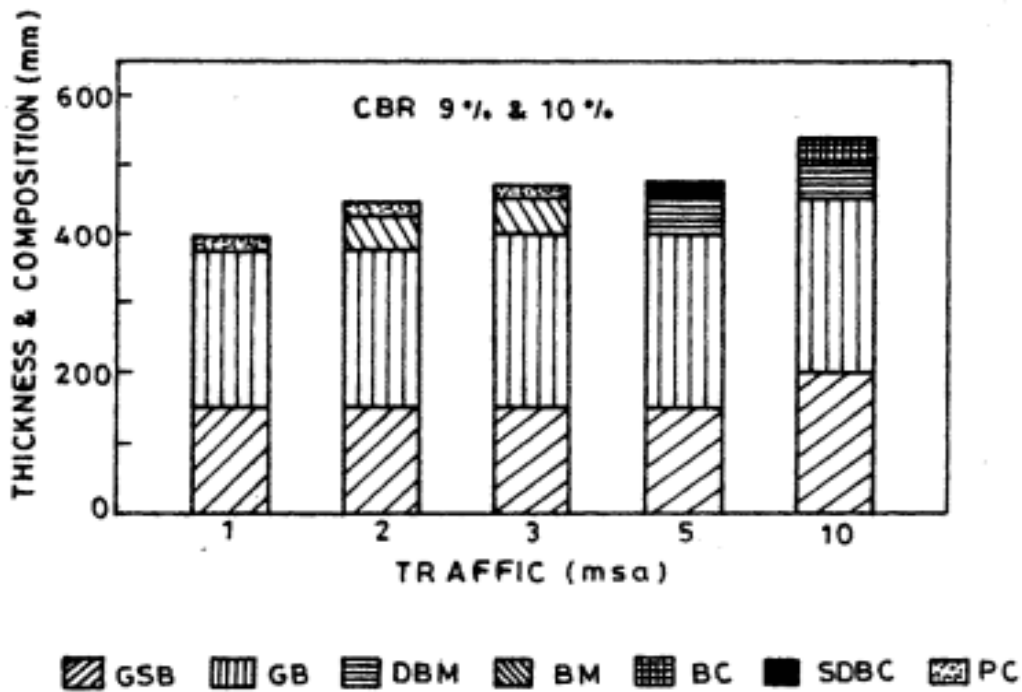| CBR 9% & 10%					
Cumulative Traffic (msa)	Total Pavement Thickness (mm)	PAVEMENT COMPOSITION			
		Bituminous Surfacing		Granular Base (mm)	Granular Sub-base (mm)
		Wearing Course (mm)	Binder Course (mm)		
1	375	20 PC		225	150
2	425	20 PC	50 BM	225	150
3	450	20 PC	50 BM	250	150
5	475	25 SDBC	50 DBM	250	150
10	540	40 BC	50 DBM	250	200

Figure 27 Pavement Design Catalogue

Pavement Composition Design

Granular Sub-Base = 150mm

Granular Base = 250mm

Total Bituminous Surfacing = 75mm

Binder Course = 50 DBM, Wearing Course = 25SDBC

Specifications on Sub–Base:

The Sub-Base layer is laid on properly compacted and placed Sub grade. The Sub-base layer is required to be made up of materials like natural sand, moorum, gravel, kankar, laterite, crushed slag, brick material, crushed stone etc. Moreover, according to Hill Road Manual soil aggregate mixes or any other materials like stabilized soil which remain stable under saturated conditions.

The sub-base layer for proposed road project should be a granular base layer conforming to MOST specification for Road and Bridges (1995) clause 401
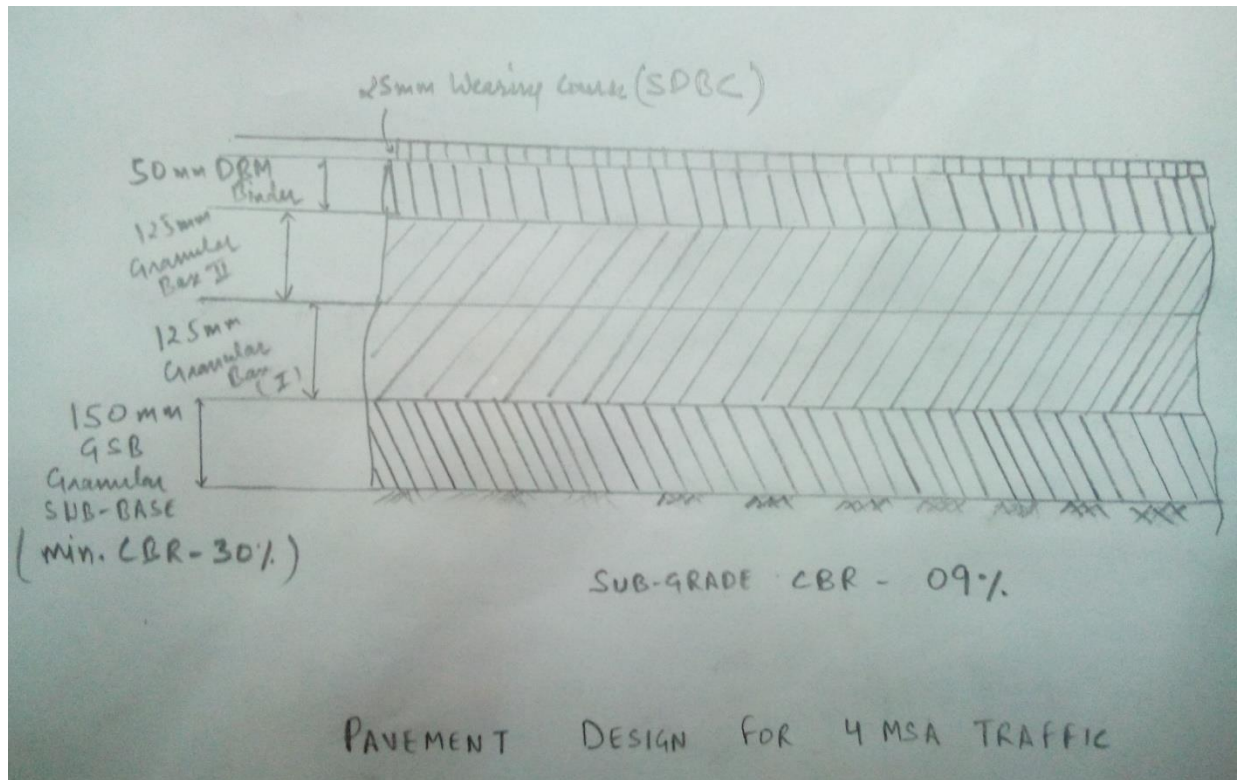
Also minimum CBR requirement of Sub-Base should be 30%.

The minimum thickness for Sub-Base layer for assessed traffic volume is 150mm

Base Course Layer: - Base Course layer should have min. Thickness of 225mm for assessed traffic.

Moreover, CBR of materials used in Base construction should not have CBR less than 100%

Pavement Design

25mm Wearing Course (SDBC)

50mm DBM Binder

125mm Granular Base II

125mm Granular Base I

150mm GSB Granular SUB-BASE (min. CBR-30%)

SUB-GRADE CBR - 09%

PAVEMENT DESIGN FOR 4 MSA TRAFFIC

CHAPTER 9

CONCLUSION

In this phase of the road widening project, earthwork in widening including excavation in cutting, formation work for structures, road side drains has been performed. The rate analysis of the earthwork has been done too. The total cost for executing works like clearing and grubbing, excavation in cutting of hill, providing a road side drain and providing a 900mm dia. Hume pipe culvert is estimated as **Rs. 42,04,098.04.**

The design for the Flexible pavement for the 10/12m widened road is also provided rigorously conforming to   IRC:37-2012. Rate analysis of Flexible pavement has not been done in this phase.   Further works like providing retaining walls on required locations to stabilize the side hill, W- beam metal crash barriers can also be according to requirements. Moreover, sign boards could also be installed on conflict points. Provided side drain is unlined, it could be constructed lined also.

The project has been executed efficiently by performing extensive surveys using Sokkia total station SET 610 for calculating earthwork.

All the works performed for the proposed project rigorously adhere to the specifications laid by Indian Road Congress, Ministry of Road Transport & Highways, Ministry of Rural Development, Ministry of Surface Transport and National Highway Authority of India.

The Traffic data provided in this report is only of 1 Day. The 7day-24-hour data along with other project related drawings will be provided separately in a compact disk.

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